NATIONAL ADVISORY COMMITTEE
FOR AERONAUTICS

REPORT No. 279

TESTS ON MODELS OF THREE BRITISH AIRPLANES
IN THE VARIABLE DENSITY WIND TUNNEL

By GEORGE J. HIGGINS, W. S. DIEHL, and GEORGE L. DeFOE
### AERONAUTICAL SYMBOLS

#### 1. FUNDAMENTAL AND DERIVED UNITS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Metric</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit</td>
<td>Symbol</td>
</tr>
<tr>
<td>Length</td>
<td>( l )</td>
<td>meter</td>
</tr>
<tr>
<td>Time</td>
<td>( t )</td>
<td>second</td>
</tr>
<tr>
<td>Force</td>
<td>( F )</td>
<td>weight of one kilogram</td>
</tr>
<tr>
<td>Power</td>
<td>( P )</td>
<td>( \text{kg/m/sec} )</td>
</tr>
<tr>
<td>Speed</td>
<td></td>
<td>( \text{km/hr} )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \text{lb. - ft.}^{-1} \text{sec.}^2 )</td>
</tr>
<tr>
<td></td>
<td>( \text{lb. - ft.}^{-2} )</td>
</tr>
</tbody>
</table>

#### 2. GENERAL SYMBOLS, ETC.

- \( W \), Weight, \( =mg \)
- \( g \), Standard acceleration of gravity \( =9.80665 \text{m/sec}^2=32.1740 \text{ft./sec}^2 \)
- \( m \), Mass, \( =\frac{W}{g} \)
- \( \rho \), Density (mass per unit volume).
- Standard density of dry air, \( 0.12497 \text{kg-m}^{-1}\text{sec.}^2 \) at \( 15^\circ \text{C} \) and \( 760 \text{mmHg} = 0.002378 \text{lb.-ft.}^{-1}\text{sec.}^2 \).
- Specific weight of "standard" air, \( 1.2255 \text{kg/m}^3=0.07651 \text{lb./ft.}^3 \)

#### 3. AERODYNAMICAL SYMBOLS

- \( V \), True air speed.
- \( q \), Dynamic (or impact) pressure \( =\frac{1}{2} \rho V^2 \)
- \( L \), Lift, absolute coefficient \( \frac{L}{qS} \)
- \( D \), Drag, absolute coefficient \( \frac{D}{qS} \)
- \( C \), Cross -wind force, absolute coefficient \( C = \frac{C}{qS} \)
- \( R \), Resultant force. (Note that these coefficients are twice as large as the old coefficients \( L_c, D_c \).)
- \( i_w \), Angle of setting of wings (relative to thrust line).
- \( i_t \), Angle of stabilizer setting with reference to thrust line.

- \( \gamma \), Dihedral angle.
- \( \frac{V}{\mu} \), Reynolds Number, where \( l \) is a linear dimension.
- \( \beta \), Angle of stabilizer setting with reference to lower wing, \( = (i_t - i_w) \).
- \( \alpha \), Angle of attack.
- \( \epsilon \), Angle of downwash.
REPORT No. 279

TESTS ON MODELS OF THREE BRITISH AIRPLANES IN THE VARIABLE DENSITY WIND TUNNEL

By GEORGE J. HIGGINS and GEORGE L. DeFOE
Langley Memorial Aeronautical Laboratory

W. S. DIEHL
Bureau of Aeronautics, Navy Department
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

NAVY BUILDING, WASHINGTON, D. C.

[An independent Government establishment, created by act of Congress approved March 3, 1915, for the supervision and direction of the scientific study of the problems of flight. It consists of 12 members who are appointed by the President, all of whom serve as such without compensation.]

JOSEPH S. AMES, Ph. D., Chairman,
Provost, Johns Hopkins University, Baltimore, Md.

DAVID W. TAYLOR, D. Eng., Vice Chairman,
Washington, D. C.

GEORGE K. BURGESS, Sc. D.,
Director, Bureau of Standards, Washington, D. C.

WILLIAM F. DURAND, Ph. D.,
Professor Emeritus of Mechanical Engineering, Stanford University, Calif.

WILLIAM E. GILLMORE, Brigadier General, United States Army,
Chief, Materiel Division, Air Corps, Dayton, Ohio.

EMORY S. LAND, Captain, United States Navy,
Assistant Chief, Bureau of Aeronautics, Navy Department, Washington, D. C.

CHARLES F. MARVIN, M. E.,
Chief, United States Weather Bureau, Washington, D. C.

WILLIAM A. MOFFETT, Rear Admiral, United States Navy,
Chief, Bureau of Aeronautics, Navy Department, Washington, D. C.

MASON M. PATRICK, Major General, United States Army,
Chief of Air Corps, War Department, Washington, D. C.

S. W. STRATTON, Sc. D.,
President, Massachusetts Institute of Technology, Cambridge, Mass.

ORVILLE WRIGHT, B. S.,
Dayton, Ohio.

George W. Lewis, Director of Aeronautical Research.

John F. Victory, Secretary.

EXECUTIVE COMMITTEE

JOSEPH S. AMES, Chairman.

DAVID W. TAYLOR, Vice Chairman.

GEORGE K. BURGESS.

WILLIAM E. GILLMORE.

EMORY S. LAND.

CHARLES F. MARVIN.

WILLIAM A. MOFFETT.

MASON M. PATRICK.

S. W. STRATTON.

ORVILLE WRIGHT.

John F. Victory, Secretary.
REPORT No. 279

TESTS ON MODELS OF THREE BRITISH AIRPLANES IN THE VARIABLE DENSITY WIND TUNNEL

By George J. Higgins, W. S. Diehl, and George L. DeFoe

SUMMARY

This report contains the results of tests made in the National Advisory Committee for Aeronautics variable density wind tunnel on three airplane models supplied by the British Aeronautical Research Committee. These models, the BE-2E with R. A. F. 19 wings, the Bristol Fighter with R. A. F. 15 wings, and the Bristol Fighter with R. A. F. 30 wings, were tested over a wide range in Reynolds Numbers in order to supply data desired by the Aeronautical Research Committee for scale effect studies.

The maximum lifts obtained in these tests are in excellent agreement with the published results of British tests, both model and full scale. No attempt is made to compare drag data, owing to the omission of tail surfaces, radiator, etc., from the model, but it is shown that the scale effect observed on the drag coefficients in these tests is due to a large extent to the parts of the models other than the wings.

INTRODUCTION

At the request of the British Aeronautical Research Committee, nominal models of three British airplanes incorporating wing sections of widely different aerodynamic characteristics, have been tested in the variable density wind tunnel over a range in Reynolds Number extending from about 150,000 to more than 3,000,000. These models have been designated as "nominal," since no attempt was made to incorporate all details necessary for geometrical similarity; the omission of the tail surfaces and radiators being the most important deviations in this respect. The tests on such models may be expected to indicate the scale effect on lift with fair accuracy, but previous experience with the variable density wind tunnel has shown that the drag data are not reliable unless exact geometric similarity is obtained. (See reference 1.) The foregoing limitations must be borne in mind in any interpretation of the test results.

The purpose of these tests was to supply data for comparative studies by the British Aeronautical Research Committee. The models had previously been tested very thoroughly in England, and comparisons made with full scale flight test data on the airplanes represented.
DESCRIPTION OF MODELS AND METHOD OF TESTING

The three models, consisting of a BE-2E to one-twelfth scale fitted with R. A. F. 19 wings, and two Bristol Fighters to one-fifteenth scale fitted with R. A. F. 15 and R. A. F. 30 wings, were tested as supplied by the British Aeronautical Research Committee. The constructional details of the models are clearly shown in Figures 1 to 5. It will be noted that the tail surfaces are omitted and that various other details do not conform to the requirements of geometrical similarity. For this reason it is desired to emphasize the fact that the test data are valid only in comparison with data obtained in other tests on the same or similar models.

The method of mounting the models during the tests is shown in Figures 2, 3, and 5. The model is supported by two vertical stream-line rods which are hinged at their point of attachment to the model and rigidly connected to the balance at their lower ends. A short horizontal yoke rigidly attached to the shielded vertical balance bar, extends upstream and is hinged to the rear of the model. The angle of attack is changed at the operating panel outside of the tunnel, through an electric drive which raises or lowers the vertical balance bar. A detailed explanation of the operation of the balance in measuring lift, drag, and pitching moments is given in reference 2. The interference between the shielded vertical balance bar and the model was carefully investigated in the tests on the Sperry Messenger model (reference 1) and found to be negligible.

TEST RESULTS

Each model was tested at pressures of approximately 1, 2½, 5, 10, and 20 atmospheres. In each test the dynamic pressure was held as nearly constant as practicable at a value corresponding to a velocity of about 22 meters per second. The coefficients are based on the true dynamic pressure which was determined for each observation. Drag coefficients and angles of attack have been corrected for tunnel wall effect by the Prandtl formulas:

$$\Delta C_D = \frac{C_L^2 S}{2\pi D^3}$$

and

$$\Delta \alpha = \frac{57.3}{2\pi} \frac{C_D S}{D^3}$$

where $S$ is the model wing area, and $D$ the tunnel diameter. In tabulating the test data, both corrected and uncorrected values of $C_D$ and $\alpha$ have been given. The test data are given in Tables I to XV inclusive and the various plots of these data in Figures 6 to 26 inclusive.

The usual absolute coefficients have been used. These are defined by the relations:

Lift = $C_L q S$

Drag = $C_D q S$

Pitching moment about reference axis = $C_M q S e$

where $q$ is the dynamic pressure $\frac{1}{2} \rho V^2$ and $S$ the wing area.

The center of gravity locations for the three models were not given, so arbitrary reference axes have been taken. The location of these axes is given along with the model dimensions in Table XVI.

The following summary of tables and figures is included for convenience:

BE-2E with R. A. F. 19 wings:
Test data at 1, 2½, 5, 10, and 20 atmospheres—Tables I to V inclusive.
$C_L$ vs. $\alpha$—Figure 6.
$C_D$ vs. $\alpha$—Figure 7.
$C_D$ vs. $C_L$—Figure 8.
$L/D$ vs. $C_L$—Figure 9.
$C_M$ vs. $C_L$—Figure 10.
FIG. 2.—BE-2F airplane model mounted in tunnel

FIG. 3.—Bristol Fighter airplane model with R. A. F. 15 wings as mounted in tunnel
FIG. 4.—Bristol Fighter airplane model with R. A. F. 30 wings

FIG. 5.—Bristol Fighter airplane model with R. A. F. 30 wings mounted in tunnel

$C_l_{\text{max}}$ and $\alpha$ vs. Reynolds Number—Figure 11.

$C_l_{\text{max}}$ vs. Reynolds Number—Figure 12.

$C_l_{\text{max}}$ vs. Reynolds Number—Figure 13.

Dimensional data on model—Table XVI.

Bristol Fighter with R. A. F. 15 wings:

Test data at 1, 22, 5, 10, and 20 atmospheres—Tables VI to X inclusive.

$C_l$ vs. $\alpha$—Figure 14.

$C_D$ vs. $\alpha$—Figure 15.

$L/D$ vs. $C_D$—Figure 16.

$L/D$ vs. $C_l$—Figure 17.

$L/D$ vs. $C_l$—Figure 18.

$C_l_{\text{max}}$ vs. Reynolds Number—Figure 19.

$C_l_{\text{min}}$ vs. Reynolds Number—Figure 20.

Dimensional data on model—Table XVI.

Bristol Fighter with R. A. F. 30 wings:

Test data at 1, 22, 5, 10, and 20 atmospheres—Tables XI to XV inclusive.

$C_l$ vs. $\alpha$—Figure 21.

$C_D$ vs. $\alpha$—Figure 22.

$L/D$ vs. $C_D$—Figure 23.

$L/D$ vs. $C_l$—Figure 24.

$L/D$ vs. $C_l$—Figure 25.

$C_l_{\text{max}}$ vs. Reynolds Number—Figure 26.

$C_l_{\text{min}}$ vs. Reynolds Number—Figure 20.

Dimensional data on model—Table XVI.

Comparison of sections R. A. F. 30, Goettingen 459, N. A. C. A. 99—Figure 27.

DISCUSSION OF DATA

BE-2E model with R. A. F., 19 wings:

The variation in $C_l_{\text{max}}$ with Reynolds Number for this model is so great that it constitutes the most striking feature of the tests. The following tabulation of data selected from Tables I to V and Figures 6, 11, and 12, will assist in the study of the changes:

<table>
<thead>
<tr>
<th>Tunnel pressure atmospheres</th>
<th>1</th>
<th>22</th>
<th>5</th>
<th>10</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reynolds Number $\times 10^{-5}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_l_{\text{max}}$</td>
<td>1.915</td>
<td>4.61</td>
<td>9.49</td>
<td>18.70</td>
<td>40.0</td>
</tr>
<tr>
<td>Angle of attack at $C_l_{\text{max}}$</td>
<td>$\sigma_m$</td>
<td>21.0°</td>
<td>20.1°</td>
<td>19.3°</td>
<td>13.5°</td>
</tr>
<tr>
<td>Angle of attack for $C_l=0$</td>
<td>$\sigma_a$</td>
<td>-9.0°</td>
<td>-9.0°</td>
<td>-9.0°</td>
<td>-8.9°</td>
</tr>
<tr>
<td>$\sigma_m$ - $\sigma_a$</td>
<td>30.0°</td>
<td>29.1°</td>
<td>28.3°</td>
<td>22.4°</td>
<td>21.5°</td>
</tr>
</tbody>
</table>

$C_l_{\text{max}}$ is greatest at 1 atmosphere and decreases gradually up to a tank pressure of 5 atmospheres. Between 5 and 10 atmospheres, or as shown by Figure 11, between Reynolds Numbers 1,000,000 and 1,800,000 there is rapid decrease in $C_l_{\text{max}}$. Increasing the Reynolds Number above this critical value causes $C_l_{\text{max}}$ to decrease slightly more but at such a slow rate that the change is negligible. It has been noted in previous tests in the variable density tunnel that all very thick and very highly cambered wing sections tend to show a decrease in $C_l_{\text{max}}$ if the Reynolds Number be made great enough. For example, the U. S. A., 35A section is of conventional form, similar to the Goettingen 387, but having a camber of 18.18% as compared with 15.2% for the R. A. F. 19. Tests on this section (reference 3) show that at 1 atmosphere $C_l_{\text{max}} = 1.57$ and at 20 atmospheres $C_l_{\text{max}} = 1.21$, with intermediate values closely parallel to those found for the R. A. F. 19. It therefore follows that very high lifts on highly cambered sections found in tests at moderate Reynolds Numbers should be viewed with suspicion since it is unlikely that they can be realized at full scale.
That these characteristics are inherent with the R. A. F. 19 section, and are not an interference effect, is clearly evident from the comparison in Figure 12 of the curves of $C_{\text{min}}$ against Reynolds Number for R. A. F. 19 section alone and for the BE-2E model. It is of interest to note in this connection that data on the R. A. F. 19 section have been obtained at very low Reynolds Numbers by operating the tunnel at subatmospheric pressures.

The effect of Reynolds Number on $C_{D}$ is not as great as on $C_{L}$, but it is considerable, as shown by the following tabulation of $C_{D,\text{min}}$ from the data in Tables I to V and plotted in Figure 13:

<table>
<thead>
<tr>
<th>Reynolds Number $\times 10^{-5}$</th>
<th>1.915</th>
<th>4.61</th>
<th>9.49</th>
<th>18.70</th>
<th>40.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{D,\text{min}}$</td>
<td>0.0861</td>
<td>0.0850</td>
<td>0.0854</td>
<td>0.0782</td>
<td>0.0719</td>
</tr>
</tbody>
</table>

The most important feature seems to be the pronounced reduction in $C_{D,\text{min}}$ concurrent with the reduction in $C_{L,\text{max}}$ previously noted. By comparison with a similar curve obtained by testing the R. A. F. 19 airfoil section, it may be concluded that this scale effect is primarily due to the wings. There also seems to be a large scale effect in the second regime but inspection of the curves in Figure 7 shows that the curves may be too irregular to justify any definite conclusions. The irregularities in the curves for both $C_{L}$ and $C_{D}$ at low angles are probably due to an unstable nature of the flow over the lower surface near the leading edge.

The plot of $C_{D}$ vs. $C_{L}$ (fig. 8), brings out the scale effect on drag much better than plot of $C_{D}$ vs. $\alpha$. For values of $C_{D}$ corresponding to values of $C_{L}$ less than 1.0, there is a large scale effect on $C_{D}$, particularly noticeable for the higher Reynolds Numbers. This condition is also shown by the plotting of $L/D$ vs. $C_{L}$, Figure 9.

The moment curves of Figure 10 are rather irregular and do not indicate any very definite tendency except that at the higher lift coefficients the 10 and 20 atmosphere curves are displaced very slightly towards the base line.

**Bristol Fighter with R. A. F., 15 wings:**

The curves of $C_{L}$ vs. $\alpha$ for this model, Figure 14, show no unusual features except at angles of attack greater than 12° where a moderate scale effect is found. $C_{L,\text{max}}$ increases from 0.99 at 1 atmosphere to 1.11 at 2.5 atmospheres and then falls off gradually to 1.032 at 20 atmospheres, Figure 19. The constancy of the angle of attack for zero lift is again noticeable. Between $C_{L}=0$ and $C_{L}=0.9$ the divergencies of the $C_{L}$ curves are small and rather inconclusive but a tendency may be observed for $C_{L}$ to decrease when the Reynolds Number is increased.

The curves of $C_{D}$ vs. $\alpha$, Figure 15, indicate a considerable decrease in $C_{D}$ as Reynolds Number is increased. If the curves for 1 and for 20 atmospheres be compared the decrease in $C_{D}$ is comparatively uniform except at the critical angle range between 13° and 16°. This is shown quite clearly by the polar plot, Figure 16, which also indicates that the value of $C_{D,\text{min}}$ is less at 1 atmosphere than at 2.5 and 5 atmospheres. This condition is probably due to the experimental errors in reading the low drags at 1 atmosphere.

The improvement in $L/D$, shown by the plot of $L/D$ vs. $C_{L}$ on Figure 17, is about of the same order as that observed on the BE–2E model, Figure 9. A point of similarity is to be found in that the curves in each series fall into two groups: One containing the 1, 2.5, and 5 atmosphere data, the other containing the 10 and 20 atmosphere data. This would indicate a change in flow type between the 5 and 10 atmosphere conditions for both models. Another point of interest is that $L/D,\text{max}$ for the various Reynolds Numbers tends to occur at the same value of $C_{L}$ for the Bristol Fighter with R. A. F. 15 wings, while for the BE–2E model the value of $C_{L}$ at $L/D,\text{max}$ decreases as the Reynolds Number increases.

Figure 20 contains the plot against Reynolds Number of $C_{D,\text{min}}$ for the Bristol Fighter model, for the R. A. F. 15 airfoil, and for the difference between the two, representing the drag of the model less wings plus interference. It is apparent that the scale effects observed on this model are due almost entirely to parts other than the wings, and in all probability the struts account for a large proportion of the total effect.

The moment curves of Figure 18 show no well defined tendencies. The cause of the irregularity in the 10-atmosphere curve is not known and no indication of a change in flow type can be found in the remaining data at 10 atmospheres.
Bristol Fighter with R. A. F., 30 wings:

The curves of $C_L$ vs. $\alpha$ for this model, Figure 21, show a very large scale effect on lift coefficients at angles of attack greater than 11°, but below this angle the effects of Reynolds Number are negligible. The angle of attack for zero lift appears to be practically unaffected by changes in Reynolds Number.

The following data have been abstracted from Tables XI to XV:

<table>
<thead>
<tr>
<th>Tank pressure atmosphere</th>
<th>1</th>
<th>2½</th>
<th>5</th>
<th>10</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reynolds Number $\times 10^5$</td>
<td>1.52</td>
<td>4.04</td>
<td>7.60</td>
<td>15.00</td>
<td>30.50</td>
</tr>
<tr>
<td>$C_{L_{\text{max}}}$</td>
<td>0.761</td>
<td>0.814</td>
<td>0.916</td>
<td>1.067</td>
<td>1.006</td>
</tr>
<tr>
<td>Angle of attack for $C_{L_{\text{max}}}$</td>
<td>14.0°</td>
<td>14.0°</td>
<td>16.0°</td>
<td>20.0°</td>
<td>17.0°</td>
</tr>
<tr>
<td>Angle of attack for $C_L = 0$</td>
<td>-0.4°</td>
<td>-0.4°</td>
<td>-0.4°</td>
<td>-0.1°</td>
<td>-0.4°</td>
</tr>
</tbody>
</table>

Both $C_{L_{\text{max}}}$ and $\alpha_n$ increase with tank pressure up to 10 atmospheres, or to a Reynolds Number of about 1,800,000, above which they decrease slowly as Reynolds Number is increased. This characteristic appears to be a property of the moderately thick, double-cambered sections, as shown by the comparative plots, on Figure 26, of $C_{L_{\text{max}}}$ vs. Reynolds Number for the present model, for the N. A. C. A. 99 airfoil and the Göttingen 459 airfoil. The Göttingen 459 section differs very little from the R. A. F. 30 but the N. A. C. A. 99 is considerably thicker at points forward of the maximum ordinate. Figure 27 is a superposed plot of the three sections, for comparison.

It is of interest to note that the major scale effect on $C_L$ for the R. A. F. 30 section is of the same type as that for the R. A. F. 15 and the R. A. F. 19, in that it consists of an expansion or contraction of the angular range between zero and maximum lift, without any marked changes in the angle of attack for zero lift or in the slope of the lift curves $dC_L/d\alpha$.

The scale effect on $C_D$ for the Bristol Fighter with R. A. F. 30 wings is about the same as that observed for the R. A. F. 15 wings, and as shown by the curves of $C_{D_{\text{min}}}$ vs. Reynolds Number, Figure 20, it is also due to the same causes, that is, to parts other than the wings. Referring to Figure 4, it is quite apparent that the considerable length of small streamline struts and of large brace wires is responsible for the greater part of the effect observed. Consequently, it is rather difficult to apply a general interpretation to the curves of $C_D$ or $L/D$.

The moment curves of Figure 25 are again erratic and show no well defined tendency. The only general conclusion justified is that the change of moment from model to full scale is probably of no great importance.

**CONCLUSIONS**

The following conclusions may be drawn from the present tests, due consideration being given to data previously accumulated in the variable density wind tunnel:

1. The scale effects depend on the airfoil section and are, in general, similar for similar sections.

2. All airfoil sections may be roughly divided into three general classes as follows:

   (a) The highly cambered or very thick section having a very high lift at Reynolds Numbers within the testing range of the average wind tunnel. This class, of which the R. A. F. 19 is an example, usually shows a decrease in $C_{L_{\text{max}}}$, with increase in Reynolds Number.

   (b) The moderately cambered, medium lift section, of which the R. A. F. 15 is an example. This class usually has a moderate, and favorable scale effect on $C_L$ with a fairly low and favorable scale effect on $C_D$.

   (c) The thin, to moderately thick, double-cambered section of low lift at normal test Reynolds Numbers. This class, of which the R. A. F. 30 is an example, usually shows a large increase in $C_{L_{\text{max}}}$ and a moderate decrease in $C_{D_{\text{min}}}$, with increase in Reynolds Number.

3. The scale effect on drag found in this investigation is caused to a large extent by the wing bracing used on the models.
4. The lift coefficients obtained in the variable density wind tunnel are in excellent agreement with those found in previous tests on the same models and also with the reported full-scale data.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va. April 5, 1927.

REFERENCES

1. MUNK, MAX M., and Diehl, Walter S.
   "The Air Forces on a Model of the Sperry Messenger Airplane without Propeller."

2. MUNK, MAX M., and MILLER, Elton W.

3. HIGGINS, GEORGE J.

4. Garner, H. M., and Bradfield, F. B.
   "Lift and Drag of BE-2E with R. A. F., 19 Wings. Comparison of Full Scale and Model Results." British Aeronautical Research Committee Reports and Memoranda No. 763 ( Ae. 24 ), August, 1921.

5. Aerodynamics Staff.
   "Lift and Drag of the Bristol Fighter with Wings of Three Aspect Ratios." British Aeronautical Research Committee Reports and Memoranda No. 859. ( Ae. 90.) April, 1923.

6. Aerodynamics Staff.

7. MUNK, MAX M.
   "Preliminary Wing Model Tests in the Variable Density Wind Tunnel of the National Advisory Committee for Aeronautics."

8. WIESELSBERGER, C., BETZ, A., and PRANDTL, L.
   "Ergebnisse der Aerodynamischen Versuchsanstalt zu Göttingen." (Results obtained in the Göttingen Aerodynamic Laboratory—Report I, 1921.)

9. Bradfield, F. B., and Hartshorn, A. S.
   "Test of Four Thick Aerofoils, R. A. F., 30, 31, 32, and 33." British Aeronautical Research Committee. Reports and Memoranda No. 928. ( Ae. 150.) September, 1924.

    "Full Scale and Model Measurements of Lift and Drag of Bristol Fighter with R. A. F. 30 Wings." British Aeronautical Research Committee Reports and Memoranda No. 1052. August, 1926.
### TABLE I

MODEL, BE-2E (R. A. F., 19 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 1 ATM. AVERAGE DYNAMIC PRESSURE, 27.4 kg/m². AVERAGE REYNOLDS NUMBER, 191,500.

<table>
<thead>
<tr>
<th>Degrees α</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>Degrees α</th>
<th>$C_D'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-11.57</td>
<td>-0.079</td>
<td>0.1575</td>
<td>-0.50</td>
<td>-0.016</td>
<td>-11.50</td>
<td>0.1574</td>
</tr>
<tr>
<td>-10.03</td>
<td>-0.032</td>
<td>0.1430</td>
<td>-0.22</td>
<td>+0.071</td>
<td>-10.00</td>
<td>0.1430</td>
</tr>
<tr>
<td>-8.48</td>
<td>+0.020</td>
<td>0.1300</td>
<td>+0.15</td>
<td>-0.003</td>
<td>-8.50</td>
<td>0.1300</td>
</tr>
<tr>
<td>-6.92</td>
<td>+0.088</td>
<td>0.1185</td>
<td>+0.74</td>
<td>+0.005</td>
<td>-7.00</td>
<td>0.1184</td>
</tr>
<tr>
<td>-5.33</td>
<td>+0.183</td>
<td>0.1044</td>
<td>+1.75</td>
<td>+0.012</td>
<td>-5.50</td>
<td>0.1038</td>
</tr>
<tr>
<td>-3.74</td>
<td>+0.272</td>
<td>0.0985</td>
<td>2.76</td>
<td>+0.012</td>
<td>-4.00</td>
<td>0.0973</td>
</tr>
<tr>
<td>-2.13</td>
<td>+0.396</td>
<td>0.0940</td>
<td>4.22</td>
<td>+0.048</td>
<td>-2.50</td>
<td>0.0914</td>
</tr>
<tr>
<td>+0.50</td>
<td>+0.526</td>
<td>0.0861</td>
<td>6.10</td>
<td>+0.063</td>
<td>-1.00</td>
<td>0.0816</td>
</tr>
<tr>
<td>+1.12</td>
<td>+0.652</td>
<td>0.0952</td>
<td>6.85</td>
<td>+0.085</td>
<td>+0.50</td>
<td>0.0882</td>
</tr>
<tr>
<td>2.75</td>
<td>+0.767</td>
<td>0.1049</td>
<td>7.30</td>
<td>+0.099</td>
<td>2.00</td>
<td>0.0952</td>
</tr>
<tr>
<td>4.35</td>
<td>+0.898</td>
<td>0.1188</td>
<td>7.58</td>
<td>+0.106</td>
<td>3.50</td>
<td>0.1055</td>
</tr>
<tr>
<td>5.95</td>
<td>+1.007</td>
<td>0.1324</td>
<td>7.64</td>
<td>+0.120</td>
<td>5.00</td>
<td>0.1157</td>
</tr>
<tr>
<td>7.56</td>
<td>+1.117</td>
<td>0.1488</td>
<td>7.46</td>
<td>+0.141</td>
<td>6.50</td>
<td>0.1283</td>
</tr>
<tr>
<td>9.14</td>
<td>+1.207</td>
<td>0.1669</td>
<td>7.25</td>
<td>+0.144</td>
<td>8.00</td>
<td>0.1429</td>
</tr>
<tr>
<td>10.75</td>
<td>+1.317</td>
<td>0.1926</td>
<td>6.55</td>
<td>+0.136</td>
<td>9.50</td>
<td>0.1640</td>
</tr>
<tr>
<td>12.32</td>
<td>+1.418</td>
<td>0.2145</td>
<td>6.20</td>
<td>+0.148</td>
<td>11.00</td>
<td>0.1825</td>
</tr>
<tr>
<td>13.88</td>
<td>+1.462</td>
<td>0.2350</td>
<td>6.22</td>
<td>+0.144</td>
<td>12.50</td>
<td>0.2066</td>
</tr>
<tr>
<td>15.46</td>
<td>+1.548</td>
<td>0.2619</td>
<td>5.92</td>
<td>+0.135</td>
<td>14.00</td>
<td>0.2224</td>
</tr>
<tr>
<td>17.02</td>
<td>+1.608</td>
<td>0.2925</td>
<td>5.49</td>
<td>+0.148</td>
<td>15.50</td>
<td>0.2506</td>
</tr>
<tr>
<td>18.52</td>
<td>+1.659</td>
<td>0.3215</td>
<td>5.16</td>
<td>+0.138</td>
<td>17.00</td>
<td>0.2762</td>
</tr>
<tr>
<td>20.10</td>
<td>+1.690</td>
<td>0.3552</td>
<td>4.76</td>
<td>+0.117</td>
<td>18.50</td>
<td>0.3082</td>
</tr>
<tr>
<td>21.60</td>
<td>+1.699</td>
<td>0.3950</td>
<td>4.28</td>
<td>+0.131</td>
<td>20.00</td>
<td>0.3480</td>
</tr>
<tr>
<td>23.08</td>
<td>+1.721</td>
<td>0.4372</td>
<td>3.84</td>
<td>+0.111</td>
<td>21.50</td>
<td>0.3911</td>
</tr>
<tr>
<td>24.56</td>
<td>+1.753</td>
<td>0.4825</td>
<td>3.43</td>
<td>+0.108</td>
<td>23.00</td>
<td>0.4373</td>
</tr>
<tr>
<td>26.04</td>
<td>+1.833</td>
<td>0.5224</td>
<td>3.13</td>
<td>+0.097</td>
<td>24.50</td>
<td>0.4784</td>
</tr>
</tbody>
</table>

*1 Uncorrected for tunnel wall effect.

### TABLE II

MODEL, BE-2E (R. A. F., 19 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 2.47 ATM. AVERAGE DYNAMIC PRESSURE, 67.6 kg/m². AVERAGE REYNOLDS NUMBER, 461,000.

<table>
<thead>
<tr>
<th>Degrees α</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>Degrees α</th>
<th>$C_D'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-11.57</td>
<td>-0.069</td>
<td>0.1512</td>
<td>-0.46</td>
<td>-0.004</td>
<td>-11.50</td>
<td>0.1511</td>
</tr>
<tr>
<td>-10.20</td>
<td>-0.029</td>
<td>0.1380</td>
<td>-0.17</td>
<td>+0.006</td>
<td>-10.00</td>
<td>0.1380</td>
</tr>
<tr>
<td>-8.91</td>
<td>+0.095</td>
<td>0.1117</td>
<td>0.85</td>
<td>+0.019</td>
<td>-8.50</td>
<td>0.1228</td>
</tr>
<tr>
<td>-6.52</td>
<td>+0.190</td>
<td>0.1011</td>
<td>1.88</td>
<td>+0.039</td>
<td>-7.00</td>
<td>0.1116</td>
</tr>
<tr>
<td>-4.22</td>
<td>+0.296</td>
<td>0.0967</td>
<td>3.06</td>
<td>+0.051</td>
<td>-5.50</td>
<td>0.0953</td>
</tr>
<tr>
<td>-10.47</td>
<td>+0.393</td>
<td>0.0940</td>
<td>4.67</td>
<td>+0.068</td>
<td>-4.00</td>
<td>0.0872</td>
</tr>
<tr>
<td>+1.16</td>
<td>+0.496</td>
<td>0.0949</td>
<td>7.30</td>
<td>+0.095</td>
<td>+0.50</td>
<td>0.0798</td>
</tr>
<tr>
<td>2.76</td>
<td>+0.799</td>
<td>0.1036</td>
<td>7.70</td>
<td>+0.106</td>
<td>2.00</td>
<td>0.0930</td>
</tr>
<tr>
<td>4.39</td>
<td>+0.942</td>
<td>0.1160</td>
<td>8.14</td>
<td>+0.121</td>
<td>3.50</td>
<td>0.1014</td>
</tr>
<tr>
<td>5.99</td>
<td>+1.043</td>
<td>0.1304</td>
<td>8.00</td>
<td>+0.131</td>
<td>5.00</td>
<td>0.1124</td>
</tr>
<tr>
<td>7.58</td>
<td>+1.148</td>
<td>0.1460</td>
<td>7.82</td>
<td>+0.137</td>
<td>6.50</td>
<td>0.1253</td>
</tr>
<tr>
<td>9.17</td>
<td>+1.240</td>
<td>0.1647</td>
<td>7.52</td>
<td>+0.139</td>
<td>8.00</td>
<td>0.1394</td>
</tr>
<tr>
<td>10.77</td>
<td>+1.339</td>
<td>0.1991</td>
<td>6.72</td>
<td>+0.143</td>
<td>9.50</td>
<td>0.1596</td>
</tr>
<tr>
<td>12.35</td>
<td>+1.429</td>
<td>0.2101</td>
<td>6.80</td>
<td>+0.130</td>
<td>11.00</td>
<td>0.1764</td>
</tr>
<tr>
<td>13.93</td>
<td>+1.514</td>
<td>0.2355</td>
<td>6.42</td>
<td>+0.168</td>
<td>12.50</td>
<td>0.1977</td>
</tr>
<tr>
<td>15.50</td>
<td>+1.602</td>
<td>0.2605</td>
<td>6.06</td>
<td>+0.156</td>
<td>14.00</td>
<td>0.2192</td>
</tr>
<tr>
<td>17.65</td>
<td>+1.633</td>
<td>0.2890</td>
<td>5.65</td>
<td>+0.148</td>
<td>15.50</td>
<td>0.2450</td>
</tr>
<tr>
<td>18.57</td>
<td>+1.661</td>
<td>0.3248</td>
<td>5.10</td>
<td>+0.118</td>
<td>17.00</td>
<td>0.2792</td>
</tr>
<tr>
<td>20.07</td>
<td>+1.664</td>
<td>0.3717</td>
<td>4.47</td>
<td>+0.095</td>
<td>18.50</td>
<td>0.3260</td>
</tr>
<tr>
<td>21.57</td>
<td>+1.662</td>
<td>0.4111</td>
<td>4.05</td>
<td>+0.085</td>
<td>20.00</td>
<td>0.3655</td>
</tr>
<tr>
<td>23.06</td>
<td>+1.645</td>
<td>0.4543</td>
<td>3.62</td>
<td>+0.077</td>
<td>21.50</td>
<td>0.4096</td>
</tr>
<tr>
<td>24.54</td>
<td>+1.624</td>
<td>0.4943</td>
<td>3.29</td>
<td>+0.060</td>
<td>23.00</td>
<td>0.4508</td>
</tr>
<tr>
<td>26.00</td>
<td>+1.591</td>
<td>0.5999</td>
<td>2.66</td>
<td>+0.059</td>
<td>24.50</td>
<td>0.5581</td>
</tr>
</tbody>
</table>

*1 Uncorrected for tunnel wall effect.
### Table III

**MODEL, BE-2E (R. A. F., 19 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 5.1 ATM. AVERAGE DYNAMIC PRESSURE, 144.6 kg/m². AVERAGE REYNOLDS NUMBER, 949,000**

<table>
<thead>
<tr>
<th>Degrees $\alpha$</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>Degrees $\alpha$</th>
<th>$C_D'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-11.57</td>
<td>-0.077</td>
<td>1.531</td>
<td>-0.50</td>
<td>-0.004</td>
<td>-11.50</td>
<td>0.1530</td>
</tr>
<tr>
<td>-10.03</td>
<td>+0.032</td>
<td>1.370</td>
<td>-0.23</td>
<td>-0.002</td>
<td>-10.00</td>
<td>0.1370</td>
</tr>
<tr>
<td>-8.47</td>
<td>+0.026</td>
<td>1.249</td>
<td>+0.21</td>
<td>+0.004</td>
<td>-8.50</td>
<td>0.1249</td>
</tr>
<tr>
<td>-6.91</td>
<td>0.098</td>
<td>1.129</td>
<td>0.87</td>
<td>0.000</td>
<td>-7.00</td>
<td>0.1129</td>
</tr>
<tr>
<td>-5.31</td>
<td>0.197</td>
<td>1.027</td>
<td>1.92</td>
<td>0.024</td>
<td>-5.50</td>
<td>0.1021</td>
</tr>
<tr>
<td>-3.71</td>
<td>0.310</td>
<td>0.946</td>
<td>3.28</td>
<td>0.045</td>
<td>-4.00</td>
<td>0.0950</td>
</tr>
<tr>
<td>-2.08</td>
<td>0.449</td>
<td>0.880</td>
<td>5.11</td>
<td>0.059</td>
<td>-2.50</td>
<td>0.0847</td>
</tr>
<tr>
<td>-1.45</td>
<td>0.580</td>
<td>0.854</td>
<td>6.80</td>
<td>0.069</td>
<td>-1.00</td>
<td>0.0799</td>
</tr>
<tr>
<td>+1.16</td>
<td>0.696</td>
<td>0.920</td>
<td>7.58</td>
<td>0.093</td>
<td>+5.50</td>
<td>0.0840</td>
</tr>
<tr>
<td>2.77</td>
<td>0.812</td>
<td>1.019</td>
<td>7.94</td>
<td>0.104</td>
<td>2.00</td>
<td>0.0910</td>
</tr>
<tr>
<td>4.39</td>
<td>0.942</td>
<td>1.133</td>
<td>8.34</td>
<td>0.106</td>
<td>3.50</td>
<td>0.0865</td>
</tr>
<tr>
<td>5.99</td>
<td>1.045</td>
<td>1.292</td>
<td>8.07</td>
<td>0.131</td>
<td>5.00</td>
<td>0.1112</td>
</tr>
<tr>
<td>7.58</td>
<td>1.141</td>
<td>1.505</td>
<td>7.58</td>
<td>0.134</td>
<td>6.50</td>
<td>0.1290</td>
</tr>
<tr>
<td>9.17</td>
<td>1.241</td>
<td>1.673</td>
<td>7.41</td>
<td>0.123</td>
<td>8.00</td>
<td>0.1420</td>
</tr>
<tr>
<td>10.77</td>
<td>1.340</td>
<td>1.808</td>
<td>7.04</td>
<td>0.138</td>
<td>9.50</td>
<td>0.1600</td>
</tr>
<tr>
<td>12.35</td>
<td>1.427</td>
<td>2.128</td>
<td>6.72</td>
<td>0.131</td>
<td>11.00</td>
<td>0.1792</td>
</tr>
<tr>
<td>13.92</td>
<td>1.503</td>
<td>2.388</td>
<td>6.29</td>
<td>0.134</td>
<td>12.50</td>
<td>0.2015</td>
</tr>
<tr>
<td>15.47</td>
<td>1.553</td>
<td>2.665</td>
<td>5.78</td>
<td>0.109</td>
<td>14.00</td>
<td>0.2287</td>
</tr>
<tr>
<td>17.01</td>
<td>1.598</td>
<td>3.000</td>
<td>5.18</td>
<td>0.105</td>
<td>15.50</td>
<td>0.2670</td>
</tr>
<tr>
<td>18.53</td>
<td>1.621</td>
<td>3.546</td>
<td>4.57</td>
<td>0.092</td>
<td>17.00</td>
<td>0.3112</td>
</tr>
<tr>
<td>20.03</td>
<td>1.620</td>
<td>3.963</td>
<td>4.08</td>
<td>0.073</td>
<td>18.50</td>
<td>0.3551</td>
</tr>
<tr>
<td>21.53</td>
<td>1.608</td>
<td>4.376</td>
<td>3.68</td>
<td>0.055</td>
<td>20.00</td>
<td>0.3980</td>
</tr>
<tr>
<td>23.00</td>
<td>1.582</td>
<td>4.715</td>
<td>3.36</td>
<td>0.072</td>
<td>21.50</td>
<td>0.4301</td>
</tr>
<tr>
<td>24.44</td>
<td>1.525</td>
<td>5.008</td>
<td>3.05</td>
<td>0.013</td>
<td>23.00</td>
<td>0.4624</td>
</tr>
<tr>
<td>25.89</td>
<td>1.471</td>
<td>5.294</td>
<td>2.83</td>
<td>0.009</td>
<td>24.50</td>
<td>0.4847</td>
</tr>
</tbody>
</table>

1 Uncorrected for tunnel wall effect.

---

### Table IV

**MODEL, BE-2E (R. A. F., 19 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 10.1 ATM. AVERAGE DYNAMIC PRESSURE, 291 kg/m². AVERAGE REYNOLDS NUMBER, 1,870,000**

<table>
<thead>
<tr>
<th>Degrees $\alpha$</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>Degrees $\alpha$</th>
<th>$C_D'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-11.61</td>
<td>-0.117</td>
<td>0.1565</td>
<td>-0.75</td>
<td>-0.036</td>
<td>-11.50</td>
<td>0.1563</td>
</tr>
<tr>
<td>-10.03</td>
<td>-0.053</td>
<td>0.1409</td>
<td>-0.39</td>
<td>-0.055</td>
<td>-10.00</td>
<td>0.1488</td>
</tr>
<tr>
<td>-8.48</td>
<td>+0.018</td>
<td>0.1318</td>
<td>0.14</td>
<td>-0.056</td>
<td>-8.50</td>
<td>0.1318</td>
</tr>
<tr>
<td>-6.88</td>
<td>0.128</td>
<td>0.1057</td>
<td>1.21</td>
<td>-0.017</td>
<td>-7.00</td>
<td>0.1054</td>
</tr>
<tr>
<td>-5.26</td>
<td>0.256</td>
<td>0.0901</td>
<td>2.84</td>
<td>-0.001</td>
<td>-5.50</td>
<td>0.0891</td>
</tr>
<tr>
<td>-3.64</td>
<td>0.376</td>
<td>0.0788</td>
<td>4.76</td>
<td>+0.016</td>
<td>-4.00</td>
<td>0.0765</td>
</tr>
<tr>
<td>-2.03</td>
<td>0.495</td>
<td>0.0782</td>
<td>6.33</td>
<td>0.040</td>
<td>-2.50</td>
<td>0.0742</td>
</tr>
<tr>
<td>-1.43</td>
<td>0.604</td>
<td>0.0796</td>
<td>7.57</td>
<td>0.066</td>
<td>-1.00</td>
<td>0.0735</td>
</tr>
<tr>
<td>-0.83</td>
<td>0.720</td>
<td>0.0839</td>
<td>8.48</td>
<td>0.092</td>
<td>+5.00</td>
<td>0.0771</td>
</tr>
<tr>
<td>-0.23</td>
<td>0.825</td>
<td>0.0929</td>
<td>8.85</td>
<td>0.116</td>
<td>2.00</td>
<td>0.0817</td>
</tr>
<tr>
<td>0.40</td>
<td>0.948</td>
<td>0.1139</td>
<td>8.34</td>
<td>0.134</td>
<td>3.50</td>
<td>0.0991</td>
</tr>
<tr>
<td>0.80</td>
<td>1.052</td>
<td>0.1287</td>
<td>8.20</td>
<td>0.103</td>
<td>5.00</td>
<td>0.1104</td>
</tr>
<tr>
<td>1.20</td>
<td>1.159</td>
<td>0.1436</td>
<td>7.94</td>
<td>0.155</td>
<td>6.50</td>
<td>0.1223</td>
</tr>
<tr>
<td>1.60</td>
<td>1.242</td>
<td>0.1737</td>
<td>7.15</td>
<td>0.118</td>
<td>8.00</td>
<td>0.1482</td>
</tr>
<tr>
<td>2.00</td>
<td>1.332</td>
<td>0.1899</td>
<td>7.00</td>
<td>0.129</td>
<td>9.50</td>
<td>0.1606</td>
</tr>
<tr>
<td>2.40</td>
<td>1.412</td>
<td>2.565</td>
<td>5.50</td>
<td>0.100</td>
<td>11.00</td>
<td>0.2255</td>
</tr>
<tr>
<td>2.84</td>
<td>1.411</td>
<td>2.565</td>
<td>5.50</td>
<td>0.100</td>
<td>12.50</td>
<td>0.2352</td>
</tr>
<tr>
<td>3.28</td>
<td>1.427</td>
<td>2.858</td>
<td>5.00</td>
<td>0.082</td>
<td>14.00</td>
<td>0.2522</td>
</tr>
<tr>
<td>3.75</td>
<td>1.412</td>
<td>3.321</td>
<td>4.20</td>
<td>0.083</td>
<td>15.50</td>
<td>0.2991</td>
</tr>
<tr>
<td>4.24</td>
<td>1.421</td>
<td>3.929</td>
<td>4.05</td>
<td>0.085</td>
<td>17.00</td>
<td>0.3190</td>
</tr>
<tr>
<td>4.74</td>
<td>1.416</td>
<td>3.949</td>
<td>3.59</td>
<td>0.038</td>
<td>18.50</td>
<td>0.3619</td>
</tr>
<tr>
<td>5.24</td>
<td>1.406</td>
<td>4.185</td>
<td>3.36</td>
<td>0.038</td>
<td>20.00</td>
<td>0.3859</td>
</tr>
<tr>
<td>5.74</td>
<td>1.398</td>
<td>4.485</td>
<td>3.12</td>
<td>0.023</td>
<td>21.50</td>
<td>0.4167</td>
</tr>
<tr>
<td>6.24</td>
<td>1.378</td>
<td>4.879</td>
<td>2.85</td>
<td>0.002</td>
<td>23.00</td>
<td>0.4566</td>
</tr>
<tr>
<td>6.74</td>
<td>1.375</td>
<td>5.143</td>
<td>2.68</td>
<td>0.000</td>
<td>24.50</td>
<td>0.4881</td>
</tr>
</tbody>
</table>

1 Uncorrected for tunnel wall effect.
TABLE V

MODEL, BE-2E (R. A. F., 19 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 20.4 ATM. AVERAGE DYNAMIC PRESSURE, 637 kg/m². AVERAGE REYNOLDS NUMBER, 4,000,000

<table>
<thead>
<tr>
<th>Degrees α</th>
<th>C_L</th>
<th>C_D</th>
<th>L/D</th>
<th>C_M</th>
<th>Degrees α</th>
<th>C_D'</th>
</tr>
</thead>
<tbody>
<tr>
<td>-11.58</td>
<td>-0.080</td>
<td>0.1416</td>
<td>-0.57</td>
<td>-0.002</td>
<td>-11.5</td>
<td>0.1415</td>
</tr>
<tr>
<td>-10.04</td>
<td>-0.096</td>
<td>0.1268</td>
<td>-0.28</td>
<td>-0.004</td>
<td>-10.0</td>
<td>0.1268</td>
</tr>
<tr>
<td>-8.48</td>
<td>+0.036</td>
<td>0.1123</td>
<td>+0.32</td>
<td>+0.001</td>
<td>-8.5</td>
<td>0.1123</td>
</tr>
<tr>
<td>-6.89</td>
<td>+0.114</td>
<td>0.0994</td>
<td>1.15</td>
<td>0.009</td>
<td>-7.0</td>
<td>0.0992</td>
</tr>
<tr>
<td>-5.35</td>
<td>+0.060</td>
<td>0.0896</td>
<td>2.90</td>
<td>0.010</td>
<td>-5.5</td>
<td>0.0885</td>
</tr>
<tr>
<td>-3.62</td>
<td>+0.045</td>
<td>0.0719</td>
<td>5.59</td>
<td>0.058</td>
<td>-4.0</td>
<td>0.0692</td>
</tr>
<tr>
<td>-2.01</td>
<td>+0.052</td>
<td>0.0698</td>
<td>7.46</td>
<td>0.037</td>
<td>-2.5</td>
<td>0.0653</td>
</tr>
<tr>
<td>-1.40</td>
<td>+0.063</td>
<td>0.0740</td>
<td>8.55</td>
<td>0.064</td>
<td>-1.0</td>
<td>0.0673</td>
</tr>
<tr>
<td>+1.21</td>
<td>+0.072</td>
<td>0.0845</td>
<td>8.93</td>
<td>0.075</td>
<td>+5.0</td>
<td>0.0752</td>
</tr>
<tr>
<td>2.50</td>
<td>+0.050</td>
<td>0.0961</td>
<td>8.85</td>
<td>0.083</td>
<td>2.0</td>
<td>0.0889</td>
</tr>
<tr>
<td>4.41</td>
<td>+0.063</td>
<td>0.1126</td>
<td>8.55</td>
<td>0.099</td>
<td>3.5</td>
<td>0.0973</td>
</tr>
<tr>
<td>6.00</td>
<td>+0.105</td>
<td>0.1286</td>
<td>8.20</td>
<td>0.105</td>
<td>5.0</td>
<td>0.1102</td>
</tr>
<tr>
<td>7.60</td>
<td>+0.118</td>
<td>0.1554</td>
<td>7.53</td>
<td>0.110</td>
<td>6.5</td>
<td>0.1229</td>
</tr>
<tr>
<td>9.18</td>
<td>+0.124</td>
<td>0.1703</td>
<td>7.30</td>
<td>0.112</td>
<td>8.0</td>
<td>0.1447</td>
</tr>
<tr>
<td>10.77</td>
<td>+0.133</td>
<td>0.1994</td>
<td>6.75</td>
<td>0.121</td>
<td>9.5</td>
<td>0.1696</td>
</tr>
<tr>
<td>12.34</td>
<td>+0.143</td>
<td>0.2290</td>
<td>6.18</td>
<td>0.099</td>
<td>11.0</td>
<td>0.1960</td>
</tr>
<tr>
<td>13.81</td>
<td>+0.182</td>
<td>0.2649</td>
<td>5.21</td>
<td>0.068</td>
<td>12.5</td>
<td>0.2334</td>
</tr>
<tr>
<td>15.30</td>
<td>+0.174</td>
<td>0.3012</td>
<td>4.57</td>
<td>0.053</td>
<td>14.0</td>
<td>0.2700</td>
</tr>
</tbody>
</table>

1 Uncorrected for tunnel wall effect.

TABLE VI

MODEL, BRISTOL FIGHTER (R. A. F., 15) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 1 ATM. AVERAGE DYNAMIC PRESSURE, 27.8 kg/m². AVERAGE REYNOLDS NUMBER, 157,000

<table>
<thead>
<tr>
<th>Degrees α</th>
<th>C_L</th>
<th>C_D</th>
<th>L/D</th>
<th>C_M</th>
<th>Degrees α</th>
<th>C_D'</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4.58</td>
<td>-0.114</td>
<td>0.0616</td>
<td>-1.85</td>
<td>-0.075</td>
<td>-4.5</td>
<td>0.0614</td>
</tr>
<tr>
<td>-3.00</td>
<td>-0.000</td>
<td>0.0513</td>
<td>+0.00</td>
<td>+0.012</td>
<td>-3.0</td>
<td>0.0513</td>
</tr>
<tr>
<td>+1.13</td>
<td>+0.019</td>
<td>0.0500</td>
<td>3.99</td>
<td>0.004</td>
<td>0</td>
<td>0.0495</td>
</tr>
<tr>
<td>1.70</td>
<td>+0.029</td>
<td>0.0534</td>
<td>5.53</td>
<td>0.008</td>
<td>+1.5</td>
<td>0.0524</td>
</tr>
<tr>
<td>3.26</td>
<td>+0.038</td>
<td>0.0604</td>
<td>6.38</td>
<td>0.022</td>
<td>3.0</td>
<td>0.0587</td>
</tr>
<tr>
<td>4.82</td>
<td>+0.048</td>
<td>0.0684</td>
<td>7.09</td>
<td>0.054</td>
<td>4.5</td>
<td>0.0657</td>
</tr>
<tr>
<td>6.37</td>
<td>+0.058</td>
<td>0.0781</td>
<td>7.14</td>
<td>0.013</td>
<td>6.0</td>
<td>0.0745</td>
</tr>
<tr>
<td>7.94</td>
<td>+0.064</td>
<td>0.0826</td>
<td>7.14</td>
<td>0.008</td>
<td>7.5</td>
<td>0.0875</td>
</tr>
<tr>
<td>9.50</td>
<td>+0.074</td>
<td>0.1045</td>
<td>7.14</td>
<td>0.070</td>
<td>9.0</td>
<td>0.0980</td>
</tr>
<tr>
<td>11.06</td>
<td>+0.085</td>
<td>0.1205</td>
<td>7.00</td>
<td>0.092</td>
<td>10.5</td>
<td>0.1123</td>
</tr>
<tr>
<td>12.62</td>
<td>+0.096</td>
<td>0.1358</td>
<td>6.81</td>
<td>0.102</td>
<td>12.0</td>
<td>0.1258</td>
</tr>
<tr>
<td>14.15</td>
<td>+0.106</td>
<td>0.1575</td>
<td>6.25</td>
<td>0.083</td>
<td>13.5</td>
<td>0.1463</td>
</tr>
<tr>
<td>15.66</td>
<td>+0.116</td>
<td>0.2155</td>
<td>4.59</td>
<td>0.080</td>
<td>15.0</td>
<td>0.2040</td>
</tr>
<tr>
<td>17.16</td>
<td>+0.126</td>
<td>0.2578</td>
<td>3.85</td>
<td>0.081</td>
<td>16.5</td>
<td>0.2464</td>
</tr>
<tr>
<td>18.64</td>
<td>+0.136</td>
<td>0.2877</td>
<td>3.37</td>
<td>0.065</td>
<td>18.0</td>
<td>0.2768</td>
</tr>
<tr>
<td>20.14</td>
<td>+0.146</td>
<td>0.3553</td>
<td>2.87</td>
<td>0.049</td>
<td>19.5</td>
<td>0.3246</td>
</tr>
<tr>
<td>21.62</td>
<td>+0.156</td>
<td>0.3949</td>
<td>2.38</td>
<td>+0.019</td>
<td>21.0</td>
<td>0.3847</td>
</tr>
<tr>
<td>23.12</td>
<td>+0.167</td>
<td>0.4373</td>
<td>2.13</td>
<td>+0.004</td>
<td>22.5</td>
<td>0.4273</td>
</tr>
<tr>
<td>24.60</td>
<td>+0.178</td>
<td>0.4644</td>
<td>1.94</td>
<td>-0.006</td>
<td>24.0</td>
<td>0.4550</td>
</tr>
<tr>
<td>26.08</td>
<td>+0.188</td>
<td>0.4920</td>
<td>1.73</td>
<td>0.047</td>
<td>25.5</td>
<td>0.4831</td>
</tr>
</tbody>
</table>

1 Uncorrected for tunnel wall effect.

58820—28—3
TABLE VII
MODEL, BRISTOL FIGHTER (R. A. F., 15 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 2.58 ATM. AVERAGE DYNAMIC PRESSURE, 69.2 kg/m². AVERAGE REYNOLDS NUMBER, 390,000

<table>
<thead>
<tr>
<th>Degrees α</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>1 Degrees α</th>
<th>1 $C_p'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4.55</td>
<td>-0.082</td>
<td>0.0545</td>
<td>-1.51</td>
<td>-0.051</td>
<td>-4.5</td>
<td>0.0544</td>
</tr>
<tr>
<td>-2.99</td>
<td>+0.013</td>
<td>0.0507</td>
<td>+2.26</td>
<td>-0.042</td>
<td>+3.0</td>
<td>0.0507</td>
</tr>
<tr>
<td>-1.42</td>
<td>+0.114</td>
<td>0.0497</td>
<td>2.29</td>
<td>-0.024</td>
<td>-1.5</td>
<td>0.0495</td>
</tr>
<tr>
<td>+1.14</td>
<td>+0.204</td>
<td>0.0513</td>
<td>3.97</td>
<td>-0.009</td>
<td>+1.5</td>
<td>0.0508</td>
</tr>
<tr>
<td>1.70</td>
<td>+0.0554</td>
<td>5.32</td>
<td>-0.001</td>
<td>+1.5</td>
<td>0.0544</td>
<td></td>
</tr>
<tr>
<td>3.26</td>
<td>+0.0615</td>
<td>6.41</td>
<td>+0.024</td>
<td>3.0</td>
<td>0.0598</td>
<td></td>
</tr>
<tr>
<td>4.83</td>
<td>+0.0685</td>
<td>7.14</td>
<td>+0.035</td>
<td>4.5</td>
<td>0.0617</td>
<td></td>
</tr>
<tr>
<td>6.39</td>
<td>+0.0703</td>
<td>7.41</td>
<td>+0.043</td>
<td>6.0</td>
<td>0.0783</td>
<td></td>
</tr>
<tr>
<td>7.95</td>
<td>+0.0890</td>
<td>7.52</td>
<td>+0.062</td>
<td>7.5</td>
<td>0.0855</td>
<td></td>
</tr>
<tr>
<td>9.51</td>
<td>+0.1040</td>
<td>7.41</td>
<td>+0.070</td>
<td>9.0</td>
<td>0.0971</td>
<td></td>
</tr>
<tr>
<td>11.07</td>
<td>+0.1178</td>
<td>7.30</td>
<td>+0.073</td>
<td>10.5</td>
<td>0.1092</td>
<td></td>
</tr>
<tr>
<td>12.63</td>
<td>+0.1356</td>
<td>7.14</td>
<td>+0.095</td>
<td>12.0</td>
<td>0.1231</td>
<td></td>
</tr>
<tr>
<td>14.19</td>
<td>+0.1560</td>
<td>6.63</td>
<td>+0.104</td>
<td>14.5</td>
<td>0.1436</td>
<td></td>
</tr>
<tr>
<td>15.72</td>
<td>+0.1940</td>
<td>5.50</td>
<td>+0.079</td>
<td>16.5</td>
<td>0.1508</td>
<td></td>
</tr>
<tr>
<td>17.25</td>
<td>+0.2355</td>
<td>4.63</td>
<td>+0.085</td>
<td>18.0</td>
<td>0.2217</td>
<td></td>
</tr>
<tr>
<td>18.74</td>
<td>+0.2858</td>
<td>3.89</td>
<td>+0.081</td>
<td>21.0</td>
<td>0.3313</td>
<td></td>
</tr>
<tr>
<td>20.22</td>
<td>+0.3450</td>
<td>3.14</td>
<td>+0.065</td>
<td>22.5</td>
<td>0.4342</td>
<td></td>
</tr>
<tr>
<td>21.69</td>
<td>+0.3960</td>
<td>2.63</td>
<td>+0.044</td>
<td>24.0</td>
<td>0.4608</td>
<td></td>
</tr>
<tr>
<td>23.16</td>
<td>+0.4458</td>
<td>2.24</td>
<td>+0.015</td>
<td>26.1</td>
<td>0.4977</td>
<td></td>
</tr>
<tr>
<td>24.64</td>
<td>+0.4788</td>
<td>2.02</td>
<td>+0.009</td>
<td>28.2</td>
<td>0.5310</td>
<td></td>
</tr>
<tr>
<td>26.12</td>
<td>+0.5078</td>
<td>1.84</td>
<td>-0.031</td>
<td>30.3</td>
<td>0.5782</td>
<td></td>
</tr>
</tbody>
</table>

1 Uncorrected for tunnel wall effect.

TABLE VIII
MODEL, BRISTOL FIGHTER (R. A. F., 15 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 5.1 ATM. AVERAGE DYNAMIC PRESSURE, 146 kg/m². AVERAGE REYNOLDS NUMBER, 780,000

<table>
<thead>
<tr>
<th>Degrees α</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>1 Degrees α</th>
<th>1 $C_p'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4.55</td>
<td>-0.068</td>
<td>0.0502</td>
<td>-1.36</td>
<td>-0.051</td>
<td>-4.5</td>
<td>0.0591</td>
</tr>
<tr>
<td>-3.00</td>
<td>+0.008</td>
<td>0.0484</td>
<td>-1.47</td>
<td>-0.026</td>
<td>-3.0</td>
<td>0.0484</td>
</tr>
<tr>
<td>-1.45</td>
<td>+0.055</td>
<td>0.0478</td>
<td>-1.26</td>
<td>-0.024</td>
<td>-1.5</td>
<td>0.0477</td>
</tr>
<tr>
<td>+1.13</td>
<td>+0.199</td>
<td>0.0500</td>
<td>3.99</td>
<td>-0.006</td>
<td>0.0495</td>
<td></td>
</tr>
<tr>
<td>1.69</td>
<td>+0.088</td>
<td>0.0517</td>
<td>5.38</td>
<td>+0.012</td>
<td>+1.5</td>
<td>0.0527</td>
</tr>
<tr>
<td>3.26</td>
<td>+0.0603</td>
<td>6.63</td>
<td>-0.032</td>
<td>3.0</td>
<td>0.0675</td>
<td></td>
</tr>
<tr>
<td>4.82</td>
<td>+0.0666</td>
<td>7.20</td>
<td>+0.047</td>
<td>4.5</td>
<td>0.0639</td>
<td></td>
</tr>
<tr>
<td>6.38</td>
<td>+0.0754</td>
<td>7.64</td>
<td>+0.059</td>
<td>6.0</td>
<td>0.0716</td>
<td></td>
</tr>
<tr>
<td>7.95</td>
<td>+0.0882</td>
<td>7.94</td>
<td>+0.085</td>
<td>7.5</td>
<td>0.0829</td>
<td></td>
</tr>
<tr>
<td>9.51</td>
<td>+0.1004</td>
<td>7.58</td>
<td>+0.089</td>
<td>9.0</td>
<td>0.0987</td>
<td></td>
</tr>
<tr>
<td>11.07</td>
<td>+0.1143</td>
<td>7.46</td>
<td>+0.108</td>
<td>10.5</td>
<td>0.1059</td>
<td></td>
</tr>
<tr>
<td>12.62</td>
<td>+0.1323</td>
<td>7.04</td>
<td>+0.104</td>
<td>12.0</td>
<td>0.1223</td>
<td></td>
</tr>
<tr>
<td>14.18</td>
<td>+0.1549</td>
<td>6.63</td>
<td>+0.119</td>
<td>13.5</td>
<td>0.1427</td>
<td></td>
</tr>
<tr>
<td>15.70</td>
<td>+0.2014</td>
<td>5.24</td>
<td>+0.111</td>
<td>15.0</td>
<td>0.1885</td>
<td></td>
</tr>
<tr>
<td>17.21</td>
<td>+0.2270</td>
<td>4.46</td>
<td>+0.087</td>
<td>16.5</td>
<td>0.1925</td>
<td></td>
</tr>
<tr>
<td>18.72</td>
<td>+0.2329</td>
<td>3.76</td>
<td>+0.091</td>
<td>18.0</td>
<td>0.2697</td>
<td></td>
</tr>
<tr>
<td>20.20</td>
<td>+0.2855</td>
<td>3.13</td>
<td>+0.078</td>
<td>19.5</td>
<td>0.3259</td>
<td></td>
</tr>
<tr>
<td>21.69</td>
<td>+0.3079</td>
<td>2.61</td>
<td>+0.030</td>
<td>21.0</td>
<td>0.3854</td>
<td></td>
</tr>
<tr>
<td>23.18</td>
<td>+0.4365</td>
<td>2.33</td>
<td>+0.041</td>
<td>22.5</td>
<td>0.4245</td>
<td></td>
</tr>
<tr>
<td>24.66</td>
<td>+0.4745</td>
<td>2.08</td>
<td>+0.004</td>
<td>24.0</td>
<td>0.4682</td>
<td></td>
</tr>
<tr>
<td>26.13</td>
<td>+0.5038</td>
<td>1.88</td>
<td>+0.002</td>
<td>25.5</td>
<td>0.4984</td>
<td></td>
</tr>
</tbody>
</table>

1 Uncorrected for tunnel wall effect.
TABLE IX

MODEL, BRISTOL FIGHTER (R. A. F., 15 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 1.5 ATM. AVERAGE DYNAMIC PRESSURE, 307 kg/m². AVERAGE REYNOLDS NUMBER, 1,580,000.

<table>
<thead>
<tr>
<th>Degrees α</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>Degrees α</th>
<th>$C_D'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4.96</td>
<td>-0.414</td>
<td>0.0434</td>
<td>-1.93</td>
<td>-0.048</td>
<td>-4.5</td>
<td>0.0433</td>
</tr>
<tr>
<td>-3.00</td>
<td>+0.00</td>
<td>0.0249</td>
<td>+0.07</td>
<td>+0.043</td>
<td>-3.0</td>
<td>0.0429</td>
</tr>
<tr>
<td>-1.44</td>
<td>+0.07</td>
<td>0.0228</td>
<td>+2.24</td>
<td>-0.063</td>
<td>-1.4</td>
<td>0.0427</td>
</tr>
<tr>
<td>+1.05</td>
<td>+0.134</td>
<td>0.0241</td>
<td>+4.37</td>
<td>-0.096</td>
<td>+1.5</td>
<td>0.0437</td>
</tr>
<tr>
<td>1.68</td>
<td>+0.10</td>
<td>0.0461</td>
<td>+5.82</td>
<td>+0.010</td>
<td>+1.5</td>
<td>0.0453</td>
</tr>
<tr>
<td>3.24</td>
<td>+0.046</td>
<td>0.0518</td>
<td>+7.10</td>
<td>+0.038</td>
<td>+5.0</td>
<td>0.0502</td>
</tr>
<tr>
<td>4.81</td>
<td>+0.063</td>
<td>0.0657</td>
<td>+7.41</td>
<td>+0.086</td>
<td>+4.5</td>
<td>0.0602</td>
</tr>
<tr>
<td>6.37</td>
<td>+0.058</td>
<td>0.0679</td>
<td>+8.20</td>
<td>+0.094</td>
<td>6.0</td>
<td>0.0643</td>
</tr>
<tr>
<td>7.92</td>
<td>+0.059</td>
<td>0.0744</td>
<td>+8.63</td>
<td>+0.087</td>
<td>7.5</td>
<td>0.0697</td>
</tr>
<tr>
<td>9.48</td>
<td>+0.07</td>
<td>0.0740</td>
<td>+7.10</td>
<td>+0.098</td>
<td>9.0</td>
<td>0.0864</td>
</tr>
<tr>
<td>11.06</td>
<td>+0.084</td>
<td>0.1080</td>
<td>+7.88</td>
<td>+0.082</td>
<td>10.5</td>
<td>0.0996</td>
</tr>
<tr>
<td>12.60</td>
<td>+0.095</td>
<td>0.1202</td>
<td>+7.52</td>
<td>+0.092</td>
<td>12.0</td>
<td>1.107</td>
</tr>
<tr>
<td>14.18</td>
<td>+0.101</td>
<td>0.1429</td>
<td>+7.10</td>
<td>+0.094</td>
<td>13.5</td>
<td>1.309</td>
</tr>
<tr>
<td>15.68</td>
<td>+0.101</td>
<td>0.2006</td>
<td>+5.11</td>
<td>+0.073</td>
<td>15.0</td>
<td>1.585</td>
</tr>
<tr>
<td>17.19</td>
<td>+0.039</td>
<td>0.2363</td>
<td>+4.41</td>
<td>+0.057</td>
<td>16.5</td>
<td>2.237</td>
</tr>
<tr>
<td>18.68</td>
<td>+0.022</td>
<td>0.2733</td>
<td>+3.74</td>
<td>+0.050</td>
<td>18.0</td>
<td>2.611</td>
</tr>
<tr>
<td>20.16</td>
<td>+0.009</td>
<td>0.3257</td>
<td>+3.07</td>
<td>+0.025</td>
<td>19.5</td>
<td>3.141</td>
</tr>
<tr>
<td>21.66</td>
<td>+0.097</td>
<td>0.3639</td>
<td>+2.72</td>
<td>+0.016</td>
<td>21.0</td>
<td>3.524</td>
</tr>
<tr>
<td>23.16</td>
<td>+0.087</td>
<td>0.4263</td>
<td>+2.32</td>
<td>-0.019</td>
<td>22.5</td>
<td>4.440</td>
</tr>
<tr>
<td>24.65</td>
<td>+0.078</td>
<td>0.4549</td>
<td>+2.15</td>
<td>-0.010</td>
<td>24.0</td>
<td>4.438</td>
</tr>
<tr>
<td>26.14</td>
<td>+0.060</td>
<td>0.5058</td>
<td>+1.90</td>
<td>-0.041</td>
<td>25.5</td>
<td>4.961</td>
</tr>
</tbody>
</table>

1 Uncorrected for tunnel wall effect.

TABLE X

MODEL, BRISTOL FIGHTER (R. A. F., 15 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 20.6 ATM. AVERAGE DYNAMIC PRESSURE, 618 kg/m². AVERAGE REYNOLDS NUMBER, 3,120,000.

<table>
<thead>
<tr>
<th>Degrees α</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>Degrees α</th>
<th>$C_D'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4.96</td>
<td>-0.090</td>
<td>0.0436</td>
<td>-2.07</td>
<td>-0.053</td>
<td>-4.5</td>
<td>0.0435</td>
</tr>
<tr>
<td>-3.00</td>
<td>-0.00</td>
<td>0.0412</td>
<td>+0.00</td>
<td>-0.032</td>
<td>-3.0</td>
<td>0.0412</td>
</tr>
<tr>
<td>-1.43</td>
<td>+0.099</td>
<td>0.0414</td>
<td>+2.40</td>
<td>-0.025</td>
<td>-1.5</td>
<td>0.0413</td>
</tr>
<tr>
<td>+1.05</td>
<td>+0.099</td>
<td>0.0427</td>
<td>+4.22</td>
<td>-0.021</td>
<td>0.0</td>
<td>0.0423</td>
</tr>
<tr>
<td>1.68</td>
<td>+0.077</td>
<td>0.0461</td>
<td>+5.99</td>
<td>+0.025</td>
<td>+1.5</td>
<td>0.0462</td>
</tr>
<tr>
<td>3.25</td>
<td>+0.077</td>
<td>0.0526</td>
<td>+7.20</td>
<td>+0.016</td>
<td>3.0</td>
<td>0.0510</td>
</tr>
<tr>
<td>4.81</td>
<td>+0.066</td>
<td>0.0594</td>
<td>+7.88</td>
<td>+0.030</td>
<td>4.5</td>
<td>0.0569</td>
</tr>
<tr>
<td>6.37</td>
<td>+0.055</td>
<td>0.0683</td>
<td>+8.14</td>
<td>+0.053</td>
<td>6.0</td>
<td>0.0547</td>
</tr>
<tr>
<td>7.93</td>
<td>+0.047</td>
<td>0.0778</td>
<td>+8.34</td>
<td>+0.062</td>
<td>7.5</td>
<td>0.0530</td>
</tr>
<tr>
<td>9.49</td>
<td>+0.040</td>
<td>0.0910</td>
<td>+8.14</td>
<td>+0.082</td>
<td>9.0</td>
<td>0.0678</td>
</tr>
<tr>
<td>11.06</td>
<td>+0.035</td>
<td>0.1075</td>
<td>+7.75</td>
<td>+0.062</td>
<td>10.5</td>
<td>0.0994</td>
</tr>
<tr>
<td>12.61</td>
<td>+0.029</td>
<td>0.1218</td>
<td>+7.58</td>
<td>+0.102</td>
<td>12.0</td>
<td>1.120</td>
</tr>
<tr>
<td>14.17</td>
<td>+0.016</td>
<td>0.1391</td>
<td>+7.20</td>
<td>+0.101</td>
<td>13.5</td>
<td>1.274</td>
</tr>
<tr>
<td>15.68</td>
<td>+0.012</td>
<td>0.1666</td>
<td>+6.41</td>
<td>+0.100</td>
<td>15.0</td>
<td>1.482</td>
</tr>
<tr>
<td>17.19</td>
<td>+0.011</td>
<td>0.2305</td>
<td>+4.39</td>
<td>+0.070</td>
<td>16.5</td>
<td>2.186</td>
</tr>
<tr>
<td>18.66</td>
<td>+0.002</td>
<td>0.2737</td>
<td>+3.64</td>
<td>+0.059</td>
<td>18.0</td>
<td>2.622</td>
</tr>
<tr>
<td>20.14</td>
<td>+0.014</td>
<td>0.3145</td>
<td>+3.07</td>
<td>+0.048</td>
<td>19.5</td>
<td>3.637</td>
</tr>
<tr>
<td>21.62</td>
<td>+0.011</td>
<td>0.3583</td>
<td>+2.60</td>
<td>+0.062</td>
<td>21.0</td>
<td>3.841</td>
</tr>
<tr>
<td>23.13</td>
<td>+0.049</td>
<td>0.3972</td>
<td>+2.37</td>
<td>+0.012</td>
<td>22.5</td>
<td>3.869</td>
</tr>
</tbody>
</table>

1 Uncorrected for tunnel wall effect.
### TABLE XI

MODEL: BRISTOL FIGHTER (R. A. F., 30 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 1 ATM. AVERAGE DYNAMIC PRESSURE, 27.2 kg/m². AVERAGE REYNOLDS NUMBER, 152,000

<table>
<thead>
<tr>
<th>Degrees $\alpha$</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>$D$</th>
<th>$C_D'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.52</td>
<td>-0.067</td>
<td>0.0603</td>
<td>-1.11</td>
<td>+0.015</td>
<td>1.48</td>
<td>0.0602</td>
</tr>
<tr>
<td>+.01</td>
<td>+.019</td>
<td>.0569</td>
<td>+.33</td>
<td>-.003</td>
<td>0</td>
<td>.0669</td>
</tr>
<tr>
<td>1.56</td>
<td>.120</td>
<td>.0570</td>
<td>2.10</td>
<td>+.020</td>
<td>+1.48</td>
<td>.0668</td>
</tr>
<tr>
<td>3.10</td>
<td>.211</td>
<td>.0604</td>
<td>3.51</td>
<td>+.017</td>
<td>2.96</td>
<td>.0696</td>
</tr>
<tr>
<td>4.64</td>
<td>.301</td>
<td>.0652</td>
<td>4.63</td>
<td>+.042</td>
<td>4.44</td>
<td>.0842</td>
</tr>
<tr>
<td>6.17</td>
<td>.400</td>
<td>.0726</td>
<td>5.50</td>
<td>+.072</td>
<td>5.91</td>
<td>.0708</td>
</tr>
<tr>
<td>7.71</td>
<td>.492</td>
<td>.0827</td>
<td>5.95</td>
<td>+.078</td>
<td>7.39</td>
<td>.0799</td>
</tr>
<tr>
<td>9.25</td>
<td>.584</td>
<td>.0938</td>
<td>6.21</td>
<td>+.116</td>
<td>8.86</td>
<td>.0909</td>
</tr>
<tr>
<td>10.77</td>
<td>.692</td>
<td>.1071</td>
<td>6.18</td>
<td>+.134</td>
<td>10.33</td>
<td>.1021</td>
</tr>
<tr>
<td>12.29</td>
<td>.726</td>
<td>.1228</td>
<td>5.92</td>
<td>+.125</td>
<td>11.81</td>
<td>.1167</td>
</tr>
<tr>
<td>13.78</td>
<td>.761</td>
<td>.1352</td>
<td>5.00</td>
<td>+.173</td>
<td>13.28</td>
<td>.1437</td>
</tr>
<tr>
<td>15.23</td>
<td>.745</td>
<td>.2084</td>
<td>3.57</td>
<td>+.155</td>
<td>14.74</td>
<td>.2020</td>
</tr>
<tr>
<td>16.69</td>
<td>.733</td>
<td>.2537</td>
<td>2.89</td>
<td>+.155</td>
<td>16.21</td>
<td>.2475</td>
</tr>
<tr>
<td>18.13</td>
<td>.712</td>
<td>.3005</td>
<td>2.37</td>
<td>+.137</td>
<td>17.66</td>
<td>.2947</td>
</tr>
<tr>
<td>19.58</td>
<td>.696</td>
<td>.3341</td>
<td>2.08</td>
<td>+.117</td>
<td>19.12</td>
<td>.3285</td>
</tr>
<tr>
<td>21.01</td>
<td>.687</td>
<td>.3670</td>
<td>1.87</td>
<td>+.110</td>
<td>20.56</td>
<td>.3516</td>
</tr>
</tbody>
</table>

1 Uncorrected for tunnel wall effect.

### TABLE XII

MODEL: BRISTOL FIGHTER (R. A. F., 30 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 2.72 ATM. AVERAGE DYNAMIC PRESSURE, 72.8 kg/m². AVERAGE REYNOLDS NUMBER, 404,000

<table>
<thead>
<tr>
<th>Degrees $\alpha$</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>$D$</th>
<th>$C_D'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.52</td>
<td>-0.066</td>
<td>0.0536</td>
<td>-1.23</td>
<td>-0.013</td>
<td>-1.48</td>
<td>0.0535</td>
</tr>
<tr>
<td>+.02</td>
<td>+.029</td>
<td>.0517</td>
<td>+.56</td>
<td>+.017</td>
<td>+1.48</td>
<td>.0515</td>
</tr>
<tr>
<td>1.57</td>
<td>.130</td>
<td>.0517</td>
<td>2.52</td>
<td>+.029</td>
<td>2.96</td>
<td>.0517</td>
</tr>
<tr>
<td>3.11</td>
<td>.221</td>
<td>.0657</td>
<td>3.97</td>
<td>+.037</td>
<td>4.44</td>
<td>.0954</td>
</tr>
<tr>
<td>4.64</td>
<td>.304</td>
<td>.0606</td>
<td>5.03</td>
<td>+.055</td>
<td>5.91</td>
<td>.0672</td>
</tr>
<tr>
<td>6.17</td>
<td>.397</td>
<td>.0690</td>
<td>5.75</td>
<td>+.057</td>
<td>7.39</td>
<td>.0742</td>
</tr>
<tr>
<td>7.71</td>
<td>.487</td>
<td>.0769</td>
<td>6.53</td>
<td>+.074</td>
<td>8.86</td>
<td>.0833</td>
</tr>
<tr>
<td>9.25</td>
<td>.570</td>
<td>.0872</td>
<td>6.82</td>
<td>+.091</td>
<td>10.33</td>
<td>.0952</td>
</tr>
<tr>
<td>10.77</td>
<td>.665</td>
<td>.1003</td>
<td>6.62</td>
<td>+.113</td>
<td>12.76</td>
<td>.1074</td>
</tr>
<tr>
<td>12.31</td>
<td>.751</td>
<td>.1139</td>
<td>6.38</td>
<td>+.127</td>
<td>15.13</td>
<td>.1190</td>
</tr>
<tr>
<td>13.82</td>
<td>.814</td>
<td>.1280</td>
<td>6.57</td>
<td>+.119</td>
<td>18.28</td>
<td>.1283</td>
</tr>
<tr>
<td>15.27</td>
<td>.889</td>
<td>.1922</td>
<td>4.21</td>
<td>+.129</td>
<td>14.74</td>
<td>.1847</td>
</tr>
<tr>
<td>16.74</td>
<td>.798</td>
<td>.2368</td>
<td>3.37</td>
<td>+.116</td>
<td>16.21</td>
<td>.2295</td>
</tr>
<tr>
<td>18.16</td>
<td>.755</td>
<td>.2808</td>
<td>2.63</td>
<td>+.085</td>
<td>17.66</td>
<td>.2802</td>
</tr>
<tr>
<td>19.60</td>
<td>.730</td>
<td>.3274</td>
<td>2.23</td>
<td>+.077</td>
<td>19.12</td>
<td>.3213</td>
</tr>
<tr>
<td>21.04</td>
<td>.721</td>
<td>.3621</td>
<td>1.99</td>
<td>+.065</td>
<td>20.56</td>
<td>.3561</td>
</tr>
</tbody>
</table>

1 Uncorrected for tunnel wall effect.
### TABLE XIII

**MODEL, BRITISH FIGHTER (R.A.F., 30 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 5.27 ATM. AVERAGE DYNAMIC PRESSURE, 141 kg/m². AVERAGE REYNOLDS NUMBER, 760,000**

<table>
<thead>
<tr>
<th>Degrees $\alpha$</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>$1^1$ Degrees $\alpha$</th>
<th>$1^1 C_D'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.52</td>
<td>-0.063</td>
<td>0.0522</td>
<td>-1.21</td>
<td>-0.022</td>
<td>-1.48</td>
<td>0.0522</td>
</tr>
<tr>
<td>+0.02</td>
<td>+0.033</td>
<td>0.0508</td>
<td>-1.65</td>
<td>-0.015</td>
<td>0.48</td>
<td>0.0508</td>
</tr>
<tr>
<td>1.57</td>
<td>+0.131</td>
<td>0.0324</td>
<td>2.50</td>
<td>+0.003</td>
<td>+1.48</td>
<td>0.0522</td>
</tr>
<tr>
<td>5.10</td>
<td>+0.218</td>
<td>0.0557</td>
<td>3.91</td>
<td>+0.013</td>
<td>2.96</td>
<td>0.0552</td>
</tr>
<tr>
<td>6.64</td>
<td>+0.306</td>
<td>0.0605</td>
<td>5.05</td>
<td>+0.033</td>
<td>4.44</td>
<td>0.0594</td>
</tr>
<tr>
<td>6.17</td>
<td>+0.396</td>
<td>0.0672</td>
<td>5.89</td>
<td>+0.048</td>
<td>5.91</td>
<td>0.0654</td>
</tr>
<tr>
<td>7.71</td>
<td>+0.485</td>
<td>0.0763</td>
<td>6.37</td>
<td>0.053</td>
<td>7.29</td>
<td>0.0730</td>
</tr>
<tr>
<td>9.24</td>
<td>+0.576</td>
<td>0.0870</td>
<td>6.63</td>
<td>0.082</td>
<td>8.56</td>
<td>0.0832</td>
</tr>
<tr>
<td>10.77</td>
<td>+0.666</td>
<td>0.0986</td>
<td>6.76</td>
<td>0.093</td>
<td>10.33</td>
<td>0.0935</td>
</tr>
<tr>
<td>12.30</td>
<td>+0.750</td>
<td>0.1113</td>
<td>6.76</td>
<td>0.110</td>
<td>11.81</td>
<td>0.1045</td>
</tr>
<tr>
<td>13.33</td>
<td>+0.831</td>
<td>0.1232</td>
<td>6.76</td>
<td>0.114</td>
<td>13.28</td>
<td>0.1150</td>
</tr>
<tr>
<td>15.34</td>
<td>+0.913</td>
<td>0.1392</td>
<td>6.54</td>
<td>0.111</td>
<td>14.74</td>
<td>0.1296</td>
</tr>
<tr>
<td>16.81</td>
<td>+0.916</td>
<td>0.1877</td>
<td>4.88</td>
<td>0.096</td>
<td>16.21</td>
<td>0.1780</td>
</tr>
<tr>
<td>18.24</td>
<td>+0.883</td>
<td>0.2338</td>
<td>3.78</td>
<td>0.102</td>
<td>17.66</td>
<td>0.2248</td>
</tr>
<tr>
<td>19.69</td>
<td>+0.870</td>
<td>0.2346</td>
<td>3.95</td>
<td>0.094</td>
<td>19.12</td>
<td>0.2550</td>
</tr>
<tr>
<td>21.08</td>
<td>+0.783</td>
<td>0.3613</td>
<td>2.17</td>
<td>0.039</td>
<td>20.56</td>
<td>0.3542</td>
</tr>
</tbody>
</table>

$1^1$ Uncorrected for tunnel wall effect.

### TABLE XIV

**MODEL, BRITISH FIGHTER (R.A.F., 30 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 10.33 ATM. AVERAGE DYNAMIC PRESSURE, 290 kg/m². AVERAGE REYNOLDS NUMBER, 1,500,000**

<table>
<thead>
<tr>
<th>Degrees $\alpha$</th>
<th>$C_L$</th>
<th>$C_D$</th>
<th>$L/D$</th>
<th>$C_M$</th>
<th>$1^1$ Degrees $\alpha$</th>
<th>$1^1 C_D'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.52</td>
<td>-0.070</td>
<td>0.0471</td>
<td>-1.49</td>
<td>-0.040</td>
<td>-1.48</td>
<td>0.0470</td>
</tr>
<tr>
<td>+0.00</td>
<td>-0.005</td>
<td>0.0461</td>
<td>-1.11</td>
<td>-0.094</td>
<td>0.48</td>
<td>0.0461</td>
</tr>
<tr>
<td>1.55</td>
<td>+0.103</td>
<td>0.0468</td>
<td>+2.20</td>
<td>+0.014</td>
<td>+1.48</td>
<td>0.0467</td>
</tr>
<tr>
<td>3.00</td>
<td>+0.193</td>
<td>0.0504</td>
<td>3.83</td>
<td>0.029</td>
<td>2.96</td>
<td>0.0500</td>
</tr>
<tr>
<td>4.62</td>
<td>+0.278</td>
<td>0.0554</td>
<td>5.03</td>
<td>0.052</td>
<td>4.44</td>
<td>0.0548</td>
</tr>
<tr>
<td>6.16</td>
<td>+0.375</td>
<td>0.0620</td>
<td>6.06</td>
<td>0.076</td>
<td>5.91</td>
<td>0.0604</td>
</tr>
<tr>
<td>7.68</td>
<td>+0.441</td>
<td>0.0695</td>
<td>6.33</td>
<td>0.046</td>
<td>7.39</td>
<td>0.0673</td>
</tr>
<tr>
<td>9.23</td>
<td>+0.506</td>
<td>0.0787</td>
<td>7.20</td>
<td>0.104</td>
<td>8.36</td>
<td>0.0750</td>
</tr>
<tr>
<td>10.76</td>
<td>+0.651</td>
<td>0.0991</td>
<td>6.58</td>
<td>0.114</td>
<td>10.33</td>
<td>0.0942</td>
</tr>
<tr>
<td>12.30</td>
<td>+0.744</td>
<td>0.1034</td>
<td>7.20</td>
<td>0.065</td>
<td>11.51</td>
<td>0.0970</td>
</tr>
<tr>
<td>13.84</td>
<td>+0.831</td>
<td>0.1198</td>
<td>7.10</td>
<td>0.120</td>
<td>13.28</td>
<td>0.1115</td>
</tr>
<tr>
<td>15.36</td>
<td>+0.918</td>
<td>0.1344</td>
<td>7.00</td>
<td>0.119</td>
<td>14.74</td>
<td>0.1242</td>
</tr>
<tr>
<td>16.87</td>
<td>+1.002</td>
<td>0.1528</td>
<td>6.58</td>
<td>0.073</td>
<td>16.21</td>
<td>0.1412</td>
</tr>
<tr>
<td>18.33</td>
<td>+1.022</td>
<td>0.1814</td>
<td>5.65</td>
<td>0.111</td>
<td>17.66</td>
<td>0.1694</td>
</tr>
<tr>
<td>19.83</td>
<td>+1.067</td>
<td>0.2225</td>
<td>4.81</td>
<td>0.073</td>
<td>19.12</td>
<td>0.2094</td>
</tr>
<tr>
<td>21.24</td>
<td>+1.031</td>
<td>0.2563</td>
<td>4.03</td>
<td>0.099</td>
<td>20.56</td>
<td>0.2441</td>
</tr>
<tr>
<td>22.66</td>
<td>+0.993</td>
<td>0.3382</td>
<td>2.94</td>
<td>0.038</td>
<td>22.00</td>
<td>0.3268</td>
</tr>
<tr>
<td>24.05</td>
<td>+0.941</td>
<td>0.3693</td>
<td>2.55</td>
<td>0.005</td>
<td>23.43</td>
<td>0.3591</td>
</tr>
</tbody>
</table>

$1^1$ Uncorrected for tunnel wall effect.
TABLE XV
MODEL BRISTOL FIGHTER (R. A. F., 30 WINGS) AIRPLANE MODEL. AVERAGE TANK PRESSURE, 21.0 ATM. AVERAGE DYNAMIC PRESSURE, 620 kg/m². AVERAGE REYNOLDS NUMBER, 3,050,000

<table>
<thead>
<tr>
<th>Degrees α</th>
<th>( C_L )</th>
<th>( C_D )</th>
<th>( L/D )</th>
<th>( C_M )</th>
<th>( ^1 ) Degrees α</th>
<th>( ^1 ) ( C_D' )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.52</td>
<td>-0.059</td>
<td>0.0449</td>
<td>-1.31</td>
<td>-0.020</td>
<td>-1.48</td>
<td>0.0449</td>
</tr>
<tr>
<td>+.02</td>
<td>+0.026</td>
<td>0.0439</td>
<td>+.59</td>
<td>+.012</td>
<td>0</td>
<td>0.0439</td>
</tr>
<tr>
<td>1.57</td>
<td>0.150</td>
<td>0.0443</td>
<td>2.93</td>
<td>+.017</td>
<td>+1.48</td>
<td>0.0441</td>
</tr>
<tr>
<td>3.10</td>
<td>0.213</td>
<td>0.0472</td>
<td>4.51</td>
<td>+.019</td>
<td>2.96</td>
<td>0.0407</td>
</tr>
<tr>
<td>4.64</td>
<td>0.297</td>
<td>0.0509</td>
<td>5.85</td>
<td>+.033</td>
<td>4.44</td>
<td>0.0499</td>
</tr>
<tr>
<td>6.17</td>
<td>0.395</td>
<td>0.0592</td>
<td>6.72</td>
<td>+.017</td>
<td>5.91</td>
<td>0.0574</td>
</tr>
<tr>
<td>7.70</td>
<td>0.476</td>
<td>0.0669</td>
<td>7.10</td>
<td>+.056</td>
<td>7.39</td>
<td>0.0643</td>
</tr>
<tr>
<td>9.23</td>
<td>0.562</td>
<td>0.0771</td>
<td>7.30</td>
<td>+.052</td>
<td>8.86</td>
<td>0.0735</td>
</tr>
<tr>
<td>10.76</td>
<td>0.650</td>
<td>0.0849</td>
<td>7.64</td>
<td>+.069</td>
<td>10.33</td>
<td>0.0800</td>
</tr>
<tr>
<td>12.30</td>
<td>0.747</td>
<td>0.1051</td>
<td>7.10</td>
<td>+.097</td>
<td>11.81</td>
<td>0.0957</td>
</tr>
<tr>
<td>13.83</td>
<td>0.822</td>
<td>0.1145</td>
<td>7.25</td>
<td>+.097</td>
<td>13.28</td>
<td>0.1055</td>
</tr>
<tr>
<td>15.35</td>
<td>0.927</td>
<td>0.1316</td>
<td>7.05</td>
<td>+.123</td>
<td>14.74</td>
<td>0.1217</td>
</tr>
<tr>
<td>16.87</td>
<td>1.006</td>
<td>0.1513</td>
<td>6.66</td>
<td>+.137</td>
<td>16.21</td>
<td>0.1397</td>
</tr>
<tr>
<td>18.32</td>
<td>0.999</td>
<td>0.1964</td>
<td>5.08</td>
<td>+.107</td>
<td>17.66</td>
<td>0.1849</td>
</tr>
<tr>
<td>19.76</td>
<td>0.976</td>
<td>0.2358</td>
<td>4.13</td>
<td>+.084</td>
<td>19.12</td>
<td>0.2249</td>
</tr>
<tr>
<td>21.14</td>
<td>0.876</td>
<td>0.3109</td>
<td>2.82</td>
<td>+.032</td>
<td>20.56</td>
<td>0.3021</td>
</tr>
</tbody>
</table>

\(^1\) Uncorrected for tunnel wall effect.

TABLE XVI
DATA ON MODELS

<table>
<thead>
<tr>
<th>Model</th>
<th>BE-2E</th>
<th>Bristol Fighter</th>
<th>Bristol Fighter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale ratio</td>
<td>1:12</td>
<td>1:15</td>
<td>1:15</td>
</tr>
<tr>
<td>Span upper wing</td>
<td>40 in. (101.6 cm.)</td>
<td>31.50 in. (80 cm.)</td>
<td>30.54 in. (77.57 cm.)</td>
</tr>
<tr>
<td>Span lower wing</td>
<td>30 in. (76.20 cm.)</td>
<td>31.50 in. (80 cm.)</td>
<td>30.54 in. (77.57 cm.)</td>
</tr>
<tr>
<td>Gap (average)</td>
<td>6.23 in. (15.82 cm.)</td>
<td>4.35 in. (11.05 cm.)</td>
<td>4.35 in. (11.05 cm.)</td>
</tr>
<tr>
<td>Chord upper wing</td>
<td>5.50 in. (13.97 cm.)</td>
<td>4.40 in. (11.18 cm.)</td>
<td>4.40 in. (11.18 cm.)</td>
</tr>
<tr>
<td>Chord lower wing</td>
<td>5.50 in. (13.97 cm.)</td>
<td>4.40 in. (11.18 cm.)</td>
<td>4.40 in. (11.18 cm.)</td>
</tr>
<tr>
<td>Area upper wing</td>
<td>1.507 sq. ft. (0.1400 sq. m.)</td>
<td>0.907 sq. ft. (0.0843 sq. m.)</td>
<td>0.901 sq. ft. (0.0837 sq. m.)</td>
</tr>
<tr>
<td>Area lower wing</td>
<td>1.919 sq. ft. (0.0947 sq. m.)</td>
<td>0.907 sq. ft. (0.0843 sq. m.)</td>
<td>0.907 sq. ft. (0.0843 sq. m.)</td>
</tr>
<tr>
<td>Area total</td>
<td>2.526 sq. ft. (0.2347 sq. m.)</td>
<td>1.814 sq. ft. (0.1680 sq. m.)</td>
<td>1.808 sq. ft. (0.1680 sq. m.)</td>
</tr>
</tbody>
</table>

PITCHING MOMENT AXIS

BE-2E (R. A. F., 19).—The axis, relative to the leading edge of the upper wing chord at root, is 3.46 inches behind and 4.72 inches below, parallel and perpendicular to the chord line.

Bristol Fighter (R. A. F., 15).—The axis, relative to the leading edge of the lower wing chord at root, is 1.125 inches behind and 2.06 inches above, parallel and perpendicular to the chord line.

Bristol Fighter (R. A. F., 30).—The axis, relative to the leading edge of the lower wing chord at root, is 1.125 inches behind and 2.03 inches above, parallel and perpendicular to the chord line.
Fig. 6.—Lift coefficient vs. angle of attack. BE-2E airplane model with R. A. F. 19 wings

Fig. 7.—Drag coefficient vs. angle of attack. BE-2E airplane model with R. A. F. 19 wings
FIG. 8.—Lift coefficient vs. drag coefficient. BE-2E airplane model with R. A. F. 19 wings

FIG. 9.—Lift/drag vs. lift coefficient. BE-2E airplane model with R. A. F. 19 wings

FIG. 10.—Lift coefficient vs. moment coefficient. BE-2E airplane model with R. A. F. 19 wings
Tests on Models of Three British Airplanes

![Graphs and charts showing test results for British airplanes.](image)

**Fig. 11.**—Scale effect on $C_{l_{\text{max}}}$, BE-2E airplane model with R.A.F. 19 wings.

**Fig. 12.**—Scale effect on $C_{l_{\text{max}}}$, BE-2E airplane model with R.A.F. 19 wings and without tail group.

**Fig. 13.**—Scale effect on $C_{d_{\text{max}}}$, BE-2E airplane model with R.A.F. 19 wings and without tail group.

**Fig. 14.**—Lift coefficient vs. angle of attack. Bristol Fighter airplane model with R.A.F. 15 wings.

**Fig. 15.**—Drag coefficient vs. angle of attack. Bristol Fighter airplane model with R.A.F. 15 wings.
Fig. 16.—Lift coefficient vs. drag coefficient. Bristol Fighter airplane model with R. A. F. 15 wings.

Fig. 17.—Lift/drag vs. lift coefficient. Bristol Fighter airplane model with R. A. F. 15 wings.

Fig. 18.—Lift coefficient vs. moment coefficient. Bristol Fighter airplane model with R. A. F. 15 wings.
Tests on Models of Three British Airplanes

![Graph 1](image1.png)

**Fig. 19.** Scale effect on $C_{\text{max}}$. Bristol Fighter airplane model with R.A.F. 15 wings

![Graph 2](image2.png)

**Fig. 20.** Scale effect on $C_{\text{min}}$. Bristol Fighter airplane model without tail group

![Graph 3](image3.png)

**Fig. 21.** Lift coefficient vs. angle of attack. Bristol Fighter airplane model with R.A.F. 30 wings

![Graph 4](image4.png)

**Fig. 22.** Drag coefficient vs. angle of attack. Bristol fighter airplane model with R.A.F. 30 wings

![Graph 5](image5.png)

**Fig. 23.** Lift coefficient vs. drag coefficient. Bristol Fighter airplane model with R.A.F. 30 wings
FIG. 24.—Lift/drag vs. lift coefficient. Bristol Fighter airplane model with R. A. F. 30 wings

FIG. 25.—Lift coefficient vs. moment coefficient. Bristol Fighter airplane model with R. A. F. 30 wings

FIG. 26.—Scale effect on $C_{L_{max}}$. Bristol Fighter airplane model with R. A. F. 30 wings

FIG. 27.—Superposed plot of airfoil sections R. A. F. 30, N. A. C. A. 99 and Göttingen 459 for comparison
APPENDIX

REPORT OF

AERODYNAMICS SUBCOMMITTEE

BRITISH AERONAUTICAL RESEARCH COMMITTEE

TESTS OF THREE AIRPLANE MODELS

By H. C. H. Townend, B. Sc.

Tests have been made of models of BE2e with R. A. F. 19 wings, Bristol Fighter with R. A. F. 15 wings, and Bristol Fighter with R. A. F. 30 wings, for comparison with those obtained with the same models in the variable density tunnel of the National Advisory Committee for Aeronautics, America. Owing to lack of time it has not been possible to produce a complete report, and in consequence the absolute lift and drag coefficients only are given here, the moment coefficients being omitted for the present.

The wind velocity was adjusted in each case to give the same value of \( \frac{Vl}{\nu} \) as in the corresponding test at atmospheric pressure in the N. A. C. A. tunnel. The particulars of the models as given in Table XVI of this report have been used in obtaining lift and drag coefficients.

The models were tested exactly as they were received, with the exception of the BE2e, which was found to be damaged on arrival. In addition to other minor defects, the lower wing was found to be slightly loose, yawed about 2°, displaced bodily about \( \frac{1}{3} \) inch to starboard and bent at the root in such a way that its angle of attack was about \( \frac{1}{4} \)° in error. With the exception of the lateral displacement, the above defects were rectified before test.

Results.—The results have been corrected for effect of the tunnel walls. There is some doubt about the exact direction of the wind in the tunnel in which the models were tested which introduces some uncertainty in the value of minimum drag and it has not been possible to test for this yet.

The absolute lift and drag coefficients are plotted in Figures 28, 29, and 30. The agreement with the results in the variable density tunnel is very close for all the models. In the case of the BE2e with R. A. F. 19 wings the sharp fall in \( C_l \) above the maximum, which is characteristic of this wing section, does not occur in the N. A. C. A. tests, the results of which for this model are particularly smooth near the stall.

June, 1927.
Fig. 28.—Lift and drag coefficients at \( M = 191,500 \) for BE2e model with R. A. F. 19 wings (without tail unit)
TESTS ON MODELS OF THREE BRITISH AIRPLANES

Fig. 29.—Lift and drag coefficients at $V_1=157,000$ for BE2c model with R.A.F. 15 wings (without tail unit)

Fig. 30.—Lift and drag coefficients at $V_2=162,000$ for BE2c model with R.A.F. 20 wings (without tail unit)
ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
15 CENTS PER COPY
Positive directions of axes and angles (forces and moments) are shown by arrows.

<table>
<thead>
<tr>
<th>Positive directions of axes and angles (forces and moments) are shown by arrows.</th>
<th>Absolute coefficients of moment</th>
<th>Angle of set of control surface (relative to neutral position), ( \delta ). (Indicate surface by proper subscript.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis</td>
<td>Moment about axis</td>
<td>Angle</td>
</tr>
<tr>
<td>Designation</td>
<td>Symbol</td>
<td>Designation</td>
</tr>
<tr>
<td>Longitudinal</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lateral</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Normal</td>
<td>Z</td>
<td>Z</td>
</tr>
</tbody>
</table>

Absolute coefficients of moment

\[
C_L = \frac{L}{gS},\quad C_M = \frac{M}{gS},\quad C_N = \frac{N}{gS}
\]

4. PROPELLER SYMBOLS

- \( T \), Thrust.
- \( Q \), Torque.
- \( P \), Power.

\( \eta \), Efficiency = \( T/V/P \).

\( n \), Revolutions per sec., r. p. s.

\( N \), Revolutions per minute., R. P. M.

\( \phi \), Effective helix angle = \( \tan^{-1}\left(\frac{V}{2\pi n}\right) \)

5. NUMERICAL RELATIONS

- 1 HP = 76.04 kg/m/sec. = 550 lb./ft./sec.
- 1 kg/m/sec. = 0.01315 HP.
- 1 mi./hr. = 0.44704 m/sec.
- 1 m/sec. = 2.3693 mi./hr.

1 lb. = 0.4535924277 kg.
1 kg = 2.2046224 lb.
1 mi. = 1609.35 m = 5280 ft.
1 m = 3.2808333 ft.