Speed Brakes vs. Spoilers

Posted by Bob Nuckolls 6/26/10
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There was a thread started on the AeroElectric-List that attended to a question of installing stick grip control switches for Precise Flight's "speed brake". This prompted recollections of what I'll call 'practical history' into this product's service on light aircraft. In particular, some thoughts about failure mode effects analysis and reduction of risk for both incorporation onto an airplane AND departures from manufacturer's recommendations.

An AE-List reader writes:

I've searched the archives but can't find help on this. I'd like to use one of my joy stick grip buttons to control the Precise Flight speed brakes. The button is a simple push button normally open. The Precise Flight Control Unit needs a voltage on one of two pins to control whether they are up or down.

How can I use a push button to switch the voltage a between two lines? Here's a screen shot of my wiring diagram in work. Note I'd also like it to work with the toggle switch on the panel.

The posting received a number of replies but none touched on the following:

This is an excellent topic for discussions of failure mode effects analysis =AND= understand the simple-ideas behind the system design goals.

An important side note on the Precise Flight product suggests that it is not "speed brake". Poor application of that phrase to the product goes to a misunderstanding of product function along with a potential for hazardous conditions borne of that misunderstanding.

A speed brake adds more DRAG to a combination of thrust, lift, weight and drag that dictates airframe performance. Drag is most often added to the performance mix by thrusting large "flat plate" surfaces into the slipstream.

I've participated in programs that crafted specialized actuators for extending large panels from aft locations on the airplane. Design goals for theses systems called for an increase in the airframe's total flat-plate drag component while having little or no effect on lift.

Large air transport aircraft extend large areas of aluminum from the top surface of the wing. In cruising flight, only the outboard panels will occasionally rise during roll control maneuvers. In this mode, the panels are SPOILERS that reduce lift on one wing at a time. Loss of lift on one side augments rolling moment offered by the ailerons.

However, during landing roll-out, one often sees every square foot of aluminum stuck in the breeze with an obvious intent of making the machine a very draggy aerodynamic shape.

With everything hanging out two functions are served:
(1) LIFT is killed to increase weight on wheels for improved directional control and braking by wheels.

(2) DRAG offered by large surfaces offer additional retarding forces that oppose forward motion.

This configuration is a combination of true SPEED BRAKE and SPOILER system.

The space shuttle has a bifurcated rudder that can be extended simultaneously right and left behind the vertical fin. This is a pure SPEED BRAKE.

There are long, low-profile surfaces on top of the Beechjet wing that augment tiny ailerons for roll control in fight -OR- an increased rate of descent when fully extended on both sides. These also are NOT SPEED BRAKES. They might be extended during a roll out for the purpose of killing lift to increase weight on wheels and improve braking by the tires . . . their effect as aerodynamic speed brakes is nil.

The Precise Flight product is the brainchild of one Bill Thompson who was chief of flight test at Cessna single engine division while I was a tech writer at that facility. Bill was directly responsible for my introduction to Ken Razak, then a former dean of engineering at Wichita State. Bill’s introduction began a collaboration on a host of interesting things lasting 40 years. Ken was my second most revered mentor, business partner and friend. But that’s another story.

Bill's product first evolved on the Cessna 210 and was later approved for installation on a host of TC aircraft. I was introduced to the device in Kerrville, TX by a Mooney test pilot and again later on another Mooney by George Masey.

I was given to understand that the Precise Flight product is a SPOILER. Design goals for this device call for reducing lift on the wing while having little effect on total drag. Artfully installed blades extended during a stabilized approach offer an increased rate of descent while having little effect on pitch angle or indicated airspeed.

The reason why this distinction is important has to do with proper and useful deployment of SPOILERS. I'm working an accident case where a pilot reports having “extended his Precise Flight speed brakes" a few seconds before an off-airport landing. He mistakenly believed that they would help slow things down before an unplanned contact with the ground.

In fact, impact forces were probably GREATER than if he had not extended the SPOILERS at all. The net effect of extending the Precise Flight paddles on top of the wing was to INCREASE rate of descent to the ground.

Armed with an understanding what this product does for you, I'll suggest that its a good thing to insure that under no circumstances . . .

(1) Are there cases where they could be extended when you don't want them and . . .

(2) Can they always be retracted when not needed or when inadvertent extension would increase the risk of bent airplanes or broken people?

When considering departures from the manufacture's instructions, make certain that you're not crafting a configuration that increases risk of unintended extension or loss of pilot control for that extension. The system should probably include an easily accessed power switch. Removal of power from the system insures positive retraction irrespective of how any other switch becomes stuck.

Operationally, it may be good policy not to use the spoilers all the way down to the threshold on landing. The effect on rate of descent is almost instantaneous and spectacularly precise, high performance landings can be accomplished with such protocols. But are you certain of your perception reaction time, diagnosis reaction time and the right combination of skills needed to deal with sticky grip switch 10 feet over the numbers?

These questions can only be answered by you as designer and pilot of your project. Correct answers evolve from your intimate and confident understanding of how the system works in your favor . . . and possibly against you. Itty-bitty switches on stick-grips are not renowned for robustness. Take care that a quest for convenience increases risk of unintended consequences.

Bob . . .