

*Tango Whiskey*  
A V I A T I O N

# **BASIC AEROBATICS**



# Basic Aerobatic Course

## *Introduction -*

Experience the total freedom and excitement of aerobatic flight as you improve your pilot skills in precision and coordination. Tango Whiskey's Aerobatic course will make you a safer pilot and it will strengthen your self confidence.

You may take as few or as many lessons as you desire, depending on how far you want to advance your flying skills. Night aerobatic training is also offered which raises the fun factor even higher! We also provide spin training and shortly a UPRT program.

During your training you will also learn skills in handling a tail wheel aircraft. A tailwheel endorsement is NOT required for this course however we do offer a separate tail wheel endorsement course in our Super Decathlon and we can custom build a course that integrates it into your aerobatic training program.

Your aerobatic lessons are scheduled in 2.0-2.5 hour blocks. We typically fly anywhere from 1.0-1.4 hours, depending on your stamina and what needs to be covered in the syllabus. The remainder of the time includes a thorough question and answer period, preflight briefing, and post flight briefing. We have found that these types of training blocks are most productive for our clients.

The complete Basic course syllabus involves approximately 5-7 lessons. To learn and master the basics of 3 maneuvers, such as aileron rolls, spins and loops, 3 lessons are usually needed. Custom courses for spins and emergency upset recovery are also available. ***All Super Decathlons, like most aerobatic airplanes are very weight – restricted. The maximum weight for a student with the FAA-mandated parachutes and safe fuel quantity for a lesson in most aerobatic airplanes is around 220 lbs.*** Clients must be in good physical health. To make meaningful progress, at least 2 lessons per week should be scheduled.

We look forward to introducing you to the wonderful world of aerobatics!

-Tango Whiskey Flight Team

# *Contents*

**Lesson 1**

**Lesson 2**

**Lesson 3**

**Lesson 4**

**Lesson 5**

**Lesson 6**

**Aresti Symbols**

**Pro Tip Techniques**

## Lesson 1

### Ground-

- Examination of student certificates and log – establish experience level, medical fitness and weight.
- Course overview.
- Super Decathlon design, systems, numbers and checklist procedures.
- Tail wheel ground dynamics and procedures.
- Aerodynamics and demonstration/recovery procedures for stalls and spins, Dutch roll exercise Slip/Skid exercise
- KROC – Airport and practice area orientation and procedures.
- Pilot physiology during aerobatic flight – Grayout, Redout, GLOC, Anti-G straining
- Preflight inspection – aircraft and parachutes

### Flight-

- Review weather.
- Preflight briefing, questions and answers, procedures, common errors and recoveries.
- Preflight parachutes and use
- Preflight aircraft/ emergency egress aircraft in flight.
- Start, taxi, run up, take off, climb, cruise and descent checklist procedures.
- Dutch roll rudder coordination exercise- Slip/Skid exercise
- Slow flight at MCA.
- Power off stall.
- Power on stall
- Steep turn and the use of “top rudder”
- Spins and introduction of ballistic aileron rolls
- Arrival and landing (landing practice if combined with tailwheel endorsement program.
- Shut down and securing

## Lesson 2

### Ground-

- Review lesson 1.
- Questions and answers.
- Emergency egress procedures review
- Emergency parachute operation procedures
- G meter and how to use for maneuvers
- Aresti symbols and aerobatic sequence cards

### Flight-

- Weather briefing.
- Preflight briefing, questions and answers, procedures, common errors and recoveries.
- Preflight inspection of parachutes and aircraft.
- Review and practice and aileron rolls.
- Introduce 2 point roll.
- Introduce inside loop.
- Combine inside loop with aileron roll – loop to roll.
- Practice spins (if time permits)

### **Lesson 3**

- Briefing and review from Lesson 2
- Weather briefing.
- Preflight inspection of parachutes and aircraft.
- Review and practice aileron rolls, inside loops, 2 point roll and loop to roll.
- Introduce 45 lines up and down.
- Introduce “slow roll” (introduction maneuver, this is a difficult maneuver and we will not work on mastery during the Basic Aerobatic Course)
- Introduce Half Cuban 8.

### **Notes**

## **Lesson 4**

- Briefing and review of Lesson 3
- Aviation weather briefing.
- Preflight inspection of parachutes and aircraft.
- Review and practice aileron rolls, inside loops, loop to roll and Half Cuban 8
- Introduce Hammerheads
- Introduce Immelmann

## **Notes**

## **Lesson 5**

- Briefing and review of Lesson 4.
- Aviation weather briefing.
- Preflight inspection of parachutes and aircraft.
- Review and practice aileron rolls, inside loops, Immelmans and Cuban 8s, hammerheads
- Introduce sustained inverted flight.
- If time permits introduce humpty bump.

## **Notes**

## **Lesson 6**

- Briefing and review of Lesson 5.
- Weather briefing.
- Preflight inspection of parachutes and aircraft
- Introduce Humpty Bump if not covered in prior lesson
- Design and fly Aerobatic sequence or we use prior IAC sequence

## **Notes**

# Aresti Symbols

## AILERON ROLL

As the name implies, the aileron roll is done with "normal" inputs of aileron and rudder (in contrast to snap rolls). At the point this maneuver is introduced to students in the Tango Whiskey Basic syllabus, no attempt is made to maintain altitude during the roll. The result is a steady transition from climb to descent until the aircraft regains upright flight. This simplified approach to rolling is ideal for beginning aerobatic pilots.

A further development of basic rolling technique introduces forward elevator (and negative G) to eliminate altitude loss while inverted. The result is a **Slow Roll**. Once mastered, slow rolls completely replace aileron rolls in the repertoires of most pilots.

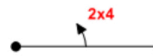
*Reprinted from IAC-*

### Aileron Rolls

Aileron rolls are flown with the rudder and elevator in the neutral position during the roll. The aileron is fully deflected in the direction of the roll. This is the easiest of the rolls to fly.

The aileron roll is started by pulling the nose up to 20 - 30 degrees above the horizon. The elevator is then neutralized and the aileron fully deflected in the direction of the roll. The controls are maintained in that position till the roll is completed. After the roll is completed the nose is usually 20 - 30 degrees below the horizon.

### Slow Rolls



Slow rolls are flown normally on a straight line (one exception is rolls flown at the top of a loop). The roll rate has to be constant and the flight path must continue in a straight line. This requires constantly changing rudder and elevator control inputs throughout the roll. Hesitation or point rolls include stops at certain roll angles. Two-, four-, and eight-point rolls are allowed. A notation such as **2x4** denotes two points of a four-point roll. A number by itself (**2**, **4**, or **8**) means a full 360° roll with the specified number of hesitations. If no points are specified, rolling is done without hesitations. A roll symbol that starts at the line denotes a half roll (see description of the **Immelman**). A roll symbol that crosses the line specifies a full roll (first figure).

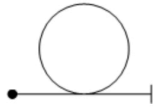
# LOOP

The loop is the best known and most easily recognized of all basic aerobatic maneuvers (it is also arguably the most difficult to fly well).

Loops (and portions of loops) form the basis of hundreds of recognized figures, and their early mastery is essential for continuing aerobatic improvement.

*Reprinted from IAC-*

## Loops



This is one of the most basic maneuvers, but not easy to fly well. It has to be perfectly round, entry and exit have to be at the same altitude. To achieve this, the pilot must adjust for ever-changing speeds and G-loads, as well as wind drift.

The maneuver starts with a pull-up of about 3 to 4 G. Once past the vertical, the back pressure on the elevator is slowly relaxed to float over to top of the loop to keep it round. Past the top, the back pressure is slowly increased again throughout the back part till horizontal flight. The plane has to stay in one plane with the wings perpendicular to the flight path. Rudder is used to maintain a constant heading throughout figure and ailerons are used to maintain the orientation of the wings.

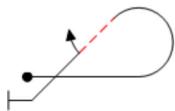
## HALF CUBAN (Cuban 8, reverse Cuban)

As the name suggests, the Half Cuban owes its existence to another, larger maneuver--the "Cuban 8." Despite this apparent stepchild relationship, the Half Cuban is a full-fledged maneuver in its own right, performed with much greater frequency than its namesake. The Half Cuban belongs in the "interrupted loop" series, along with the Immelmann and 3/4

Loop, and is a valuable turn-around tool. When needed, 1/2 Cubans provide an easy way to rebuild airspeed, as it is not mandatory to begin and end at the same altitude.

*Reprinted from IAC-*

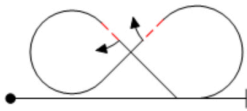
### Half Cuban Eight



Five-eighths of a loop to a down-line at a 45° angle. The plane is inverted at this point. Centered on this downline is a half roll from inverted to upright. A pullout to horizontal completes the figure.

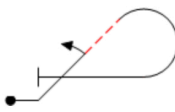
This is another one of the maneuvers that reverse direction. The downline can be used to adjust the altitude and speed at the end of the figure.

### Cuban Eight



Two Half Cuban Eights can be combined to form a Cuban Eight or Lay-down Eight. In this figure in competition the two looping parts have to be flown at the same altitude with the same radius. The exit has to be at the same altitude as the entrance to the figure.

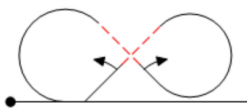
### Reverse Half Cuban Eight



This figure starts with a pull to a 45° up-line. Centered on this line is a half roll from upright to inverted. Five-eighths of a loop complete the figure to horizontal flight.

This again is one of the maneuvers that have been used to reverse direction while preserving altitude and airspeed

### Reverse Cuban Eight



Like the Cuban Eight, a Reverse Cuban Eight can be formed by flying two Reverse Half Cuban Eights back to back.

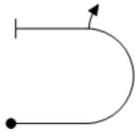
# IMMELMANN

The Immelmann carries the name of the pilot credited with its invention: Max Immelmann, a German WW I flyer. Although there is some question whether aircraft of his era had the horsepower and agility needed to actually perform the maneuver as a perfect-half loop, it is certain that some version of this unique method of getting turned around found merit with early fighter pilots.

Immelmanns belong in the "interrupted loop" series, along with Half Cubans, Cuban Eights and 3/4 loops. They are commonly used for course reversal and serve as a quick way to lose speed prior to performing snap rolls, spins, and other slower speed figures.

*Reprinted from IAC-*

Immelman



The figure starts with a half loop to inverted flight. A half roll then results in horizontal upright flight. This trades speed for altitude.

# SPIN

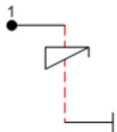
Spin instruction is the standard starting point for all beginning aerobatic programs. In addition to providing an essential basic maneuver, the training greatly increases safety and confidence for pilots denied exposure to spins during primary instruction.

A spin is a natural "autorotation" that builds from other, more desirable, design characteristics of fixed wing aircraft. Any airplane that can be stalled can be spun. When pilots view spins with mistrust, it is due to the fact that not every spin is recoverable--a circumstance usually traceable to inadequate control surfaces.

This animation traces spin development through the first full turn; all certificated single-engine aircraft in the US are capable of recovery at this point. In subsequent rotations, the nose will continue to rise until stabilizing approximately 60° below the horizon. At that stage, recovery is not possible for all aircraft. Aerobatic airplanes are naturally built with the controls necessary for recovery at any stage of spin development, and spins are a standard figure at every level of competition.

*Reprinted from IAC-*

## Spin




Spins come in 1, 1¼, 1½, 1¾, and 2 turns. Spins may be entered from upright or inverted horizontal flight. During spin entry, the plane has to show a stall break, followed by the auto-rotation. The rotation has to stop exactly after the specified number of turns. Once the rotation has stopped, a vertical downline has to be established.

# Hammerhead Turns

The Hammerhead (sometimes called "stall turn") is the first **vertical maneuver** taught in most aerobatic programs. In addition to giving a recovery from vertical flight, the maneuver provides a convenient 180° course reversal and an excellent way to rebuild airspeed (it is not necessary to begin and end at the same altitude).

*Reprinted from IAC-*

## Hammerhead



The quarter loop is flown just like the first part of a loop. When the plane is vertical, the elevator back pressure is released completely. During the vertical line up, some right aileron and right rudder is needed to maintain the vertical attitude because of the engine torque and p-factor. When the plane has slowed enough, full rudder initiates the turnaround. It is followed by right-forward stick (right aileron and forward elevator) to keep the plane from torquing off. The pivot is stopped with opposite rudder when the nose points straight down. When the pivot is completed, the ailerons and rudder are neutralized. Elevator and rudder are used to keep the nose pointing straight down. The pivot must be completed within  $\frac{1}{2}$  wingspan. Rolls on the downline require only aileron input if the plane is trimmed correctly.

This maneuver is sometimes called a hammerhead stall. This is not an accurate name because the airplane never stalls. The airspeed may be very low, close to zero, but since there is no wing loading during the turn-around, there is no stall (at zero g wing loading, a wing does not stall). The plane is flying throughout the maneuver with all the control surfaces effective (although sometimes only marginally so).

This also is one of the maneuvers that have been used to reverse direction while adjusting altitude and airspeed by changing the length of the down-line.

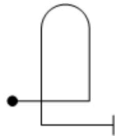
# Humpty Bump

The Humpty Bump is the second vertical maneuver taught in most aerobatic programs including ours at Tango Whiskey, directly following the Hammerhead. The maneuver consists of two vertical lines connected by a half circle flown across the top.

In addition to giving a recovery from vertical flight, “humps” as they are affectionately called provide an excellent platform for vertical rolls, and a convenient way to rebuild airspeed.

*Reprinted from IAC-*

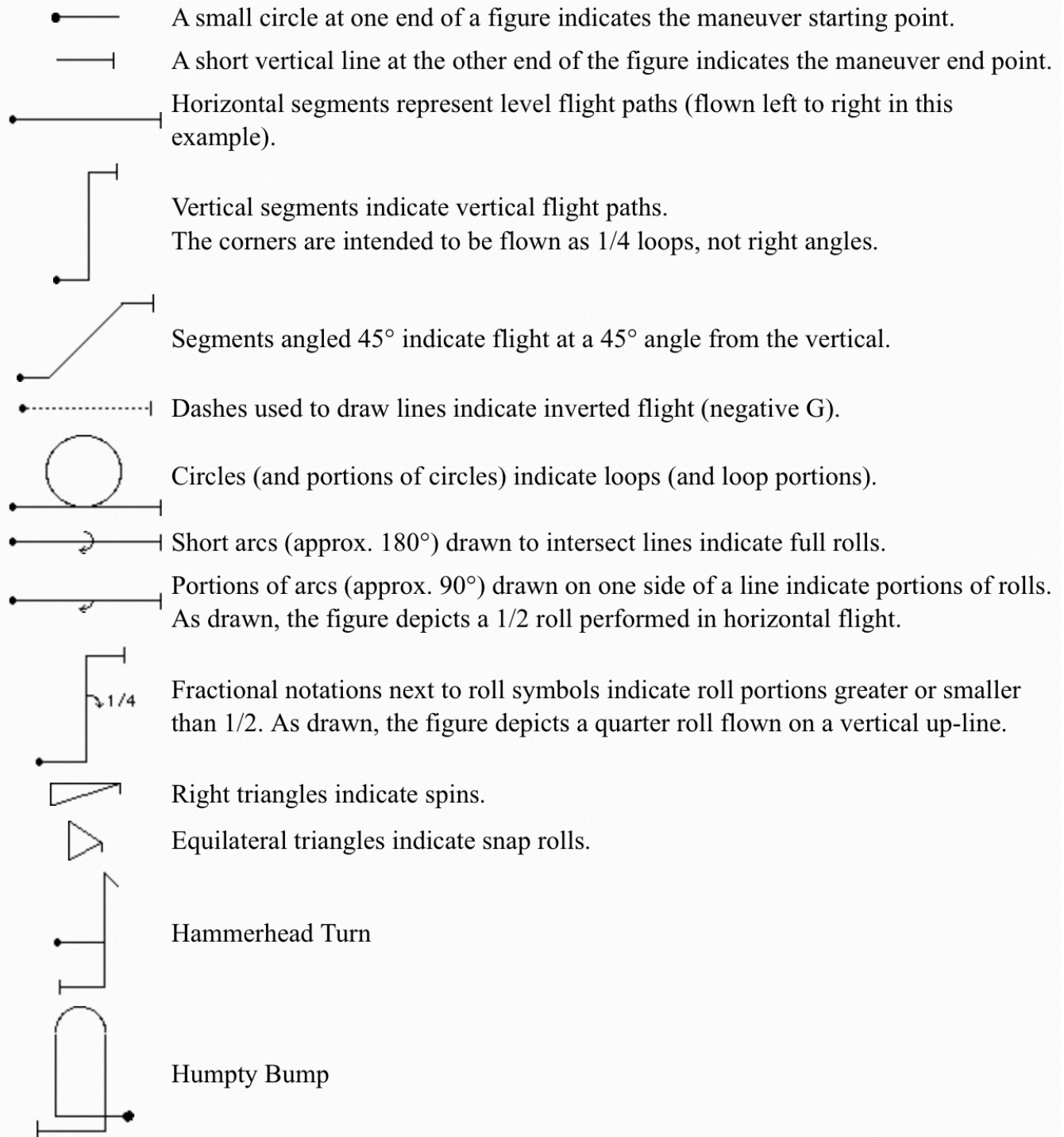
## Humpty-Bump



The figure starts with a quarter loop to a vertical climb. A half loop then results in a vertical down-line. The figure completes with another quarter loop to horizontal flight. The looping part on the top of the figure does not have to be the same radius as the two other looping portions (the quarter loops going into and coming out of the humpty). Again the figure can have optionally rolls on both the up-line and the down-line.

## Other Aresti Symbols

Here is a basic primer of Aresti symbols you will see and reference in the aerobatic flying community



## Pro Tip - Flying the Slow Roll-

*From IAC 2006 Sport Aerobatics- Rob Holland*

Let's start at the beginning. What is a slow roll? It is simply the act of rolling an aircraft 360 degrees around its longitudinal axis without changing heading or gaining or losing altitude. That sounds simple enough, right? Grab your parachute and let's head to the practice area to see how gravity, lift, drag, and thrust tend to complicate things.



To perform a slow roll, we first need to understand the dynamics of what is happening with the aircraft as we roll the airplane. Let's study this a bit by looking at what happens to the aircraft if we simply push the stick to the side. For this article we will go left and roll the airplane 360 degrees without worrying about any other control inputs.

From level flight we push the stick full left. The first thing we will notice is that the airplane starts to roll to the left, but at the same time the nose begins to yaw to the right. This is caused by adverse yaw. The downward deflecting aileron on the right wing is producing a higher angle of attack (AOA) than the upward deflecting aileron on the left wing. While this lopsided lift favoring the right wing helps roll the aircraft, it also creates more induced drag. That drag holds back the right wing, which causes the yaw to the right.

As the plane rolls, the main vector of lift remains perpendicular to the chord of the wing, which means we will be losing our vertical component of lift and adding to the horizontal component of lift. As we lose the vertical component of lift required to maintain level flight, the nose will start to drop and the rest of the airplane has to follow...we start to descend. Remember, at this point we are flying the roll using only full left stick. As we pass through knife-edge flight (90 degrees of bank) and start to roll inverted, we are still carrying a "positive" AOA. However, our lift vector is now directed at the earth below, causing us to lose more altitude and drive the nose further toward the ground. At the same time gravity is helping things along, and we are dramatically increasing airspeed.

I'm sure you can see where this is going. By the time the roll is completed, the aircraft will be dramatically nose-down, increasing airspeed and losing altitude. Some of you may have recognized this maneuver as the good old aileron roll. And you would be right if we had pitched the nose up about 30 degrees above the horizon before we started the actual roll. You can see through this example why that initial change in attitude at the beginning of an aileron roll is so important.

So, how do we roll the plane without this happening? The answer is to use all of the control surfaces at the right time as we roll around the longitudinal axis. Let's start from the beginning.

Again, we are at a safe altitude and getting ready to roll left. This time we pick a good reference point in front of the airplane. That point helps us recognize how we need to fine-tune the control inputs to prevent the "corkscrew" we experienced when using only the ailerons a few moments ago. When pushing the stick to the left, it is important to mention that the aileron deflection is really the only "constant" during this maneuver. As we start the roll, we need to counter the adverse yaw described earlier. We do this with the application of left rudder as we apply the left stick to coordinate the beginning of the roll.

As the airplane approaches close to 45 degrees of bank, the loss of vertical lift is going to cause the aircraft to start to descend. We can counter this by now applying some right rudder. Interestingly, we don't need too much right rudder. Adverse yaw is trying to yaw the plane right, and that is what we are trying to achieve with right rudder. In fact, too much right rudder will cause the nose to yaw too far to the right.

As we start to approach knife-edge a few things need to happen, and the pilot's ability to coordinate the control surfaces over the next few moments will make or break the rest of the roll. We need to lower the AOA of the wing. If we forget to lower the angle of attack, then the aircraft will begin to turn. Reducing AOA is accomplished with slight forward pressure on the stick. While passing through knife-edge we need to compensate somehow for the complete lack of vertical component of lift required to maintain altitude. We can accomplish this by adding a bit more right rudder to get the nose of the aircraft above the horizon. Sometimes pilots new to aerobatics have difficulty understanding that sometimes traditional control inputs have a different effect in aerobatic flight than they do in traditional flight attitudes. For example, while the aircraft is knife-edge, the rudder is in essence acting as an elevator. The fuselage of the aircraft on its side is an inefficient wing and will create some lift if it is at an AOA to the relative wind. Though it's not a good way to generate lift for a cross-country flight, it is enough to help us maintain altitude for the short time we are knife edge in the roll.

As the roll continues toward inverted, we now need to push to maintain our relationship to the reference point. For lack of a better term, we need to create a negative AOA. We need the bottom of the wing to create a vertical component of lift to maintain altitude

As we approach completely inverted, we will be at our maximum forward push on the stick. You should also be at -1g as you pass through level inverted flight (remember that upright level flight is 1g, so level inverted flight is -1g). This is actually a great way to determine if you have the right amount of forward stick during the roll. If, when the roll is completed, the g-meter reads more than -1g, you pushed too hard. If it reads less than -1g, you didn't push enough. Checking the g-meter really helps you understand the forces required to fly maneuvers well. Now that the airplane is passing inverted, you will also need to maintain right rudder. The ailerons are still deflected for a left roll (left stick), and the wing is at a "negative" AOA. Therefore you need to keep pushing on the right rudder pedal to coordinate the roll and counter adverse yaw inverted. This is because relative to the new negative AOA the rudder is now hinged backward while you are inverted. Therefore right rudder is required to counter the left roll. If you happen to have a model airplane handy, turn it upside down and move the rudder as if the pilot has applied full right rudder. You will see that the effect on the airplane is as if the pilot has applied full left rudder.

As the roll now continues to the 225- to 230-degree point of the roll, you will start backing off the forward pressure a bit and transition to left rudder again. Left rudder is needed as the plane approaches the 270-degree point of the roll (right knife-edge) to again increase the AOA of the fuselage to create enough lift to maintain altitude. As the roll continues back to upright from right knife-edge, make sure you no longer have any forward pressure on the stick so as to not cause the nose of the aircraft to be pushed down as you re-establish straight and level flight. You will also need to increase the amount of left rudder to counter the adverse yaw from the left roll coming back upright.

As the plane approaches level, return all the controls back to the position that was required to maintain level flight. It still sounds simple enough, right? Here are some tips to help you with your rolls.

Whether you are in a fast-rolling monoplane or a slow-rolling Decathlon, push the stick in to the direction of the roll smoothly. Don't "jam it over" as fast as you can. You don't want to deflect

the ailerons so fast that the air separates from them momentarily. When the roll ends, you can pull the ailerons back to neutral as fast as you want. Just remember, "Smooth in, fast out."

The roll will always require less rudder at the first knife-edge and more rudder at the second knife edge. This is because adverse yaw is working with you to keep the nose above the horizon at the first knife edge. Adverse yaw is working against you at the second knife-edge trying to bring the nose down below the horizon, so more rudder is required to overcome it.

When practicing your slow rolls, reset your g-meter before each roll. When the roll is completed it should read no more than 1 positive g and no more than 1 negative g. This will help you to determine if you are using the appropriate amount of elevator in the roll.

Keep a constant amount of aileron in the roll. If you're going to use full aileron, keep full aileron till the roll is done. If you are going to use only half aileron, then use only half all the way around.

Happy rolling, and remember that there is no substitute for practice. Be sure to practice within your own limits, and take your time. ***Come to think of it, maybe the maneuver is called the slow roll because it takes so long to fly well!***