

Basic Aerobatics: Part 2. Rolls & Cubans

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 Illustrations by Dave Scott

Introduction

This month, 1st U.S. R/C Flight School's progressive basic aerobatic training series features the techniques required to roll a helicopter. Those techniques will then be combined with the vertical line and loop elements detailed in part 1 to perform additional maneuvers. As always, it's presumed that these lessons will be practiced on a simulator prior to flying in the real world, the control techniques described apply primarily to flying collective (adjustable) pitch helicopters, and in the interest of simplifying the text, the control applications will be described using the customary airplane terms aileron, elevator, and rudder.

Horizontal Aileron Rolls

The objective of a horizontal aileron roll is to maintain the same line and height throughout (figure 1). Note: Rolls performed at higher airspeeds are less influenced by gravity and are thus less prone to dropping, whereas rolls entered at slower airspeeds are more prone to dropping and therefore

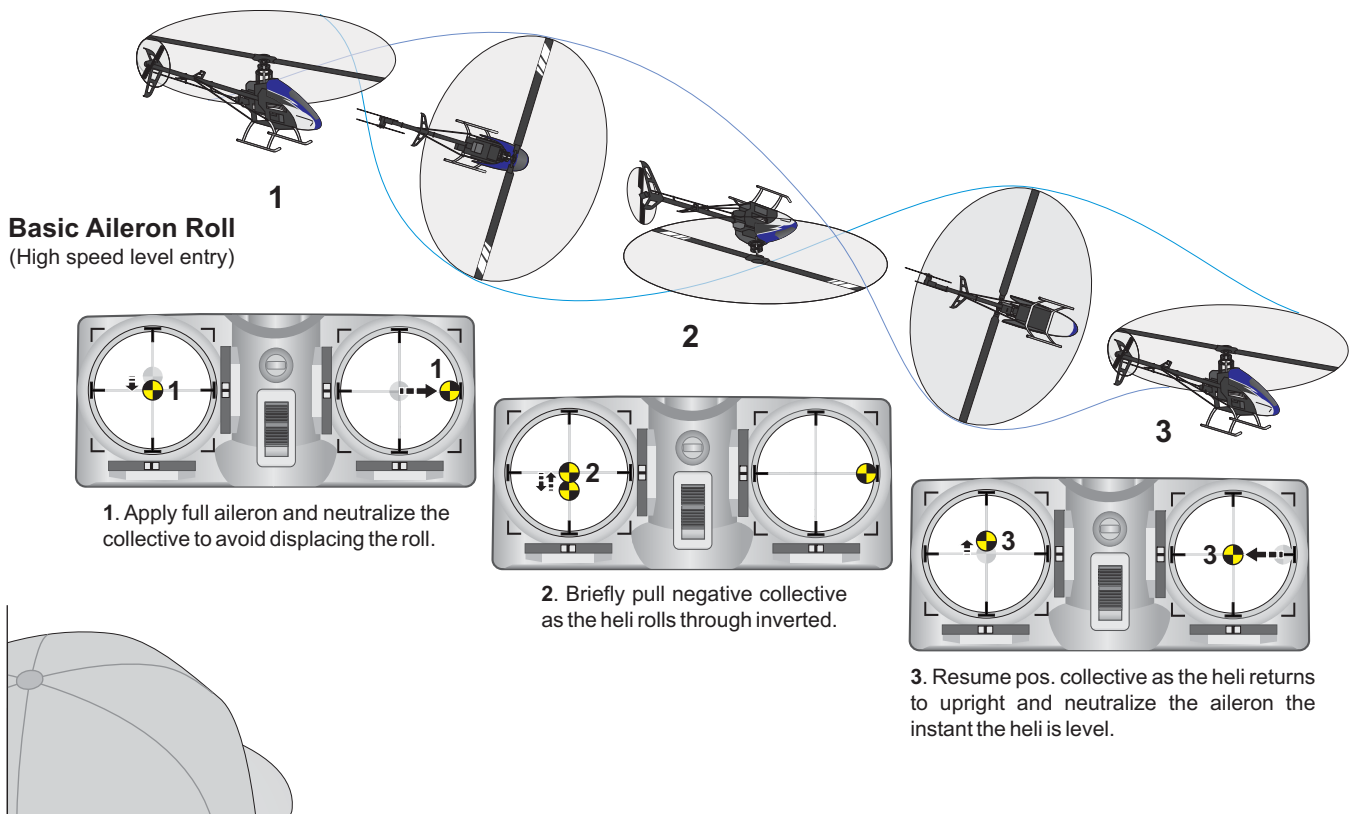
require more skill to keep level. Consequently, novice aerobatic pilots should set up all their early roll attempts at higher entry speeds, and then expand into lower entry speeds as skills improve. Similarly, rolls are initially a little easier using a larger aileron input to help complete the rolls quickly before losing altitude.

Upon initiating the aileron input, the collective has to be centered as the aileron to remove any thrust that would cause the heli to move sideways or enter a disorienting "barrel roll". As the heli approaches inverted, briefly pull a little negative collective to keep it from dropping. Note that since the helicopter is inverted for only a brief moment during the roll, the application of negative collective needs to be brief as well, i.e., "in-out". The objective is to pull just enough negative collective to keep the roll level through inverted without actually being seen. If the application of the negative collective forces the heli off heading, it was likely premature or held in too long.



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Similarly, hold off on resuming positive collective until the roll is nearly completed, because if you rush into positive collective before the heli is near level, you'll end up thrusting the roll off line. Lastly, quickly neutralize the aileron at the instant the rotor disk is level and return the collective to whatever's needed to fly away level.



Sideflips and Slow Rolls

A neat thing about heli flying is that it's possible to perform rolls at lower airspeeds as well as stationary "sideflips" (figure 2). Compared to high speed rolls, low speed rolls and sideflips are more prone to dropping during the segments when the heli is on its side, therefore, you'll have to input slightly more positive collective at the start to initiate an imperceptible climb that will prevent the heli from dropping through the first part of the roll. Then center the collective shortly after the heli starts rolling to keep the roll axial. As the heli approaches inverted, briefly pull negative collective to again initiate an imperceptible climb that will prevent the heli from dropping throughout the remainder of the roll, then center the collective until the roll or sideflip is nearly completed.

Slow rolls using a smaller aileron input are typically performed at higher entry speeds in order to carry more horizontal inertia through the lengthier segments where the heli is on its side and prone to dropping (figure 3). A slow roll also requires you to input the negative collective slightly earlier and longer to keep the heli level through inverted. However, an earlier-longer application of negative collective will tend to thrust the roll off line unless you keep it small and ease in and out of it very smoothly (compared to the quicker "in-out" collective adjustment made during a standard roll).

Half Cuban Turnaround

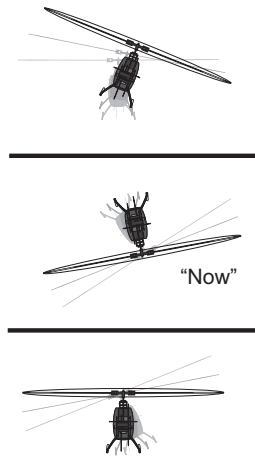
Having acquired the skills to loop and roll, the different ways that they can be combined are virtually limitless. The first example is a "half Cuban" turnaround consisting of a 5/8 loop into a 45 degree downline, then a half roll to upright, ending with a pull out to level (figure 4). This maneuver requires a moderate to high entry speed along with additional positive collective during the initial pull up to achieve enough altitude during the loop to perform the downline and half roll

without feeling rushed. Note: Due to the compound effect that a deviation at the start of the loop will have on the rest of this maneuver, it's vital that you enter the loop with the rotor disk perfectly level and the body straight to ensure the maneuver tracks vertically.

As with all loops, pull negative collective during the inverted segment to keep the loop round and to prevent a significant altitude drop. Then center the elevator and collective to establish the downline and to avoid barreling the

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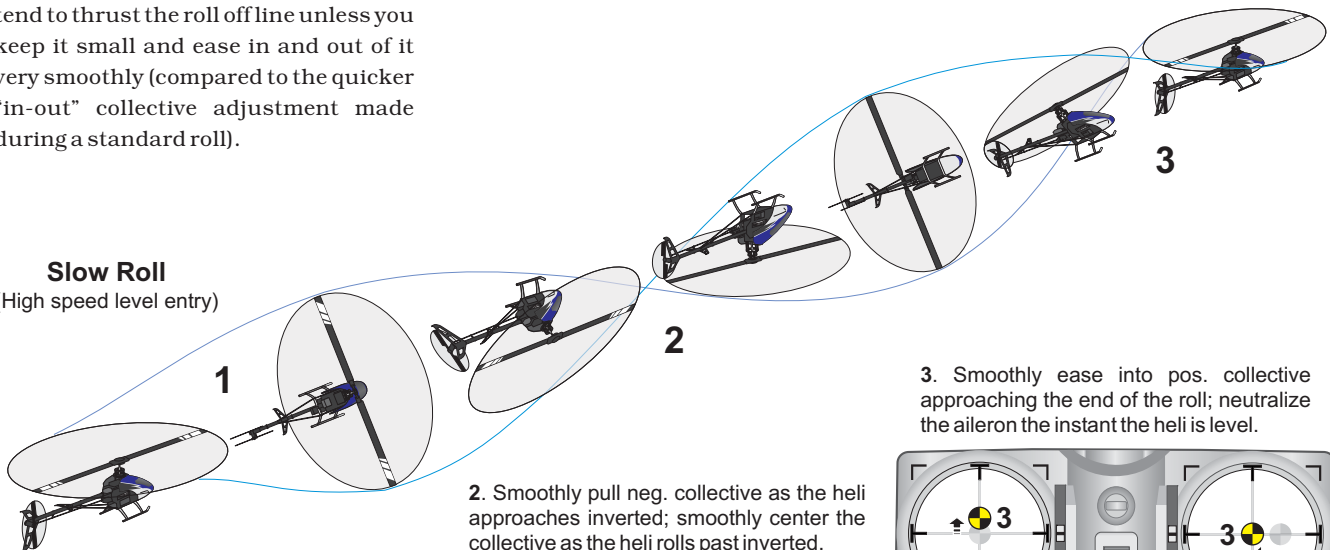


1. Simultaneously initiate the roll while briefly increasing positive collective; center the collective almost immediately after the roll starts.

2. Briefly input negative collective as the heli flips through inverted.

3. Resume positive collective as the heli returns to upright and neutralize the aileron the instant the heli is level.

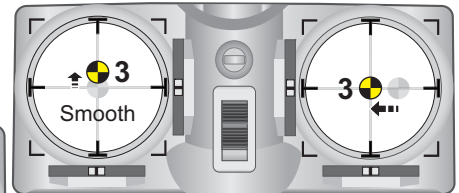
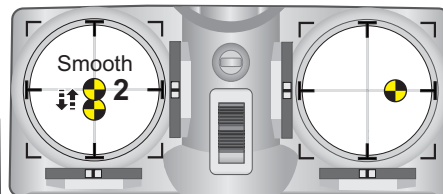
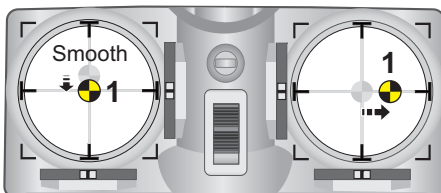
Slow Roll
(High speed level entry)

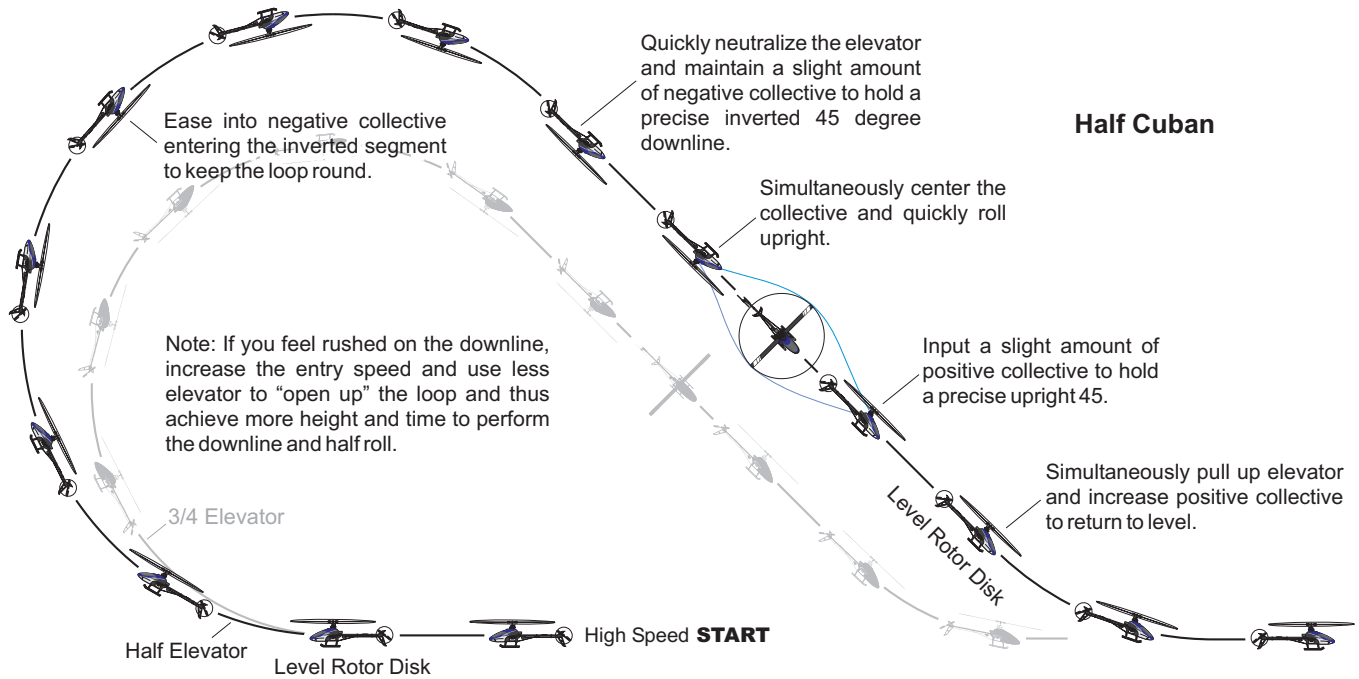


2. Smoothly pull neg. collective as the heli approaches inverted; smoothly center the collective as the heli rolls past inverted.

3. Smoothly ease into pos. collective approaching the end of the roll; neutralize the aileron the instant the heli is level.

1. Apply and hold a smaller aileron input while smoothly centering the collective.





Half Cuban

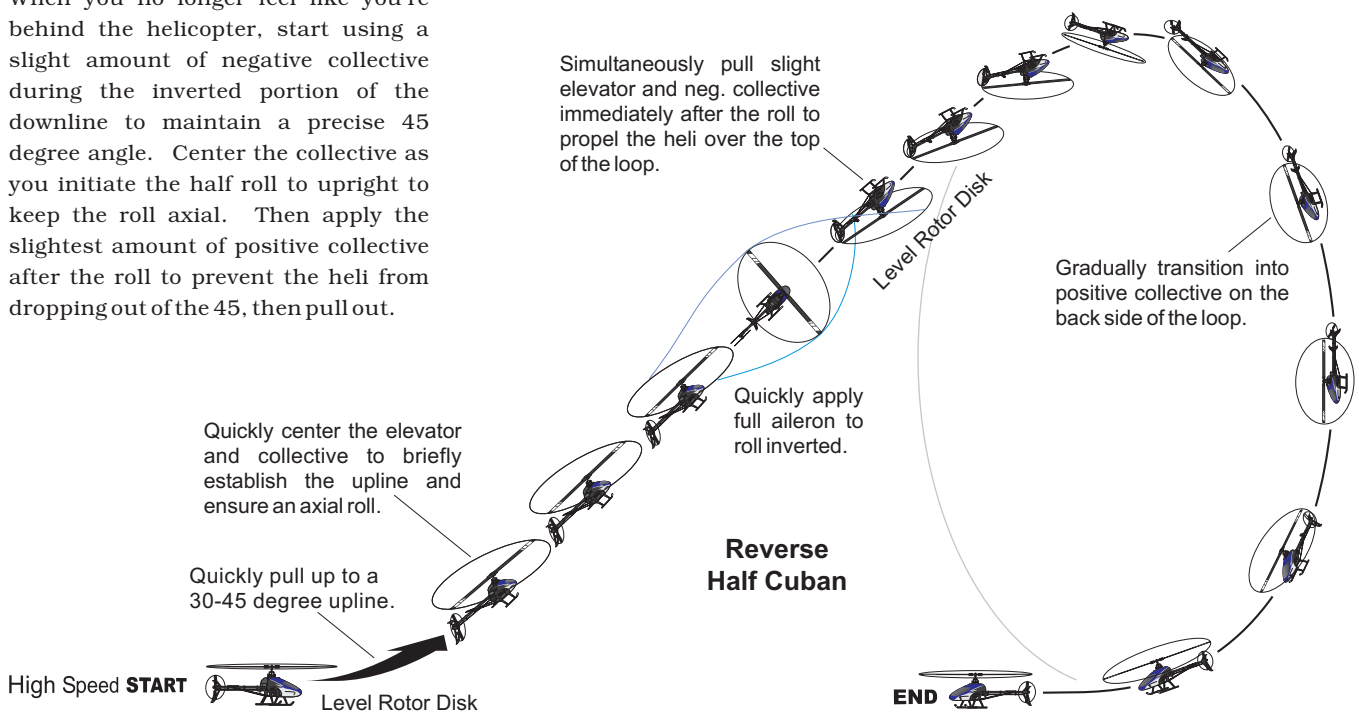
half roll. As a rule, always use maximum aileron anytime a roll is performed on a climbing or descending line in order to complete the roll as quickly as possible before running out of airspeed or altitude. It's also recommended that you fly a shallower 30 degree downline at first to give yourself more time to make sure that the half roll has been completed with the rotor disk perfectly level before simultaneously pulling out and adding positive collective.

When you no longer feel like you're behind the helicopter, start using a slight amount of negative collective during the inverted portion of the downline to maintain a precise 45 degree angle. Center the collective as you initiate the half roll to upright to keep the roll axial. Then apply the slightest amount of positive collective after the roll to prevent the heli from dropping out of the 45, then pull out.

Reverse Half Cuban Turnaround

A "reverse Cuban" is a turnaround option that starts with pulling the heli up into a 45 degree climb, rolling inverted, then pulling into a 5/8 loop finish (figure 5). This maneuver runs out of forward speed very quickly, and thus requires the fastest entry speed of all. Indeed, some small-lightweight helicopters cannot perform the 45 degree upline and half roll before running out of airspeed, so instead a

shallower 30 degree upline has to be flown. To help ensure that the heli reaches the start of the loop with enough speed to fly a nice arc over the top, you'll need to quickly pull up, establish the upline, and quickly execute the half roll. Just be careful that you're not in such a rush to start rolling that you neglect to center the elevator and/or collective beforehand and cause the heli to enter an awkward barrel roll.



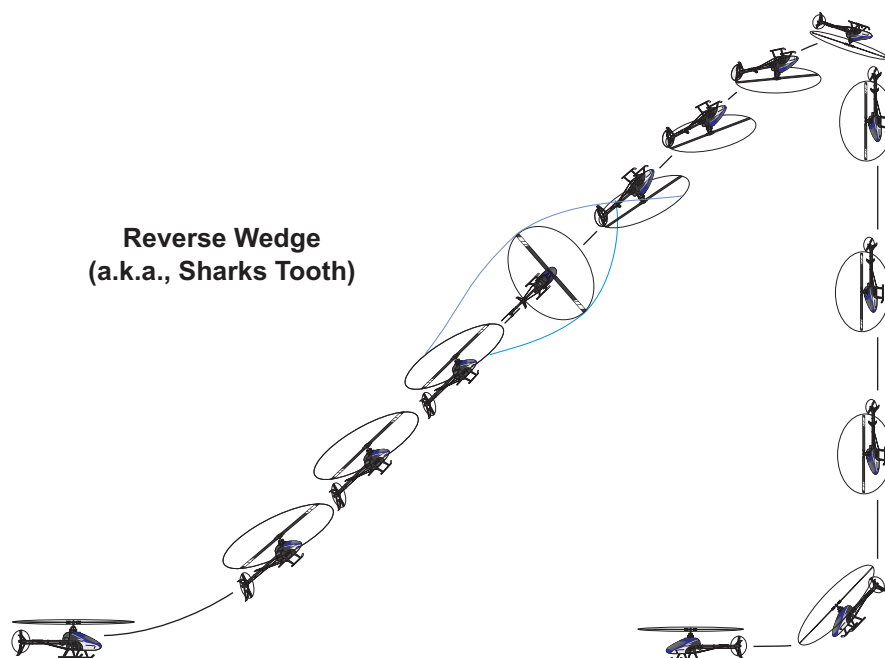
Reverse Half Cuban

Aim to complete the roll to inverted with the rotor disk level to avoid veering off to the side during the rest of the maneuver. Upon completing the roll, simultaneously pull a slight amount of elevator and negative collective to propel the heli up and over the top of the loop. Adjust the elevator as needed to carve a nice arc over the top and wait for the heli to start building some speed coming down before gradually transitioning into positive collective on the backside to complete the loop.

A “reverse wedge” turnaround is similar to a reverse Cuban, except on top you’ll pull the nose straight down and center the collective rather than transitioning into a loop (figure 6). This maneuver tends to be easier because it removes the need to gradually transition the collective coming down.

Conclusion

There’s no shortage of people telling pilots what they’re supposed to do, but not many can explain how. Consequently, most flyers hold on to the narrow view that only practice makes perfect. The million dollar



question is, “practice what?” In the absence of any plan for success, it becomes more difficult to maintain the motivation to overcome challenges when attempting to advance. On the other hand, those who increase their

odds of success entering each flight with a plan are more motivated to continue putting forth the effort. Thus, while heli flying is very much a reactive sport, it also entails a strong mental component. Good luck!