



Safer skies through education

FAA Safety Team

Topic: The Safety Benefits of Angle of Attack (AOA) systems supplementing existing stall warning systems.

Background: More than 25% of general aviation fatal accidents occur in the maneuvering phase of flight. Of those accidents – half involve stall/spin scenarios.

Discussion: Loss of Control is the #1 root cause of fatalities in both general aviation (GA) and commercial aviation. Currently, in GA alone, there is one fatal accident involving loss of control every 4 days on average. We need to do something different to reverse this trend.

AOA is taught as a theory to private pilots starting in Ground School. However, when starting flying lessons, the student relies on SPEED (and published 1G stall speeds) to avoid the stall. The problem with airspeed alone is that an airplane can stall at any speed, attitude, and power setting. (See reference in Airplane flying handbook).

The 1G stall speed published in the airplane flight manual is ONLY VALID for uncelebrated flight (1g Load factor), coordinated flight (ball centered), and at one weight (usually max gross weight.) These conditions are not always met on a given real world flight. Consequently, speed by itself is not a reliable parameter to avoid a stall.

An airplane can stall at any speed. AOA is a better parameter to use to avoid a stall. For a given configuration, the airplane always stalls at the same AOA (the critical angle of attack). This stall AOA does not change with weight, temperature, and density altitude.

Without an AOA indicator, AOA is "invisible" to pilots. An AOA indicator can be a useful reference when used in conjunction with airspeed and existing stall warning systems. An AOA system can be used with an AOA indicator to get the pilot's attention (via audio and/or low cost stick shakers even if the pilot is not looking at it.) This focuses the pilot's attention on where it needs to be to avoid the stall.

AOA has many other benefits other than stall warning. For example, the AOA for V_y , V_g , V_x , and V_{ref} is the same for any given configuration and does not vary with weight or density altitude. The pilot can use AOA to fly more precisely and more efficiently.

FAA's Small Airplane Directorate has streamlined the process for production and retrofit approval of AOA devices.

Key Message: AOA can be very useful in enhancing safety and flying more efficiently. It should be used in conjunction with airspeed and existing stall warning systems when available.

References:

- Article on Real World AOA use in Transponder magazine (by Dave Sizoo)
- FAA-H-8083-3A, Airplane Flying Handbook, chapter 4, page 4-3, figure 4-2
- FAA-H-8083-15B, Instrument Flying Handbook, chapter 4, page 4-6, figure 4-8
- FAA-H-8083-25A, Pilot's Handbook of Aeronautical Knowledge, chapter 4, page 4-22
- NAVAIR 00-80T-80, Aerodynamics For Naval Aviators, Chapter 1, Figure 1.11
- FAA Safety Brief Magazine Article