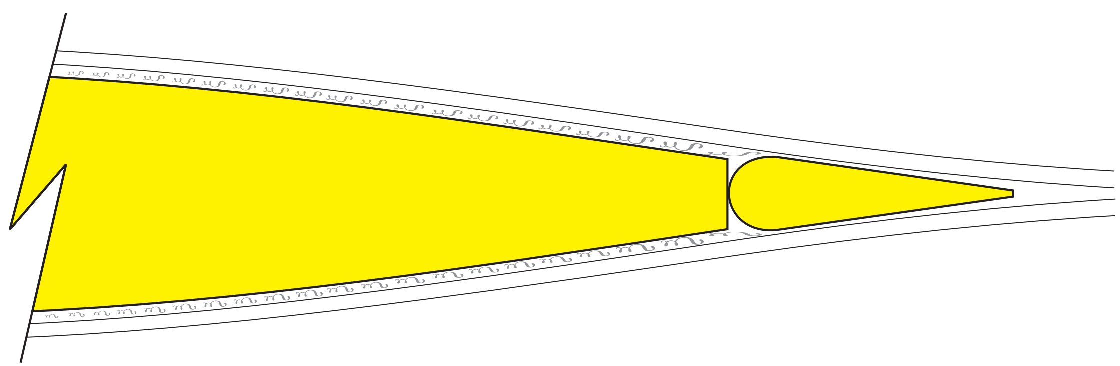
DAS UNIVERSAL

Improving Airplane Performance

Thicker Control Surfaces



Improving Airplane Performance

In this section: A-6 illustrates a factor to be considered called *skin friction*, and its effect upon disrupting the airflow over the surfaces of the wing, tail group, and control surfaces — and also how the traditional practice of *beveling* the leading edge of the control surfaces disrupts the airflow even further.

The resulting delayed and uneven control responses brought on by the control surfaces being entirely surrounded by disturbed air near neutral is highly undesirable when performing aerobatics: Since the area of disrupted air fluctuates depending on the airspeed, and since the airspeed is constantly changing during aerobatics, the ensuing inconsistent *rates* of response interfere with a pilot's ability to positively control all his maneuvers. (This would be especially undesirable in a full-time Flight School where frequent windy conditions often require immediate and positive control in order to train effectively, regardless of windspeed.)

A-7 illustrates the applied and recommended practice of *thicker* control surfaces with round leading edges, to improve flight control in all attitudes and throughout aerobatic's wide range of maneuvering speeds as much as 50%!

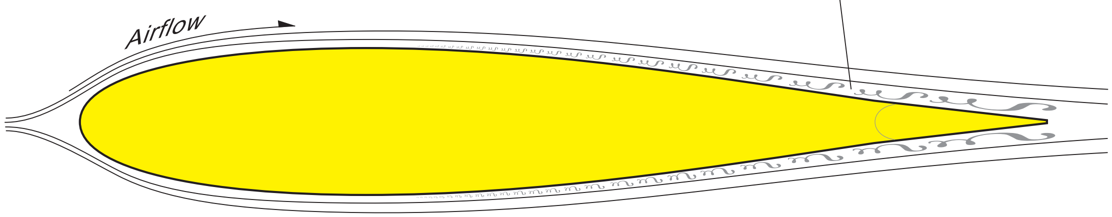
1st U.S. R/C Flight School programs are predicated on an approach that one improvement is only that — yet several improvements add up to make a real impact! Thicker control surfaces improve a pilot's ability to maintain positive control during stalls, in wind, as well as provide in-flight results that continually reflect the *exact* types of inputs made.

> The practice of thicker control surfaces is modeled after most full-scale aerobatic aircraft designed since the 1970's. They are utilized on every model of the Extra, Cap, Edge, Staudacher, Superstar, Laser, Giles, and most Pitts. The improved control they provide helped several of these aircraft go on to dominate the World Aerobatic Championships and individual competitions!

KPTR: Thicker control surfaces provide increased positive control when slow and/or in wind!

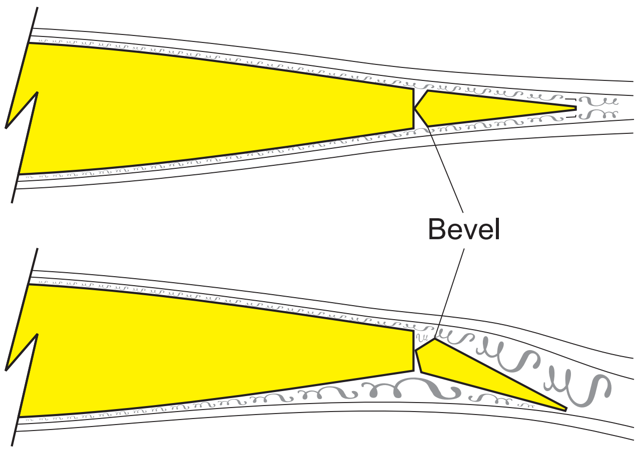
Skin Friction and Beveled Control Surfaces Disrupting Airflow

The air encounters friction (as your hand would) as it moves over the surface (skin) of the wing, tail, etc.. *Skin friction* causes the air at the surface to become disrupted (turbulent). The further along the air flows over the surface, the greater the area of disturbed air becomes.



This same principle (friction) is what causes wind to create ripples at the upwind end of a lake that develop into waves further downwind.

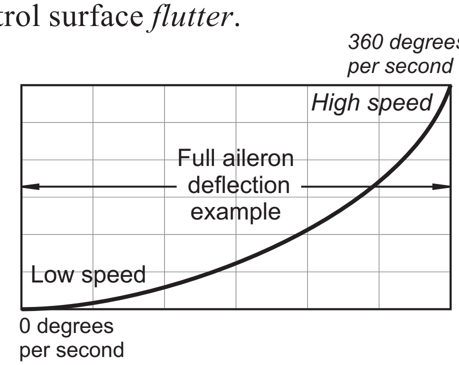
The skin friction air disturbance surrounds all the control surfaces around neutral.



Aileron example: Due to the absence of smooth air flowing over the surfaces, small aileron deflections (stick movements) provide sluggish or erratic responses, especially at slower speeds. To begin achieving positive control, the pilot needs to apply larger inputs to deflect the surface up into the smoother air.

Traditional *beveled* control surfaces help to disrupt the already turbulent airflow even further due to the air catching or tripping over the squared corners of the bevel (as would your fingertips). Consequently, the skin friction air disturbance and beveling also increase the potential for control surface *flutter*.

Due to the area of disturbed air becoming greater at slower speeds, the most noticeable aspect of flying with conventional control surfaces is that the in-flight *rates* of response speed up and slow down as the plane speeds up and slows down—thus resulting in an out-of-sync relationship between the plane and the pilot's expectations, i.e., one rarely feels *connected* to the plane!



KPTR: Traditional beveled surfaces inhibit the pilot's ability to predict how the airplane will respond to commands.

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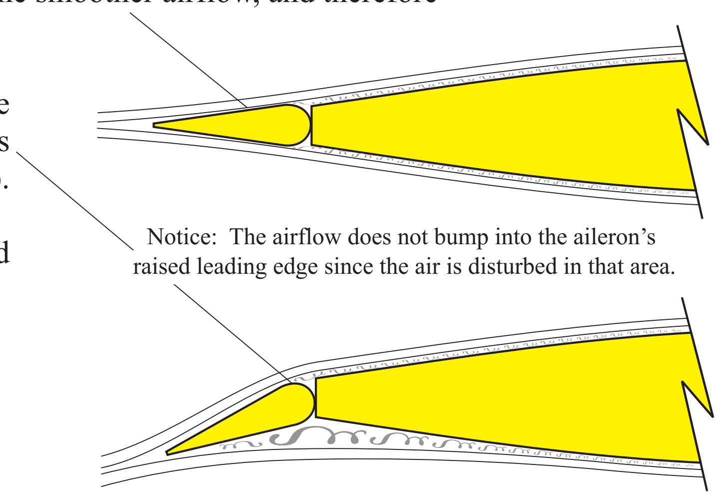
Thicker Control Surfaces Improving Control

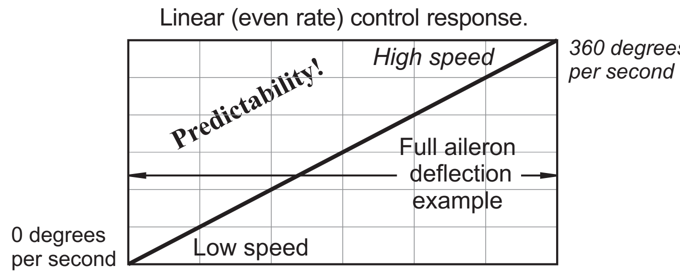
Slightly away from the surface of the wing or tail, the smoother and more layered the air flows. By incorporating slightly *thicker* control surfaces, the physical surfaces of the ailerons, elevator, and rudder will be *flush* with the smoother airflow, and therefore provide more positive (linear) control.

A round leading edge applied to a control surface provides a smoother contour for the airflow to pass smoothly over the surface (as would your fingertips).

The primary benefits of control surfaces with round leading edges and increased thickness are:

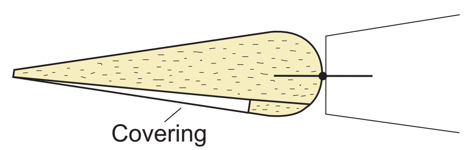
- Improved pilot-airplane correlation. The degree of airplane response will more closely match the stick input—especially precise smaller inputs.
- The *flight envelope* is expanded! The minimum controllable airspeed is lowered on all models.
- Smooth-positive responses during aerobatics, on windy days, and/or when low to the ground.
- The potential for *flutter* is significantly reduced. (The practice of *sealing the gaps* is unnecessary.)





.40 - .1.20 models: Aileron, elevator, and rudder raised approx. 1/16" each side - 3/32" to 1/8" thicker overall.

While 1st U.S. R/C Flight School utilizes the above techniques on all control surfaces, the ailerons and wing control are most important. For your model, you could purchase thicker tapered aileron-elevator balsa, or, build up the leading edge of the provided ailerons with strips of balsa to achieve the increased thickness, and then re-center the hinge.



 KPTR: Thicker control surfaces achieve a smoother airflow over them—providing a full range of improved control.