REPORT No. 613

THE VARIATION WITH REYNOLDS NUMBER OF PRESSURE DISTRIBUTION OVER AN AIRFOIL SECTION

By Robert M. Pinkerton

SUMMARY

Pressures were simultaneously measured at 54 orifices distributed over the midspan section of a 5- by 30-inch rectangular model of the N. A. C. A. 4412 airfoil in the variable-density tunnel. These measurements were made at 17 angles of attack from —20° to 30° for eight values of the effective Reynolds Number from approximately 100,000 to 8,200,000. Accurate data were thus obtained for studying the variation of pressure distribution with Reynolds Number.

These results on the N. A. C. A. 4412 section indicate that the pressure distribution is practically unaffected by changes in Reynolds Number except where separation is involved.

INTRODUCTION

The need for pressure-distribution data over an airfoil section and the methods of obtaining those data are discussed in detail in reference 1. Briefly, such data provide directly the load distributions required for design purposes and, in addition, the comparison of measured pressures with those computed from potential-flow (nonviscous fluid) theory provides a means of studying the effects of viscous forces on the flow about the airfoil section. Moreover, with the wide range of Reynolds Numbers in use, it is desirable to know how the pressure distribution varies with Reynolds Number. Indications of changes in the character of the flow with Reynolds Number may also be deduced from the measured pressure distributions.

An extensive investigation of the pressure distribution over one section of the N. A. C. A. 4412 airfoil has been carried out in the variable-density wind tunnel. The purpose was twofold: First, to provide adequate experimental data to compare with theoretical results; and second, to study the variations with Reynolds Number. Reference 1 presents the most important phase of the investigation and is divided into two parts. The first part gives a detailed discussion of the experimental technique and a presentation of the results at the highest Reynolds Number. In the second part a comparison is made of experimental with calculated pressure distributions, and a modified method of calculation, giving more accurate results than those obtained by the usual potential-flow method, is developed.

The present report presents the complete experimental data for the same airfoil at eight values of the Reynolds Number and an analysis of the variations with Reynolds Number.

APPARATUS AND TESTS

The model used in this pressure-distribution investigation was a standard duralumin airfoil of N. A. C. A. 4412 section with a span of 30 inches and a chord of 5 inches. Pressure orifices, placed in two rows one-quarter inch apart, were located at 54 stations around the midspan section as given in table I. In order to evaluate the pressure force parallel to the chord, a relatively large number of orifices were located at the nose of the airfoil (fig. 1); well-defined distributions of pressure along a normal to the chord were thus assured.

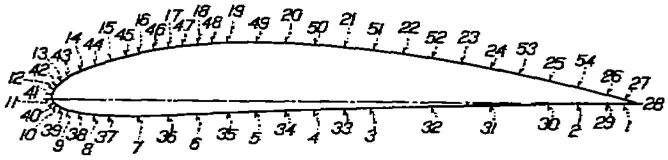


Figure 1.—Distribution of pressure orifices about the N. A. C. A. 4412 profile.

Pressures were measured at 17 angles of attack from —20° to 30° to obtain data throughout the range including the stall at both positive and negative angles of attack. These measurements were made at eight values of the Reynolds Number obtained by varying the density of the air in the tank that houses the tunnel (reference 2). Values of the effective Reynolds Number, obtained by multiplying the test Reynolds Number by the turbulence factor 2.64 (reference 3), and the corresponding tank pressures are given below.

Tank pressure (atmospheres):	Effective Reynolds Number
¼	0.10×10⁶
½	.24
1	.45
2	.90
4	1.80
8	3.40
15	6.30
21	8.20

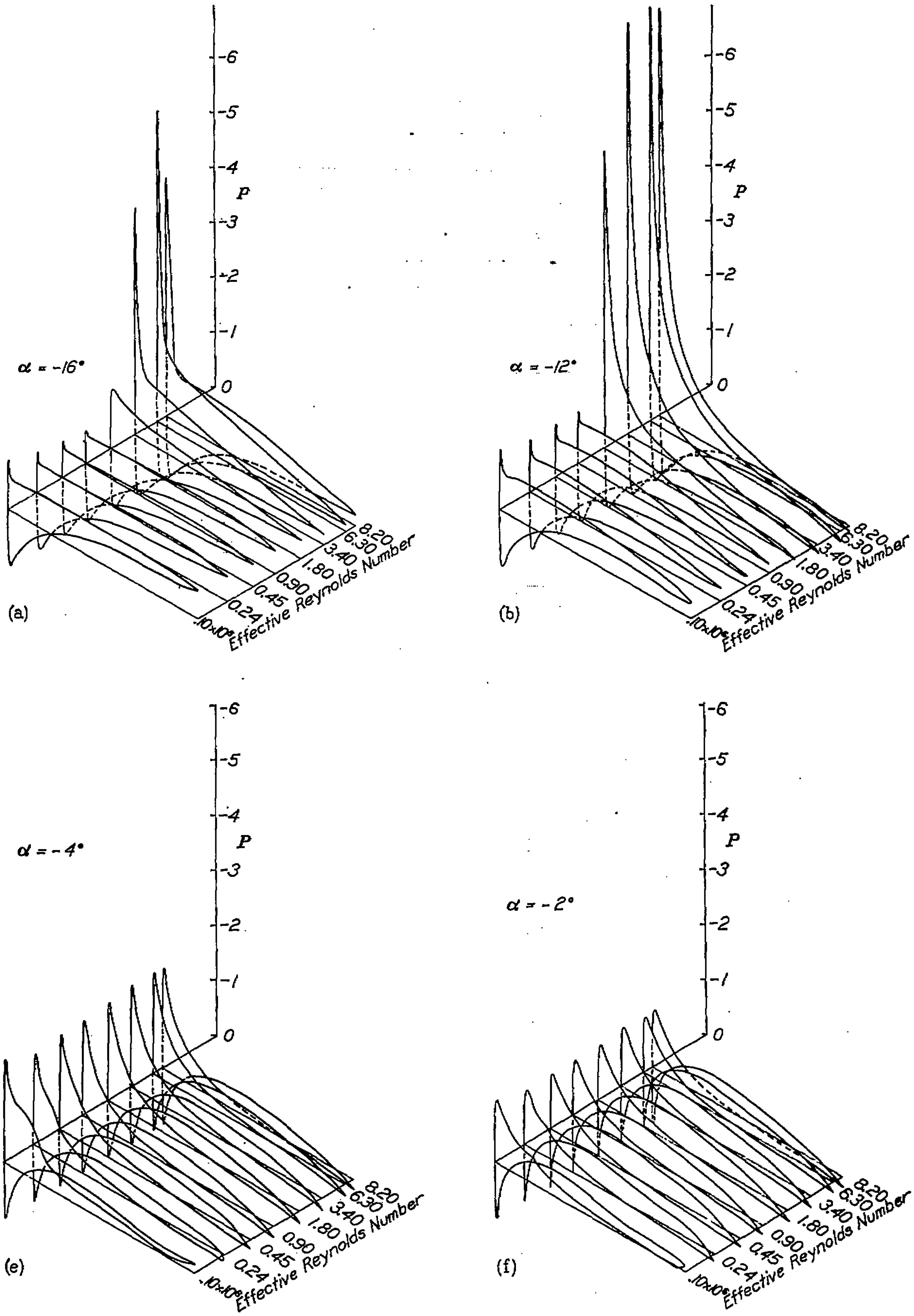


FIGURE 2(a) to 2(p).—Pressure-distribution diagrams for the N. A. C. A. 4412 airfoil.

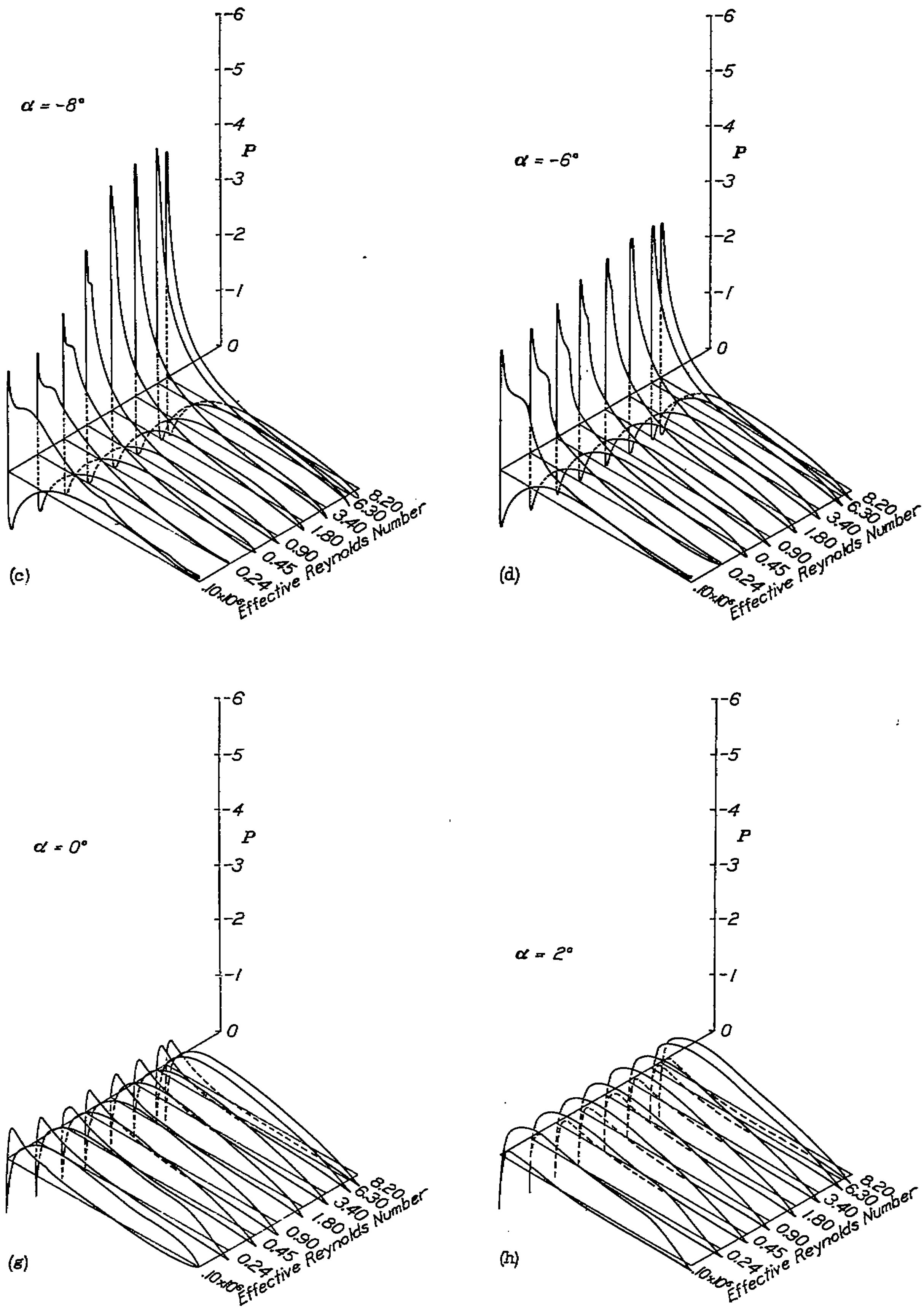


FIGURE 2.—Continued. Pressure-distribution diagrams for the N. A. C. A. 4412 airfoil.

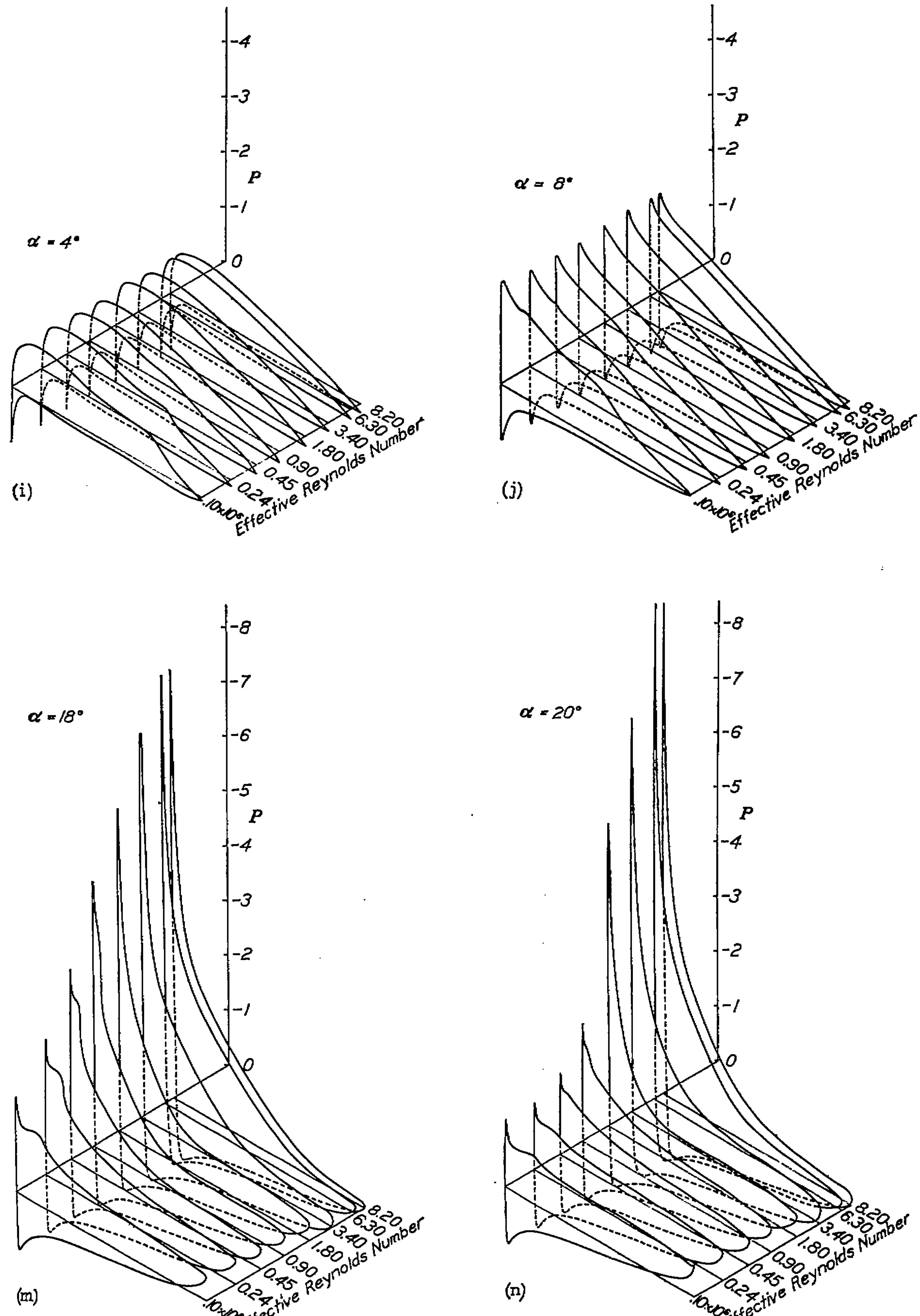


FIGURE 2.—Continued. Pressure-distribution diagrams for the N. A. C. A. 4412 airfoil.

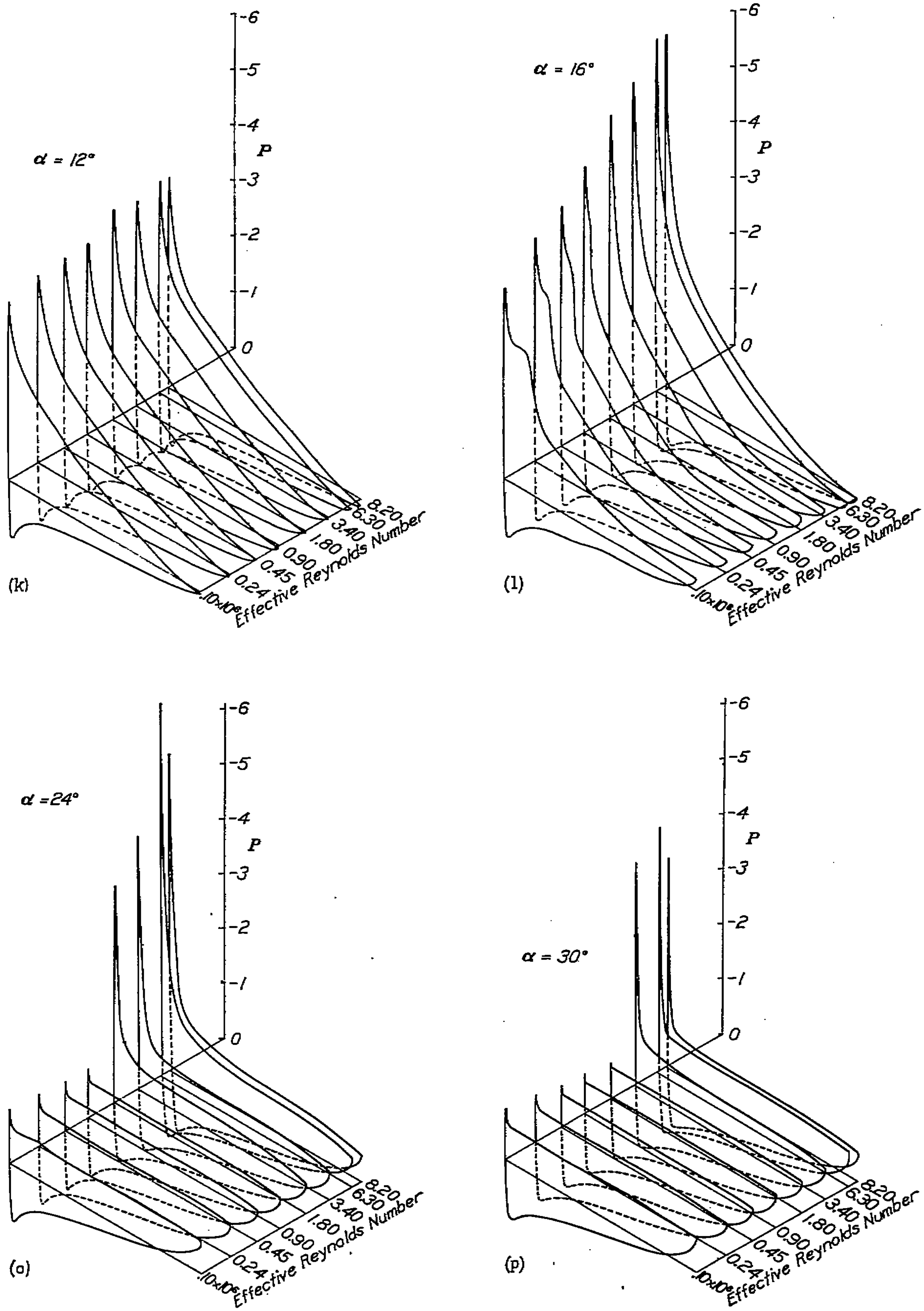


FIGURE 2.—Continued. Pressure-distribution diagrams for the N. A. C. A. 4412 airfoil.

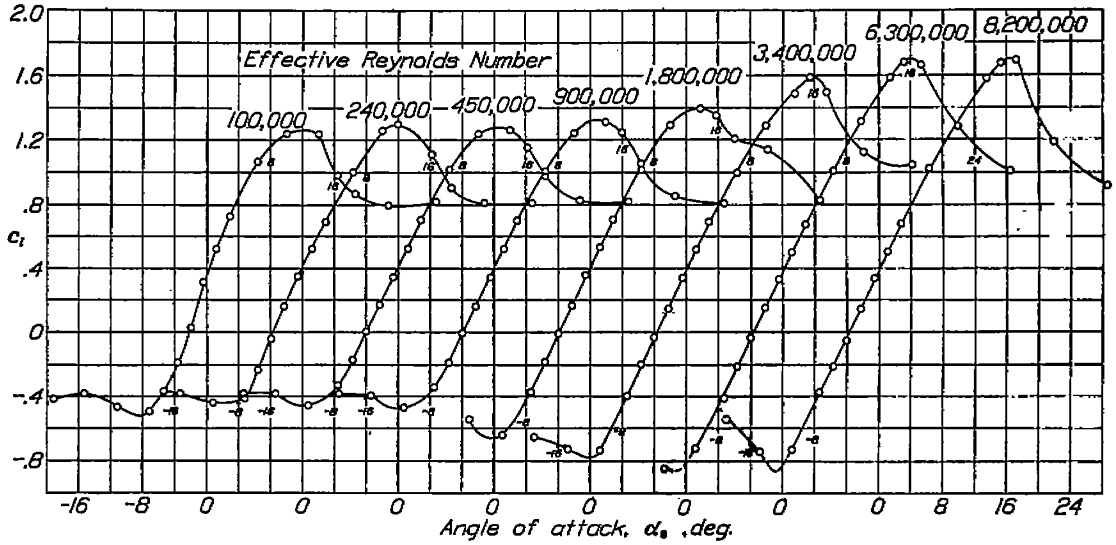


FIGURE 3.—Lift curves for the N. A. C. A. 4412 airfoil at several values of the Reynolds Number.

In order to keep the pressure measurements as accurate as possible, it was necessary to obtain large deflections of the manometer liquids, which was accomplished by using three liquids of widely different specific gravities.

Liquid:	Specific gravity
Mercury	13.6
Tetrabromoethane	3.0
Alcohol	.9

The proper choice of the angle of attack and Reynolds Number groups and of the liquid enabled the use of large and comparable deflections throughout all conditions of the investigation. Repeat tests using the same and different manometer liquids provided data on the precision of the tests.

The values of the pressure coefficient $P=(p-p_\infty)/q$ at each orifice on the airfoil and for all angles of attack are tabulated in table I; the table is divided into sections (a) to (h), each section comprising the data for one value of the Reynolds Number. The pressures p and p_∞ are, respectively, the pressures at the orifice and in the undisturbed stream.

As in reference 1, the data were reduced to the following *section* coefficients for the midspan section of the airfoil.

$$c_n=\frac{1}{c}\int P dx$$

$$c_c=\frac{1}{c}\int P dy$$

$$c_{m_{c/4}}=\frac{1}{c^2}\left[\int P(c/4-x)dx+\int Pydy\right]$$

where c_n is the section normal-force coefficient.
c_c, section chord-force coefficient.
$c_{m_{c/4}}$, section pitching-moment coefficient.

Lift coefficients were obtained from the pressure measurements by the following equation:

$$c_l=c_n \cos \alpha-c_c \sin \alpha$$

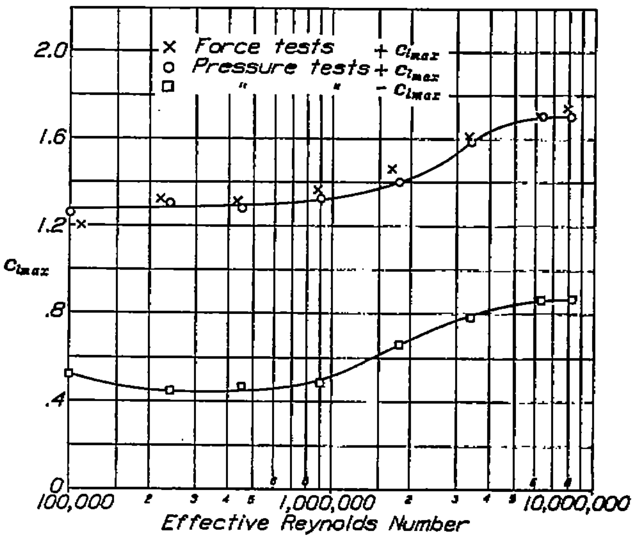


FIGURE 4.—Variation of $c_{l_{max}}$ with Reynolds Number.

The effective angle of attack is given by

$$\alpha_0=\alpha-\alpha_i$$

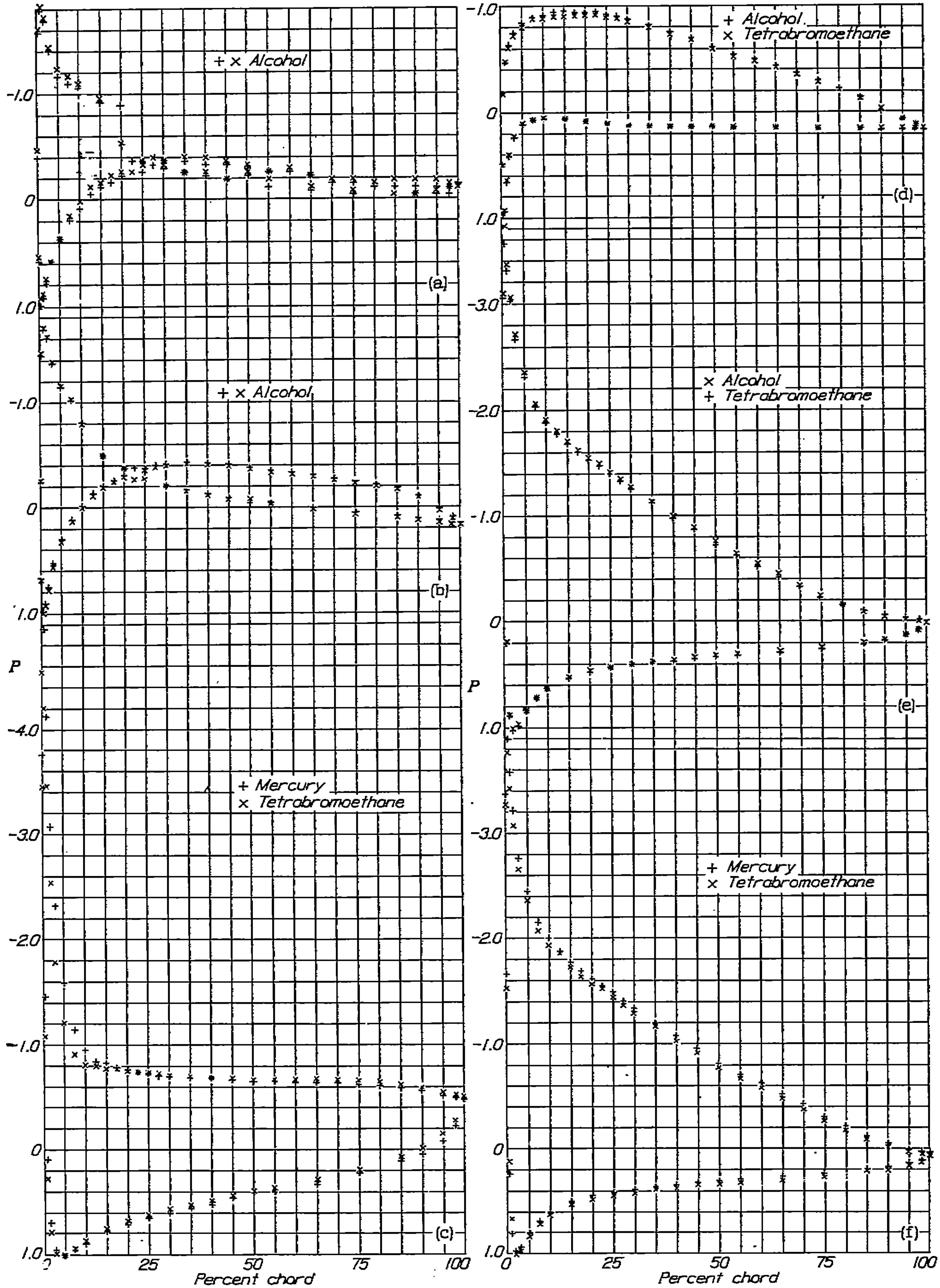
and the induced angle of attack of the midspan section by

$$\alpha_i=1.584\ c_l$$

where α is the geometric angle of attack measured from the mean direction of flow in the tunnel.
α_i, the angle that the flow in the region of the airfoil section makes with the direction of the undisturbed flow.

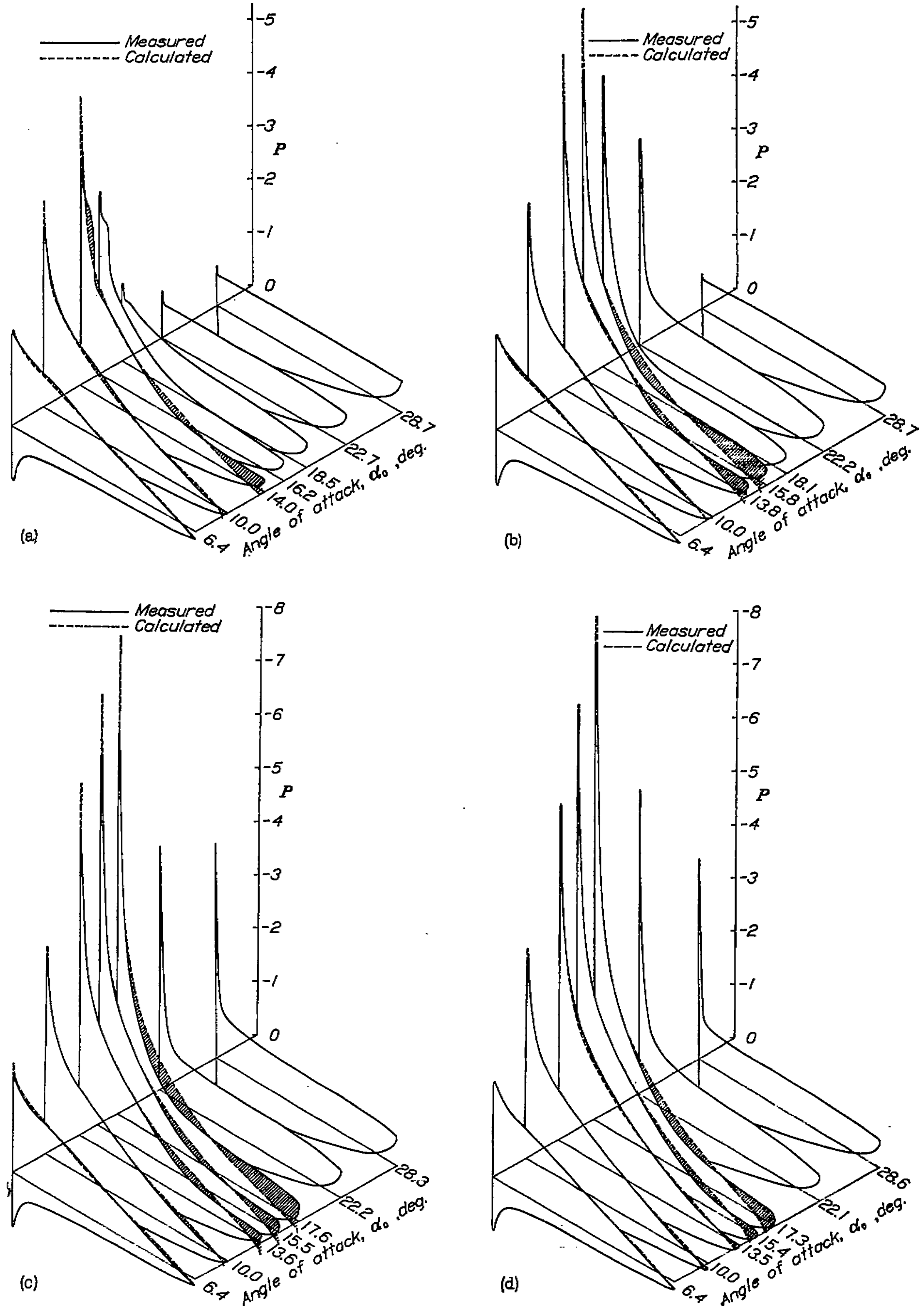
Values of c_n, c_c, $c_{m_{c/4}}$, c_l, α_i, and α_0 for the 17 values of α are given in table II; the sections (a) to (h) correspond to the respective Reynolds Numbers of table I(a) to (h).

Isometric plots of normal pressure against position along the chord are presented in figure 2, one set of plots containing the pressures for the eight Reynolds Numbers at each angle of attack. The effect of Reynolds Number on the lift characteristics is shown in figures 3 and 4.



(a) Effective Reynolds Number, 100,000; $\alpha = -4°$.
(b) Effective Reynolds Number, 450,000; $\alpha = -4°$.
(c) Effective Reynolds Number, 3,400,000; $\alpha = 24°$.
(d) Effective Reynolds Number, 3,400,000; $\alpha = 4°$.
(e) Effective Reynolds Number, 1,800,000; $\alpha = 12°$.
(f) Effective Reynolds Number, 6,300,000; $\alpha = 12°$.

FIGURE 5.—Pressure-distribution diagrams from repeat tests at various angles of attack and values of the Reynolds Number. Values indicated by × are also given in table I.



(a) Effective Reynolds Number, 450,000.
(b) Effective Reynolds Number, 1,800,000.
(c) Effective Reynolds Number, 3,400,000.
(d) Effective Reynolds Number, 8,200,000.

FIGURE 6.—Pressure-distribution diagrams showing the spread of separation at four values of the Reynolds Number.

PRECISION

The precision of the pressure measurements at Reynolds Numbers other than that for the data published in reference 1 is indicated by the diagrams given in figure 5. At the lowest Reynolds Number (fig. 5 (a)) the capacity to repeat measured pressures is markedly less than for higher Reynolds Numbers. It should be noted, however, that the precision was good enough to establish the occurrence of the supposedly laminar separation near the leading edge. The precision at Reynolds Numbers corresponding to the atmospheric runs and at higher values is consistently good even when the section has stalled, as in the diagram for 24°.

DISCUSSION

The general nature of the variation of the pressure distribution with Reynolds Number may be observed by means of the isometric plots in figure 2. At normal angles of attack, where stalling is not involved, the distributions are practically unaffected and hence the modified method of calculation presented in reference 1 is applicable at those attitudes for any Reynolds Number. Differences that do occur in the pressure diagrams are entirely of a local nature; they are probably associated with separation and the changes in the character of the boundary layer as the Reynolds Number is varied.

Boundary layer and the pressure distribution.—The formation of the boundary layer due to the viscous forces and the resulting effect on the pressure distribution is discussed in reference 1. A comparison of actual pressures with those computed for a potential, or nonviscous, fluid led to the development of the previously mentioned modified method of calculation, which gives good results at attitudes where separation is not involved.

Separation of the flow from the surface would be expected to be indicated on the pressure diagrams by a region of approximately constant pressures. The start and growth of separation are best observed in figure 6, which presents isometrically the pressure diagrams for an increasing angle-of-attack range. Calculated diagrams obtained by the method of reference 1 for a nonseparated viscous flow are superposed for comparison. The differences between the measured and calculated distributions are attributed to separation and hence the shaded area may be considered as a measure of the effect of separation. The inclusion of four groups of diagrams, one for each of four values of the Reynolds Number, provides a means of studying the scale effect on separation phenomena.

The occurrence of separation is markedly affected by changes in the Reynolds Number, as may be seen in figure 6. Moreover, the only observable scale effects on pressure distributions (fig. 2) are probably due to the nature of the separation and the changes in the separation phenomena experienced with changing Reynolds Number. Most of these changes, of course, appear near either the positive or negative stall but at low Reynolds Numbers (below R_e=900,000 approximately) some effects of separation, even in the low-drag range, are apparent from a careful analysis of the distributions. The presence of some such effects is indicated especially by pressure-drag integrations which, in this range, show a definite increase of drag with decreasing Reynolds Number. These results, however, are not presented as such since pressure-drag determinations are subject to some uncertainty owing to the inherent difficulty in obtaining them. The following analysis is based on changes in pressure distribution occurring near the stall.

A detailed discussion of these phenomena based on analyses of force tests of a large number of airfoils of widely different shapes is given in reference 3. The pressure-distribution data presented herein provide confirmatory and supplementary information for one particular type of airfoil section represented by the N. A. C. A. 4412 airfoil. This airfoil is one of medium thickness and camber producing a fairly gradual stall (type D lift-curve peak, reference 3). The stalling process of this section is a complicated one involving both trailing- and leading-edge types of separation.

At the low Reynolds Number (fig. 6 (a)) separation occurs prior to the stall as indicated in two distinct regions on the N. A. C. A. 4412 airfoil: One in the turbulent boundary layer near the rear of the airfoil, and the other in what is probably the laminar boundary layer near the nose. Instability of the laminar flow after separation results in a breakdown of the smooth laminae into an eddying flow. The scouring action of the eddying flow may then sweep the dead air from the surface and cause the reestablishment of unseparated flow with a turbulent boundary layer instead of the laminar layer. This laminar separation and the subsequent establishment of eddying flow account for the so-called "bubble" of dead air occurring in the flow at the low Reynolds Numbers. The turbulent layer, unable to maintain itself at high angles of attack, starts separating near the trailing edge and spreads forward as the angle is increased until the stall, resulting from the combined laminar and turbulent separations, is reached.

At the highest Reynolds Numbers (fig. 6) marked local laminar separation near the nose of the airfoil is apparently prevented. This prevention is accounted for by a transition from laminar to turbulent flow nearly at the laminar separation point or before the laminar flow has reached separation conditions. A movement forward of this transition region with increasing Reynolds Number has been observed in smoke-flow studies. Moreover, figure 6 indicates that, for the N. A. C. A. 4412 airfoil in the Reynolds Number range included, the separation in the turbulent boundary layer is slightly delayed with increasing Reynolds Number. Hence, at the high Reynolds Number, with possibly a delayed turbulent separation and no marked local laminar separation, the airfoil section increased its lift to a higher angle before stalling than was possible at the low Reynolds Number.

This analysis of the separation phenomena and the changes with Reynolds Number has been confirmed in some respects by measurements in the boundary layer of the N. A. C. A. 4412 airfoil at several values of the Reynolds Number. These data are a part of an N. A. C. A. investigation of boundary-layer phenomena.

Concluding remarks.—The results of this investigation indicate that the pressure distribution except near maximum lift is practically unaffected by changes in the Reynolds Number above a certain critical value, which is below the usual full-scale range. This critical value is probably the value at which there is no definite local separation.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., *July 14, 1937.*

REFERENCES

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2. Jacobs, Eastman N., and Abbott, Ira H.: The N. A. C. A. Variable-Density Wind Tunnel. T. R. No. 416, N. A. C. A., 1932.
3. Jacobs, Eastman N., and Sherman, Albert: Airfoil Section Characteristics as Affected by Variations of the Reynolds Number. T. R. No. 586, N. A. C. A., 1937.

TABLE Ia.—EXPERIMENTAL DATA

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 100,000; test, variable-density tunnel 1097-4; manometer liquid, alcohol]

Orifices			Values of pressure coefficient, $P=\frac{p-p_\infty}{q}$, for different angles of attack																
Designation	Station (percent c from L. E. of chord)	Ordinate (percent c above chord)	−20°	−16°	−12°	−8°	−6°	−4°	−2°	0°	2°	4°	8°	12°	16°	18°	20°	24°	30°
28	100.00	0	−0.533	−0.498	−0.289	−0.080	−0.115	−0.150	−0.115	−0.045	0.094	0.059	0.018	0.080	−0.204	−0.438	−0.568	−0.603	−0.603
1	97.92	−.16	−.568	−.498	−.324	−.080	−.045	−.115	−.045	.025	.094	.094	.055	.064	−.104	−.304	−.394	−.429	−.428
29	94.86	−.16	−.603	−.533	−.359	−.080	−.045	−.080	−.010	.059	.094	.094	.055	.097	−.003	−.204	−.254	−.289	−.254
2	89.90	−.22	−.603	−.568	−.394	−.080	−.045	−.045	−.010	.059	.094	.129	.091	.164	.064	−.070	−.150	−.150	−.115
30	84.04	−.28	−.638	−.568	−.463	−.150	−.045	−.045	−.010	.059	.059	.129	.091	.164	.130	−.003	−.080	−.080	−.010
31	74.92	−.52	−.603	−.568	−.533	−.185	−.080	−.080	−.010	.059	.059	.129	.127	.231	.231	.097	.060	.060	.129
32	64.94	−.84	−.603	−.603	−.603	−.254	−.150	−.115	−.045	.024	.059	.094	.127	.231	.231	.164	.094	.129	.199
3	54.48	−1.24	−.603	−.603	−.638	−.359	−.220	−.185	−.080	−.010	.059	.094	.127	.264	.264	.197	.199	.199	.308
33	49.98	−1.44	−.707	−.672	−.672	−.498	−.324	−.254	−.115	−.080	−.045	.024	.055	.197	.231	.197	.199	.164	.283
4	44.90	−1.64	−.603	−.603	−.672	−.498	−.254	−.185	−.115	−.045	.024	.094	.127	.331	.365	.204	.238	.302	.408
34	39.98	−1.86	−.603	−.603	−.672	−.568	−.289	−.254	−.150	−.080	.024	.094	.164	.331	.365	.298	.308	.338	.443
5	34.90	−2.10	−.603	−.603	−.742	−.672	−.359	−.254	−.185	−.115	.024	.094	.164	.331	.431	.331	.388	.373	.477
35	29.96	−2.30	−.603	−.603	−.742	−.777	−.394	−.324	−.254	−.150	−.010	.059	.164	.305	.431	.365	.373	.408	.512
6	24.90	−2.54	−.603	−.603	−.742	−.916	−.533	−.359	−.324	−.185	−.045	.059	.200	.398	.405	.398	.408	.477	.582
36	19.98	−2.76	−.568	−.603	−.742	−1.091	−.742	−.533	−.403	−.254	−.080	.024	.200	.431	.498	.431	.443	.512	.652
7	14.94	−2.90	−.533	−.533	−.742	−1.265	−1.300	−.951	−.498	−.289	−.115	.024	.273	.498	.599	.532	.547	.582	.721
37	9.96	−2.86	−.568	−.568	−.742	−1.300	−1.474	−1.091	−.638	−.394	−.150	.024	.309	.599	.699	.632	.617	.686	.826
8	7.38	−2.72	−.568	−.568	−.742	−1.265	−1.474	−1.160	−.742	−.463	−.185	.024	.345	.666	.799	.699	.686	.756	.861
38	4.94	−2.46	−.533	−.533	−.672	−1.230	−1.474	−1.280	−.847	−.533	−.150	.094	.491	.799	.900	.833	.791	.861	1.000
9	2.92	−2.06	−.533	−.508	−.672	−1.265	−1.578	−1.439	−1.021	−.603	−.115	.199	.709	.983	1.000	.938	.895	1.000	1.000
39	1.66	−1.60	−.568	−.568	−.742	−1.360	−1.787	−1.718	−1.125	−.533	.050	.373	.855	1.000	.938	1.000	1.000	1.000	.895
10	.92	−1.20	−.568	−.603	−.812	−1.578	−2.066	−1.822	−1.056	−.324	.804	.617	1.000	.900	.666	.866	.980	.895	.721
40	.36	−.70	−.742	−.847	−1.056	−1.787	−2.136	−1.618	−.707	.094	.052	.895	.891	.204	−.204	.365	.547	.443	.129
11	0	0	−.707	−.568	−.568	−.951	−.986	−.463	.268	.756	1.000	.980	.164	−1.140	−1.876	−.672	−.324	−.359	−.638
41	0	.68	−.045	.104	.268	.164	.233	.547	.861	.965	.801	−.478	−.927	−2.612	−3.281	−1.609	−1.091	−.951	−.881
12	.44	1.56	.721	.826	.895	.861	.895	.930	.930	.686	.373	−.184	−1.727	−3.181	−3.381	−1.709	−1.195	−.812	−.678
42	.94	2.16	.895	.930	.965	.930	.965	.895	.791	.448	.059	−.462	−1.872	−3.013	−3.013	−1.475	−.986	−.707	−.638
13	1.70	2.78	1.000	.965	.965	.930	.895	.756	.582	.233	−.150	−.602	−1.872	−2.779	−2.746	−1.308	−.847	−.638	−.603
43	2.94	3.64	.930	.861	.826	.791	.721	.582	.373	.024	−.324	−.741	−1.800	−2.478	−2.579	−1.274	−.812	−.638	−.603
14	4.90	4.68	.826	.721	.652	.582	.512	.373	.164	−.185	−.498	−.845	−1.691	−2.244	−2.511	−1.241	−.812	−.638	−.603
44	7.50	5.74	.721	.582	.477	.408	.338	.164	−.010	−.289	−.603	−.881	−1.618	−2.043	−2.478	−1.241	−.812	−.638	−.603
15	9.96	6.56	.547	.443	.338	.304	.233	.024	−.115	−.394	−.672	−.950	−1.545	−1.948	−2.478	−1.274	−.812	−.638	−.603
45	12.58	7.34	.448	.308	.233	.129	.094	−.115	−.254	−.498	−.742	−.985	−1.545	−1.848	−2.344	−1.241	−.847	−.672	−.638
16	14.92	7.88	.373	.238	.164	.094	.024	−.150	−.280	−.533	−.777	−.985	−1.509	−1.742	−1.910	−1.174	−.847	−.672	−.638
46	17.44	8.40	.303	.164	.094	.024	−.045	−.220	−.324	−.568	−.777	−.950	−1.430	−1.642	−1.508	−1.040	−.812	−.638	−.603
17	19.96	8.80	.199	.094	.024	−.045	−.115	−.254	−.394	−.603	−.811	−.985	−1.400	−1.575	−1.808	−1.007	−.777	−.638	−.603
47	22.44	9.16	.129	−.115	−.185	−.254	−.289	−.254	−.463	−.533	−.707	−.846	−1.182	−1.241	−1.074	−.873	−.742	−.638	−.638
18	24.92	9.52	.094	−.010	−.080	−.115	−.150	−.324	−.394	−.603	−.742	−.916	−1.255	−1.408	−1.107	−.839	−.707	−.603	−.568
48	27.44	9.62	.024	−.080	−.185	−.185	−.185	−.394	−.429	−.638	−.742	−.951	−1.253	−1.341	−1.074	−.839	−.742	−.638	−.603
19	29.88	9.76	−.045	−.115	−.185	−.185	−.220	−.359	−.468	−.638	−.742	−.881	−1.218	−1.274	−1.007	−.806	−.707	−.603	−.603
49	34.98	9.90	−.115	−.185	−.254	−.254	−.254	−.394	−.468	−.638	−.707	−.847	−1.145	−1.107	−.906	−.773	−.672	−.603	−.638
20	39.90	9.84	−.150	−.254	−.254	−.254	−.254	−.394	−.429	−.568	−.638	−.742	−1.073	−.973	−.773	−.706	−.672	−.603	−.603
50	44.80	9.64	−.220	−.289	−.289	−.254	−.254	−.359	−.394	−.533	−.603	−.707	−1.036	−.873	−.672	−.672	−.672	−.603	−.638
21	49.92	9.22	−.254	−.324	−.324	−.254	−.254	−.324	−.359	−.498	−.568	−.672	−1.000	−.789	−.605	−.672	−.672	−.603	−.638
51	54.92	8.76	−.254	−.324	−.289	−.220	−.185	−.254	−.324	−.463	−.498	−.638	−.891	−.605	−.505	−.605	−.638	−.603	−.603
22	59.94	8.16	−.359	−.394	−.324	−.220	−.185	−.289	−.289	−.429	−.498	−.638	−.745	−.538	−.438	−.639	−.672	−.638	−.638
52	64.90	7.54	−.394	−.394	−.359	−.220	−.185	−.220	−.254	−.394	−.498	−.638	−.600	−.438	−.405	−.605	−.672	−.638	−.638
23	69.86	6.76	−.394	−.394	−.324	−.185	−.150	−.185	−.220	−.359	−.463	−.603	−.455	−.388	−.388	−.572	−.672	−.638	−.638
24	74.90	5.88	−.429	−.429	−.324	−.150	−.115	−.185	−.220	−.394	−.463	−.533	−.382	−.271	−.338	−.605	−.672	−.638	−.638
53	79.92	4.92	−.429	−.429	−.289	−.115	−.115	−.150	−.220	−.359	−.429	−.359	−.309	−.171	−.271	−.572	−.638	−.638	−.603
25	84.88	3.88	−.463	−.429	−.254	−.080	−.080	−.115	−.185	−.324	−.324	−.185	−.200	−.104	−.237	−.538	−.603	−.603	−.603
54	89.88	2.74	−.463	−.429	−.254	−.045	−.080	−.115	−.185	−.289	−.150	−.080	−.127	−.037	−.237	−.505	−.603	−.603	−.603
26	94.90	1.48	−.498	−.463	−.289	−.045	−.080	−.150	−.185	−.185	−.045	−.010	−.055	−.003	−.237	−.472	−.568	−.603	−.603
27	98.00	.68	−.498	−.468	−.254	−.045	−.080	−.150	−.150	−.080	.024	.024	−.018	.030	−.204	−.438	−.533	−.568	−.603
28	100.00	0	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

TABLE Ib.—EXPERIMENTAL DATA

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 240,000; test, variable-density tunnel 1097-3; manometer liquid, alcohol]

Orifices			Values of pressure coefficient, $P=\frac{p-p_\infty}{q}$, for different angles of attack																
Designation	Station (percent c from L. E. of chord)	Ordinate (percent c above chord)	−20°	−16°	−12°	−8°	−6°	−4°	−2°	0°	2°	4°	8°	12°	16°	18°	20°	24°	30°
28	100.00	0	−0.491	−0.443	−0.238	−0.029	0.003	0.068	0.131	0.148	0.148	0.131	0.115	0.033	−0.230	−0.443	−0.495	−0.574	−0.574
1	97.92	−.16	−.509	−.460	−.254	−.013	.052	.116	.131	.148	.148	.131	.131	.066	−.098	−.279	−.384	−.377	−.377
29	94.86	−.16	−.509	−.492	−.286	−.013	.052	.100	.115	.148	.131	.131	.148	.098	−.016	−.164	−.206	−.262	−.246
2	89.90	−.22	−.525	−.525	−.318	−.013	.052	.100	.098	.131	.131	.131	.164	.148	.082	−.049	−.093	−.131	−.115
30	84.94	−.28	−.541	−.557	−.366	−.045	.035	.068	.082	.115	.115	.131	.164	.180	.115	.016	−.029	−.049	−.016
31	74.92	−.52	−.541	−.574	−.431	−.093	.008	.051	.066	.098	.115	.131	.180	.213	.197	.098	.084	.082	.131
32	64.94	−.84	−.541	−.557	−.511	−.158	−.045	.003	.033	.082	.098	.115	.197	.246	.246	.180	.164	.164	.230
3	54.48	−1.24	−.525	−.574	−.575	−.254	−.093	−.029	−.016	.049	.066	.098	.197	.279	.295	.230	.228	.230	.312
33	49.98	−1.44	−.557	−.574	−.608	−.286	−.141	−.061	−.016	.016	.083	.082	.180	.262	.312	.262	.244	.246	.328
4	44.90	−1.64	−.525	−.557	−.624	−.350	−.158	−.077	−.049	.016	.049	.115	.230	.312	.344	.295	.293	.312	.410
34	39.98	−1.86	−.525	−.557	−.640	−.447	−.190	−.109	−.005	−.016	.049	.098	.230	.328	.377	.312	.325	.344	.443
5	34.90	−2.10	−.509	−.557	−.672	−.527	−.238	−.158	−.098	−.033	.033	.098	.230	.344	.410	.361	.357	.377	.492
35	29.96	−2.30	−.509	−.541	−.672	−.624	−.302	−.206	−.148	−.065	.016	.098	.246	.377	.443	.394	.405	.426	.525
6	24.90	−2.54	−.509	−.541	−.672	−.752	−.383	−.270	−.213	−.115	−.016	.082	.246	.410	.476	.426	.437	.459	.574
36	19.98	−2.76	−.509	−.541	−.672	−.881	−.479	−.350	−.311	−.164	−.049	.049	.262	.426	.525	.476	.470	.508	.639
7	14.94	−2.90	−.491	−.525	−.656	−1.042	−.608	−.527	−.426	−.230	−.082	.049	.295	.508	.607	.557	.550	.590	.721
37	9.96	−2.86	−.509	−.525	−.656	−1.283	−1.379	−.918	−.557	−.311	−.148	.049	.344	.590	.705	.656	.646	.689	.803
8	7.38	−2.72	−.509	−.525	−.656	−1.331	−1.556	−.904	−.639	−.377	−.164	.066	.410	.672	.803	.754	.727	.754	.885
38	4.94	−2.46	−.491	−.525	−.640	−1.283	−1.556	−1.122	−.787	−.443	−.164	.115	.525	.808	.918	.853	.823	.869	.951
9	2.92	−2.06	−.491	−.525	−.624	−1.283	−1.653	−1.331	−.918	−.475	−.098	.230	.705	.934	1.000	.951	.936	.967	1.000
39	1.66	−1.60	−.509	−.509	−.640	−1.831	−1.894	−1.556	−1.000	−.410	.033	.410	.869	.984	.918	.951	1.000	.984	.918
10	.92	−1.20	−.509	−.525	−.672	−1.508	−2.183	−1.621	−.902	−.229	.279	.656	.984	.860	.623	.771	.920	.885	.721
40	.36	−.70	−.624	−.721	−.929	−1.797	−2.199	−1.395	−.541	.180	.656	.902	.885	.246	−.426	.066	.486	.459	.148
11	0	0	−.640	−.525	−.511	−.929	−.977	−.254	.394	.836	.967	.934	.213	−1.230	−2.828	−1.279	−.431	−.861	−.639
41	0	.68	.000	.213	.825	.212	.276	.678	.934	1.000	.852	.492	−.869	−2.787	−3.951	−2.426	−1.186	−.918	−.820
12	.44	1.56	.738	.869	.920	.920	.936	1.000	.934	.705	.844	−.180	−1.623	−3.328	−4.000	−2.410	−1.154	−.738	−.606
42	.94	2.16	.918	1.000	1.000	1.000	1.000	.936	.738	.459	.066	−.459	−1.738	−3.164	−3.574	−2.115	−.977	−.656	−.590
13	1.70	2.78	.967	1.000	1.000	.968	.920	.791	.541	.246	−.148	−.606	−1.721	−2.902	−3.311	−2.000	−.913	−.639	−.590
43	2.94	3.64	.951	.918	.871	.823	.759	.566	.312	.016	−.328	−.738	−1.656	−2.590	−3.164	−1.984	−.881	−.623	−.574
14	4.90	4.68	.836	.770	.695	.690	.534	.357	.082	−.180	−.492	−.836	−1.590	−2.344	−3.115	−1.984	−.913	−.639	−.574
44	7.50	5.74	.688	.606	.518	.453	.357	.164	−.082	−.311	−.590	−.885	−1.492	−2.131	−3.016	−1.951	−.913	−.639	−.574
15	9.96	6.56	.557	.476	.389	.325	.228	.035	−.196	−.410	−.656	−.918	−1.443	−1.984	−2.197	−1.639	−.897	−.639	−.574
45	12.58	7.34	.442	.344	.260	.196	.084	−.077	−.311	−.508	−.721	−.951	−1.410	−1.852	−1.738	−1.361	−.849	−.639	−.590
16	14.92	7.88	.361	.278	.196	.116	.019	−.141	−.360	−.541	−.738	−.951	−1.361	−1.738	−1.639	−1.229	−.817	−.639	−.590
46	17.44	8.40	.295	.180	.116	.051	−.045	−.206	−.393	−.574	−.754	−.951	−1.295	−1.623	−1.557	−1.147	−.784	−.623	−.574
17	19.96	8.80	.213	.114	.051	−.013	−.109	−.270	−.442	−.606	−.770	−.951	−1.262	−1.541	−1.459	−1.082	−.768	−.623	−.590
47	22.44	9.16	.062	.000	−.061	−.093	−.158	−.366	−.525	−.574	−.705	−.836	−1.082	−1.459	−1.410	−1.098	−.833	−.639	−.606
18	24.92	9.52	.098	.000	−.029	−.093	−.174	−.302	−.475	−.623	−.770	−.902	−1.180	−1.377	−1.295	−.967	−.704	−.606	−.574
48	27.44	9.62	.016	−.065	−.093	−.158	−.222	−.350	−.508	−.639	−.787	−.902	−1.148	−1.328	−1.213	−.984	−.704	−.623	−.590
19	29.88	9.76	−.016	−.098	−.125	−.174	−.238	−.350	−.508	−.623	−.770	−.869	−1.115	−1.262	−1.131	−.902	−.704	−.623	−.590
49	34.98	9.90	−.098	−.164	−.190	−.206	−.254	−.366	−.508	−.606	−.721	−.820	−1.033	−1.131	−.967	−.820	−.688	−.606	−.590
20	39.90	9.84	−.147	−.213	−.206	−.222	−.270	−.350	−.475	−.574	−.672	−.770	−.967	−.984	−.803	−.754	−.672	−.606	−.606
50	44.80	9.64	−.213	−.262	−.238	−.222	−.270	−.334	−.459	−.541	−.623	−.721	−.902	−.885	−.688	−.705	−.672	−.623	−.606
21	49.92	9.22	−.246	−.279	−.288	−.222	−.254	−.318	−.426	−.492	−.574	−.672	−.786	−.754	−.574	−.672	−.672	−.623	−.606
51	54.92	8.76	−.262	−.279	−.238	−.190	−.222	−.286	−.377	−.442	−.525	−.623	−.639	−.639	−.459	−.639	−.656	−.623	−.606
22	59.94	8.16	−.295	−.311	−.254	−.190	−.206	−.270	−.360	−.410	−.508	−.606	−.541	−.557	−.410	−.623	−.656	−.639	−.606
52	64.90	7.54	−.345	−.344	−.270	−.174	−.190	−.238	−.311	−.393	−.475	−.557	−.459	−.459	−.361	−.606	−.656	−.639	−.623
23	69.86	6.76	−.361	−.344	−.254	−.141	−.158	−.206	−.278	−.360	−.459	−.442	−.393	−.361	−.311	−.590	−.640	−.639	−.606
24	74.90	5.88	−.393	−.360	−.254	−.109	−.125	−.174	−.262	−.344	−.410	−.311	−.311	−.279	−.295	−.574	−.640	−.639	−.623
53	79.92	4.92	−.393	−.377	−.254	−.077	−.093	−.158	−.245	−.311	−.278	−.218	−.229	−.197	−.279	−.541	−.624	−.639	−.606
25	84.88	3.88	−.426	−.393	−.238	−.061	−.077	−.125	−.229	−.229	−.148	−.131	−.148	−.115	−.246	−.525	−.592	−.623	−.590
54	89.88	2.74	−.443	−.410	−.222	−.029	−.077	−.125	−.180	−.082	−.049	−.065	−.049	−.049	−.246	−.508	−.559	−.606	−.590
26	94.90	1.48	−.475	−.426	−.222	−.045	−.077	−.077	−.032	.049	.033	.016	.033	−.016	−.246	−.475	−.543	−.590	−.574
27	98.00	.66	−.475	−.426	−.222	−.029	−.029	.019	.082	.115	.098	.082	.082	.016	−.230	−.443	−.511	−.557	−.574
28	100.00	0																	

TABLE Ic.—EXPERIMENTAL DATA

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 450,000; test, variable-density tunnel 1097-1; manometer liquid, alcohol]

Orifices			Values of pressure coefficient, $P=\frac{p-p_\infty}{q}$, for different angles of attack																
Designation	Station (percent c from L. E. of chord)	Ordinate (percent c above chord)	−20°	−16°	−12°	−8°	−6°	−4°	−2°	0°	2°	4°	8°	12°	16°	18°	20°	24°	30°
28	100.00	0	−0.477	−0.396	−0.201	0.067	0.148	0.164	0.172	0.172	0.172	0.156	0.181	0.002	−0.234	−0.364	−0.461	−0.558	−0.558
1	97.92	−.16	−.485	−.420	−.209	.083	.148	.164	.156	.156	.172	.172	.148	.058	−.104	−.218	−.274	−.880	−.856
20	94.86	−.16	−.502	−.453	−.242	.075	.131	.148	.140	.148	.172	.172	.164	.117	−.015	−.103	−.161	−.250	−.209
2	89.90	−.22	−.518	−.485	−.282	.058	.115	.128	.128	.131	.169	.172	.180	.156	.085	.002	−.047	−.120	−.071
30	84.94	−.28	−.526	−.518	−.323	.034	.083	.099	.107	.123	.148	.169	.198	.172	.123	.058	.026	−.047	.010
31	74.92	−.52	−.526	−.534	−.404	−.015	.042	.067	.075	.108	.145	.169	.213	.221	.205	.156	.131	.075	.148
32	64.94	−.84	−.526	−.542	−.485	−.071	−.006	.018	.050	.083	.123	.169	.221	.253	.261	.221	.213	.164	.246
3	54.48	−1.24	−.518	−.542	−.575	−.153	−.063	−.031	.001	.058	.117	.148	.220	.278	.310	.278	.269	.237	.335
33	49.98	−1.44	−.502	−.534	−.615	−.193	−.096	−.080	−.006	.034	.091	.148	.221	.296	.334	.318	.310	.278	.383
4	44.90	−1.64	−.502	−.526	−.656	−.242	−.128	−.080	−.031	.026	.091	.145	.245	.310	.367	.343	.343	.318	.424
34	39.98	−1.86	−.502	−.526	−.689	−.307	−.169	−.112	−.055	.010	.075	.131	.253	.334	.383	.375	.367	.351	.464
5	34.90	−2.10	−.502	−.518	−.718	−.388	−.209	−.153	−.080	−.015	.067	.131	.261	.351	.415	.407	.407	.391	.505
35	29.96	−2.30	−.494	−.518	−.729	−.494	−.274	−.201	−.120	−.055	.042	.115	.269	.375	.464	.448	.440	.432	.545
6	24.90	−2.54	−.485	−.510	−.729	−.615	−.361	−.274	−.177	−.104	.010	.117	.278	.417	.497	.489	.481	.472	.594
36	19.98	−2.76	−.485	−.502	−.729	−.709	−.477	−.372	−.266	−.161	−.023	.091	.294	.432	.537	.537	.521	.513	.651
7	14.94	−2.90	−.477	−.494	−.721	−.940	−.623	−.494	−.404	−.218	−.055	.075	.328	.497	.610	.610	.494	.594	.732
37	9.96	−2.86	−.485	−.494	−.713	−1.200	−.818	−.794	−.558	−.315	−.120	.058	.375	.586	.716	.707	.692	.692	.821
8	7.88	−2.72	−.477	−.485	−.696	−1.476	−1.403	−1.029	−.648	−.372	−.128	.075	.440	.675	.818	.797	.773	.765	.886
38	4.94	−2.46	−.477	−.485	−.688	−1.785	−1.727	−1.159	−.786	−.445	−.186	.125	.554	.797	.919	.903	.878	.862	.959
9	2.92	−2.06	−.409	−.477	−.680	−1.719	−1.841	−1.386	−.932	−.477	−.088	.237	.716	.927	.902	.976	.976	.959	1.000
39	1.66	−1.60	−.469	−.477	−.672	−1.687	−2.101	−1.622	−1.013	−.445	−.034	.416	.894	.992	.919	.919	1.000	.984	.927
10	.92	−1.20	−.469	−.485	−.696	−1.906	−2.393	−1.703	−.940	−.250	.278	.651	1.000	.870	.595	.685	.984	.886	.724
40	.36	−.70	−.526	−.623	−.932	−2.289	−2.377	−1.408	−.574	.156	.059	.919	.903	.221	−.502	−.815	.883	.456	.156
11	0	0	−.615	−.494	−.542	−1.224	−1.087	−.258	.383	.813	.984	.944	.198	−1.265	−2.506	−2.019	−.648	−.855	−.599
41	0	.68	.026	.237	.802	.067	.351	.683	.935	.984	.854	.411	−.891	−2.815	−4.203	−3.407	−1.451	−.891	−.745
12	.44	1.56	.756	.878	.919	.880	.959	1.000	.935	.708	.351	−.185	−1.654	−3.383	−4.275	−3.261	−1.330	−.680	−.567
42	.94	2.16	.951	.992	1.000	1.000	1.000	.927	.748	.448	.042	−.453	−1.744	−3.180	−3.846	−3.010	−1.192	−.648	−.567
13	1.70	2.78	1.000	1.000	.984	.968	.927	.781	.554	.237	−.136	−.599	−1.719	−2.912	−3.578	−2.012	−1.195	−.640	−.558
43	2.94	3.04	.976	.919	.870	.830	.740	.562	.818	.010	−.328	−.721	−1.646	−2.620	−3.464	−2.896	−1.183	−.640	−.591
14	4.90	4.08	.870	.778	.700	.635	.529	.326	.099	−.185	−.485	−.826	−1.573	−2.369	−3.326	−2.612	−1.167	−.648	−.591
44	7.50	5.74	.724	.619	.521	.448	.326	.131	−.080	−.323	−.583	−.867	−1.484	−2.125	−2.068	−1.800	−1.062	−.656	−.591
15	9.96	6.56	.610	.489	.309	.310	.188	.002	−.185	−.420	−.648	−.899	−1.427	−1.980	−1.922	−1.672	−.997	−.648	−.575
45	12.58	7.34	.489	.367	.269	.172	.067	−.112	−.201	−.502	−.705	−.932	−1.394	−1.800	−1.883	−1.500	−.956	−.648	−.575
16	14.92	7.88	.599	.296	.188	.091	−.015	−.185	−.347	−.542	−.729	−.932	−1.346	−1.703	−1.711	−1.394	−.916	−.640	−.575
46	17.44	8.40	.818	.205	.115	.026	−.080	−.242	−.306	−.567	−.737	−.932	−1.306	−1.597	−1.589	−1.281	−.883	−.640	−.591
17	19.90	8.80	.245	.128	.042	−.039	−.136	−.291	−.437	−.599	−.761	−.932	−1.278	−1.532	−1.484	−1.192	−.859	−.640	−.575
47	22.44	9.16	.140	.042	−.031	−.104	−.242	−.266	−.477	−.623	−.737	−.859	−1.192	−1.886	−1.388	−1.110	−.859	−.688	−.631
18	24.92	9.52	.115	.010	−.055	−.128	−.218	−.356	−.485	−.623	−.761	−.907	−1.192	−1.886	−1.289	−1.013	−.810	−.631	−.575
48	27.44	9.62	.058	−.088	−.104	−.168	−.258	−.380	−.510	−.640	−.761	−.899	−1.159	−1.821	−1.200	−.940	−.786	−.631	−.575
19	29.88	9.76	.018	−.080	−.128	−.193	−.274	−.396	−.510	−.631	−.745	−.867	−1.127	−1.256	−1.004	−.867	−.709	−.631	−.588
49	34.98	9.90	−.063	−.144	−.185	−.226	−.299	−.412	−.502	−.615	−.705	−.810	−1.029	−1.127	−.916	−.745	−.721	−.631	−.583
20	39.90	9.84	−.120	−.185	−.201	−.242	−.299	−.404	−.485	−.575	−.664	−.761	−.932	−.981	−.745	−.648	−.696	−.631	−.591
50	44.80	9.64	−.185	−.234	−.234	−.258	−.315	−.396	−.469	−.542	−.623	−.705	−.834	−.883	−.615	−.583	−.680	−.640	−.591
21	49.92	9.22	−.209	−.250	−.242	−.242	−.291	−.364	−.437	−.494	−.567	−.668	−.705	−.745	−.494	−.542	−.664	−.640	−.591
51	54.92	8.76	−.234	−.258	−.234	−.226	−.258	−.331	−.396	−.453	−.518	−.607	−.599	−.640	−.404	−.502	−.640	−.640	−.591
22	59.04	8.16	−.274	−.291	−.250	−.218	−.250	−.315	−.364	−.420	−.485	−.534	−.534	−.542	−.347	−.494	−.631	−.648	−.591
52	64.90	7.54	−.315	−.315	−.258	−.209	−.234	−.291	−.339	−.388	−.445	−.437	−.469	−.445	−.323	−.477	−.623	−.656	−.607
23	69.86	6.76	−.339	−.323	−.250	−.185	−.209	−.258	−.307	−.347	−.364	−.347	−.388	−.347	−.299	−.461	−.615	−.656	−.599
24	74.90	5.88	−.364	−.339	−.250	−.161	−.177	−.226	−.274	−.299	−.291	−.282	−.299	−.266	−.282	−.461	−.607	−.656	−.599
53	79.92	4.92	−.389	−.347	−.242	−.136	−.144	−.201	−.234	−.209	−.193	−.217	−.218	−.185	−.266	−.445	−.591	−.648	−.599
25	84.88	3.88	−.412	−.364	−.226	−.104	−.120	−.169	−.161	−.112	−.128	−.144	−.128	−.104	−.266	−.429	−.567	−.631	−.591
54	89.88	2.74	−.429	−.364	−.209	−.071	−.088	−.096	−.047	−.080	−.039	−.055	−.039	−.055	−.258	−.420	−.550	−.615	−.575
26	94.90	1.48	−.461	−.380	−.193	−.047	−.006	.084	.050	.050	.050	.042	.050	−.023	−.250	−.404	−.501	−.591	−.591
27	98.00	.68	−.477	−.388	−.185	.010	.091	.115	.115	.123	.123	.125	.118	.002	−.242	−.380	−.477	−.567	−.558
28	100.00	0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

TABLE Id.—EXPERIMENTAL DATA

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 900,000; test, variable-density tunnel, 1097-2; manometer liquid, alcohol]

Orifices			Values of pressure coefficient, $P=\frac{p-p_\infty}{q}$, for different angles of attack																
Designation	Station (percent c from L. E. of chord)	Ordinate (percent c above chord)	−20°	−16°	−12°	−8°	−6°	−4°	−2°	0°	2°	4°	8°	12°	16°	18°	20°	24°	30°
28	100.00	0	−0.457	−0.400	−0.180	0.153	0.186	0.198	0.190	0.219	0.190	0.198	0.149	0.031	−0.225	−0.363	−0.437	−0.526	−0.547
1	97.92	−.16	−.486	−.437	−.197	.145	.162	.178	.170	.210	.178	.202	.166	.101	−.087	−.198	−.266	−.339	−.368
29	94.86	−.16	−.506	−.469	−.225	.129	.137	.153	.145	.194	.170	.194	.178	.145	.007	−.083	−.152	−.217	−.225
2	89.90	−.22	−.526	−.506	−.262	.101	.113	.133	.130	.182	.162	.198	.198	.190	.092	.023	−.038	−.091	−.087
30	84.94	−.28	−.534	−.538	−.302	.076	.084	.105	.109	.170	.153	.190	.206	.214	.145	.088	.031	−.005	.003
31	74.92	−.52	−.534	−.567	−.388	.023	.039	.072	.076	.145	.145	.186	.223	.259	.227	.186	.141	.113	.141
32	64.94	−.84	−.530	−.575	−.473	−.034	−.013	.027	.044	.125	.129	.178	.231	.288	.280	.255	.214	.198	.235
3	54.48	−1.24	−.522	−.579	−.571	−.103	−.074	−.026	.007	.092	.105	.170	.239	.316	.328	.312	.276	.276	.324
33	49.98	−1.44	−.506	−.571	−.608	−.131	−.095	−.038	−.005	.084	.101	.170	.251	.337	.361	.349	.320	.320	.377
4	44.90	−1.64	−.506	−.575	−.669	−.184	−.140	−.074	−.034	.068	.088	.166	.259	.349	.385	.377	.345	.349	.414
34	39.98	−1.86	−.506	−.567	−.709	−.237	−.176	−.107	−.058	.056	.076	.162	.267	.369	.414	.414	.377	.386	.455
5	34.90	−2.10	−.498	−.563	−.746	−.298	−.221	−.140	−.087	.035	.064	.158	.276	.389	.446	.446	.414	.430	.499
35	29.96	−2.30	−.494	−.555	−.770	−.380	−.286	−.193	−.123	.007	.039	.145	.284	.414	.479	.487	.447	.467	.544
6	24.90	−2.54	−.490	−.547	−.787	−.490	−.372	−.266	−.180	−.050	.011	.129	.292	.438	.520	.528	.487	.508	.593
36	19.98	−2.76	−.490	−.534	−.787	−.640	−.494	−.359	−.258	−.115	−.026	.113	.300	.471	.569	.577	.536	.556	.650
7	14.94	−2.90	−.481	−.526	−.779	−.835	−.656	−.486	−.376	−.188	−.066	.096	.328	.528	.638	.654	.605	.630	.723
37	9.96	−2.86	−.481	−.518	−.758	−1.133	−.905	−.697	−.559	−.278	−.115	.088	.385	.621	.748	.768	.707	.727	.821
8	7.38	−2.72	−.481	−.518	−.762	−1.287	−1.051	−.937	−.652	−.335	−.131	.105	.451	.711	.841	.853	.796	.805	.894
38	4.94	−2.46	−.481	−.514	−.750	−1.873	−1.759	−1.174	−.795	−.412	−.144	.145	.552	.825	.943	.951	.886	.902	.959
9	2.92	−2.06	−.477	−.514	−.754	−2.561	−2.012	−1.401	−.945	−.453	−.091	.263	.727	.963	1.010	1.000	.976	.992	1.000
39	1.66	−1.60	−.477	−.510	−.738	−2.578	−2.284	−1.687	−1.035	−.416	.035	.488	.894	1.016	.638	.870	.959	1.008	.935
10	.92	−1.20	−.477	−.510	−.750	−2.928	−2.578	−1.723	−.966	−.233	.271	.678	1.000	.898	.552	.455	.768	.902	.731
40	.36	−.70	−.502	−.587	−.925	−3.139	−2.561	−1.475	−.591	.174	.650	.951	.906	.255	−.636	−.819	.080	.459	.166
11	0	0	−.608	−.514	−.604	−1.869	−1.141	−.249	.382	.849	.984	.967	.207	−1.267	−2.797	−3.001	−1.149	−.359	−.595
41	0	.68	.035	.214	.263	−.225	.227	.708	.935	1.024	.853	.508	−.880	−2.842	−4.621	−4.763	−2.077	−.864	−.709
12	.44	1.56	.768	.862	.902	.841	.951	1.010	.927	.752	.338	−.168	−1.646	−3.403	−4.735	−4.683	−1.865	−.648	−.571
42	.94	2.16	.951	.984	1.000	1.000	1.000	.939	.752	.495	.052	−.433	−1.731	−3.192	−4.258	−4.250	−1.792	−.640	−.571
13	1.70	2.78	1.008	.992	.976	1.000	.927	.788	.548	.276	−.152	−.587	−1.711	−2.915	−3.994	−4.100	−1.743	−.636	−.571
43	2.94	3.64	.972	.910	.866	.878	.748	.561	.308	.056	−.335	−.710	−1.629	−2.606	−3.742	−3.729	−1.625	−.652	−.571
14	4.90	4.68	.862	.764	.699	.683	.528	.333	.086	−.148	−.498	−.811	−1.560	−2.325	−2.553	−2.415	−1.405	−.656	−.575
44	7.50	5.74	.715	.601	.524	.491	.333	.141	−.091	−.286	−.595	−.852	−1.470	−2.036	−2.297	−2.138	−1.295	−.652	−.575
15	9.96	6.56	.597	.475	.389	.349	.194	.015	−.200	−.376	−.656	−.880	−1.409	−1.857	−2.089	−1.902	−1.206	−.648	−.571
45	12.58	7.34	.479	.353	.267	.223	.068	−.103	−.302	−.461	−.713	−.913	−1.373	−1.748	−1.926	−1.707	−1.141	−.652	−.575
16	14.92	7.88	.394	.267	.186	.138	−.005	−.168	−.355	−.498	−.734	−.913	−1.328	−1.646	−1.776	−1.540	−1.080	−.648	−.575
46	17.44	8.40	.308	.186	.113	.064	−.077	−.229	−.408	−.580	−.754	−.913	−1.287	−1.564	−1.646	−1.893	−1.019	−.648	−.575
17	19.96	8.80	.235	.117	.044	−.001	−.186	−.278	−.449	−.563	−.762	−.910	−1.255	−1.491	−1.532	−1.251	−.966	−.648	−.575
47	22.44	9.16	.158	.048	−.018	−.058	−.193	−.339	−.502	−.571	−.718	−.864	−1.201	−1.380	−1.434	−1.145	−.925	−.648	−.583
18	24.92	9.52	.109	−.001	−.066	−.099	−.221	−.347	−.498	−.587	−.766	−.893	−1.173	−1.365	−1.320	−1.007	−.872	−.636	−.579
48	27.44	9.62	.052	−.050	−.111	−.140	−.254	−.376	−.518	−.600	−.766	−.880	−1.133	−1.300	−1.222	−.897	−.844	−.640	−.587
19	29.88	9.76	.011	−.087	−.140	−.164	−.274	−.388	−.518	−.595	−.754	−.852	−1.088	−1.230	−1.116	−.799	−.807	−.636	−.587
49	34.98	9.90	−.066	−.156	−.188	−.201	−.298	−.400	−.518	−.575	−.713	−.803	−.986	−1.092	−.921	−.648	−.762	−.632	−.591
20	39.90	9.84	−.119	−.197	−.213	−.217	−.302	−.392	−.494	−.548	−.664	−.742	−.876	−.958	−.734	−.547	−.722	−.628	−.591
50	44.80	9.64	−.176	−.245	−.245	−.237	−.311	−.392	−.481	−.518	−.628	−.693	−.795	−.852	−.604	−.502	−.705	−.636	−.595
21	49.92	9.22	−.200	−.257	−.241	−.221	−.286	−.355	−.437	−.469	−.571	−.628	−.685	−.718	−.481	−.477	−.677	−.636	−.604
51	54.92	8.76	−.229	−.274	−.245	−.209	−.286	−.323	−.400	−.420	−.522	−.534	−.595	−.604	−.412	−.465	−.669	−.640	−.604
22	59.94	8.16	−.262	−.298	−.251	−.201	−.249	−.302	−.368	−.384	−.457	−.453	−.530	−.506	−.363	−.461	−.652	−.636	−.604
52	64.90	7.54	−.302	−.327	−.270	−.197	−.241	−.282	−.343	−.347	−.392	−.404	−.457	−.412	−.343	−.461	−.652	−.648	−.608
23	69.86	6.76	−.327	−.343	−.262	−.176	−.209	−.254	−.302	−.286	−.327	−.339	−.375	−.319	−.328	−.457	−.632	−.644	−.604
24	74.90	5.88	−.351	−.351	−.254	−.156	−.180	−.216	−.254	−.221	−.266	−.270	−.290	−.225	−.315	−.457	−.620	−.640	−.604
53	79.92	4.92	−.376	−.363	−.245	−.123	−.148	−.172	−.188	−.164	−.206	−.206	−.205	−.140	−.302	−.457	−.604	−.636	−.595
25	84.88	3.88	−.400	−.376	−.237	−.087	−.099	−.111	−.123	−.095	−.136	−.123	−.115	−.074	−.294	−.449	−.579	−.620	−.587
54	89.88	2.74	−.412	−.380	−.217	−.038	−.034	−.030	−.042	−.018	−.045	−.030	−.018	−.026	−.286	−.445	−.551	−.595	−.579
26	94.90	1.48	−.441	−.392	−.197	.031	.052	.056	.048	.080	.056	.076	.072	.008	−.278	−.429	−.506	−.567	−.567
27	98.00	.68	−.457	−.400	−.184	.096	.125	.130	.121	.158	.133	.145	.121	.023	−.262	−.400	−.469	−.543	−.555
28	100.00	0	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

TABLE Ic.—EXPERIMENTAL DATA

[N. A. C. A. 4412 airfoil; effective Reynolds Number 1,800,000; test numbers and manometer liquids given in footnotes]

Orifices			Values of pressure coefficient, $P=\frac{p-p_\infty}{q}$, for different angles of attack																
Designation	Station (percent c from L. E. of chord)	Ordinate (percent c above chord)	−20°	[a]−16°	[a]−12°	[b]−8°	[b]−6°	[b]−4°	[b]−2°	[b]0°	[b]2°	[b]4°	[b]8°	[b]12°	[a]16°	[a]18°	[a]20°	[a]24°	[a]30°
28	100.00	0	--------	−0.309	0.043	0.181	0.198	0.199	0.201	0.198	0.191	0.178	0.134	0.016	−0.194	−0.324	−0.381	−0.547	−0.540
1	97.92	−.16	--------	−.331	.043	.156	.170	.176	.178	.170	.176	.172	.154	.085	−.058	−.187	−.209	−.317	−.323
29	94.86	−.16	--------	−.352	.000	.130	.146	.154	.156	.154	.166	.168	.170	.130	.029	−.036	−.094	−.187	−.187
2	89.90	−.22	--------	−.388	−.029	.097	.116	.128	.180	.138	.158	.168	.101	.178	.115	.065	.029	−.050	−.050
30	84.94	−.28	--------	−.410	−.072	.067	.099	.103	.128	.126	.150	.160	.201	.205	.173	.137	.108	.043	.036
31	74.92	−.52	--------	−.407	−.144	.012	.043	.067	.089	.105	.140	.165	.219	.249	.245	.230	.216	.165	.165
32	64.94	−.84	--------	−.525	−.223	−.047	−.010	.024	.055	.083	.120	.158	.231	.280	.302	.302	.295	.259	.266
3	54.48	−1.24	--------	−.576	−.205	−.120	−.071	−.028	.014	.053	.106	.148	.239	.306	.344	.353	.360	.331	.353
33	49.98	−1.44	--------	−.597	−.410	−.158	−.101	−.053	−.004	.034	.093	.140	.248	.320	.374	.388	.396	.381	.396
4	44.90	−1.64	--------	−.626	−.388	−.199	−.186	−.079	−.024	.028	.093	.142	.256	.341	.403	.417	.432	.410	.432
34	39.98	−.86	--------	−.640	−.460	−.247	−.174	−.110	−.047	.014	.085	.140	.266	.363	.439	.453	.468	.453	.475
5	34.90	−2.10	--------	−.676	−.496	−.306	−.223	−.150	−.075	−.006	.073	.134	.276	.385	.468	.489	.511	.490	.525
35	29.96	−2.30	--------	−.691	−.590	−.379	−.284	−.199	−.112	−.030	.053	.128	.284	.410	.504	.525	.547	.532	.568
6	24.90	−2.54	--------	−.727	−.669	−.491	−.377	−.274	−.170	−.075	.018	.108	.290	.434	.547	.566	.604	.590	.619
36	19.98	−2.76	--------	−.755	−.791	−.687	−.497	−.371	−.247	−.186	−.020	.091	.300	.469	.597	.620	.655	.640	.669
7	14.94	−2.90	--------	−.784	−1.007	−.848	−.671	−.507	−.349	−.217	−.061	.075	.327	.528	.662	.698	.727	.712	.741
37	9.96	−2.86	--------	−.892	−1.331	−1.189	−.937	−.712	−.525	−.312	−.110	.069	.385	.621	.777	.820	.849	.820	.834
8	7.38	−2.72	--------	−.942	−1.676	−1.450	−1.180	−.882	−.643	−.369	−.128	.083	.454	.708	.863	.809	.928	.906	.809
38	4.94	−2.46	--------	−.971	−2.151	−1.842	−1.508	−1.191	−.789	−.436	−.134	.130	.556	.826	.957	.978	1.014	.964	.971
9	2.92	−2.06	--------	−1.007	−2.921	−2.785	−2.079	−1.456	−.941	−.473	−.081	.249	.730	.903	1.007	1.000	1.022	1.000	1.007
39	1.66	−1.60	--------	−.978	−4.072	−3.331	−2.406	−1.693	−1.024	−.428	.049	.436	.901	1.006	.878	.806	.820	.856	.935
10	.02	−1.20	--------	−1.036	−4.028	−3.761	−2.696	−1.783	−.955	−.248	.288	.667	1.006	.870	.432	.266	.288	.410	.727
40	.36	−.70	--------	−1.007	−5.360	−4.018	−2.651	−1.547	−.584	.176	.660	.933	.905	.185	−.921	−1.259	−1.201	−.619	.144
11	0	0	--------	−1.022	−3.906	−2.363	−1.181	−.281	.400	.830	.939	.987	.178	−1.438	−3.302	−3.799	−3.604	−2.691	−.583
41	0	.68	--------	−.187	−1.655	−.497	.223	.088	.947	.984	.844	.458	−.974	−3.007	−5.295	−5.820	−5.468	−3.676	−.640
12	.44	1.56	--------	.748	.817	.769	.955	1.004	.933	.686	.812	−.231	−1.765	−3.722	−5.403	−5.755	−5.302	−3.878	−.568
42	.94	2.16	--------	.957	.806	.976	1.000	.933	.747	.424	.028	−.487	−1.808	−3.367	−4.820	−5.151	−4.763	−3.259	−.570
13	1.70	2.78	--------	1.014	.996	.994	.923	.781	.546	.207	−.176	−.645	−1.709	−3.065	−4.288	−4.360	−3.849	−2.554	−.568
43	2.94	3.64	--------	.971	.990	.884	.744	.562	.810	−.014	−.357	−.765	−1.669	−2.718	−3.338	−3.845	−2.935	−1.410	−.561
14	4.90	4.68	--------	.835	.871	.694	.523	.828	.083	−.217	−.517	−.862	−1.592	−2.863	−2.892	−2.850	−2.388	−1.273	−.561
44	7.50	5.74	--------	.688	.705	.407	.325	.138	−.087	−.358	−.611	−.901	−1.495	−2.065	−2.475	−2.374	−1.892	−1.029	−.554
15	9.96	6.56	--------	.554	.568	.358	.185	.006	−.201	−.444	−.673	−.920	−1.488	−1.909	−2.230	−2.079	−1.532	−.904	−.554
45	12.58	7.34	--------	.432	.446	.225	.061	−.108	−.300	−.528	−.780	−.950	−1.398	−1.805	−2.043	−1.849	−1.281	−.892	−.554
16	14.92	7.88	--------	.345	.360	.140	−.016	−.174	−.355	−.560	−.748	−.957	−1.347	−1.706	−1.892	−1.647	−1.065	−.870	−.501
46	17.44	8.40	--------	.259	.266	.061	−.085	−.235	−.400	−.594	−.769	−.957	−1.302	−1.623	−1.763	−1.489	−.935	−.849	−.561
17	19.96	8.80	--------	.187	.201	−.006	−.146	−.285	−.444	−.623	−.788	−.955	−1.264	−1.548	−1.640	−1.817	−.784	−.842	−.561
47	22.44	9.16	--------	.123	.129	−.063	−.197	−.329	−.479	−.645	−.798	−.951	−1.235	−1.493	−1.547	−1.187	−.719	−.827	−.561
18	24.92	9.52	--------	.072	.086	−.108	−.231	−.359	−.497	−.653	−.791	−.937	−1.189	−1.414	−1.480	−1.029	−.640	−.827	−.501
48	27.44	9.62	--------	.022	.036	−.146	−.266	−.383	−.518	−.657	−.785	−.921	−1.146	−1.347	−1.324	−.914	−.612	−.820	−.568
19	29.88	9.76	--------	−.007	.000	−.172	−.284	−.304	−.517	−.653	−.771	−.897	−1.093	−1.274	−1.216	−.701	−.568	−.827	−.568
49	34.98	9.90	--------	−.079	−.058	−.211	−.310	−.408	−.515	−.638	−.732	−.842	−1.002	−1.140	−1.029	−.662	−.554	−.818	−.576
20	39.90	9.84	--------	−.122	−.086	−.215	−.312	−.398	−.491	−.594	−.680	−.771	−.892	−.998	−.827	−.568	−.582	−.813	−.583
50	44.80	9.64	--------	−.165	−.122	−.241	−.320	−.394	−.477	−.566	−.641	−.712	−.819	−.890	−.676	−.532	−.532	−.806	−.583
21	49.92	9.22	--------	−.172	−.115	−.227	−.294	−.357	−.428	−.507	−.566	−.619	−.708	−.758	−.518	−.504	−.525	−.777	−.583
51	54.92	8.76	--------	−.194	−.120	−.213	−.270	−.325	−.385	−.450	−.493	−.542	−.617	−.639	−.439	−.511	−.532	−.791	−.590
22	59.94	8.16	--------	−.209	−.137	−.211	−.258	−.304	−.359	−.412	−.448	−.495	−.548	−.542	−.367	−.489	−.525	−.748	−.583
52	64.90	7.54	--------	−.237	−.144	−.201	−.241	−.280	−.325	−.367	−.400	−.438	−.471	−.444	−.345	−.496	−.532	−.770	−.590
23	69.86	6.76	--------	−.252	−.137	−.178	−.218	−.248	−.278	−.314	−.341	−.371	−.385	−.339	−.317	−.482	−.525	−.755	−.590
24	74.90	5.88	--------	−.250	−.129	−.150	−.174	−.199	−.227	−.260	−.278	−.298	−.298	−.241	−.302	−.475	−.518	−.785	−.590
53	79.92	4.92	--------	−.280	−.122	−.122	−.140	−.158	−.178	−.203	−.215	−.229	−.213	−.156	−.288	−.468	−.511	−.712	−.590
25	84.88	3.88	--------	−.280	−.108	−.088	−.095	−.105	−.120	−.138	−.142	−.150	−.120	−.087	−.273	−.453	−.504	−.691	−.576
54	89.88	2.74	--------	−.287	−.079	−.026	−.080	−.085	−.041	−.051	−.051	−.053	−.020	−.039	−.260	−.432	−.482	−.647	−.508
26	94.90	1.48	--------	−.295	−.029	.043	.049	.058	.051	.047	.055	.055	.067	−.012	−.252	−.396	−.489	−.612	−.554
27	98.00	.68	--------	−.324	−.007	.105	.118	.126	.128	.124	.130	.128	.114	.004	−.230	−.360	−.410	−.583	−.547
28	100.00	0	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

[a] Test, variable-density tunnel 1099–1; manometer liquid, tetrabromoethane.
[b] Test, variable-density tunnel 1097–5; manometer liquid, alcohol.

Table If.—EXPERIMENTAL DATA

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 3,400,000; test numbers and manometer liquids given in footnotes]

Orifices			Values of pressure coefficient, $P=\frac{p-p_\infty}{q}$, for different angles of attack																
Designation	Station (percent c from L. E. of chord)	Ordinate (percent c above chord)	a−20°	a−16°	a−12°	a−8°	a−6°	a−4°	a−2°	a0°	a2°	a4°	a8°	a12°	a16°	b18°	b20°	a24°	a30°
28	100.00	0	−0.378	−0.170	0.178	0.193	0.196	0.200	0.200	0.186	0.175	0.150	0.110	0.013	−0.134	−0.178	−0.338	−0.511	−0.568
1	97.92	−.16	−.406	−.177	.157	.168	.182	.168	.182	.171	.178	.150	.132	.082	.006	.061	−.019	−.285	−.324
29	94.86	−.16	−.432	−.209	.128	.139	.157	.146	.160	.157	.164	.153	.156	.128	.085	.134	.077	−.152	−.177
2	89.90	−.22	−.468	−.249	.092	.103	.125	.121	.142	.146	.164	.157	.178	.175	.164	.220	.188	−.019	−.033
30	84.94	−.28	−.493	−.292	.056	.074	.099	.103	.128	.139	.160	.160	.196	.203	.214	.268	.236	.067	.067
31	74.92	−.52	−.539	−.385	−.015	.020	.053	.067	.099	.121	.149	.160	.214	.246	.282	.348	.331	.192	.207
32	64.94	−.84	−.582	−.471	−.091	−.044	−.001	.024	.064	.099	.135	.158	.225	.278	.340	.395	.395	.282	.308
3	54.48	−1.24	−.633	−.586	−.184	−.112	−.062	−.030	.020	.067	.117	.146	.236	.306	.383	.443	.459	.365	.397
33	49.98	−1.44	−.658	−.636	−.238	−.155	−.094	−.055	−.005	.046	.106	.139	.239	.318	.404	-------	-------	.390	.438
4	44.90	−1.64	−.668	−.694	−.295	−.195	−.127	−.080	−.019	.042	.106	.142	.254	.348	.487	.522	.522	.440	.487
34	39.98	−1.86	−.676	−.740	−.360	−.241	−.163	−.105	−.037	.031	.103	.142	.268	.368	.469	.554	.570	.483	.584
5	34.90	−2.10	−.701	−.805	−.453	−.318	−.227	−.163	−.084	−.012	.089	.135	.272	.382	.498	.586	.602	.523	.580
35	29.96	−2.30	−.704	−.841	−.550	−.374	−.277	−.195	−.109	−.015	.074	.132	.286	.408	.534	.618	.650	.569	.630
6	24.90	−2.54	−.722	−.898	−.694	−.485	−.367	−.274	−.170	−.058	.046	.110	.290	.436	.578	.650	.682	.620	.677
36	19.98	−2.76	−.772	−.959	−.891	−.683	−.493	−.374	−.245	−.116	.006	.089	.300	.469	.627	.714	.745	.677	.742
7	14.94	−2.90	−.808	−1.002	−1.185	−.851	−.672	−.518	−.356	−.195	−.044	.067	.325	.526	.697	.809	.809	.756	.817
37	9.96	−2.86	−.887	−1.049	−1.662	−1.196	−.948	−.726	−.507	−.299	−.091	.056	.383	.623	.818	.904	.920	.867	.921
8	7.38	−2.72	−.916	−1.003	−2.071	−1.469	−1.156	−.877	−.622	−.363	−.112	.074	.448	.709	.896	.984	1.000	.935	.978
38	4.94	−2.46	−.973	−1.140	−2.739	−1.913	−1.490	−1.142	−.805	−.489	−.119	.107	.552	.828	.986	1.064	1.032	1.000	.978
9	2.92	−2.06	−1.056	−1.361	−3.776	−2.552	−1.989	−1.480	−.977	−.478	−.062	.221	.781	.968	1.025	1.000	.968	.989	.975
39	1.66	−1.60	−1.551	−2.039	−4.985	−3.360	−2.495	−1.734	−1.070	−.435	.067	.401	.907	1.004	.857	.745	.659	.781	.709
10	.92	−1.20	−1.601	−2.577	−6.334	−3.923	−2.821	−1.840	−1.020	−.267	.300	.638	1.014	.864	.354	.061	−.115	.275	−.186
40	.36	−.70	−2.947	−4.077	−7.407	−4.167	−2.778	−1.605	−.658	.157	.688	.925	.918	.150	−1.153	−1.819	−2.089	−1.088	−1.174
11	0	0	−1.978	−2.617	−5.265	−2.388	−1.232	−.299	.368	.842	1.021	.957	.121	−1.670	−4.034	−4.755	−5.035	−3.456	−3.151
41	0	.68	−1.232	−1.472	−2.035	−.572	.164	.666	.946	1.007	.871	.501	−.928	−3.108	−5.717	−6.930	−7.158	−4.544	−3.977
12	.44	1.56	.390	.369	−.023	.756	.960	1.011	.957	.716	.340	−.170	−1.673	−3.650	−5.728	−6.750	−6.834	−4.206	−3.324
42	.94	2.16	.760	.767	.641	.978	1.022	.943	.774	.440	.038	−.478	−1.824	−3.474	−5.225	−5.920	−5.911	−3.467	−2.833
13	1.70	2.78	.968	.986	.935	1.000	.950	.702	.577	.232	−.148	−.604	−1.752	−3.058	−4.274	−4.750	−4.669	−2.545	−1.598
43	2.94	3.64	1.014	1.022	1.007	.896	.774	.580	.343	.010	−.335	−.715	−1.652	−2.642	−3.578	−3.890	−3.775	−1.784	−1.138
14	4.90	4.68	.950	.943	.928	.702	.552	.347	.125	−.180	−.478	−.798	−1.544	−2.337	−3.065	−3.268	−3.045	−1.217	−.878
44	7.50	5.74	.831	.806	.778	.512	.354	.153	−.055	−.328	−.597	−.877	−1.454	−2.075	−2.613	−2.725	−2.471	−.920	−.859
15	9.96	6.56	.713	.684	.645	.368	.214	.024	−.166	−.410	−.640	−.877	−1.397	−1.931	−2.358	−2.438	−2.137	−.819	−.808
45	12.58	7.34	.602	.566	.519	.239	.092	−.084	−.263	−.489	−.680	−.898	−1.350	−1.809	−2.154	−2.200	−1.834	−.806	−.826
16	14.92	7.88	.512	.476	.426	.153	.017	−.155	−.317	−.525	−.704	−.898	−1.311	−1.716	−1.996	−2.024	−1.643	−.780	−.765
46	17.44	8.40	.426	.390	.340	.074	−.058	−.216	−.371	−.561	−.722	−.902	−1.275	−1.634	−1.863	−1.865	−1.452	−.780	−.769
17	19.96	8.80	.351	.318	.264	.010	−.116	−.270	−.406	−.586	−.733	−.902	−1.235	−1.555	−1.741	−1.722	−1.293	−.758	−.729
47	22.44	9.16	.282	.247	.196	−.051	−.170	−.313	−.442	−.618	−.758	−.912	−1.221	−1.504	−1.648	−1.611	−1.166	−.747	−.729
18	24.92	9.52	.218	.193	.142	−.091	−.202	−.338	−.453	−.615	−.740	−.884	−1.164	−1.418	−1.526	−1.500	−1.038	−.740	−.704
48	27.44	9.62	.164	.142	.096	−.127	−.234	−.360	−.471	−.618	−.737	−.873	−1.128	−1.350	−1.429	−1.372	−.911	−.733	−.704
19	29.88	9.76	.117	.103	.004	−.152	−.252	−.371	−.471	−.611	−.719	−.841	−1.074	−1.275	−1.325	−1.261	−.847	−.715	−.683
49	34.96	9.90	.035	.028	.003	−.196	−.281	−.385	−.475	−.597	−.686	−.794	−.984	−1.146	−1.135	−1.038	−.704	−.704	−.676
20	39.90	9.84	−.015	−.012	−.033	−.202	−.281	−.371	−.446	−.554	−.633	−.726	−.877	−1.006	−.948	−.846	−.656	−.686	−.661
50	44.80	9.64	−.073	−.062	−.066	−.220	−.292	−.371	−.439	−.532	−.597	−.676	−.801	−.895	−.787	−.687	−.608	−.683	−.661
21	49.92	9.22	−.098	−.076	−.066	−.202	−.263	−.328	−.389	−.468	−.521	−.586	−.686	−.755	−.615	−.560	−.592	−.668	−.658
51	54.92	8.76	−.130	−.094	−.069	−.191	−.245	−.302	−.353	−.417	−.464	−.514	−.597	−.636	−.485	−.496	−.576	−.676	−.661
22	59.94	8.16	−.170	−.127	−.087	−.191	−.241	−.292	−.335	−.396	−.420	−.471	−.525	−.543	−.396	−.432	−.545	−.672	−.661
52	64.90	7.54	−.206	−.148	−.087	−.184	−.224	−.267	−.299	−.351	−.374	−.414	−.446	−.446	−.328	−.401	−.529	−.679	−.665
23	69.86	6.76	−.227	−.155	−.080	−.163	−.196	−.231	−.256	−.299	−.313	−.346	−.363	−.342	−.281	−.337	−.496	−.668	−.661
24	74.90	5.88	−.249	−.159	−.066	−.130	−.159	−.188	−.206	−.238	−.249	−.274	−.274	−.238	−.249	−.305	−.496	−.661	−.654
53	79.92	4.92	−.277	−.173	−.055	−.109	−.130	−.148	−.159	−.184	−.191	−.206	−.191	−.155	−.231	−.273	−.464	−.651	−.651
25	84.88	3.88	−.303	−.190	−.033	−.009	−.064	−.098	−.102	−.116	−.116	−.123	−.098	−.087	−.206	−.273	−.464	−.625	−.636
54	89.88	2.74	−.317	−.177	.010	−.015	−.023	−.026	−.026	−.033	−.026	−.030	−.008	−.041	−.191	−.258	−.449	−.597	−.622
26	94.90	1.48	−.335	−.177	.060	.056	.060	.060	.071	.067	.084	.064	.067	−.012	−.173	−.242	−.401	−.550	−.586
27	98.00	.68	−.396	−.195	.103	.117	.124	.128	.135	.132	.135	.121	.096	.003	−.163	−.226	−.353	−.529	−.572
28	100.00	0	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

a Test, variable-density tunnel 1099–2; manometer liquid, tetrabromoethane.
b Test, variable-density tunnel 1096–1; manometer liquid, mercury.

TABLE Ig.—EXPERIMENTAL DATA

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 6,300,000; test numbers and manometer liquids given in footnotes]

Orifices			Values of pressure coefficient, $P=\frac{p-p_\infty}{q}$, for different angles of attack																
Designation	Station (percent c from L. E. of chord)	Ordinate (percent c above chord)	−20°	[a] −16°	[a] −12°	[a] −8°	[b] −6°	[b] −4°	[b] −2°	[b] 0°	[b] 2°	[b] 4°	[b] 8°	[b] 12°	[a] 16°	[a] 18°	[a] 20°	[a] 24°	[a] 30°
28	100.00	0	--------	−0.106	0.207	0.234	0.208	0.208	0.205	0.196	0.186	0.167	0.181	0.063	−0.011	−0.124	−0.194	−0.588	−0.620
1	97.92	−.16	--------	−.185	.155	.146	.177	.177	.186	.181	.177	.167	.162	.128	.085	.016	−.045	−.806	−.315
29	94.86	−.16	--------	−.236	.129	.112	.145	.150	.167	.108	.171	.165	.179	.162	.155	.103	.051	−.167	−.167
2	89.90	−.22	--------	−.272	.059	.077	.118	.128	.148	.150	.168	.169	.200	.204	.216	.181	.146	−.028	−.028
30	84.94	−.28	--------	−.333	.042	.042	.078	.092	.118	.129	.143	.154	.194	.209	.251	.225	.208	.042	.059
31	74.92	−.52	--------	−.411	−.019	−.011	.044	.068	.104	.126	.150	.169	.230	.268	.312	.295	.294	.172	.198
32	64.94	−.84	--------	−.506	−.115	−.063	−.006	.027	.072	.122	.137	.164	.244	.297	.356	.355	.373	.268	.303
3	54.48	−1.24	--------	−.620	−.202	−.141	−.071	−.025	.030	.072	.114	.152	.251	.322	.390	.408	.425	.355	.399
33	49.98	−1.44	--------	−.628	−.254	−.176	−.105	−.056	.003	.048	.100	.150	.258	.333	.416	.425	.451	.416	.452
4	44.90	−1.64	--------	−.725	−.306	−.228	−.134	−.076	−.008	.046	.100	.152	.271	.341	.452	.468	.504	.425	.468
34	39.98	−1.86	--------	−.776	−.359	−.272	−.177	−.118	−.085	.027	.087	.142	.276	.375	.495	.521	.530	.477	.512
5	34.90	−2.10	--------	−.829	−.455	−.333	−.225	−.149	−.064	.010	.078	.142	.289	.390	.512	.588	.504	.521	.564
35	29.96	−2.30	--------	−.890	−.559	−.408	−.282	−.194	−.096	−.014	.066	.138	.304	.426	.547	.582	.617	.564	.608
6	24.90	−2.54	--------	−.934	−.690	−.515	−.377	−.273	−.155	−.057	.037	.124	.311	.452	.599	.625	.669	.617	.660
36	19.98	−2.76	--------	−.985	−.899	−.664	−.490	−.372	−.231	−.113	.002	.102	.320	.484	.652	.686	.721	.669	.721
7	14.94	−2.90	--------	−1.055	−1.186	−.881	−.676	−.511	−.334	−.184	−.048	.077	.348	.537	.713	.756	.800	.739	.782
37	9.96	−2.86	--------	−1.117	−1.700	−1.221	−.975	−.722	−.482	−.282	−.113	.059	.394	.630	.826	.852	.896	.848	.869
8	7.38	−2.72	--------	−1.266	−2.110	−1.482	−1.159	−.869	−.585	−.347	−.126	.081	.467	.732	.918	.930	.965	.918	.930
38	4.94	−2.46	--------	−1.379	−2.790	−1.951	−1.508	−1.122	−.765	−.432	−.143	.116	.569	.838	.991	.991	1.000	.930	.965
9	2.92	−2.06	--------	−1.935	−3.825	−2.589	−1.992	−1.466	−.935	−.475	−.006	.234	.745	.973	1.000	.922	.852	.801	.904
39	1.66	−1.60	--------	−3.000	−5.070	−3.400	−2.493	−1.731	−1.029	−.430	.087	.413	.916	1.008	.800	.582	.390	.521	.634
10	.92	−1.20	--------	−4.520	−6.510	−3.965	−2.825	−1.840	−.966	−.259	.264	.649	1.015	.665	.225	−.202	−.611	−.236	.050
40	.36	−.70	--------	−5.600	−7.400	−4.210	−2.770	−1.599	−.603	.154	.653	.935	.918	.120	−1.379	−2.222	−3.016	−2.100	−1.342
11	0	0	--------	−4.410	−5.460	−2.485	−1.286	−.341	.892	.830	1.004	.971	.185	−1.530	−4.035	−5.880	−6.530	−4.855	−3.225
41	0	.08	--------	−2.810	−2.660	−.608	.164	.607	.958	1.010	.868	.409	−.989	−3.278	−6.257	−7.755	−9.080	−6.080	−4.363
12	.44	1.56	--------	−.036	−.071	.780	.949	1.008	.950	.726	.862	−.159	−1.700	−3.762	−6.261	−7.475	−8.430	−5.800	−3.730
42	.94	2.16	--------	.582	.617	.922	1.006	.948	.771	.459	.072	−.436	−1.798	−3.423	−5.420	−6.255	−6.820	−4.770	−2.482
13	1.70	2.78	--------	.896	.918	.965	.935	.794	.507	.245	−.128	−.593	−1.744	−3.072	−4.590	−5.270	−5.725	−3.790	−1.671
43	2.94	3.64	--------	1.000	1.000	.887	.758	.573	.327	.017	−.319	−.711	−1.680	−2.658	−3.818	−4.340	−4.655	−2.850	−1.001
14	4.90	4.68	--------	.956	.913	.695	.589	.341	.101	−.189	−.486	−.880	−1.544	−2.360	−3.250	−3.642	−3.820	−2.080	−.760
44	7.50	5.74	--------	.826	.705	.486	.344	.156	−.008	−.316	−.559	−.824	−1.424	−2.070	−2.763	−3.050	−3.148	−1.585	−.723
15	9.96	6.56	--------	.721	.626	.347	.204	.028	−.181	−.406	−.616	−.874	−1.391	−1.983	−2.492	−2.720	−2.763	−1.264	−.705
45	12.58	7.34	--------	.608	.495	.216	.084	−.086	−.278	−.480	−.668	−.905	−1.369	−1.860	−2.284	−2.476	−2.400	−1.125	−.705
16	14.92	7.88	--------	.529	.416	.138	.005	−.155	−.326	−.515	−.690	−.806	−1.311	−1.728	−2.128	−2.285	−2.240	−1.064	−.705
46	17.44	8.40	--------	.448	.312	.051	−.061	−.208	−.368	−.543	−.710	−.902	−1.272	−1.644	−1.989	−2.129	−2.050	−.985	−.699
17	19.96	8.80	--------	.378	.234	−.010	−.120	−.261	−.410	−.574	−.726	−.902	−1.237	−1.571	−1.874	−1.989	−1.875	−.925	−.688
47	22.44	9.16	--------	.312	.164	−.072	−.181	−.314	−.460	−.612	−.759	−.919	−1.230	−1.528	−1.770	−1.875	−1.752	−.908	−.680
18	24.92	9.52	--------	.251	.112	−.106	−.206	−.324	−.463	−.606	−.736	−.886	−1.170	−1.441	−1.665	−1.752	−1.570	−.865	−.680
48	27.44	9.62	--------	.207	.077	−.132	−.232	−.353	−.475	−.610	−.734	−.871	−1.128	−1.309	−1.560	−1.640	−1.422	−.840	−.688
19	29.88	9.76	--------	.164	.051	−.158	−.250	−.300	−.475	−.599	−.713	−.840	−1.075	−1.293	−1.466	−1.526	−1.282	−.829	−.680
49	34.98	9.90	--------	.108	−.002	−.176	−.280	−.377	−.476	−.587	−.681	−.794	−.988	−1.164	−1.281	−1.309	−1.021	−.795	−.671
20	39.90	9.84	--------	.042	−.045	−.211	−.280	−.366	−.452	−.546	−.627	−.723	−.882	−1.027	−1.125	−1.126	−.820	−.777	−.688
50	44.80	9.64	--------	−.002	−.088	−.219	−.295	−.368	−.442	−.520	−.503	−.677	−.806	−.920	−.969	−.951	−.673	−.760	−.688
21	49.92	9.22	--------	−.011	−.088	−.219	−.263	−.328	−.301	−.461	−.515	−.585	−.694	−.779	−.811	−.777	−.585	−.750	−.688
51	54.92	8.76	--------	−.028	−.097	−.202	−.244	−.299	−.350	−.414	−.458	−.519	−.602	−.666	−.672	−.629	−.515	−.750	−.688
22	59.94	8.16	--------	−.068	−.124	−.211	−.244	−.294	−.335	−.391	−.425	−.471	−.536	−.582	−.568	−.524	−.472	−.750	−.688
52	64.90	7.54	--------	−.080	−.115	−.185	−.219	−.261	−.296	−.339	−.368	−.410	−.458	−.480	−.437	−.411	−.420	−.734	−.688
23	69.86	6.76	--------	−.088	−.106	−.158	−.190	−.223	−.250	−.288	−.307	−.340	−.372	−.377	−.332	−.333	−.376	−.707	−.680
24	74.90	5.88	--------	−.097	−.080	−.115	−.155	−.181	−.200	−.228	−.245	−.267	−.282	−.272	−.223	−.272	−.359	−.707	−.688
53	79.92	4.92	--------	−.097	−.080	−.098	−.122	−.141	−.152	−.174	−.181	−.198	−.198	−.179	−.158	−.246	−.333	−.690	−.680
25	84.88	3.88	--------	−.100	−.086	−.054	−.076	−.088	−.094	−.106	−.107	−.116	−.105	−.090	−.106	−.202	−.306	−.664	−.671
54	89.88	2.74	--------	−.097	.007	−.002	−.012	−.015	−.016	−.021	−.016	−.022	−.010	−.017	−.071	−.176	−.289	−.629	−.653
26	94.90	1.48	--------	−.106	.077	.077	.068	.072	.078	.076	.064	.080	.076	.080	−.036	−.150	−.254	−.576	−.628
27	98.00	.08	--------	−.132	.112	.155	.135	.141	.148	.146	.148	.137	.116	.055	−.028	−.150	−.219	−.542	−.610
28	100.00	0	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

[a] Test, variable-density tunnel 1096-2; manometer liquid, mercury.
[b] Test, variable-density tunnel 1099-3; manometer liquid, tetrabromoethane.

TABLE Ib.—EXPERIMENTAL DATA

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 8,200,000; test numbers and manometer liquids given in footnotes]

Designation	Orifices		Values of pressure coefficient, $P=\frac{p-p_\infty}{q}$, for different angles of attack																		
	Station (percent c from L. E. of chord)	Ordinate (percent c above chord)	a −20°	a −16°	a −12°	a −8°	b −6°	b −4°	b −2°	b 0°	b 2°	b 4°	b 8°	a 12°	a 16°	a 18°	a 20°	a 24°	a 30°
28	100.00	0	−0.421	−0.199	0.114	0.198	0.217	0.204	0.207	0.200	0.181	0.158	0.134	0.101	0.010	−0.062	−0.173	−0.466	−0.518
1	97.92	−.16	−.454	−.251	.159	.224	.181	.178	.180	.188	.164	.157	.167	.140	.121	.094	.049	−.291	−.304
29	94.86	−.16	−.466	−.291	.107	.185	.152	.151	.158	.166	.154	.156	.180	.166	.179	.166	.127	−.160	−.167
2	89.90	−.22	−.505	−.330	.074	.153	.122	.128	.140	.156	.152	.160	.208	.199	.231	.237	.224	−.030	−.086
30	84.94	−.28	−.538	−.382	.035	.107	.072	.082	.098	.118	.118	.158	.211	.212	.257	.270	.288	.049	.042
31	74.92	−.52	−.558	−.454	−.043	.055	.049	.068	.095	.126	.136	.158	.231	.251	.322	.348	.374	.179	.179
32	64.94	−.84	−.564	−.539	−.101	.002	.000	.028	.062	.104	.120	.154	.244	.283	.374	.407	.453	.270	.289
3	54.48	−1.24	−.571	−.643	−.199	−.082	−.063	−.024	.021	.072	.100	.157	.250	.309	.414	.452	.492	.348	.368
33	49.98	−1.44	−.571	−.695	−.252	−.115	−.099	−.053	−.005	.050	.091	.134	.252	.316	.426	.472	.531	.381	.407
4	44.90	−1.64	−.571	−.721	−.304	−.160	−.128	−.075	−.017	.048	.088	.140	.268	.342	.459	.505	.570	.413	.446
34	39.98	−1.86	−.558	−.754	−.368	−.206	−.169	−.105	−.041	.031	.071	.136	.265	.362	.485	.544	.609	.466	.498
5	34.90	−2.10	−.551	−.773	−.447	−.258	−.217	−.146	−.073	.010	.066	.133	.290	.387	.516	.576	.642	.504	.544
35	29.96	−2.30	−.545	−.786	−.545	−.330	−.274	−.190	−.105	−.011	.048	.116	.293	.414	.551	.609	.687	.557	.596
6	24.90	−2.54	−.545	−.806	−.688	−.427	−.367	−.266	−.165	−.054	.025	.115	.318	.433	.589	.661	.726	.609	.648
36	19.98	−2.76	−.551	−.819	−.896	−.591	−.490	−.365	−.244	−.111	−.011	.093	.321	.472	.627	.687	.752	.642	.700
7	14.94	−2.90	−.558	−.825	−1.178	−.799	−.663	−.502	−.348	−.180	−.053	.076	.346	.518	.713	.785	.857	.733	.778
37	9.96	−2.86	−.551	−.832	−1.660	−1.143	−.946	−.716	−.501	−.279	−.111	.059	.402	.616	.818	.883	.948	.824	.876
8	7.38	−2.72	−.577	−.916	−2.070	−1.407	−1.153	−.867	−.596	−.333	−.131	.071	.462	.713	.896	.961	1.019	.902	.941
38	4.94	−2.46	−.571	−.897	−2.807	−1.861	−1.490	−1.106	−.777	−.428	−.150	.109	.568	.818	.980	1.013	1.046	.948	.980
9	2.92	−2.06	−.702	−1.242	−3.745	−2.468	−1.931	−1.380	−.932	−.467	−.098	.231	.748	.948	.993	.948	.909	.883	.941
39	1.66	−1.60	−1.058	−1.947	−4.940	−3.198	−2.478	−1.709	−1.059	−.436	.028	.409	.916	.974	.791	.596	.433	.602	.713
10	.92	−1.20	−2.082	−3.212	−6.177	−3.770	−2.765	−1.812	−.995	−.266	.254	.643	1.018	.831	.264	−.173	−.518	.003	.244
40	.36	−.70	−3.204	−4.300	−7.337	−4.052	−2.732	−1.559	−.631	.156	.639	.924	.905	.094	−1.379	−2.285	−3.012	−1.671	−1.059
11	0	0	−2.623	−3.433	−5.480	−2.397	−1.232	−.296	.356	.834	.989	.952	.157	−1.555	−3.648	−5.060	−6.073	−3.695	−2.382
41	0	.68	−1.178	−1.549	−2.625	−.538	.184	.681	.945	1.010	.854	.473	−1.000	−3.250	−6.230	−7.775	−8.941	−5.660	−3.730
12	.44	1.56	.322	.231	−.043	.765	.955	.994	.948	.720	.336	−.202	−1.740	−3.738	−5.961	−7.125	−7.954	−4.698	−2.552
42	.94	2.16	.739	.720	.596	.974	1.009	.939	.770	.468	.055	−.456	−1.793	−3.399	−5.210	−6.110	−6.681	−3.881	−2.006
13	1.70	2.78	.928	.935	.883	1.000	.989	.782	.569	.246	−.148	−.611	−1.743	−3.053	−4.478	−5.190	−5.620	−3.010	−1.249
43	2.94	3.64	.987	1.000	.974	.896	.761	.559	.382	.018	−.336	−.728	−1.647	−2.637	−3.765	−4.285	−4.562	−2.200	−.786
14	4.90	4.68	.922	.985	.896	.713	.542	.333	.110	−.179	−.485	−.813	−1.547	−2.343	−3.190	−3.570	−3.731	−1.529	−.695
44	7.50	5.74	.804	.798	.752	.498	.344	.139	−.066	−.312	−.568	−.831	−1.432	−2.057	−2.709	−2.981	−3.060	−1.235	−.644
15	9.96	6.56	.687	.687	.622	.374	.208	.017	−.168	−.388	−.623	−.872	−1.391	−1.912	−2.440	−2.662	−2.681	−1.059	−.630
45	12.58	7.34	.583	.576	.498	.263	.089	−.091	−.271	−.468	−.676	−.899	−1.350	−1.802	−2.240	−2.415	−2.382	−1.007	−.611
16	14.92	7.88	.498	.485	.407	.178	.014	−.152	−.309	−.500	−.700	−.912	−1.306	−1.769	−2.149	−2.285	−2.180	−.955	−.604
46	17.44	8.40	.414	.407	.329	.100	−.052	−.210	−.360	−.537	−.721	−.910	−1.272	−1.620	−1.952	−2.062	−1.984	−.910	−.604
17	19.96	8.80	.335	.335	.257	.036	−.111	−.262	−.402	−.568	−.740	−.914	−1.239	−1.548	−1.841	−1.927	−1.815	−.870	−.598
47	22.44	9.16	.263	.257	.172	−.024	−.176	−.322	−.452	−.609	−.769	−.930	−1.224	−1.502	−1.758	−1.822	−1.685	−.851	−.591
18	24.92	9.52	.212	.211	.140	−.063	−.196	−.332	−.454	−.599	−.746	−.895	−1.163	−1.418	−1.640	−1.692	−1.592	−.825	−.591
48	27.44	9.62	.166	.165	.100	−.096	−.228	−.355	−.471	−.606	−.742	−.881	−1.122	−1.347	−1.535	−1.573	−1.391	−.812	−.591
19	29.88	9.76	.114	.133	.068	−.114	−.241	−.364	−.469	−.594	−.722	−.851	−1.071	−1.280	−1.438	−1.463	−1.254	−.786	−.591
49	34.98	9.90	.036	.055	.009	−.154	−.275	−.381	−.473	−.596	−.693	−.804	−.962	−1.144	−1.269	−1.255	−1.005	−.760	−.591
20	39.90	9.84	−.017	.009	−.030	−.178	−.272	−.370	−.447	−.542	−.635	−.732	−.880	−1.007	−1.099	−1.059	−.798	−.727	−.584
50	44.80	9.64	−.095	−.044	−.069	−.194	−.291	−.371	−.439	−.519	−.609	−.691	−.809	−.902	−.961	−.910	−.655	−.720	−.591
21	49.92	9.22	−.121	−.056	−.075	−.173	−.256	−.329	−.389	−.455	−.525	−.595	−.690	−.759	−.786	−.734	−.538	−.715	−.591
51	54.92	8.76	−.147	−.069	−.075	−.161	−.238	−.303	−.351	−.406	−.471	−.527	−.601	−.649	−.649	−.584	−.473	−.700	−.591
22	59.94	8.16	−.199	−.101	−.095	−.161	−.244	−.298	−.342	−.391	−.438	−.487	−.541	−.576	−.551	−.480	−.414	−.695	−.591
52	64.90	7.54	−.225	−.108	−.082	−.128	−.214	−.264	−.296	−.334	−.378	−.421	−.456	−.460	−.414	−.343	−.369	−.688	−.591
23	69.86	6.76	−.252	−.121	−.082	−.115	−.181	−.225	−.250	−.282	−.319	−.351	−.371	−.375	−.316	−.264	−.337	−.682	−.584
24	74.90	5.88	−.277	−.128	−.056	−.082	−.148	−.183	−.200	−.222	−.252	−.279	−.285	−.264	−.212	−.212	−.310	−.655	−.584
53	79.92	4.92	−.297	−.147	−.069	−.076	−.115	−.144	−.155	−.169	−.191	−.210	−.199	−.190	−.147	−.178	−.291	−.642	−.578
25	84.88	3.88	−.330	−.154	−.024	−.024	−.066	−.091	−.094	−.101	−.116	−.113	−.106	−.082	−.082	−.140	−.271	−.604	−.565
54	89.88	2.74	−.356	−.161	.022	.028	−.006	−.019	−.016	−.017	−.026	−.032	−.009	−.004	−.043	−.114	−.246	−.565	−.562
26	94.90	1.48	−.388	−.174	.075	.100	.073	.060	.078	.082	.076	.070	.079	.062	−.016	−.096	−.226	−.519	−.519
27	98.00	.68	−.454	−.200	.127	.165	.141	.139	.147	.150	.143	.127	.120	.088	−.004	−.075	−.200	−.479	−.506
28	100.00	0	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

a Test, variable-density tunnel 1098; manometer liquid, mercury.
b Test, variable-density tunnel 1099-4; manometer liquid, tetrabromoethane.

TABLE IIa.—INTEGRATED AND DERIVED CHARACTERISTICS

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 100,000]

α (deg.)	c_n	c_c	$c_{m_{c/4}}$	c_l	α_i (deg.)	α_0 (deg.)
−20	−0.479	0.0916	0.023	−0.418	−0.7	−19.3
−16	−.425	.0864	.016	−.354	−.6	−15.4
−12	−.491	.0671	.025	−.466	−.7	−11.3
−8	−.504	.0238	−.028	−.496	−.8	−7.2
−6	−.370	.0050	−.061	−.367	−.6	−5.4
−4	−.191	.0118	−.067	−.191	−.3	−3.7
−2	.025	.0227	−.080	.026	0	−2.0
0	.317	.0240	−.114	.317	.5	−.5
2	.522	.0093	−.106	.521	.8	1.2
4	.722	−.0166	−.108	.721	1.1	2.9
8	1.061	−.0954	−.089	1.064	1.7	6.3
12	1.224	−.1855	−.063	1.238	2.0	10.0
16	1.229	−.2060	−.058	1.238	2.0	14.0
18	1.011	−.0600	−.114	.980	1.6	16.4
20	.916	−.0093	−.127	.864	1.4	18.6
24	.874	.0070	−.127	.795	1.3	22.7
30	.948	.0062	−.143	.818	1.3	28.7

TABLE IIb.—INTEGRATED AND DERIVED CHARACTERISTICS

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 240,000]

α (deg.)	c_n	c_c	$c_{m_{c/4}}$	c_l	α_i (deg.)	α_0 (deg.)
−20	−0.428	0.0896	0.013	−0.371	−0.6	−19.4
−16	−.425	.0852	.020	−.384	−.6	−15.4
−12	−.464	.0670	.019	−.440	−.7	−11.3
−8	−.422	.0215	−.049	−.415	−.7	−7.3
−6	−.236	.0000	−.085	−.234	−.4	−5.6
−4	−.045	.0112	−.095	−.046	−.1	−3.9
−2	.161	.0186	−.104	.162	.3	−2.3
0	.350	.0151	−.104	.350	.6	−.6
2	.522	.0032	−.100	.521	.8	1.2
4	.690	−.0210	−.093	.690	1.1	2.9
8	.999	−.0968	−.082	1.000	1.6	6.4
12	1.242	−.1921	−.064	1.256	2.0	10.0
16	1.281	−.2410	−.052	1.299	2.1	13.9
18	1.129	−.1134	−.106	1.108	1.8	16.2
20	.953	−.0162	−.134	.901	1.4	18.6
24	.891	.0086	−.137	.810	1.3	22.7
30	.983	.0061	−.143	.809	1.3	28.7

TABLE IIc.—INTEGRATED AND DERIVED CHARACTERISTICS

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 450,000]

α (deg.)	c_n	c_c	$c_{m_{c/4}}$	c_l	α_i (deg.)	α_0 (deg.)
−20	−0.440	0.0912	0.014	−0.353	−0.6	−19.4
−16	−.425	.0844	.023	−.385	−.6	−15.4
−12	−.483	.0655	.013	−.458	−.7	−11.3
−8	−.335	.0051	−.086	−.331	−.5	−7.5
−6	−.172	−.0044	−.102	−.172	−.3	−5.7
−4	.001	.0079	−.103	.002	0	−4.0
−2	.170	.0148	−.099	.171	.3	−2.3
0	.349	.0113	−.096	.349	.6	−.6
2	.520	−.0008	−.093	.520	.8	1.2
4	.704	−.0244	−.092	.704	1.1	2.9
8	1.014	−.0978	−.080	1.018	1.6	6.4
12	1.225	−.1922	−.062	1.239	2.0	10.0
16	1.243	−.2432	−.048	1.261	2.0	14.0
18	1.156	−.1677	−.086	1.152	1.8	16.2
20	1.023	−.0378	−.135	.975	1.5	18.5
24	.906	.0091	−.139	.824	1.3	22.7
30	.948	.0073	−.149	.817	1.3	28.7

TABLE IId.—INTEGRATED AND DERIVED CHARACTERISTICS

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 900,000]

α (deg.)	c_n	c_c	$c_{m_{c/4}}$	c_l	α_i (deg.)	α_0 (deg.)
−20	−0.442	0.0900	0.018	−0.384	−0.6	−19.4
−16	−.437	.0856	.025	−.396	−.6	−15.4
−12	−.494	.0634	.011	−.470	−.7	−11.3
−8	−.342	−.0199	−.096	−.341	−.5	−7.5
−6	−.190	−.0098	−.096	−.190	−.3	−5.7
−4	−.008	.0051	−.100	−.008	0	−4.0
−2	.162	.0122	−.096	.162	.3	−2.3
0	.344	.0108	−.097	.344	.5	−.5
2	.521	−.0033	−.093	.520	.8	1.2
4	.696	−.0248	−.092	.696	1.1	2.9
8	1.000	−.0990	−.082	1.004	1.6	6.4
12	1.231	−.1948	−.063	1.244	2.0	10.0
16	1.290	−.2587	−.059	1.311	2.1	13.9
18	1.231	−.2360	−.076	1.244	2.0	16.0
20	1.093	−.0747	−.131	1.054	1.7	18.3
24	.938	.0077	−.143	.853	1.4	22.6
30	.934	.0074	−.142	.906	1.3	28.7

TABLE IIe.—INTEGRATED AND DERIVED CHARACTERISTICS

[N. A. C. A. 4412 airfoil; effective Reynolds Number 1,800,000]

α (deg.)	c_n	c_c	$c_{m_{c/4}}$	c_l	α_i (deg.)	α_0 (deg.)
−20						
−16	−0.582	0.0646	0.016	−0.542	−0.9	−15.1
−12	−.640	−.0659	−.069	−.640	−1.0	−11.0
−8	−.368	−.0407	−.101	−.370	−.6	−7.4
−6	−.182	−.0124	−.099	−.182	−.3	−5.7
−4	−.009	.0045	−.100	−.009	0	−4.0
−2	.170	.0117	−.098	.170	.3	−2.3
0	.360	.0085	−.097	.360	.6	−.6
2	.531	−.0047	−.094	.530	.8	1.2
4	.705	−.0288	−.092	.705	1.1	2.9
8	1.015	−.1026	−.081	1.019	1.6	6.4
12	1.277	−.2014	−.066	1.291	2.0	10.0
16	1.374	−.2672	−.058	1.396	2.2	13.8
18	1.335	−.2768	−.084	1.356	2.2	15.8
20	1.199	−.2284	−.099	1.204	1.9	18.1
24	1.198	−.1138	−.167	1.140	1.8	22.2
30	.950	.0080	−.149	.826	1.3	28.7

TABLE IIf.—INTEGRATED AND DERIVED CHARACTERISTICS

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 3,400,000]

α (deg.)	c_n	c_c	$c_{m_{c/4}}$	c_l	α_i (deg.)	α_0 (deg.)
−20	−0.713	0.0411	0.028	−0.656	−1.0	−19.0
−16	−.761	.0058	.009	−.730	−1.2	−14.8
−12	−.725	−.1204	−.105	−.734	−1.2	−10.8
−8	−.395	−.0405	−.098	−.397	−.6	−7.4
−6	−.197	−.0128	−.096	−.194	−.3	−5.7
−4	−.031	.0030	−.095	−.031	0	−4.0
−2	.148	.0104	−.094	.148	.2	−2.2
0	.341	.0086	−.094	.341	.5	−.5
2	.521	−.0040	−.089	.520	.8	1.2
4	.691	−.0253	−.090	.692	1.1	2.9
8	.994	−.0933	−.078	.997	1.6	6.4
12	1.275	−.2034	−.060	1.290	2.0	10.0
16	1.456	−.3171	−.059	1.488	2.4	13.6
18	1.547	−.3585	−.079	1.581	2.5	15.5
20	1.470	−.3292	−.119	1.495	2.4	17.6
24	1.165	−.1408	−.150	1.121	1.8	22.2
30	1.150	−.1015	−.160	1.046	1.7	28.3

TABLE IIg.—INTEGRATED AND DERIVED CHARACTERISTICS

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 6,300,000]

α (deg.)	c_n	c_c	$c_{m_{c/4}}$	c_l	α_i (deg.)	α_0 (deg.)
−20						
−16	−0.869	−0.0497	0.026	−0.849	−1.3	−14.7
−12	−.712	−.1245	−.103	−.722	−1.1	−10.9
−8	−.410	−.0417	−.069	−.412	−.7	−7.3
−6	−.209	−.0155	−.094	−.210	−.3	−5.7
−4	−.036	.0029	−.093	−.036	0	−4.0
−2	.157	.0118	−.092	.157	.2	−2.2
0	.333	.0079	−.091	.333	.5	−.5
2	.501	−.0034	−.067	.500	.8	1.2
4	.674	−.0256	−.086	.674	1.1	2.9
8	1.002	−.0998	−.080	1.006	1.6	6.4
12	1.300	−.2126	−.073	1.315	2.1	9.9
16	1.550	−.3410	−.064	1.584	2.5	13.5
18	1.633	−.4020	−.067	1.678	2.7	15.3
20	1.605	−.4425	−.061	1.661	2.6	17.4
24	1.300	−.2329	−.143	1.283	2.0	22.0
30	1.111	−.1019	−.171	1.014	1.6	28.4

TABLE IIh.—INTEGRATED AND DERIVED CHARACTERISTICS

[N. A. C. A. 4412 airfoil; effective Reynolds Number, 8,200,000]

α (deg.)	c_n	c_c	$c_{m_{c/4}}$	c_l	α_i (deg.)	α_0 (deg.)
−20	−0.592	0.0318	0.030	−0.545	−0.9	−19.1
−16	−.767	−.0170	.036	−.742	−1.2	−14.8
−12	−.722	−.1264	−.092	−.732	−1.2	−10.8
−8	−.372	−.0445	−.096	−.374	−.6	−7.4
−6	−.210	−.0151	−.096	−.211	−.3	−5.7
−4	−.026	.0043	−.095	−.026	0	−4.0
−2	.146	.0107	−.092	.146	.2	−2.2
0	.338	.0098	−.091	.338	.5	−.5
2	.501	−.0034	−.087	.501	.8	1.2
4	.677	−.0258	−.087	.677	1.1	2.9
8	1.020	−.1003	−.084	1.024	1.6	6.4
12	1.275	−.2043	−.074	1.289	2.0	10.0
16	1.548	−.3357	−.068	1.579	2.5	13.5
18	1.626	−.4040	−.063	1.671	2.6	15.4
20	1.640	−.4374	−.080	1.690	2.7	17.3
24	1.212	−.1838	−.141	1.182	1.9	22.1
30	1.009	−.0776	−.146	.913	1.4	28.6