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I - SECTION CHARACTERISTICS, NACA 23012 AIRFOIL

By F. M. Rogallo and John G. Lowry

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WASHINGTON

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SUMMARY

An investigation was made in the NACA 7- by 10-foot wind tunnel to determine the aerodynamic section characteristics of several arrangements of an NACA full-span high-lift lateral-control combination. The combination is essentially a full-span flap of airfoil profile that retracts ahead of a narrow-chord full-span aileron. In the flap-retracted condition the aileron is a conventional trailing-edge aileron of short chord and long span. In the flap-deflected condition the flap is similar to a Fowler flap and the aileron becomes a full-span slot-lip aileron. The aileron is drooped in the flap-deflected condition to improve high-lift characteristics. Tests were run at several aileron and flap angles and with several widths of slot to determine the optimum arrangement.

Comparisons made with a Fowler and an NACA slotted flap showed that the combination under investigation gave lift coefficients as high as the other slotted flaps, and also provided lateral control with full-span flaps in all flight conditions. There was, however, an increase, negatively, in pitching-moment coefficients over those of the Fowler flap.

INTRODUCTION

With increasing speed and wing loading of the modern airplane arises the difficulty of obtaining high lift for landing and take-off and still maintaining adequate lateral control under all flight conditions. In order to obtain solutions for this problem the NACA is investigating lateral-control devices for wings with full-span flaps.

The ultimate aim of this investigation is to obtain arrangements with high-lift coefficients and adequate lateral control, with a minimum of drag in the high-speed condition, and with a minimum of structural and mechanical difficulties.

Two devices, the plug-type spoiler-slot aileron (reference 1) and the plain and slot-lip aileron combination (reference 2), have been developed for use with full-span NACA slotted flaps (reference 3). These devices show much promise from wind-tunnel results. Because retractable flaps (references 4 and 5) as typified by the Fowler flap may give higher lift coefficients than the NACA slotted flap, several lateral-control devices (references 6, 7, and 8) have been developed for use with full-span retractable flaps. The devices all appear from wind-tunnel tests to be satisfactory. The results of tests made with full-span external-airfoil flaps and ordinary ailerons (reference 9) indicate satisfactory lateral control.

The results of the investigations of the retractable and the external-airfoil flaps led to the development of the full-span high-lift lateral-control device described in this paper. This device is much simpler than the ones described in references 7 and 8 and offers lower drag in the high-speed condition than the external-airfoil flap of reference 9 because it retracts within the airfoil contour.

The NACA high-lift lateral-control combination is a full-span flap of airfoil profile that retracts ahead of the narrow-chord full-span aileron. In the flap-retracted condition the aileron is a conventional trailing-edge aileron of small chord and large span, a device known to give satisfactory lateral control and light stick forces. In the flap-deflected condition the flap is similar to a Fowler or an external-airfoil flap and the aileron becomes a full-span slot-lip aileron. This type of aileron has been shown to be very powerful when flaps are deflected. (See references 2, 8, and 9.) The aileron is drooped in the flap-deflected position to improve the high-lift characteristics of the combination.

The high-lift characteristics of an NACA 23012 airfoil with 0.15c and 0.25c chord retractable flaps in combination with a plain and with a slotted 0.08c chord aileron are presented herein.

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MODEL

The airfoil model used in these tests had a chord of 3 feet and a span of 7 feet. It conformed to the NACA 23012 airfoil profile (fig. 1(a) and table I) and had a removable trailing-edge portion that allowed for rapid changing of aileron and slot shapes. The basic model was the same as used in references 4 and 5.

The full-span retractable flaps used in this investigation had Clark Y airfoil profiles and chords of 9.00 and 5.4 inches (25 and 15 percent of airfoil chord, respectively) (fig. 1, table I). They were constructed of laminated mahogany and were attached to the airfoil with three metal fittings. The flap-nose point, the point of tangency of a line drawn normal to the flap chord line and tangent to flap-nose arc, could be moved along the path given in table II. This path was so laid out that the plain aileron would just clear the flap nose and allowed for a wide variation in flap-nose position. The flap gap is defined as the distance from the lower surface at the trailing edge of the aileron to nose point of the flap (table II). The flap was arranged for locking in downward, or positive, flap deflections from 10° to 60° in 5° increments.

The various aileron-flap arrangements tested are shown in figure 1. Both the retracted and the extended condition of the devices are shown.

The plain aileron had a chord of 2.88 inches (8 percent of airfoil chord) and conformed to the trailing-edge portion of airfoil (fig. 1(b)). It was attached to the airfoil with three metal fittings that allowed for downward or positive deflections of 0° to 30° in 5° increments. The fittings also provided for lowering the aileron 1.5 percent of the airfoil chord to open a slot ahead of the aileron. (See fig. 1(c).)

Slotted aileron 2 (fig. 1(d)) conforms to the airfoil profile in table I and is fastened to the airfoil with three metal hinges. It is hinged about the aileron-nose point and can be locked at downward or positive deflections of 0° to 30° in 10° increments.

The shape of the flap well used with the plain aileron was designed to clear the flap upper surface when the 25-percent-chord flap was fully retracted. In the present investigation the well was terminated at the 69.5-percent-chord station on the airfoil lower surface to simulate an extension to seal the flap when fully retracted (fig. 1(b)). This extension of lower surface was not expected to affect the characteristics with flap deflected because a similar extension reported in reference 5 had no effect. The same flap well was used with the 15-percent-chord flap since it was believed that slight modifications in the forward shape of the well have little effect on airfoil characteristics (reference 5). The plain airfoil with fittings was obtained by covering the flap well with a thin metal plate. This plate appreciably increased the trailing-edge thickness of the airfoil.

The slot shape for the slotted ailerons conformed to the ordinates in table I. It can be seen that this shape, which was made for a previous investigation (reference 5), will not allow for retraction of flap. For a full-scale installation it would be necessary to refair the forward portion of the slot to clear the flap when retracted. The slot was terminated at the 69.5-percent station on the lower surface of the airfoil. The same slot shape was used with the 15-percent-chord flap as with the 25-percent-chord flap because it was believed that the change in slot shape would have practically no effect on the characteristics.

TESTS

The model was so mounted in the closed-test section of the NACA 7- by 10-foot wind tunnel that it completely spanned the jet except for small clearances at each end. (See references 3 and 10.) The main airfoil was rigidly attached to the balance frame by torque tubes extending through the upper and the lower boundaries of the test section. The angle of attack was changed from outside the tunnel by a calibrated electric drive connected to the torque tubes. Approximately two-dimensional flow is obtained with this test installation and the section characteristics of the model under test can be determined.

For all the tests a dynamic pressure of 16.37 pounds per square foot was maintained; this dynamic pressure corresponds to a velocity of about 80 miles per hour under standard conditions and to an average test Reynolds number of about 2,190,000. The effective Reynolds number, based on the chord of the airfoil with flap retracted and a turbulence factor for the tunnel of 1.6, was approximately 3,500,000. For the effect of Reynolds number on the aerodynamic characteristics see reference 11.

Tests were made with the various arrangements to determine the flap gap and the aileron and flap angles to give maximum lift with the 25-percent-chord flap. Tests were made with the 15-percent-chord flap for the optimum arrangements found with the 25-percent-chord flap. Lift, drag, and pitching moment were measured for the arrangements throughout the angle-of-attack range from -6° to the stall. Only a few tests were made above the stall because of the unsteady conditions of the model.

RESULTS AND DISCUSSION

Coefficients

All test results are given in standard nondimensional coefficient form corrected as explained in reference 3. The section coefficients are:

c_l section lift coefficient (l/qc)

c_{d_o} section profile-drag coefficient (d_o/qc)

$c_{m_{(a.c.)_o}}$ section pitching-moment coefficient about aerodynamic center of plain airfoil

$$\left(m_{(a.c.)_o}/qc^2\right)$$

where

l section lift

d_o section profile drag

$m_{(a.c.)_o}$ section pitching moment

q dynamic pressure of free stream $\left(\frac{1}{2}\rho V^2\right)$

c	chord of basic airfoil with flap retracted
c_f	chord of flap (over-all length)
c_a	chord of aileron (length behind hinge line)

and

α_o	angle of attack corrected to infinite aspect ratio
δ_f	flap deflection, measured between airfoil chord line and flap chord line
δ_a	aileron deflection, measured between airfoil chord line and aileron chord line

The values of the increment of section maximum lift coefficient $\Delta c_{l_{max}}$ are all based on the standard airfoil value $c_{l_{max}} = 1.55$.

Precision

The accuracy of the various measurements in the tests is believed to be within the following limits:

α_o	$\pm 0.1^\circ$	$c_{d_{o(c_l = 1.0)}}$	± 0.0006
$c_{l_{max}}$	± 0.03	$c_{d_{o(c_l = 2.5)}}$	± 0.002
$c_{m_{(a.c.)_o}}$	± 0.003	δ_f and δ_a	$\pm 0.2^\circ$
$c_{d_{o_{min}}}$	± 0.0003	Flap position	$\pm 0.001c$

No attempt was made to determine the effect of hinge fittings because the effect is believed to be small. The relative merits of the several arrangements should not be appreciably affected by hinge-fitting drag because similar hinge fittings were used for all arrangements.

Plain Airfoil

The complete aerodynamic section characteristics of the plain NACA 23012 airfoil with and without hinge fittings are given in figure 2. The data for the standard airfoil have been discussed in reference 3 and require no further discussion here. The airfoil with the flap fittings showed an increase in drag, an increase negatively of the pitching-moment coefficient, and a decrease in the slope of the lift curve. The change in pitching-moment coefficient and the change in the slope of the lift curve were probably caused by the increase in thickness of the trailing edge of the airfoil due to the method of covering the flap well.

Determination of Optimum Aileron-Flap Arrangement

Arrangement A.- The comparison of the increments of section maximum lift coefficient (fig. 3(a)) shows that the retractable external-airfoil flap, $\delta_a = 0$, gave a $\Delta c_{l_{max}}$ of 1.27. This value is comparable with the values reported in references 3 and 9 for the external-airfoil flap and is about the same as the value for the 0.2566c slotted flap 2-h (reference 3). Drooping the aileron to 15° with a gap of 0.018c gave the maximum value of $\Delta c_{l_{max}} = 1.43$, and an aileron deflection of 10° with a gap of 0.016c gave $\Delta c_{l_{max}} = 1.42$. Drooping the aileron either 10° or 15°, therefore, gives an increase in $\Delta c_{l_{max}}$ of about 0.16.

A comparison of profile-drag coefficients (fig. 3(b)) shows that the plain airfoil had the lowest profile-drag coefficient to values of $c_l = 1.4$ and that $\delta_a = 0$, gap = 0.015c had the lowest profile-drag coefficient from $c_l = 1.4$ to 1.9. Above $c_l = 1.9$ the arrangement with $\delta_a = 10°$, gap = 0.016c gave the lowest profile-drag coefficient.

From the results presented in figures 3(a) and 3(b), it would appear that the optimum δ_a for arrangement A, based on a compromise of lift and drag, would be 10°.

Arrangements B and C.- A comparison of the increments of section maximum lift coefficient for arrangement B (fig. 4(a)) shows that there was only a slight increase in lift coefficient over the values of arrangement A. Arrangement C (fig. 4(a)), however, showed an increase of 0.38 in $\Delta c_{l_{max}}$ with $\delta_a = 30^\circ$ and gap = 0.014c over the value for arrangement A with $\delta_a = 0$, gap = 0.015c. The lift coefficient for arrangement C, $\Delta c_{l_{max}} = 1.65$, is comparable with the values for a 0.25c Fowler flap (reference 4). This arrangement gave the maximum value of lift coefficient for the arrangements tested in this investigation.

The comparison of the profile-drag coefficient for these two arrangements (fig. 4(b)) shows that the plain airfoil gave the lowest profile-drag coefficient below values of $c_l = 1.4$. Between values of $c_l = 1.4$ and 2.5 arrangement B with $\delta_a = 0$, gap = 0.015c gave the lowest value of profile-drag coefficient. Above values of $c_l = 2.7$ arrangement C, $\delta_a = 30^\circ$, gap = 0.014c gave the lowest value of profile-drag coefficient. If arrangement B were used, the lowest profile-drag coefficient could be obtained by adjusting the values of δ_f and δ_a to the optimum angle for a given lift coefficient; it does not appear, however, that arrangement B gives sufficient lift increase over arrangement A to be practicable.

Comparison of arrangements A and C with 0.25c Fowler flap and 0.2566c slotted flap 2-h.- The comparison of increments of section maximum lift coefficients (fig. 5(a)) shows that the Fowler flap (reference 4) gave the highest value of $\Delta c_{l_{max}}$ (that is, 1.67) but arrangement C with $\delta_a = 30^\circ$ gave only slightly less, $\Delta c_{l_{max}} = 1.65$. Arrangement C, however, required a flap deflection of 60° for maximum lift; whereas the Fowler flap gave maximum lift at $\delta_f = 40^\circ$. Arrangement A for $\delta_a = 10^\circ$ has a higher value of $\Delta c_{l_{max}}$ (that is, 1.42) than the 2-h slotted flap (reference 3).

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Figure 5(b) gives the profile-drag envelope polars for the four airfoil-flap arrangements. The plain airfoil has the lowest profile-drag coefficient below $c_l = 1.1$, and the Fowler flap (reference 4) has the lowest profile-drag coefficient above $c_l = 1.1$. The slotted flap 2-h (reference 3) has a slightly lower profile-drag coefficient than arrangement A for $\delta_a = 10^\circ$ below $c_l = 2.65$, but above $c_l = 2.65$, arrangement A has the lower profile-drag coefficient. Arrangement C for $\delta_a = 30^\circ$ has the highest profile-drag coefficient up to nearly the maximum lift coefficient for arrangement A and slotted flap 2-h and has a higher profile-drag coefficient than the Fowler at all values of c_l.

From the data in figure 5 it would appear that, from considerations of low drag, arrangement A for $\delta_a = 10^\circ$ was the optimum tested. It appears that arrangement C, although it did give the highest lift coefficient, is handicapped by a large profile-drag coefficient over the entire lift range.

A comparison of pitching-moment coefficients for the arrangements tested with those of a 0.25c Fowler flap (reference 4) and a 0.2566 slotted flap 2-h (reference 3) is given in figure 5(c). These curves were obtained by taking the maximum negative pitching-moment coefficient for a given aileron and flap deflection and plotting against the maximum lift coefficient for those deflections. Since all the flaps compared have the basic NACA 23012 airfoil as the flap-retracted condition, the values may be taken as the increments of pitching-moment coefficient resulting from a given aileron-flap deflection. From the data of figure 5(c) it is apparent that the subject combination gives an increase negatively relative to the Fowler flap (reference 4) of about 0.1 in pitching-moment coefficient.

Arrangements D and E.- The comparison of the increments of section maximum lift coefficient for arrangements D and E and for the 0.15c Fowler flap (reference 4) are given in figure 6(a). Arrangement E for $\delta_a = 30^\circ$, gap = 0.014c gave the highest value of $\Delta c_{l_{max}}$. This value of 1.16 is only slightly higher than the value for the 0.15c Fowler flap (reference 4). For the 0.15c retractable flap the optimum aileron-gap arrangements were about the same as for the 0.25c retractable flap.

The comparison of profile-drag coefficient (fig. 6(b)) shows the plain airfoil to have the lowest profile-drag coefficient to values of $c_l = 1.1$; above that value the 0.15c Fowler has the lowest profile-drag coefficient. A comparison of arrangements tested shows that arrangement D for $\delta_a = 0$ gave the lowest profile-drag coefficient from $c_l = 1.4$ to 1.7 and that above $c_l = 1.7$ arrangement E gave the lowest profile-drag coefficient.

Section Aerodynamic Characteristics

Figures 7 to 10 give the section aerodynamic characteristics for the optimum arrangements tested. Figures 7(a) to 7(c) give the characteristics for arrangement A for $\delta_a = 0^\circ$, 10°, and 15° at the optimum gap. The effect of gap on the characteristics of arrangement A with $\delta_a = 15^\circ$ and $\delta_f = 40^\circ$ is given in figure 7(d), which shows a gap of 0.018c to be optimum for maximum lift coefficient at those deflections. Figures 8 to 10 give the characteristics for the optimum aileron deflections and flap gaps for arrangements C, D, and E.

Lateral-Control Characteristics

From the high-lift data presented in this report it appears that the optimum arrangement tested, considering both structural and aerodynamic qualities, is arrangement A with the aileron drooped 10°. Since the arrangement offers no new lateral-control device in itself, further tests will not be made at this time to determine the lateral-control characteristics. It should be possible to design a practical installation for flight or wind-tunnel tests from available data.

Plain aileron.- With the flap retracted, the lateral-control device consists of an 0.08c by 1.00 b/2 plain sealed aileron. Data for such an aileron are not directly obtainable but it appears that there are sufficient data in references 2, 8, 12, 13, and 14 to predict the characteristics.

From the data of reference 12, it appears that the full-span 0.08c aileron would give about 50 to 60 percent more rolling moment than the 0.10c by 0.37 b/2 plain aileron of reference 8 and have only 10 to 20 percent more hinge moment for the same deflection range. Thus, it would appear from these data that the 0.08c aileron would give satisfactory rolling moments and light stick forces. If the stick forces were high, however, they could be reduced by incorporating an internal balancing system.

From the results of flight tests (reference 13) and from the criterion for satisfactory lateral control as given in reference 14, a 0.09c by 0.82 b/2 plain sealed aileron gave satisfactory characteristics on a wing of somewhat questionable torsional rigidity. It would appear, therefore, that a 0.08c by 1.00 b/2 plain sealed aileron should be satisfactory.

Slot-lip aileron.- With the flap in the deflected position, the aileron becomes a slot-lip aileron, a type that has always appeared from tests to give high rolling-moment coefficients (references 2, 8, and 9). Since the aileron of 0.37 b/2 span in references 2 and 8 gave sufficient rolling moment, no difficulty should be encountered with the full-span slot-lip aileron. It might be feasible to provide a differential for the slot-lip aileron that would be acceptable for the plain aileron also, thus eliminating one more of the difficulties usually found with lateral-control devices for use with full-span flaps.

CONCLUSIONS AND RECOMMENDATION

The results of the present investigation indicate that the NACA full-span high-lift lateral-control combination will give maximum lift coefficients as high as those of any other combination of equal mechanical and structural acceptability but may give larger pitching-moment coefficients. From available test results of previous investigations it appears that the lateral-control characteristics of the NACA combination will be acceptable under all flight conditions with the flap either extended or retracted. It is recommended that wind-tunnel tests be made of the combination on an NACA low-drag airfoil.

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TABLE I .- *Ordinates for airfoil, flap, aileron, and slot shapes.*

NACA 23012 airfoil

[Stations and ordinates in percent wing chord]

Station	Upper surface	Lower surface
0	—	0
1.25	2.67	-1.23
2.5	3.61	-1.71
5.0	4.91	-2.26
7.5	5.80	-2.61
10	6.43	-2.92
15	7.19	-3.50
20	7.50	-3.97
25	7.60	-4.28
30	7.55	-4.46
40	7.14	-4.48
50	6.41	-4.17
60	5.47	-3.67
70	4.36	-3.00
80	3.08	-2.16
90	1.68	-1.23
95	.92	-.70
100	.13	-.13

L.E. radius: 1.58. Slope of radius through end of chord: 0.305.

Clark Y flaps

[Stations and ordinates in percent flap chord]

Station	Upper surface	Lower surface
0	3.50	3.50
1.25	5.45	1.93
2.5	6.50	1.47
5.0	7.90	.93
7.5	8.85	.63
10	9.60	.42
15	10.68	.15
20	11.36	.03
30	11.70	0
40	11.40	0
50	10.52	0
60	9.15	0
70	7.35	0
80	5.22	0
90	2.80	0
95	1.49	0
100	.12	0

L.E. radius: 1.50

Slotted aileron 2

[Stations and ordinates in percent aileron chord]

Station	Upper surface	Lower surface
0	-10.00	-10.00
1.25	-6.46	-11.94
2.5	-4.34	-12.15
5.0	-1.15	-11.88
10	3.30	-11.32
15	5.94	-10.76
20	7.36	-10.24
30	8.68	-9.17
40	9.24	-8.13
60	7.88	-5.97
80	4.86	-3.82
90	3.23	-2.74
100	1.63	-1.63

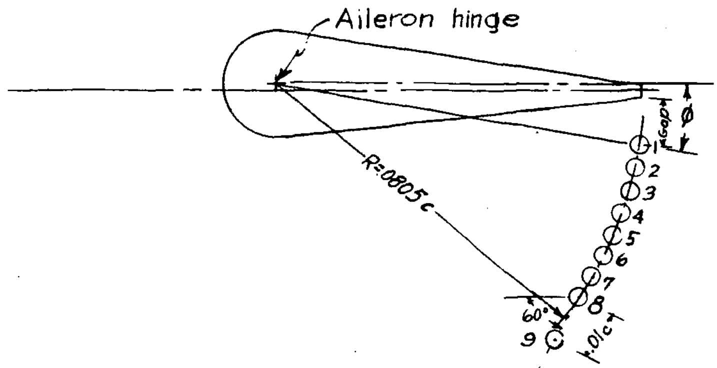
L.E. radius: 2.19

Slot-shape slotted aileron

[Stations and ordinates in percent wing chord]

Station	Ordinate
69.96	-3.10
69.96	-1.88
70.83	-.90
72.92	.23
77.08	1.25
80.00	1.58
81.25	1.67
83.33	1.79
85.42	1.88
86.88	1.90
90.00	1.52
91.80	1.23

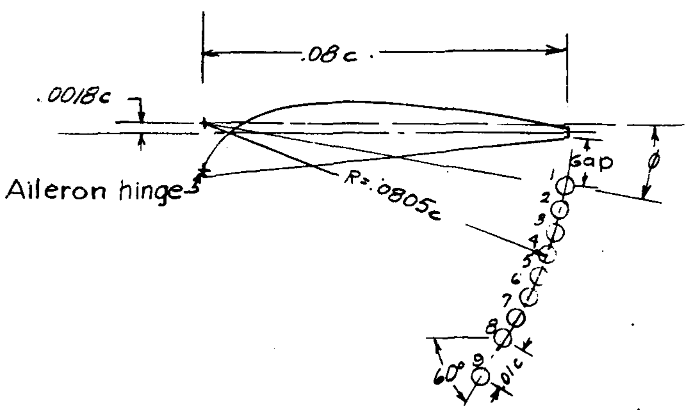
TABLE II.- Flap-nose position and flap-slot gaps for arrangements tested



Gap in percent airfoil chord

Flap-nose position	φ	Aileron deflection, δ_a, deg			
		0	10	15	20
1	9.34°	.99	—	—	—
2	12.90°	1.48	.09	—	—
3	16.45°	1.97	.55	—	—
4	20.09°	2.46	1.05	.35	—
5	23.57°	2.95	1.55	.84	.15
6	27.12°	3.43	2.04	1.33	.64
7	30.68°	3.91	2.53	1.83	1.14
8	34.23°	4.40	3.02	2.32	1.64
9	—	5.38	3.99	3.31	2.63

(a) Plain aileron and slotted aileron 1.



Gap in percent airfoil chord

Flap-nose position	φ	Aileron deflection, δ_a, deg			
		0	10	20	30
1	9.34°	.99	—	—	—
2	12.90°	1.48	—	—	—
3	16.45°	1.97	.58	—	—
4	20.09°	2.46	1.08	—	—
5	23.57°	2.95	1.58	—	—
6	27.12°	3.43	2.08	.79	—
7	30.68°	3.91	2.57	1.28	—
8	34.23°	4.40	3.06	1.78	—
9	—	5.38	4.05	2.76	1.42

(b) Slotted aileron 2.

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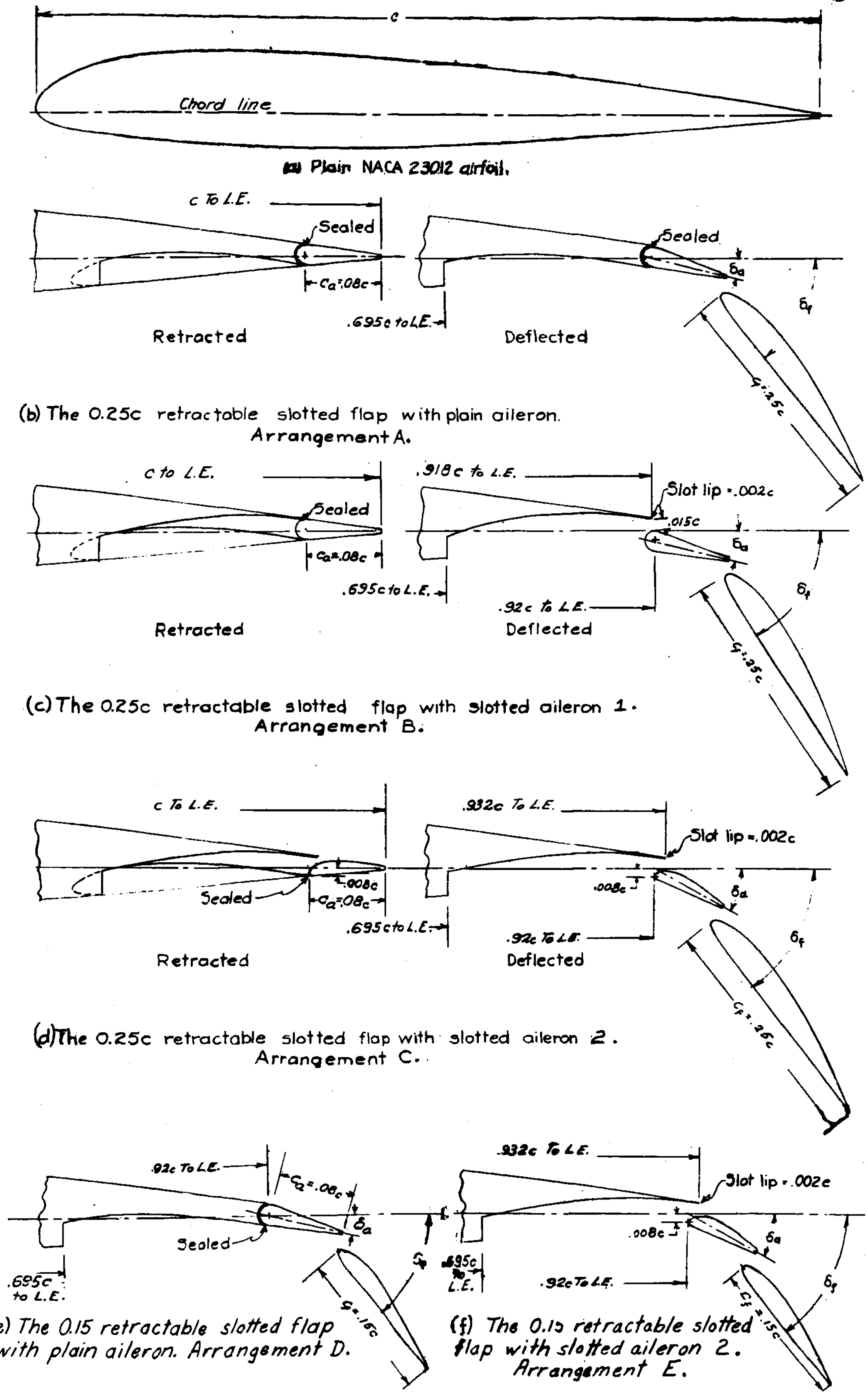

Figure 1.- Aileron flap arrangements tested.

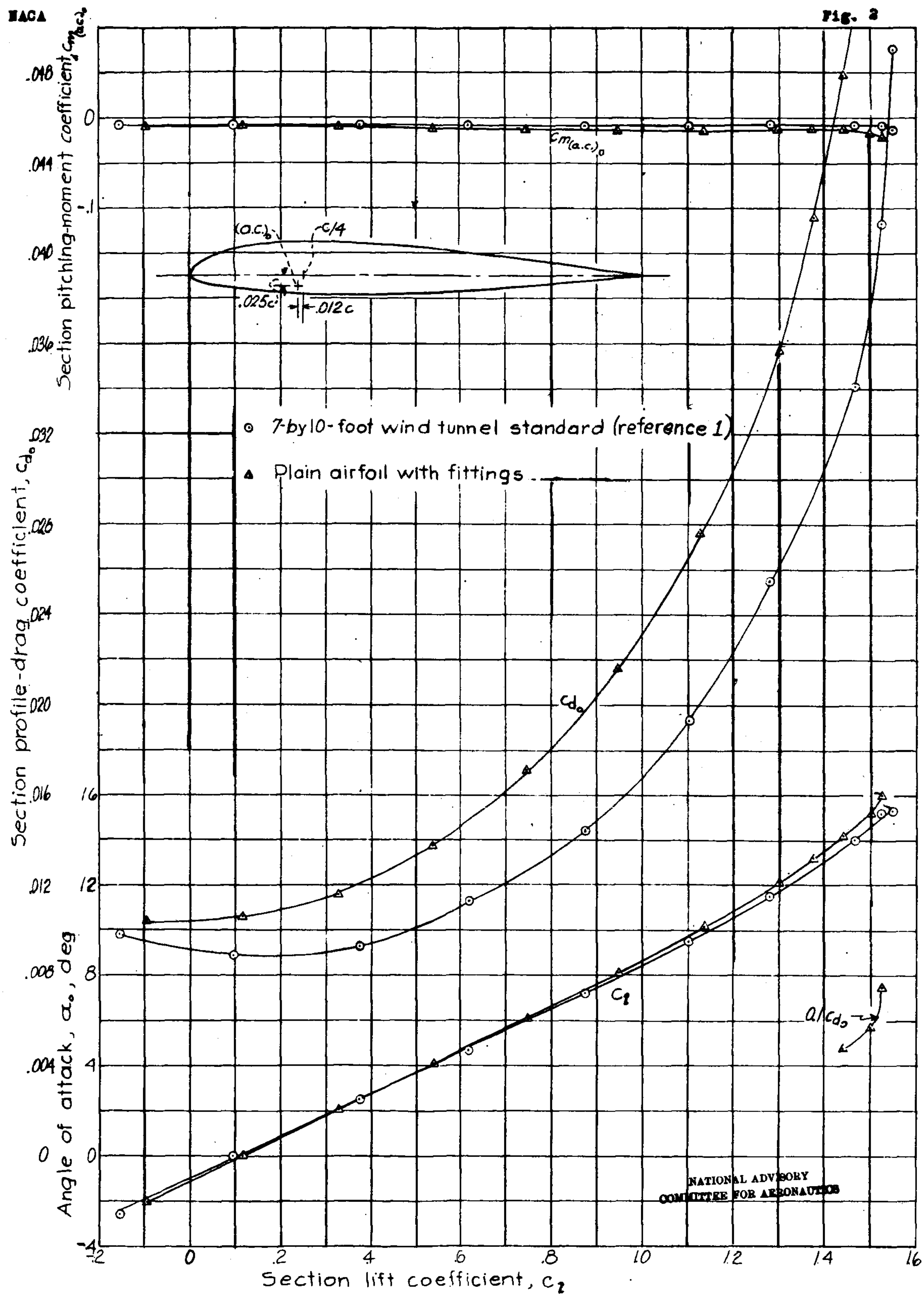

FIGURE 2. - Aerodynamic section characteristics of NACA 23012 plain airfoil.

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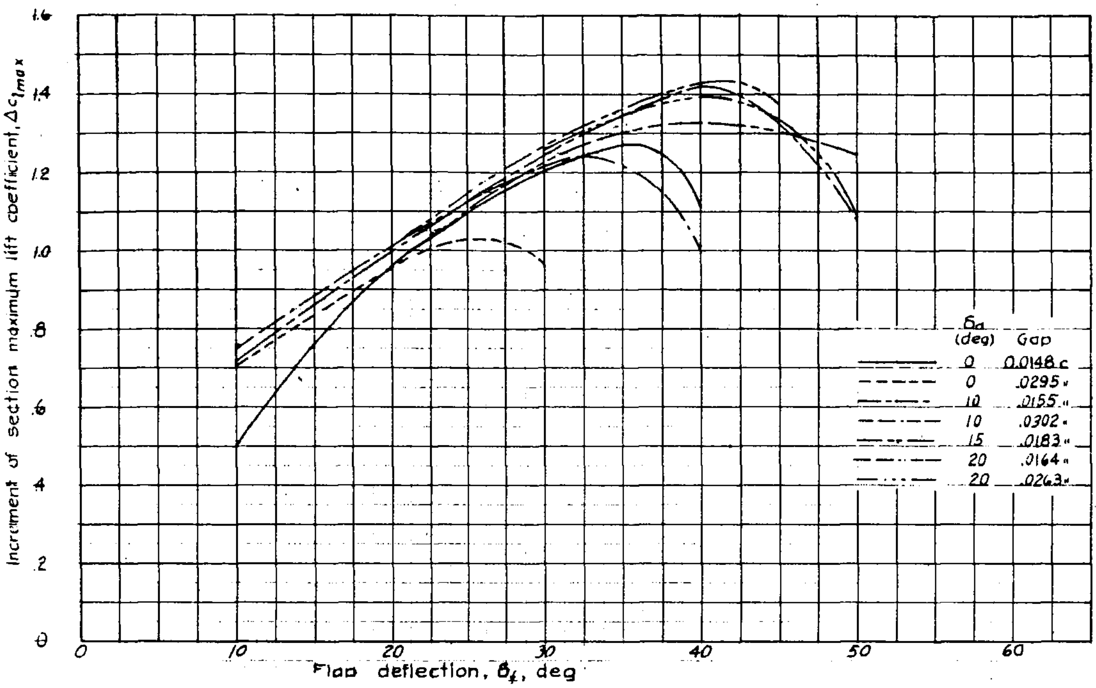


(a) Increment of section maximum lift coefficient.

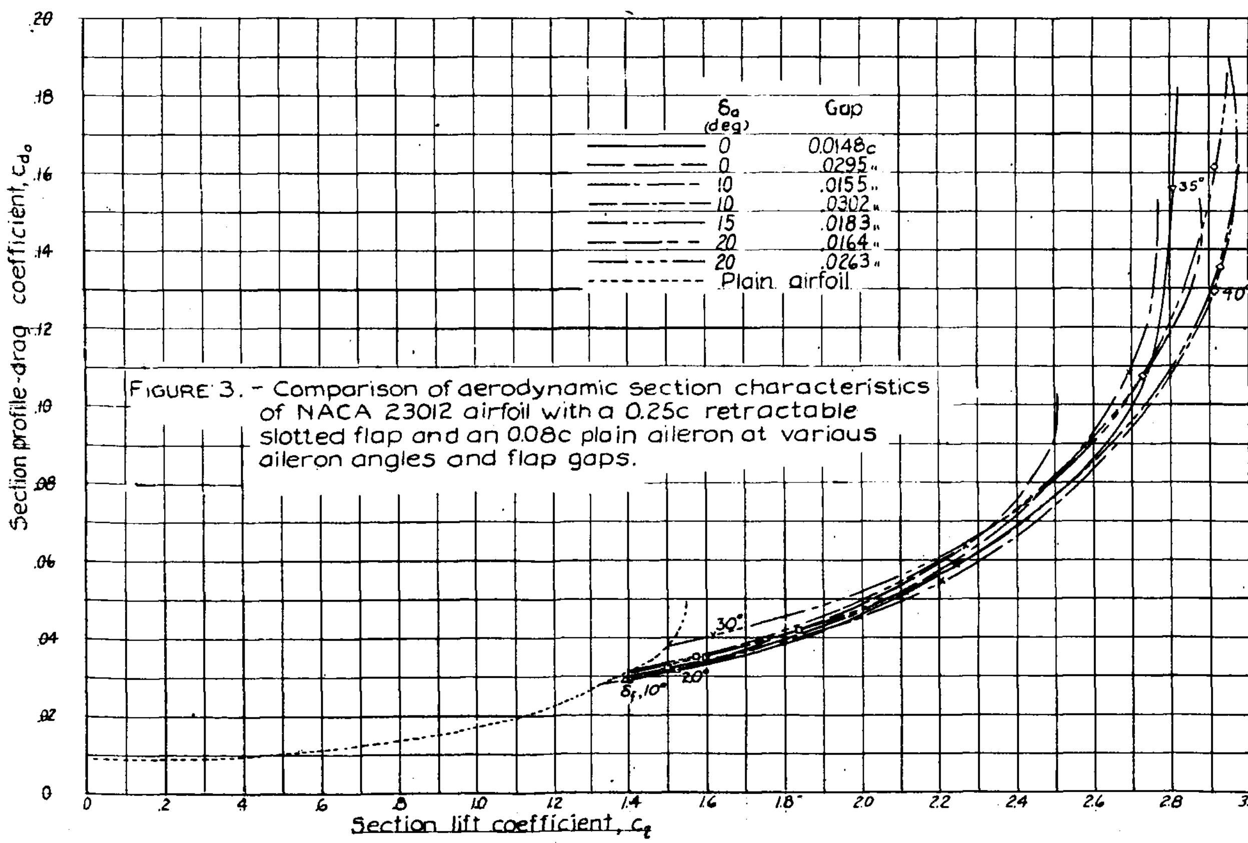
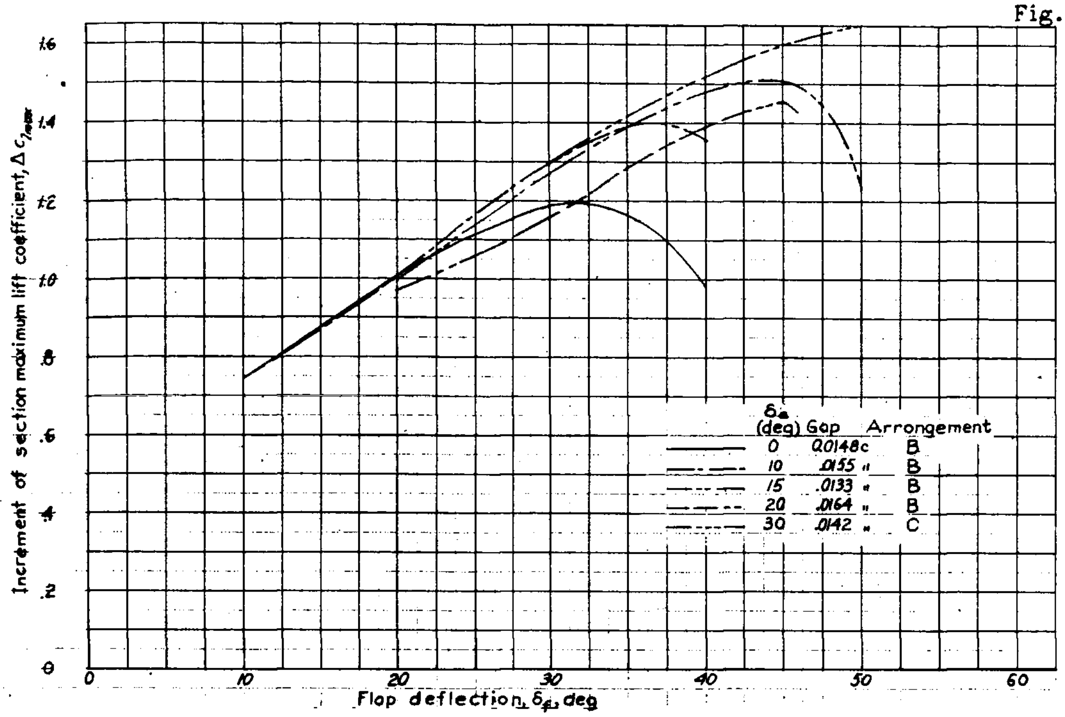
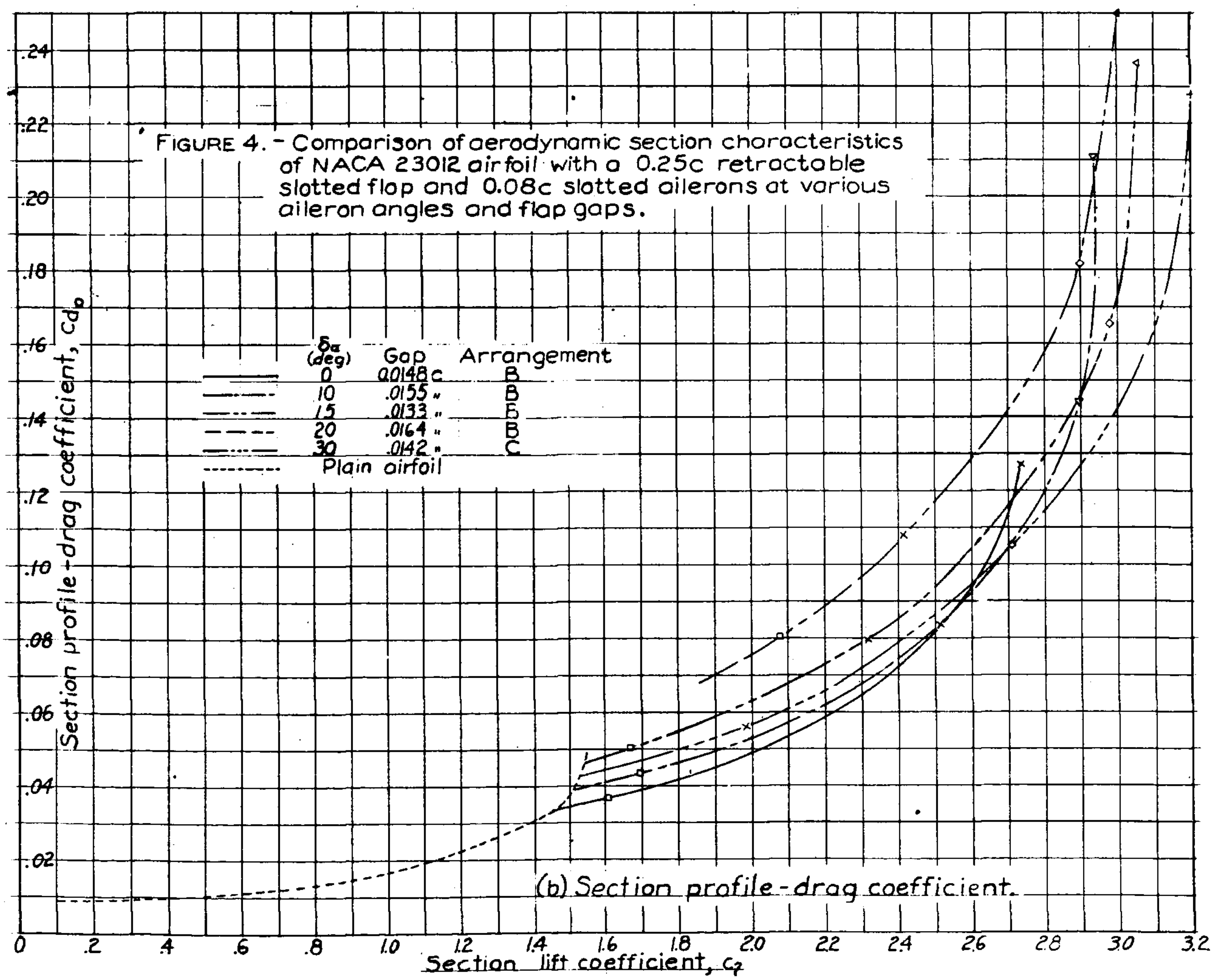


FIGURE 3. - Comparison of aerodynamic section characteristics of NACA 23012 airfoil with a 0.25c retractable slotted flap and an 0.08c plain aileron at various aileron angles and flap gaps.

(b) Section profile-drag coefficient.

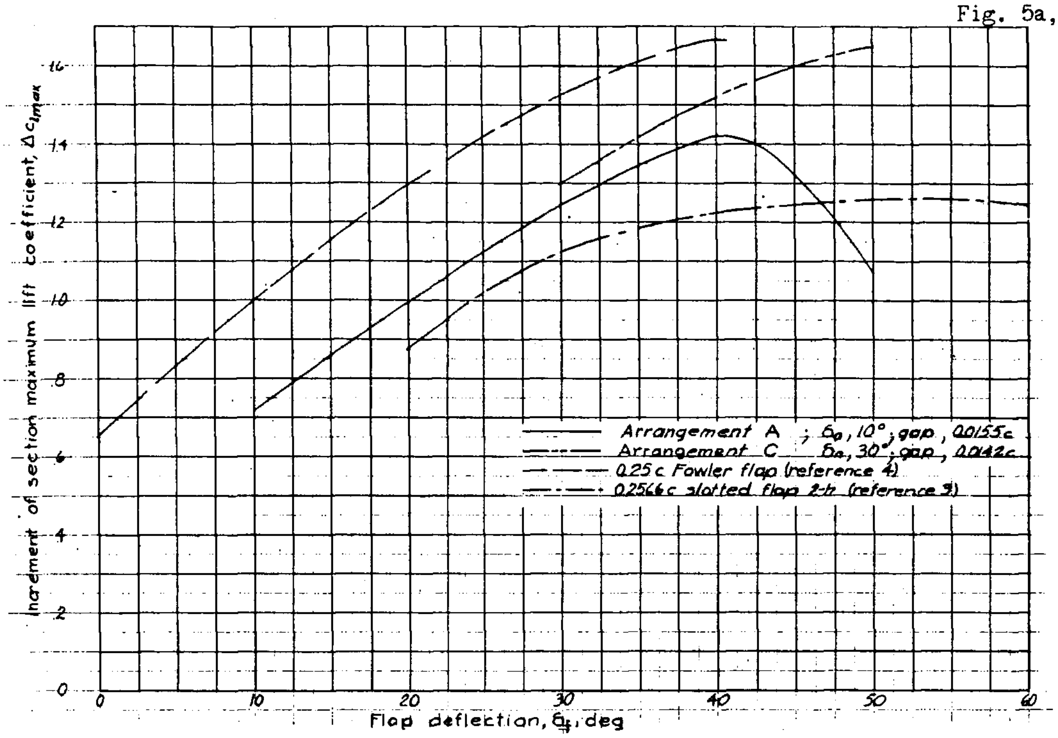


(a) Increment of section maximum lift coefficient.



(b) Section profile-drag coefficient.

FIGURE 4. - Comparison of aerodynamic section characteristics of NACA 23012 airfoil with a 0.25c retractable slotted flap and 0.08c slotted ailerons at various aileron angles and flap gaps.



(a) Increment of section maximum lift coefficient.

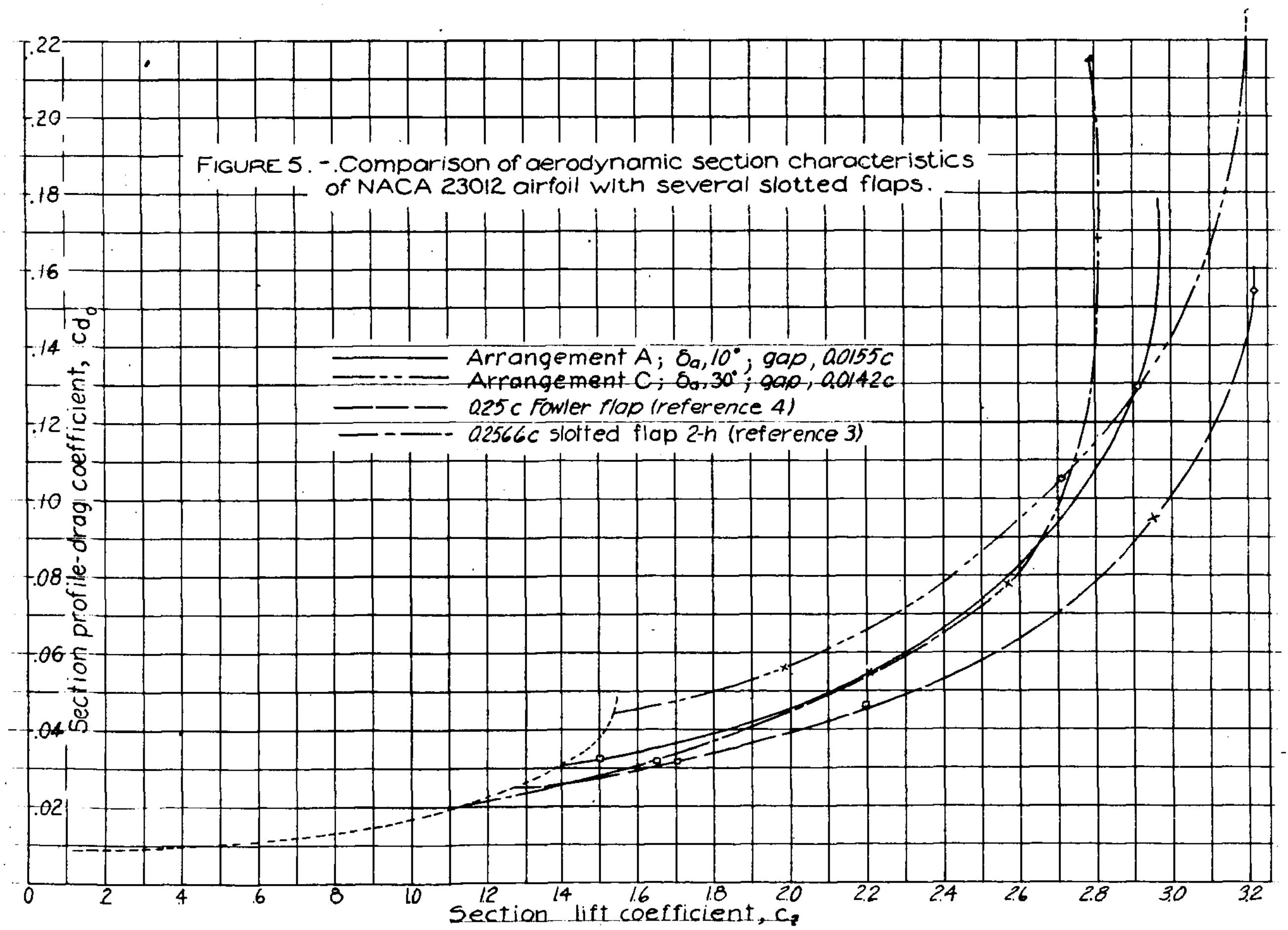
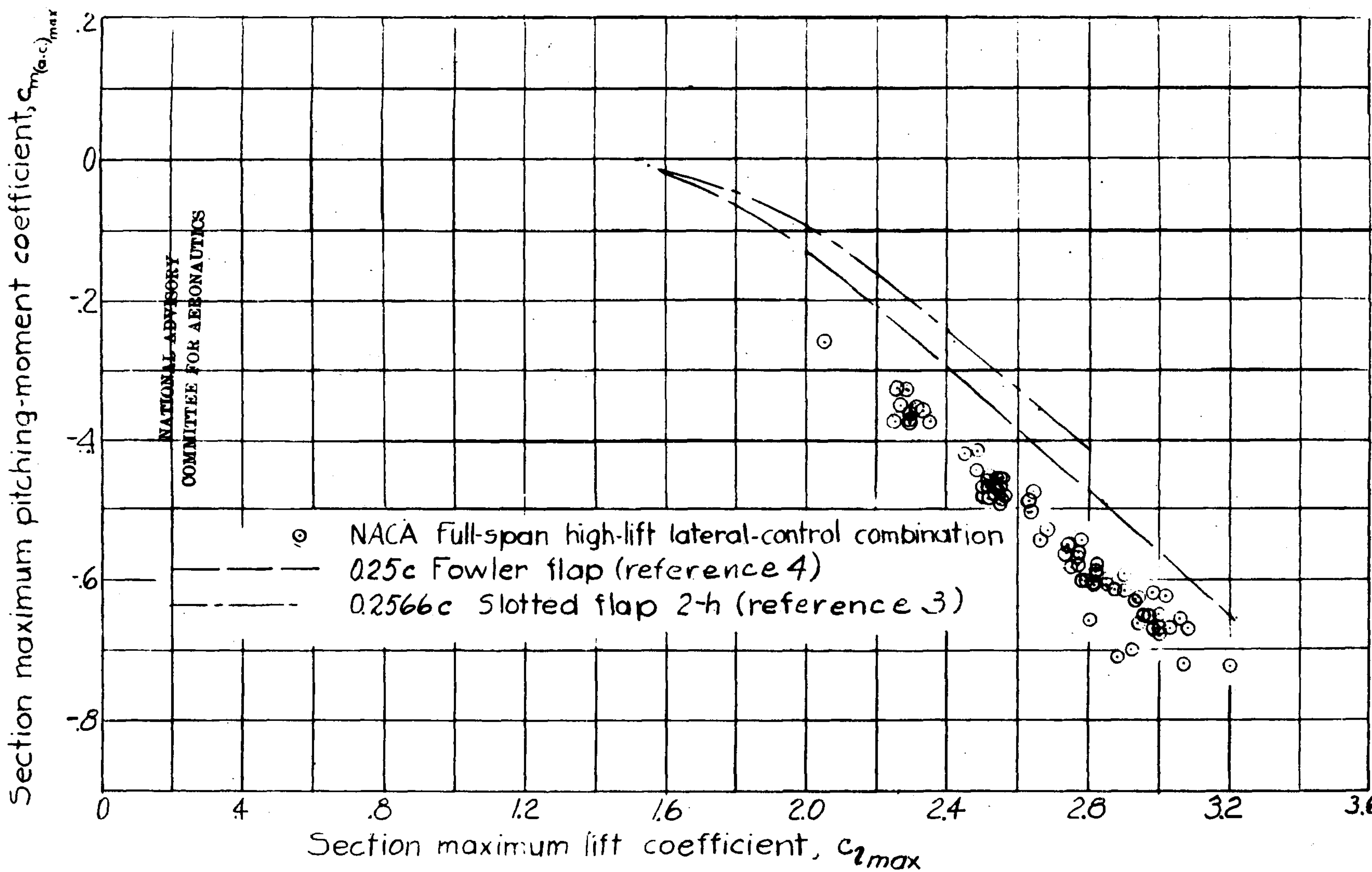


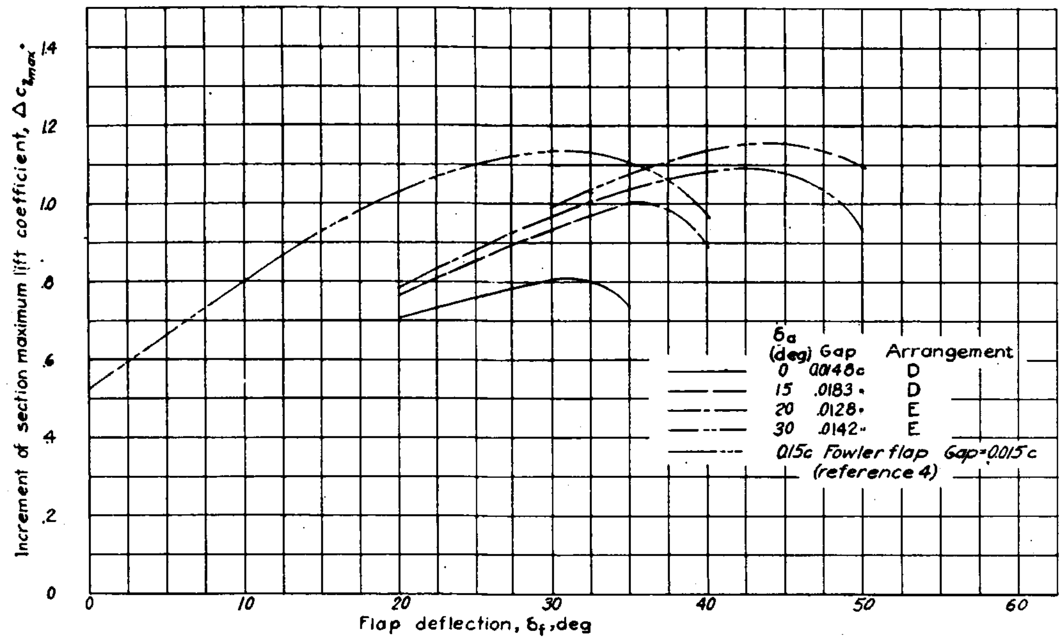
FIGURE 5. - Comparison of aerodynamic section characteristics of NACA 23012 airfoil with several slotted flaps.

(b) Section profile-drag coefficient.

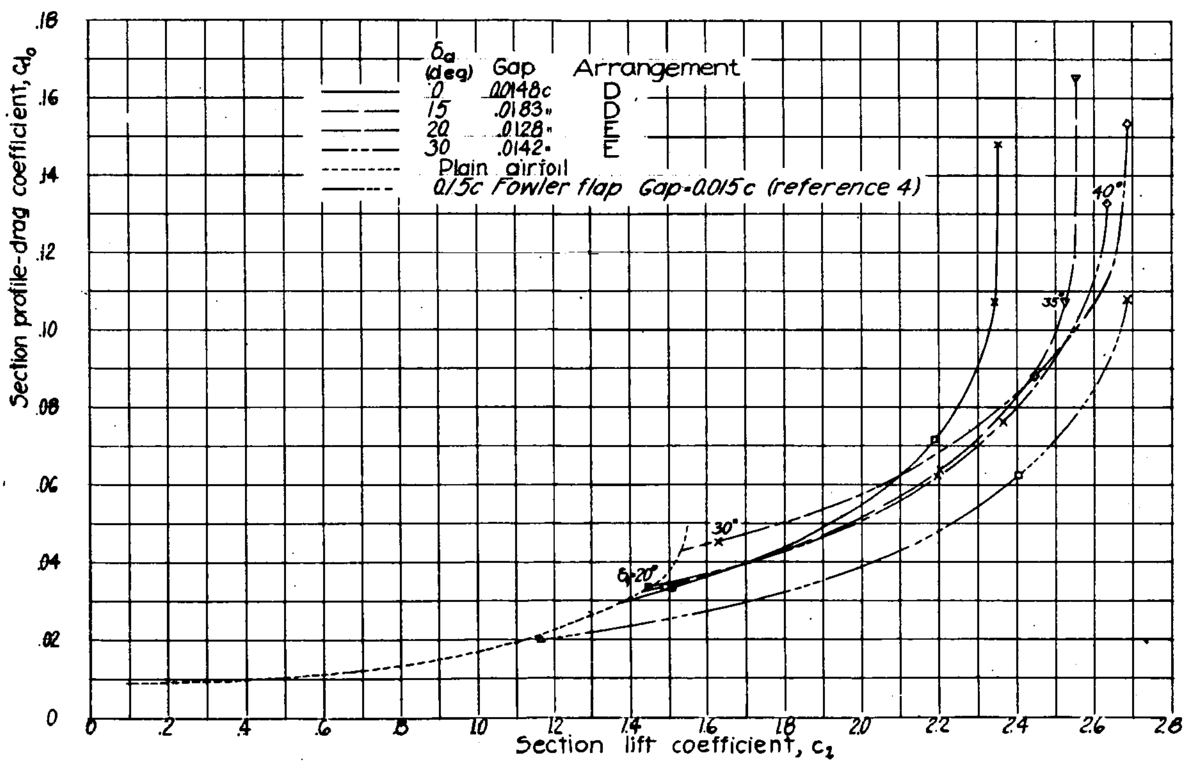


(c) Section maximum pitching-moment coefficient.

FIGURE 5.- Concluded.

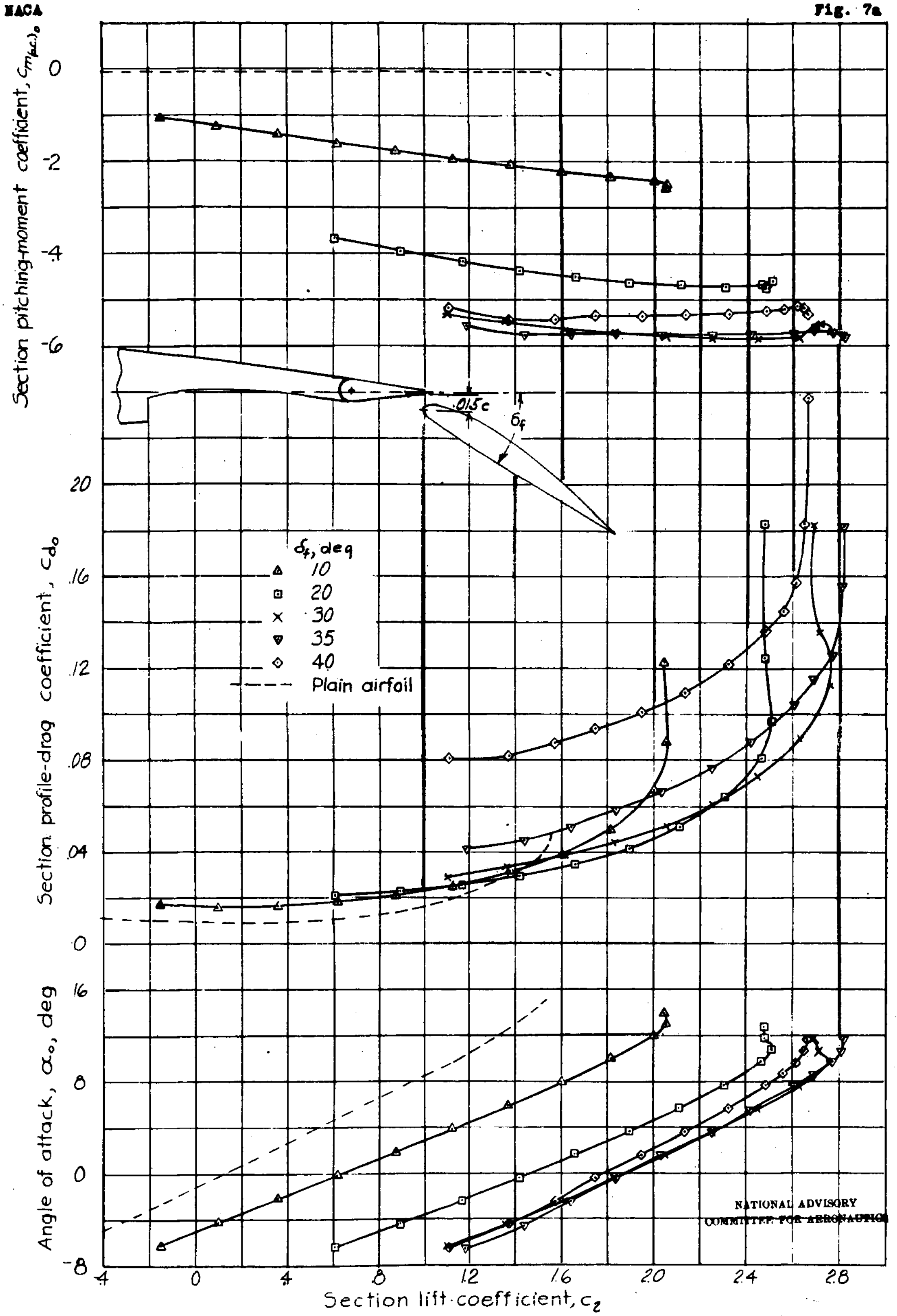


(a) Increment of section maximum lift coefficient.



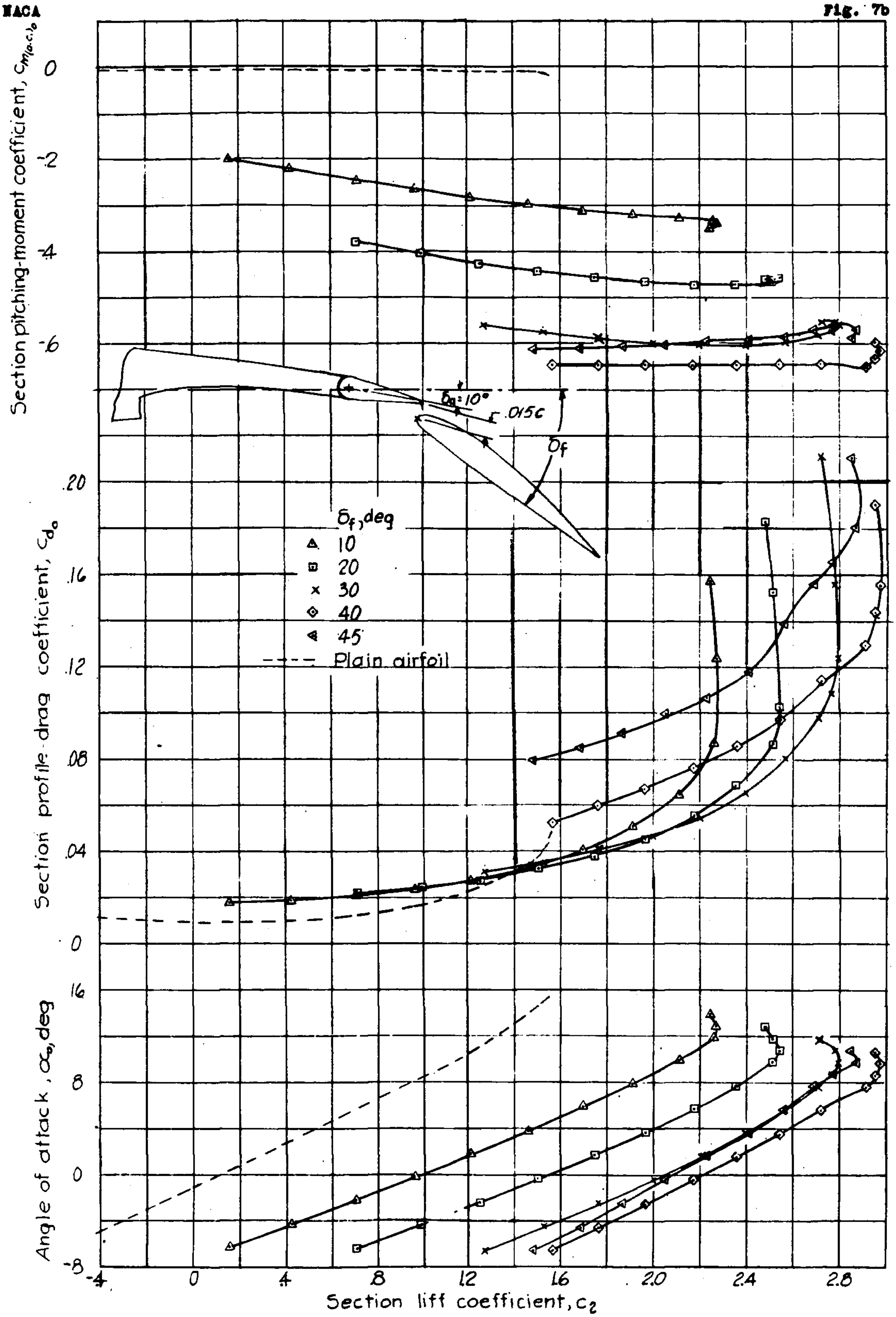
(b) Section profile-drag coefficient.

FIGURE 6. - Comparison of aerodynamic section characteristics of NACA 23012 airfoil with a 0.15c retractable slotted flap and both 0.08c slotted and plain ailerons at various aileron angles and flap gaps.



(a) $\delta_a = 0°$; gap = 0.015c.

FIGURE 7.- Aerodynamic section characteristics of an NACA 23012 airfoil with a 0.25c retractable slotted flap and an 0.08c plain aileron.



(b) δ_a=10°; gap = 0.016c.

FIGURE 7.- Continued.

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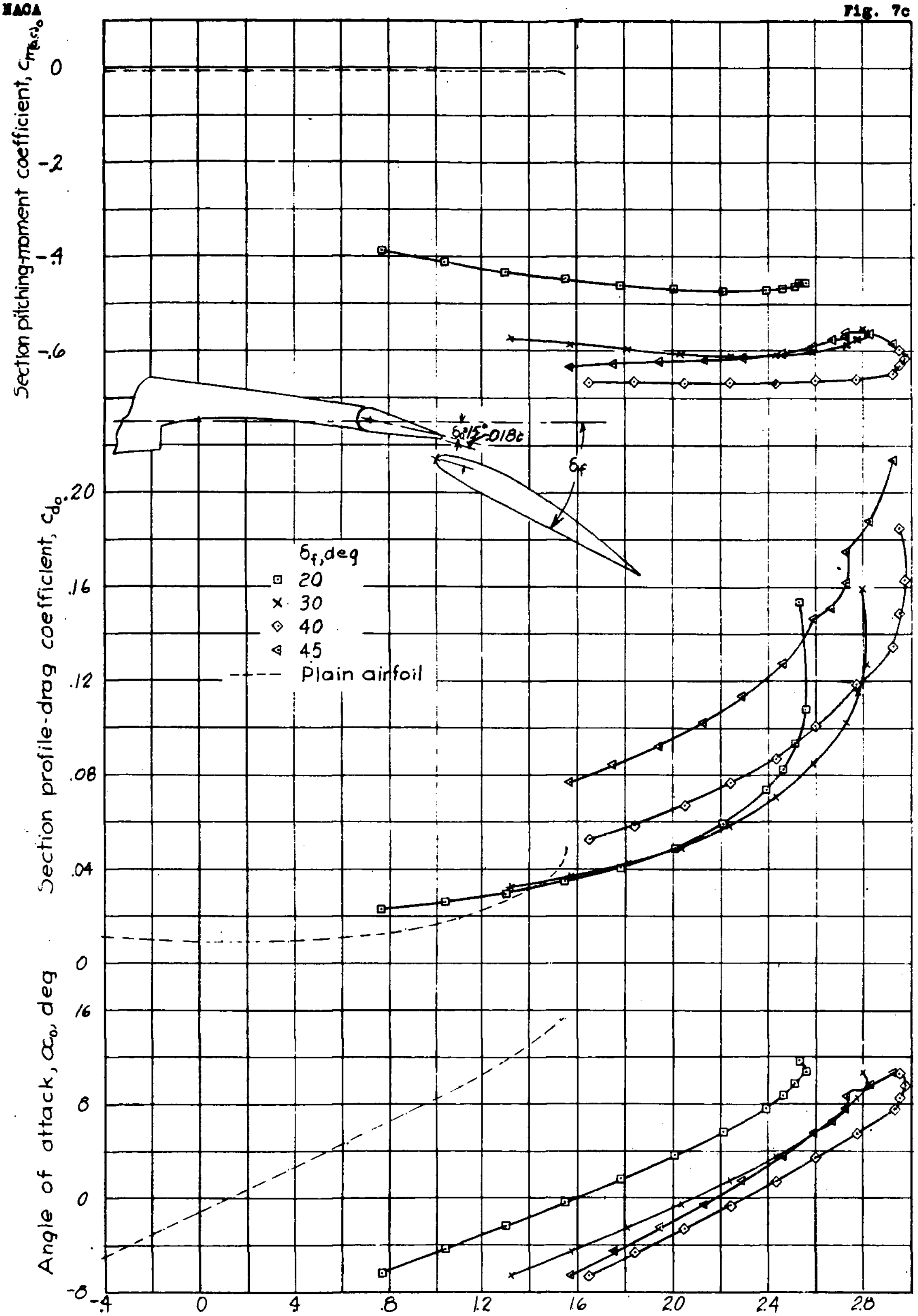

(c) $\delta_a = 15°$; gap = 0.018 c.

FIGURE 7.- Continued

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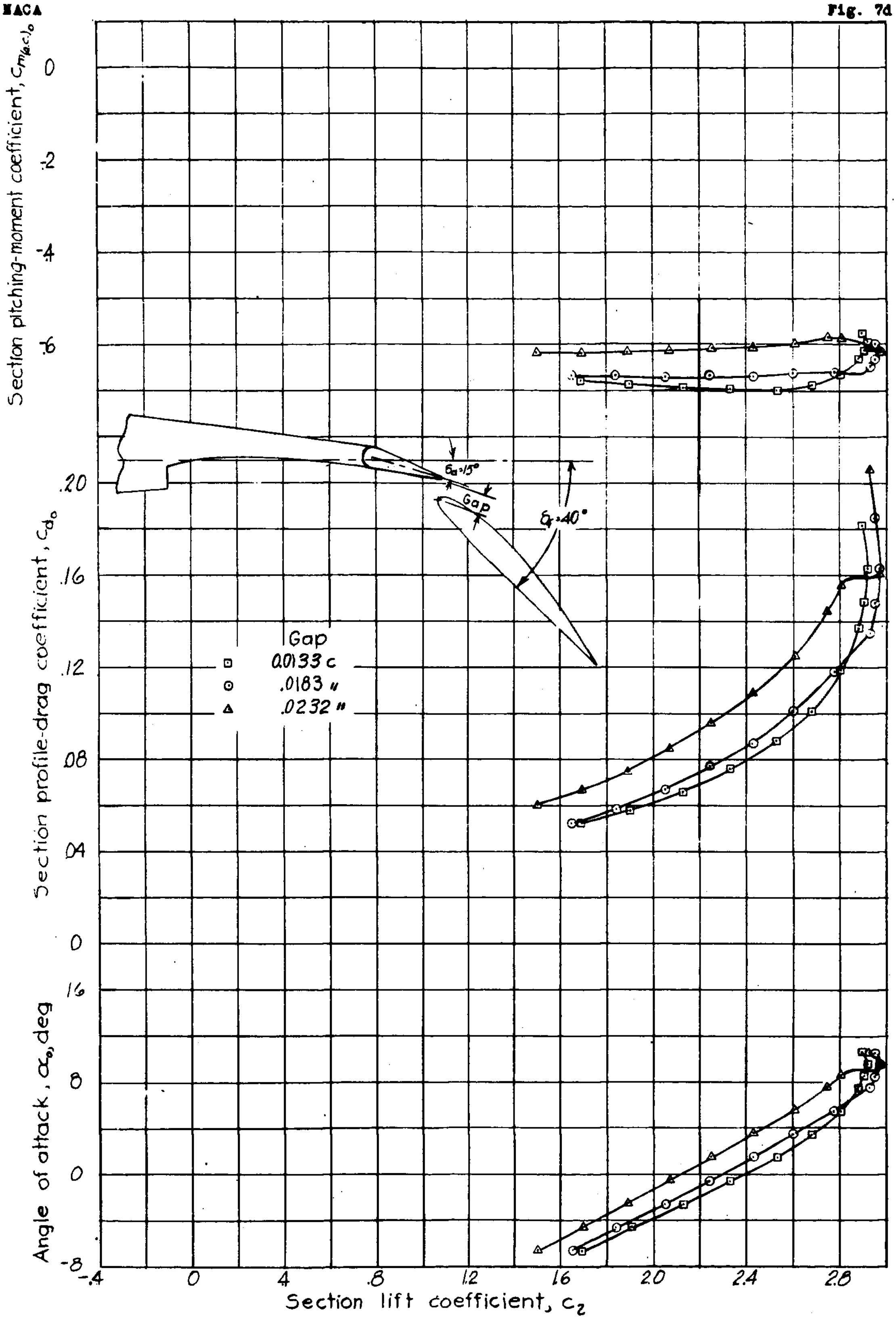

(d.) $\delta_a = 15°$; $\delta_f = 40°$.

FIGURE 7.– Concluded.

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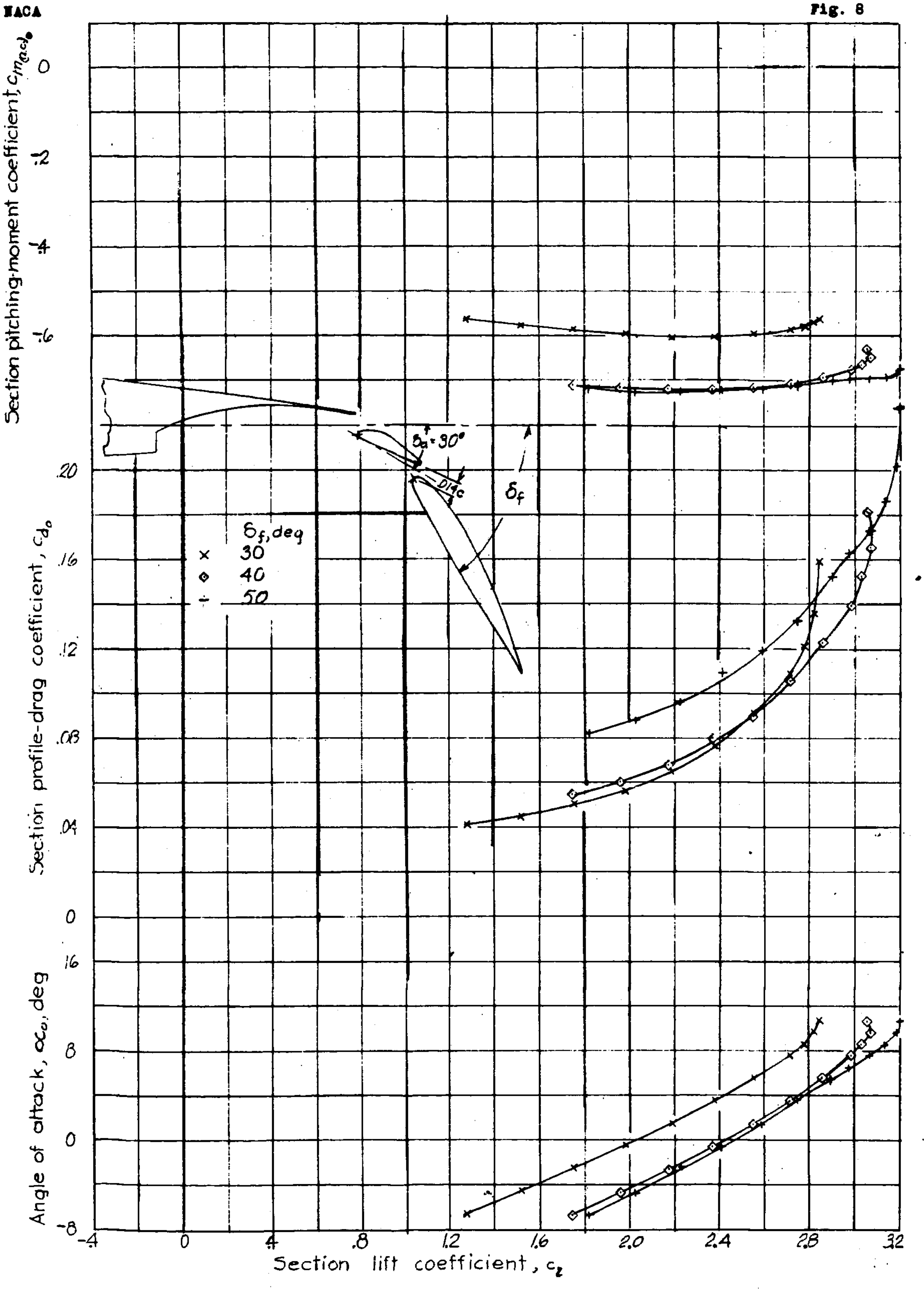
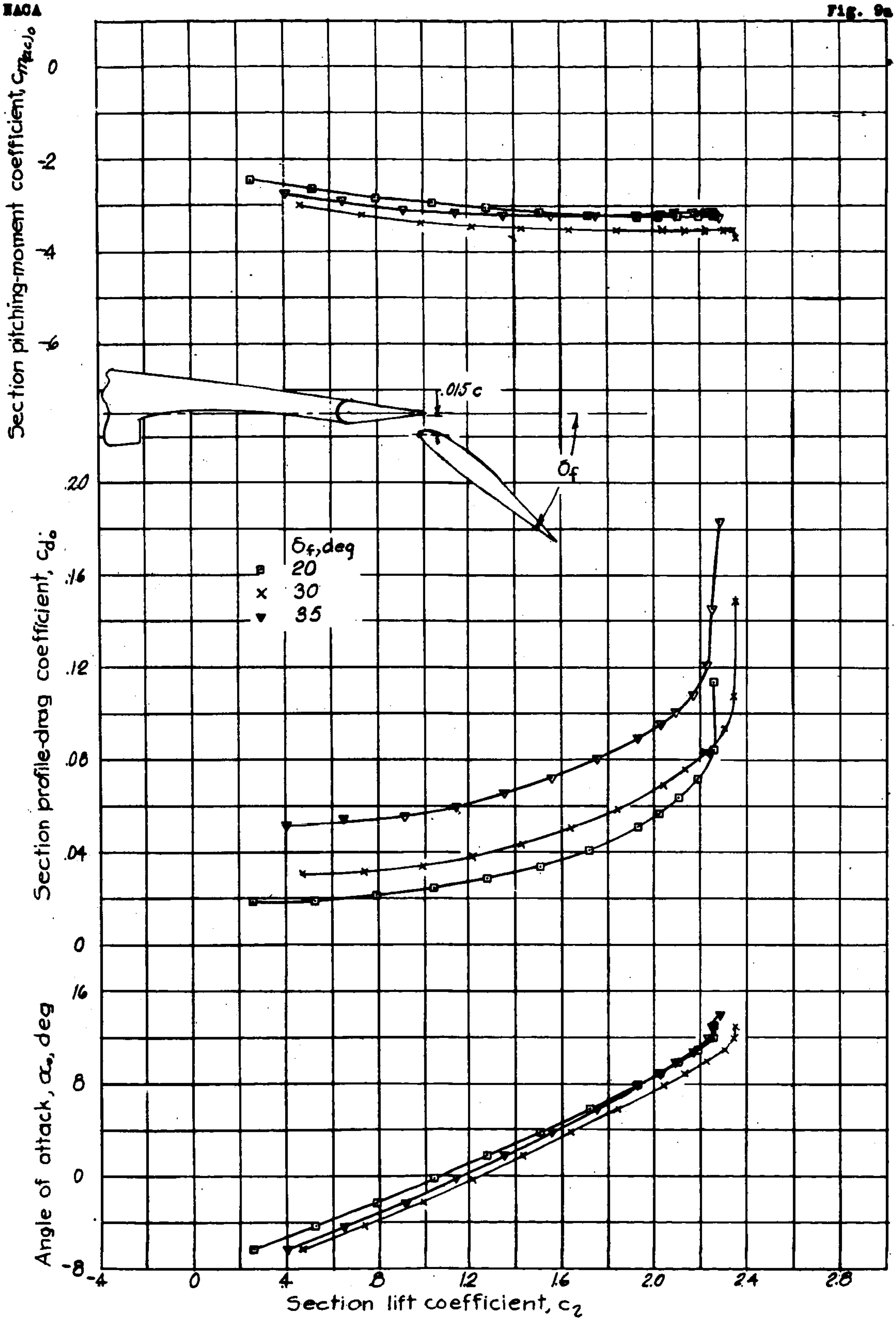


Figure 8.- Aerodynamic section characteristics of an NACA 23012 airfoil with a 0.25c retractable slotted flap and an 0.08c slotted aileron 2. δ_a = 30°; gap = 0.014c.



(a.) $\delta_a = 0°$; gap = 0.015c.

Figure 9.- Aerodynamic section characteristics of an NACA 23012 airfoil with a 0.15c retractable slotted flap and an 0.08c plain aileron.

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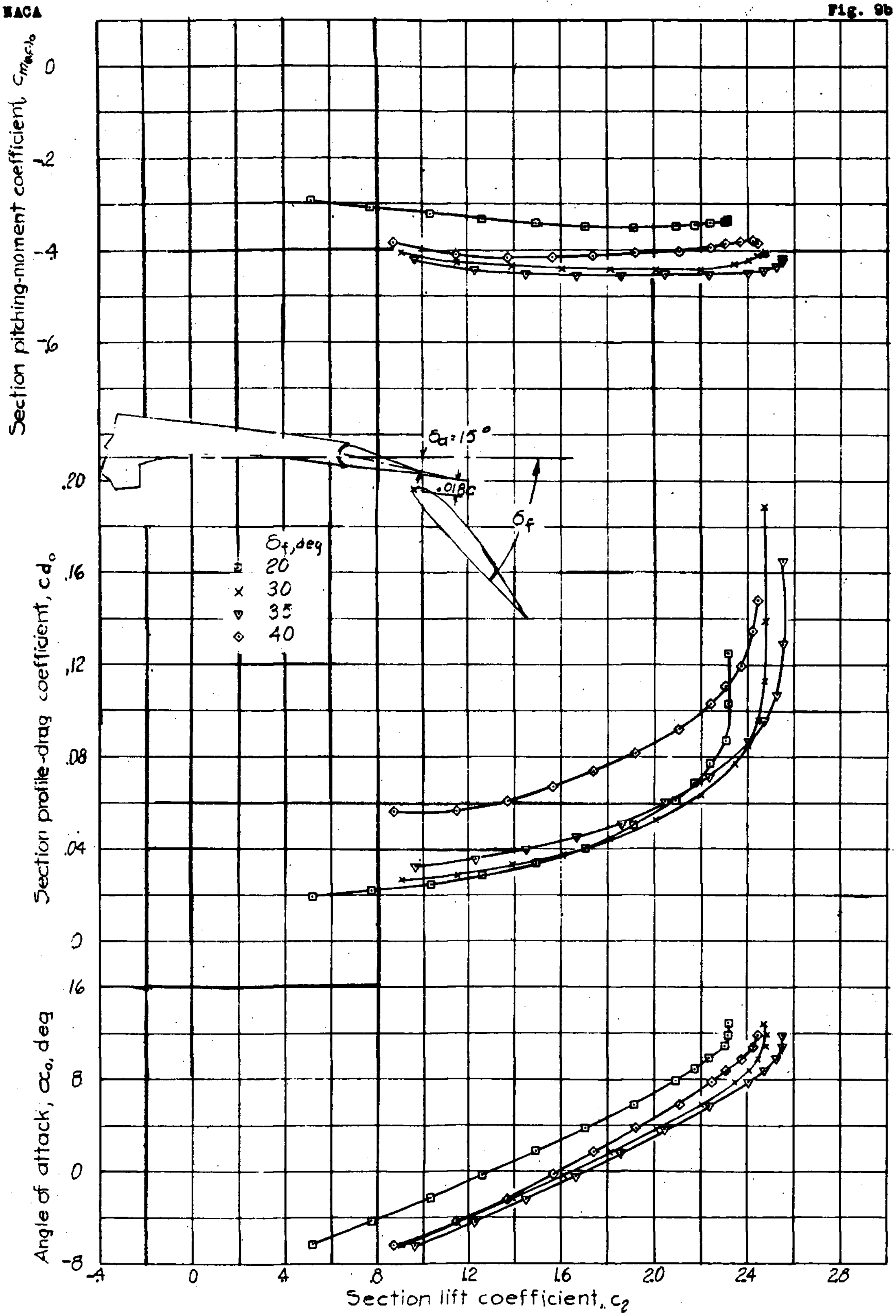

(b.) $\delta_a = 15°$; gap = 0.018c.

FIGURE 9.- Concluded.

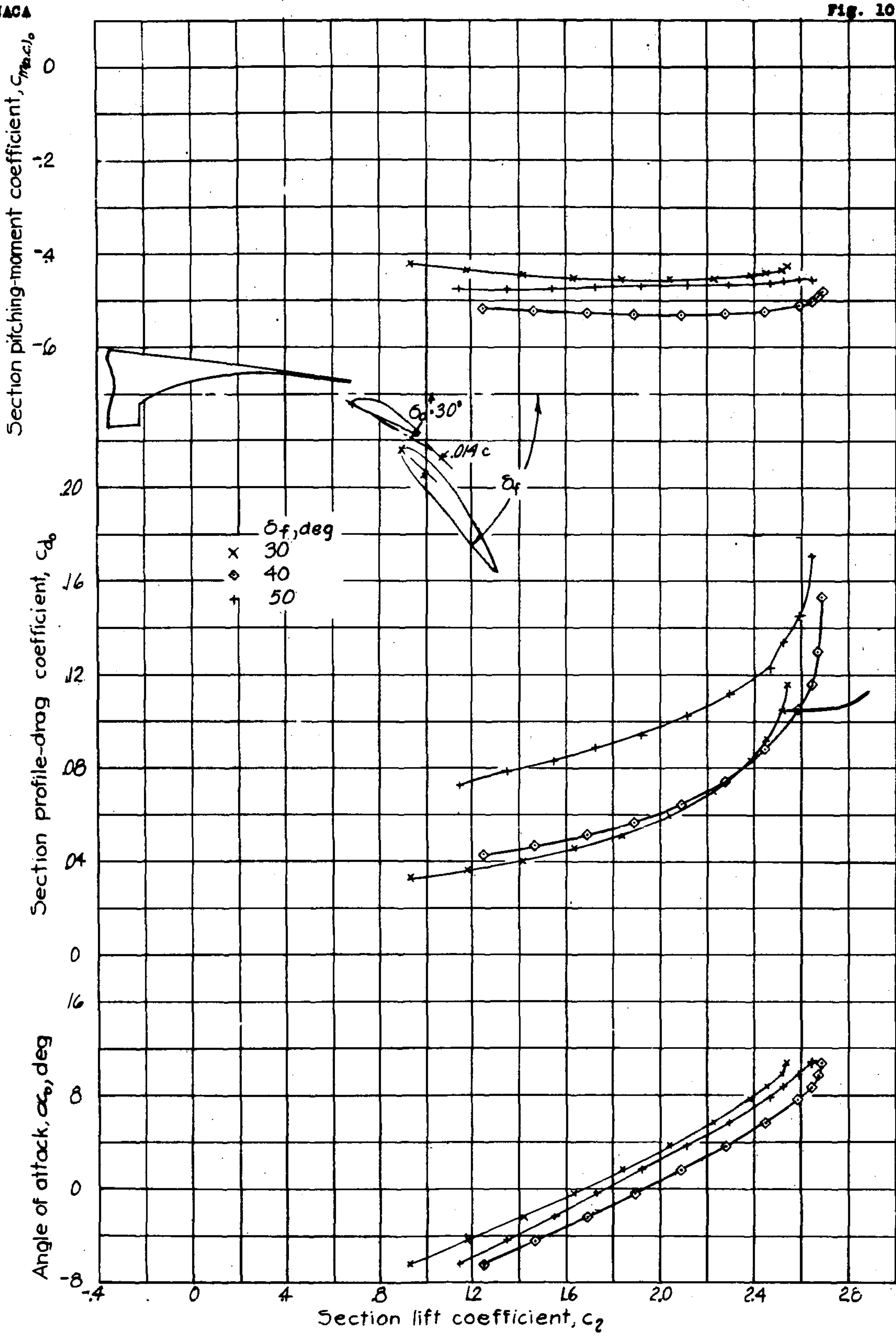

FIGURE 10.-Aerodynamic section characteristics of an NACA 23012 airfoil with a 0.15c retractable slotted flap and an 0.08c slotted aileron 2. δ_a = 30°; gap = 0.014 c.

AUTHOR(S)	DIVISION / SECTION / CROSS REFERENCES	ATI- 7912
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ABSTRACT

Full-span flap of airfoil profile retracting ahead of arrow-chord, and a full-span aileron was tested to determine aerodynamic characteristics. In flap-retracted condition, the aileron is conventional trailing-edge type, but with flaps deflected it resembles the Fowler flap and becomes the full-span, slot-lip type. Comparison between Fowler and NACA slotted flap showed that the combination under investigation gave lift coefficients as high as other slotted flaps and provided lateral control with full-span flaps in all flight conditions.

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