STATIC TEST AND DETERMINATION
OF THE ELASTIC AXIS OF THE (MATÉRIEL DIVISION)
IMPROVED STRESSED SKIN TYPE GLIDER WING

(AIRPLANE BRANCH REPORT)

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STATIC TEST AND DETERMINATION OF THE ELASTIC AXIS OF THE (MATÉRIEL DIVISION) IMPROVED STRESSED SKIN TYPE GLIDER WING

Prepared by Charles J. Spere, Matériel Division, Air Corps, Wright Field, Dayton, Ohio, June 25, 1929

HISTORY

This wing, the test of which is covered by this report, is an all-metal glider wing of the stressed skin type designed and built by the Matériel Division. This stressed skin glider wing was developed by Capt. C. F. Greene and Dr. J. E. Younger, of the Research Department of the Matériel Division. The last previous improvement in this type of wing was the Auld glider wing.

The tests were conducted under the supervision of Mr. E. R. Weaver.

DESCRIPTION OF WING

This wing is constructed of 0.040 riveted sheet dural reinforced with a single spar and a corrugated strip of dural along the span of the wing. The corrugations are parallel with the spar and intended to aid the skin or surface covering in absorbing compressive stresses, due to the air loads. The spar is designed to take all bending loads, and the wing is tapered in plan and thickness. The contour of the airfoil is maintained by means of dural bulkheads which take the place of the conventional wing ribs. This wing is constructed according to drawing SK 13772. All stresses due to the drag loads are absorbed by the skin of the wing.

The trailing edge is reinforced with a narrow strip of dural riveted between the upper and lower covering of the wing where they come together to form the trailing edge.

The following is the area and weight data of the wing:

- Area: 18 square feet
- Weight: 22 pounds
- Weight per square foot: 1.22 pounds

Figure 1 is a plan view of the glider wing.

OBJECT

The object of this test was to determine the structural strength and elastic axis of the wing.

PLACE AND DATES

The tests described in this report were conducted in the static test laboratory at Wright Field, Dayton, Ohio, May 21 and 22, 1929.

WITNESSES OF TESTS

C. F. Greene, captain, Air Corps; chief, research unit.
Dr. J. E. Younger.
H. Z. Bogert, first lieutenant, Air Corps; chief, structures unit.
Mr. E. R. Weaver, chief, static test laboratory.
DETERMINATION OF ELASTIC AXIS OF THE WING

Procedure

The wing was mounted on a timber jig in the inverted position by means of two clamps which had been constructed to fit the airfoil at the root section. The underside of the airfoil section was level.

A beam approximately 6 feet long with a 50-pound weight on each end was balanced on a knife-edge and the point at which the beam balanced was marked.

The balanced beam was then placed on the wing and moved along the chord until the beam was level. The point at which the beam balanced was marked on the wing. This procedure was followed at several stations along the span of the wing.

Figure 2 is a drawing of the set-up used in finding the elastic axis.

RESULTS

Figure 3 shows the elastic axis of the glider wing. The curve follows a line parallel with the spar nearly to the point of support and then breaks sharply toward the trailing edge. The average location of the elastic axis is 37.6 per cent of the wing chord.

The following are the airfoil characteristics used for the Auld glider wing:

Center of pressure: 31 per cent of chord.

Chord to beam component ratio: 0.144.

The inverted wing was securely clamped on a timber jig by means of two clamps which had been constructed to fit the airfoil contour at the root section. Figure 8 is a photograph of the set-up used. The chord of the wing was inclined at an angle of 8° 12', leading edge down.

Each half of the wing was divided into three sections of equal area.
The loads were applied in increments of 10 pounds per square foot until the wing was supporting a load of 65 pounds per square foot. The increments of load were then reduced to 5 pounds per square foot until failure occurred. Figure 4 shows the load schedule and the load sections.

![Diagram showing load schedule and load sections for the improved Matériel Division glider wing.]

**Table of Deflections in Inches**

<table>
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<tr>
<th>Load</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
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**Notes:**
- Figure 5 shows the table of deflections for improved type Matériel Division glider wing.
FIGURE 6.—Deflection curves for improved type Material Division glider wing

FIGURE 7—Shear and bending moment curves for improved Material Division glider wing based on a load of 110 pounds per square foot.
RESULTS

The wing supported a static load of 110 pounds per square foot without failure. Failure occurred under a load of 115 pounds per square foot. Figures 5 and 6 are the table of deflections and deflection curves. Figure 7 is the shear and bending moment curves. The airfoil section also showed some deformation while subjected to the static loads.

CONCLUSION

The wing is very rigid as it supported a static load of 110 pounds per square foot without abnormal tip deflection and is structurally satisfactory for target glider use.

RECOMMENDATIONS

None.

NOTE

No exact comparison of the structural strength of the Auld glider wing and the improved Matériel Division glider wing is made in this report as the Auld glider wing had been damaged in flight test before being static tested. However, it is believed that the improved Matériel Division glider wing is the stronger wing, as it supported a much larger static load than the Auld glider wing.