12 Things All Pilots Need to Know

Tips and advice from the experts to save your plane BY THE MODEL AIRPLANE NEWS CREW

IF YOU'VE JUST STARTED out as an RC pilot, chances are you've had a few unexplained situations pop up that has left you wondering what went wrong. One minute you're flying along having a good time and the next your shiny new model is not so shiny anymore. Even with an instructor nearby, new pilots can experience moments of confusion or experience less than optimal control over their planes. It's not fun. We discussed this at a recent Model Airplane News photoshoot and came up with a list of 12 things we think every pilot needs to know. We hope that pilots will use these tips to prevent the loss of a model. Read on and hopefully, the next plane you save will be your own.

1. **CHECKING THE CG AND WHY IT'S IMPORTANT**
   In specific terms, the center of gravity (CG) refers to a model's longitudinal (nose to tail) balance point. Every model has a specific balance range where its CG should be located for it to fly properly. When the CG is placed too far back in this range the model becomes more tail- heavy. As you move the CG forward, the model becomes more nose-heavy. Moving the CG aft makes a model less stable and more maneuverable while moving the CG forward makes a model more stable and less maneuverable. At the extremes, a tail-heavy model can become so unstable and the controls so sensitive that it becomes uncontrollable. An extremely nose-heavy model can become so stable that you can't move the elevator surfaces enough to raise the nose out of a dive. This is often referred to as running out of elevator on the landing so you can't properly flare to slow the model down. Always balance your model so the CG is located within the model's balance range, even if this means adding nose-to-tail weight.

2. **GROUND CONTROL CHECK**
   The best way to avoid problems while airborne is to get in the habit of performing regular system checks on your model. You don't have to do this before every flight, but you should come up with a routine and stick with it. The first time you assemble your model, be it for a single day at the local flying field or on the first

day at an away-from-home event, be sure to check that you've installed all the servo extension leads properly. For the most part, this means the ailerons but can also mean flaps and mechanical retracts. Use some tape to identify multiple leads so you can identify them quickly. This is extremely important if you have two aileron channels mixed together. In this case, identify your leads with A1 A2 so you don't get your aileron leads mixed up and end up with the controls reversed. To make the hookup task easier, install leads to the receiver and identify them with tape labels. This way, you don't have to peel back any packing foam protecting the receiver.

Once the model is properly set up the leads are plugged in, do a control check with the transmitter, and be sure to get the frequency pin first. Turn on the transmitter make sure you have the proper memory (aircraft) selected if you have a computer radio, and then switch on the receiver. Start with the left stick and check the throttle to confirm that the carburetor opens and closes (or the electric motor increases and decreases speed) when you advance and retard the throttle stick. This will prevent trying to start your engine the throttle open. Next, check that the rudder moves in the same direction as the stick.

With the right stick, check elevator control by pulling the stick back. The elevators should move up. For aileron, don't just wiggle the stick back and forth. Move it to the right and confirm that the right aileron moves up. Move the stick left and see that the left aileron moves up as well. I have seen more than one model seriously damaged and even lost a model myself because the ailerons were functioning backward. These control checks are needed every time you assemble your model. Don't forego this important check. The airplane you save will be our own!

3. **FLIGHT TRIMMING**

To properly trim your model for straight and level flight, you should know that your model is balanced correctly longitudinally within its suggested CG range and laterally (wingtip to wingtip). You should also make that you have the engine down and side thrust properly set. From here on out, all in the air.

Take off and climb to a safe altitude of about 100 feet. Smaller models can be flown lower and giant-scale models can be flown a little higher. The idea is to have a safe altitude while still being able to easily see if your model is climbing or losing altitude. Set the throttle to about 1/2 to 2/3 throttle for your cruise speed and fly the model directly into the wind.

Neutralize the elevator and aileron stick and see what happens. If your model wants to climb, add several clicks of down. If the model wants to come down, add some up clicks. This usually takes a little while so make as many passes into the wind as it takes to get the elevator sorted out. Now do the same for the ailerons. Set up a flight path directly into the wind and neutralize the aileron control. Left trim corrects for a right turning tendency and right trim is needed for a model that wants to turn left. Now go around and set up one last trim pass into the wind to confirm the model will fly straight and level with the control stick in the neutral position. Remember that a properly trimmed model will climb slightly when you increase the throttle from the cruise speed throttle position, and it will lose altitude if you decrease the throttle below the preset cruise speed position. The last thing to do is to land and take note of the positions of the control surfaces. Move the trim levers back to their neutral positions and mechanically adjust the control devises so the surfaces are back in their trimmed positions. It may take two or three more flights to fine-tune the trim positions of the control surfaces, but you should end up with a model that flies straight and level with the trim levers centered.

4. **FLIGHT ORIENTATION**

A lot of airplanes are lost simply because the pilot loses his orientation while flying. That is to say, the pilot loses his ability to see what the model is doing and what he has to do to properly maintain control. With experience, pilots learn to fly with both visual cues as well as with instinct involving muscle memory. The best way to learn proper flight orientation is to practice. Fly, fly and fly some more. And while you are flying, keep ahead of your model by not just flying around the patch, but rather fly with a purpose. Make up a flight plan and stick to it. Don't just do whatever comes to mind after you take off. Do the same thing every time. Take off into the wind and when you reach traffic altitude make a 90-degree turn away from the pit area. Continue to climb, and then make another 90-degree turn in the same direction so you are flying downwind. Throttle back to cruise speed then follow the rest of your flight plan. Two more 90-degree turns in the same direction will have you flying upwind again. This helps you to maintain your situational awareness.

Should you become disorientated, having a flight plan in mind will allow you to think your way through a maneuver. If you know you are flying left to right in a slightly banking turn, should you fly too close to the sun and your model becomes a dark silhouette you'll know what to do, or not do until you can see your model clearly again. If you fly your model so far away that you can't see it and what it's doing, add a little aileron and see what happens. If the model lowers the wing to the left when you give left aileron, you'll know it is going away from you so you can now make a turn to bring the model back toward you. If the wing on the left goes

up when you give left stick then the model is already heading back toward you. A good thing to remember when the model is flying back toward you is that you can keep the wings level by moving the aileron strike toward the lower wingtip.
With practice, you'll soon be able to see the subtle cues your model makes, and then you'll make needed corrections more quickly until you do it almost automatically. You'll be flying the model instead of letting the model fly you.

5. **HOW TO RECOVER FROM A STALL**
The stall, or more accurately the inadvertent stall, has probably caused more RC planes to crash than any other cause. The safety of your airplane depends on your knowledge of its slow-speed handling and stall characteristics. To minimize the number of crashes due to stalls, the pilot must understand the principles of what makes a plane fly and how to make practical use of the information.
First, we must understand how the wing supports the plane in flight. As the plane moves through the air, the amount of lift is determined by the particular airfoil and its angle of attack (AOA). The AOA is the angle formed by the wing's chord line and the oncoming airstream. The other primary factor in the amount of lift is the speed of the airfoil through the air. A stall will occur when the AOA exceeds the wing's critical angle of attack. At this angle, the lift suddenly decreases and the drag increases, resulting in the plane losing altitude very rapidly. The pilot has control over the AOA with the elevator. For example, if the pilot inputs up-elevator the tail drops and the nose rises, which increases the wing's AOA. An important point to note is that the plane can be moving in any direction, including straight down, and a stall will occur if the AOA is exceeded.
The only way to recover from a stall is by decreasing the angle of attack below the critical angle by pushing forward on the elevator. By learning your plane's slow-speed and stall behavior, you should be able to avoid getting into an unintentional stall situation in the first place. Take your plane up high; reduce the throttle while increasing the elevator deflection to maintain your altitude. As it slows, note how the plane reacts to your control inputs, and when it does stall, note if a wingtip drops or if it stalls straight ahead. Recover from the stall by lowering the nose to gain flying speed. Adding power will speed the recovery and minimize altitude loss. Practice this until you can recover with the wings level. All models stall differently, so you'll want to learn your model's characteristics.

6. **HOW TO RECOVER FROM A SPIN**
Spins are an exciting aerobatic maneuver when done intentionally, but an unintentional spin close to the ground will spoil your day. Spin cannot occur unless

the plane is stalled. If at the moment of the stall there is a yawing moment, an autorotation will commence. The spin is caused by a complex series of events. If the rudder is applied as the wing stalls then it will cause one wing to drop. For instance, if the left rudder is applied with an up-elevator, the left-wing will move downward and rearward resulting in a left roll. The left-wing will, therefore, have a greater angle of attack and slower speed relative to the right-wing. The right-wing will essentially be less stalled than the left-wing resulting in autorotation about the spin axis. In the fully developed spin, the aerodynamic and inertial forces are stabilized into a predictable pattern of rotation. The rotation, airspeed, and vertical speed are stabilized and the descent path is vertical. Unless something is done, the spin will continue.

Turns in the landing pattern can lead to spins if a skidding turn is attempted. A skid is when too much rudder is used for a given bank angle. Often a pilot will use rudder when overshooting the turn in order to avoid a steep bank angle. This is the recipe for a spin. If you find yourself in a spin, most planes will recover easily by letting go of the controls and letting the speed build-up. Some high-performance planes require opposite rudder and/or down-elevator to recover. Use caution during the recovery as the speed can build up quickly. Also, avoid a secondary spin during the recovery by not using excessive up-elevator. Every plane has its own peculiar spin characteristics, so make sure you try spin recovery at high altitudes.

7. **FLUTTER AND HOW TO PREVENT IT**

If you're doing some hard aerobatics or high-speed dives and hear a loud pop or buzzing sound, you probably encountered flutter. Flutter is the severe and destructive vibration caused by the aerodynamic bending loads. It can quickly destroy an aircraft if it is not slowed down or cause the control surfaces to separate. Flutter has many causes, but by using the proper precautions during the build and proper flying technique, it can be avoided.

Larger planes and the lightweight 3D designs with oversized controls are more prone to flutter To prevent flutter, slop-free control surfaces are a must. Any play in the control surfaces can initiate flutter. Check the surfaces frequently, as play can develop over time, especially when using a Z-bend in a plastic servo arm. Servo gears can also develop slop over time. Sealing the control surface hinge gaps will also help eliminate flutter and increase their effectiveness. You can use heat-shrink covering or packaging tape to seal the gaps. Large scale models sometimes use mass balancing of the control surfaces similar to full-scale planes. Mass balancing uses counterweights to offset the control surface weight and prevent instability. Keep all linkages as short as possible and use wire with adequate diameter. Also, take advantage of leverage; use the outer holes on the control horns and make sure the clevis pins are a good fit with the horns.

Proper throttle management is key factor in preventing flutter. The throttle should be reduced during dives to reduce the aerodynamic loads on the plane's structure. Most 3D planes are designed for slower-speed flight and full-throttle should only be used for takeoff and vertical climbs. Using common-sense during the building, setting up and flying of your model will go a long way in preventing this destructive phenomenon.

8. **SETTING UP FOR LANDING**

Getting into a routine landing pattern will contribute to perfecting your touchdown. Start your pattern by traveling into the wind away from you. Your landing pattern will have a rectangular shape with four distinct 90-degree turns. Enter your first turn and travel the crosswind leg of the landing pattern so that the plane has about 100 feet of altitude. Your second 90-degree turn will also be in the same direction and should set up the downward leg so the plane will be traveling parallel to the runway on the opposite side of the field away from you. Fly the plane straight and level until it enters a spot directly away from your location then reduce the throttle to about 75 degrees and begin your descent. Execute another 90- degree turn in the same direction and begin flying the plane into the base leg descent. You should reduce your throttle to about 50 percent and let the plane's altitude drop down to about 50 feet before turning into the final 90-degree turn. Remember to use the throttle to control the rate of descent and the elevator to control the speed.

our final 90-degree turn into the final approach should have the plane fairly lined up with the runway; minor adjustments can be made along the way to the touchdown. Depending on your plane, the throttle should be reduced to somewhere between 25 percent and idle. The most important thing to remember on the final approach is to keep the wings level. Use your rudder to move the plane from left to right and line up with the runway; use the ailerons only to keep the wings level. Once lined up, the plane should cross the end of the runway at about 10 to 15 feet above, hopefully, lined up with the centerline.

Just before touchdown, all pilots have to perform one of the most precise maneuvers there is: the flare. Depending on your plane, the flare will be performed either 2 feet above the ground or 2 inches. The main idea with the flare is to pull back on the elevator and raise the nose of the plane just enough to slow it down even more and perform a small stall with the wheels just barely above the ground. If done correctly, the plane will softly greet the runway and perform a smooth rollout. That's all there is to it; almost any plane can land following this landing approach.

9. **CROSSWIND LANDINGS**
Crosswind landings are one of the most difficult situations for novice and experienced pilots. Regardless of the wind conditions, the key to any landing is a good approach. If you're not happy with your landing approach, call it off and come around again. Consistently following a rectangle pattern every time you land your plane will improve your odds of a good approach. It is good practice to keep your approach speed a little above what you would normally use, especially in gusty winds, in order to maintain better control.
When landing with a crosswind, the plane will have a tracking path. This will be the direction the plane is traveling. By using a technique called crabbing, the plane will also have a heading direction, which is the direction the plane's nose is pointed. The strength and direction of the crosswind will determine how much crab angle you will need to keep the plane on a straight track down the center of the runway. For example, a 15mph wind coming across the runway at a 10-degree angle will make little difference to your landing approach. However, a 15mph wind coming across the runway at a 45-degree angle will require some compensation on your part during landing. But, a 15mph wind coming across the runway at 90 degrees will require total concentration on landing.
Establish a natural crab angle so that the plane tracks parallel down the runway with the fuselage slightly angled into the wind (the angle will be dictated by the crosswind). Use the rudder to turn the nose into the wind and the ailerons to keep the wings level. If you have too much or too little crab angle, the plane will start to track off course. Adjust your rudder accordingly to get the plane tracking straight down the runway. Once the plane is just about a foot or two above the runway, slowly apply opposite rudder so that the fuselage will straighten out parallel to the runway and flare the plane like you normally would. Remember to move all of your controls slowly, including the rudder. Moving the rudder quickly at this slow speed could cause a spin, which is the last thing you want. After a bit of practice, you'll never need to fear crosswind landings again.

10. **TAKEOFF**
Begin the takeoff by pointing the plane into the wind, however slight it may be, and standing behind it. Slowly advance the throttle until the plane is moving along the ground at a pretty good speed and use the rudder to keep the plane tracking straight. Be sure to get on the rudder quick to prevent the torque and p-effect

from pulling the plane offline. Smooth, slow movements on the rudder will keep the plane on track. If you are flying a tail-dragger, give it just enough elevator to bring the tail up so that the plane is rolling on its main gear. Don't force the plane into a climb out just yet; let it build a little more speed. Once the plane has enough speed it will only take a little elevator to get it airborne.
Now that the plane is flying, you will be able to use the ailerons to keep the wings level and let off the elevator a little so the plane will maintain a nice shallow climb out. Don't hold in a lot of elevator, especially after takeoff, or you will slow down the plane and stall it out. On some planes you will actually have to push a little down-elevator in it to maintain a shallow climb. This is especially true if your plane is on its maiden flight and needs some trimming. You'll want to keep climbing until the plane is about 100 to 200 feet above the ground. Slowly push the stick to the right or left and make a nice, easy turn. Once the wing banks (one wingtip higher than the other) to about 10 or 20 degrees from level, hold the stick there. As the plane flies through the turn, it will start to drop and lose altitude. Gently pull back on the elevator stick and feed in a small amount of up-elevator to keep the plane level throughout the turn. When the plane has completed the turn and is heading back toward you, return the stick(s) back to the neutral position and the plane should level out. If the plane continues in the turn after the stick is centered, slowly add in the opposite turn until the wing is level then center the stick again. Congratulations! You just made a beautiful takeoff. st made a beautiful takeoff.

11. **SETTING UP HIGH AND LOW RATES**

Most pilots will set the low and high rates on the aircraft to the manufacturer's recommendation and this is a very good starting point. But both the high and low control throws are a matter of personal preference. Don't be afraid to adjust them from the recommended rates. After all, the recommended rates are simply what the test pilot for the company liked. If the plane feels "twitchy" or responds too slowly for your taste, add more or less throw. A good starting point is to set the low rates so that the plane will fly smoothly but will still be responsive enough to get you out of trouble. Use high rates to have more control, especially at lower speeds such as when you're landing or performing 3D maneuvers. High rates will generally not be used at full throttle or on all the time.
When using high rates, the center part of the stick gets to be a little sensitive because a tiny amount of movement on the transmitter stick translates to a large amount of movement on the control surfaces. To eliminate this center-stick sensitivity you will need to program in exponential. This makes the area around the center stick less sensitive so it will not move the control surfaces much, but it

will still allow the full throw at the ends of the stick travel.
Another tip is to put the high and low rates on one switch for all control surfaces. This reduces your workload when switching from one rate to another. While this does make life easier, you should only do that after testing each surface for the correct high and low rates. Keep the rates on individual switches until you find the perfect amounts, and then transfer them all onto one toggle switch.

12. **CONTROL THROWS**
Setting your control throws is another area where the pilot just sets them to the manufacturer's recommended rates without ever adjusting them. You should always adjust your control rates to your comfort zone of flying or what feels right to you. The reason for this is that every plane, even an ARF kit, will end up flying a little different. Your choice of radio, servo, and battery pack will make the control surface's response time unique. Each type of plane, such as scale, aerobatic, racer or sport, will have different requirements for control throws. Weight will give the plane different flight characteristics depending on how heavy or light it is. Finally, where you set the balance will make a huge difference in how the plane flies. All of these things will contribute to how much control throw your plane will require for smooth and responsive flight.
n the air, flight-testing will allow you to adjust the control throws to the correct amount. For the ailerons, a good starting point is to have the plane do a complete roll in one second when holding the aileron stick all the way over. If the plane performs the roll faster, reduce the rates. If it performs it slower, increase the rates. This is a good starting point and don't be afraid to adjust faster or slower depending on your comfort zone. The elevator can be adjusted by performing a full-stick loop or a full-elevator pylon turn. If the plane snaps out of either of these maneuvers, reduce the amount of elevator throw. If the plane pulls through with no problem, add some more throw until it starts to show signs of snapping. Be sure to perform these tests at a safe altitude. The rudder throws should be set to allow a smooth banking turn when used and enough ground control for a smooth takeoff.