A Flight Evaluation Mini

by RICHAR

Figure 1

MINI-NIMBUS AIRSPEED SYSTEM CALIBRATION

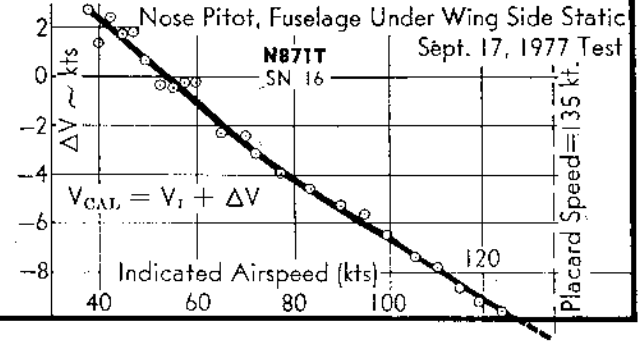
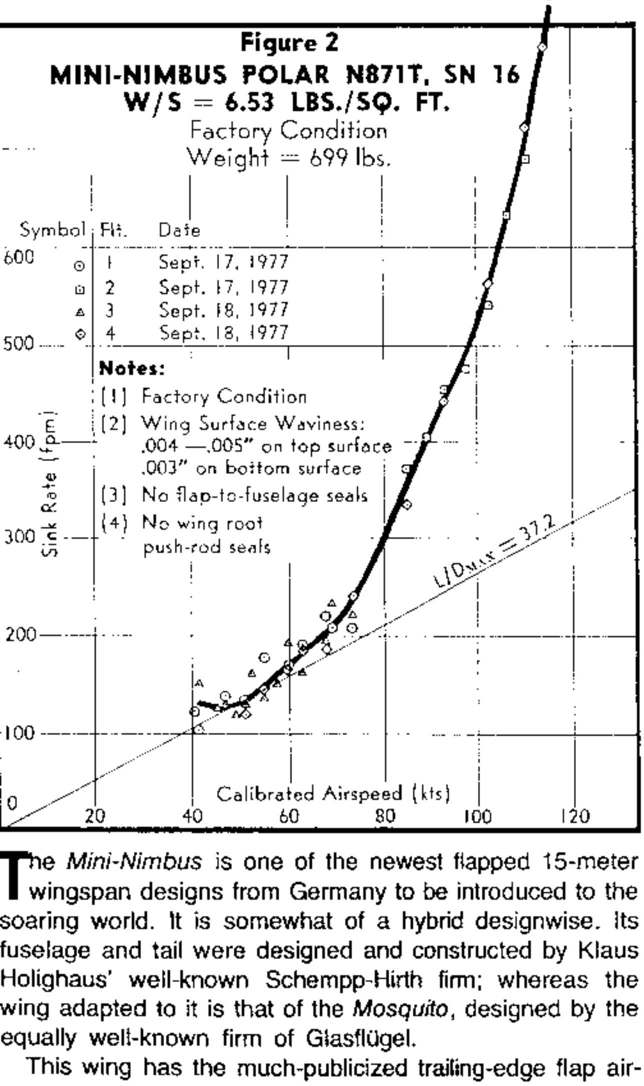


Figure 2

MINI-NIMBUS POLAR N871T, SN 16

W/S = 6.53 LBS./SQ. FT.

Factory Condition
Weight = 699 lbs.



The *Mini-Nimbus* is one of the newest flapped 15-meter wingspan designs from Germany to be introduced to the soaring world. It is somewhat of a hybrid designwise. Its fuselage and tail were designed and constructed by Klaus Holighaus' well-known Schempp-Hirth firm; whereas the wing adapted to it is that of the *Mosquito*, designed by the equally well-known firm of Glasflügel.

This wing has the much-publicized trailing-edge flap air-brake system that protrudes both above and below the wing when operated in the air-brake mode, and it functions quite well, permitting very steep approaches and fairly slow landings. The *Mini-Nimbus*' upward-protruding portion of the air-brake system destroys some of the lift that is available with the Schreder-type, PIK 20 A/B flap air-brake, and therefore landings are slightly faster, but with less tendency to float. Also on the credit side, it appears to be impossible to inadvertently take off with the air-brakes extended more than about one-third open. This is because a combination of springs and airloads bring the air-brake lever to that position when the air-brakes are left open and no force is applied to the cockpit actuating handle. Because of the air-brake's aerodynamically balanced design, actuation forces are relatively low. It is a very good system.

The Glasflügel wing appears to be well-designed and constructed. Chordwise wave gage measurements showed .004 to .005-inch peak-to-peak waviness on the wing top surfaces, and only about .003 inches on the lower surfaces. This test sailplane was one of the first to arrive in the U.S.A., and it left its moulds only about 60 days before these measurements were made. It will be interesting to see if this wing surface waviness magnitude will hold at its measured low readings, or if the waviness will gradually increase with time as with most glass sailplanes.

The *Mini-Nimbus* handbook gave no value for the wing area, nor any information as to the airfoil sections used. I measured about 107 ft.^{2} of wing area and wing thickness-to-chord ratios of .16 at the wing root tapering to .14 at the aileron outboard tip. When I placed my PIK-20 leading edge templates on the MN's wings, I found that the airfoil has a larger nose radius and is shaped considerably differently from the PIK's Wortmann FX 67-K-170/150 profiles. It may be a Hütter profile developed from the *Libelle 301.*

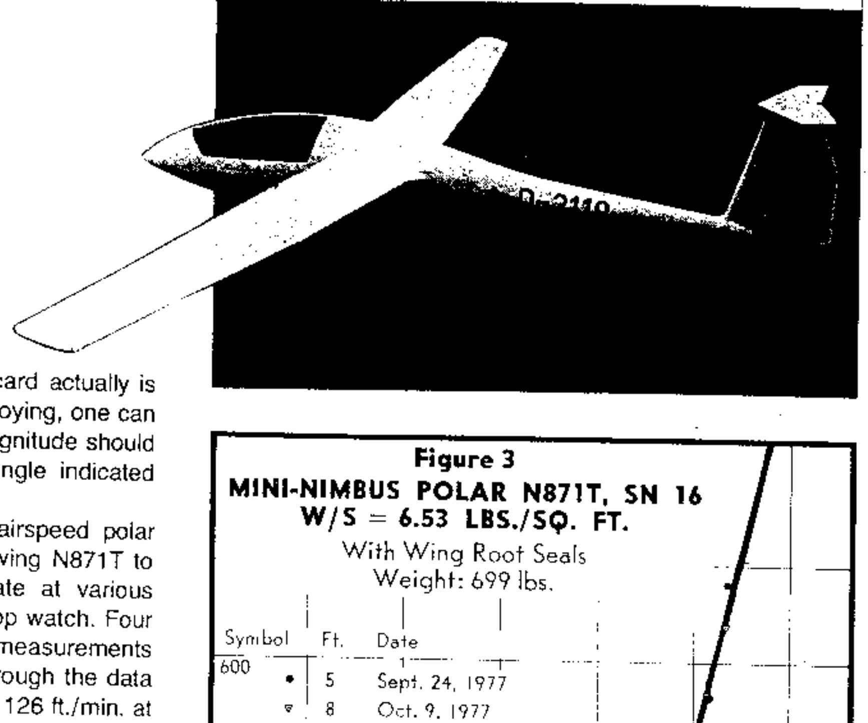
As to empty weight, this test sailplane was about 40 to 50 pounds lighter than most recent 15-meter German sailplanes. The empty flight test weight of Dick Mockler's N871T was close to 523 pounds, of which roughly 14 pounds consisted of a radio, battery, and instruments. The left wing panel weighed 149 pounds and the right panel weighed 137 pounds, the reason for this 12-pound difference in wing panel weights was not apparent. The heavier panel did have the forked-spar root stub, and the lighter panel had the mating center single-spar root stub, but from a cursory estimate of the mass differences it does not appear that the difference should be that much.

As is customary with Schempp-Hirth sailplanes these days, the cockpit layout is excellent — good visibility, a side-hinged canopy, and all controls are well-located. Unfortunately, the airspeed system has its static ports located on the fuselage sides under the wing in almost the exact location used for the *Std. Cirrus B*, and this static port location produces very large airspeed system errors.

Figure 1 shows the airspeed system errors that were measured with *Mini-Nimbus* N871T, and these values are even slightly higher than those measured with the *Std. Cirrus B* and reported in Reference A. The Figure 1 data show an airspeed system error of almost −10 knots at the 124-knot highest indicated airspeed test point. Extrapolating the error magnitude curve to the 135-kt. *indicated airspeed* placard dive speed results in a −11 knot error. Since this value must be added to the indicated airspeed to arrive at

Test of the Nimbus

. JOHNSON



the true calibrated airspeed, the 135-kt. placard actually is only about 124 knots for N871T. Though annoying, one can live with airspeed system errors, but their magnitude should be known because speed ring and glide angle indicated airspeed values are directly affected.

Next, the performance sink rate versus airspeed polar measurements were made by repeatedly towing N871T to 13,000-foot altitudes and timing its sink rate at various airspeeds using a calibrated altimeter and stop watch. Four high tows were made and their data point measurements are shown in Figure 2. Fairing a best line through the data points indicates a minimum sink rate of about 126 ft./min. at 45 knots and a maximum glide ratio of approximately 37.2:1 at 51 knots.

This measured performance is fairly good but considerably below that advertised by the manufacturer. The preceding performance measurements were made with the sailplane in an as-factory-delivered condition which did not include any sealing at the flap-to-fuselage joints nor any sealing around the control pushrods at the wing root. In an effort to attain a better performance level for the *Mini-Nimbus* measurements, the wings were removed, seals installed, and more high tows were made.

The air was not smooth enough to provide good data during the first half of Flight 5, and there was too much data scatter during all of Flights 6 and 7 to use any of their data. Finally, during Flights 8 and 9 the following week, good still air was found where accurate measurements could be made. The resulting measured sink rate data with the seals installed are shown in Figure 3. These data indicate the minimum sink rate was now about 115 ft./min. and that the maximum glide ratio was approximately 38.8:1. These performance improvements are well worth the few hours needed to install the seals.

The last test performed with N871T was with the sink-rate polar measurements with the wings roughened with the standard 20 tape "bugs" per meter span attached to the wing leading edges. Two flights were made to measure these data and the results are shown plotted in Figure 4.

The *Mini-Nimbus'* minimum sinking speed increases to about 140 ft./min. with the roughened leading edges, and its maximum glide ratio decreases to roughly 36:1. Percentagewise, these amount to a 22 percent increase in minimum sink rate but only a seven percent decrease in L/D max. At 90 knots the penalty due to the roughened wings is severe, amounting to an increase in sink rate of almost 40 percent.

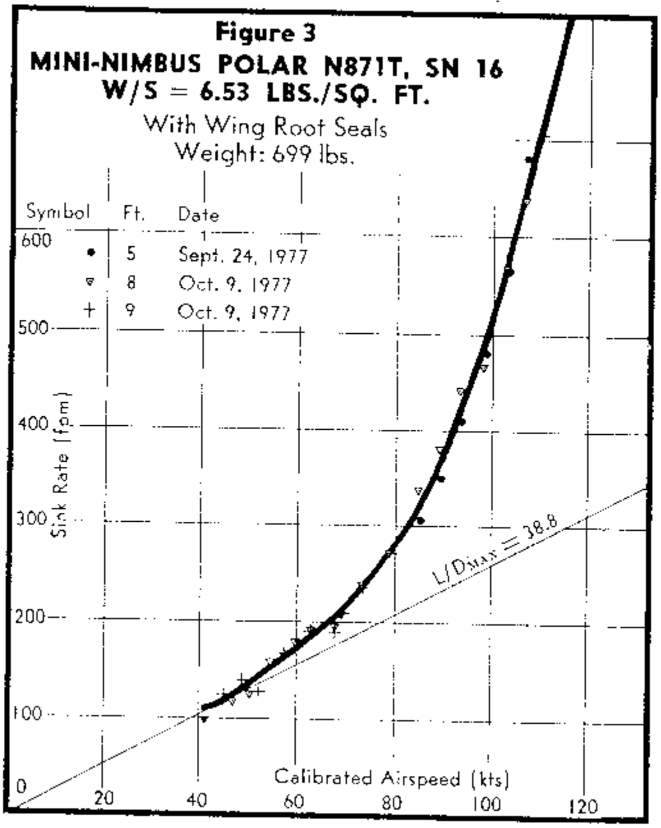


Figure 3
MINI-NIMBUS POLAR N871T, SN 16
W/S = 6.53 LBS./SQ. FT.
With Wing Root Seals
Weight: 699 lbs.

Figure 5 is a comparison plot showing N871T's factory condition and sealed-condition polars, along with that measured recently for the smoothed and sealed PIK-20B (Reference B). The sealed *Mini-Nimbus* appears to have a somewhat lower minimum sink than the PIK, and a slightly better L/D max. Between 50 and 70 knots performances appear near equal, but between 75 and 95 knots the little *Nimbus* appears to have a measurable edge in this important interthermal cruise region. Above 96 knots the PIK appears to be better, but that speed range is seldom useful in competition flying. The *Mini-Nimbus* will definitely be a good competitive sailplane.

Its lateral handling is fairly good, with 4.5 seconds required to perform −45° to +45° rolls at 45 knots indicated airspeed with +6° flap setting. Rudder control is okay for a GRP sailplane, but its longitudinal sailplane stability and control characteristics are somewhat marginal. The Mini-Nimbus appears to use the same small, poorly-balanced, all-movable, horizontal tail that was used for both the *Std. Cirrus* and pre-1977 *Nimbus II's*. Longitudinal control appears to be adequate, but stability is low, requiring considerable attention to maintain constant airspeeds during the test data runs.

At calibrated airspeeds above about 80 knots, the same poor longitudinal dynamic characteristics are shown with the *Mini-Nimbus* that exist with the one *Std. Cirrus* and three *Nimbus II's* I have flown. The objectionable characteristic appears to be that the all-moving horizontal tail is *overly mass balanced* so that when a gust or pilot-induced vertical acceleration is encountered, the control stick has a tendency to move in the direction to *increase* the acceleration. When positive *g's* are encountered, the control stick tends to move aft, and vice versa when at negative *g*. The magnitude of this unstable elevator system feedback increases rapidly with airspeed such that it would be extremely dangerous to let the control stick slip from one's hand when flying above 100 knots calibrated. For safety reasons, I normally grip my *Nimbus* control stick with *both hands* when flying in gusty conditions above 100 kts.

I did not remove the *Mini-Nimbus'* horizontal tail to check the mass balance about its pivot hinge, but it is probably the same as that of my *Nimbus II*. There the hinge pivot is well-located, about one-quarter of the way aft of the mean chord leading edge. There seems to be an internal balance weight located inside the foremost part of the all movable tail unit to partially balance it about the pivot *before* the fairly heavy steel control rod is connected near the leading edge of the horizontal tail surface. It appears that the addition of the leading edge control rod causes the elevator system to be overbalanced masswise — leading to the poor elevator system dynamics described above.

I understand that a conventional fixed horizontal stabilizer tail option like those of the PIK-20, AS-W 19, and Schweizer 1-35 is available with the *Mini-Nimbus* now. Although I have not seen it, I would assume it to be of similar good design engineering and a big improvement over the flight-tested all-movable tail design.

The other item that I thought to be below par with the *Mini-Nimbus* was that it was equipped with a relatively small 12-inch diameter by 4-inch wide landing wheel. Most of the older 15-meter sailplanes were equipped with this smallish wheel, but with the current heavier water ballast loadings, almost all modern 15-meter sailplanes use the larger 13.6-inch diameter by 5-inch wide wheel. The little 4-inch diameter brake in the *Mini-Nimbus'* wheel hub did work satisfactorily for the unballasted flight testing, but I wonder if the wheel will prove strong enough to survive repeated takeoffs at the full 992 pound allowable gross weight of the *Mini-Nimbus*.

The thermaling characteristics of the *Mini* are quite good, at least with the seals installed. The climb rate in weak thermals is excellent, and stall characteristics are good, both from circling and straight flight. As to stall speed, the handbook's stated values are optimistic as it states 32 knots with a 6.76 lbs./ft.^{2} wing loading and the flaps set to +10°. With my lighter 6.53 lbs./ft.^{2} flight test wing loading the *Mini* stalled at 34 kts *indicated*, which is 36.3 kts by my trailing bomb calibration.

Many thanks are owed to Dick Mockler for the generous loan of his fine new sailplane for these flight tests, to DGA and TSA for providing the 10 high tows, and to Bob Gibbons for reducing the test data to sea level standard atmosphere conditions.

References

A. Johnson, R. H. "A Flight Test Evaluation of the Standard Cirrus B," *Soaring*, March, 1976.

B. Johnson, R. H. "Facts About Flaps." *Soaring*, Sept., 1977.

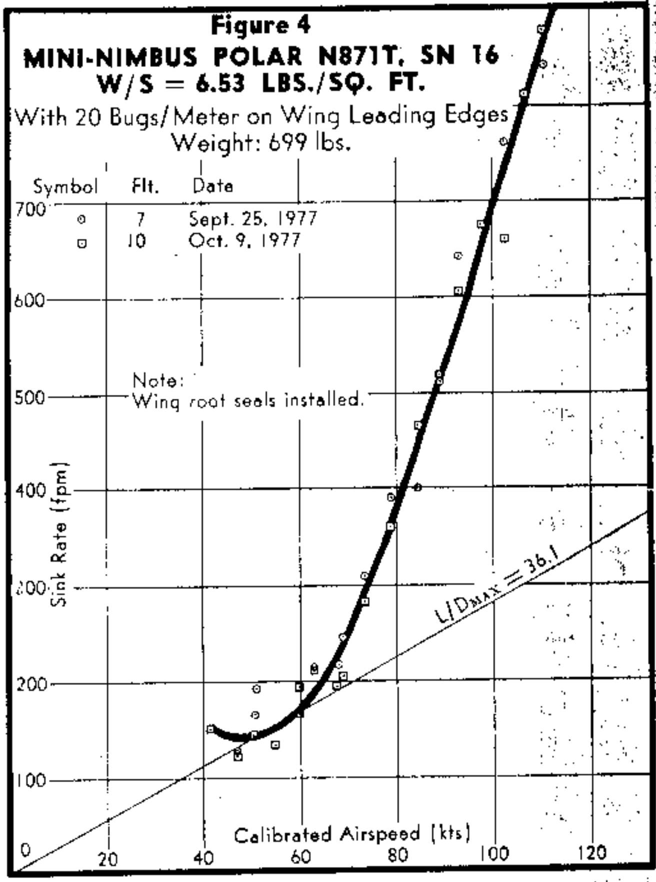


Figure 4

MINI-NIMBUS POLAR N871T, SN 16

W/S = 6.53 LBS./SQ. FT.

With 20 Bugs/Meter on Wing Leading Edges

Weight: 699 lbs.

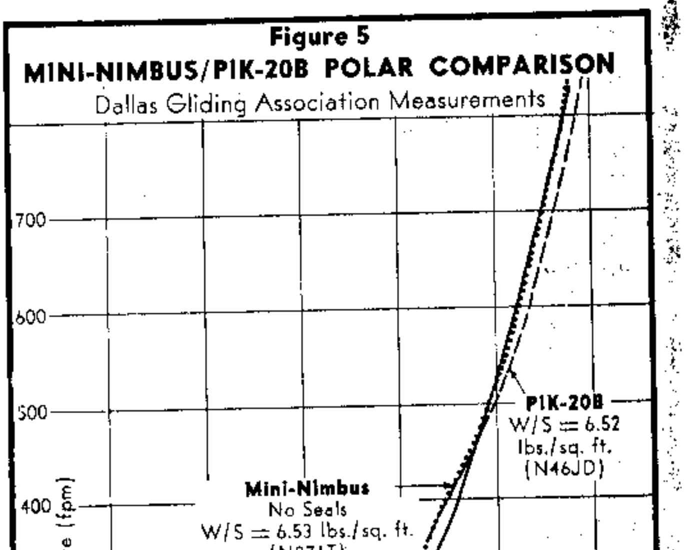


Figure 5

MINI-NIMBUS/PIK-20B POLAR COMPARISON

Dallas Gliding Association Measurements