Safety Spot
By Malcolm McBride

ROTAX PUSHRODS ALERT, SPORTCRUISER NOSE LEG ISSUE, TWISTER AIR SHOW ENGINE FAIL & PLACARDS

The latest LAA Engineering topics and investigations

Hello again, and welcome to *Safety Spot*. As always, I hope that things are good for you, wherever you are and whatever you're doing. Thanks to all of you who have taken the trouble to write, call and email over the last month or so, with your stories and comments about continuing airworthiness safety matters. If you haven't yet put pen to paper or tapped out a line on the keyboard, about something that's bothering you, 'airworthiness'-wise, then don't be shy, get scribbling. It's better we hear about an issue before it turns into an accident – it might be you've spotted something that no-one else has and a few lines may just avert a catastrophe.

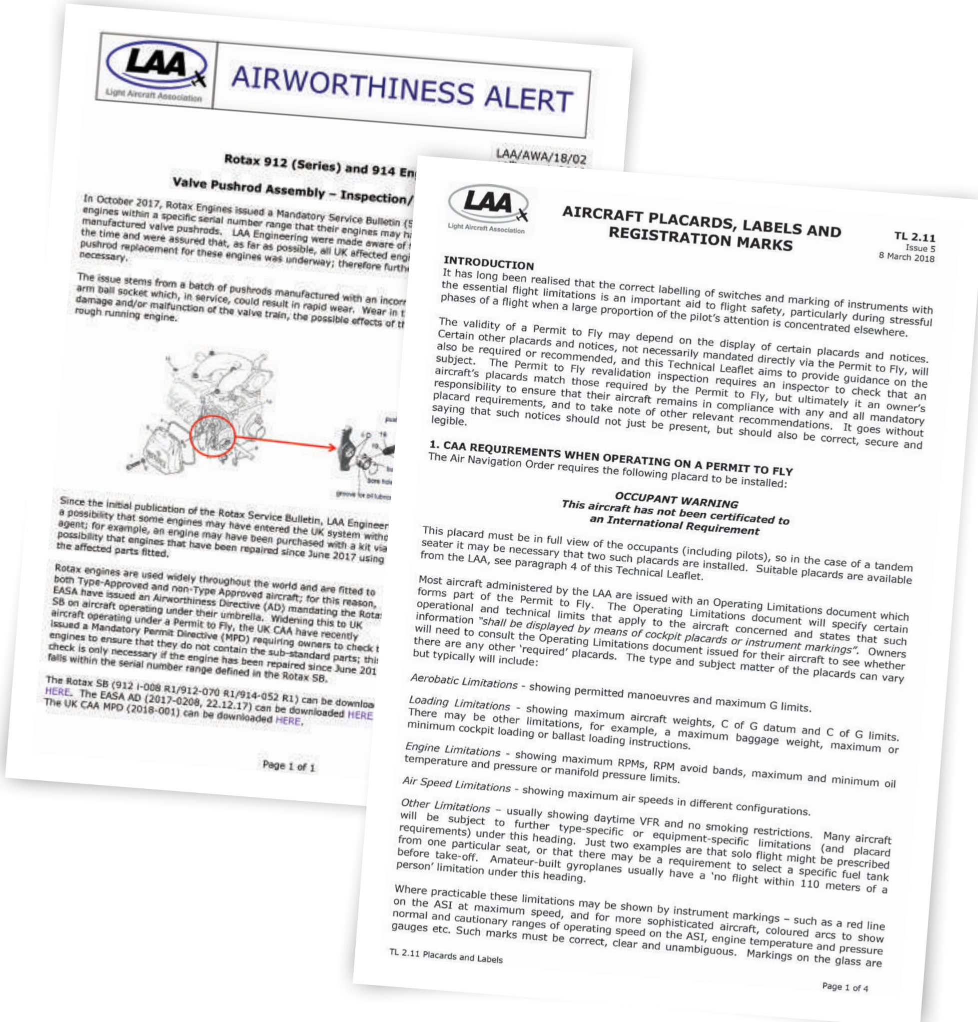
Like most of you, the unusual weather the UK has been experiencing over the last few weeks has caused some disruption at LAA HQ, though even through the worst of it, somebody at least managed to get into the office. Then, last week, just as the weather turned to its spring-like normal we were all a bit surprised to hear that the 'Beast from the East' was set to return. The bike has been returned to the shed and, as I write, the snow is again falling – I've got my head down, writing, but I'd be a bit miffed if I had outdoor plans in the diary. I hope that the spring has finally arrived by the time you read this and you're able to have a bit of fun outside, hopefully topside!

RECENT SAFETY INFORMATION FROM LAA HQ

You will see from the pictures above right that LAA Engineering has issued an *Airworthiness Alert* (*LAA/AWA/18/02*) and 'up-issued' the existing *Technical Leaflet TL.2.11*. As the associated pictures show, the *Alert* is about a quality-related issue concerning some pushrods fitted to both the Rotax 912 and 914 Series engines assembled or repaired since June 2017.

In this case, the hardening process on the rocker arm ball socket – that's the contact point between the rod itself and the rocker arm – went wrong and, in service, the sub-standard parts suffered accelerated wear. Though this isn't something that's likely to cause a catastrophe in the short term, wear will affect the operation of the engine's intake and exhaust valves and could, over time, lead to a gradual power loss. Eventually, of course, this ball-end could give way completely and that would very likely stop the engine.

Rotax has been very pro-active and, with the assistance of its UK agent, CFS Aero, thinks all the wayward rods have been 'captured'. I've heard some good things about the level of support offered by CFS to



LAA Light Aircraft Association

AIRWORTHINESS ALERT

LAA/AWA/18/02

Rotax 912 (Series) and 914 En

Valve Pushrod Assembly – Inspection/

In October 2017, Rotax Engines issued a Mandatory Service Bulletin (S engines within a specific serial number range that their engines may h manufactured valve pushrods. LAA Engineering were made aware of the time and were assured that, as far as possible, all UK affected engi pushrod replacement for these engines was underway; therefore furth necessary.

The issue stems from a batch of pushrods manufactured with an incor arm ball socket which, in service, could result in rapid wear. Wear in t damage and/or malfunction of the valve train, the possible effects of th rough running engine.

Since the initial publication of the Rotax Service Bulletin, LAA Engineer a possibility that some engines may have entered the UK system witho agent; for example, an engine may have been purchased with a kit via possibility that engines that have been repaired since June 2017 using the affected parts fitted.

Rotax engines are used widely throughout the world and are fitted to both Type-Approved and non-Type Approved aircraft; for this reason, EASA have issued an Airworthiness Directive (AD) mandating the Rota SB on aircraft operating under their umbrella. Widening this to UK aircraft operating under a Permit to Fly, the UK CAA have recently issued a Mandatory Permit Directive (MPD) requiring owners to check t engines to ensure that they do not contain the sub-standard parts; thi check is only necessary if the engine has been repaired since June 201 falls within the serial number range defined in the Rotax SB.

The Rotax SB (912 i-008 R1/912-070 R1/914-052 R1) can be downloa HERE. The EASA AD (2017-0208, 22.12.17) can be downloaded HERE The UK CAA MPD (2018-001) can be downloaded HERE.

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LAA Light Aircraft Association

AIRCRAFT PLACARDS, LABELS AND REGISTRATION MARKS

TL 2.11
Issue 5
8 March 2018

INTRODUCTION

It has long been realised that the correct labelling of switches and marking of instruments with the essential flight limitations is an important aid to flight safety, particularly during stressful phases of a flight when a large proportion of the pilot's attention is concentrated elsewhere.

The validity of a Permit to Fly may depend on the display of certain placards and notices. Certain other placards and notices, not necessarily mandated directly via the Permit to Fly, will also be required or recommended, and this Technical Leaflet aims to provide guidance on the subject. The Permit to Fly revalidation inspection requires an inspector to check that an aircraft's placards match those required by the Permit to Fly, but ultimately it an owner's responsibility to ensure that their aircraft remains in compliance with any and all mandatory placard requirements, and to take note of other relevant recommendations. It goes without saying that such notices should not just be present, but should also be correct, secure and legible.

1. CAA REQUIREMENTS WHEN OPERATING ON A PERMIT TO FLY

The Air Navigation Order requires the following placard to be installed:

OCCUPANT WARNING
This aircraft has not been certificated to an International Requirement

This placard must be in full view of the occupants (including pilots), so in the case of a tandem seater it may be necessary that two such placards are installed. Suitable placards are available from the LAA, see paragraph 4 of this Technical Leaflet.

Most aircraft administered by the LAA are issued with an Operating Limitations document which forms part of the Permit to Fly. The Operating Limitations document will specify certain operational and technical limits that apply to the aircraft concerned and states that such information *"shall be displayed by means of cockpit placards or instrument markings"*. Owners will need to consult the Operating Limitations document issued for their aircraft to see whether there are any other 'required' placards. The type and subject matter of the placards can vary but typically will include:

Aerobatic Limitations - showing permitted manoeuvres and maximum G limits.

Loading Limitations - showing maximum aircraft weights, C of G datum and C of G limits. There may be other limitations, for example, a maximum baggage weight, maximum or minimum cockpit loading or ballast loading instructions.

Engine Limitations - showing maximum RPMs, RPM avoid bands, maximum and minimum oil temperature and pressure or manifold pressure limits.

Air Speed Limitations - showing maximum air speeds in different configurations.

Other Limitations – usually showing daytime VFR and no smoking restrictions. Many aircraft will be subject to further type-specific or equipment-specific limitations (and placard requirements) under this heading. Just two examples are that solo flight might be prescribed from one particular seat, or that there may be a requirement to select a specific fuel tank before take-off. Amateur-built gyroplanes usually have a 'no flight within 110 meters of a person' limitation under this heading.

Where practicable these limitations may be shown by instrument markings – such as a red line on the ASI at maximum speed, and for more sophisticated aircraft, coloured arcs to show normal and cautionary ranges of operating speed on the ASI, engine temperature and pressure gauges etc. Such marks must be correct, clear and unambiguous. Markings on the glass are

TL 2.11 Placards and Labels

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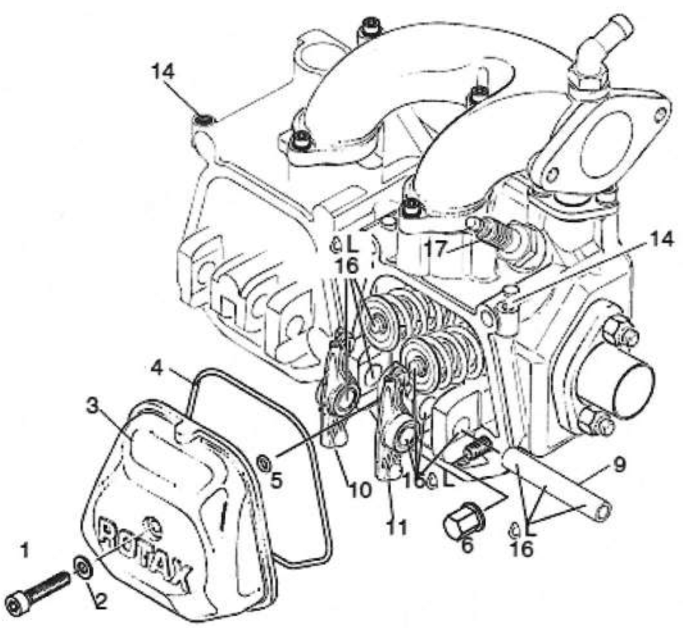
(Above) **LAA Engineering has recently published two documents, both in response to external safety recommendations by other stakeholders. The first, an *Airworthiness Alert*, offers access to a recent *Mandatory Permit Directive* (*MPD*) requiring owners of Rotax 912/914 engines to check their paperwork to see if their powerplants might contain a set (or sets) of defective valve pushrods. The second is a rewrite of a *Technical Leaflet*, giving guidance on the correct placards needed on our aircraft to stay safe. Both documents can be found in the Engineering section of our website.** *(Photo: LAA Library)*

LAA members who have been affected by this issue, so well done to the Coventry team for that.

One thing John Rowley, CFS's Rotax Team Leader, explained was that, for good economic reasons, many owners choose to purchase their engine with the aircraft kit and this puts the local agent out of the loop from a continuing airworthiness standpoint. So, it's still possible that the engine that you've purchased from an overseas source may have defective rods so, to be safe, check its serial number against the list in the *Rotax Service Bulletin* – there's a link in the *Alert*.

The 'up-issued' *Technical Leaflet* relates to the fitment of placards on LAA machines. We've now included advice about the need to fit 'instruction placards' near canopy latches, primarily to let first-responders, who may never have been near a small sports aircraft



(Above) **Manufacturing errors occasionally occur, even in the best-run production workshop. When it comes to components which are going to be used on aircraft, it's especially important that potentially defective components which may have entered the supply chain can be traced and the affected owners notified. But this can be a difficult thing to achieve in the uncertified sports-aviation arena.**

The UK CAA has recently issued a *Mandatory Permit Directive* (*MPD*) alerting owners to a potential problem with the surface-hardening treatment of some of the pushrod sets used on Rotax 912 and 914 engines. In this case, the defective pushrods can easily be spotted as they have a black finish, as opposed to the correct silver sheen. For further information, please visit the LAA website, head for the Engineering section and then look for 'Alerts'. *(Photos: Rotax Engines/UK CAA)*

before, understand how they can reach an injured pilot in the event of an accident.

Like so much 'safety stuff' issued to aviators, this up-issue was driven by a recent incident where first responders couldn't get to an unconscious pilot following a very heavy landing. I'll describe this incident a little later, but first we need to chat about why it's so important to keep a watchful eye on undercarriages. As you'll doubtless have seen in your picture 'fly-past' of *Safety Spot*, one LAA member suffered a nose undercarriage failure whilst taxying to the hangar for a twenty-five-hour check.

Before I go there, as we've been chatting about *Technical Leaflets* and *Alerts*, it's worth reminding you that the Engineering section of the LAA website contains an absolute wealth of information.

A review of the *Technical Leaflet* library might save you picking up the telephone to ask one of us here a question – don't get me wrong, it's lovely to speak to you and the Engineering team is always happy to help, whatever your issue. However, quite often our response will include the suggestion, 'Why don't you have a read of the *Technical Leaflet* about this?'

CZAW SPORTCRUISER PS MK I NOSE LEG FAILURE

This is definitely one of those stories which seems to reoccur on a fairly regular basis. I checked through the last ten years of *Safety Spot* – yes, it's been that long – looking for previous discussions relating to this recalcitrant, though essential, component.

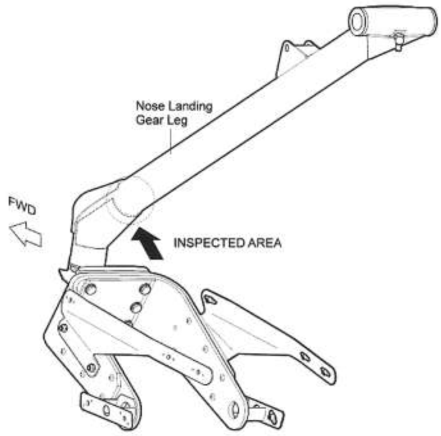
The saga started, at least in the world of *Safety Spot*, in the November 2012 issue of *LA* and it hasn't been far from my consciousness ever since – perhaps this latest nose leg failure will supply enough impetus to finally 'crack' the problems.

(Above) **I had a choice as to whether I used this 'stock' photo of the group-owned CZAW SportCruiser which was recently involved in a nose undercarriage leg failure, or a picture of the aircraft sat at a rather ungainly angle, sent in by the unhappy pilot after the incident. On reflection, I'm glad I chose this shot as it shows the clean lines of this fabulous, two-seat, kit-built machine rather better than the one with its tail up! Note that this aircraft has very close-fitting spats, which although they look good and offer some drag reduction, are bad for keeping a close eye on the undercarriage system.** *(Photo: Martin Uzzell)*

The occurrence itself was a fairly benign event because the leg failure occurred while the aircraft was taxying at quite a low speed. Consequently, the damage was limited to the propeller which, naturally, disintegrated when it hit the taxiway's concrete surface.

However, even this sort of taxying incident has it's dangers – for example, if a passer-by is struck by flying debris, which actually happened a couple of years ago now – so I'm certainly not being light-hearted. Of course, the real danger of this sort of failure is if it occurs at higher speeds, during take-off or landing. Though this failure occurred on a SportCruiser aircraft, pilots of other nose-wheel types, for example the 'A-Series' Van's machines, should be reminded that a regular, detailed inspection of the leg and fork assemblies is essential for safety.

On many types of nosewheel undercarriage, correct damping of the fork to the attaching spindle is essential. At one end of the scale, to prevent shimmy, and at the other, to ensure smooth operation without the need for excessive asymmetric braking while turning. Relatively speaking, torsional loading on this type of spindle is quite low. The big loads come from bending and these forces are increased massively by ham-footed over-braking, which is necessary if the fork is too stiff on ›



(Above & above right) **Because of design limitations, nosewheels can have a tendency to shimmy – a reasonably stable dynamic oscillation around the spindle (side to side). Apart from being uncomfortable, shimmy can impose very high local loading on supporting structure, which may exacerbate the effects of both wear and material fatigue.**

Some aircraft use hydraulic or friction-based dampers, fixed in parallel in the nosewheel steering, but the SportCruiser's system relies on the friction created between the fork assembly and the spindle itself. After receiving the broken undercarriage at our Turweston workshop, one of our first jobs was to establish whether the friction figure obtained was within the allowable limits – it was. The sketch shows the area of the leg that needs regular inspection – sensibly, before every flight.
(Photos: Malcolm McBride/Czech Sport Aircraft)

(Left & above) **The early failures of the CZAW SportCruiser's nose undercarriage were due to two factors, firstly, poor maintenance – primarily incorrect friction loading and lack of lubrication – and design issues.**

To 'fix' the design weaknesses in the original leg, in 2013 all the UK CZAW undercarriages were modified by fitting what's become known as the 'Dover' mod. At the same time, some legs were strengthened with a mod designed by LAA Inspector, Farry Sayyah. Another option was the fitment of the then-new PiperSport PS-28 Mk I nose leg. Up until quite recently. both options have operated well on LAA members' aircraft, though there's been some cause for concern in the 'certified' PiperSport world that the PS-28 leg was prone to failing, and a new PS-28 Mk II leg was introduced.

These pictures at left show the spindle from the failed Mk I leg. As you can see from the picture at left, apart from some corrosion in the centre of the shaft, it's in good order. The picture above, however, shows the fracture face of the tube itself – corrosion suggests that this part has been failing for some (unknown, of course) time. *(Photos: Malcolm McBride)* the spindle. That's why all the spindles on the original CZAW undercarriage system were upgraded – known as the Dover mod, this effectively doubled the strength of this spindle.

LAA Engineering issued an *Airworthiness Information Leaflet* (*LAA/MOD/338/017 Issue 1*) in April 2013, requiring replacement of the existing CZAW nose-legs with either the Derby mod (pretty much a one-off), the Graham Smith-designed Dover mod, or the then-new EASA-certified PiperSport nose-leg.

Both the Dover and Derby mods required the replacement of the troublesome spindle assemblies but when these modified legs re-entered service, it soon became clear that the leg itself was suffering from problems elsewhere.

The first issue was bending in the leg, the second was cracking in the area of the weld joining the leg to the spindle housing. Both of these problems were dealt with by adding doubler plates to the leg, to increase its stiffness and ultimate strength.

Another mod was also cleared by LAA Engineering, adding doubler plates to the leg. These doublers were extended over the connection with the nosewheel assembly to reduce the local loads on the welds. This strengthening mod has since become known as the Sayyah mod after its designer, LAA Inspector Farry Sayyah

Some owners complied with the requirement to strengthen the nose legs by fitting the new PiperSport leg assembly and, at least up until just recently, we've had only a few problems reported, which appeared to relate to either poor maintenance (we've heard of one PS Mk I leg actually seizing solid through lack of care) or 'snap' loads created when pushing the aircraft back into the hangar.

This latest failure is different. The aircraft involved, a group-owned machine, is very well maintained – this was clear when the failed leg was dismantled here at our Turweston workshop, as the drag friction was spot on and the leg was well-lubricated. However, what was clear was that this leg had been failing for some time – in some ways it's a good thing because it means we can, just for a short time, keep them in service until they can be upgraded, either with the later PiperSport Mk II undercarriage system or the fully modified, original CZAW leg.

Naturally, we've written to all of the LAA's SportCruiser owners, alerting them to this recent failure, and have backed this up with an *Airworthiness Information Leaflet* (*AIL*) requiring owners operating with the PiperSport Mk I legs to remove the nosewheel spat, carefully clean the area surrounding the spindle support and check that all's well before their next flight. We do know that some SportCruiser owners already operate without spats so that they can keep an eye on things between the 25-hour inspections. Further requirements will no doubt follow, and I suspect that I shall be able to describe the full 'fix' in next month's *Safety Spot*.

TWISTER: ENGINE FAILURE AT AIR SHOW

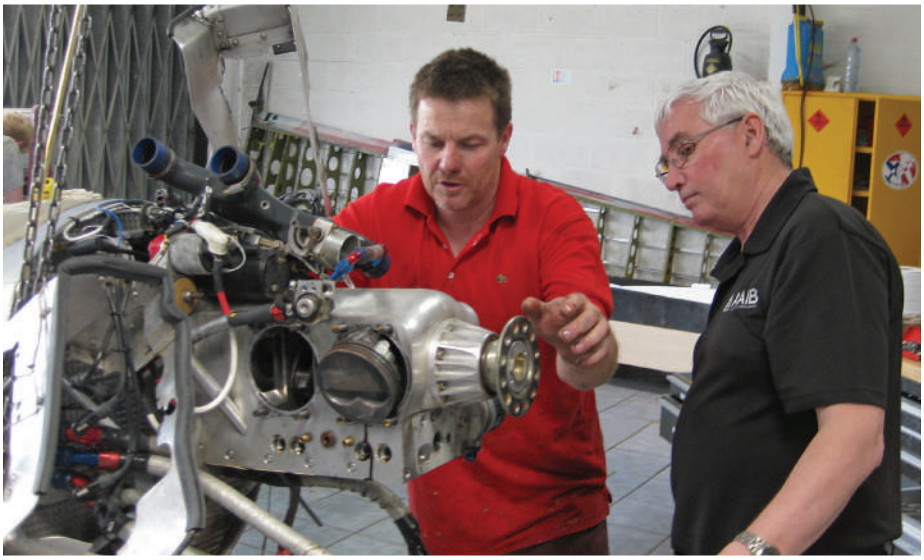
I think that the introduction to the AAIB's report into this incident is worth copying here as it describes well the incident: '*During a formation aerobatics display of a pair of aircraft at MOD Abingdon, the engine of the number two aircraft lost power and then stopped in flight. The subsequent attempted forced landing onto the runway at Abingdon was unsuccessful*.'

Anyway, that's how the flight ended, but the day started when the two aircraft flew from their base in Buckinghamshire and landed at Abingdon prior to the display. ›

(Above) **This Twister was performing at an air show when the engine failed – the aircraft was quite low when it occured and was flying downwind. The pilot was unable to maintain sufficient airspeed during his turn into wind and the aircraft hit the ground with a much higher vertical velocity component than he would've liked. The pilot was briefly knocked unconscious and, although the emergency services were on the scene very quickly, they had no idea how to enter the cockpit to rescue the occupant. Fortunately, the pilot regained consciousness and was able to release the canopy lock.**

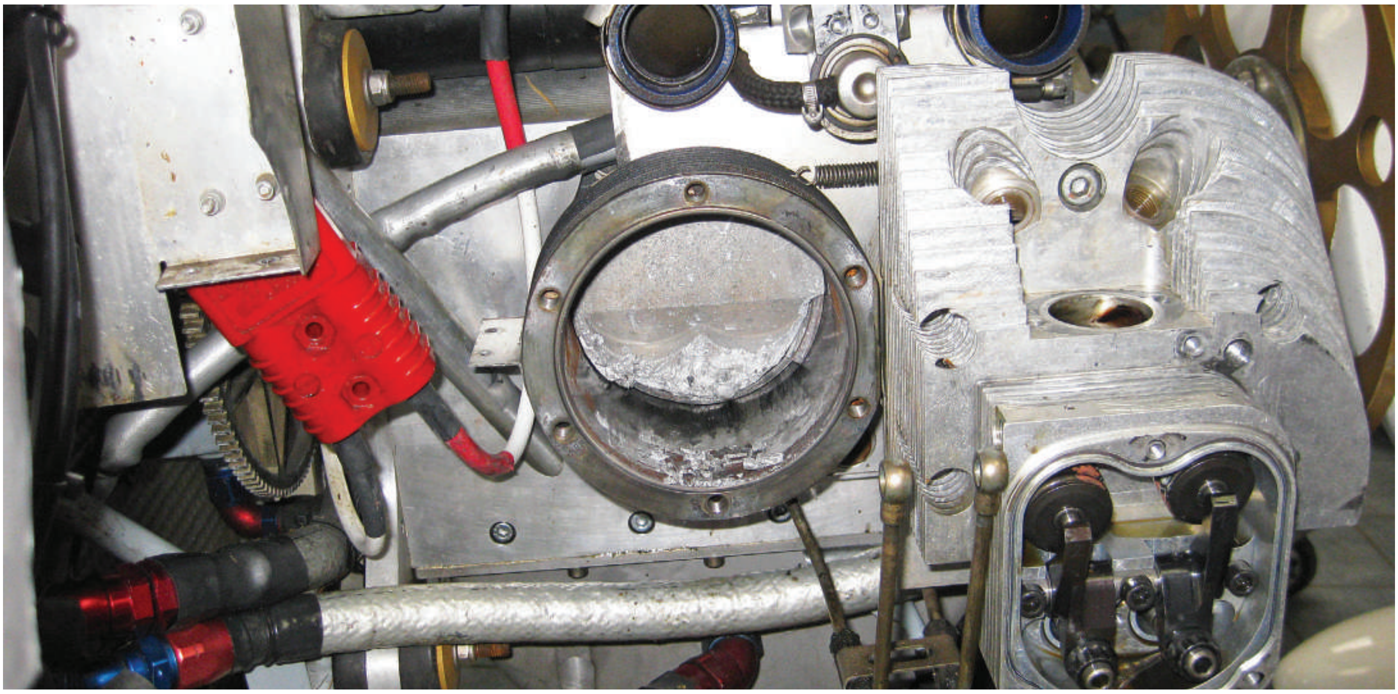
Thus started a twofold investigation. One, why had the engine failed and, two, why couldn't the first-responders get into the aircraft? *(Photo: YouTube)*

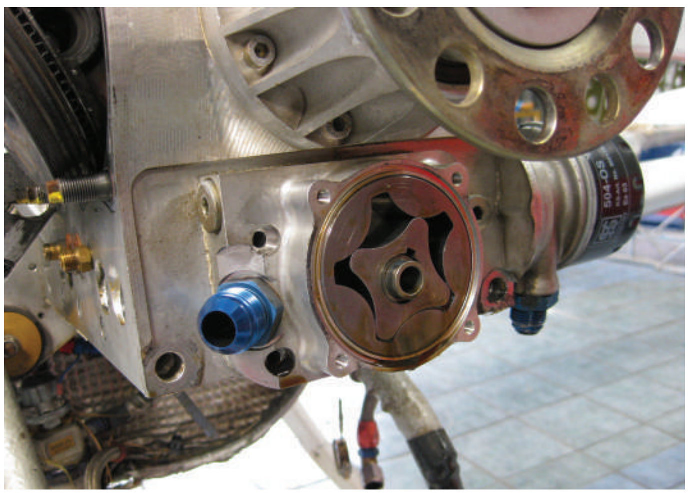
(Left above & left) **These pictures show close-ups of the nosewheel fitted to the SportCruiser which suffered the leg failure. I include them to reinforce the point that spats can hide an unhappy engineering situation. This Matco wheel came with the original kit and was supplied without any surface protection. As you can see, after not that long in service, it's now very corroded. Remember, when you see the products of corrosion on any part of an aircraft, you're looking at material which is unable to participate in any further useful work and, perhaps worse still, may focus stress inappropriately through a component, which could lead to premature failure.**
(Photos: Malcolm McBride)



(Left) **Under normal circumstances, an engine failure on a Permit aircraft wouldn't drive a full-field investigation by the UK Air Accident Investigation Branch (AAIB). However, when the failure occurs at an air show, there's a good deal more scrutiny. This picture shows AAIB Senior Investigator Brian McDermid, who's a keen pilot and has recently joined the LAA, in the process of stripping the ULPower engine with Twister expert and LAA Inspector, Pete Wells, to ascertain the likely reason for its failure.** *(Photo: Malcolm McBride)*

(Below) **It didn't take too long to discover the cause of the engine stoppage – the piston in number three cylinder had effectively seized in the barrel. What seems strange was that there was no oil residue at all in the cylinder, piston skirt or rings.** *(Photo: Malcolm McBride)*





(Above left & right) **The picture above left shows the main bearing shell from the ULPower engine which suffered a piston seizure. The result of the oil loss is clear in the material of the shell, though note that there's only limited local blueing (top left), which suggests this was a very rapid event and the bearing itself didn't actually seize. The picture above right shows the geared oil pump – note there's some residual oil in the pump and no evidence that it ran dry, except perhaps for a brief moment. The piston/cylinder lubrication on the ULPower engine, like most powerplants in its class, is provided by the mist of oil that's ejected from the main bearings. That's why, in this class of engine, a reasonable oil pressure is so important. Some engines increase this internal 'oiling' by allowing the crank to rotate in the oil contained in the sump.** *(Photos: Malcolm McBride)*

When preparing for the display, the pilot of the accident aircraft checked the engine oil quantity and found it was indicating full.

The two Silence Twisters were given departure clearance, took off in formation and were cleared to commence their display by the controller as soon as the previous aircraft had landed.

The first few minutes of the display proceeded without incident. However, the accident pilot became aware that his engine appeared to have been under-performing during the barrel rolls which formed the second manoeuvre in the display sequence and transmitted to the leader, asking him to reduce power slightly because he was finding it difficult to maintain the correct formation position.

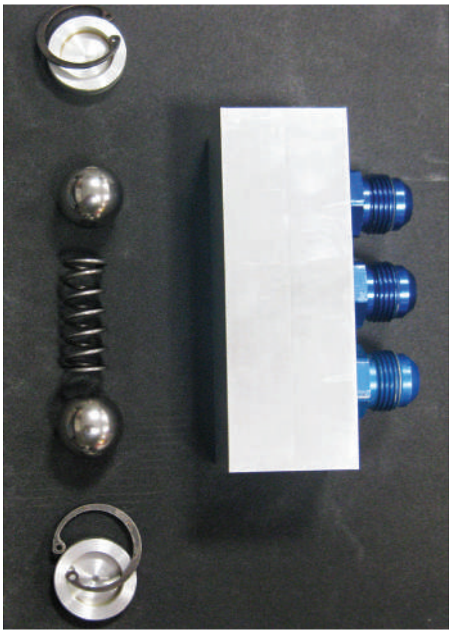
After the next manoeuvre, a stall turn, the leader transmitted, "Are you going to be okay? You're a bit low," to which the accident pilot replied, "I am very low on energy here," followed a few seconds later by, "I've got a problem, I'm landing off this."

The pilot then flew what he called a 'hard-reversal' and commenced a steep, descending right turn, both to gain speed and to try to align with the runway. It was during this final manoeuvre that the engine stopped. The aircraft struck the grass to the east of the runway, with its landing-gear and flaps retracted, in a wings-level and slightly nose-down attitude. The aircraft bounced and slid to a halt. The formation leader, who was unaware of the accident, continued with the display.

The good news is that everybody agreed that the F1 'safety cell' concept designed into the Twister worked well, clearly reducing the possible injuries to the pilot.

Much of the discussion regarding the possible reasons for the engine failure are dealt with in the associated picture captions. However, the accident also highlighted the need for clear instructions about how to get into the cockpit to reach the incapacitated pilot, in a language which can be quickly understood by non-flyers. In response, the LAA has updated *Technical Leaflet TL. 2.11* to include specific advice about the fitment and content of placards which describe how to get into a cockpit.

Food for thought? I hope so. Stay safe and fair winds. ■



(Left) **Though it was agreed that the cause of the engine stoppage was lack of oil at the cylinder walls, there was no obvious cause. One suggestion, and the general consensus, was that the oil supply inversion valve was the most likely culprit. This picture shows the valve dismantled – before it was taken apart, the sealing qualities were tested using air pressure and it worked well. However, the nature of this valve is that the slightest bit of detritus between the sealing ball and the socket would allow air into the system and stop oil reaching the pump.** *(Photo: Malcolm McBride)*

(Above) **Although the method of getting into and out of an aircraft might seem obvious to the aviator, it'd be wrong to assume it's instinctive to non-flyers. I've taken this picture, originally supplied by LAA Inspector, Peter Wells, straight out of the AAIB *Bulletin*. If you've had any experience of gliding you will immediately recognise that, to lift the canopy, you must reach for the catch through the DV window. However, because there were no placards directing the first responders to this procedure, potentially valuable moments were lost during the pilot's rescue.** *(Photo: UK AAIB)*

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**
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
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
Latest SPARS – No 17 April 2018	