

EVOLUTION
FLIGHT DISPLAY SYSTEM

**Angle of Attack
(AOA) Indicator**

Technology that Matters



Reduce the likelihood of loss of control accidents by increasing stall margin awareness.

Using a simple, software-only upgrade for Evolution displays, Aspen provides a unique, patent-pending technology to address the FAA's key issue for general aviation safety – loss of control from aircraft stalls.

Based on AHRS, air data computer and certified GPS data, Aspen's Evolution AOA Indicator calculates and intuitively displays the aircraft AOA for both flaps up and flaps down aircraft configurations on a single flight display. This advanced technology improves flight safety without the need for additional hardware or any external aircraft modifications or sensors.

With a quick upgrade to either Aspen Evolution Primary or Multi-function flight display software plus a short calibration flight, the innovative Aspen Evolution AOA Indicator enhances aircraft safety for the general aviation community.

System Description

- Unique patent-pending technology for Aspen Evolution
- Calculates AOA from flight envelope data received from AHRS, air data computer and a certified GPS
- Displays aircraft AOA for flaps up and flaps down aircraft configurations on a single flight display
- Simple software upgrade that requires no additional sensors, external hardware or extra cabling for installation

Key Benefits

- Improves safety - provides real time flaps up and flaps down stall margin awareness – enables the pilot to see the available lift before changing the configuration – crucial when making a go-around.
- Intuitive display – provides an immediate, clear visual display of trend toward stall and stall margin. Pilot comprehends important information at a glance.
- Easy Installation – requires no additional probes, wiring or equipment. Installation costs and downtime are minimal.
- Primary Field of View – AOA is displayed on the Aspen PFD or MFD. Information is displayed in pilot's natural field of view.

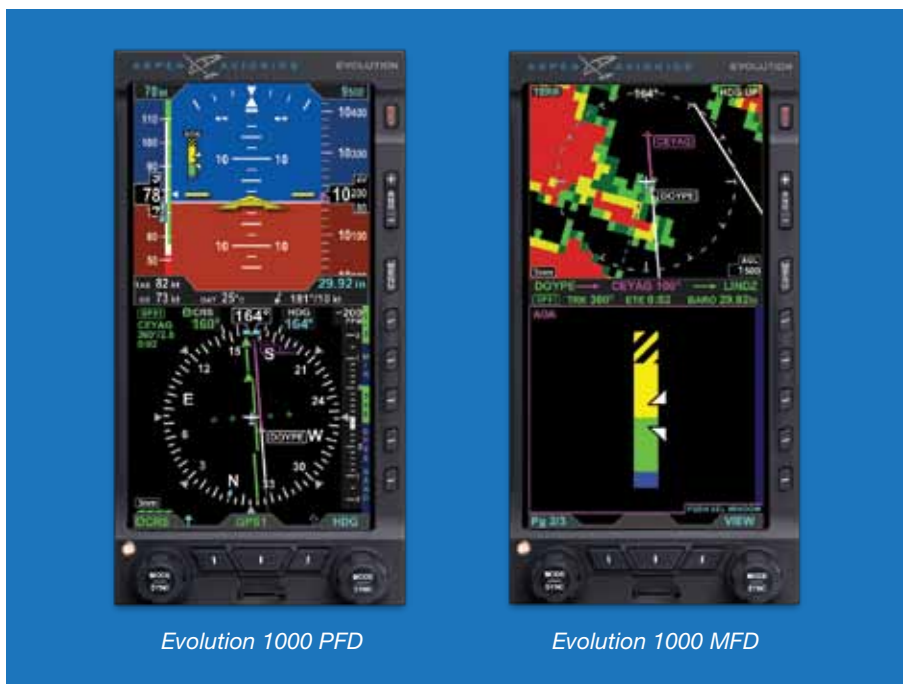
Evolution AOA Indicator

Aspen's innovative Evolution AOA indicator provides the pilot a visual display of the AOA trend and the approximate available lift simultaneously in all phases of flight.

AOA Display

AOA is featured on either the Aspen PFD or MFD in a single indicator regardless of flaps up or flaps down configuration.

- Can be displayed on any of the views on the MFD page two or three
- Unique PFD "Auto" feature removes screen clutter and only displays AOA when its needed



Evolution 1000 PFD

Evolution 1000 MFD

AOA Indication

Provides the pilot a visual display of the AOA trend and the approximate available lift simultaneously in all phases of flight.

Flaps Down	Yellow – Caution Zone	Green – Normal Approach Zone	Blue – Low AOA Zone
Flaps Up	Yellow-Black Cross Hatch – Warning Zone	Yellow – Caution Zone	Green – Normal Approach Zone

For more information: www.aspenavionics.com/AOA



www.aspenavionics.com

Evolution Angle of Attack (AOA) Frequently Asked Questions

1. Why AOA?

The airspeed at which an aircraft stalls varies with weight, aircraft attitude, center of gravity, etc. which makes air speed a relatively poor predictor of available lift.

But unlike airspeed, the wing always stalls at the same critical angle of attack which makes AOA an excellent predictor of lift regardless of airspeed, weight or attitude.

Your Evolution AOA indicator provides an immediate, clear visual display of trend toward stall and stall margin, especially during approach phase in windy and turbulent atmosphere and in accelerated maneuvers (e.g. accelerated turns).

2. Define AOA.

The definition of AOA is the angle between the air mass flow and the chord line of the airfoil (i.e. wing).



3. Does weight, CG, air speed or attitude changes effect the Aspen AOA?

The Aspen AOA algorithms are continuously compensated using GPS and air data information to correct the AOA algorithm for changes in CG and gross weight. Airspeed and attitude are directly measured by the air data and attitude heading reference system (AHRS) and used by the AOA algorithms to determine the appropriate AOA for that speed and attitude. As a result, once calibrated the Aspen AOA correctly determines the AOA for any combination of speed, attitude, gross weight or CG.

4. Why use gross weight during calibration?

Since the AOA algorithms are not designed for a specific aircraft, it must first “learn” the aerodynamic characteristic of your aircraft by measuring the air data, AHRS and GPS information with a known gross weight. This is done one time by flying a calibration flight as part of installation. Once the AOA algorithm learns the aircraft, it can then determine the AOA for any gross weight or CG configuration.

5. How does the Aspen Evolution AOA work?

The Aspen AOA is based upon a software algorithm that calculates the AOA regardless of aircraft, flap state, weight and balance.

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FLIGHT DISPLAY SYSTEM

A calibration flight is used to have the algorithm learn the aircraft lift characteristics based on a range of flap positions and gross weight. Also during the calibration flight the aircraft flight parameters from the pilots operating handbook (POH) are used for setting AOA indicator range thresholds.

Once calibrated, the real time AOA calculation is a two-step process. A first step is based on kinematic relations independent of the aircraft using measures from the AHRS and the air data computer. This initial AOA calculation is then corrected using GPS and calibration data. The corrected AOA is displayed on the metered indicator providing the pilot an immediate view of trend of the margin to stall, available lift and contributes to energy state awareness

6. What type of certified GPS is required?

Any GPS certified to TSO-C129, TSO-C145, TSO-C146.

7. How do you calibrate it?

- *Why use this data?*

The calibration flight is performed acquiring sensor data during three flight conditions of varying air speeds and flap positions. The calibrations can normally be accomplished in about 15 minutes.

- *Do I need to do a pitot static leak test or is the IFR certification good enough?*

We only require that the aircraft be current on their pitot static test. Aspen recommends testing the pitot static before performing the AOA calibration flight if it has not been tested in the last year.

- *Do I need to have actual weights for weight and balance?*

The Aspen Evolution AOA system only needs the gross weight of the aircraft during the calibration flight. Weight is not needed during normal AOA usage.

- *How long does calibration take?*

It should take not more than 10 to 15 minutes.

- *Once AOA is calibrated will I have to re-calibrate it with every new software release?*

No you don't need to re-calibrate for every new software release.

- *Which Aspen units need to be calibrated?*

The Aspen Evolution AOA option can be added to the Evolution EFD 1000 Pro PFD, VFR PFD, portrait orientation Evolution Back-up Display (EBD) and the MFD 1000. Each unit will have to be calibrated separately.

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8. How does the performance of the Evolution Angle of Attack compare to direct sensor AOAs?

The sensor-based AOA systems that are being sold in the general aviation market under FAA Memo AIR100-14-110-PM01 can only guarantee the accuracy of the direct sensor they use for measuring AOA.

The AOA accuracy of sensor based systems is affected by sensor mounting location, , AOA probe ice and side slips. All factors which do not affect the performance of the Aspen Evolution AOA.

9. How accurate is it?

By virtue of the calibration process, the Aspen AOA provides a very accurate indication of the available stall margin in any flight condition.

10. Why does it have dual AOA pointers?

The wings coefficient of lift and critical angle of attack changes when the flaps are up vs. down.

Having two pointers provides the pilot the proper flaps up/flaps down AOA indication without requiring the addition of a flap position sensor on the airplane.

11. What is the benefit of dual pointers?

Dual pointers provide the pilot an immediate indication of available lift with and without flaps. Most helpful during an unplanned go-around.

12. What is the benefit of AOA over traditional aircraft instruments?

In a recent report, the General Aviation Joint Steering Committee claimed that “Loss of Control” accidents represented over 40% of the general aviation fatal accidents from 2001-2010. The GAJSC’s “Loss of control working group’s” number one recommended safety enhancement was for the general aviation community to install and use an AOA for better stall margin awareness. Adding an Evolution Angle of Attack feature is a great way to meet that safety enhancement and improve your stall margin awareness.

Since you were a student pilot you have been taught that an aircraft can stall at any airspeed or attitude. With the addition of the Aspen AOA to your panel there is now a level of stall margin awareness well beyond the air speed indicator you may have previously relied on.

Only Aspen’s unique technology allows you to add AOA to your aircraft without having to cut holes in the aircraft skin to mount AOA sensors, tap into your pitot static system or run cables from your wing to the airframe and instrument panel.

13. Is the AOA display shown exactly how it will ship?

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FLIGHT DISPLAY SYSTEM

The Aspen Evolution AOA is currently going through certification and as we go through the certification processes, there may be some changes to the indicator look to meet certification requirements.

14. What are the Aspen Evolution AOA benefits over other manufacturer's systems?

Evolution AOA is available as part of a certified system with display directly on the PFD.

The stall margin indications are tailored to your specific aircraft. Instead of the pilot having to learn what a specific AOA indication means, with the Aspen AOA the pilot will know what the indication means.

Software only upgrade, no cables, holes drilled, etc.

No mechanical components to wear out or fail.

15. Who is CIRA, what is their value? What do they have to offer?

CIRA is the Italian Center for Aerospace Research. It has a research center with some of the world's most unique wind tunnels and test facilities. CIRA is committed to developing new technologies in several areas (aerodynamics, materials, structure, avionics, etc.) for the benefit of both space and aeronautical applications.

CIRA brings a unique advanced technology capability to Aspen's innovative product development culture that results in great things. CIRA and Aspen have been collaborating on a number of technical projects over the past few years and AOA is just the first to be commercialized.

16. How should I use my Aspen Evolution AOA indicator?

The Aspen AOA provides awareness of the available stall margin, something air speed indicators can't fully provide. It provides trend toward stall to help avoid the stall before stall warning system goes off.

The Aspen AOA indicator is not a replacement for following approach or climb speeds and it does not replace the aircraft stall warning system.

17. Other AOA systems on the market provide aural warnings why not the Aspen's AOA?

The Aspen AOA is not a replacement for your aircraft's certified stall warning system.

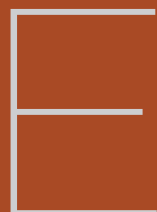
18. Does Aspen AOA system work with wind and turbulence?

Yes it works under all weather conditions because it calculates the wind.



FLYING

2015 EDITORS' CHOICE AWARDS



Each year, we at *Flying* select a small handful of products, companies or organizations that have had a positive impact on general aviation during the previous year. It's the stamp of approval pilots look for when shopping for avionics, making aircraft-purchase decisions, or trying to separate merely good products from great ones. But it's more than that. It is recognition of a job well done by teams of engineers, test pilots, marketers and other professionals who, working together, have taken bright ideas and turned them into certified realities. We hope that, in some small way, it also helps to spur competition, drive innovation and inspire the brilliant minds in aviation to dream of creating the next game-changing technology or product.

The airplanes we bestow the honors on this year are about as different as can be, yet they certainly fit the definition of game changing in the segments they represent. The avionics products we've selected also exemplify technology that pushes boundaries with new ways of thinking and presenting information. This year, we also recognize a charitable organization that is doing exceptional work to help get kids excited about aviation, a goal you'll see us putting a renewed emphasis on here at *Flying* as we enter the new year. So join us in congratulating this year's highly deserving 2015 Editors' Choice award winners.



2015  EDITORS' CHOICE AWARDS

ASPEN AVIONICS AOA INDICATOR

OK, we'll admit that we were skeptical of this one when Aspen announced it earlier this year. Then we flew with the company's software-only angle of attack indicator and became believers. The reason we questioned whether it could really work as advertised is because there aren't any external sensors that you need to install to display angle of attack on your Aspen flight display. You merely upload the software, plug in airspeed numbers specific to your airplane, go up for a quick calibration flight, and you're in business.

How exactly does it work? The technology uses the accelerometers in the Aspen Evolution primary flight

display and GPS track angle to derive angle of attack based on what the system sees. Developed by the Italian Space Agency and patented by Aspen, not only does the software provide accurate angle of attack indications on the PFD (even in an accelerated stall), but they are also theoretically more accurate than those supplied by permanently installed pressure-transducer-type angle of attack systems. The needles on the Aspen display provide fast-slow indications of margin above stall that are a huge improvement over what the airspeed indicator can tell you and provide more useful information than a stall-warning horn alone.