A back view of Seagull Cessna Skymaster with the landing gear down. Note this picture is the same orientation as pictures three and four.

CESSNA-TYPE RETRACTS

Tips for retracting your gear into the fuselage

by Cal Orr || Photos by Steven Gooseman and the author

Several high-wing Cessna airplanes retract their landing gear into the fuselage. The Cessna 172RG, 182RG, Cardinal RG, 210, and the Skymaster 337 are examples. Many of these airplanes retract the nose wheel forward. That's not too difficult; simply turn the retract unit around. But the main landing gear seems to come together, and then fold back like duck feet. Although retracts are gaining popularity in model airplanes, including many ARFs, we don't seem to see the duck feet.

I plan to show how you can add Cessna-type retracts to your model using a standard 90° retract mechanism. I have now built two Cessna models with these types of retracts: an 182RG without gear doors, and a Skymaster complete with the gear doors. The model highlighted in this article, a Seagull Models Cessna Skymaster 337, can be purchased from Sig Manufacturing. It is an ARF model with a wingspan of nearly 77 inches and is approximately 57 inches long. Although the manual briefly discusses electric power, the model was intended for glow-powered .36 to

The Seagull Cessna Skymaster shortly after takeoff shows the landing gear retracting.

.46 two-stroke or .52 to .72 four-stroke engines.

I made this Skymaster electric powered by adding two outrunner E-flite Power 15s—an APC 10 x 7E propeller on the front and an APC 10 x 6 (gas) pusher propeller on the back. (APC does not make a pusher in a 10 x 7E.) Each motor is powered with its own four-cell 3,300 mAh LiPo battery. The batteries are easily accessed by removing the windshield hatch.

You can use larger motors, which means bigger ESCs and batteries, more weight, and more money. This model is now a true 337 (the Cessna 336 had fixed gear). I modified this model for retracts and used a set of tricycle 60-120 E-flite retracts. I also included a set of sequencing gear doors that are also closed when the gear is down.

There are two ECSs in the model, each with a 5.5-volt BEC. The front BEC powers a receiver in the fuselage that operates the retracts, doors, nose wheel steering, right aileron, and right elevator half. (I cut the elevator in half and operate each half with its own servo.) The second receiver is in the wing and is powered from the rear ESC. The wing receiver operates the left aileron, left elevator half, both rudders, and both flaps. This installation means that I only have three servo cables between the fuselage and wing and I also have some power distribution and redundancy. I simply bind both receivers at the same time.

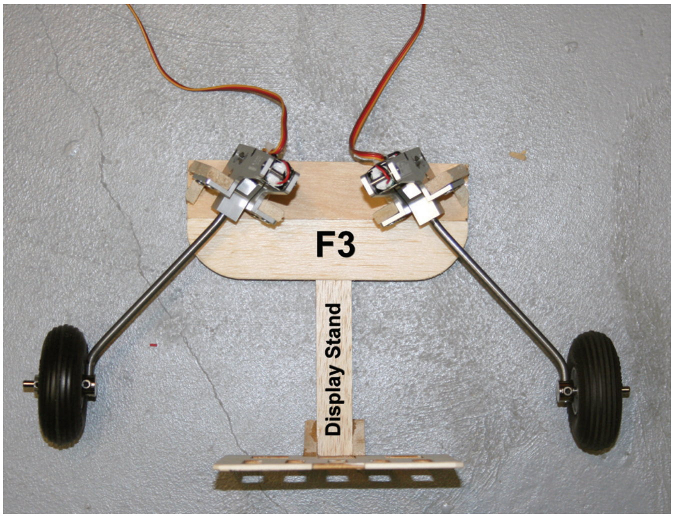
This Skymaster flies well in a scalelike manner. It looks great in the air with the gear up and sounds good, too.

If you have ever crawled beneath a full-scale Cessna while it is on jacks during an inspection, you see that the main landing gear retracts in one operation (excluding the operation of any gear doors). Many people think that there are two operations; it looks as though the main struts come together and then fold back. Cessna simply pivots the main landing gear struts at an angle so that as they are retracting, they are also moving closer to the fuselage. Cessna operates its retracts with hydraulics—one system for all three wheels.

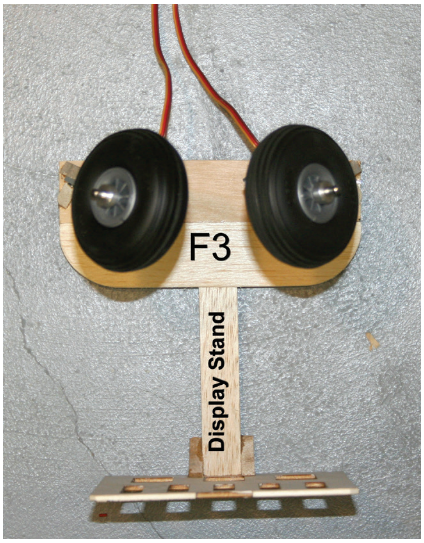
If you watch a full-scale Cessna on takeoff as the gear starts to go up, the mains unlock and fall to a lower point. The hydraulics will then catch up and push the struts back into the wheel wells. Seeing this operation, it appears to be a two-step process, but the main struts just retract back and in from the one pivot.

When adding retracts to any model, I start with the nose wheel. This will set the propeller clearance and the height of the model off of the ground. Don't overdo it with the propeller clearance; it is easier to retract short struts than longer ones. If you look at a full-scale Skymaster, you will note that there is roughly one tire diameter distance between the top of the tire and the bottom of the fuselage. Also, shortening the struts and lowering the airplane to the ground makes for better ground handling. If you are flying from a hard surface, purchase wheels that are as hard as you can buy; the model will track much better down the runway!

The full-scale Skymaster retracts the nose wheel forward and rotates it as it retracts. I retracted it forward, but did not rotate it. To retract forward, I installed the retract unit backward, which caused some minor problems with the nose wheel steering that had to be worked out. Check your steering linkage. Make sure that it is free to operate at each extreme with the gear up or down.



This depicts the back view as though you were in the fuselage near the tail looking forward toward the nose. The landing gear is in the down position. What I have called F3 could be a bulkhead in your model that supports the front of the mounting rails for the retract units. A bulkhead would also be required to support the back of the rails, but is omitted here for clarity. On the struts near the retract units is a 10° degree bend as the strut exits the retract unit. The struts are actually rotated outward 40° (30° plus 10°). You can have a straight strut and rotate the retract unit the full 40° but depending on the width of the fuselage, the wheels might hit in the retracted position. Other angles could also change.



Looking forward toward the nose, the landing gear is shown in the up position. The wheels have retracted and are within the outline of F3. The retract units are mounted more than half of the wheel diameter away from the aircraft's belly.

For the main landing gear, the trick is then how to take a 90° retract unit and end up with the angles necessary to tuck the mains back and into the fuselage. Try mounting the main retract units following these four steps.

1. The retract units need to be mounted so that they are rotated outward 30°.

2. Mount the retract units so that they are also angled back toward each other roughly 15° each.

3. The retract units need to be mounted so that they are up in the fuselage (away from the belly) at least half of the

Electric Retract Considerations

Electric retracts have a built-in motor or servo for each wheel. Just bolt the retract mechanism into your model, add a wheel to the strut, and plug the wire into the receiver. If you are using two retracts (tail-dragger), a Y harness is provided to the receiver. If you have a tricycle-gear model, you are provided with a three-way Y harness, so that all three retracts plug into the receiver.

This also means that, as with your other servos, the power is supplied by your receiver. Electric retracts can draw approximately 300 mAh (each) when the gear is in transit. This is nearly 1 amp (900 mAh) each time a tricycle gear is cycled. When the gear hits its lock, there can be a short (20 to 50 milliseconds) current spike of another few hundred mAh as each wheel shuts off. This is an argument to power the retracts from a separate battery supply, but it is not absolutely necessary.

The E-flite retracts operate on a voltage range from 4.8 to 7.2 volts. If you operate them on the lower end, you might dip below their operating voltage range during the shutoff current spikes, which could reset the retract unit. If you operate the retracts on higher voltages, they will operate faster and draw more current, exaggerating the possible reset problem. Each retract unit might operate slightly differently than the others and a current/voltage spike might only reset one wheel.

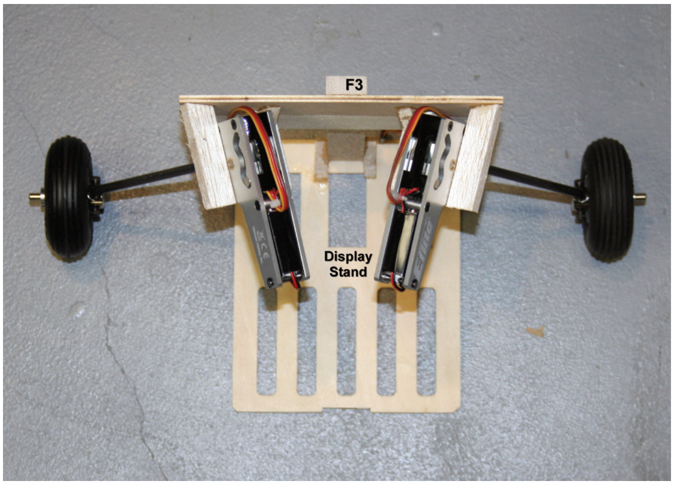
Here are a few things to keep in mind:

1. I like to operate the retracts on 5.5 volts from a good regulator or a speed controller's BEC. The current output should be at least 4 amps.

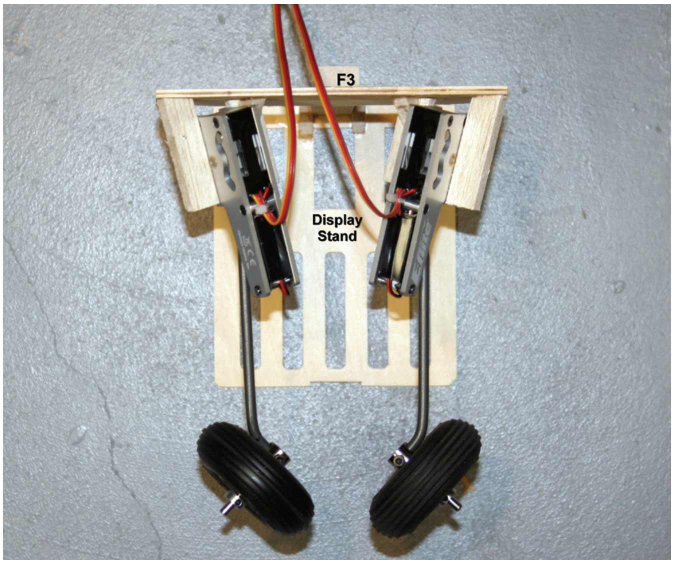
2. Get a current meter and measure the retracts' current draw. The important thing to note is that although the retracts draw a large amount of current during transit, they should draw almost nothing (less than 10 mAh) at rest, up or down. If you have a bind in the wheel well, etc., and a retract unit is stalled, it will turn itself off and reset.

3. Current spikes, and therefore voltage dips, are a problem for all electronics and can cause resets. I add a capacitor to the system, generally close to one of the retracts. This is easily done with a short aileron extension cord. Solder a 1,000uF capacitor of at least 15 volts across the red and black/brown wires in the extension. I have also soldered a second capacitor of .01uF across (in parallel) with the 1,000uF. The .01uF might catch fast spikes that could upset the retract amplifier. Use heat shrink tubing to insulate and plug your capacitor extension in between the Y harness and retract units.

4. Although I have not seen it in writing, the retracts' default position is down. The model should be stored with the gear down and the radio is then powered on with the transmitter's gear switch down. This also means that the failsafe on your radio (and when you bind a 2.4 GHz radio) and the gear switch on the transmitter need to be down. If you store the model with the gear up, then power on your radio, you might have to cycle the gear a few times to get everything in sync.



The top of the picture is toward the nose of the airplane. The landing gear is in the down position. The retract units are angled back 15°, so the rear of the retract units are closer together than the front.



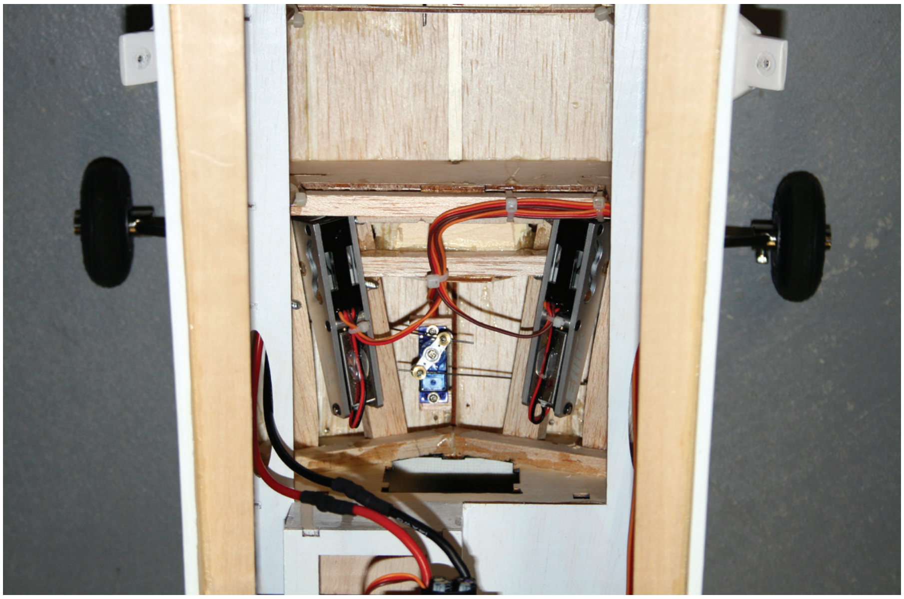
The top view looking into the fuselage with the wing removed. The landing gear is in the up position. Note the bend in the struts close to the retract units. The struts do not follow and are not in line with the retract units. This 10° bend allows for a narrow fuselage.

diameter of the wheels.

4. Bend or make struts that have a 10° bend at the retract mechanism end and a bend at the other end for the axle. The length of the strut will determine the height of the model off of the ground to match that of the nose wheel.

Although other combinations of angles will work, keep in mind that if you change one angle you might also have to change others. Because you are probably adding retracts to a fixed-gear model, you will need to consider the existing structure with regard to the best angles and support for the retract units.

It is difficult to see all of the installation and angles in a completed airplane, so I have included pictures that better show the angles and installation. You can use any modeling retract unit—pneumatic or electric—that rotates 90°. I chose 60-120 size E-flite electric retracts, with a $^{3}/_{16}$-inch strut



A look inside the Seagull Cessna Skymaster fuselage from the wing saddle. The top of the picture is toward the nose of the airplane. The blue servo between the two main retract units operates both of the main strut gear doors. Note the mounting rails for the retract units and their supports on the bulkheads.

diameter. Because the "flats" on the struts were in the wrong location, as were the spring coils for this application, I started over and made my own struts from $^{3}/_{16}$ wire.

I suggest starting with the mounting rails for your retract units. Make them out of lightweight balsa, which is easy to work with and reshape. Pin these balsa mounting rails to the bulkheads in your model. Make your struts out of lightweight wire that is easy to bend and cut. With some tinkering and repinning, you will end up with mounting rails that are the correct size and location, with all of the necessary angles.

Now take your balsa mounting rails and duplicate them using a harder wood such as spruce, trial fit them, then glue them into place. After your retract units are mounted, recheck your light wire struts then copy them using heavier $^{3}/_{16}$ wire. When you are happy with the landing gear's operation, plank the bottom of the fuselage with the gear extended. After it has been planked, retract the gear halfway and cut out the planking around the struts and wheels so the landing gear will slip inside.

Many early Cessna airplanes had gear doors that were closed when the gear was up or down. The gear doors only opened when the gear cycled. Later-model Cessnas got rid of the gear doors on the mains, but included them on the nose wheel. Some Skymasters were modified to remove the main gear doors that cover the wheels, but kept the doors for the struts, and the nose wheel remained stock. The complexity and expense of the gear door system is undesirable for many Cessna owners.

If you add gear doors to your model, I suggest that you operate the doors from a separate servo. Some computer radios have a mixing program or a gear door sequencer you can use. If not, use an aftermarket sequencer. I have successfully used the Electronic Model Systems (EMS) gear door sequencer in several models.

Install the EMS unit in your model and plug it into the receiver's retract channel. Then you plug your gear door servos and your landing gear into the EMS sequencer. The sequencer will take care of the landing gear and the door operation with a single flip of a switch on your transmitter.

This project will take a little work and a lot of tinkering. When you are finished and you get to see it all work, show it off to your friends at the flying field. You will know that all of the effort and fussing was worth it!

—Cal Orr
calorrflyrc@hotmail.com

SOURCES:

E-flite
(800) 338-4639
www.e-fliterc.com

Sig Manufacturing
+1 (641) 623-5154
www.sigmfg.com

APC Propellers
(530) 661-0399
www.apcprop.com

EMS
mschwing@earthlink.net
www.emsjomar.com

The Cessna Skymaster makes a flyby with the gear up.