

# Basic RC Trim & Aerobatic Maneuvers

## Balance or CG

- Background on CG checks:
  - “A nose-heavy plane flies poorly. A tail-heavy plane flies once”. So we balance a new model at a conservative nose-heavy point (usually at about 25% of MAC). This is often what plans or instructions suggest too. This is a reasonable starting point but should NEVER be the final balance point. It flies. But remember it flies poorly.
  - In flight a nose-heavy condition causes a pitch forward, so we must compensate with something – usually up trim or incidence compensation. Now the plane flies straight at cruise. But it flies poorly.
- Dynamic CG checks:
  - The 45° dive check. I have found this to be the most reliable for most planes.
    - Take the plane high. No, really high. Now do another lap and climb some more.
    - Aim into the wind if at all possible and cut the throttle to idle.
    - When speed has significantly decreased but before a stall, push the elevator to a 45° dive. Release elevator (take fingers off sticks!)
    - Observe the dive – but remember to pull out in time!
      - Nose heavy: As the speed increases, any up-trim that was set to compensate for the “nose-heavy” will cause the aircraft to pull out of the dive.
      - Neutral: The 45° dive will be maintained.
      - Slightly tail heavy: The dive will get steeper.  
If the aircraft was a lot tail-heavy, its 1<sup>st</sup> & only flight would have ended long before this!
    - I prefer a very slight pull-out. (very slight nose-heavy) and I will repeat this check a couple of time just make sure of my observations.
  - The 45° Bank check.
    - At cruise speed, roll the plane to a 45° bank and let go the sticks.
    - Observe the attitude of the aircraft.
      - Nose heavy: The nose will drop more than the tail.
      - Neutral: The whole aircraft will drop. Nose as much as tail.
      - Slightly tail heavy: The tail will drop more than the nose.
    - Note that because there is less lifting surface at a 45° bank angle the plane will be expected to lose altitude. We are looking to see if it goes nose down or tail down.
  - Inverted flight check.
    - Once the aircraft can fly hands off in normal flight, roll to inverted at the same throttle setting, release the sticks and observe the aircraft.
      - Nose heavy: nose drops and it goes into a dive
      - Neutral: no pitch change
      - Slightly tail heavy: nose lifts and goes into a climb
  - What does nose-heavy result in? Or what does “flies poorly” mean?
    - Take-off (lift –off) distance is increased.
    - During landing flair, the plane suddenly drops out of the air.
    - The aircraft noses over easily during touch-down and taxiing.
    - The aircraft has a higher stall speed and a more sudden stall.
    - Axial rolls are more difficult to perform.
    - Nose drops a lot during intended level turns.

## Aerobatics

- Always start with wings level
- Inside Loop
  - From level, pull elevator
  - Maintain round loop, by
    - full throttle on the first half
    - Reduce amount of elevator over the top
    - $\frac{1}{4}$  throttle on second half
  - Exit at same altitude as entry
  - Now try looping with less than full elevator.
- Outside Loop (2 ways to do this)
  1. From Top
    - From very high level, reduce throttle to  $\frac{1}{4}$
    - Push elevator
    - Just before fully inverted, full throttle until level again at the top.
  2. From bottom
    - Enter inverted, push elevator
    - Maintain round outside loop by
      - full throttle on the first half
      - Reduce amount of elevator over the top
      - $\frac{1}{4}$  throttle on second half
- Roll
  - Start with simple roll (military roll):
    - Begin with wings level and pull to about  $20^\circ$  up and release elevator
    - Apply aileron (your choice of direction)
    - With no elevator or rudder correction, aircraft will exit at about  $20^\circ$  down.
  - Add elevator correction:
    - Begin with wings level and pull to about  $20^\circ$  up and release elevator
    - Apply aileron (your choice of direction)
    - As aircraft passes through inverted, apply some “push” elevator.
    - With appropriate elevator correction, aircraft will exit between level and  $20^\circ$  up.
  - Add rudder correction:
    - Begin with wings level and pull to about  $20^\circ$  up and release elevator
    - Apply aileron (your choice of direction)
    - As aircraft passes through 1st knife edge, apply some rudder opposite to the aileron direction. Then release rudder.
    - As aircraft passes through 2nd knife edge, apply some rudder in same direction as the aileron direction. Then release rudder.
    - With appropriate rudder correction, aircraft will exit between level and  $20^\circ$  up.
  - Now combine elevator and rudder correction for an axial roll. Then try a slow axial roll (same inputs but slow the roll rate)
- Split S (Starts high and ends low, so plan ahead!)
  - From high level flight, half roll until aircraft is inverted. Release aileron.
  - Cut throttle
  - Pull elevator to perform half inside loop.

- Immelmann. Also called Immelmann Turn. (Starts low and ends high)
  - From level flight and full throttle, pull elevator to do half loop. Release elevator when inverted.
  - Half roll either way to upright.
- Cuban 8
  - From level flight pull elevator for just more than a half loop.
  - When aiming back down at about 45°, cut throttle and half roll. Release aileron
  - Pull elevator and open throttle for just more than a half loop again.
  - When aiming back down at about 45°, cut throttle and half roll. Release aileron
  - Pull elevator to level off.
- Reverse Cuban 8
  - From level flight & full throttle, pull elevator to climb at a 45° angle up. Release elevator
  - Half roll. Release aileron.
  - Pull elevator for just more than half a loop. Cut to ¼ throttle soon after inverted.
  - When aiming at 45° up again, open throttle, release elevator.
  - Half roll. Release aileron.
  - Pull elevator for just more than half a loop, going to ¼ throttle soon after inverted. Release elevator at level flight.
- Stall Turn (Hammerhead)
  - This is a great one to exercise rudder use\*
  - From level flight, wings level and full throttle, pull elevator until aircraft is going straight up.
  - If needed, correct with rudder to keep a straight up-line.
  - Once up-line is established, cut throttle to ¼. (not idle)
  - Just as upward motion stops (or an eye-blink before), apply full rudder.
  - Aircraft should yaw within a wing-span to vertically down.
  - Establish down-line
  - Pull elevator until level flight.
  - \* As a variation; to practice the use of the rudder, “wag” the aircraft tail on the up line, but make sure the up-line does not drift to the right or left.

#### Flap Use:

- Flaps increase lift and **INCREASE** drag.
- Flaps induce wash-out → better roll control at low flight speed.
- Flaps permit steeper approach angles.
- Using flaps is cool!