EAA 266

Experimental Aircraft Association Chapter 266, Montreal Canada

The Leader In Recreational Aviation

In this Issue:

Newsletter, January 2017

Notice of Meeting:
Thursday, January 26, 2017 at 7:30 PM

Topic:
Frank Hofmann will present. The history of Ultralights and their developing regulations will be traced. Design standards will be explained.

Location:
Room 204, Penfield Building
John Abbott College
Ste. Anne de Bellevue

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David Cyr

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Check out our website at: http://eaa266.org

A word from our Chapter President... Mike Lustig

Dear Members,
On December 15, 2016, our annual Christmas Dinner was held at the Casa Grecque Vaudreuil. The St. Lazare Flying Club was invited as well and they turned out in impressive numbers! Nick Wolochatiuk, renowned aerial photographer entertained us with his stunning work. Thanks to Nick and everyone who contributed to the success of this event.

Don't have too much to say this month, except that we have a fantastic program lined up so far for 2017, with all the presenter spots filled up until May.

Snow covering on fields seems light for this point in the winter (Ground Hog Day about a week away) and fuel prices are looking good also (surplus oil production), so reasonably good hope for a long and economical 2017 flying season!

Best Regards to All,

Mike Lustig

President

A word from our Editor — Richard Guevara

Over the holidays, I have been studying (again) Alex Strojnik's three well known books: Low Power Laminar Aircraft Technologies (1993), Low power Laminar Aircraft Design (1983) and Low Power Laminar Aircraft Structures (1995). He proposes (and shows to some extent) that if you build an aircraft with the right laminar profile and shapes, you get to go very fast on a surprisingly small engine, which got my attention. If you look at most aircraft design textbooks, (example: Airplane Design Parts 1-8 by Jan Roskam) you will find many references to some parameter from any of the ubiquitous tractor configurations that exist: a wing loading "like a Cessna 150", a tail volume "like a Piper Cub", and so on. For aircraft designed with laminar flow in mind, there are not nearly as many examples around to refer to, which is a shame. The books are filled with some things that I understand (the formula for the bending moment in a cantilever beam) to some things I have no clue about (how to prepare a 6061-T6 square tube to be adhesed to a composite structural board. He continually talks about a small group of about a half dozen laminar flow airfoils that he compares relentlessly from many viewpoints. The books present many valuable gems of information and insight that serve as the puzzle pieces that you put together to make a quilt of you own choosing. Originally I was thinking of changing the airfoil on my VP1, from the designer's choice of a modified NACA 4412 to a laminar flow airfoil such as the FX67-K-170 or the NASA GA(W)-1, but these books also underline the fact that in aircraft design, when you rob Peter you must pay Paul, and Paul is not to be trifled with because he can pay you back by ways and means that you never thought of.

Angle of Attack Sensor, Part I — by David Cyr

We present the first part of a five part series on a novel AOA Sensor that was presented at the October 2016 EAA 266 meeting.

Introduction:
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. E.g.

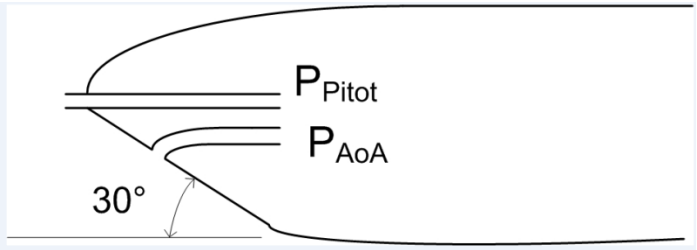
Note the small hole on the bevelled lower face of the Pitot probe

Some lift reserve and AoA indicators do not take into account the speed of the aircraft, even though an aircraft can stall at a much higher airspeed than the "advertised" or understood stall speed if it is heavily loaded or flying with high "G" loading, as in a steep turn or pulling hard out of a dive. This AoA indicator will show the true angle of attack at any speed within the operating range that does not exceed the "G limit" of the aircraft. It is the actual angle of attack that determines when the aircraft stalls, not its velocity

To determine the AoA, a micro controller with two differential pressure sensors drive a 10-segment LED on the instrument panel and an audible stall warning in the aircraft radio/intercom sound system.

The Arduino micro controller and an LCD display/keyboard with a few buttons are used to calibrate the indicator so that it will show an increasing angle of attack from a chosen base angle, such as AoA at cruise, up to the point of stall. The base point can also be set to a midpoint such that the 10-segment LED will cover the flight envelope closer to the stall point. This will give a more refined sense of proximity to an approaching stall.

Theory of Operation:
The Pitot probe has a second port below and behind the tip on an angled surface as shown in the diagram below; e.g. the Dynon Angle of Attack Pitot probe (that can be mounted on a PBK-12 Paintable GRETZ Bracket). As the AoA increases, the pressure in the AoA port increases and it is the ratio of the AoA pressure to the Pitot pressure that determines the angle of attack



P_{Pitot} = Pitot pressure P_{AoA} = Angle of Attack pressure

$P = \frac{1}{2} \rho V^2$ where ρ is air density and V is velocity

The formula for air pressure as a function of speed is:
angle of attack. The cosine is involved because the Pitot angle into the oncoming air changes with AoA

$P_{AoA} = \frac{1}{2} \rho (V \sin^2(30° + \theta))$ or
$P_{Pitot} = \frac{1}{2} \rho (V \cos\theta)^2$

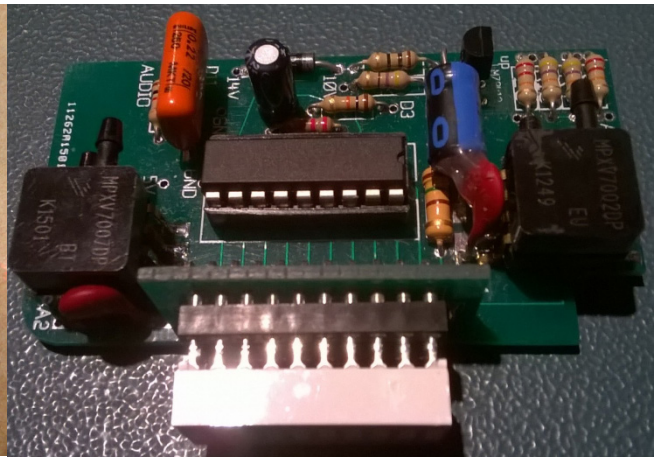
where θ (theta) is the actual $\cos^2(60° - \theta)$

where the surface with the AoA port is 60° "out of the wind"

$P_{AoA} / P_{Pitot} = \sin^2(30° + \theta) / \cos^2\theta$ or $\cos^2(60° - \theta) / \cos^2\theta$

We can measure both PAoA and PPitot with differential pressure sensors. An MPXV7002 Differential Pressure Sensor measures up to 2 kPa for the AoA port and an MPXV7007 is rated to 7 kPa or 232 mph for Pitot pressure. Now since we don't the 10-segment LED display along with an audible warning in the headset. develop the formula for θ (angle of attack), or we can iteratively substitute the value of θ to match the pressure ratio of PAoA / PPitot . So we propose an angle and compute the pressure ratio PAoA / PPitot and compare this to the measured value from the pressure sensors. If the difference is positive, we subtract a portion of the error from the proposed AoA and recalculate the pressure ratio. If the difference is negative, we add… After several iterations, we converge on the true AoA. This result is displayed on the 10-segment LED display along with an audible warning in the headset.

This method of calculating AoA is independent of air density, temperature, altitude, etc, because the wings and the pressure probes "see" the air the same way. Thus no compensation is required for any of these variables.



Next month we will continue with calibration of the AoA Sensor.

EAA 266 Library — Ed Hannaford

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
Cost to borrow these items is $2.00 for a one month period

The Unclassified Classified — Free Ads for Paid-Up Members

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

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

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

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

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

Please note: Graham's email has changed to graham@flyairprestige.com.