With Malcolm McBride
Airworthiness Engineer

FOD FOR THOUGHT & WHEELS-UP LANDINGS

A new collection of cautionary tales that highlight importance of foreign object debris and faulty components. Would you know how to react if it happened to you?

FOD, or Foreign Object Debris, can be a real problem around aircraft. When working on an aircraft it's essential to operate in a disciplined way so that the area remains clean and all tools are accounted for after the job has been completed. Many operators of aerobatic aircraft insist on a 'nothing in the pockets' policy for their pilots… a good idea in my view. *(Photo: LAA Library)*

Straight into things this month with a thanks to all of you who let me know that some of the pictures connected with the corroded Europa rudder cable weren't actually shown. Last month's mag, at least my bit of it, was finished at the very last minute and the editor simply ran out of space and time; I've featured the important photograph (of a correct swage) this month, while if you want to read about this particular airworthiness event you can go to the LAA's website *(www.lightaircraftassociation.co.uk)* where, after a bit of searching, you'll find all the back-issues of *Safety Spot* – just look for the August 2015 issue.

I have also received, and thank you to all those who have written supporting this section of the mag, a few comments about the propeller-swinging letter sent in by the designer of the rather unusually named FRED single-seater, Eric Clutton. I do accept that there are a number of different approaches to the tricky job of starting an engine, particularly a big engine, and perhaps there's no 'one size fits all' solution. I still think that Eric gave some useful tips on how to stay safe whilst performing this potentially dangerous operation. A regular (and valued) contributor to my mailbox, LAA Inspector Robin Dispain, suggests that it is a dangerous practice to curl one's fingertips around the trailing-edge of a propeller whilst hand-starting an aircraft engine because it could damage your fingers. Robin was worried that a kick-back, that's when the engine fires before Top Dead Centre (TDC) and there's not enough inertia in the prop (and the swinger I suppose) to carry the engine through the compression stroke so the propeller shoots backwards, could be catastrophic… especially for a sax player (like me!).

LAA'ers Barry Brown and Dave Scott both reminded me of the dangers of turning some engines backwards. Dave commented, *"If you have an engine with an engine-mounted/driven dry vacuum pump, such as Airborne (or a Rapco refurbished pump), then there is a likelihood of causing a pump failure – the graphite hubs and vanes are canted in the normal direction of rotation thus opposite rotation will very quickly result in failure of these parts, as well as the internal frangible plastic coupling which may also shear."*

All except one of the UK's Christen Eagle IIs transferred as soon as they were able to an LAA administered Permit to Fly. This aircraft, originally constructed in 1980, joined the LAA fleet in 2007 and has been quite recently completely refurbished. After a period of inverted flight, it suffered an elevator control restriction which meant that the pilot couldn't slow the aircraft below about 85mph. The pilot handled the emergency well and the aircraft, after a couple of attempts, was landed safely; a little less movement in the elevator travel may have led to a different outcome. Never be complacent where FOD is concerned. *(Photo Dennis Maddocks)*

Barry added, *"The Sigma-Tek pump is designed for idiots and so it doesn't mind which way you rotate it."* Thanks to you both for your 'inside' information.

I'm reminded that kick-back was a problem for my leg (rather than my fingertips) whilst trying to start my uncle's old motorbike, a very old un-roadworthy machine with a sidecar, or at least the remains of a side-car, that lived out its retirement in a ditch at the bottom of his back field. The machine that was just right for the 'interested' eight-year-old – the deal was, if I got it started I was allowed to ride it around his fields until the fuel ran out. When you only weigh-in at about 50lb, getting the piston through TDC was more difficult in practice than in theory, and I can remember ending up unexpectedly in a hedge more than once, the inevitable consequence of a backwards power stroke, 50 or so pounds weight on the kick starter and the, as instructed, dead straight leg!

Anyway, I'll admit to being a bit reticent about putting Eric's advice straight into *Safety Spot* because I guessed some would disagree with the 'nuts and bolts' of it but, bearing in mind the number of injuries caused during the process of starting aeroplane engines this year, I am happy to bring the subject up to your table in almost any form.

Only yesterday an LAA member called me to let me know that one of our members had just had to have his ear sewn back on when, whilst turning the propeller during routine maintenance, the engine unexpectedly fired. Apparently, although I haven't at the time of writing got the full facts, he was knocked unconscious… a state he remained in for some time. A reminder perhaps that we should **TREAT A PROPELLER AS LIVE** at all times.

Another recurring and potentially fatal airworthiness issue is the problem of unwanted foreign objects often, in aerobatic types, quite literally floating around inside an aircraft. The aviation industry has coined the acronym FOD, the letters of which stand for Foreign Object Debris. I'm sure that many of you will remember the huge posters warning about the problem of unwanted bits and pieces in and around aircraft on every hangar noticeboard. You won't meet a competent aero-engineer who doesn't know where every one of his tools are at any one time, and woe betide the person that borrows a spanner without asking first because a missing spanner could hold-up the release of an aircraft into service. FOD, and lost tools, are taken very seriously in the aircraft maintenance world.

After taking the panels off, the reason for the control restriction could easily be seen – a £1 coin had jammed itself in the elevator bellcrank, severely limiting the up movement. *(Photo Dennis Maddocks)*

Further FOD checks throughout the aircraft revealed a loose set of aircraft keys. If you lose something around an aircraft, it is very likely that it's hiding somewhere in the airframe. Don't rest until you can be absolutely sure that it isn't waiting to cause you trouble at some time in the future. *(Photo Dennis Maddocks)*

This next tale, sent in by LAA'er Dennis Maddocks, actually increased my heart rate when I first read it, although I suspect, not quite as much as it accelerated his cardiac rhythm during the event.

Christen Eagle – Jammed Elevator Control

There can be very few flyers of my generation that didn't consider buying one of Frank Christen's Eagle II kits when it first became available in the late 1970's. Apart from the fact that it was a must-have aircraft in itself, the kit was so good that it set the standard for all future aircraft kits both in terms of assembly instructions and parts documentation. I remember the kit's advertisement showing a picture of the box of goodies and an arrow pointing out the knife taped to the outside of the kit's delivery box so that the box could be opened without fuss!

When the first kits started arriving in the UK, the LAA, at the time the PFA, wasn't able to manage the build because our approval at that time limited us to engine sizes of 180hp or below. The first Eagle II, and in fact most of the subsequent airframes, were designed around Lycoming 200hp injected engine (the AEIO-360), meaning the builds were overseen under the CAA's own Permit to Fly scheme.

The aircraft that sits at the centre of this recent event was actually constructed in 1980 and gained its first Permit in 1981, joining, along with almost all of the other 18 UK examples, the LAA's fleet in 2007.

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The Eagle II is, in many respects, very similar to the Pitts S2, being constructed from a mixture of wood, metal and fabric. Incident-wise, even though this is an aircraft type often flown in extremis, its safety record is really quite good; we lost one airframe in a horrible accident at Seething in 2008 when, while making an approach to land, the aircraft collided with an agricultural vehicle that was spraying crops in a field adjacent to the runway threshold. The aircraft was destroyed in the impact and post-crash fire, and both occupants suffered fatal injuries. We also have a record of one unusual incident where a wheel fell off because the pilot flew without a spat, not appreciating that the spat acted as a lock for the wheel nut.

This aircraft has been operated for the last seven years by a small group of five enthusiastic members from RAF Cosford. Dennis Maddocks, the pilot at the time of the incident is, as are all of the rest of the group, ex-RAF. Having left the service in 2003, Dennis explains that he still wear uniform in his role as an (Aviation Officer) Air Traffic Controller in the Cosford Tower. He's also a full cat gliding instructor and regularly flies the gliding club's Supermunk. When I chatted with him, he explained that he is well used to flying 'tricky to land' aircraft… useful practice. Here's what happened:

I spoke to Ken Craigie (Chief Inspector) yesterday and told him about a control restriction I had whilst flying our Christen Eagle last Friday. Although the aircraft was not damaged, Ken asked for some background on the flight and for a copy of any pictures taken when the control restriction was investigated.

The flight was flown on 31 July from RAF Cosford where the aircraft is based. The purpose of the flight, which I flew solo, was to fly up to Camphill (in the Peak District) and fly some aerobatics, then return to the Cosford area. The weather was great and towards the end of the flight I commenced some basic aerobatics – loops and rolls mostly, which culminated in a short period of inverted flight. A few minutes later, on my recovery to Cosford, I entered the overhead at 3,500ft with the intention of completing a few more aerobatic manoeuvres before landing.

After updating the usual HASELL checks, I increased speed to commence a barrel roll and tried to pitch the nose up to fly round the barrel but found that the stick was heavy and felt 'spongy'. I therefore reduced the pressure on the stick to regain straight-and-level flight to see what was going on. A handling check showed that whilst the controls were normal in roll and forward pitch, there was a solid restriction when applying back pressure and I could not bring the stick back much beyond the neutral position. I was able to maintain straight-and-level at about 85mph, which is the aircraft's initial approach speed. Lucky, in a way, I wasn't wearing a parachute so abandonment was not an option.

As ATC was closed I called the CPFC CFI on the radio and informed him of the issue and my intention to fly an approach to RW 24 grass. It was agreed that he would man the safety vehicle and position himself on dispersal 2. Although the approach itself went well, I cut the power a little bit too high and, as I could not maintain the landing attitude, I ended up in a bounce scenario that was getting out of hand, so I went around. On the next approach I judged it better and was able to land the aircraft safely.

On shutting down, back at the hangar the restriction was still very evident, albeit at the time I couldn't see what the cause was. On an independent inspection the following day, it became apparent that the cause of the restriction was a £1 coin that had lodged between the elevator bell-crank and the horizontal stabiliser spar. Once removed, the restriction disappeared. A further more comprehensive inspection was carried-out yesterday to check the elevator bell-crank, horizontal stabilizer and elevator push-rod for damage and none was found.

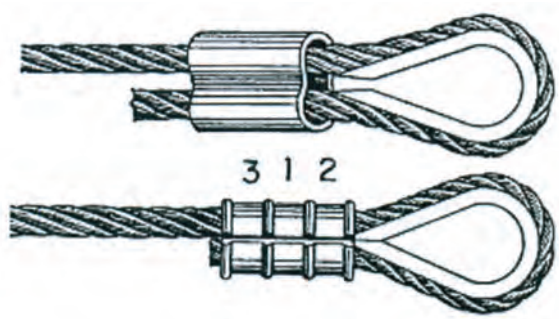
To be absolutely sure that there was no other loose articles in the airframe, we removed all the bottom panels and appropriate inspection covers for a thorough inspection and, after removing the cover on the fin below the elevator itself, two keys on a plastic fob (a set of aircraft keys) were discovered at the bottom of the fin. No other loose articles were found (note the round part of each key is the same size as a £1 and we were able to prove very easily that if lodged in the same position they would have cause the same restriction).

Obviously there is a big lesson to learn here with regards to loose articles in the cockpit and the all five group members are aware of just how serious this incident was.

I think that we would all agree that Dennis was lucky to get away with this control jam and thanks to him for letting me share his experience through Safety Spot. Fortunately the jam didn't occur at the point where the controls were fully pushed over, as they might have been in some aerobatic manoeuvres. That situation doesn't bear thinking about.

Regular readers of Safety Spot will remember the recent case of an in-flight control jam where the pilot of a Kolb TwinStar only just managed to get the aircraft down into a field shortly after take-off after his elevator control jammed (see the June issue of *Light Aviation* or, as I mentioned earlier, check out the LAA website). In this case, a wallet and some keys in the pilot and his passenger's pockets were thought to be to blame. In this most recent case, it looks like the keys and the one pound coin may have fallen out of an occupant's pocket at some point in the past and worked their way back to the aircraft's empennage.

We put this image of an incorrectly swaged cable-end in last month's mag but because space became tight we weren't able to show the graphic of the correct swage number and swaging order; thanks to those of you that noticed the missing graphic. The problem was discovered in a routine inspection of the aileron system on a Piper Cub carried out by Targett Aviation's engineer, Toby Wilcox – good spot Toby. You can see that, whilst the ferrule is holding everything in place under normal circumstances, if for any reason there was a jam in the aileron circuit and the pilot needed to put in extra effort to move the control, this joint would almost certainly fail. *(Photo Toby Wilcox)*



Cable Diameter	Number of Crimps	
	Oval Sleeves	Stop Sleeves
3/64"	2	1
1/16"	2	1
3/32"	2	2
1/8"	3	2
5/32"	3	2
3/16"	4	2
7/32"	4	2
1/4"	4	3
9/32"	4	3

This graphic shows the correct swage order and the number of swages per ferrule, which increases with cable size. Note that the 'dead-end' reduces in size as the cable is crimped; experienced technicians often do a test cable end before making a final part. The material used in the manufacture of these ferrules has been especially chosen for its initial malleability and rapid work hardening, in other words, they are easy to form but, once formed, create a very stable connection. *(Diagram Nicopress)*

There's a lesson here for everybody: don't just check the aircraft for loose articles, check yourself too. If you're going to fly aerobatics then it's worth having a 'nothing in the pockets' rule before you climb into the cockpit. FOD's a killer, don't give it the opportunity to perform its mischief.

Spitfire Mk. 26 – Undercarriage Failure

We have just written to all out Spitfire Mk 26 owners asking them to check their undercarriage rigging to ensure that, if the normal extension system fails to operate, the emergency-drop system will work. Both systems failed on LAA'er Andrew Thomas' Mk 26 Spitfire recently during a routine flight and he was forced to complete a wheels-up landing at his local flying site in Peterborough. It looks like the aircraft's airframe has been fairly extensively damaged and the Jabiru eight-cylinder engine will need a full shock-load inspection before it takes to the air again. Naturally, the MT variable pitch propeller has been effectively destroyed. Andrew escaped the aircraft after landing without injury, thank goodness.

I actually heard about this incident one Monday morning from a press cutting sent to me by our Chief Engineer, Francis Donaldson. The header, in a typical press way exclaimed. 'First of the Phew …Spitfire pilot successfully lands plane with no wheels'. I'm quite glad I didn't think of that!

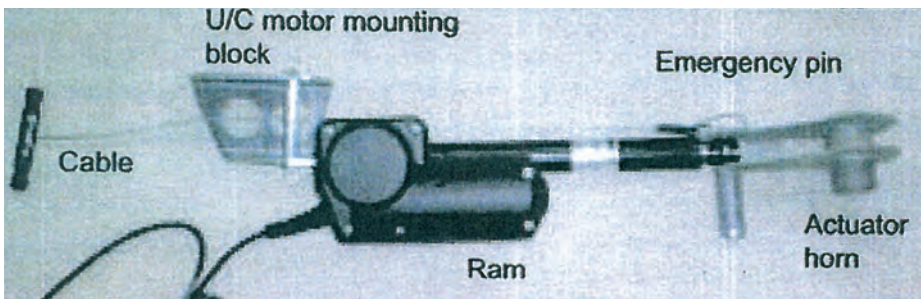
Later that day, the usual notification came through from the AAIB and I got to speak to Andrew directly. He explained that he had flown from his home base at Sibson to Connington to practice some landings on tarmac. He did a full-stop there and had a cup of tea before setting off back to Sibson; as he approached the airfield things started to go pear-shaped. Here's his report into the incident.

Having visited Peterborough Connington in the morning, I departed for a return flight to Sibson at 11.05. The climb-out and departure procedure went as normal, departing to the west towards Oundle and changing frequency to Sibson on 120.325. The landing gear configuration lights and wing indicators displayed as normal (all lights out, wing indicators showing above wings).

I called Sibson radio from Oundle for Airfield information and requested a downwind join as normal. On joining downwind, I slowed the aircraft to within the gear deployment arc and switched the cockpit panel switches from neutral to the down position. At this point I noticed a green light on the port gear indicator (indicating down). I checked the wing indicator which, worryingly, still showed the gear in the up position. I then activated both gear levers to deploy the undercarriage in the normal way. The right indicator turned red and showed gear travelling and the left remained green.

Having completed the cycle, a visual check of the wing indicators showed left gear still up but right gear down. At this point, I completed downwind checks and requested a go around and visual configuration check of the undercarriage. The Tower confirmed that the right gear leg was down but the left was still up.

I then I retracted the right gear and departed to the south of Sibson, where I recycled both gear legs on numerous occasions using positive g to try and release the gear, I then joined for a second pass to gain a visual check which confirmed no change.



(Left) **This picture, taken straight out of a Spitfire Assembly Manual, shows an undercarriage operating ram. As you will note, it's basically an electric motor driving a ram via a worm gear. Although worm gears provide a very good reverse-lock function, the Mk 26, which has a motor for each undercarriage leg, also has separate up and down locks.**
(Picture: Mk 26 gear motor)

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First of the phew! Many of you will have seen this video showing LAA Pilot Andrew Thomas landing his Mk 26 Spitfire wheels-up at Leicester Sibson airfield recently. I've mercilessly pinched these frame-by-frame images showing the sequence of events during the, well, arrival! The important thing about a situation like this is that the pilot walked away from the incident without a scratch, so well done to him for handling a very difficult situation in an exemplary manner.

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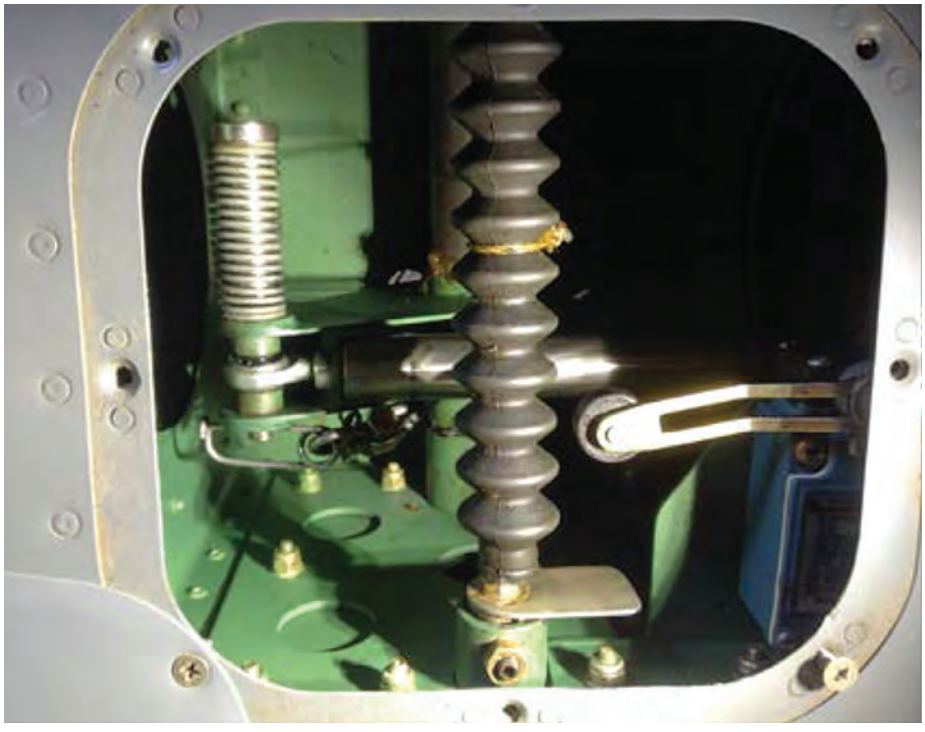
(Right) **The three position switches – down, neutral and up. Note that the two LEDs above the switches, controlled by an electronic box, show when the undercarriage is in-transit.** *(Photo Gary Cotterell)*



(Left) **Here's the emergency pin as fitted to the Mk 26; because the undercarriage wasn't rigged correctly, this pin was placed under a significant tension when the undercarriage was in the up position and it failed to work when needed. The LAA is still looking at this incident although, as an interim measure, we've asked all our Mk 26 owners to check the rigging of their undercarriages to ensure that the emergency drop system will work correctly in case of an emergency.** *(Photo Gary Cotterell)*

(Below) **This picture shows the up and down microswitches which are used to control both the undercarriage operating motor and the undercarriage's position lights. The LAA is looking closely at the circuitry involved to see whether the system needs improvement.** *(Photo Gary Cotterell)*

(Left) **The operation of the undercarriage on the Mk 26 is reasonably complicated. This picture shows the left and right undercarriage operating levers – pulling the levers back, either one at a time or both together, releases the undercarriage lock-pin(s). When the levers are fully back, a microswitch completes the electrical circuit and the motor will function. When the undercarriage reaches its correct position, either up or down, a microswitch at the undercarriage leg sw-ew's aircraft – whilst the undercarriage was up, the system was being told that it was actually down!** *(Photo Gary Cotterell)*

During the second climb out, I noticed a high oil temp (probably due to operating for some time at slower speeds inside the undercarriage deployment range). I powered-up and departed south to bring the oil temps back into the green. At the same time, I contacted Sibson Tower and informed them of my intention to deploy the emergency release and, if this also failed, I would prepare for a wheels-up landing. Sibson recommended either Peterborough Connington or RAF Wittering due to better fire cover and informed me they would try and contact Wittering.

At this point I pulled the emergency release cable and pin for the left undercarriage leg, but this also failed to work, the wing indicator still showing gear still up.

I changed frequency to Peterborough Connington first and was informed that the grass was not suitable and the hard runway not advisable; they suggested Sibson would be the best option. Following this, I changed back to Sibson (still working to release the undercarriage) and was informed that no contact was made with Wittering. I confirmed my intention to land at Sibson as this was most familiar. Another go around was conducted at this point to confirm visually that the emergency gear release had not worked and this was confirmed by the tower. The Tower requested my fuel status and confirmed that fire cover had been requested. I confirmed that I had ¾ tanks and would continue to circle in the vicinity to burn fuel and wait for emergency services.

Whilst burning-off the fuel I had plenty of time to consider my options. I considered both power on or off approaches as well as the differences between both clean and flap configurations. In the end I opted for a powered approach with normal landing flap. The weather was good but the conditions were quite gusty with a crosswind on Runway 24L. I felt maintaining powered control over the control services would give me a slower, more accurate, approach and touchdown.

Having received confirmation that the ground crew were in place, I carried out a low level go-around to assess landing spot, condition of runway and to obtain a final visual check of undercarriage configuration. I informed the tower that my next approach would be my planned landing.

I climbed out into a downwind position and completed checks as normal and retracted the cockpit canopy in case of emergency evacuation. I rolled onto final approach at c.55kts IAS and maintained until the round out, reducing to c.45kts IAS. The aircraft touched down on the stall which felt comfortable; mags were switched off before it stopped followed by the fuel valve and the master switch. I evacuated the aircraft unaided with no injuries and ensured cockpit status was safe before confirming this to the fire crews.

Well done to Andrew for coping with this awful situation well and thank you for this very concise report.

The Mk 26 undercarriage is, although more complicated to operate than in aircraft with a simple up and down switch, is actually quite straightforward to operate. An 'up' selection is first made by arming the system using the panel-mounted three-position switches (one for the left and one for the right). Then, using the levers on the side of the cockpit, the undercarriage is operated – pulling the lever back pulls out the locking pin using a Teleflex cable then, when the pin is fully disengaged, a microswitch completes the circuit to the motor. When the undercarriage reaches its 'up' position, it contacts a microswitch which stops the motor, the lever can then be moved forward allowing the lock pin to re-engage.

It is essential that the system is rigged so that everything lines-up correctly and, when the lock-pin engages, there's no residual tension in the system. Now that this aircraft is being repaired, it was discovered that one turn on a rod end relieved all the tension in the port undercarriage leg when it was in the up position and the emergency-drop system works well now.

Falco FL18 – Undercarriage Failure

I think that I can guarantee that you'll find this a very odd report. Let's start with the problem which, as you can see by the title, relates to an undercarriage failure. Truth is, I'm not even sure that this is absolutely accurate although, looking at the pictures of the damage to the underside of the fuselage, I think that this aircraft definitely landed wheels-up.

Why the uncertainty? Surely we should know what's going on when one of our aircraft has an accident? Well, and this is the real reason why I feature this unfortunate event, it's true to say that, when an incident involving an LAA machine occurs in the UK, we are in a good position to help the member/owner and, importantly, extract and disseminate any valuable safety information learnt from the event. When an incident happens overseas and is written-up in the local ›

We think, although we're not absolutely sure, that this LAA-administered Falco suffered an undercarriage failure because of a microswitch failure. The reason that we're not sure is that this aircraft was in foreign ownership and operated overseas. The accident itself was investigated and repairs carried out without any consultation with LAA Engineering, clearly rendering our continuing airworthiness and inspection processes irrelevant. The problem for the owner is that, because correct procedures weren't used, his Permit to Fly was most probably invalid. *(Photo Francois Magnat)*

lingo, the situation can be very different and even with wonders of 'Bablefish' (or some other computer translation Apps), the outputs can leave us none the wiser as to what's happened, as you can see below.

We learnt about this crash from an LAA Inspector who had been asked to sign-off the annual Permit. I'm not going to say where, suffice to say that it wasn't in Blighty. Naturally he was rather bemused as to how all of the repair work to the fuselage, the engine shock load inspection and the fitment of the new propeller had been signed for. On investigation it turned out that this had all been done at a foreign repair shop.

When we learnt about this we discovered that, although the aircraft was being operated under the LAA's banner, the owner, a foreigner, was actually operating the aircraft overseas on a permanent basis. He naturally thought that the LAA system of Permit oversight was the best in the world and wanted to stay in our gang. Sorry mate, the LAA is a national organisation and we don't have the capacity to look after machines operating permanently overseas.

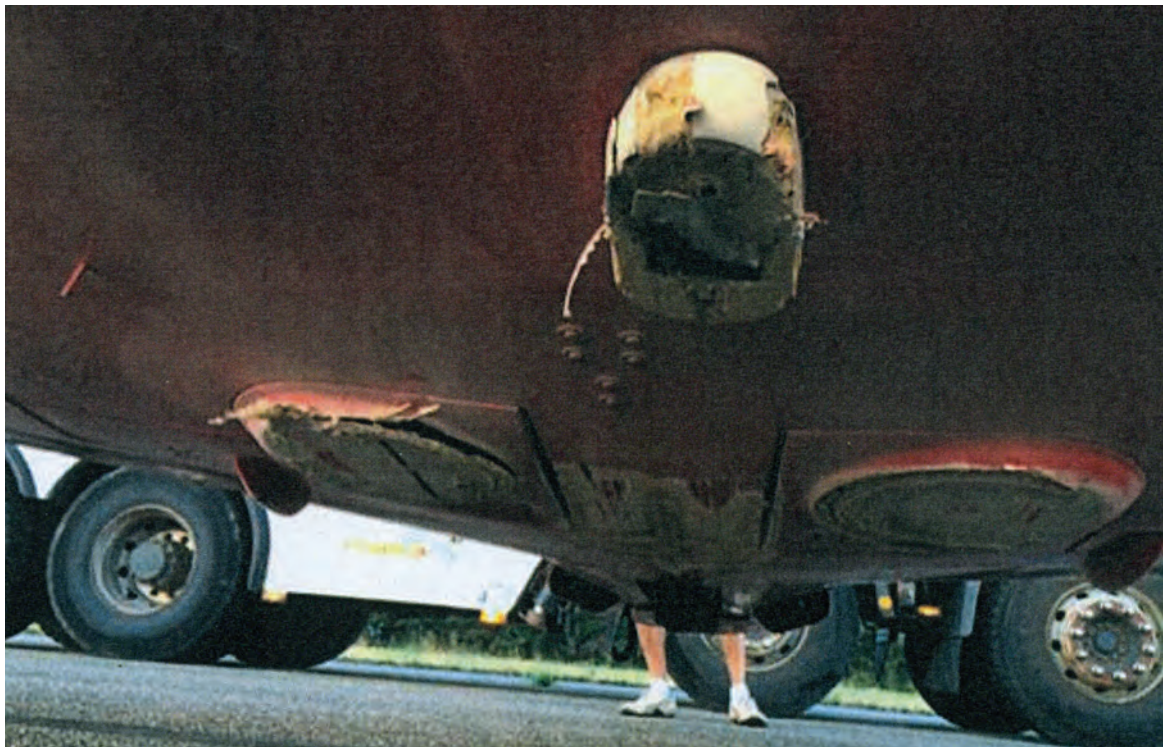
Ken Craigie, our Chief Inspector, established that the repair shop had actually done a first-class job of putting the aircraft back together and, after an inspection by an LAA Inspector, the aircraft was deemed fit for flight, although it will be doing this under another country's flag! I asked Ken whether we could learn anything from the incident, after all, I was, at the time looking at a microswitch problem on the Mk 26 which I guess you've already read about. Ken sent me the pilot's report into the incident with a wry smile. Here's a (verbatim) part of it relating to the cause of the problem:

… found the cause of the accident when it dismantled the aircraft: broken electrical cables in the nose landing gear. When the two bare wires touched, the contact indicated that the landing gear was down. On completion of the repairs, we took several test flights and noticed that in turns involving g+ and in turbulence, the undercarriage indicator signalled that the electric motor was retracting the landing gear; repetition of the manoeuvre tripped the thermal circuit breaker. The problem no longer arose during turbulence or under stress.

When I reached the accident phase of the report, having more or less worked-out that a short in the electrical system sat at the heart of the incident I read, with some interest:

Yesterday I took off at 8:30 local destination with a transient who is my friend. Around 17 hours I did with the mechanical point of mechanic. We conducted a candle on train output. I was on board, and the mechanic was below the unit. There was no problem. The sequences of openings and closings hatches went well.

I was very pleased to hear, as I'm sure you are that, continuing with the report: *My transient, with no aeronautics competence, is not disturbed, I just said that the situation is serious but I manage. She did not panic and just wait.* Fair Winds. ■



Once the Falco was lifted, the extent of the damage to the underside of the fuselage can be seen. In actual fact, the repairs themselves, when completed, appeared to have been done to a very high standard but, because they weren't done under LAA supervision, a Permit Maintenance Release couldn't be signed and the aircraft couldn't be released back to service. This aircraft is now being transferred to the French register. *(Photo Francois Magnat)*

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

LAA Project Registration	
Kit Built Aircraft	£300
Plans Built Aircraft	£50
Issue of a Permit to Test Fly	
Non-LAA approved design only	£40
Initial Permit issue	
Up to 450kg	£450
451-999kg	£550
1,000kg and above	£650
Permit renewal	
Up to 450kg	**£155**
451-999kg	**£200**
1.000kg and above	**£230**
Modification application	
Prototype modification	minimum £60
Repeat modification	minimum £60

Transfer	
(from CofA to Permit or CAA Permit to LAA Permit)	
Up to 450kg	£150
451-999kg	£250
1,000kg and above	£350
Four-seat aircraft	
Manufacturer's/agent's type acceptance fee	£2,000
Project registration royalty	£50
Category change	
Group A to microlight	£135
Microlight to Group A	£135
Change of G-Registration fee	
Issue of Permit Documents following G-Reg change	£45
Replacement Documents	
Lost, stolen etc (fee is per document)	£20

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