Sport Aviation FEBRUARY 1978

THE WITTMAN WING TIPS

To the casual observer of the homebuilt airplane world, it might appear that Steve Wittman designed the Tailwind in the early 1950s, drew up a set of plans, and has been selling them on a very low key basis ever since . . . while going on to other interests, himself. Not true. Progressive improvements have been made to the design down through the years — and more are on the drawing board now. The perceived permanency of the Tailwind stems from the fact that in its original form, it was such a simple, straight-forward design that very few changes have been necessary. Individual builders and Steve, himself, have installed all sorts and sizes of engines and propellers, tri-gears, various windshield and side window configurations, etc., but none have strayed too far from the original concept. And, except for the obvious example of the tri-gear, few of the changes are perceptible from 20 feet away.

The one thing that has changed has been the Tailwind's wing. The original Tailwind — on display in the EAA Museum, incidentally — was not intended as a homebuilder's project. Steve designed and built the airplane for his own personal use — a high speed, economical, easy to maintain machine in which, among other purposes, he and his wife, Dorothy, could scoot from one race to another at various places around the country. In order to get the speed he wanted on only 85 hp, a "racing" wing was employed . . . nothing extreme for one of his ability and experience, but perhaps a little on the "hot" side for some of the garden variety pilots who would later build their own. Consequently, a new wing with a thicker airfoil was eventually developed which made possible slower landings without sacrificing very much on the top end of the performance scale.

Steve still was not satisfied, however. He wanted to cut down the rate of sink and improve the rate of climb . . . but, again, he wanted to do it without giving up cruise or top speed. He also wanted to avoid structural and mechanical complexity — which inevitably translates into higher weight, cost and, sometimes, drag. He knew he could get half of what he wanted by installing a sophisticated flap system or a higher aspect ratio wing . . . but not without paying the price.

The seeds for the ultimate solution of the problem had been sown in Steve's mind years before, largely by Dr. Gus Raspet of Mississippi State University. During the period in which Dr. Raspet was running extensive flight tests on the original Tailwind, the two often engaged in extensive discussion of various aerodynamic esoterica, among them aspect ratio theory. One thing they had very much in common was the knack of reducing complex aerodynamic theory to surprisingly simple hardware — witness each and every one of the Wittman airplanes as the best examples.

At the time (1955-56), Steve was wrestling with the problem of tip losses. He saw the wing as having three hindrances to his desire to go fast on low power — wing/fuselage intersection drag, induced drag and tip losses. He had already accomplished what he felt was practical in his type of sport airplane to overcome wing/fuselage drag by choosing a high wing configuration, by tailoring the shape of the top of the fuselage to conform to what he perceived the airflow in this area to be and by pinching in the wing root as much as spar placement would permit. Induced drag he figured he could do least about — perhaps a bit in airfoil selection and by making his plywood covered wings as smooth as possible, but that was about it. But tip losses were something else. No simple solution seemed possible at the time. He had become interested in tip plates and asked Dr. Raspet if they would help. Indeed they would, Steve was told — if he could live with plates a minimum of a wing chord-width deep! That ended that.

Steve did, however, get a lot of good ideas from Dr. Raspet and later when the Hoerner study came to his attention, he started thinking about tip losses again. One thing stuck in his mind: somewhere he had read that on the typical rectangular wing if you go inward from the tip a chord width, about half the lift of that area is being destroyed by tip vortices. This became the basis of the Wittman Wing Tips.

In his always disarmingly direct, largely empirical approach to problem solving, Steve thought the thing through in approximately the following sequence: he knew that, structurally, the simplest thing he could do to lower the rate of sink was to increase the aspect ratio . . . and since, according to theory, only half of the last chord- width of wing was working, why not (diagonally) lop off the unproductive half, thereby reducing weight and the skin area molecules of air would have to scrub over as the wing sliced through them. This would leave a triangular tip which he would pinch down (from top to bottom) much as he had done to the wing root to, hopefully, impede the progress of still fewer air molecules. Steve had a gut feeling that the right triangle should point to the rear, but for structural reasons, he had to aim it to the front. In fact, the final version of the new tips, as you see them in the accompanying photograph of N37SW, are different still — more like a triangle with the apex clipped off.

Would they work? Only one way to find out, to Steve's way of thinking . . . build them, and go fly them. But Steve likes to be reasonably sure about something before he puts a lot of time into it — so he built only one new tip and went out to fly it to see if it made a difference he could detect.

Immediately upon lift off, Steve knew he was on to something . . . it took about half of opposite aileron to keep the wings level. He went right back to his shop and built on the other tip.

Before installing the tips, Steve had carried out a series of tests which would serve as the baseline for his evaluations. He took off from Oshkosh, climbed to 10,000 feet, headed back in the direction of Oshkosh, and shut down the engine. Cranking in full nose-up trim to get his minimum trim speed, he proceeded to time his rate of descent down to 4,000 feet. This test was repeated a number of times, resulting in an average rate of descent of 1200 feet per minute at an indicated air speed of about 73 mph.

After installing the tips, the same tests were run again with the result that the rate of descent was reduced to 900 fpm. Rate of climb had not been accurately measured before the tests, but due to his experience in the plane, Steve could tell it was markedly improved. Further, stall characteristics were unchanged and stall speed was lowered a little over 10%. The real pay-off came when Steve went out to see what, if any, price he had paid for the gains. Straight and level, he flew at various power settings up to and including wide open and compared airspeed indications with those he had previously recorded on a card he always carries in his shirt pocket. Result? No measurable changes in airspeed!

The new tips worked so well, Steve built them onto his Formula V racer, the V-Witt . . . and obtained similar beneficial results. The Tailwind tips are 27 inches long and terminate in one foot wide clipped tips. They are washed out 2° (but are straight on the V-Witt).

Aerodynamicists may or may not have a different explanation for Steve's empirically derived results, but the bottom line is that they do what his reasoning said they would do ... and that, in the world of amateur builders, is as good as a million dollars worth of wind tunnel testing.