contributed by Grant Benns

Aerobatic Competition 101

IN THE last few issues of KiwiFlyer I have covered off some lofty philosophising on aerobatics in general, and then some technical aspects of the aerobatic planes we fly. Now I will try to describe the sporting aspects of competition aerobatics, which may/will take an issue or three to work through. Hold on tight… and I will try to make this sound like fun (which it truly is).

Rules

For any sporting code to be fair and objective there needs to be rules. If you have seen some of our more advanced category aircraft flying an aerobatic sequence you may doubt they are flying to any rules at all – either written or physical – but yes, they are.

The rules we work to in NZ are based on those of the International Aerobatic Commission (CIVA) and cover many facets of the sport, such as categories, programmes and sequence design.

Most importantly for the pilots and judges they contain the criteria for judging the various flown manoeuvres and the methods of grading that which the judges view. It is very important that the pilots understand the criteria against which they are judged. As the judges are viewing the sequence from the ground, and only their opinion that counts, the pilots must fly their aircraft in a manner which is 'pleasing' to the judges in terms of meeting the criteria prescribed.

Amongst other things, the judging criteria says "the competitor is required to make the shape of all loops perfectly round as seen by the judge on the ground. Wind correction is required for loops so that the aircraft's flight path describes a constant radius circle". The flight path is the path of the aircraft's centre of gravity, also known as CGT in aerobatic parlance.

That can't be too hard. Pull back, keep the wings level, keep pulling back and after a period of time and when the nose gets back on to the horizon, fly level again. But let's examine this most basic manoeuvre in some more depth.

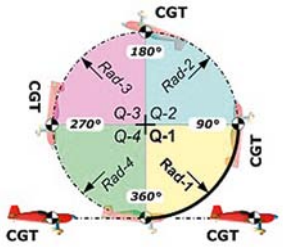
The Competition Loop

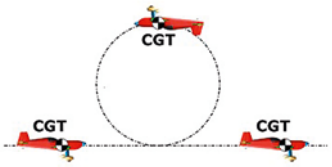
For the uninitiated (and this does not negate getting proper dual instruction!) a loop is commenced from a suitable speed, normally a bit higher than the regular cruise speed, with a sustained pull back on the elevator control to pitch the nose up. This pull and the resultant pitching motion continues such that the aircraft's attitude increases through the vertical to inverted and then back to upright. All the while, the wings are held level, i.e. no rolling, and the aircraft is kept in balance through the changing speeds and resultant yaw forces with rudder.

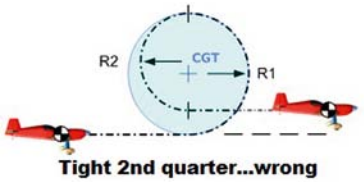
For the perfect *competition loop* you must start from a level period of flight – a dive for the optimum looping speed just prior might be required. Now that you have the right speed, say 140 kts in your Robin 2160, you abruptly pull the stick back to get a nice clean break off the horizontal line - judges like to see crisp and defined movements off straight lines into looping segments.

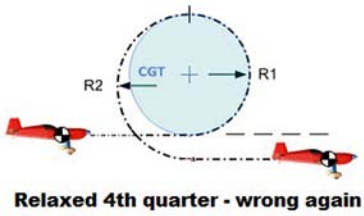
But now relax the back pressure, just a little, or you will pull too many 'G' and bleed speed too quickly. The ideal 'G' will be around 4-5G depending on your entry speed. This is more than a casual 'Sunday' loop, because we want it to be ROUND.

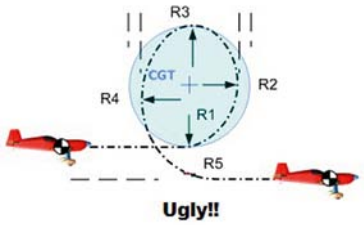
As the nose goes through the vertical we start to relax the stick pressure, although not necessarily the stick position – a constant stick position should produce a nicely rounded loop despite the changing airspeed. The speed is now rapidly decaying, as is both the 'G' and rate of change of angular velocity (crikey… big words). But that is okay – if we were still











The Yak Display Team makes it look easy, but executing the perfect loop takes a lot of practice.
(Graphics above used with permission of Nick Buckenham / British Aerobatic Association)

pulling back with the same initial back pressure and 'G' our looping radius would start to decrease quite markedly. All the while we are keeping the wings level (with aileron) and aircraft in balance (with rudder) – as the aircraft slows down the free-air slipstream decreases, the effective propeller slipstream increases and the aircraft will start to yaw out of balance.

As the nose now approaches the horizon with the aircraft inverted we are at the slowest point in the loop – probably around 40-50 kts – and also at the lowest 'G', below 1G and approaching 0G. At first this can be somewhat unnerving, as we are used to being pressed firmly into our seats, but have no fear – you will not fall out! Neither will you stall if you continue to maintain the constant stick position you started with at 140 kts – the stick pressure will now be back to almost nothing and with the 'G' approaching zero your stall speed will also be approaching zero. (Think about that – a trick question, but what is the stall speed of your aircraft at zero 'G'?) The rate of change of angular velocity is now at its lowest, and the top of your loop is carving a nice constant radius across the sky, bringing great smiles to the judge's faces!

As the nose now starts to fall towards the ground, it is all too easy to pull back just a little more, in the belief that more speed downhill equals less time to a sudden end to your flight, but keep the faith – maintain the constant stick position and let the nose slowly pitch down (or 'up' from where you are sitting). You will feel the stick pressure start to increase as the airspeed and 'G' loading also increases.

As the nose gets to vertically down, the 'G' is now coming back up through 1 and approaching 2, with the airspeed increasing through 80-90 knots… the end is in sight. But don't be too aggressive pulling on the stick as the loop nears its end. Many loops finish 'pinched' from an over-enthusiastic finish. Alternatively, a relaxed pull-out will have you going through the line of entry with a noticeable or even significant height loss.

If you started the loop at 140 kts and 4G, it is logical this is where you should end it. Bear in mind you may be pulling a positive angle of attack of 10 degrees or more as you complete the loop at 4G, and therefore you will need to keep pulling the nose just a bit higher above the horizon that normal 1G level flight to complete the manoeuvre, before crisply relaxing the back pressure back to maintain straight and level.

You have just scored a perfect 10!

A great day beckons. CT4s (Murray Rogers and Jeff Hunter) and RV7 (Des Barry) at Masterton.

Believe me, it is much easier to write about a perfectly round loop than to fly one, in part because of the feedback we get from our other senses – weight, sound, overthinking (is that a sense?) – and very much because of the effect of wind. Recall the judging criteria above – 'Wind correction is required for loops so that the aircraft's flight path describes a constant radius circle'. If only we didn't have to contend with wind.

The wind effect on a loop is similar to those 'interesting' constant radius turns you did during your PPL and/or CPL training. Remember? Ease the bank angle coming into wind - increase the bank angle going down wind. Applied to our loop, we must now ease the back pressure going into wind and increase the back pressure going downwind, relative to a nil-wind loop. This can and will be very subtle, and is very much a seat-of-the-pants thing, unless you have had some quality ground coaching and critiquing in a range of winds.

Either with wind or without, incorrect technique with the elevator can produce some wildly strange looking loops. The judges will often break their judgement of the loop into quarters. Typical comments might be 'pinched 3rd quarter', 'tall', 'egg-shaped', 'tight 4th quarter', 'finished higher than the start', to which scores will definitely be somewhat less than the magical 10. In fact, it is very rare to see a common garden loop score more than an 8. Now imagine putting a snap roll or two-point roll on the top of a loop.

Without a doubt, loops are one of the most challenging aspects of competition aerobatics, and are a fundamental aspect of the sport, given that pretty much any vertical manoeuvre (stall turn, Cuban, Immelmann etc.) begins and/or ends with a part-loop of some degree, judged to the same criteria as a full loop. Keep practicing.

Competition Results

The NZ National Aerobatic Championships were held during March at Hood Aerodrome, Masterton.

Weather started average but ended great, and a full programme involving 19 competitors across four categories was contested. Aircraft ranged from a Robin, various RVs and CT4s through to Pitts, Zlin, Yak 55 and Extra 300L.

Superbly hosted by the Wairarapa and Ruahine Aero Club with the support of the Masterton District Council, the event was a great success for the first venture away from Waipukurau in 29 years.

Category winners were: Recreational – Tom Hall (Christchurch – Robin 2160); Sports – Andrew Love (Christchurch – Pitts S1S); Intermediate – Morris Tull (Dubai – Pitts S1S); Advanced – Wayne Ormrod (Auckland – Extra 300L).

Morris Tull and Pitts S1S with their haul of silverware from the National Championships.

Footnote:

These articles are intended to whet appetites for advanced flying and to offer tips to aerobatics beginners. Dual instruction and observance of CAA rules is a must-have - especially for safety and also for learning correct techniques and finesse of manoeuvres for the particular aircraft you are flying. For more information, enquire about aerobatics instruction at your local aero club or go to www.aerobatics.co.nz

contributed by Bill Beard

Insurance for engines run on-condition

ONE OF THE main provisions of an aircraft insurance policy is that operation and maintenance of the aircraft must be conducted in full compliance with the CAA Rules. Accordingly, aviation insurers accept the use of engines beyond the manufacturer recommended TBO (time between overhauls) subject to certain manufacturer recommendations and/or CAA approved programmes.

Under the policy terms and conditions, insurance companies will pay for, repair, or make good accidental damage to the insured aircraft. BUT in the case of repairs to an on-condition engine, though different insurance companies may have different views, generally the following ground rules will be applied.

In the case of a total loss – no problem. The company will pay the agreed value including the engine, less the deductible. However, in the event of engine repairs even say following a prop strike, the normal procedure is that the Claims Adjuster will approve a bulk strip (paid for by the insurers). If any damage is found (ie. crankshaft damage or the like) the insurers may provide for replacement of damaged part(s) caused directly as a result of the accident, subject to age and AD (airworthiness directive) status. If the crankshaft is on its second or third life or has been superseded then settlement may be subject to negotiation. However, as the engine is beyond its TBO it will not be approved for "return to service" without a complete overhaul. The cost of this will be to direct account of the insured/owner as the policy does not cover wear and tear or deterioration.

The long and short of it therefore is that if your time expired engine is damaged, the insurance company will compensate the insured for accident related damage but the cost of the overhaul to enable it to return to service will not form part of the claim.

Likewise, with airframe damage, insurers will only pay for the accident damage. Additional rectification such as corrosion etc. identified during the repair process will be to the account of the insured.

To discuss this topic or any other questions relating to aviation insurance or to seek quotations, contact Bill Beard at Avsure on 0800 322 206.