FIRSTLY, thanks must go to all those who took the time to call me about last month’s Safety Spot. Yes, I know there were a few problems. It just goes to highlight the hidden cost of the annual holiday – complete chaos when you return!

If you’re interested in how I spent my ‘hard won’ bit of time off, I went to Turkey, sailing, it was fantastic and yes, I am very happy to be back. Well, every day was the same, force 4 to 5, brilliant sunshine and crystal clear water. Sounds great but, and I can sense you moving about in a slightly agitated manner, it does get a bit boring. Give me the rough and tumble of the British weather any day. As they say, “If you don’t like it today, don’t worry, it’ll be different tomorrow.”

Let me start this offering by rounding off the Nut & Bolt saga discussed, albeit in reduced form, last month.

AIRCRAFT FASTENERS

As has been said many times I’m sure, you could write a book about bolts. Safety Spot is not the place for this of course (and I would be the wrong bloke to write it anyway!). My intention, when I talk about any subject really, is to give you a flavour of what goes wrong and why. It’s up to you whether you take on board what’s discussed.

Original thoughts, in my experience anyway, are actually rather rare. Listening to some other unfortunate’s disaster story may prevent a personal mishap.

Some chaps have told me (at length) that, “there’s nothing wrong with commercial bolts”. I agree, there is nothing wrong per se with any bolt in its correct application, so here’s the real question. “Are you qualified to decide what bolt should be used in any particular application and, if you are, can you be absolutely sure that the commercial bolt is what you think it might be?”

A couple of the photographs missed out last month were too good to be lost to time so, I’ve put them in this month. Actually, they’re cap-head screws and not bolts, note the multiple ‘fracture faces’ so often seen in high tensile fatigue failure. A keen eye will spot the damage to thread faces caused by shear loads. This bolt was being used in an incorrect application, it didn’t like it, and let the owner of the aircraft know by putting him in a field in the middle of nowhere.
The best laid plans

Murphy’s Law strikes twice with a starter motor pinion problem

The best laid schemes o’ mice an’ men
Gang aft a-gley
Robert Burns (1785)

There can be no doubt that Murphy exists. He is an unassuming fellow and, most times (but not always), can be found lurking in the shadows.

Quiet, though he is, when Murphy strikes... “weel aff a’ploonz a cockup” as the great bard might have said.

LAA member Peter Kynsey, who owns the beautiful single-seat racer, the LeVier Cosmic Wind, is still picking up the pieces of a visit by Murphy. For those who think that all this ‘traceability and inspection’ nonsense demanded by Certification Authorities is a “complete waste of time”, take note.

Peter is particularly unlucky in that Murphy struck a number of times in quick succession. Had there only been one attack, Peter would have probably not had to completely rebuild his engine. As it happened, he ended up with a huge bill.

I will take you through this in the order that it came to me.

As I have said before (many times) I am not here sitting in judgement, my job is to illuminate the facts as far as possible and, humbly, make suggestions about how a problem may be prevented in the future.

It started, as far as I was concerned, with a report from Peter which explained that he had just had to have his engine rebuilt due to swarf throughout his oil system, lots of it.

The Cosmic Wind is powered by the Continental O-200, until recently, like many of our aircraft, it was hand-started. Beguiled by the possibilities unleashed by fitment of one of the “new-fangled” light weight electrical starter systems, Peter purchased a complete B&C system from Aircraft Spruce and Specialty.

There were no issues with the fitment – “easy, easy” – and Peter was duly impressed by the performance of the starter motor. I will quote him, “I could almost taxi on the starter motor alone”. So far so good.

Then, after the normal pre-flight checks, the only response to pressing the starter button was a horribly sounding graunch... and absolutely no go.

The new starter was removed and the drive pinion examined. You can see from the picture that it’s clearly not been engaging the driven gear correctly. After some investigations it was discovered that the pinion used on Peter’s starter was actually a Lycoming part.

Peter wisely pulled the filters and these were full of the sharp, hardened steel, remains of the pinion. Those of you familiar with Continental starters will know that the unit is fitted to the accessory housing at the back of the engine which is, in effect, on the “wet” side.

Lycoming engines are started, perhaps more conventionally, using a Bendix system and starter ring gear fitted to the front of the engine and is “out in the breeze” as far as the oil system is concerned.

So how could a Lycoming pinion be fitted to a Continental starter unit?

From here on I shall be discussing anonymous individuals. They do exist, this is not a work of fiction but, and commercial sensitivities aside, I am not in the business of scooping points over other people’s discomfort. But there are big lessons to be learnt here; back to the saga.

My job, as Airworthiness Engineer for the LAA, requires me to investigate failures in systems. Generally these failures show themselves as a broken part (or aeroplane) and the broken bit is obvious - this is a failure in a mechanical system.

The most interesting part of the job for me is identifying the ‘other’ factors, the diapora of seemingly unrelated events that surround the original incident. I’ve read work which identifies this as ‘Human Factors’ but, and I welcome discussion, for me this is far too simplistic. Like any good game, life is a mixture of planning and fate!

When discussing the bolt issue earlier I asked, “can you be sure?” With an aircraft bolt you may have to be - an incorrect bolt may work acceptably for years but then, fate takes charge and a whole new set of loads are thrown at it, and somebody like me ends up writing up an accident report.

Within aircraft manufacturers, and suppliers of aircraft components there are rules in place to ensure that “what you ask for you get”. This is one of the main reasons why aircraft parts cost more than the (seemingly) same item from the local hardware store. So, I will ask the question again, how could a Lycoming pinion be fitted to a Continental starter unit?

The answer - multiple system failures.

Firstly, there is a failure in the design process in that there should have been no physical way that incorrect parts could be fitted to the individual sub-assemblies. The potential for error here should have been spotted at the design stage.
Why? Murphy... If an incorrect part can be fitted it will be.
Secondly, I understand that these starters are built in batches, which is fairly normal in a low volume production unit.

Bill Bainbridge, the owner of B&C Specialty Products explained that they have been assembling starters for over 20 years like this and, up until this incident at least, there has been no issue about component control. Fate had yet to show its hand. The Murphy effect of an employee by-passing the stores issue system and collecting the wrong parts from a bin in the stores.

So what was the double dose of Murphy that afflicted Peter Kynsey? During the course of my investigations somebody mentioned that they had ‘heard’ of another incident of a starter failure which lead to an engine rebuild. Hackles up, I chased about and eventually found the ‘other’ unfortunate victim. He explained that he too had bought the starter directly from the States (not from B&C) and that B&C had been “fantastic” and had hunted down the required parts for his engine.

Only problem was that he didn’t feel the need to report the incident to us. For two months Murphy was able to play his hand unopposed. From personal experience I note that problems like this once spotted rarely just go away of their own bat. A bit like a drive shaft on a car, the first time you notice that something’s not quite right is when going around a sharp bend, it doesn’t take long though before it’s rattling on the straight.

So, lessons to be learnt. Well, just because we operate in the lighter end of the market we shouldn’t ignore good traceability, price shouldn’t be the only concern.

As flyers, we share a common responsibility for the safety of others. It’s in our individual interest to keep accidents and failures to a minimum. Psychologists, or perhaps more accurately, anthropologists, might describe this as reciprocal altruism. If you have had something go wrong, let other people know about it.

At the time of writing, the UK CAA is in discussion with the US FAA about this issue, so, more to follow.

Human factors played an important part in the above example of Murphy effect but, sort of on purpose, I have not mentioned the inspection failure. There undoubtedly was one but, and I hope that you will agree, it would have been an incredible Spot, deserved of an Inspection Oscar, to detect a one-eighth of an inch difference in a drive pinion, especially when the pinion is hidden inside the starter motor body.

In the next section of Safety Spot I will discuss another failure incident where the participants will not be on any Oscar shortlist, but again, none of us are Murphy-proof.

‘As flyers, we share a common responsibility for safety - let other people know if something goes wrong’
SAFETY SPOT

WHO NEEDS A PROPELLER ANYWAY?

I HAVE done my fair share of 'first' flights on aeroplanes, both the 'just out of the box' type, and the 'straight off the drawing board' type. There is quite a bit of difference in the approach one takes. There shouldn't be, but there is.

If an aircraft type has flown before you will know the numbers, you know what to expect and you will be in an environment that you have got used to. If something's not quite right the chances are you will pick it up straight away.

This is why Francis likes the annual air test to be done by somebody who is experienced on the type of aircraft to be tested. If you've never flown the machine before there would be nothing to relate to and it wouldn't be a very valuable check.

First of type flights... well, sometimes they go without incident.

Imagine yourself flying a Mk26 Spitfire. I have never met a pilot who hasn't) on a maiden flight over the beautiful Scottish Highlands. Lots of noise and lots of go, what a fantasy.

Then, imagine a loud bang, still lots of noise, but now, no go... why?

Well, the propeller has just left the aircraft. Thanks to a combination of luck, and a brilliant bit of airmanship on the part of the pilot, the aircraft was landed without further damage. Despite considerable efforts, the propeller and its attachment flange have not, as yet, been located.

Now, in your mind's eye, travel south to Dunkeswell. Put yourself at the heiln of an X-Air Hawk at about 1500 feet or so. Also a maiden flight, all's well until... massive vibration. Close throttle, switches and fuel off, glide approach to a good landing back on the runway.

The pilot tells me that he is not sure why he did the next bit. It certainly doesn't make a great deal of sense (but you show me somebody that makes any sense after a (real) emergency landing). You've guessed it, he re-started the engine. There was a sudden bang and the propeller flew off. Fortunately, Murphy decided not to play his full hand and there weren't many people wandering around the middle of the runway.

This, by the way, is not an attempt at humour. After an emergency like this there could have been rescue types about. Fortunately, there were no injuries and the propeller and its flange were soon located.

TWO SIZES OF FLANGE

The Mk26 Spitfire, as I am sure you all know, is powered by the five-litre Jabiru engine. This engine is the eight-cylinder big brother of the six-cylinder three-litre and the four-cylinder two-litre engines.

There are six Mk26s flying in the UK at the time of writing and 15 in build at various stages.

The Jabiru engine does not use a gearbox; in previous Safety Spots I have discussed the structural/fatigue implications of this, particularly with regard to propellers. The engine is proving itself to be extremely reliable and there is a good product support service offered by ST Aviation Services from its Southey strip.

Jabiru offer two sizes of propeller flange which give some flexibility in terms of the powerplant’s overall length. On the four and the six this flange is bolted using six appropriate length High Tensile cap screws which are supplied with the flange; the eight uses 12 cap screws.

There is a special procedure for fitting this flange which

AIRWORTHINESS ALERTS

CZAW SportCruiser 6D-SC-005 Nose Landing Gear - Shimmery
Rotax Service Letter SL-912-014 R2 - Unapproved Engine Components
Rotax Service Letter SL-914-012 R2 - Unapproved Engine Components
Rotax Service Letter SL-921-066 R2 - Unapproved Engine Components
Europe Aircraft Service Bulletin 15 - Guide of Flap Pin Drive Engagement
Aerosport Owners Service Bulletin OSB 27 issue 1 - Cracks In Engine Mount
Pioneer Aviation UK Owners Service Bulletin OSB 08/02 - Leg Cracking
Teledyne Continental CSB SIB 553.08 - Mandatory Magneto Inspection
X=AIR Jabiru Engines - Procedure - Engine through Bolt nut installation
FAA Special Airworthiness Info. Bulletin (swf-GC-1A/B) - Brake Pedal and Rod
Technair Service Bulletin 01-UL rev.1 - Vertical Fin Base Reinforcement

IN DRAFT

MPD 2006- X000: Purlator in Line Filters
Aerosport Owners Service Bulletin OSB 28 issue 1 - Throttle Catching

A monthly round-up of Airworthiness Directives (AD), Mandatory Permit Directives, (MPD) Service Bulletins,(SB) Airworthiness Information Leaflets(AL), Service Letters (SL), Critical Service Bulletin (CSB) and Technical News Sheets (TNS) that have been received by the Light Aircraft Association.
includes the use of a high strength Loctite. There is a discussion going on at the moment as to whether these cap screws should be wire-locked or not. I am on the side of wire-locking High Tensile screws/bolts as a matter of course (for reasons I’ve talked about before).

The owner of the Mk26 decided that he wanted an MT variable-pitch propeller.

This is the meather MT flange for the constant-speed prop.

for his new machine, and this was duly purchased. Because of the extra weight of this propeller MT requires that the flange be changed to one they supply. You can see from the photograph that it would be difficult to mix the two up.

There is very convincing evidence that the screws that hold the flange to the crankshaft were not correctly fitted. It is possible that the builder temporarily fitted the flange (we’re not absolutely sure which one yet) and propeller to complete a cowling fit using just a couple of the screws, possibly only ‘nipped’ up.

When the propeller is fitted you cannot see these screws and the evidence is pointing to the fact that the other ten were not fitted. I’ve explained what happened earlier.

The lesson here: it is very easy to miss the ‘big’ things when focussed on the ‘small’. Inspectors, please note: ‘if you haven’t seen it – it hasn’t happened.’

FEELS TIGHT?
What about the X-Air Hawk? This won’t take long!
I mentioned the fact that Jabiru supply two sizes of flange, a long and a short. The designer of the X-Air wanted something in between so he had a spacer made. So far so good, longer bolts were purchased and the whole lot bolted up.
So why did it fail off? I will refer you to the picture of fatigue failure above. Simply put, the bolts used were (just) too long and bottomed out in the hole, they torqued up fine but were not really gripping the propeller.

On each power stroke the propeller whacked backwards and forwards - a lifetime of stress in minutes.

Oops, where’s Francis! A bit like working for the LAA!
Flash in the pan!

How a little bit of plastic caused an awful lot of trouble

The Rotax was purring away smoothly at the little grass airfield on the Norfolk coast, just as it had done for the 100 or so hours since new. Just the power checks and we’d be away, along the coast into the sunset then south to find my tiny farm strip half an hour or so away. Exactly the sort of flying I built this kitplane for.

Prop fine and power to 5000rpm. I can get more revs but she’ll skid along on the grass... What was that?

Was it my imagination or was there an rpm drop? Not much, maybe 30rpm. You all know how attuned you get to the sound of your aircraft - the exhaust note, squeaks, creaks and rattles. Maybe it was a gust, I’m a bit crosswind, so let’s move directly into wind and do it again.

T&Ps green, I run the engine for full power, electric pump on and off, check the mags again, I run it at 5000rpm for another three minutes. Perfect. I fly home keeping a sharper than normal eye on the engine gauges.

This was the second time I’d noticed this tiny rpm drop. It only lasted a fraction of a second, and was soon dismissed as a figment of my imagination, or a gust, or maybe a tiny bit of carb ice.

But what do you do when there’s a voice on your head whispering, “There’s something wrong, matey.” Do you shut down, call a taxi and have the aircraft picked up on a transporter for an engine strip down? Or do you balance the odds and fly?

Two weeks later and I’m doing the engine checks at the end of my 200-metre strip for a local flight. The weather’s been bad and I’m itching to fly. Everything’s looking good, checks are normal, so full throttle and off we go.

Everything happens really quickly. Initially I’ve got lots of power, and even at max gross I’m usually off the ground in 40 metres. At 40 metres, there’s a change in engine note, I glance at the tacho and am horrified to see it un-winding.

I slam the throttle closed and brake to a halt easily with 30 metres left. Crikey. Another five minutes. Perfect. I fly home keeping a sharper than normal eye on the engine gauges.

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I slam the throttle closed and brake to a halt easily with 30 metres left. Crikey. Another five minutes and I’d have been at 50 feet with very few options.

I taxi back to the hanger and try the throttle. Smooth power up to 3500rpm, but at 3600rpm the engine starts to vibrate and the power drops away to 2800rpm. Push the throttle any further and the vibration is so bad it sounds like the engine’s going to shake itself to pieces. I shut it down, take a look under the hood and can’t see anything obvious. I start up again, but the symptoms persist, electric pump on/off, mags. Nothing makes any difference.

Gloom descends as the sun goes down. It’s so bad it sounds like the engine’s going to shake itself to pieces. I shut it down, take a look under the hood and can’t see anything obvious. I start up again, but the symptoms persist, electric pump on/off, mags. Nothing makes any difference.

A call to the incredibly knowledgeable Con-Air brings forth the advice, “I’d bet it’s a bit of s*** in one of the main jets.”

No, I think, it can’t be. It’s like a switch - 3500rpm OK, 3600rpm all hell lets loose. Surely that’s electrical? Surely a piece of dirt would either lodge, or not lodge. Be pulled through or float away?

In any case, I fit the filter carefully, only buy from a garage with a high turnover and I only changed the fuel filter three hours ago at the 100 hours check.

“Aha” says Conrad.

Conrad insists. “If it’ll be dirt in the fuel, or something to do with fitting the new filter.”

So, I take off the carbs and the float bowls, and there it was. In an otherwise impeccably clean carburettor, lodged firmly in the jet, a piece of black ABS plastic perfectly shaped to fit exactly into the hole, it even had a small barb which, once located, prevented the thing dropping back out. It was really wedged in there, letting enough fuel through for only half-throttle.

To me it looks like a piece of injection moulding flashing: the thin slivers that are squeezed through the faces of a injection tool when it’s closed.

Was this imported into my fuel system when I fitted the new filter? Is it actually a bit of the new filter left inside it during manufacture? Or has it been floating around in the float chamber ever since I built the aircraft? Has it been bobbing up and down, occasionally floating up sideways to momentarily block the jet, causing that occasional slight drop in rpm?

Has it been waiting three hours, or 103 hours for the day when it floats end-on, perfectly aligned to enter the jet?