SAILPLANE PERFORMANCE EVALUATION

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THIS paper is an expression of a long felt desire to place American sailplane performance specification on a sound footing. For years sailplane design has been based on estimated performance values projected, in general, without the use of wind tunnel tests. Such determinations, resting upon definitely precarious assumptions, do not utilize the particular design to project it in a systematic series. Only when designers and builders realize the necessity for accurately flight testing each completed design will it be possible to progressively improve the performance of American sailplanes.

In the past sailplane performance measurement has been a difficult task because precision instruments were not available and because the high order of technique required for the collection and evaluation of the data was considered a barrier. There was also a psychological handicap among those who felt that performance estimates were precise enough for most uses to which the information would be put. It is the purpose of this study to show that flight data can serve an extremely useful purpose in diagnosing the aerodynamic ills of current models by offering information for perfecting future designs.

As an example which illustrates clearly the fallacy of dependence on performance estimates refer to Figure 1. It will be seen that not only was there a wide disparity between the estimates of two rather talented computors but also there appears a marked difference in the two flight tested sailplanes. Since extreme precautions were taken to insure stable atmospheric flight test conditions this dispersion can be attributed only to the differences in aerodynamic lines of the two craft. In themselves these facts are merely interesting and somewhat deflating to our ego.

However, the real test of aerodynamic design comes from a critical examination of the performance curve of Figure 1. It will be seen that the minimum sinking speed is attained at much higher speeds than was estimated by either computor. This means that the induced drag is much higher than was allowed for by the computors. In other words, the effective aspect ratio of the sailplane is much less than the geometric or, looking at the effect from another view point, there occurs an early separation over some portion of the airfoil. Quite naturally, based on either of these concepts, one is led to suspect the interference of the fuselage with the flow over the wing. Further confirmation of this phenomenon lies in the fact that the maximum lift coefficient developed by this sailplane is less than 0.9. The expected CL max was 1.29. It would be extremely valuable to sailplane designers to know the exact cause and cure for this behavior. An example of refined mid-wing design (Lippisch's Fafnir II) attained a maximum lift coefficient of 1.4 by the careful control of the aerodynamic lines of the wing-fuselage junction. In fact the wing actually grew out of the fuselage. It may be because of this difficulty that many German designs—Weihe, Olympia, Mu13, D-28 and D-30 have been high wing. It would be well worth a refined study of all available sailplane designs, particularly the German high wing ships, in an effort to delineate this effect. A guide to this study (Reference 1) shows the most favorable combination of wing and fuselage on the basis of best L/D.

In Figure 2 is plotted the flight polar of the Pratt-Read two-place from the flight test data of #516 in Fig. 1. This display of performance is independent of wing loading except in so far as changes of Reynolds' number affects the performance. As a sidelight, a very valuable research might easily be performed to determine the effect of Reynolds' number by running a series of flight tests on the new Schweizer design SGS 121 at the different wing loadings and then comparing the flight polars at the respective Reynolds' numbers.

Using the flight polar it is a simple matter to compare various designs for the perfection of aerodynamic

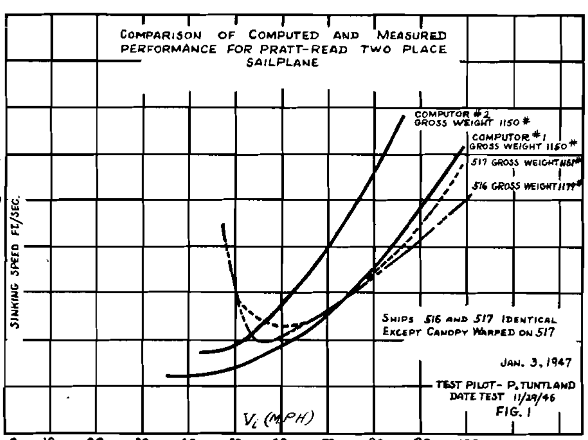

FIG. 1

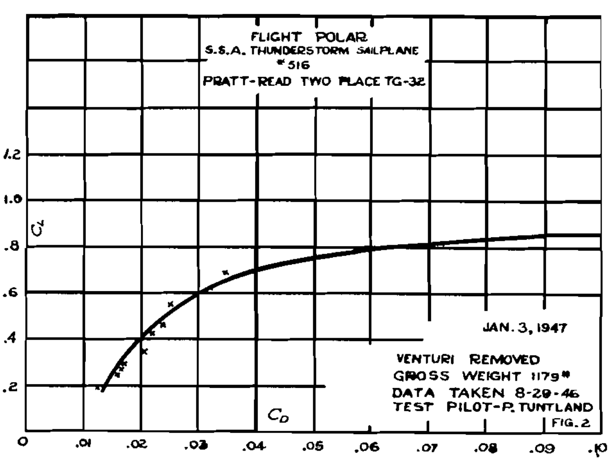

FIG. 2