A Summary of the Deturbulator Project in 2010

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Background

In 2003, I began working with Dr. Sumon K. Sinha to develop his deturbulator device. After initial success measuring drag reductions on the lower wing surface, we thought we were on the way to new product. But, reality turned out to be much more complicated than that and after seven years we have only demonstrated a concept that will take the efforts of the larger aerodynamics community to fully comprehend and exploit.

The Johnson Flight Test Evaluation

Early in the project, we began testing top surface configurations. This was much trickier than pressure side applications, but the payoff was greater. We had to use up-stream ventilation ports to hold the deturbulator skins down on the substrate ridges and we had problems with condensation under the skins. Nevertheless, in December 2006, we took the glider to Dick Johnson for independent testing. He reported 13% and 18% improvement at 50 KIAS, depending on whether he averaged measurements from all six flights or just the three best behaved ones. Dick concluded that "*the new Sinha Deturbulator could be the first really significant drag-reducing aerodynamic invention since the development of the now-common laminar-flow airfoils that were developed some 65 years ago.*" [1]

Repeat Performance

Analysis of manually acquired data and IGC logs from Johnson's flights led me to the conclusion that the wild deviations from baseline in his data were not random errors, but genuine effects from deturbulator dynamics. A year later, in December 2007, I took measurements that replicated Johnson's first measurement of extreme performance. Across the airspeed range, my strange polar matched Johnson's, feature for feature. This was the first evidence that I was correct and that extreme performance was in fact occurring. I laid out the evidence at the SSA Convention in Albuquerque, New Mexico in 2008 and I predicted that it would take five years for such a revolutionary concept to gain acceptance. We are now two years into that estimate, three years from Johnson's report, and I am optimistic.

Project Status

Today, I am concentrating my efforts merely on demonstrating the concept in hopes of convincing aerodynamicists in academia and industry to take up the work. This would be easier if the potential were only say 18%, but extreme performance is entirely out of the box that most professionals want to deny it outright without doing the work to give the evidence proper consideration. However, I can report that two others have now entered the work. Jari Hyvärinen, of ANKER–ZEMER Engineering AB in Karlskoga, Sweden, is using his LINFLOW software (www.linflow.us) to model the aeroelastic flow-surface interaction modes to discover how they work, what triggers them and why they quit. From his work we hope to find ways to achieve reliable operation. Jari also owns a Standard Cirrus and will soon be installing deturbulators for testing. The second researcher is, Dr. Hermann Fasel of The University of Arizona. He is conducting wind tunnel experiments. That's a start and I am hopeful that this next year will see others enter into the work too.

My progress has been slow because of a lack of resources and the remoteness of the gliderport at Cherry Valley, Arkansas. It's a 2 ½ hour trip one way, so every small accomplishment is an all day affair and usually it depends on the weather. However, lately I have begun using a porous polyester mesh for deturbulator skins and this appears to yield consistent behavior every time I fly, regardless of temperature or humidity. As a result, I should be able take data more often. Also, we now have other Standard Cirrus gliders at the field, so I will be able to fly parallel with gliders of the same type. That will cut costs and offer more opportunities for testing.

With porous membranes, often, when flying at performance airspeed in smooth air, the nose dips dramatically and stays down while holding the airspeed constant. I recently captured such an event with a camcorder and published it online. You can see it at www.deturbulator.org/20100402-PerformanceEvent.asp. This is an interesting case, because it demonstrates the deturbulators switching on and off again while holding a performance airspeed. For more information, see www.deturbulator.org.

Performance Plots

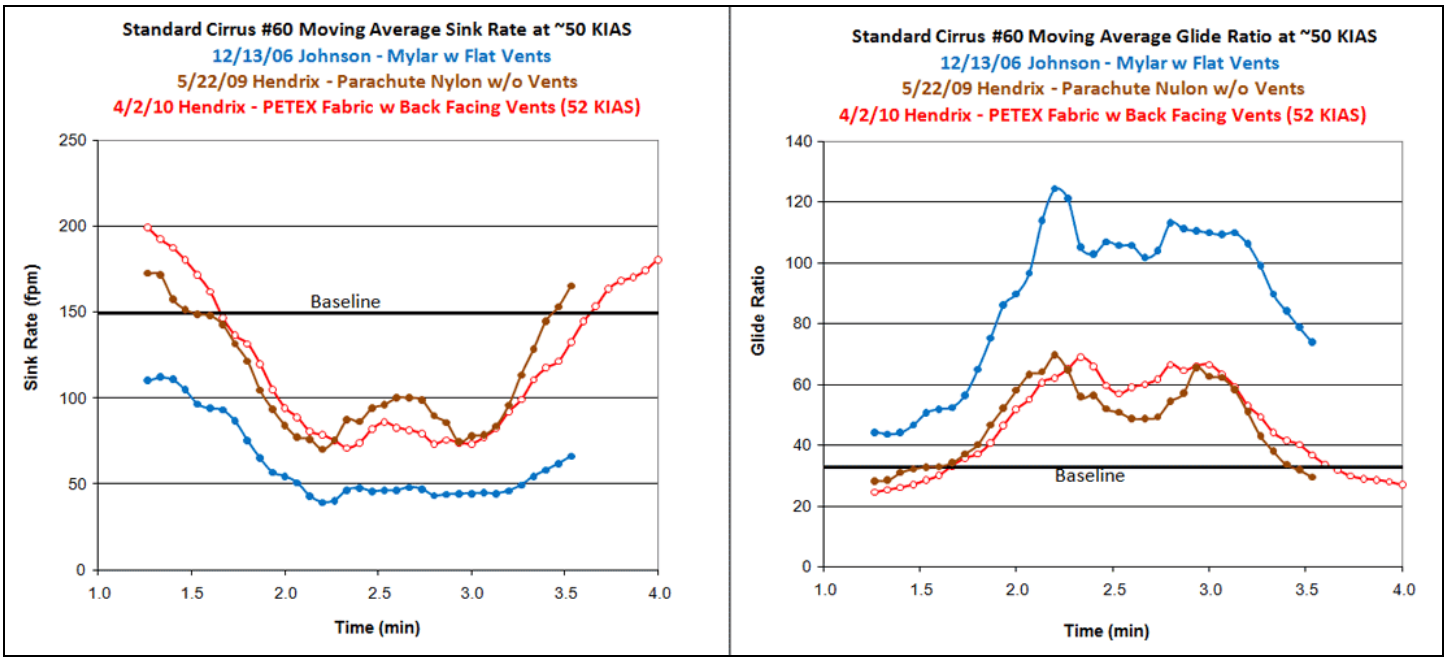

Figure 1 - Limited Duration of Deturbulator Performance Events

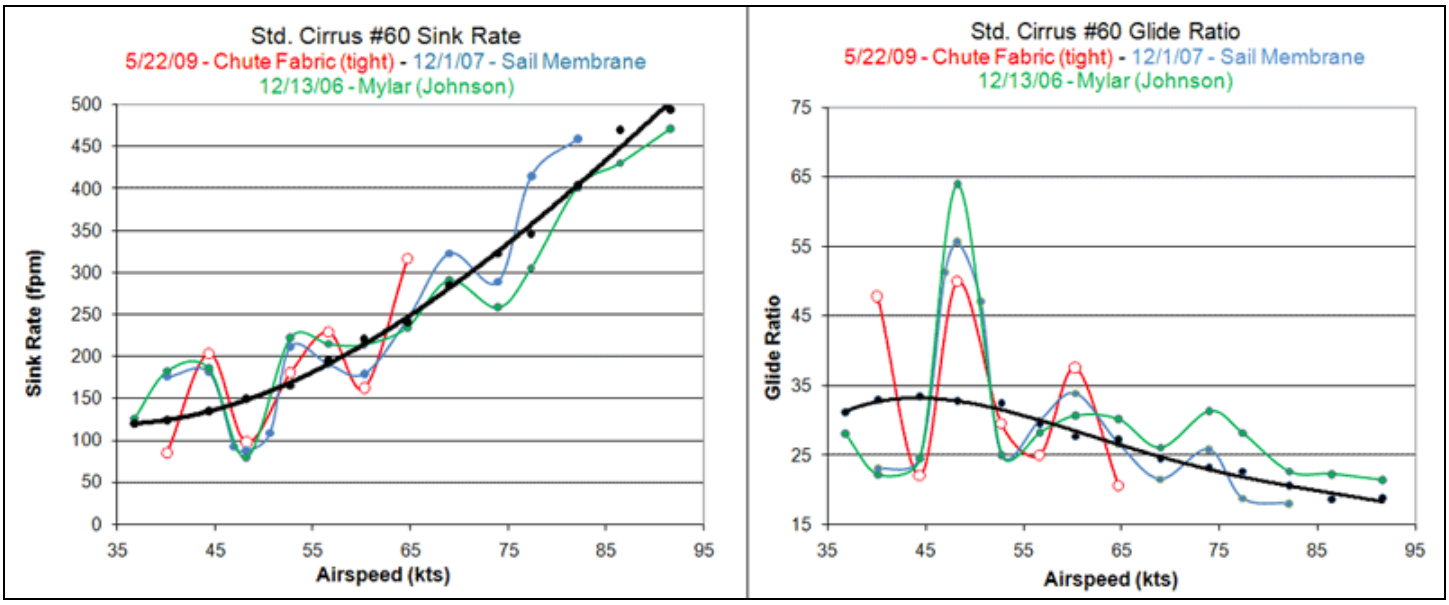

Figure 2 - Performance Peak at 50 Knots

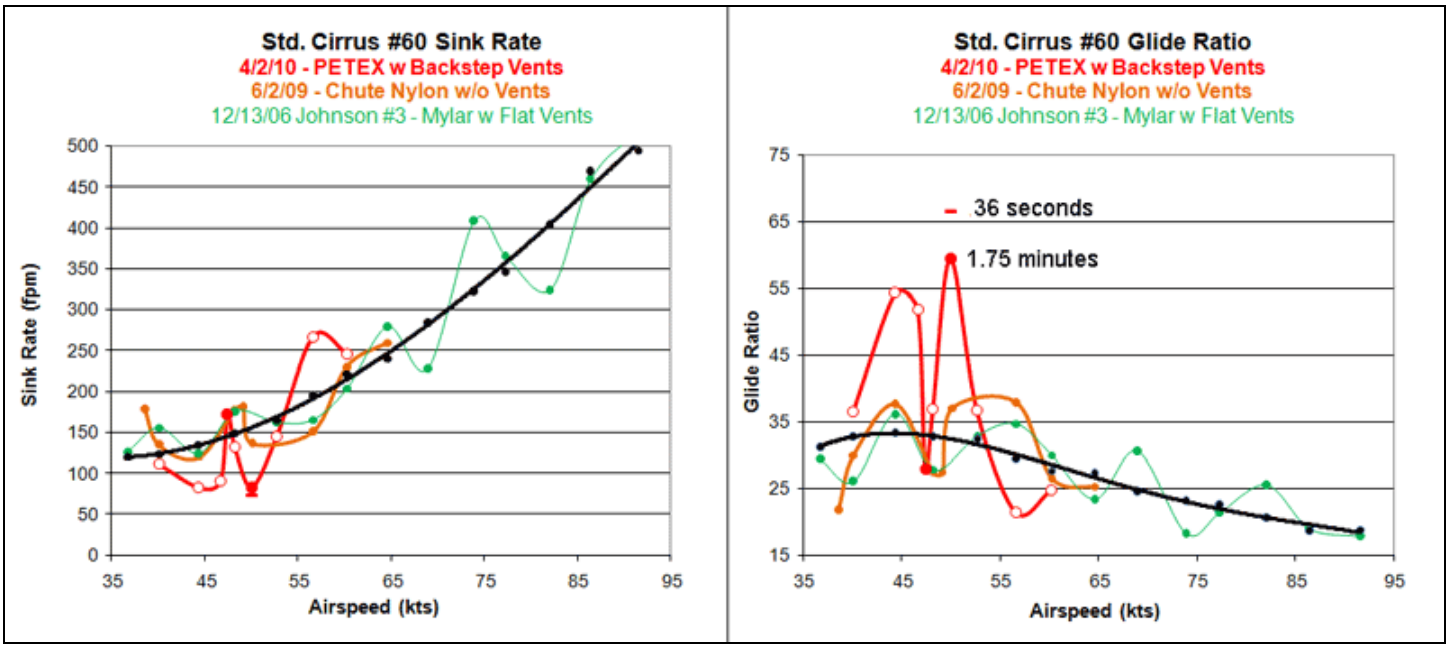

Figure 3 - Performance Notch at 50 Knots

Emerging Information

Since publication of this article in Gliding International Magazine, several soaring flights have occurred without deturbulator panels but with the leading edge tapes that provide a small rear-facing step to "pre-condition" the flow for deturbulator operation. Performance improvements around 25% were experienced on long glides in smooth air. One set of sink-rate measurements was taken in poor conditions. Though of poor quality, the data confirms expectations and indicates that much of the performance I have been measuring for years derives from the leading edge tapes alone. Indications are that a rear-facing step near the leading edge on both upper and lower surfaces may offer significant performance enhancements that are more stable than deturbulated performance (Fig. 1). More measurements are needed before publishing this information.

References

[1] Richard H. Johnson, *A Fight Test Evaluation Of The Sinha Wing Performance Enhancing Deturbulators*, Soaring Magazine, January 1, 2007.

Jim Hendrix lives in Oxford, Mississippi, USA. He holds a master's degree in physics; has written books on computer software and holds patents in acoustics, digital signal processing, aerodynamics and avionics. Jim took up soaring in 1995 with the Memphis Soaring Society, now located at Cherry Valley, Arkansas.