



AIRCRAFT OWNERS AND PILOTS ASSOCIATION

Protecting Your Freedom to Fly

## The angle's the thing

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By Bruce Landsberg

"A wing is an odd thing, strangely behaved, hard to understand, tricky to handle. In many important respects, a wing's behavior is exactly contrary to common sense." These profound words were penned by Wolfgang Langewiesche 50 years ago in the classic book *Stick and Rudder*. The subtitle "An Explanation of the Art of Flying" is a good description of what we do in airplanes. Ignorance of the art or the science of flight results in a continuing stream of accidents. The years have changed, but the reasons for so many of our losses have not. Our collective ability to distinguish between the angle of attack and pitch attitude is not conspicuously better than it was 50 years ago.

Langewiesche, a former test pilot for Cessna and the Vought Division of United Aircraft, was a regular contributor to *Air Facts* magazine, published in the 1940s through the early 1970s. The magazine was primarily focused on persuading pilots to fly more safely. Recognizing that there would be a boom in personal flying after World War II, Langewiesche commented that "aviation would never work unless we got the accident rate down." Back in the 1940s, general aviation was piling up aircraft at the rate of 77.8 accidents per 100,000 hours.

We've come a long way since then, with the accident rate declining to 8.79 accidents per 100,000 hours. However, in looking at 1993's statistics, which were analyzed and released this spring by the AOPA Air Safety Foundation, the leading phase of flight where pilots have serious accidents is the maneuvering phase. The National Transportation Safety Board defines that as "aerobatics, low passes, buzzing, pull-up, aerial application maneuver, turn to reverse direction (box canyon type maneuver), or engine failure after takeoff where the pilot tries to return to the runway." Single-engine fixed-gear aircraft were by far the leaders with 35 percent of that group's serious accidents.

So how does this relate to *Stick and Rudder*? If you don't fully understand the concept of angle of attack, you are at least a possible candidate for joining the more than 100 pilots who in 1993 crashed in their attempt to make an aircraft do the impossible. Accidents are the ultimate manifestation of confusion. Understanding how the controls affect flight has a marked effect on the learning process, as well.

Langewiesche wrote in 1944: "At this very moment, thousands of men, trying to learn to fly, are wasting tens of thousands of air hours simply because they don't really understand how an airplane flies.... They lack the one key that with one click unlocks most of the secrets of the art of flying.... No maneuver can be fully understood unless you understand this well." (The angle of attack is the angle made by the chord line of the wing and flight path of the aircraft. if the wing is pointed at too great an angle from where the aircraft is going, a stall results.) He recommends

that we forget Bernoulli's theorem, which may serve to confuse more than illuminate those few facts that a pilot really needs to know.

In speaking with Langewiesche, as he was approaching his eighty-seventh birthday in April of this year, I was struck by the simplicity and humility of his explanations. When asked how he would interpret the critical facts about angle of attack and aircraft control to a student pilot, he replied, "I would not be a very good flight instructor because I would try to say too much. The student would be overloaded with too much theory." For those of us engaged in flight instruction, perhaps a few well-chosen words will do far more good than a running commentary.

Judging by the record, as instructors, we're not doing a good job of explaining angle of attack and how to avoid being overcome by a gust of gravity. Note that the longest chapter in Langewiesche's book, some 40 pages, is devoted to the nuances of turning flight. Pilots have the wrong idea about the rudder and about angle of attack in turns. In the accident scenarios, this fact comes up repeatedly.

The principles of turning flight also apply to pull-outs from dives, which Langewiesche describes as nothing more than an upward turn. "Everything that is true of the turn, of the curving of the flight path sideways, is also true of the pull-out from the dive, the flare-out from the glide, the pull-up into a loop...it is simply a turn of zero bank." Langewiesche enlivens this theory in a practical illustration called "Diving on Girls' Houses," which was a popular pastime in the 1940s and unfortunately continues to this day. This chapter also contains a very clear picture that explains that the radius of a vertical turn quadruples as the airspeed doubles. This is equally true in the horizontal plane; it's just that the consequences aren't as severe. The description is equally graphic on the failure of the airframe or the ensuing high-speed stall as the pilot realizes too late that he is going to overshoot the vertical turn and strike the ground.

One topic that is guaranteed to start an argument is the function of the flight controls and his claim that the elevator controls airspeed, throttle controls climb and descent, bank angle controls the turn, and rudder controls the lateral balance. If the student understood these relationships, he would have an easier time. There are strongly held opinions on both sides, and I asked Langewiesche what he thought about the controversy. A sensible answer followed. "We might disagree on the precise words, but if we flew side by side, we would both be doing essentially the same thing to place the aircraft where we wanted it."

Langewiesche's position, greatly simplified, is that the elevators are the angle-of-attack control and that they control airspeed. They do not "elevate" or cause the airplane to go up. "Power is the only thing that will ever make an airplane go up. You can make it go up temporarily by ballooning it with your elevators, but only engine power can make it go up and stay up, and hence your up and down control is the throttle."

We briefly discussed flying an ILS, where it is easier to use the elevators to climb or descend on a glideslope, accepting minor speed changes, and using power as necessary to handle major excursions. Carrier landings and flight at minimum-control airspeed are an exception to this, because there is no excess airspeed to trade for altitude. The comments here are not the last word, and all pilots would do well to understand what angle of attack means in all flight phases.

We agreed that airplanes should have angle-of-attack indicators to help guide the unwary. While he is complimentary of the aerodynamics of most modern aircraft Langewiesche laments the fact that we suffer so many losses for exactly the same reasons that were prevalent in 1944. It appears that those who don't learn from history are condemned to repeat it. *Stick and Rudder* is available in a fiftieth-anniversary edition from McGraw-Hill Books and is highly recommended reading for all pilots.