NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

REPORT No. 628

AERODYNAMIC CHARACTERISTICS OF A LARGE NUMBER OF AIRFOILS TESTED IN THE VARIABLE-DENSITY WIND TUNNEL

By ROBERT M. PINKERTON and HARRY GREENBERG

1938

AERONAUTIC SYMBOLS

1. FUNDAMENTAL AND DERIVED UNITS

	Symbol	Metric		English	
		Unit	Abbreviation	Unit	Abbreviation
Length	l	meter	m	foot (or mile)	ft. (or mi.)
Time	t	second	sec.	second (or hour)	sec. (or hr.)
Force	F	weight of 1 kilogram	kg	weight of 1 pound	lb.
Power	P	horsepower (metric)		horsepower	hp.
Speed	V	kilometers per hour	k.p.h.	miles per hour	m.p.h.
		meters per second	m.p.s.	feet per second	f.p.s.

2. GENERAL SYMBOLS

W, Weight $= mg$

g, Standard acceleration of gravity $= 9.80665$ m/s^2 or 32.1740 ft./sec.^{2}

m, Mass $= \frac{W}{g}$

I, Moment of inertia $= mk^2$. (Indicate axis of radius of gyration k by proper subscript.)

μ, Coefficient of viscosity

ν, Kinematic viscosity

ρ, Density (mass per unit volume)

Standard density of dry air, 0.12497 kg-m^{-4}-s^2 at 15° C. and 760 mm; or 0.002378 lb.-ft.$^{-4}$ sec.^{2}

Specific weight of "standard" air, 1.2255 kg/m^3 or 0.07651 lb./cu. ft.

3. AERODYNAMIC SYMBOLS

S, Area

S_w, Area of wing

G, Gap

b, Span

c, Chord

$\frac{b^2}{S}$, Aspect ratio

V, True air speed

q, Dynamic pressure $= \frac{1}{2}\rho V^2$

L, Lift, absolute coefficient $C_L = \frac{L}{qS}$

D, Drag, absolute coefficient $C_D = \frac{D}{qS}$

D_o, Profile drag, absolute coefficient $C_{D_o} = \frac{D_o}{qS}$

D_i, Induced drag, absolute coefficient $C_{D_i} = \frac{D_i}{qS}$

D_w, Parasite drag, absolute coefficient $C_{D_w} = \frac{D_w}{qS}$

C, Cross-wind force, absolute coefficient $C_C = \frac{C}{qS}$

R, Resultant force

i_w, Angle of setting of wings (relative to thrust line)

i_t, Angle of stabilizer setting (relative to thrust line)

Q, Resultant moment

Ω, Resultant angular velocity

$\frac{Vl}{\nu}$, Reynolds Number, where l is a linear dimension (e.g., for a model airfoil 3 in. chord, 100 m.p.h. normal pressure at 15° C., the corresponding number is 234,000; or for a model of 10 cm chord, 40 m.p.s., the corresponding number is 274,000)

C_p, Center-of-pressure coefficient (ratio of distance of c.p. from leading edge to chord length)

α, Angle of attack

α_o, Angle of downwash

α_{oi}, Angle of attack, infinite aspect ratio

α_i, Angle of attack, induced

α_a, Angle of attack, absolute (measured from zero-lift position)

γ, Flight-path angle

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AERODYNAMIC CHARACTERISTICS OF A LARGE NUMBER OF AIRFOILS TESTED IN THE VARIABLE-DENSITY WIND TUNNEL

By Robert M. Pinkerton and Harry Greenberg

SUMMARY

The aerodynamic characteristics of a large number of miscellaneous airfoils tested in the variable-density tunnel have been reduced to a comparable form and are published in this report for convenient reference. Plots of the standard characteristics are given for each airfoil and, in addition, the important characteristics are given in tabular form. Included also is a tabulation of important characteristics for the related airfoils reported in N. A. C. A. Report No. 460.

This report, in conjunction with N. A. C. A. Report No. 610, makes available in comparable and convenient form the aerodynamic data for airfoils tested in the variable-density tunnel since January 1, 1931.

INTRODUCTION

A large number of miscellaneous airfoils not included in the systematic investigations reported in references 1 and 2 have been tested in the variable-density tunnel. The larger part of these airfoils consists of unrelated sections, tests of which were requested by various agencies; and the results, except those published in reference 3, have not heretofore been available in published form. The rest of the airfoils consist of small groups of related sections tested to study the effects of certain local variations in shape.

One of these local shape variations involved changes of the nose shape, consisting primarily of changes of the leading-edge radius. The effects of these changes were determined by tests of modifications of the Göttingen 398 (reference 4), of the Clark Y (reference 5), and of the N. A. C. A. 2412 (unpublished). References 4 and 5 present data on the effect of sharp leading edges. The modifications to the N. A. C. A. 2412 consisted in varying the leading-edge radius from normal to zero (N. A. C. A. 2412, N. A. C. A. 15, 16, 19, and 20) and in dropping the leading edge from the normal position (N. A. C. A. 17 and 18). A second local shape variation involved the rear portion of the airfoil and consisted in reflexing the mean line. Such modifications were made on the Göttingen 398, the Boeing 106, and the N–60 sections, and the results of the tests were published in reference 6. A series of related forward-camber airfoils having reflexed mean lines was tested, and the results were published in reference 7. Another series of reflexed airfoils, for which the results have not been published, includes the N. A. C. A. 21, 23, 24, 25, 26, and 27 airfoils.

The results of these tests, including both published and unpublished data, have not heretofore been available in comparable form nor convenient for ready reference by the user. It has therefore been deemed desirable to collect these data into one report.

This report, in conjunction with reference 2, makes available, in convenient form, comparable data for sections tested in the variable-density tunnel since January 1, 1931. The important fully corrected characteristics for the miscellaneous sections described earlier and also for the sections reported in reference 1 are tabulated for easy reference. In addition to the tabulated data, plots of standard aerodynamic characteristics are presented for the miscellaneous airfoils.

TESTS AND APPARATUS

Routine airfoil tests were made in the variable-density tunnel at an effective Reynolds Number of approximately 8,000,000. Tests of some of the models were extended through the range of negative angles of attack. Airfoils for which these results were obtained are designated "inverted" sections. The duralumin models were of rectangular plan form with a 5-inch chord and a 30-inch span. A description of the tunnel, the test procedure, and the method of constructing the models is given in reference 8.

The precision of the tests and of the results is discussed in references 1 and 9.

RESULTS

The method chosen to present these results is intended to be convenient for designers. The important characteristics, fully corrected as described in references 9 and 10, are presented in tables I and II and are comparable with those given in reference 2. These important characteristics are:

$c_{l_{max}}$, the section maximum lift coefficient.

α_{l_0}, the angle of zero lift.

a_0, the section lift-curve slope.

$c_{l_{opt}}$, the optimum lift coefficient, or the section lift coefficient corresponding to $c_{d_{0_{min}}}$.

$c_{d_{0_{min}}}$, the minimum profile-drag coefficient.

$c_{m_{a.c.}}$, the pitching-moment coefficient about the section aerodynamic center.

a.c., the aerodynamic center, or the point, with respect to the airfoil section, about which the pitching-moment coefficient tends to remain constant over the range of lift coefficients between zero and maximum lift.

c.p., the position of the center of pressure in percentage of the chord behind the leading edge.

m_6, the lift-curve slope for aspect ratio 6.

A more complete description of these characteristics is presented in references 9 and 10.

Tables I and II contain these data for available sections tested in the variable-density tunnel, except those given in reference 2. Reference is made to the original publication for the airfoil results that have been previously reported.

Plots of the standard characteristics (figs. 1 to 88) are given for the miscellaneous sections (exclusive of those for the N. A. C. A. 22112, 23112, 24112, and 25112 sections, which are published in reference 7) because they are not available elsewhere. Plots for the sections in table I are given in reference 1.

LANGLEY MEMORIAL AERONAUTICAL LABORATORY,
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS,
LANGLEY FIELD, VA., *October 1, 1937.*

REFERENCES

1. Jacobs, Eastman N., Ward, Kenneth E., and Pinkerton, Robert M.: The Characteristics of 78 Related Airfoil Sections from Tests in the Variable-Density Wind Tunnel. T. R. No. 460, N. A. C. A., 1933.

2. Jacobs, Eastman N., Pinkerton, Robert M., and Greenberg, Harry: Tests of Related Forward-Camber Airfoils in the Variable-Density Wind Tunnel. T. R. No. 610, N. A. C. A., 1937.

3. Anderson, Raymond F.: The Aerodynamic Characteristics of Airfoils at Negative Angles of Attack. T. N. No. 412, N. A. C. A., 1932.

4. Jacobs, Eastman N.: Characteristics of Two Sharp-Nosed Airfoils Having Reduced Spinning Tendencies. T. N. No. 416, N. A. C. A., 1932.

5. Weick, Fred E., and Scudder, Nathan F.: The Effect on Lift, Drag, and Spinning Characteristics of Sharp Leading Edges on Airplane Wings. T. N. No. 447, N. A. C. A., 1933.

6. DeFoe, George L.: A Comparison of the Aerodynamic Characteristics of Three Normal and Three Reflexed Airfoils in the Variable-Density Wind Tunnel. T. N. No. 388, N. A. C. A., 1931.

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8. 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.

9. 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.

10. Jacobs, Eastman N., and Rhode, R. V.: Airfoil Section Characteristics as Applied to the Prediction of Air Forces and Their Distribution on Wings. T. R. No. 631 N. A. C. A., 1938.

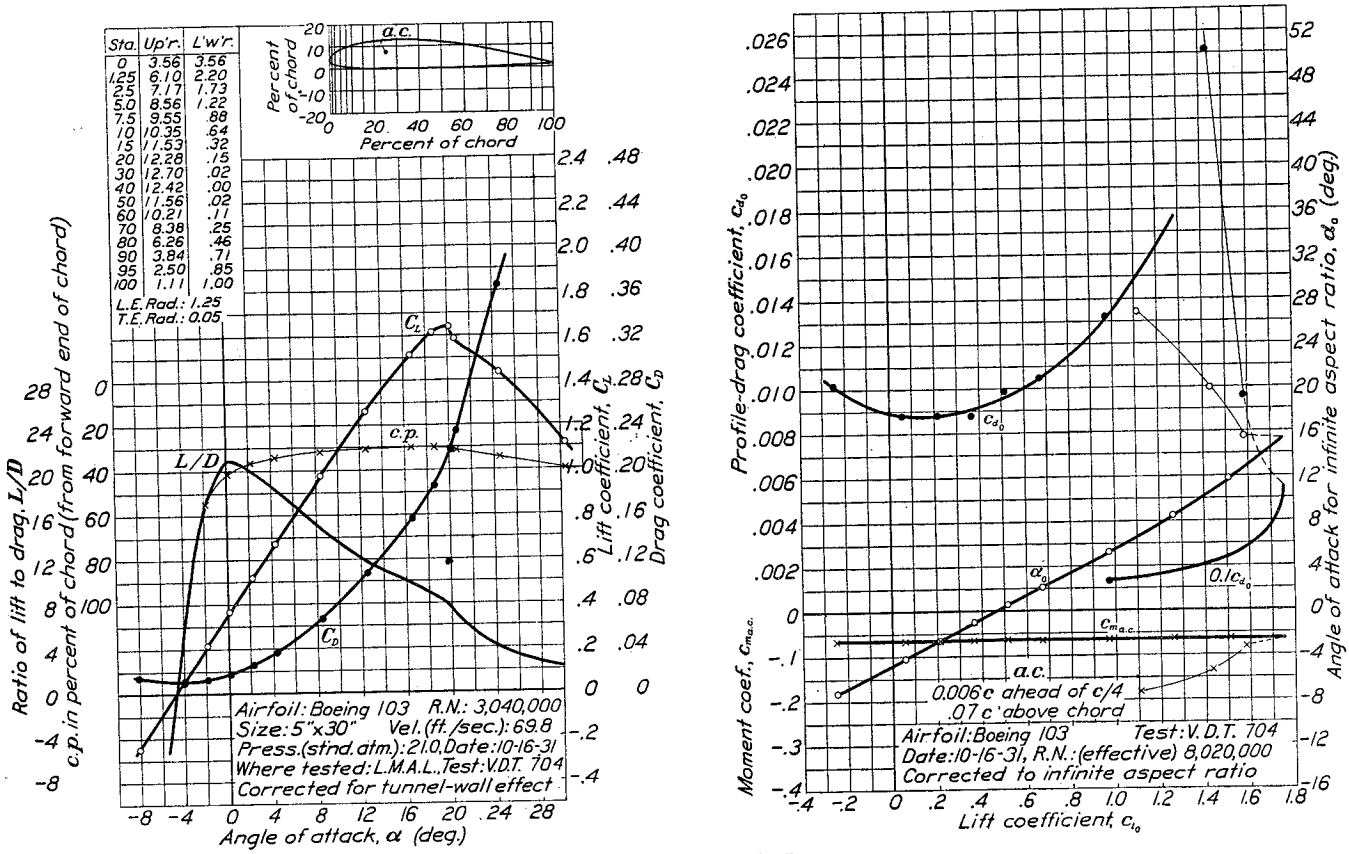


FIGURE 1.—Boeing 103 airfoil.

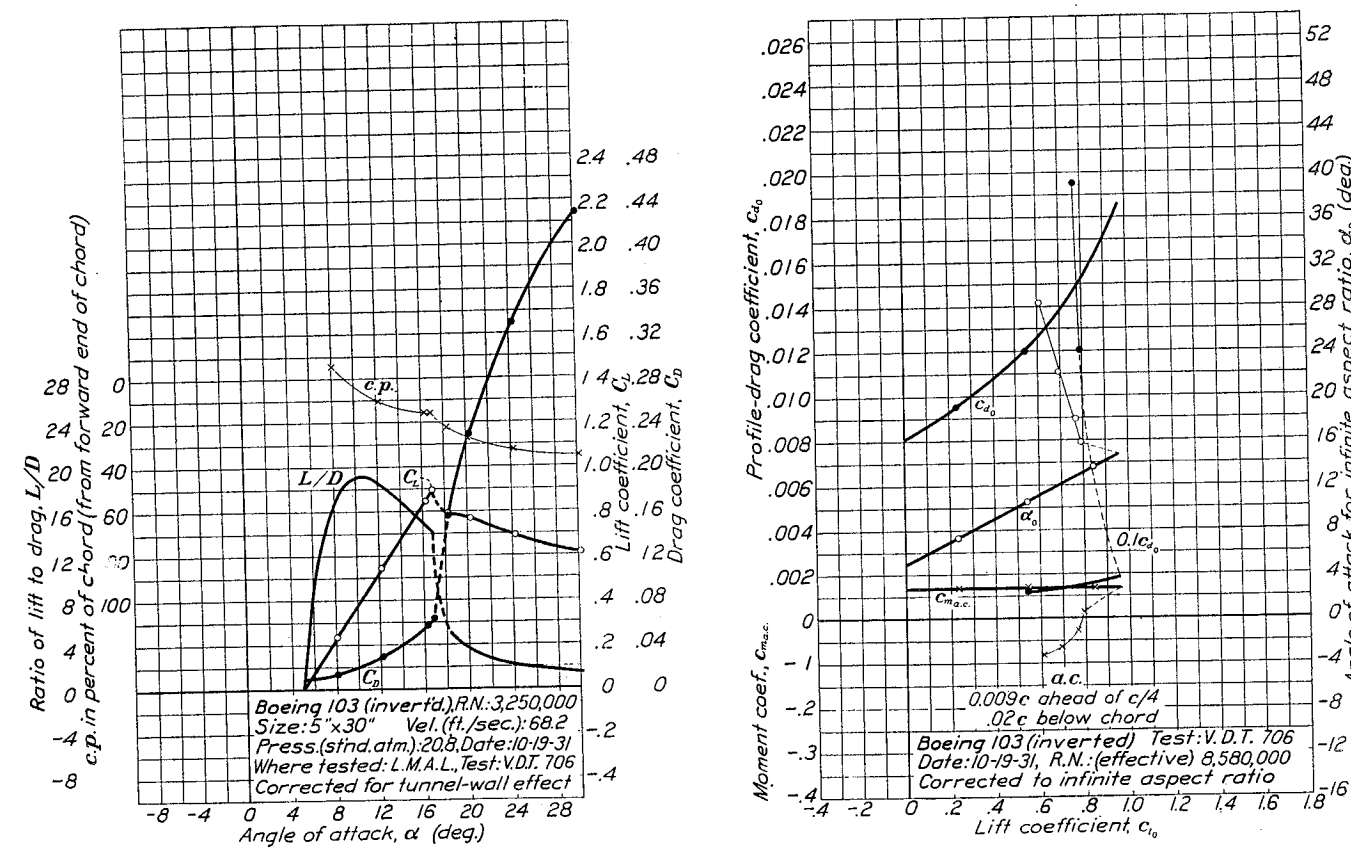


FIGURE 2.—Boeing 103 airfoil (inverted).

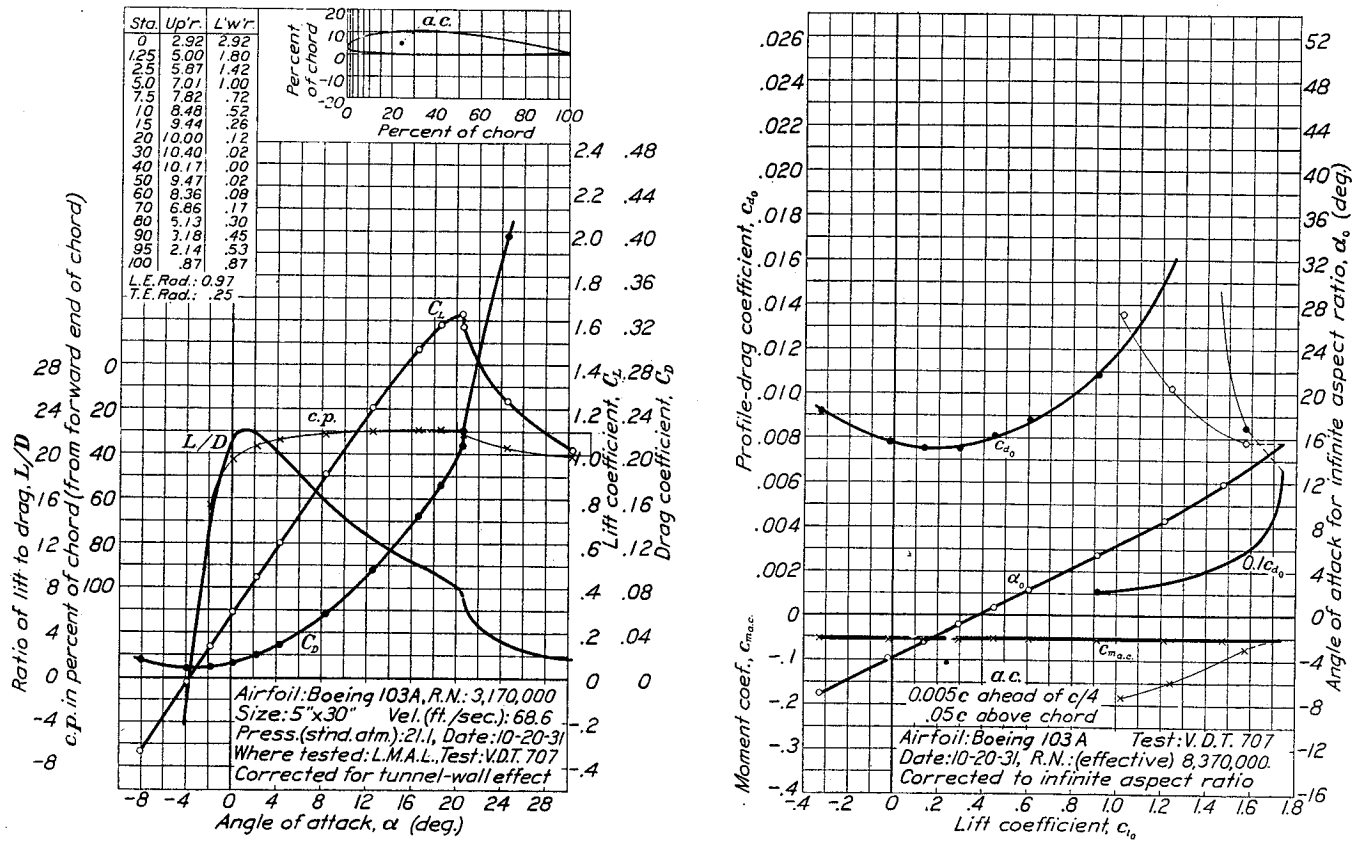


FIGURE 3.—Boeing 103 A airfoil.

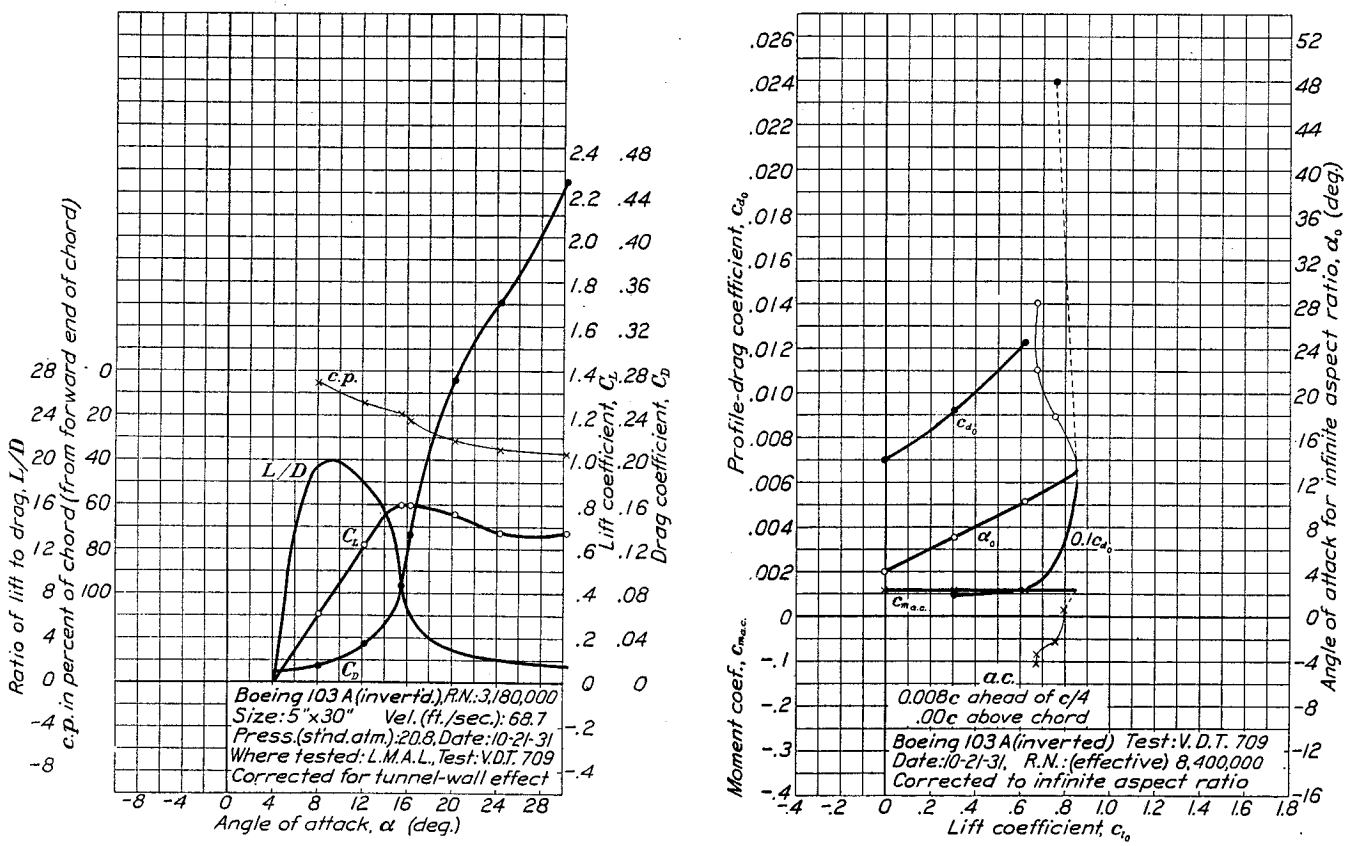


FIGURE 4.—Boeing 103 A airfoil (inverted).

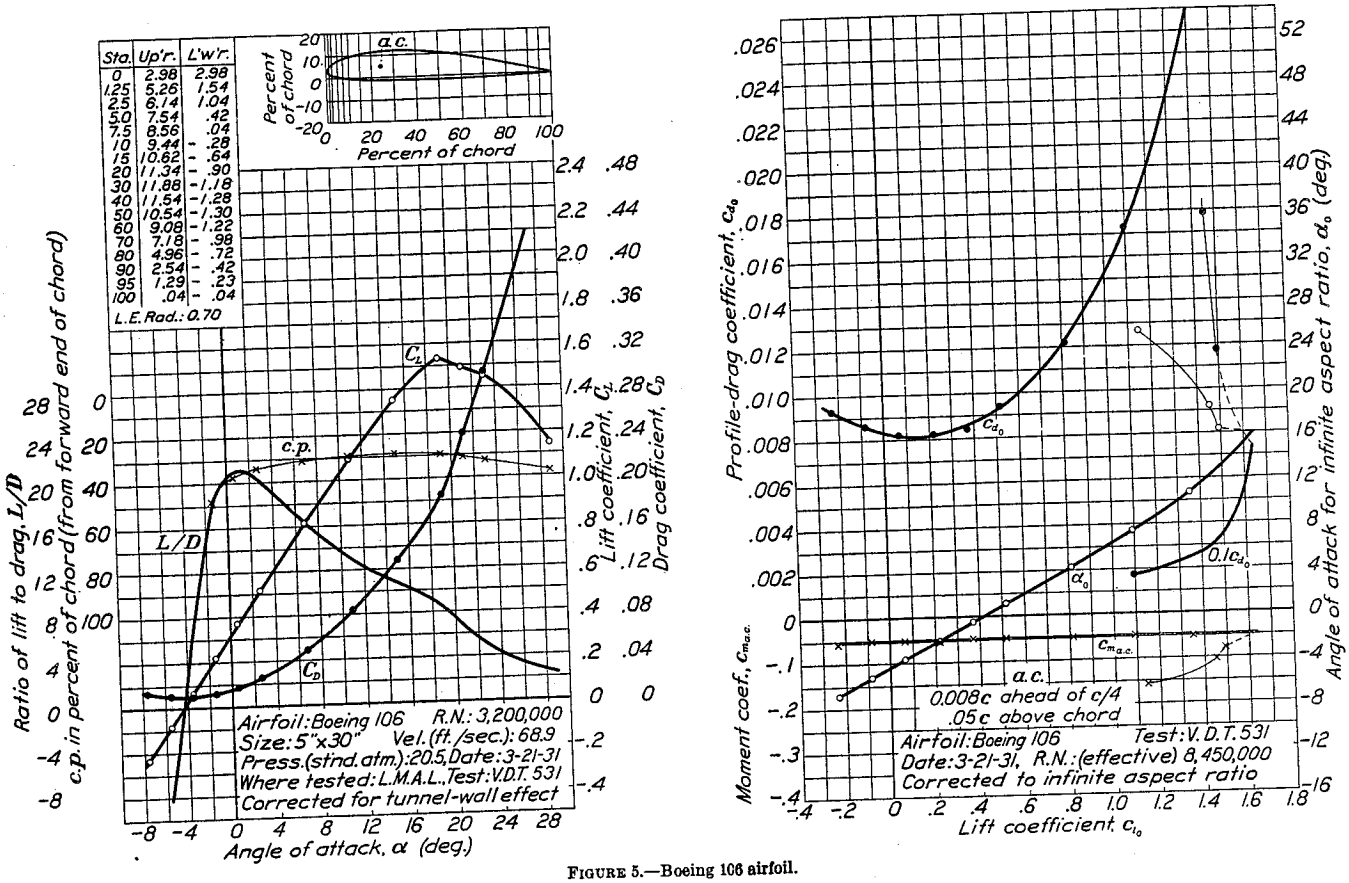


FIGURE 5.—Boeing 106 airfoil.

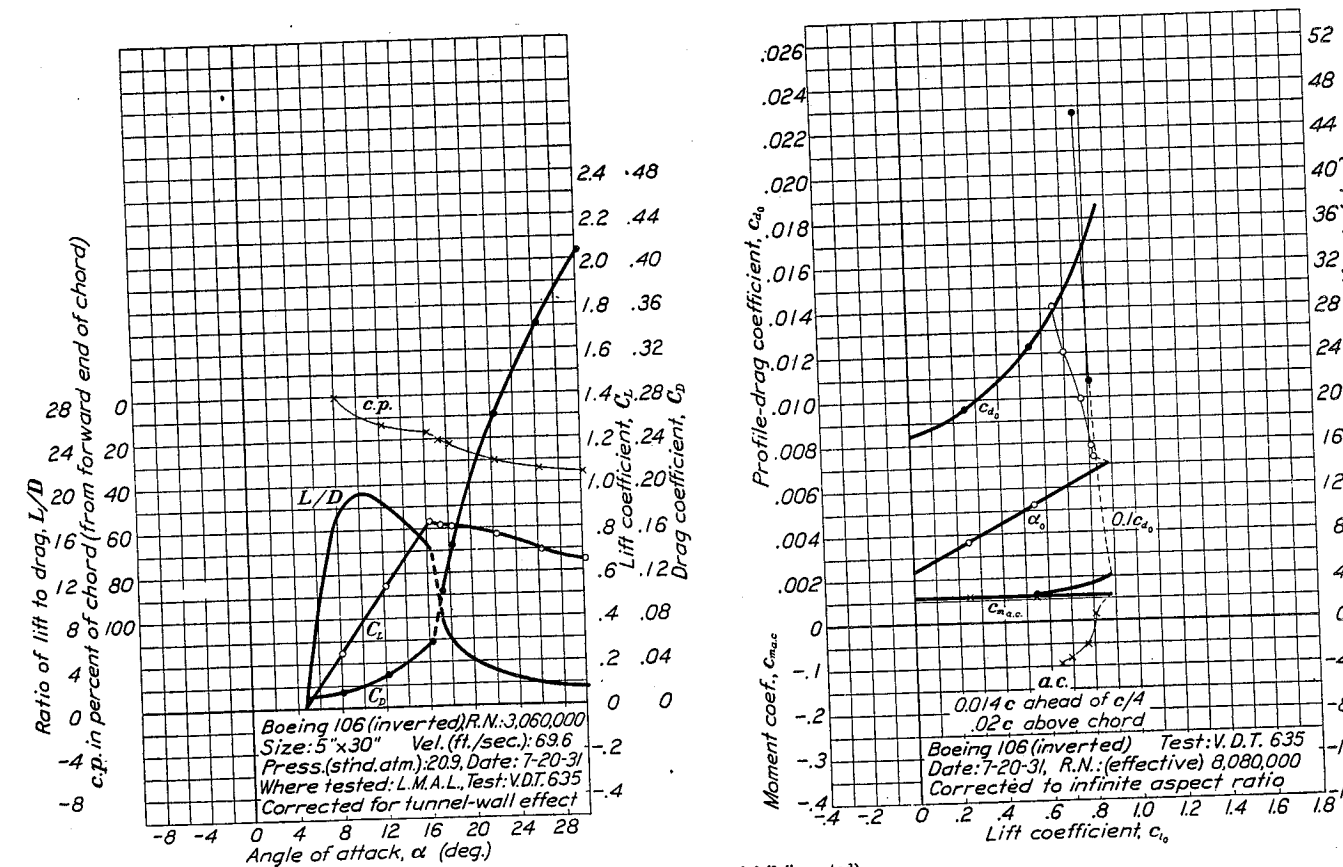


FIGURE 6.—Boeing 106 airfoil (inverted).

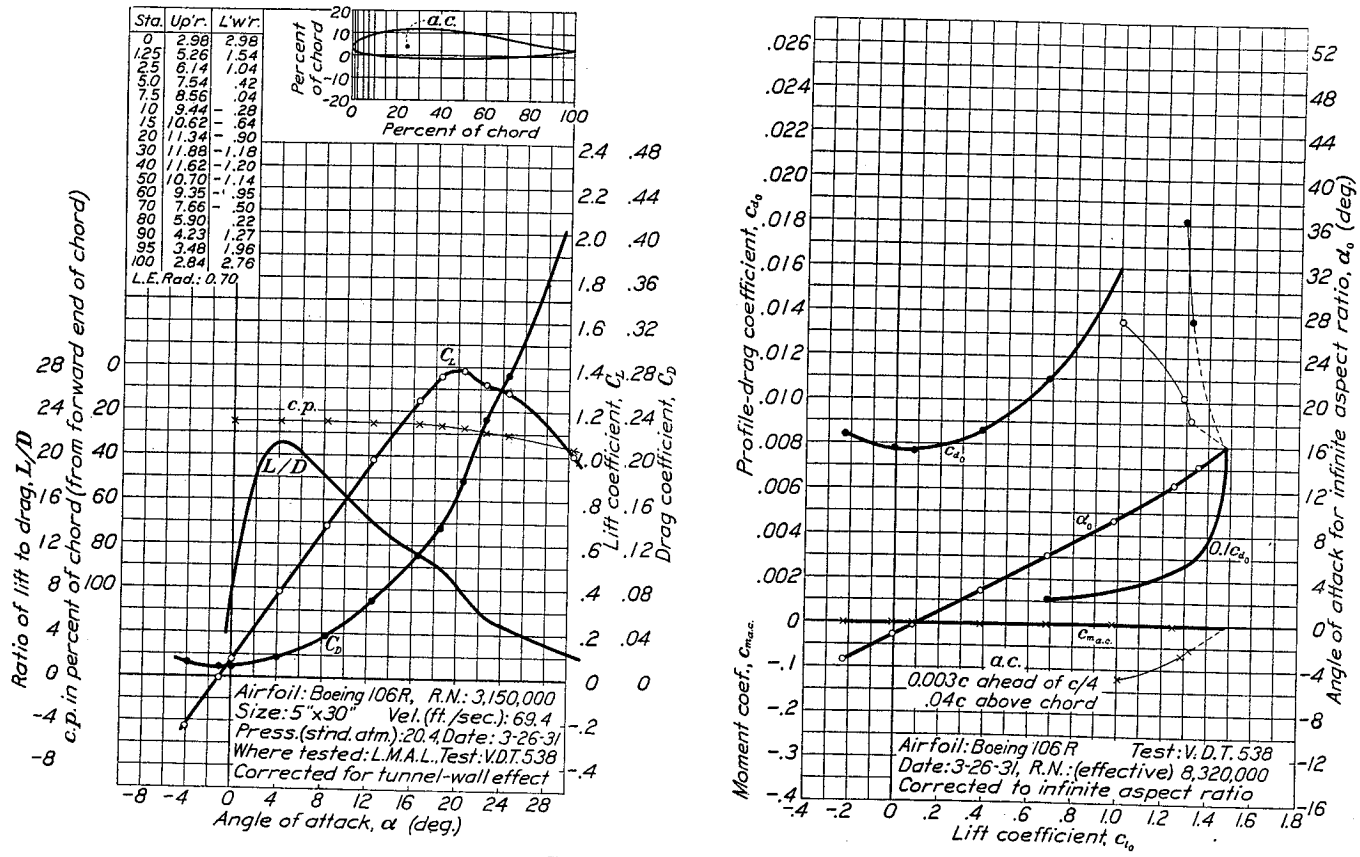


FIGURE 7.—Boeing 106 R airfoil.

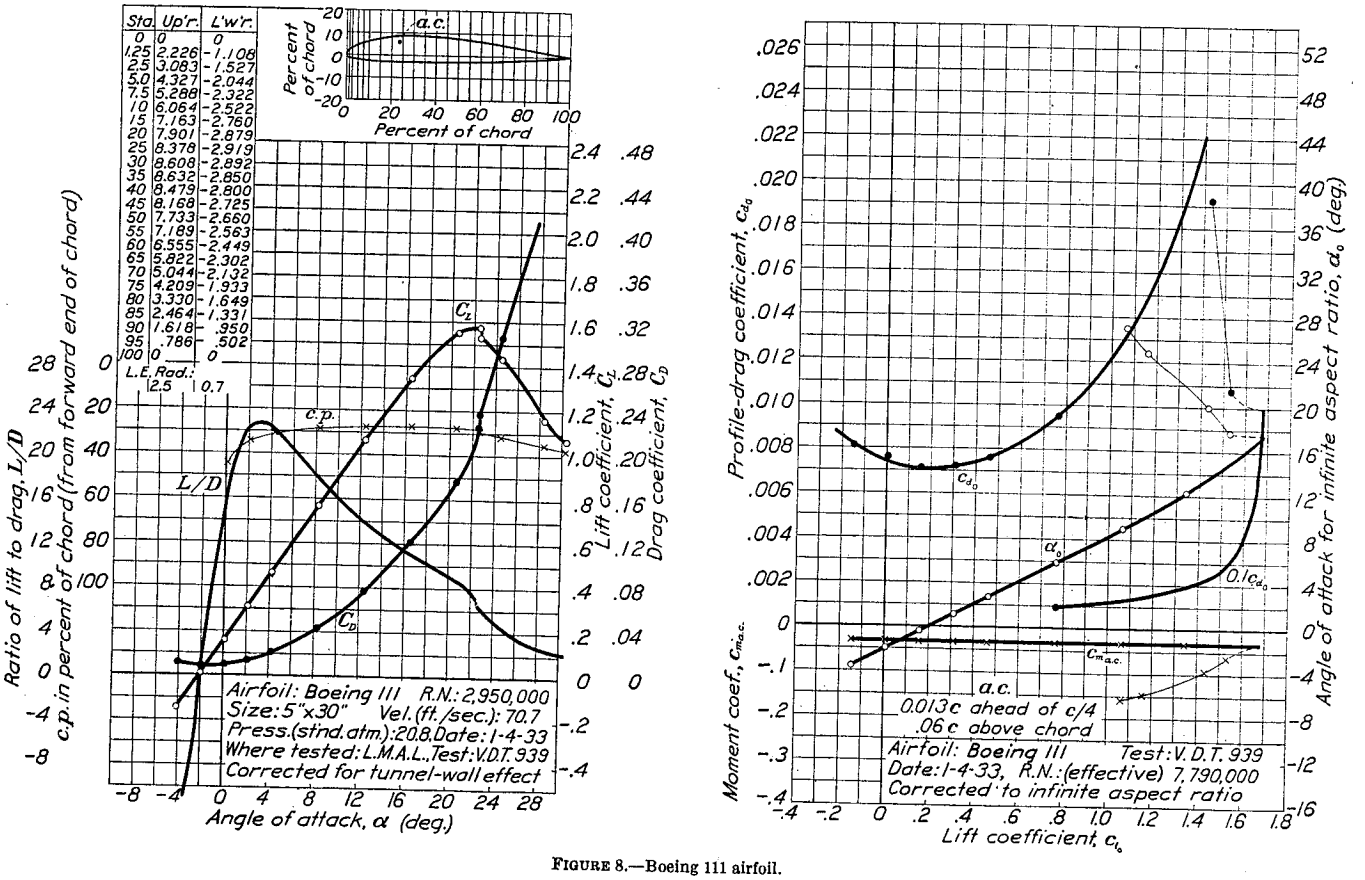


FIGURE 8.—Boeing 111 airfoil.

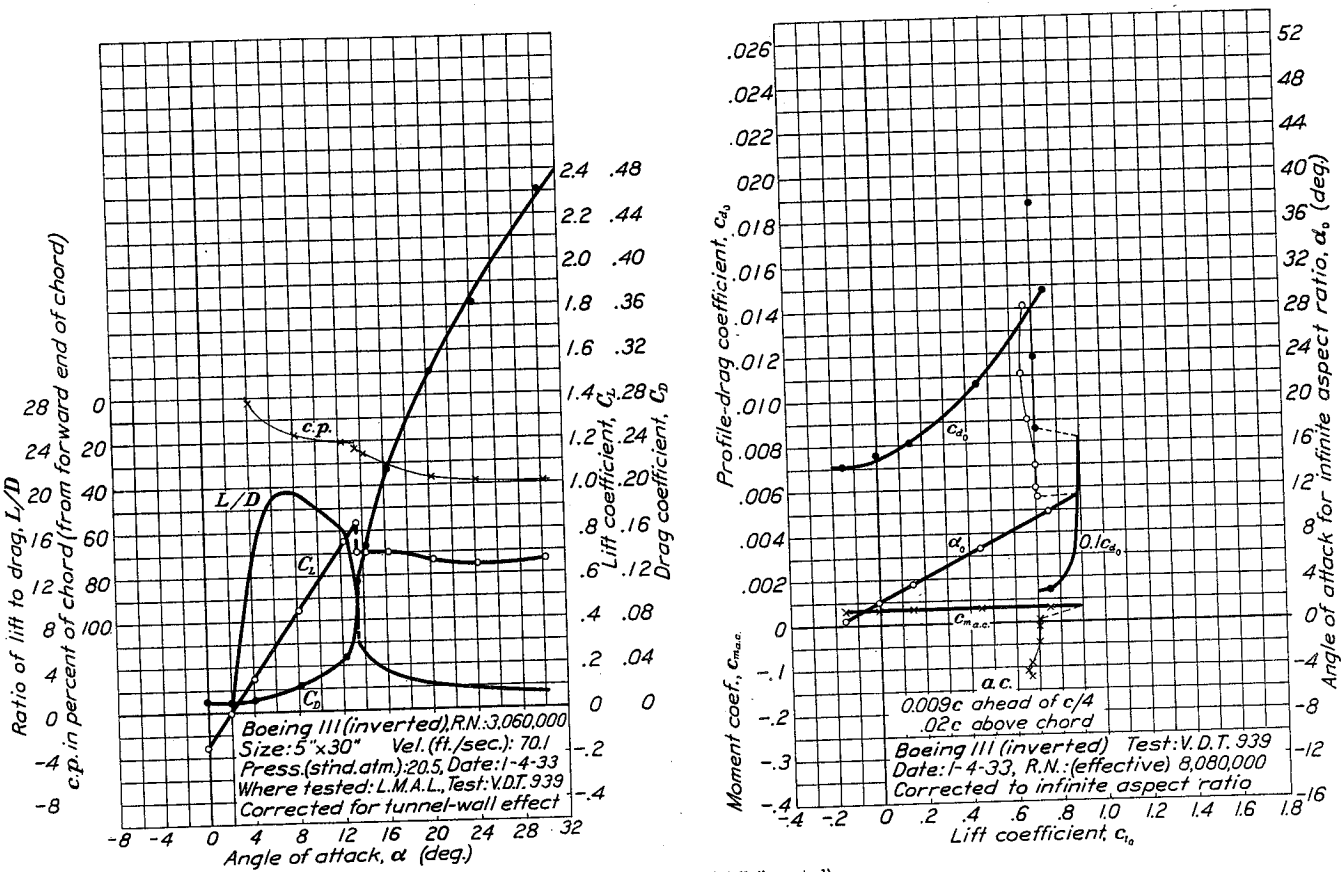


FIGURE 9.—Boeing 111 airfoil (inverted).

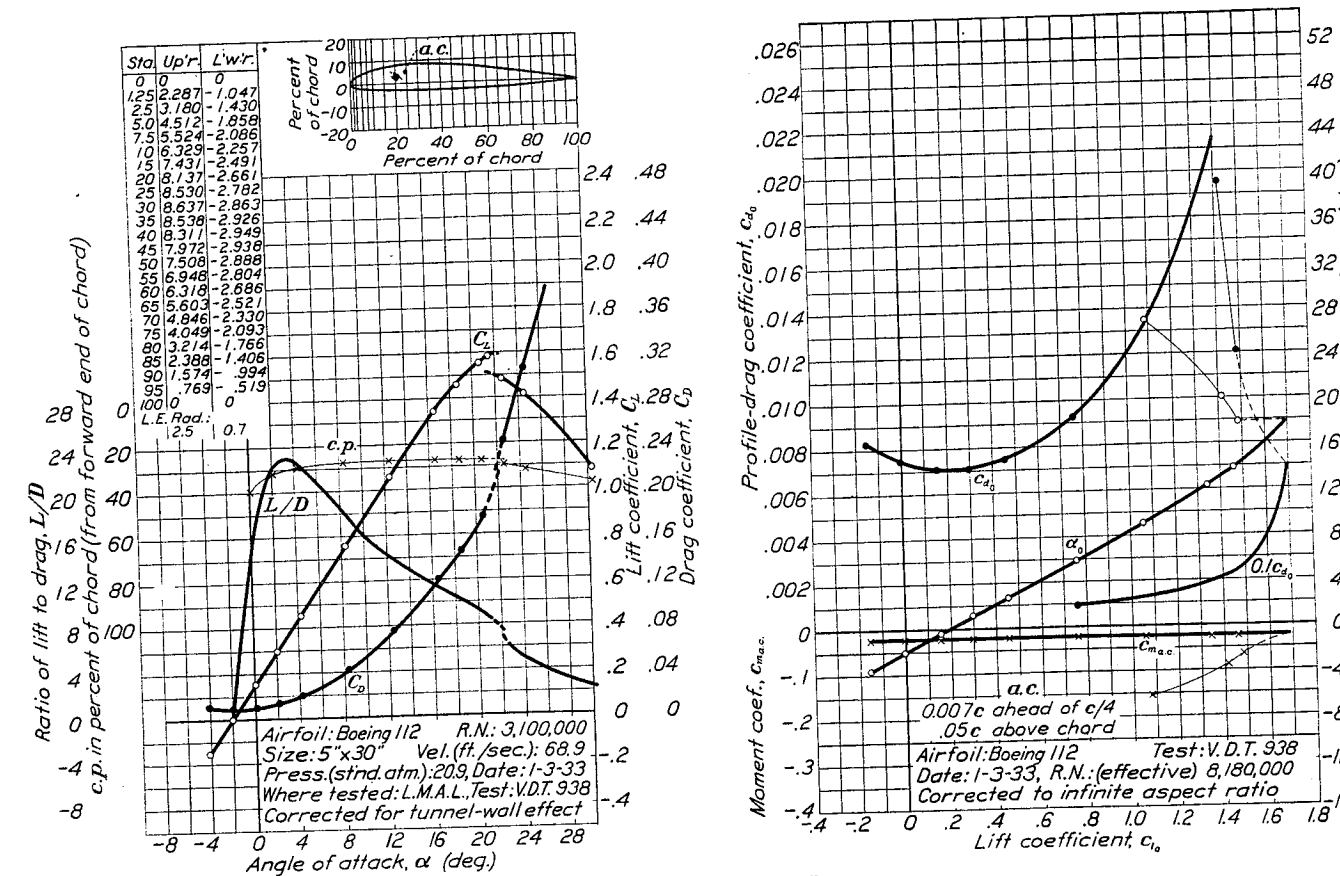


FIGURE 10.—Boeing 112 airfoil.

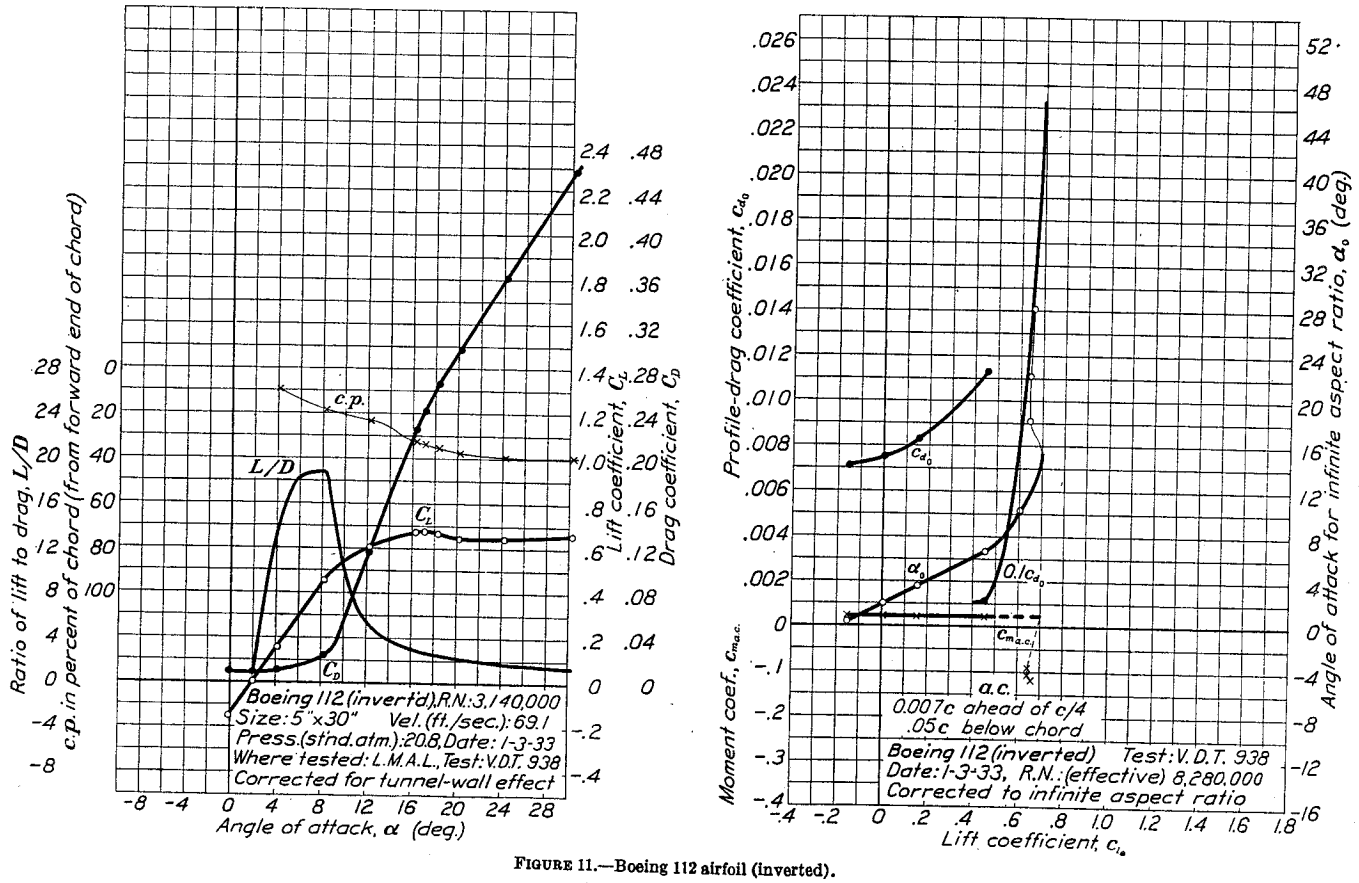


FIGURE 11.—Boeing 112 airfoil (inverted).

Sta.	Up'r.	L'w'r.
0	5.58	5.58
0.25	7.03	4.42
.50	7.56	3.99
.75	7.98	3.68
1.00	8.31	3.42
1.25	8.61	3.18
2.5	9.73	2.19
5.0	11.30	1.15
7.5	12.60	.50
10	13.62	.18
15	15.29	.00
20	16.25	.26
25	16.63	.58
30	16.72	.89
40	16.10	1.43
50	14.51	1.75
60	12.18	1.80
70	9.42	1.64
80	6.44	1.23
90	3.37	.65
95	1.77	.31
100	.09	.09

L.E. Rad.: 2.77
T.E. Rad.: 0.09

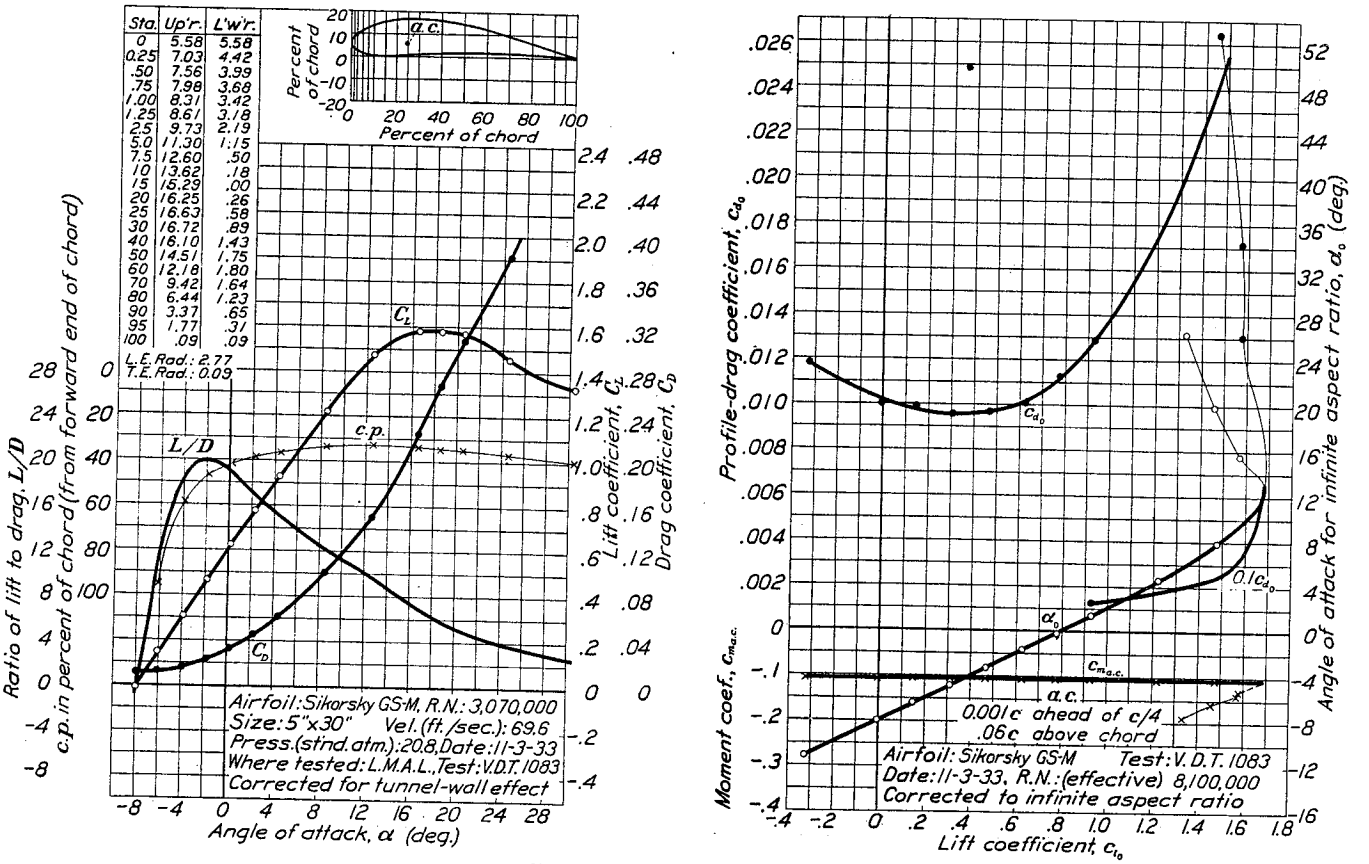


FIGURE 12.—Sikorsky GS-M airfoil.

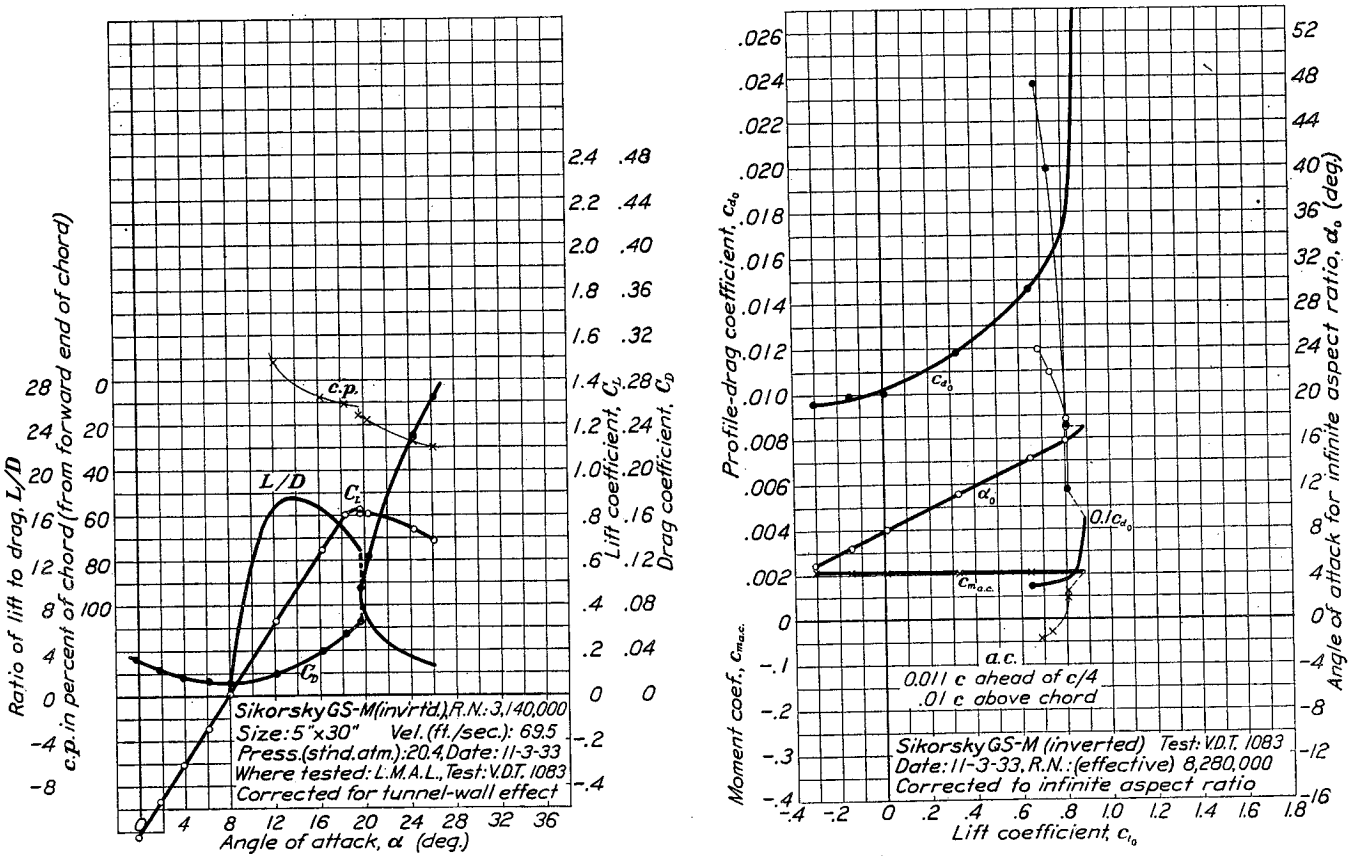


FIGURE 13.—Sikorsky GS-M airfoil (inverted).

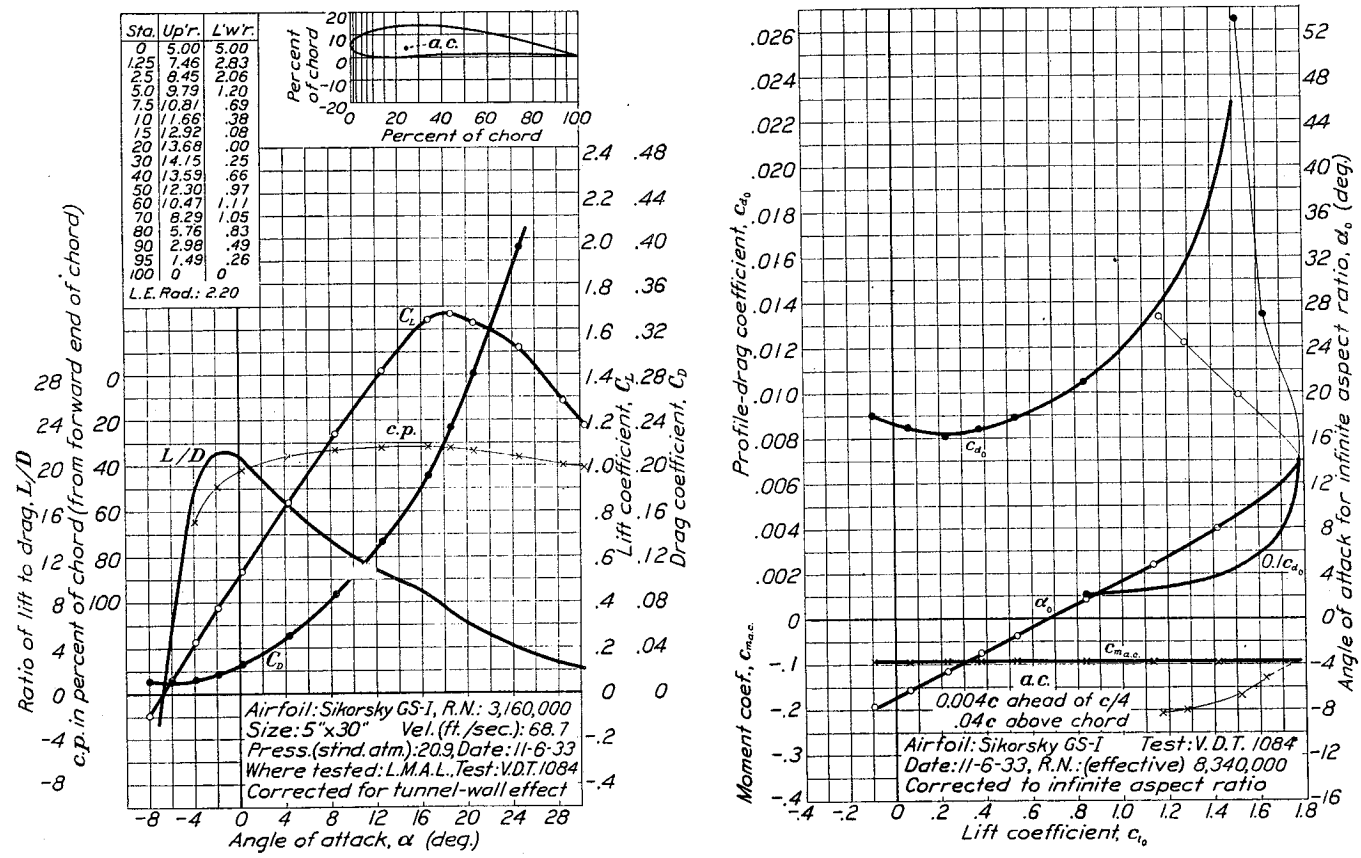


FIGURE 14.—Sikorsky GS-I airfoil.

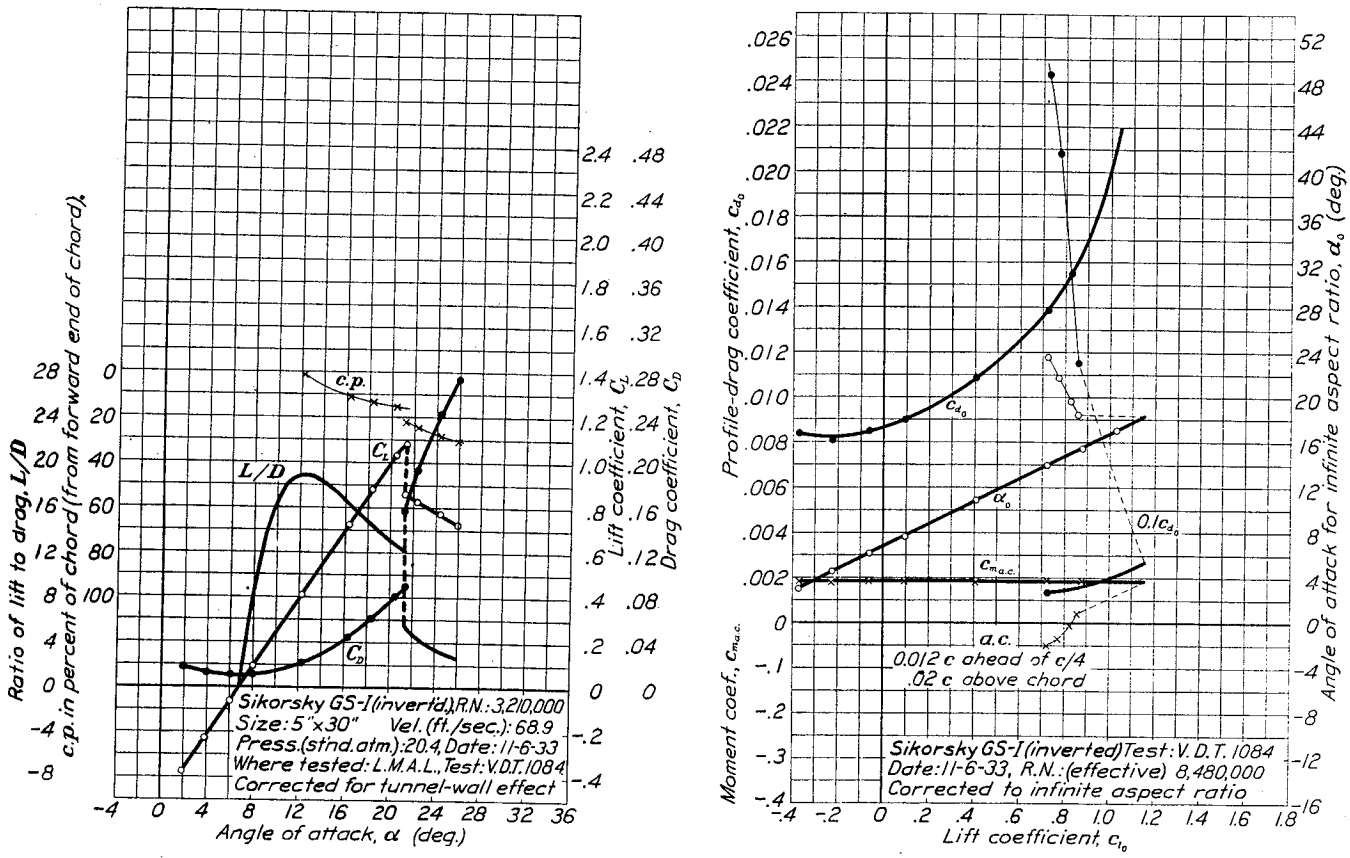


FIGURE 15.—Sikorsky GS-I airfoil (inverted).

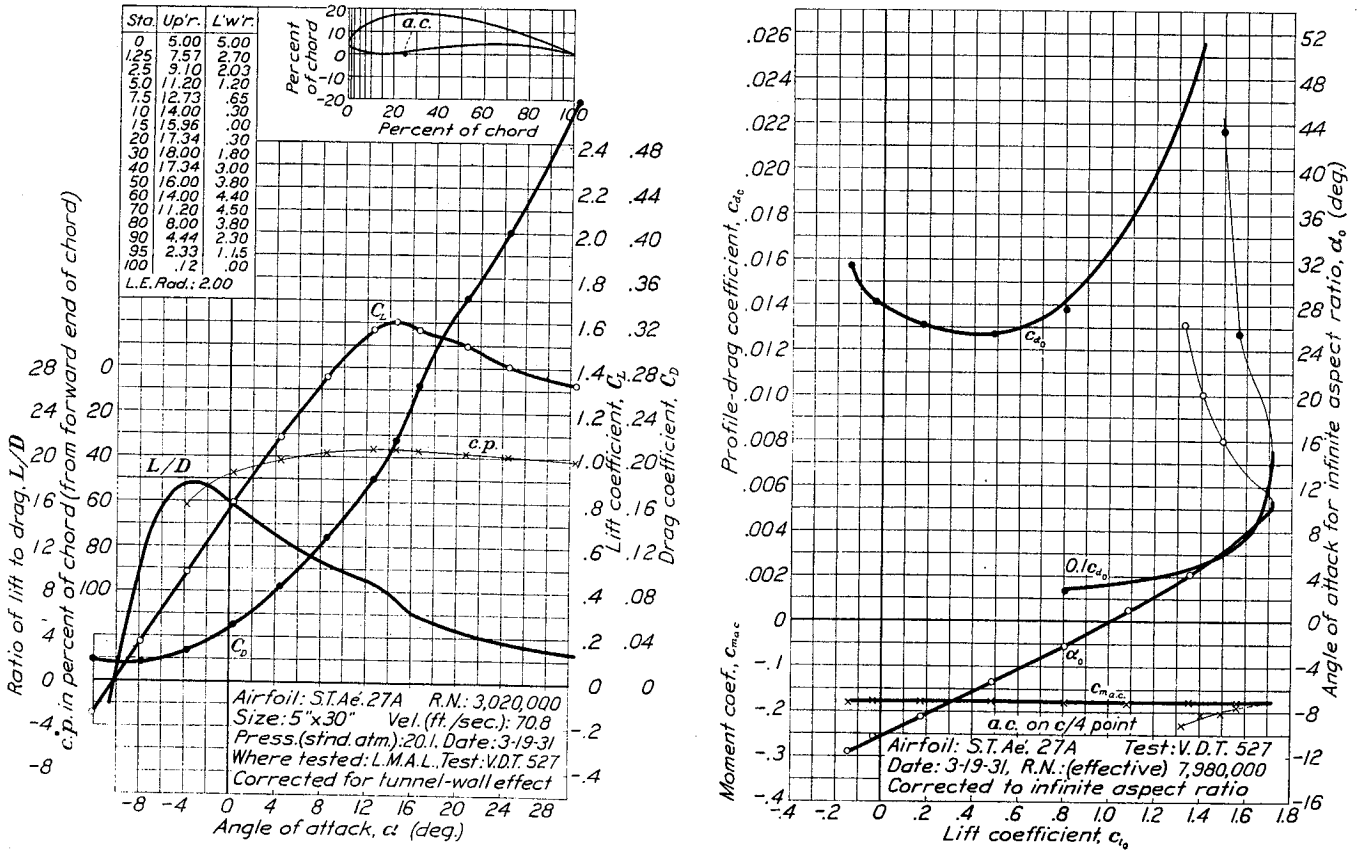


FIGURE 16.—S. T. A6. 27A airfoil.

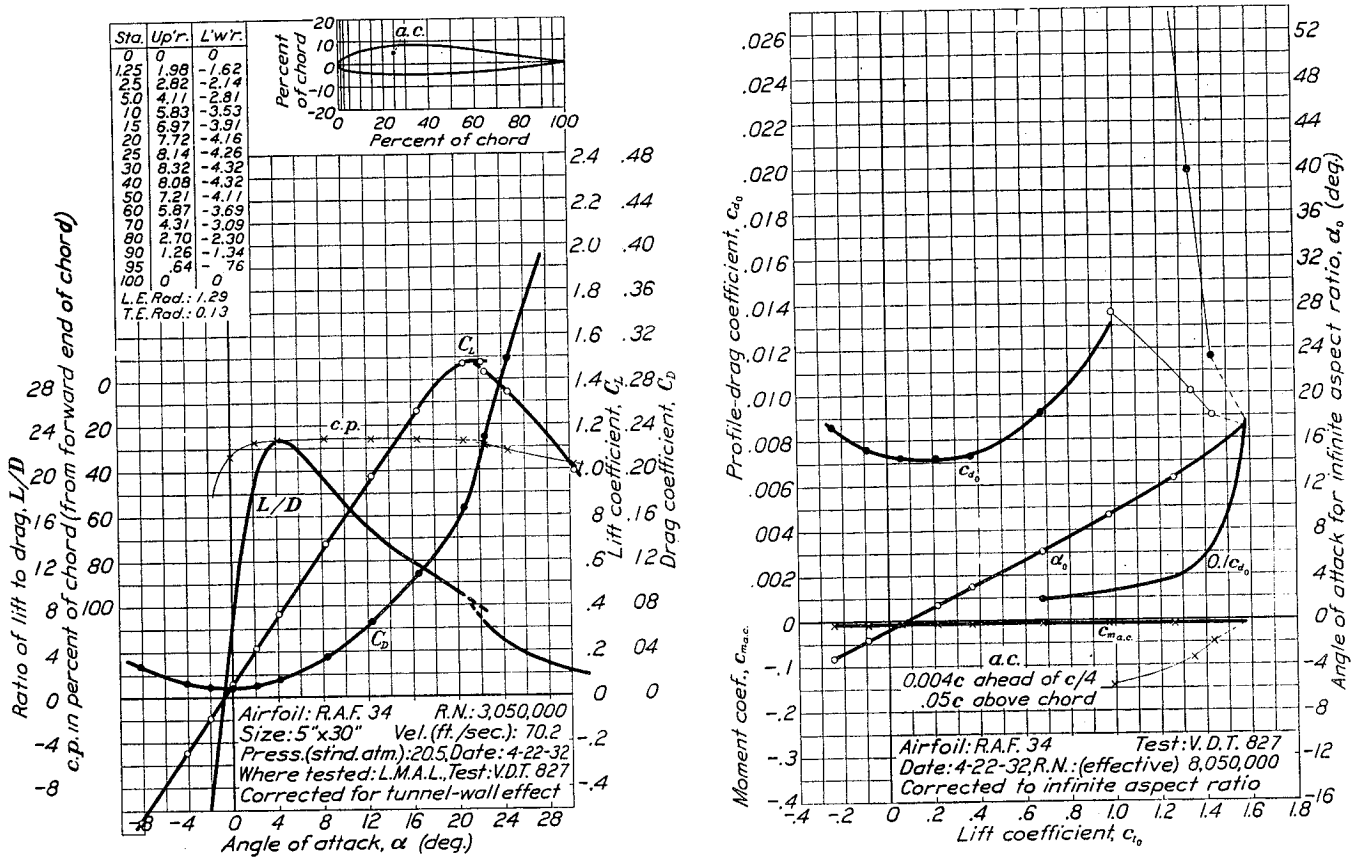


FIGURE 17.—R. A. F. 34 airfoil.

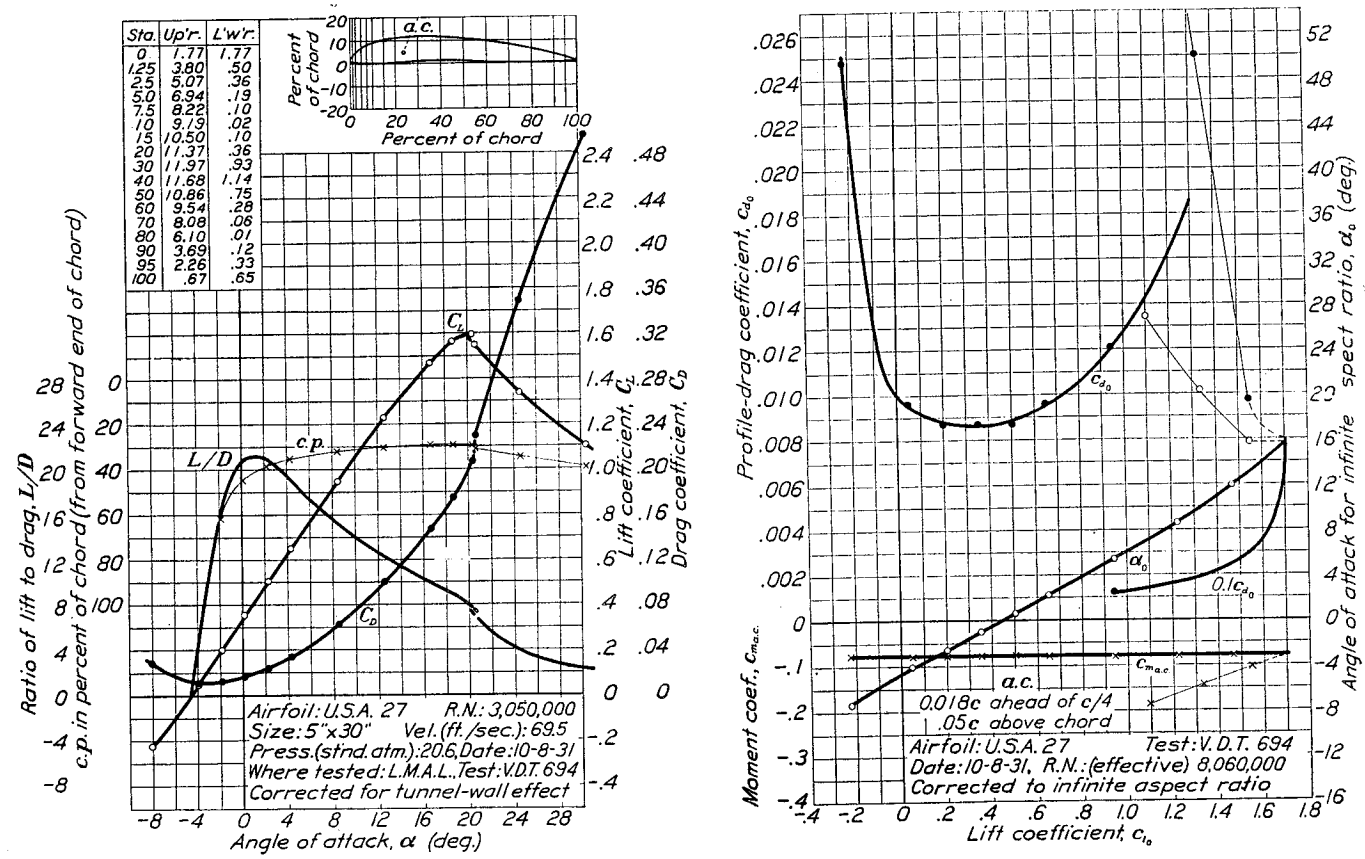


FIGURE 18.—U. S. A. 27 airfoil.

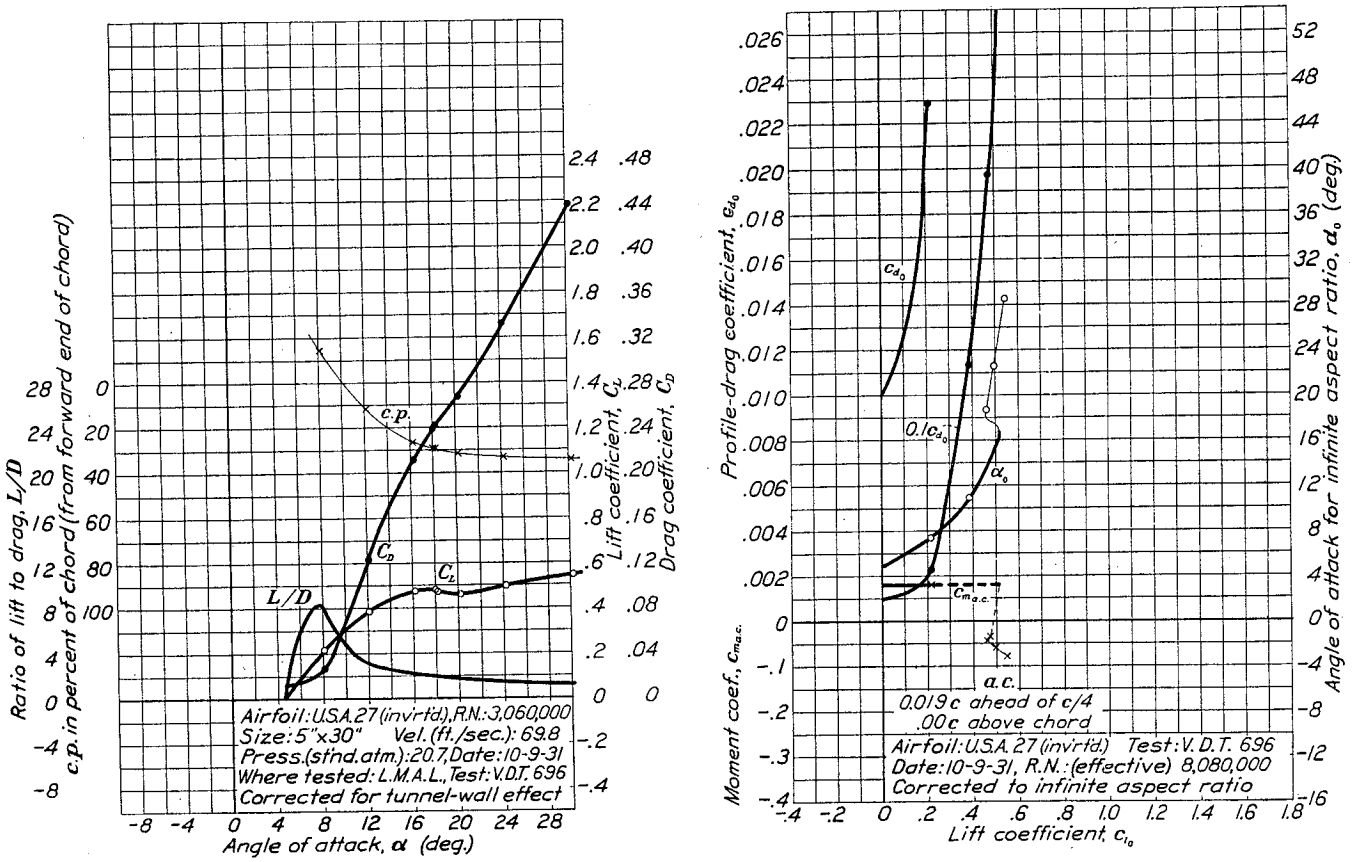


FIGURE 19.—U. S. A. 27 airfoil (inverted).

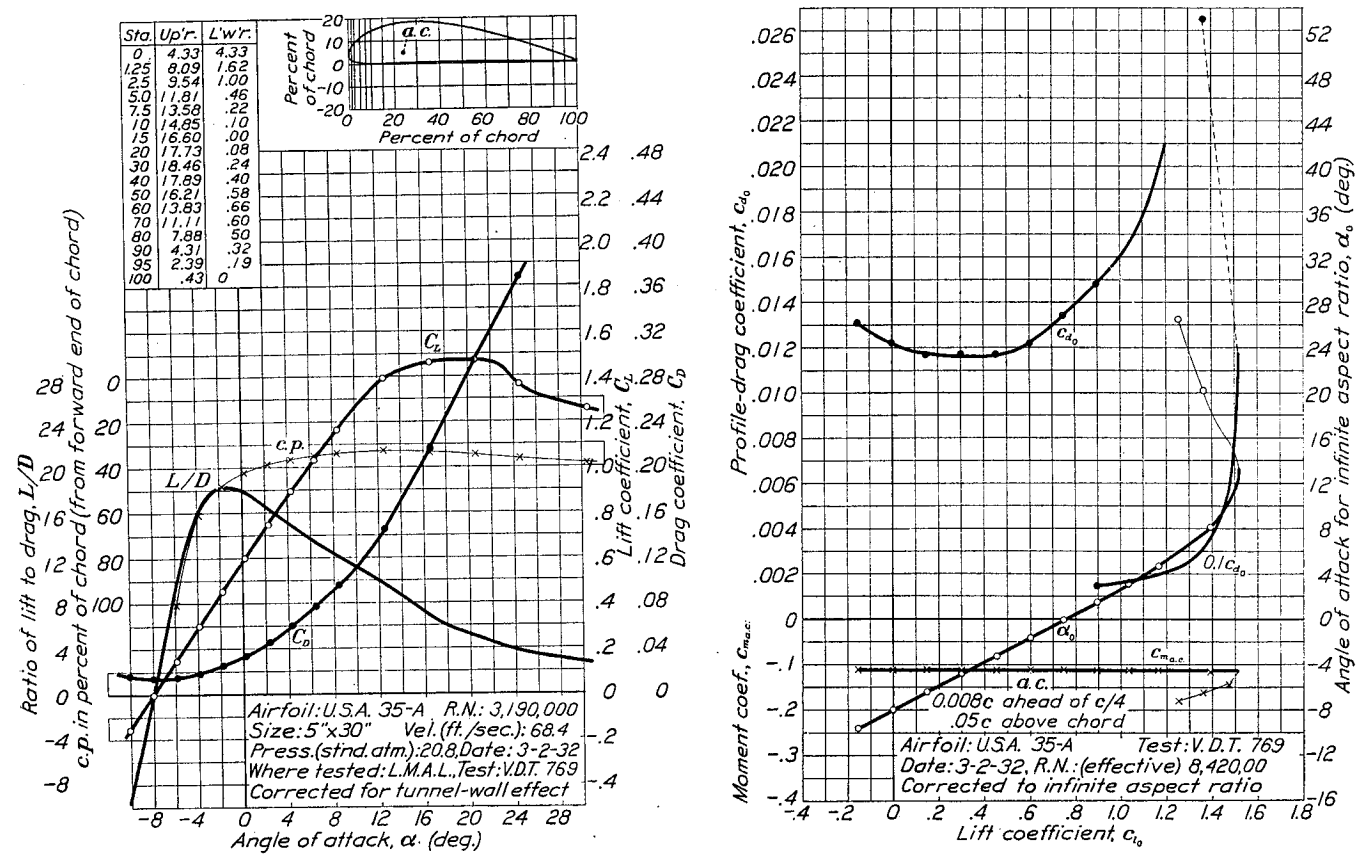


FIGURE 20.—U. S. A. 35-A airfoil.

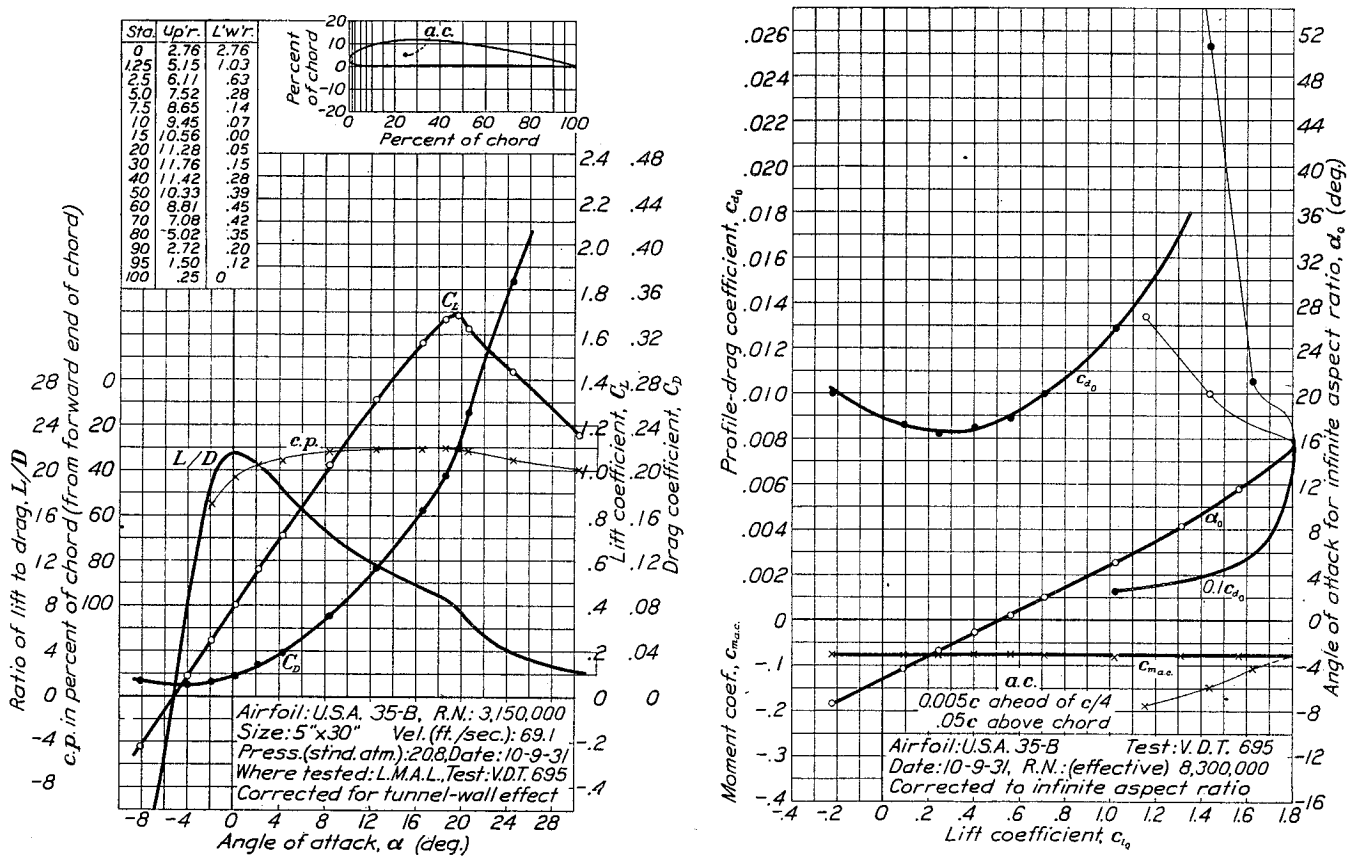


FIGURE 21.—U. S. A. 35-B airfoil.

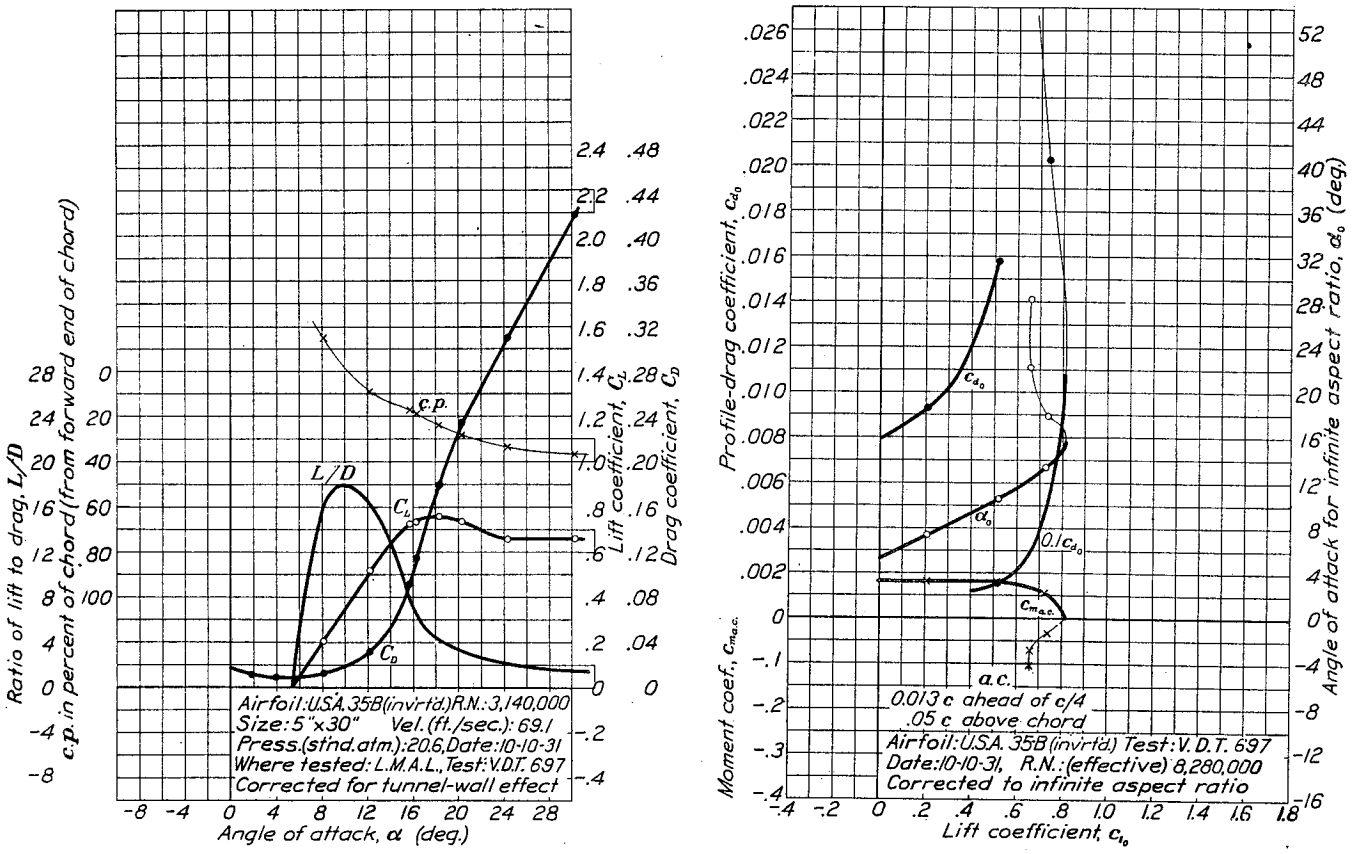


FIGURE 22.—U. S. A. 35-B airfoil (inverted).

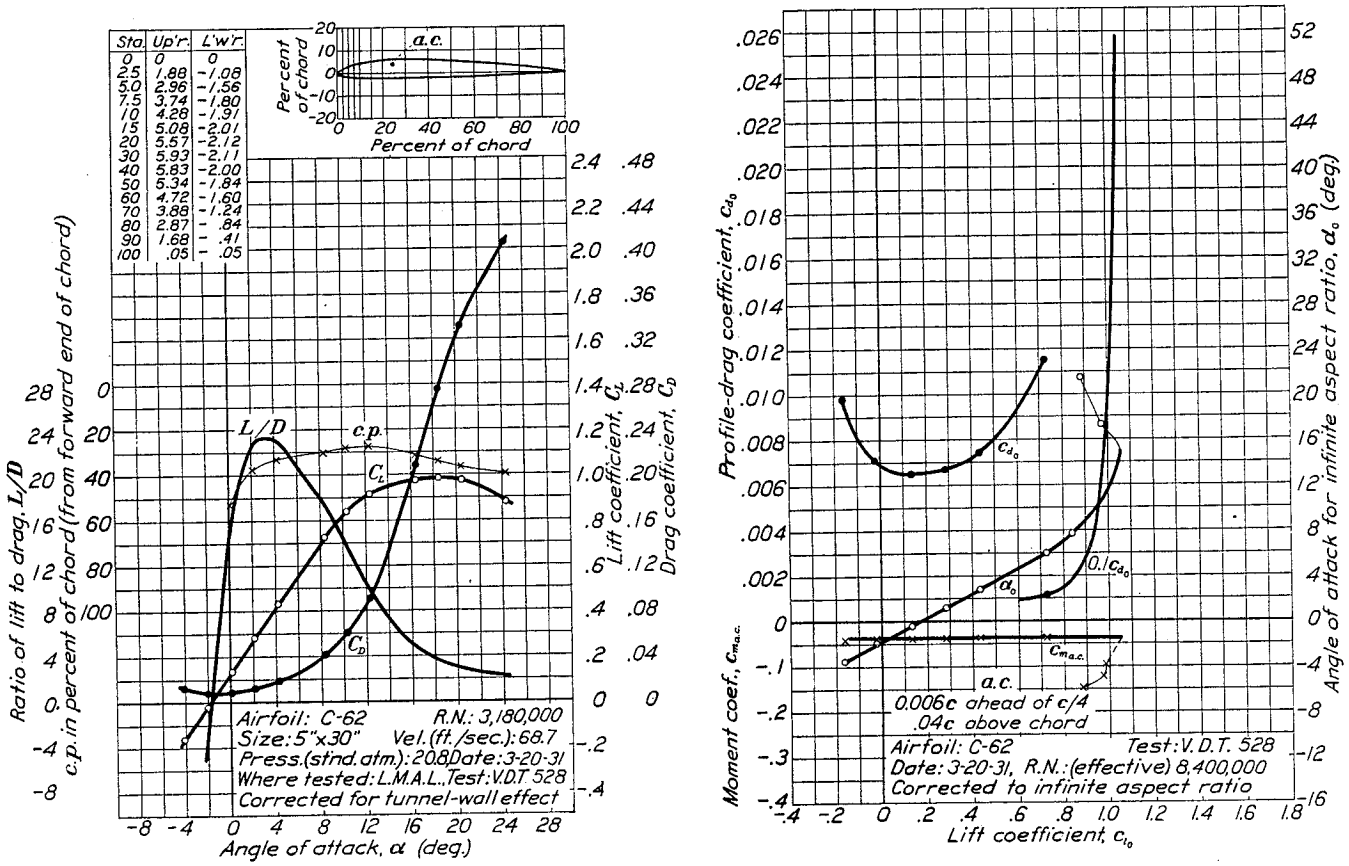


FIGURE 23.—C-62 airfoil.

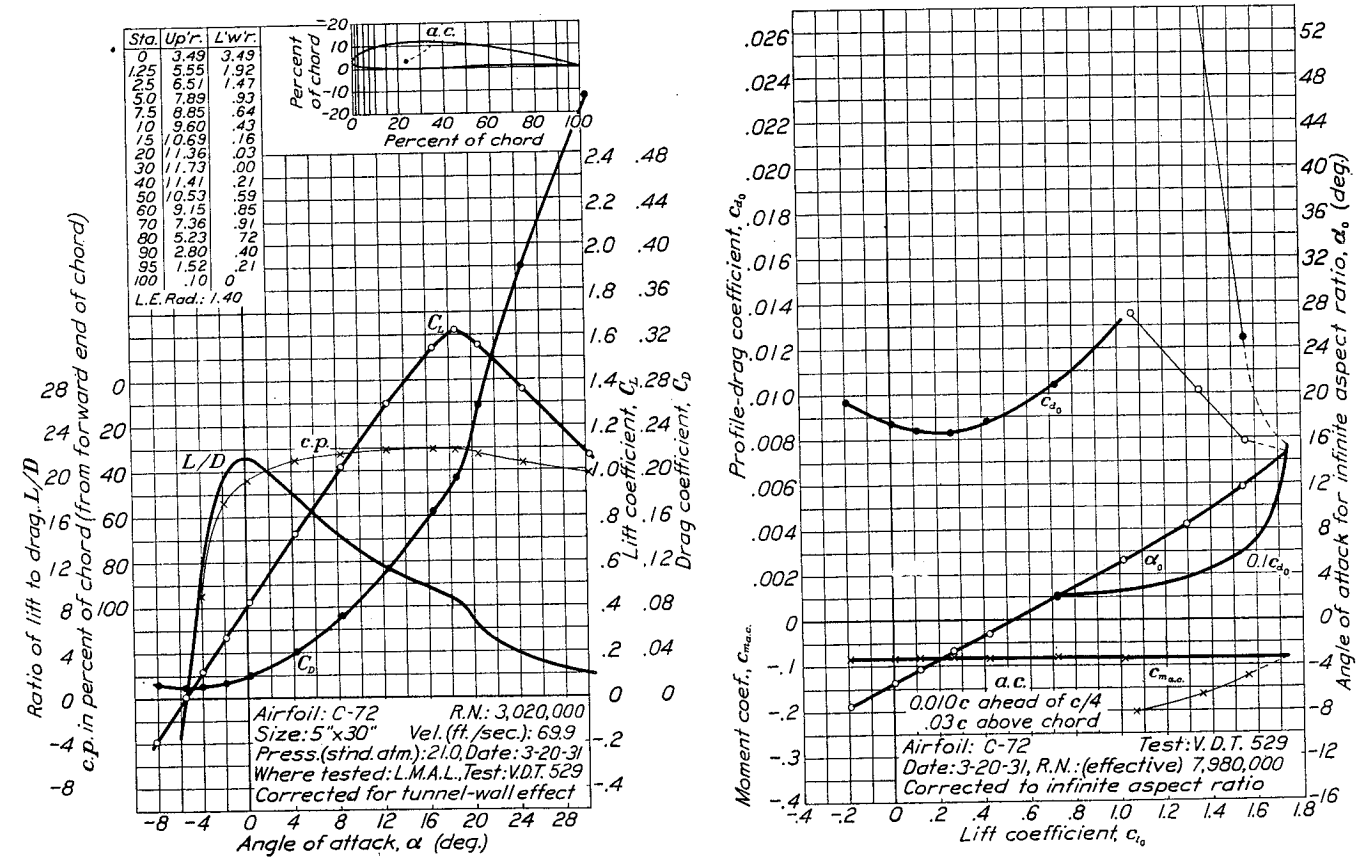


FIGURE 24.—C-72 airfoil.

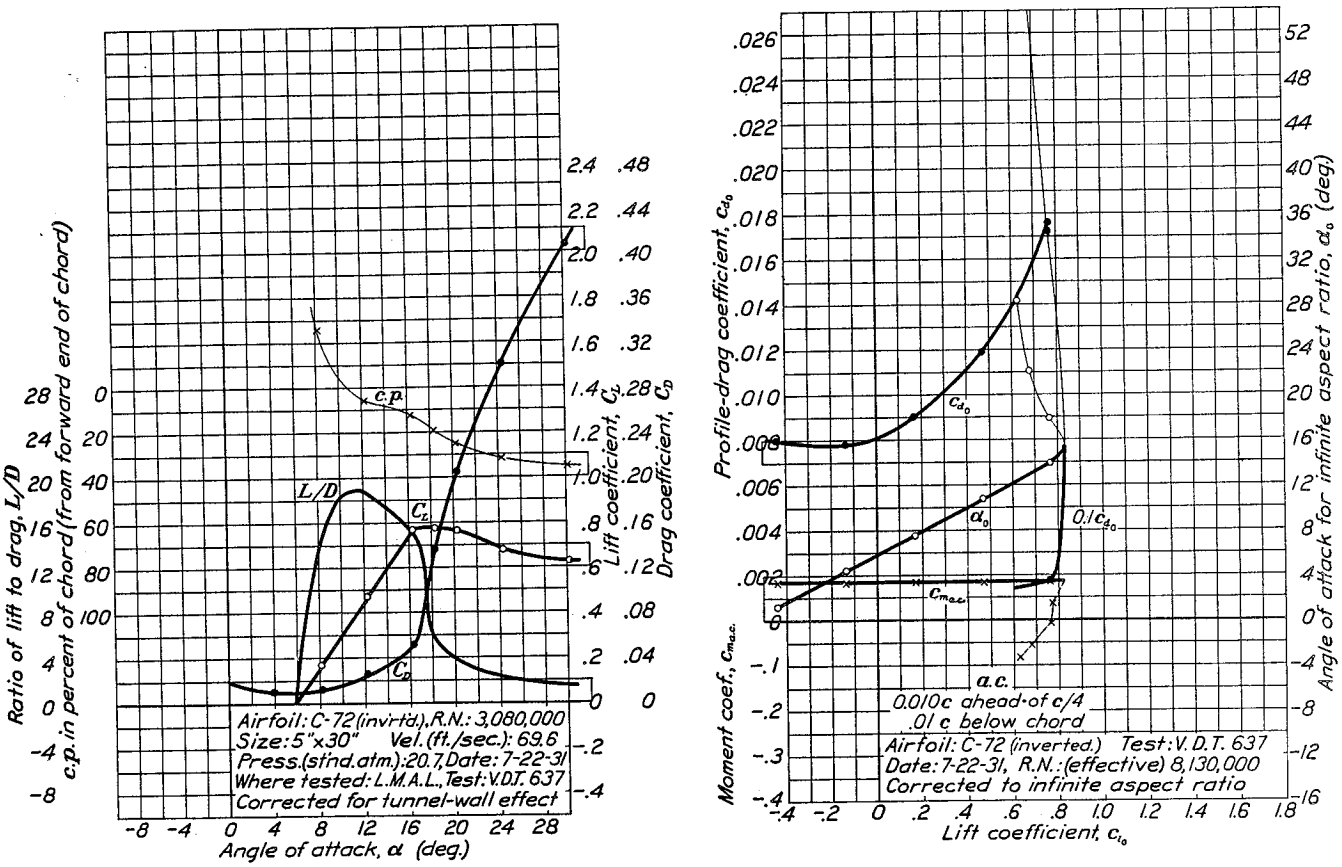


FIGURE 25.—C-72 airfoil (inverted).

Sta.	Up'r.	L'w'r.
0	0	0
1	1.18	- .81
3	2.54	- 1.38
5	3.48	- 1.71
7	4.13	- 1.97
10	4.83	- 2.25
15	5.40	- 2.51
20	5.69	- 2.71
25	5.73	- 2.85
30	5.69	- 2.85
40	5.31	- 2.65
50	4.69	- 2.27
60	3.90	- 1.77
70	3.00	- 1.21
80	2.00	- .72
90	1.00	- .36
95	.51	- .21
100	.05	- .05

L.E. Rad.: 0.5

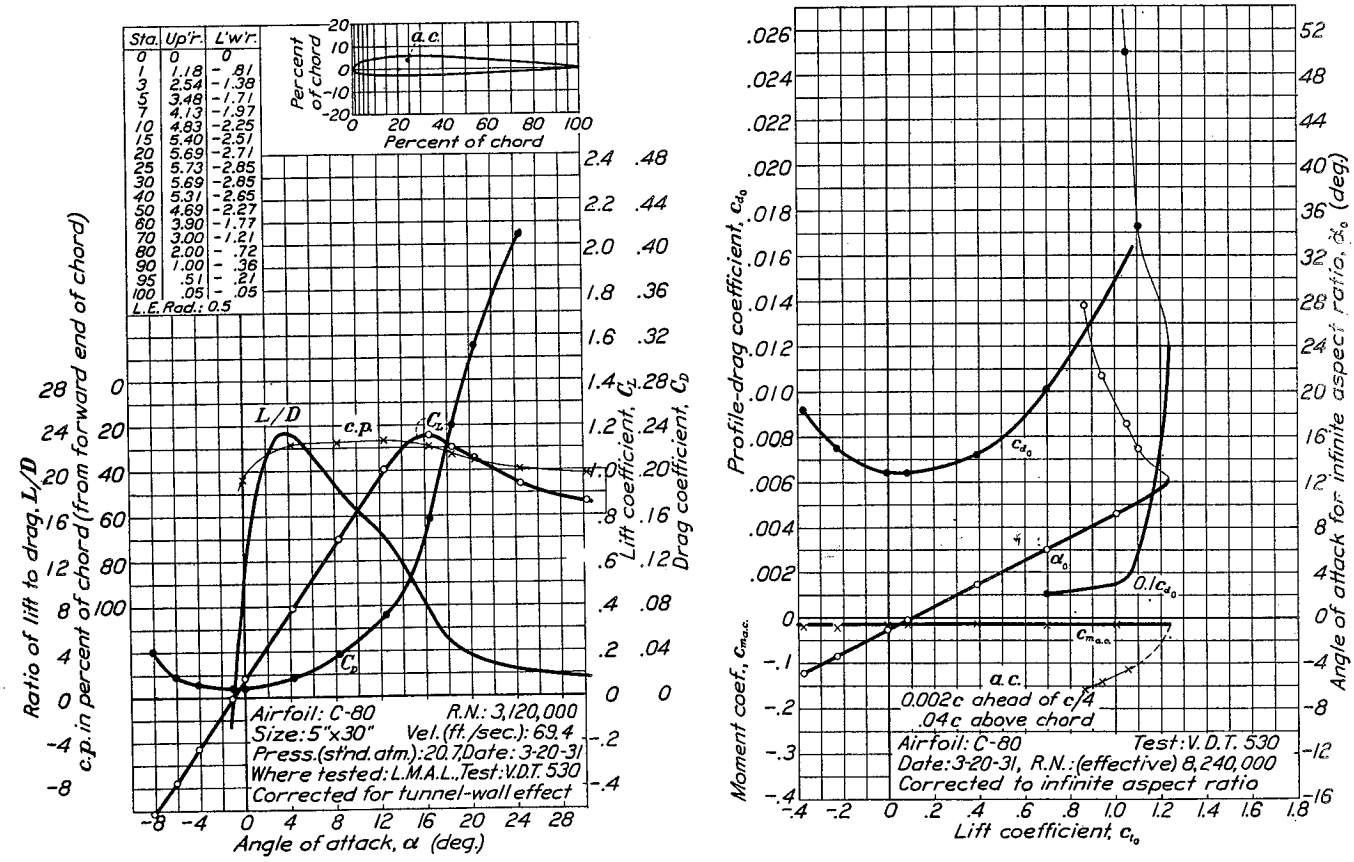


FIGURE 26.—C-80 airfoil.

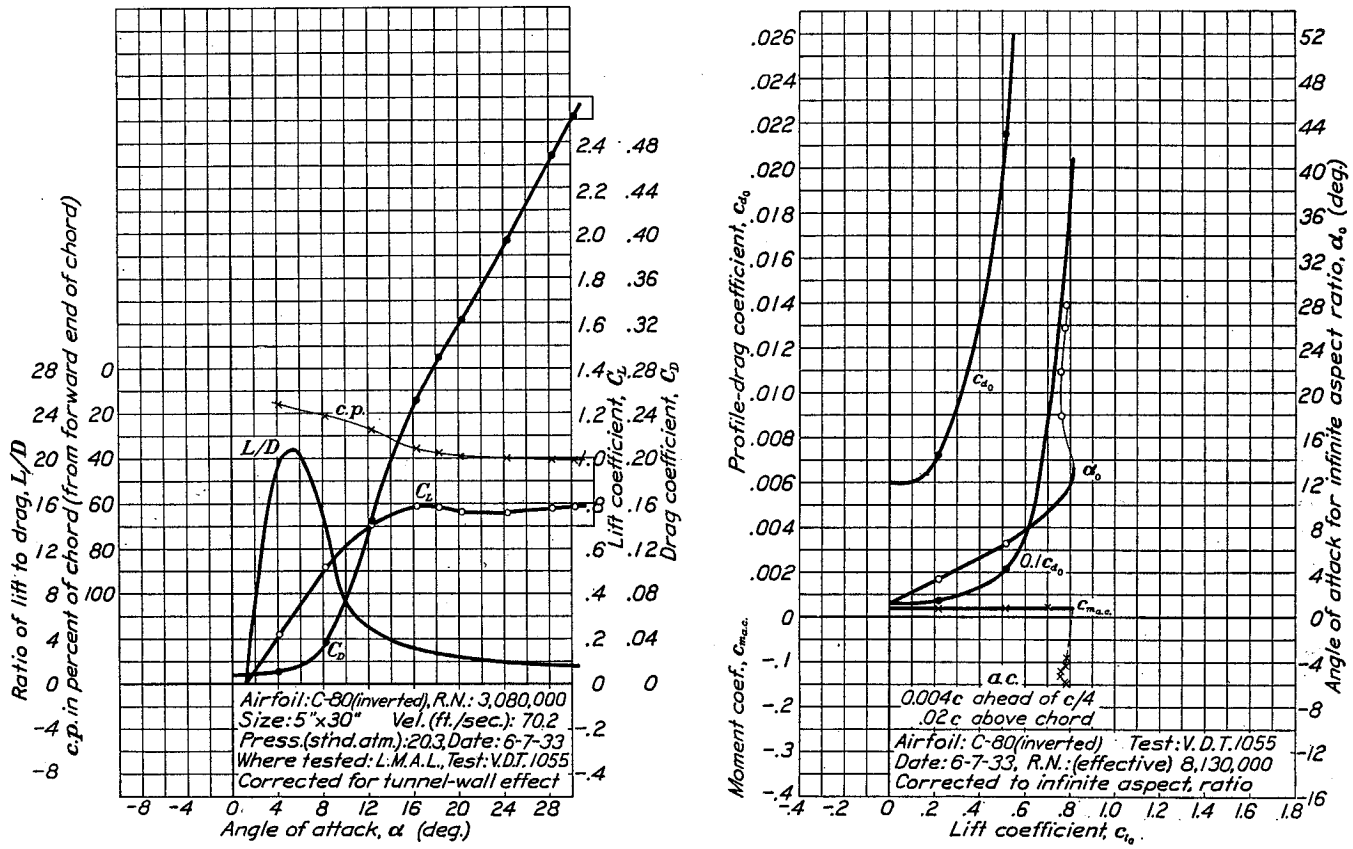


FIGURE 27.—C-80 airfoil (inverted).

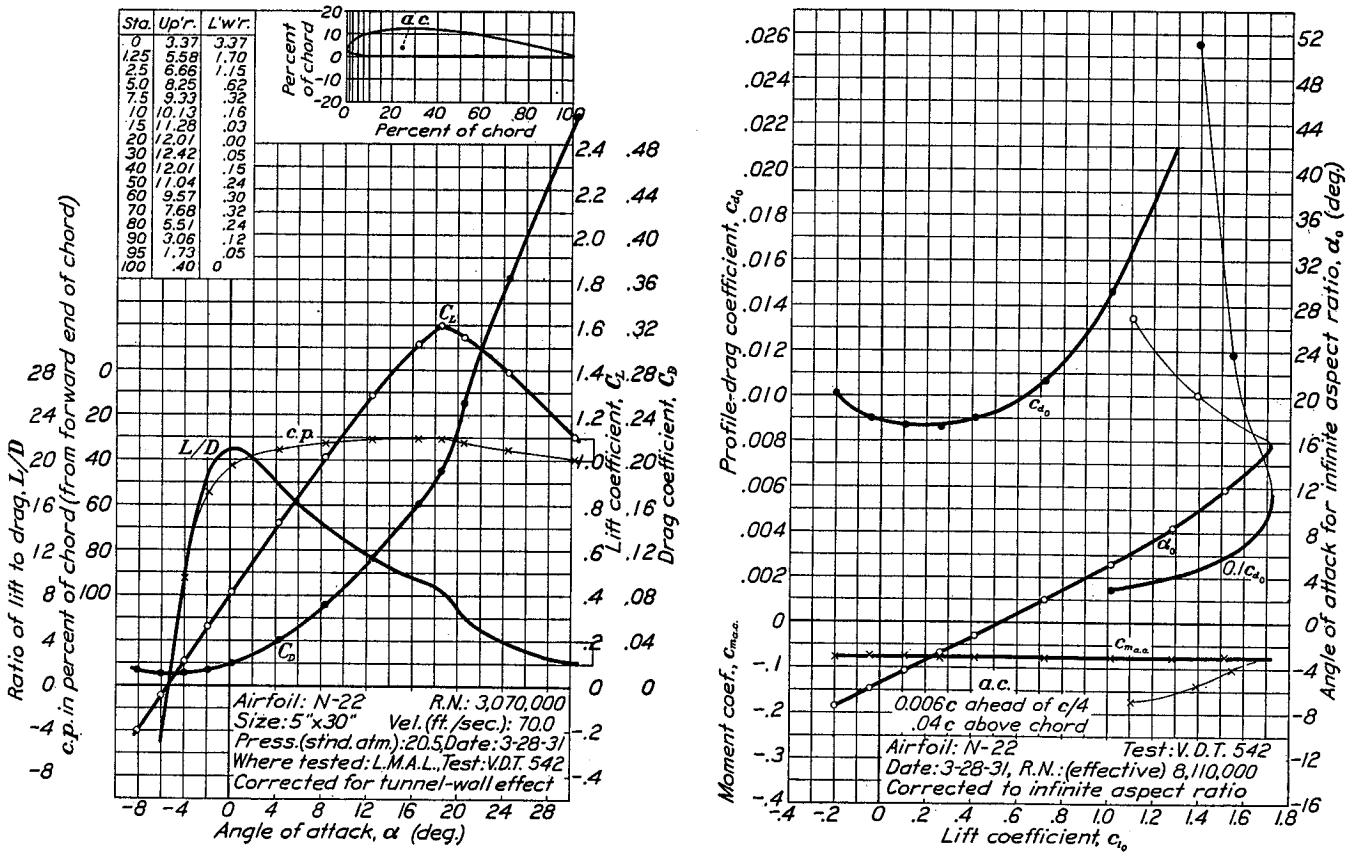


FIGURE 28.—N-22 airfoil.

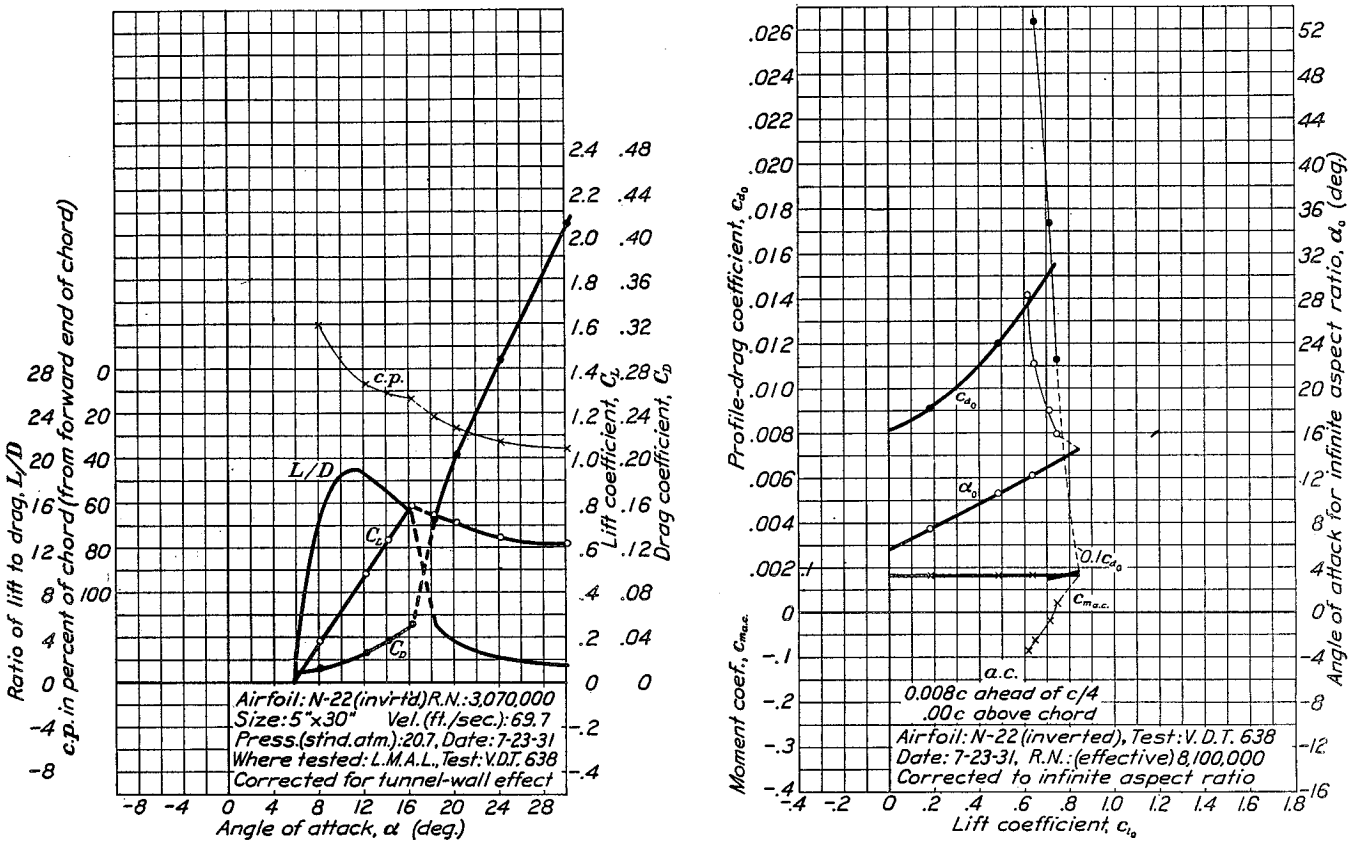


FIGURE 29.—N-22 airfoil (inverted).

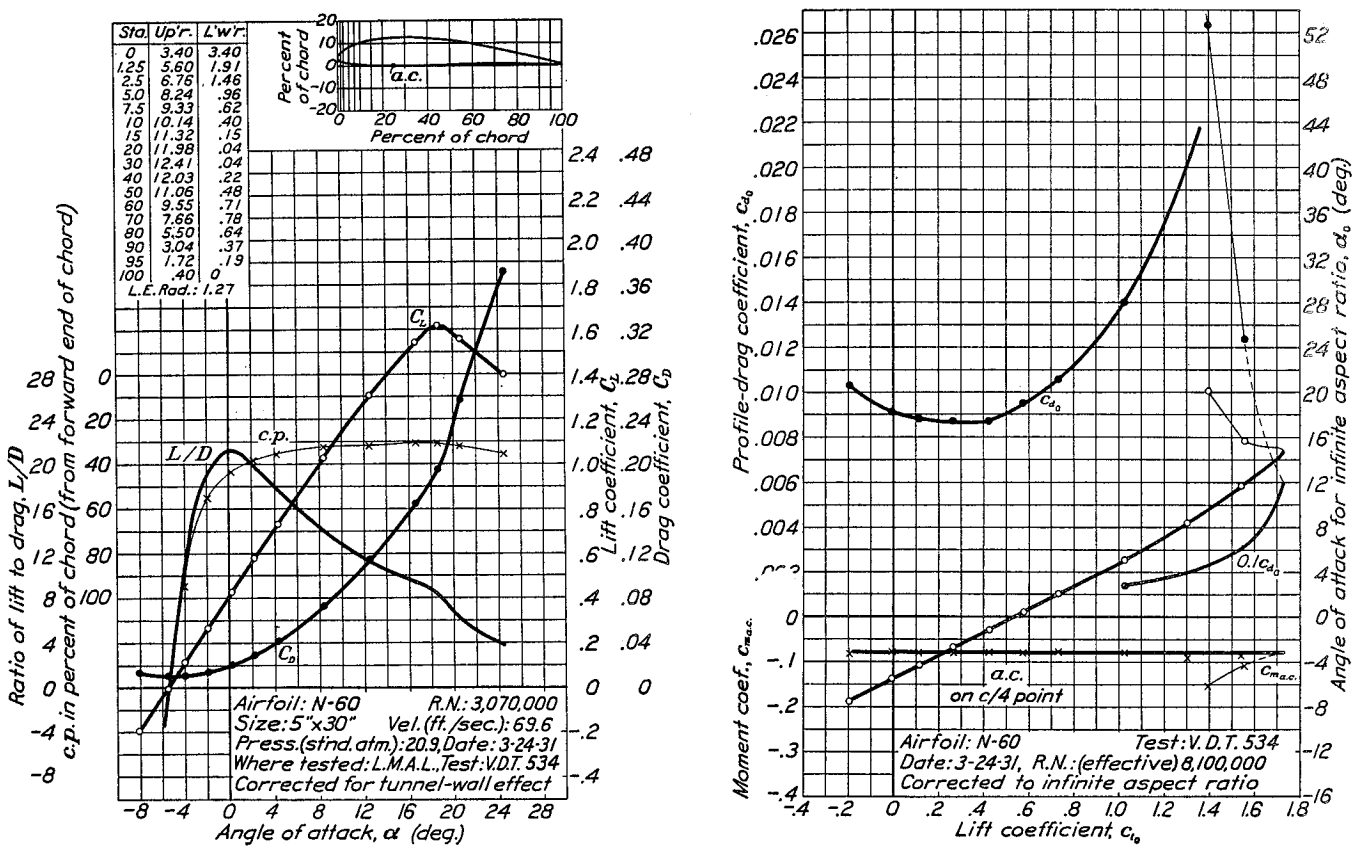


FIGURE 30.—N-60 airfoil.

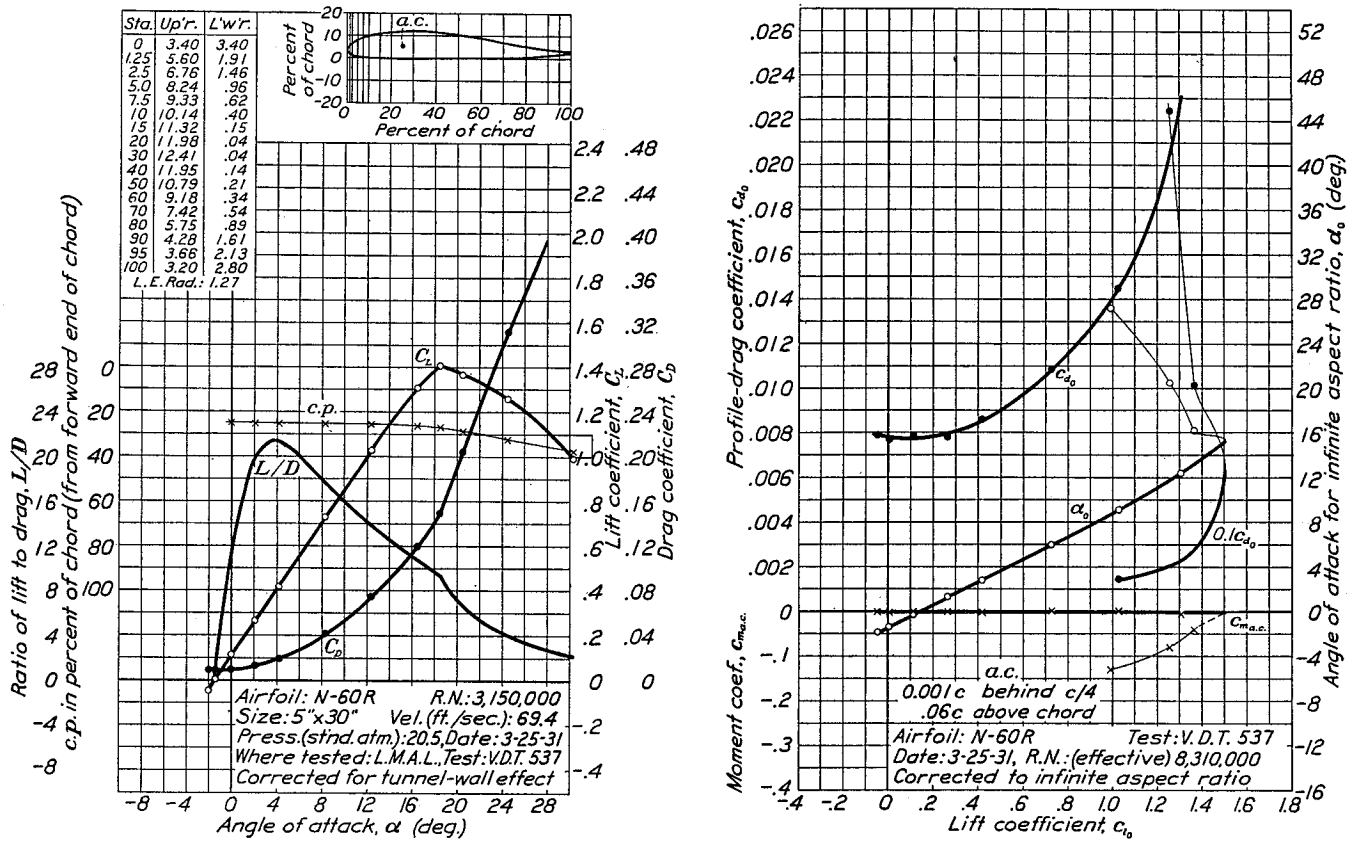


FIGURE 31.—N-60 R airfoil.

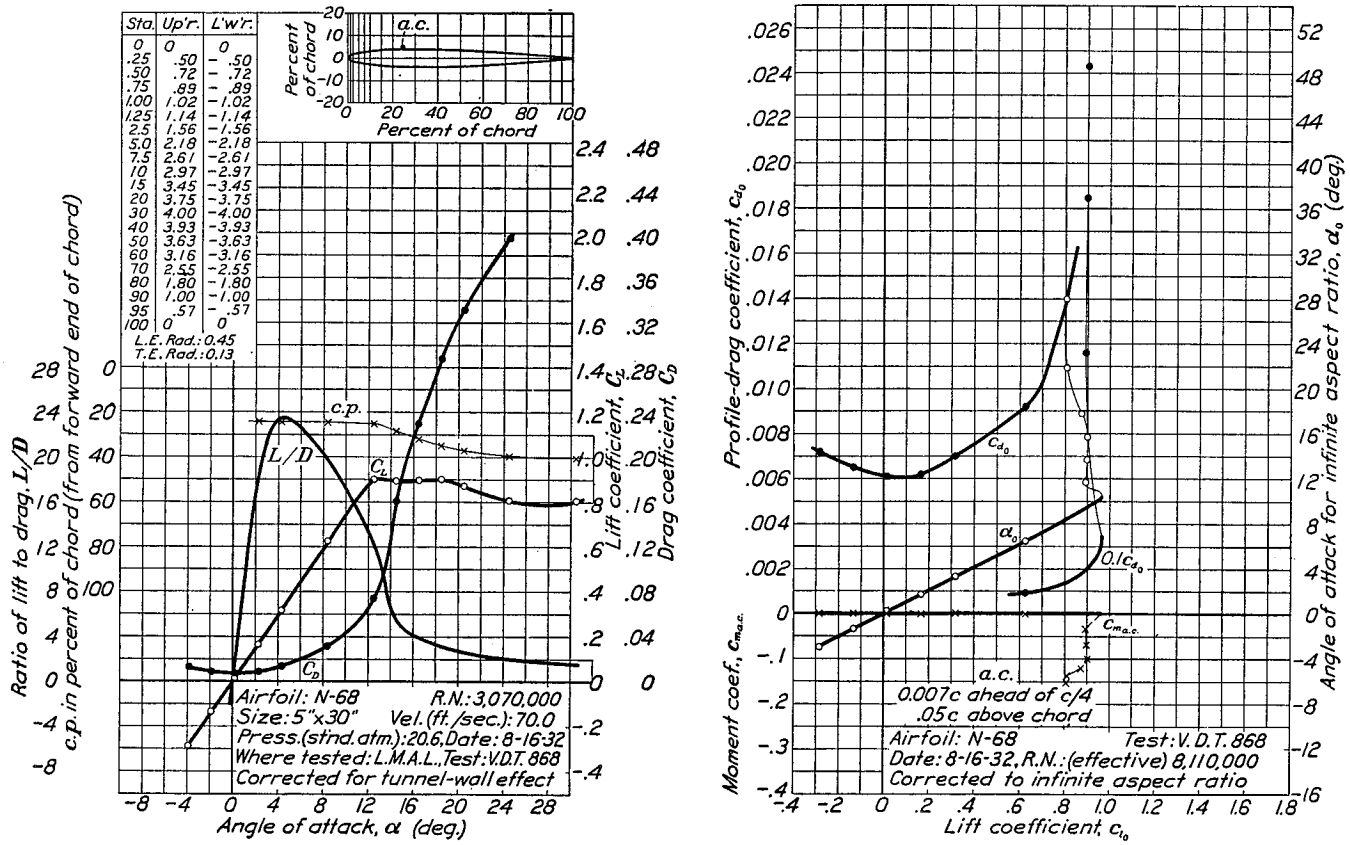
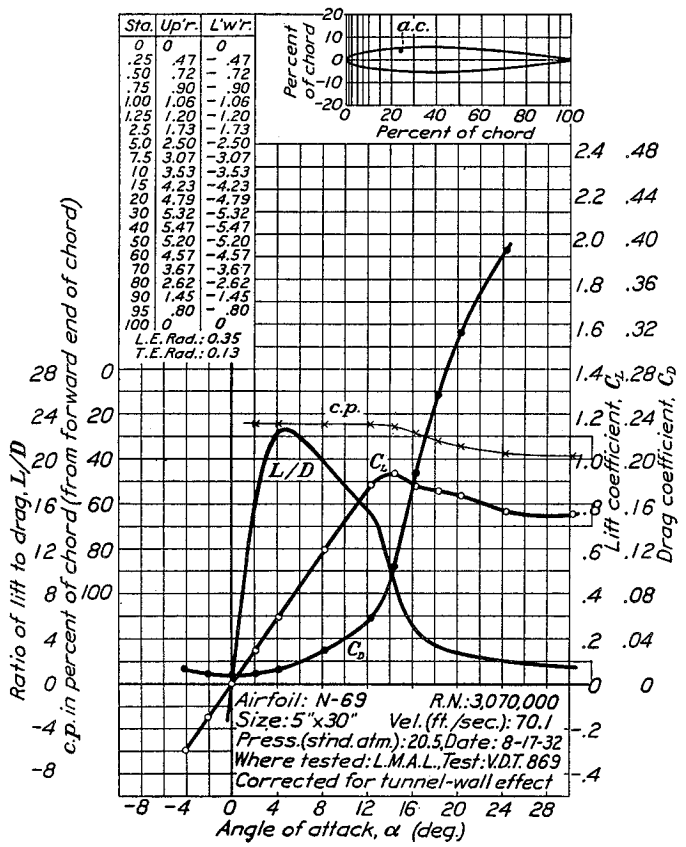


FIGURE 32.—N-68 airfoil.



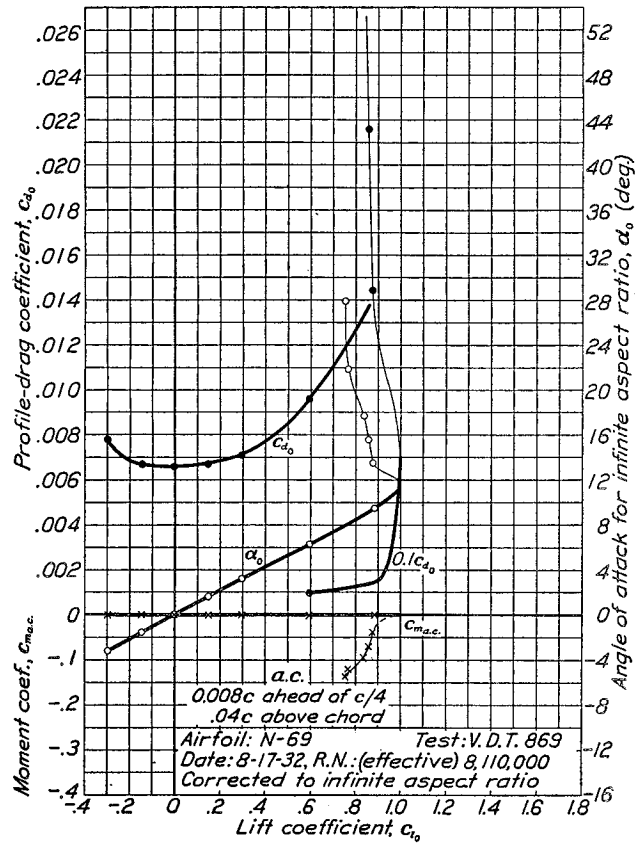
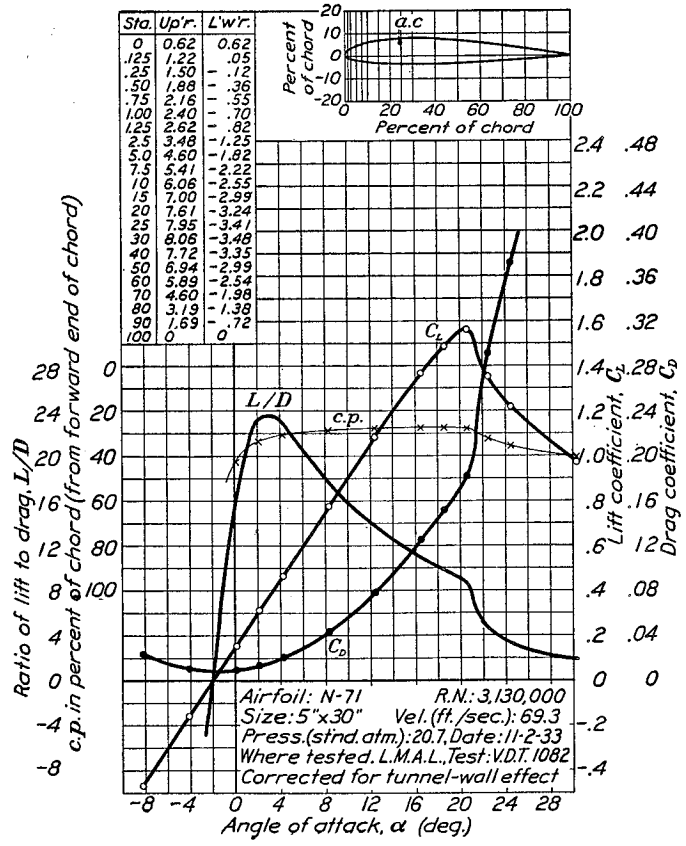


FIGURE 33.—N-69 airfoil.



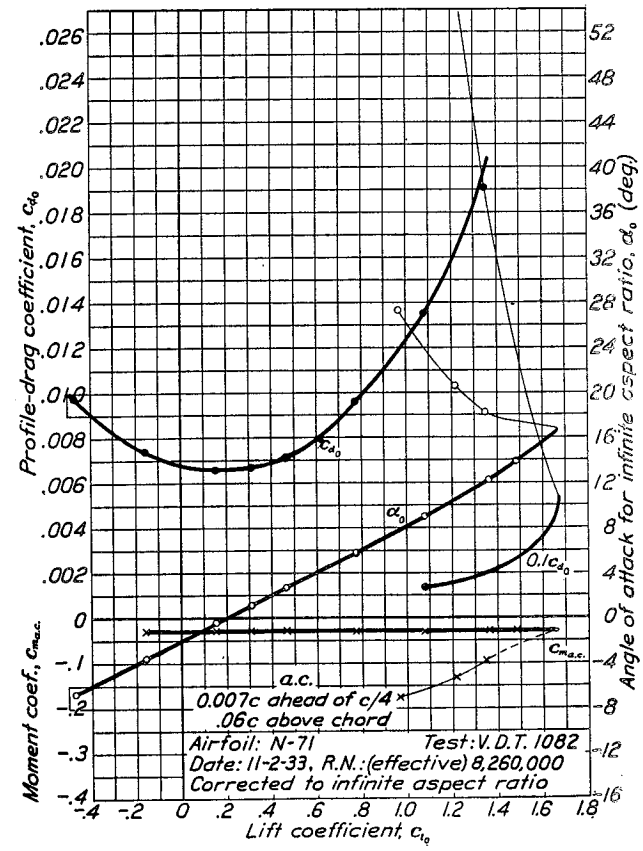


FIGURE 34.—N-71 airfoil.

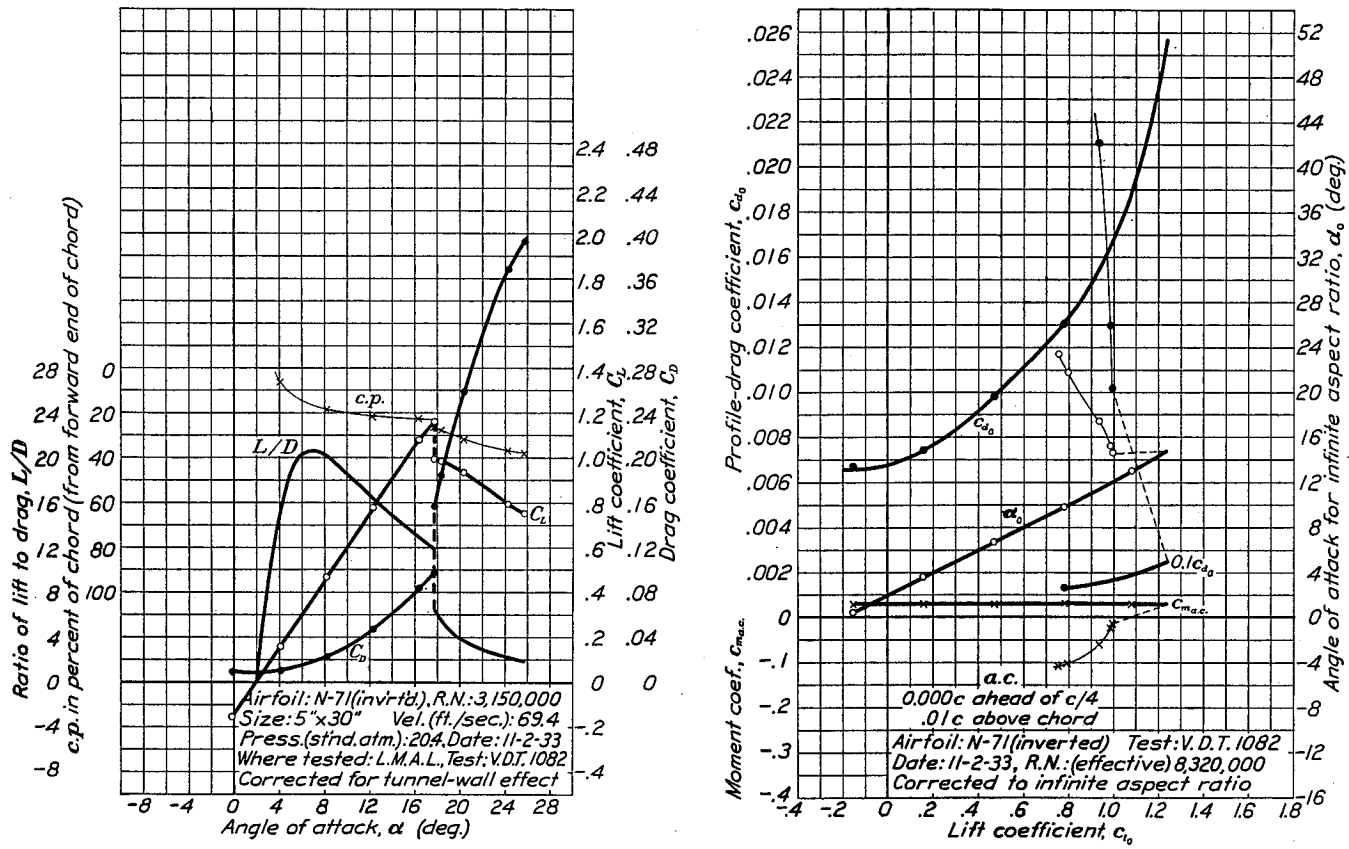


FIGURE 35.—N-71 airfoil (inverted).

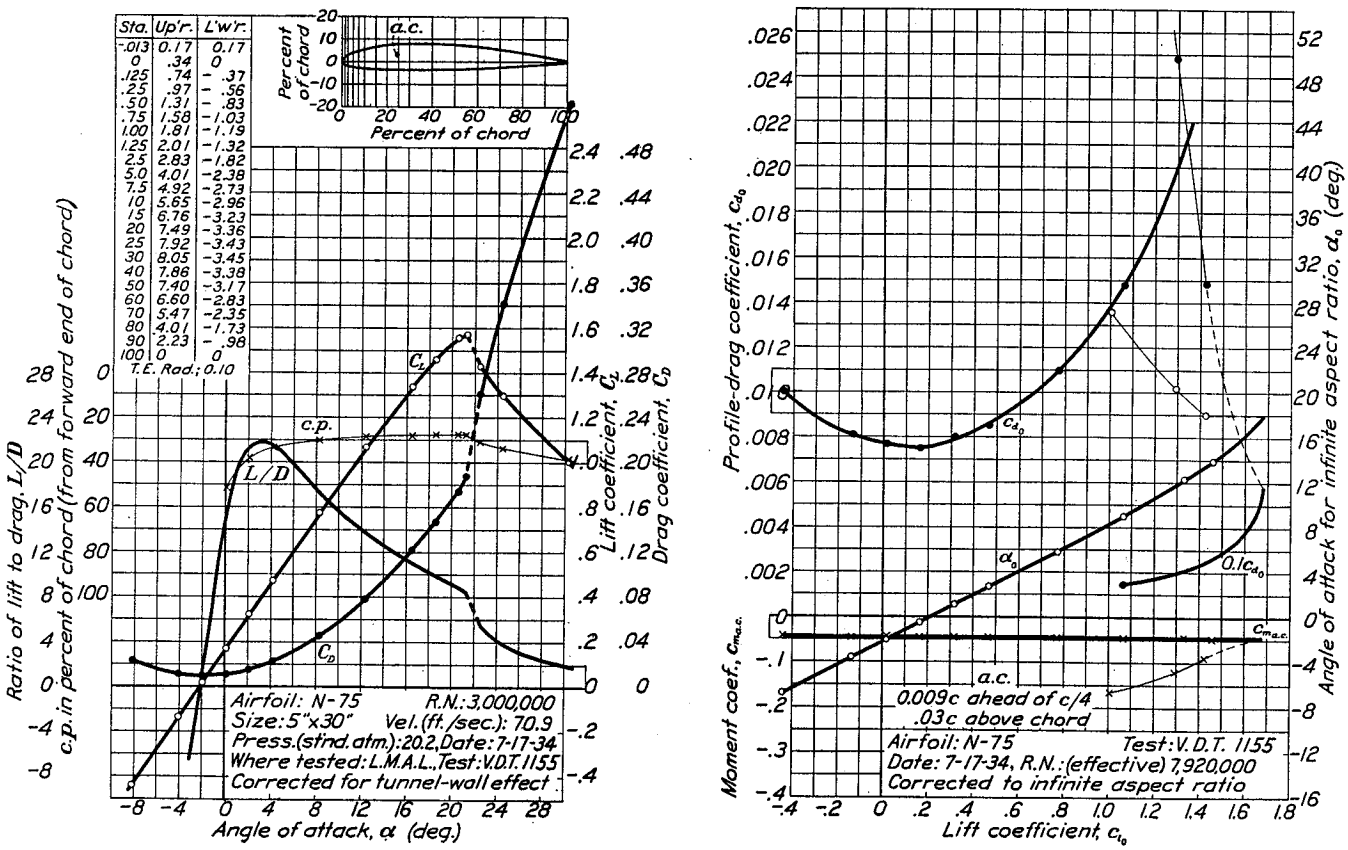


FIGURE 36.—N-75 airfoil.

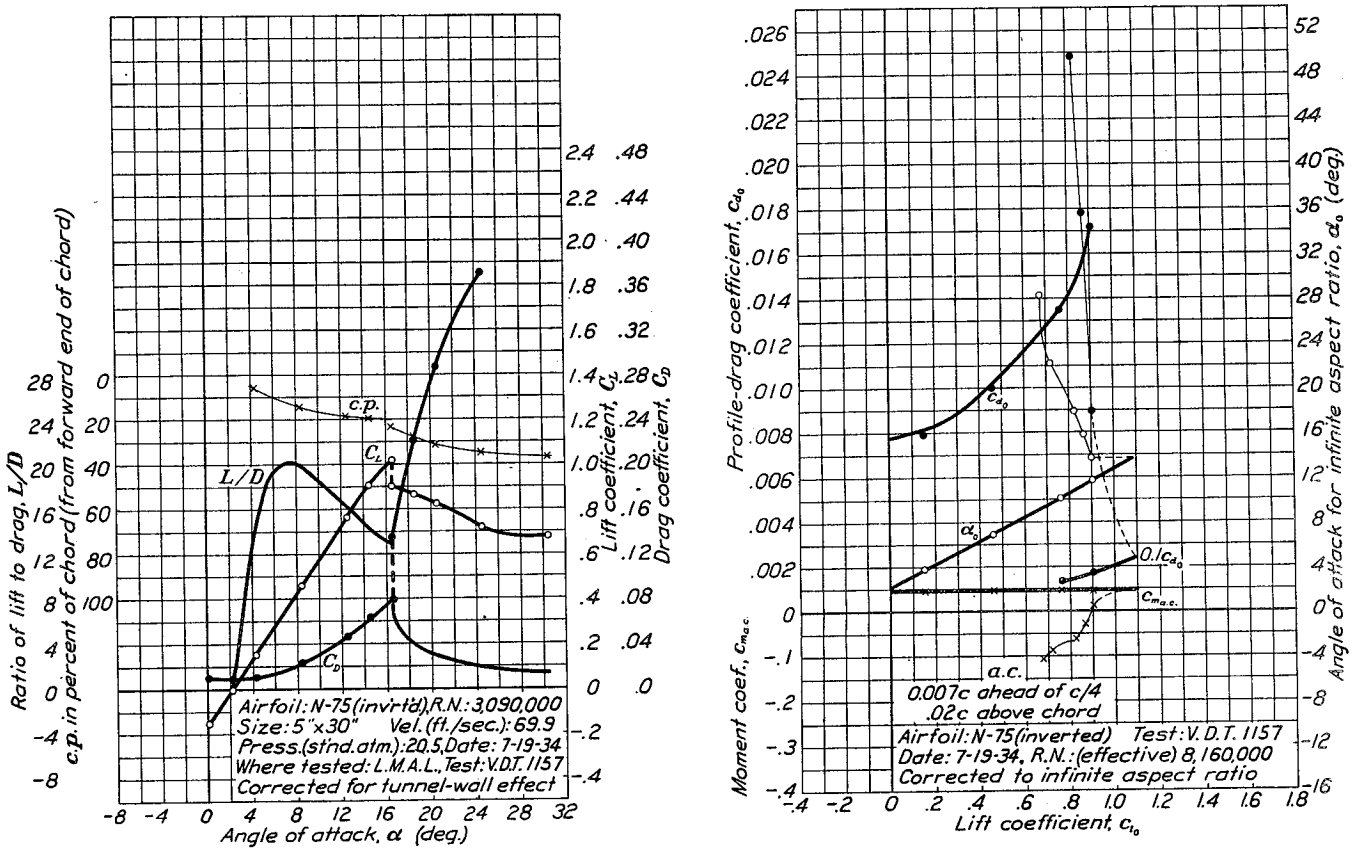


FIGURE 37.—N-75 airfoil (inverted).

Sta.	Up'r.	L'w'r.
-.02	0.21	0.21
0	.42	0
.125	.80	- .34
.25	1.03	- .53
.50	1.38	- .78
.75	1.65	- .97
1.00	1.89	- 1.12
1.25	2.11	- 1.25
2.5	2.98	- 1.70
5.0	4.25	- 2.19
7.5	5.22	- 2.46
10	6.01	- 2.64
15	7.20	- 2.80
20	8.01	- 2.86
25	8.47	- 2.87
30	8.63	- 2.87
40	8.42	- 2.84
50	7.81	- 2.77
60	6.79	- 2.64
70	5.37	- 2.46
80	3.69	- 2.05
90	1.97	- 1.23
100	0	0

T.E. Rad.: 0.10

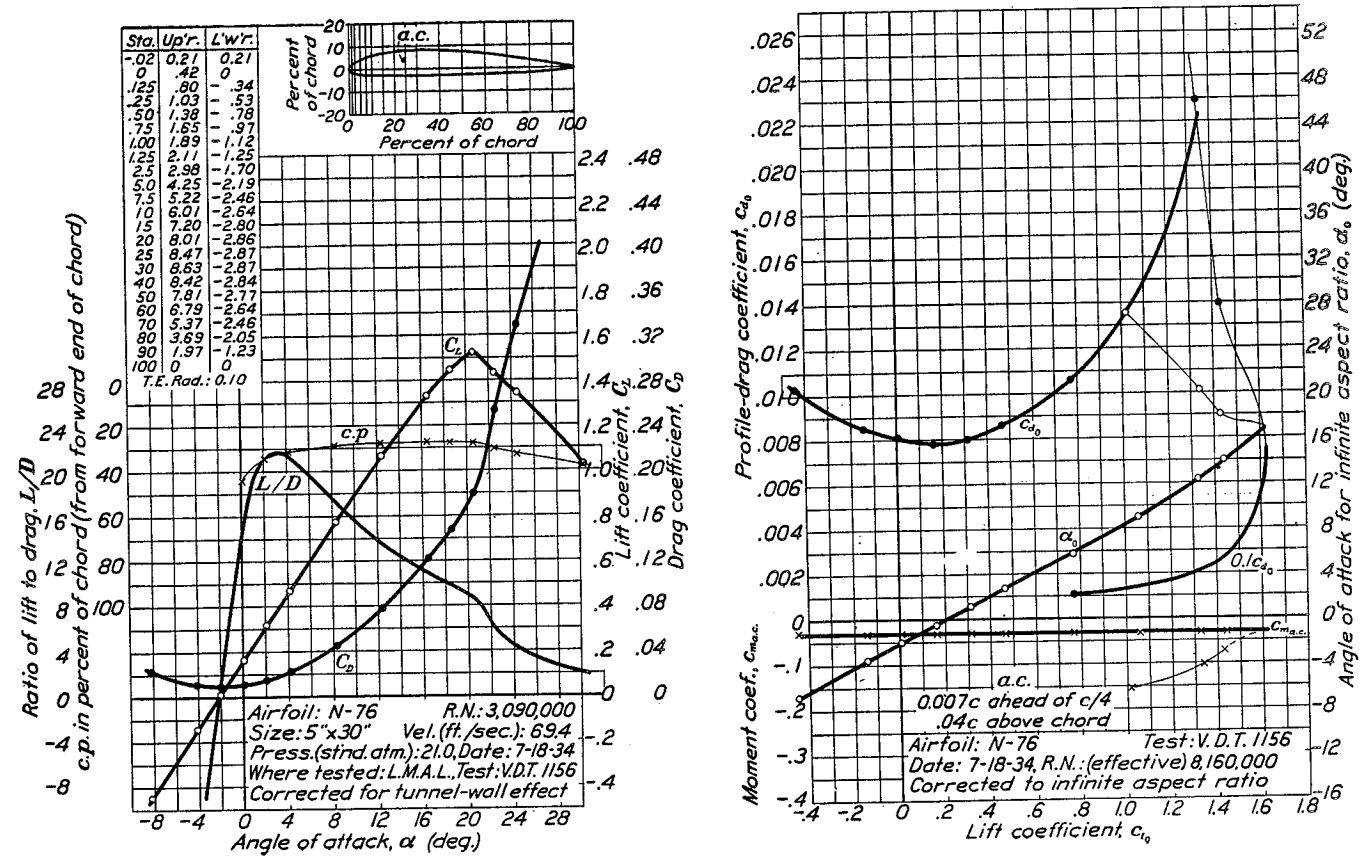


FIGURE 38.—N-76 airfoil.

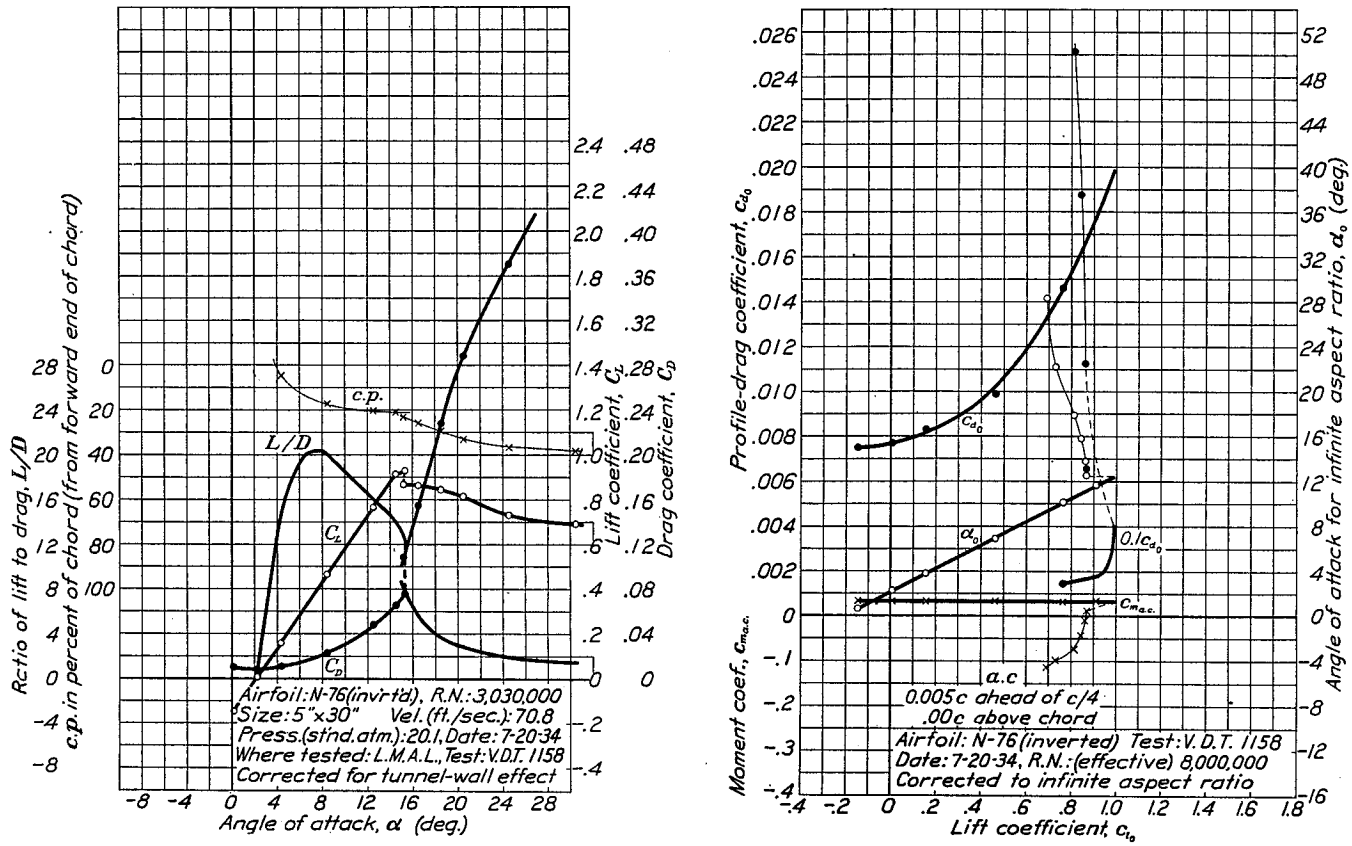


FIGURE 39.—N-76 airfoil (inverted).

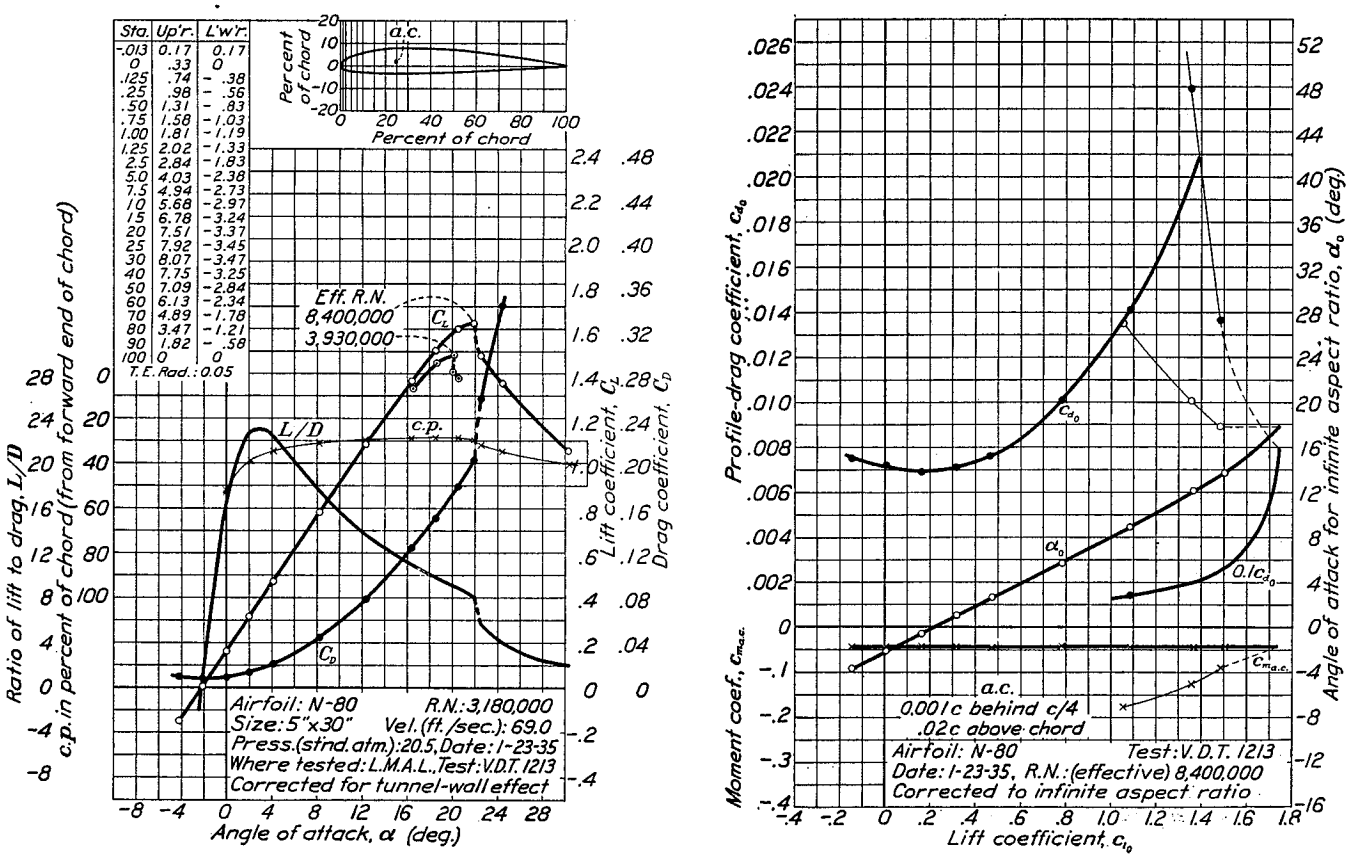


FIGURE 40.—N-80 airfoil.

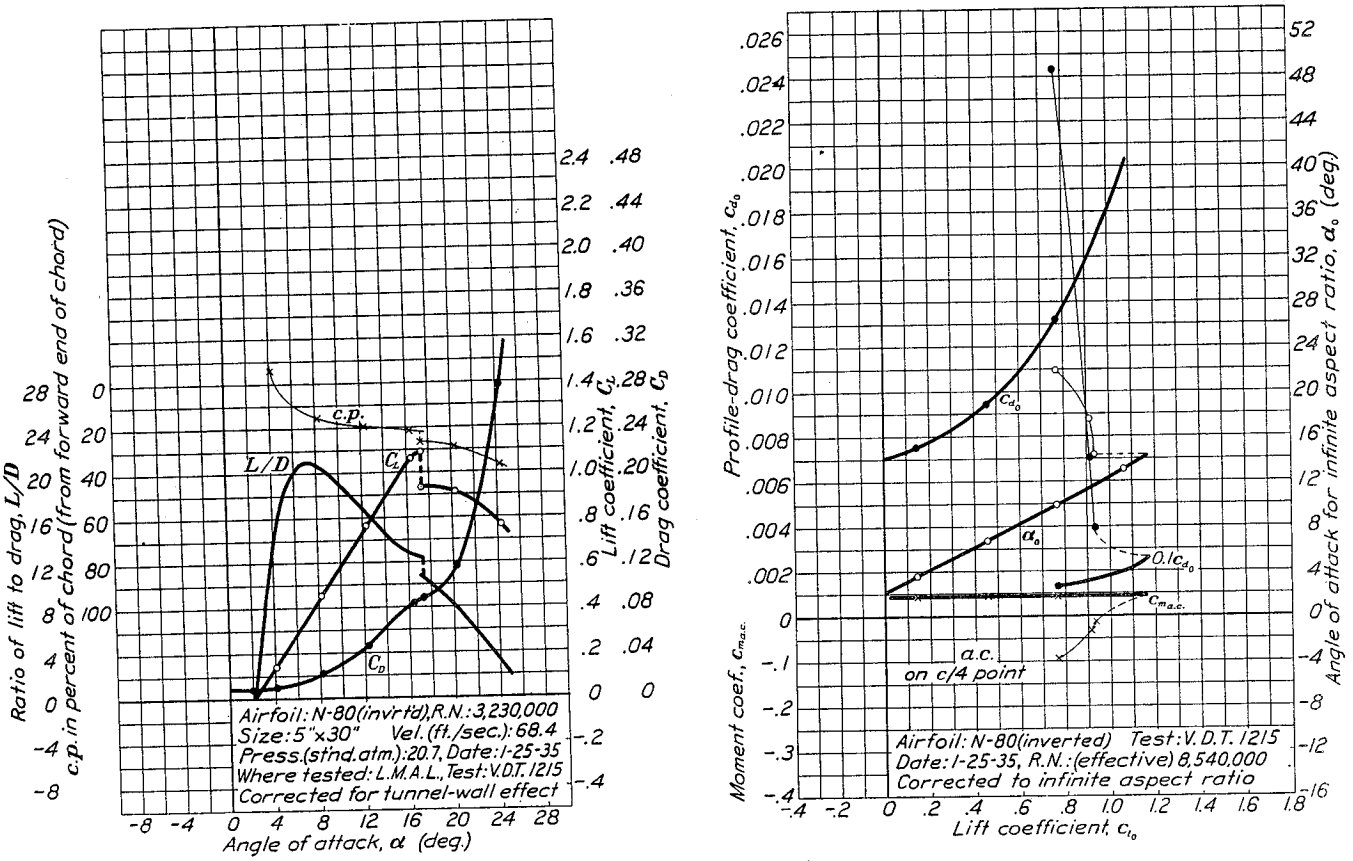


FIGURE 41.—N-80 airfoil (inverted).

Sta.	Up'r.	L'w'r.
.022	0.24	0.24
0	.48	0
.125	.90	− .38
.25	1.14	− .58
.50	1.51	− .86
.75	1.81	−1.07
1.00	2.06	−1.25
1.25	2.28	−1.39
2.5	3.18	−1.92
5.0	4.48	−2.50
7.5	5.45	−2.85
10	6.20	−3.07
15	7.27	−3.33
20	7.88	−3.43
25	8.07	−3.47
30	7.99	−3.40
40	7.53	−3.10
50	6.79	−2.70
60	5.83	−2.22
70	4.62	−1.67
80	3.25	−1.12
90	1.72	− .57
100	0	0

T.E. Rad.: 0.10

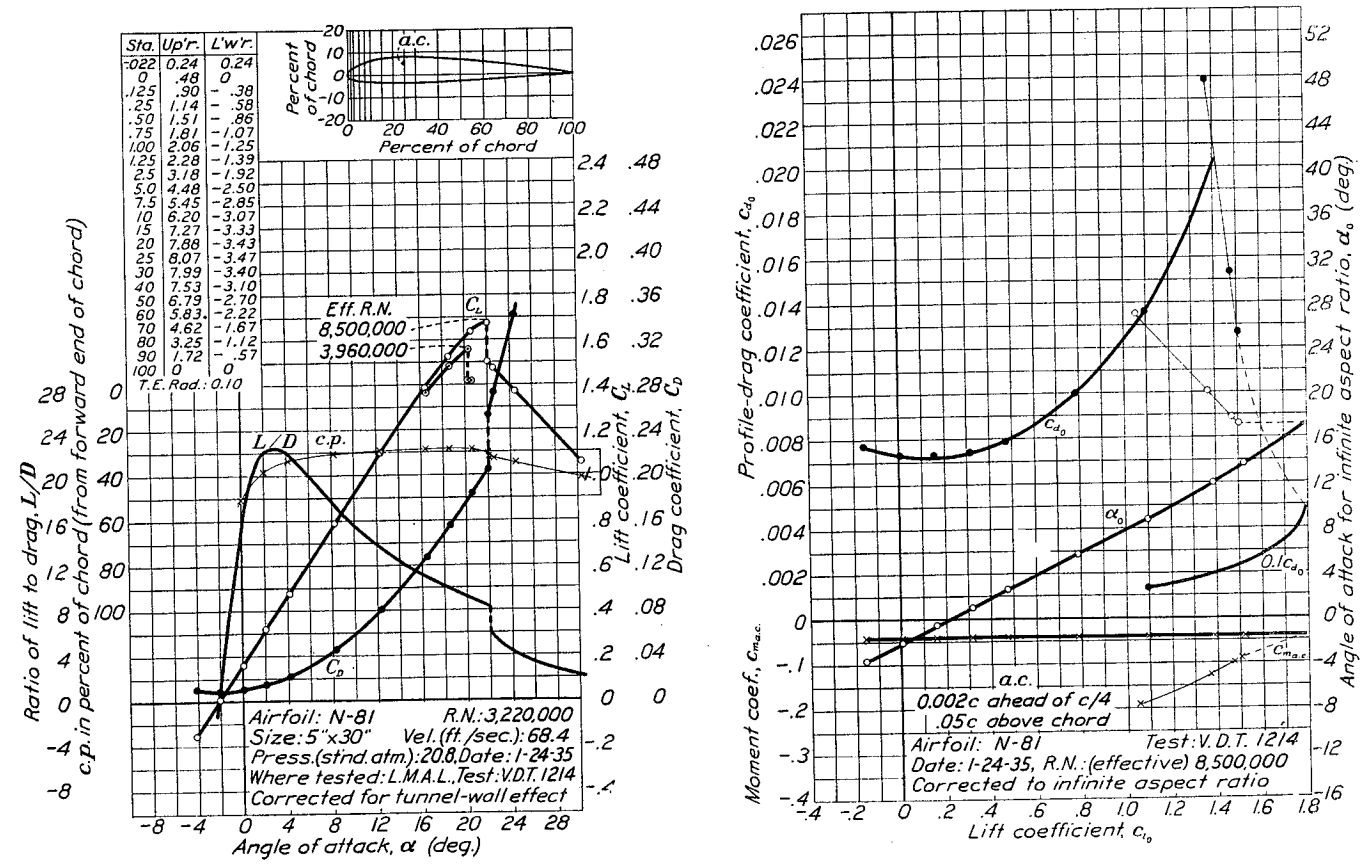


FIGURE 42.—N-81 airfoil.

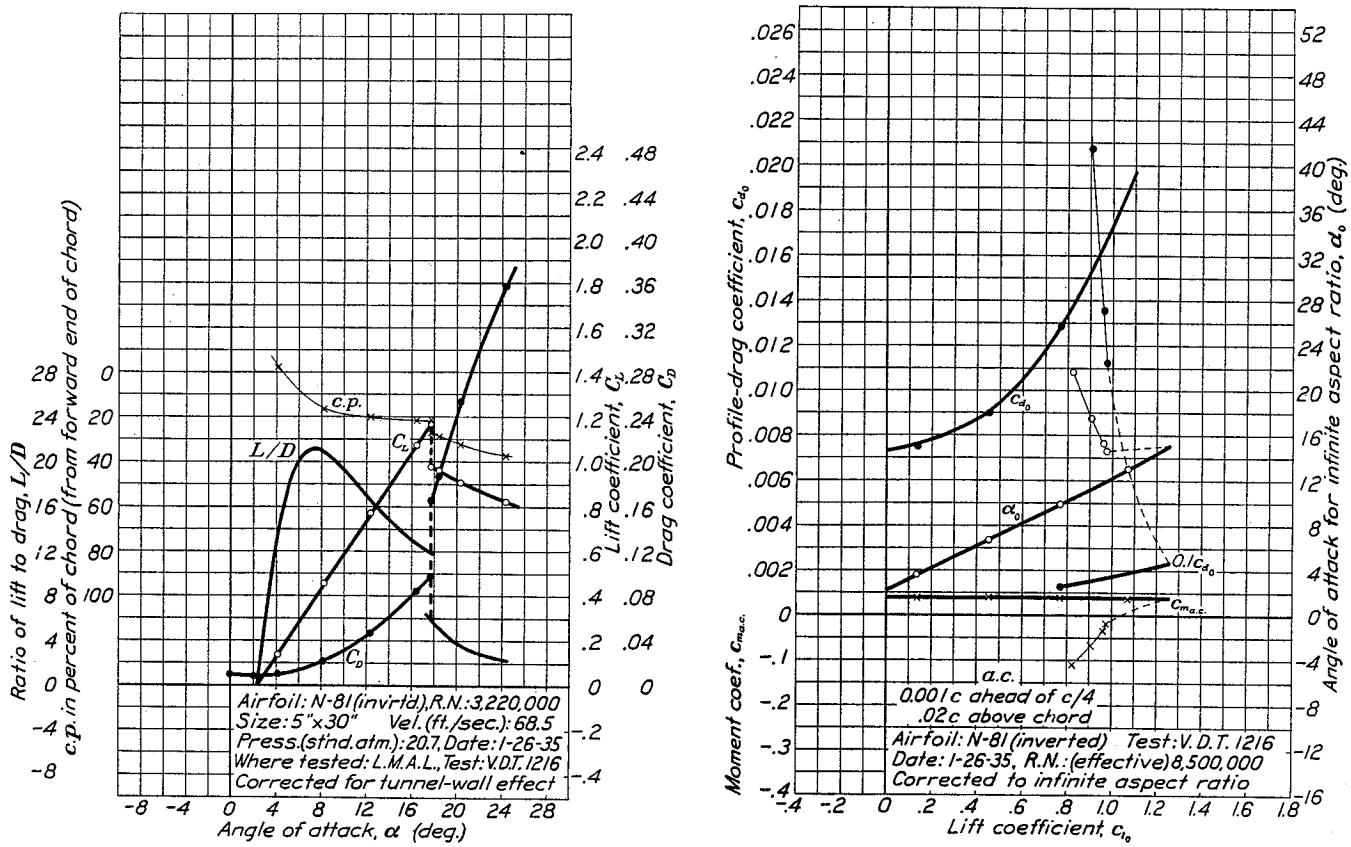


FIGURE 43.—N-81 airfoil (inverted).

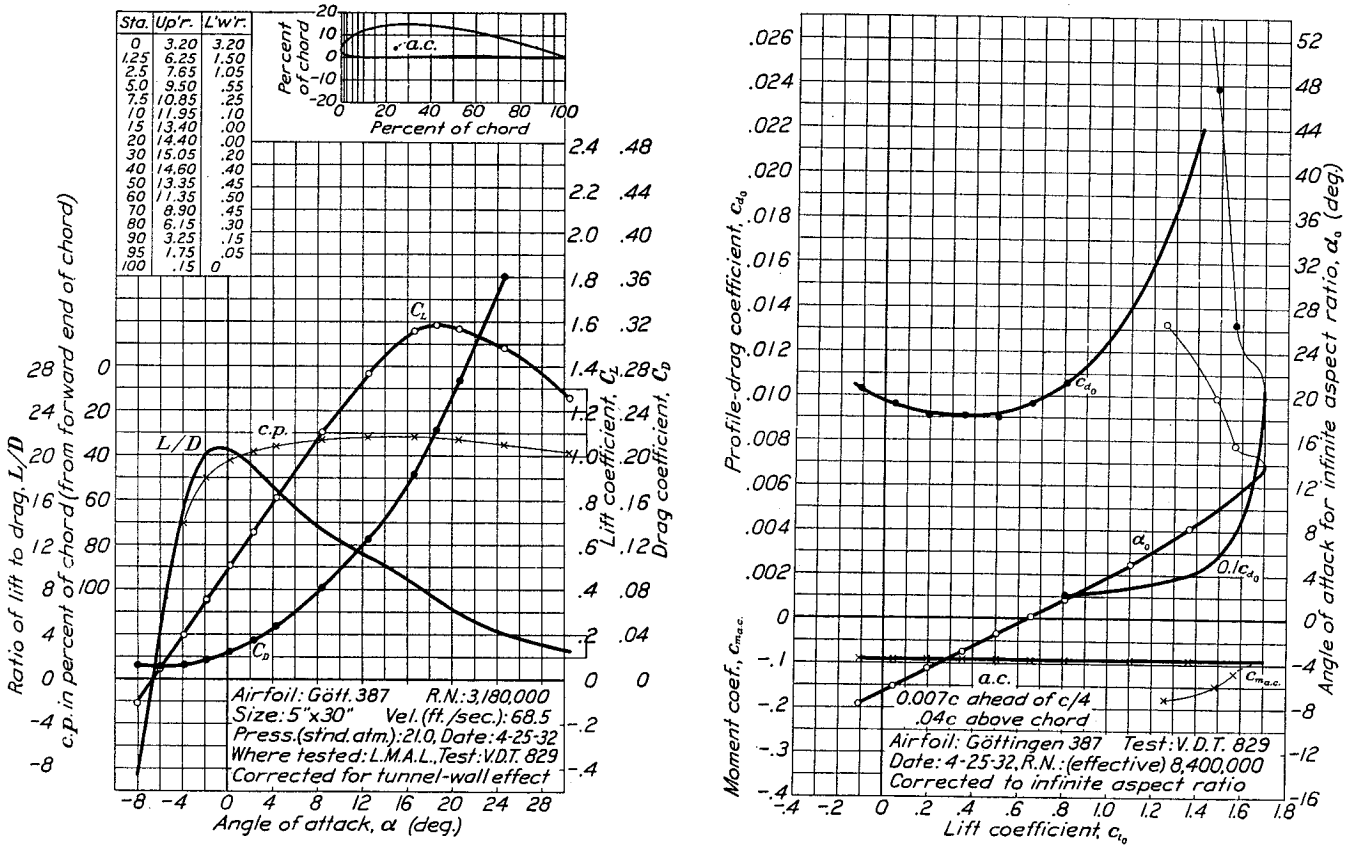


FIGURE 44.—Göttingen 387 airfoil.

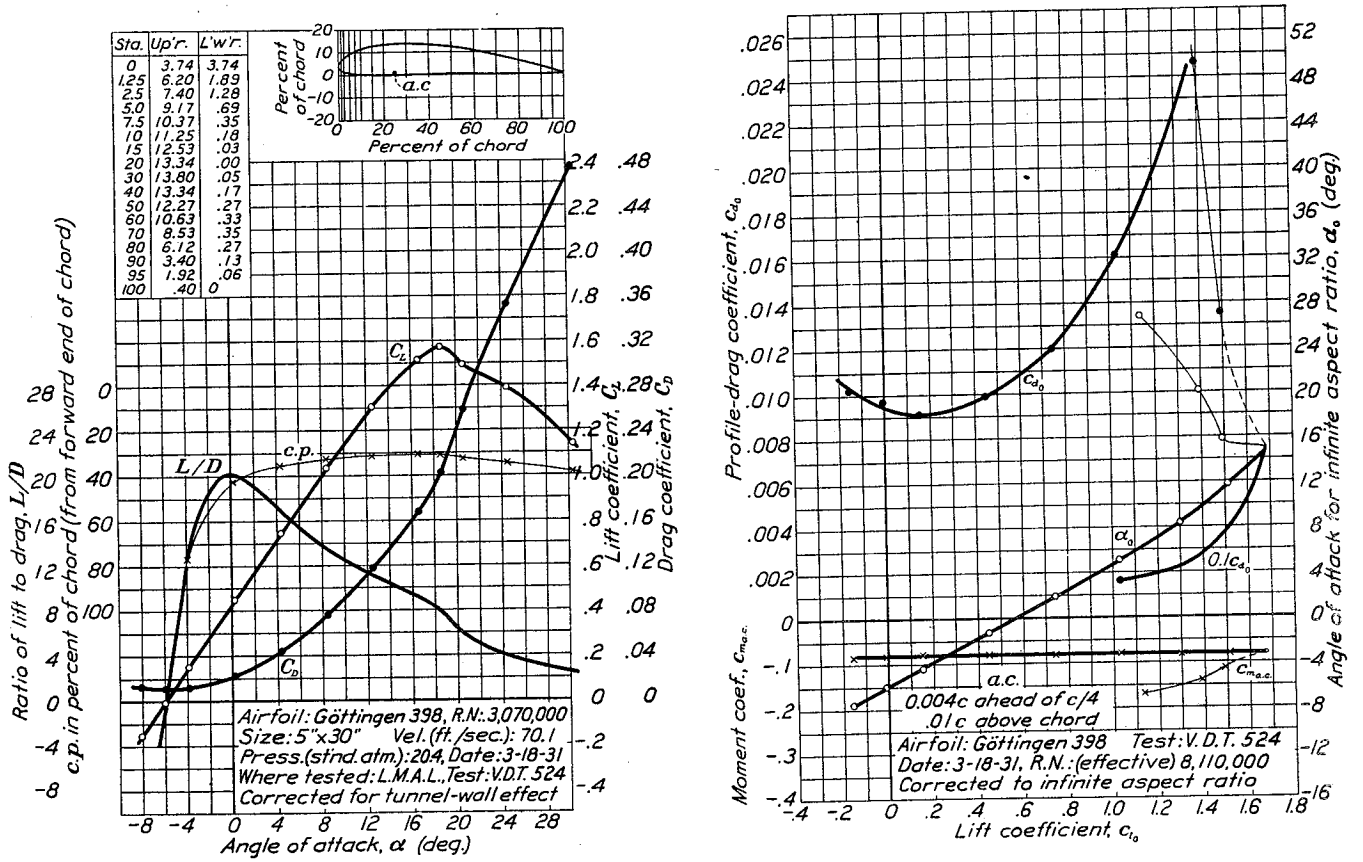


FIGURE 45.—Göttingen 398 airfoil.

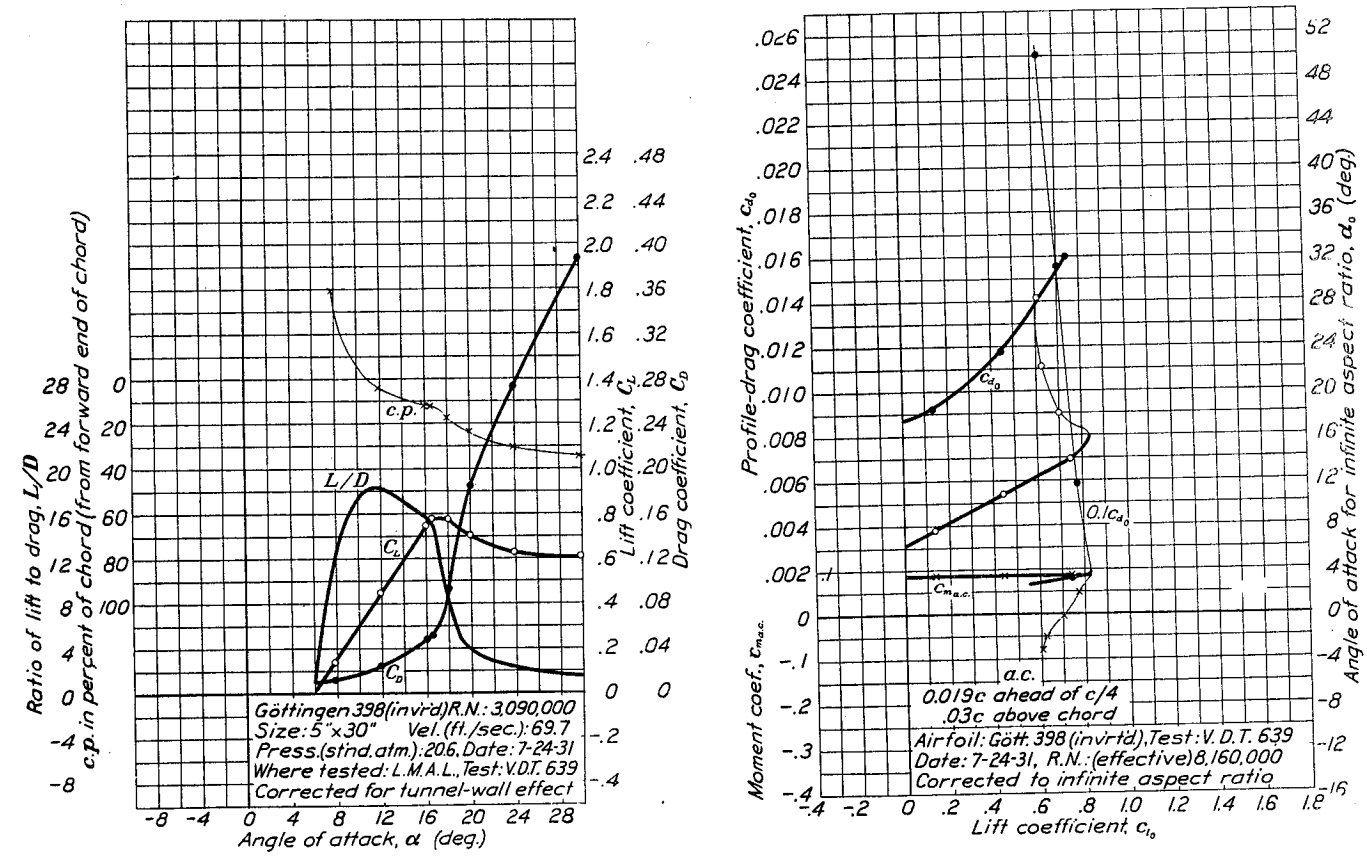


FIGURE 46.—Göttingen 398 airfoil (inverted).

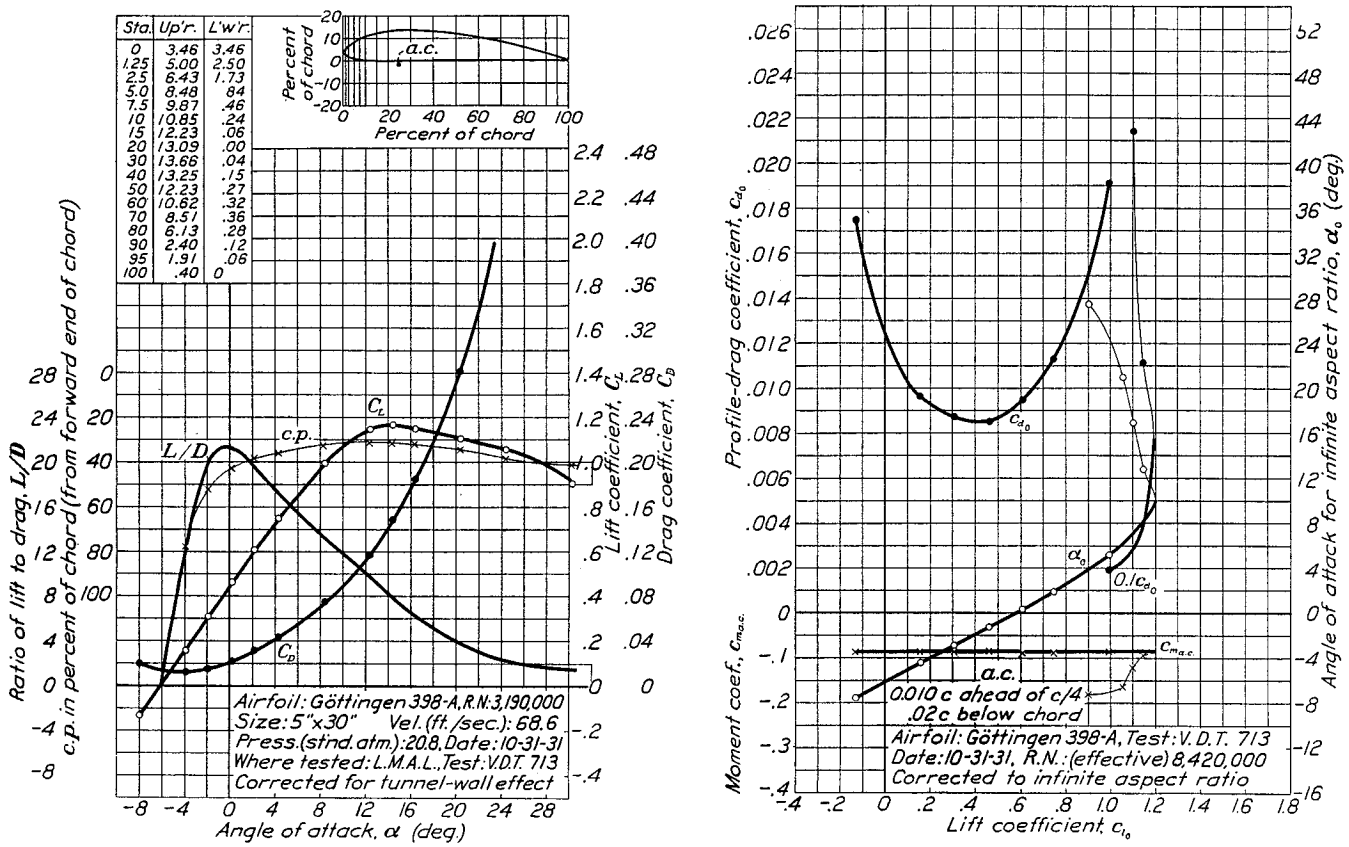


FIGURE 47.—Göttingen 398-A airfoil.

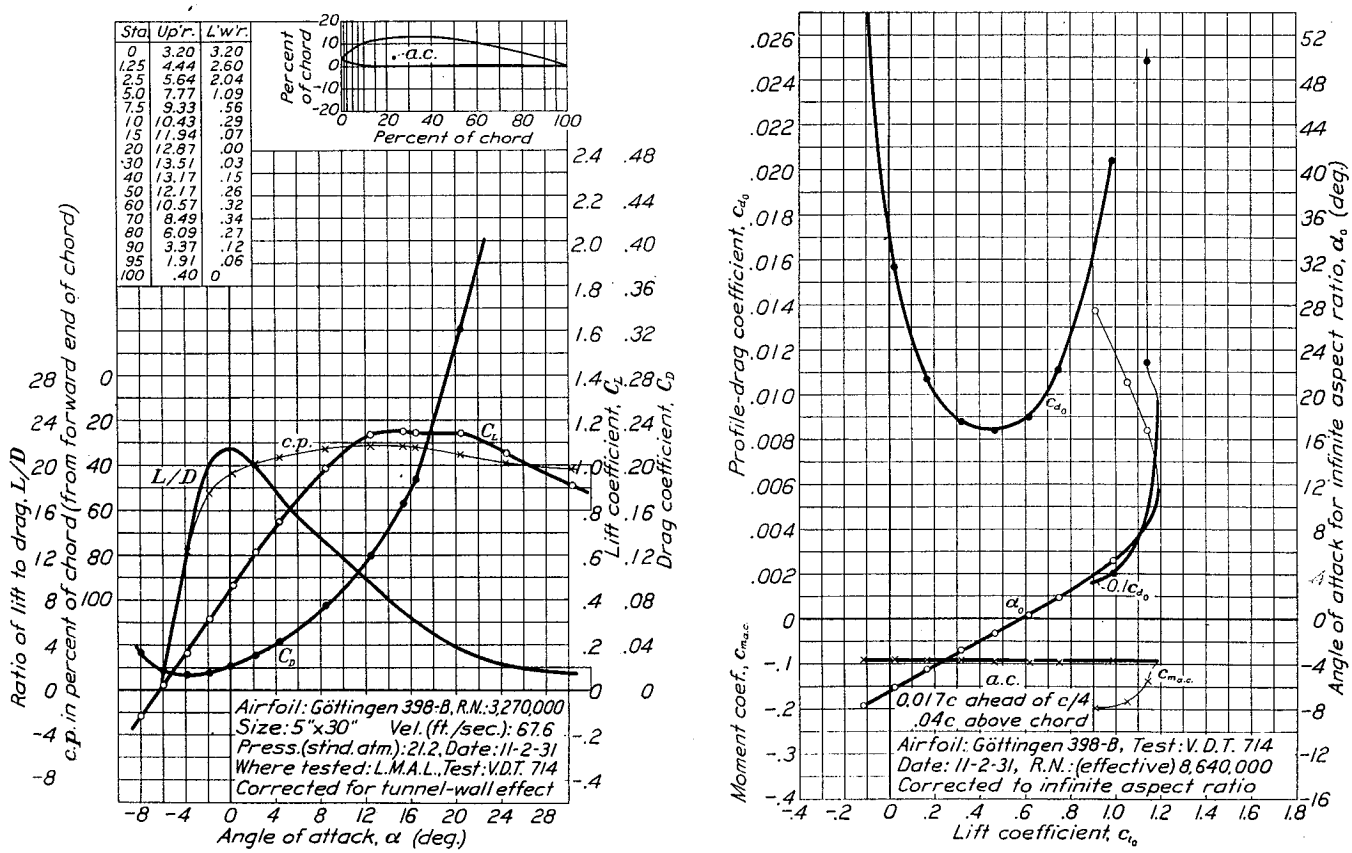


FIGURE 48.—Göttingen 398-B airfoil.

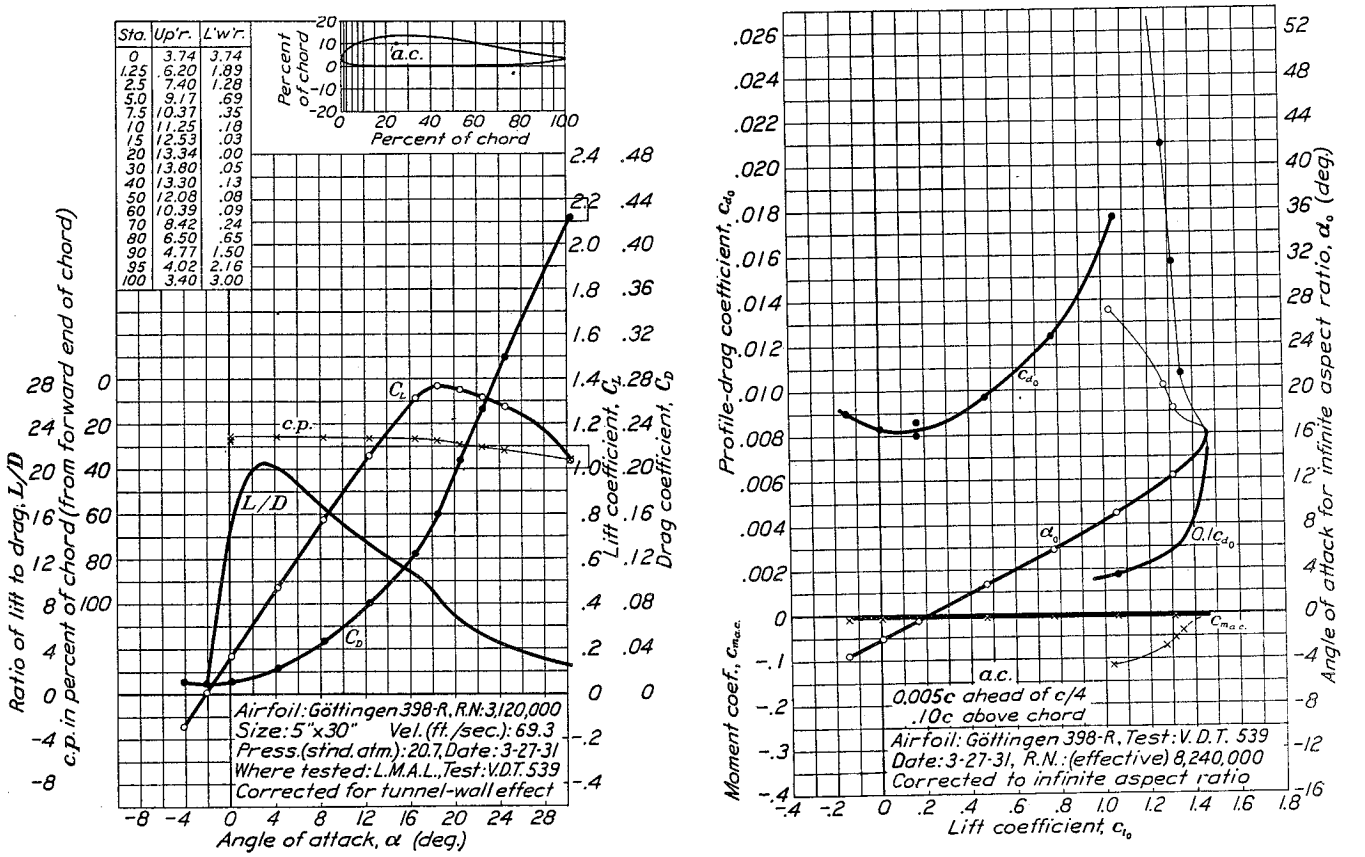


FIGURE 49.—Göttingen 398-R airfoil.

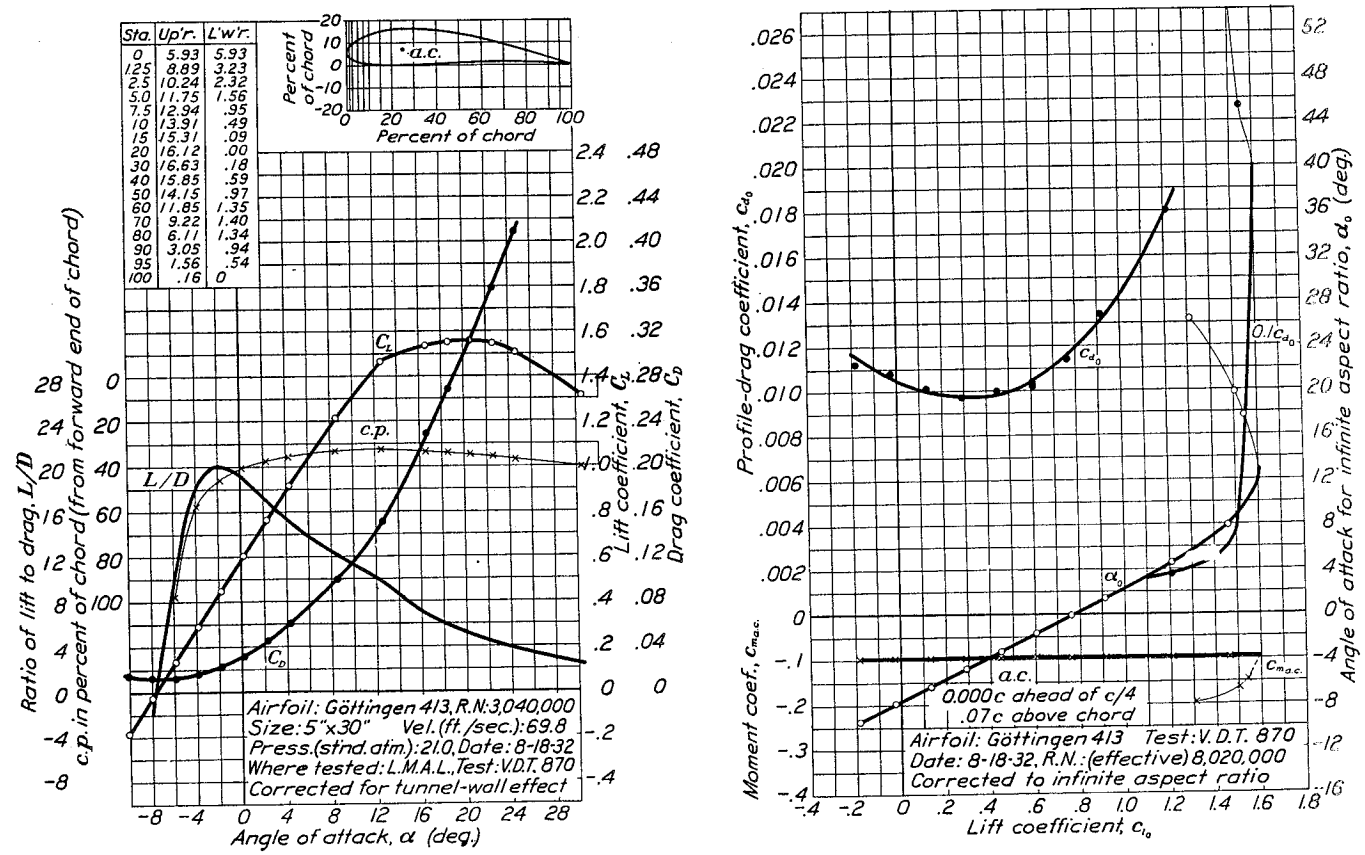


FIGURE 50.—Göttingen 413 airfoil.

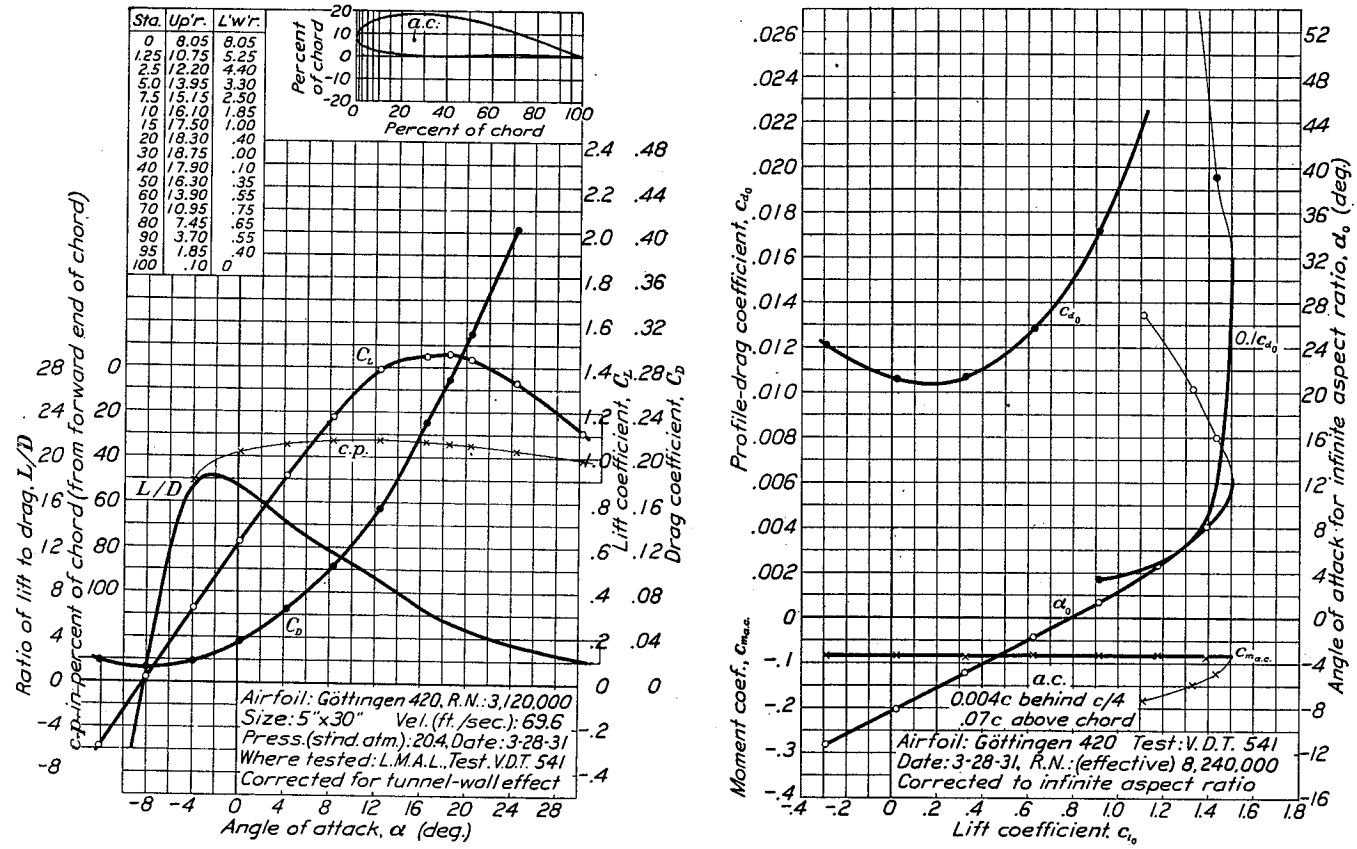


FIGURE 51.—Göttingen 420 airfoil.

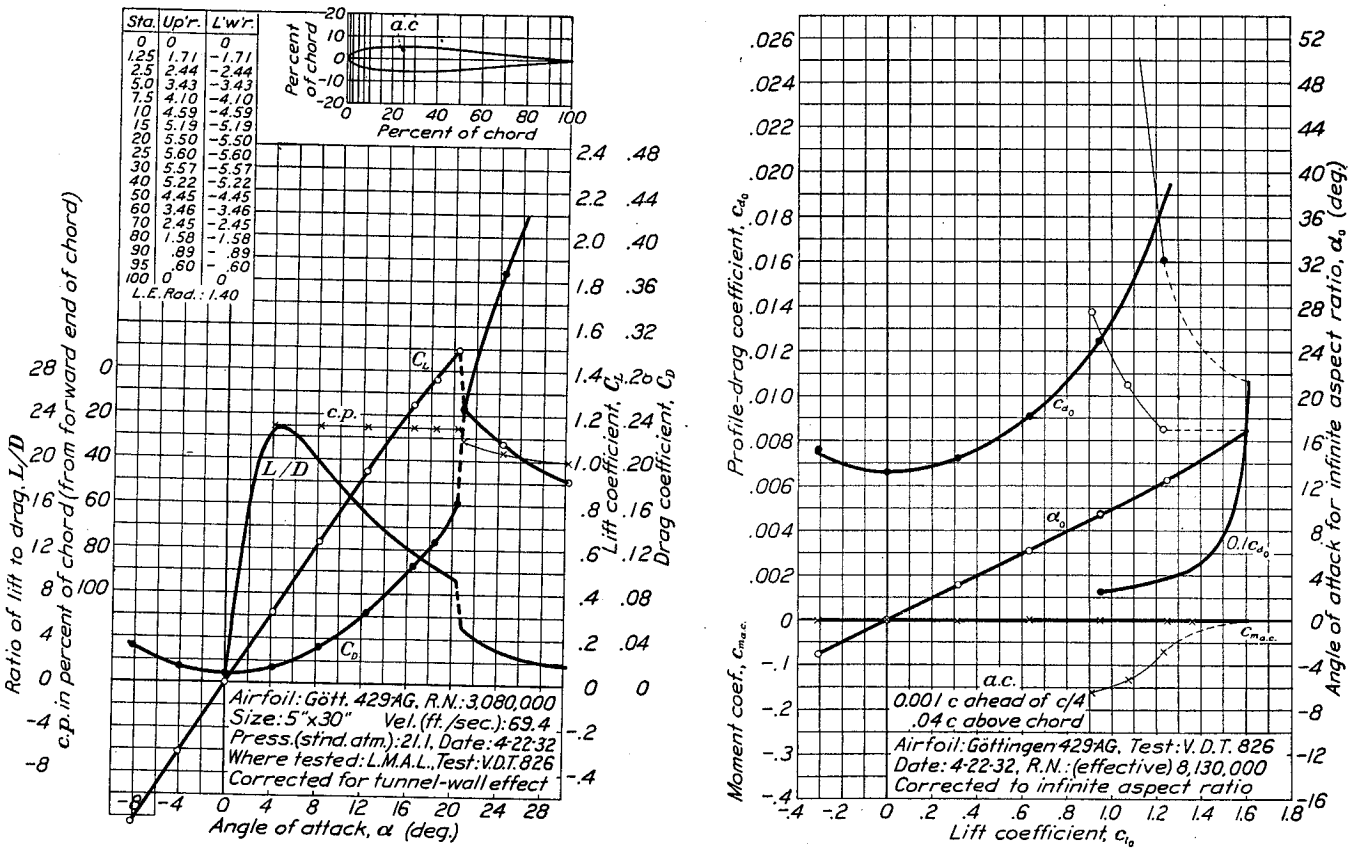


FIGURE 52.—Göttingen 429-AG airfoil.

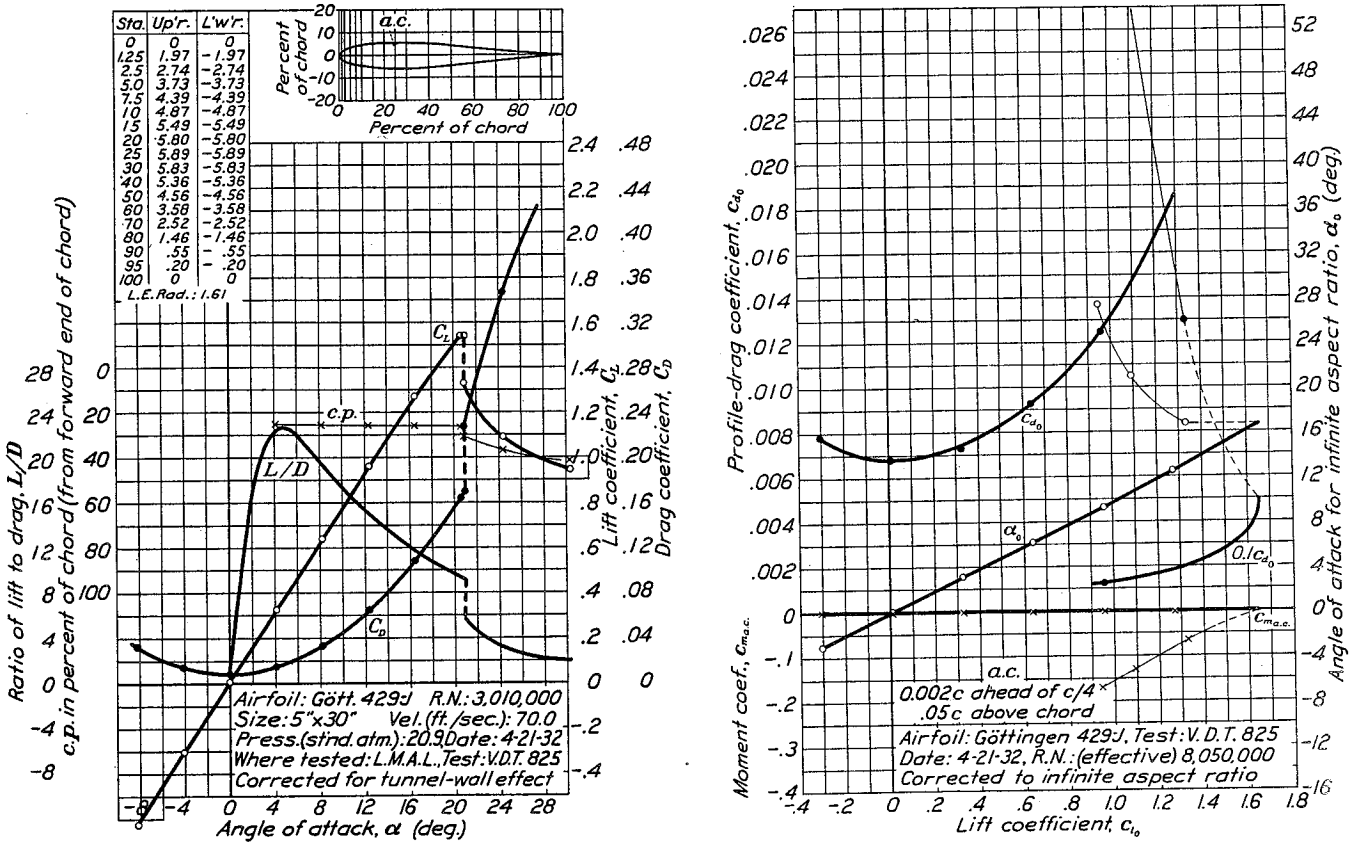


FIGURE 53.—Göttingen 429-J airfoil.

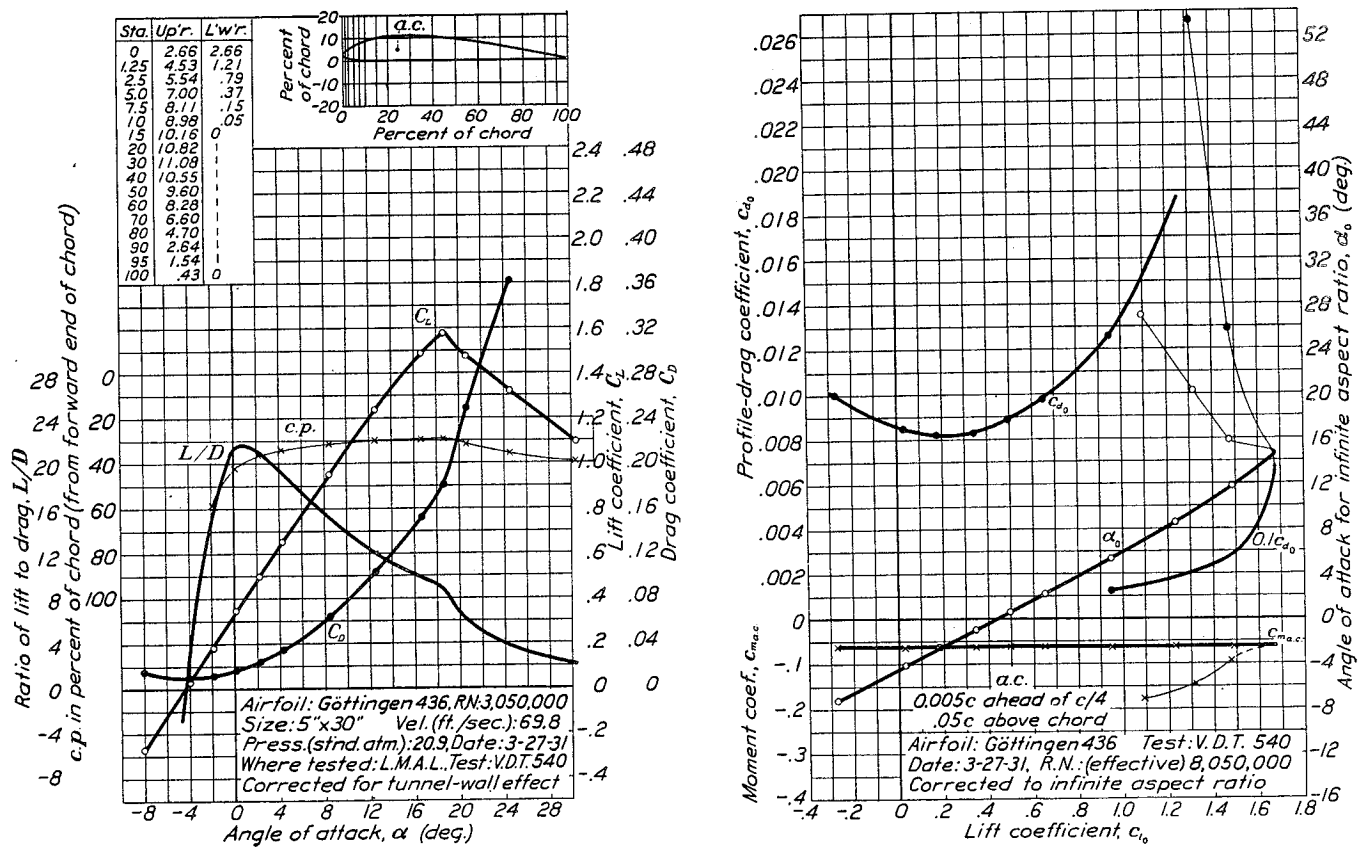


FIGURE 54.—Göttingen 436 airfoil.

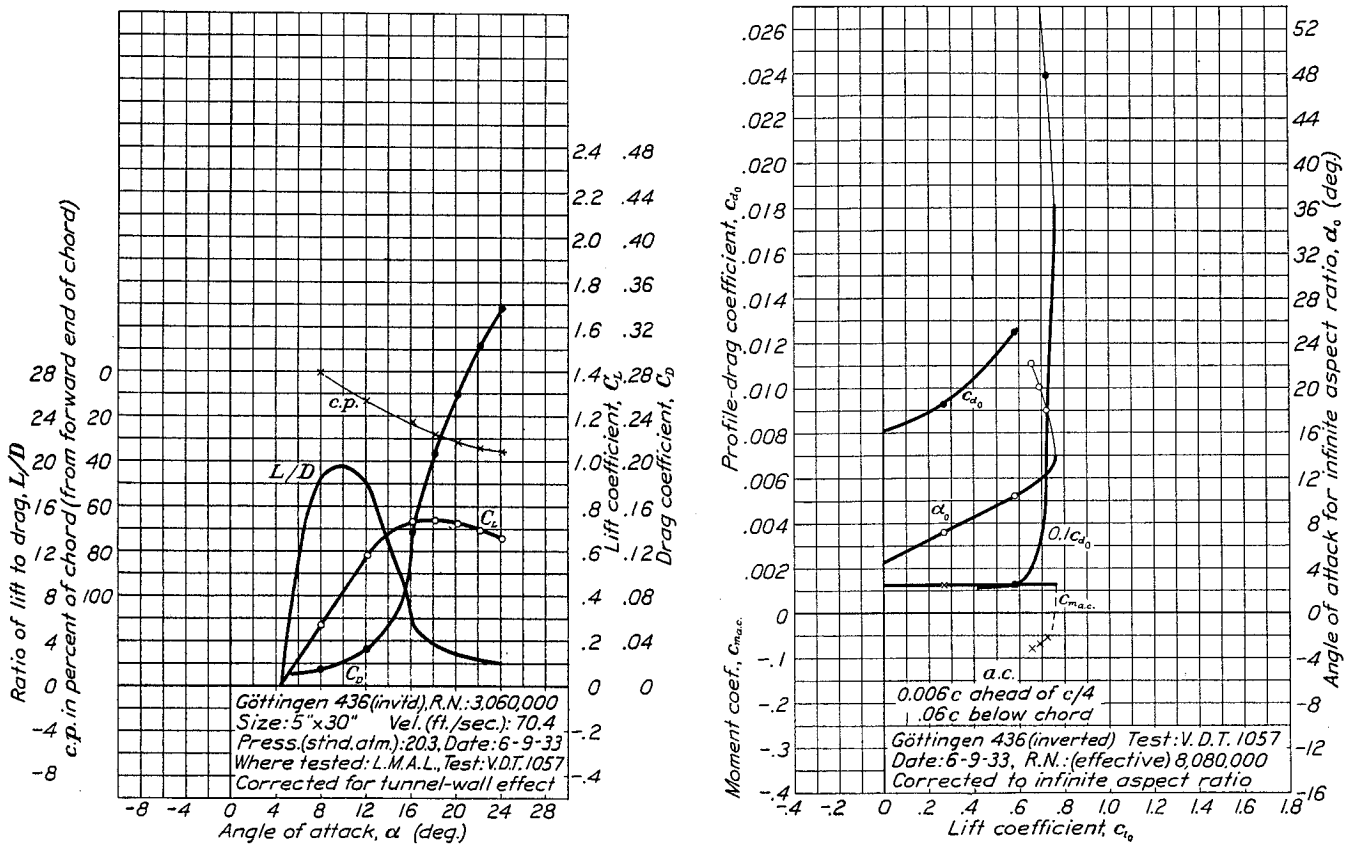


FIGURE 55.—Göttingen 436 airfoil (inverted).

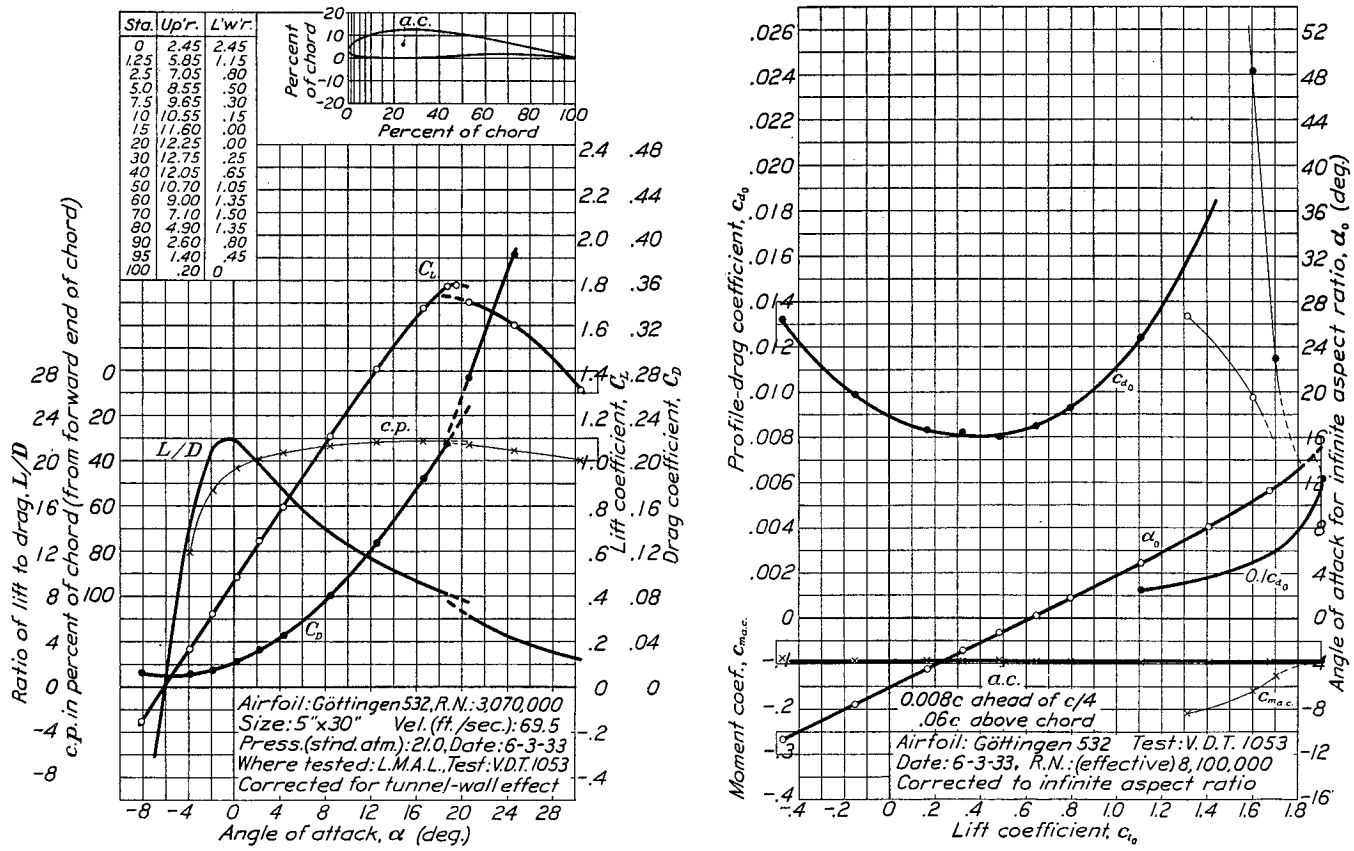


FIGURE 56.—Göttingen 532 airfoil.

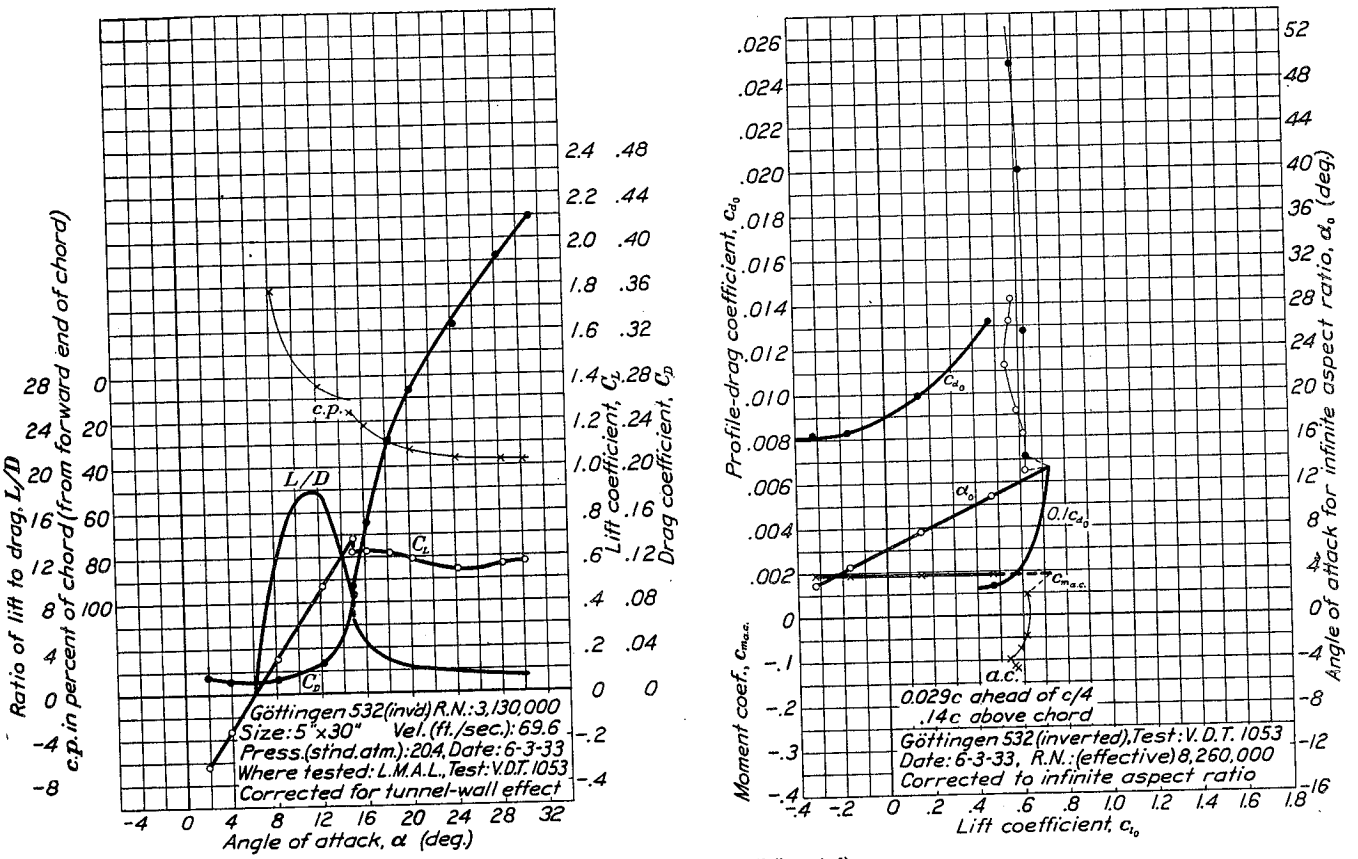


FIGURE 57.—Göttingen 532 airfoil (inverted).

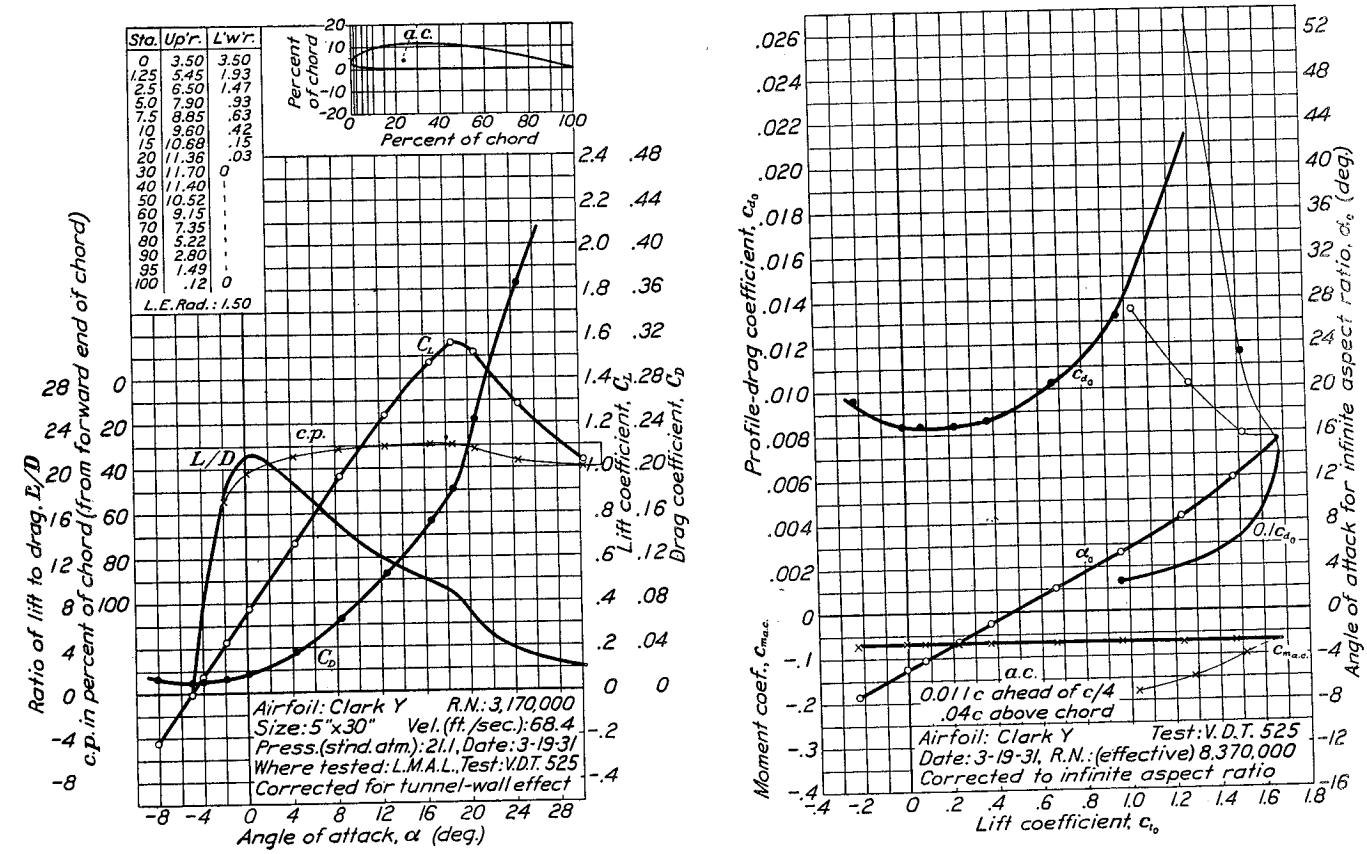


FIGURE 58.—Clark Y airfoil.

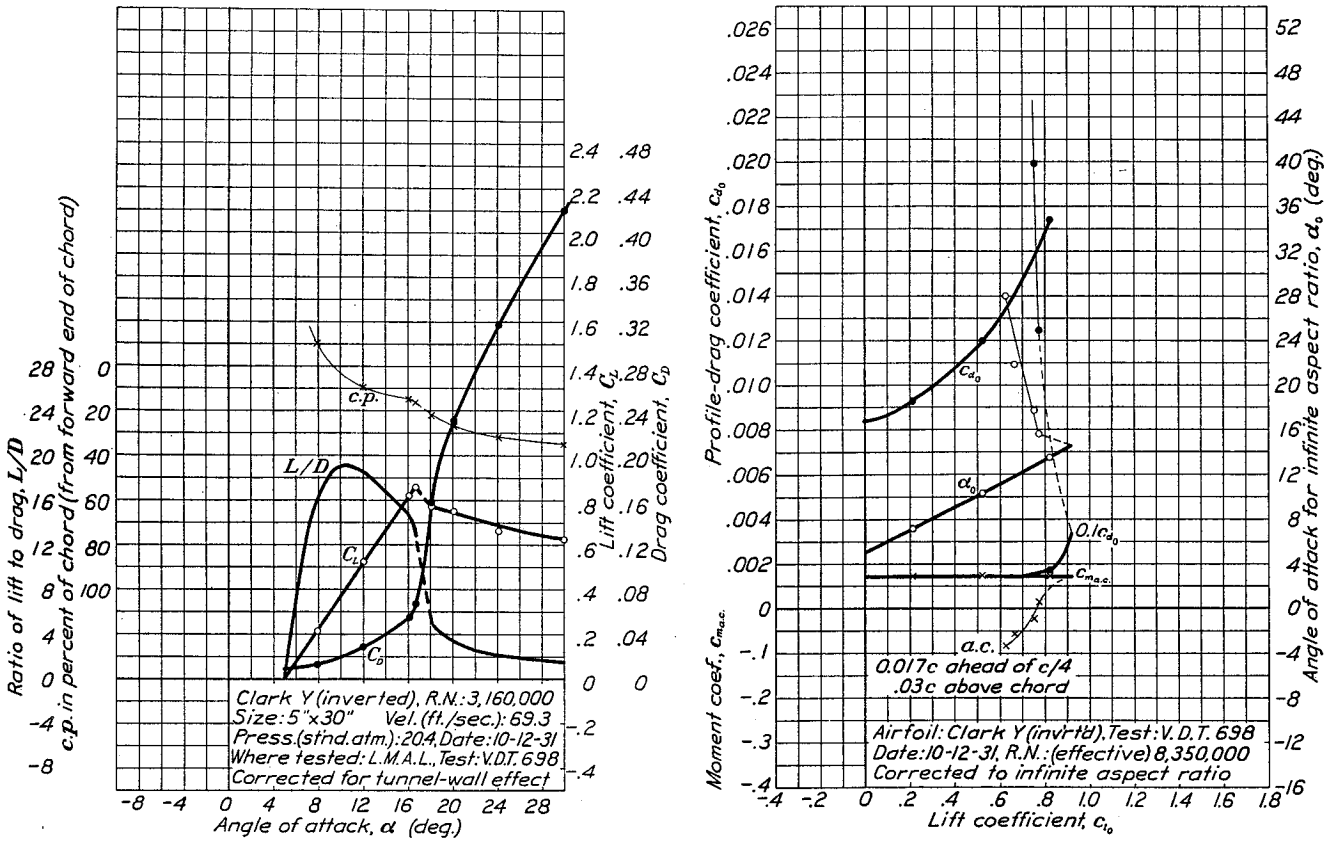


FIGURE 59.—Clark Y airfoil (inverted).

Sta.	Up'r.	L'w'r.
0	3.43	3.43
1.25	4.29	2.83
2.5	5.11	2.23
5.0	6.76	1.28
7.5	8.02	.81
10	8.92	.57
15	10.14	.14
20	11.00	.03
30	11.46	0
40	11.24	0
50	10.44	0
60	9.09	0
70	7.32	0
80	5.21	0
90	2.81	0
95	1.47	0
100	.12	0

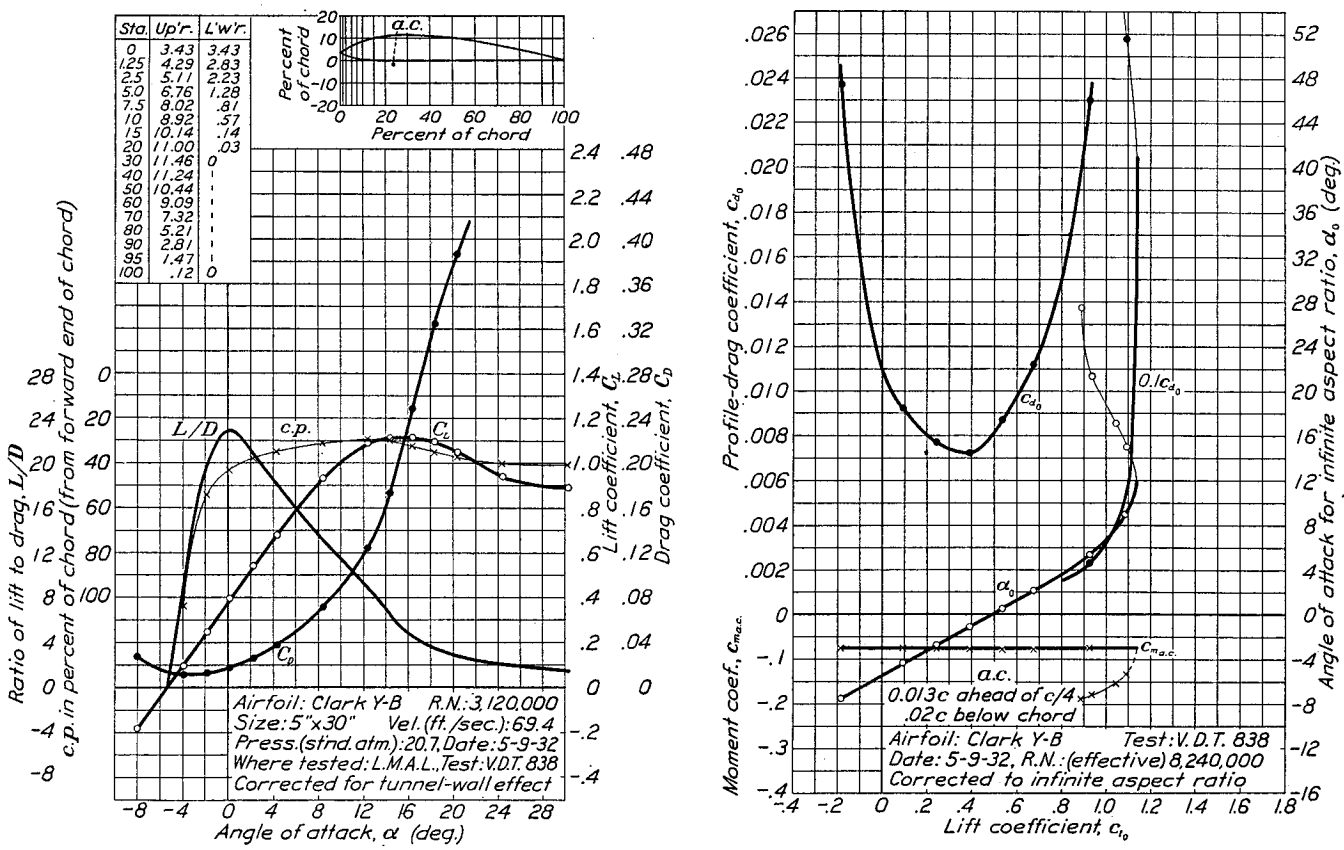


FIGURE 60.—Clark Y-B airfoil.

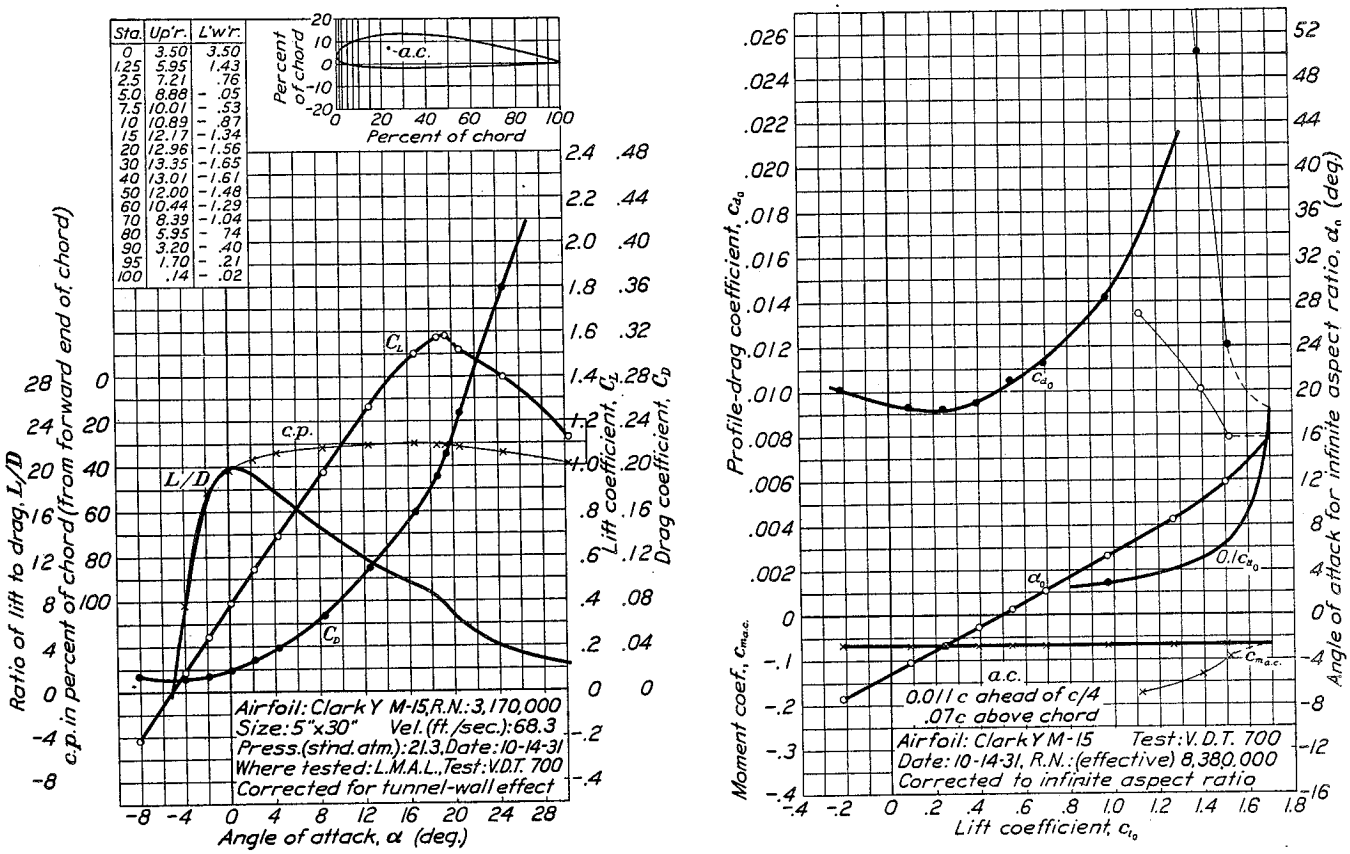


FIGURE 61.—Clark Y M-15 airfoil.

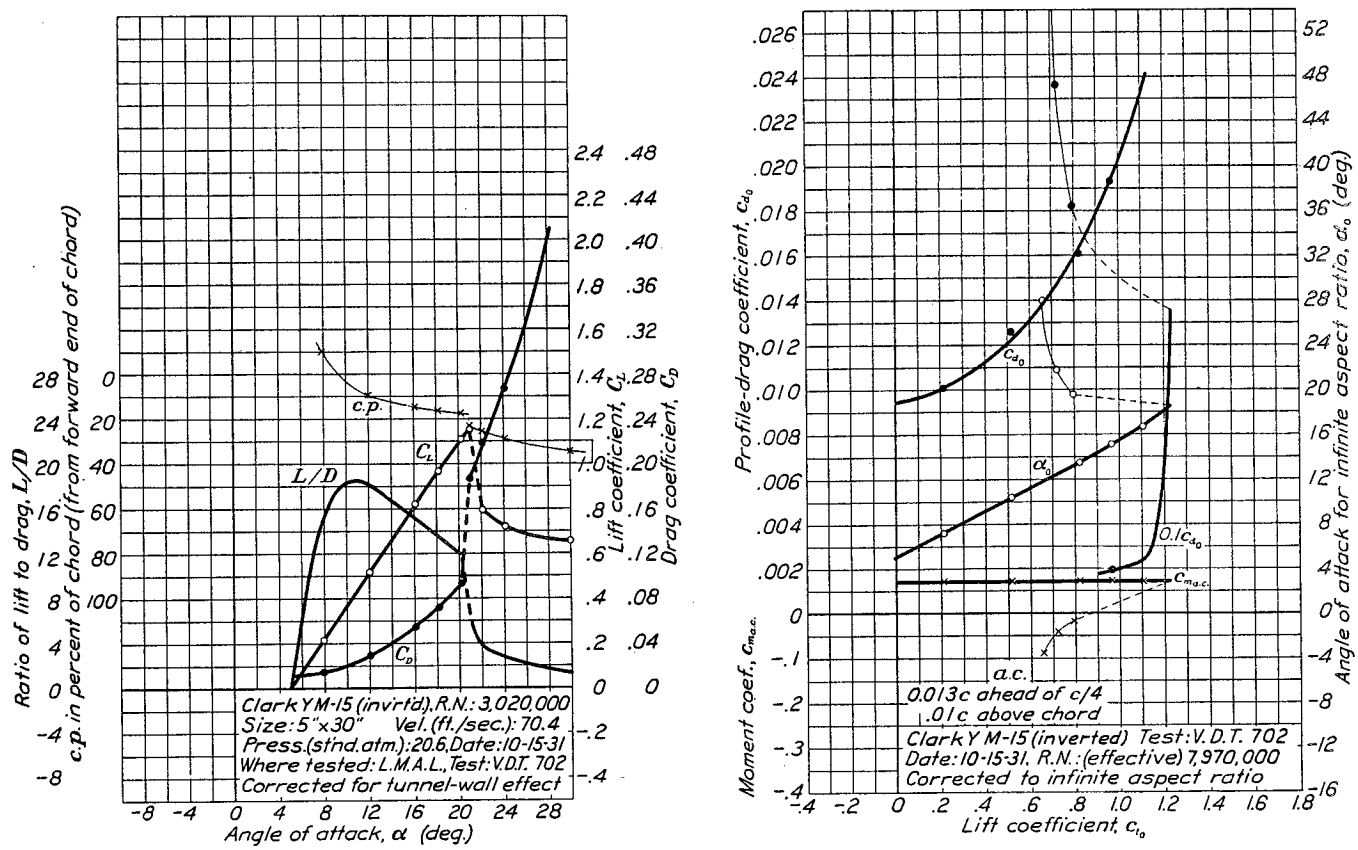


FIGURE 62.—Clark Y M-15 airfoil (inverted).

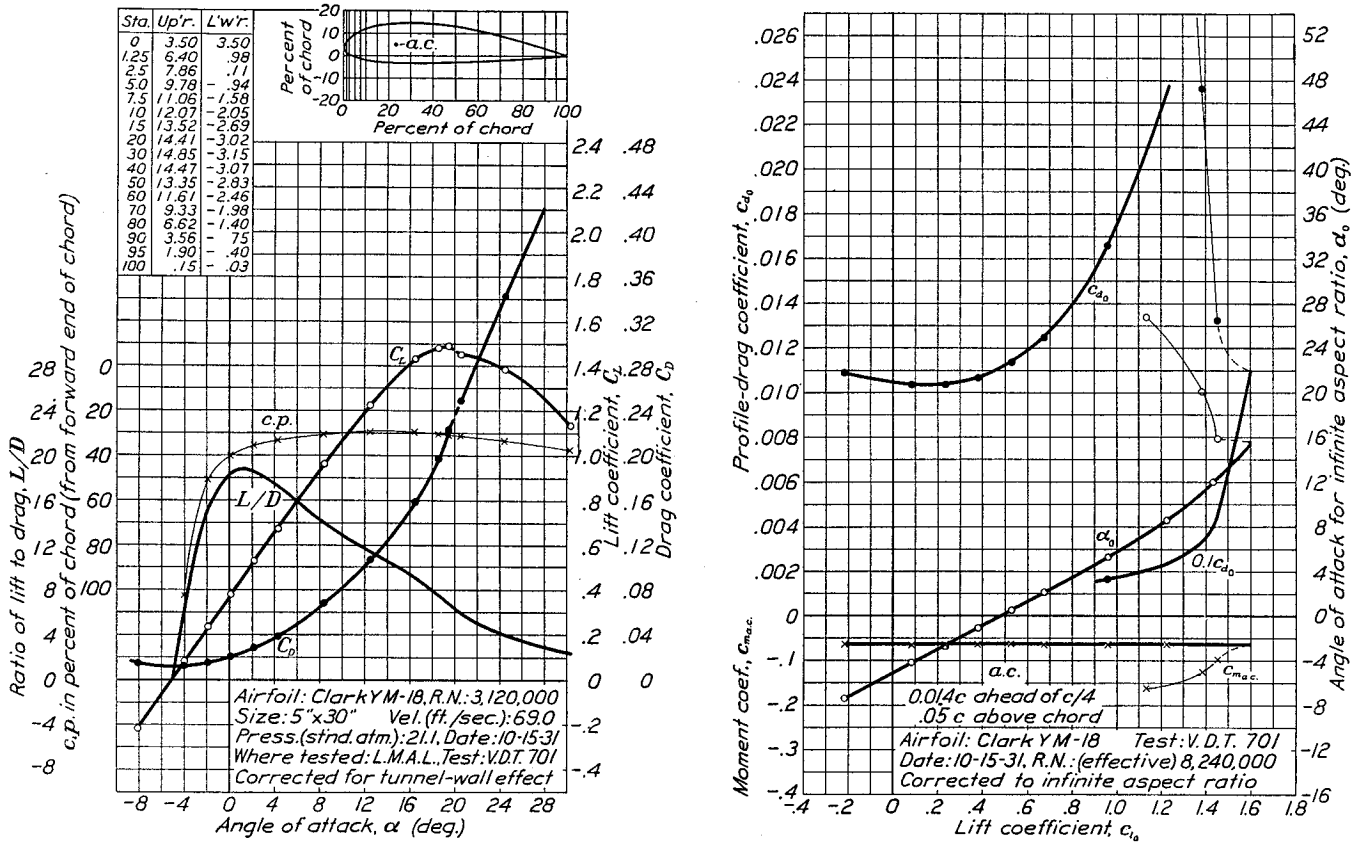


FIGURE 63.—Clark Y M-18 airfoil.

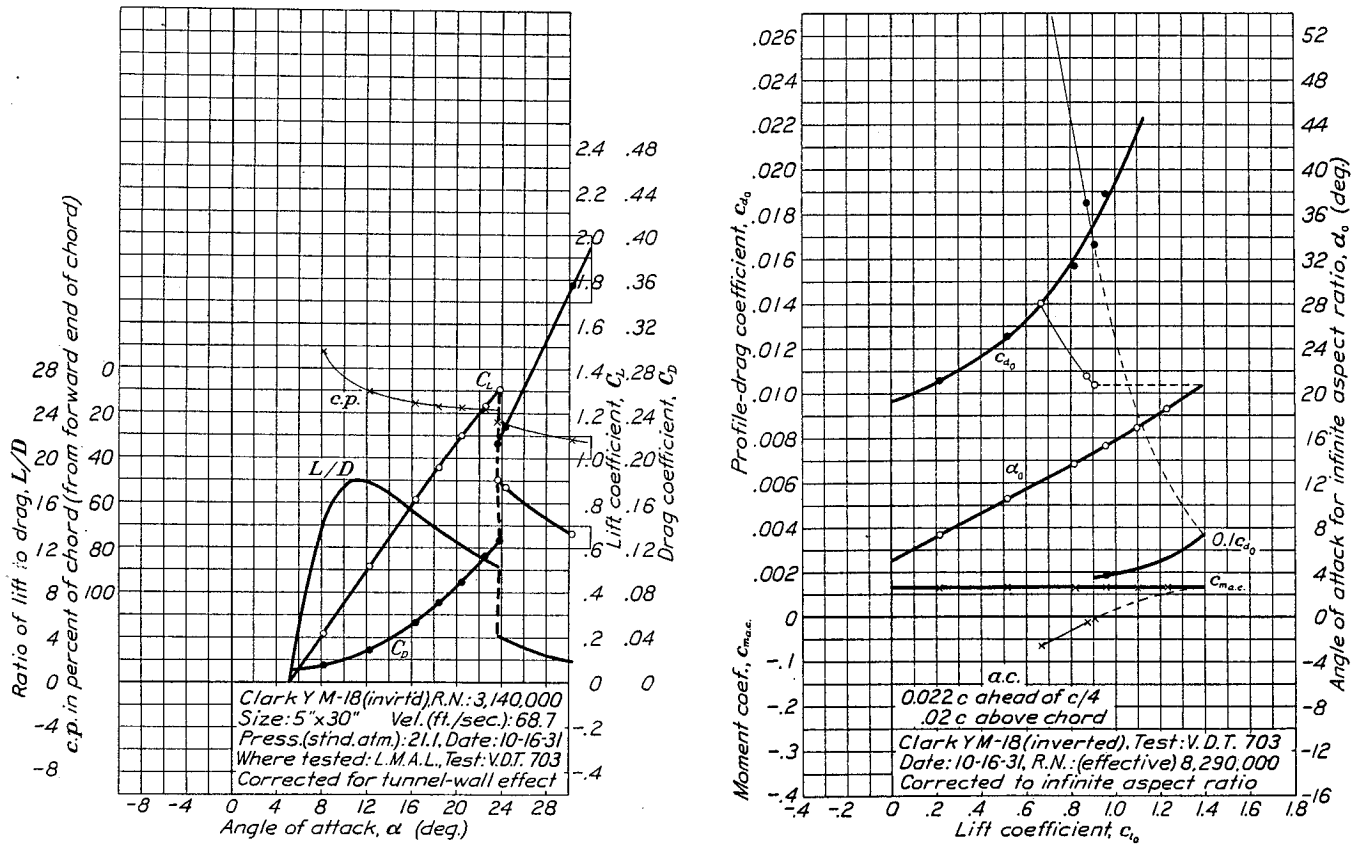


FIGURE 64.—Clark Y M-18 airfoil (inverted).

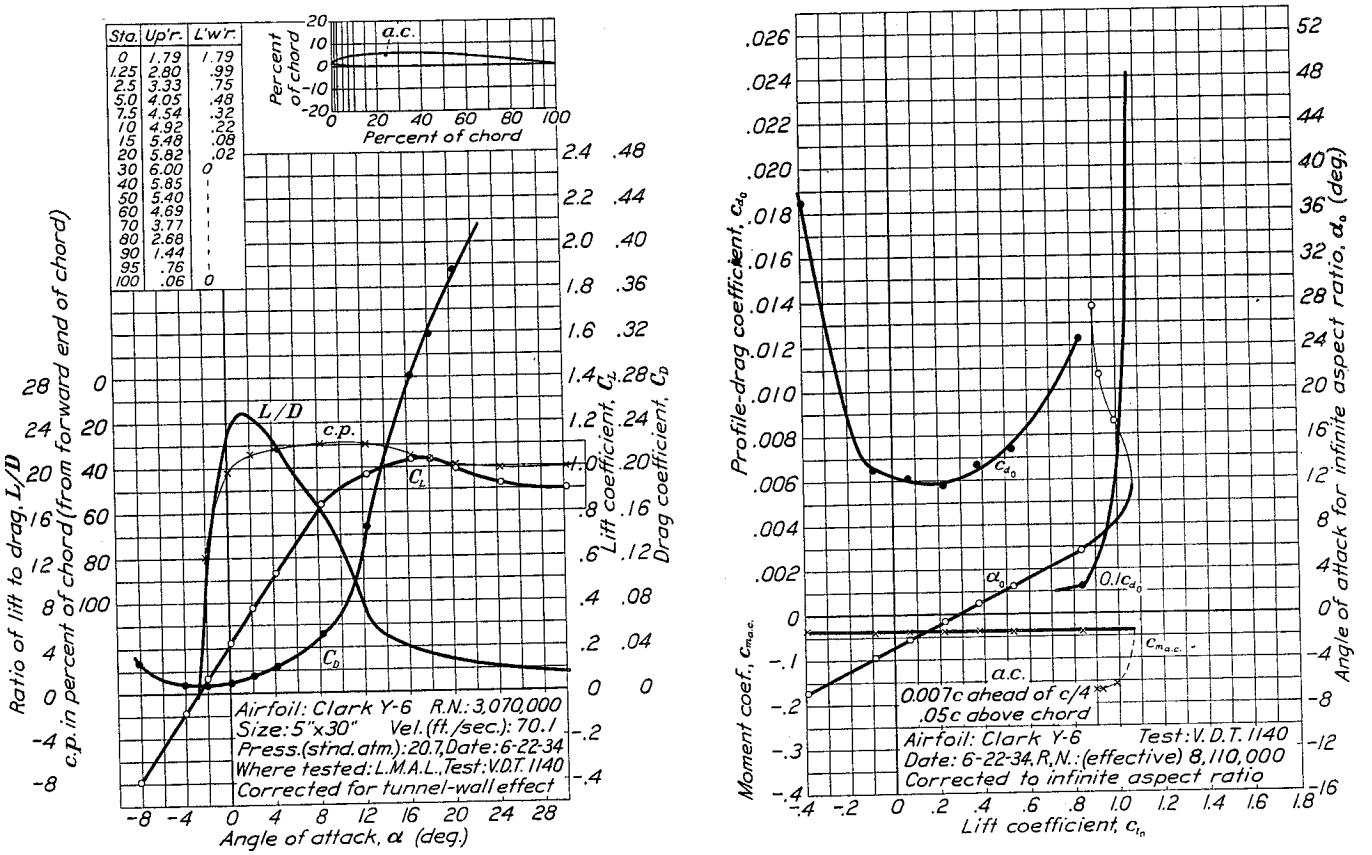


FIGURE 65.—Clark Y-6 airfoil.

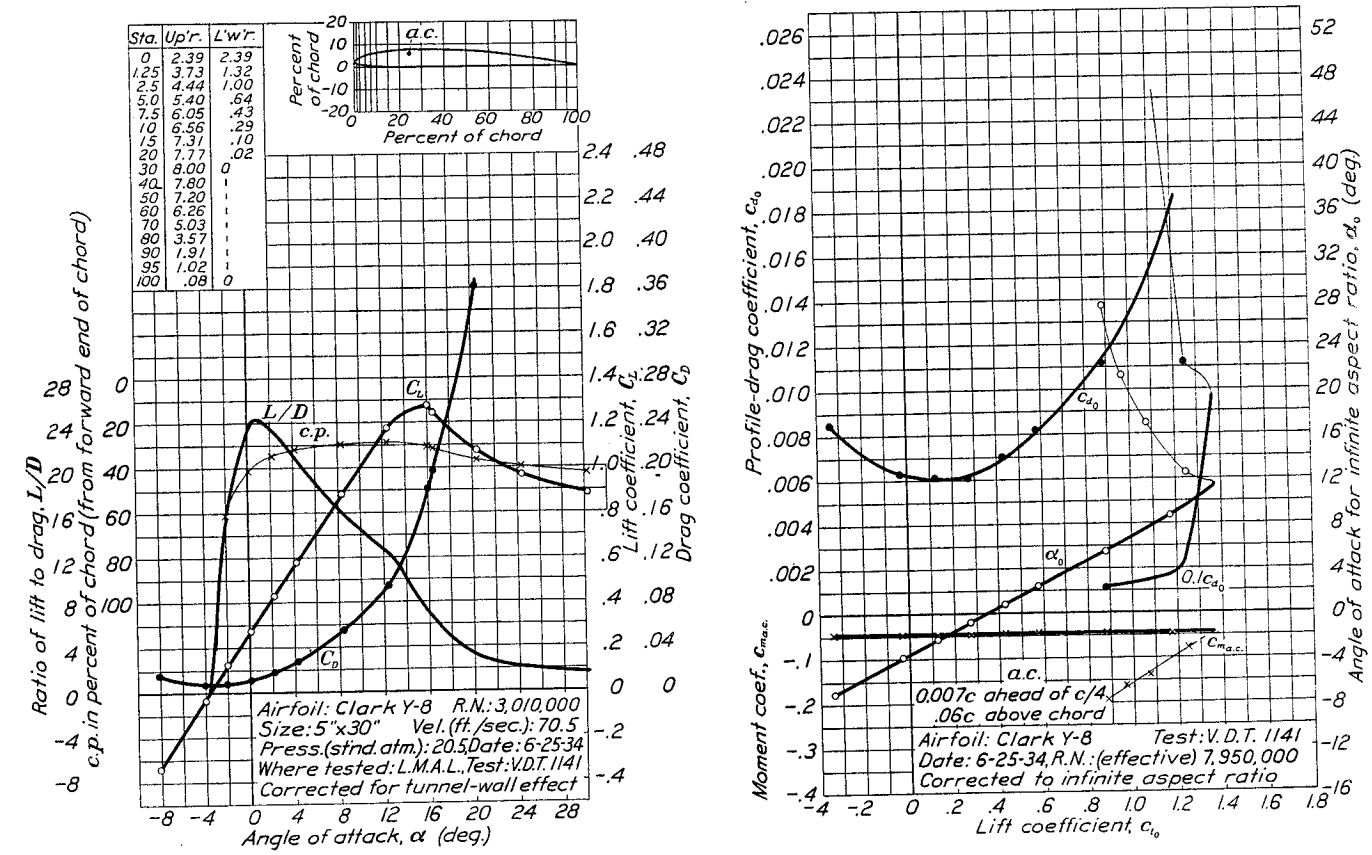


FIGURE 66.—Clark Y-8 airfoil.

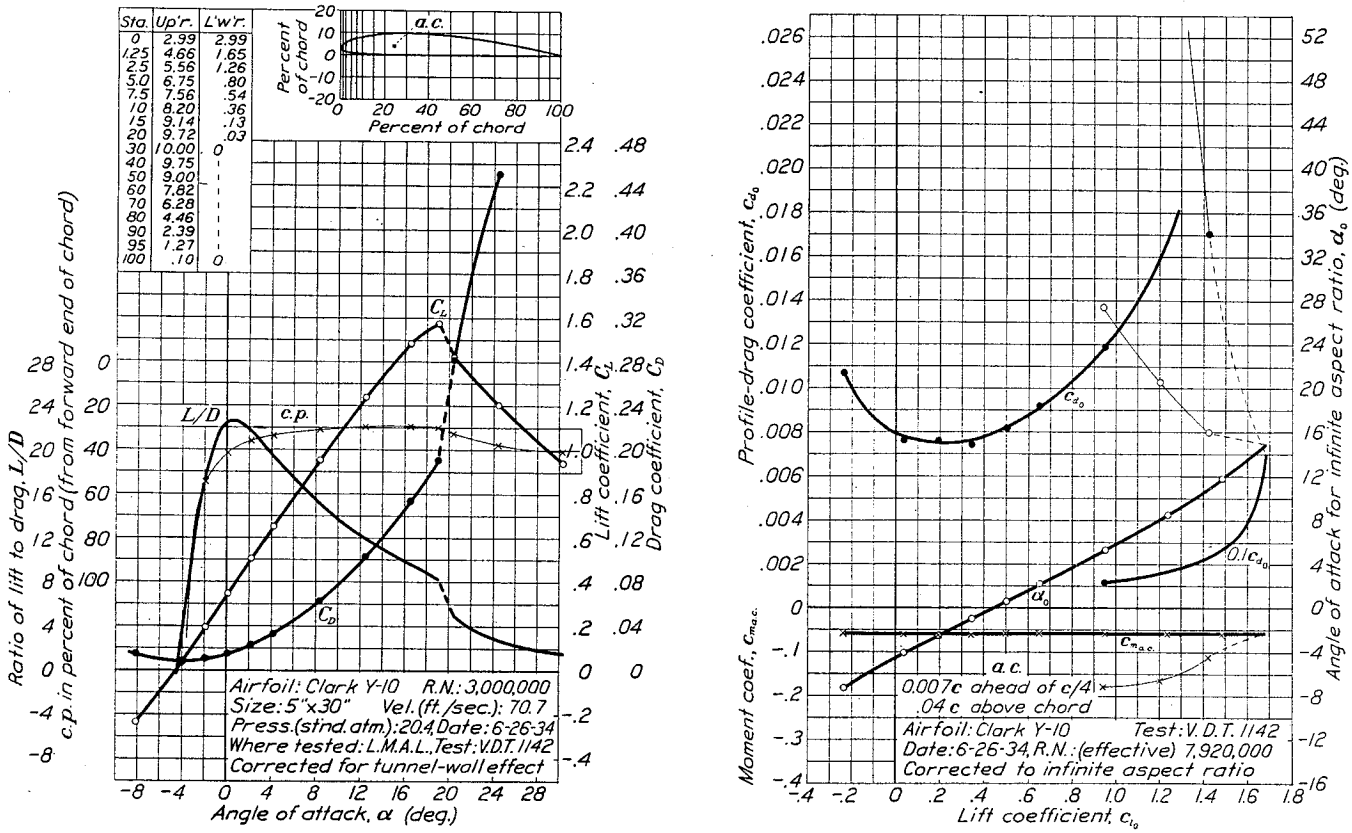


FIGURE 67.—Clark Y-10 airfoil.

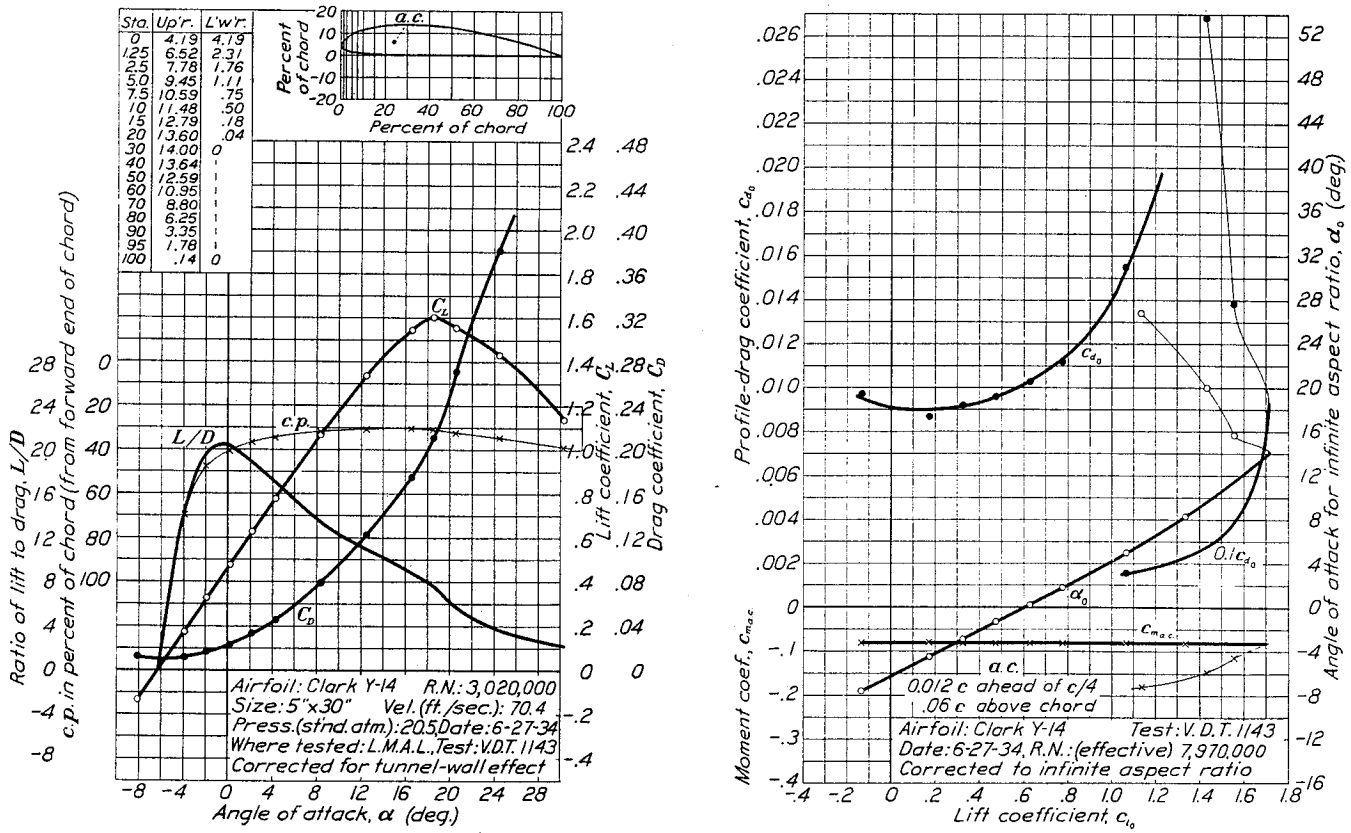


FIGURE 68.—Clark Y-14 airfoil.

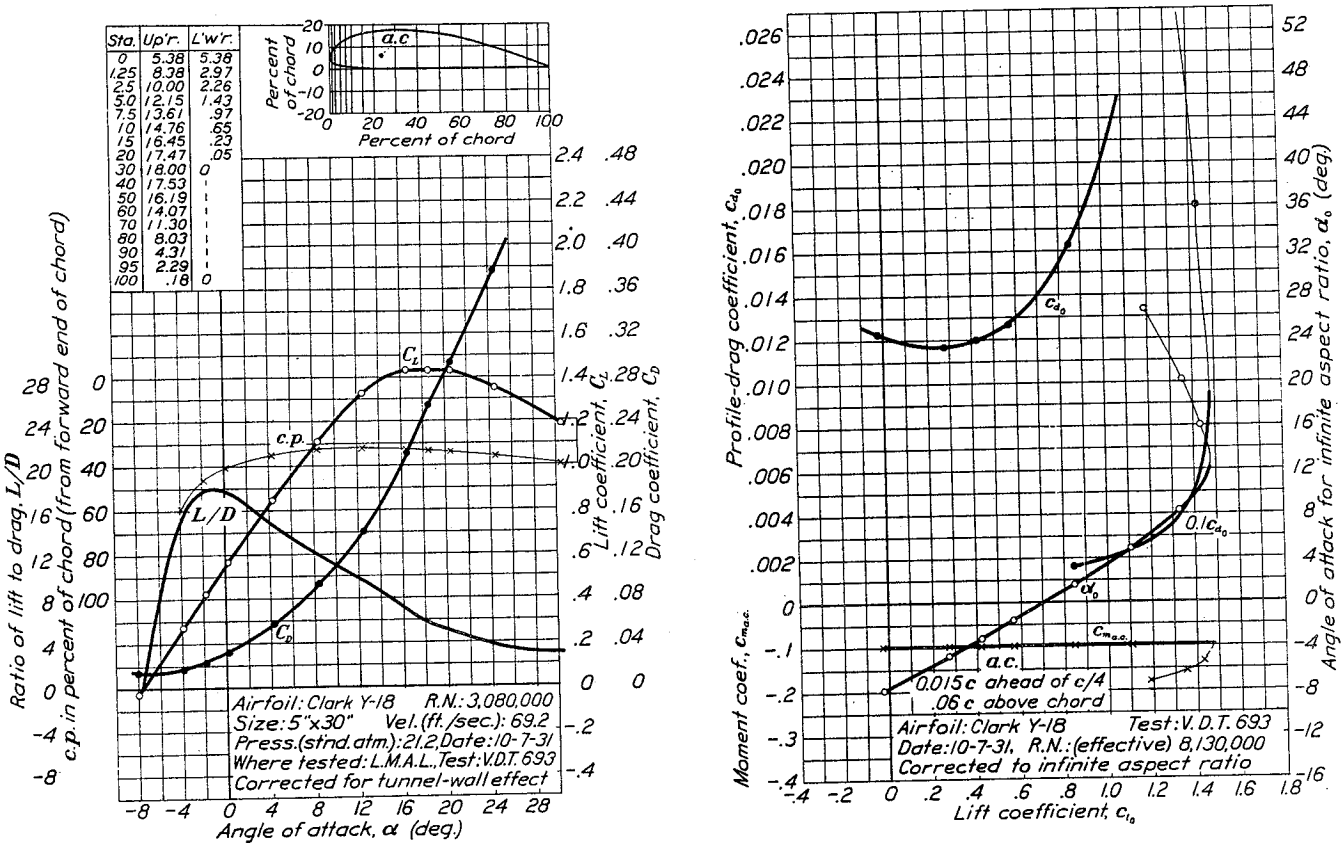


FIGURE 69.—Clark Y-18 airfoil.

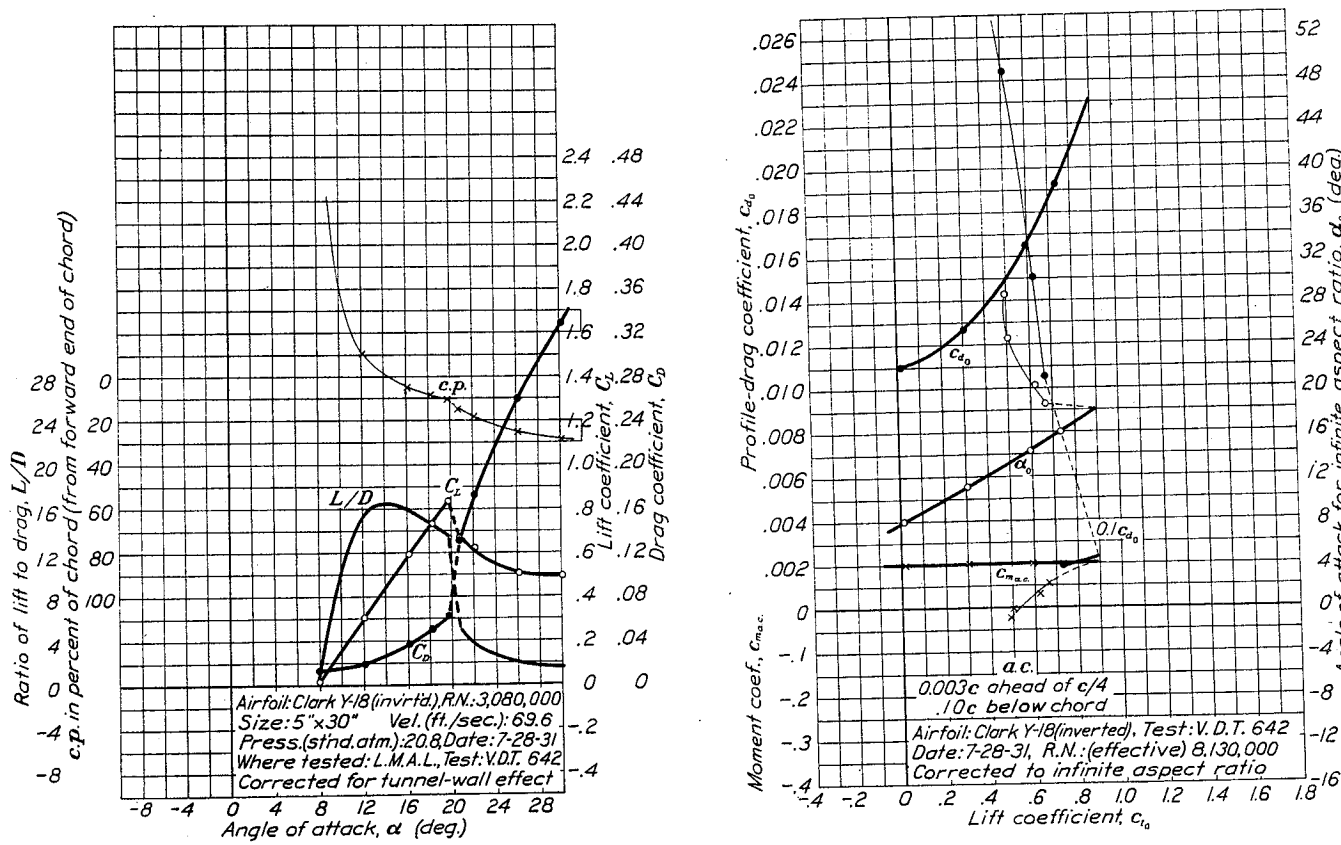


FIGURE 70.—Clark Y-18 airfoil (inverted).

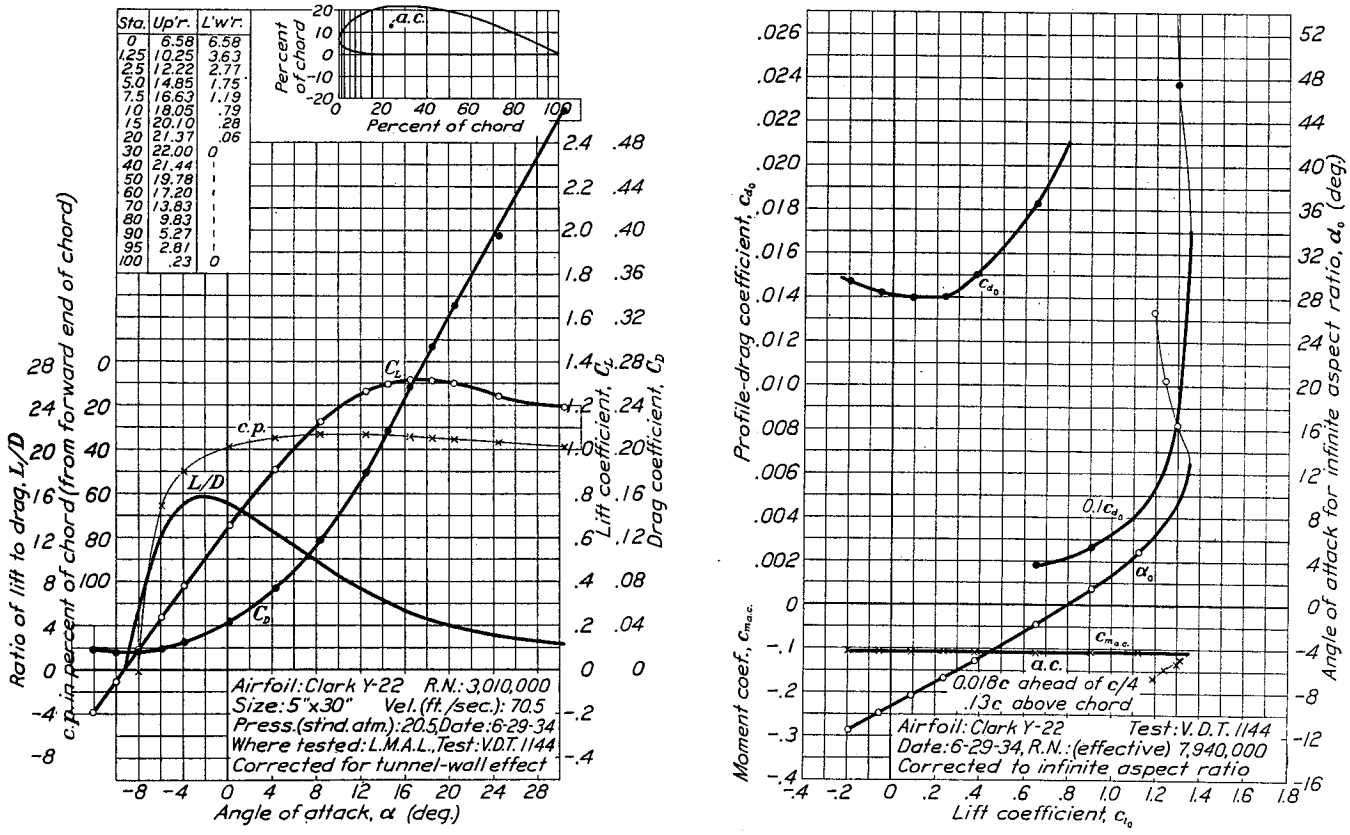


FIGURE 71.—Clark Y-22 airfoil.

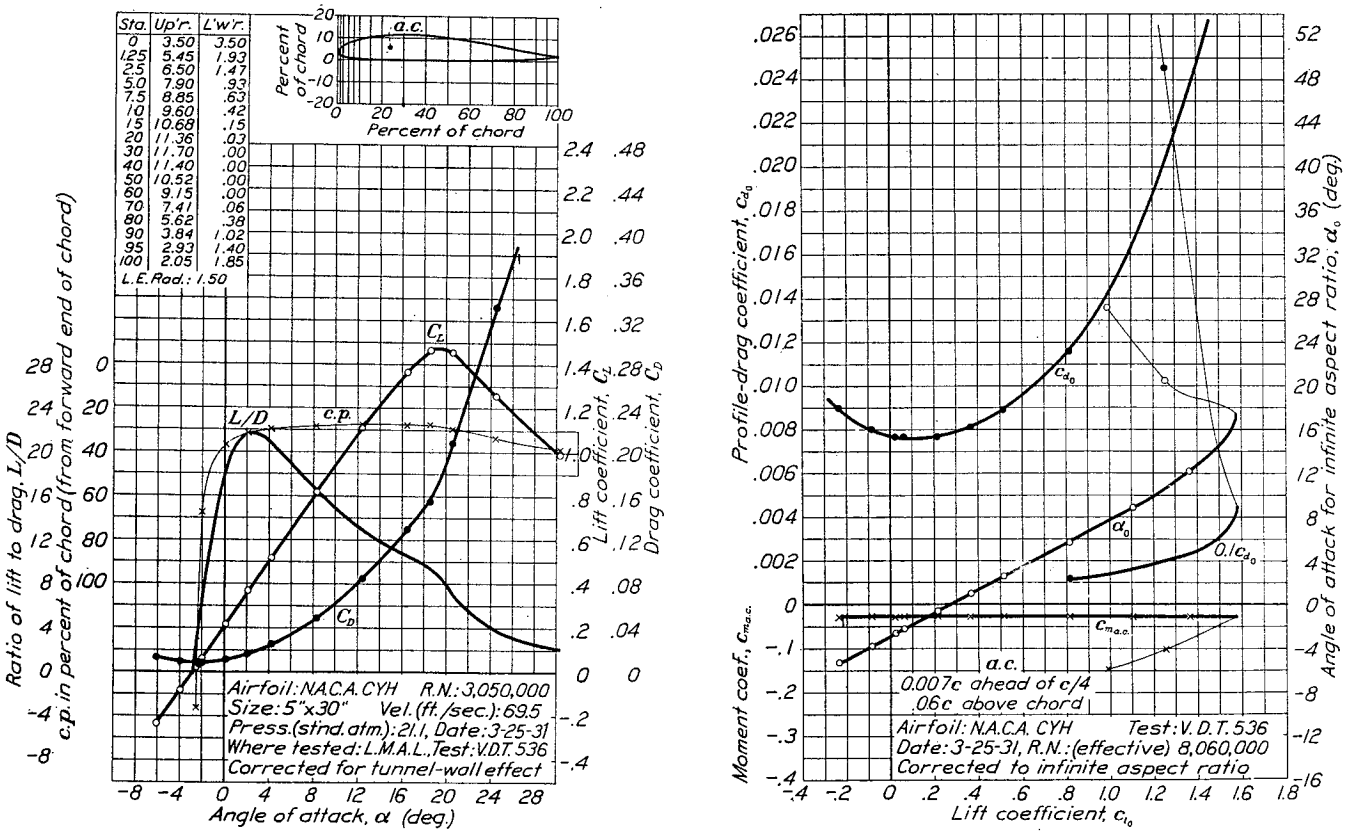


FIGURE 72.—N. A. C. A. CYH airfoil.

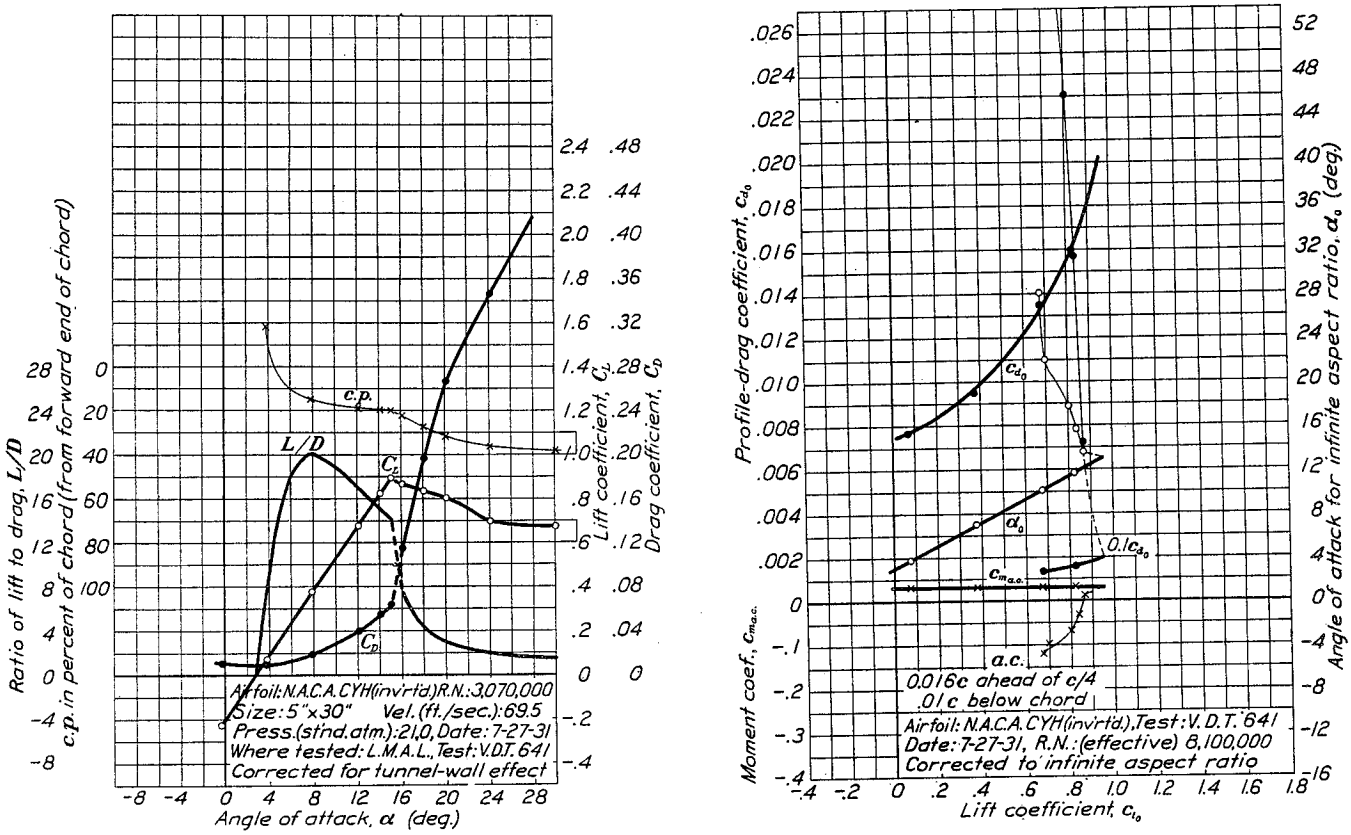


FIGURE 73.—N. A. C. A. CYH airfoil (inverted).

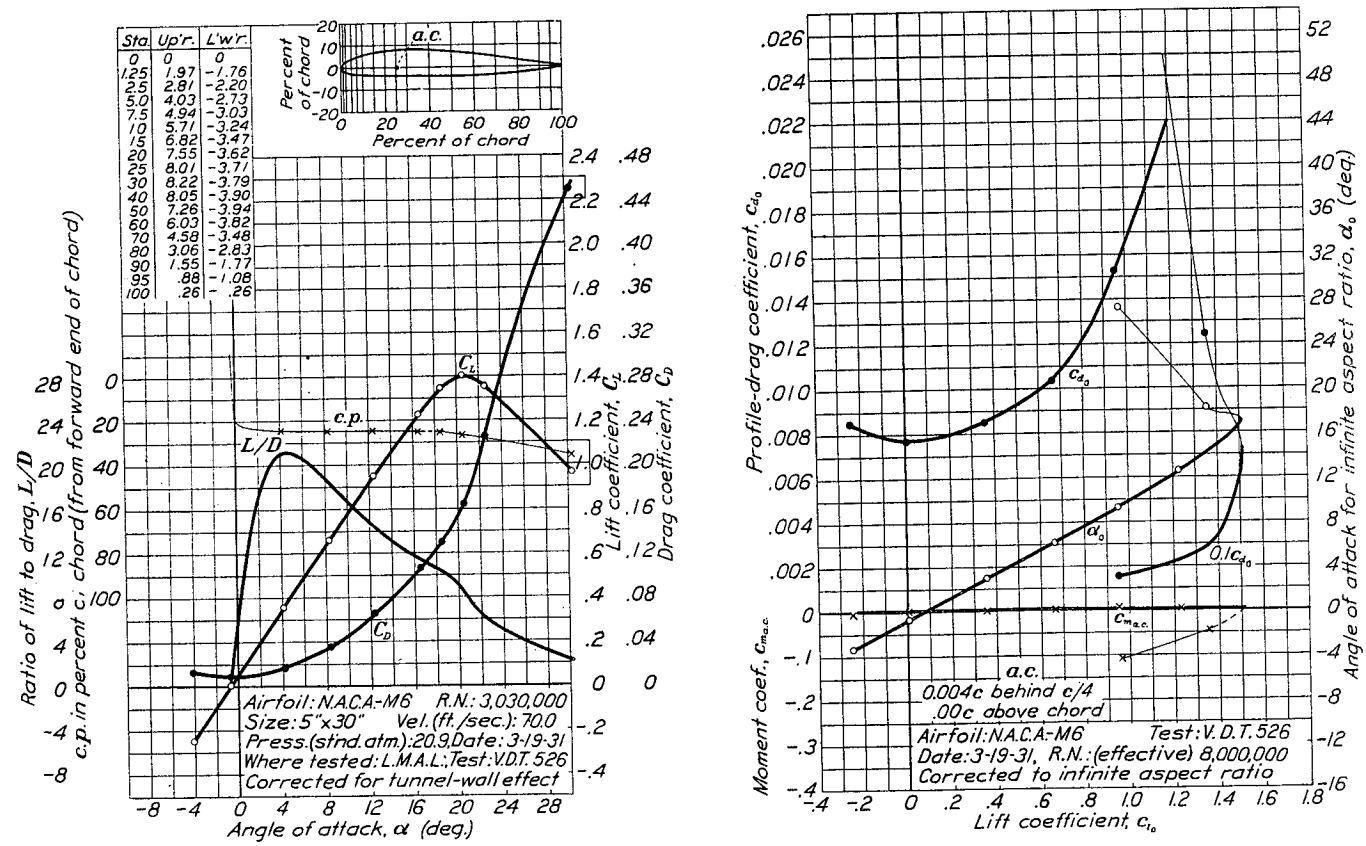


FIGURE 74.—N. A. C. A. —M6 airfoil.

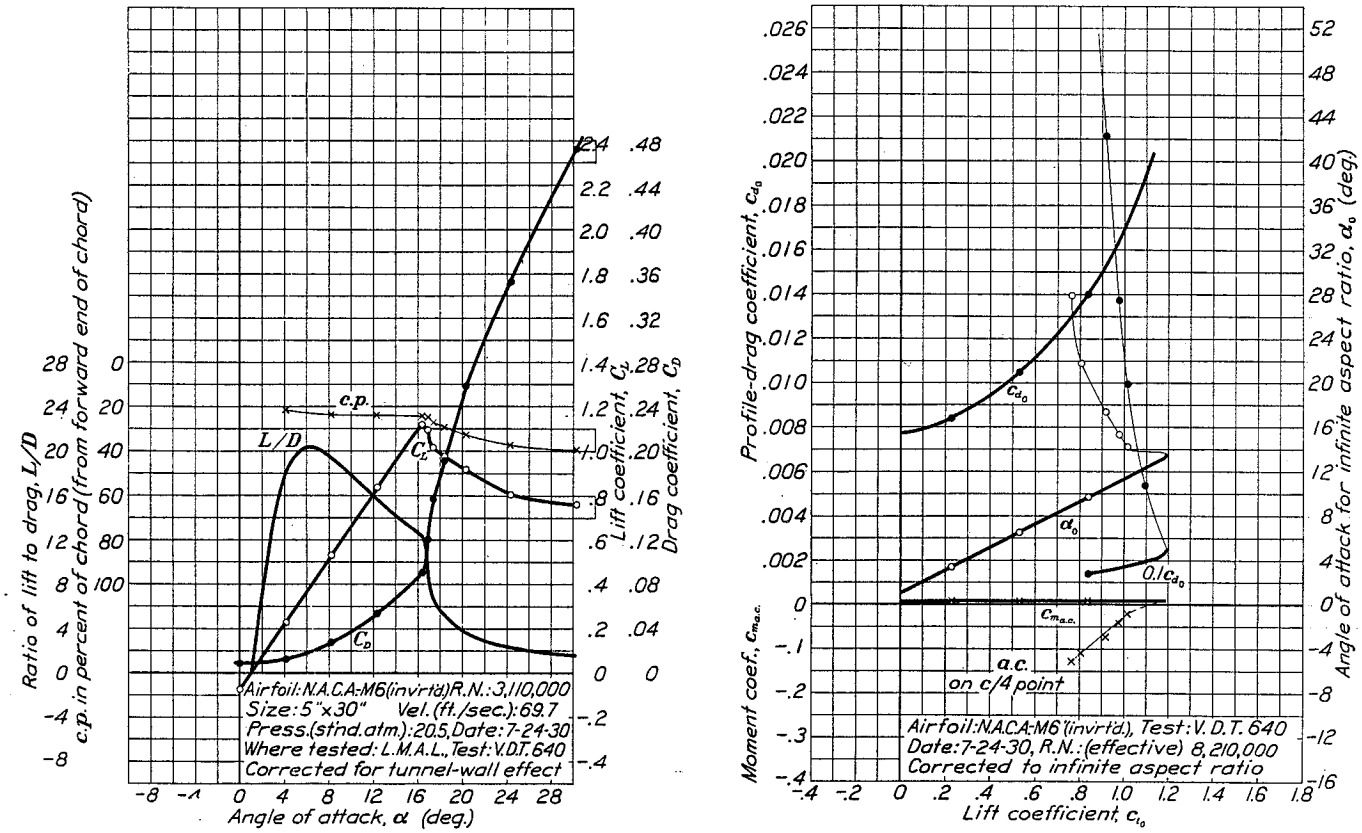


FIGURE 75.—N. A. C. A. —M6 airfoil (inverted).

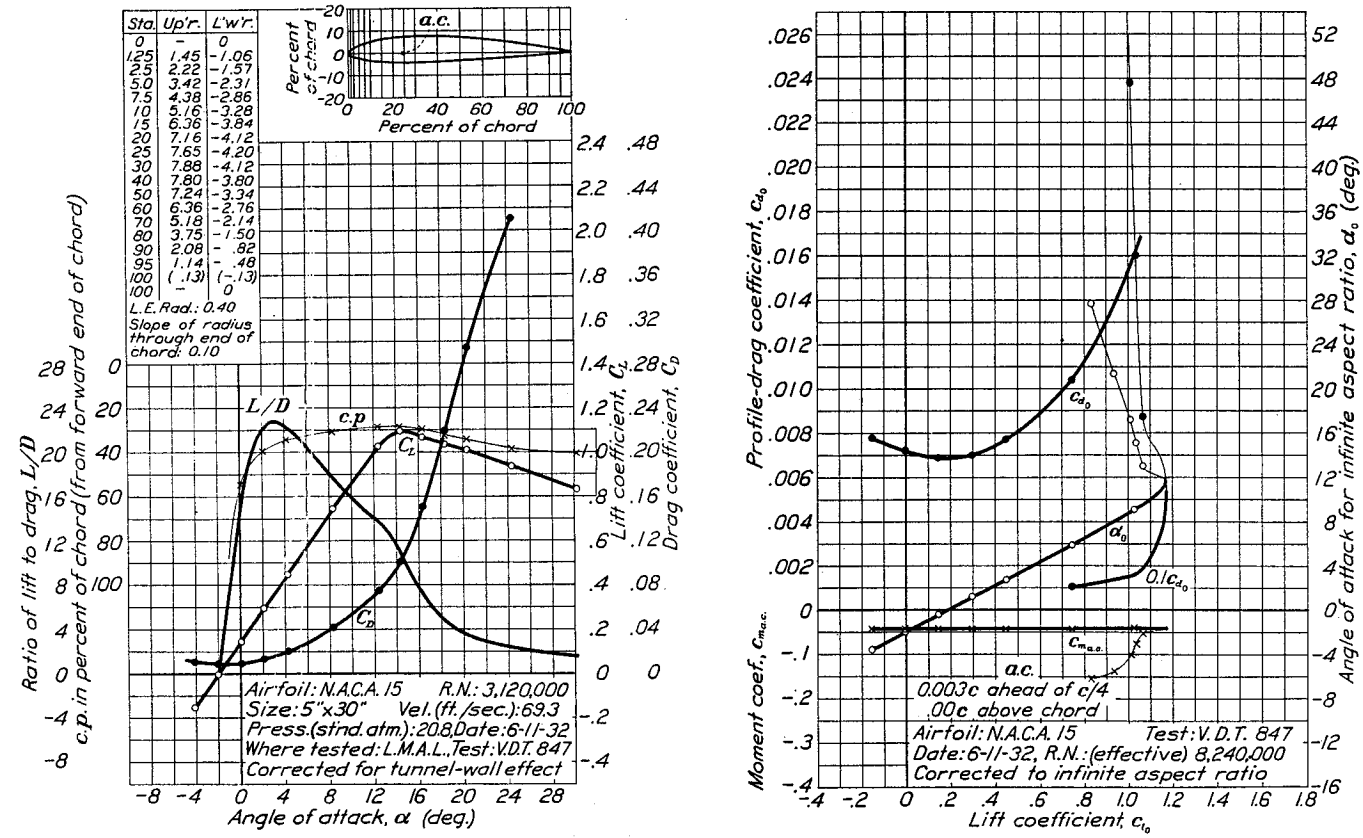


FIGURE 76.—N. A. C. A. 15 airfoil.

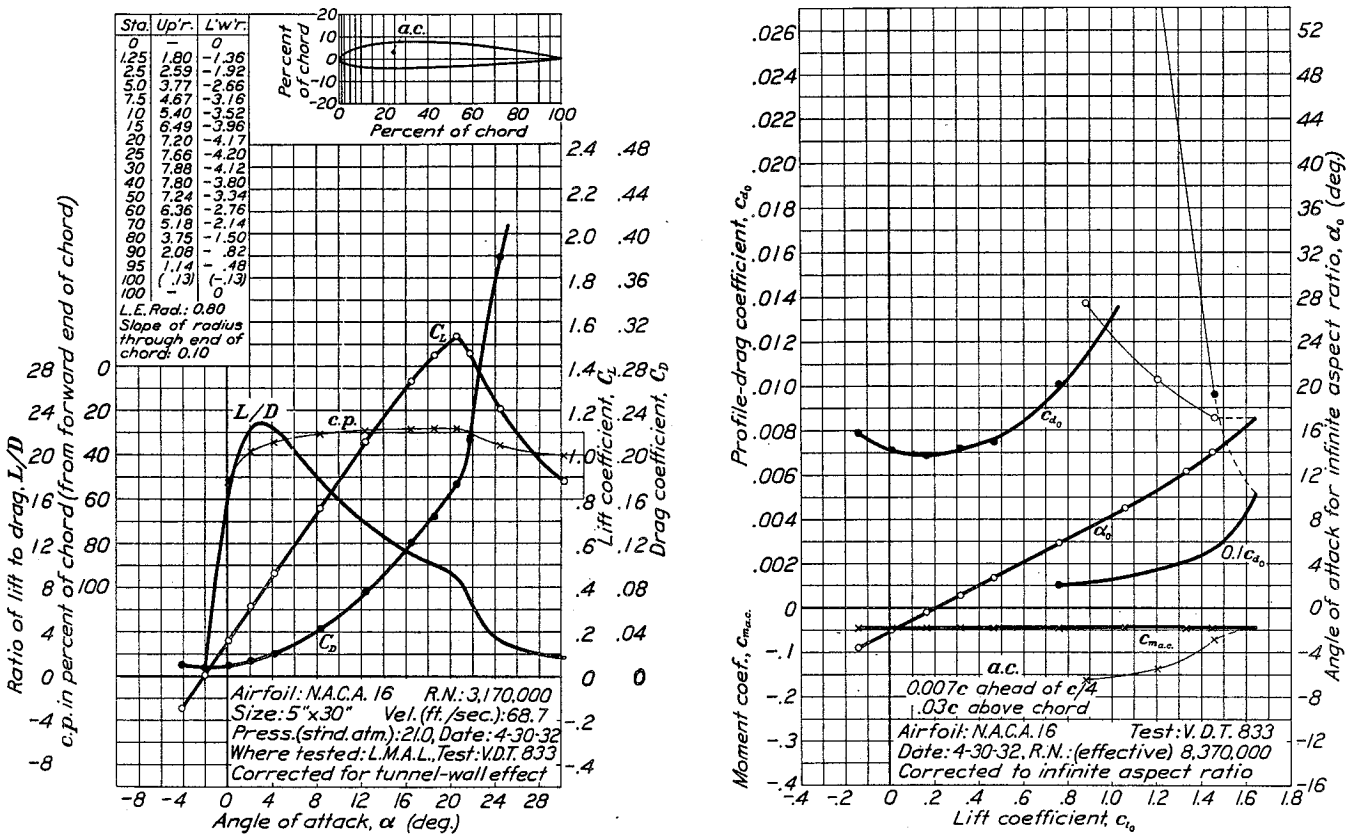


FIGURE 77.—N. A. C. A. 16 airfoil.

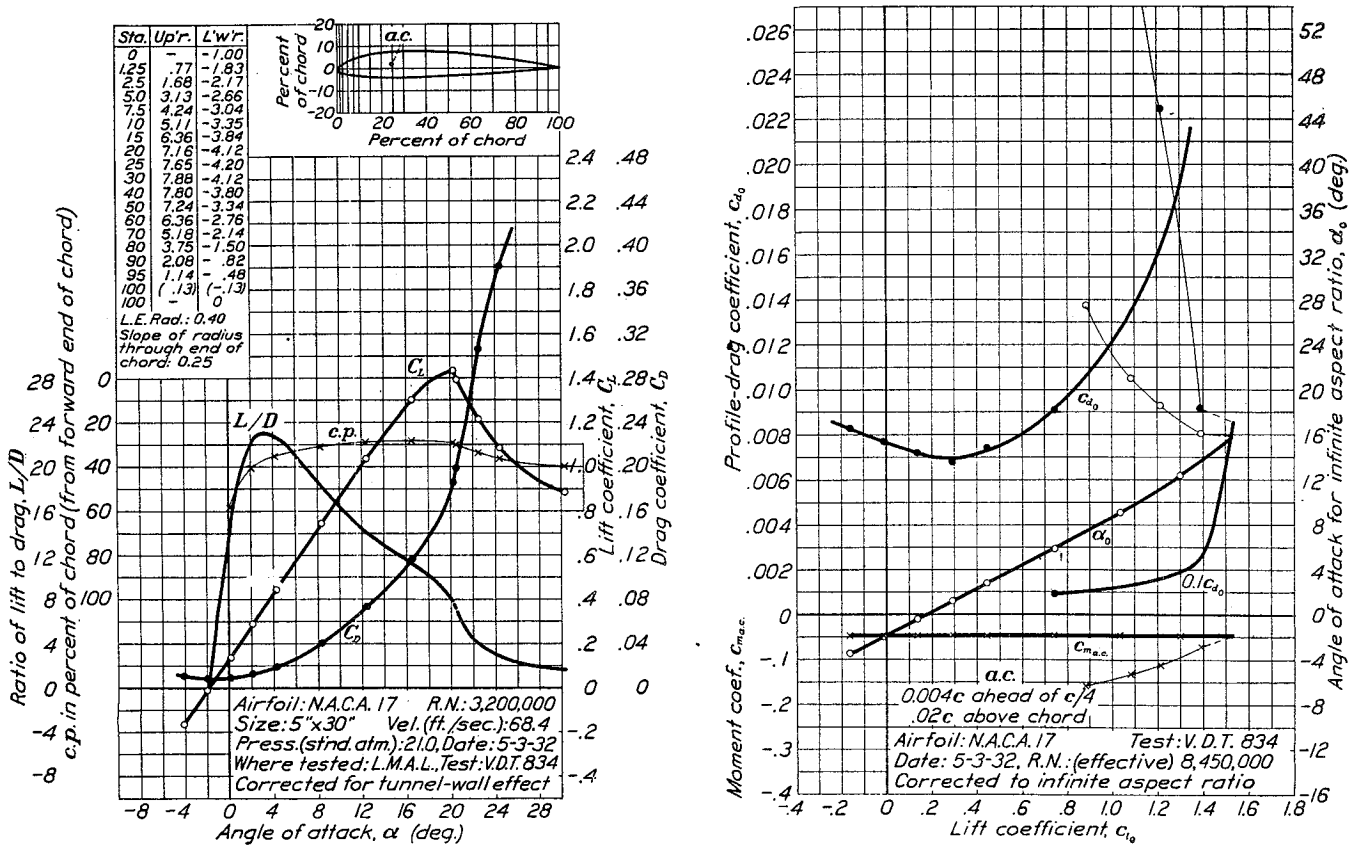


FIGURE 78.—N. A. C. A. 17 airfoil.

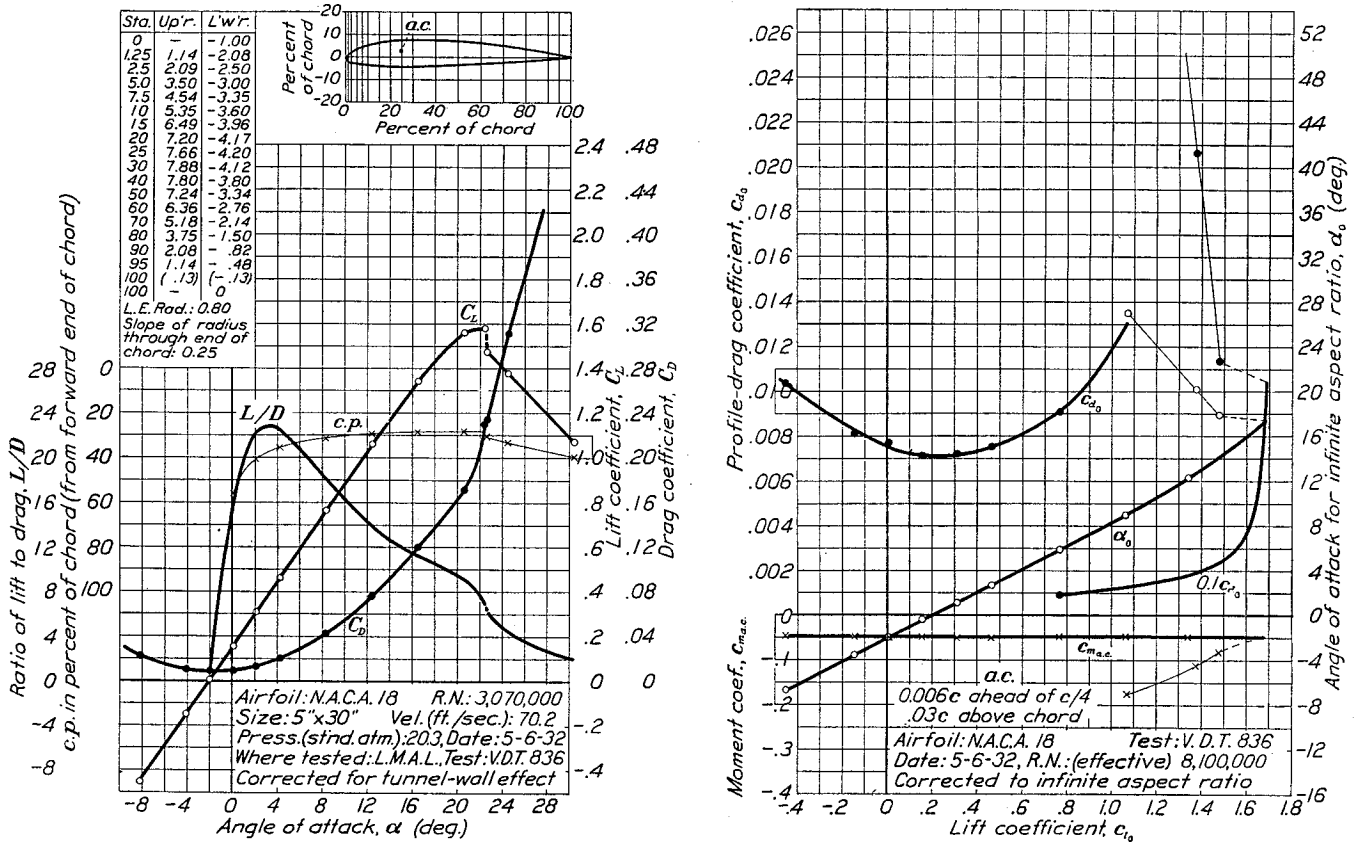


FIGURE 79.—N. A. C. A. 18 airfoil.

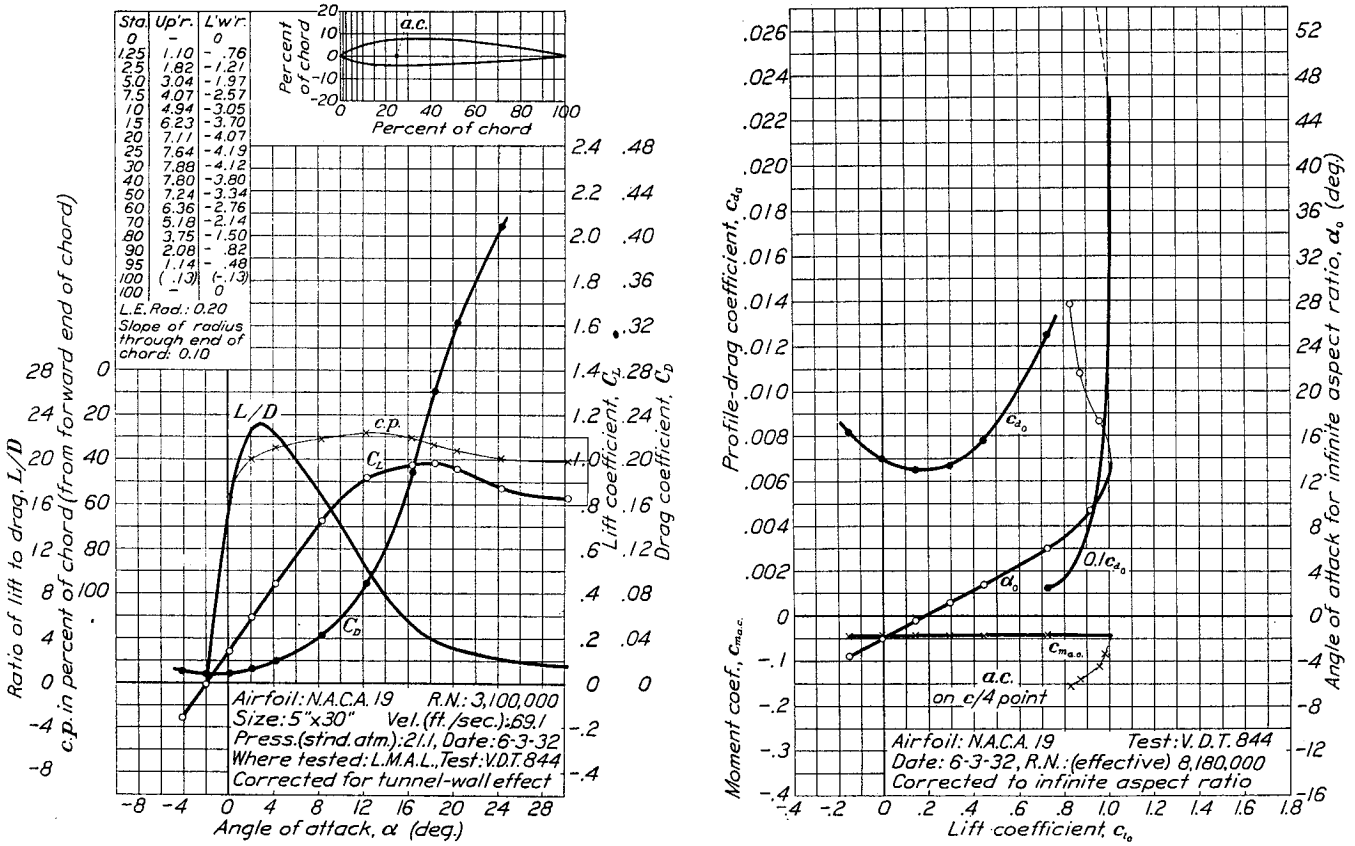


FIGURE 80.—N. A. C. A. 19 airfoil.

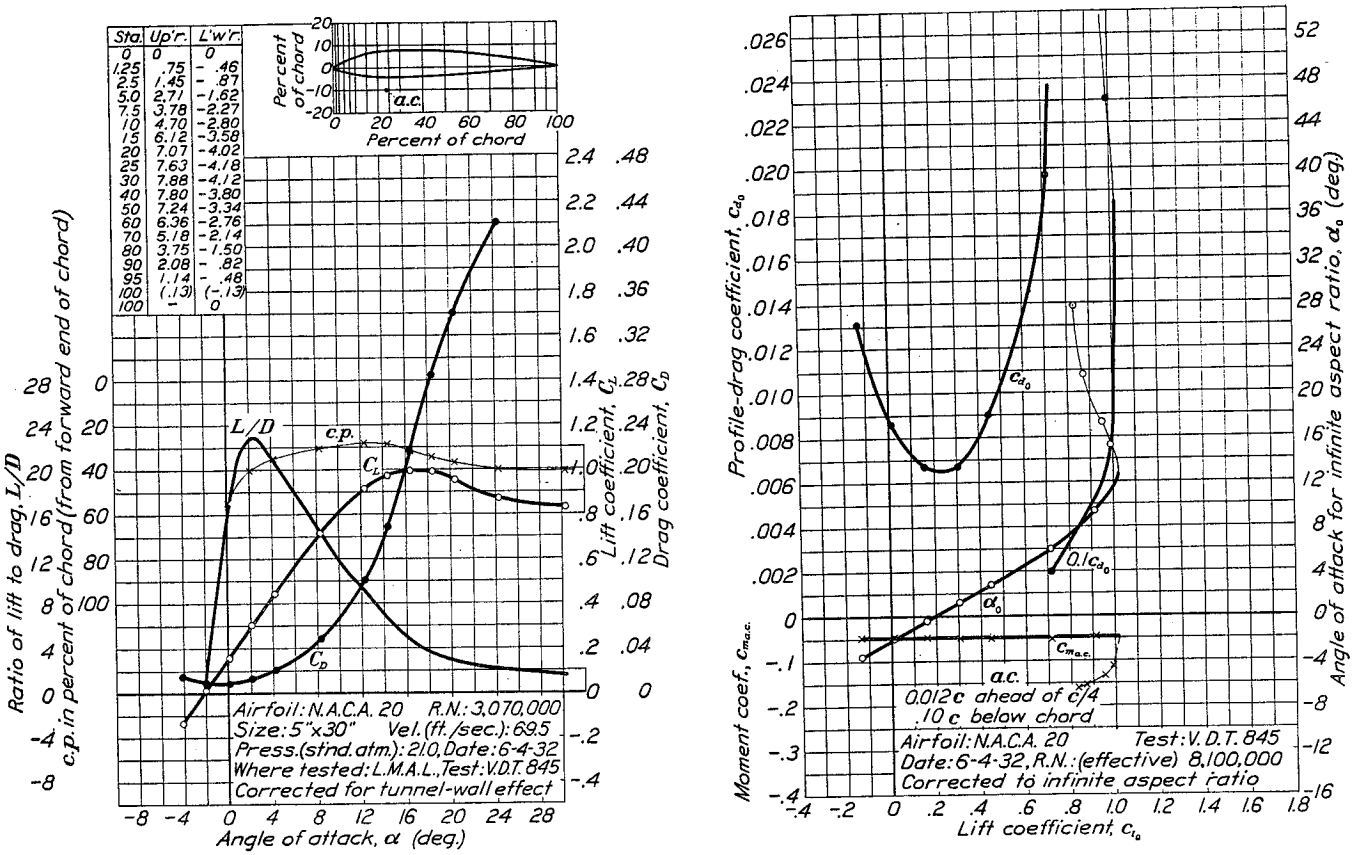


FIGURE 81.—N. A. C. A. 20 airfoil.

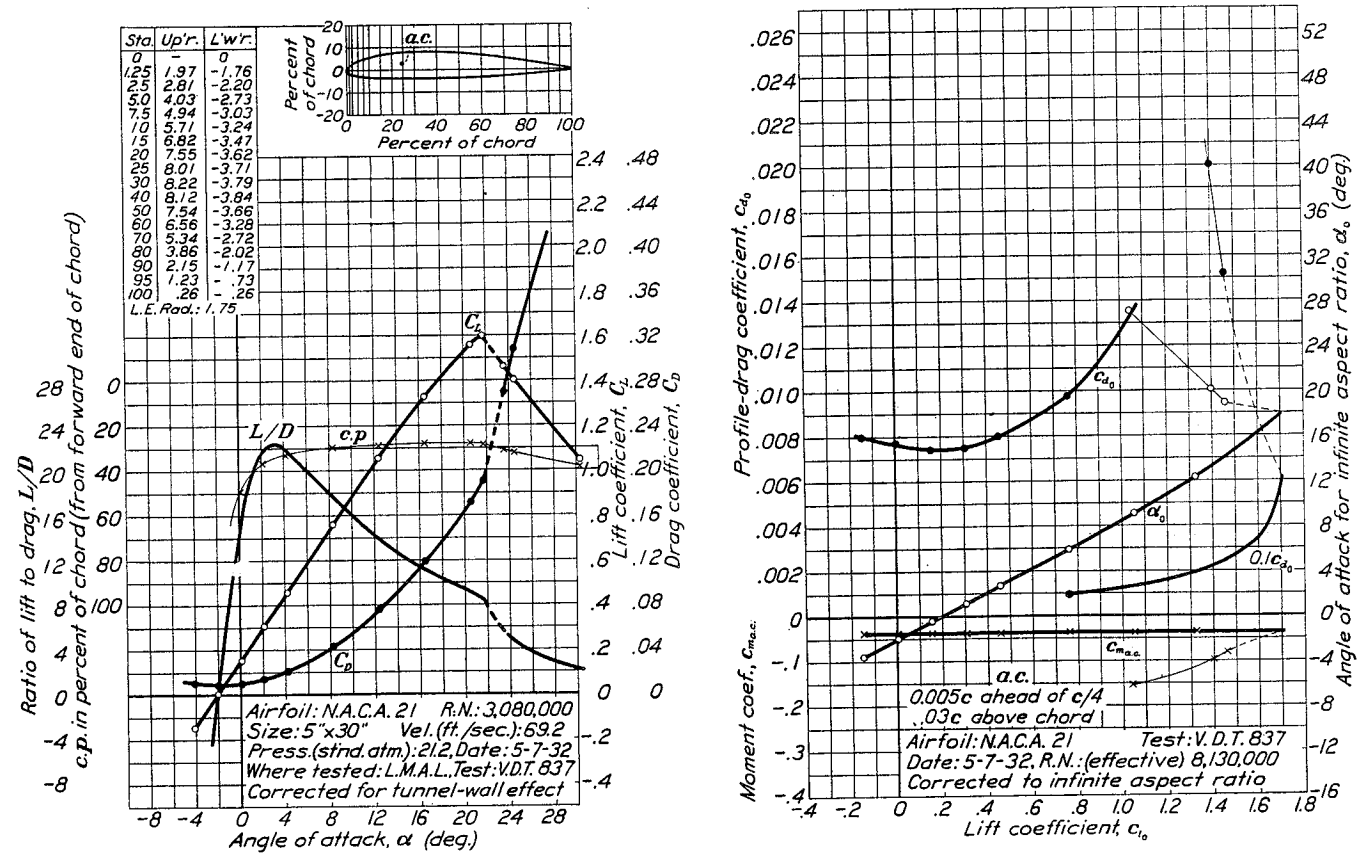


FIGURE 82.—N. A. C. A. 21 airfoil.

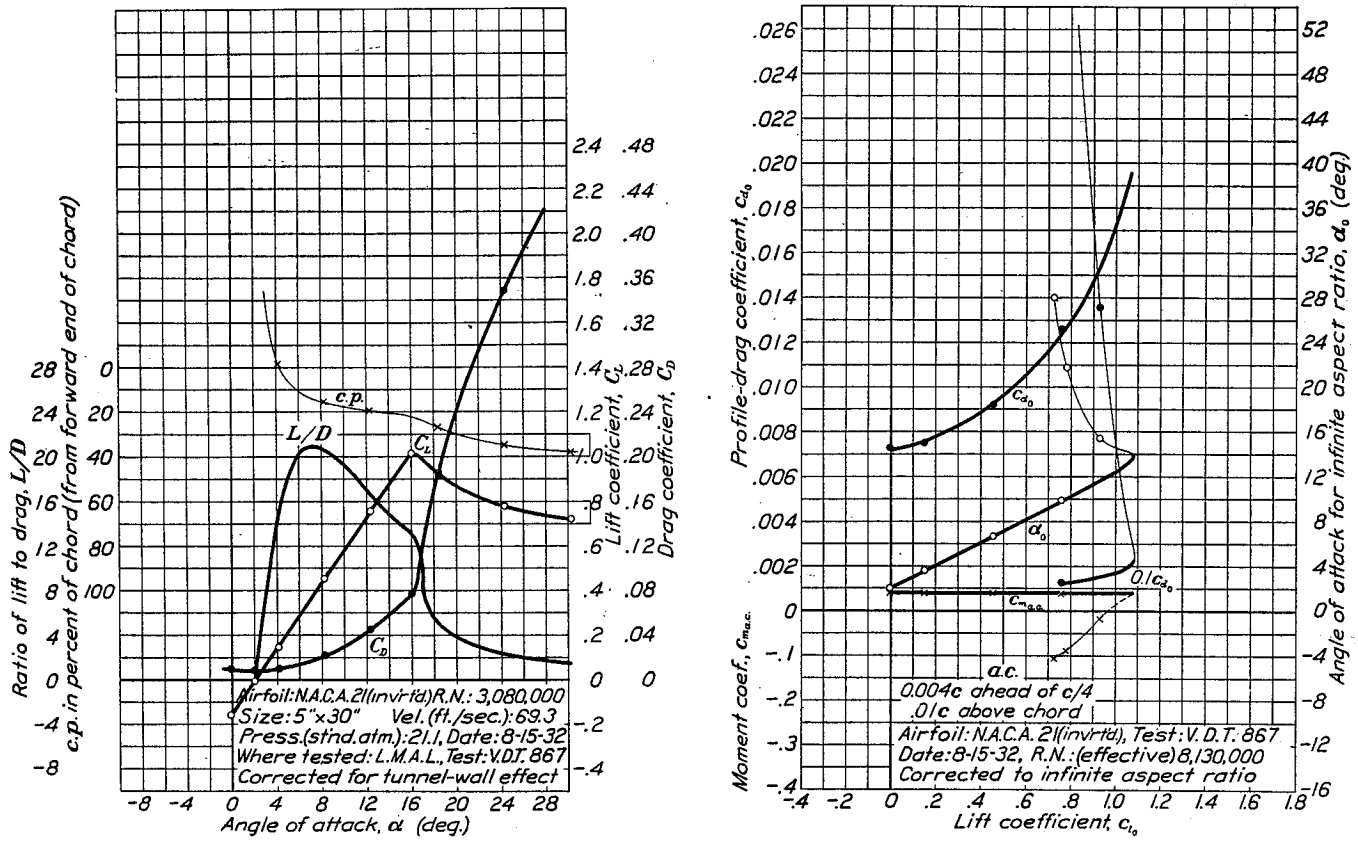


FIGURE 83.—N. A. C. A. 21 airfoil (inverted).

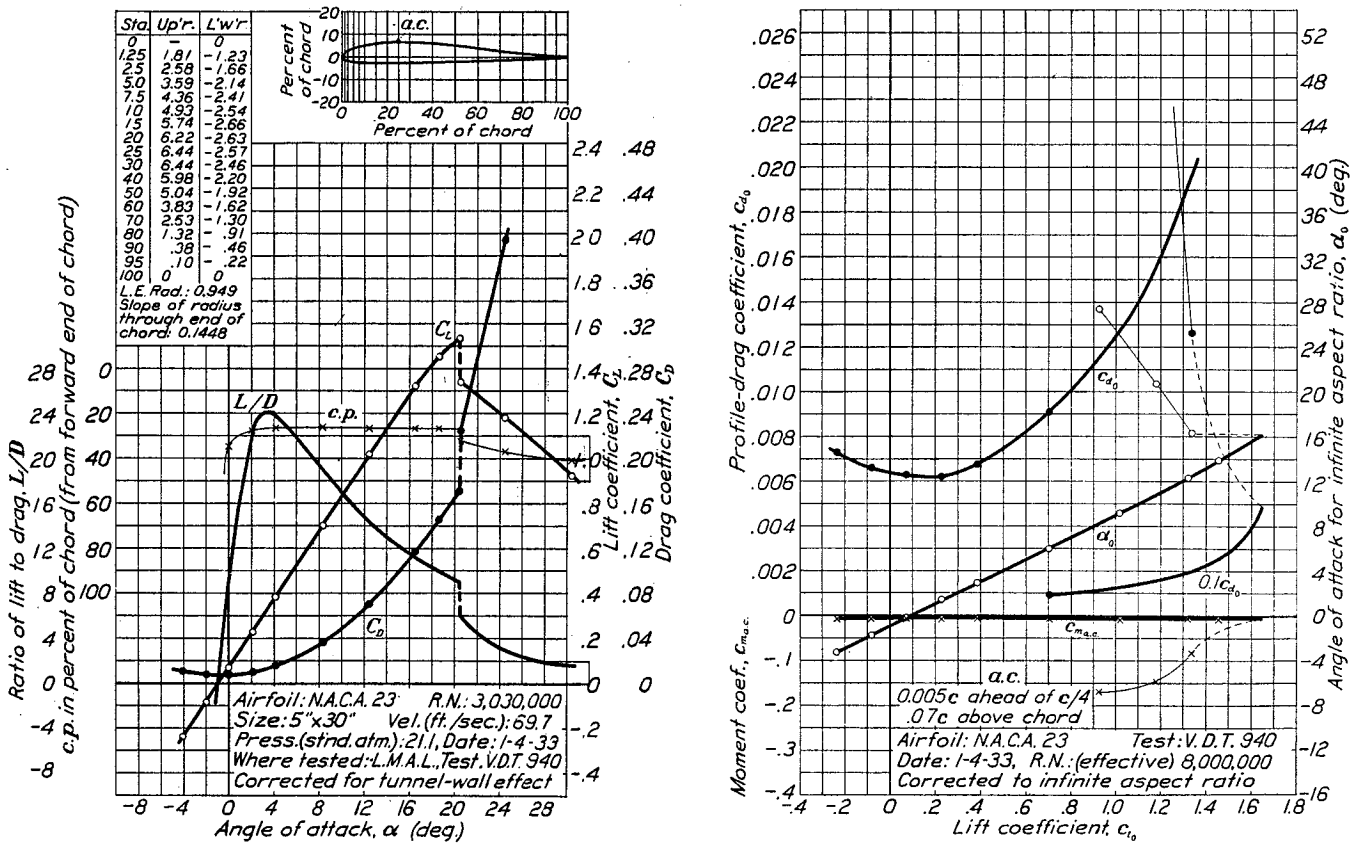


FIGURE 84.—N. A. C. A. 23 airfoil.

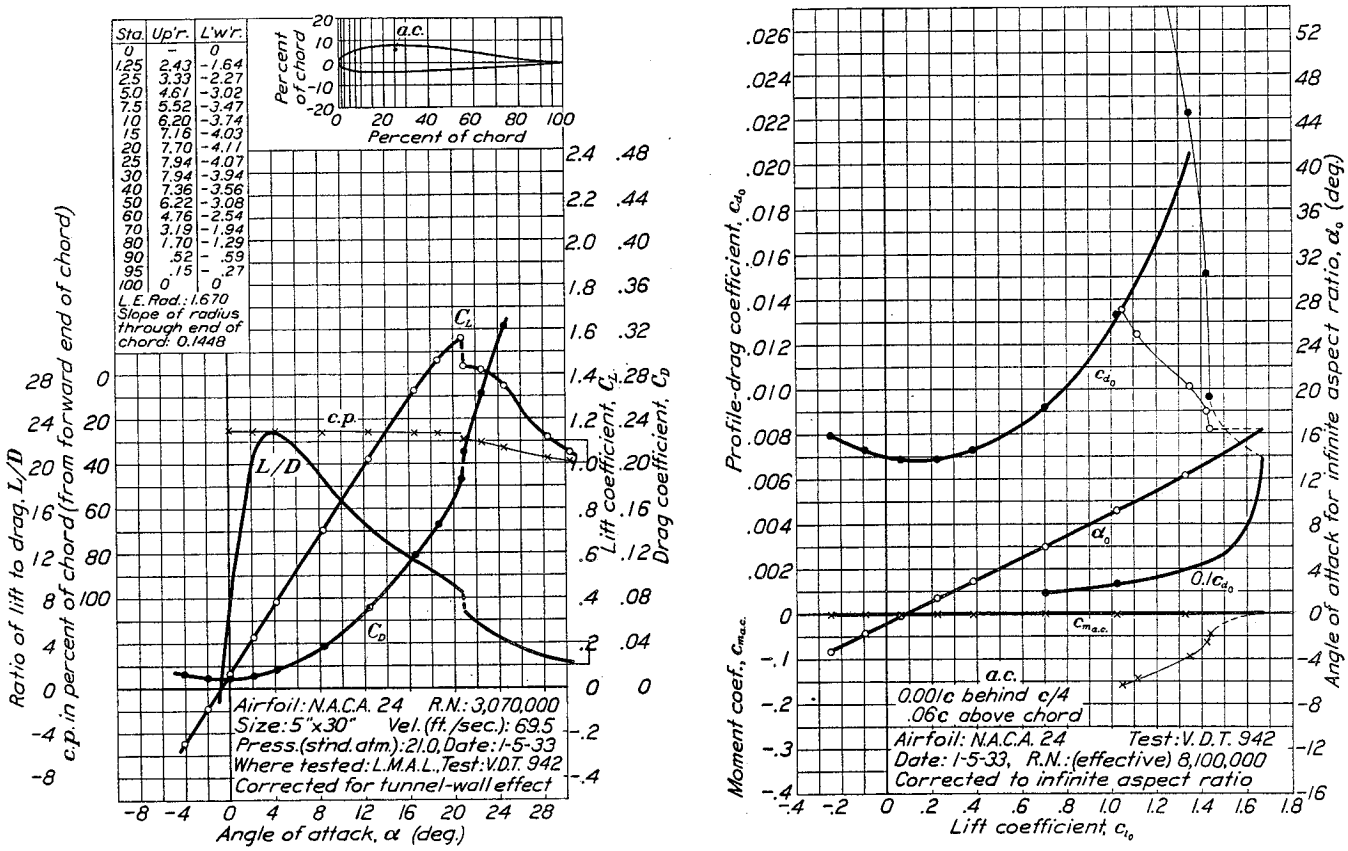


FIGURE 85.—N. A. C. A. 24 airfoil.

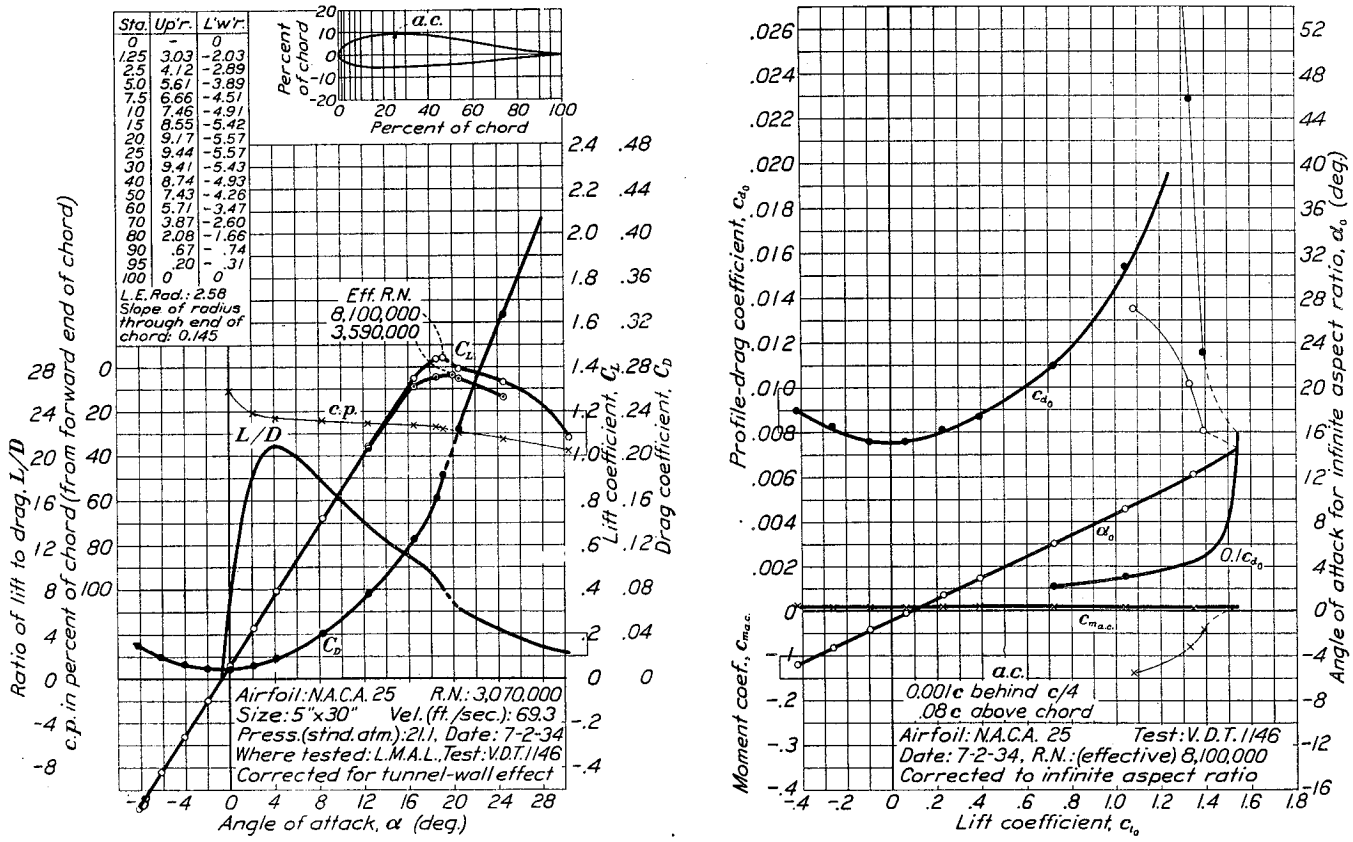


FIGURE 86.—N. A. C. A. 25 airfoil.

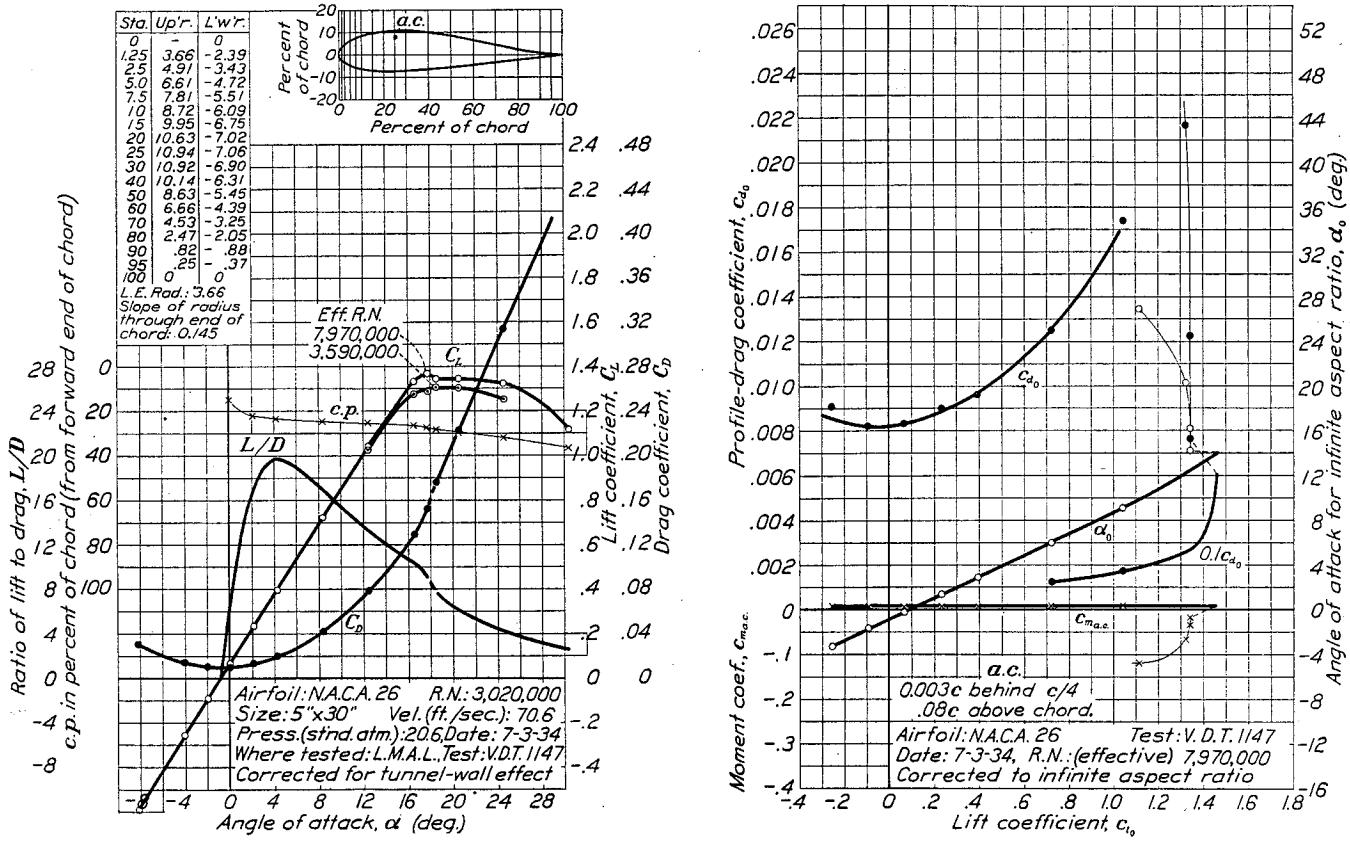


FIGURE 87.—N. A. C. A. 26 airfoil.

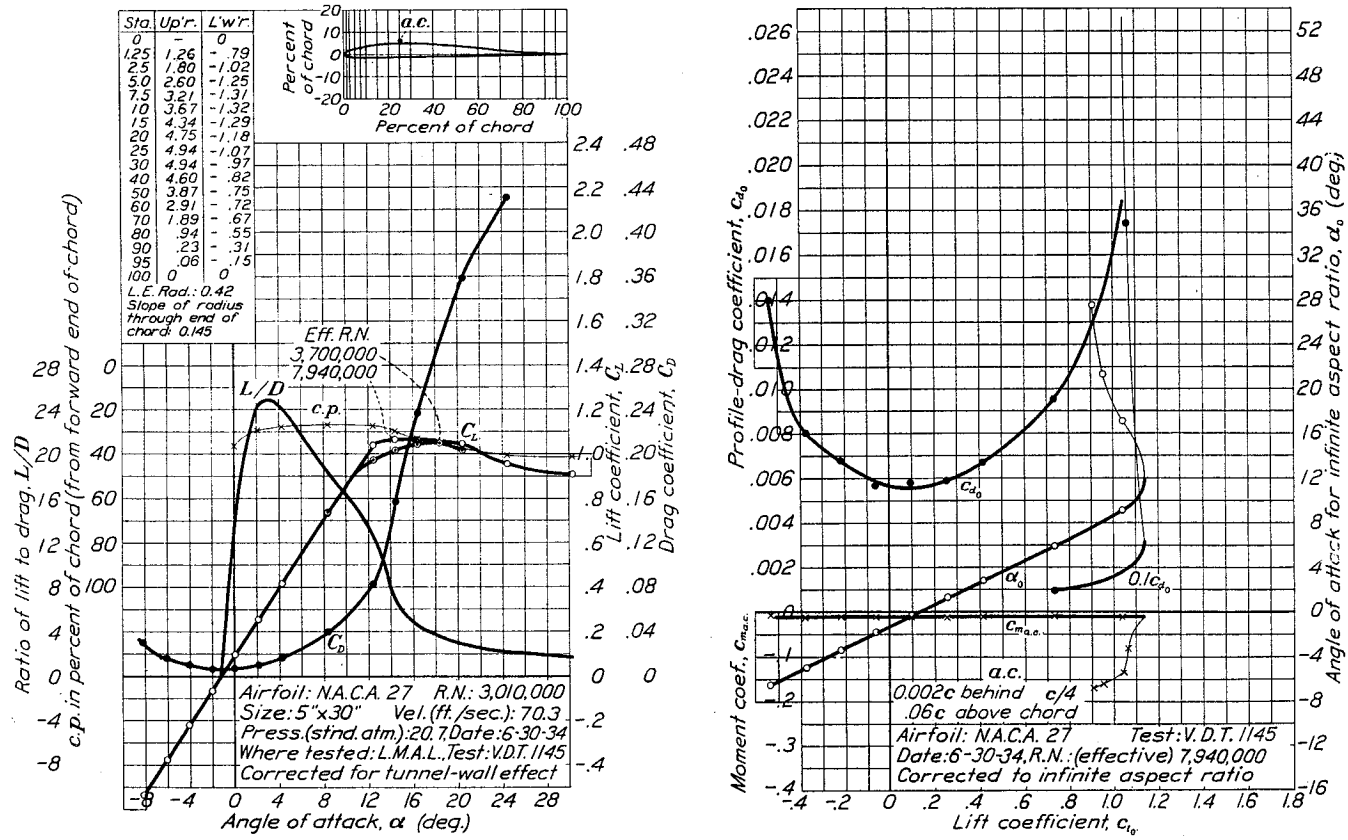


FIGURE 88.—N. A. C. A. 27 airfoil.

TABLE I.—CHARACTERISTICS OF RELATED N. A. C. A. AIRFOILS REPORTED IN REFERENCE 1

Airfoil	Classification				Effective Reynolds Number (millions)	Fundamental section characteristics								Derived and additional characteristics that may be used for structural design							
	Chord	PD	SE	$C_{L_{max}}$		$c_{l_{max}}$	α_{l_0} (deg.)	a_0 (per deg.)	$c_{l_{opt}}$	$c_{d_{0_{min}}}$	$c_{m_{a.c.}}$	a. c. (percent c from c/4)		$\frac{c_{l_{max}}}{c_{d_{0_{min}}}}$	c. p. at $C_{L_{max}}$ (percent c)	Wing characteristics $A=6$; round tips		Thickness at—			Camber (percent c)
												Ahead	Above			m_0 (per radian)	$C_{D_{min}}$	0.15c (percent c)	0.65c (percent c)	Maximum (percent c)	
N. A. C. A.:	(1)	(2)	(3)	(4)	(5)	(6)		(6)	(6)	(6)											
0006	A	A10	A	D	8.5	0.91	0	0.098	0	0.0054	0	0.7	2	169	35	4.28	0.0054	5.35	4.13	6	0
0009	A	B10	B0	A	8.3	1.39	0	.098	0	.0064	0	1.0	5	217	26	4.28	.0064	8.02	6.20	9	0
0012	A	C10	C0	A	8.4	1.66	0	.099	0	.0069	0	.6	3	241	26	4.32	.0069	10.69	8.27	12	0
0015	A	D10	D0	A	8.6	1.66	0	.097	0	.0077	0	1.2	4	216	25	4.24	.0077	13.36	10.33	15	0
0018	A	E10	E0	A	7.8	1.53	0	.096	0	.0088	0	1.7	4	174	25	4.20	.0088	16.04	12.40	18	0
0021	A	F10	E1	A	8.3	1.48	0	.093	0	.0100	0	3.0	6	148	24	4.11	.0100	18.71	14.46	21	0
0025	A	------	E2	B	8.5	1.28	0	.085	0	.0119	0	2.7	5	108	25	3.82	.0119	22.27	17.22	25	0
2212	A	C12	C3	B	8.4	1.72	−1.8	.099	.12	.0072	−.029	.9	5	238	27	4.31	.0073	10.69	8.25	12	2
2306	A	A10	A	D	8.1	1.11	−1.8	.100	.14	.0063	−.036	.4	4	176	29	4.34	.0064	5.36	4.14	6	2
2309	A	B10	B2	A	7.8	1.62	−2.0	.099	.14	.0070	−.037	.8	5	239	29	4.31	.0072	8.04	6.21	9	2
2312	A	C10	C2	B	8.2	1.72	−1.9	.097	.12	.0074	−.039	1.2	4	232	27	4.24	.0075	10.71	8.27	12	2
2315	A	D10	D2	B	8.0	1.65	−1.7	.098	.08	.0083	−.034	.9	3	199	28	4.28	.0084	13.38	10.36	15	2
2406	A	A10	A	D	8.2	1.04	−1.7	.099	.18	.0060	−.039	.4	4	173	34	4.31	.0063	5.34	4.14	6	2
2409	A	B10	B2	B	8.1	1.62	−1.7	.099	.08	.0067	−.044	.7	4	242	28	4.31	.0069	8.02	6.20	9	2
2412	A	C10	C2	B	8.2	1.72	−2.0	.098	.14	.0071	−.043	.5	3	242	28	4.28	.0072	10.71	8.27	12	2
2415	A	D10	D2	C	8.0	1.66	−1.7	.097	.10	.0082	−.040	1.4	5	201	28	4.24	.0083	13.39	10.34	15	2
2418	A	E10	E2	C	8.0	1.53	−1.9	.094	.06	.0093	−.038	1.1	2	165	27	4.14	.0094	16.08	12.39	18	2
2421	A	F10	E3	D	7.9	1.44	−1.7	.093	.06	.0106	−.035	1.4	2	136	28	4.11	.0106	18.75	14.46	21	2
2506	A	A10	A	D	8.1	1.06	−2.0	.099	.14	.0062	−.048	0	0	171	37	4.31	.0064	5.36	4.13	6	2
2509	A	B10	B2	D	8.0	1.48	−2.0	.098	.13	.0068	−.051	.3	2	218	29	4.28	.0069	8.04	6.21	9	2
2512	A	C10	C2	B	8.1	1.73	−2.1	.098	.18	.0074	−.054	1.0	2	234	28	4.28	.0076	10.70	8.27	12	2
2515	A	D10	D2	B	8.1	1.64	−2.0	.095	.09	.0085	−.050	.9	2	193	28	4.18	.0087	13.38	10.33	15	2
2518	A	E10	E2	D	8.1	1.58	−2.0	.092	.06	.0093	−.047	1.1	2	170	28	4.07	.0093	16.07	12.41	18	2
2521	A	F10	E3	B	8.2	1.48	−1.8	.091	.02	.0105	−.044	2.3	4	141	28	4.04	.0105	18.72	14.47	21	2
2612	A	C10	C1	B	8.4	1.78	−2.3	.096	.16	.0075	−.062	1.4	2	237	23	4.20	.0076	10.70	8.26	12	2
2712	A	C10	C0	B	8.0	1.80	−2.6	.096	.16	.0076	−.075	1.0	1	237	29	4.20	.0079	10.69	8.25	12	2
4212	A	C10	C5	A	8.5	1.83	−3.4	.098	.28	.0078	−.060	.6	2	235	29	4.28	.0084	10.70	8.27	12	4
4306	A	A10	A	D	8.1	1.28	−3.8	.099	.28	.0071	−.075	.5	2	180	31	4.31	.0079	5.40	4.14	6	4
4309	A	B10	B5	B	8.1	1.71	−3.6	.099	.24	.0077	−.073	.7	3	222	29	4.31	.0080	8.09	6.21	9	4
4312	A	C10	C5	B	8.3	1.74	−3.9	.096	.27	.0080	−.076	.9	3	218	30	4.20	.0085	10.77	8.27	12	4
4315	A	D10	D4	B	8.2	1.67	−3.6	.099	.10	.0090	−.069	1.2	4	186	29	4.31	.0091	13.47	10.34	15	4
4318	A	E10	E4	B	8.1	1.56	−3.5	.095	.16	.0101	−.065	1.3	3	154	29	4.18	.0103	16.14	12.41	18	4
4321	A	F10	E5	D	8.2	1.38	−3.6	.091	.04	.0113	−.058	1.8	3	122	31	4.04	.0113	18.81	14.46	21	4
4406	A	A10	A	D	8.1	1.32	−3.9	.100	.32	.0067	−.087	.4	0	197	32	4.34	.0077	5.40	4.16	6	4
4409	A	B10	B4	A	8.1	1.77	−3.9	.096	.26	.0073	−.088	.6	2	242	31	4.20	.0077	8.07	6.21	9	4
4412	A	C10	C4	D	7.9	1.74	−4.0	.098	.32	.0082	−.088	.8	2	212	31	4.28	.0084	10.77	8.28	12	4
4415	A	D10	D4	C	7.9	1.72	−4.0	.097	.22	.0090	−.085	1.0	1	191	31	4.24	.0092	13.45	10.34	15	4
4418	A	E10	E4	D	8.1	1.57	−3.7	.092	.13	.0097	−.078	1.4	1	162	31	4.07	.0100	16.15	12.40	18	4
4421	A	F10	E5	D	8.2	1.41	−3.4	.089	.08	.0111	−.071	1.9	2	127	32	3.96	.0112	18.79	14.48	21	4
4503	A	A10	A	D	8.0	1.18	−4.3	.100	.34	.0078	−.110	.5	−1	151	36	4.34	.0088	5.38	4.14	6	4
4509	A	B10	B3	D	8.2	1.67	−4.1	.099	.27	.0081	−.106	.3	0	206	31	4.31	.0086	8.08	6.21	9	4
4512	A	C10	C3	B	8.4	1.81	−4.2	.093	.21	.0081	−.106	1.1	0	223	31	4.11	.0085	10.74	8.28	12	4
4515	A	D10	D3	D	8.0	1.73	−4.1	.097	.17	.0097	−.097	.9	0	178	31	4.24	.0099	13.44	10.35	15	4
4518	A	E10	E3	D	8.2	1.65	−3.9	.092	.13	.0106	−.093	1.4	2	156	31	4.07	.0107	16.14	12.41	18	4
4521	A	F10	E4	D	8.2	1.50	−3.4	.091	.06	.0117	−.082	1.6	2	128	32	4.04	.0117	18.80	14.47	21	4
4612	A	C10	C2	B	8.3	1.88	−4.6	.094	.24	.0086	−.124	1.0	0	219	31	4.14	.0090	10.73	8.27	12	4
4712	A	C10	C1	A	8.2	1.95	−5.0	.093	.26	.0091	−.143	1.2	0	214	33	4.11	.0095	10.74	8.26	12	4
6212	A	C10	C7	A	8.5	1.87	−5.2	.096	.45	.0090	−.089	.8	4	208	30	4.20	.0101	10.78	8.29	12	6
6306	A	A10	B0	D	8.1	1.65	[7]−5.2	.101	.57	.0086	−.109	−.4	0	192	32	4.37	.0179	5.47	4.15	6	6
6309	A	B10	B6	B	8.2	1.78	−5.4	.100	.27	.0090	−.112	.6	3	198	32	4.34	.0103	8.18	6.23	9	6
6312	A	C10	C6	B	8.4	1.78	−5.5	.097	.35	.0090	−.111	.7	1	198	31	4.24	.0100	10.86	8.29	12	6
6315	A	D10	D6	B	8.1	1.66	−5.4	.097	.22	.0104	−.105	.7	2	160	32	4.24	.0107	13.58	10.37	15	6
6318	A	E10	E6	D	8.1	1.53	−5.2	.094	.15	.0112	−.098	1.3	1	137	32	4.14	.0113	16.27	12.44	18	6
6321	A	F10	E7	D	8.2	1.41	−5.2	.092	.10	.0123	−.090	1.5	2	115	33	4.07	.0124	18.92	14.51	21	6
6406	A	A10	B0	D	8.1	1.53	−5.6	.100	.50	.0080	−.129	−.7	0	191	34	4.34	.0119	5.42	4.15	6	6
6409	A	B10	B6	D	8.0	1.80	−5.9	.097	.48	.0085	−.133	0	−2	212	33	4.24	.0100	8.14	6.21	9	6
6412	A	C10	C6	D	8.2	1.82	−5.9	.098	.33	.0091	−.133	.9	1	200	33	4.28	.0103	10.85	8.29	12	6
6415	A	D10	D6	D	8.0	1.70	−5.7	.095	.25	.0104	−.125	.7	−2	163	34	4.18	.0109	13.55	10.36	15	6
6418	A	E10	E6	D	8.1	1.62	−5.7	.095	.25	.0114	−.118	1.3	0	142	34	4.18	.0119	16.28	12.43	18	6
6421	A	F10	E7	D	8.0	1.51	−5.2	.092	.10	.0125	−.110	1.7	0	121	34	4.07	.0126	18.96	14.50	21	6
6506	A	A10	A	D	8.3	1.38	[7]−6.3	.097	.40	.0088	−.159	0	0	157	35	4.24	.0109	5.41	4.14	6	6
6509	A	B10	B4	D	8.2	1.83	−6.3	.099	.48	.0091	−.158	.1	−3	201	34	4.31	.0106	8.14	6.21	9	6
6512	A	C10	C5	D	8.4	1.87	−6.2	.097	.40	.0094	−.155	.8	−3	199	33	4.24	.0103	10.84	8.30	12	6
6515	A	D10	D6	D	8.1	1.79	−6.0	.095	.25	.0112	−.147	1.0	−2	160	33	4.18	.0115	13.53	10.36	15	6
6518	A	E10	E6	D	8.1	1.72	−5.7	.091	.10	.0122	−.139	1.6	−2	141	34	4.04	.0123	16.22	12.44	18	6
6521	A	F10	E7	D	8.1	1.60	−5.3	.090	.10	.0133	−.129	1.8	3	120	34	4.00	.0134	18.92	14.49	21	6
6612	A	C10	C4	D	8.5	1.96	−6.6	.095	.25	.0102	−.185	1.7	−2	192	34	4.18	.0109	10.80	8.28	12	6
6712	A	C10	C2	A	8.1	2.05	−7.3	.096	.35	.0115	−.199	1.2	−2	178	34	4.20	.0119	10.76	8.27	12	6
0006T	A	A10	A	D	8.4	.91	0	.096	0	.0058	0	1.0	9	157	36	4.20	.0058	5.09	3.84	6	0
0006B	A	B10	B0	D	8.1	1.13	0	.100	0	.0065	0	.6	2	174	25	4.34	.0065	5.74	4.57	6	0
0012T	A	B10	B0	D	8.2	1.10	0	.095	0	.0067	0	.6	4	164	25	4.18	.0067	10.19	7.68	12	0
0012B	A	D10	D0	A	8.1	1.60	0	.097	0	.0080	0	2.0	6	200	25	4.24	.0080	11.48	9.13	12	0
0018T	A	D10	D0	D	8.3	1.38	0	.094	0	.0083	0	.8	3	166	26	4.14	.0083	15.28	11.52	18	0
0018B	A	F10	E2	A	8.3	1.50	0	.093	0	.0103	0	2.5	3	146	23	4.11	.0103	17.23	13.70	18	0
$2R_112$	A	C11	C3	B	8.6	1.64	−1.5	.097	.15	.0068	−.020	1.1	5	241	26	4.24	.0071	10.70	8.26	12	2
$2R_212$	A	C11	C2	B	8.4	1.61	−.6	.098	.10	.0073	.005	1.0	7	221	26	4.28	.0072	10.71	8.25	12	2
$0012F_0$	A	------	C0	A	8.5	1.64	−.2	.107	0	.0089	0	0	8	184	27	4.57	.0089	10.70	-------	12	0
$0012F_1$	-------	------	C0	A	8.5	2.19	−11.7	.095	.66	.0130	−.196	−1.5	−16	168	34	4.18	.0170	10.70	-------	12	6

[1] Type of chord. See reference 10.
[2] Type of pressure distribution. See reference 10.
[3] Type of scale effect on maximum lift. A signifies practically no scale effect.
For other designations see reference 9, fig. 44.

[4] See footnote 4, table II.
[5] Turbulence factor is 2.64.
[6] These data have been corrected for tip effect.
[7] Based on straight portion of lift curve extended.

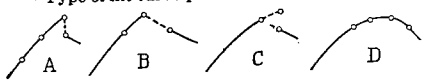
TABLE II.—CHARACTERISTICS OF MISCELLANEOUS AIRFOILS

[An inverted airfoil is considered as another distinct section]

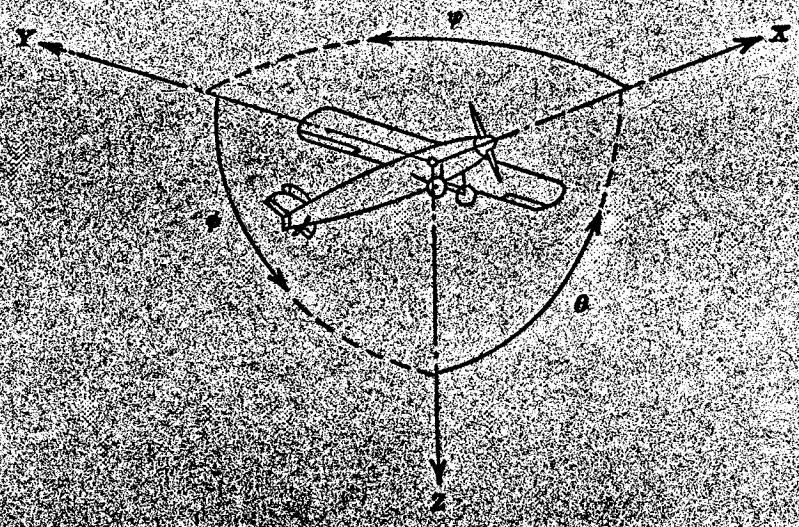
Airfoil	Figure No.	N. A. C. A. reference, R= report, N= note	Classification				Effective Reynolds Number (millions)	Fundamental section characteristics								Derived and additional characteristics that may be used for structural design						
			Chord	PD	SE	$C_{L_{max}}$		$c_{l_{max}}$	α_{l_0} (deg.)	a_0 (per deg.)	$c_{l_{opt}}$	$c_{d_{0_{min}}}$	$c_{m_{a.c.}}$	a. c. (percent c from c/4)		$\frac{c_{l_{max}}}{c_{d_{0_{min}}}}$	c. p. at $c_{l_{max}}$ (percent c)	Wing characteristics $A=6$; round tips		Thickness at			Camber (percent c)
														Ahead	Above			m_0 (per radian)	$C_{D_{min}}$	0.15c (percent c)	0.65c (percent c)	Maximum (percent c)	
			(1)	(2)	(3)	(4)	(5)	(6)		(6)	(6)	(6)											
Boeing 103	1	N 412	B	C10	C4	B	8.0	1.76	−4.8	0.097	0.15	0.0088	−0.065	0.6	7	200	30	4.24	0.0089	11.21	9.14	12.68	4.2
Boeing 103 (inv.)	2	N 412				B	8.6	.96		.098			.069	.9	−2		16	4.28					
Boeing 103A	3	N 412	B	B10	C3	A	8.4	1.74	−3.8	.098	.17	.0075	−.053	.5	5	232	29	4.28	.0077	9.18	7.52	10.38	3.2
Boeing 103A (inv.)	4	N 412				D	8.4	.85		.100			.058	.8	0		20	4.34					
Boeing 106	5	N 412	C	C10	B4	D	8.4	1.64	−4.4	.094	.14	.0081	−.052	.8	5	202	29	4.14	.0082	11.26	9.26	13.06	3.5
Boeing 106 (inv.)	6	N 412				B	8.1	.88		.093			.057	1.4	2		17	4.11					
Boeing 106R	7	N 388	C	C11	B3	D	8.3	1.48	−1.1	.095	.05	.0077	−.001	.3	4	192	27	4.18	.0077	11.26	9.29	13.06	2.0
Boeing 111	8		A	C10	D3	A	7.8	1.68	−2.1	.096	.17	.0071	−.033	1.3	6	137	28	4.20	.0073	9.92	8.14	11.50	3.0
Boeing 111 (inv.)	9					A	8.1	.89		.096			.033	.9	2		21	4.20					
Boeing 112	10		A	C10	D2	C	8.2	1.69	−2.0	.096	.20	.0071	−.023	.7	5	238	28	4.20	.0074	9.92	8.12	11.50	2.8
Boeing 112 (inv.)	11					D	8.3	.70		.096			.023	.7	−5		34	4.20					
Sikorsky GS-M	12		B	D10	D6	D	8.1	1.69	−7.9	.099	.30	.0096	−.105	.1	6	176	34	4.31	.0101	15.29	9.11	16.05	5.5
Sikorsky GS-M (inv.)	13					A	8.3	.89		.101			.105	1.1	1		12	4.37					
Sikorsky GS-I	14		B	D10	D4	D	8.3	1.78	−6.8	.097	.25	.0082	−.094	.4	4	217	32	4.24	.0086	12.84	8.31	13.98	4.5
Sikorsky GS-I (inv.)	15					A	8.5	1.16		.100			.093	1.2	2		16	4.34					
S. T. Aé. 27A	16		B	F10	E8	D	8.0	1.72	−10.2	.100	.40	.0127	−.177	0	0	135	36	4.34	.0137	15.96	8.20	19.80	8.0
R. A. F. 34	17		A	C11	C1	C	8.0	1.58	−.8	.098	.20	.0071	−.006	.4	5	222	27	4.28	.0072	10.88	8.55	12.64	1.8
U. S. A. 27	18	N 412	B	C10	C6	B	8.1	1.71	−4.7	.094	.30	.0086	−.078	1.8	5	199	30	4.14	.0098	10.40	8.70	11.12	5.6
U. S. A. 27 (inv.)	19	N 412				D	8.1	.52		.094			.080	1.9	0		29	4.14					
U. S. A. 35-A	20		B	E10	E6	D	8.4	1.52	−8.0	.095	.38	.0116	−.111	.8	5	131	34	4.18	.0121	16.60	11.90	18.18	7.3
U. S. A. 35-B	21	N 412	B	C10	C5	B	8.3	1.81	−5.2	.099	.35	.0083	−.076	.5	5	218	30	4.31	.0087	10.56	7.54	11.61	4.6
U. S. A. 35-B (inv.)	22	N 412				D	8.3	.81		.102			.081	1.3	5		24	4.41					
C-62	23		A	D10	A	D	8.4	1.06	−1.8	.095	.15	.0065	−.038	.6	4	163	34	4.18	.0067	7.09	5.72	8.04	1.9
C-72	24	N 412	B	C10	C4	D	8.0	1.74	−5.6	.095	.23	.0083	−.084	1.0	3	210	30	4.18	.0087	10.53	7.39	11.73	4.0
C-72 (inv.)	25	N 412				D	8.1	.83		.096			.085	1.0	−1		19	4.20					
C-80	26		A	B10	A	D	8.2	1.24	−1.0	.098	.05	.0064	−.015	.2	4	194	29	4.28	.0064	7.91	5.77	8.58	1.3
C-80 (inv.)	27					D	8.1	.81		.100			.018	.4	2		36	4.34					
N-22	28	N 412	B	C10	C4	D	8.1	1.72	−5.4	.096	.17	.0087	−.075	.6	4	198	30	4.20	.0089	11.25	8.36	12.37	4.3
N-22 (inv.)	29	N 412				B	8.1	.84		.098			.082	.8	0		14	4.28					
N-60	30	N 388	B	C10	C4	D	8.1	1.73	−5.5	.097	.30	.0086	−.078	0	0	201	31	4.24	.0090	11.17	7.88	12.37	4.0
N-60 R	31	N 388	B	C11	C3	D	8.3	1.50	−1.5	.098	.09	.0077	−.001	−.1	6	195	27	4.28	.0078	11.17	7.88	12.37	2.8
N-68	32		A	B10	A	D	8.1	.96	0	.097	0	.0060	0	.7	5	160	25	4.24	.0061	6.90	5.76	8.00	0
N-69	33		A	B10	A	D	8.1	1.00	0	.093	0	.0066	0	.8	4	152	25	4.11	.0066	8.46	8.22	10.94	0
N-71	34		C	C10	C2	D	8.3	1.67	−2.0	.099	.18	.0066	−.029	.7	6	253	28	4.31	.0068	9.99	7.52	11.54	2.0
N-71 (inv.)	35					A	8.3	1.24		.099			.030	0	1		23	4.31					
N-75	36		C	C10	C2	B	7.9	1.68	−2.2	.097	.15	.0075	−.045	.9	3	224	28	4.24	.0077	9.99	8.69	11.50	2.0
N-75 (inv.)	37					A	8.2	1.09		.096			.046	.7	2		20	4.20					
N-76	38		C	C10	C3	D	8.2	1.63	−2.1	.096	.19	.0078	−.032	.7	4	209	28	4.20	.0081	10.00	8.69	11.50	2.7
N-76 (inv.)	39					A	8.0	.99		.095			.032	.5	0		21	4.18					
N-80	40		C	C10	C2	B	8.4	1.74	−2.2	.098	.16	.0069	−.044	−.1	2	252	29	4.28	.0071	10.02	7.59	11.54	2.0
N-80 (inv.)	41					A	8.5	1.17		.100			.043	0	0		22	4.34					
N-81	42		C	C10	C2	A	8.5	1.79	−2.2	.100	.14	.0072	−.041	.2	5	249	29	4.34	.0073	10.60	7.18	11.54	2.0
N-81 (inv.)	43					A	8.5	1.26		.101			.038	.1	2		22	4.37					
Gött. 387	44	N 428	B	D10	D6	D	8.4	1.70	−6.6	.097	.30	.0091	−.093	.7	4	187	32	4.24	.0097	13.40	9.69	14.85	5.9
Gött. 398	45	N 412	B	D10	D5	D	8.1	1.68	−6.0	.094	.15	.0091	−.081	.4	1	185	31	4.14	.0094	12.50	9.27	13.75	4.9
Gött. 398 (inv.)	46	N 412				D	8.2	.83		.097			.086	1.9	3		12	4.24					
Gött. 398-A	47	N 416	B	C10	A	D	8.4	1.20	−6.1	.095	.40	.0085	−.086	1.0	−2	141	31	4.18	.0108	12.17	9.25	13.62	4.5
Gött. 398-B	48	N 416	B	C10	A	D	8.6	1.19	−6.4	.090	.45	.0084	−.093	1.7	4	142	31	4.00	.0122	11.87	9.24	13.48	4.5
Gött. 398-R	49	N 388	B	D11	D4	D	8.2	1.46	−2.2	.098	.10	.0082	−.005	.5	10	178	28	4.28	.0083	12.50	9.27	13.75	3.5
Gött. 413	50		B	D10	D5	D	8.0	1.61	−7.7	.101	.35	.0097	−.096	0	7	166	35	4.37	.0104	15.22	9.21	16.45	5.0

Gött. 420	51		B	E10	E4	D	8.2	1.51	−8.3	.095	.18	.0104	−.084	−.4	7	145	34	4.18	.0107	16.50	11.84	18.75	4.5
Gött. 429–AG	52		A	C10	C0	A	8.1	1.61	0	.100	0	.0066	0	.1	4	244	26	4.34	.0066	10.38	5.90	11.20	0
Gött. 429–J	53		A	C10	C0	A	8.0	1.65	0	.102	0	.0068	0	.2	5	243	27	4.41	.0068	10.98	6.10	11.78	0
Gött. 436	54		B	C10	C4	D	8.0	1.68	−4.4	.098	.22	.0082	−.061	.5	5	205	30	4.28	.0085	10.16	7.47	11.10	3.9
Gött. 436 (inv.)	55					D	8.1	.76		.099			−.062	.6	−6		28	4.31					
Gött. 532	56		B	C10	C5	C	8.1	1.91	−6.1	.101	.37	.0080	−.095	.8	6	239	31	4.37	.0088	11.60	6.63	13.00	4.8
Gött. 532 (inv.)	57					A	8.3	.73		.101			.095	2.9	14		10	4.37					
Clark Y	58	N 412	B	C10	C4	D	8.4	1.68	−5.0	.092	.12	.0083	−.069	1.1	4	202	29	4.07	.0085	10.53	8.30	11.70	3.9
Clark Y (inv.)	59	N 412				B	8.4	.92		.098			−.072	1.7	3		16	4.28					
Clark Y–B	60	N 447	B	C10	A	D	8.2	1.14	−5.4	.089	.35	.0072	−.075	1.3	−2	158	30	3.96	.0096	10.00	8.26	11.46	3.3
Clark Y M–15	61	N 412	C	D10	D4	C	8.4	1.70	−5.2	.094	.10	.0091	−.068	1.1	7	187	30	4.14	.0093	13.51	10.63	15.00	4.0
Clark Y M–15 (inv.)	62	N 412				B	8.0	1.23		.097			.071	1.3	1		18	4.24					
Clark Y M–18	63	N 412	C	E10	E4	C	8.2	1.60	−5.1	.091	.07	.0104	−.064	1.4	5	154	30	4.04	.0104	16.21	12.72	18.00	4.0
Clark Y M–18 (inv.)	64	N 412				A	8.3	1.39		.094			.065	2.2	2		18	4.14					
Clark Y–6	65		B	A10	A	D	8.1	1.07	−2.9	.098	.15	.0059	−.038	.7	5	181	37	4.28	.0062	5.40	4.24	6.00	1.9
Clark Y–8	66		B	B10	B3	D	8.0	1.37	−3.6	.096	.14	.0060	−.045	.7	6	228	30	4.20	.0062	7.21	5.68	8.00	2.6
Clark Y–10	67		B	B10	C3	B	7.9	1.68	−4.5	.098	.23	.0075	−.059	.7	4	224	30	4.28	.0078	9.01	7.08	10.00	3.2
Clark Y–14	68		B	D10	D4	D	8.0	1.72	−6.2	.096	.15	.0090	−.080	1.2	6	191	31	4.20	.0091	12.61	9.93	14.00	4.6
Clark Y–18	69	N 412	B	E10	E6	D	8.1	1.48	−7.6	.092	.23	.0117	−.098	1.5	6	126	33	4.07	.0121	16.22	12.74	18.00	6.3
Clark Y–18 (inv.)	70	N 412				B	8.1	.89		.089			.101	.3	−10		10	3.96					
Clark Y–22	71		B	F10	E8	D	7.9	1.36	−9.3	.088	.15	.0140	−.107	1.8	13	97	34	3.93	.0141	19.82	15.53	22.00	8.0
N. A. C. A.:																							
CYH	72	N 412	B	C11	C3	D	8.1	1.58	−2.9	.095	.08	.0076	−.027	.7	6	208	28	4.18	.0077	10.53	8.30	11.70	3.1
CYH (inv.)	73	N 412				B	8.1	.96		.095			.032	1.6	−1		20	4.18					
–M6	74	N 412	A	C11	C3	D	8.0	1.51	−.8	.095	.03	.0077	.002	−.4	0	196	26	4.18	.0077	10.29	9.00	12.01	2.4
–M6 (inv.)	75	N 412				D	8.2	1.19		.097			.007	0	0		24	4.24					
15	76		A	C10	A	D	8.2	1.17	−2.0	.094	.15	.0069	−.043	.3	0	170	29	4.14	.0071	10.20	8.27	12.00	2.0
16	77		A	C10	B4	D	8.4	1.64	−2.1	.095	.17	.0069	−.045	.7	3	238	28	4.18	.0071	10.45	8.27	12.00	2.0
17	78		C	C10	B4	B	8.4	1.53	−1.9	.095	.25	.0069	−.047	.4	2	222	29	4.18	.0076	10.20	8.27	12.00	2.6
18	79		C	C10	C2	A	8.1	1.69	−2.0	.096	.25	.0071	−.049	.6	3	238	28	4.20	.0074	10.45	8.27	12.00	2.6
19	80		A	B10	A	D	8.2	1.01	−1.9	.093	.17	.0065	−.044	0	0	155	33	4.11	.0068	9.93	8.27	12.00	2.0
20	81		A	B10	A	D	8.1	1.02	−2.2	.090	.24	.0065	−.048	1.2	−10	157	31	4.00	.0078	9.70	8.27	12.00	2.0
21	82		A	C11	C2	B	8.1	1.71	−2.1	.096	.20	.0074	−.038	.5	3	231	28	4.20	.0077	10.29	8.96	12.00	2.4
21 (inv.)	83					D	8.1	1.08		.097			.040	.4	1		22	4.24					
23	84		A	B11	B2	A	8.0	1.65	−1.0	.100	.18	.0062	−.007	.5	7	266	27	4.34	.0064	8.40	4.67	9.00	2.0
24	85		A	C11	C2	A	8.1	1.67	−.8	.103	.15	.0068	0	−.1	6	246	27	4.44	.0070	11.19	6.21	12.00	2.0
25	86		A	D11	D2	B	8.1	1.54	−.8	.105	0	.0075	.008	−.1	8	205	27	4.51	.0075	13.97	7.79	15.00	2.0
26	87		A	E11	E2	D	8.0	1.46	−.9	.104	−.05	.0082	.008	−.3	8	178	27	4.47	.0082	16.70	9.38	18.00	2.0
27	88		A	A11	A	D	7.9	1.14	−1.3	.102	.10	.0056	−.010	−.2	6	204	30	4.41	.0057	5.63	3.10	6.00	2.0
22112		R 37	A	C11	D2	B	8.5	1.64	−.8	.100	.06	.0072	.001	1.0	5	228	25	4.34	.0073	10.69	8.27	12.00	1.6
23112		R 537	A	C11	D2	A	8.2	1.73	−.8	.100	.08	.0074	.002	1.5	8	234	25	4.34	.0075	10.69	8.28	12.00	2.1
24112		R 537	A	C11	C3	A	8.0	1.67	−.9	.100	.10	.0074	0	1.4	8	226	26	4.34	.0074	10.71	8.26	12.00	2.4
25112			A	C11	C3	B	8.2	1.62	−1.2	.100	.08	.0074	−.002	1.3	7	219	25	4.34	.0075	10.73	8.28	12.00	2.7

[1] Type of chord. See reference 10.
[2] Type of pressure distribution. See reference 10.
[3] Type of scale effect on maximum lift. A signifies practically no scale effect. For other designations see reference 9, fig. 44.
[4] Type of lift-curve peak as shown in the sketches:



[5] Turbulence factor is 2.64.
[6] These data have been corrected for tip effect.



Positive directions of axes and angles (forces and moments) are shown by arrows

Axis			Moment about axis			Angle		Velocities	
Designation	Symbol	Force (parallel to axis) symbol	Designation	Symbol	Positive direction	Designation	Symbol	Linear (component along axis)	Angular
Longitudinal	X	X	Rolling	L	$Y \rightarrow Z$	Roll	ϕ	u	p
Lateral	Y	Y	Pitching	M	$Z \rightarrow X$	Pitch	θ	v	q
Normal	Z	Z	Yawing	N	$X \rightarrow Y$	Yaw	ψ	w	r

Absolute coefficients of moment

$C_l = \frac{L}{qbS}$ (rolling) $\quad C_m = \frac{M}{qcS}$ (pitching) $\quad C_n = \frac{N}{qbS}$ (yawing)

Angle of set of control surface (relative to neutral position), δ. (Indicate surface by proper subscript.)

4. PROPELLER SYMBOLS

D, Diameter

p, Geometric pitch

p/D, Pitch ratio

V', Inflow velocity

V_s, Slipstream velocity

T, Thrust, absolute coefficient $C_T = \frac{T}{\rho n^2 D^4}$

Q, Torque, absolute coefficient $C_Q = \frac{Q}{\rho n^2 D^5}$

P, Power, absolute coefficient $C_P = \frac{P}{\rho n^3 D^5}$

C_s, Speed-power coefficient $= \sqrt[5]{\frac{\rho V^5}{P n^2}}$

η, Efficiency

n, Revolutions per second, r.p.s.

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

5. NUMERICAL RELATIONS

1 hp. = 76.04 kg-m/s = 550 ft-lb./sec.
1 metric horsepower = 1.0132 hp.
1 m.p.h. = 0.4470 m.p.s.
1 m.p.s. = 2.2369 m.p.h.

1 lb. = 0.4536 kg.
1 kg = 2.2046 lb.
1 mi. = 1,609.35 m = 5,280 ft.
1 m = 3.2808 ft.

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