A FLIGHT TEST EVALUATION OF THE ASH-26E SELF LAUNCHING 18-METER SAILPLANE

By Richard H. Johnson, Published in *Soaring* Magazine, September 1995

DESCRIPTION

The ASH-26E is the latest model high performance sailplane to be produced by the well known Alexander Schleicher Segelflug-zeugbau Company in Poppen-hausen, Germany near the famous Wasserkuppe soaring site. It is a very modern 18-meter wingspan sail-plane, and the "E" option equips it with a quiet and smooth running internally mounted Mid-West AE 50 HP self launching Wankel engine. This sailplane design is one of a number of new 18-meter class racing sailplanes that are becoming very popular in Europe, and they appear to be destined to possibly replace both the Open and 15-meter as major competition classes within the next 10 years. The engine adds considerable capability in that one can self-launch, quickly motor to good soaring areas, and avoid unwanted off-field landings when soaring becomes impossible.

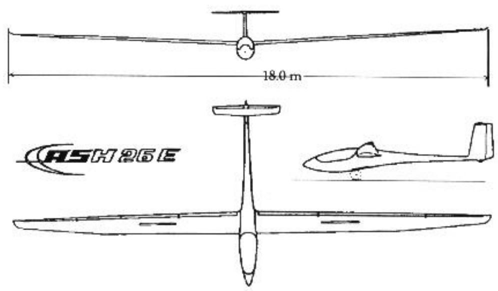
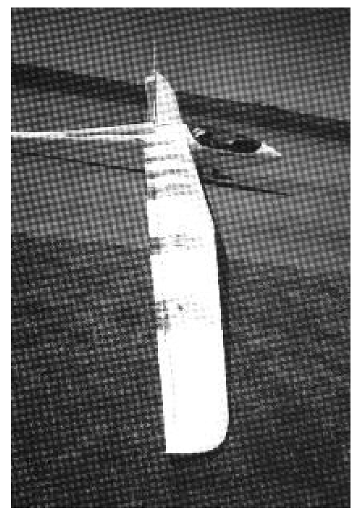


FIGURE 1. 3-View of ASH- 26E.

Martin Heide is the brilliant young principal designer of the ASH-26E. Sharing heavily in the aerodynamics of the design is the talented and well known Delft University of Technol-ogy (Holland) Faculty Member, researcher, glider pilot and newly elected OSTIV President Loek Boermans. Loek is an outstanding aerodynamicist and airfoil designer, and is in charge of the Delft University's highly regarded Low Speed Aerodynamics Laboratory, including its excellent wind tunnel. The ASH-26 is the first sailplane to utilize Loek's new thin super sailplane airfoil, the DU89-134/14, which he developed in the Delft Wind Tunnel. Reportedly the same airfoil is being used on Gerhard Waibel's new soon-to-be-produced ASW-27 15-meter racer. Not only is this new airfoil relatively thin (t/c = 0.134), but it has an unconventional reflex (concave upper surface) at the trailing edge along the entire wing span. Figure 1 is a 3-view of the ASH-26E.


ASH-26E oil flow patterns at end of a test flight. Black oil was applied at 6 spanwise locations prior to the flight and the test flight airflows produced the resulting patterns about 1 hour later.

FACTORY CONDITION POLAR MEASUREMENT:

When Don Pollard, of Winter Haven, Florida offered to bring his new ASH-26E to Caddo Mills for flight testing during 6 days in April, we happily accepted his offer. A tow plane was not to be needed because the -26 could self-launch and easily climb to 12,000 feet to find the smooth air needed for performance measurements. April and May normally deposit considerable rain on Texas, and 1995 was no exception. Fortunately, the weather was clear on the first day after Don's arrival, and we decided that we should take that opportunity to measure the ASH-26's sink rate versus airspeed polar. Its configuration was as the factory had prepared it, with several hundred small blowing turbulator holes located in a spanwise line on the bottom surfaces of both the wing flaps and ailerons. The air pressure supply for the blowing turbulators was provided by 4 pitot tubes of 5 mm (.20 in) inlet diameter attached to and extending about 20 mm (.78 in) below the flaps and ailerons of each wing panel. The ends of the flaps and ailerons were sealed, thus making them the pressure tanks to supply the turbulator air supply. In addition, both the horizontal and vertical tail surfaces were equipped with relatively large .7 mm (.28 in) high Zig-Zag turbulator strips on each side slightly ahead of their hinge lines.

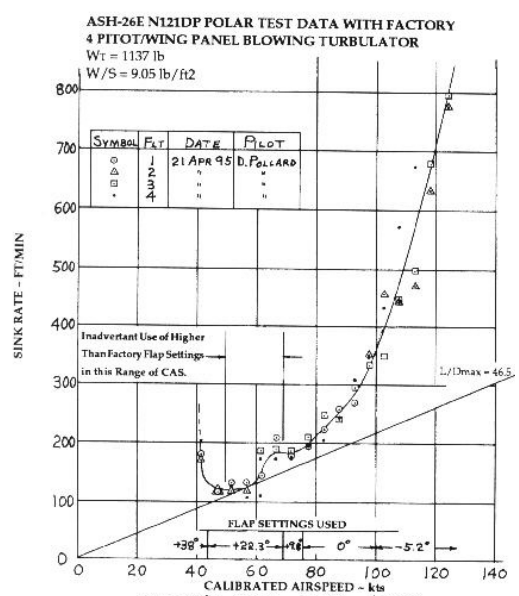


FIGURE 2.

Figure 2 presents the sink rate versus airspeed polar that was measured during the first day's testing. We had intended to use

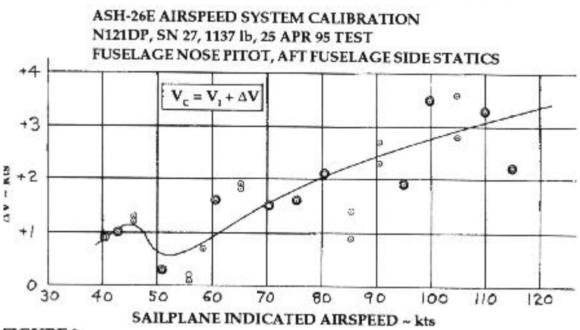


FIGURE 3.

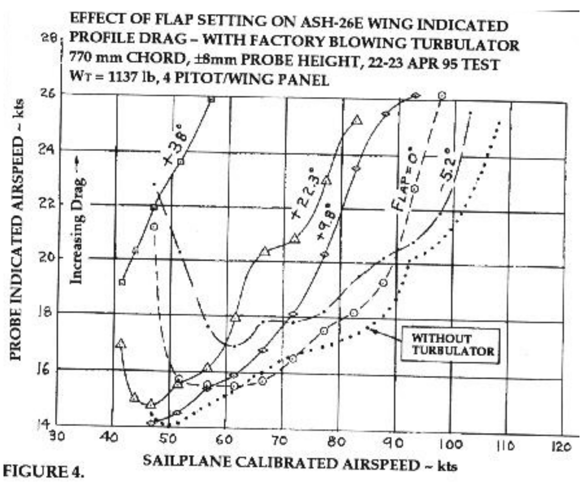
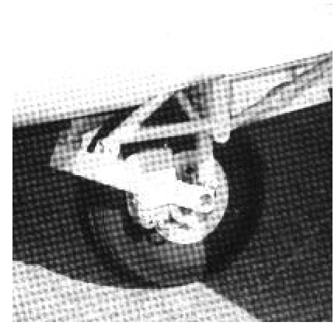
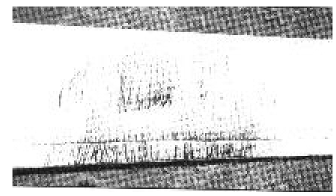


FIGURE 4.

the factory recommended flap settings, but unfortunately we erred and used higher-than-recommended flap settings in the 50 to 68 kt airspeed range. Factory recommended flap settings were used at all the remaining test airspeeds. The 46.5 -to-1 maximum glide ratio indicated at 56 kts would likely have been somewhat higher had the lower + 9.8 degree flap setting been used instead of the +22.3 degree setting mistakenly used. However, by utilizing the remaining portions of the polar, and fairing through the data taken with higher-than-factory recommended flap settings, one can reasonably estimate how much higher the L/D max value might have been. My estimate is about 48-to-1, based principally on the 116 fpm sink rate indicated at 47 kts, and the 182 fpm sink rate measured at 72 kts. Both of those points were flown at factory recommended flap settings.



Sturdy shock mounted 5 inch by 5 inch landing wheel, with CG tow hook mounted on the left side.



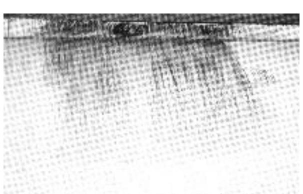
Wing upper surface oil flow near wing tip, viewed from mid-aileron trailing edge. The airflow near the center of oil pattern appears to be laminar back to about .7 chord, as indicated by very thin oil at about .75c, where high surface shearing is present. Turbulent wedges emanating from wing forward surface roughness are shown located to both left and right hand sides of central laminar area.

AIRSPEED SYSTEM CALIBRATION

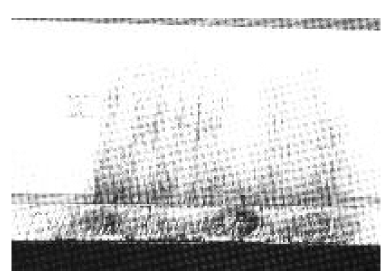
The weather was not suitable for further sink rate testing during the following 3 days. Therefore we performed the airspeed system calibration, and evaluated a number of wing turbulator configurations using the Reference A drag rake system. The airspeed system was calibrated with our standard Kiel tube and trailing static bomb method, and those test data are shown in Figure 3 as system error versus sailplane indicated airspeed. The calibration ap-pears to be accurate, but about +/- 1 kt of scatter is apparent in the test data. That is in part due to the ASH-26 being equipped with a small 2.25 inch (57 mm) diameter ASI which was more difficult to read than is a standard full size ASI. The +1 to +3 system errors are not very large, but their increasing magnitude with airspeed suggests that the flush pitot on the fuselage nose may not be receiving full stagnation pressure at the higher airspeeds.

WING DRAG RAKE TESTING

An airfoil drag measuring rake was installed on the ASH-26's left wing panel trailing edge about 2 meters outboard from the fuselage joint, and various Zig-Zag turbulator configurations were then flight tested. Concurrently, blackened 10W-40 motor oil was applied to the right hand wing panel to study its airflows and look for any indication of airflow separation. The drag rake tests were performed over a large airspeed range at each flap setting, such that the minimum drag flap setting can be determined for all airspeeds between stall and 108 kts CAS. Since previous drag rake testing on other sailplanes had shown that turbulator configuration often affects the optimum flap settings, it was decided that all of the ASH-26 drag rake testing would be per-



Top surface laminar flow oil patterns near outboard end of airbrake, with turbulent 15 degree wide wedge shown near center of pattern, caused hy purposely installed duct tape "bug," seen near leading edge. Note unusually thick oil swirl located on wing flap behind the turbulent wedge.



Rear view of wing oil flow near outboard end of airbrake, showing unusual thickness of oil at wing trailing edge.

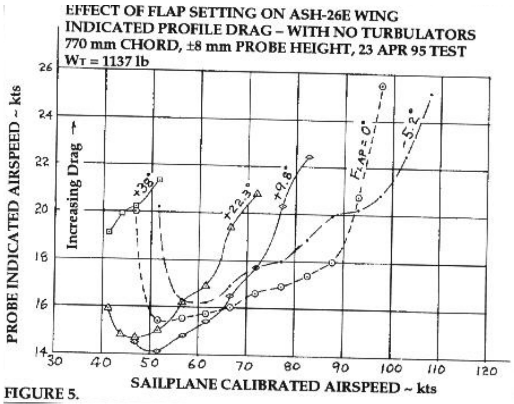


FIGURE 5.

formed thoroughly, and as described above.

Figure 4 presents the wing drag rake data that was measured with the factory blow hole turbulators operating, as they were during the initial sink rate testing. Note that the + 9.8 degree flap setting was best up to 58 kts, with the 0 flap setting best from there up to 90 kts, and the -5.2 degree setting best at higher airspeeds. Also shown in Figure 4 are similar test data taken during a subsequent flight with the blowing turbulators sealed off (see Figure 5), by taping over all 8 air supply pitot inlets. Note that except for a small region between 63 and 73 kts, the wing profile drag was measurably higher with the blow hole turbulators operating, especially at airspeeds above 75 kts. The drag increase indicated there does not include the profile drag of the 8 turbulator air source pitots, or the momentum loss drag of the turbulator air supply. For those reasons it was judged that the blow hole turbulator system was not beneficial and would not be used during our following testing. All 8 turbulator air supply pitots were removed from the wing lower surfaces, and their flush inlet mounting holes on the bottom surfaces of the flaps and ailerons holes were taped over.

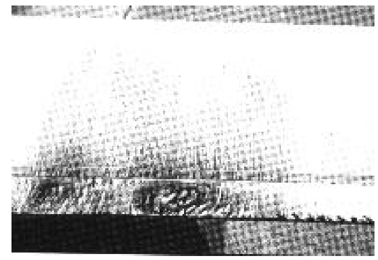

Wing top surface oil flow near fuselage where only partial laminar flow is indicated, and relatively heavy oil accumulations on the flap surface trailing edge.

Figure 5 presents the wing profile drag data that were measured with no turbulator. There the +9.8 degree flap setting was best over a much wider range of airspeeds, from 46 through 65 kts. Also, the 0 flap range now extended from 65 through 92 kts, with -5.2 degrees best at the higher airspeeds. Below 46 kts the +22.3 degree thermaling flap setting created the least drag.

The Caddo Mills weather continued to be unsuitable for sink rate testing during the following two days; therefore, more time was spent performing additional wing drag rake testing to determine if a plain Zig-Zag turbulator, such as those found beneficial in Reference B, might reduce the wing profile drag. A .26 mm (.010 in) high turbulator was tested on the wing bottom surface at .77, .82, .87, and .92 chord locations. and a .46 mm (.018 in) high turbulator was tested at the .82, .87, and .92 chord locations; all without success. Three test flights were made with a .46 mm high turbulator mounted on the wing top surface at about .61, .68, and .75 chord locations; also without measuring any drag reduction.

PROPULSION FAILURE

It was during this testing period that the ASH-26 suffered a propulsion system failure, and we had to resort to aero towing to finish the testing. The engine itself did not fail, but a sealed propeller drive belt idler pulley bearing failed, causing a sudden and complete loss of propeller thrust. The cause of the bearing failure was not determined. The engine had been operated only about 18 hours total time before the bearing failed. The ASH-26 was equipped with both a nose and a CG tow hooks, so most of the testing was able to continue uninterrupted.

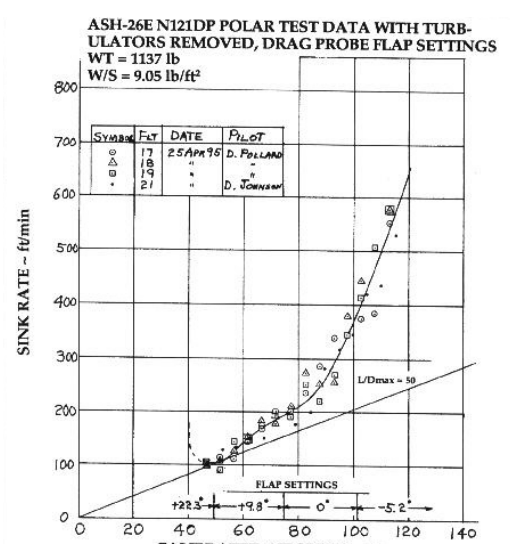
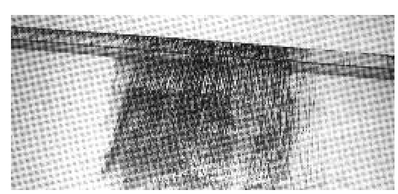
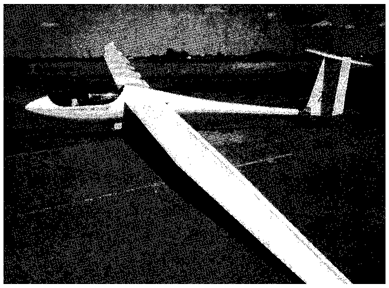


FIGURE 6.

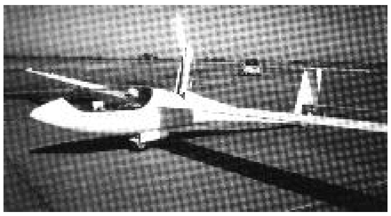
ADDITIONAL SINK RATE TESTING

The weather cleared nicely on 25 April, providing an opportunity for additional sink rate measurements in relatively still air. The final sink rate measurement test flights were performed with no turbulators on the wing Also, the .7 mm (.028 in) high Zig-Zag turbulators on the tail surfaces were removed because they were


Wing bottom surface oil flows indicate good laminar flow almost all the way to the trailing edge, except behind the duct tape "bug," intentionally placed near the leading edge as aflow quality proof indication.

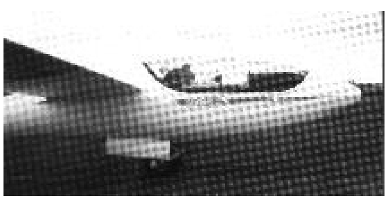


Ready for takeoff. Note large upper surface air brakes whose actuating handle also operate wheel brake.



ASH-26E on Caddo Mills runway, with propeller retracted.

Don in ASH-26E on Caddo Mills runway, with engine running for



Don Pollard ready for takeoff for wing drag measurement flight at Caddo Mills.

believed to be excessively high, and likely the cause of unnecessary additional drag (Ref. C). Four high tows were made to measure the sailplane sink rates at airspeeds between 46 and 115 kts, and those test data are shown in Figure 6.

The minimum sink rate now appeared to decrease to about 100 fpm at 47 kts, and that is markedly better than the 116 fpm previously measured at the same airspeed and flap setting with turbulators install-ed (Figure 2). Also, the L/D max improved to about 50-to-1 at 52 kts, which is excellent for an 18-meter sailplane.

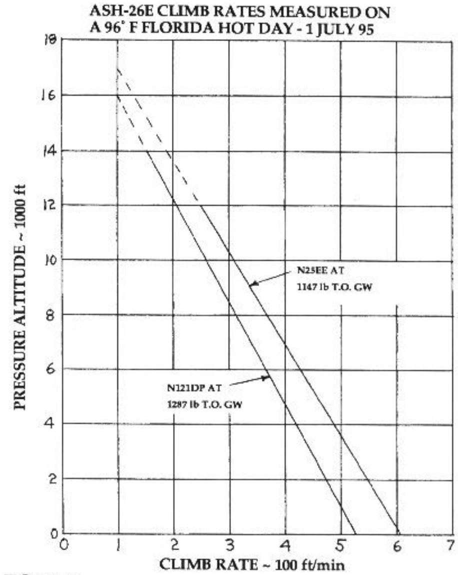


FIGURE 7.

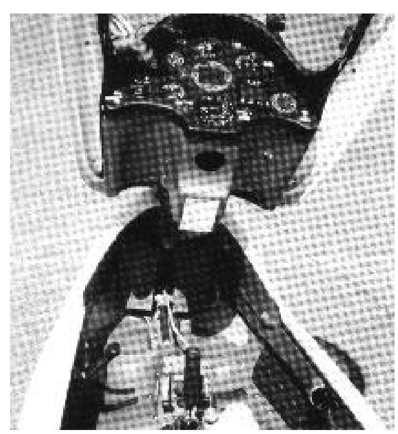
The turbulatorless ASH-26 polar looks quite good except in the mid-speed range of 56 to 80 kts, where the polar bows upward slightly.

Apparently the wing airflows are not as good as they should be in that region, but none of the turbulator configurations tested appeared to reduce the wing drag. Our oil flow testing had failed to identify any airflow separation areas or bubbles, except that the oil built up unusually deeply on the concave top surfaces of both the flaps and ailerons. Bottom surface oil flows indicated that the lower wing surface was achieving good low drag laminar airflow back to at least the flap and aileron hinge lines. The oil flow on the top of the wing generally showed laminar airflow back to about .7 chord; but in a number of regions, including most of the airbrake span, the low drag laminar flow appeared to transition to turbulent flow at more nearly the mid-chord. Wave gage measurements showed only about .001 to .002 inch waves on the wing bottom surfaces, and that is exceptionally good. The top surface waviness averaged about .005 inches, except over the air brakes where about .011 was measured. The top surfaces really needed some additional smoothing, and that should result in lowered wing drag and higher sailplane performance.

CLIMB RATE TESTING

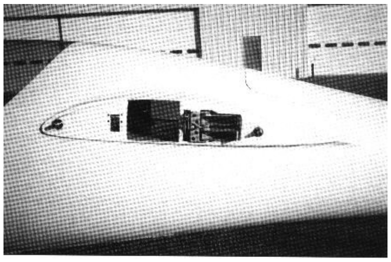
After Don returned to Florida and replaced his propeller drive belt idler pulley, climb rate versus altitude test flights were performed. Chicho Estrada joined the climb rate testing, flying his own ASH-26E. Both sailplanes were essentially identical in configuration, with all turbulators removed. The only difference in the sailplanes was that Don was carrying water ballast, and was flying at about 140 lbs higher gross weight.

The test day was a hot 96 degrees F (36.5 deg C) at takeoff, but the climb rates were nevertheless very good. Those test data for each of the two sailplanes are shown in Figure 7, with no standard day corrections made to the data. The Mid-West engines did not have a mixture control, and the climbs were terminated when the engines began to run rough. Don made it to 14,000 feet in 49 minutes, and Chicho quit at 12,000 feet after about 31 minutes. When a mixture control is available for the Mid-West engine, it appears that the ASH-26E service ceiling (R/C = 100 ft/min) will be at least 17,000 feet when flying at normal 1157 lb maximum gross weight.



Roomy cockpit with forward hinged canopy and instrument panel which permits easy entry and exit for pilot.

WEIGHTS



Horizontal tail interface, featuring automatic elevator connection.

The empty weight of N121DP was about 934 lb (424 kg) and that included 37 lb (16.7 kg) of nose ballast needed to counter-balance the pro-pulsion system installation which is located behind the cockpit.

The wing panels are single piece units weighing about 186 lb (84.4 kg) for the left panel, and about 189 lb (85.7 kg) for the right panel. For all but the strongest people, that requires either a 3 man crew or a now popular assembly dolly, to assemble the ASH-26.

LANDING GEAR SYSTEM

The main landing wheel is a well sized 5 by 5 inch unit equipped with a hydraulic disc brake. Its supporting steel weldments appear sturdy and the wheel itself is sprung to provide additional smoothness to normal landings, and shock absorption during hard or rough field landings.

Though the main landing wheel support structure appears impressively strong, it is very difficult to retract after takeoff, and, in my opinion, that needs to be improved.

Unless one has an arm like Hercules, it is not possible to fully retract the wheel with a straight steady pull of the cockpit handle.

The only way Don or I could retract the wheel was to first push the handle full forward, then swiftly pull it back to build up the mechanism's momentum and try to engage the uplock détente before the gear started down again. It took me about 10 tries to succeed the first time I retracted the gear.

The CG tow hook is bolted to the landing gear, therefore the landing gear should not be retracted until after the tow line is released.

The airbrake handle also actuates the wheel brake, so one needs to be careful to not apply the airbrake too vigorously on landing, to prevent a nose scraping.

The tail wheel is a fixed 210 by 65 mm pneumatic unit that is not steerable.

No wing tip wheels were provided, so it was necessary to use the tail dolly and a wing tip walker or slide-on tip wheel to bring the sailplane to takeoff position.

The empty weight on the tail wheel is close to 125 lbs (56.7 kg), but a clever Cobra trailer (Alfred Spindleberger) supplied tail dolly lever system makes it easy for one person to install and remove the tail dolly.

Wing to fuselage interface shows thin airfoil, automatic connection for all wing controls.

Bladder type water ballast tanks are located in each wing. The standard tanks each hold about 50 liters (13 US gal), and special tanks holding about 80 liters (21 US gal) each can be ordered. Since our test sailplane's gross weight with Don piloting was about 1137 lb without ballast, and its maximum certified gross weight is 1157.6 lb (525 kg), there was almost no need for water ballast, unless the engine system is removed; and that can be done easily.

GENERAL CHARACTERISTICS

The cockpit is large and comfortable, and the visibility is excellent.

All of the flight controls connect automatically on assembly, as they should. The stall characteristics are surprisingly gentle, and reminded me of Gerhard Waibel's ASW-17, the "Grand Father's" sailplane.

With wings level, there was moderate buffeting but no wing dropping. I had less than 1000 ft of altitude at the end of my evening sink rate test flight, therefore I did not press the stall testing further. Don has a great deal more experience with the ASH-26E, and I have therefore asked him to add his impressions and opinions to this sailplane evaluation.

Many thanks go to Don Pollard for bringing his fine new ASH-26E to Caddo Mills for flight testing, and also for sharing the towing and hangarage costs with the Dallas Gliding Association. Also, to Bob Santo who was of great assistance during the testing, and to Chicho Estrada who participated in the climb testing.

References

A. "At Last; An Instrument That Reads Drag," R.H. Johnson, *Soaring* Magazine, October, 1983.
B. "Turbulator Flight Tests Part II, Ventus 16.6 Wing," R.H. Johnson, *Soaring* Magazine, September, 1995.
C. "Are Your Turbulators Too Large - Part I, Winglets," R.H. Johnson, *Soaring* Magazine, January, 1995.

DON POLLARD'S ASH-26E EVALUATION

by Don Pollard

The ASH-26E is one of the nicest flying sailplanes that I have ever flown. The control response and harmony are excellent. When thermaling in trim it will fly practically hands off. The cockpit is very comfortable and will accommodate a wide variety of pilot sizes and weights.

The engine is easy to start, very smooth, and quiet running. Takeoff and climb gives you the feeling of confidence that you would have in a Cessna 150. This is not an under powered motor glider.

Regarding the failure of the idler pulley bearing, I was able to secure the engine in flight without further incident. When I returned home from Texas, the factory had airmailed a replacement part. To date factory support has been excellent.

When we think about self-launch sailplanes, our main interest is the performance of the sailplane. However, the ASH-26E has a real breakthrough in propulsion packages. Martin Heide has designed an ingenious engine mount and extendible propeller mast. It is a well integrated unit that is mounted in the engine bay by 3 bolts. The electrical connection is through a single plug connector. The throttle and fuel line also are simple disconnects. I can tell you from hands-on experience that I can remove the engine unit in 20-25 minutes, place it on rny workbench in a simple cradle and have complete access for maintenance. Reinstallation is equally easy.

This is such a well designed unit, I think it could easily be used in many sailplane designs. The Mid-West rotary engine does a fine job. The addition of fuel injection with automatic mixture control would make this an outstanding engine. Rumor has it that this is now being developed, and I understand that it will be retrofitable to the existing MidWest engines.

From a competitive point o f view, my only ASH-26E experiences are two US contests: the 1995 Seniors Nationals at Seminole Gliderport in Florida, where it placed 3rd, and the Regional Contest at Cordele, Georgia, where with 3 flying days for the contest, Chicho Estrada won 2 days, and I won 1 day. The former contest was flown with factory turbulators installed, but that was before the Caddo Mills flight testing. After the Caddo Mills tests, both Chicho and I flew very successfully without turbulators during the latter contest. The coming 1995 Motor Glider Nationals at Minden, Nevada, will be the first in-depth U.Ss test for the ASH-26E. However, I have never flown there before, and the results may not reflect the sailplane's true capabilities.