With **Malcolm McBride**
Airworthiness Engineer

# OF CORBETT, MOTHS, PUMPS, FIRE & EXHAUSTS

## The latest LAA Engineering topics and investigations

Hello, and welcome again to *Safety Spot*. As always, I hope that you and those close to you are in reasonable enough form to enjoy your aviation exploits, whatever they might be. Thanks to those of you who sent comments about the last *Safety Spot*, especially those who liked the word discombobulate – comments, both positive and negative are always appreciated.

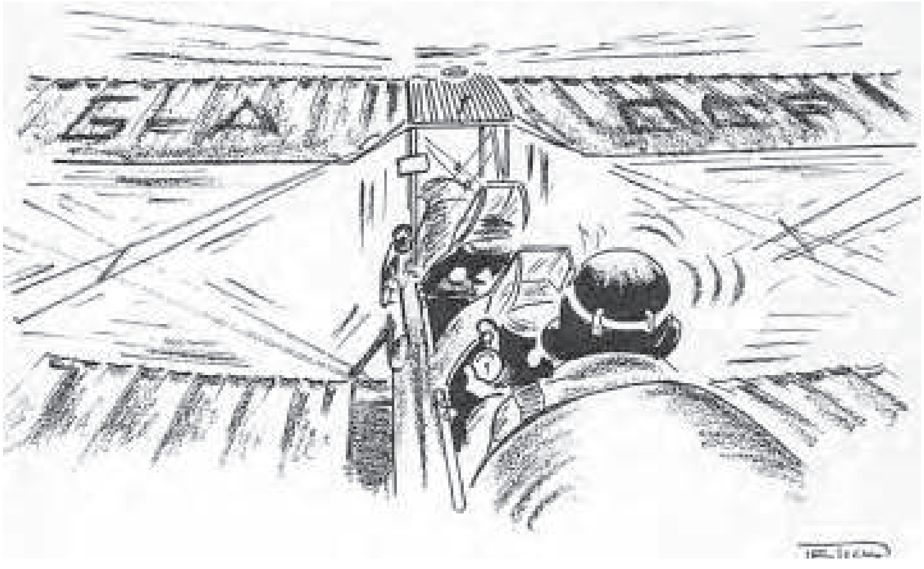
During a telephone call, one commentator said that I reminded him of the late Ronnie Corbett who, incidentally, passed on 31 March 2016, almost exactly one year ago. Ronnie, as those of us who are over a certain age will remember, was a stand-up comedian of the old school – nothing explicit, but much implied.

One of his 'acts' was a sit-down chat with the audience where he, after some shuffling about, started to tell a story but, by using distraction and digression, made a two-minute tale last over ten. I'll take that member's comparison as a compliment… I think.

Checking Ronnie Corbett out on Wikipedia, I discovered that he was once an RAF Flying Officer, having been called up for National Service in the early fifties. He started his military career as an Aircraftsman (Second Class) in the then-new film department – talent will out. I think he still retains the honour, though now posthumously, of being the shortest-ever Commissioned Officer in Her Majesty's Armed Forces. Mind you, I'm not five-feet-one and am hopeless at telling jokes, so any similarity between me and the great Mr Corbett must lie elsewhere…

Quite a few of you commented on the story told by Richard Parker, describing his smoke-filled Van's RV-6 adventure at Staverton, when the Facet fuel pump burst into – well – smoke, just before take-off. I was going to continue the saga by concentrating on the toxic nature of fumes which have their origin in burning polyurethane (and other plastics – especially PVC) and, to make an almost perfect segue into a discussion about the continuing issue of carbon monoxide in cockpits, by introducing an article by one of our LAA Member Safety Committee colleagues, Doug Blair. He's a former mining engineer so he knows a thing or two about atmospheric poisons. Doug's written his article but you'll have to wait until our next issue to read it.

Anyway, perhaps demonstrating a Ronnie-ism, to get back to the point, you may remember that I couldn't work out how the Facet pump worked, and the manufacturer certainly wouldn't talk to an 'aeroplane type' like me. Well, LAAer Bob Robinson took the hint and wrote me a description of how it works, which was so good that I asked him whether I could include it in *Safety Spot*. A bit of arm-twisting later and, well, later in this edition you may want an electrical engineering dictionary to hand.



*(Above)* **'With the tail up and almost ready to lift off… plugs again, better not.'** *(Thanks to Stuart McKay)*

Another quick diversion, before we actually get started, is to let you know that we shall be including an 'Airprox of the Month' into *Safety Spot* for the next few editions – you may have cast your eyes over this month's offering already. Regular readers will recall the stand-alone piece about the work on the UK Airprox Board in last month's *LA*. The stories we'll feature come directly from the UK Airprox Board, which is headed by another ex-RAF man, fast-jet pilot Air Commodore Steve Foreward.

If you haven't come across the term 'Airprox' before, here's the ICAO's definition: "An AIRPROX is a situation in which, in the opinion of a pilot or air traffic services personnel, the distance between aircraft as well as their relative positions and speed have been such that the safety of the aircraft involved may have been compromised."

Over the last few years, there have been a number of actual collisions of aircraft in our skies, and many near-misses. Because of this the UK Civil Aviation Authority and the Military Airworthiness Authority (CAA/MAA) co-fund the UK Airprox Board as a national initiative. It's purpose, as the title of last month's Airprox article suggests, reminds us that when flying it's essential to *keep a good lookout*.

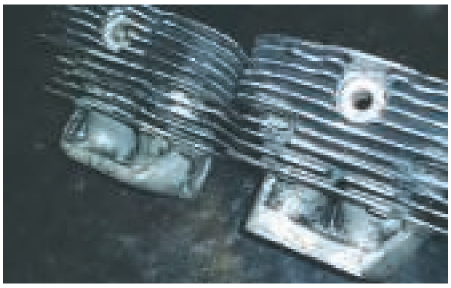
You'll have seen the cartoon and the picture of the de Havilland cylinder heads I during your 'first pass' over this edition. Well, I borrowed both the illustrations from the latest issue of The de Havilland Moth Club's *The Moth* magazine. While I was 'on the pinch', I thought I should make off with the words as well – no 'Burglar Bill' mask required! Many thanks to Moth Club men, Stuart Mackay and Nigel Reid and, of course, the story-teller himself, Malcolm Paul, for letting us use the piece herein.

### KEEPING IT SAFE: A GRUFF-RUNNING GIPSY MOTH ENGINE

**BY NIGEL REID**

Malcolm was flying his Gipsy Moth, which is powered by a Gipsy II upright engine, on a nice day at Lee-on-Solent Airfield in Hampshire. He explained that he'd been having problems with plugs fouling and, together with Paul Groves, his LAA Inspector, had fitted slightly hotter-running plugs in an attempt to prevent this happening.

During a subsequent take-off, with the tail up and almost ready to lift off, the engine started vibrating and, of course, Malcolm's first thought was, "those bloody plugs! Will they clear or not?" A fraction of a second later, he thought better of the situation and abandoned the take-off. While taxying back, the engine continued to run roughly and appeared to be missing on one cylinder.



*(Above)* **Aborting a take-off because of a rough-running engine was exactly the right thing to do, as LAA'er Malcolm Paul recently discovered. At the beginning of the take-off roll in his Gipsy Moth, the engine sounded rough, but he put this down to a fouled sparking plug, thinking "It'll probably clear". As it turned out, the engine had lost a cylinder because a valve push rod had come adrift. This picture shows a pair of early Gipsy cylinder heads with an additional rocker platform support flange welded in, a rather sensible modification according to Gipsy engine specialist Mike Vaisey.** *(Photo: Vintech)*

Fortunately, Paul was at the airfield and a discussion about the plugs ensued but, of course, it would need two plugs 'out' on the same barrel to lose a cylinder altogether.

They stopped the engine to investigate, making sure that the plug leads were still secure, etc, and then Paul pointed out that one of the valve push rods had come adrift. Closer investigation revealed that the rocker pedestal had cracked, allowing the push rod to disengage from its rocker. No valve operation equals no cylinder operation, over 25 per cent loss of 'oomph' and a gruff engine! Malcolm reflected that, if the failure had occurred thirty seconds or so later, he'd have been climbing out over the Solent at very low level.

So, a correct and timely decision to reject the take-off and an excellent reminder to us all that if the engine isn't working correctly on the ground, it's very unlikely to be any better in the air! Should you find yourself in a similar position, immediately reject the take-off and investigate.

As you begin a take-off roll, always check that the indicated RPM is what you're expecting and don't accept anything less. In reality, some of the needles on older RPM indicators can wave around a bit but, know where you expect yours to be and if it doesn't look, sound or even 'feel' right, close the throttle. That may sound obvious but, on occasions, aircraft flown by experienced pilots have tried to get airborne with less than full power, and the results weren't good.

On the engineering side, cracks in the cylinder head pedestals or the cylinder heads themselves, and failed rocker bolts aren't unknown in any of the Gipsy series of engines, although there tends to be more of a problem with the earlier marks.

As knowledge was gained, reinforcing gussets were added to the cylinder heads and there are now quite a few different designs of head to counter this problem. Malcolm submitted his head to Vintage Engine Technology, who repaired it and added gussets to the three other heads for good measure. If you run an early series Gipsy engine it's worth considering submitting the heads for a similar modification the next time you pull them for overhaul. I've experienced two similar failures in the past and so had all of my heads 'tweaked' a few years back.

After the first incident, I just happened to be flying out to Los Angeles the following day, so I cycled from my hotel to see Ed Clarke.

"Oh yes," he said, "I've had several of those go and now always add gussets to my Gipsy I cylinder heads."

The trouble was that such information hadn't been shared with some of the other Moth'ists around the world, including me!

*Malcolm comments:* I hope that, by squeezing this short feature into *Safety Spot* we'll help to pass this important message on. Regular readers will remember a similar incident in August 2015, where an engine kept on intermittently running rough. By coincidence, this aircraft also operated regularly from Lee-on-Solent, though it lived mostly on the Isle of Wight. The pilot put up with this bad behaviour for far too long and, when the engine nearly stopped completely over the Solent, it was finally stripped down.

Engineers found a bit of broken valve, left after an earlier overhaul, rattling around in the air intake. This bit of debris was intermittently holding a valve open as it passed backwards and forwards from the intake duct to the cylinder. If an engine isn't running well there's always a reason – make sure you find out what that is before flying with it again.

## THE FACET 'CUBE' FUEL PUMP – HOW IT WORKS!

As explained earlier, this is a continuing story about the rather dramatic failure of an electric fuel pump in an RV-6 aircraft operated by LAAer Richard Parker. I must say I believe that 'knowledge is power', but not in the miserly way the phrase is often used – perhaps an opposite meaning.

This is especially true, in my view, when operating and flying aircraft. I think that the sheer variety of subjects that need to be mastered by the pilot or aero-engineer before they could be classed as a 'complete' aviator is one of the reasons I love aviation so much.

Certainly, technology moves on, and many of the control mechanisms that allow us to operate the equipment in our modern world now exist only at the atomic level. Sometimes this can mean that the operator, living on a different scale, may find it difficult to picture what's actually happening in a device.

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## AIRPROX OF THE MONTH

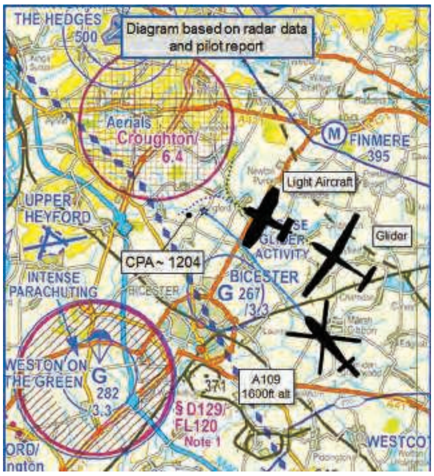
### BY STEVE FORWARD, DIRECTOR UK AIRPROX BOARD

**This new column** aims to provide recreational pilots with some learning themes, and this time we'll deal with avoiding collisions. Not counting six drone/UAV reports that were assessed this month, February's Board meeting also looked at fifteen aircraft-to-aircraft incidents, of which eight were assessed as having a definite risk of collision – three in Category A and five in Category B.

All three of the Category A Airproxes, and one of the Category B incidents, resulted from head-on encounters, where the pilots effectively didn't see each other, and none of these encounters had the benefit of electronic conspicuity equipment to assist the pilots in gaining situational awareness.

Collision warning systems are becoming more affordable, and I know that the PilotAware system is gaining popularity amongst many GA pilots (other systems are available), so I can only encourage everyone to have a look at what's on offer and see whether it's time to invest in something that may well save your life.

The other main themes discussed this month were: poor airmanship decisions in six incidents, late-sightings/non-sightings in nine events; and a couple of incidents caused by pilots flying too close to promulgated landing strips and microlight sites which were clearly marked on the map.



**My Airprox of the Month, as shown above, is incident 2016209, which was an overtaking situation that ended up as Category B incident. Constrained to a certain degree by airspace, an A109 pilot was routing past Bicester when he saw a tug/glider combo ahead. As he flew between this combo and the airfield, the glider unexpectedly separated from the tug, which then turned left in front of the A109 and dived towards Bicester. There are four lessons here:**

**1 Try not to come between a tug/glider combo and a gliding site in case the glider releases. If it does then the tug will then likely dive immediately towards the glider site, to try to get on the ground for the next tow as soon as possible.**

**2 Overtake on the right because this is what is required and expected by other pilots.**

**3 Don't overtake too close to other aircraft, in case they unexpectedly manoeuvre.**

**4 Tug pilots need to remember to clear their airspace also before automatically turning and diving after glider release.**

**The full report can be found on the UKAB website, in the 'Airprox Reports and Analysis' section, under the appropriate year of the 'Individual Airprox reports' tab:** ***www.airproxboard.org.uk***

Microprocessor control is, as we've all come to expect, excellent in terms of manufacturing cost, reliability and performance, However, it isn't so good when it comes to understanding how something actually works. I come from the non-digital world – it's an age thing – but have tried hard to keep up with this new-fangled way of managing machinery and equipment.

Of course, there were computers when I was a lad, you just couldn't fit many of them onto a postage stamp. I do remember a visit once to the mysteries – and mysteries they were – of the computer centre operated by the late BOAC in Boadicea House at Heathrow Airport, which was cutting edge in the seventies. In those days, most of the equipment on aircraft was, more or less, mechanical or more commonly, electro-mechanical.

Right at this moment we're looking into a new, brushless, motor-driven, rotary electric fuel pump to be offered as an alternative to the Pierburg-brushed type found on many aircraft with Rotax 914 and 912iS engines. Its brain, a microprocessor, takes the place of the more mechanical commutator but, when you think about it, the mechanism of action is largely the same. The clever thing, and why I love aviation (and the modern world), is understanding the similarities, not the differences.

LAAer, SportCruiser-flyer and electrical engineering boffin, Bob Robinson decided to explain how the electrical pulse pump worked. Luckily, he had a spare pump in his workshop which he could take to bits! Here's his report:

*(Below)* **Regular readers will remember this picture of the damaged internals from a Facet-type fuel pump from last month's *LA*. You'll recall that the electronics overheated, which melted a small amount of the potting compound, probably some kind of polyurethane. That produced enough smoke and toxic effluent to completely fill the cockpit of Richard Parker's Van's RV-6.**

**We did try to find out what had caused this failure, the only clue lay in the fact that the pump was consuming nearly twice the amps it should have done. I had a problem understanding how this pump worked and LAA'er Bob Robinson, who had a spare example in his garage, came to my rescue by describing this clever pump's operation.** *(Photo: Richard Parker)*

## INTRODUCTION

The 40*** series Facet electronic fuel pumps are sometime referred to as Cube pumps. The information here relates to a 40105 pump, but other models in this series are very similar. This description will start with an overview of its mechanical assembly, making reference to the diagram Fig 1. This will be followed by an overview of the built-in electronic circuit, shown in Fig 2, which controls the pump operation. A description of the pump's operation then completes this explanation.

## MECHANICAL ASSEMBLY

The pump is completely enclosed in a substantial steel case, which also provides a magnetic path for its operation. Two wires for the supply of power are routed into the main body, red for +12V and black for 0V. The fuel inlet of the pump is the longer hexagonal block and is tapped with a 1/8 nptf thread for a hose fitting. The shorter block is the outlet, with a similar tapped thread.

The diagram *Fig 1* shows a section through the mechanical operating parts of the pump. On the left of the diagram, the hexagonal inlet block is shown, and on the right, the outlet block. The vertical lines from the blocks show the external casing. Linking these blocks is a brass tube in which a stand-alone piston has a sliding fit. The steel piston is hollow in the centre and contains a valve allowing fuel to flow to the outlet.

The piston also has a counter-bore at the other end, to locate one end of a compression spring. The other end of the spring engages with the inlet block, which contains a non-return valve to allow fuel from the inlet into the brass connecting tube. *Fig 1* shows the inlet block deliberately separated from the brass tube, for clarity. The tube is normally a push-fit in the inlet block and is sealed using an 'O' ring. The piston is biased towards the outlet block by the spring and is stopped by a circlip fitted in the block.

It should be noted that the steel body of the outlet block extends approximately halfway down the outside of the brass connecting tube, leaving the other half exposed. The 'at rest' location of the spring end of the piston inside the tube is approximately halfway along the exposed section of the brass tube. These factors are essential for the pump's operation.

Fitted around the connecting tube and between the side cheeks of the external casing is a coil assembly associated with control electronics. The coil consists of two windings which are joined, and the common connection is coloured black. The other connections are white and a plain wire, all of which are routed to the electronic PCB located at the base of the pump.

## ELECTRONICS CIRCUIT

The electronic control circuit is contained on a small PCB and uses discreet components. Wires to the PCB are the red and black 12V power supply PCB the three wires, white, black and plain, from the coil assembly.

The Darlington drive transistor, which controls energy into the main drive coil L2, is fitted with a heatsink tab that's thermally coupled to the lower plate of the external case.

The screw head fitting is visible from the outside of the pump. Don't try to undo that as it could affect the thermal conductivity of the drive transistor, which is dissipating the greatest power, and it'll go up in smoke.

The diagram *Fig 2* shows the circuit diagram for the electronics and will be used in the description of the operation of the pump.

## PUMP OPERATION

The start conditions, before power is applied, will be that the spring is biasing the piston at the outlet end of the brass connecting tube against the circlip end stop. Also that the inlet, outlet and connecting tube are full of fuel.

Using the mechanical diagram in *Fig 1* and the circuit diagram in *Fig 2*, let's proceed with the description of operation.

On application of the 12V power, current will flow from the +12V through L2, L1, 3K and 24K and the Darlington transistor will begin to conduct. As the current through L2 increases, the voltage across L1 will increase due to their

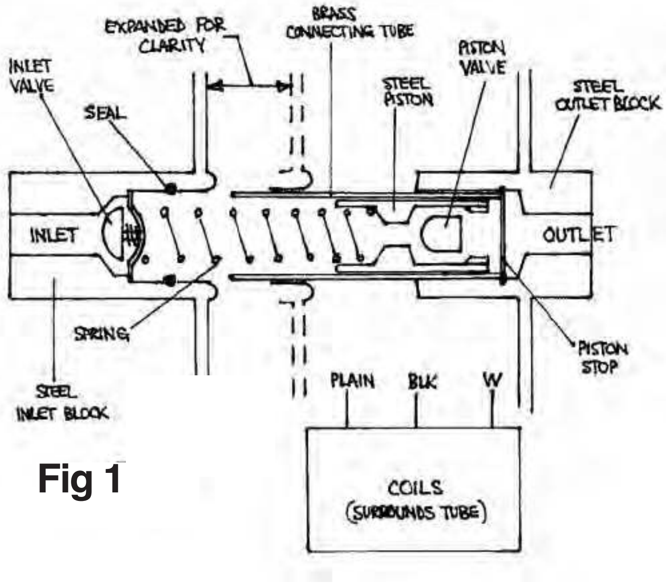


Fig 1

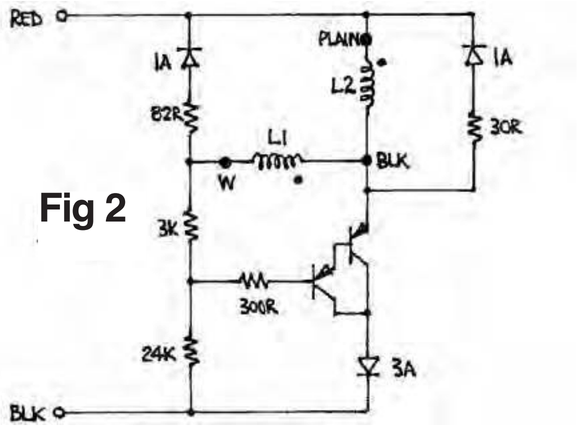


Fig 2

**Fig 1 shows the basic layout of the Facet fuel pump, while Fig 2 is the reverse-engineered circuit diagram – read Bob's description of events through the pump's cycle in the main text. I got the gist of it after a couple of readings, though electronics has never been one of my strong suits.**

mutual coupling and will regeneratively turn the transistor fully on.

The current though L2 will cause a magnetic path to flow through the steel casing, and through the extended internal outlet block and through that part of the piston extending from this block into the exposed brass coupling tube. It's worth clarifying, at this stage, that the brass tube is invisible to the magnetic path (but not, of course, fuel) but the piston inside the brass tube, being steel, is influenced by the magnetic field.

However, to complete the magnetic path, it has to traverse a section of non-magnetic material. This magnetic gap introduces reluctance into the magnetic circuit, such that core saturation is less likely. The energy created in the effective airgap propels the piston to close the gap by sliding against the force of the spring towards the inlet block. The fuel in the inlet side of the connecting tube will flow through the piston, and its valve and the inlet block valve will stop any fuel flowing back towards the source.

So, the overall fuel displacement will be negligible. As the piston closes the gap in the magnetic circuit, the reluctance decreases and will cause the core to saturate. This will cause the mutual coupling between L1 and L2 to cease, and the transistor won't be fully turned on, as its base is now only driven by the 24K. During this time, the piston is pushed by the spring towards the outlet end of the connecting tube and, because the piston valve is now closed, pushes fuel into the outlet.

The valve in the inlet block becomes open during this time and allows fuel in, to replenish that pushed from the outlet. The effect of the piston moving back towards its starting position opens the magnetic gap and increases the reluctance again, taking the core out of saturation, to allow mutual coupling to take place, and the cycle repeats itself.

It should be noted that the time taken for the piston to be pushed back to its starting point is quite variable as it'll be determined by the flow rate required. As the float chamber becomes full and its shut-off valve limits the flow, the spring will find it harder and take longer to push the piston back. This is usually quite noticeable when listening to the clacking of the pump.

*Malcolm comments:* Phew! I'll be honest and say that I had to read through this explanation twice, though I did understand it in the end (with a little help from Wikipedia).

I'd never heard of a Darlington transistor and 'mutual coupling' – an easily confused concept for the average aviator's mind that took some figuring out. Worth the effort, though – remember, knowledge is power. Thanks to Bob for taking the time to write this explanation.

## SILENCE TWISTER: ENGINE FIRE DURING THE START-UP

LAA Inspector Tim Dews climbed into his Silence Twister to have a quick aerobatic practice over the Wiltshire countryside, as he'd done many times before. Can there be any nicer pastime after a hard day's work in the hangar? I doubt it!

Tim is a careful chap and although he knows his Twister from back to front, he still completed a thorough pre-flight inspection. The weather was good and he was looking forward to looking at the world from a different aspect and pulling a few Gs. He turned on the electrical master switch, checked that the fuel was on – it was – and switched the fuel pump on. In a well-rehearsed dance only an aviator, or perhaps a musician, would understand. Tim conducted his pre-start checks, opened the throttle, turned the ignition switches to on, checked around for any reason he shouldn't start the Jabiru 2200 engine, shouted "clear prop" and pressed the starter.

As you can see from the pictures supplied by Tim, fired-up is an appropriate verb, as the engine immediately, and quite terrifyingly, burst into flame. There wasn't an on-board fire extinguisher (there is now) and Tim, hurriedly releasing his harness and leaping from the cockpit, twisted his ankle rather painfully during the exit. Tim limped off towards the hangar, where he knew there was a wall-mounted carbon dioxide fire extinguisher. All this, naturally, took time and the fire started to take hold of the engine pipework and electrical wiring, creating a dense black smoke.

Carbon dioxide is the perfect fire extinguisher to use on a fire in an enclosed space, though care is needed if it's to be deployed against burning liquids (fuel) because the pressure of the gas can spread the fire. That said, the fire was soon put out without fuss.

Straight away, Tim realised that, during his understandable hurry to leave the cockpit, he'd left the fuel pump on and liquid fuel could be seen dripping from the rear of the lower cowl. He realised what may have happened and, switching the fuel and the pump off, sat down by the aircraft to give it – and himself – time to cool down before removing the cowls to investigate.

At first, Tim thought that there had been a fuel leak, perhaps from a pipe connection, though when he checked the system out later, it became clear the carburettor float valve had jammed itself open for some reason and the excess fuel was simply draining out into base of the lower cowl.

Naturally, Tim removed the engine and replaced all the connecting pipe and wirework, including the ignition harness. He felt that the spark which had set the whole thing alight probably emanated from the alternator which, as you may know, is a rather 'open' affair, situated at the back of the Jabiru engine.

When we first saw this picture, our thoughts went straight to the security of the surrounding structure. Though the firewall is very substantial

*(Left)* **LAA Inspector and composite specialist, Tim Dews, sent this picture showing soot and debris in the engine compartment of his lovely Twister.**

**As you can see, Tim's aircraft suffered an engine fire on start-up. Naturally, after the fire was extinguished, there was quite a bit of damage to ancillary equipment (wires, pipes and suchlike) but our real concern was to establish whether the engine-supporting composite structure had been compromised.** *(Photo: Tim Dews)*

*(Right)* **This picture shows how Tim set about checking that the engine mounting structure on his Twister remained sound after possible heat damage.**

**Essentially, the engine was fixed to the ground via a Whiffletree structure from the engine's centre of gravity position, via a pressure gauge, which was there to measure the applied load.**

**The force trying to pull the engine out was supplied by Tim's son Ben, seen here at the back of the Twister. However, as it turned out, Tim and Ben had to call in the CFI to add a bit of extra weight.** *(Photo: Tim Dews)*

*(Above & above right)* **These two pictures show the details of mechanics of the limit load test (6g). Note the Whiffletree mechanism, which is a clever way of getting the load acting in the right place.** *(Photo: Tim Dews)*

and appeared to be in good shape we – and as it turned out, the manufacturers of the kit – felt that a close look at the supporting structure behind it would be needed. The fuselage of the Twister is, after all, a composite laminated structure and an internal de-lamination was considered to be a distinct possibility.

After some consideration, and discussions with Tim, the manufacturer and the LAA Design Department, it was considered that the only way to be absolutely sure the structure supporting the engine was still in a sound state was to test the engine mounting structure to the maximum in-service load it'd be expected to resist; engineers call this a proof load test.

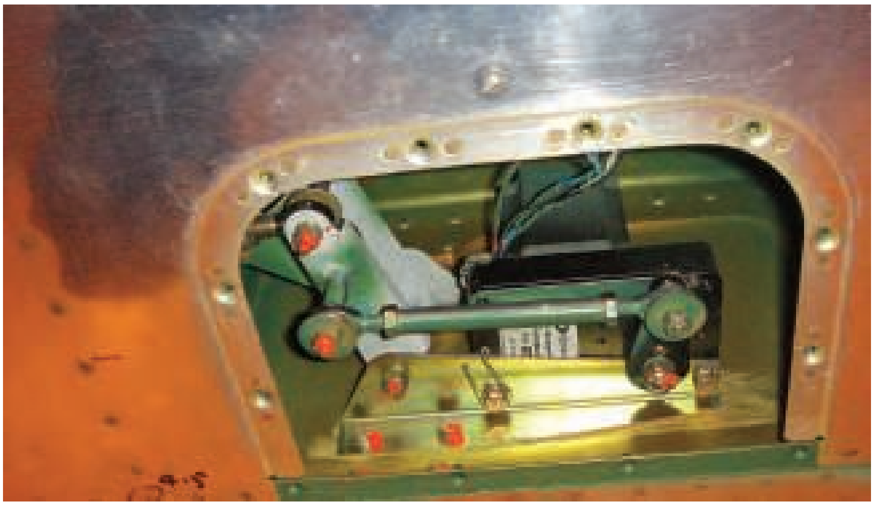
You can see how this was done in the accompanying pictures and I'm sure that you'll be pleased to hear that Tim's Twister passed the test with flying colours – it is, after all an aerobatic display aircraft.

Anyway, lessons learnt? Well, it would be a shame if there weren't any! A fire extinguisher close to hand is always a good idea when starting an aircraft engine. Perhaps, in a more general sense, it's a reminder that one should always expect the unexpected.

Tim says he's going to check whether the float valve is actually doing its job before starting the engine, perhaps by leaving the fuel pump on during the walk-round check. I think, again perhaps in a more general sense, its worth remembering that fires need fuel, and of course oxygen, to continue burning.

So if you're ever faced with a situation where there's a fire in the aircraft you're flying, or even suspect there might be one further down the line – for example, if you've got to conduct a forced landing – then turn off the fuel and the pump as soon as is practically possible. Fair winds… ■

## DYNON AUTOPILOT ROLL SERVO WOES



*(Above)* **LAA'er Andrew Collett operates his Van's RV-10 aircraft from Turweston Aerodrome, so we often see him about the place. The other day, he asked me to look at a picture of the insides of his Dynon autopilot roll servo, which had started to become rather jerky in its operation. The above picture shows the roll servo as it sits in the wing. You can see that the servo is mechanically connected, direct to the aileron bellcrank so it's essential that the device remains in tip-top condition – no jamming allowed.**

*(Left)* **When Andrew opened up the Dynon roll servo's cover plate, he was rather alarmed to find that the board was covered in some kind of contamination – it rather looked like watery soil had got inside.**

*(Right)* **Andrew further stripped the servo down and, as you can see, the unit's motor and associated bearings have been damaged by ingested water. Andrew sent the pictures to Dynon HQ and they came back saying that this unit wasn't repairable.** *(Photos: Andrew Collett)*

## EXHAUST FAILURE ON A VAN'S RV-8

**Here are a couple of photos showing a very recent area of failure on the exhaust of a Lycoming O-360-powered Van's RV-8. The exhaust failed shortly after take-off and, quite rightly, the pilot elected to land as soon as possible.**

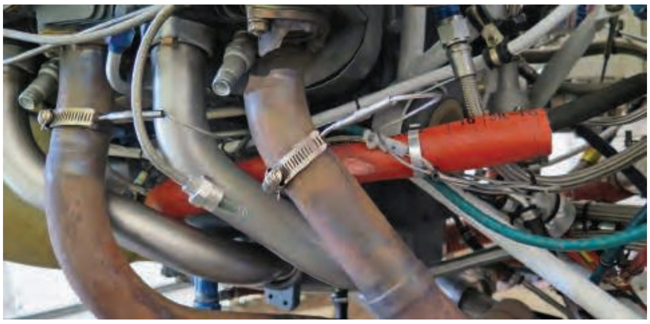
**As you can see, the exhaust has principally failed at the long junction of the two down pipes but also near the connection with the rear (no 4) cylinder.**

**There's been some debate about the actual sequence of events. My best guess is that this exhaust failed at the top of the junction between the two pipes. Notice the small crack, which is clearer in the second, close-up photo, that's emanating from the weld.**

**We've just received the exhaust system from the owner, though sadly too late to feature any detailed failure analysis herein.**

**However, two things do jump out straight away. The first is that the cup and ball fitting (top right in the first photo) was completely seized, preventing any relative movement between the pipes. Secondly, that the failures are predominantly along weld lines. Initially, there appears to be no evidence of fatigue in the fracture faces, though we'll need to look more closely to be sure of that.**

## LYCOMING EXHAUST WELD FAILURE



*(Above)* **This photo shows a complete separation of the exhaust pipe from this Lycoming O-360 engine. I believe this failure was caused because of the loss of support supplied when the connecting weld failed further down the system.**

**Notice the EGT probe will now not be in the major exhaust gas stream. The loss of EGT information was this pilot's first indication that there was a developing engine problem.**

**We're looking into the origin of this system and will take a much closer look at the pipe's construction, particularly the quality of the welding. If you recognise this type of exhaust assembly, or have any experiences similar to this failure, please let us know by emailing *engineering@laa.uk.com***

*(Above)* **When the pilot noticed that the EGT was rapidly dropping, and the engine note appeared different, he elected to conduct an immediate precautionary landing.**

**Unfortunately, the landing was conducted into a low sun and one wheel left the runway, into the rough ground running alongside, and the aircraft tipped on its nose, though from all accounts quite gently. The owner thought that the damage would be limited to the wheel spat and, naturally the propeller. Sadly, as you can see from this photo, the firewall has been creased, which will mean a more difficult repair.**

## CHIPMUNK EXHAUST FAILURE

**Initially, the job was to remove the intake manifold and carburettor from this Gipsy 10 engine, fitted to a DHC-1 Chipmunk which was in the hangar for a service.**

**However, LAA Inspector Alan Turney didn't like the look of the staining around the exhaust pipe to cylinder joint, so he removed that as well. The second photo shows why this was a good idea - "Honest, Guvnor, it came off in me 'ands."**

**Clearly, this pipe has been held in place by inertia for quite some time and the problem should have been picked up on a pre-flight inspection. Apart from the loss of power experienced when an exhaust fails like this, there's a greatly increased risk of an in-flight fire, particularly as a flexible fuel pipe passes very close to the rear cylinder exhaust outlet.**

**The engine cowlings open very easily on the Chippy, for good reason, though looking round some of our fleet the same cannot be said for every aircraft. So take a tip, check your engine thoroughly before the first flight of each day (at least every five hours), however difficult your aircraft's designers have made cowl removal.** *(Photos: Alan Turney)*

## 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 CofA to Permit or CAA Permit toLAA 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.16 February 2015* | |