Test Flying

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For those that design and build their own flying model aircraft there is a giant step to overcome before the plane or prototype can be classified as a flying model and that is its maiden flight. This first flight has many possible points of failure, in the aircraft design, build, and pilotage which can cause the first flight to end in disaster. This pamphlet is to help you approach the maiden with a degree of confidence that the result will be a successful flight and landing.

The suggested or recommended steps for a successful first flight are as follows.

Workshop!

Before packing up to head to the field you must ascertain that the following are completed in the workshop so that field time can be dedicated to the process of test flying and not to preflight repairs or modifications.

Mechanical

1. When fully assembled does the plane have any obviously loose items or unrequired movement in the control surfaces, wing attachment, tail attachment, the undercarriage, the motor, the motor mount or the propeller to motor connection?
2. Are the wings warp free, of equal profile and weight?
3. Do all control surfaces move freely under servo control?
4. Are the wings, horizontal stabiliser, vertical stabiliser and fuselage boom rigid enough to resist the bending and twisting forces in flight?
5. Does the motor/propeller combination cause vibratory resonances in the plane itself or of any of the flight control surfaces?
6. Does the propeller rotate such that it gives forward thrust?
7. Is the undercarriage firmly attached and are the wheels able to rotate freely when weighted with the plane?
8. Does the plane when on the undercarriage move directly forward when pushed or does it veer to one side?

Radio and electrics installation

1. Is the radio receiver securely mounted?
2. Are the receiver antennas mounted clear of all other wiring, metal obstructions and as per the manufacturers recommendations?
3. Are all servo lead connections into the receiver fitted firmly and correctly?
4. Do all of the servo leads from the receiver have sufficient slack to avoid a minor movement of the receiver from disconnecting a servo or the ESC?
5. Are all servos secured, firmly plugged into the receiver and connected to the control linkages securely?
6. Are all control horns, pushrod connections and linkage stoppers fitted correctly and properly secured?
7. Are the battery and ESC mounts capable of securing them from all unwanted movement in flight, including during negative "G" maneuvers?

8. Are the servo leads tidy and secured from being caught on a servo, pushrod, or any other device that might move in flight?
9. With the battery properly and securely installed does the plane balance at the recommended CG point or just slightly forward thereof?

Radio and control surface deflections setup

1. Do the control surfaces move in the correct direction when the transmitter sticks are moved?
2. Does moving all of the control surfaces in a rapid and violent manner cause the receiver to drop out?
3. Does your setup pass a radio range check in the workshop?
4. Set transmitter trim levers to neutral!
5. With the transmitter and receiver switched on, (Trims neutral), set all control surfaces to be flush. (Ailerons flush with wing surfaces, Rudder flush with the vertical stabliser and the Elevator flush with the horizontal stabiliser), MECHANICALLY!
6. Set your control deflections to the manufacturers recommendations, MECHANICALLY!
7. Configure the transmitter to have 15 to 30% of "Expo" on all of the control surface channels!
8. Set transmitter for dual rate if possible and reduce control rates on one switch setting to 85% of manufacturers recommendations.
9. Set transmitter/receiver "Failsafe" to ensure that the motor is cut if receive signal is lost!
10. With the plane properly secured against movement, calibrate the ESC.
11. Remove battery and charge for maiden.

Transport!

As transport accounts for more damage to models than flying them, please ensure that the model is secured safely for transport, is unable to move around and also that nothing is able to impact the plane. Pay attention not to snag bend or otherwise effect the control surfaces and the wing as they should be free from all physical contact at all times during transport.

Field preflight!

1. When fully assembled does the plane have any obviously loose items or unrequired movement in the control surfaces, wing attachment, Tail attachment, the undercarriage, the motor, the motor mount, or the propeller to motor connection?
2. Are the wings warp free, undamaged, or properly repaired?
3. Do all control surfaces move freely under servo control?
4. Are the wings, horizontal stabiliser, vertical stabiliser and fuselage boom rigid enough to resist bending and twisting forces in flight?
5. Does the motor/propeller combination cause vibratory resonances in the plane itself or of any of the flight control surfaces?
6. Does the propeller rotate such that it gives forward thrust?
7. Is the undercarriage firmly attached and are the wheels able to rotate freely when weighted with the plane?
8. Is the plane when on the undercarriage able to move directly forward when pushed or does it veer to one side?
9. Fit and secure flight battery! Do the control surfaces move in the correct direction when the transmitter sticks are moved?
10. Does moving all of the control surfaces in a rapid and violent manner cause the receiver to drop out?

11. Does your radio setup pass a radio range check?
12. Ensure transmitter trim levers are set to neutral!
13. Check your control deflections are set to the manufacturers recommendations on one dual rate setting and 85% on the other switch position!
14. Check transmitter/receiver "Failsafe" to ensure that the motor is cut if receive signal is lost!
15. With the plane properly secured against movement, Check motor thrust and throttle range!

The maiden flight!

1. Select a day where there is little or no wind and definitely no wind gusts.
2. All taxi runs and take offs, except for taxiing back to the pits after landing should be done with the pilot directly behind the aircraft! NEVER attempt a maiden flight with the plane taking off towards you!
3. On the transmitter select the 85% control deflection setting, (with the required Expo).
4. Using half throttle as maximum, practice taxiing your plane along the runway and get used to the effectiveness, (feel), of the rudder and elevator.
5. When comfortable and confident with the taxiing increase the throttle a little and do a fast taxi run with the tail elevated and cut the throttle to emulate the final stages of landing and observe the "Roll out" behaviour of the plane.
6. Commence a number of high speed taxi runs with the tail up and attempt GENTLE hops into the air and back onto the ground, at this stage, (DO NOT ever cut the throttle), so that you can ascertain the behaviour at lift off and how it responds to minor aileron inputs for roll correction if any. Maximum hop height should be less than 1 metre.
7. Once the hops have been completed successfully you can start a fast taxi run and slowly increase the throttle further until the throttle is almost, if not at, maximum. When travelling fast GENTLY give a minute amount of up elevator to drop the tail slowly and hold the aircraft at a slow climb until a good and safe working height is obtained, (my preference is around 10 to 20 metres. Correct roll and direction etc as required!
8. Again using the controls in a gentle manner, do a turn, (as flat as possible), and enter the flight circuit remembering to ALWAYS be gentle upon the controls! Adjust the transmitter trims for stable, flat and level flight.
9. After a number of circuits start practicing your landings and the landing approaches whilst still at a reasonable height.
10. After a few practice attempts it is time to do your first landing. Do your approach LONG and SHALLOW and basically fly the plane at half or slightly less power to the ground. When very close to the ground start to reduce the throttle whilst still maintaining the approach until touchdown where the throttle is cut and try to keep the plane level as the speed decreases until the tail drops and then apply full up elevator to plant the tail firmly on the ground.
11. Taxi back to the flight line with the elevator at max up but do not do so at high speed or an unwanted take off and crash will occur.
12. Observe the control surface positions and if required adjust the mechanical linkages to give the exact same control surface positions when the transmitter trims are returned to neutral.
13. Remove the flight battery and perform the preflight physical checks again to ensure that nothing has come loose or has been damaged during the maiden flight and landing.
14. If desired fit a flight battery and practice further until the maiden flight procedures are no longer required.

Please note:

Ideally each time a plane is repaired or modified the above procedure should be followed to ensure the maximum safety of the plane and all persons in the vicinity of your flights.

ADDENDUM

Most maiden flight failures are due to lack of experience with the handling properties of the aircraft concerned. Some of the most common pilot error causes of a maiden crash are as follows;

1. Too much throttle applied too soon and the aircraft takes off rapidly, rolls and dives into the ground normally at full power.
   Reason: The propeller wake causes a side thrust to the vertical fin which in turn causes the plane to turn at a time when the control surfaces did not have sufficient airspeed to counteract the turning forces.
2. The aircraft takes off, wobbles, rolls over and crashes into the ground.
   Reason: Insufficient airspeed for the control surfaces to fuction adequately. Often the use of ailerons for roll control at low speed can cause a wing to stall and the plane crashes as an immediate result.
3. Aircraft "Noses over" and breaks propeller or worse when throttle opened up for take off.
   Reason: The motor generated thrust line as way above the wheel axles and if the wheels are not free or are obstructed by the ground the plane will want to pivot about the wheel axle centres causing propeller contact with the ground.
4. Violent wobble upon lift off or porpoising in flight often leading to a rather violent low level inverted dive into the ground.
   Reason: Excessive control deflection due to poor pilotage or setup, (referred to as OVERCONTROLLING).
5. Sudden uncontrollable climb, loop and vertical impact upon take off.
   Reason: Setup of balance far too tail heavy or the battery has moved rearwards at take off.
6. Aircraft will not taxi or take off in a straight line.
   Reason: Motor thrust line is incorrect, Throttle setting is too high, and the result of all aerodynamic forces upon the tail are beyond the rudders ability to overcome the turning forces.
7. Plane performs OK in one direction but when flight direction reversed or inverted the plane loses receive signal and crashes.
   Reason: Receive antenna location is obstructured by the internal wiring or other metal objects which block receive signal.
8. Plane does not gain sufficient speed for take off.
   Reason: Flight battery, wrong current capacity, flat, faulty, or the ESC calibration in incorrect.
9. Control surface reversal and plane crashes for unknown reason.
   Reason: Some transmitters do not always remember settings when power is switched off. Do not take the control settings as already tested, **do your preflight!**

This is an evolving document and if you know of anything that should be added or amended please contact the author via email: nedkelly1956@gmail.com.