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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

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PRESSURE-DISTRIBUTION MEASUREMENTS OF A LOW-DRAG AIRFOIL WITH SLOTTED FLAP SUBMITTED BY CURTISS-WRIGHT CORPORATION

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Langley Field, Va.

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

MEMORANDUM REPORT

for the

Materiel Division, Army Air Corps

PRESSURE-DISTRIBUTION MEASUREMENTS OF A LOW-DRAG AIRFOIL WITH SLOTTED FLAP SUBMITTED BY CURTISS-WRIGHT CORPORATION

By I. H. ABBOTT

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INTRODUCTION

Pressure-distribution measurements were made at the request of the Materiel Division, U. S. Army Air Corps, on a 24-inch-chord wooden model equipped with a slotted flap and submitted by the Curtiss-Wright Corporation. The tests were made in the Langley two-dimensional tunnel at a Reynolds number of about 5,600,000.

The model was the one described in reference 1 and represented a wing section of the P-60A airplane. The model was equipped with a 0.25c slotted flap with the lip on the upper airfoil surface at approximately 90 percent of the airfoil chord. The model was equipped with pressure-distribution orifices.

RESULTS AND DISCUSSION

Pressure-distribution diagrams are presented in figures 1 to 5 for the model at about -16°, 0°, and 16° with a flap deflection of 15°, and for angles of attack of 0° and 12° for a flap deflection of 30°. Pressures are plotted directly as obtained from the manometer in terms of 1/2-inch units of carbon tetrachloride. The abscissa is the projection on the chord line of the pressure orifices. The values of the corrected dynamic pressure q and the impact pressure level in terms of the same units are given on each figure. The static pressure level is obtained by adding the value of q to the impact pressure level. The value $\left(\frac{v}{V}\right)^2$, where v is the local velocity and V is the free-stream velocity, is obtained by dividing the local pressure, measured from the impact pressure level, by the value of q.

The normal-force coefficient, as obtained by integration of the pressure diagrams, is given on each figure and is in essential agreement with the lift coefficients presented in reference 1. Moment coefficients about the quarter-chord point are also presented as obtained for integration of the diagrams. These moment coefficients do not contain the component of moment due to the chord force which may be appreciable, especially at the larger flap deflection.

The projections of the pressure orifices of the model on the chord are given in table I in percentage of chord for flap deflections of 0°, 15°, and 30°.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., December 11, 1941.

REFERENCE

1. Abbott, I. H.: Lift and Drag Characteristics of a Low-Drag Airfoil Model with Slotted Flap Submitted by Curtiss-Wright Corporation. NACA MR, Dec. 2, 1941.

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TABLE I

PROJECTION ON CHORD OF PRESSURE ORIFICES

CURTISS-WRIGHT 24-INCH CHORD FLAP MODEL FOR P60-A AIRPLANE

Airfoil			
Upper Surface		Lower Surface	
Orifice No.	Percent Chord	Orifice No.	Percent Chord
L.E.	0		
1T	.83	1B	.91
2T	2.45	2B	2.62
3T	5.16	3B	5.10
4T	7.61	4B	7.57
5T	10.06	5B	10.17
6T	15.08	6B	15.13
7T	19.99	7B	20.15
8T	25.05	8B	25.15
9T	30.05	9B	30.17
10T	35.06	10B	35.05
11T	40.00	11B	40.08
12T	45.12	12B	45.10
13T	50.10	13B	50.04
14T	54.95	14B	55.00
15T	59.99	15B	60.26
16T	65.10	16B	64.93
17T	70.06	17B	69.90
18T	75.00	18B	75.04
19T	80.15	19B	75.80
20T	85.10	20B	77.95
		21B	80.90
		22B	82.39
		23B	83.72
Flap, $\delta = 0^{\circ}$			
L.E.	75.35		
1FT	75.90	1FB	76.09
2FT	76.92	2FB	77.05
3FT	78.85	3FB	78.96
4FT	82.40	4FB	82.54
5FT	85.00	5FB	84.91
6FT	87.50	6FB	87.40
7FT	89.98	7FB	89.90
8FT	93.30	8FB	93.14
9FT	96.33	9FB	97.01
		T.E.	100.00

TABLE I (Concluded)

PROJECTION ON CHORD OF PRESSURE ORIFICES

Flap, $\delta = 15^{\circ}$			
Upper Surface		Lower Surface	
Orifice No.	Percent Chord	Orifice No.	Percent Chord
L.E.	81.75		
1FT	82.50	1FB	82.13
2FT	83.72	2FB	82.95
3FT	86.10	3FB	84.89
4FT	89.65	4FB	88.55
5FT	92.20	5FB	91.05
6FT	94.70	6FB	93.65
7FT	97.08	7FB	96.20
8FT	100.00	8FB	99.53
9FT	102.85	9FB	103.40
		T.E.	106.22
Flap, $\delta = 30^{\circ}$			
L.E.	88.72		
1FT	89.70	1FB	88.78
2FT	91.11	2FB	89.44
3FT	93.60	3FB	91.19
4FT	97.17	4FB	94.72
5FT	99.58	5FB	97.05
6FT	101.70	6FB	99.54
7FT	103.70	7FB	102.00
8FT	106.23	8FB	105.15
9FT	108.60	9FB	108.81
		T.E.	111.51

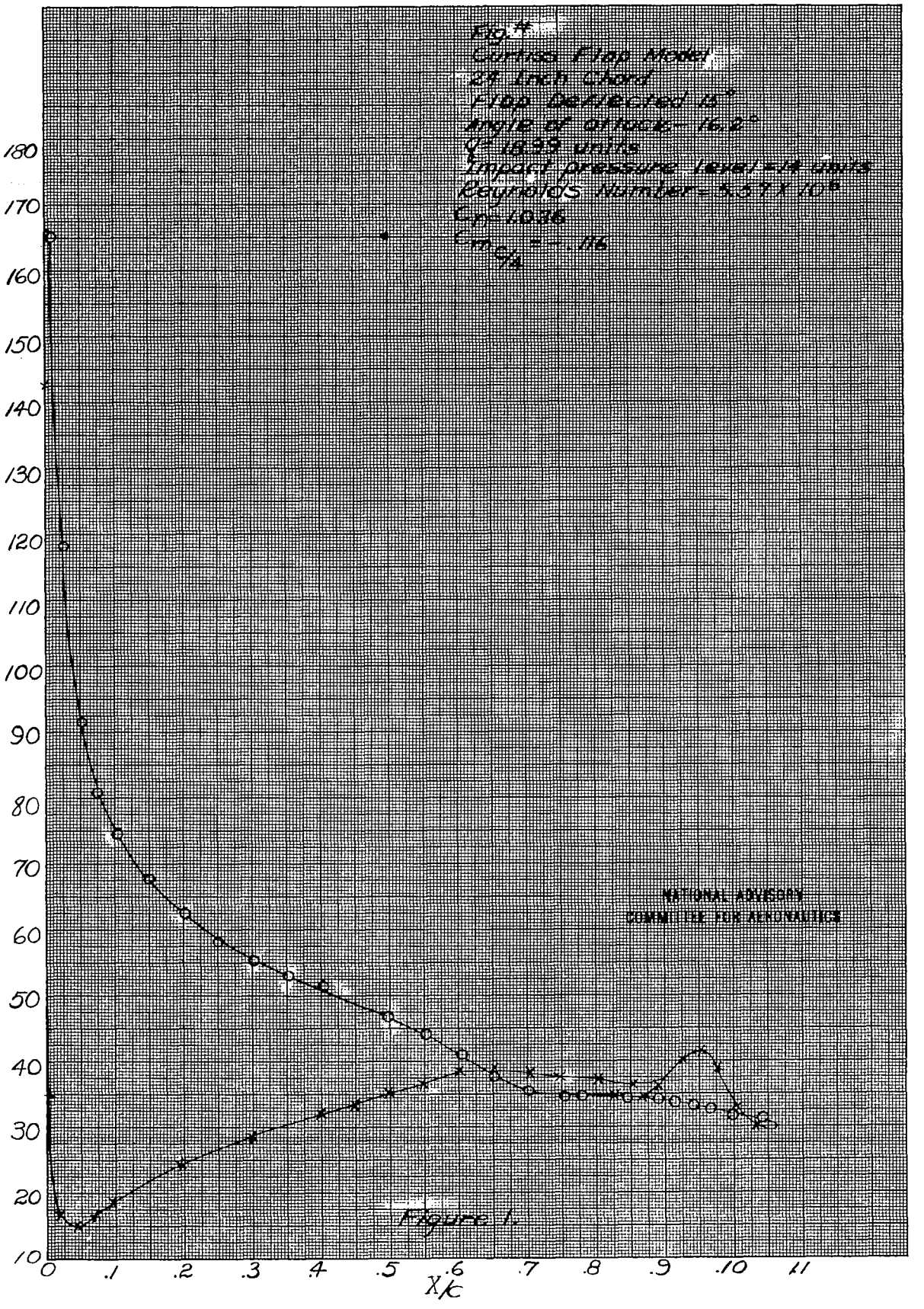
Fig. 4
Curtiss Flap Model
24 Inch Chord
Flap Deflected 15°
Angle of attack - 16.2°
q = 18.93 units
Impact pressure level = 14 units
Reynolds Number = 5.57 X 10^6
Cp = 1.036
Cm c/4 = - .116
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Figure 1.
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
.10
.11
X/c

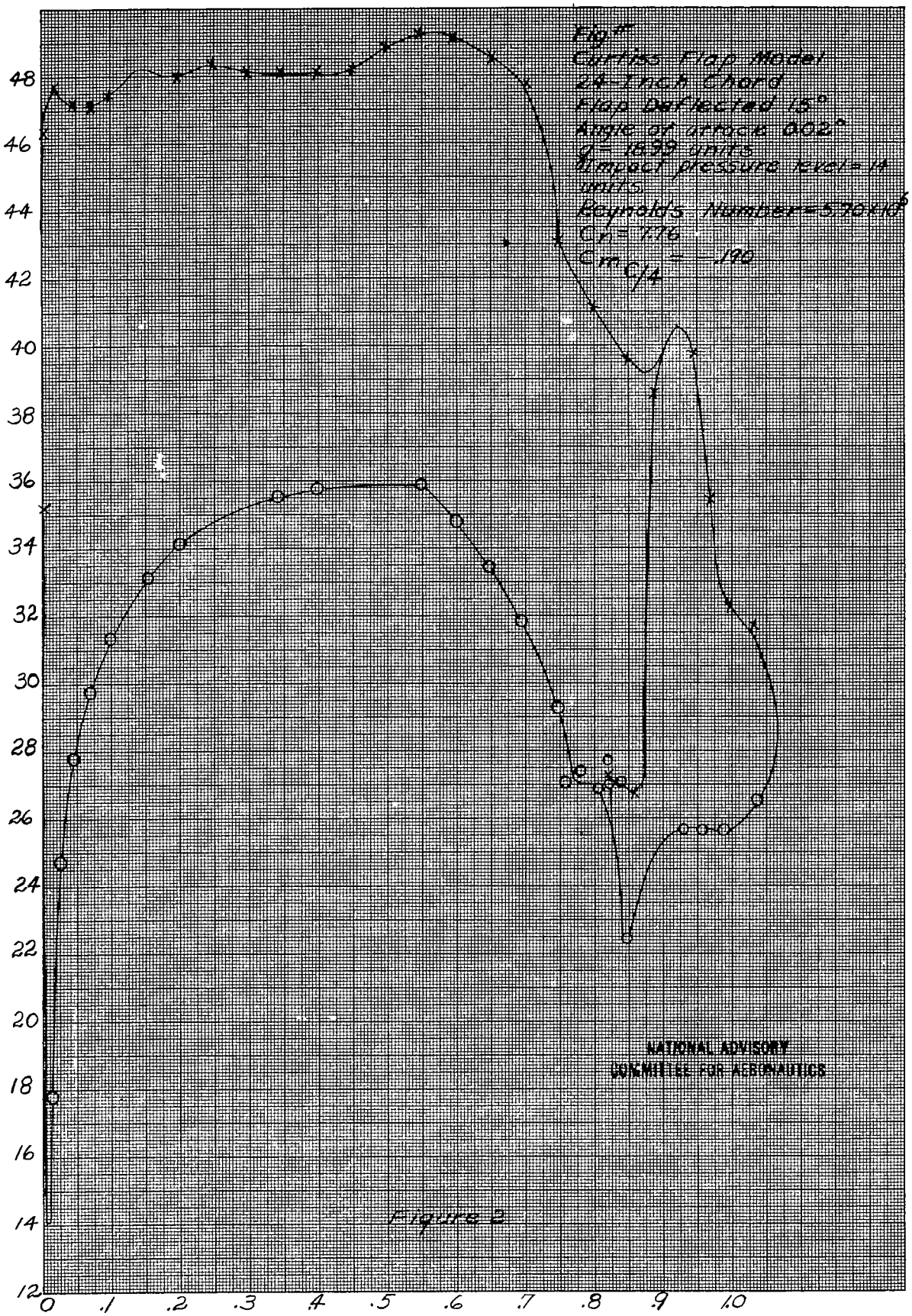
Fig. 8
Curtiss Flap Model
24-Inch Chord
Flap Deflected 15°
Angle of attack 0.02°
q = 18.99 units
Impact pressure level = 14 units
Reynold's Number = 5.70×10^6
C_L = 7.76
$C_{m\,c/4}$ = -.190
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
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Figure 2

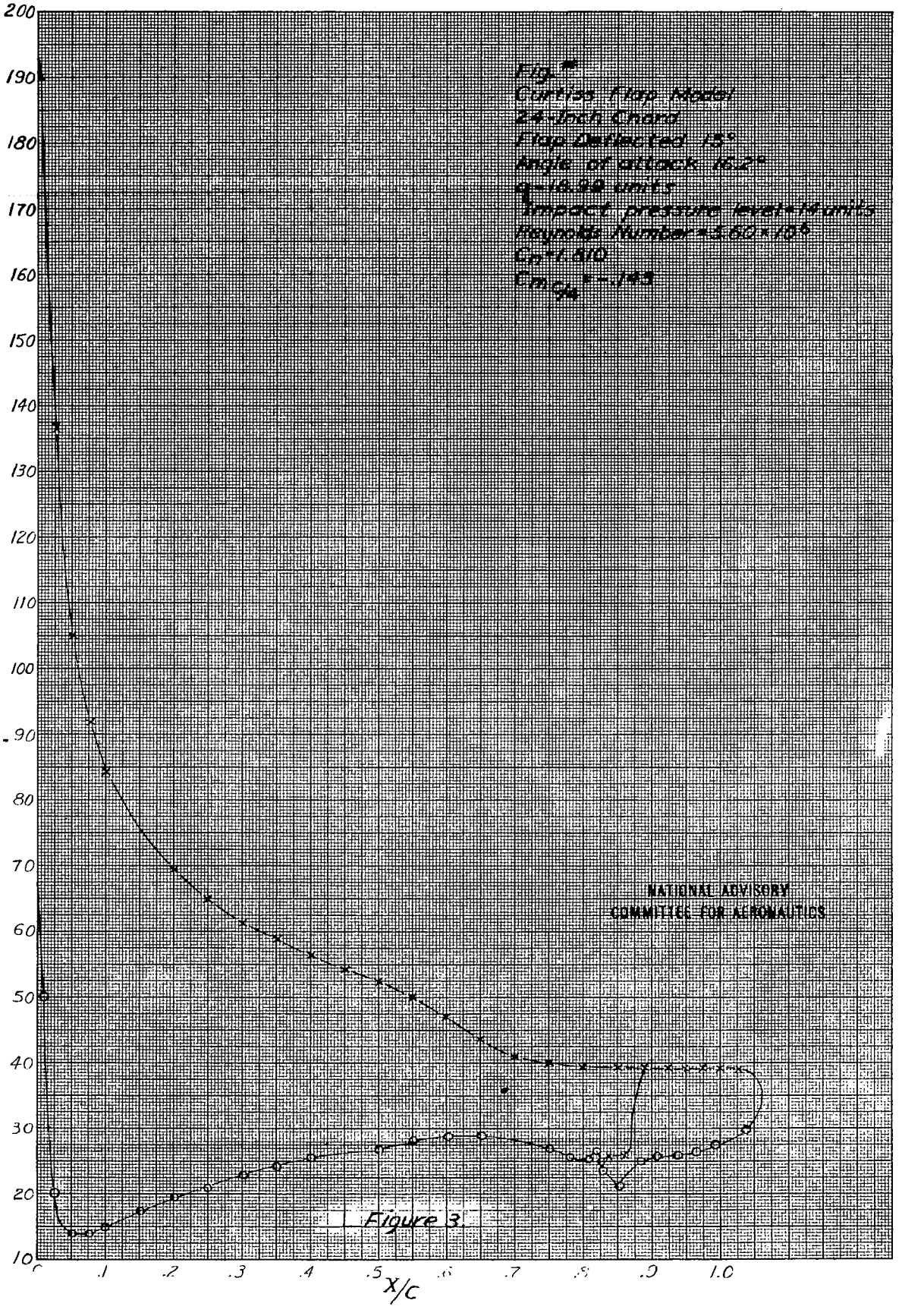
Fig. #
Curtiss Flap Model
24-Inch Chord
Flap Deflected 15°
Angle of attack 16.2°
q=18.99 units
Impact pressure level=14 units
Reynolds Number=5.60×10^6
Cn=1.810
Cm c/4=-.143
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200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
X/C

Figure 3.

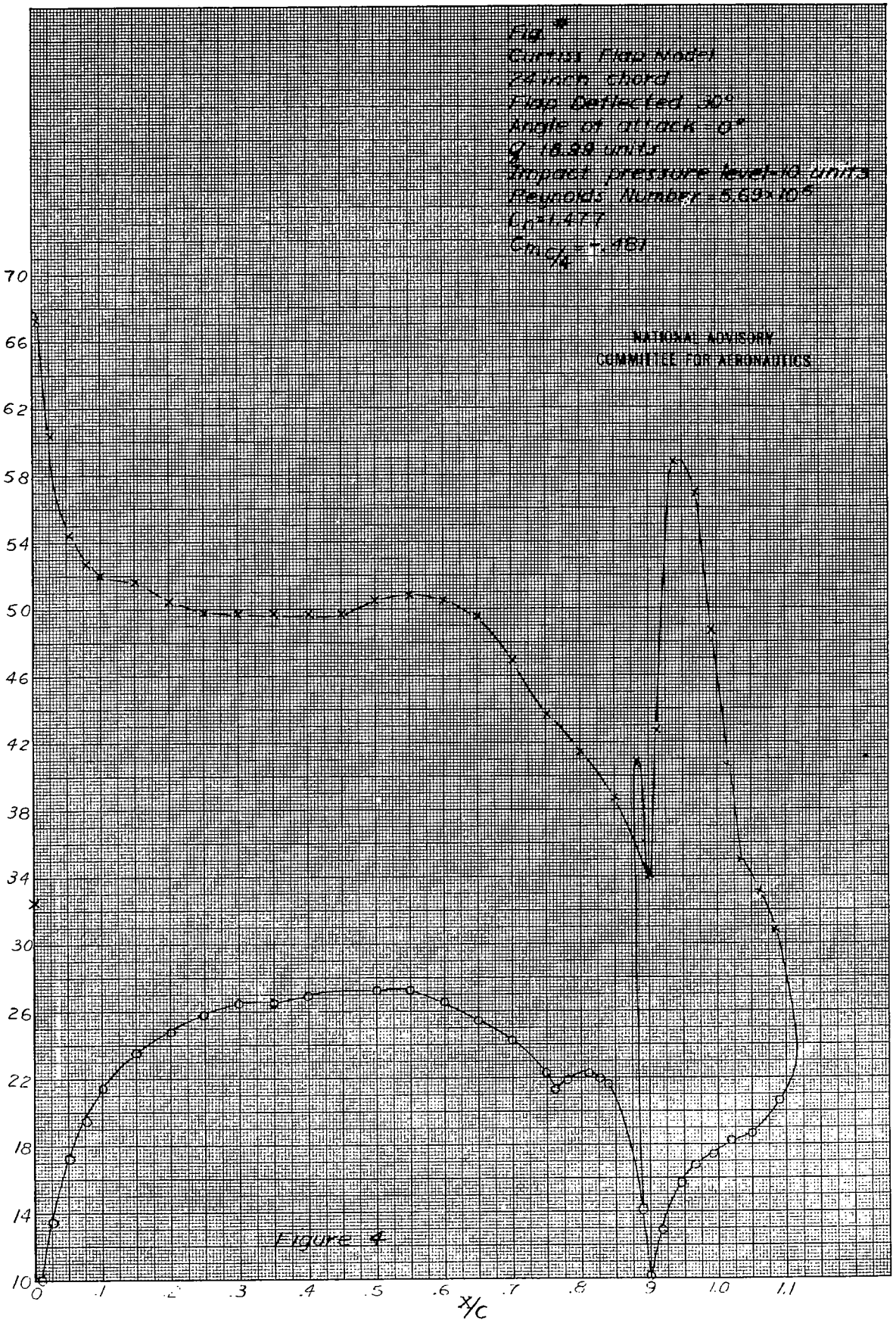
Fig. 4
Curtiss Flap Model
24 inch chord
Flap Deflected 30°
Angle of attack = 0°
q 18.99 units
Impact pressure level-10 units
Reynolds Number = 5.69×10^5
C_L=1.477
$C_{m_{c/4}}$=-.481
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70
66
62
58
54
50
46
42
38
34
30
26
22
18
14
10
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
x/c

Figure 4

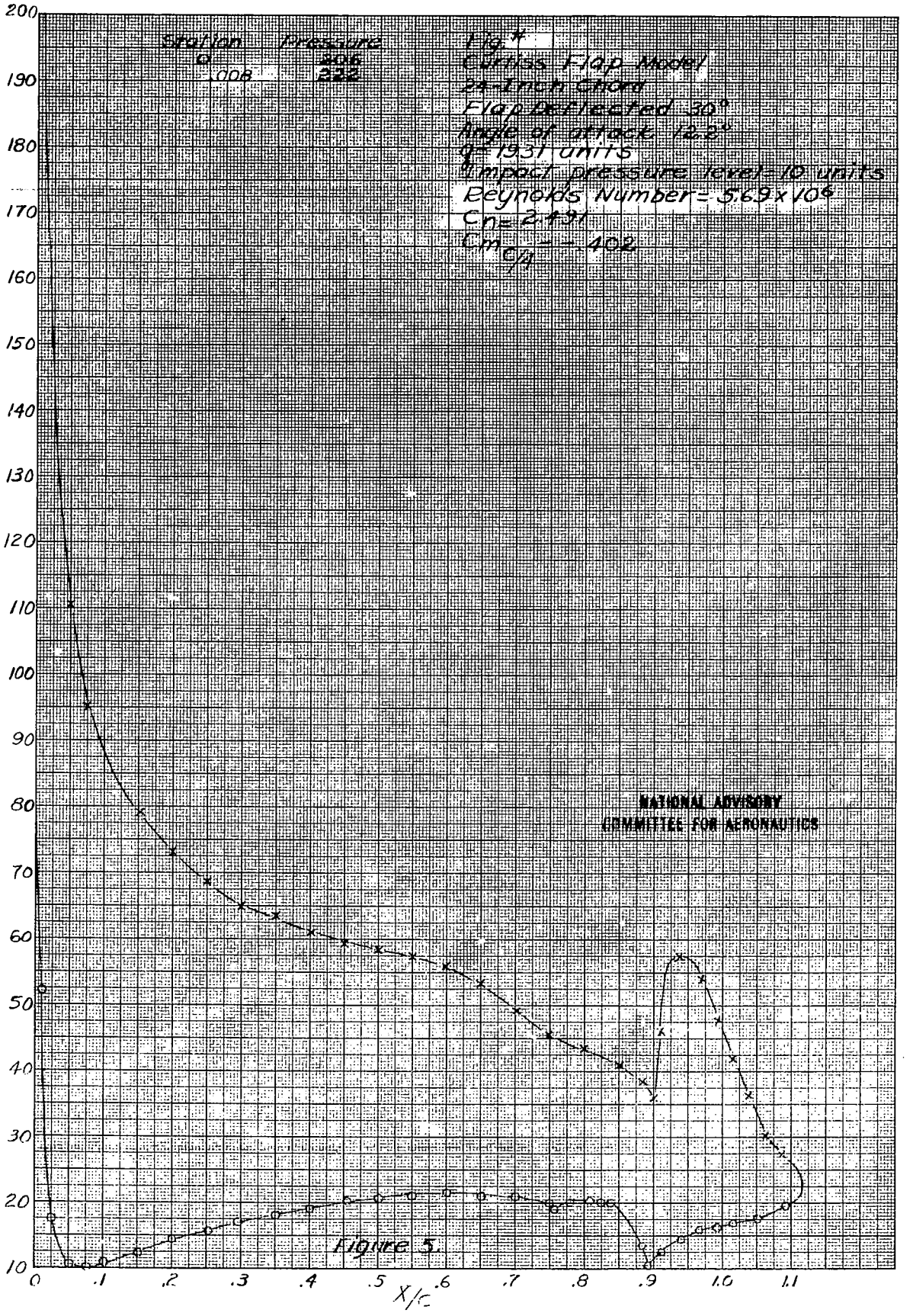
Station Pressure
0 .006
.006 .222
Fig. 4
Curtiss Flap Model
22-inch Chord
Flap Deflected 30°
Angle of attack 12.2°
q=19.31 units
Impact pressure level=10 units
Reynolds Number=5.69x10^6
Cn=2.191
Cm c/4 = -.102
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Figure 5.
X/c
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1

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