



Hawk Operations Manual



Alpha Systems AOA

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HAWK

DSTR-AOA-9800K
DSTR-AOA-9800PK
DSTR-AOA-9800KDUAL
DSTR-AOA-9800DPK

OPERATIONS MANUAL

P# AOA-9810

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1. CALIBRATION AND SETUP

1.1 Definitions:

Angle of Attack (AOA) is the difference between the airfoils chord line (a line from the leading edge to the trailing edge of the wing) and the relative wind (the inverse of the aircraft flight path).

Coefficient of Lift (C_L) is a relative measurement of an airfoil's lifting capabilities. High lift airfoils found on typical general aviation aircraft have a curved or cambered upper surface and a flat lower surface. Airfoils found on high performance aircraft will typically have a thinner symmetrical airfoil. The C_L in both airfoils will increase with angle of attack until the stalling angle (C_{Lmax}) is reached, at which point the C_L drops off rapidly. A plot of C_L vs. angle of attack will typically show C_L increases in a straight line for both airfoils to C_{Lmax} . A key difference between the two airfoils would be that high performance airfoil will generally stall at a much lower angle of attack then the high lift airfoil.

A **Stall** is a reduction in the lift coefficient generated by an airfoil as angle of attack increases. This occurs when the critical angle of attack of the airfoil is exceeded. The critical angle of attack or **Critical Alpha Angle (CAA)** is typically about 15 degrees, but it may vary significantly depending on the airfoil design. The **CAA** is identified by the pilot once the AOA system is calibrated by an indication of the position of the needle in the RED at the occurrence of the stall.

Optimum Alpha Angle (OAA) is the term Alpha Systems identifies as a set point for calibration of the AOA system at a 30% safe margin above Stall. This set point is easily identified, in flight, as **1.3Vs** and is identified when the needle is in the middle of the **BLUE** background.

Cruise is the term Alpha Systems identified when the needle is at the end of the green segment. This calibration set point is easily identified first from the POH of the aircraft and will be weight corrected **Va** (maneuvering speed). To be as accurate as possible, **Va** is gross weight adjusted and corrected for installation errors from the "air speed correction table" for that flight. The Alpha Systems AOA will have the needle at the bottom end of the green segment until the AOA increases to start the transition up the scale.

1.2 Restrictions and Limitations:

- This AOA system has not been determined to be suitable for installation in any specific aircraft by Alpha Systems. It may be installed in a type-certificated aircraft, provided that it has been determined suitable for installation by an appropriately rated mechanic by means such as field approval or as a minor alteration.
- Installation of the Alpha Systems AOA in a commuter or transport category airplane is prohibited, unless approval is given from the FAA.
- Installation of the Alpha Systems AOA as a replacement for or modification to an existing approved stall warning system is prohibited!
- The Alpha Systems AOA is required to have a placard located in plain view that must state the following: "Not for use as a primary instrument for flight."
- The AOA system may not be used as a substitution for the certified aircraft stall warning system.
- No operational credit may be taken for such items as reduced approach speed and shorter landing distances.
- The Alpha Systems AOA is not required and is intended to provide supplemental information to the pilot.

The Alpha Systems AOA cannot be placed in the cockpit in such a manner as to interfere with the pilot's view of primary flight instruments.

The Alpha Systems AOA cannot be placed in the cockpit in such a manner as to obstruct the pilot's view or cause distraction.

The Alpha Systems AOA is a stand-alone system and does not replace any existing, primary instruments, or displays and is not considered essential for flight.

1.3 Theory of Operation:

Every aircraft, in flight, has an alpha range from **Stall** (highest alpha angle) to the **Cruise** angle of attack (lowest alpha angle). All pilots manage the appropriate amount of lift for the varying stages of flight, whether it's setting up to enter the pattern, downwind, base, final, short final, flaring to touch down or knowing when to climb, maneuver, bank and turn safely.

The Alpha Systems AOA measures Angle of Attack through a probe mounted solidly in a location that would sense undisturbed air at any aircraft Attitude, Pitch, Slip or Skid. **There are NO moving parts.** This AOA probe protrudes approximately 3.5" down from the surface of the mounting plate. The AOA probe has two sense holes BOTH measuring ram pressures. Both ram sense ports are connected to an interface module (**IM**) through BLUE and a WHITE ¼" hoses. The electronics in the **IM** convert pressures to digital signals. The **IM** module also communicates with the display(s), aircraft audio panel for AOA warning messages and houses the system computer that controls the entire operational functionality.

The Alpha Systems AOA Angle of Attack system is designed, once calibrated, to correlate a needle movement to indicate the entire range of lift, from no lift (**in the red**), to the highest margin of lift above stall - the lowest Angle of Attack (**needle at the end of the green**). It does this using the principles and accuracies of an Angle of Attack (**AOA**) measurement system.

After calibration, a pilot can repeatedly have an indication of **Stall (Vs) to Optimum Alpha Angle (OAA, 1.3 Vs or 30% above Stall)** to the top of the Alpha Systems AOA scale at **Cruise** - calibrated at weight corrected **Va** (maneuvering speed). After these calibration set points are entered and stored, the AOA display will swing the needle to indicate the angle of attack range from before **Stall, (in the red) to OAA (at the Blue) to Cruise (needle at the end of the green).**

1.4 AOA Probe Angle and In-Flight Calibration Correlation:

The Alpha Systems Angle of Attack system displays **AOA / LIFT** measurement of the aircraft by means of an AOA probe that's mounted solidly to the aircraft. The AOA value consists of the AOA of the wing (**when in flight**) combined with the angle of the AOA probe to the chord of the wing measuring differential pressures derived throughout the entire flight envelope of the aircraft in which it's installed.

The electronics must see data within a given range to allow for a linear and full-scale reading. Due to the number of aircraft and other variables; stall angles, wing designs, coefficient of lift, mounting locations, and so on, **the probe angle will be initially set at an angle of 50 degrees to the chord of the wing. In most aircraft, starting angle would be derived from the bottom of the wing skin.**

During the calibration flight, the display will give direct feedback if the pressure values received from the AOA probe are outside of the range to give a proper full scale display indication, the system will flash combinations of background segments, **RED + BLUE**, (pressures too low) or **YELLOW + BLUE**, (pressures too high) which will indicate the direction to tilt the probe.

1.5 Three Set-Point Calibration Overview:

The computer system forces the calibration steps to be completed in the following order:

(Set-Point 1) Zero-Offset Calibration: On-the-ground, no pressure and no air flow at the AOA probe set-point. The Ground calibration wipes all values from the data base and stores a value of zero in the computer for a reference and self-check procedures. A valid **zero-offset** calibration must be entered before the computer will allow the in-flight procedures to be entered.

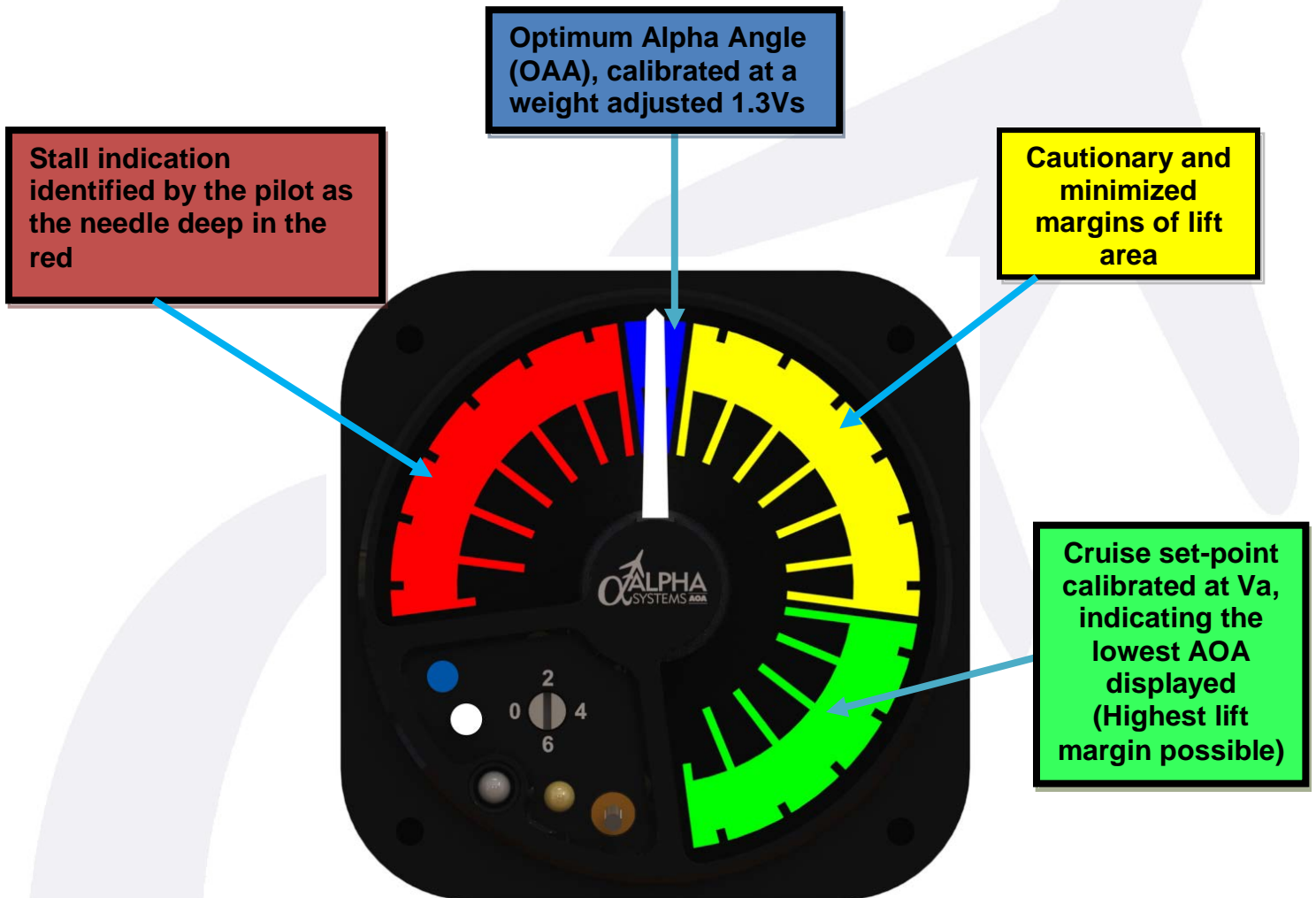
(Set-Point 2) Optimum Alpha Angle (OAA): Indicated by the needle over the blue segment. Alpha Systems AOA defines the **(OAA)** set-point by: In the **CLEAN CONFIGURATION**, first flying to identify the true and actual **Stall** speed for the current weight, CG, passengers, and baggage. Then, multiply the identified **Stall** value, by **1.3 (Vs)**. With the AOA system in the **OAA** calibration mode, fly the aircraft at the **1.3 Vs (30% above Stall)**. Maintain airspeed and trim for straight and level flight. When set, the display feedback will correlate to the **OAA** Angle of Attack of your aircraft.

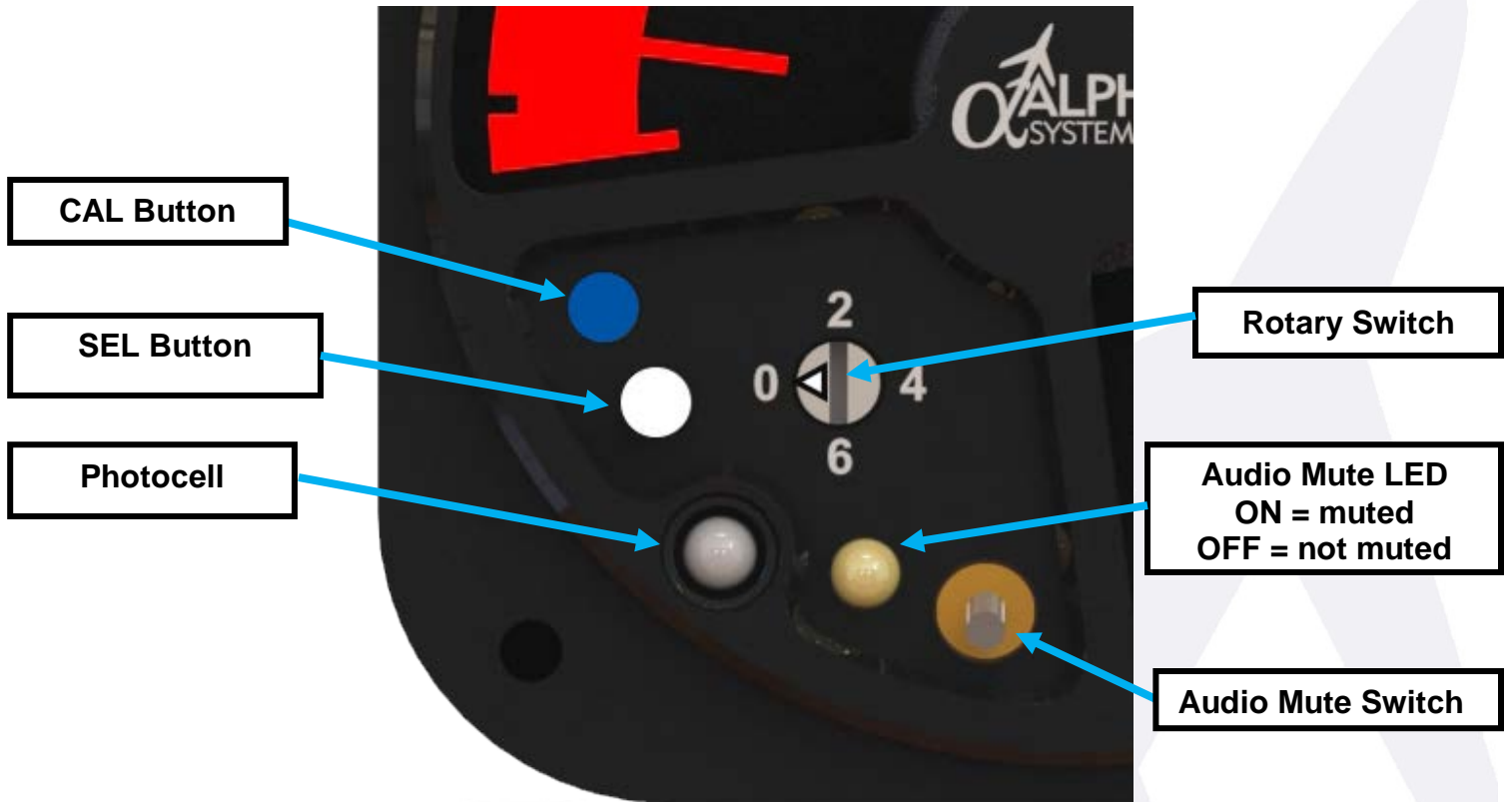
(Set-Point 3) Cruise: Set-point is indicated by the position of the needle over the green segment. To finish calibration, the set-point for the lowest angle of attack calibrated and displayed must be entered. After the **OAA** set point is flown and entered in the system, the in-flight **Cruise** set-point mode must be identified. This set-point is from the POH of the aircraft and will be **V_a** (maneuvering speed) - gross weight adjusted and corrected for installation errors according to the "air speed correction table" for that flight. The aircraft is calibrated at a maneuvering speed (alpha). This set-point allows the system to create a needle movement range from **Cruise (green)** to **OAA (1.3Vs, blue)** and up to **Stall (1.0Vs, deep in the red), or Critical Alpha**.

Once the pilot has completed the calibration procedure, both **OAA** and **CRUISE**, the entire range of lift is displayed and can be used to identify angles of attack related to aircraft performance, such as: approach, **OAA**, **Cruise**, **Stall**, best glide and best climb, to name a few. Once identified by the corresponding needle position, these angles may be used accurately at any weight or density altitude, CG and bank angle every time.

Display Function Overview

The Hawk display has a background with highly visible, colored segments and an illuminated, servo driven needle to indicate the available lift throughout the AOA range of an aircraft, once calibrated.





Switch Definitions:

- 1.) **Audio Mute Switch:** Switch used for activation or deactivation of the AOA warnings to be heard from the aircraft's audio system. When in the UP position, audio warning can be heard.
- 2.) **Audio Mute LED:** Amber colored LED indication of audio ON or OFF.
- 3.) **CAL Button:** When directed in the calibration procedure, the depression of this BLUE button enters (as in "saves to memory") the value sampled.
- 4.) **SEL Button:** This is the white button protruding out from the case. When quickly pushed and released, the display will step through 16 levels of brightness. Use at corresponding rotary switch locations.
- 5.) **Rotary Switch:** An 8-position rotary switch that has a **TRIANGLE SHAPED POINTER** to indicate the switch position, **NOT THE SCREW DRIVER SLOT**. There are markings on the case at **0,2,4,6** but can be positioned in-between to gain access to the **ODD** numbered mode procedures when directed in the calibration sequences.
 - a. **Position 1** – Reset previous calibration set-points and enter **zero-offset** calibration.
 - b. **Position 2** – Enter **OAA** and **Cruise** set-point calibration.
 - c. **Position 3** – Enter day/night brightness level calibration.
 - d. **Position 4** – Enter volume level calibration. CAL button increases volume level.
 - e. **Position 5** – Enter audio type calibration. CAL button cycles through audio choices.
- 6.) **Photocell:** Detects ambient light levels and sets display brightness accordingly.

1.6 (Set-Point 1) Zero Offset Calibration (Ground):

The first calibration step after the system has been installed and all of the electrical connections are made is to verify electrical and zero-pressure set-points. When the unit is first turned on and all of the LED's flash, the AOA must have the **Ground** calibration procedure completed.

ATTENTION: *The ground calibration set-point can be reset at any time after the initial calibration. However, ALL in-flight set points will be reset and therefore must be re-entered.*

Zero Offset calibration (Ground) is the on-the-ground, no pressure and no air flow at the AOA probe set-point. The **Ground** calibration wipes **ALL** values from the database and stores a value of zero in the computer for a reference and self-check procedures. A valid **Ground** set-point must be entered before the computer will let the in-flight calibration start.

Follow these steps to complete the **Zero Offset Calibration (Ground)**:

- 1.) Turn the **Rotary Switch** to **position 1** with a small screw driver. The triangle on the switch should be pointing in-between 0 and 2.
- 2.) With **power OFF**, hold the **SEL button down (white button)** and power the AOA system **ON**. The AOA computer, through the aircraft's audio panel, will announce "**Set Zero Offset.**" All segments on the display will be flashing **ON and OFF** indicating the **Zero Offset** needs to be calibrated.
- 3.) Press and hold the **CAL button (blue button)** down.

ATTENTION: *You must complete this step to retain a zero offset set-point. Failure to press the CAL button before powering OFF, and then ON, will cause the system to revert to previous settings.*

- A.) If the **Zero Offset** set-point is accepted, the unit will announce "**Zero Offset Complete**" and will flash the **blue and the green background segments** 5 times to indicate that the ground calibration was successful and in-flight set-points can now be flown and entered.
- B.) If the **Zero Offset** set-point is not accepted, the display will continue to flash ALL SEGMENTS, and the unit will announce "**Invalid Zero Offset**".



Failure to Complete Zero Offset Calibration

If the AOA continues to annunciate “**Invalid Set-Point**” when the **CAL** button is pushed, the zero pressure value from the sensor is too high. This indicates something is wrong electrically or mechanically with the system, or something in the environment is affecting the system. The electronics of the system will flag the bad zero offset by flashing ALL segments until an acceptable **Zero Offset** set-point is entered.

To isolate the failure between mechanical or electrical problems, the air hoses should be disconnected from the IF module (**IM**) and repeat steps 1-3 on the previous page.

If the condition persists, then the failure is electrical and the **IM** should be returned for an authorized repair.

If the setting is successful, the failure is mechanical, such as a blockage in the air hoses or AOA probe, etc. Identify the blockage and, once fixed, repeat steps 1-3.

ATTENTION: *Again, the ground calibration set-point can be reset at any time after the initial calibration. However, ALL in-flight set-points will reset and must be re-entered.*

1.7 In-Flight Calibration Overview:

The calibration flight(s) may be conducted under §91.407 by at least a private pilot that is rated to fly the aircraft. The adjustment and tightening of the AOA probe may be accomplished by a mechanic, a person that holds a repairman's certificate for that specific aircraft or the aircraft owner if he/she holds at least a private pilot certificate under part §43.3(g) and Appendix "A" to Part §43 item (c)(26).

This procedure may be done as a single pilot operation; however, it does require your attention to be diverted away from flying the airplane. In the interest of safety, we strongly recommend that you solicit the aid of someone that can perform the calibration procedure while you fly the airplane or vice versa. Use the following outline as a guide to complete the in-flight calibration:

- Review the aircraft records; ensure that the return to service entry has been made.
- Plan a flight to an area where slow flight can be performed without any undue hazards (reference § 91.303 & § 91.305).
- Review the stall recovery and minimum controllable flight procedures for your aircraft. If an inadvertent stall occurs, immediately recover from the stall per your training and the aircraft manufacturers instructions.
- Acquaint yourself with the Alpha Systems AOA "Hawk" display and its operation prior to attempting actual in-flight calibration maneuvers.

Note: *The OAA set-point calibration set-point calibration button entries can be practiced on the ground.*

While the in-flight calibration can be accomplished by a solo pilot, it is advisable that the pilot flying focuses on safely and correctly achieving the calibration set points while a second person assists in performing the indicator calibration.

- Preflight and operate the aircraft as you would normally.
- When in an area where slow flight can be performed, perform clearing turns to ensure the area is clear.
- Make sure the winds are calm with little or no turbulence to allow an accurate calibration.
- Follow the aircraft flight procedures and slow the aircraft. Maintain coordination in the clean configuration, with aircraft engine set to lower **RPM (Pattern RPM) or Manifold Pressure**.
- Maintain altitude with the pitch (use pitch trim to relieve back pressure).
- Use power as needed to maintain safe, straight, level and slow flight.
- Perform in-flight Optimum Alpha Angle (**OAA**) calibration, fly at true **1.3Vs**.
- **Once an OAA value is accepted and entered**, perform in-flight **Cruise** set-point calibration and fly at weight corrected **V_a** (maneuvering speed) use that value for the AOA Cruise set-point.
- **Once a Cruise value is accepted and entered**, perform the exit procedure (Rotary Switch position 0), save and exit from the calibration mode.
- Return to the airport and shut down the aircraft.

- If everything was set properly when the unit is turned ON, the display will move the needle. First to the right, then fully to the left, and announce, “**Alpha Systems AOA Test Complete.**”

Note: *If the AOA system indicates a bad set-point, note the display indications at the time of button push and return to the airport. Make the necessary angle adjustments to the AOA probe. When the AOA probe angle adjustments have been made, perform the entire in-flight calibration procedure, OAA & Cruise, as outlined in this section until you are successful.*

1.8 In-Flight Calibration of Optimum Alpha Angle (OAA) Overview:

CAUTION: *Always maintain complete control of your aircraft!*

The Alpha Systems AOA requires calibration to each aircraft at the Optimum Alpha Angle (**OAA**) in-flight. This angle of attack is **flown** to identify the angle of attack that represents **the weight corrected, 1.3Vs** or 30% above a stall, corresponding to **OAA**.

To accurately identify 1.3Vs:

Calculate the true stall speed for the conditions of the current aircraft's gross weight, passengers, baggage, CG, and density altitude (gross weight adjusted Vs). Take the calculated number for that condition of Stall speed and multiply the calculated Stall speed by 1.3Vs (add 30%). Fly the aircraft at a safe altitude for slow flight maneuvers. Reduce to slow flight power setting such as a downwind airport power setting. Use pitch and trim to fly at **Calculated 1.3Vs (OAA)** on a calm, non-turbulent day, in a **CLEAN** configuration. Stabilize aircraft's airspeed and fly straight and level. Quickly push and release the **CAL** button, follow the OAA set-point calibration procedures.

1.9 (Set-point 2) Calibrating the Optimum Alpha Angle (OAA):

Follow these steps to enter OAA calibration mode:

- 1.) Turn the power ON.
 - a. The display should flash the blue and green segments indicating Ground Calibration has been completed but the in-flight calibration must be done.
- 2.) Turn the **Rotary Switch** to position 2. (The triangle identifies the selection)
- 3.) Press the **SEL button**.
 - a. The **blue segment** on the display will flash three times and the unit will announce “**Set-point Calibration ON**” followed by “**Set OAA Set-point.**”
- 4.) Fly the OAA Value and when ready to enter a set-point, press the **CAL button**.

The unit will do one of the following:

- The AOA system accepts the **OAA** value, the needle will become semi-operational and the unit will announce “**OAA Set-Point Complete.**”
- The AOA display will flash the **red and blue segments** on the display three times and announce “**Invalid OAA Set-Point.**” The set-point is too low; tip the AOA Probe 5° away from the wing (proceed to **INVALID SET POINT TOO LOW** in the troubleshooting section 5.9).
- The AOA display will flash the **blue and yellow segments** three times and announce “**Invalid OAA Set-Point.**” The set-point is too high; tip the AOA Probe 5° towards the wing (proceed to **INVALID SET POINT TOO HIGH** in the troubleshooting section 5.9).



Note: If the AOA system indicates a bad set-point, note the display indications at the time of the button push and return to the airport. Make the necessary angle adjustments, relative to the direction of the error code, to the AOA probe. Adjust the probe in 5 degree increments. When the AOA probe angle adjustments have been made, perform the entire in-flight calibration procedure outlined in this section until you are successful.

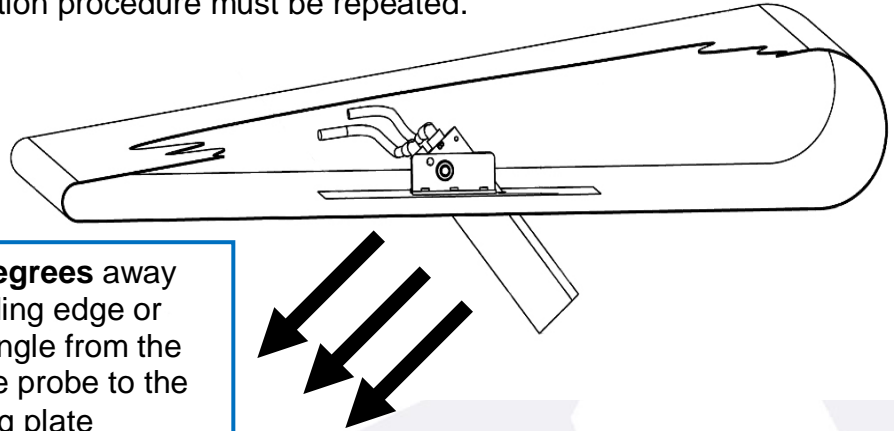
1.10 Invalid OAA Set Points:

Invalid Set-Point - Too Low



If the pilot could not get a valid **OAA** value entered during the button push and the display flashed **BLUE and RED segments**, the aircraft must be landed, and the AOA probe angle must be unpinned, rotated **away from the leading edge of the wing 5 degrees** and re-pinned, allowing the new angle to be secured and tightened. The in-flight **OAA** calibration procedure must be repeated.

Tip probe **5 degrees** away from the leading edge or increase the angle from the front side of the probe to the mounting plate

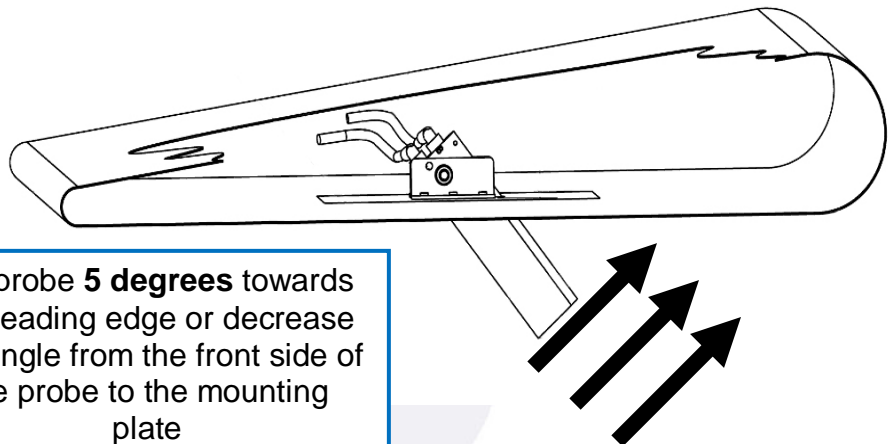


Invalid Set-Point - Too High



If the pilot could not get a valid **OAA** value entered during the button push and the display flashed **BLUE and YELLOW segments**, the aircraft must be landed, and the AOA probe angle must be unpinned, rotated **toward the leading edge of the wing 5 degrees**, re-pinned and tightened. The **OAA** in-flight calibration procedure must be repeated.

Tip probe **5 degrees** towards the leading edge or decrease the angle from the front side of the probe to the mounting plate



Note: The **CAL** Button can be pushed as many times as desired to continuously attempt a new Optimum Alpha Angle (**OAA**) set-point. If the set-point is valid the display needle will be functional using the new **OAA** value. If the set-point is invalid, the display needle will no longer be operational and continue to flash the error colored backgrounds. As long as the unit is in the **OAA CAL** routine, it will flash the **blue segment** twice, every five to six seconds until you enter **Cruise Calibration**.

Note: If power is removed, the unit will become non-functional and the in-flight procedure must be started over; **unless** the calibration routine was entered after the display was already calibrated.

By turning the Rotary Switch to position 2 and pressing the SEL button AFTER the initial calibration, you can re-enter calibration mode to assign new set-points. If no new set-points are entered, the system will retain its previous settings.

(Continued)

1.11 (Set-Point 3) Calibrating the Cruise Set-Point:

Attention: *The unit must have a valid OAA value before it allows the Cruise set-point to be entered*



Follow these steps to set the Cruise set-point:

- 1.) To set the Cruise set-point, **with the rotary switch still in position 2**, press the **SEL** button.
 - a. The display will flash the **green** segment three times and will announce **“Set Cruise Set-Point”**. **Cruise set-point will be indicated by the needle pointing at the most clockwise position over the green background**. The set-point for the lowest angle of attack calibrated and displayed, bottom of the scale, must be entered. After the **OAA** set-point is flown, identified and stored in the system, the in-flight **Cruise** set point must be entered. This set-point is identified first from the POH of the aircraft and will be **V_a** (maneuvering speed), gross weight adjusted and corrected for that flight.
- 2.) Fly the aircraft at the **Cruise AOA (weight corrected, V_a speed) for that flight**. Trim for straight and level flight.
- 3.) When ready, press the **CAL** button. The unit will do one of the following:
 - The needle will move to the most clock-wise position and announce **“Cruise Set-Point Complete.”**
 - Flash the **green segment** three times on the display and announce **“Invalid Cruise Set-Point,”** if out of range.

Note: *The **CAL** button can be pushed as many times as desired, to continuously attempt entering a new **Cruise** set-point. The pilot may have to try different speeds in order to find an acceptable set-point, or the sensor probe may need to be adjusted on the ground. The display will remain operational for both invalid and valid set-points at this point.*

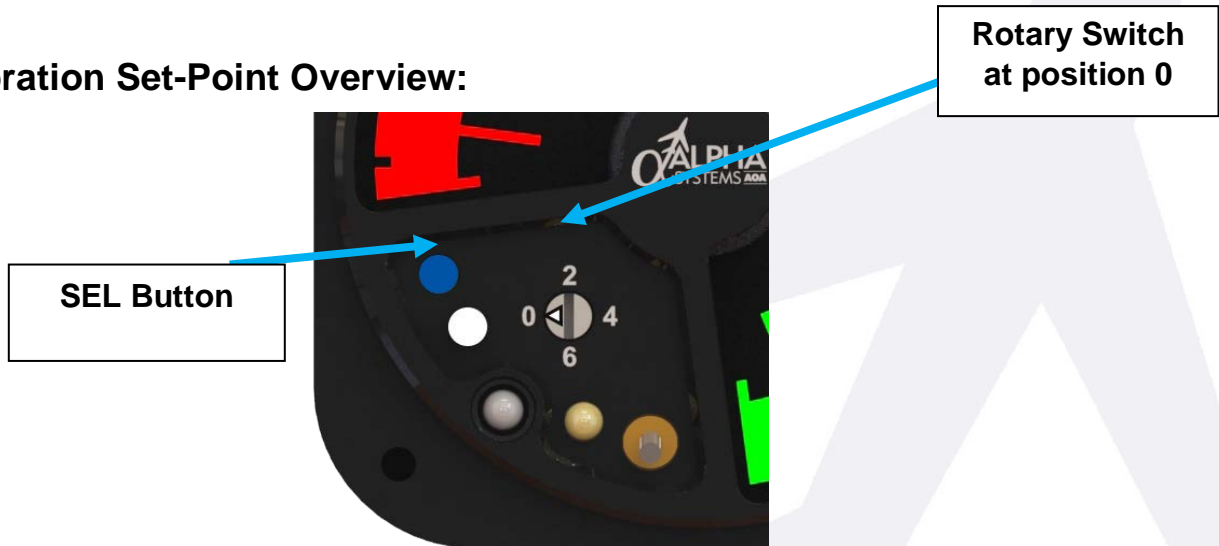
Note: *As long as the unit is in the **Cruise** calibration routine, it will flash the **green segment** twice, every six seconds as a reminder that the unit is still in the **Cruise** calibration routine.*

Attention: **The values must be saved or all values will be lost!!**

If satisfied with both set-point values (OAA & Cruise) exit and **STORE** the set-points to memory:

- 1.) Turn the **Rotary Switch** to position **0**.
- 2.) Press the **SEL** button. The unit will announce “**Calibration Off**” and remain operational or the unit will announce “**Calibration Fail**” and become inoperative if one of the set-points was invalid or the calibration procedure was not completed.

1.12 Calibration Set-Point Overview:



Verify performance and valid set-points by repeating the identification of both **OAA** and **Cruise**. Check that set-points are functional and match previous results. The display must give you an increasing movement of the needle toward the green segment as AOA decreases (approaching Cruise) and a needle movement toward the red segment as the AOA increases (approaching Stall).

1.13 Identify Stall AOA Indication:

Using the weight corrected Stall speed, multiply the corrected Stall speed by 1.1, or 10% (equals **1.1Vs**). Fly the aircraft at **1.1Vs** and identify the needle position or correlate that the next movement deeper in the red is your aircrafts stall AOA indication.

1.14 Setting Calibrated Day / Night Brightness Levels:

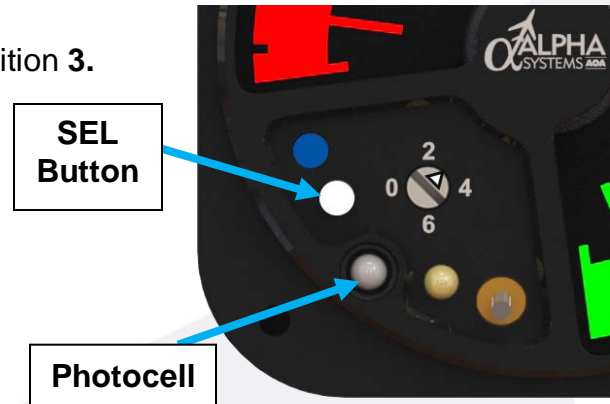
Note: There are 16 levels of brightness from a minimum level to a maximum level.

1.) With **power OFF**, turn the Rotary Switch to position **3**.

2.) Hold the **SEL** button down and power the AOA ON.

The unit will announce “**Set Brightness Levels**” and the background will be illuminated.

3.) Cover the photocell on the AOA DISPLAY with your thumb and wait 5 seconds.



With the photocell covered:

4.) Press the brightness button repeatedly on the AOA DISPLAY until at the acceptable low ambient light brightness level.

5.) Wait about 5 seconds for the unit to store the calibrated setting before removing your thumb.

6.) Now, apply light directly to the photo diode on the AOA DISPLAY and wait 5 seconds.

With light on the photocell:

7.) Press the brightness button repeatedly on the AOA DISPLAY until it is at the acceptable high ambient light brightness level.

You'll know when at the maximum brightness level because the unit will announce “**Maximum Brightness Reached,**” and going passed it will cause the brightness of the background to return to the minimum brightness level.

8.) Wait about 5 seconds for the unit to store the calibrated setting before removing the light from the photocell.

9.) Power the system OFF.

(Continued)

1.15 Adjusting the Audio Volume Level:

- 1.) With power OFF, turn the Rotary Switch to position 4.
- 2.) Hold the **SEL** button down and power the unit on.
- 3.) Wait until the unit announces “Set Volume.”
- 4.) Now, press the **CAL** button repeatedly until the acceptable volume level.



Note: When at the maximum volume level, the unit will announce “Maximum Volume Reached.” When at the minimum volume level, the unit will announce “Minimum Volume Reached.”

- 5.) Power the unit OFF.

1.16 Select Audio Type:

- 1.) With power OFF, turn the Rotary Switch to position 5.
- 2.) Hold the **SEL** button down, power the unit on. The unit will announce “Set Audio Choice.”



Currently there are 4 choices of audio:

A 3 beep audio tone when the AOA increases and the needle moves to the lower part of the yellow scale (audio occurs once) or,

A 2 note, high / low audio tone when the AOA increases and the needle moves to the lower part of the yellow scale (audio occurs once) or,

A 2 note, high / low audio tone when the AOA increases and the needle moves to the lower part of the yellow scale (audio occurs once) and a feminine voice “**Too Slow**” annunciation when the needle enters the red segment (repeats 3 times) or,

A feminine voice “**Getting Slow**” (audio occurs once) when the AOA increases and the needle moves to the lower part of the yellow scale) and a feminine voice “**Too Slow**” annunciation when the needle enters the red segment (repeats 3 times).

- 3.) Press and then release the **CAL** button.

The first audio choice will sound. If the 1st audio choice is desired, power the unit OFF and it will be stored to system memory.

- 4.) If you want to select the next audio choice, press the **CAL** button again.

You will hear the 2nd audio choice. If the 2nd audio choice is desired, power the unit OFF and it will be stored to system memory.

5.) To select the next audio choice, press the **CAL** button again.

You will hear the 3rd audio choice. If the 3rd audio choice is desired, turn power OFF and it will be stored to system memory.

6.) To select the 4th audio choice, press the **CAL** button again.

You will hear the 4th audio choice. If the 4th audio choice is desired, power the unit OFF and the last selection played will be stored into system memory.

To hear all choices again, press and release the **CAL** pushbutton again and again. The system will start with the first audio choice and all selections can be repeated until the selected audio is determined and power is removed.

(End of Chapter)

2. OPERATING

2.1 Background information:

The Alpha Systems AOA system was primarily designed to improve operational safety of airplanes by increasing pilot awareness of available lift during operations at high angles of attack. Additional benefits include identifying aircraft performance based on a fixed angle of attack or a constant C_L , such as maximum range and best glide - Stall.

AOA: Angle of Attack is the difference between the airfoils chord line (a line from the leading edge to the trailing edge of the wing) and the relative wind (the inverse of the aircraft flight path).

C_L : Coefficient of Lift is a relative measure of an airfoil's lifting capabilities.

C_{Lmax} : Coefficient of Lift Maximum is the angle of attack which if exceeded will cause the airfoil to stall.

C_D : Coefficient of Drag is a measure of total drag; induced and parasite drag.

C_L/C_D : Coefficient of Lift over Coefficient of Drag is a ratio between lift and drag.

C_L/C_D Maximum: is the maximum lift-to-drag ratio at which maximum range and maximum glide distance will be found for propeller airplanes.

2.2 System Description and Operation:

The Alpha Systems AOA "Hawk," electronic angle of attack system measures pressure at two points on a AOA probe and conveys those pressures, via AOA sense lines, to the AOA interface module (**IM**). The AOA **IM** converts those pressures into an electrical signal that is then transmitted to the display. The display interprets the signal and positions the illuminated needle over the colored background to convey angle of attack information to the pilot. In addition to the visual display the AOA interface module can connect to the aircraft's audio panel and sound an alert for an impending high Angle of Attack as a warning tone.

The Alpha Systems AOA system draws a minimal current of approximately ¼ Amp (250mA) of electrical power. For the system to operate correctly, it must be supplied electrical power within a range of 12 to 28VDC, be calibrated correctly and the openings on the AOA probe must be kept clear of any obstructions - mounted securely in clean air flow.

Probe heat is an option and if installed requires approximately 8 Amps of electrical power at 12 or 28VDC to operate. To extend the life of the probe's heating element, it is recommended that the probe heat **not** be used while on the ground.

2.3 The Indicator:

The display background is highly visible and is color coded. The needle moves over the illuminated background, **once calibrated**, indicating the angle of attack for the aircraft.

WHEN THE NEEDLE MOVES OVER THE.....

- **Green colored section:** It is indicating high amounts of lift, lower angle of attack, operations allowing full deflections of flight controls, V_a (angle of attack) and higher. The angle of attack is relatively low with lots of surplus lift.
- **Yellow colored section:** It is indicating caution; the angle of attack is relatively high. If not intentional, take action to reduce the angle of attack.
- **Blue colored section:** It is defining the segment that identifies Optimum Alpha Angle (**OAA**) or $1.3V_s$, **30% margin away from stall (see definition)**.
- **Red colored section:** It means the angle of attack is too high. Take immediate action to reduce the angle of attack such as performing a stall recovery procedure. You are in dire straits, stall impending.



Optimum Alpha Angle

Optimum Alpha Angle (**OAA**) is achieved during an in-flight calibrations maneuver with the pilot taking the aircraft to altitude, then complete the following steps:

- 1.) Identify the true stall speed for that flight
- 2.) Take the true stall speed and multiply by 1.3 V_s (In the clean configuration)
- 3.) Fly the aircraft, trim for straight and level.
- 4.) The pilot is to then fly the aircraft at **OAA**. Calibrate the AOA at a weight adjusted true stall speed plus 30% or $1.3 V_s$ airspeed. This will position the needle over the **blue** when the computer accepts the value for **OAA**.

Cruise Indication

The **Cruise** set-point is identified when the needle is positioned over the last green segment on the green background and is an indication when the aircraft is in **Cruise** (angle of attack). The **Cruise** set-point is calibrated when the aircraft is flying at a weight adjusted V_a (maneuvering speed).

Max Climb Angle

Shown when the needle is at the lower part of the yellow colored segment and is the indication of the aircraft's maximum angle of attack that will allow continued climb.

Stall Indication

After the calibration is complete, the pilot will identify where the needle is over part of the red segment that identifies the Stall angle of attack for his/her aircraft. The corresponding needle position over the red segment that represents Stall is dependent on the coefficient of lift and the angle of attack for each airplane. Once identified, the needle position over the red segment will always indicate the aircraft's stall.

Other Flight Reference Values

Other flight values such as **Stall, V_x and V_y** can be identified after the AOA system has completed the calibration procedures. The pilot then flies the aircraft at the exact weight adjusted airspeed value from the pilot operating handbook that references **V_x**, for example. The corresponding needle position will always equal the associated angle of attack (**V_x**) from that day on; regardless of gross weight changes, density altitude, bank angle or CG. Simply put, once calibrated, the needle will allow the pilot to identify the margins of lift from Cruise up to Stall and instantly identify the appropriate AOA for any flight maneuver.

Switch and Indicator Definitions

Audio Mute Switch: This switch is used for activation or deactivation of the AOA warnings through the aircraft's audio system. This switch, when toggled **UP**, activates the audio warnings and the amber LED will be **OFF**. The audio warnings will be heard when the angle of attack increases and the needle is within the yellow segment, near the blue segment. They are also activated when the needle is in the red (if certain audio choices were selected). When the switch is in the **DOWN** position, ALL audio warnings will be deactivated and indicated by the amber LED being **ON**.

Audio Muted LED: This Amber LED, when illuminated, is an indication of the audio being muted. When the Amber LED is **OFF**, ALL audio warnings are allowed to go through the audio panel.

SEL Button: This white button has two functions:

- 1.) When depressed and released repeatedly, will step through 16 levels of brightness. When the maximum brightness level is reached, the brightness returns to the minimum and will step up each time the button is depressed and released.
- 2.) The button is used to enter or exit the different calibration modes in conjunction with the rotary switch.

CAL Button: This is the blue recessed button and when directed in the calibration procedure, the depression of this button enters (**as in, "saves to memory"**) the value sampled.

Calibration Mode Rotary Switch: This is an 8-position rotary switch that has a **triangle shaped pointer** to indicate the switch position **NOT the screw driver slot**.

There are markings on the case at **0, 2, 4 and 6**, but can be positioned in-between to gain access to the **odd** numbered calibration modes when directed in the calibration sequences

Auto Brightness Detect Photocell: The photocell is at the bottom of the AOA display. It detects the ambient light and will switch from **daytime** brightness to **nighttime** brightness presets automatically. Please note that the repeated pressing of the SEL button will override the preset level at any time. When power is turned off, the calibrated nighttime and daytime brightness levels will return.

2.4 Demonstration of Optimum Alpha Angle (OAA), Clean and Dirty:

As noted earlier, this AOA system was primarily designed to improve operational safety of airplanes by increasing pilot awareness during operations at high angles of attack. The system is calibrated with the aircraft in the **clean configuration** which means that when the flaps are lowered, the display will indicate a higher angle of attack (**deeper into the red**) before stalling. It is our contention that **any operation in the red at low altitude is unsafe and, if encountered, immediate corrective actions should be taken to reduce the angle of attack regardless of the aircraft configuration.**

To familiarize you with the AOA indications during stalls use the following outline as a guide.

- Plan a flight to an area where stalls can be performed without any undue hazards (reference § 91.303 & § 91.305).
- Review the stall recovery procedures for your aircraft.
- Acquaint yourself with the AOA indicator and controls.
- Preflight and operate the aircraft as you would normally.
- When in an area where stalls can be performed and the air is smooth, perform clearing turns to ensure the area is clear.
- Follow the aircraft procedures and slow the aircraft, in the clean configuration (no flaps):
 - Maintain coordination.
 - Maintain altitude.
 - Monitor the AOA indicator.
 - Slow to a stall.
 - Perform the stall recovery procedure for your aircraft.

OBSERVED INDICATIONS:

As the aircraft slows and the angle of attack increases, note the following:

- The needle on the AOA indicator will smoothly transition from the green, through the yellow, to the blue and then into the red.
- The High Angle of Attack Audio Warning will sound anytime the needle on the display shows an angle of attack that is increasing beyond the second to the last mark before the Blue segment and if programmed at the beginning of the Red segments.
- The aircrafts stall warning should activate prior to the Needle over the Blue segment.
- When the airfoil stalls, the needle will be positioned deep in the red.

As the recovery progresses:

- The AOA indicator's needle will smoothly transition towards the green.
- The aircrafts stall warning will silence.
- The needle will progress from the red, through the blue and towards the green, indicating more lift available and lower angles of attack. (Continued on next page)

Follow the outline above again but perform the stall and recovery in the landing configuration (dirty) and observe the following:

- The needle will smoothly transition from the green towards the red.
- The aircraft's stall warning should activate prior to the needle moving over the blue segment.
- When the airfoil stalls, there may be a small change in the needle position then in the clean configuration. Note the possible needle differences.

As the recovery progresses:

- The AOA indicator's needle will smoothly transition towards the blue, through the yellow, then finally in the green as AOA decreases and the lift margin from stall increases.
- The aircraft's stall warning will silence.
- The further the needle moves towards the green simply equals more lift (lower angle of attack).

Practice these two stalls until you become familiar with the indications on the AOA and your airspeed indicator. Since the airfoil on your aircraft will stall at the same angle of attack every time, (**regardless of weight**) the AOA indications should be the same every time. To prove this, try an accelerated stall in the clean configuration using the same outline as above. Notice that as the wing loading is increased in turn, the aircraft stalls at a **higher indicated airspeed** but **at the same angle of attack**.

Do you remember, ever since you were a student pilot you heard that an aircraft can stall at any airspeed, attitude or power setting? Now you have an instrument that will indicate the angle of attack and an impending stall **every time, regardless of airspeed, attitude or gross weight**.

2.5 Demonstration of Takeoff and Climb Using AOA:

The use of AOA for takeoff and climb performance will greatly increase the pilot's awareness while operating at high angles of attack and yield safe and consistent results.

For example, if you intend to perform a short field takeoff over an obstacle there are a number of factors you must consider arriving at the proper indicated airspeed for the climb. Changing gross weight, pressure altitude and temperature will all have an effect on the indicated climb speed. On the other hand, once you establish the correct angle of attack for the climb, it will be the same regardless of the factors previously mentioned.

To determine the correct AOA for a climb, we need a base line to start from. For this example, we will figure it out for V_x (best angle of climb). Some aircraft may use two different speeds based on the aircraft configuration. Let's use the one for clearing an obstacle on takeoff. Refer to the aircraft manual to determine the configuration and airspeed for V_x considering the following factors:

- Identify actual gross weight.
- Pressure altitude, at the demonstration altitude.
- Temperature, at the demonstration altitude.
- Correct CAS for installation errors to arrive at IAS.

As before, to familiarize you with the AOA indications for V_x , use the following outline as a guide:

- Plan a flight to an area where the desired maneuvers may be performed without any undue hazards (reference § 91.303 & § 91.305).
- Acquaint yourself with the AOA indicator.
- Preflight and operate the aircraft as you would normally. (Continued on next page)
- When in the area, perform clearing turns to ensure the area is clear.

- Maintain coordination.
- Maintain altitude.
- Use power to slow and configure for V_x .
- Maintain the indicated airspeed for V_x .
- Observe the AOA indication and make a mental note.
- Return to normal flight.
- Write down the position of the needle.

This AOA indication will be accurate for future use at any gross weight or altitude, **every time**. Also, this same method may be used to determine the AOA for any climb. Now try it for V_y (best rate of climb) using the procedure described above.

Document the angles of attack by the position of the needle in a permanent record for future use. For example, V_x is equal to the needle in the middle of the yellow.

Now practice using the AOA for takeoffs at airports that give you a comfortable margin. Then, when you perfect the technique, you can perform short field takeoffs over an obstacle safely.

Use the following outline as a guide:

- Review your aircraft procedures for short field over an obstacle takeoff.
- Plan for a flight at an airport where normal takeoffs and landing may be performed.
- Preflight and operate the aircraft as you would normally.
- Perform the takeoff run as specified in the aircraft manual.
- At the specified takeoff speed rotate smoothly to the AOA for V_x .

WARNING: Do not over-rotate or rotate too rapidly as either will cause catastrophic results.

- When well above the obstacle, decrease the AOA (allow the needle to move clockwise into the yellow and towards the green) and clean up on schedule.
- Adjust the pitch to achieve the AOA for V_y and continue the climb.

Takeoffs

As the aircraft accelerates down the runway, the AOA indicator will move the needle clockwise starting over the red and the beyond the needle position that represents V_x until rotation. When the pitch is rotated up, the AOA indication will move towards V_x . Adjust the pitch to maintain the V_x angle. To accelerate and clean up, the pitch is lowered, thus lowering the AOA and decreasing induced drag. This will allow the aircraft to accelerate so the flaps can be retracted. The changes in angle of attack can be observed.

2.6 Demonstration of Performance Based on a Constant AOA or C_L :

As mentioned earlier, the AOA may be used for identifying aircraft performance based on a fixed angle of attack or a constant C_L . For this discussion, C_L/C_D maximum indication will be identified. This is the maximum lift-to-drag ratio at which maximum range and maximum glide distance will be found for propeller airplanes.

For those of you that really get into researching, find the data on the airfoil that is installed on your aircraft. Compare the C_L at various angles of attack to C_D for your aircraft at respective angles of attack. The angle of attack that provides the maximum ratio between C_L and C_D is considered C_L/C_D Maximum.

OR

For the rest of us, the aircraft manufacturer has already figured this out. They show it as a calibrated airspeed that will result in an angle of attack that is C_L/C_D Maximum. They had to present the information in this fashion because they did not install an angle of attack indicator on the aircraft. To find the angle of attack for best glide, calculate an indicated airspeed considering:

- Actual gross weight.
- Pressure altitude at the demonstration altitude.
- Temperature at the demonstration altitude.
- Correct CAS for installation errors to arrive at IAS.

As before, to familiarize you with the AOA indications for C_L/C_D maximum, use the following outline as a guide:

- Plan a flight to an area where the desired maneuvers may be performed without any undue hazards (reference § 91.303 & § 91.305).
- Acquaint yourself with the AOA indicator.
- Preflight and operate the aircraft as you would normally.
- When in the area perform clearing turns to ensure the area is clear.
- Maintain coordination.
- Maintain altitude.
- Use power to slow and maintain best glide speed.
- Observe the AOA indication; this is C_L/C_D maximum.

This AOA indication will be correct for future use at any gross weight or altitude, **every time**.

Document the angles of attack by the position of the needle in a permanent record for future use. For example: best glide equals needle over the first green segment.

The methods used to arrive at this AOA indication will be the same for all constant angle of attack or C_L maneuvers.

2.7 Demonstration of Approaches using AOA:

A long standing rule of thumb is to use an approach speed of 1.3 times the power off stall speed in the landing configuration. Another rule of thumb is in gusty winds add 5kts. for mom and if it's really gusty add 10kts. for mom and the kids. While flying the approach at higher speeds seems to be safer, having additional speed and kinetic energy on a short runway may not be in the best interest of mom and the kids. With the means to accurately know and control the angle of attack, you can fly a more stable approach and land with less kinetic energy for any given situation than flying arbitrary approach speeds. Flying an approach and landing using an AOA indicator may be a safer procedure.

The AOA has been calibrated for an angle of attack just slightly less than C_{LMAX} . However, an acceptable margin above that angle to fly approach and landings has not been determined. As a starting point use the aircraft manual to determine the stall speed of the aircraft at the **actual gross weight** in the landing configuration. Take that calibrated airspeed and multiply it by 1.3, 1.2 and 1.1. Then refer to the airspeed correction chart to determine the correction, if any, to convert from calibrated airspeed to indicated airspeed for the three speeds. For example:

Calibrated Stall Speed X 1.3 = App. CAS ± the correction = App. IAS
58Kts. CAS X 1.3 = 75.4kts. CAS + 2 kt correction = 77kts. IAS
58Kts. CAS X 1.2 = 69.6kts. CAS + 3 kt correction = 73kts. IAS
58Kts. CAS X 1.1 = 63.8kts. CAS + 4 kt correction = 68kts. IAS

For ease of discussion, let's call these speeds and the resulting AOA indication as 3, 2 and, 1 respectively. Once the AOA angles have been identified, they will be **accurate at any gross weight, every time.**

To establish angles of attack for approach using AOA indications use the following outline as a guide.

- Plan a flight to an area where stalls and slow flight can be performed without any undue hazards (reference § 91.303 & § 91.305).
- Review the stall recovery procedures for your aircraft.
- Acquaint yourself with the AOA indicator.
- Preflight and operate the aircraft as you would normally.
- When in an area where stalls and slow flight can be performed and the air is smooth, perform clearing turns to ensure the area is clear.

CAUTION: IF THE AIRCRAFT IS INADVERTENTLY STALLED, PERFORM THE STALL RECOVERY PROCEDURE FOR YOUR AIRCRAFT.

- Follow the aircraft procedures, slow and configure to the landing configuration:
 - Maintain coordination.
 - Maintain altitude with the pitch (use pitch trim to relieve back pressure).
 - Use power as needed to maintain flight at the first of the calculated approach speeds, 3.
 - Write down the correlated needle position.
 - Use power as needed to slow to and maintain flight at the second of the calculated approach speeds, 2.
 - Write the correlated needle position.
 - Use power as needed to slow to and maintain flight at the third of the calculated approach speeds, 1.
 - Write down the correlated needle position.
 - Return to normal flight.

Document the angles of attack by the number of the last correlated needle position in a permanent record for future use. For example: 3 = 1.3 approach is equal to the needle at the bottom of the yellow.

To familiarize you with the aircraft while flying practice approaches using the AOA indicator as a guide, please use the following outline:

- Plan a flight to an area where stalls and slow flight can be performed without any undue hazards (reference § 91.303 & § 91.305).
- Review the stall recovery procedures for your aircraft.
- Acquaint yourself with the AOA indicator.
- Preflight and operate the aircraft as you would normally.
- When in an area where stalls and slow flight can be performed and the air is smooth, perform clearing turns to ensure the area is clear.
- Follow the aircraft procedures, slow and configure to the landing configuration:
 - Maintain coordination.
 - Set the power as you would to fly a normal approach.
 - Maintain altitude with the pitch until the AOA approaches the 3 indication. Lower and use pitch to maintain that AOA (use pitch trim to relieve back pressure).
 - Fly the aircraft in the descent (straight & turning). Pay attention to the flight control effectiveness.
 - While the aircraft is still at a safe altitude, simulate a landing flare by reducing the power to idle and increasing the angle of attack to maintain altitude until the stall (note the relative time in seconds from the start of the simulated landing to the stall).
 - Perform a stall recovery.
 - Climb back to the initial altitude.

Note: Repeat the steps above using AOA indications 2 and 1. Gain experience by practicing these simulated approaches and landings using the AOA indicator.

Some noticed observations:

- The control effectiveness decreased with higher angle of attack.
- The higher the angle of attack, the more attention has to be given to rudder inputs to compensate for adverse yaw.
- Approaches at the higher angles of attack left little time between starting the flare and stall.

Some techniques and things to consider when using an AOA to fly the approach:

- Coordinate the use of pitch and power to fly the approach and landing.
 - **Use PITCH primarily to control the AOA**
 - **Use POWER primarily to control the descent rate.** (Keep in mind how much power it took to maintain altitude)
- A stable approach all the way to the runway is much safer than making radical changes to the AOA or descent rate once an obstacle is cleared.
- **Set a safe standard for yourself using all your experience to set a maximum AOA for any approach and do not let pressures cause you to fly an approach at too high of AOA.**
- When flying in gusty conditions, fly a lower AOA so that when a wind gust changes your angle of attack it does not exceed **your maximum AOA.**
- Having a great new system to indicate angle of attack does not change the laws of physics. Use it as a new tool to fly safe.
- If you are planning to use the AOA to land on a postage stamp, use your excellent judgment skills so you don't have to use your exceptional pilot skills just to survive.

2.8 Post Calibration Testing:

A correctly calibrated Alpha Systems AOA will provide a linear increase in AOA indication as the aircraft slows. The Alpha Systems AOA is not a certified stall warning system. If the aircraft is equipped with a certified stall warning system, the following test must be performed upon completion of the system calibration. This test is to ensure that the final alert is active prior to the stall warning from the certified stall warning system in order to ensure no conflicting information is provided. Ensure during post-calibration testing that the final Alpha Systems AOA alert state is displayed prior to any stall indications.

- Plan a flight to an area where high AOA flight can be performed without any undue hazards (reference § 91.303 & § 91.305).
- Review the stall recovery procedures for your aircraft. If an inadvertent stall occurs, immediately recover from the stall per your training and the aircraft manufacturer's instructions. At no time is a stall required to correctly calibrate or operate the AOA system.
- Acquaint yourself with the Alpha Systems AOA indicator and its functions.
- Preflight and operate the aircraft as you would normally.
- When in an area and at a safe altitude that safe operation at slow flight can be performed and the air is smooth, perform clearing turns to ensure the area is clear.
- Follow the aircraft procedures and slow the aircraft, in the clean configuration (No Flaps).
- Maintain coordination.
- Maintain altitude.
- Monitor the Alpha Systems AOA indicator.
- Slow to just above the stall and ensure that the final Alpha Systems AOA alert state is displayed prior to any stall indications. If any stall warning device activates or an impending aerodynamic stall is imminent, recover immediately using the appropriate procedure for your aircraft.
- Return to normal flight.
- If the aircraft stall warning device activated prior to the final "Too slow Too slow" alert with flashing red arrow repeat the calibration procedure as described in section 4 of this Installation Manual.

We just barely scratched the surface of aerodynamics. If you are interested in learning more, may we suggest obtaining a copy of "The Advanced Pilot's Flight Manual" by William K. Kershner published by Aviation Supplies & Academics, Inc. (ASA).

There is a wealth of knowledge to be found by visiting the FAA's website about flight training information such as what can be found in the Pilot's Handbook of Aeronautical Knowledge. Please visit www.FAA.gov to learn more.

FLY SAFE!

3.1 CONTINUED MAINTENANCE:

Maintenance and upkeep of the Alpha Systems AOA Hawk unit is very simple. All of the aluminum parts have been anodized for maximum protection. There are NO overhaul time requirements.

Probe Maintenance

During calibration, the probe angle was locked with the **BLUE** safety pin plate and secured with the probe mounting bolt. Confirm that the probe is tight; mounted securely and there are no visible cracks in the mounting plate or probe. The inspection plate screws must be secure and the mounting plate shows no sign of wear or cracking around the screw heads. If the probe plate is to be removed, assure hoses and fittings are tight and hoses are inserted completely into connectors and are not kinked. After re-installation assure probe angle is as originally mounted and re-check in-flight calibration set points and other in-flight dynamic values are at the same calibrated colored segment illumination reference points.

Display Maintenance

The Alpha Systems AOA display should be inspected to ensure that it is securely mounted to the instrument panel or glare shield. It should not be loose and all mounting screws should be tight. Each time the AOA is turned on, the unit will illuminate the background and the needle will position at the most counter clockwise position over the red, then smoothly rotate clockwise through the red, blue, and yellow, then to the most clockwise position at the end of the green. Verify the needles full deflection and smooth movements. Verify set-points and the other aerodynamic values are still identical to the calibrated and correlated needle position that had been previously set in flight.

AOA Interface Module (IM) Maintenance

Verify all electrical connectors are completely inserted and all connections are tight. Electrical wires and connections are secure and no cuts or wear is visible on the wire. The AOA Interface Module mounting screws are tight and no cracks or loose brackets are present. Hoses are inserted completely – no kinks, wear, or depressions.

Basically, if you believe that the lines may be blocked, cut or kinked, remove the lines from the AOA IM and blow air from the cockpit **out** towards the probe. This will remove the obstruction and test the lines integrity from the inside of the cockpit out to the AOA probe mount. Verify hoses are intact with no leaks and are not restricted or kinked in any way. If there is any doubt, **DO NOT** rely on the instrument and have a mechanic check on the installation or call the Alpha Systems Company.

Note: *Verify correlation of the needle position to aircrafts AOA. Recalibrate when ANY AOA probe angle changes or adjustments are identified or completed.*

CAUTION: DO NOT BLOW INTO THE PROBE.

If the calibration is in question, **recalibrate as per manual.**

The Hawk AOA display will move a lit needle over a highly visible, colored background with repeated responses to the same aircraft AOA after calibration. Verify as to the calibration procedures contained herein this manual. If the responses are different or don't respond in a smooth transition from the **Cruise** setpoint to **OAA**, and from **OAA** to **Stall**, or with the needle positioned at the most counter-clockwise position at the bottom of the red on the ground, and then a clockwise linear transition through all of the segments until the **Cruise** set point is reached, (needle at the top of the green) **recalibrate.**

If the recalibrations are unsuccessful, have the mechanic inspect ALL installation mounts, tubes, fittings, verify AOA probe holes are clear and hoses are not cut.

**If reattempts at calibrations are unsuccessful,
call Alpha Systems AOA/DepotStar, Inc. for customer service.
763-506-9990**

We appreciate the opportunity to provide an instrument that will aid every pilot with additional information, increasing pilot awareness of lift when in flight. Alpha Systems is committed to support the GA community with innovative solutions and improvements to all of our Angle of Attack Systems.

**Please tell all your friends and fellow pilots about
Alpha Systems AOA!**

“OUR MISSION IS FLYING SAFER”