Cessna 150 Safety Review

By Brian Lowe

In the days following the tragic fatal crash of Cessna 150 EI-AST in Birr on the 11th November 2012, a friend challenged me over the soundness of learning to fly in a 45 year old aircraft. My initial response was that all EASA aircraft are required to be certified to the highest standard and are maintained in a rigorously controlled maintenance environment and so are therefore as safe as they possibly can be. Despite my confident belief in the EASA safety system and the general perception of the Cessna 150 as a docile aircraft, a nagging sense of doubt prompted further investigation.

EI-AST was the second fatal Cessna 150 accident to befall our small Irish flying community in the past 10 years. In 2006 Cessna 150 EI-CHM was engaged in a training flight with an experienced instructor on board when it inexplicably crashed killing both on board. Earlier in 2012, Cessna 150 G-BDOW had suffered an engine stoppage while on final to land at Newcastle, Co. Wicklow resulting in a crash just short of the runway threshold from which the experienced pilot and passenger were lucky to escape with their lives.

In the past 15 years, Irish Air Accident Investigation Unit reports showed four other engine stoppages in flight had occurred on board Cessna 150s with only one of these being attributed to mechanical failure. In all the other cases the exact cause could not be determined, but was attributed to either Carburettor Icing or Fuel Starvation.

In contrast there were no reported Irish accidents involving engine stoppages in flight attributed to the Cessna 152 despite there being an equal number of C152s on the Irish register as the C150.

Looking further afield at UK and International reports, an alarming pattern started to emerge. Considering only accidents involving flight training or normal category VFR flight, in the US over the past ten years, it became apparent that the Cessna 150 fatality rate was over 6 times higher than the Cessna 152. Three times more C150s have been built than the C152 but twice as many hours are flown annually by the C152 so all told, the C150 had an inexplicable 3 times higher fatality rate per hour flown.

The General Aviation Safety Council in the UK had commissioned a report into Loss of Control incidents involving the Cessna 150 in 2008 which was published in 2010. Looking at UK statistics over a 28 year period the study identified 11 Loss of Control fatal accidents involving the C150 compared to only one C152. They concluded that a C150 pilot was 16 times more likely to be involved in a fatal accident due to Loss of Control than a C152 pilot based on hours flown. GASCO recommended that all C150 pilots and instructors undergo aircraft specific type training.

Numerous Aircraft Accident Investigation Units and Safety Bodies worldwide have all highlighted significantly high levels of accidents involving the Cessna 150 and with many investigators identifying safety issues in relation to the aircraft, many of which are unique to the C150.

So what makes the Cessna 150 more dangerous than its almost identical sibling, the Cessna 152

An exceptionally high quantity of the total fuel on board is unusable.

The unusable fuel on the Cessna 150 is 7 Litres per tank, over 13.5% of

the total 49 Litre tank capacity. In contrast, most other light aircraft including the Cessna 152 have unusable fuel quantities of 6% or less. As a result pilots accustomed to the much lower unusable values of other aircraft fail to recognise the significant difference and so miscalculate their fuel requirements. Due to the design of the fuel tank in the Cessna 150, the quantity of unusable fuel is at its highest point in a steep climb during takeoff or in a steep descent with flap 40 for landing, times when the aircraft is slow and most vulnerable to Loss of Control.

Fuel imbalance can develop between tanks

The fuel venting system of the Cessna 150 is such that when the tanks are full or when the aircraft is banked at a steep angle, fuel can decant from one tank into the other resulting in a fuel imbalance between the tanks. Flying the aircraft out of balance can have a similar effect. Post accident investigations have shown that as much as 12 Litres extra can be in one tank compared to the other which can result in one tank running dry and sucking in air while ample fuel remains in the other tank. This problem is most evident in aircraft that have been engaged in aerobatics, or flight training involving circuits or steep turns.

Inaccurate and Faulty Fuel Gauges

The Fuel Gauges of the Cessna 150 and other similar aircraft have long been regarded with suspicion by pilots as inaccurate. Pilots are strongly recommended to dip the tanks before flight to establish the exact quantity of fuel on board and to maintain a flight log during the flight, yet despite this advice once airborne the only true means a pilot has of knowing how much fuel is still in the tanks is from the fuel gauges which are known to be inaccurate or worse. In fact the only calibration requirement of the Fuel Gauge is that it be accurate when empty at which point it is too late for the unfortunate pilot and passenger.

Varying Fuel Consumption

The Cessna 150 is regarded as having a very consistent fuel consumption of 20-22 Litres per flying hour. These figures are derived from cruise power settings of 75% however if the engine is required to constantly deliver over 85% power then the fuel consumption can increase significantly to over 25 Litres per hour. This significant increase for a relatively small gain in power will reduce flight duration by 20%, which can catch many pilots off guard.

Presence of Water in the Fuel Tanks

In 1992 Cessna issued a Supplemental Safety Bulletin in which it informed aircraft owners, operators and national regulators that due to the design of the fuel tanks in many of its aircraft including the Cessna 150, that it is not possible to conclusively detect for the presence of water in a fuel tank equipped with only one fuel drain and it strongly recommended the fitting of additional fuel drains to each tank. The FAA in 2010 published advice on fuel contamination in which it reminded pilots of Cessna's recommendation. These recommendations have not been made mandatory in most European countries so the problem remains. Because of the position of the fuel filler caps on the top of the wing the aircraft is very vulnerable to fuel contamination due to leaky fuel caps especially if parked in the open.

Vulnerability to Carburettor Icing

The Continental O-200 and O-240 engines used in the Cessna 150 are highly prone to Carburettor Icing due to the location of the carburettor directly in the oncoming airstream. Carburettor Icing is 5 times more likely and is far more severe on the O-200/240 than on the Lycoming O-235 used in the C152. Carburettor Icing is prevalent mostly in countries with high humidity above 50 degree latitude. It's therefore no coincidence that the majority of Carburettor Icing incidents involving Cessna 150s in Europe occurred in the UK, Ireland and Poland. Following a spate of accidents involving Continental 0-200 aircraft, the majority of which were Cessna 150s, the Polish authorities initiated an investigation in 2009 which concluded with the recommendation that a Carburettor Temperature Gauge be fitted to all O-200 engines. The Cessna 150 is most vulnerable to Carburettor Icing during takeoff or in the descent phase.

Conflicting pressures on pilot due to restrictions in payload

The maximum all up weight of the Cessna 150 is 1600 lbs (727 kg). Due to the requirement to carry modern avionics, the aircrafts empty weight has increased over the years to 1130 lbs (514 kg) leaving a payload of only 470 lbs (214 kg). With the average pilot/passenger

weighing 85kg (187 lbs) a crew of two can weigh 374 lbs (170kg) and assuming no baggage this leaves only 96 lbs for fuel which equates to 15 US Gallons (60 Litres). 60 Litres gives a maximum endurance of 3 Hours at 20 Litres per hour or only 2 Hours 25 Minutes at a consumption of 25 Litres per hour. Subtracting 45 minutes of fuel reserve gives an endurance time at the higher consumption rate of only 1 Hour 40 Minutes which is very limiting for a modern aircraft.

The temptation is for the pilot to carry more fuel, and therefore to takeoff , with a takeoff-weight exceeding of the maximum permissible, thus increasing the risk of stall or the likelihood of the aircraft hitting the airfield boundary perimeter. Alternately the pilot may opt to carry a reduced fuel load and be tempted to dip into the fuel reserves with potentially disastrous consequences.

Problems with operation of Flaps

Instead of the C152s Gated Flap system the Flap Switch Design of C150 (models F-L) has a Flip Up/Down Flap switch in the centre panel near the throttle control with the flap position indicator up on left pillar. (Some models of 150M used the Gated Flap system of the C152) The flap indicator location requires the pilot to look up away from the Airspeed Indicator. The flap switch can be problematic in a emergency as the slightest bump may cause the crew to inadvertently tip the up switch which would then automatically retract the flaps.

The FLAP 40 setting on the C150 is like a barn door. In the event of a Go Around the C150 struggles on full power to maintain height with FLAP 40 deployed and failure to promptly retract the flaps in a controlled fashion can result in a Stall/Spin. A partial or complete engine failure at this point can be catastrophic.

Increased tendency for Loss of Control to occur resulting in Stall /Spin

Aerodynamically the Cessna 150 and 152 are virtually the same. Both are prone to Loss of Control resulting in Stall Spin if steep banked turns are made during climb-out, or on the turn from base to final, or if very steep 180 degree turns are made in level flight without maintaining sufficient airspeed.(AOA). Such accidents are more likely during gusty conditions.

However the GASCO report concluded that the Cessna 150 gave less notice of the impending stall and that the aircraft exhibited more aggressive stall characteristics than the Cessna 152. The Brunell University study on behalf of GASCO attributed this to the fact that the C150 has poor Longitudinal Static Stability. During tests it failed to demonstrate a clearly discernible stick force gradient. The C150 also has a more rearward CofG which contributes to its more rapid entry to the stall.

Recipe for Disaster

Many of the issues identified also affect other aircraft types manufactured during the same period. One single problem in isolation is unlikely to bring about a fatal accident for a trained pilot however if some of these issues are combined in a particular sequence they can create a deadly cocktail especially for the pilot who is unaware such problems exist. Looking closely at the profile of the pilots involved in fatal Cessna 150 accidents, reveals that they were mostly either, student or novice pilots, pilots with low currency in the aircraft type, or those who had never received formal training in the aircraft type. Equally worryingly however is that 25% of the pilots were qualified instructors but since the C150 and C152 share the same type certificate it is impossible to know if they ever received formal training on the Cessna 150.

Conclusion

This brings us back to the initial question as to the soundness of the decision to let students learn to fly in 45 or even in 30 year old aircraft, and in particular the suitability of the Cessna 150 for this role. I'll let you the reader, decide this question for yourself!

Over the coming months in Flying In Ireland I hope to explore in depth the safety issues identified in this Cessna 150 Safety Review, what can be done to mitigate against these risks and the burning question of the continued place for aging aircraft in our GA fleets. As always I greatly appreciate any comments on this article.

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Common Scenario 1

Pilot A intends to do one hours flying in a Cessna 150 with a friend. He calculates that at an average fuel burn of 20 litres per hour he will need 36 litres of fuel which includes a 45 minute reserve adds a little for luck and accordingly refuels with 20 Litres in each tank. They take off and after 15 minutes the pilot performs steep turns to the left over his friend's house for a period of 30 minutes. On the way back they hit a strong headwind. As they are 25 miles away from the airfield and worried that they may be late the pilot pushes the power to 85%. At this point the left tank is indicating 1/4 full while the right tank shows 1/8 full. Upon reaching the airfield the left tank is indicating 1/8 while the right is showing empty. (In reality there are 13 Litres remaining in the left tank and 6L in the right – still a combined total of 5L <15 minutes flight time> above unusable). The pilot takes up a left downwind and on base deploys 20 degrees of flap, he then banks for the turn to final and as he reaches to select 40 degrees of flap, the engine starts to stutter…