

# A PILOT'S WING PROFILE DRAG MONITOR SYSTEM

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Performance flight test measurements of modern high performance sailplanes have shown that their highly laminar wing airfoils are often subject to separation bubbles, on both the upper and lower wing surfaces. These airflow separations significantly increase the wing drag, and if they appear abruptly with airspeed, they are shown on the polar test data as higher drag discontinuities or knees in what would otherwise be a smooth polar curve. On other occasions a bi-stable drag phenomena has been observed, where at a given airspeed and flap setting the sailplane can cruise steadily in still air and exhibit either a low drag sink rate, or a repeatably higher drag sink rate.

It is not really possible for even an expert pilot to achieve a sailplane's full performance potential unless he has some reliable instrumentation in the cockpit that will display information about his aerodynamic drag level. The wing profile drag is the largest variable over which the pilot has some control, except for induced drag which the pilot controls principally thru airspeed, "G's" and gross weight.

It is relatively easy to make real time wing profile drag measurements and to display these in a relative fashion to the pilot. The profile drag of any wing manifests itself as a momentum loss in the wing boundary layer airflow, and that can be measured by a probe mounted on the wing trailing edge. A large number of probe configurations were flight tested during the development of this concept, and the configuration deemed best is shown in Figure 1. Figure 2 is an installation schematic diagram, showing the wing probe pressure tube connected to the static side of a sensitive helicopter airspeed indicator, mounted in the cockpit. The pitot side of this sensitive ASI is connected to the sailplane's normal ASI pitot line, which should provide full free stream total pressure to the pitot inlets of both the sailplane's normal ASI and the drag measuring ASI.

Figure 3 shows the pneumatically uncompensated wing drag probe readings taken in turbulent air while descending between thermal climbs. Figure 4 shows similar test data taken with the drag probe ASI system fully compensated for dynamic lag effects.

In summary, the wing profile drag monitor system performs well even when uncompensated pneumatically for lag effects. Useful information is readily available to the pilot on a real time basis as to which flap settings produce the least

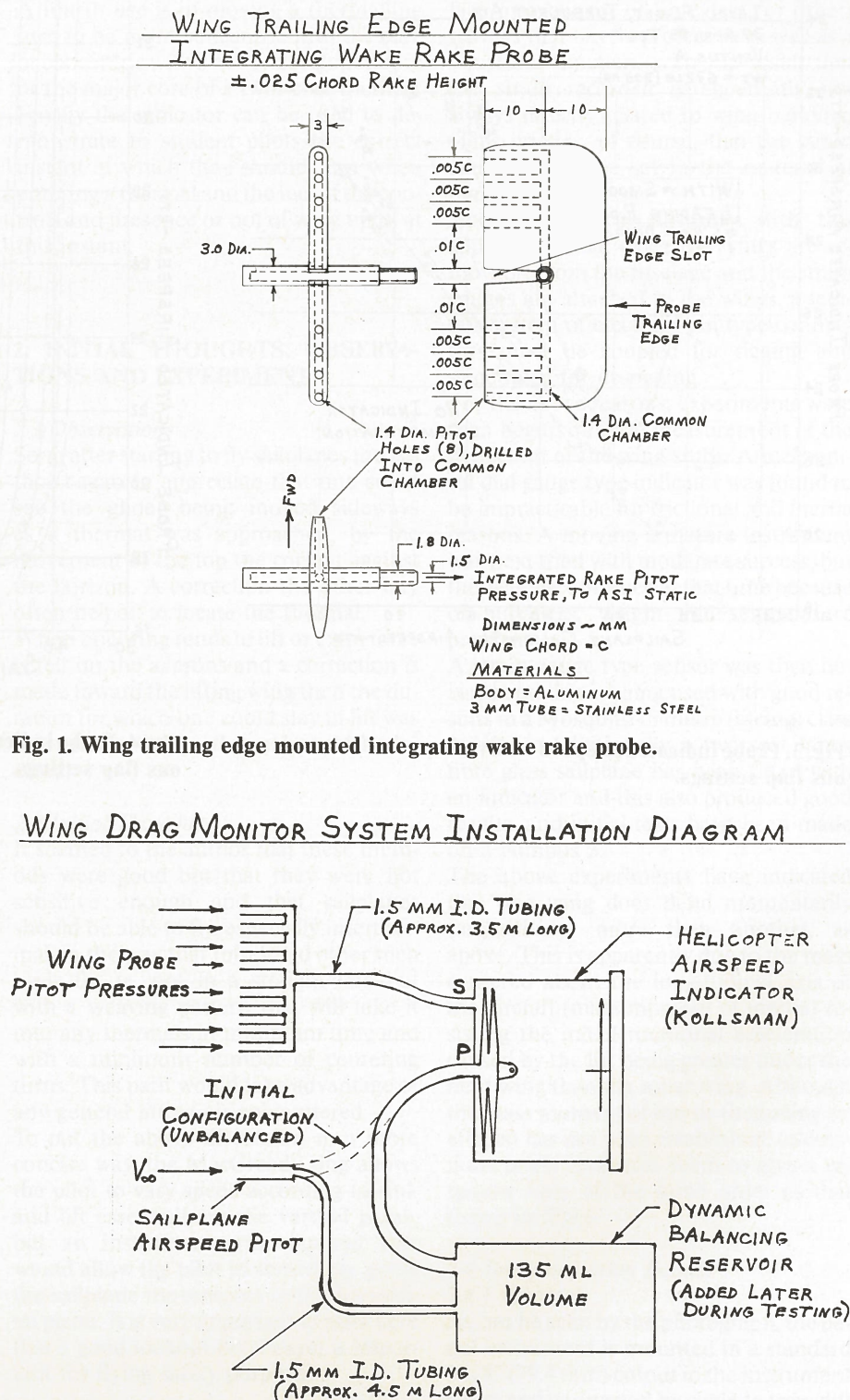


Fig. 1. Wing trailing edge mounted integrating wake rake probe.

Fig. 2. Wing drag monitor system installation diagram.

drag - with any degree of wing roughening due to bugs, dirt or rain. It is also useful when thermalling because it tells the pilot immediately when a tightened turn drives the wing out of its low drag laminar bucket, or when a better flap setting is achieved. If one's sailplane has a bi-stable

polar region, the probe can promptly inform the pilot as to which drag level he is flying.

Thanks are due the Dallas Gliding Association and its members and friends who supported this drag probe development and testing.

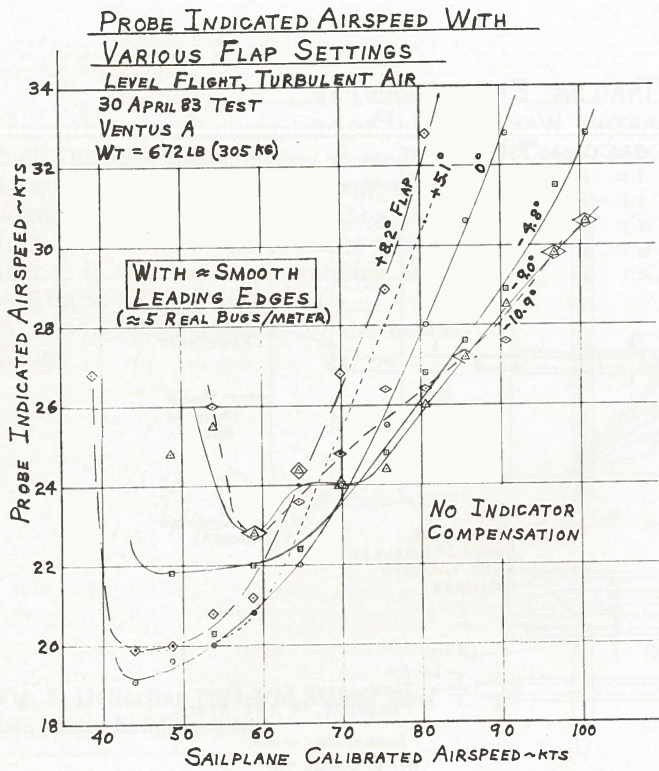


Fig. 3. Probe indicated airspeed with various flap settings.

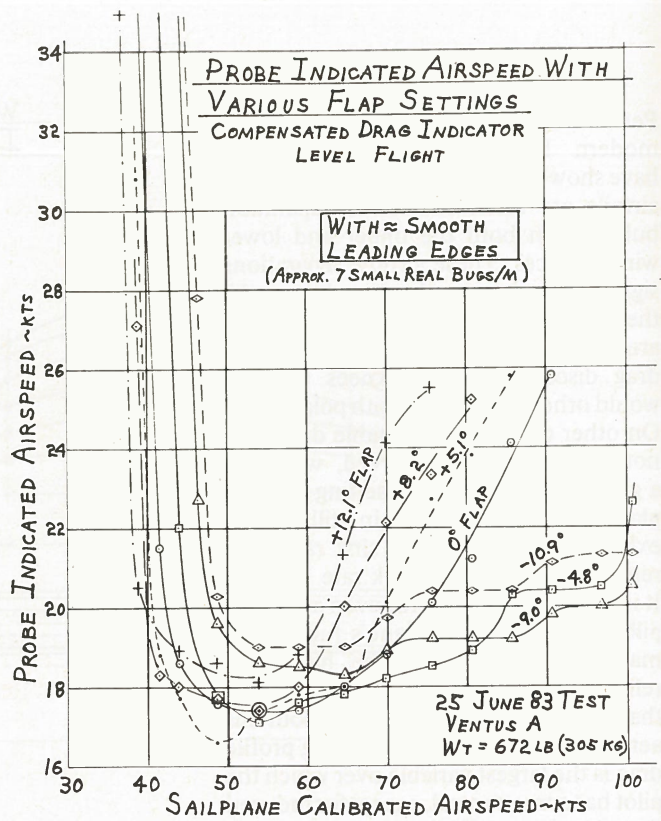


Fig. 4. Probe indicated airspeed with various flap settings.