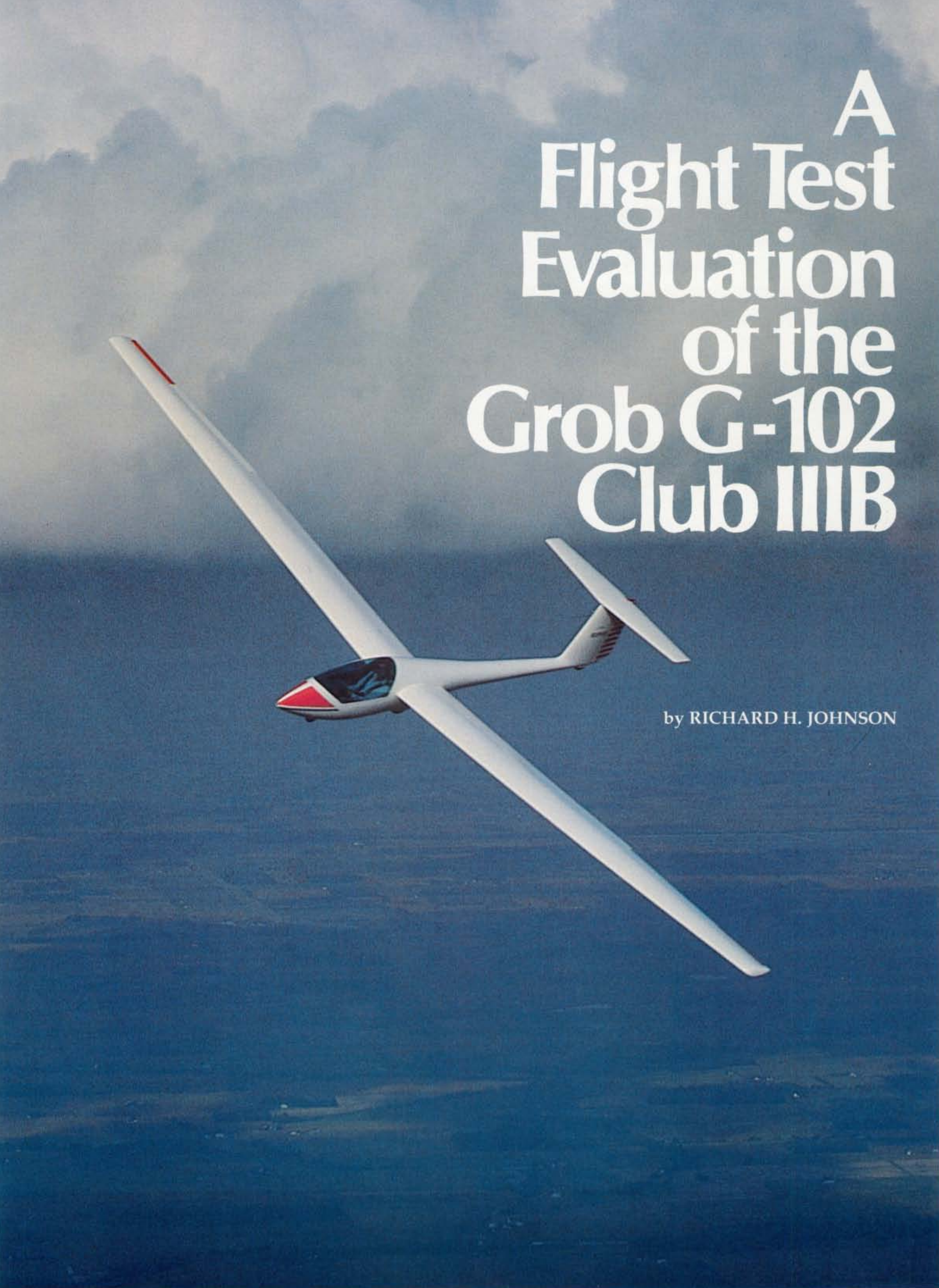
A Flight Test Evaluation of the Grob G-102 Club IIIB



by RICHARD H. JOHNSON

The Grob G-102 Club IIIb is a modern medium-to-high performance 15-meter span, single seat, fiberglass sailplane manufactured by Grob Werke GmbH & Co. in the southern part of West Germany. It is essentially identical to the earlier reported two-seat Grob 103 Twin II (Ref. A) except for being smaller, having 2.5 meters less wingspan and only one seat. As with the Twin, the single seat 102's wing features the relatively new Eppler 603 laminar airfoil with a measured thickness-to-chord ratio of about .198.

Since the Grob Twin II had been very popular at Caddo Mills in its leaseback flight operation, its owners, Jim Clayton and Charlie Bangert, decided to add a new single-seat Grob G-102 Club IIIb sailplane. This is logical because the two-place Twin II is being used extensively for training pilots, and the single-seat 102 Club is equally easy to fly and is almost identical in its excellent flight characteristics. The size and layout of the Twin II's front cockpit is essentially the same as that of the G-102 Club. This provides a transitioning pilot with a minimum number of changes when checking out in the new smaller sailplane. The only difference in flight characteristics that I can notice is slightly faster control response for the 102C and somewhat lighter control forces.

The wing is mounted slightly below the fuselage centerline as shown in Figure 1, but with adequate dihedral to provide good ground clearance at the wingtips. Three fixed landing wheels are installed in the fuselage, and they provide good ground handling without a removable tail dolly. The main wheel is a generous 5 x 5 inch size located slightly aft of the sailplane's flight-loaded *cg*. When empty, the sailplane rests principally on its main wheel and lightly on its 210 x 65 mm pneumatic tailwheel. When loaded, it again sits principally on the large main wheel, but in a nose-down attitude resting lightly on a 210 x 65 mm nosewheel located beneath the instrument panel.

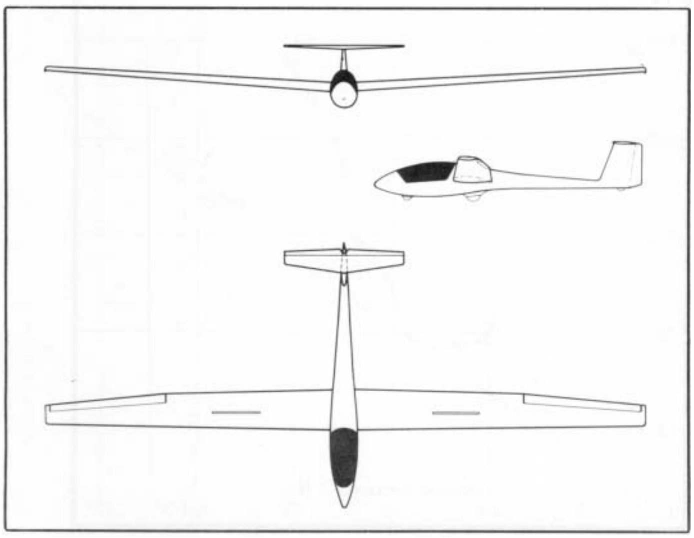
This wheel arrangement provides not only excellent ground handling, but also nearly ideal takeoff and landing characteristics, especially in crosswind operations. There is little tendency for the sailplane to yaw or roll unintentionally, because any sideward drift or turn-induced ground sideloads are counteracted principally by the main wheel, located slightly aft of the sailplane's *cg*.

The new 102C was delivered to Caddo Mills during early August and our measurements began soon thereafter. The sailplane's detail workmanship appeared to be equally as good as that of the earlier tested Twin II. Chordwise wave gauge measurements of the wing surfaces showed relatively little waviness, averaging about .004 in. (.10 mm) peak-to-peak on the top surfaces and about .0025 in. (.06mm) on the flatter bottom surfaces. The wing airfoil is designated as the Eppler 603, the same as with the Twin II. Our thickness and chord length measurements showed that its T_{MAX}/C ratios were .196 at the wing roots, .199 at the aileron root station and .198 at the aileron tip. The wings appeared to be carefully fabricated with essentially identical measurement values recorded for both the left and right wing panel chord lengths and thicknesses. No wing flaps or water ballast tanks are included, which simplified the flight testing.

Three high tows were made during early morning test flights to measure smooth air sink rates in its factory delivered condition. These data are shown in Figure 2, where an L/DMAX of about 31.5 at 47 kts and a minimum sink rate of approximately 142 fpm (.72 m/s) at 42 kts are indicated. This performance was somewhat below that expected, and the polar exhibited a high drag knee at about 65 kts.

To investigate this further, the wing leading edges were roughened with our standard 20 tape "bugs" per meter of span, using a regular pattern of duct tape cut in 5 mm x 5 mm squares. Only one test flight was performed with roughened leading edges, but the air appeared to be quite still and very little data scatter was evident. Figure 3 shows those data, where an L/DMAX of about 29.5 at 55 kts and a minimum sink rate of roughly 185 fpm (.94 m/s) at 53 kts are indicated. It was appreciated that only one flight provides insufficient data on which to base a great deal of confidence in the buggy polar test, but it was enough to show that the roughening did not degrade the 102C's L/DMAX as

Figure 1

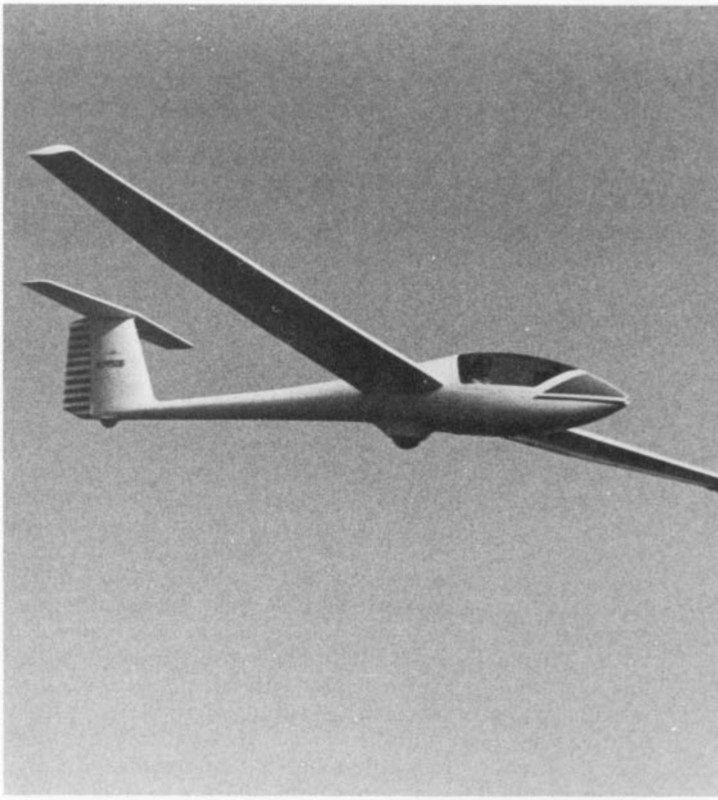


Author Dick Johnson stands beside the G-102 Club IIIb, which rests on main and tail wheels when empty but settles onto the nose wheel with a pilot aboard, offering better handling on takeoff and landing. With wings properly sealed, he rates it "very high" in soaring performance.

much as it should. Only about 10% degradation was shown near L/DMAX.

Roughening of modern highly laminar sailplane wings generally reduces L/DMAX by 20 to 30 per cent, but this was not so with our test 102C. That usually means that something else is disturbing the wing's normally low-drag laminar flow, and we set about looking for a likely source. The most damaging item appeared to be air leakage from the airbrakes, where their spring-loaded cap strips lay in a recess on the wing upper surfaces. It had been noted earlier that when the air-brakes were even slightly opened, the cockpit noise level increased markedly and the cockpit pressure decreased noticeably. This indicated that no air seals were installed in the airbrake system, at least when opened, and that the air could migrate freely from the fuselage to the critical suction area of the wing upper surfaces. If the air leaks there, even modestly, then it is aerodynamically equivalent to flying with the airbrakes partially opened. With the airbrakes locked closed it was found that I could place my mouth over various sections of the airbrake cap and blow past it with surprising ease. Also, the airbrake cap loading springs that hold the cap against the recess bottom were not very tight, especially at the inboard ends.

For these reasons the wings were removed from the fuselage and relatively simple tape and fabric air seals were installed at the root ribs only (see photos). Subsequent flight testing exhibited reduced cockpit noise levels when the airbrakes were opened and significantly better flight performance when the airbrakes were closed. Even roll rate appeared to improve—45° to 45° rolls at 45 kts required



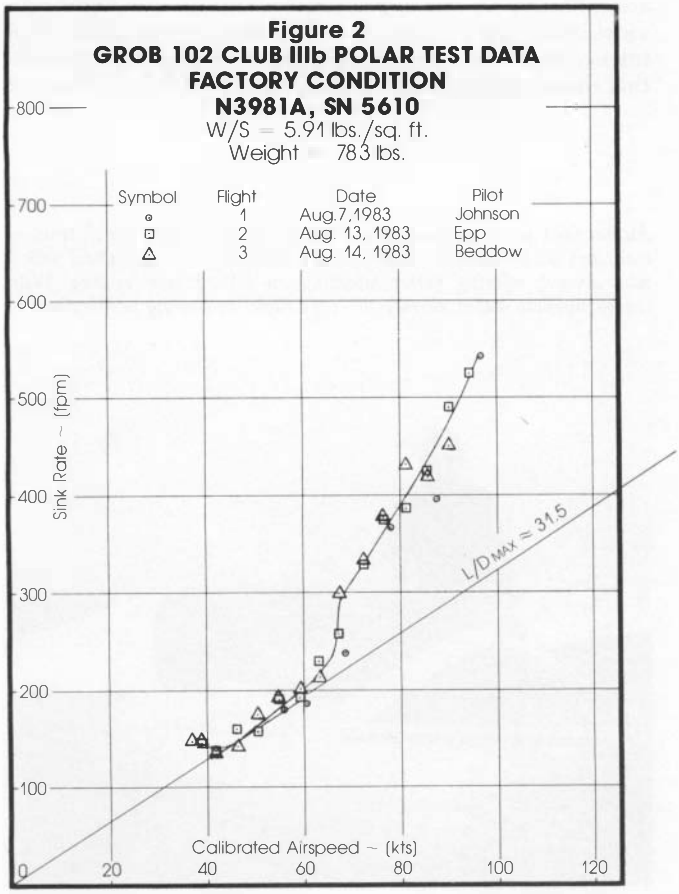


Figure 2
GROB 102 CLUB IIIb POLAR TEST DATA
FACTORY CONDITION
N3981A, SN 5610

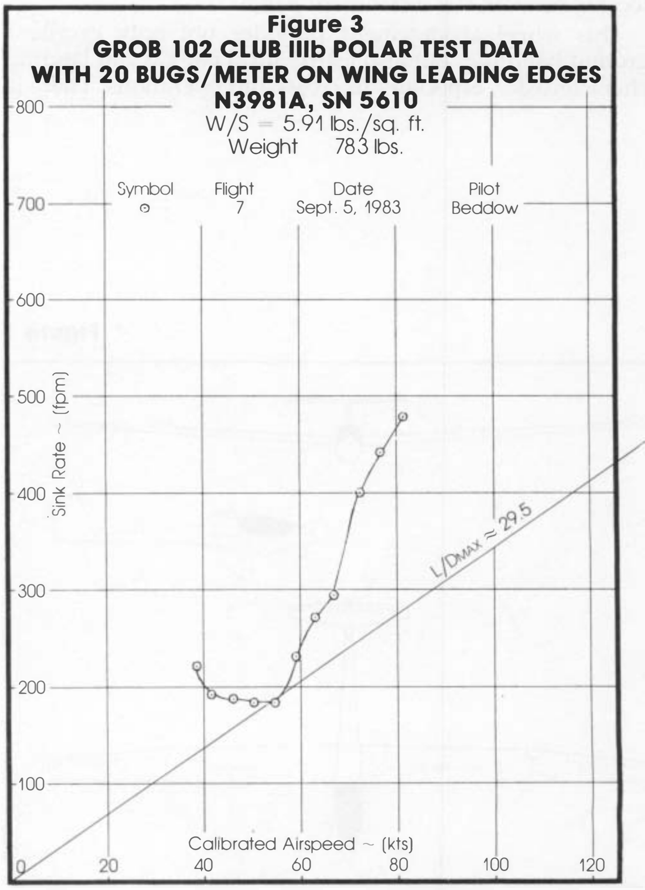


Figure 3
GROB 102 CLUB IIIb POLAR TEST DATA
WITH 20 BUGS/METER ON WING LEADING EDGES
N3981A, SN 5610

about 5.0 seconds before sealing, but decreased to about 4.5 seconds after sealing. Six early morning high tows were then performed to measure the sink rates with the wing root seals installed. Those data are shown in Figure 4, where an L/DMAX of about 33.3 at 50 kts and a minimum sink rate of roughly 138 fpm at 42 kts are indicated. The sealed polar is more normally shaped than the unsealed polar, and the high drag knee shown in the unsealed data at 68 kts now disappeared.

Despite the installation of the wing root air seals, there still existed some concern that significant amounts of air originating from the aileron pushrod holes in the wing aft spars might still be leaking through the airbrakes. For that reason the airbrakes were sealed with thin tape during Flights 12 and 13, but no performance improvement was shown by those test data. Such airbrake taping is somewhat risky because it can prevent emergency use of the airbrakes when needed. Our Scotch brand Mystic tape only overlapped the wing surface about .10 inches (2.5 mm) at the airbrake edges, but about 15 minutes of sustained effort at the airbrake handle was required for me to break the tape loose. Even the wheel brake was unavailable because that was also actuated by the airbrake handle. Care must be taken not to overload the airbrake control by forcing it too hard or damage may occur in the airbrake control system.

The 33.3 glide ratio is quite good for a general purpose sailplane, especially considering that its sink rate at 80 kts is only about 370 fpm and that no retracting wheels are used. Actually, this performance approaches that of the *Std. Cirrus* with wheel retracted (Ref. B), where 35.9 L/DMAX at 52

At six feet two inches, test pilot Bruce Beddow fits nicely into the Club IIIb, whose faired nose wheel allows for heavy braking on landing.

Photos by Skip Epp

Facing page: good all-around handling qualities, a respectable 33:1 L/D and much similarity to the two-seat G-103 increasingly used as a trainer all give the Club IIIb built-in advantages as a transition trainer or personal sport machine. And to top it off, the glass bird even looks good!

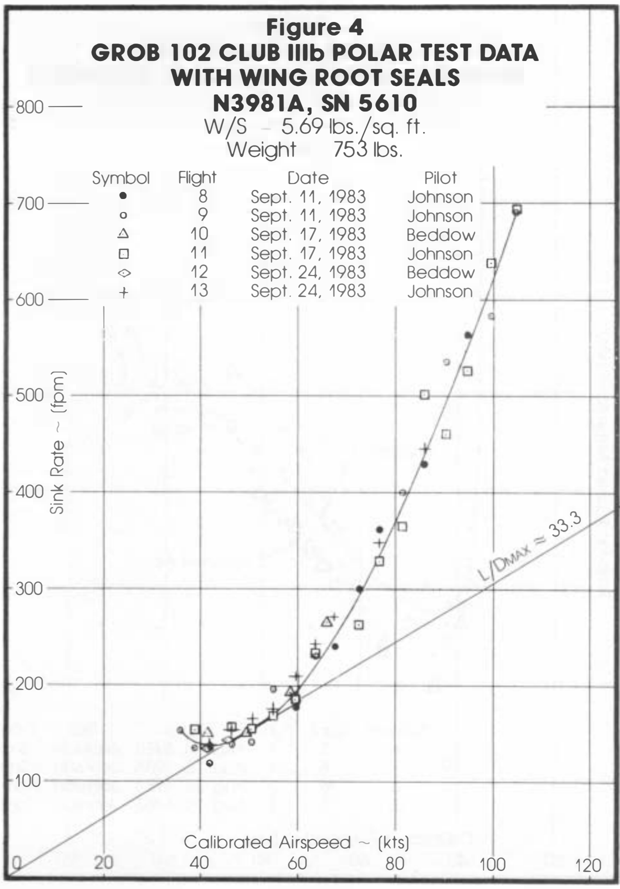


Figure 4
GROB 102 CLUB IIIb POLAR TEST DATA WITH WING ROOT SEALS
N3981A, SN 5610

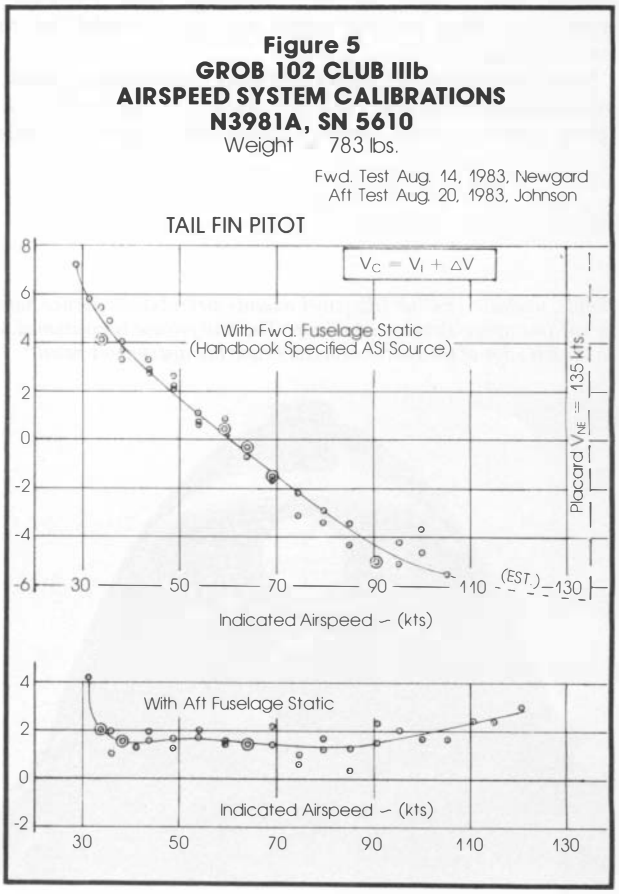


Figure 5
GROB 102 CLUB IIIb
AIRSPEED SYSTEM CALIBRATIONS
N3981A, SN 5610

kts and 330 fpm at 80 kts were measured. In addition, the *Std. Cirrus's* test wing loading was 6.78 lbs./sq.ft. (33.1 kg/sq. m), which is 1.09 lbs./sq.ft. (5.3 kg/sq.m.) heavier than the Grob 102C's test wing loading.

The 102C's flight characteristics are all excellent, in my opinion, and are much better than those of the *Std. Cirrus B*. The stall is very gentle and is preceded by buffeting, just as with the Twin II. Even when well into a stall there is no tendency for a wing to drop during either straight or turning flight. Also, aileron control still appears to be effective in moderate stall, though much diminished.

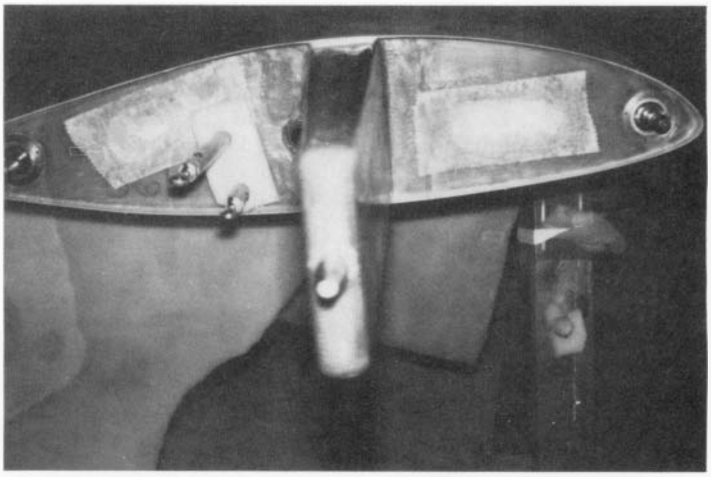
An aero tow release hook is installed in the tip of the fuselage nose, which provides a natural tendency for the 102C to follow the towplane while on tow. When properly trimmed it is possible to tow much of the time without touching any controls. A second winch/auto tow release is provided farther aft on the fuselage bottom, forward of the main wheel. This was not used during our testing, but it appears to be in a good position for its intended purpose. A sensibly sized conventional horizontal tail, complete with a fixed stabilizer measuring 9.85 ft. (3.0 m) in span, provides excellent longitudinal characteristics. A spring type of elevator trim system provides easy and effective trimming at all test airspeeds.

The airspeed system uses a pitot mounted high on the vertical stabilizer, and it functions well there. As stall is approached the ASI begins to twitch, apparently due to wing root airflow separation vortices impinging upon the fin-mounted pitot. That is a good indicator for the pilot that a stall condition exists.

Two sets of static sources are provided. The pair designated for use with the cockpit ASI are located on the fuselage sides about 2.0 inches (50 mm) forward of the wing leading edges and roughly 9.4 inches (240 mm) below the airfoil nose. The second static source is intended for use with variometers. It is located on the aft fuselage sides, halfway between the wing trailing edges and the vertical fin root leading edge.

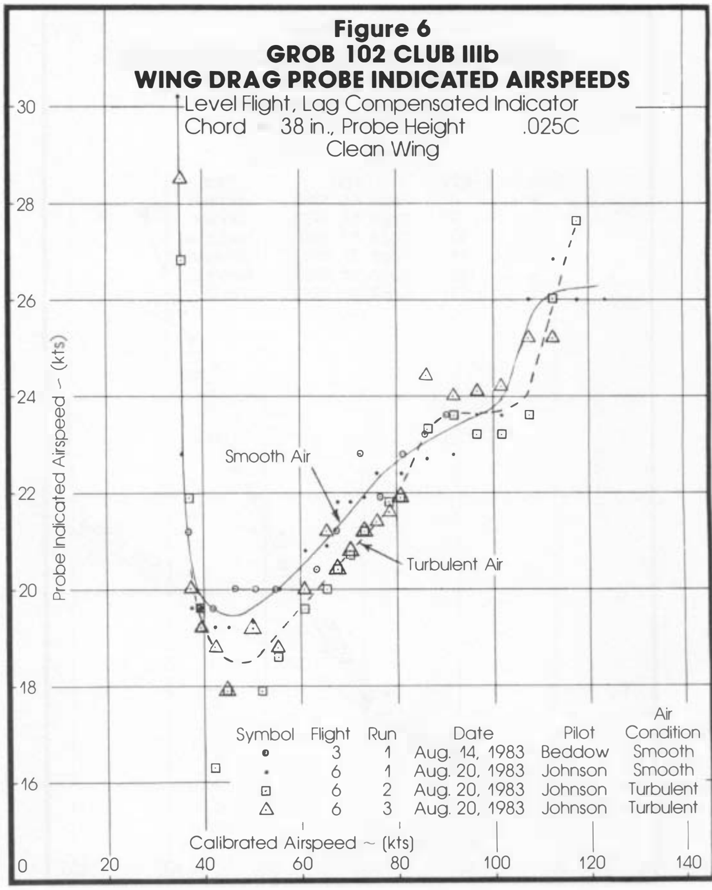
Both systems were calibrated using our standard measuring equipment. Those data are shown in Figure 5 as airspeed system error versus indicated airspeed. Neither

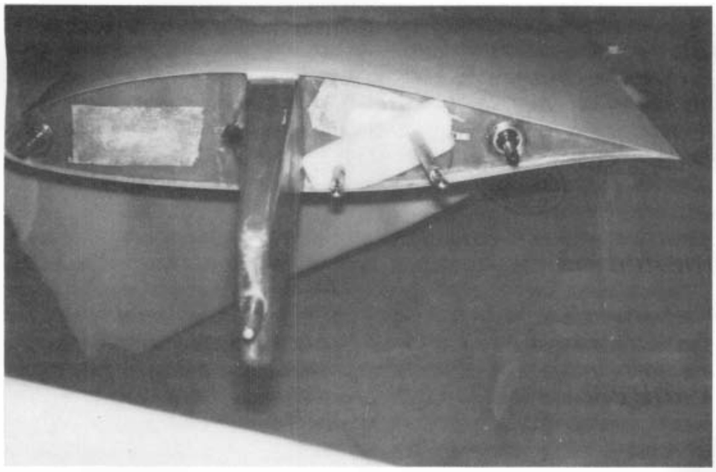
Simple, uncluttered Club IIIb panel mounts airbrake/wheelbrake handle on left just above elevator trim lever. The tow release is positioned low on the left edge of the center pedestal below the instrument panel.



Left wing root showing areas where major air leakage was corrected.

system is very accurate, though adequate for most purposes and better than those of some of the current racing sailplanes. At stall the 102C ASI could be forced to read approximately 29 kts, with the ASI connected to the handbook specified forward static sources. The Figure 5 calibration indicates that about 7 kts must be added to the 29-kt indicated value to arrive at a 36 kts calibrated airspeed level flight stall (CL≈1.35).





Right wing root taping helped improve the measured L/D by two points.

No significant airframe buffeting was encountered at high airspeeds, so apparently the wheel fairings are better shaped than those of the Twin II. The empty weight of our test 102C was about 573 lbs. (260 kg), including basic instruments. Each wing panel weighed about 146 lbs. (66 kg), which two persons can normally handle during assembly. The overall assembly and control attachments are similar to the Twin II and many current sailplanes. Good design, but the controls are not automatically connected anywhere.

The airbrakes are relatively large 47.2-inch-long (1.20 m) Schempp-Hirth type flat plates that protrude from the wing top surfaces only. Their effectiveness is about ideal for this type of sailplane; adequate for good glidepath control, but not so powerful that a relatively inexperienced pilot would be apt to get into difficulty. The 102C sideslips well, so that if a very steep approach is needed, it can easily be achieved by combining sideslip with full airbrake. A slight nose-down pitch occurs when the airbrakes extend, which is desirable.

With an L/D ten points better than that of another popular club single seater (the 1-26), the Club IIIb is finding favor with clubs and FBOs.

The main wheel brake is a very effective hydraulically-actuated disk design, which functions when the airbrake handle is pulled fully aft. For that reason one should be careful not to force the airbrake handle hard aft at touchdown or the wheel brake will be operating too early.

The last data plot is Figure 6, which shows the wing drag probe data measured at a station roughly 4 feet (1.22 m) outboard from the fuselage side on the left wing. Drag probe readings were made during flight three, while still air sink rate measurements were being performed simultaneously. Additionally, flight six was devoted entirely to wing drag probe data measurements. There a high tow was made in still morning air, and the Run 1 data were taken in smooth air. By the end of that run the sailplane had descended into the convective lower air layer, and thermaling flight was initiated. The probe drag data shown for Runs 2 and 3 were taken during glides in turbulent air between thermal climbs.

Curiously, between 40 and 80 kts CAS, the indicated wing profile drag values were measurably lower when flying in turbulent air than in smooth air. The reason for that is uncertain, but possibly the Eppler 603 airfoil has some laminar separation bubble regions that are reduced in magnitude by the slightly turbulent interthermal air. Even though the Grob 102C airfoil has a considerably larger t/c ratio than that of the *Ventus* (.197 vs .145), its profile drag in turbulent air appears to be only about 5 to 10% higher between 50 and 80 kts than that of the *Ventus* with its flap set to 0° (See Ref. C).

Overall, the Grob 102C must be rated very high for a modern general use sailplane, both for advanced training and for pleasure flying. It has excellent climb performance and moderately high L/D's between thermals, close to those of the earlier fiberglass Standard Class sailplanes, but without the problems and complications of a retracting landing gear system.

A word of caution concerning flight characteristics of the Grob 102, and perhaps other sailplanes, when the relatively small gaps between the fuselage and wing roots are left untaped. Both of the owners made their initial flights with the new sailplane in that condition, and Charlie in particular noted unacceptable wing dropping at stall airspeeds. This was unexpected and apparently was caused by wing root air separation migrating toward the tips asymmetrically. Taping the wing root joints solved that problem.

Thanks are owed to Jim Clayton and Charlie Bangert for kindly providing DGA with the use of N3981A for test evaluation, to DGA which provided the towing funds and to the tow pilots and others who contributed their efforts to this testing.

References

A. Johnson, Richard H., "A Flight Test Evaluation of the Grob 103 Twin II," *Soaring*, Feb. 1983.

B. Johnson, Richard H., "A Flight Test Evaluation of the Std. Cirrus B," *Soaring*, Mar. 1976.

C. Johnson, Richard H., "At Last: An Instrument That Reads Drag," *Soaring*, Oct. 1983.

The reader of flight test evaluations should recognize the data are subject to uncertainties regardless of the method used. The data presented are those measured and experienced, but they do not purport to be absolute or always repeatable and comparable to other data. Hence they should be used with appropriate consideration of the implications and uncertainties involved.—ED.