

Pilot Zulu's

QUICK REFERENCE FOR PILOTS



“The essential Reference not only for Private Pilots and for flight students but for everyone who is interested in learning about flying an airplane.”

**AERODYNAMICS - AIRCRAFT PERFORMANCE - AIRSPACE &
AIRPORTS - CHECKLISTS - COMMUNICATIONS - FLIGHT PLANNING -
NAVIGATION - WEATHER - AEROBATICS - EMERGENCIES**

This book summarizes the basic knowledge needed by a Private Pilot to fly under visual flight rules (VFR) in airspace almost anywhere in the world. It is presented in a very clear and easy to understand format and specific items are quickly located.

Making it especially useful to take along in the flight bag are the working E6B circular flight calculator, the transparent compass rose and plotter, the scaled rulers, the plastic pockets for notes and checklists and the rotating pattern indicator.

Long time pilots as well as those who are interested in learning to fly or are just interested in learning about flying will enjoy meeting Zulu and his associate Juliet who have both been awarded the designation Master Flight Instructor.

"Pilot Zulu's Quick Reference for Pilots is a great reference for the student pilot. Great illustrations and cartoon characters, also."

Phil Boyer, President, Aircraft Owners and Pilots Association (AOPA).

*"Yes, I remember teaching Zulu to fly all those years ago. He was a very good student but possibly a bit sure of himself. Doesn't look as if he's changed! More seriously, *Pilot Zulu* is a reference guide that will provide students with a world of aviation knowledge and information. As a pilot and Master Flight Instructor with over forty-seven years of flying and teaching experience, I found the many features and memory aids a great refresher!"*

David H. Faile, Jr., 1999 National Flight Instructor of the Year.

*"Yesterday evening you flew into Denver International at 5,430 feet with the mercury at about 70°F. Today, you've picked up your husband and son and a couple of suitcases. It is now 97°F and you are a bit hazy on calculating Density Altitude. *Pilot Zulu* to the rescue with a quick and clear explanation accompanied by the requisite graphs. A bit rusty with an E6B? No problem; *Pilot Zulu* has a working calculator and concise instructions and examples. Not so good with weather terminology? *Pilot Zulu* has a glossary and a plain English translation."*

Dr. Peter F. Stratmann, CEO, Melbourne Business Jets, Melbourne, Australia.

*"*Pilot Zulu's Quick Reference for Pilots* is an excellent tool for study and review both before and after your flight test".*

Wallace J. Moran, Master Flight Instructor, Commercial Jet Captain and FAA Designated Pilot Examiner.

*"Take *Pilot Zulu* and a Sectional Chart with you on your next visit to a desert island. In a week or two, you will have mastered most of the book learning needed to become a Pilot."*

Mike Falls, Sr., Chief Pilot, Shortstop Aviation (Learjet, Citation 2, DC3, and several restored and flying Warbirds), Essendon Airport, Australia.

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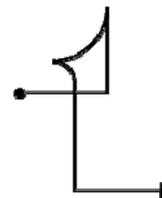
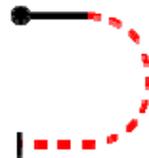


AEROBATICS: The term Aerobatics refers to the sport of performing precision maneuvers such as rolls, loops, stalls, spins, and dives with an airplane. Anyone who has read all the way through the preceding chapters deserves a little fun!

There are three basic aerobatic maneuvers; a roll, a loop and a spin, each a rotation around one of the three axes (longitudinal, lateral and vertical), which are perpendicular to each other and which intersect at the aircraft's center of gravity. In three dimensional space, an axis is a line around which rotation occurs. Rotation around the longitudinal axis, which is a line drawn from the nose of the aircraft to the tail, is called a bank or roll. Rotation around the lateral axis, which is a line drawn from wingtip to wingtip, is called pitch. Rotation around the vertical axis, which is a line drawn from top to bottom of the aircraft, is termed yaw. Each axis relates to the position of the aircraft regardless of its orientation to the earth.

More complicated aerobatics are combinations of the three basic maneuvers with lines (flown horizontally, vertically or angled), and gyroscopic and tumbling maneuvers using the torque provided by the engine and propeller. In this section, we will show each of the basic maneuvers and then show some of the combinations.

NOTATION: In aerobatics, as in dance and music, there is a system of notation or shorthand which uses symbols to describe physical movement in three dimensions. The system is known as the Aresti System, named for its creator, Spanish pilot Jose Luis Aresti. The system was developed in the early 1960's and quickly adopted by the Federation Aeronautique Interanationale (FAI) in Lausanne, Switzerland which is the non governmental international body formed in 1905 for the purpose of furthering aeronautical activity worldwide. In the US, the International Aerobatic Club (a division of the Experimental Aircraft Association, Inc. and of the National Aeronautic Association) is responsible for promoting the sport of aerobatics under the regulations of the FAI. Three typical Aresti symbols are shown below, a Cuban Eight, an English Bunt, and a Tail Slide.



All Aresti Symbols - Wikipedia

AIRCRAFT: Many different types of aircraft have been designed and certified to be used in aerobatics and they include high wing and low wing aircraft as well as biplanes. Aerobatic aircraft differ from normal aircraft in that they are designed to withstand greater stresses and often have fuel and oil systems which will function when inverted.



The **Extra 300L**, which we have used as a model in the following pages, competes in the unlimited category and is approved to plus/minus 10G's, has a roll rate of up to 400° per second and will cruise at 170 knots. It has two seats in a tandem arrangement, fixed landing gear, a constant speed propeller, and a six cylinder 300 HP engine. And, it is a great looking airplane!

AEROBATIC MANEUVERS - ROLLS: A roll is a rotation around the longitudinal axis of the aircraft. Types of rolls include an **aileron roll**, a **hesitation roll**, a **slow roll**, a **barrel roll** and a **snap roll**.

An **aileron roll** is performed by using the ailerons to initiate and control the roll, and using the rudder for coordination, to minimize yaw or movement away from the longitudinal axis. A four or eight point aileron roll with a short hesitation at each point is termed a **Hesitation Roll**. The Aresti symbol for an eight point roll is shown below on the left. The starting point for the aircraft is the black dot on the left. Moving to the right along the straight line represents upright flight, and the arrow indicates an eight point roll to the left. The symbol for a simple aileron roll (without hesitation) is as shown below on the right, but omitting the number.

A **barrel roll** is a maneuver where the aircraft is rolled around an imaginary point at 45° to the original flight path. The pilot is completing both a loop and a roll at the same time. The path of the aircraft resembles a horizontal corkscrew or stretched out spring. Done expertly, this maneuver places very little stress on the aircraft and its passengers. The Aresti symbol is shown below on the right.

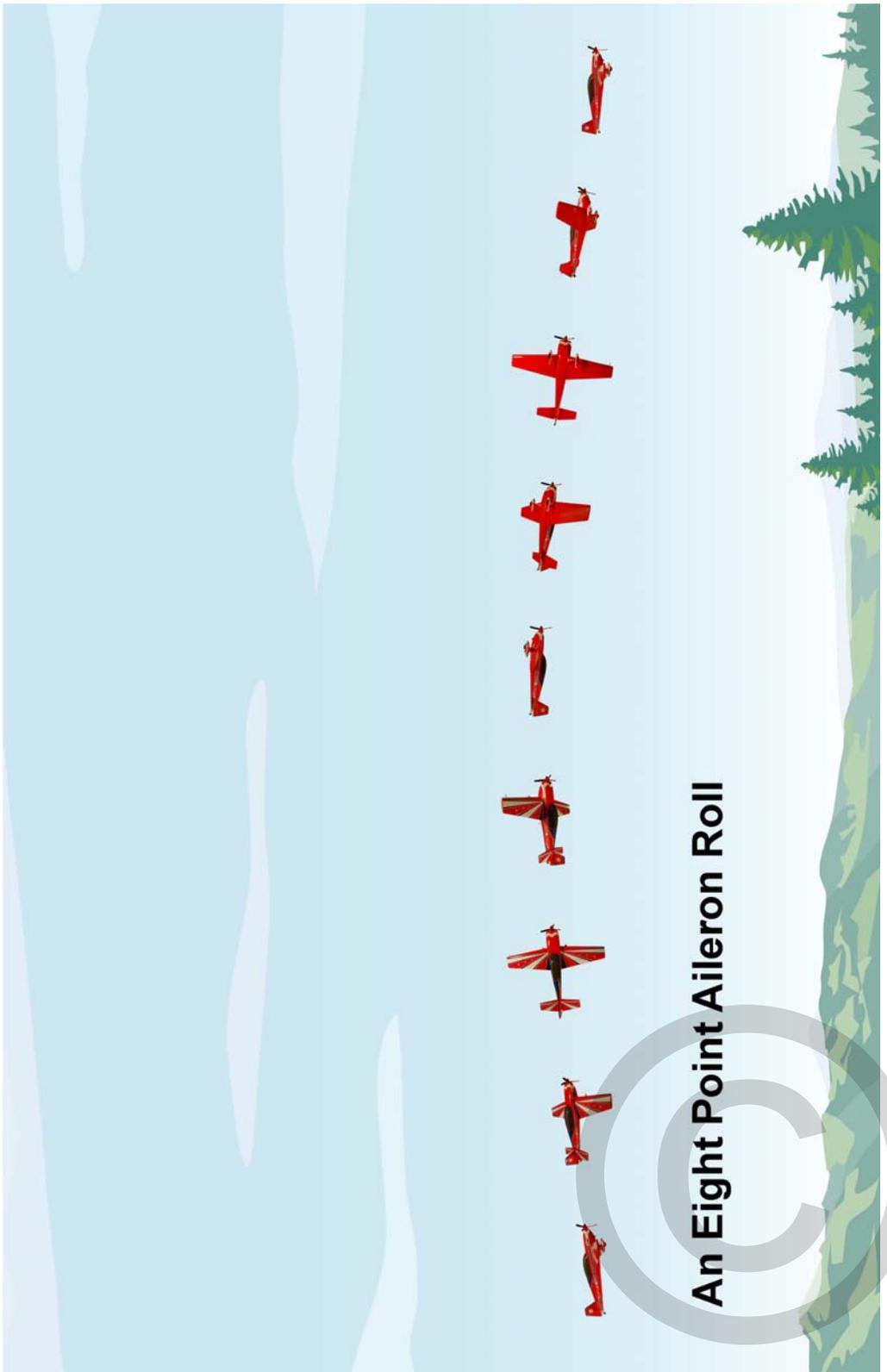


Bob Hoover, a very well known and expert US pilot, used a barrel roll as one of the maneuvers to demonstrate the capabilities of a twin-engined piston business aircraft known as the Shrike Commander. He would put a drinking glass on the top of the panel in front of him and then slowly pour it full of iced tea while guiding the aircraft through a complete barrel roll. In an interview, he maintained that passengers riding with him could hold a cup of coffee right through a barrel roll and never spill a drop.

A **snap roll** does roll an aircraft around its longitudinal axis, but the aerodynamics of a snap roll are similar to those experienced in a spin so we will describe this maneuver under that heading.

EXAMPLE: We have used an **eight point aileron roll** as an example on the next page. In this and in the other examples used, the maneuver is compressed in order to show an entire maneuver on one page without making the miniature airplane even smaller. In this case we show a roll to the right though beginning aerobatic pilots often find it easier to roll to the left. Techniques differ somewhat depending on the aircraft and the following procedures are intended only to give the reader a feel for what is required to perform a specific maneuver. No one should attempt these maneuvers without appropriate instruction.

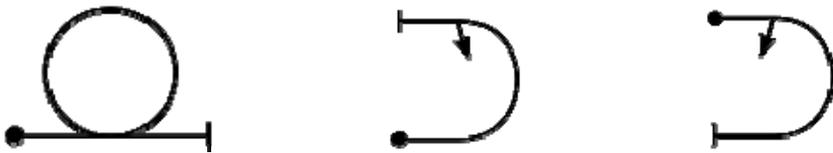
To reach the desired entry speed it is sometimes necessary to ease the nose over prior to beginning the roll. At the entry point, the nose is usually pulled up to an attitude between 10° and 30°, wings level. This is done to prevent coming out of the roll in a nose low position. In competitions where high performance aircraft are used, rolls are flown in a straight line. The maneuver is then initiated with right aileron and rudder as if entering a steep turn. As the aircraft passes a 45° bank, less rudder is used and as the bank passes 90°, back pressure on the control column is slowly relaxed. Additional right aileron is applied to maintain the speed of the roll. As the aircraft rolls inverted (180°) and then through 270°, more right rudder is applied and as 300° is passed, more back pressure is applied and then all aileron, rudder and elevator deflections are gradually reduced as the wings come level.



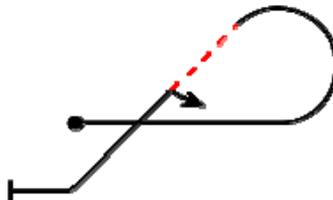
An Eight Point Aileron Roll

AEROBATIC MANEUVERS - LOOPS: A loop is a rotation around the lateral axis of the aircraft. Types of loops include a basic round **Loop**, an **Immelmann** turn, a **Split S** and varieties of a **Cuban Eight**.

A basic round **Loop** is self explanatory and the Aresti illustration is shown below to the left. An **Immelmann** turn (usually just called an Immelmann) and a **Split S** are variations of a loop which result in a change of direction. The Immelmann, shown below in the center, is a half loop up leaving the aircraft inverted. A half roll, indicated by the downward pointing arrow, brings the aircraft upright and flying in the opposite direction. The maneuver is named for Max Immelmann, a German World War I flying ace who was killed midway through the war at the age of 25. The Split S, shown on the right below, is the reverse of an Immelmann and trades altitude for speed while also reversing direction.

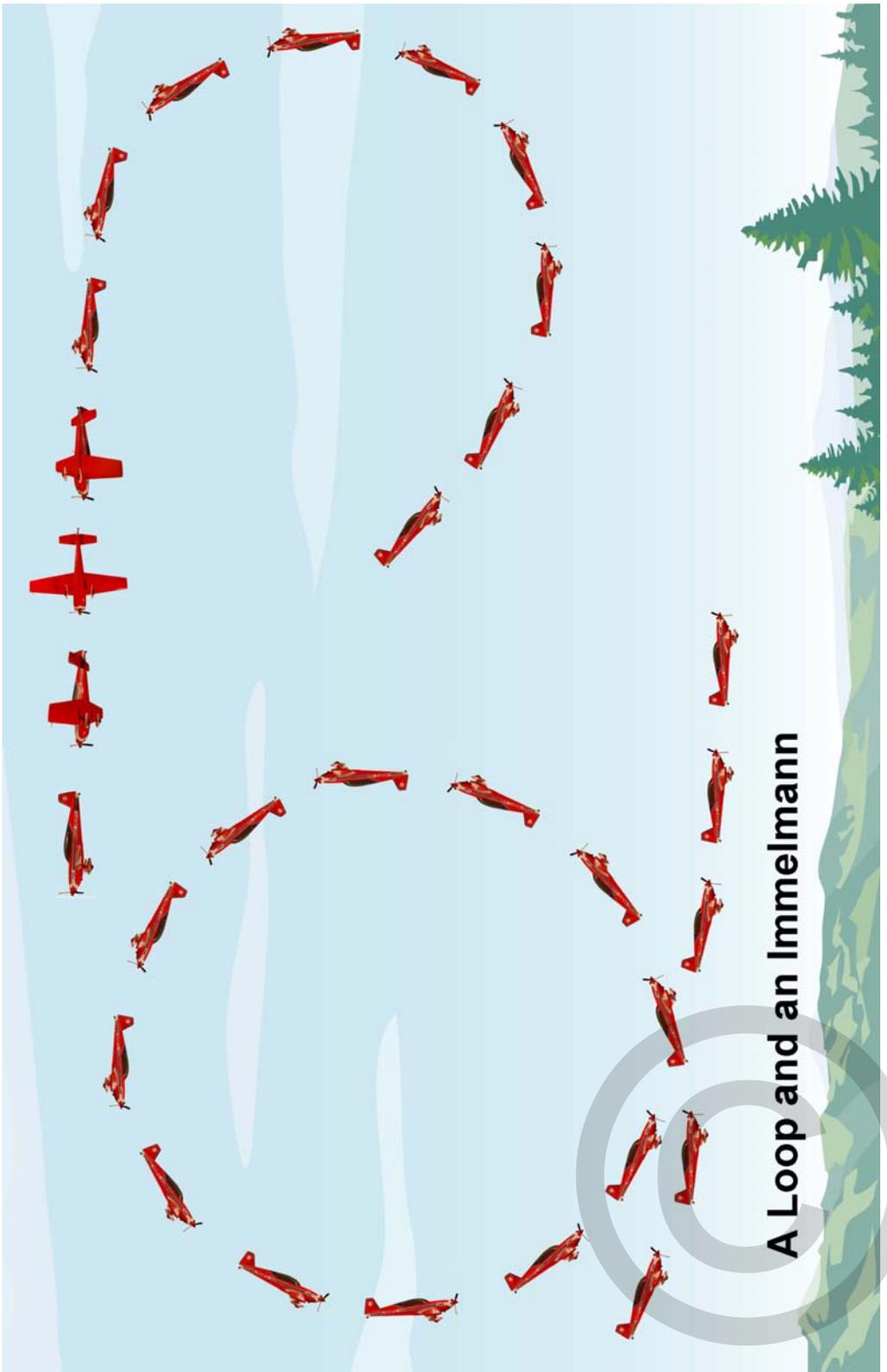


Another variation of a loop is the **Cuban Eight**. There are many varieties of this maneuver, a half Cuban Eight, a reverse Cuban Eight, and various inverted Cuban Eights. We show a **Half Cuban Eight** below (a full Cuban Eight is illustrated earlier). The red dashed line represents inverted flight and the downward pointing arrow shows a half roll back to upright.



EXAMPLES: On the next page, we use our Extra 300L to illustrate a **Loop** and an **Immelmann**. The **loop** requires the attainment of a designated entry speed which may require easing the nose over prior to the loop. When the proper speed is reached, begin a smooth pull up. Full power is used as the nose moves up to vertical. As the aircraft moves past the vertical, speed will be decreasing and more back pressure will be needed. The controls will be getting lighter. As the aircraft approaches the inverted position, back pressure is eased off somewhat and then increased carefully again on the back side of the loop. Throughout the loop, check that the wings are level. Power is reduced as the aircraft becomes vertical on the back side unless the aircraft has a constant speed propeller, in which case settings for RPM and manifold pressure can remain the same. Be careful on the pull-up not to use too much back pressure too quickly to avoid adding to the stress on the aircraft and passengers and possibly resulting in a stall.

An **Immelmann** follows the same procedures through a half loop, followed by a roll-out at the top.

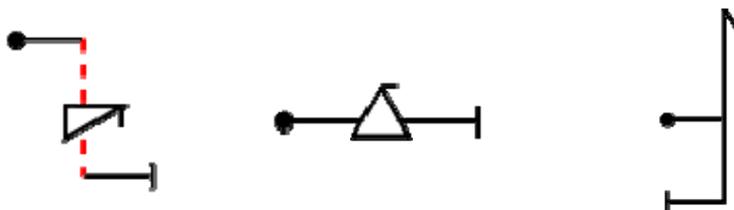


A Loop and an Immelmann

AEROBATIC MANEUVERS - SPINS: A spin is a rotation around the vertical axis of the aircraft where one wing is stalled before the other causing the aircraft to fall off and rotate, usually nose down. A **spin** is an integral part of some more advanced aerobatic maneuvers. Spins include **normal spins, inverted spins** and **flat spins**. The Aresti symbol for a spin is the left hand figure below, and we illustrate a spin on the next page.

A **snap roll** can be described as a horizontal spin where one wing is stalled. While traveling at a speed higher than the normal stall speed, the aircraft is quickly stalled by applying positive g forces, using up elevator (the control column pulled back), while applying full rudder in the direction of the desired roll. Because one wing is stalled while the other is still flying and because the aircraft retains momentum, it will roll quickly in the direction of the rudder deflection. Recovery is initiated at about 270° of rotation by applying full opposite rudder and moving the control column forward bringing the elevator down. A snap roll happens very quickly and the roll rate can be very fast. Sometimes the ailerons are used to assist in beginning and ending the maneuver. The Aresti symbol for a snap roll is the center figure shown below.

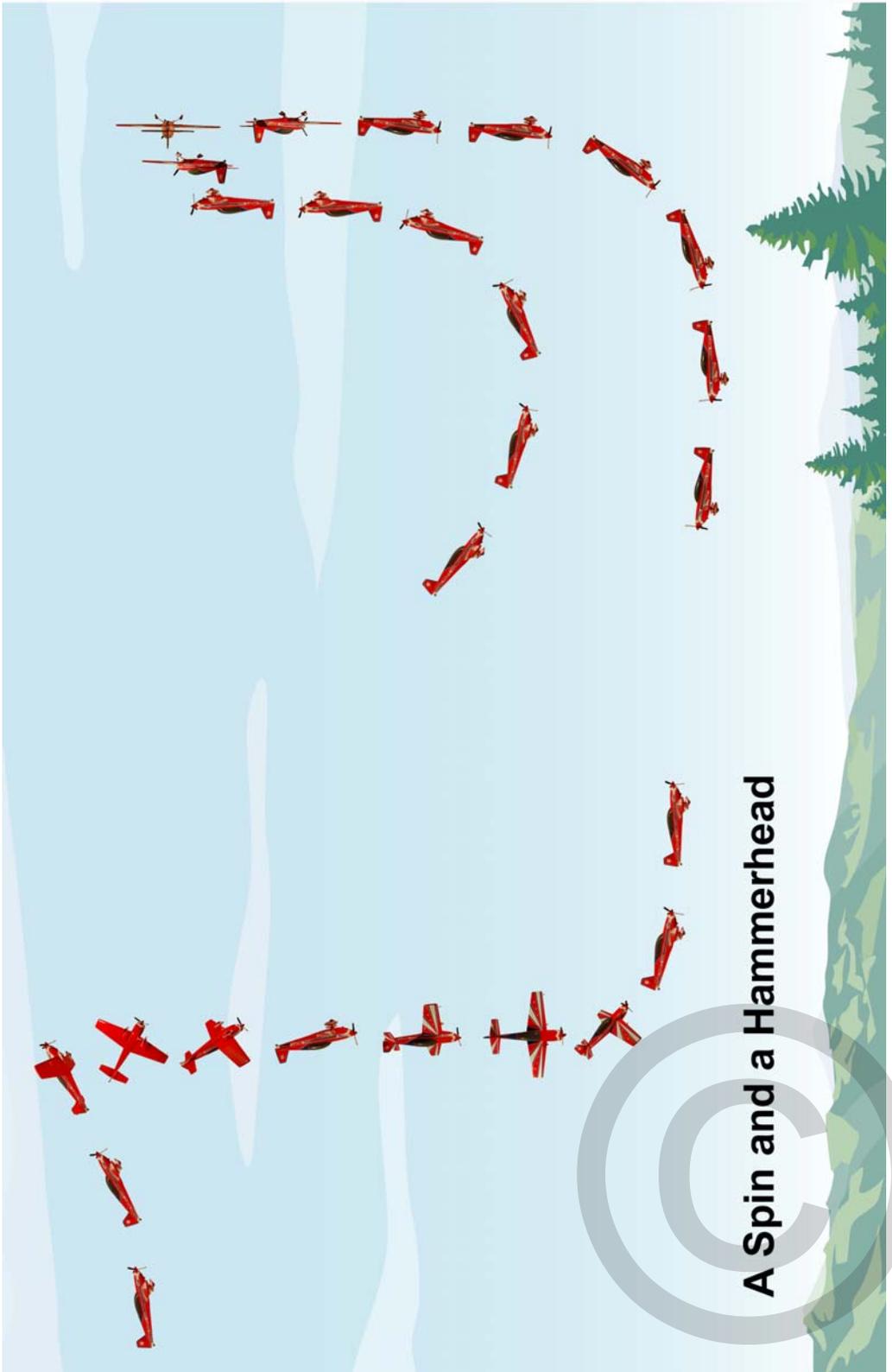
A **hammerhead** is another vertical maneuver which also rotates around the vertical axis. The Aresti symbol is shown below to the right, and we illustrate a hammerhead on the next page.



EXAMPLES: On the next page, we use our Extra 300L to illustrate a **spin** and a **hammerhead**. The **spin** is initiated from a flaps-up stall where power is reduced and the aircraft is pulled up using up elevator (control column back). As the stall begins, full rudder is applied in the direction of the desired spin. The wing on that side stalls and loses lift more rapidly than the other wing and drops rapidly causing the aircraft to begin a rotating motion, usually nose down. Recovery for most aircraft is initiated by reducing power, neutralizing the ailerons, applying full opposite rudder so that both wings are equally stalled, and briskly pushing the control column forward to break the stall. As rotation stops, the pilot neutralizes the rudder and eases back on the control column to pull out of the dive.

The **hammerhead** (illustrated on the next page) begins with a vertical climb which is continued until the aircraft has nearly stopped. At that point, the pilot applies full left rudder, causing the aircraft to pivot sideways to the left until it is pointing straight down. Some right aileron is applied to maintain the vertical plane. The pilot eases out of the dive and ends up flying in the opposite direction.

NOTE: The reader should note that the material in this section is provided for illustrative purposes only and is not intended to be an accurate guide to the various maneuvers shown. The illustrations deliberately compress the aerobics into an unrealistically small area so that they can be depicted on a printed page without further reducing the size of the little airplane which is demonstrating the maneuver. Each aerobatic aircraft requires control inputs which are specific to that type of aircraft. No person should attempt any of these maneuvers without specific training with an experienced instructor in an aircraft designed and maintained for the purpose and at appropriate altitudes and in appropriate weather conditions. Parachutes are routinely worn by pilots and passengers when aerobatic maneuvers are performed. The applicable FAA, CAA or other national regulations should be consulted by anyone contemplating aerobatics.



A Spin and a Hammerhead