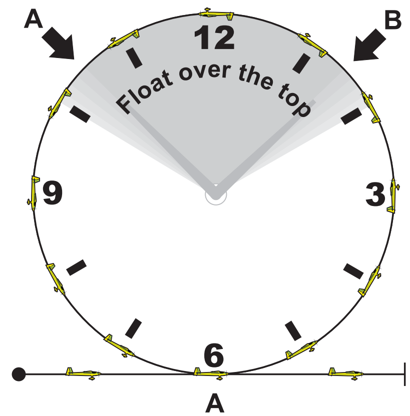
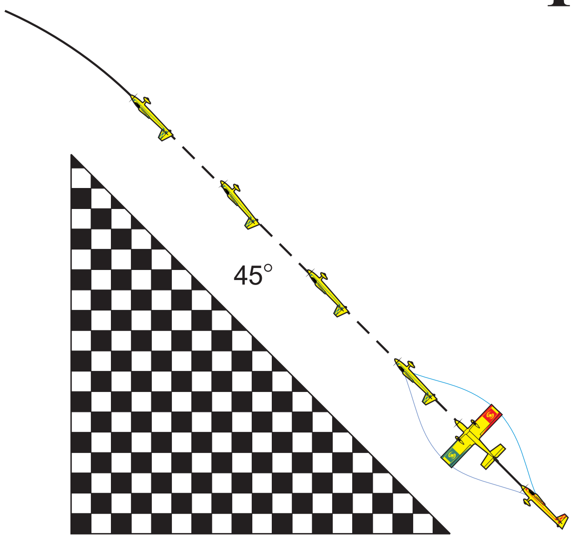
Symmetry of Loops and Lines

Round Loops

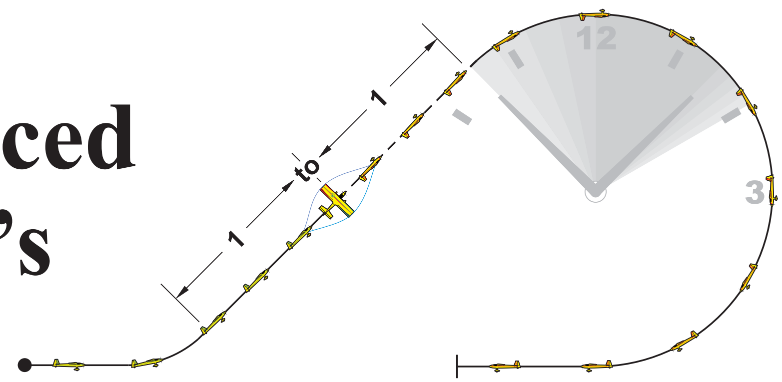
Float Over the Top





Holding True 45’s

Balanced 45’s



Symmetry of Loops and Lines: The Controller's Approach

In this section: D-32 illustrates the influence of gravity on a loop and the tendency of a loop to tighten or "pinch" toward the top, because understanding where the pinch is likely to occur is paramount to doing something about it.

D-33 & 34 illustrate targeting specific points in the loop to initiate smooth elevator adjustments to *float over the top* and fly a symmetrical round loop. Your foreknowledge of the control inputs required and where to typically target those adjustments (before a deviation from round has a chance to occur) will not only result in your quickly achieving routine round loops, but your *float* technique will compliment many other looping maneuvers as well.

D-35 & 36 illustrate applying the constant radius float technique and the refined roll technique to Immelmann and reverse Immelmann turnarounds.

D-37 through D-40 apply the float technique to half Cuban 8 turnarounds, and identify when it is necessary to push elevator during the slower sections of the 45 degree up and downlines to hold precise 45's when the plane is most susceptible to the effects of gravity.

D-41 illustrates how the combination of floating the tops of loops and not allowing the plane to drop prematurely out of the 45's buys more time to fly lines of equal length before and after the half rolls on the 45's. (Developing the proper timing to maintain precise 45's, together with using the same loop inputs, will all help to ensure that your Cubans routinely exit at the same altitude).

D-42 & 43 summarize the refinements of floating over the top of loops and centering the half rolls along the 45's, along with what adjustments to make if the exit altitudes of your Cubans turn out not to be the same as the start.

Summary: By building in refinements one at a time, each receives the majority of your attention and thus develops more rapidly—ultimately leading to a level of routine bordering on automatic and allowing you to start thinking about adding rudder corrections.

KPTR: Knowledge is the key to correcting deviations <u>before</u> they have a chance to occur.

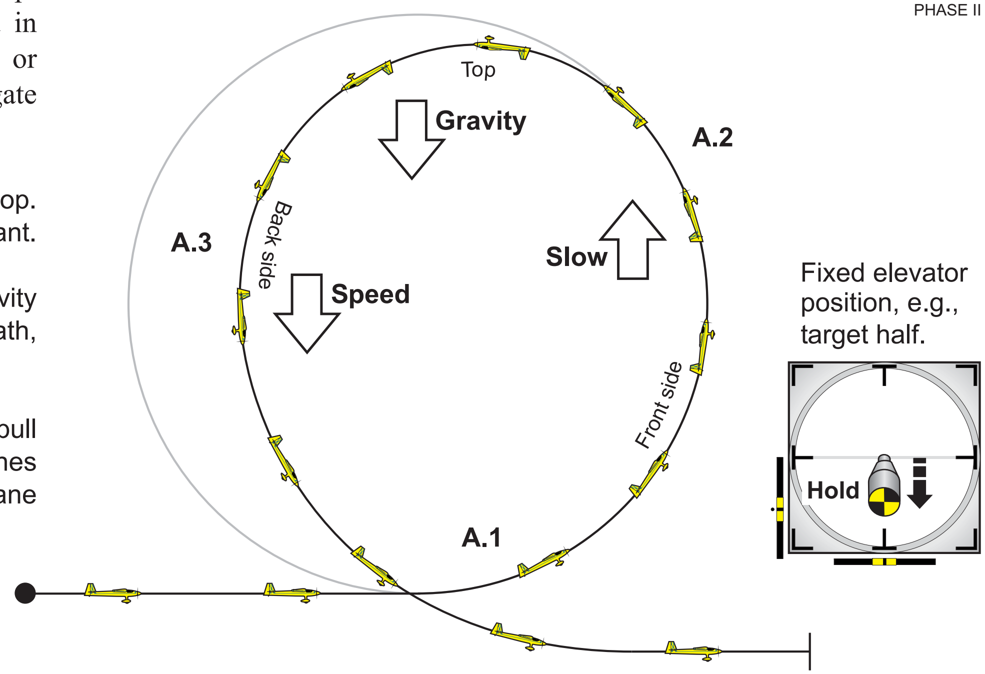
Anatomy of a *Pinched* Loop

Let's examine gravity's effect on a basic inside loop. A basic loop with roughly half up elevator held in throughout starts out well, but begins to tighten or "pinch" toward the top, while it tends to elongate coming back down.

A.1. Pulling approx. half up elevator initiates the loop. When applied smoothly, the radius is initially constant.

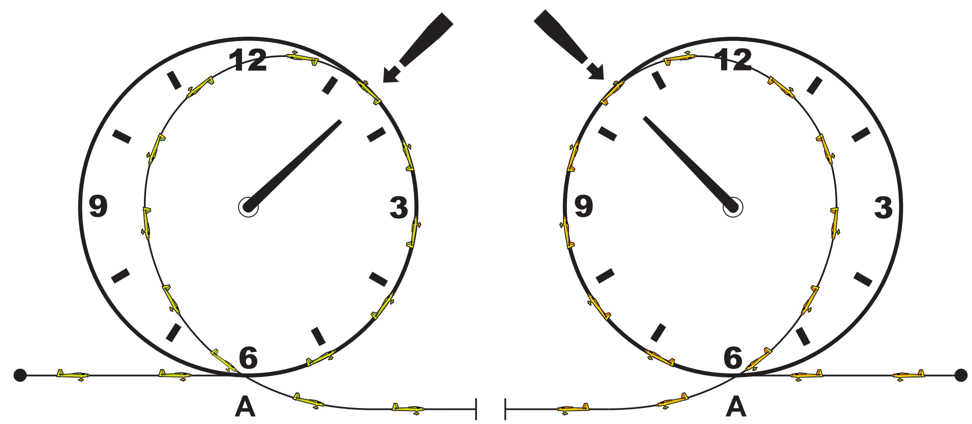
A.2. As the airplane slows heading upward, gravity begins to have a greater influence on the plane's path, and the loop begins to tighten or *pinch*.

A.3. Once the plane has made it over the top, the pull of gravity and subsequent speed build-up stretches the back side of the loop, and in the end the airplane exits the loop other than where it was started.



If one was to place a clock into the loop for reference, the pinch typically starts becoming apparent between the 1:00 & 2:00 positions for a left to right entry, and between 10:00 & 11:00 for a right to left entry, and that is where something would need to be done with the elevator to keep a loop round over the top...

Prior to attempting to fly round loops, the first objective should be to identify and/or confirm the point where your loops start to pinch by performing a warmup loop with no elevator adjustments and simply watching.



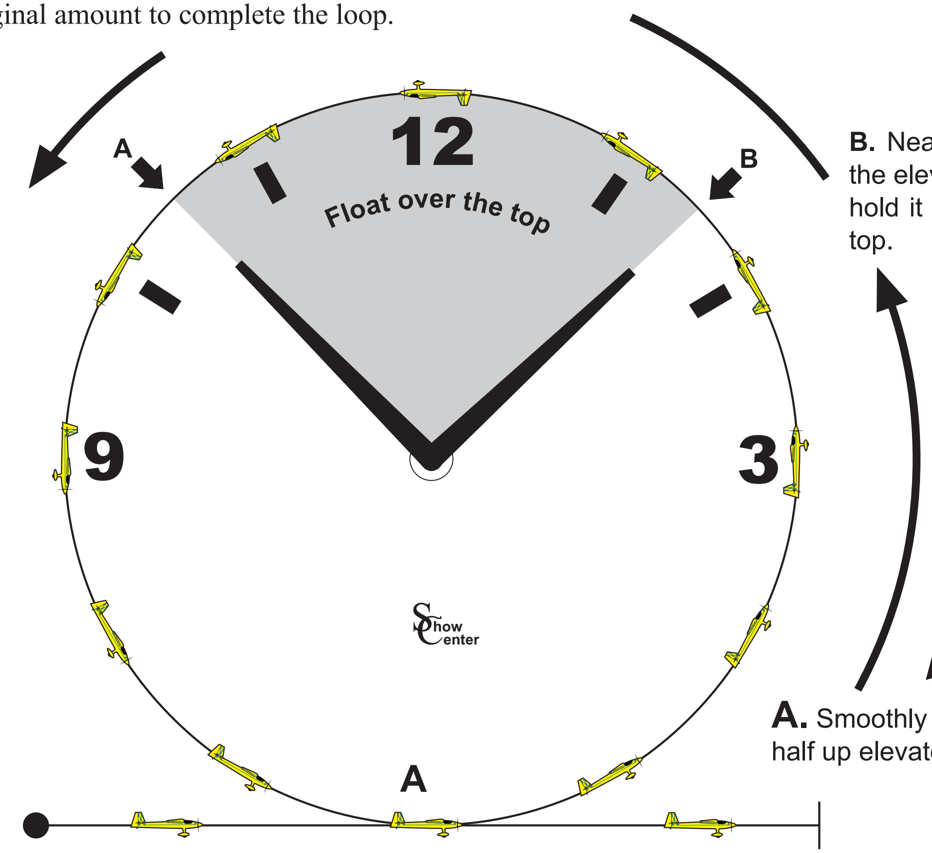
KPTR: Look for your loops to *pinch* around 10:00 or 2:00, depending on the direction you enter them from.

Refined Round Loop Sequence: Float Over the Top

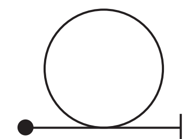
The technique that results in a nearly perfectly round loop every time is: Pull a fixed amount of elevator, reduce the elevator input slightly between 1:30 and 10:30 to *float over the top*, then return the elevator back to the original amount to complete the loop.

A. Near 10:30, return (increase) the elevator input to the original amount and hold it there to overcome the pull of gravity while completing the loop.

Note: In order to fly consistent loops, you must target a specific amount of elevator at the start (A) so that after you float over the top (B) you will consistently know where to return the elevator (A) to complete the loop with the same radius as the start.

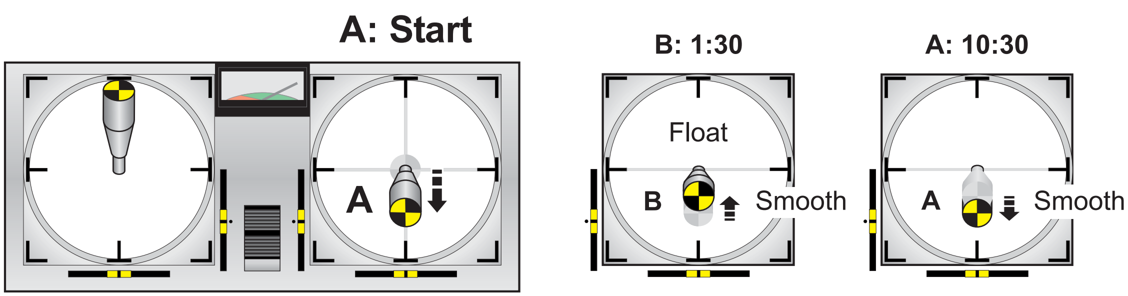


B. Near 1:30, relax (reduce) the elevator input slightly and hold it there to float over the top.



STEP #1

A. Smoothly pull approx. half up elevator and hold.



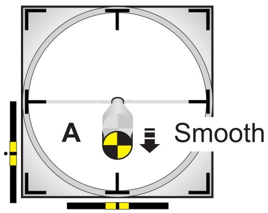
Note that the *float* technique works the same regardless of how much elevator you use to start a loop: Reduce whatever amount of elevator you pull when you loop <u>slightly</u> to float over the top.

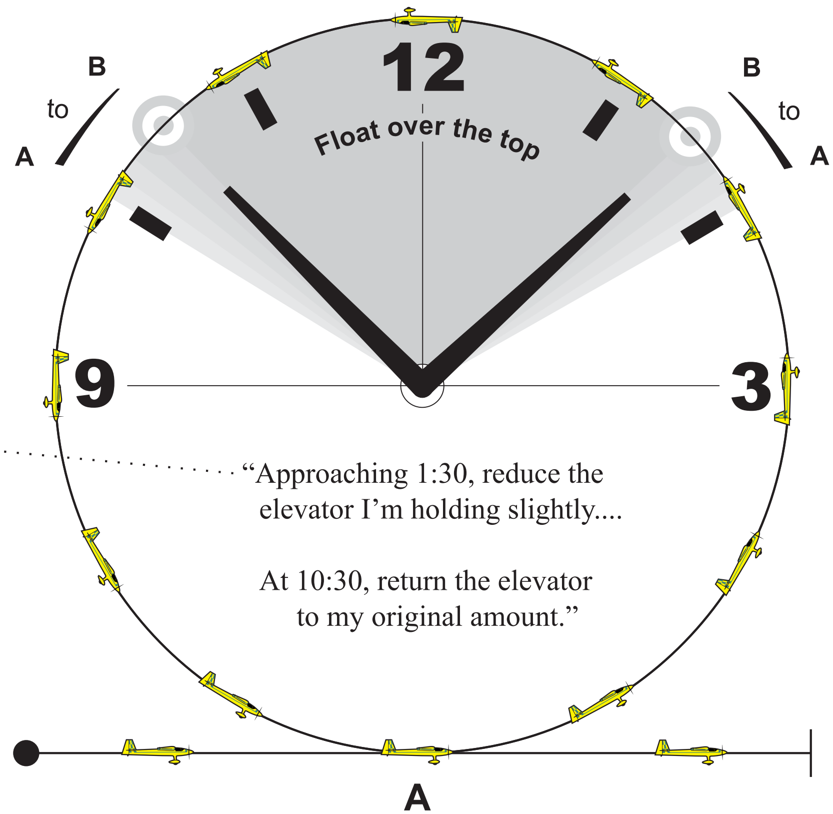
 KPTR: Routinely maintain round loops over the top by simply reducing your elevator input slightly between 1:30 and 10:30.

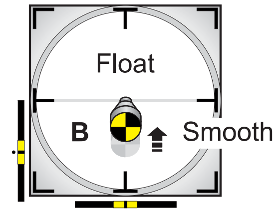
Round Loop: Targeting Smooth Input Transitions

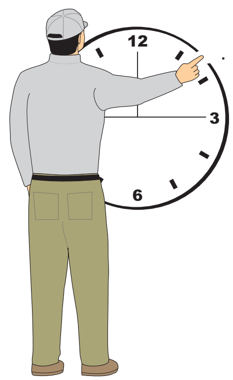
DAS
PHASE II

Proficient pilots target the 45° cardinal points, that is, between 2:00 & 1:00 and 11:00 & 10:00, to make the elevator transitions <u>before</u> the loop deviates from round—knowing that it soon would—while making the elevator transitions in and out of the float smooth and therefore undetectable.



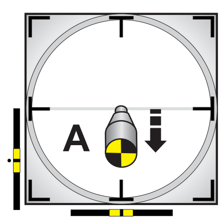






Each input transition from A to B and B back to A should be a smooth, yet also deliberate, movement paced with the time it normally takes to say or think "smooth" — thus avoiding the tendency to "hunt" (make too many elevator adjustments) due to falling behind the airplane when trying to react to it, or trying to keep up with an irregular elevator response when too much radio expo. is being used.

Proficiency note: Ideally, you'll visualize and become familiar with the 45° cardinal points within a loop prior to flying. After doing so, you will likely feel as if you have to wait for the airplane to reach each point to make your elevator adjustments during your loops, and that's good!



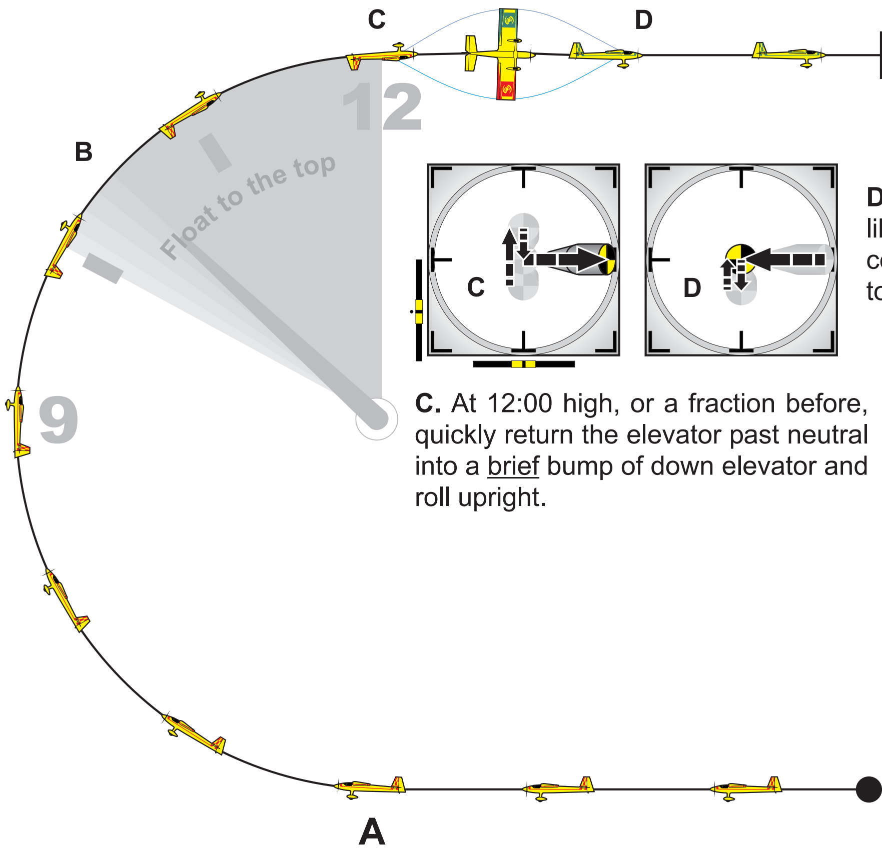
The optimal points in and out of the float could vary slightly between different planes. Yet, committing the elevator transitions to the cardinal points initially is key, even if only as *points of reference* to help determine where the transitions actually need to happen. Ultimately, if we are going to make effective judgments, we must target something, rather than nothing, to first shoot for!

KPTR: To stay ahead of deviations from round, target a loop's 45° cardinal points to make smooth elevator transitions.

DAS
PHASE II

Refined Immelmann Turnaround Sequence

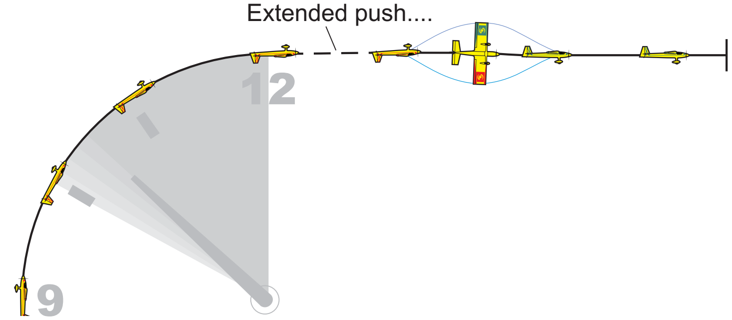
The logical progression after full round loops is to roll off the top and thus perform an Immelmann. The crux at this stage is that the plane will be slower at the top, so one needs to go from pulling up elevator during the loop directly into a bump of down (forward) elevator and roll upright as quickly as possible to keep from losing altitude.



D. A bump of up will likely be needed after completing the half roll to fly away level.

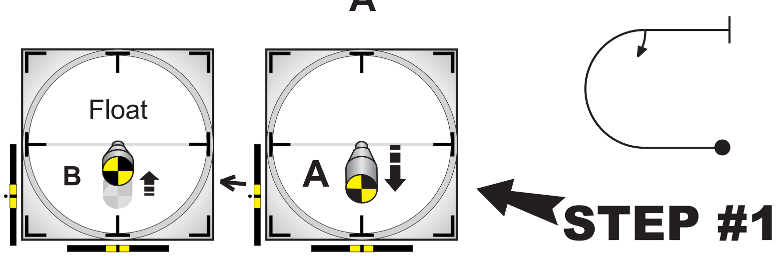
C. At 12:00 high, or a fraction before, quickly return the elevator past neutral into a brief bump of down elevator and roll upright.

ATTENTION: While the steps that make up the half roll need to be performed quickly due to the slower airspeed atop the half loop, each input should pass through neutral to avoid *barreling* the roll and effecting a loss of heading!



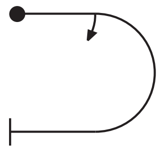
Building a Refined Immelmann

In competition, there is not supposed to be any delay between reaching the top of the loop and initiating the half roll. However, that requires making inputs faster than one can think (i.e., using muscle memory). To initially cement the mechanics involved, it's recommended that you extend the push inverted for a few moments before rolling upright; then settle into a faster rhythm of one step after another.



KPTR: To compensate for being slow atop an Immelmann, the bump of down and the roll need to be inputted quickly.

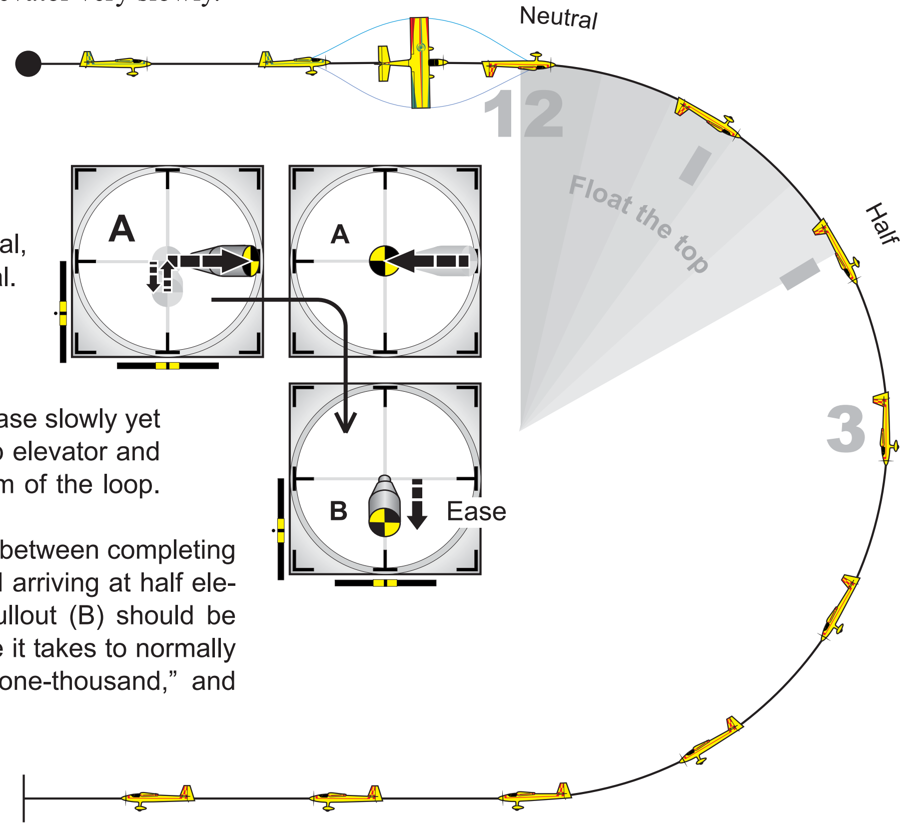
Refined Reverse Immelmann (Split S) Sequence



A refined reverse Immelmann starts out with the familiar undetectable bump up and then roll. The crucial point is after rolling inverted: In order to keep from *pinching* the top of the loop, one has to be aware that the elevator will be twice as effective initially when pulling out with the help of gravity, and thus apply the elevator very slowly.

Reverse Immelmann Tip: Rolling to inverted and entering a loop from the top results in such a rapid pullout that there is not enough time between 12:00 & 2:00 to apply a smaller amount of elevator to float the top, and then transition the elevator again to complete the loop. Instead, the elevator will need to be applied in one steady input, <u>yet at a slower pace to keep from arriving at the standard half elevator amount too early.</u>

Note: If your airplane requires more or less than the easily targeted half elevator input to comfortably loop, why not adjust the elevator travel to achieve this happy-medium and move on? Why needlessly force yourself to get used to an overly sensitive or sluggish elevator, or employ large amounts of radio exponential and sacrifice the correlation between your control inputs and the flight responses, when a simple control surface travel adjustment may be all that is needed to achieve routine control inputs and maneuvers?

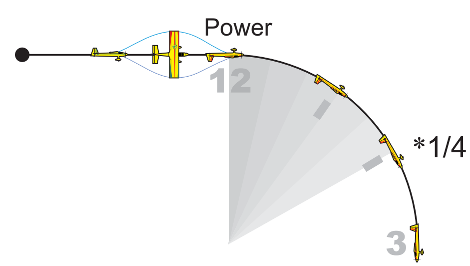


A. Bump up–neutral, roll inverted–neutral.

B. From neutral, ease slowly yet steadily into half up elevator and hold it to the bottom of the loop.

The transition time between completing the half roll (A) and arriving at half elevator during the pullout (B) should be paced with the time it takes to normally say or think "one-one-thousand," and hold.

While throttle reductions will be featured at the end of this program, the reverse Immel. cannot be discussed without repeating the basic Phase I emphasis of reducing power when pulling out (mostly to reduce stress on the airframe). Hence, a steady power reduction to roughly 1/4* throttle should coincide with the application of elevator at the top.



KPTR: Specific to a Split S, if it feels like you're initially easing into the elevator too slowly, you're probably doing it right.