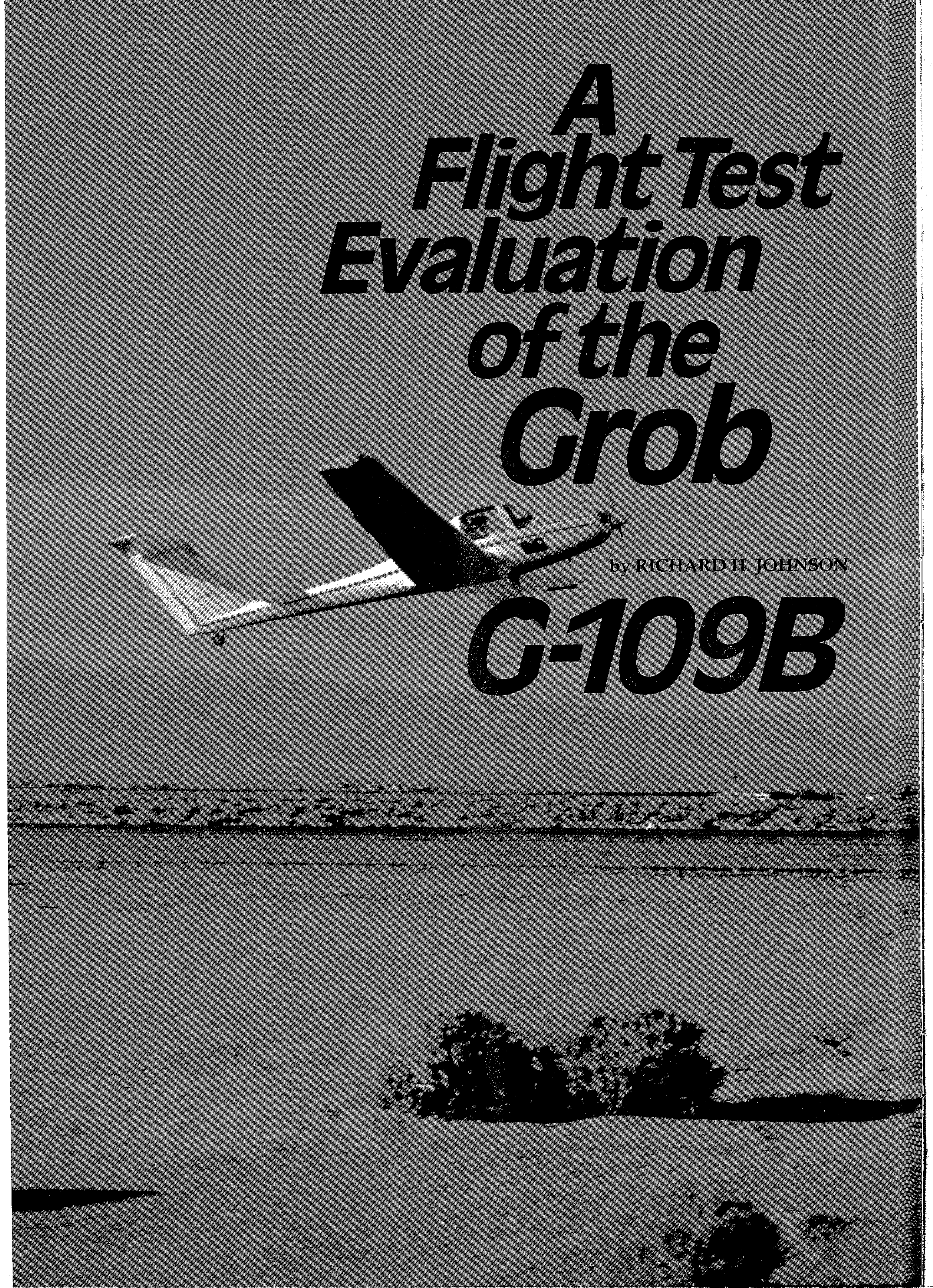
A Flight Test Evaluation of the Grob G-109B

by RICHARD H. JOHNSON



The Grob G-109B is a new, side-by-side, two-seat motorglider currently in production by the well-known and modern Burkhart Grob Flugzeugbau factory. They also produce the G-102 and G-103 modern composite single and two-seat sailplanes that are popular worldwide, especially as club and training aircraft.

Figure 1 is a 3-view of the G-109B showing its basic outline and dimensions. It has a low wing location and uses a fixed conventional sprung landing gear. The individual hydraulic main wheel brakes and the steerable tail wheel connected to the rudder made taxiing easy without any need for a ground assistant or wing helper. Its wings are foldable for easy storage and have a 57.1 ft. (17.4 M) wingspan when extended to the flight position. Power for this fine new motorglider is provided by a new 87-hp four cylinder air-cooled GROB 2500 engine driving a 2-bladed variable-pitch Hoffman propeller.

The wing spar caps, aft fuselage and most of the tail are made from carbon fiber. A new, thinner Eppler wing airfoil is used that is reportedly less degraded by bug impact roughness and rain than that of its predecessor, the G-109. That model, which went into production in 1981, was similar in appearance to the new G-109B, but possessed about 2.65 ft (.8 M) less wingspan and had a thicker Eppler 603 airfoil, seven less horsepower in its engine and used no carbon fiber in its construction. The older model G-109 also used a wider chord, lower aspect ratio wing than the one on the new G-109B.

Konrad Lewald, one of Burkhart Grob's sales managers, kindly offered the use of a new G-109B demonstrator for flight testing, and we gladly accepted the task. Bruce Beddow and I performed the airspeed system calibration on the last day of 1985, and those data are shown in **Figure 2**. We measured less than 1 knot error over the entire normal airspeed range and only about 1.5 knots error at stall. The airspeed system was actually calibrated twice; once with the engine power set to about half throttle, and again with the engine power off and the propeller feathered.

The excellent design of the G-109B's airspeed system provided the same low errors regardless of engine operation, as it should. Both the pitot and the static are located in a com-

FIGURE 2
GROB G109B AIRSPEED SYSTEM CALIBRATION
Tail Fin Mounted Pitot/Static Tube
N300BG, SN6390
31 Dec. 86 Test, Pilot=D. Johnson, Data=B. Beddow

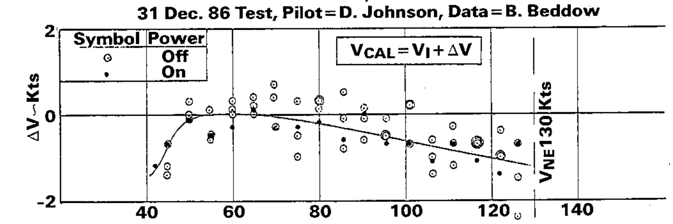
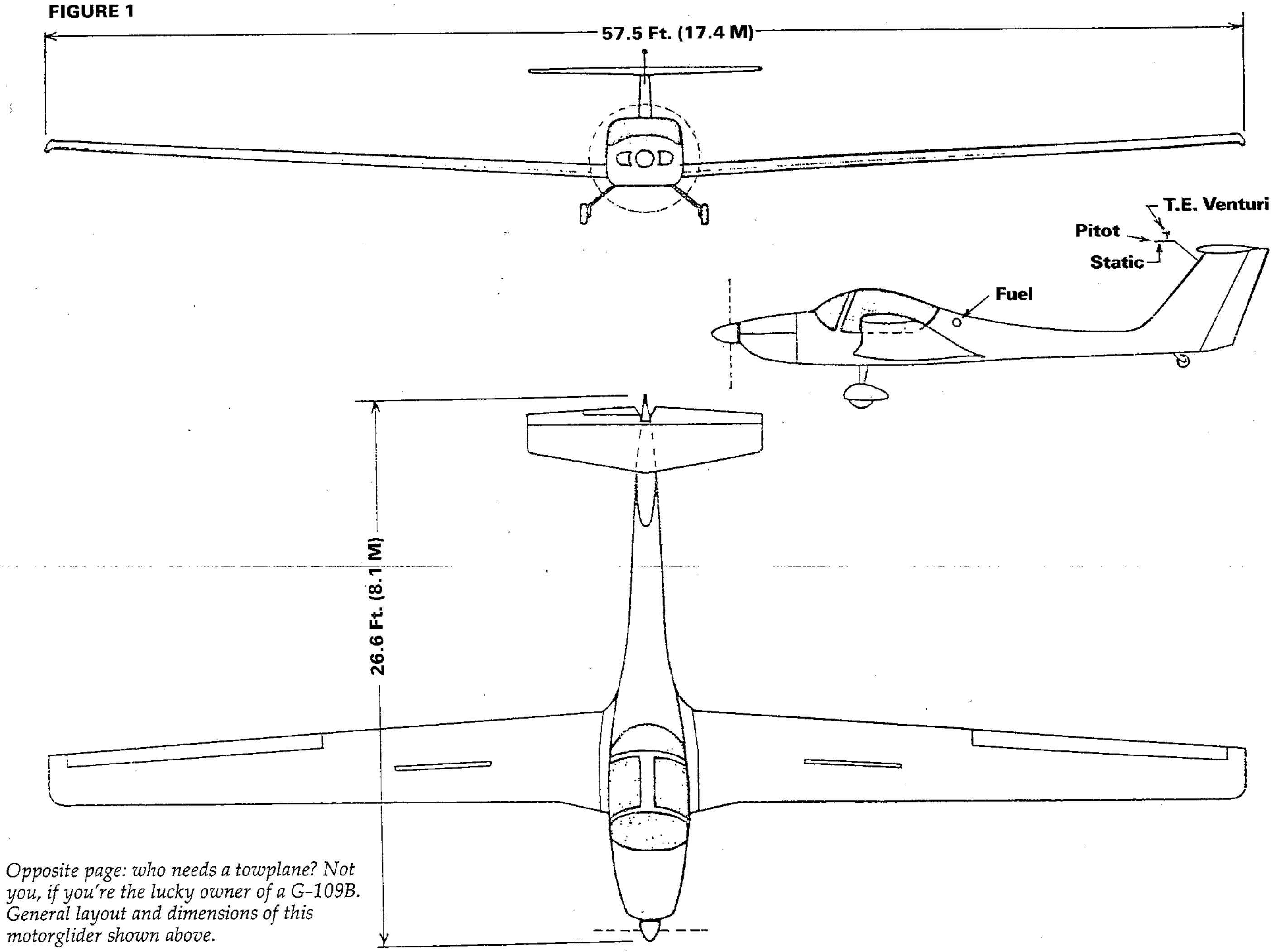


FIGURE 1



Opposite page: who needs a towplane? Not you, if you're the lucky owner of a G-109B. General layout and dimensions of this motorglider shown above.

Photos by the author

mon tube protruding from the vertical fin's upper leading edge. To provide a total energy static for the variometer, a small venturi tube is mounted on the upper side of the same tail fin pitot/static tube, and that performed very well in addition.

The weather was still good for flight testing the following day; so Mike Newgard and I set out to measure the G-109B's sink rate polar in gliding flight. Those data are shown in **Figure 3**, along with additional sink rate data that I measured during a following solo flight. My lighter gross weight solo test data were corrected to the heavier dual test weight by the usual square-root-of-the-weight-ratio method.

Those sink rate test data show an L/D_{MAX} of about 24.5 at 57 knots and a minimum sink rate of about 217 fpm (1.10 M/s) at 50 knots. This performance level is quite satisfactory for soaring in all but very weak conditions, and I did manage some short power off climbs in our modest winter thermals during the New Year's Day testing.

The G-109B's wing surfaces were smooth and polished but do not include lower surface turbulators that are now commonly used to reduce drag on many modern sailplanes. For that reason we dedicated the following five short test flights to measuring the wing relative profile drag with and without turbulator strips installed. A drag probe was mounted on the left wing trailing edge about halfway out on the span, and the first flight measured the wing drag with no turbulators installed. Those test data are shown in **Figure 4**, along with the relative drag data measured with a 24-inch length of standard dimpled turbulator tape fastened to the wing surface ahead of the probe, and at the locations noted in the figure.

Note that no turbulators (clean wing) provided lowest drag between 57 and 95 knots. However, a top surface turbulator mounted at .75 c aft of the wing leading edge provided a little less drag below 56 knots, but high drag at all airspeeds above that. In conclusion, we could not find a turbulator location that provided less overall polar drag than that provided by the factory condition clean wing.

Our test motorglider was not equipped with any form of wing root seals, and large holes around the aileron and airbrake pushrods allowed cockpit air to flow directly into the wing in flight. Also, the wing upper surface airbrake had no air sealing box inside the wing so that when the airbrake was opened the entire aft wing interior was vented to both the cockpit and the outside airstream. When the airbrakes were opened at speeds above about 80 knots, the cockpit air pressure blew both of the canopy's vent air-scoops wide open!

The airbrakes are equipped with spring-loaded upper surface cap strips such that they seal fairly well against their recessed mating surfaces when the airbrakes are closed. Thus there is little air leakage likely with closed airbrakes. The ailerons are hinged at their upper surfaces, but tape covers the gap between the aileron and wing upper surfaces, so little air leakage could occur. However, the aileron control pushrod hole through the aft spar is unsealed, and that would permit cockpit air to flow out through the opening and possibly cause unwanted drag.

For these reasons air seals were added to the wing roots and additional sink rate tests were made to re-measure the G-109B's polar. Those test data are shown in **Figure 5**, where an L/D_{MAX} of *approximately* 25 is shown at 56 knots and a minimum sink rate of roughly 216 ft/min (1.10 M/s) is indicated at 51 knots. It must be emphasized that these are somewhat uncertain values since the test atmosphere was not very still during any of these final three test days.

Although we did not prove a performance improvement through the addition of the wing root seals (and there may have been), it did very noticeably reduce the cockpit noise and pressure changes experienced when the airbrakes were opened in flight.

The 87-hp engine that powers the new G-109B motorglider is the new factory-manufactured G-2500 model that normally comes with single magneto ignition. For those who prefer the added reliability of a dual magneto system, it is available as an option. The earlier model G-109 was powered by a smaller 80-hp modified Limbach engine, what is in its turn a four cylinder air-cooled Volkswagen engine derivative.

Out test G-109B motorglider was almost new and had less than 20 hours of engine time on its tachometer. Even though it was new, the engine required no oil addition during our testing. I was told that the factory assembles these engines to relatively small clearances and that somewhat more power is available after the engine has been run for about 100 hours. For that reason, we deferred the rate-of-climb and maximum cruise speed testing to the last portion of our evaluation flying.

Figure 6 shows our initial climb rate versus altitude data, where the four test climbs were performed at four different indicated airspeeds. There appears to be little difference in

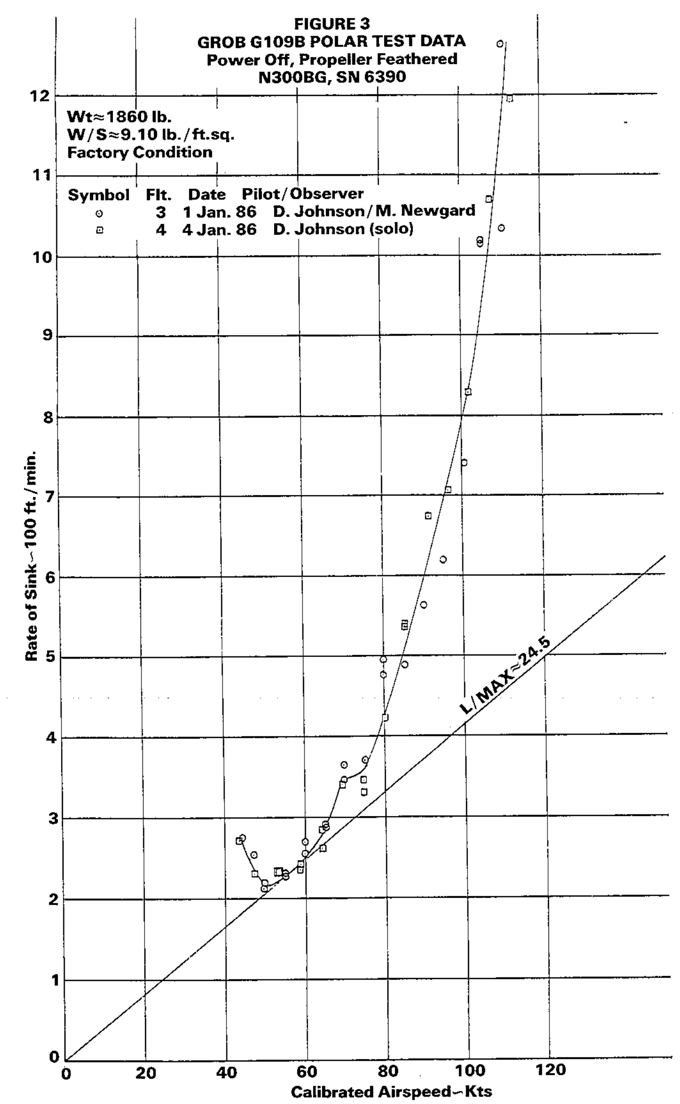


FIGURE 3
GROB G109B POLAR TEST DATA
Power Off, Propeller Feathered
N300BG, SN 6390

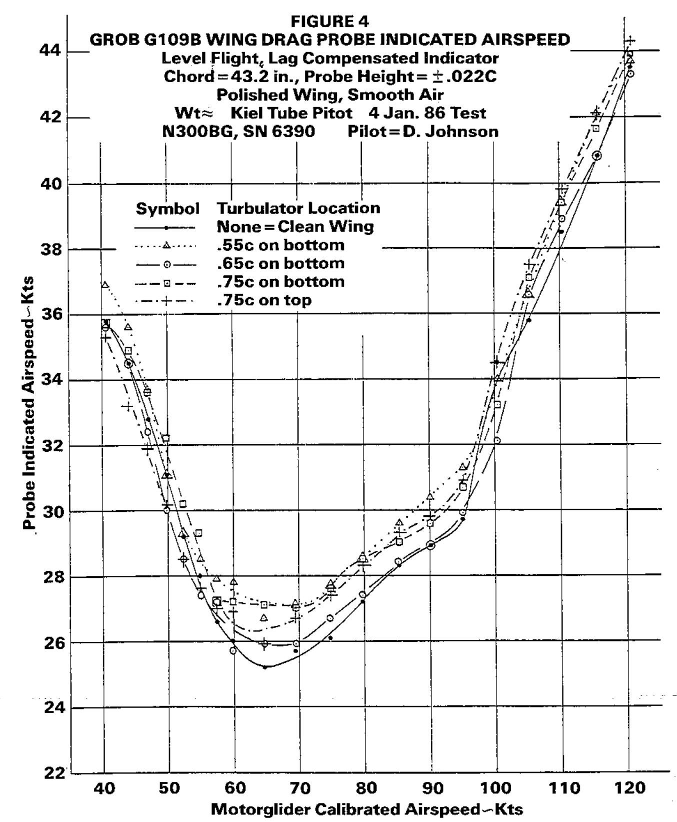


FIGURE 4
GROB G109B WING DRAG PROBE INDICATED AIRSPEED

"I've been waiting for 30 years for this type of aircraft to come along . . ."
—Bill Rodenberg

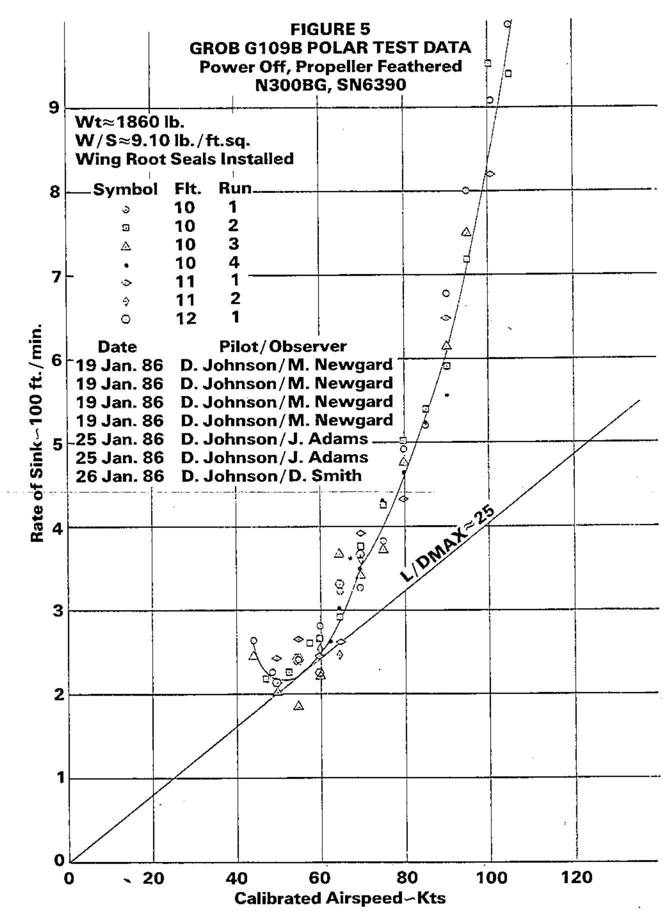


FIGURE 5
GROB G109B POLAR TEST DATA
Power Off, Propeller Feathered
N300BG, SN6390

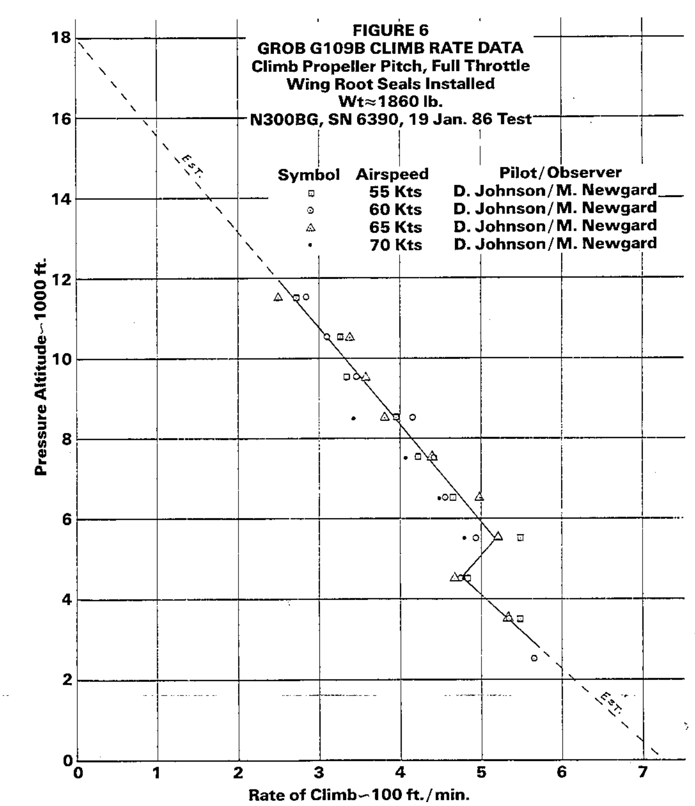


FIGURE 6
GROB G109B CLIMB RATE DATA
Climb Propeller Pitch, Full Throttle
Wing Root Seals Installed
Wt≈1860 lb.
N300BG, SN 6390, 19 Jan. 86 Test

climb rates when flown at 55, 60, or 65 knots, and only a small decrease in climb rate is shown at 70 knots. That day's test showed a slight increase in climb rate at about 5000 feet (1500 M) altitude. I understand that the automatic mixture control on the carburetor likely leaned the fuel-air mixture at that point. The carburetor is equipped with a manual choke which is very helpful during cold engine starting, but it is not equipped with a manual mixture control system.

Out test climbs were flown with two people aboard and at near the 1874 pound (850 kg) maximum allowable gross weight. Even at that relatively high weight the climb rates were quite good, showing about 500 fpm (2.5 M/s) at 6000 feet (1800 M) altitude and about 250 fpm (1.3 M/s) at 12,000 feet (3700 M) altitude. Since we did not have oxygen aboard, we limited our climbs to 12,000 feet. Extrapolating the Figure 6 data, one could expect a climb rate of about 700 fpm (3.6 M/s) at sea level, and an absolute ceiling of about 18,000 feet (5500 M). The outside air temperature averaged about 13° F (7° C) above standard atmosphere values during that test, and no correction was applied to correct those climb rate data for any increase in engine power that might occur if the test had been flown in a cooler *standard* atmosphere (59° F at sea level).

Additional climb rate testing was performed during the following weekend. Those data are shown in **Figure 7**. The air was not as still during those two test days as it had been during the prior week's testing, so greater data scatter occurred, especially during the second day because of a cold front that passed during the preceding night.

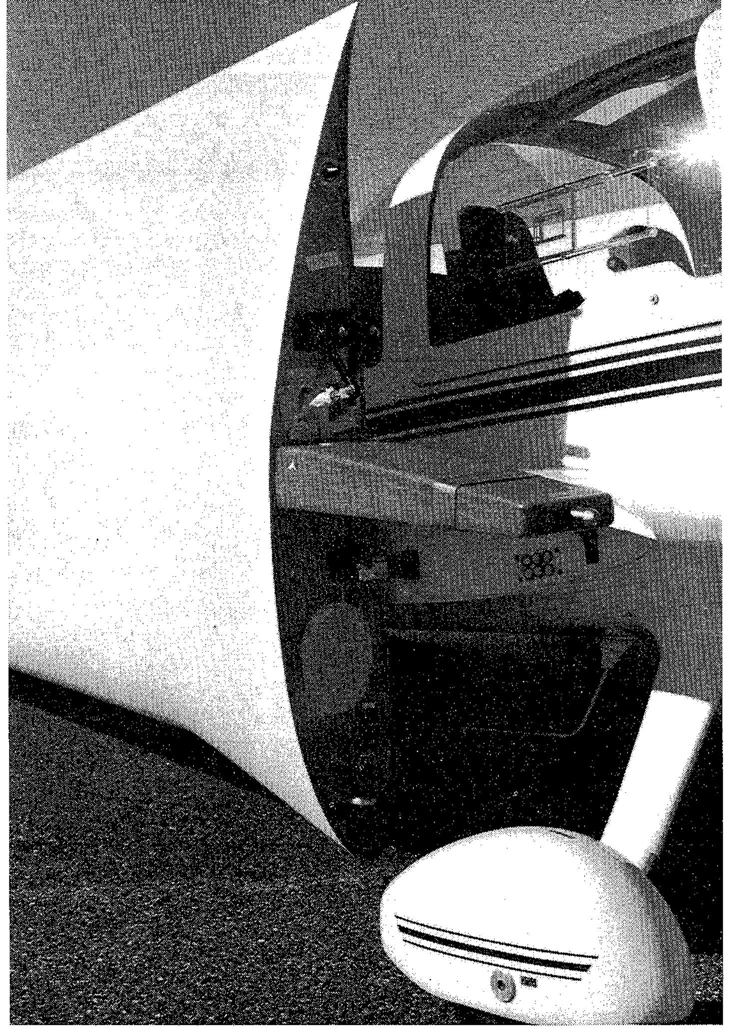
The pre-cold front data were measured during Flight 11, and the averaged outside air temperature was close to *standard*. The post-cold front data were taken during Flight 12, flown in air that averaged about 7° F (4° C) colder than standard below 9000 ft., and somewhat higher climb rates are shown there.

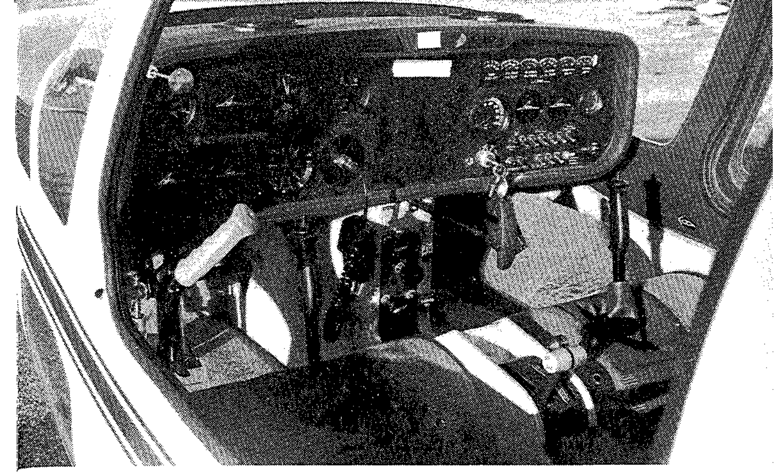
The final data measurements are of level flight *maximum* cruise airspeeds versus altitudes, and those are shown in **Figure 8**. The Hoffman selectable pitch propeller has three manually-controlled settings. A fine (climb) pitch allows the engine to turn at about 3000 rpm during climb, and that is normally used for takeoff and climb. A coarse (cruise) pitch allows the engine to slow to about 2700 rpm maximum during cruise, and that was used in the Figure 8 full throttle cruise data where true airspeeds of approximately 110 knots are shown. Normally, the engine is throttled to about two-thirds setting where better economy and about 100-knot true airspeeds are attained.

The G-109B carries a relatively large 26.4 U.S. gallon (100 L) fuel tank in the fuselage behind the cockpit area. We did not include cruise range testing in our limited evaluation, but I understand that this remarkable machine can cruise for close to 1100 miles (1750 km) on one tank of fuel if throttled back to a maximum-economy 70 knot airspeed. There the handbook indicates a fuel consumption rate of only about 1.9 U.S. gallons (7 L) per hour!

The third selectable pitch setting for the propeller is feather, which aligns the blades into the airstream to minimize drag during engine-off gliding flight. With two people aboard the G-109B, its wingloading is roughly 9.0 lb/ft.^{2} (44 kg/M^2), so it soars about like a 15-Meter sailplane with water ballast aboard. I soared our test motorglider for about five or six hours total in our mid-winter Texas thermals and found it to be quite capable of climbing in any but small, weak thermals. Also, I could work thermals outside of the motorglider's glide-back-to-the-airport range since I could reliably start the engine whenever that was needed.

The engine is equipped with an electric starter and generator system, along with a good-sized 12-volt 28-amp-hour lead-acid storage battery. The electric starter cranks the engine briskly during both ground and in-flight starting. In addition, the engine can be easily air started at airspeeds above about 80 knots by slowly unfeathering the propeller, which permits the airstream to crank the engine. Possibly lower airspeeds may be used for air starting after the engine has been run-in longer than ours had.





Opposite page: folded wing showing spar stub and control air seals installed by author. Left: instrument panel is complete and well arranged. Above: with both wings folded, ship requires little in the way of hangar space.

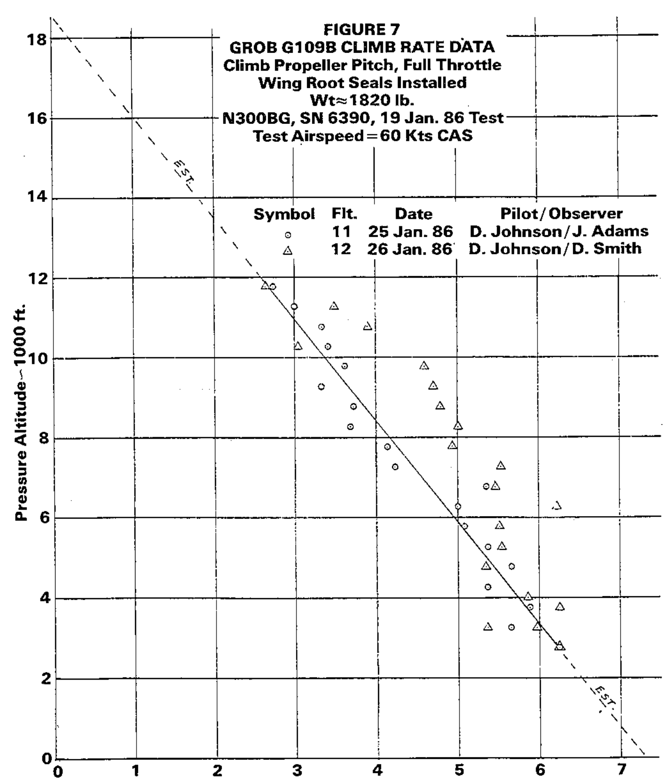
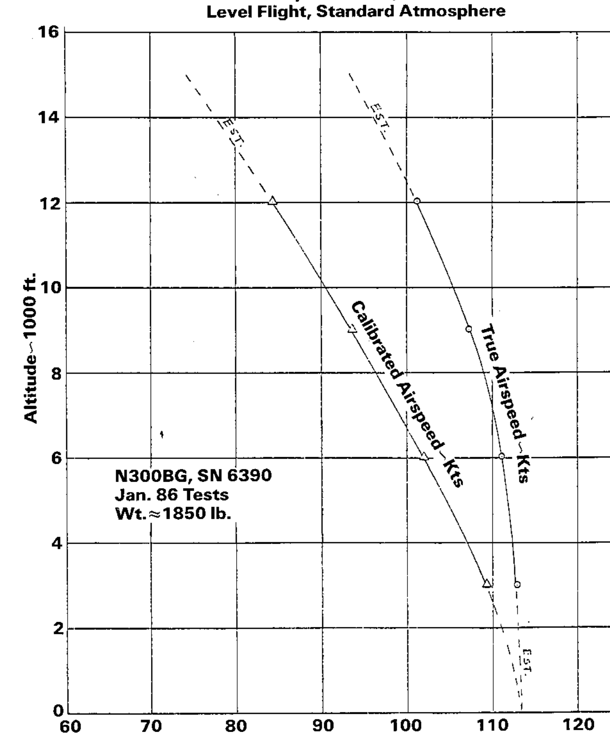


FIGURE 7
GROB G109B CLIMB RATE DATA
Climb Propeller Pitch, Full Throttle
Wing Root Seals Installed
Wt≈1820 lb.
N300BG, SN 6390, 19 Jan. 86 Test
Test Airspeed=60 Kts CAS

FIGURE 8
GROB 109B MAXIMUM CRUISE AIRSPEED TEST DATA
Cruise Propeller Pitch, Full Throttle
Level Flight, Standard Atmosphere



The G-109B's stability and controlability are excellent in my opinion. An adequately-sized horizontal tail surface with a conventional fixed stabilizer and a movable trim tab on the right side allows one to control this aircraft easily and comfortably. The rudder and vertical fin are also well-sized and provide good directional characteristics. The engine turns its propeller in a counter-clockwise direction, viewed from the rear. Since most aircraft engines turn in the opposite direction, it is somewhat unnatural for the pilot to hold partial left rudder during takeoff to counter engine torque instead of more usual right rudder.

During steep sideslips there is some tendency for the rudder to stay in the pro-slip direction, as with most sailplanes, and a light opposite rudder pedal force is needed to recover from the sideslip. Much less rudder is required for recovery if counter-slip aileron is applied at the same time. Full opposite rudder will permit straight path flight with about 20 degrees of wing bank.

The G-109B's stall characteristics are excellent in my opinion and about equal to those of a Grob 102 or 103 sailplane. Significant buffeting starts at about two knots before stall and there is little wing drop tendency during stalls from either straight or turning flight. The wing top surface airbrakes are of the Schempp-Hirth type and they are adequately effective and easy to use.

A partial-open detent is provided for the airbrake control handle such that the G-109B's glide ratio is degraded to approximately that of a light powerplane. Thus power pilots who are unfamiliar with airbrakes can use that detent to land the G-109B as easily as they can land most airplanes. Care must be taken to fully close the airbrakes before taking off again since the drag created by the partially open airbrakes will greatly degrade climb performance.

The cockpit is well laid out and the large canopy provides excellent sailplane-type visibility in the forward and side directions. Because of the center-hinged cockpit access door support structure, a small portion of the pilot's upward visibility is lost. However, that is more than made up by the large aft direction visibility provided by the G-109B, which few sailplanes can claim.

The concept of combining the practicality of a light airplane and the soarability of a medium performance sailplane is a good one and well executed in the new Grob G-109B. I think that many pilots around the world will enjoy this new motorglider and will find that they can do more soaring than they had before in their higher performance but less convenient sailplanes.

Thanks to Konrad Lewald and Burkhart Grob for the use of their fine new motorglider and to those who assisted with the flight testing.

It may look more or less like a conventional power plane in this shot, but respectable soaring performance is yours for the asking.

> 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.