Angle of Attack Equipment in General Aviation Operations

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Background

The Federal Aviation Administration (FAA) in conjunction with the general aviation (GA) industry formed the General Aviation Joint Steering Committee (GAJSC) with the goal to improve overall general aviation safety.

- The GAJSC tasked their technical division, the Safety Analysis Team (SAT), with identifying safety issues present within GA. Upon review of fatal GA accidents between 2001 and 2010, it was concluded that over half of the fatal accidents were a result of loss of control inflight, or LOC-I.

"The GAJSC, being data driven, decided to focus on LOC, the highest risk area.[2] "

- A Loss of Control Working Group (LOC-WG) was formed between the FAA and the GA industry to research and recommend safety improvements. One of the recommended safety improvements offered is to consider the use of Angle of Attack Indicators in GA aircraft.

This project is being conducted by the Partnership to Enhance General Aviation Safety, Accessibility and Sustainability (PEGASAS), an FAA Center of Excellence.

PEGASAS
www.pegasas.aero

Ohio State is one of three core schools that participate in numerous FAA funded projects enhancing safety and our national airspace system.

What is Angle of Attack?

The Angle of Attack, or AOA, is "the acute angle between the chord line of the airfoil and the direction of the relative wind".[1]

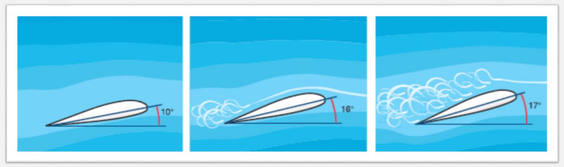

Fig. 1 – Angle of Attack[1]

Why do we care about the Angle of Attack?

- As AOA increases it approaches the critical angle of attack (CAA), or "the angle of attack at which a wing stalls regardless of airspeed, flight attitude, or weight".[1]
- If the CAA is exceeded the wing is no longer flying, and a stall condition occurs.
- A stall condition requires immediate recovery, using specific techniques, and the recovery commonly results in a sudden loss of aircraft altitude and attitude.
- An unexpected stall in close proximity to the ground, especially during maneuvering flight, can be catastrophic, possibly causing a loss of aircraft control that typically results in a fatal accident.
- Pilots are at additional risk for encountering stalls during the departure, maneuvering and arrival phases of flight.

Avoiding Stalls

Pilot training and airman techniques recognize the importance of proper stall avoidance. Current GA practices involve awareness of aircraft status to provide the pilot with a stall safety margin. The addition of an AOA display would greatly enhance the pilot's situational awareness and provide another useful tool in conjunction with aircraft instrumentation and basic airmanship skills.

Stall Warning Devices

At present, in general aviation aircraft, the most common instrument indication of a stall is a warning horn and/or light.

- The horn sounds if a stall is imminent or the wing has already stalled. It functions like a switch, making an aural '*buzz*' sound when stalled, and nothing when off.
- Unlike an AOA Indicator, a stall warning device does not display information related to AOA, or how far the wing is from the CAA. It also does not factor in g-loading or aircraft weight.
- An AOA indicator greatly enhances pilot awareness by providing instant, dynamic information regarding current AOA.

Fig. 2 – Stall Warnings[1]

Fig. 3 – AOA Display[3]

AOA Displays

AOA Indicators have their origins with military high performance jet aircraft. The display featured (Fig. 3) is a common type of AOA display available to for GA use, and the type that will be used for this research.

Flight Testing

Experimental use of the AOA display will be conducted using aircraft avionics capable of data downloading for analysis. This will be used to develop training materials and analyze the benefits and risks for AOA indications.

- A control group without access to AOA information or training.
- A group with AOA access and training.
- A group without AOA training but will have access to AOA display information.

Project Goals

- Analysis of best practices provided by manufacturers, AOA advocates and trade publications.
- Development of education materials and training curriculum.
- Provide pilots with aircraft attitude awareness using AOA displays to enhance understanding of aerodynamic principles.
- Provide AOA guidance to aid performing a stabilized approach to landing.
- Analyze costs, benefits and risks to maximize the potential impact of an AOA display for GA pilots.

References

1.Airplane Flying Handbook FAA-H-8083-3A
2. General Aviation Joint Steering Committee (GAJSC) : Loss of Control Work Group : *Approach and Landing* September 1, 2012, p3
3. PEGASAS Project 3: Angle of Attack Equipment Proposal