NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

[redacted]

TEST OF N.A.C.A. 21 AIRFOIL (MODIFIED N.A.C.A. M-6) INCLUDING CHARACTERISTICS AT POSITIVE AND NEGATIVE ANGLES OF ATTACK

By Raymond F. Anderson

June 25, 1932

C O P Y

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MEMORANDUM

Subject: Test of N.A.C.A. 21 airfoil.

1. In accordance with letter of the Bureau of Aeronautics, dated March 30, 1932, requesting that the Committee test a model of the N.A.C.A. M-6 airfoil modified to give a moment coefficient at zero lift of -0.035, an airfoil designated as the N.A.C.A. 21 was designed by modifying the N.A.C.A. M-6 to give the desired value of moment coefficient, and a standard 5-by-30-inch model was tested in the variable density wind tunnel at approximately 20 atmospheres.

2. The results of the tests have been plotted in the standard form on the accompanying figure. The moment at zero lift is -0.035, which differs from the value desired by little more than the experimental error.

3. In the following table the principal characteristics of the N.A.C.A. 21 airfoil are compared with the characteristics of the N.A.C.A. $2R_1 12$ section. The N.A.C.A. $2R_1 12$ section has practically the same thickness as the N.A.C.A. 21 section, but less camber and a small amount of reflex.

	N.A.C.A. 21	N.A.C.A. $2R_1 12$
C_L max	1.60	1.53
C_{D_o} min	.0089	.0084
C_L max/C_{D_o} min	180	182
C_{m_o} (C_m at $C_L = 0$	-.038	-.020
$dC_L d\alpha_o$	.100	.101

Because the camber is greater the values of $C_L$max, C_{D_o} min, and C_{m_o} for the N.A.C.A. 21 are larger than those for the N.A.C.A. $2R_1$12 section. The N.A.C.A. $2R_1$12 section has an advantage of a slightly higher value of C_L max/C_{D_o} min, and a smaller value of C_{m_o}.

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AIRFOIL N.A.C.A. 21

Average Reynolds Number: 3,100,000

Size of model: 5 by 30 inches

Pressure, standard atmospheres: 20.8

Test No.: 867 and 837 Variable-density tunnel Date 8-15-32 and 5-7-32

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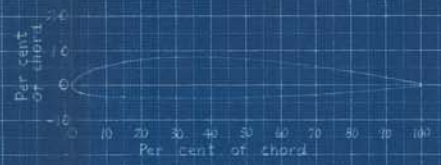
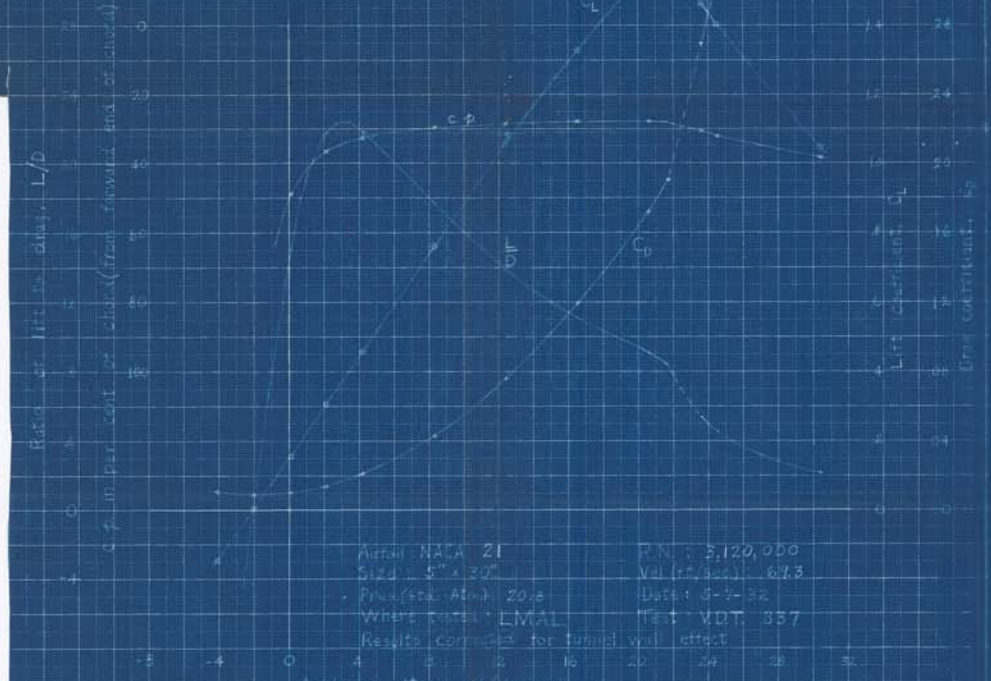
C_L	α_o	C_{D_o}	$C_{m_{c/4}}$
-0.723	-27.7	0.4356	0.109
-.780	-21.5	.3144	.083
-.927	-15.1	.1357	.016
-1.015	-12.4	.0198	
-.756	-9.6	.0132	-.041
-.452	-6.6	.0104	-.041
-.148	-3.5	.0090	-.040
.005	-2.0	.0092	-.038
.155	-.5	.0089	-.037
.308	1.0	.0088	-.036
.459	2.5	.0092	-.036
.763	5.6	.0104	-.035
1.057	8.6	.0135	-.036
1.329	11.8	.0205	-.037
1.559	15.0	.0359	-.042
1.599	16.0	.0475	
1.461	18.4	.1502	-.084
1.401	19.5	.1985	-.100
1.045	26.7	.4189	-.152

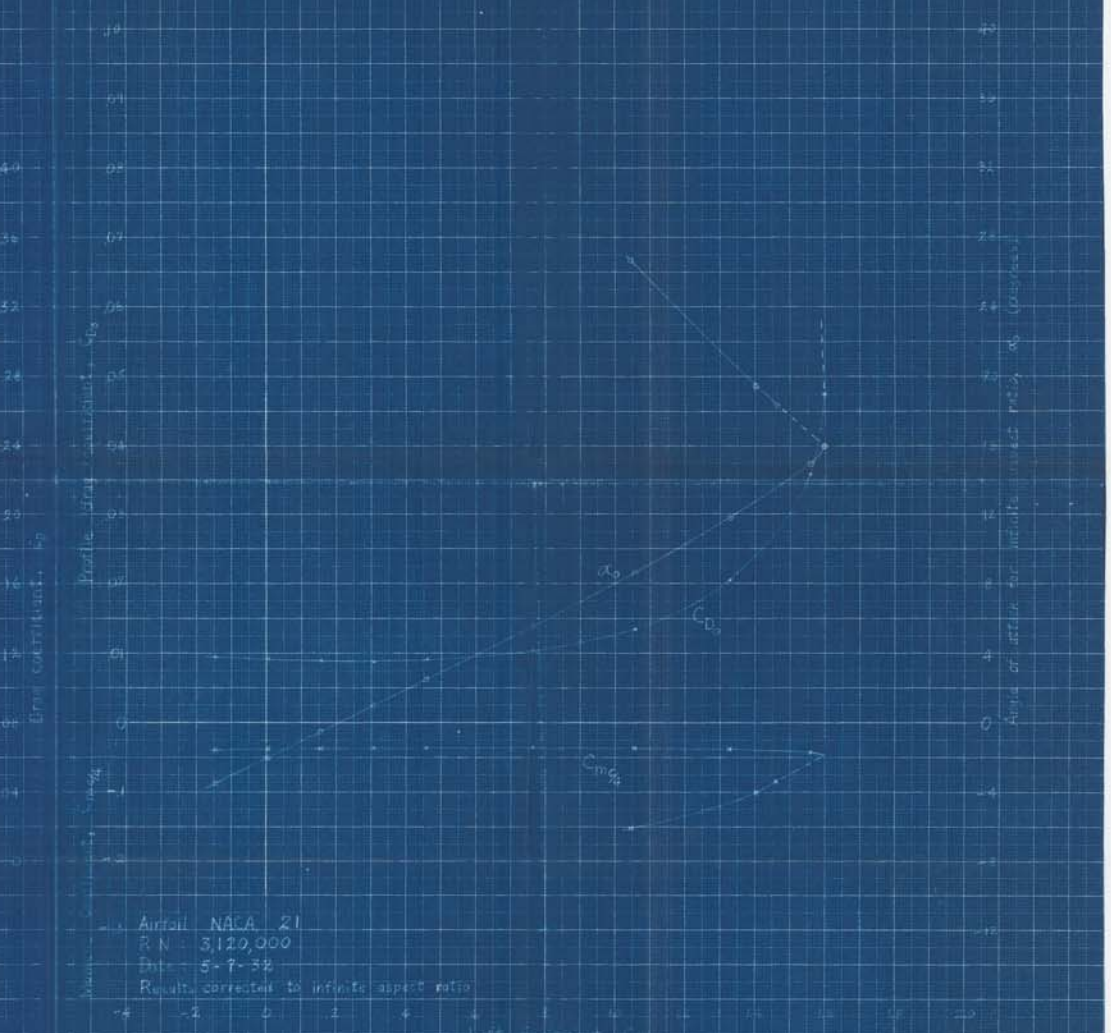
Sta	Upper	Lower
0	0.00	0.00
1¼	1.87	-1.76
2½	2.81	-2.20
5	4.03	-2.73
7½	4.94	-3.03
10	5.71	-3.24
15	6.82	-3.41
20	7.55	-3.62
25	8.01	-3.71
30	8.22	-3.74
40	8.12	-3.64
50	7.54	-3.36
60	6.56	-2.93
70	5.34	-2.42
80	3.86	-1.82
90	2.15	-1.17
95	1.23	-.72
100	.26	-.26
L.E. Rad.	1.75	





Airfoil NACA 21
Size 5" x 30"
Pressure (abs. Atm.) 20.8
Where tested LMAL
Results corrected for tunnel wall effect

R.N. 3,120,000
Vel. (ft./sec.) 69.3
Date 6-1-32
Test V.D.T. 337



Airfoil NACA 21
R.N. 3,120,000
Date 5-7-32
Results corrected to infinite aspect ratio

National Advisory Committee for Aeronautics