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## This month's contributors:

**David Cyr**

## Newsletter, March 2017

### Notice of Meeting:

Thursday, March 31, 2017 at 7:30 PM.

Topics include ...

**AIRSHIPS:** Christian Schulthess, founder and Joint owner of Skyship Cruise AG and Skycruise Switzerland ( From 1996 to 2010) will describe the operations of the Company(s) that took passengers over the Swiss Alps and had two Skyships 600 B at the Athens 2004 Olympics.

### BLACKSHAPE AIRCRAFT:

Nicholas Horn, a Dealer for Blackshape Aircraft (Eastern US and Canada) from Lachute Airport (CSE4), will speak about the Blackshape Prime Aircraft, along with the BK 160. The Prime Aircraft is a High Technology Performance tandem (2 seat) Aircraft, featuring a full carbon fiber frame from Italy.

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**A word from our Chapter President...****Mike Lustig**

Dear Members,

Thanks to everyone who showed up to the February 2017 meeting, which was exceptionally well attended! We enjoyed a presentation by Francois Vrana and Luc Martineau of Lachute Aviation about their aerobatic training program. Included were some thrilling GoPro videos of actual training sessions involving some unbelievably complex aerobatic manoeuvres.

This month's meeting promises to be equally, if not more entertaining; a double-header by two very special presenters: Christian Schulthess and Nicholas Horn. Both these gentlemen are outstanding aviators with tales to tell of a distinctly European flavour.

Important local news to be aware of:

The Annual General meeting of the Aeroclub Saint-Lazare Flying Club will be held Tuesday, April 18th, 2017. Location:

Casa Grecque Vaudreuil, 110A, rue Joseph-Carrier, Vaudreuil, QC J7V 5V5

Meet and greet at 18:00; supper and elections at 19:00.

For further info, contact Leo Nikkinen, President ASLFC

[leo49@videotron.ca](mailto:leo49@videotron.ca) , 450-424-6355.

New this month for our March meeting:

By popular demand, decaffeinated coffee will be available for the first time at break time, as well as our usual ever-popular Van Houtte Columbian Dark, both for the remarkably low price of \$1.00 per cup, brewed while you wait.

Best Regards to All,

Mike Lustig

President, EAA 266

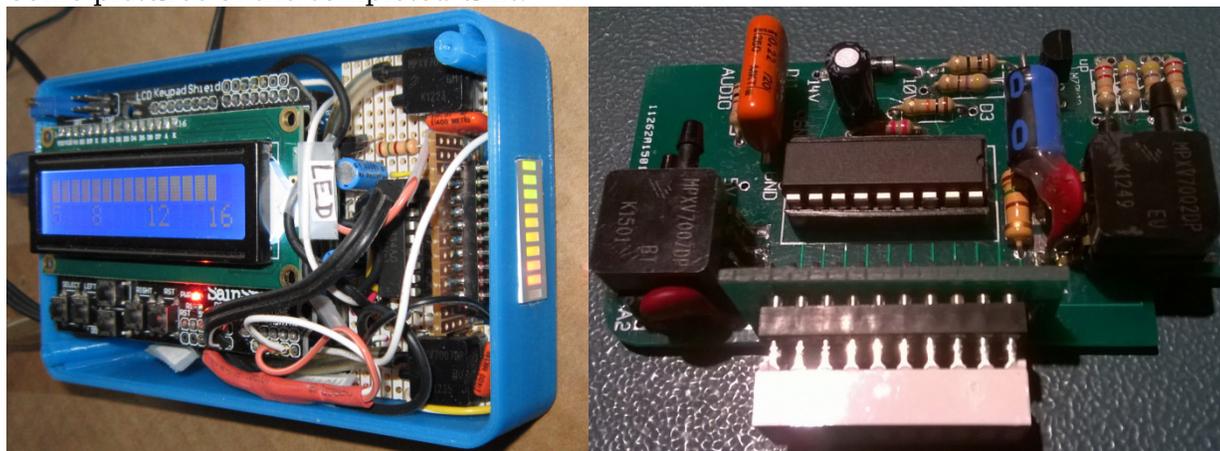
**A word from our Editor****Richard Guevara**

As I try to stay on top of all the amazing stuff that is happening in our sport, I realize more and more that I am in danger of losing focus from building an airplane to building cool gizmos that I can put on my airplane. For example, there are open source avionics packages, affordable glass cockpits, DIY radar altimeter projects, electronic engine management controller projects, flight management systems, amazing affordable and good sensors, and on and on. Don't even get me started on electric propulsion. But there are more mundane considerations of being a builder, such as, do I drill the holes in the bracket before or after I bend it? Or what thickness of 6061-T6 tubing wall gives the same strength as a 0.058 wall 2024-T3 and how much heavier will it be? Why is good plywood so hard to find and so expensive? I have been told by many people that the big sin in homebuilding is not adhering to the weight budget and ending up in a homebuilt category where you don't belong with an aircraft that really is not fun to fly. That being said, I will be very careful to establish some kind of weight budget and stick to it, and I will have a basic, reliable and lightweight electrical system. And, oh yes, I will have at least one fun, geeky thing (that no one else owns) connected to it.

We present the third part of a five part series on a novel AOA Sensor that was presented at the October 2016 EAA 266 meeting. This month we cover:

### Troubleshooting.

Some pictures of the completed unit:



#### A brief review of Part I:

This Angle of Attack indicator was designed for use on a Lancair 360 that has a Dynon heated Pitot probe. The probe also has an angle of attack port to allow display of AoA; but only with a Dynon EFIS. The Grand Rapids EFIS on the Lancair panel does not support this Pitot/AoA probe, so a standalone indicator was designed using the Dynon probe. However, it will function with any other similar Pitot/AoA probe.

#### A brief review of Part II:

The AoA indicator needs to be calibrated to properly respond to an approaching stall as well as show the current angle of attack on the LED display. In order to make it configurable for any aircraft personality, it requires setting some data points on the ground and some in flight. If you have flaps, you need to make some assumptions of your typical landing configuration, and if you do not have flaps, the calibration is very straightforward. It should be noted that the display and LED will not show meaningful results until the flight and stall characteristics have been properly entered into the AoA indicator.

#### Troubleshooting and Miscellaneous:

The AoA Indicator will show random and meaningless results on the LED until calibration is performed.

The LED will indicate errors by pulsing at the rate of 4 pulses per second followed by a half second pause as follows:

- 1 pulse followed by a half second delay – Pitot pressure lost
- 2 pulses – this indicates an “out of range” condition, usually due a problem with either the Pitot pressure or the AoA pressure. The calculation of AoA is not within the normal range of zero to 25 degrees angle of attack. There is the possibility that the Pitot/AoA probe is getting higher pressure in the AoA port than the Pitot port, which means the probe might be pointing too high off the horizontal.
- 3 pulses – AoA pressure lost

NOTE: While stationary on the ground, the LED will show a default 10 degree AoA. This indicates the unit is ON, but no meaningful information is available for display.

**Miscellaneous Information:**

The permanent memory (EEPROM) on the Arduino microcontroller is used to store the flight characteristics of your aircraft and has been set to integer zeros. That is, bytes 0 and 1 will contain an integer value of zero, followed by an integer of zero in bytes 2 and 3, etc. This memory will be updated during calibration.

Reference Material: Flying Magazine published an article by Dale Smith, on March 17, 2016, describing the AoA indicator referring to the parameters that should be monitored to give the true angle of attack and also the need for full familiarization with the indicator to make it a useful addition to flight safety.

**Other interesting but non-essential information:**

Effect of flaps on Stall AoA: This chart is an extract from a document available on the Internet. Search for “Absolute Angle of Attack - NAR Associates”. It shows the relationship between flap extension and stall angle of attack. As flaps are deployed, the angle of attack from the pilot’s perspective will decrease.

The EEPROM Arduino should be set up with sample data in EEPROM and the rest of EEPROM memory set to -1 or some other consistent value so the flaps logic won’t produce false indications until the process until flaps extension time has been set up, or left alone if no flaps.

**ABSOLUTE VERSUS GEOMETRIC ANGLE of ATTACK**

There are many discussions about the definition of AoA and whether or not it changes with flaps deployed. For purposes of this discussion, we assume AoA decreases with flaps down because if we did not compensate for flaps, the aircraft would stall before the AoA indicator would show an impending stall. An example of such a discussion is found at:

<http://www.pprune.org/flying-instructors-examiners/153457-angle-attack.html>

We are free to choose how the angle-of-attack reference stick is aligned relative to the rest of the wing. Throughout this book, See How It Flies by John Denker, we choose to align the reference with the zero-lift direction. That means that zero angle of attack corresponds to zero coefficient of lift. According to the standard terminology, the angle measured in this way is called the absolute angle of attack.

Some other books try to align the reference with the chord line of the wing. The angle measured in this way is called the geometric angle of attack.

If you try to compare books, there is potential for confusion, because this book uses “angle of attack” as shorthand for absolute angle of attack, while some other books use the same words as shorthand for other things, commonly geometric angle of attack. To make sense when comparing books, you must avoid shorthand and use the fully explicit terms. In particular, to convert from one system to another:

Absolute angle of attack = geometric angle of attack + k

Geometric angle of attack = absolute angle of attack - k

where  $-k$  is the X-intercept of the graph of the coefficient of lift according to the “geometric” scheme, in which the angle is measured relative to the chord line. The X-intercept is always zero in this book.

Also note that there are many possibilities, not just absolute versus geometric; the choice of reference is really quite arbitrary. It is perfectly valid to measure angles relative to any reference you choose, provided you are consistent about it. Aligning the reference stick with the fuselage is useful in some situations [This is most useful when talking about an AoA indicator that is in a fixed location on the aircraft].

Using the chord as a reference works OK if you are only talking about one section of a plain wing. On the other hand: On typical airplanes, the chord of the wing tip is oriented differently from the chord of the wing root. Which one should be considered “the” reference? When you extend the flaps, the chord line changes. Most books that choose to measure angle of attack relative to the chord line violate their own rules when the flaps are extended, and continue to measure angles relative to where the chord of the unflapped wing would have been. That is illogical and creates confusion about how you should use the flaps. This is one of the reasons why it is advantageous to think in terms of absolute rather than geometric angle of attack. Thinking about geometric angle of attack would be advantageous if you were building an airplane, or conducting wind-tunnel research on wing sections. Engineers can look at a wing section and determine the geometric angle of attack.

In contrast, if you are piloting the airplane, geometric angle of attack has no advantages and several big disadvantages: it’s hard to define, it’s hard to perceive, and it doesn’t tell you what you need to know anyway! We care about coefficient of lift, which is proportional to absolute angle of attack over a wide range (i.e. not too close to the stall). Each degree of angle of attack is worth about 0.1 units of coefficient of lift.

The simple rule “pitch plus incidence equals angle of attack plus angle of incidence” is always mathematically valid, no matter what reference you’re using to measure angle of attack. (That’s because the arbitrariness in the angle of incidence cancels the arbitrariness in the angle of attack.) But if you want the rule to be useful in the cockpit, especially in situations where flap settings are changing (as discussed in section 5.5), you need to focus on absolute angle of attack.

#### Summary

Trim for angle of attack! Trim for angle of attack!

Pitch attitude is not the same as angle of attack. Angle of attack is what really matters. You can observe pitch attitude and direction of flight as a means for controlling angle of attack.

The airspeed indicator gives you quantitative information about angle of attack (except near the stall). If the aircraft is producing a non-standard amount of lift, many (but not all) of the critical V-numbers must be corrected. The percentage change in speed is half the percentage change in weight.

A previous contributor to this thread has already posted the link to John Denkers book and for those who doubt the value of Slots and the re-energizing of airflow may also wish to give it at least a fleeting a glance.

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#### Contact Us!

<http://eaa266.org>

While that may be "simple" and self-consistent as a convention, it is not the way that aerodynamicists treat flap.

The convention in the classic texts (such as Abbott and von Doenhoff) is to use the chord line of the aerofoil with flap retracted as the zero of angle of attack. This has the advantage that the zero reference does not change relative to the aircraft geometry when configuration changes.

Using that convention, trailing-edge flap extension increases the maximum lift coefficient but tends to reduce the AoA at which that maximum occurs. Leading edge device extension also increases the maximum lift coefficient and tends to increase the AoA at which that maximum occurs.

Next month (April) we will cover the technical aspects of this device in some detail.

#### **Next Month ...**

Next month we start a multi-part article by Charles Peter Colomello that sheds some light on the coloured past of the New Standard D-25 aircraft in its role as a rum hauling mule around the time of prohibition in the United States.

The EAA 266 library contains a collection of books and DVDs that cover aircraft in general, homebuilding construction techniques, local events, history and Technical Manuals.

**To order books - Call Ed Hannaford  
613-347-1201 e-mail [Skyranch33@gmail.com](mailto:Skyranch33@gmail.com)  
Cost to borrow these items is \$2.00 for a one month period**

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**Seeking:** Looking for partner (or partners) to purchase a small (2-4 place) airplane. Would consider factory or home-built, tricycle or tail wheel. Robert Hope, [roberthope530@gmail.com](mailto:roberthope530@gmail.com)

**For Sale:** Hangar doors (sliding) complete with rails for 40-foot hangar. Door height is 11'5½" all metal. As removed from hangar at Cornwall. \$1200.00. Ed Hannaford.

[skyranch33@sympatico.ca](mailto:skyranch33@sympatico.ca)

**For Sale:** 1 ea. H-Type shoulder harness 2 inch, black with metal to metal fittings. New never used, from Aircraft Spruce, no lap belts, \$100.00. [skyranch33@sympatico.ca](mailto:skyranch33@sympatico.ca)

**For donation:** Vari-Viggen Rutan, designed by Burt Rutan inspired by the SAAB 37 Viggen. It is 60% complete with almost everything you need to complete except the engine and the propeller. Located at the airport of Louiseville, QC CSJ4. Gaston Girard (438) 495-5253

**Seeking:** Active aircraft builder looking for old projects or materials. Specialized in old wood aircraft and restoration. Ron Gosselin (514) 808-1808 - [ronny@total.net](mailto:ronny@total.net)

**For Sale:** Landing lights, 50W, 24V, 20\$ each, Frank Grayer (613) 874-2837.



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