UNDERSTANDING Angle of Attack

Learning how to teach AOA awareness is a core topic for CFIs

BY SEAN ELLIOTT

PILOTS WHO UNDERSTAND AND correlate angle of attack (AOA) in their flying are better equipped and safer than pilots who do not. Loss of control continues to be one of the greatest causes of serious injury and fatal accidents, and the classic stall/spin in the traffic pattern still prevails as one of the biggest killers of pilots. These types of accidents are preventable, and the flight-instructor community needs to do a better job of emphasizing the concepts of angle of attack.

AOA is now one of the 10 core topic requirements for flight instructor refresher clinics (FIRCs). Every two years, flight instructors who renew their certificate at a FIRC will receive an in-depth review of AOA concepts important for the flight-training community. In the past, AOA was taught only to varying degrees. More often than not, it was simply skimmed over with little or no emphasis.

So what is angle of attack? The textbook definition of AOA—called Alpha by test pilots—is the angle between the chord line of the wing and the relative motion of the aircraft through the atmosphere. A much simpler definition of AOA is the angle between where the wing (chord line) is pointing and where the wing is going. This is important to grasp because it reminds us that a wing will, in fact, stall at any airspeed if AOA exceeds the critical point or coefficient of lift, CL_{MAX}. In fact, the only way to stall a wing is to cause AOA to exceed CL_{MAX}.

In primary flight training, we tend to relate the occurrence of a stall with a given airspeed. The wing stalls at this airspeed (V_S) only in level, unaccelerated flight. And the V_S airspeed in the book applies only when the airplane is at its maximum gross weight. Perhaps the fact that students have to demonstrate this stall

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condition per the practical test standards is the reason we as pilots place so much emphasis on the airspeed number equating to a stall.

Don't get me wrong, using the V speeds as a reference is just fine. My point is there is much more to avoiding a stalled wing than simply avoiding slowing below a single speed point on the airspeed indicator. It is more important to visualize what is truly happening with the AOA of the wing in every flight condition. Change the bank angle or cause an abrupt pitch change (acceleration) and you might as well throw that V speed reference out the window.

One of the first things you can do to learn more about AOA is do an Internet search for some of the aviation crash videos on YouTube. Unfortunately, there are plenty to choose from that clearly show a low-altitude accelerated stall and impending crash. Keep in mind what is usually referred to as a low-altitude stall/spin is actually a stall and wing drop resulting in a loss of control. The airplane rarely appears to be spinning before striking terra firma. Note the seemingly normal appearance of the flight path right up to the point of losing control. That tells you the airplane was in an accelerated state and exceeded the critical AOA at a higher than V_S stall speed. The pilot abruptly pulled, the wing stalled, and the result was a crash caused by the lack of altitude to make a recovery.

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One of the best demonstrations I have seen of an accelerated stall is in the North American T-6 military trainer. Rolling the airplane over into a steep bank, allowing the airspeed to build a bit in a descent, and then rapidly increasing the AOA (loading some *g*'s on the wing) produces the most pronounced buffet you can imagine. It is as if there are a dozen monkeys all stomping on the wing as the trailing half of the wing loses laminar flow and the air becomes turbulent. The wing is not fully stalled, mind you, but it is definitely past CL_{MAX}. This all is occurring in a condition that results in a significantly higher airspeed indication than the published V_S. Pull just a bit more and the airplane will "unhook" completely and enter a fairly brisk roll, thus showing you why it has hurt people attempting low-level higher *g* maneuvers at air shows without the proper understanding and respect of AOA.

Ultimately, being keenly aware of your AOA is paramount to being a safe and proficient aviator. Always fly the airplane first and manage your flight path over the ground second. Be smooth and precise. Never let the ground track override your good airmanship. This means do not tighten the base to final turn just because you misjudged and are flying right through the final approach path. This means do not abruptly change pitch because of a mistake or misjudgment in your desired flight path. Remember, rapid pitch inputs do not allow the aircraft momentum to keep pace with the quick change of the chord line angle, regardless of indicated airspeed.

Finally, be mindful of what the sight picture out the window is telling you on each and every approach. A bad landing is almost always the result of a bad approach. Go-arounds are your friend!

AOA is a simple concept that is not understood to the degree it could be within GA. Take the time to go flying with a qualified instructor and practice how to recognize the impending stall AOA in all conditions, including with the nose level, or even down, not just pointed way up the way we usually demonstrate stalls. You will be glad you did. EAA

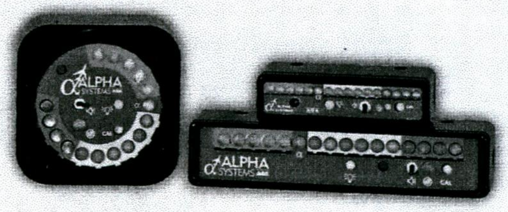
Sean Elliott, EAA 520258, is EAA vice president of advocacy and safety.

FAA Clears Path for AOA Systems

The FAA recently ruled that installing an angle of attack (AOA) measuring system in a non-pressurized piston airplane is a minor modification, meaning no STC or FAA field approval is required. An aircraft logbook entry by an A&P who performed the work is all that is necessary after installation. The AOA system cannot—and really doesn't—replace any airspeed indication or other systems in the airplane.

The new policy is aimed initially at AOA equipment from Alpha Systems, which has been making sensors for many years but lacked the STCs and other approvals to install the equipment in most certified airplanes. Since the FAA is emphasizing AOA awareness as a means to avoid stall-spin accidents, it makes sense to encourage airplane owners to install AOA sensors with the least cost and hassle possible. The new policy allows that to happen.

The Alpha Systems sensor uses two air ports mounted on a short mast that is typically mounted to the lower surface of the wing to measure AOA as the slipstream flows over the ports. The lowest cost systems that use only pneumatic pressure from the ports costs around $800. Alpha Systems also offers more advanced electrical displays that use lights and graphics to show pilots AOA, and those systems can range in cost up to around $2,000.



The new FAA policy will also apply to other companies that make AOA sensing equipment, such as Safe Flight Instruments, which has manufactured hundreds of thousands of stall warning systems.

Of course, AOA sensors can be installed in experimental aircraft using the same approval procedures that have been in place for years.

For more information on Alpha Systems visit *www.AlphaSystemsAOA.com*; for Safe Flight visit *www.SafeFlight.com*.