PLANE TALK **GREENHORN CHAPTER 808 EAA**

MEETING: SECOND WEDNESDAY EACH MONTH 7:15 PM, FREMONT COUNTY AIRPORT, East of Canon City, CO on Highway 50. ANNEX BUILDING #2. BREAKFAST EACH SUNDAY MORNING 9:00 AM SPITFIRE Grill at PUEBLO MEMORIAL AIRPORT TERMINAL BUILDING.

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WEBPAGE ADDRESS: WWW.EAA808.0RG LOOK IT OVER!!!

Dues: **$15.00 a year**; due **June 1** of each year, **$20.00** if not received by **July 1st**. Mail to: Leonard Mino, 2013 Hesperus Dr. Pueblo West, CO 81007

Randy's Shop Notes

Happy New Year Folks, I hope this new year brings your dreams and aspirations and projects closer to flight. As all of us struggle to keep the staggering economy and uncertain political environment in focus, we can rely on the solid feel of brushing against your airplanes wing. You know beyond a shadow of doubt, that at 60 knots the wing will come alive and the plane will feel like a race horse yearning to be free of the gate. A tiny nudge on the stick and you are free of the earth, free of the traffic, free of stop lights that always turn red just as you shift into high gear. You know just as surely that 70 knots will give you the best climb, and the ground drops away below that same wing that was a pile of metal and rivets not long ago. I could just hold that 70 knots and 1500 feet per minute for five minutes and hear the rustling of angel wings at close to 13,000 feet. At that altitude, the front range becomes a line of white capped giants marching north and south as far as you can see. With no oxygen on board, it's not a good idea to chase the clouds at that height. The wonderful thing about flying is the many certain, solid results that your airplane gives you in response to your practiced inputs. Your creation talks to your thru cable and tube and bearings and aluminum formed into a flying thing. She doesn't lie, deceive, fib or tell you untruths. Everything is honest and up front. There is no hidden agenda, or conspiracy unless you have neglected her and let all those little details to keep her safe and flying go forgotten or procrastinated.

That honesty and pure feeling of freedom is why I fly, build and restore these wonderful machines. I know that many of you share these same feelings and thats why we enjoy being a part of such a great big bunch of people who feel that way, called the EAA. I know some parts of this great big group don't always see things the same way, but we all love flying and things that fly. I would love to see our little group of EAA'rs grow this year as we strive to include more people that love to fly and things that fly. I believe we need to get more of our friends aware of our group and wonderful sport. Just talk about what your doing, or what you did, and the interest will be expressed. We also could use some sort of magnet to draw junior birdmen and women into the group. Young Eagles is a great taste of flight, but there is so much more. I am open to suggestions and am investigating other chapters and what they do to encourage participation from all ages. I would love to have evenings where we could visit or see some of the other projects happening in our chapter, and get an update on their progress every month at our meetings. Thanks for such a great showing at the Christmas party! I heard a lot of good comments about the food and the fun evening. Your entertainment was free, so there should be no complaints about that. I hope to see many of you at our meeting the second Wednesday of January. Randy

Upcoming Events

January 14th – EAA 808 Chapter Meeting, Fremont County Airport

February 11th – EAA 808 Chapter Meeting, Fremont County Airport

Minutes From The Last Meeting

There was no meeting held in December, as the chapter Christmas Party took it's place. No pictures or reports on the party have been received at this time.

Tips 'N Tricks

This month we are beginning a 4 part series on airfoils by Chris Heintz of Zenith Aircraft. This presentation is available both from the EAA website and from http://www.exp-aircraft.com

About the author, Chris Heintz

Aeronautical engineer Chris Heintz, the designer of Zenith Aircraft Company's line of kit aircraft, is one of the most qualified and knowledgable light aircraft designers today. With prior experience from Aerospatiale, de Havilland, and Avions Robin (France), Heintz has designed and introduced more than 12 successful kit aircraft designs. Recently, the ZENITH CH 2000 design was put into production as a standard FAA type-certificated production aircraft.

Heintz regularly shares his design and construction expertise as a speaker to aviation groups and students of aeronautical engineering, and is a regular speaker at both the EAA Oshkosh and Sun'n Fun fly-in conventions. An aeronautical engineer, Heintz has the unique ability of being able to simplify design concepts and to clearly explain and illustrate light aircraft design and construction.

Chris Heintz' articles were published in the Experimental Aircraft Association's (EAA) Light Plane World or Experimenter publications.

AIRFOILS

By Chris Heintz

Part 1

We have to keep in mind that the airfoil of our flying surfaces is only one variable of the many components which makes our airplanes fly well - or not so well - in a range of possible configurations. When we do an investigation of any part of our aircraft we must not look at this part as THE solution, rather we must always remember that it is only one part of a whole. Analysis is necessary; but only a synthetic view will give us the whole picture. It is a bit like somebody trying to understand the human body by studying the skeleton only, or the chemicals of the body only, etc.: the failure of modern medicine comes from this fact. Scientists look at the parts of a corpse and decide they know something about a living body!

But, let us go back to something less serious (!?!) and look at the airfoil or wing section of our airplane in such a way that we will have a little better understanding of how our aircraft flies.

Relative Motion

Today it is universally accepted that an airfoil in motion through still air and air blowing over a stationary airfoil have the same effects. This was not the case in scientific circles some 120 years ago, but now is common knowledge, and justifies the wind tunnel tests where true air flows over an airfoil and from which we can predict characteristics of an airplane moving through still air. The important thing is the relative speed of airfoil and air.

Reynolds Numbers

Early investigations into the theory of fluid dynamics have predicted a certain number of constants to which similar disturbances (and an airfoil in the air is a disturbance) produce similar effects - in hydrodynamics, these are referred to as 'Froude Numbers" (hulls of boats); in high speed aerodynamics the "Mach Number' are other examples. For our smaller and slower aircraft, the only "number" which really needs to be considered is the "Reynolds Number" and it is defined as:

Re = **V** x **I / v**

Where:
V = Relative speed (m/sec)
I = typical "length" of a solid body (M)
v = cinematic viscosity of the air (sec/m^2)

Re is a dimensionless number, which makes it independent of the measuring systems. The cinematic viscosity is to a certain extent dependent on the density of the air, but for our aircraft flying below 12,000 ft., it can be assumed constant (equivalent to 15×10^6 sec/m^2 in metric).

The speed can easily be converted to metric:
1 mph = 1.15 Kts. = 1.61 km/h = 1.61 / 3.6 m/s = .45 m/sec.

The same applies to the length:

1 ft. = .305 m.

Our small aircraft have a wing chord, which is the "length" to use when talking about airfoils, of some 5 ft. equivalent to 1.5 m.

Thus the Reynolds number simplifies to:

Re = (.45 x vmph x 1.5) / (15×10^{-6}) = 4.5 vmph

or at stall speed of **50 mph: Re = 1.8×10^6** (you know that 10^6 = 1,000,000 = 1 million).

Keep in mind the above values are for a 5 ft. chord. For a 2-1/2 ft. chord typical of tail surfaces or the tip of a tapered wing, the **Re** will be only 1/2 above values.

If the air is looked at, not as a continuous medium, but composed of small balls (the molecules of modern physics), there is obviously an average distance between those balls. The Reynolds number is then nothing else than the relation between the typical solid body length to this average distance between the molecules of the air in which the solid is moving.

As long as this Reynolds number is between the values of .4 x 10^6 (400,000) and some 10 X 10^6 (ten million) what we will say about airfoils will apply.

Note that for smaller **Re** (say 10,000 to 400,000, which is the range for radio controlled models and smaller windmills), other lows apply; however, we will not consider these numbers in this present set of articles which deal with light planes. The same applies at very large Reynolds numbers, which are practically associated with Mach numbers larger than .3, where the compressibility of the air can no longer be neglected as it is in classic aerodynamics which considers the air as an incompressible, continuous medium.

Boundary Layer

When the air hits the airfoil leading edge it will separate into the upper and lower airstream, which meets again at the trailing edge. (See Figure 1).

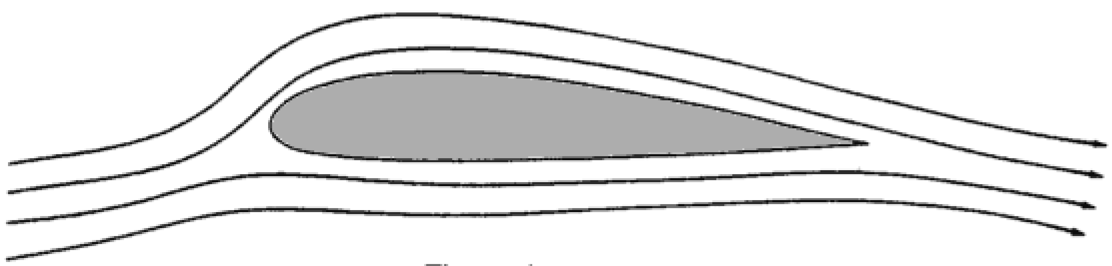

Figure 1

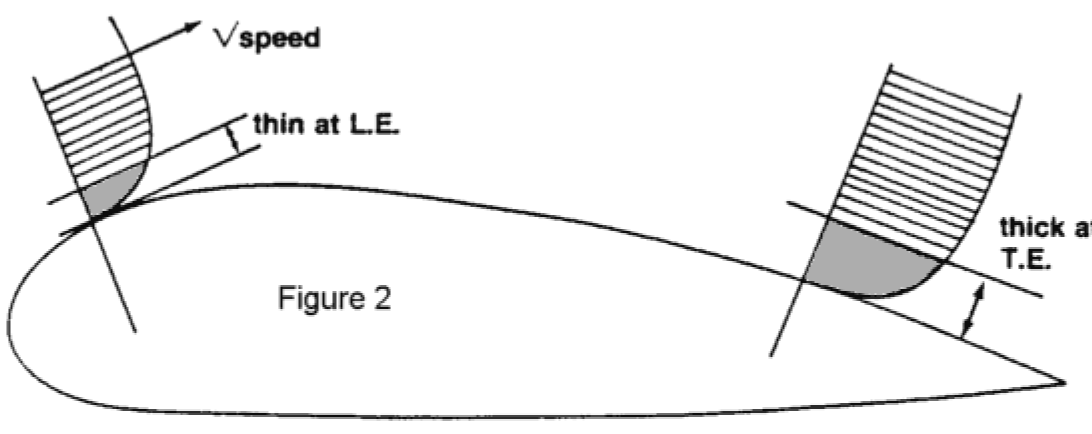

Figure 2

It is obvious that the air very close to the airfoil "rubs" against the solid surface and is slowed down. In other words, starting downstream of the impact point, the air loses some of its momentum, or velocity. And it loses more and more as we follow it along the path close to the solid airfoil. We can see that friction creates an area where there is less speed. The reduced speed area just outside of the airfoil becomes thicker and thicker as we follow it from the leading edge to the trailing edge. This area is called the *boundary layer.* Its thickness is increasing as described and is defined as the thickness at which the local free stream speed is finally reached. (See Figure 2). A typical boundary layer thickness is 1/2" near the trailing edge. The friction, which obviously, is a loss, results in the friction drag of the airfoil.

Again the theory of fluid dynamics shows that there are two possible types of stable boundary layers:

The first, to build up, is called 'laminar" because the flow is nice and steady and the friction drag is relatively low.

The second is called 'turbulent" because the flow is rather rough and the friction drag is higher.

The unfortunate thing is that the "laminar boundary layer" will automatically become turbulent (with associated higher drag) close to the leading edge of the airfoil unless very special precautions are taken. These precautions are:

A very smooth airfoil surface: Slight construction defects (or bugs as they stick to the airfoil leading edge) will change the laminar boundary layer into a turbulent one. Unless you have a perfect airfoil *and keep it this way* forget about the gain possible with a laminar flow!

A special shape of the airfoil: The pressure distribution on the airfoil is related to the airfoil shape. Today we can calculate (with high speed computers) airfoils which maximize the length of the laminar boundary layer. Still, what is mentioned in a) applies. But, do not get desperate. The friction drag of the airfoil with a laminar boundary layer is .08, whereas in turbulent flow it becomes .12. Sure, this is a 50% increase but only on the friction drag of the airfoil. The other drag contributions are airfoil shape, wind induced drag, tail drag, fuselage and landing gear drag, interference drag, cooling drag and a few more. Your aircraft will never go 50% faster just by changing the airfoil - at the very best, you may gain a few (3 to 5) percentage points.

Airfoil Design and Geometry

I will simply refer you to a very good (and understandable) book, *Theory of Wing Sections* by Ira Abbott and Albert Von Doenhoff (Dover, 1959), available as a reprint from EAA. Get your copy and study it a bit.