DYNON AVIONICS

Heated AOA/Pitot Probe

Installation Guide

This product is intended for the experimental aircraft category and is not approved for installation in certified aircraft

Revision B

2/23/2007

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1. INTRODUCTION

Thank you for your purchase of the Dynon's Heated AOA/Pitot Probe. This guide will walk you through the steps to install and calibrate the Heated AOA/Pitot Probe. While the probe will sense standard pitot pressure, allowing it to work with any standard airspeed indicator, its AOA functionality is designed specifically to work with Dynon's EFIS series of products. Do not expect it to work properly with another AOA system.

To ensure accuracy, it is very important that you install the probe correctly and—if using the AOA functionality with a Dynon EFIS-based product—perform the specified calibration steps. We recommend that you read the entire guide before proceeding with the installation.

Dynon's Heated AOA/Pitot Probe is nickel-plated. Do not polish the probe as this will cause the finish to come off.

AOA Calculation: Principles of Operation

The Dynon Avionics AOA/Pitot probe performs two functions: airspeed sensing and angle of attack sensing. These functions require two pressure ports on the tip of the probe. The normal pitot pressure port is on the front face of the probe and is designed to be insensitive to angle of attack. The second pressure port is located on an angled surface just under the pitot port and is designed to be very sensitive to AOA. A Dynon EFIS-based product then uses the difference between these two pressures to calculate the current angle of attack.

Heating: Principles of Operation

This much-anticipated heated version of Dynon's AOA/Pitot Probe utilizes a heating mechanism unlike any other heated pitot on the market. The probe is heated by a high-quality nichrome heating element whose temperature is accurately measured and regulated by a microprocessor-based controller. This controller—located in an enclosure which can be mounted in a wing or elsewhere—regulates the heat at the tip of the probe to a constant temperature. There are several advantages to this, including: lower power consumption, increased heating element lifespan, and a much cooler pitot on the ground when de-icing is not necessary. This unique technique ensures that the pitot can be rapidly de-iced when required, but does not needlessly waste electricity when not in icing conditions.

While the probe does not operate like a normal heated pitot, it will still get fairly hot in normal ambient temperatures. When turned on, it will regulate its internal temperature to about 70°C to 80°C. To ensure that the heater is working, briefly touch the end of the pitot farthest from the snout after 1 minute of operation and verify that it is warm.

Failure Warning

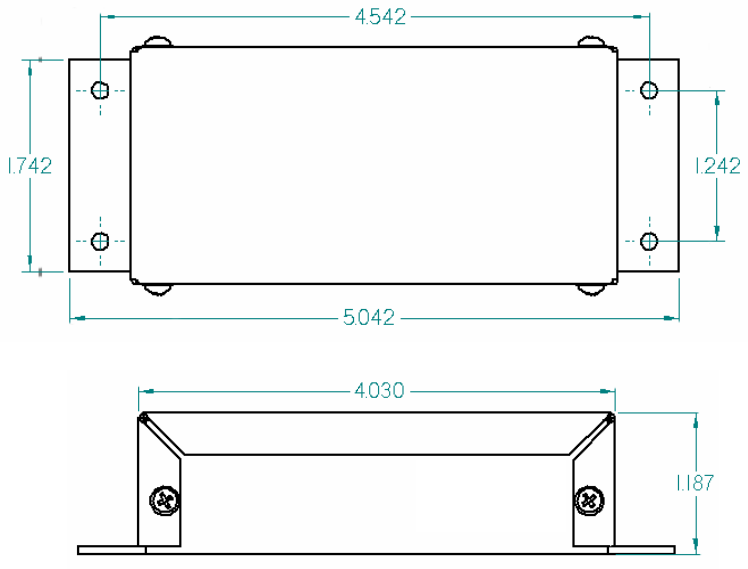
Designed to meet the indication requirements of FAR 23.1326, the heated pitot controller has an output that can trigger a warning light in the cockpit whenever the probe heater is turned off or is not functioning properly. While not required for Experimental and LSA category aircraft, this feature provides peace of mind, giving you instant feedback that your probe's heater is working as designed.

2. HEATER CONTROLLER WIRING AND MOUNTING

Please follow these instructions explicitly as improper installation can result in permanent damage to your device and/or aircraft.

Mounting

The heater controller box should *ideally* be mounted close to the AOA/Pitot Probe. The box's dimensions are found at right, for reference. When mounting the controller close to the probe, ensure that it is close enough for its wires to mate with the probe's, with room for strain-relief. If you find it difficult to mount the controller in the wing, or simply wish for the controller to be mounted closer to the battery, you must extend the lines using the correct wire gauge as described in the Wiring section below.



When the desired location is selected, secure the heater controller via the 4 mounting holes. Route the wiring between the probe, controller, panel, and power source, as described below.

Wiring

RECOMMENDED WIRING PRACTICES

NOTE: For all electrical connections, use correct wiring techniques, taking care to properly insulate any exposed wire. A short circuit between any of the wires may cause damage to the probe, heater controller, or your airplane. Make all connections to the harnesses before plugging it into any of the components of the system. Do not make connections while power is applied at any point in the system.

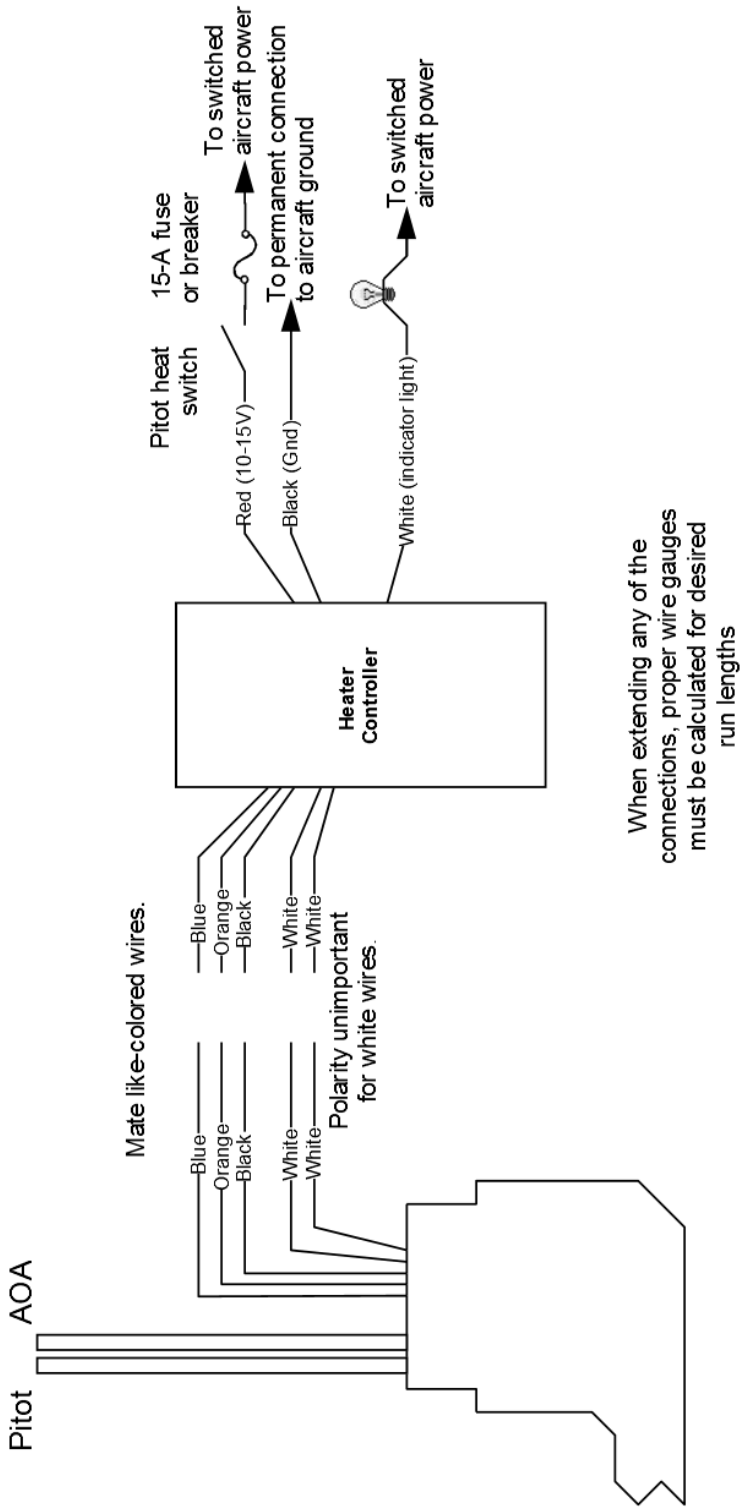
Recommended wire gauge for runs, given 10-amp peak current	
Run length	**Gauge**
0' – 7'	18 AWG
7' – 9'	16 AWG
10' – 16'	14 AWG
17' – 24'	12 AWG
25' – 40'	10 AWG

From FAA AC 43.13-1B, page 11-30

All wires emanating from the probe and the heater controller meet Mil Standard MIL-W-22759/16 (Tefzel insulation). We recommend that all wire you use meets this specification, as well. The wires that run between the probe and heater controller are appropriately sized for their current requirements and lengths. Route all wiring through the aircraft such that there are no spots where it could chafe or break. Use appropriate strain relief at all junctions between wires and connectors. Secure all wires at regular intervals along wiring runs to accommodate vibration effects. Use correctly-sized wire for the length of runs between the battery, heater controller, and probe, as shown in the chart above.

WIRING SYSTEM OVERVIEW

The following block diagram depicts the basic layout of the electrical connections between the probe and heater controller. This diagram should be used in conjunction with detailed instructions on the following pages. Read the specific instructions for each connection prior to installation.



PROBE TO CONTROLLER WIRING

As mentioned above, it is preferable that the heater controller box be mounted near enough to the probe that 5 wires between the controller and probe can be connected without extension. The three mating pairs of colored wires – terminated with fastons – are used to carry the current to the heating element in the probe. The 2 white wires are for temperature measurement, and can thus be small. If you have mounted the heater controller near the probe and do not need to extend the wires between the two, simply plug each wire on the controller into its corresponding like-colored wire from the probe.

If you do need to extend the wires between the probe and the controller, use the recommended wire size (see chart on page 2-1) for the length run you will need. Since extending the wire runs will require that you cut the connectors off the 5 wires between the probe and controller, you should splice the extension wires between the probe and controller using butt splices or other similarly secure method. The white wires are not polarity-dependant. Additionally, as the white wires do not carry any significant current, you may extend them with 26 AWG or larger for any run length.

CONTROLLER POWER WIRING

Three wires—colored red, black, and white—exit the controller for connection to your electrical system. Power (between 10 and 15 volts) is fed to the controller via the red and black wires. The maximum current draw of the heated pitot controller/probe is 10 amps. You must route your own appropriately-sized wires to where the heater controller is mounted. Both power and ground lines should be able to handle 10 amps with minimal voltage drop, as recommended in the chart on page 2-1.

Color	Notes
Red	Connected through a pilot-accessible switch to 10–15V supply. Must handle up to 10 amps.
Black	Must have a constant connection to ground. This is required for the warning light to operate when controller is powered off or not functioning. Line must handle up to 10 amps.
White	Connected to a light bulb (or resistor & LED) tied to switched ship's power. This line is grounded when the heater controller is powered off or not functioning. Connection can handle no more than 1 amp. Current depends on light source connected.

The red wire should be connected through a pilot-accessible switch to the main power source in the aircraft (limited to 15 volts). The switch will allow you to manually turn the heater controller on and off, depending on the situation. Install a 15-amp fuse at any point along the power line to the heater controller. Remember that even when the controller is powered on, it will only heat the probe the amount necessary to maintain temperature.

The black wire should be permanently connected to ground. Cutting power to the heater controller should occur via the red power line, not the black ground line.

HEATER STATUS CONNECTION

Note: The probe heater will function properly whether or not you make this connection. It is simply a status output for your convenience.

The white heater status wire is grounded when the probe heater is turned off or not functioning properly. This wire should be connected to a light on the panel, whose other terminal is connected to switched aircraft power. When the heater is on and functioning properly, the white heater status line will be open, leaving the indicator light turned off. When there is no power to the heater controller—or it is not functioning properly—the white line will be grounded, turning the indicator light on.

Aircraft Spruce p/n 17-410 is an example of a light that will work for this application. An LED and resistor in series will also suffice. If you use an LED as the indicator, you must choose a resistor that delivers the appropriate current to the LED, and can accommodate the power required for its current and voltage drop.

If you own a Dynon EMS-based product, you may also use one of its two contact input to display an onscreen indication. Connect this heater status output directly to the desired EMS contact input, with no additional resistors or lights. You will need to configure the contact display as described in your EMS-based product's Installation Guide.

3. PROBE MOUNTING AND PLUMBING

Tools and Materials Required

- Dynon Avionics Heated AOA/Pitot Probe.
- Two plumbing lines (usually ¼" soft aluminum or plastic tubing) routed from a Dynon EFIS product to the probe mounting location. If using another airspeed indicator, only one plumbing line is needed for pitot pressure.
- Adapters to interface with the 3/16" aluminum tubing from the probe to whatever plumbing lines are installed in the airplane (AN919-2D for 3/16 to ¼ , AN819-4D sleeve AN818-4D nut, AN819-3D sleeve, and AN818-3D nut)
- #36 Drill and 6-32 tap
- Mounting hardware (such as the Gretz Aero pitot mounting kit for the PH502-12CR or AN5812 pitot, available at http://aircraftspruce.com or http://www.gretzaero.com or http://www.safeair1.com) that will allow you to mount the Dynon Avionics AOA/Pitot probe to your airplane.
    - Examples of the mount installation could be found at:
      http://bmnellis.com/WingSkinning3.htm
      http://www.cafes.net/leo/RV-6/Pitot/Pitot.html

Mounting

The Dynon Avionics AOA/Pitot probe has been designed as an under-wing pitot. The following information applies to this type of installation. The heated version of Dynon's AOA/Pitot Probe does not come in a boom-mount configuration. Dimensions can be found on the following page.

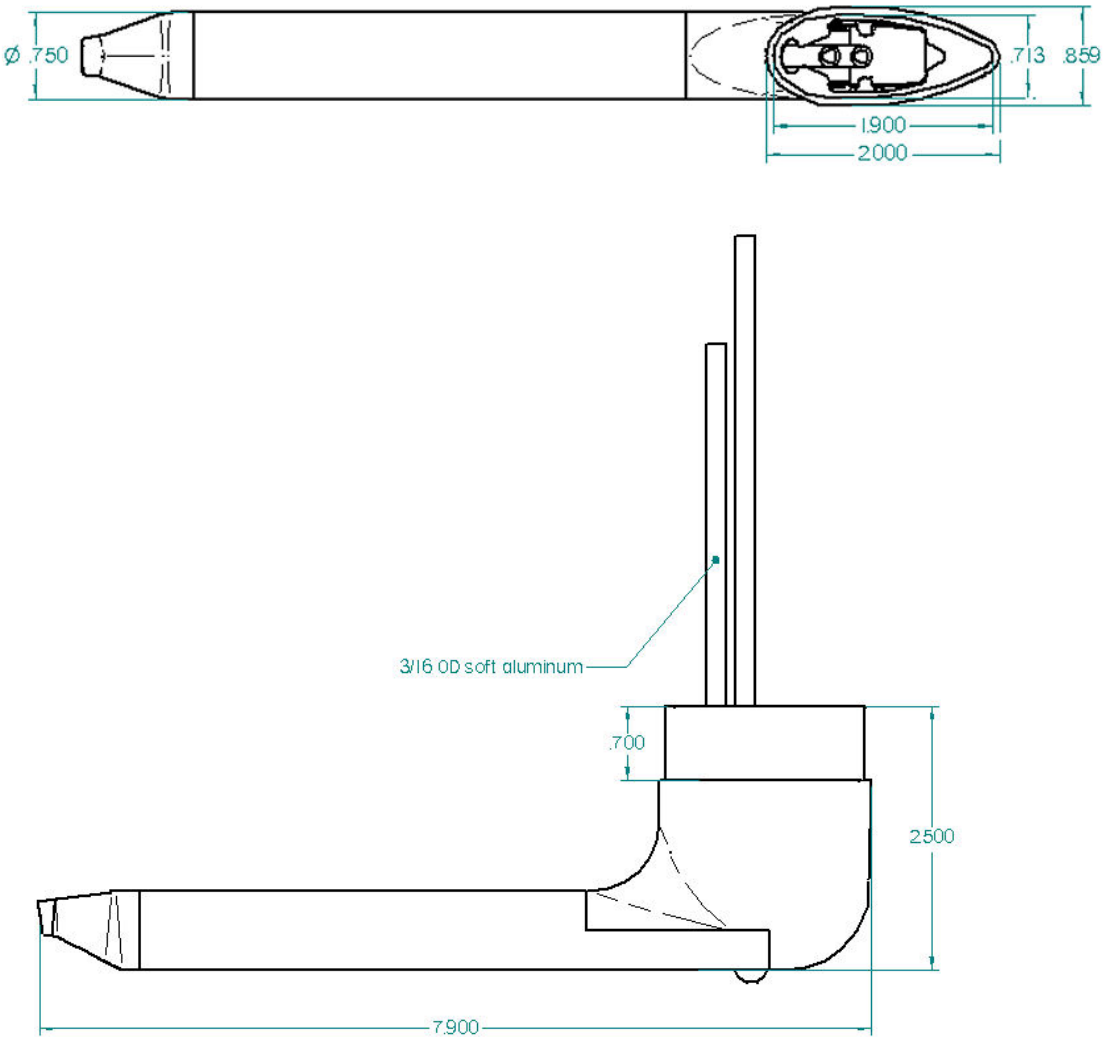
MOUNT LOCATION

The Dynon Avionics AOA/Pitot probe will work correctly only when mounted in a location where the airflow over the probe is relatively undisturbed by the aircraft. In general, we recommend you mount it at least 6 inches below the wing and with the tip of the probe between 2 and 12 inches behind the leading edge of the wing. Typically, pitot probes are mounted about mid-wing span wise to minimize the effects of both the propeller and the wing tips. Testing during the probe development has shown that the standard mounting locations for the pitot probe in the RV series of aircraft also works for the Dynon probe.

MOUNTING INSTRUCTIONS

After the mounting location has been determined, you will need to mount the pitot mounting kit per the included instructions or fabricate your own mount. In either case, mount the probe securely to the wing such that the body of the probe is horizontal during level flight. Drill and tap mounting holes (#6-32) on the probe to match your mounting bracket. Use caution when drilling the holes, ensuring that you avoid drilling into the pitot and AOA pressure lines. As long as you do not penetrate these lines, you may drill all the way through the outer metal without affecting the probe's waterproofing.

Dimensions



Plumbing

NOTE: Because the pitot and AOA plumbing tubes have not been annealed, they will work-harden rapidly when manipulated. Make gentle bends, and only bend any given section **once**.

After mounting the probe, you will need to route the pitot and AOA lines from the probe to your airspeed indicator and/or Dynon EFIS-based product. The tube closest to the snout is the pitot line, while the tube in the rear is the AOA line. There is no static source on the probe.

You will need to install adaptors to connect the 3/16 aluminum plumbing lines from the probe to whatever plumbing lines run back to the instrument (AN 919-2D for 3/16 to ¼). We strongly recommend using aircraft-grade fittings such as standard AN fittings. Make sure the plumbing lines will not chafe or interfere with any aircraft control systems. If you will not be using the AOA port, cap off the AOA tube inside the wing to prevent water from traveling through the tube into the wing.

Pressure Check

Dynon's pitot design deliberately has a pin-sized leak hole in each of the two tubes to permit draining any moisture which might accumulate inside. These holes are located in the middle of the tube at the bottom. Plugging these holes will *not* guarantee a pneumatic seal (although one is sometimes present). The leak that may exist will not affect the performance of the probe. It will, however, need to be taken into account when doing pressure/leak tests on your pitot system.

4. EFIS-BASED CALIBRATION AND CONFIGURATION

As mentioned above, the angle of attack functionality of the probe can only be used with a Dynon EFIS-based product. If you are using your heated pitot with just an airspeed indicator, you may disregard this section.

Calibration

CAUTION: It is your responsibility to fly your plane safely while performing any configuration or calibration in flight. The best scenario would include a second person to perform any necessary steps on the Heated AOA/Pitot Probe.

Once you are flying straight and level at a safe altitude for stalls,

1. Press any button below an EFIS page to bring up the menu.
2. Press MORE to display Main Menu 2.
3. Press SETUP and then MORE twice.
4. Press AOACAL and then you will see the AOA User Calibration Menu.

Once you are in the AOACAL menu, oscillate between ± 5° pitch 4 times at fast cruise airspeed. During this maneuver the EFIS will record the lowest angle of attack that you usually see during flight. You do not need to push any additional buttons before starting this maneuver.

Below you will see a list of the stalls recommended to complete the user calibration. The general idea is to record stall data to find the lowest angle of attack stall. The list we have suggested is a good starting point and will produce a good calibration under most circumstances. However, if there are different flight regimes that are not listed that you suspect would create stalls at lower angle of attack it would be good to record those as well.

- With full power, no flaps
- With no power, no flaps
- With full power, full flaps
- With no power, full flaps

For each stall, you need to first push the STALL button. When you push the STALL button, a 45-second timer will start. Notice the "T" next to the time that is counting down. During the 45 seconds that the timer is counting down, you are expected to have completed the stall maneuver. If any stall maneuver is not completed before the timer expires, the calibration will be invalid, and should be reset. In order to do this, push the CANCEL button. This will exit the AOACAL menu, and you will have to re-enter the AOACAL menu to perform the calibration. **After completing the stall, make sure you let the 45 second timer count down to 0 before you push the STALL button for the next stall.**

When the listed stall maneuvers have been completed according to the above procedure, push FINISH. At this point, the angle of attack has been calibrated. If it is not visible, make it visible through the menu system (see "Show/hide display items" in Heated AOA/Pitot Probe Pilot's User Guide). This calibration should result in the lowest angle of attack stall occurring just above the red/yellow boundary. If this is not the case, please perform the AOA user calibration again,

including flight configurations that resulted in stalls with incorrect indications. If the user calibration continues to be unsuccessful, please contact Dynon Avionics technical support.

Alarm Setup

Once the AOA/Pitot probe is calibrated with your EFIS-based product, you may configure an audible alarm at various angles of attack. For information on connecting the intercom audio out signal, refer to the Installation Guide that came with your EFIS product.

Enter the EFIS menu by pressing any button (except the leftmost or rightmost buttons) beneath an EFIS page. Press MORE > SETUP > MORE > MORE > MORE > AOAALM. In that menu, press any of the four buttons beneath the AUDIO label to select the point on the AOA bar at which you wish the alarm to sound. Some of the alarms—the ones that begin with "START AT"—are progressive, meaning the audio alert gets more intense as your angle of attack increases. You may set these progressive alarms to start at the top, middle, or bottom of the yellow section of the AOA bar.

5. SPECIFICATIONS

Pitot

Weight:..... 7 oz. (200 g)

Tubing Connection: ..... 3/16” OD

Pitot Mounting: ..... AN5812 type mast *(not provided)*

Moisture Protection:..... Dedicated drain hole provided for each line

Finish: ..... Nickel-plated

Operating Temperature: ..... -60°C to 100°C

Controller

Weight:..... 5 oz. (140 g)

Power: ..... 100 watts @ nominal 13.8 V

Operating Temperature: ..... -40°C to 70°C