EVALUATION OF THE FIRST PLANK PERFORMANCE MEASUREMENTS

by A. A. Backstrom
Aerophysics Department, Mississippi State College

The development process of a sailplane is basically a series of steps. the first of these being design and construction of a prototype, then flying, and redesigning if necessary. If this work leads to reasonable results there is a great tendency to stop there. It is a shame to see so many potentially exceptional sailplanes stopped at this point. In this paper I am presenting an illustrative example of how to proceed beyond the prototype with the development of a sailplane.

In order to obtain the information required to guide the modifications, a careful series of flight measurements should be made. The first tests to be done are the sinking speed measurements which will yield the aerodynamic characteristics of the sailplane. Then subsequent studies should be made in order to determine the characteristics of the flow on the sailplane. This flow information should serve as a guide in modification.

The performance flight tests of the Plank (Ref. 1) were conducted late in October with Jack Powell as the research pilot. These tests included both rate of sink tests and tuft studies. The condition of the ship was the same as when it was at the 23rd national meet.

The rate of sink, and L/D vs airspeed curves (Fig. 1) reveal that although the ship was rather good in the mid-speed range, around 60 MPH. the performance fell off both above and below this range. The curve of C_L^2 vs C_D (Fig. 2) was then plotted to analyze this behavior. From this curve it was seen that the actual airplane curve (solid line) was deviating from the theoretical curve (dotted line). The slope of C_L^2 vs C_D is a function of span efficiency factor and from this it can be seen that the span efficiency is being reduced in the low speed, high C_L range. Also it should be noted that the drag is increasing in the high speed range. The average span efficiency factor is also seen to be 75% which is much lower than that which can be anticipated with a clean wing fuselage intersection. Also the maximum lift coefficient was found to be 0.75 when it should have been approximately 1.0. These factors point out that there are several things wrong but give no indication as to what.

A series of tuft studies were then made to determine the causes of these deficiencies. The low speed photograph (Fig. 3) reveals that there is a very large area of separation in the area of the wing center section. This area is seen to begin just forward of the bubble and to fan out at approximately 45° to the line of flight. The high speed photograph (Fig. 4) shows that there is still separation over the aft section of the bubble and the intersection of the bubble and wing. A photograph of the bottom of the ship is not presented but there was an area of separation similar to that on top in the wing-pod intersection occurring at high speeds.

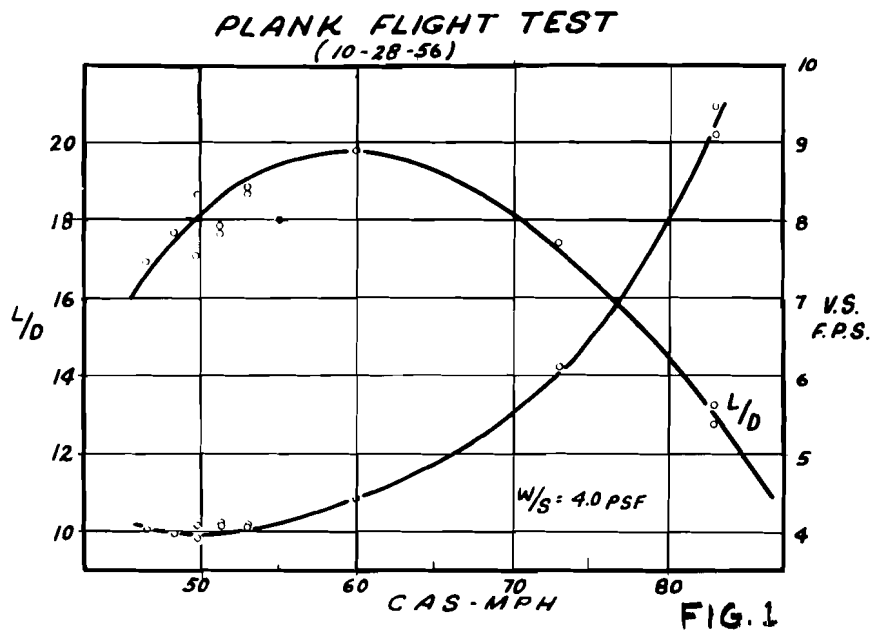

FIG. 1

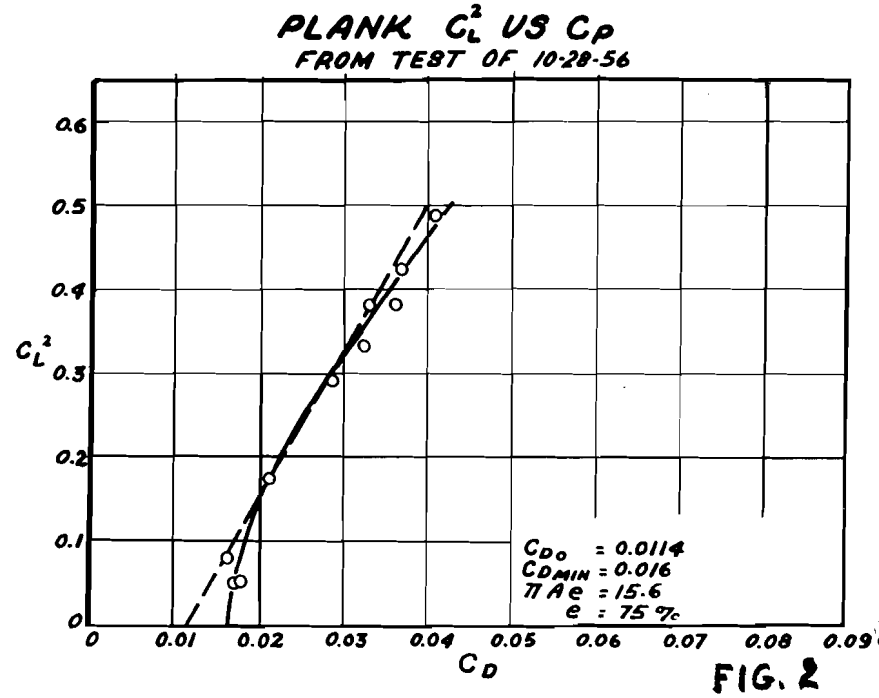

FIG. 2