# —The R.A.F. 34---A NEW AIRFOIL SECTION for AIRPLANE DESIGN

IN the course of systematic research for new airfoil sections that can be used to advantage in high-performing sailplanes, the RAF 34 section is suggested as one deserving particular attention. This section is derived from the symmetrical RAF 30 section, by using a reflexed mean line of .02 camber. It was originally developed in England in 1926 (Reports & Memoranda ♯1071) by H. Davies. The main features of the section are the extremely low pitching moment coefficient, and an exceptionally small center of pressure travel for normal flying range.

The RAF 34 section was investigated by the NACA in 1932 in the Variable Density Tunnel. The data obtained has been published in the NACA Technical Report ♯628.

The RAF 34 has the same thickness at any point along the chord as the symmetrical form RAF 30 (a Joukowski section), from which it is derived by curving the mean line according to the equation:

$$Y = 0.02065 \, . \, X \, . \, (1—X) \, . \, 7—8X)$$

This gives a reflexed center line whose maximum ordinate is 0.02c (at x = 0.31c) and whose maximum ordinate is —0.006c (at x = 0.94c). The equation of the center line is designed to give a fixed center of pressure according to Munk's theory of thin airfoils.

It is instructive to compare the results of wind tunnel tests for RAF 34 with those for NACA 4412 section, which has been most widely used in this country in recent years by sailplane designers.

It is interesting to note that reflexing the trailing edge has the effect of reducing the maximum lift, but the effect is less marked in RAF 34 than RAF 33, a section which was investigated simultaneously. The minimum drag is slightly increased by the reflexed trailing edge in RAF 33, and actually reduced in RAF 34 (R & M 1071). It also can be seen from the available data that the RAF 34 has an almost fixed center of pressure over the normal range of flight. Consequently, the RAF 34 is especially interesting from the sailplane designer's point of view. Especially for wings of cantilever construction, troubles due to twisting under air loads must always be anticipated. Obviously a small center of pressure movement will minimize this difficulty.

In the Reports and Memoranda ♯1635 (1934) extensive data was published on the characteristics of this section with variation of the maximum thickness and Reynolds Number. At low angles very little systematic change arises as the thickness ratio of the section is increased, but a substantial alteration occurs in maximum lift. Most of the effect is experienced when the thickness-chord ratio is altered from 5 to 12%. If plotted on a diagram, it can be shown that the slope of the lift curves increases with increase in the thickness of the section, but a marked drop occurs at 25%. The typical thickness-chord ratios for a cantilever sailplane wing can be assumed to be 18% at the root and 12% at the tip. When calculating the corrected airfoil characteristics, the representative section at the M.A.C. can be assumed to have a thickness of 15%. The RAF 34 section, having this thickness ratio, has very fortunately the best characteristics among all other thickness ratios.

Alternation in Reynolds Number gives rise to marked, though not large, increase in maximum lift on the thin sections, but the thick sections show an equally marked effect the other way. At low angles the lift is but slightly affected by the scale of the test, though the thick airfoils show a tendency for the lift to increase. The maximum lift coefficient at a representative (effective) Reynolds Number in sailplane design of 1,400,000 can be safely assumed to be approximately 1.20 for the RAF 34 section of 15% maximum thickness.

The profile drag remains practically constant over a comparatively large range. A change in the Reynolds Number gives rise to practically no alteration in minimum drag coefficient over a fair range of flight.

In conclusion it can be said that after comparison with available data for other airfoil sections, the RAF 34 has some definite and very interesting advantages over other airfoil sections.

*THICKNESS DISTRIBUTION, AIRFOIL R.A.F. 34*

| *Station* | *Upper* | *Lower* |
|---|---|---|
| 0 | 0 | 0 |
| 1.25 | 1.98 | —1.62 |
| 2.5 | 2.82 | —2.14 |
| 5.0 | 4.11 | —2.81 |
| 10 | 5.83 | —3.53 |
| 15 | 6.97 | —3.91 |
| 20 | 7.72 | —4.16 |
| 25 | 8.14 | —4.26 |
| 30 | 8.32 | —4.32 |
| 40 | 8.08 | —4.32 |
| 50 | 7.21 | —4.11 |
| 60 | 5.87 | —3.69 |
| 70 | 4.31 | —3.09 |
| 80 | 2.70 | —2.30 |
| 90 | 1.26 | —1.34 |
| 95 | .64 | — .76 |
| 100 | 0 | 0 |

Leading Edge Radius 1.29% of chord length.

Trailing Edge Radius 0.13% of chord length.

Note: all values in the above table are in % of chord length.

(*Continued on page* 13)