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ASD-TDR-63-679
PART II

JAN 1964

PRESSURE AND HEAT TRANSFER MEASUREMENTS FOR HYPERSONIC FLOWS OVER EXPANSION CORNERS AND AHEAD OF RAMPS

PART II: MACH 5 PRESSURE DATA FOR FLOWS AHEAD OF RAMPS Part of an Investigation of Hypersonic Flow Separation and Control Characteristics

TECHNICAL DOCUMENTARY REPORT No. ASD-TDR-63-679
PART II

**DEPARTMENT OF AERONAUTICS
U. S. Naval Postgraduate School
Monterey, California
SEPTEMBER 1963**

AF FLIGHT DYNAMICS LABORATORY
RESEARCH AND TECHNOLOGY DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

Project No. 8219, Task No. 821902

(Prepared under Contract No. AF 33(616)-8130 by the
Research Department, Grumman Aircraft Engineering Corporation
Bethpage, New York
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FOREWORD

This entire report, written in four parts under separate covers, presents the results of a portion of the experimental program for the investigation of hypersonic flow separation and control characteristics being conducted by the Research Department of Grumman Aircraft Engineering Corporation, Bethpage, New York. Mr. Donald E. Hoak of the Flight Control Laboratory, Aeronautical Systems Division, located at Wright-Patterson Air Force Base, Ohio, is the Air Force Project Engineer for the program, which is being supported primarily under Contract AF33(616)-8130, Air Force Task 821902.

The author wishes to express his appreciation to the staff of the von Karman Facility for their helpfulness in conducting the tests; their gracious assistance in preparing these reports; and particularly to Messrs. Schueler, Baer and Burchfield for providing the machine plotted graphs of the experimental data included in this report. Ozalid reproducible copies of the tabulated data are available on loan from the Flight Control Laboratory.

The parts which constitute a complete report for this segment of the over-all program are:

- Part I: Mach 5 and 8 Data for Expansion Corner Flows
- Part II: Mach 5 Pressure Data for Flows Ahead of Ramps
- Part III: Mach 8 Pressure Data for Flows Ahead of Ramps
- Part IV: Mach 8 Heat Transfer Data for Flows Ahead of Ramps

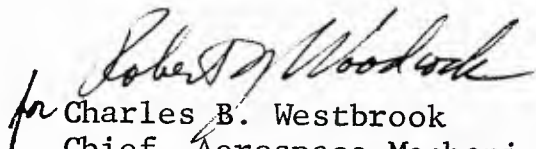
ABSTRACT

Pressure and heat transfer data were obtained for hypersonic flows over 40-degree expansion corners and ahead of ramps. Full and partial span ramps, having wedge angles up to 90 degrees, were tested at two locations on a sharp leading edge flat plate, with and without end plates. Pressure data were obtained for $M_\infty = 5$ for model length Reynolds numbers between 1.1 and 6.6 million. Both pressure and heat transfer data were obtained for $M_\infty = 8$ for Reynolds numbers between 1.1 and 3.3 million.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:


for Charles B. Westbrook
Chief, Aerospace Mechanics Branch
Flight Control Laboratory

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* See Table II, page 6, for figure numbers corresponding to particular test conditions.

LIST OF SYMBOLS

C_p	pressure coefficient, $C_p \equiv (p - p_\infty)/q_\infty$
M_∞	free stream Mach number
p	pressure (psia)
p_o	stagnation pressure (psia)
p_∞	free stream static pressure (psia)
q_∞	free stream dynamic pressure (psia)
Re_∞/ft	Reynolds number per foot, $Re_\infty/\text{ft} \equiv \rho_\infty U_\infty / \mu_\infty$
T_o	stagnation temperature ($^{\circ}\text{R}$)
T_∞	free stream static temperature ($^{\circ}\text{R}$)
U_∞	free stream velocity (ft/sec)
X'	nondimensional streamwise distance downstream of the leading edge, measured on the surface
Y'	nondimensional spanwise distance measured outboard from the model centerline
α	angle of attack of model (degrees)
μ_∞	viscosity of air in the free stream (slugs/ft sec)
ρ_∞	density of air in the free stream (slugs/ft ³)

INTRODUCTION

The experimental data generated for an investigation of hypersonic flow separation and aerodynamic control characteristics are to be presented in a series of reports, of which this is one. Pressure, heat transfer, and force data are to be obtained for hypersonic flows over "basic geometries," such as a wedge mounted on a flat plate, and for "typical" hypersonic flight configurations with aerodynamic control surfaces. The experimental portion of the program requires a total of 11 models (see Fig. 1, page 9); 8 for tests in the von Karman Facility of the Arnold Engineering Development Center and 3 for tests in the Grumman Hypersonic Shock Tunnel (Refs. 1 and 2). The data obtained from AEDC tests of one of the models are given in this four-volume report (see Foreword).

This report (Part II) presents data obtained at $M_\infty = 5$ in the AEDC 40-inch Supersonic Tunnel on a flat plate model having three, remotely controlled, flaps. The same model was tested in the AEDC 50-inch Mach 8 Tunnel to obtain pressure and aerodynamic heating rate distributions. The instrumented lower surface of the model was used to obtain data for the investigation of hypersonic flows over expansion corners. Geometrically similar models, one with internal cooling and the other with limited pressure and heat transfer instrumentation, are to be tested in the AEDC 50-inch Mach 8 Tunnel and in the Grumman Hypersonic Shock Tunnel (see Fig. 1).

MODEL

The model has a nominally sharp leading edge (35° included angle) and has a 12-inch square planform. A photograph of the model, with end plates attached, is shown in Fig. 2. The removable end plates were slightly toed in to account for the boundary layer growth along the inner walls of the end plates. There are three remotely controlled flaps on the model (Figs. 2 and 3). The forward flap has a 1-inch chord, is deflectable through 90 degrees, and has its hinge line located three inches downstream of the sharp leading edge of the model. The aft flap has a 3-inch chord, is deflectable through 45 degrees, and has its hinge line 9 inches downstream of the leading edge. The center portion of the aft flap, having a span of 4 inches, can be deflected separately.

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The chord to hinge-line station ratio of the forward and aft flaps are the same, providing data on Reynolds number and leading edge effects. When deflected 90 degrees, the forward flap serves as a forward facing step. Another function of this flap is to create separated flows which reattach on the flat plate downstream of it. The aft flap serves to form forward facing ramps of various angles up to 45 degrees. Span and tip effects are obtained by using the center portion of the aft flap and the end plates.

Pressure tap locations, as well as the locations of the thermocouples used for Part IV of this series, are shown in Fig. 3.

TEST CONDITIONS

The pressure data presented herein were obtained from Mach 5 tests in the AEDC 40-inch Supersonic Tunnel (Ref. 3). The model was pitched from 30 degrees nose down to 15 degrees nose up for various flap settings and for free stream Reynolds numbers per foot of 1.1, 3.3 and 6.6 million. The tunnel conditions corresponding to the different Reynolds numbers are shown in Table I; the model configurations, flap settings, and test conditions are shown in Table II.

DATA REDUCTION AND ACCURACY

All pressure data were reduced to standard pressure coefficient form:

$$C_p = \frac{p - p_\infty}{q_\infty},$$

where p is the measured pressure, p_∞ is the free stream static pressure, and q_∞ is the free stream dynamic pressure. The inaccuracy in the measured pressure varies from ± 0.005 psia for pressures below 1.00 psia, to ± 0.075 psia for pressures greater than 15 psia. Depending upon the values of C_p and Re_∞/ft , the pressure coefficient accuracy varies from about ± 0.009 to ± 0.020 . Variations in the tunnel conditions affect the accuracy of the tabulated pressure coefficient data to a negligible extent; the tunnel conditions shown in Table I were kept constant to well within one per cent of the values shown.

The automatic plotting machines, used in presenting the data herein, introduce another source of possible error. The discrepancy in the plotted pressure coefficients due to this machine error should not exceed ± 0.01 . Nevertheless, there is always the rare possibility that a point will be completely misplotted. Each graph has been inspected and questionable points checked with the tabulated pressure coefficients.

Finally, the remotely controlled flap settings were estimated to be accurate to well within half a degree.

RESULTS

Table II summarizes the Mach 5 data obtained on the upper portion of the model and indicates the corresponding figure numbers where the sets of data are presented. The AEDC group number is presented in the last column. This number indicates the order in which the data were obtained and is to be used when referring to the tabulated data.

High speed, schlieren motion pictures (7,000 frames per second), were obtained for the thirty conditions indicated in Table II. Observation of these films indicated that the flow, including the separation and reattachment locations, was steady in every instance. In addition to the high speed motion pictures, still schlieren flow photographs were obtained for six test conditions with the end plates on the model.

Streamwise and spanwise plots of the pressure coefficients are presented in Figs. 14 through 116. The first page of each figure presents streamwise plots of the pressure coefficients at two semi-span stations, one essentially along the centerline, at $Y' = 0.03$, and the other outboard, at $Y' = 0.34$. Six spanwise plots of the data are presented on the second page of each figure: one upstream of the forward flap, at $X' = 0.18$, one on the forward flap, at $X' = 0.29$, two upstream of the aft flaps, at $X' = 0.59$ and 0.68 , and two on the aft flaps, at $X' = 0.83$ and 0.92 .

Although the accuracy of the plotted data should suffice for engineering purposes, ozalid reproducible copies of the tabulated data are available on loan (see Foreword). The plotted data may be read accurately using standard 20/inch grid, tracing graph paper overlays.

REFERENCES

1. Kaufman, L.G. II, Oman, R.A., Hartofilis, S.A., Meckler, L.H., Evans, W.J., and Weiss, D., A Review of Hypersonic Flow Separation and Control Characteristics, ASD-TDR-62-168, March 1962.
2. Evans, W.J., and Kaufman, L.G. II, Pretest Report on Hypersonic Flow Separation and Control Models for AEDC Tunnels A, B, Hotshot 2 and Grumman Hypersonic Shock Tunnel, Grumman Research Department Memorandum RM-209, July 1962.
3. Arnold Center, Test Facilities Handbook, Arnold Air Force Station, January 1961.
4. Kaufman, L.G. II and Meckler, L.H., Pressure and Heat Transfer Measurements at Mach 5 and 8 for a Fin-Flat Plate Model, ASD-TDR-63-235, April 1963.
5. Hartofilis, S.A., Pressure Measurements at Mach 19 for a Winged Re-entry Configuration, ASD-TDR-63-319, May 1963.
6. Meckler, L.H., Static Aerodynamic Characteristics at Mach 5 and 8 for an Aerodynamically Controllable Winged Re-entry Configuration, to be published as an ASD Technical Documentary Report.
7. Kaufman, L.G. II, Pressure and Heat Transfer Measurements for Hypersonic Flows Over a Blunt Pyramidal Configuration with Aerodynamic Controls, to be published as an ASD Technical Documentary Report.

TABLE I
TUNNEL CONDITIONS

$Re_{\infty}/10^6 \text{ ft}$	1.1	3.3	6.6
M_{∞}	4.99	5.01	5.03
$p_{\infty}(\text{psia})$	0.040	0.134	0.272
$q_{\infty}(\text{psia})$	0.70	2.35	4.82
$p_o(\text{psia})$	21	72	150
$T_o(^{\circ}\text{R})$	570	620	635

TABLE II

TEST CONDITIONS

End Plates	Flap Settings (deg)			$\frac{Re_{\infty}}{10^6 \text{ ft}}$	α (deg)	Fig. Nos.		AEDC GROUP NO.
	For- ward	Aft Center	Aft Full Span			Photo [†]	C _P	
OFF ↓ OFF				1.1 3.3 6.6	-30 ↓ -30		14 15 16	4 15 31
	30		10	3.3 3.3			17 18	14 23
			30	1.1 3.3 6.6			19 20 21	8 9 32
				1.1 3.3 6.6	-15 ↓ -15		22 23 24	3 16 30
	15 15 30		10	3.3 3.3 6.6			25 26 27	13 19 26
				3.3 3.3 6.6			28 29 30	22 24 27
		30 30		1.1 3.3 6.6			31 32 33	7 10 33
			30	1.1 3.3 6.6		4a b	34 35 36	2 17 29
	15 15 20 30 30		10	1.1 3.3 6.6			37 38 39	5 18 25
				3.3 1.1 3.3		c	40 41 42	20 1 21
			30	1.1 3.3 6.6 6.6 3.3			43 44 45 46 47	6 11 28 34* 12
OFF			45	3.3	- 5			

*Repeat run.

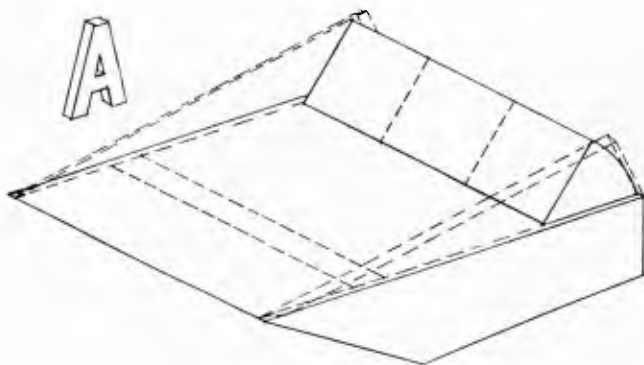
[†]Schlieren flow photographs. Still photographs for configurations with end plates; frames from high speed motion pictures for configurations without end plates.

End Plates	Flap Settings (deg)			$\frac{Re_{\infty}}{10^6 \text{ ft}}$	α (deg)	Fig. Nos.		AEDC GROUP NO.
	For- ward	Aft Center	Aft Full Span			Photo	C _p	
OFF				1.1	0	5a	48	72
ON				1.1		b	49	103
OFF				3.3		c	50	35
ON				3.3		d	51	98
OFF				6.6		e	52	60
ON				6.6		f	53	89
ON	10			1.1		6a	54	108
OFF	10			3.3			55	38
OFF	10			6.6		b	56	53
OFF			10	1.1		c	57	77
ON			10	1.1			58	104
OFF			10	3.3			59	46
ON			10	3.3			60	97
OFF			10	6.6		d	61	69
ON			10	6.6			62	90
OFF	15			3.3		7a	63	39
OFF	15			6.6		b	64	54
OFF	20			3.3		8a	65	40
OFF	20			6.6		b	66	55
OFF			20	1.1		c	67	76
ON			20	1.1			68	105
OFF			20	3.3			69	47
ON			20	3.3			70	96
OFF			20	6.6		d	71	68
ON			20	6.6			72	91
OFF	30			1.1		9a	73	78
OFF	30			3.3			74	41
OFF	30			6.6			75	56
OFF		30		1.1		c	76	79
OFF		30		3.3			77	45
OFF		30		6.6			78	52
OFF			30	1.1		e	79	75
ON			30	1.1			80	106
OFF			30	3.3			81	48
ON			30	3.3			82	95
OFF			30	6.6		f	83	65
ON			30	6.6			84	92
OFF			45	1.1		10a	85	51
OFF			45	1.1			86	80*
ON			45	1.1			87	107
OFF			45	3.3			88	70
ON			45	3.3			89	94
OFF			45	6.6		d	90	66
ON			45	6.6			91	93
ON	90			1.1	Y 0	11a	92	109
OFF	90			3.3		b	93	44
OFF	90			6.6		c	94	59

* Repeat run with model rolled 180°.

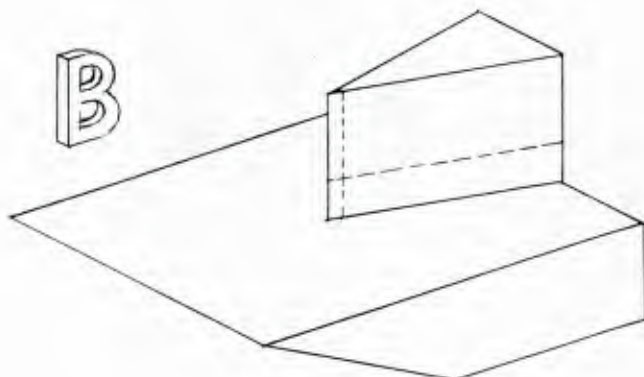
End Plates	Flap Settings (deg)			$\frac{Re_{\infty}}{10^6 \text{ ft}}$	α (deg)	Fig. Nos.		AEDC GROUP NO.
	For- ward	Aft Center	Aft Full Span			Photo [†]	C _p	
OFF ↓ OFF				1.1 3.3 6.6	+ 5 ↓ + 5	12a	95	73
						b	96	36
							97	61
	15			3.3			98	86
	30			1.1			99	83
	30			3.3			100	42
	30			6.6			101	57
			30	1.1			102	74
			30	3.3			103	49
			30	6.6			104	64
				1.1			105	81
				3.3			106	37
OFF ↓ OFF				6.6	+15 ↓ +15		107	62
	15			3.3		13	108	85
	30			1.1			109	82
	30			3.3			110	43
	30			6.6			111	58
			30	1.1			112	84
			30	3.3			113	50
			30	6.6			114	63
			45	3.3			115	71
			45	6.6			116	67

[†]Schlieren flow photographs. Still photographs for configurations with end plates; frames from high speed motion pictures for configurations without end plates.



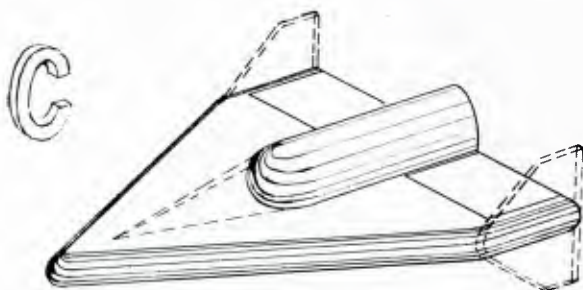
Separated Flows ahead of a Ramp
Fore and aft flaps, end plates
3 separate models:

- 1) Pressure and heat transfer, AEDC Tunnels A & B, $M = 5$ & 8 , Results herein.
- 2) Controlled wall temperature, pressure, AEDC Tunnel B, $M = 8$, Results not yet available.
- 3) Pressure and heat transfer, Grumman Shock Tunnel, $M \approx 13$ & 19 , Results not yet available.



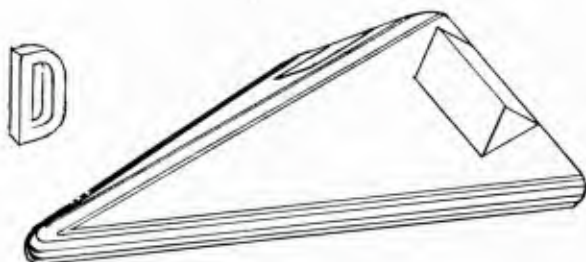
Wedge - Plate Interaction
Small and Large fins with sharp
and blunt leading edges
2 separate models:

- 1) Pressure and heat transfer, AEDC Tunnels A & B, $M = 5$ & 8 , Results in Ref. 4.
- 2) Pressure and heat transfer, Grumman Shock Tunnel, $M \approx 13$ & 19 , Results not available yet.



Clipped Delta, Blunt L.E.
Center body, T.E. flaps, drooped nose,
spoiler, tip fins
3 separate models:

- 1) Pressure and heat transfer, AEDC Tunnels A & B, $M \approx 5$ & 8 , Results not available yet.
- 2) Pressure, AEDC Hotshot 2, $M \approx 19$, Results in Ref. 5.
- 3) Six component force, AEDC Tunnels A & B, $M \approx 5$ & 8 , Results in Ref. 6.



Delta, Blunt L.E., Dihedral
T.E. flaps, canard, ventral fin
3 separate models:

- 1) Pressure and heat transfer, AEDC Tunnels A & B, $M = 5$ & 8 , Results in Ref. 7.
- 2) Pressure and heat transfer, Grumman Shock Tunnel, $M \approx 19$, Results not available yet.
- 3) Six component force, AEDC Tunnels A & B, $M = 5$ & 8 , Results not available yet.

Fig. 1 General Outline of Models and Remarks for Over-all Program

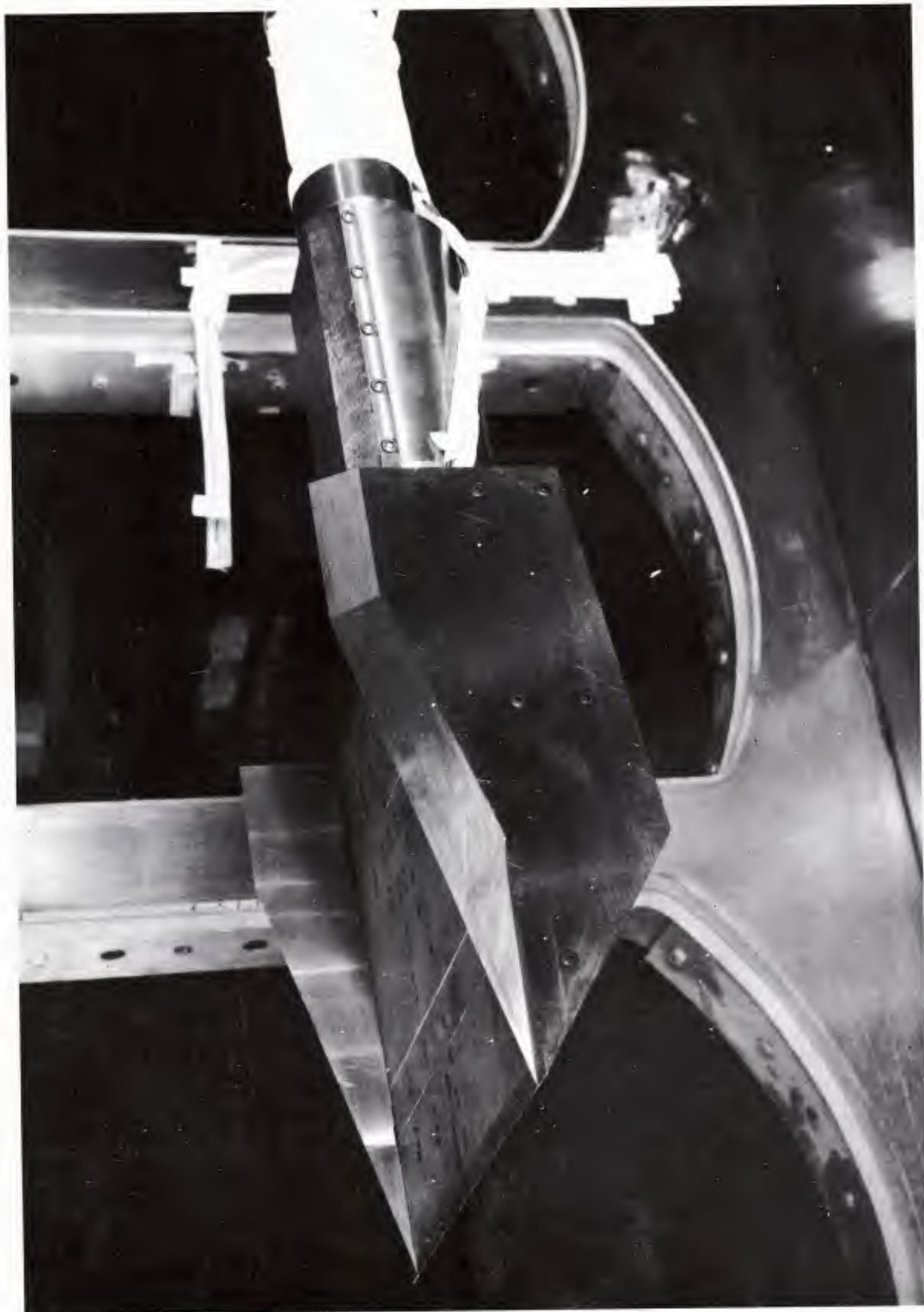


Fig. 2 Photograph of Upper Surface of Model, with End Plates,
Installed in the AEDC 40-inch Supersonic Tunnel

ATTACHABLE END PLATES

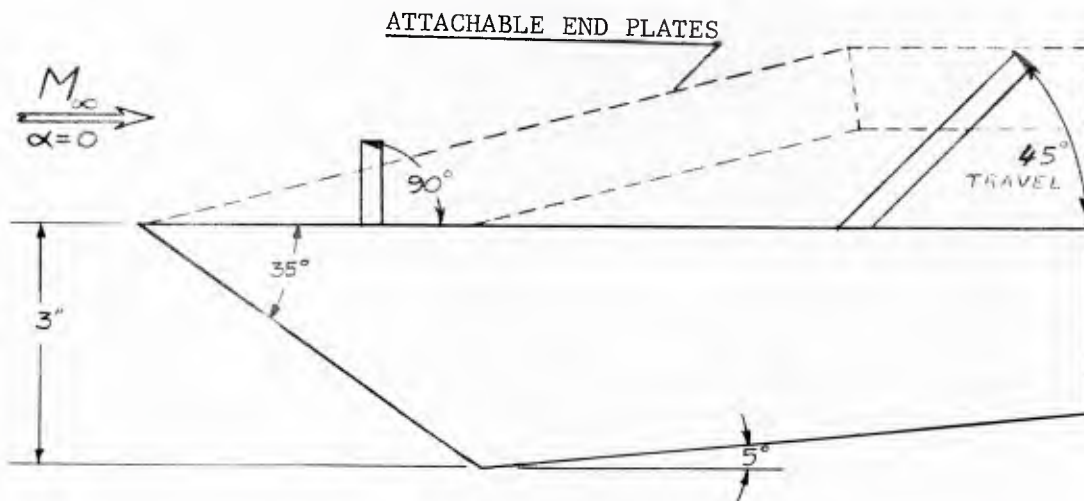
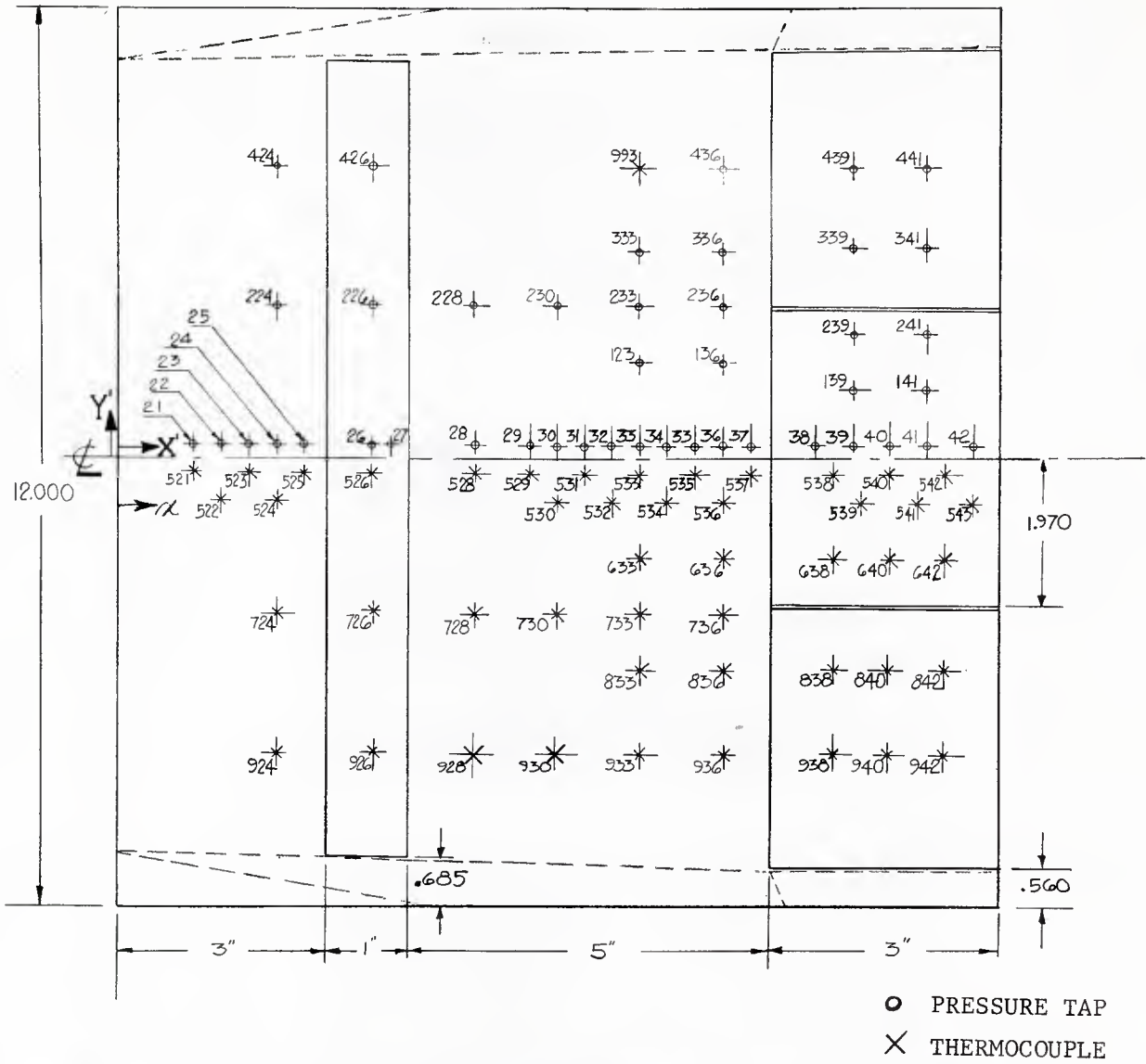


Fig. 3 Instrumentation on Upper Surface of Model



a)



b)

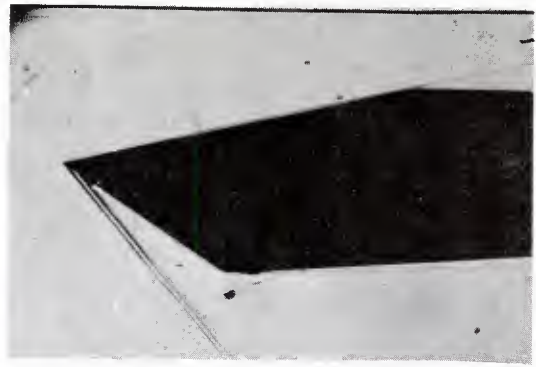


c)

Fig. 4 Schlieren Flow Photographs, $\alpha = -5^\circ$
 a) $Re_\infty / 10^6 \text{ ft} = 1.1$
 b) $Re_\infty / 10^6 \text{ ft} = 3.3$
 c) $Re_\infty / 10^6 \text{ ft} = 6.6$, Forward Flap at 15°



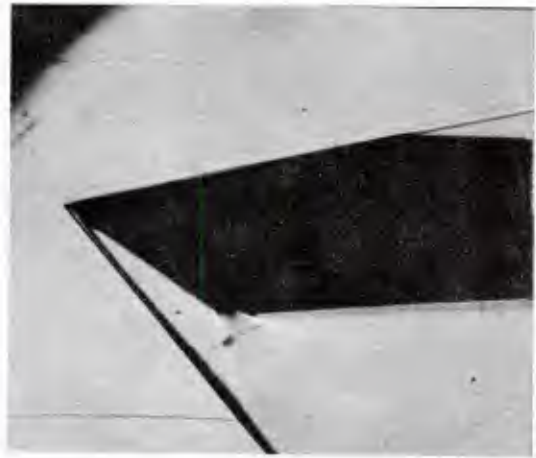
a)



b)



c)



d)



e)



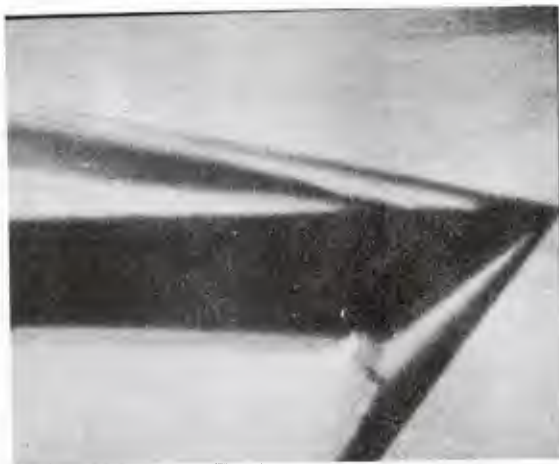
f)

Fig. 5 Schlieren Flow Photographs, $\alpha = 0$

a) & b) $Re_\infty/10^6 \text{ ft} = 1.1$

c) & d) $Re_\infty/10^6 \text{ ft} = 3.3$

e) & f) $Re_\infty/10^6 \text{ ft} = 6.6$



a)



b)



c)



d)

Fig. 6 Schlieren Flow Photographs, $\alpha = 0$

a) $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 10°

b) $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 10°

c) $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 10°

d) $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 10°



a)



b)

Fig. 7 Schlieren Flow Photographs, $\alpha = 0$
 a) $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 15°
 b) $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 15°



a)



b)



c)



d)

Fig. 8 Schlieren Flow Photographs, $\alpha = 0$

a) $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 20°

b) $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 20°

c) $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 20°

d) $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 20°



a)



b)



c)



d)



e)



f)

Fig. 9 Schlieren Flow Photographs, $\alpha = 0$

a) $Re_\infty/10^6 \text{ ft} = 3.3$, Forward Flap at 30°

b) $Re_\infty/10^6 \text{ ft} = 6.6$, Forward Flap at 30°

c) $Re_\infty/10^6 \text{ ft} = 3.3$, Aft Center Flap at 30°

d) $Re_\infty/10^6 \text{ ft} = 6.6$, Aft Center Flap at 30°

e) $Re_\infty/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30°

f) $Re_\infty/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30°



a)



b)



c)



d)



e)

Fig. 10 Schlieren Flow Photographs, $\alpha = 0$

a) $Re_\infty/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 45°

b) $Re_\infty/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 45°

c) $Re_\infty/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 45°

d) $Re_\infty/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 45°

e) $Re_\infty/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 45°



a)



b)



c)

Fig. 11 Schlieren Flow Photographs, $\alpha = 0$
 a) $Re_\infty / 10^6 \text{ ft} = 1.1$, Forward Flap at 90°
 b) $Re_\infty / 10^6 \text{ ft} = 3.3$, Forward Flap at 90°
 c) $Re_\infty / 10^6 \text{ ft} = 6.6$, Forward Flap at 90°



a)



b)

Fig. 12 Schlieren Flow Photographs, $\alpha = +5$

a) $Re_\infty/10^6 \text{ ft} = 1.1$

b) $Re_\infty/10^6 \text{ ft} = 3.3$



Fig. 13 Schlieren Flow Photographs, $\alpha = 15^\circ$
 $Re_\infty/10^6 \text{ ft} = 3.3$, Forward Flap at 15°

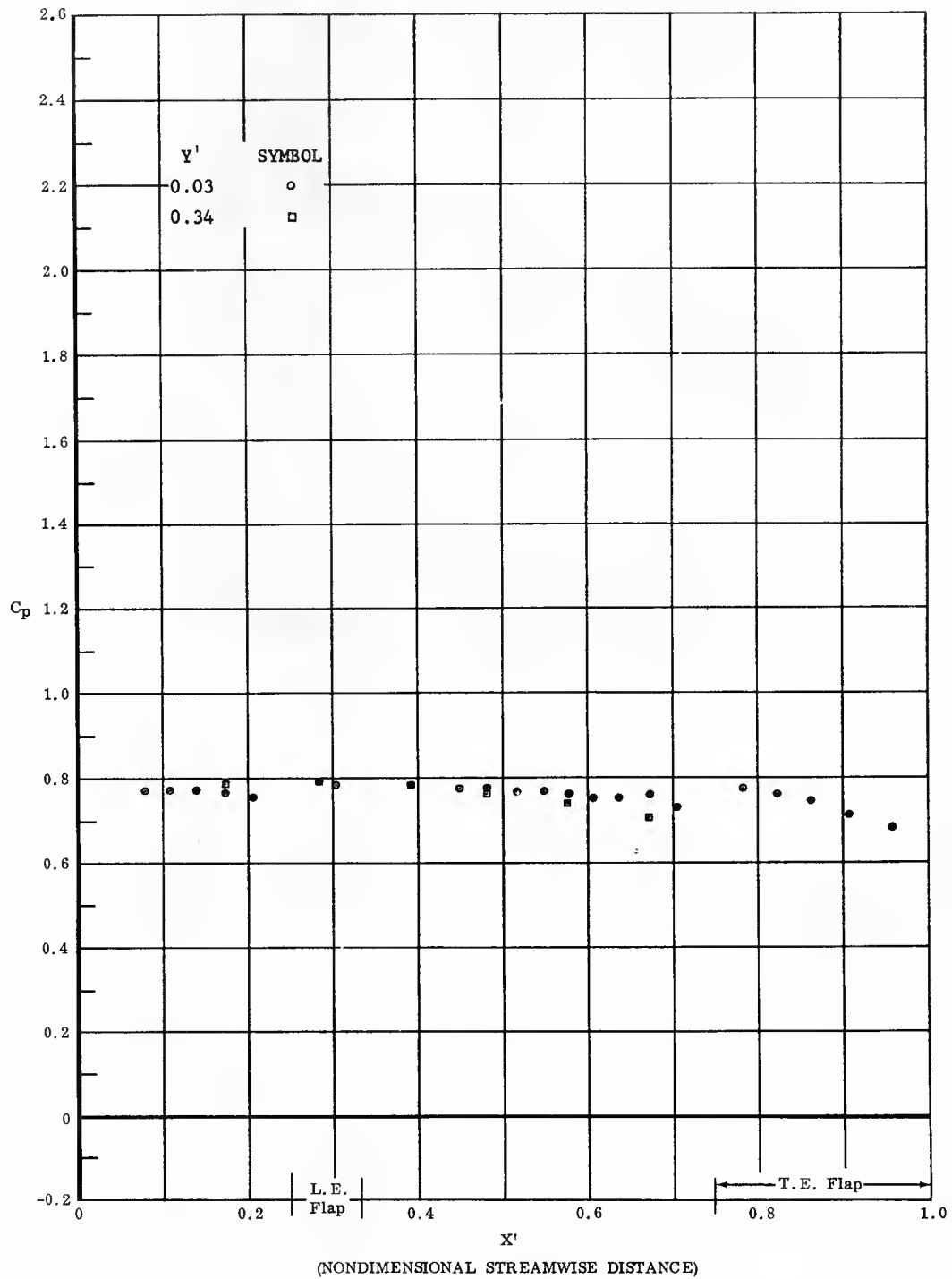


Fig. 14 Pressure Coefficient Data Plots; $\alpha = -30^\circ$,
 $Re_\infty / 10^6 \text{ ft} = 1.1$, No Flap Deflections, End
 Plates Off

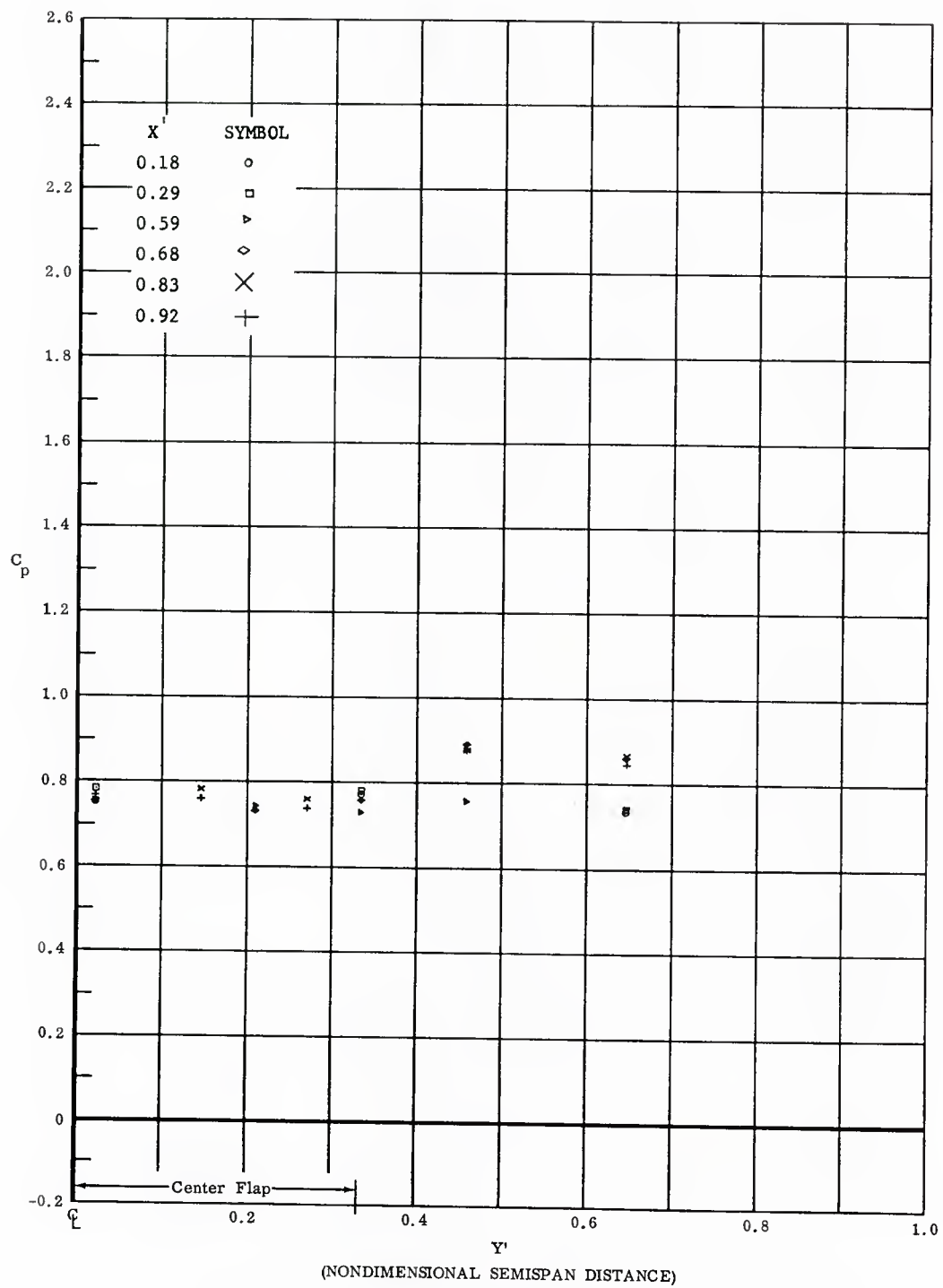


Fig. 14 Pressure Coefficient Data Plots; $\alpha = -30^\circ$
 $Re_\infty / 10^6 \text{ ft} = 1.1$, No Flap Deflections, End
 Plates Off

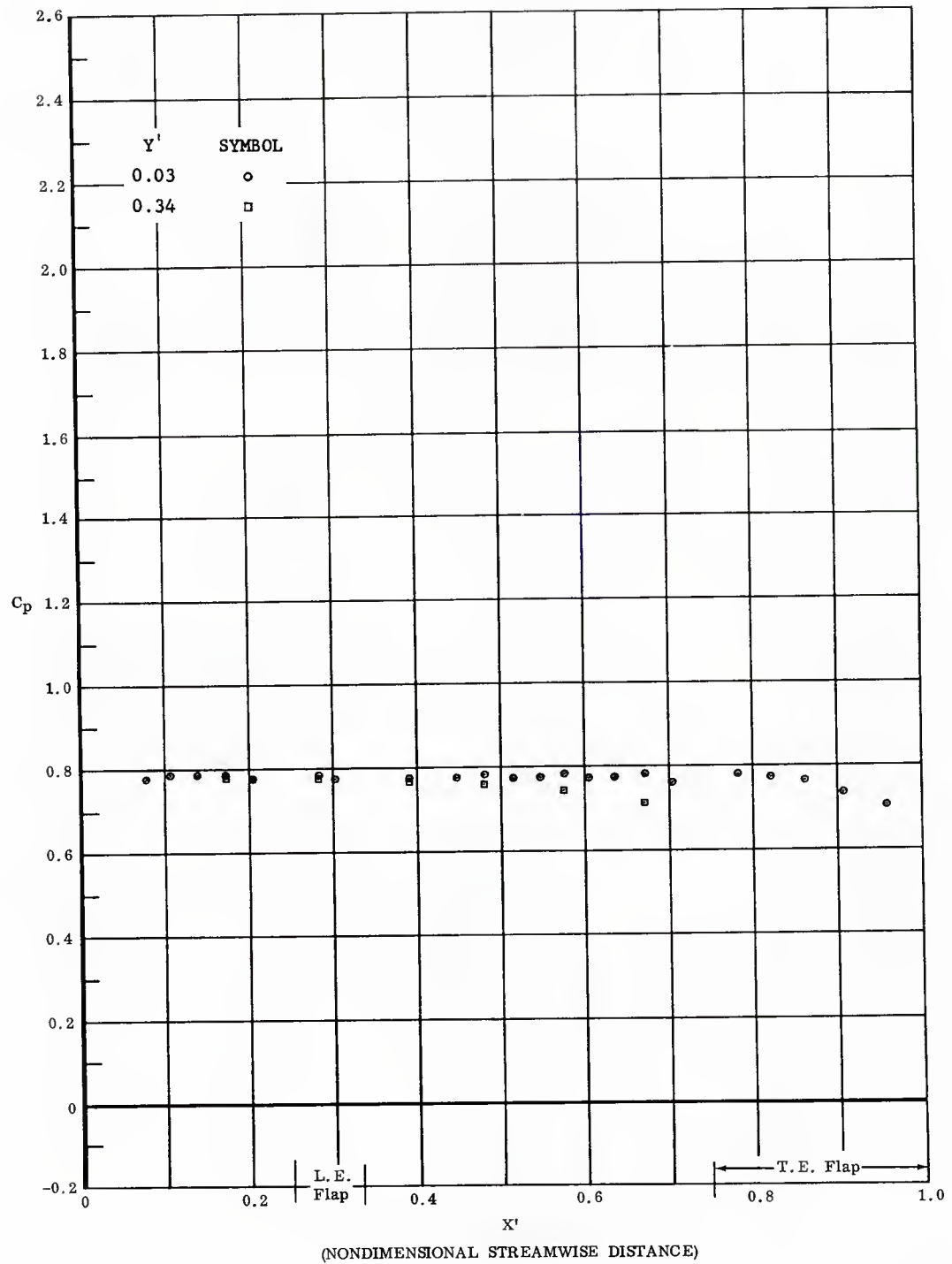


Fig. 15 Pressure Coefficient Data Plots; $\alpha = -30^\circ$
 $Re_\infty/10^6 \text{ ft} = 3.3$, No Flap Deflections, End
 Plates Off

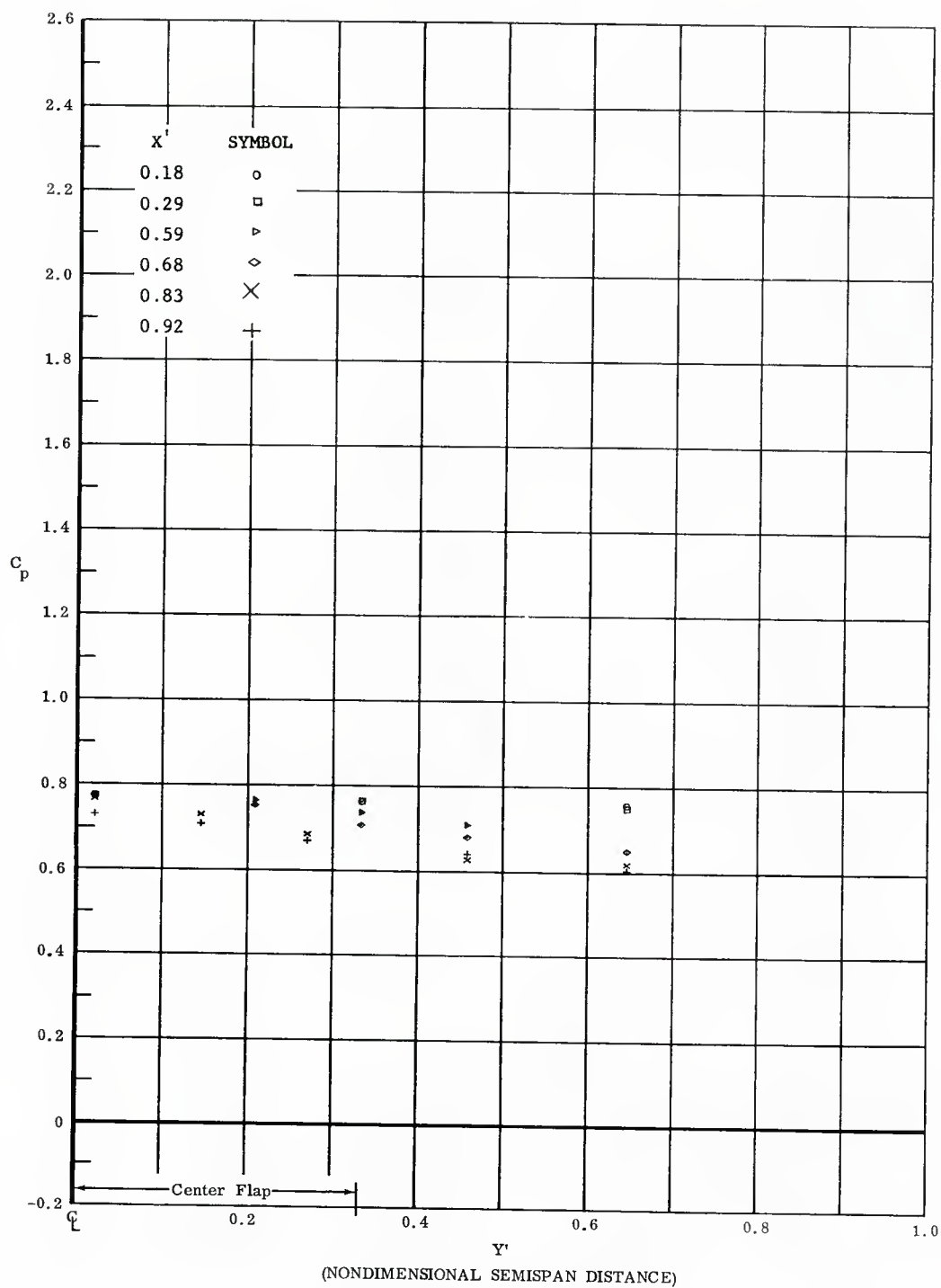


Fig. 15 Pressure Coefficient Data Plots; $\alpha = -30^\circ$
 $Re_\infty / 10^6 \text{ ft} = 3.3$, No Flap Deflections, End
 Plates Off

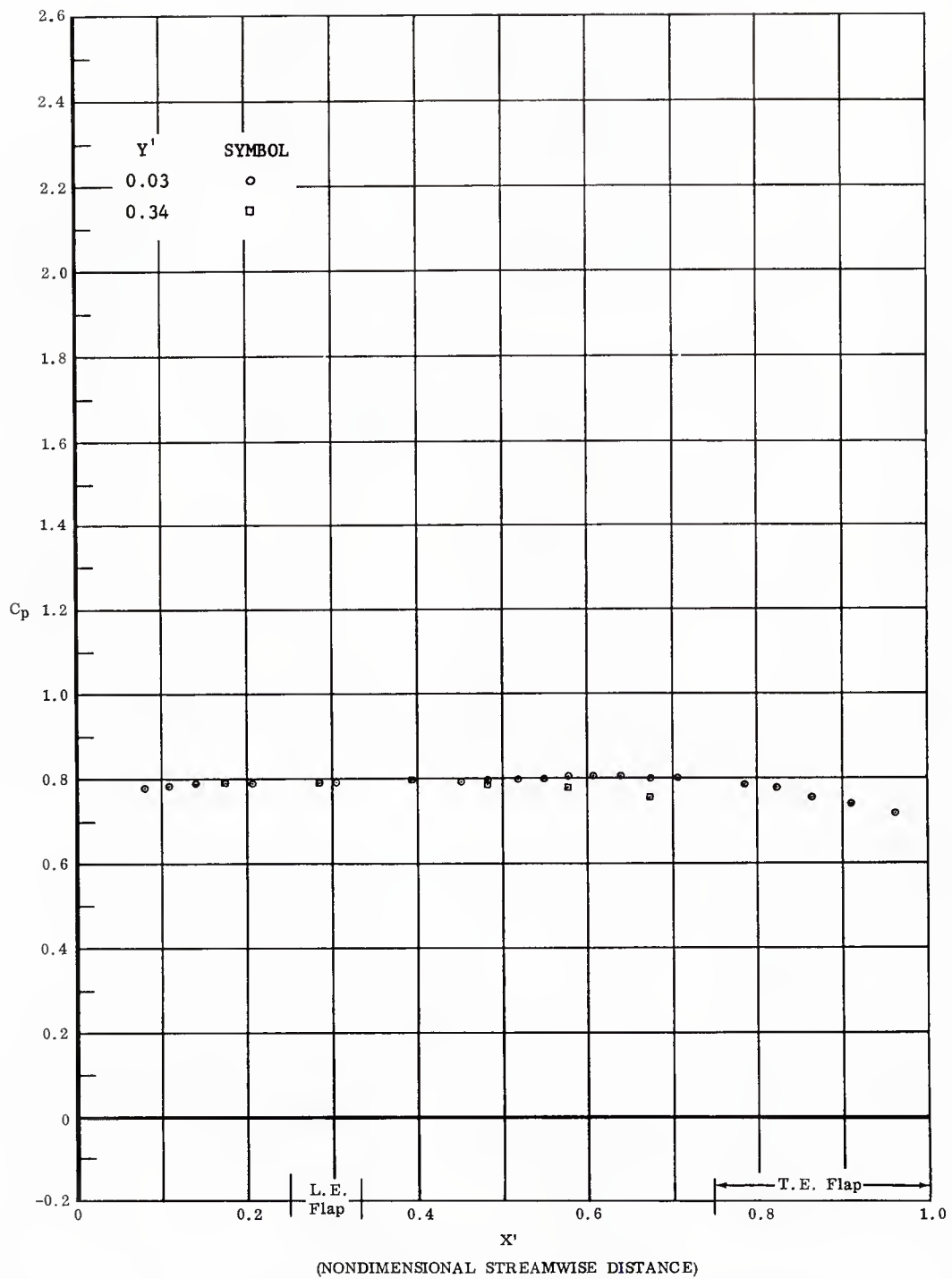


Fig. 16 Pressure Coefficient Data Plots; $\alpha = -30$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, No Flap Deflections, End
 Plates Off

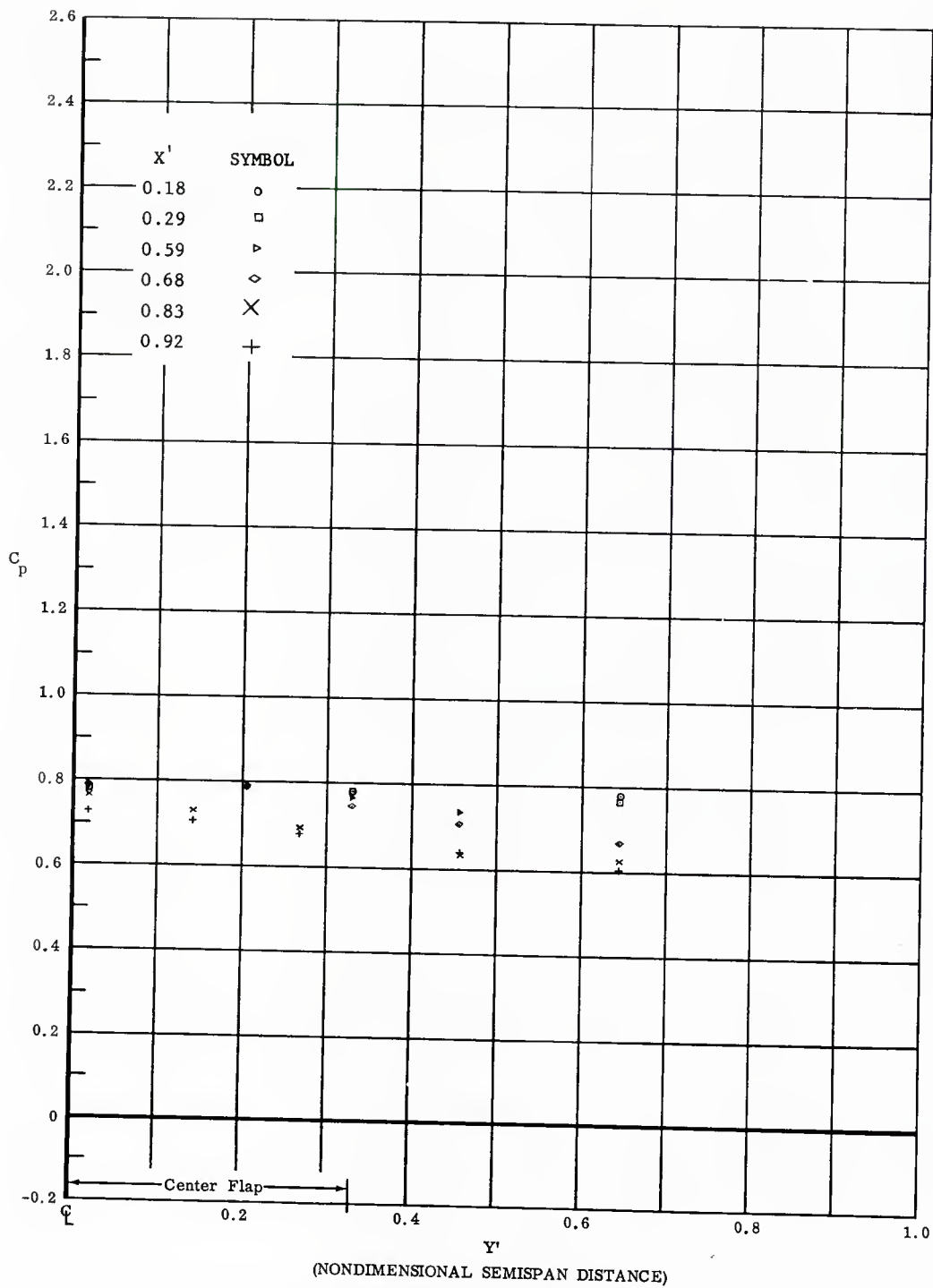


Fig. 16 Pressure Coefficient Data Plots; $\alpha = -30$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Flap Deflections, End
 Plates Off

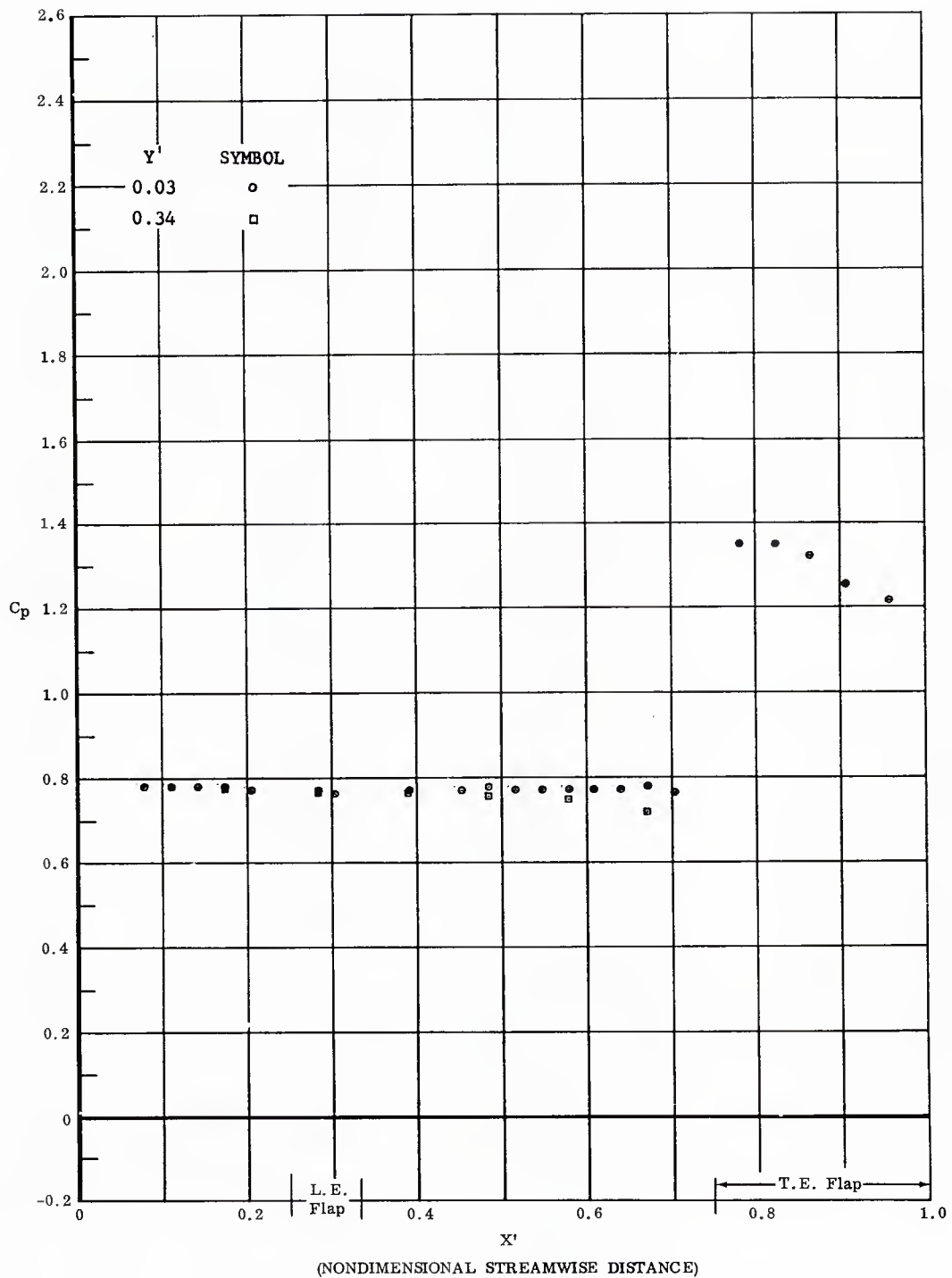


Fig. 17 Pressure Coefficient Data Plots; $\alpha = -30$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 10° ,
 End Plates Off

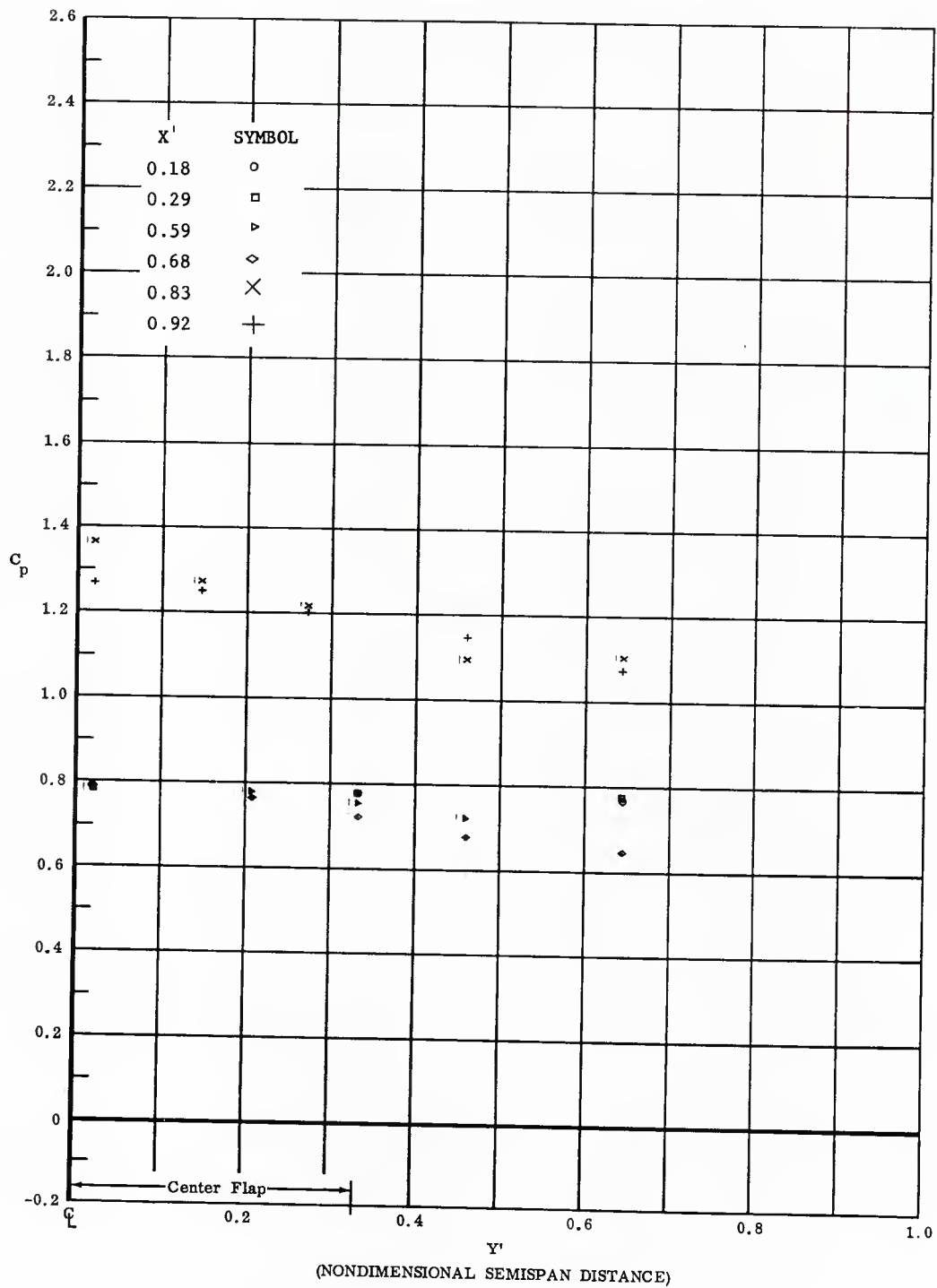


Fig. 17 Pressure Coefficient Data Plots; $\alpha = -30$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 10° ,
 End Plates Off

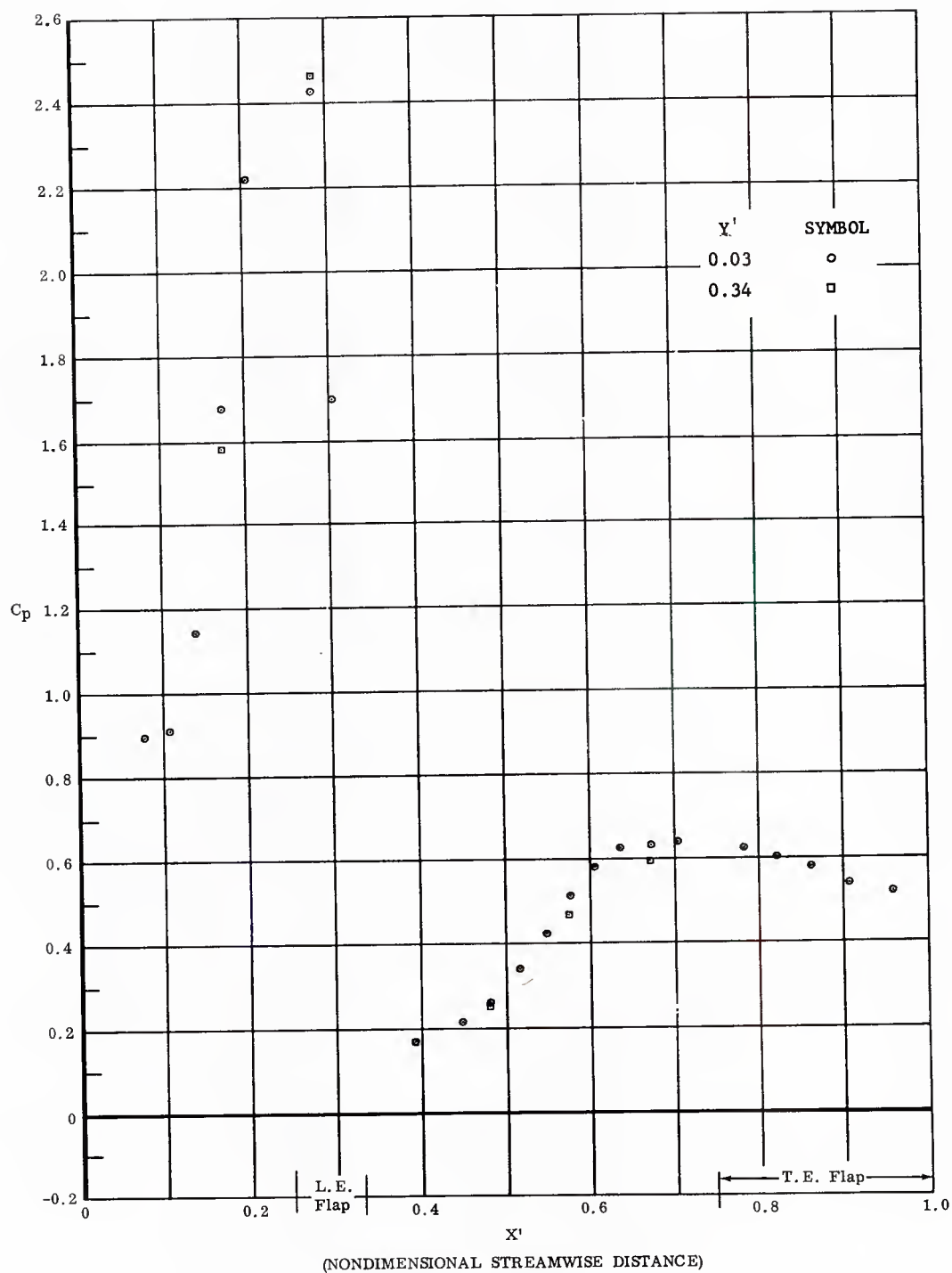


Fig. 18 Pressure Coefficient Data Plots; $\alpha = -30$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 30° , End
 Plates Off

□ (2.92)

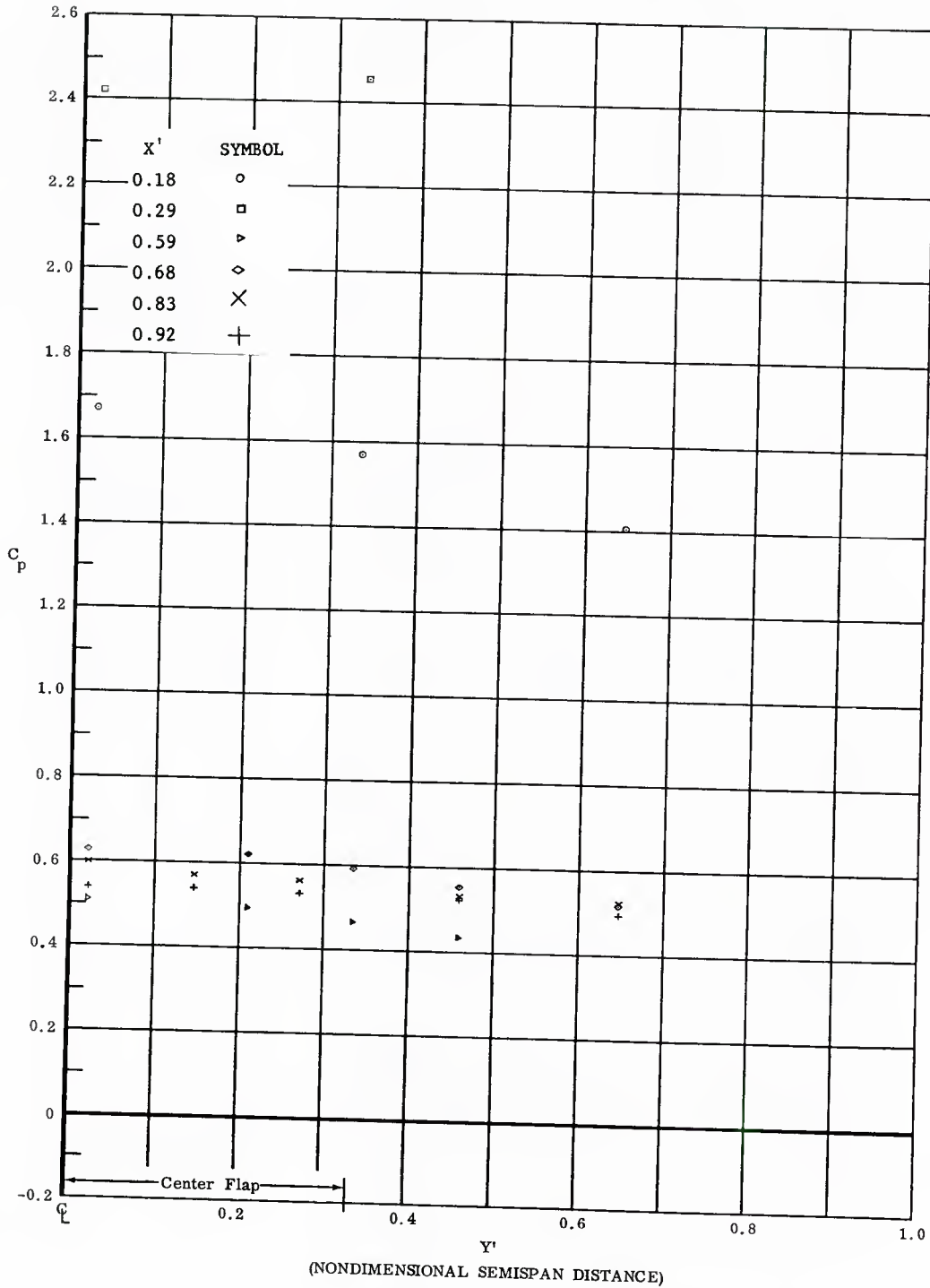


Fig. 18 Pressure Coefficient Data Plots; $\alpha = -30$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, Forward Flap at 30° , End
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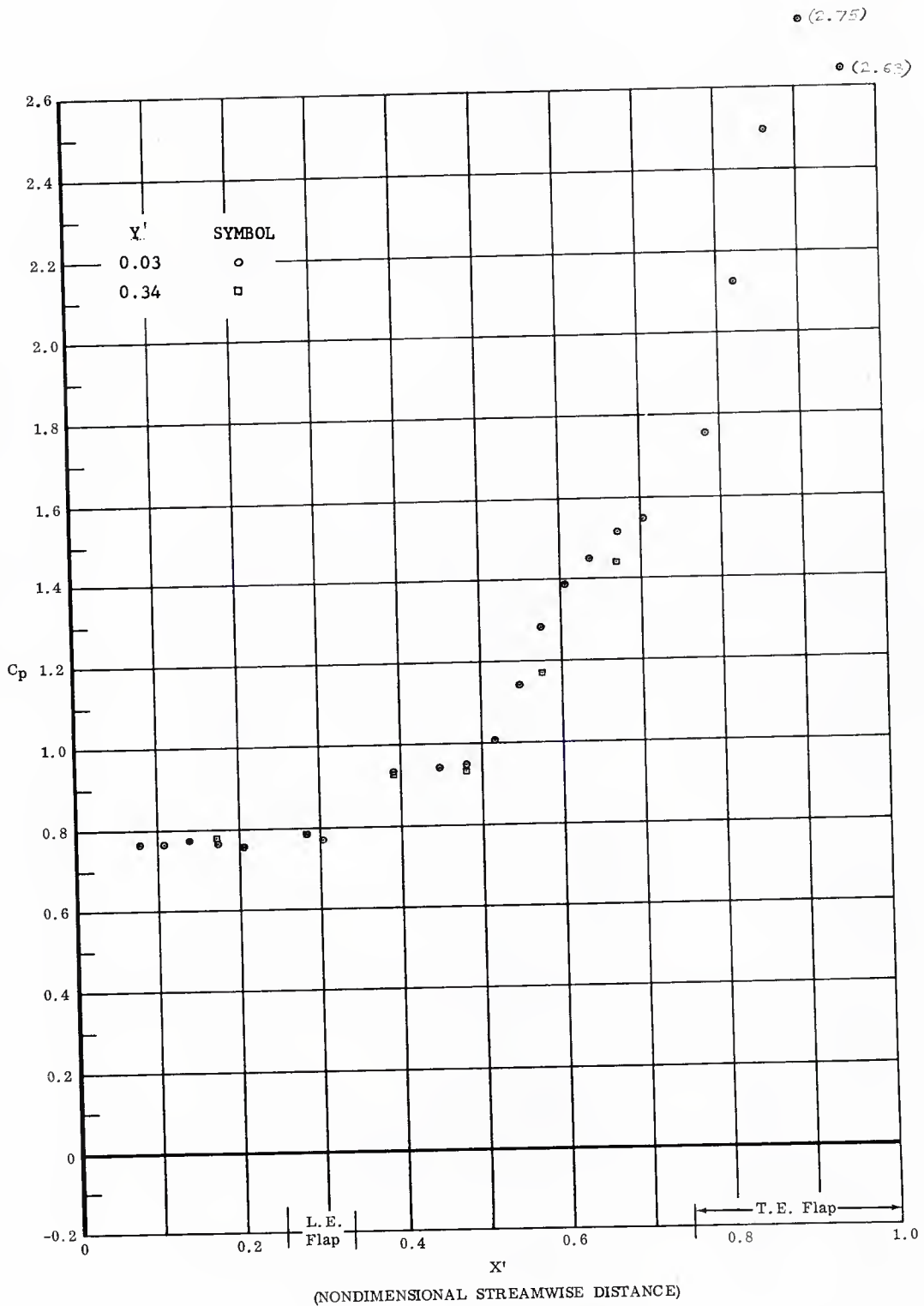


Fig. 19 Pressure Coefficient Data Plots; $\alpha = -30$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plates Off

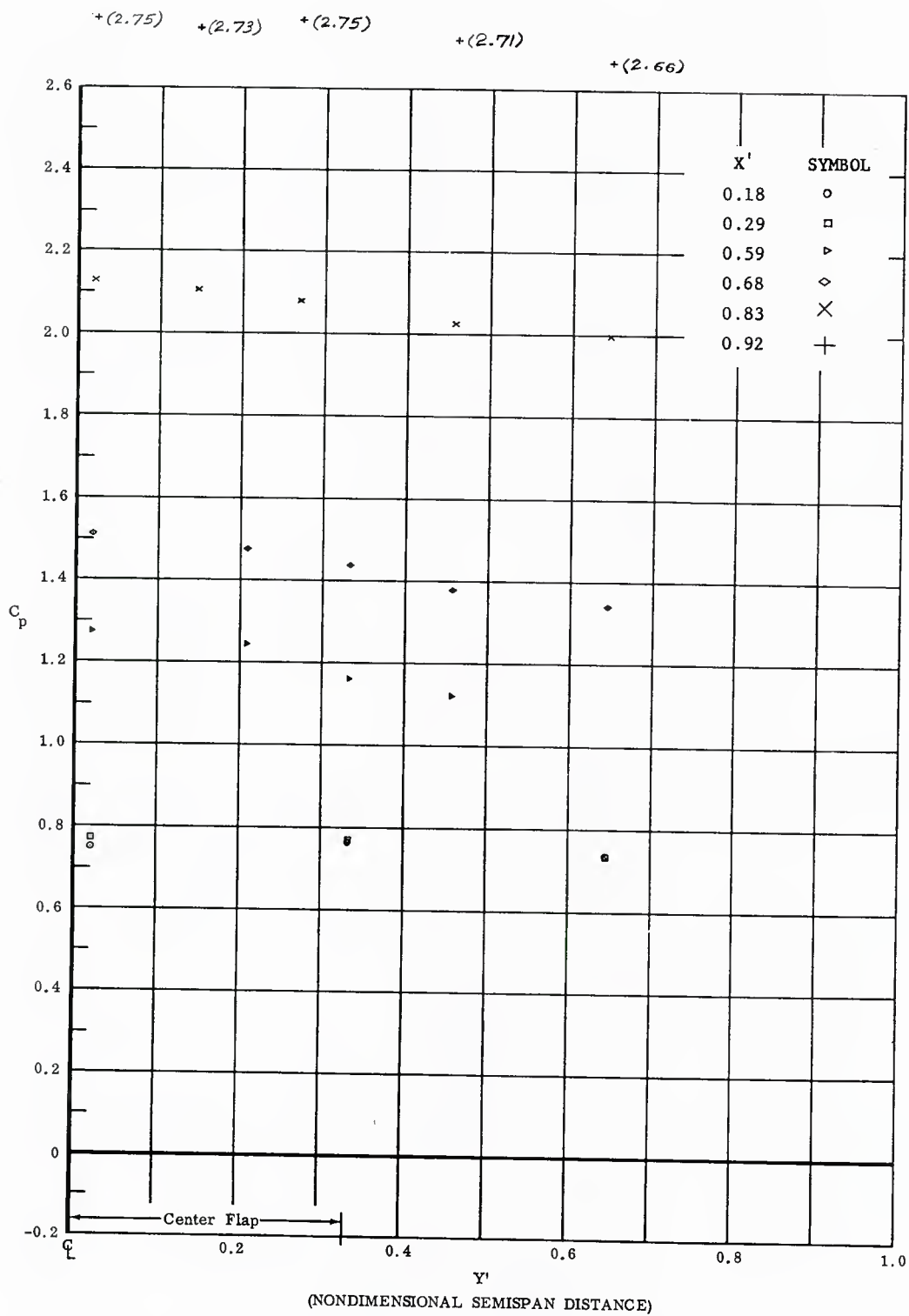


Fig. 19 Pressure Coefficient Data Plots; $\alpha = -30$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plates Off

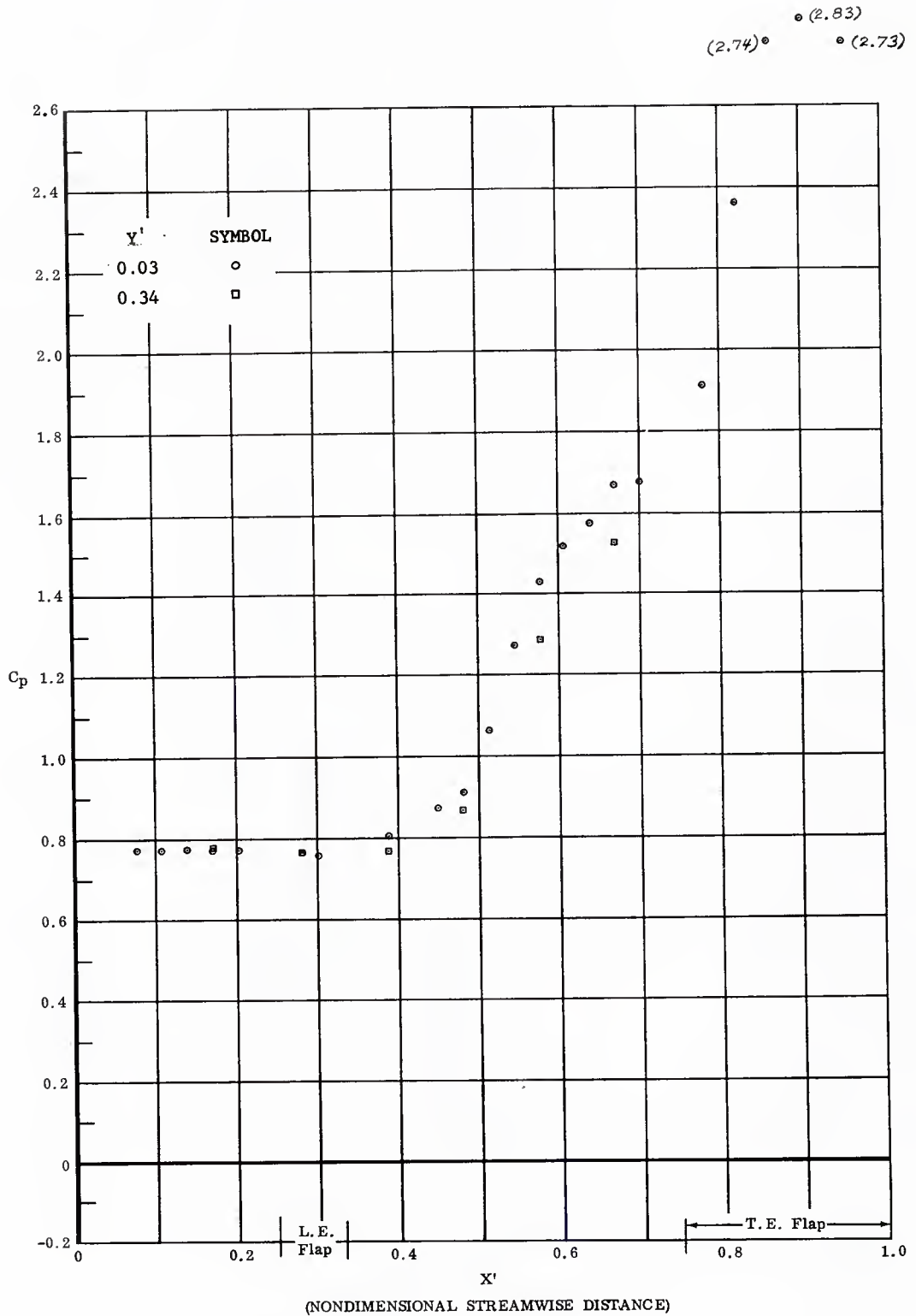


Fig. 20 Pressure Coefficient Data Plots; $\alpha = -30^\circ$
 $Re_\infty / 10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30° ,
 End Plates Off

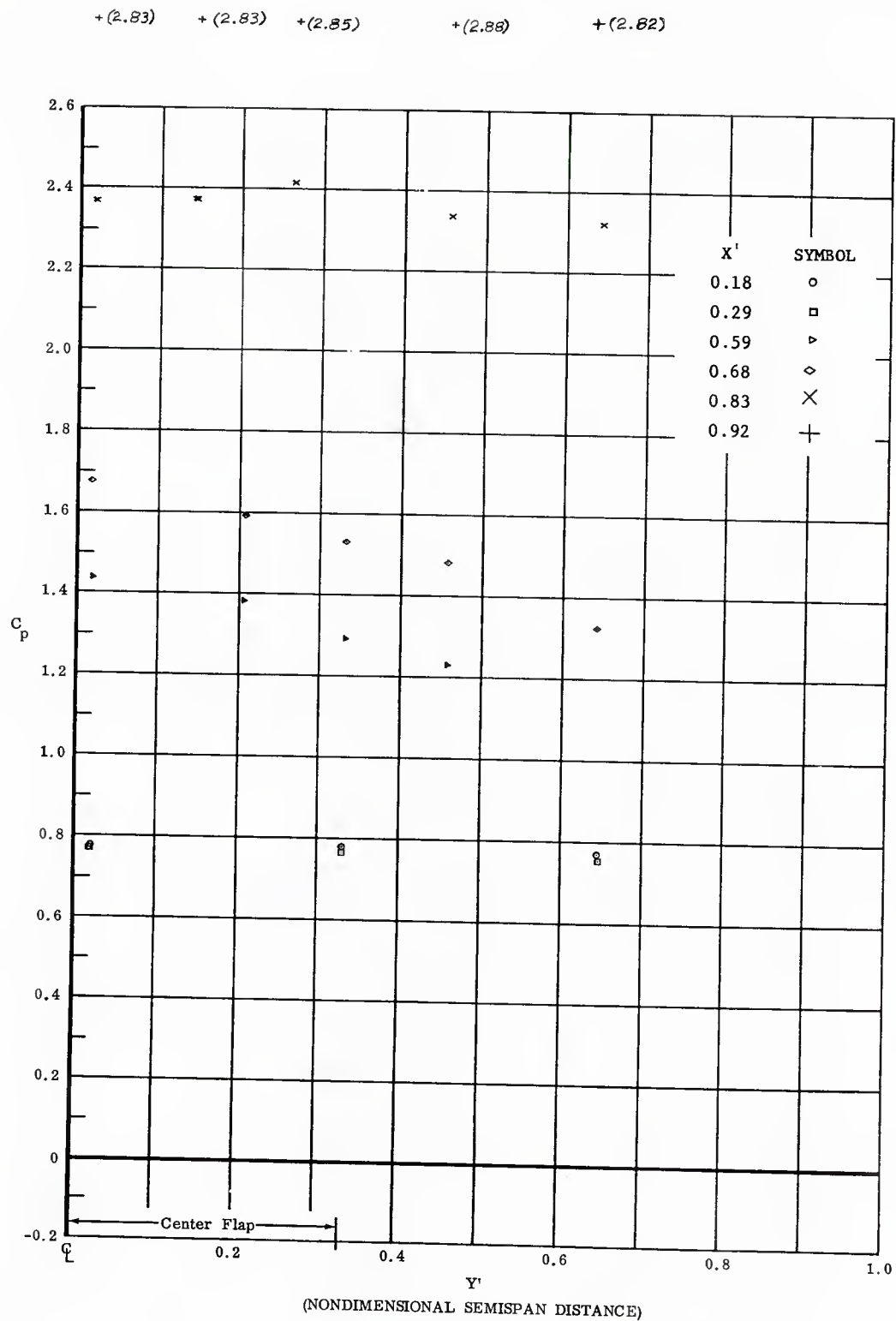


Fig. 20 Pressure Coefficient Data Plots; $\alpha = -30$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, Aft Full Span Flap at 30° ,
 End Plates Off

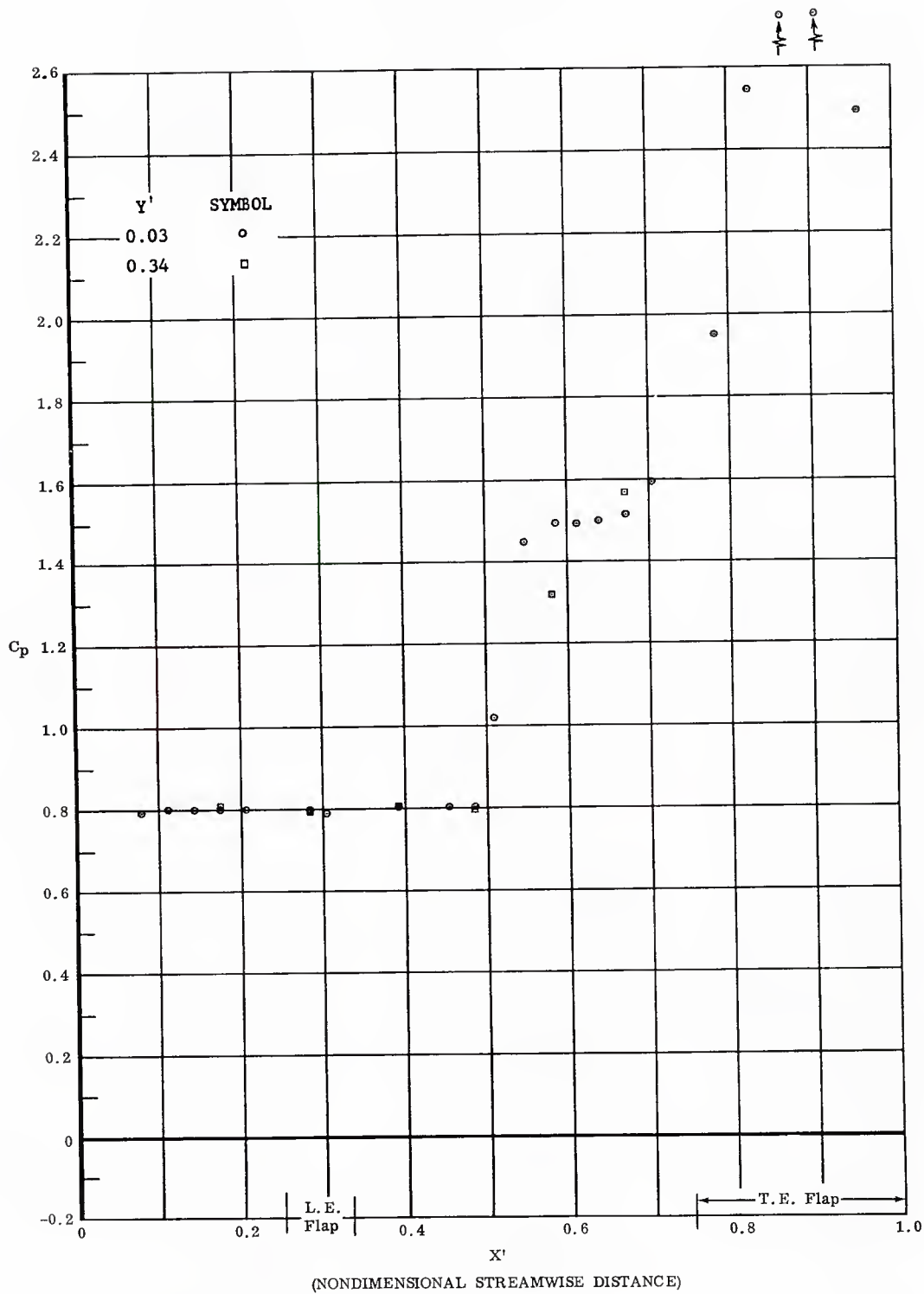


Fig. 21 Pressure Coefficient Data Plots; $\alpha = -30$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, Aft Full Span Flap at 30° ,
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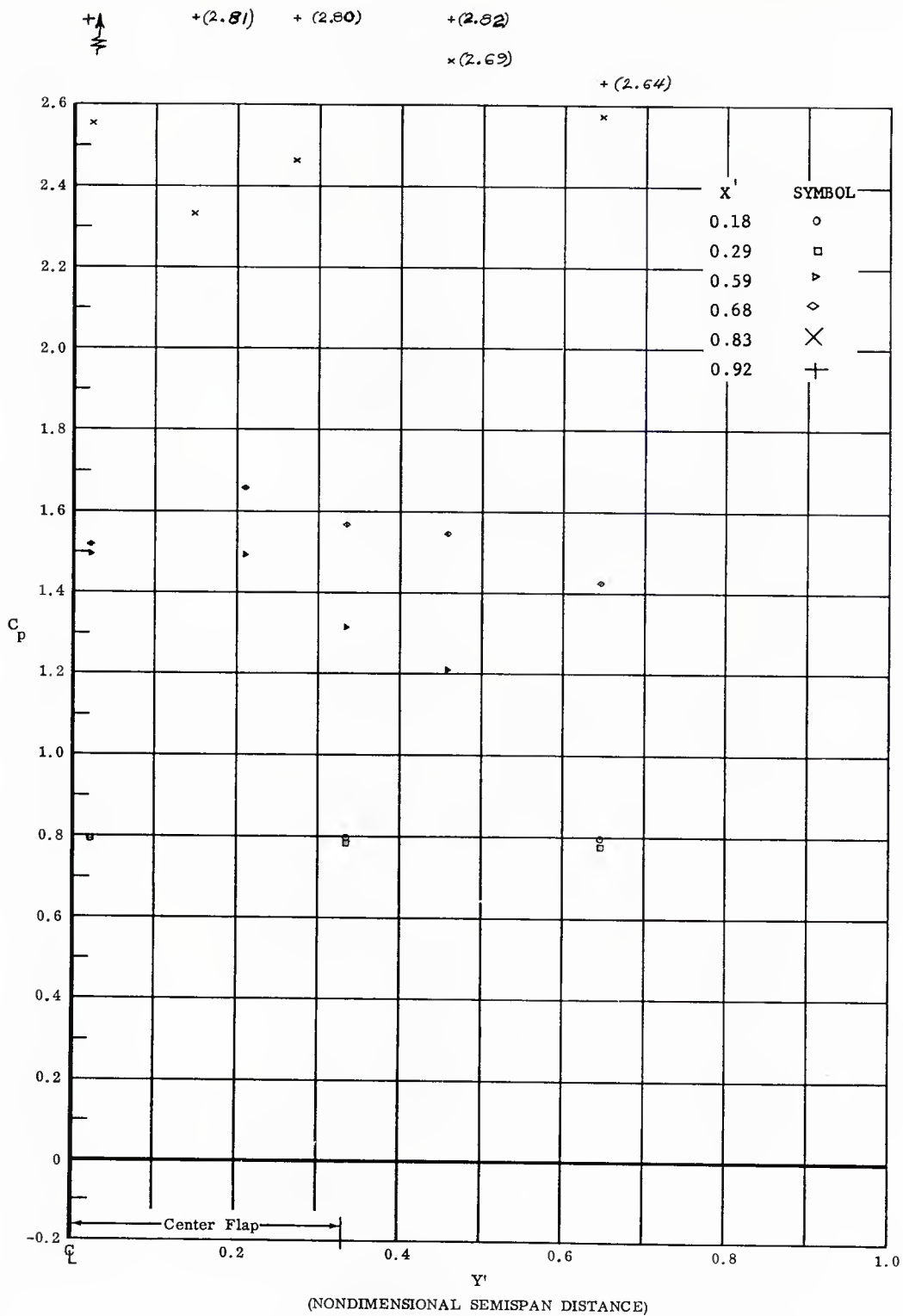


Fig. 21 Pressure Coefficient Data Plots; $\alpha = -30$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plates Off

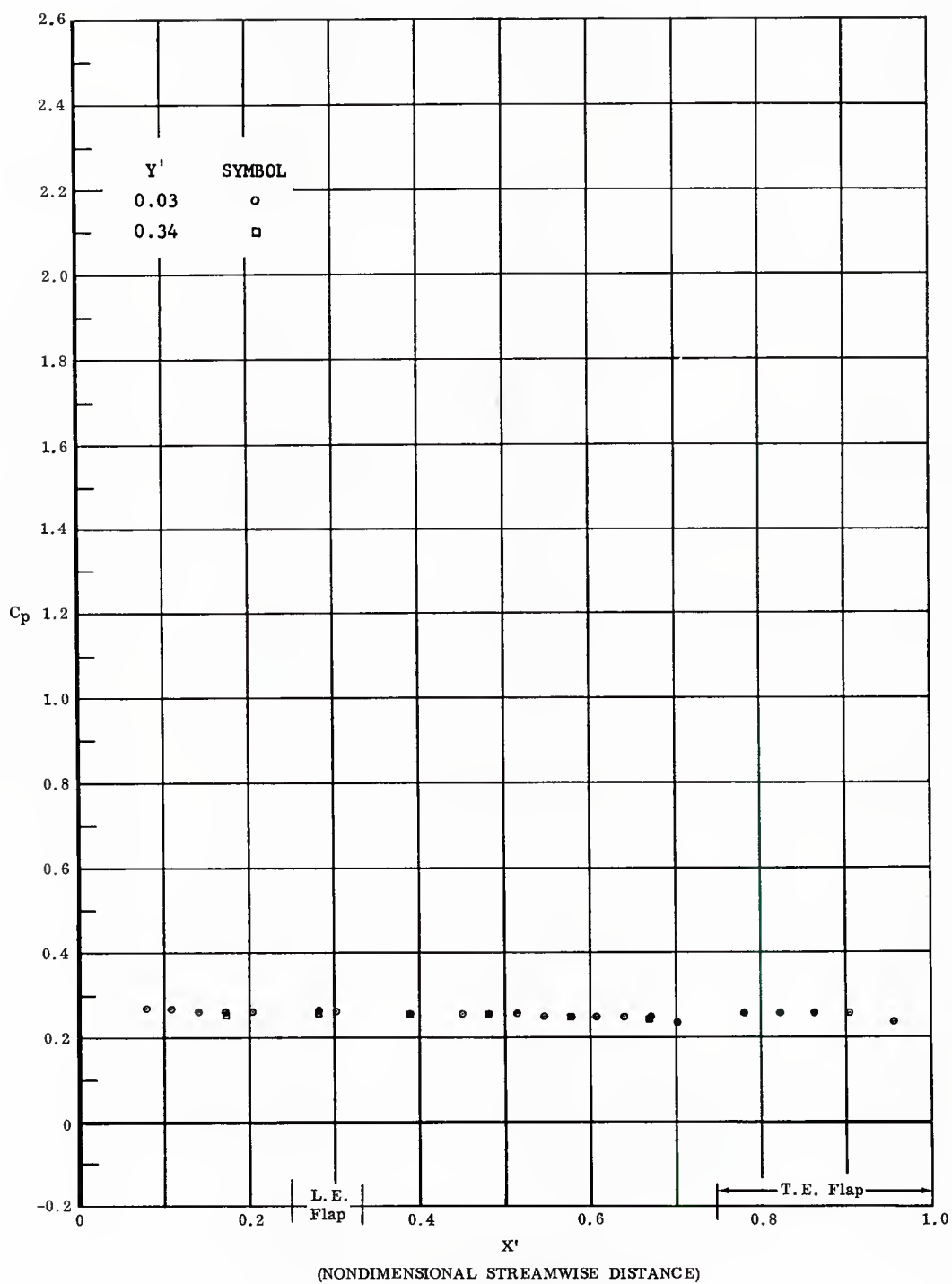


Fig. 22 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ft} = 1.1$, No Flap Deflections, End
 Plates Off

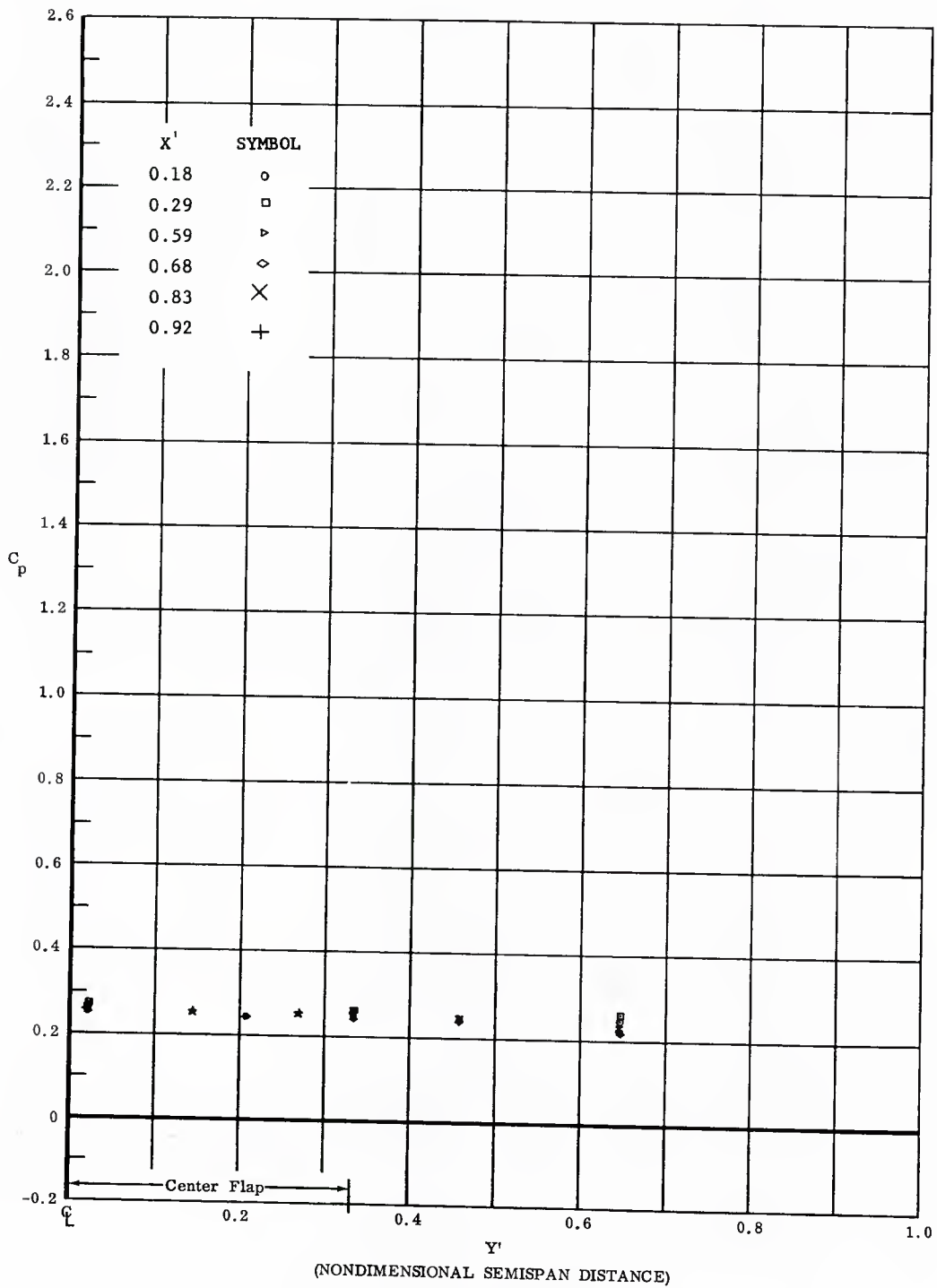


Fig. 22 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, No Flap Deflections, End
 Plates Off

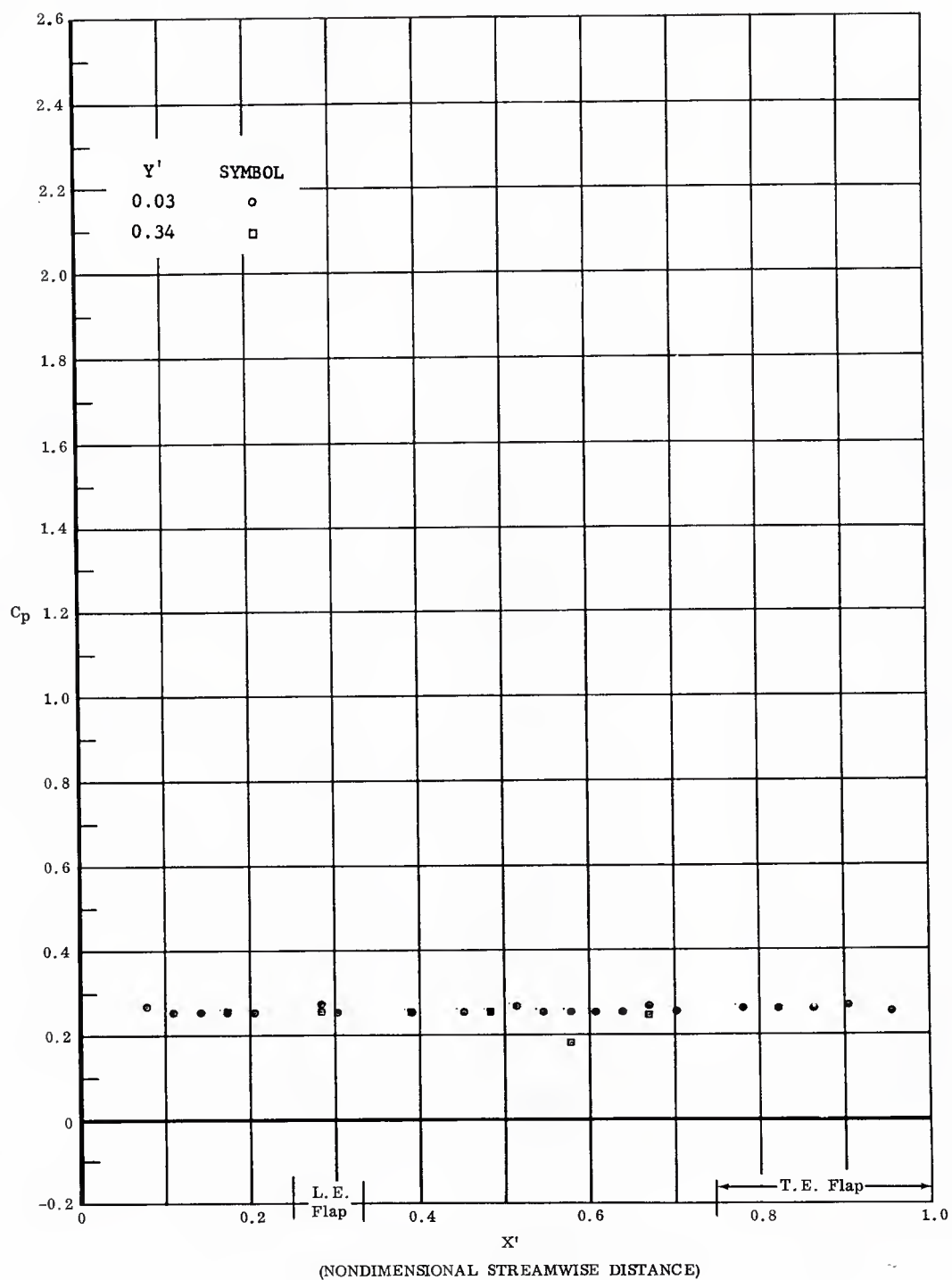


Fig. 23 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, No Flap Deflections, End
 Plates Off

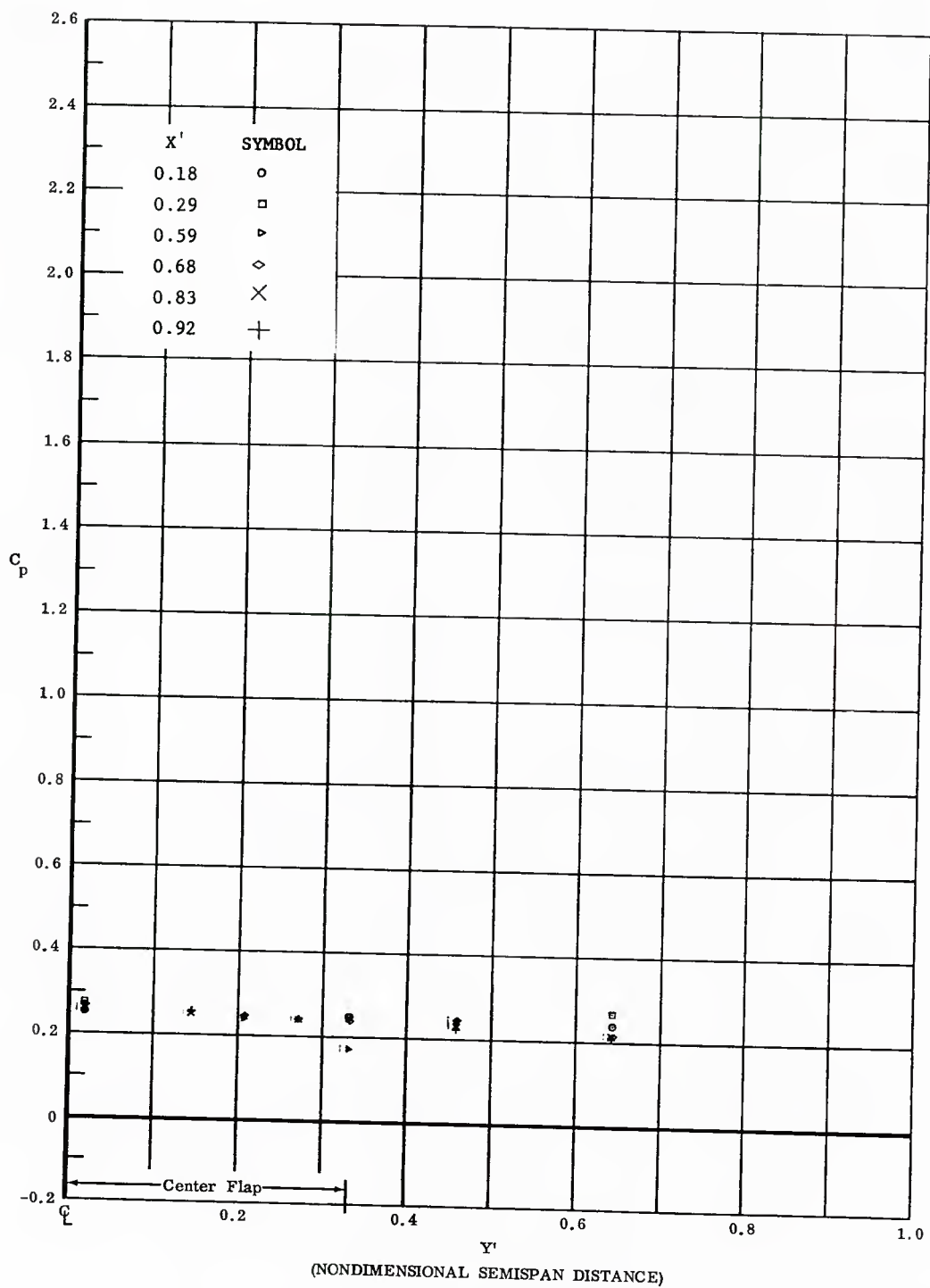


Fig. 23 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, No Flap Deflections, End
 Plates Off

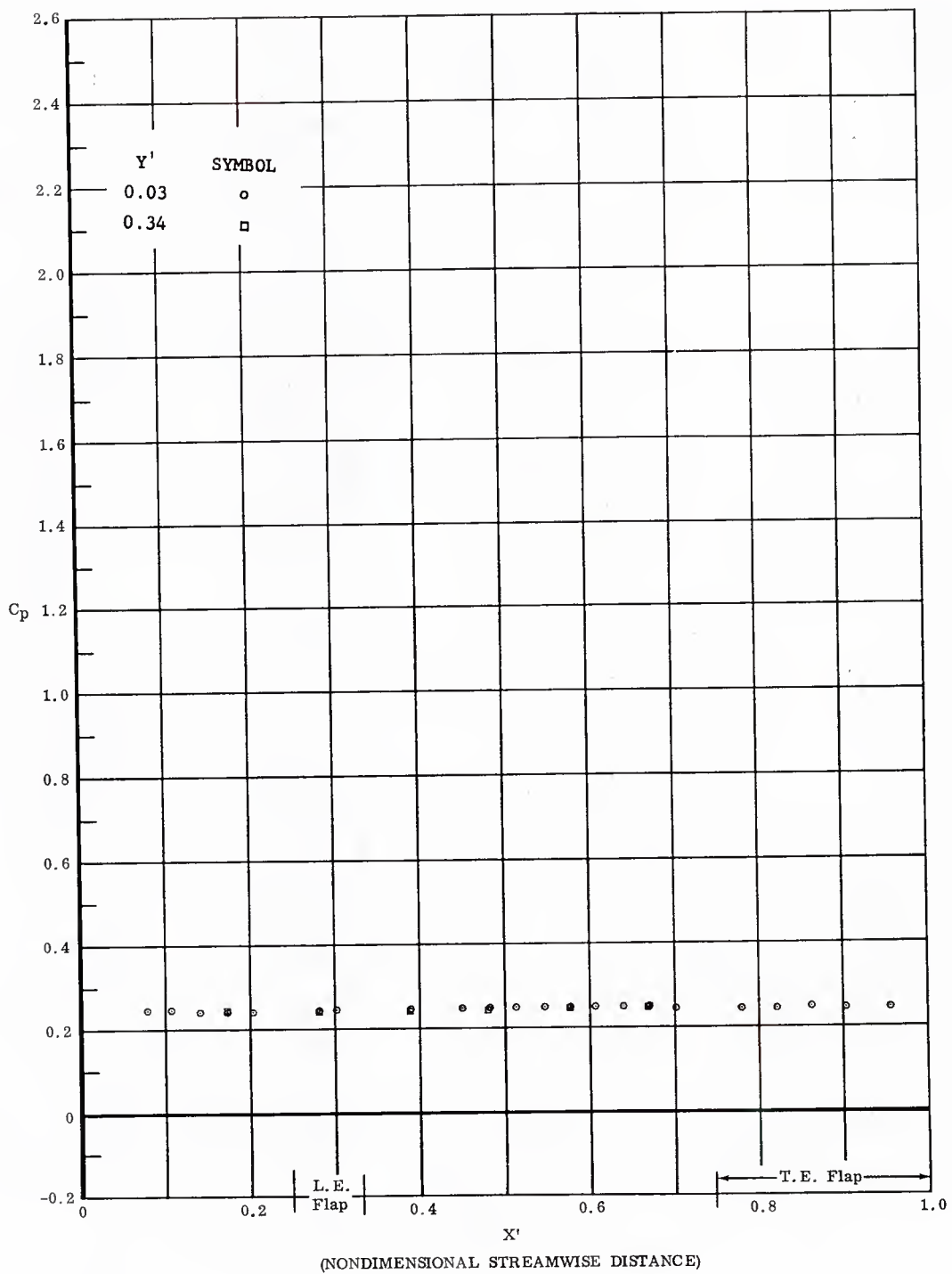


Fig. 24 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Flap Deflections, End
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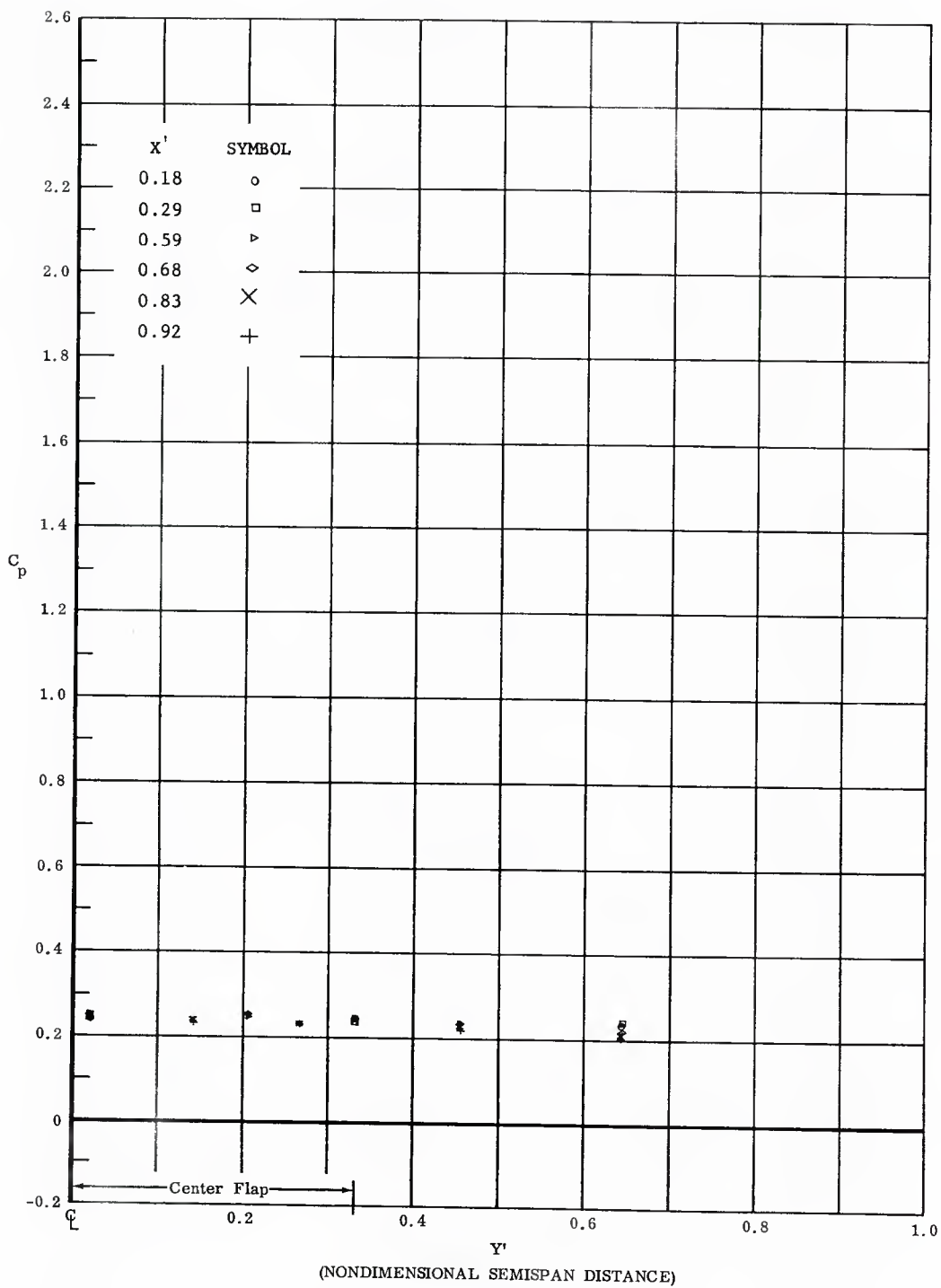


Fig. 24 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Flap Deflections, End
 Plates Off

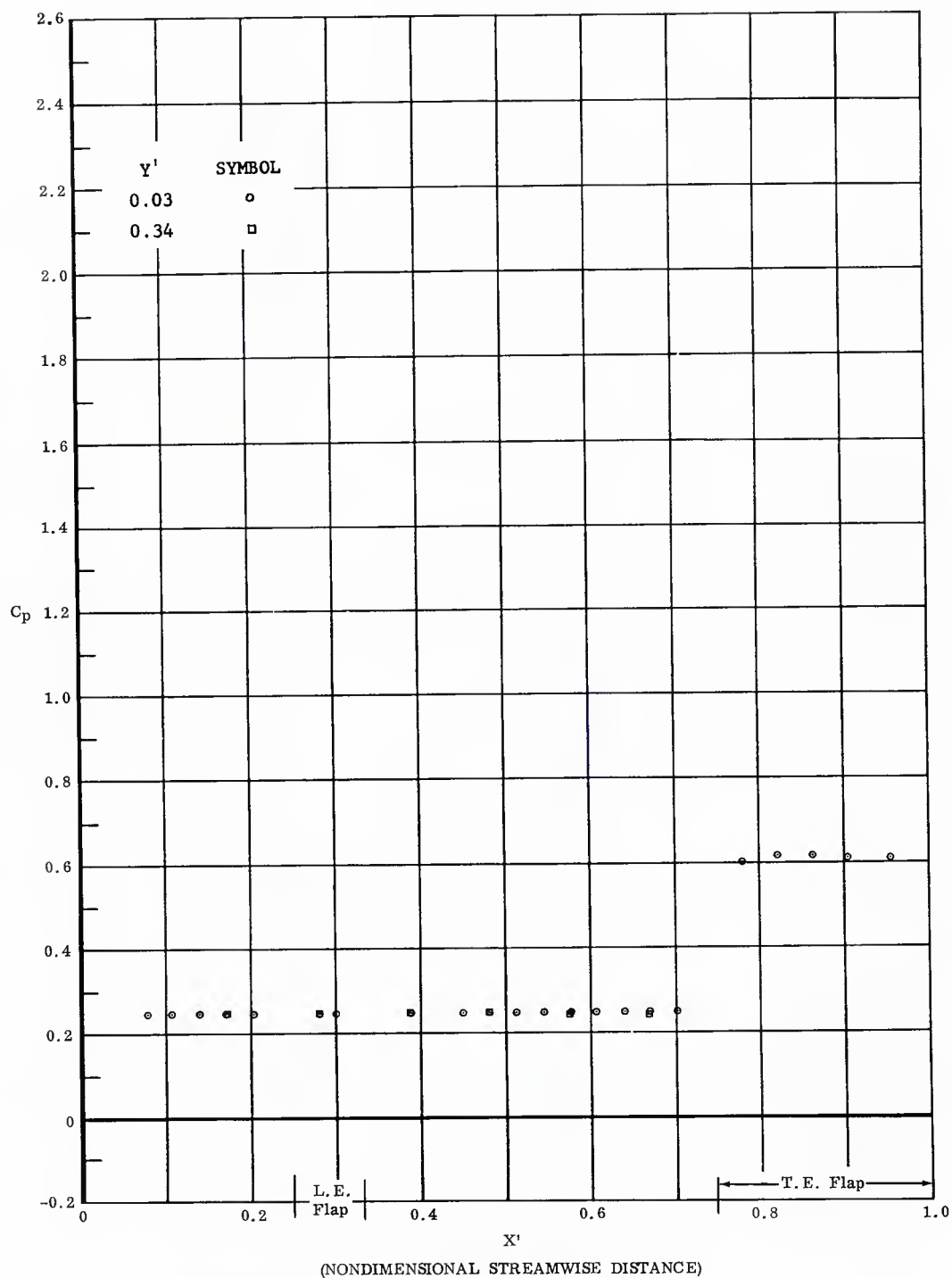


Fig. 25 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 10° ,
 End Plates Off

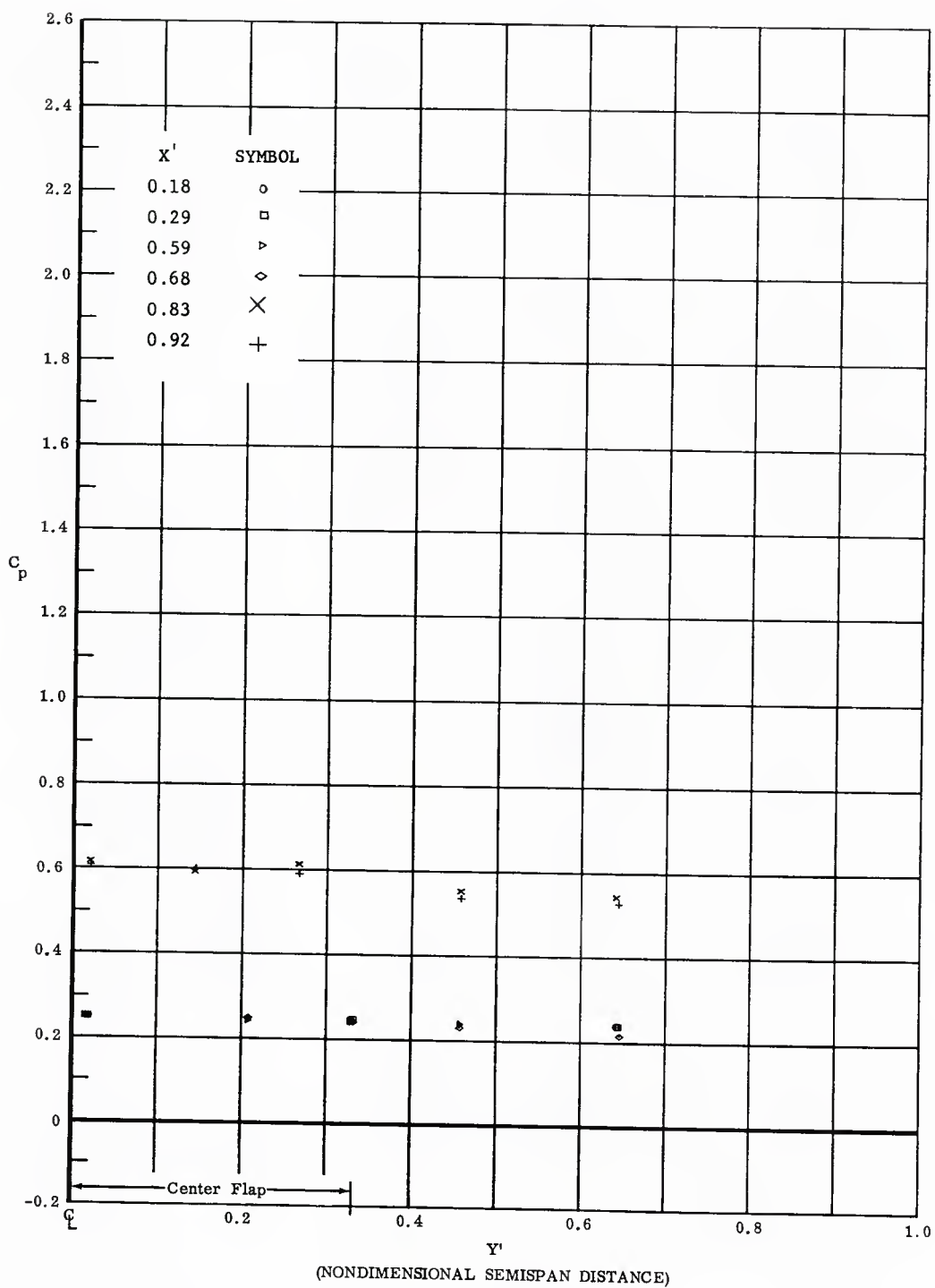


Fig. 25 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 10° ,
 End Plates Off

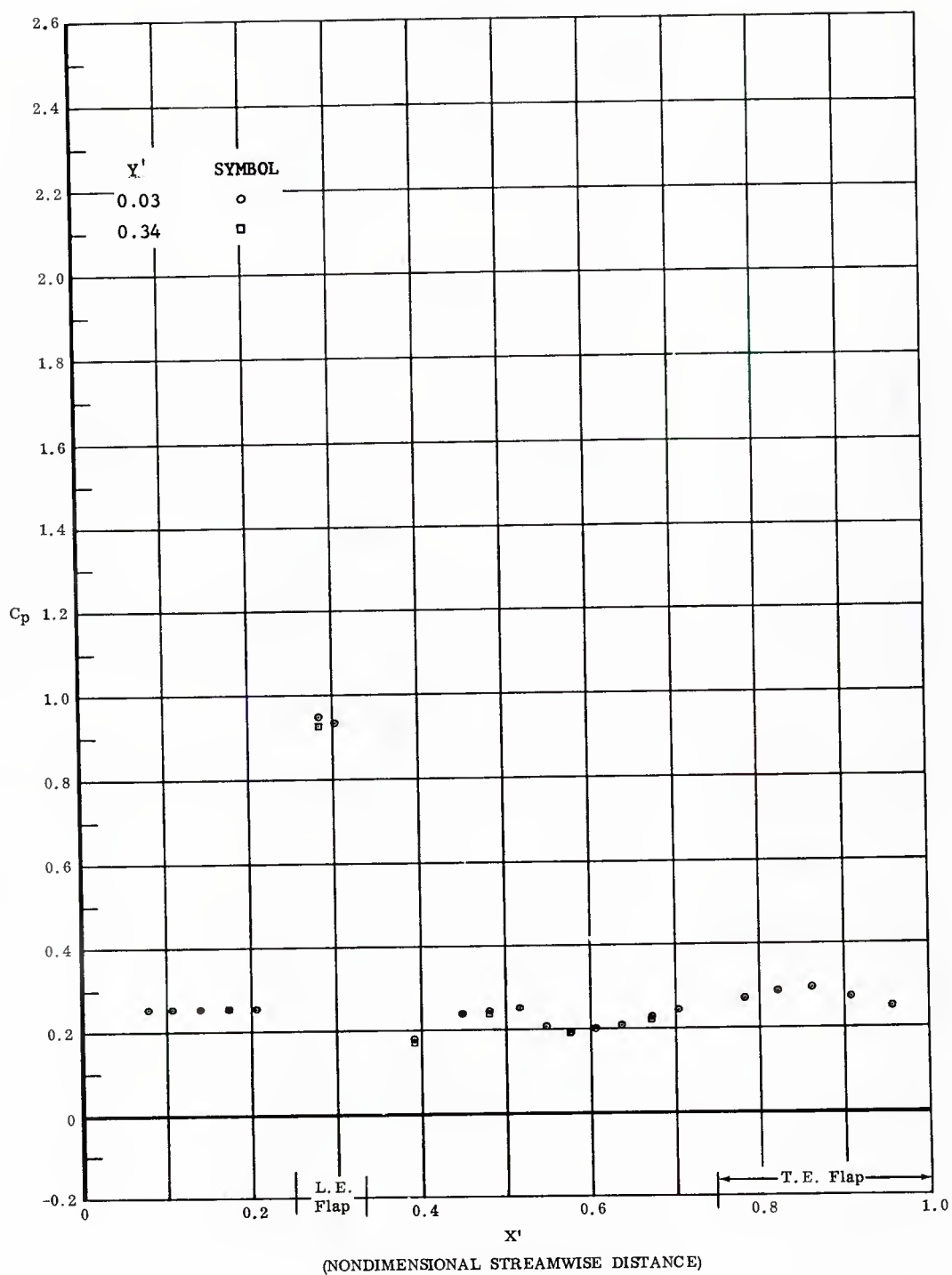


Fig. 26 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flaps at 15° , End
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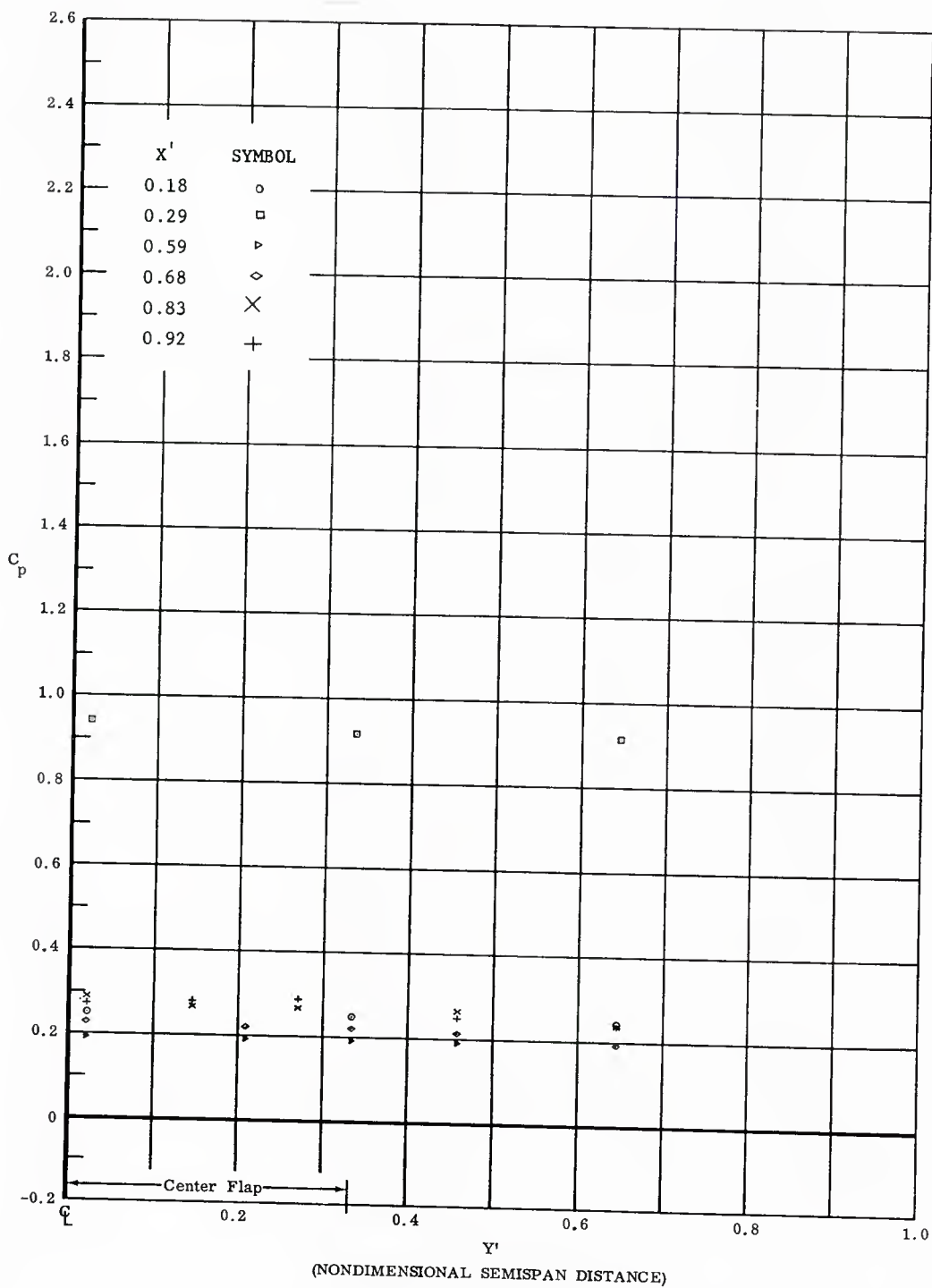


Fig. 26 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flaps at 15° , End
 Plates Off

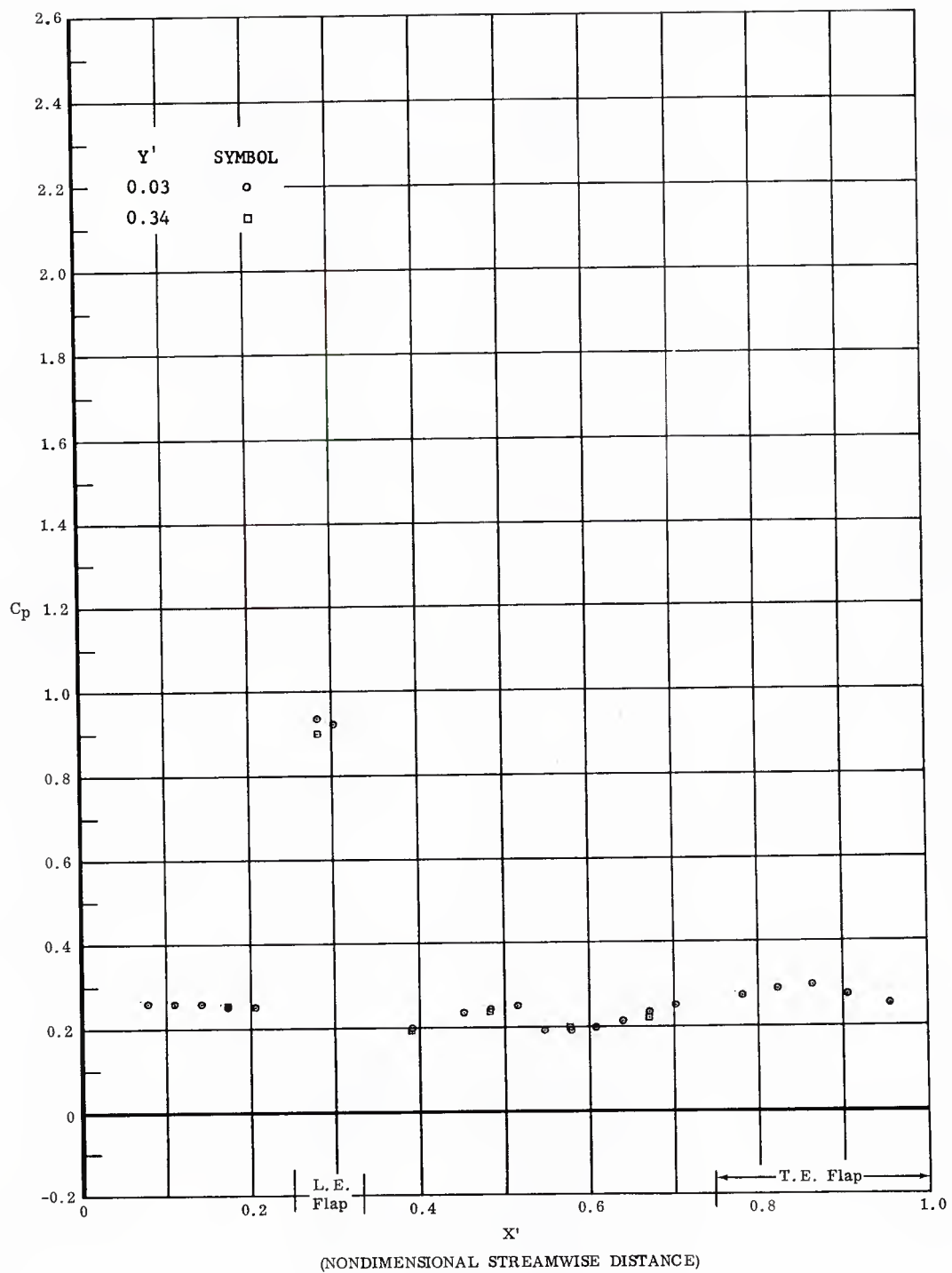


Fig. 27 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 15° , End
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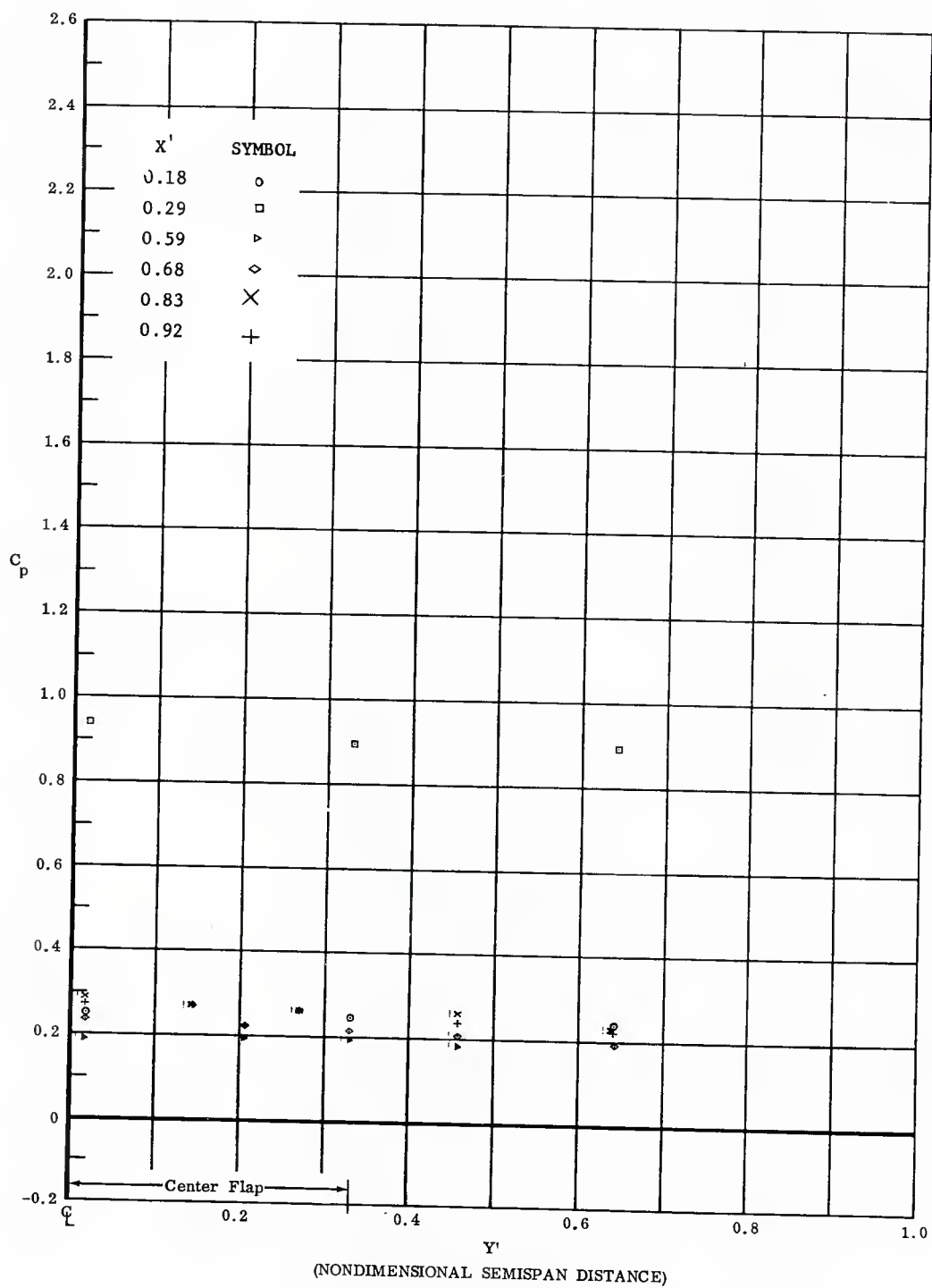


Fig. 27 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 15° , End
 Plates Off

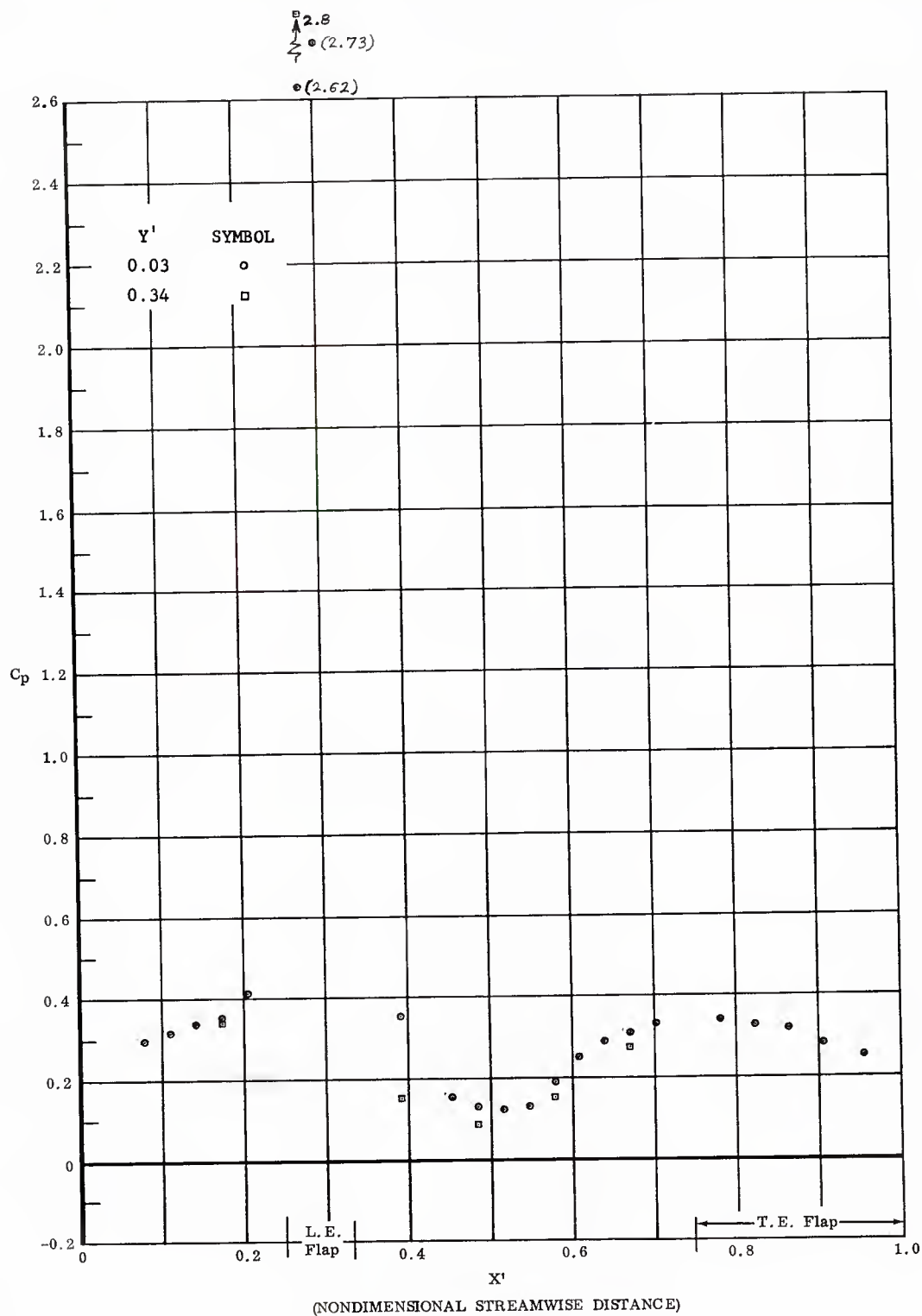


Fig. 28 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 30° , End
 Plates Off

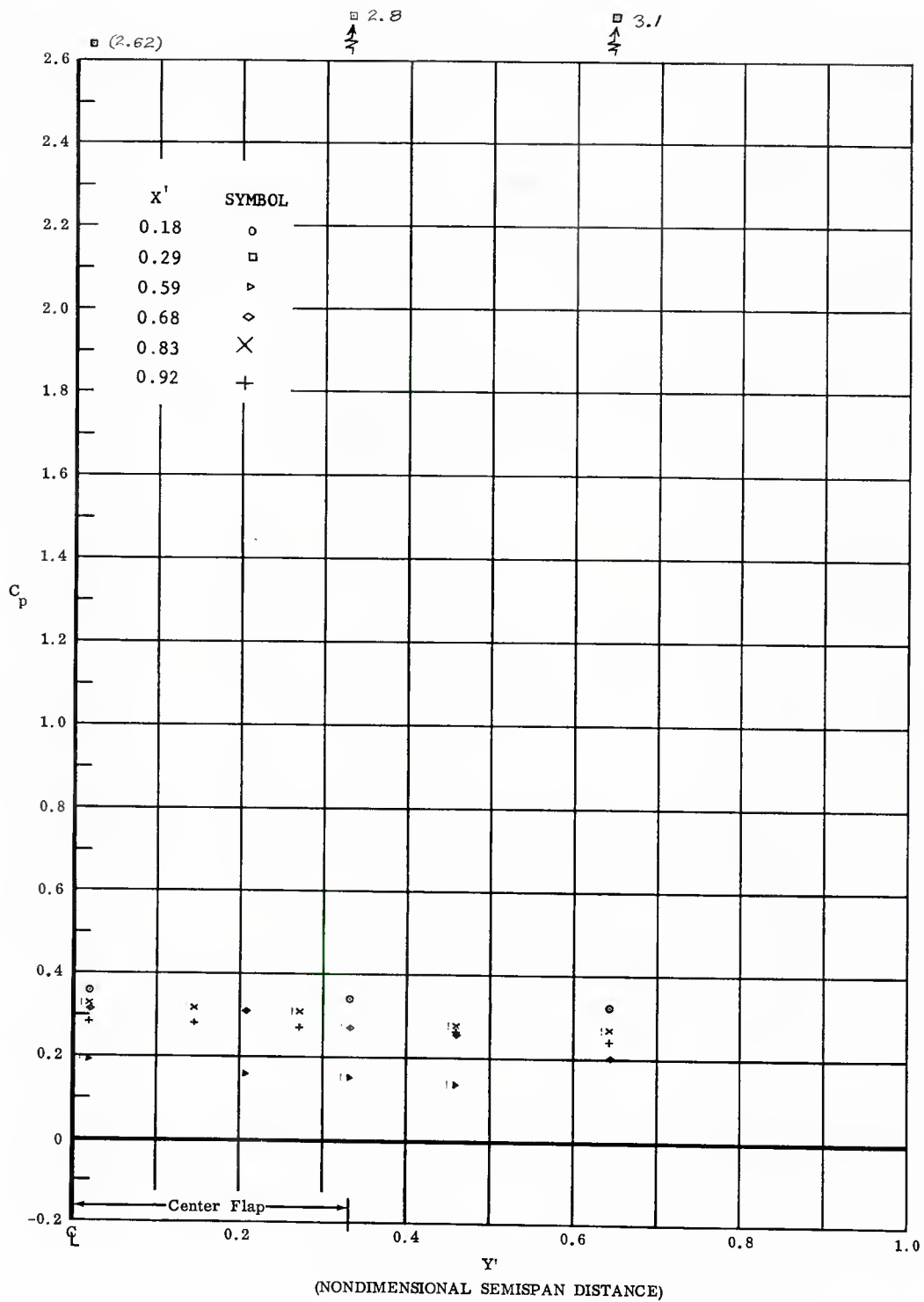


Fig. 28 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 30° , End
 Plates Off

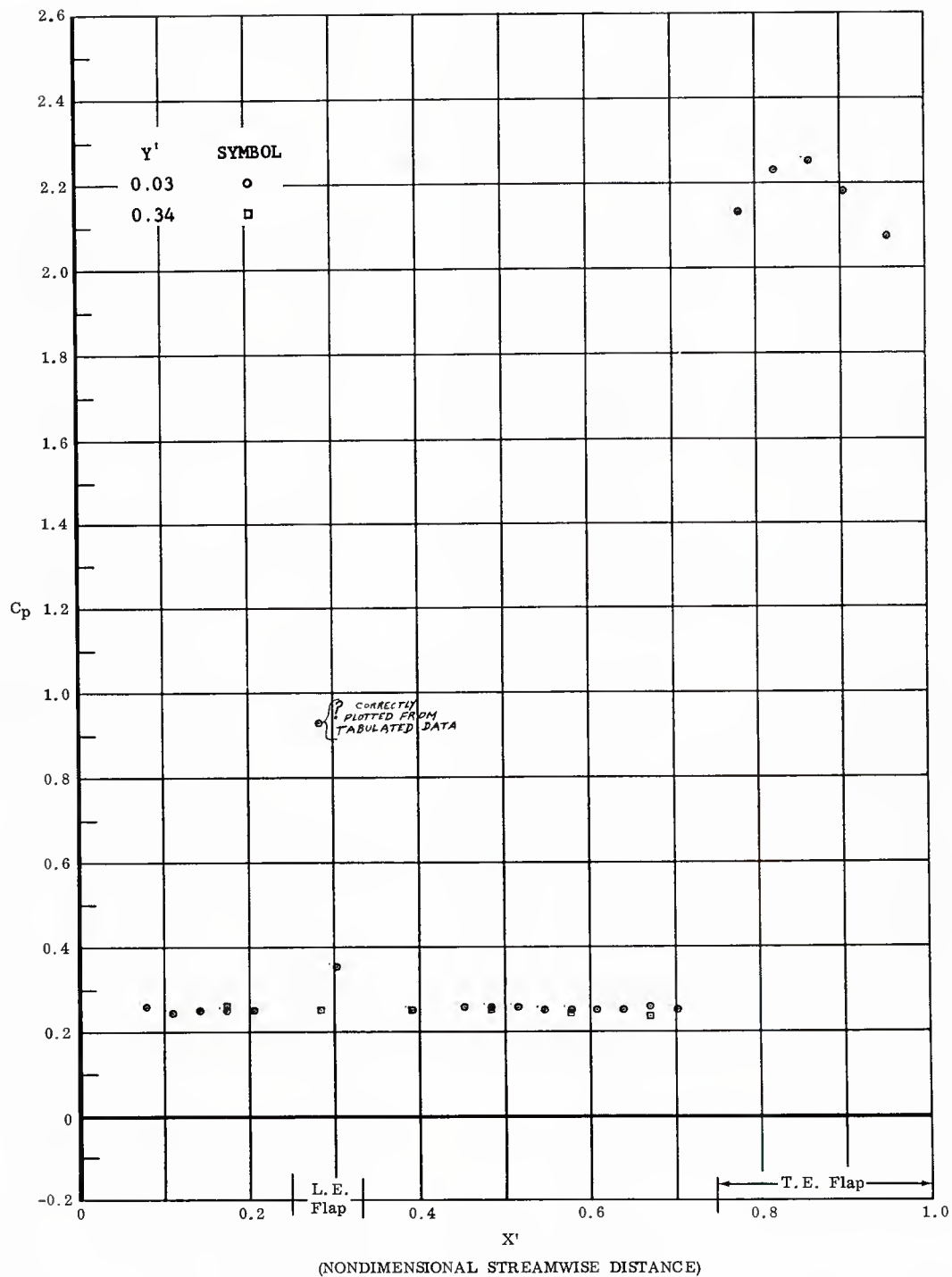


Fig. 29 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Center Flap at 30° ,
 End Plates Off

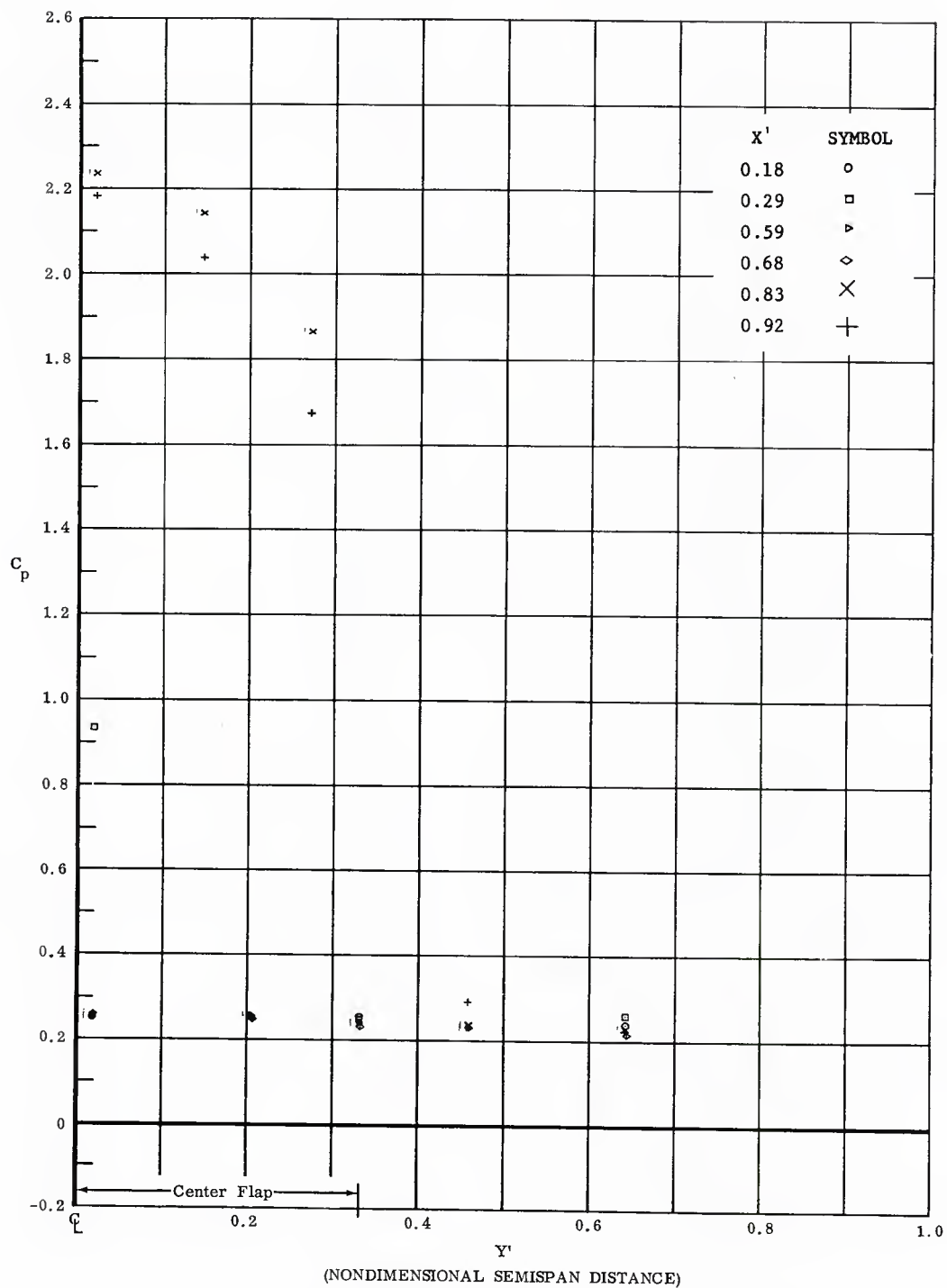


Fig. 29 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Center Flap at 30° ,
 End Plates Off

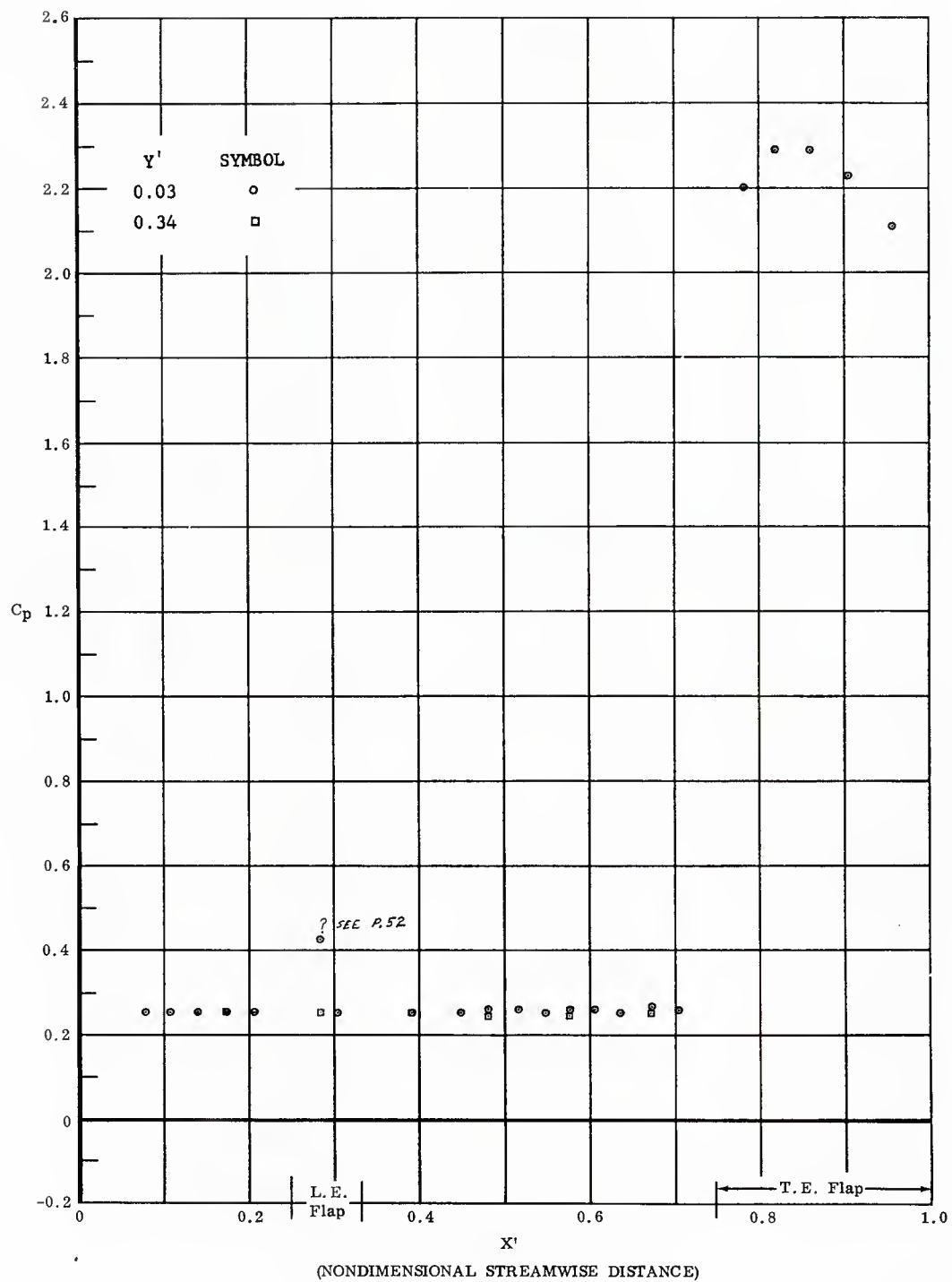


Fig. 30 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Center Flap at 30° ,
 End Plates Off

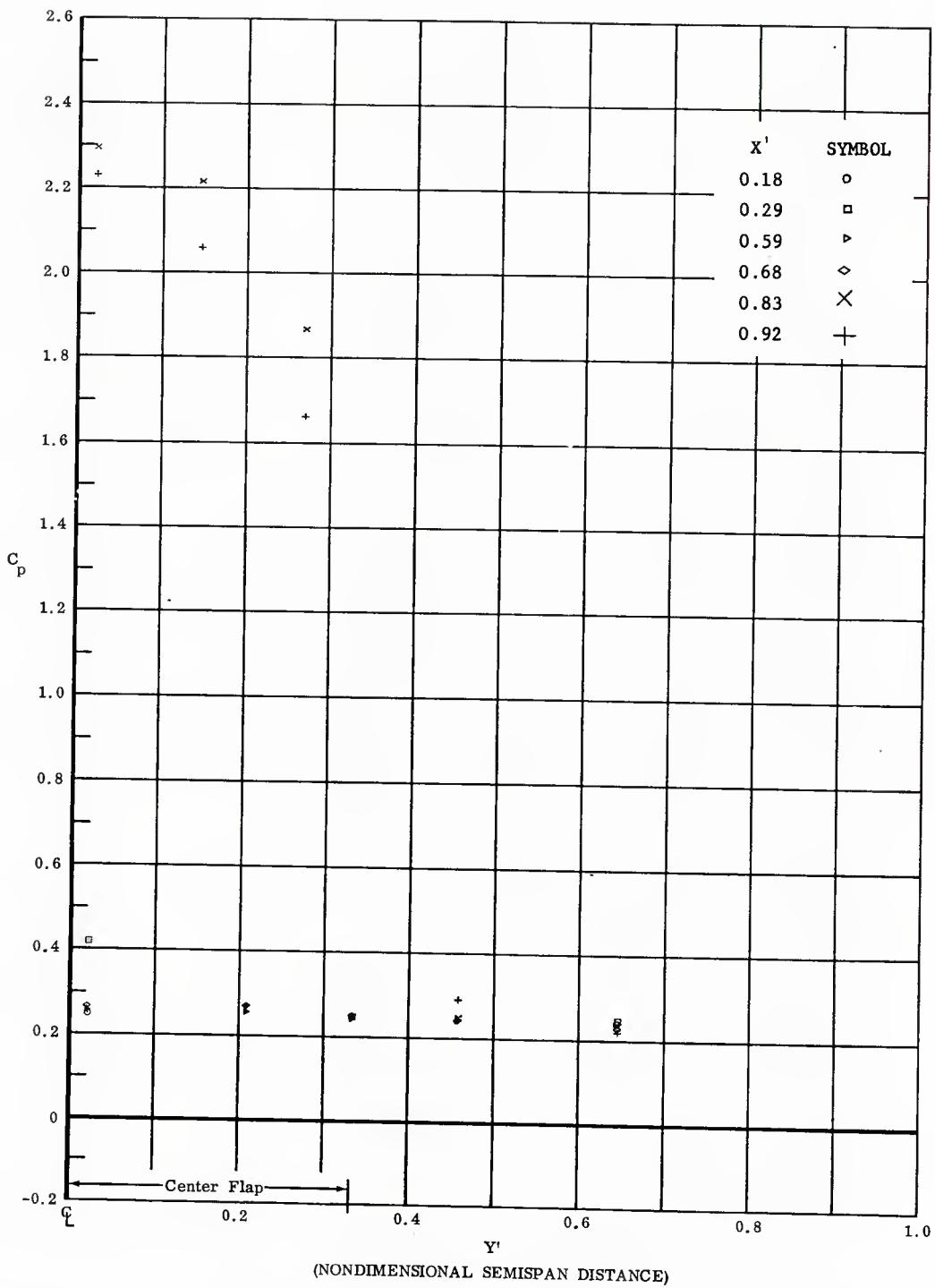


Fig. 30 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, Aft Center Flap at 30° ,
 End Plates Off



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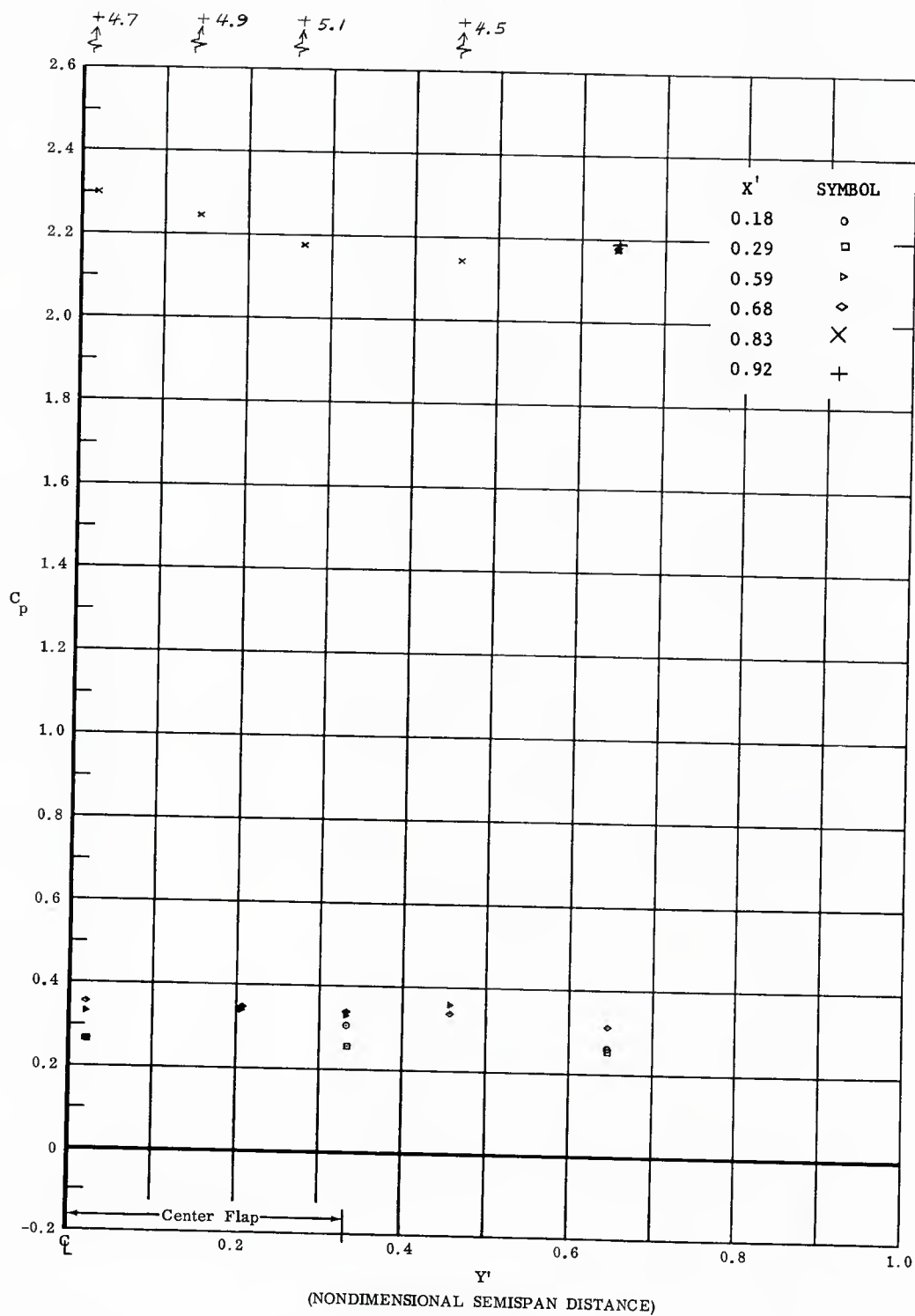


Fig. 31 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plates Off

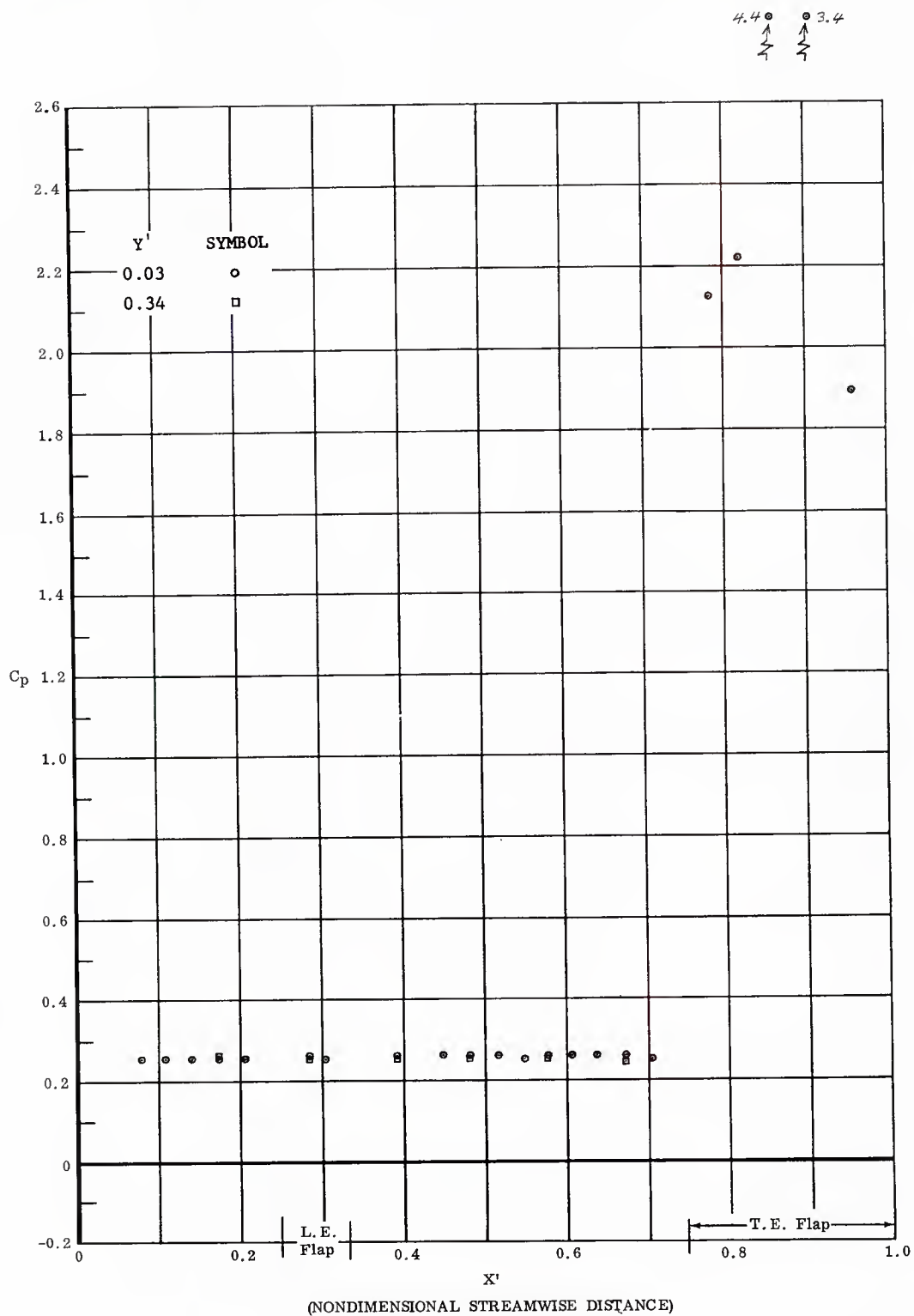


Fig. 32 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30° ,
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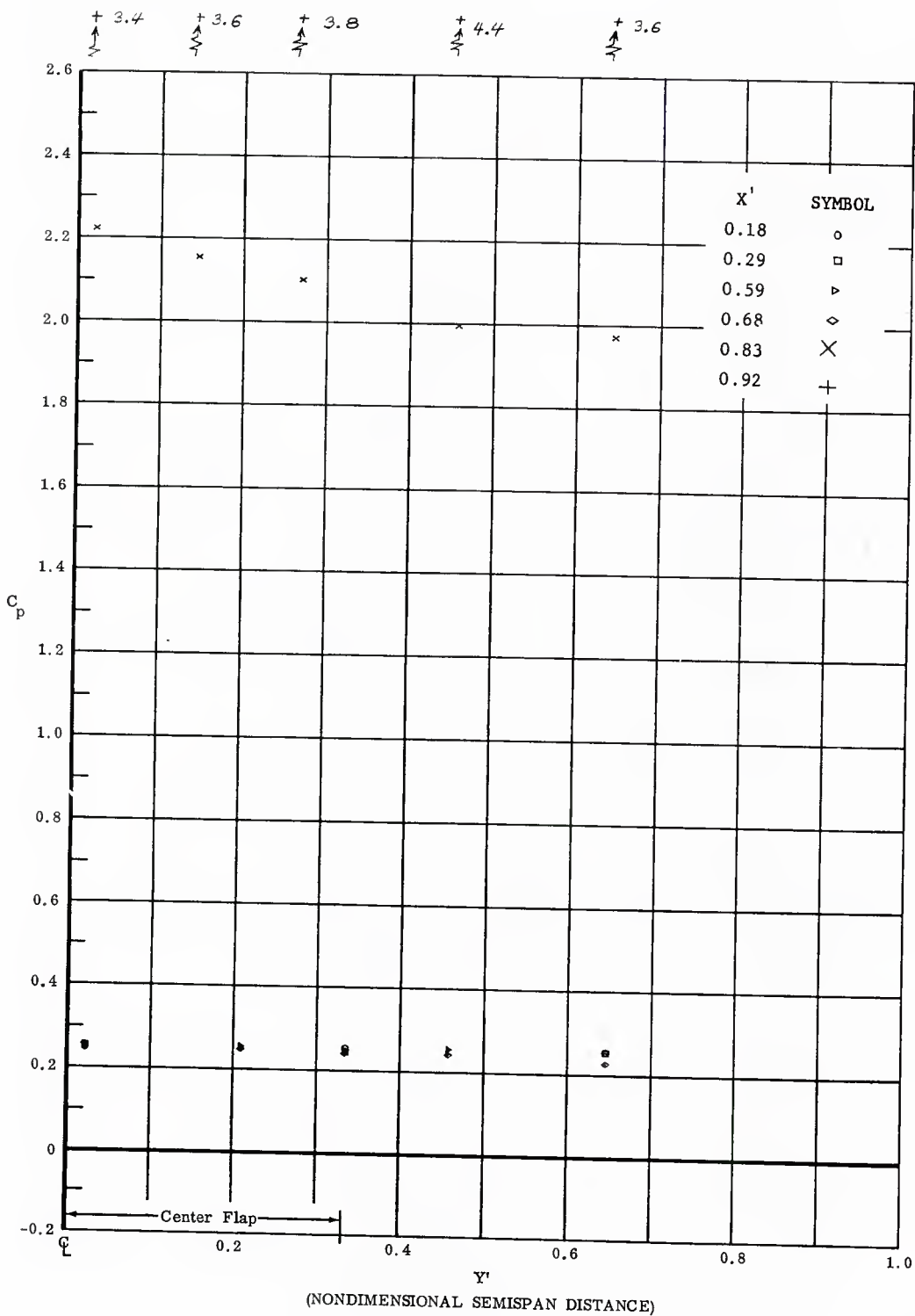


Fig. 32 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30° ,
 End Plates Off

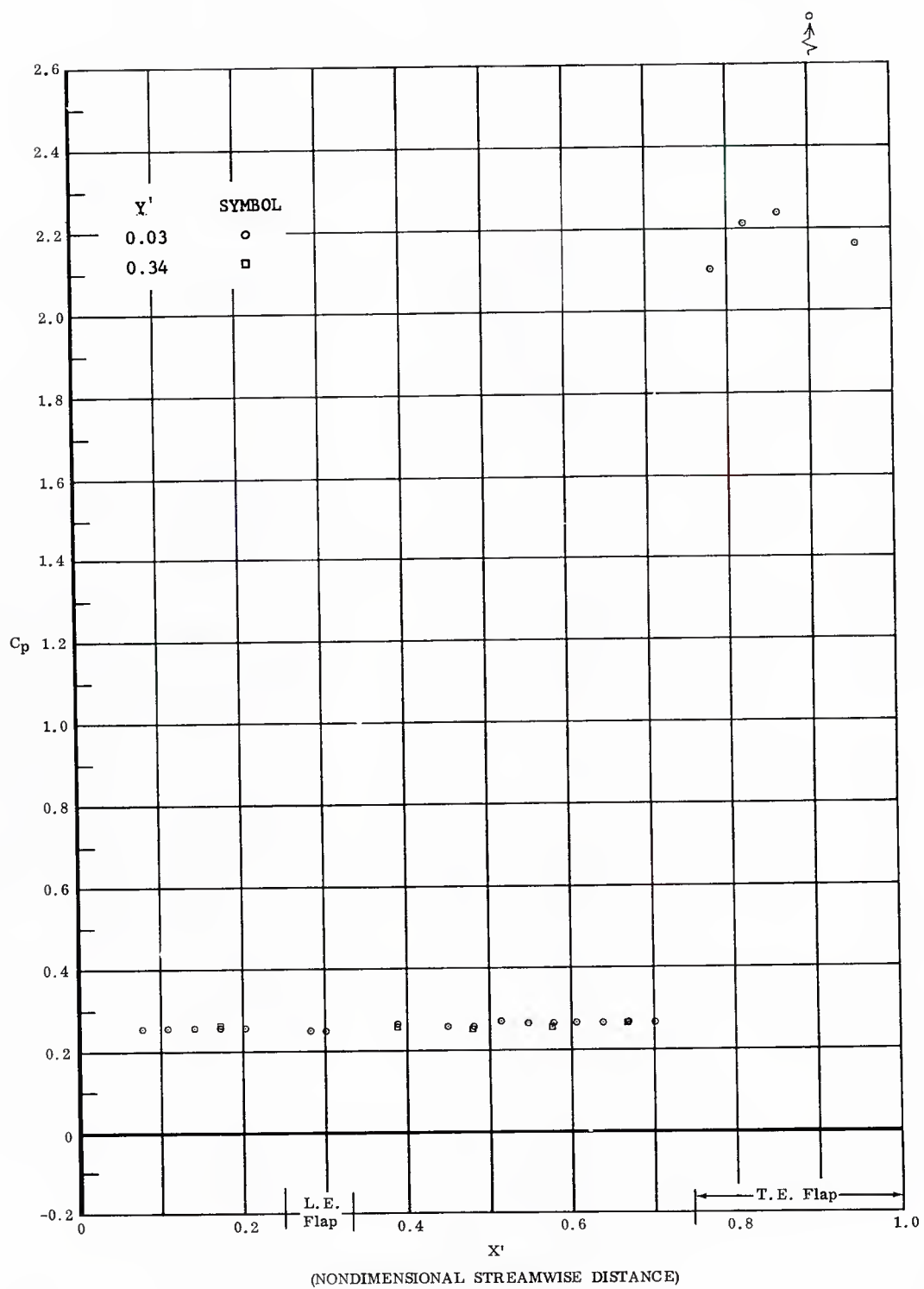


Fig. 33 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plates Off

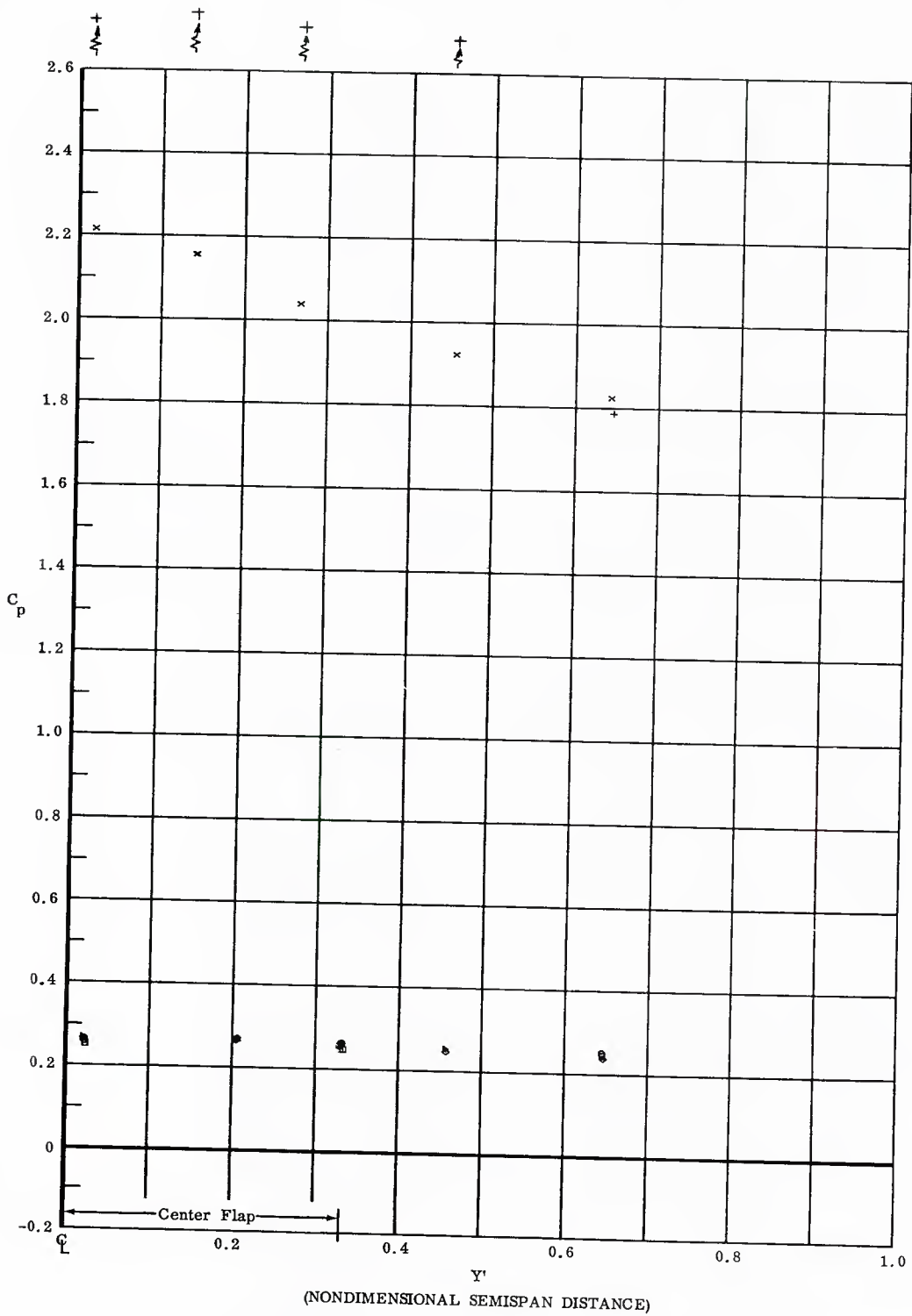


Fig. 33 Pressure Coefficient Data Plots; $\alpha = -15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plates Off

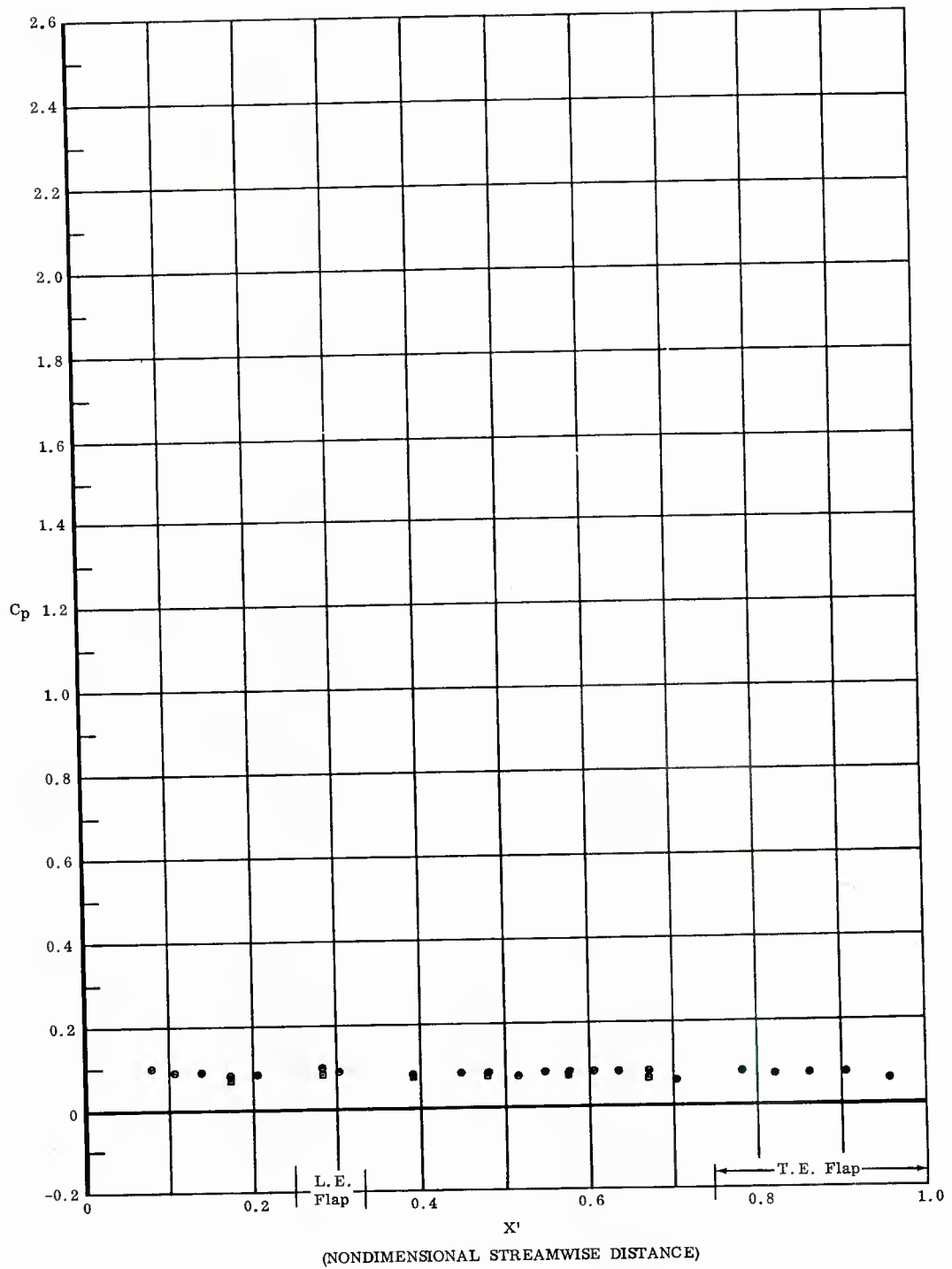


Fig. 34 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, No Flap Deflections, End
 Plates Off

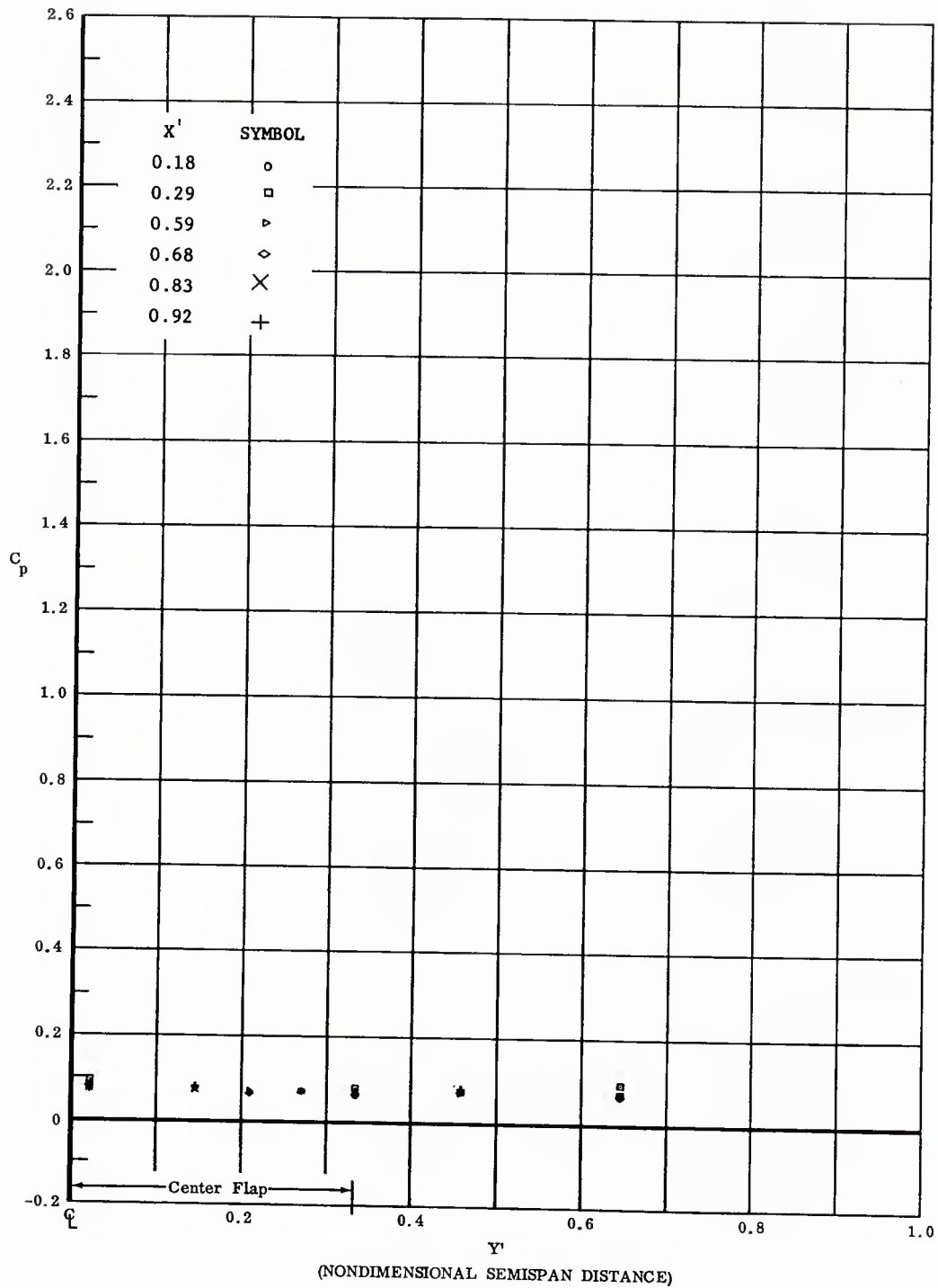


Fig. 34 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, No Flap Deflections, End
 Plates Off

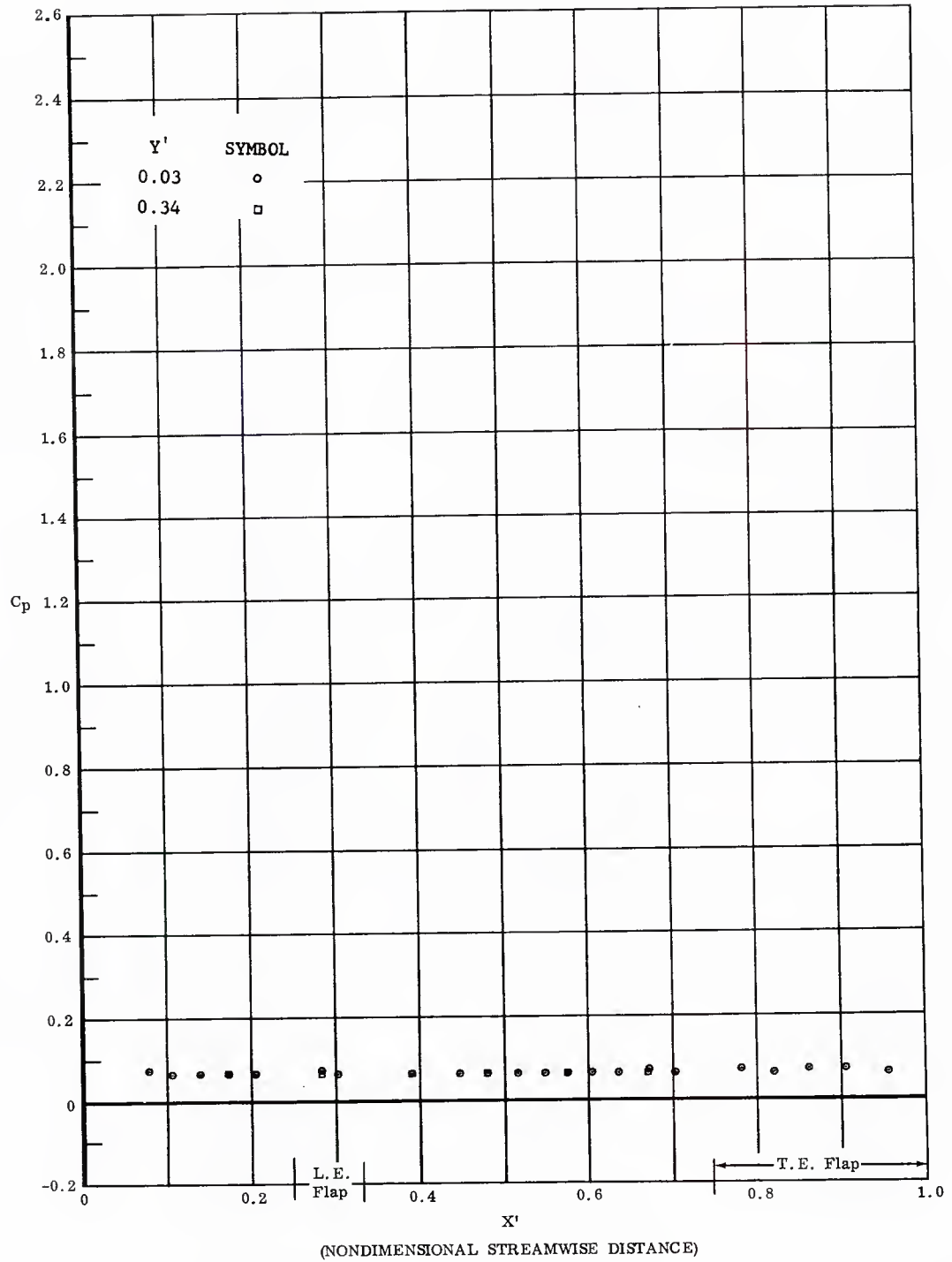


Fig. 35 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, No Flap Deflections, End
 Plates Off

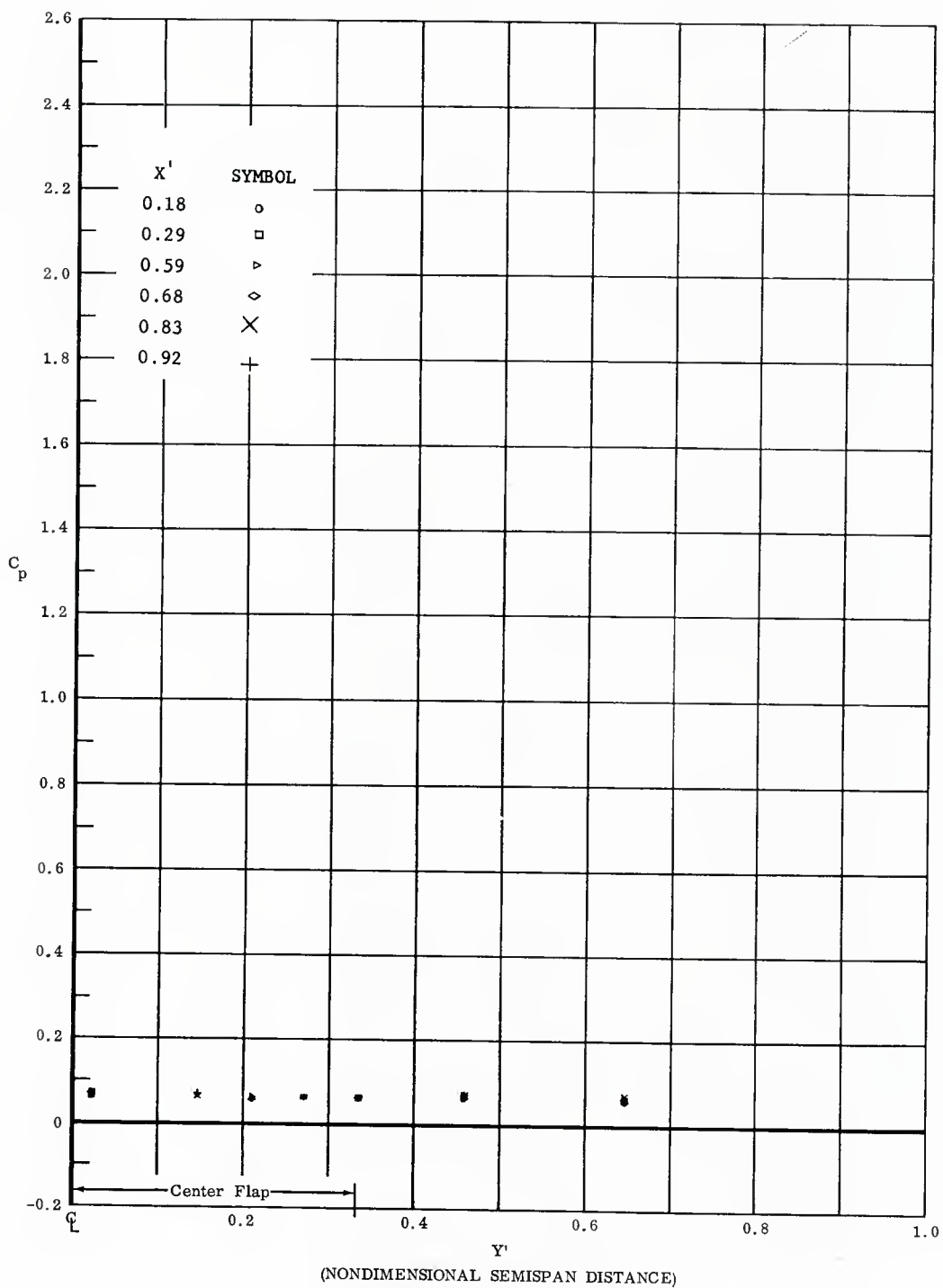


Fig. 35 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, No Flap Deflections, End
 Plates Off

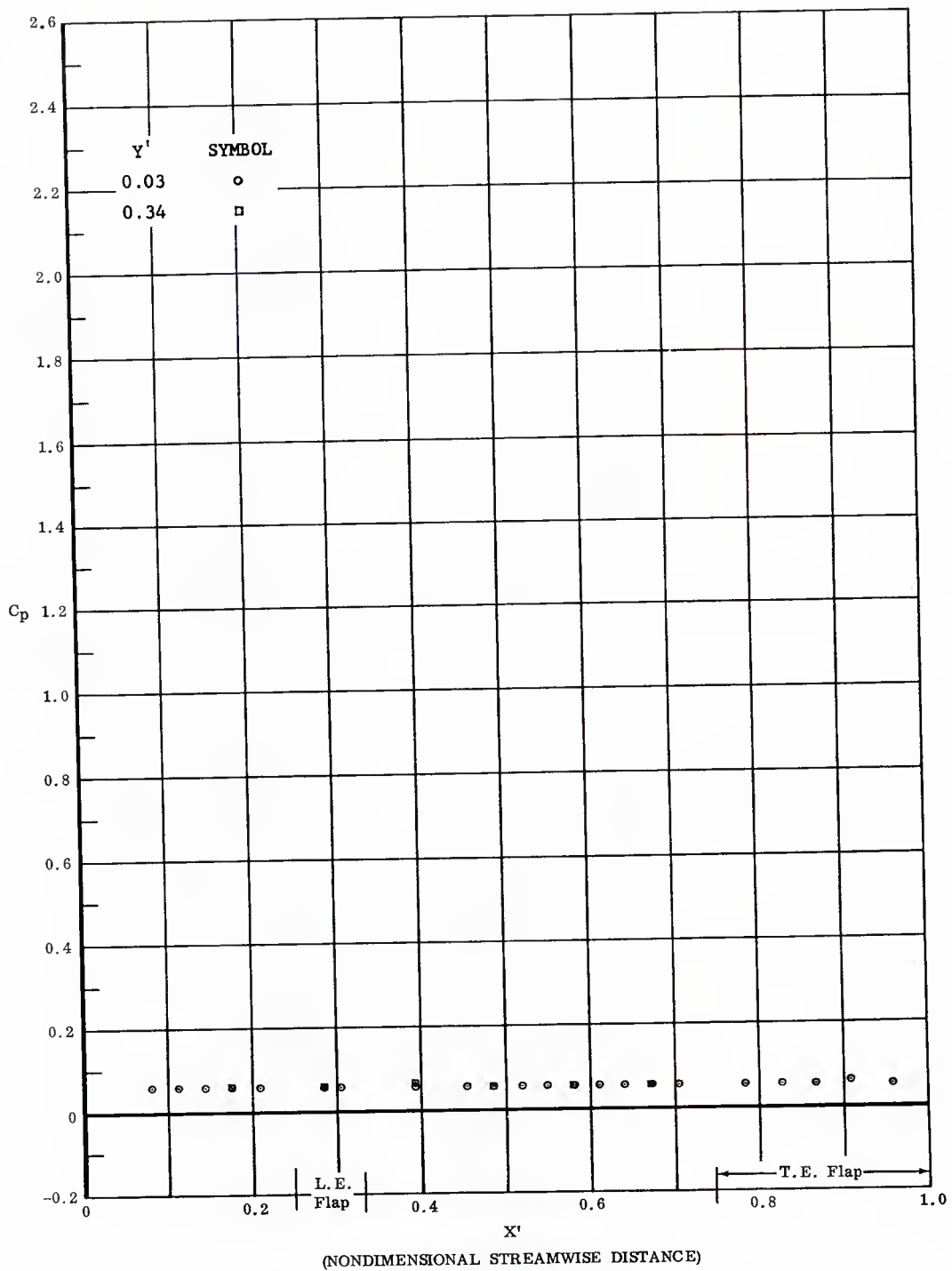


Fig. 36 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Flap Deflections, End
 Plates Off

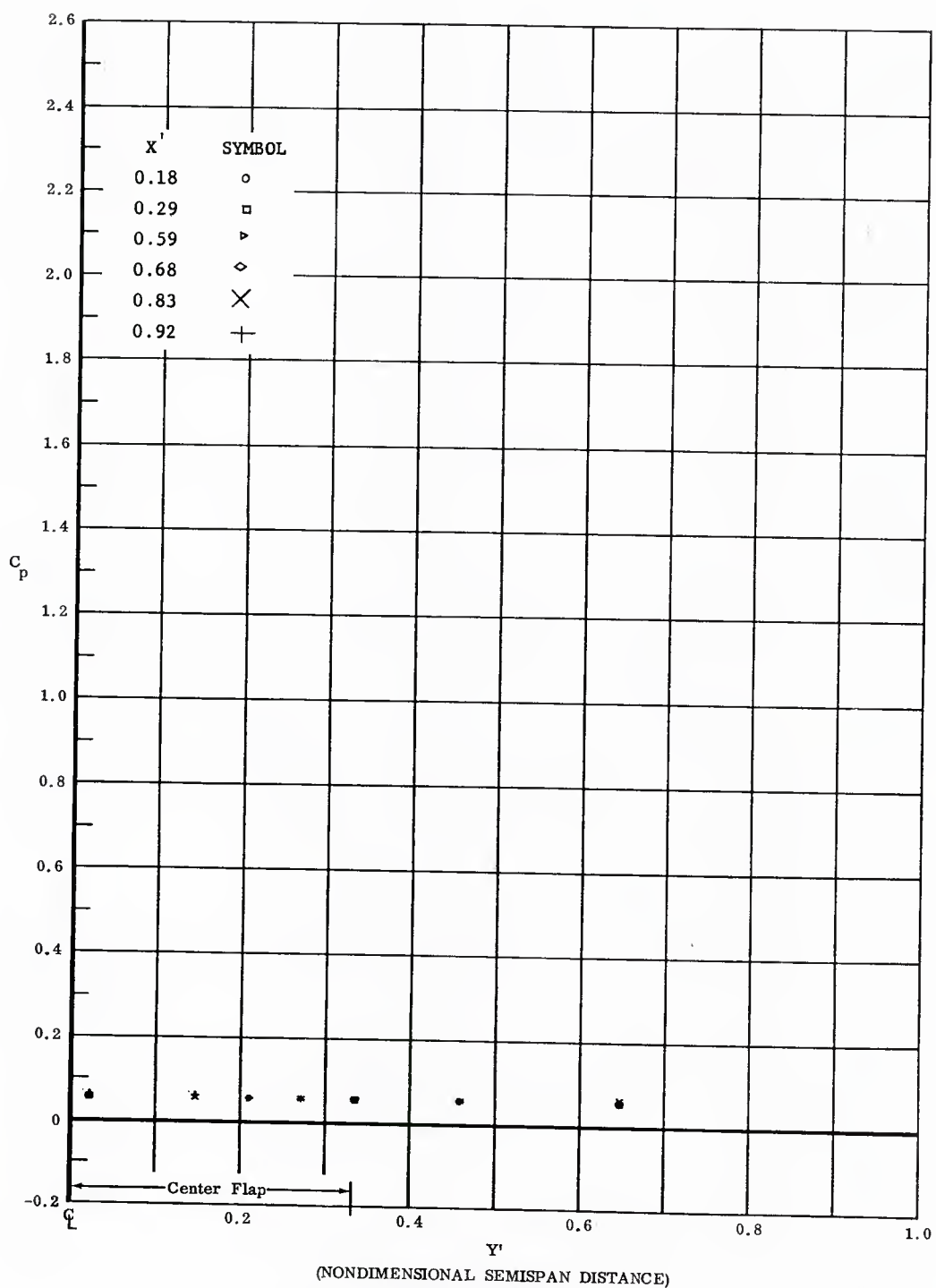


Fig. 36 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Flap Deflections, End
 Plates Off

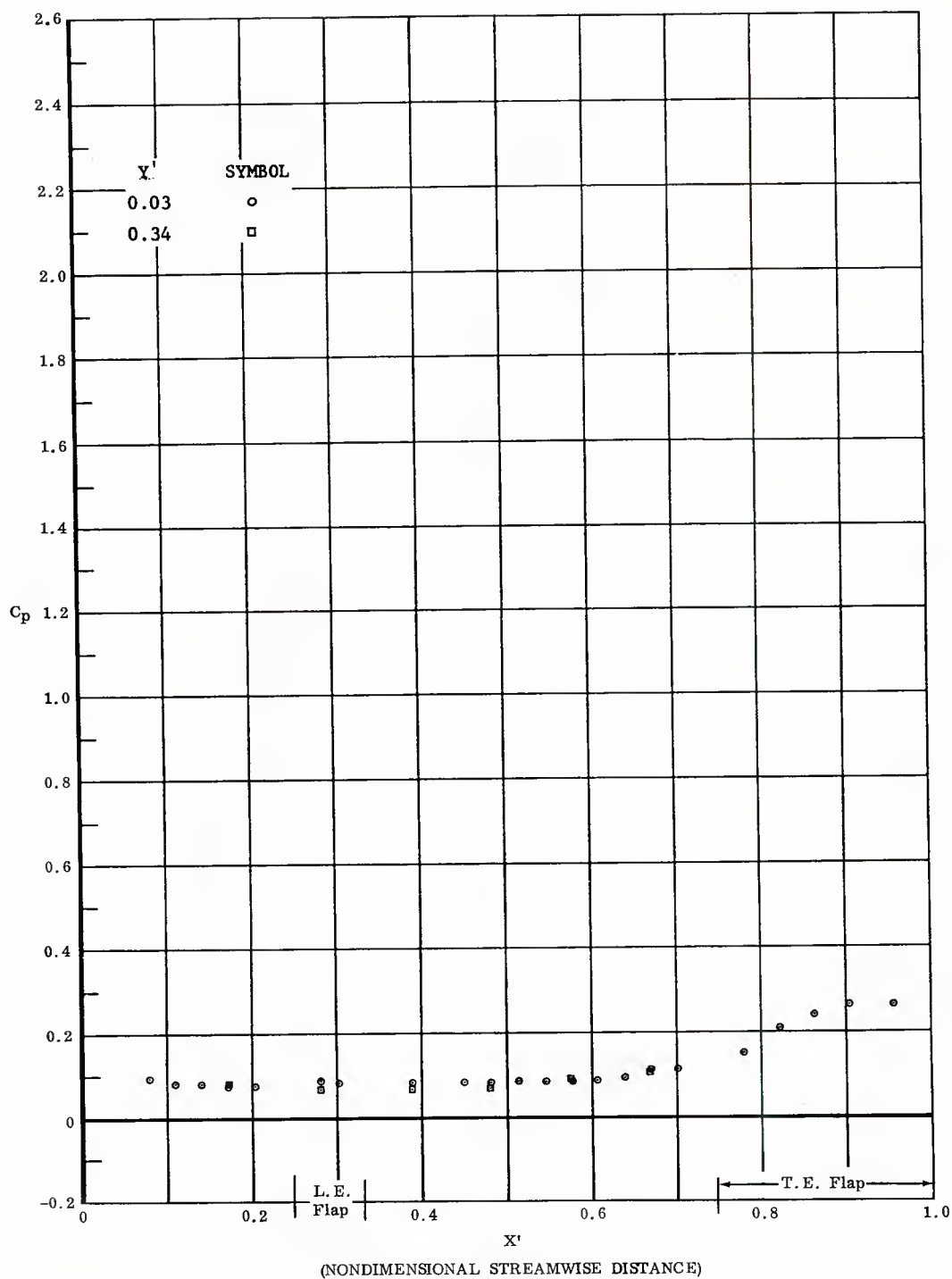


Fig. 37 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 10° ,
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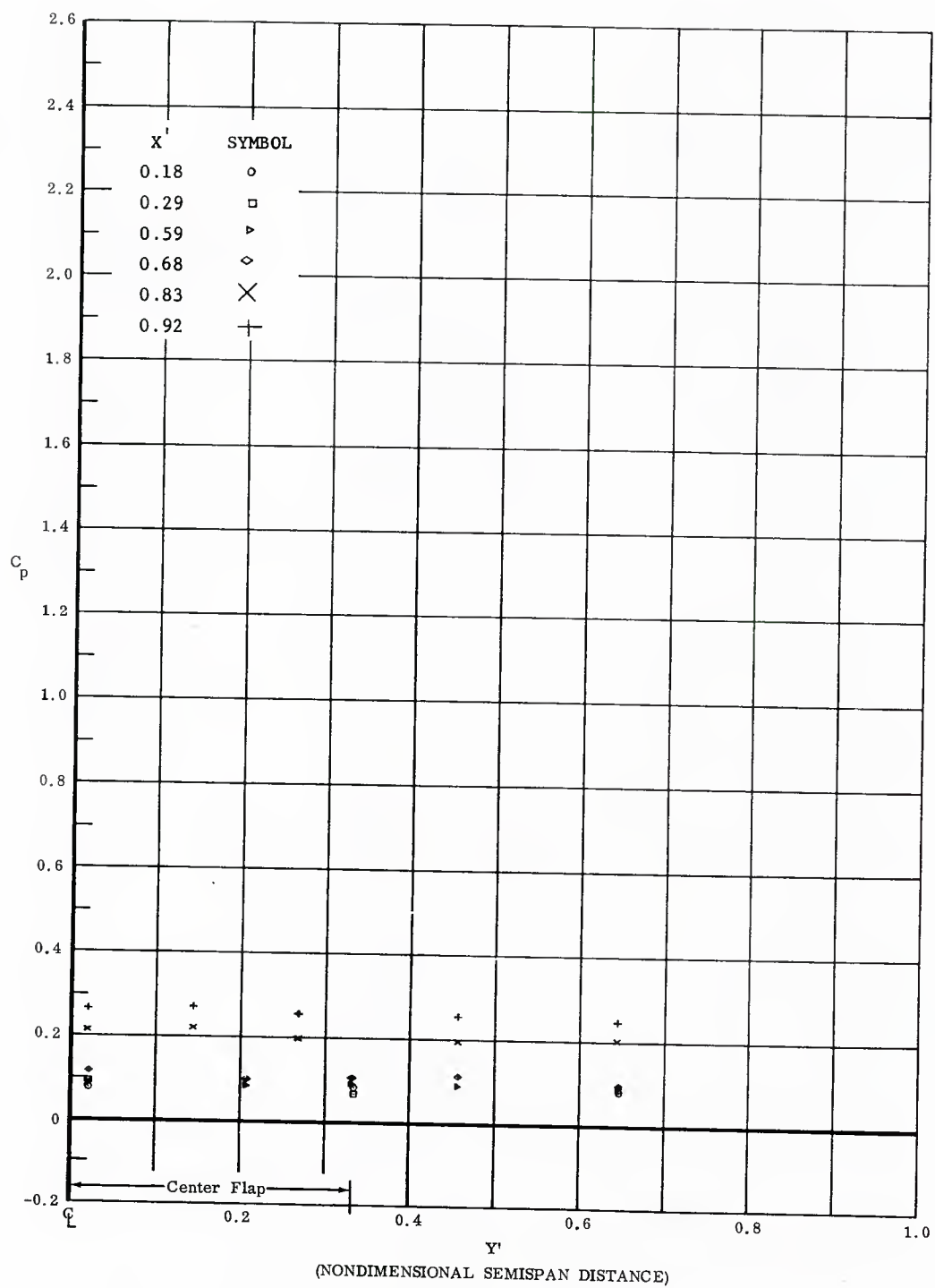


Fig. 37 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 10° ,
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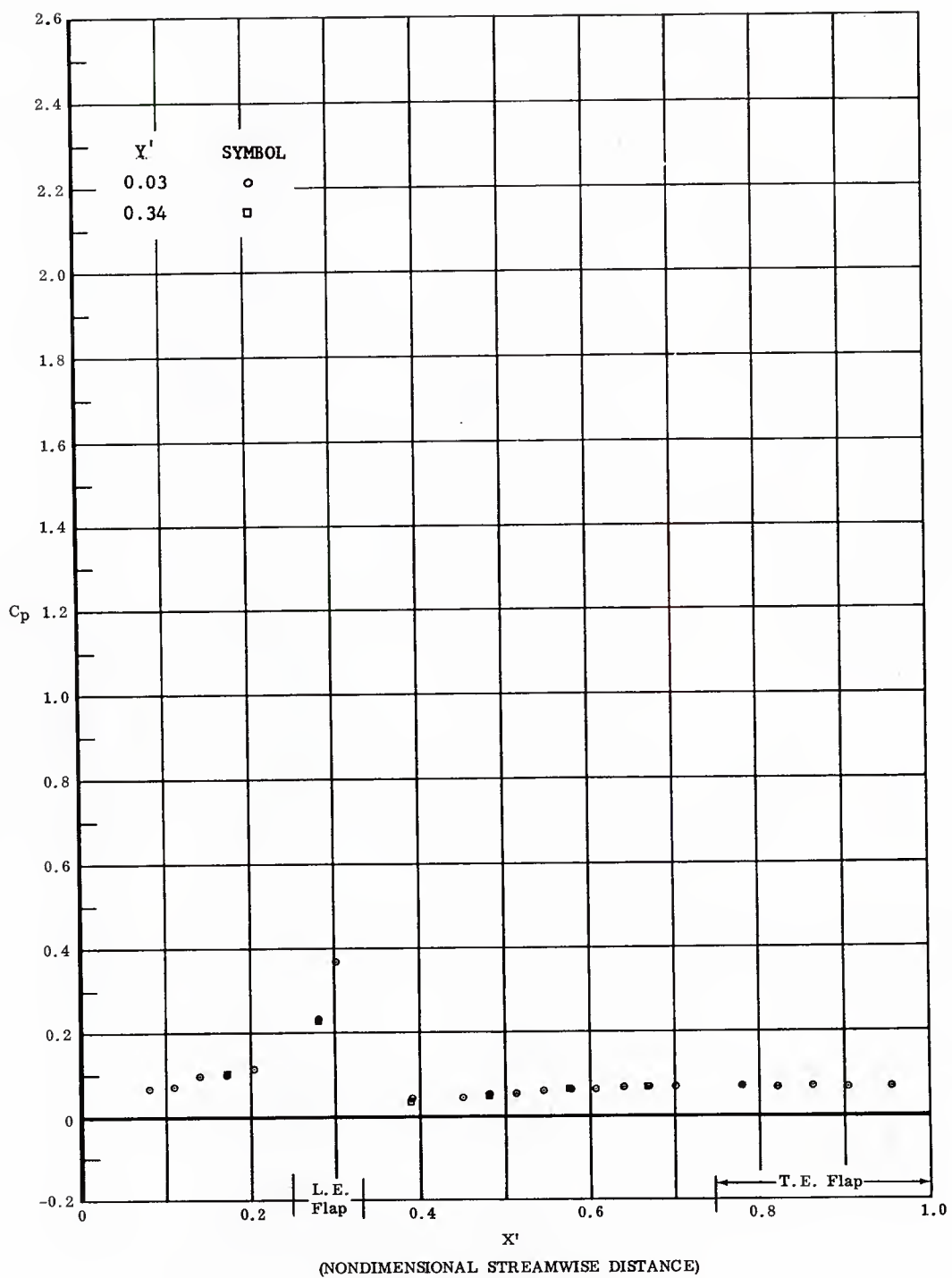


Fig. 38 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, Forward Flap at 15° , End
 Plates Off

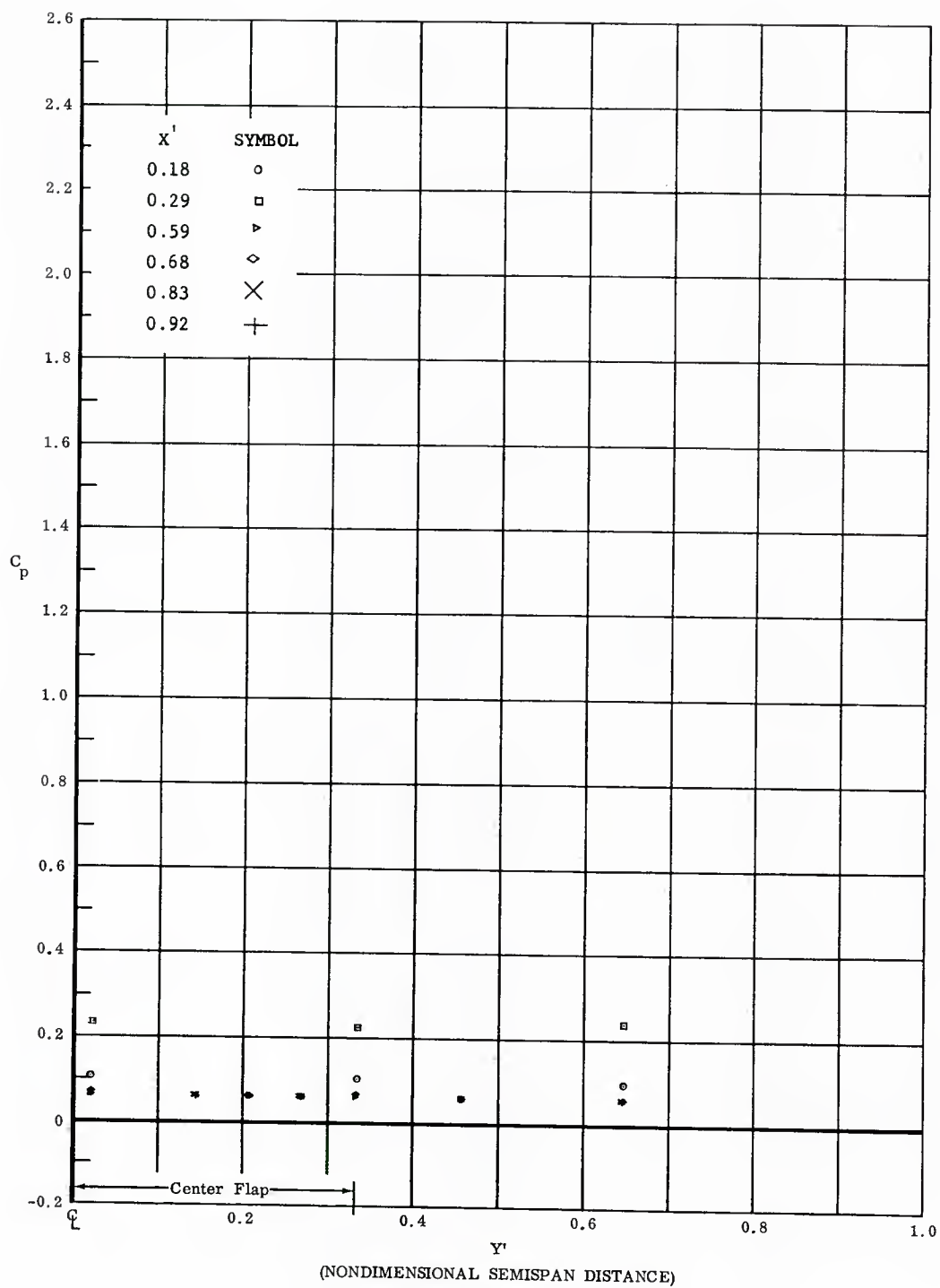


Fig. 38 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, Forward Flap at 15° , End
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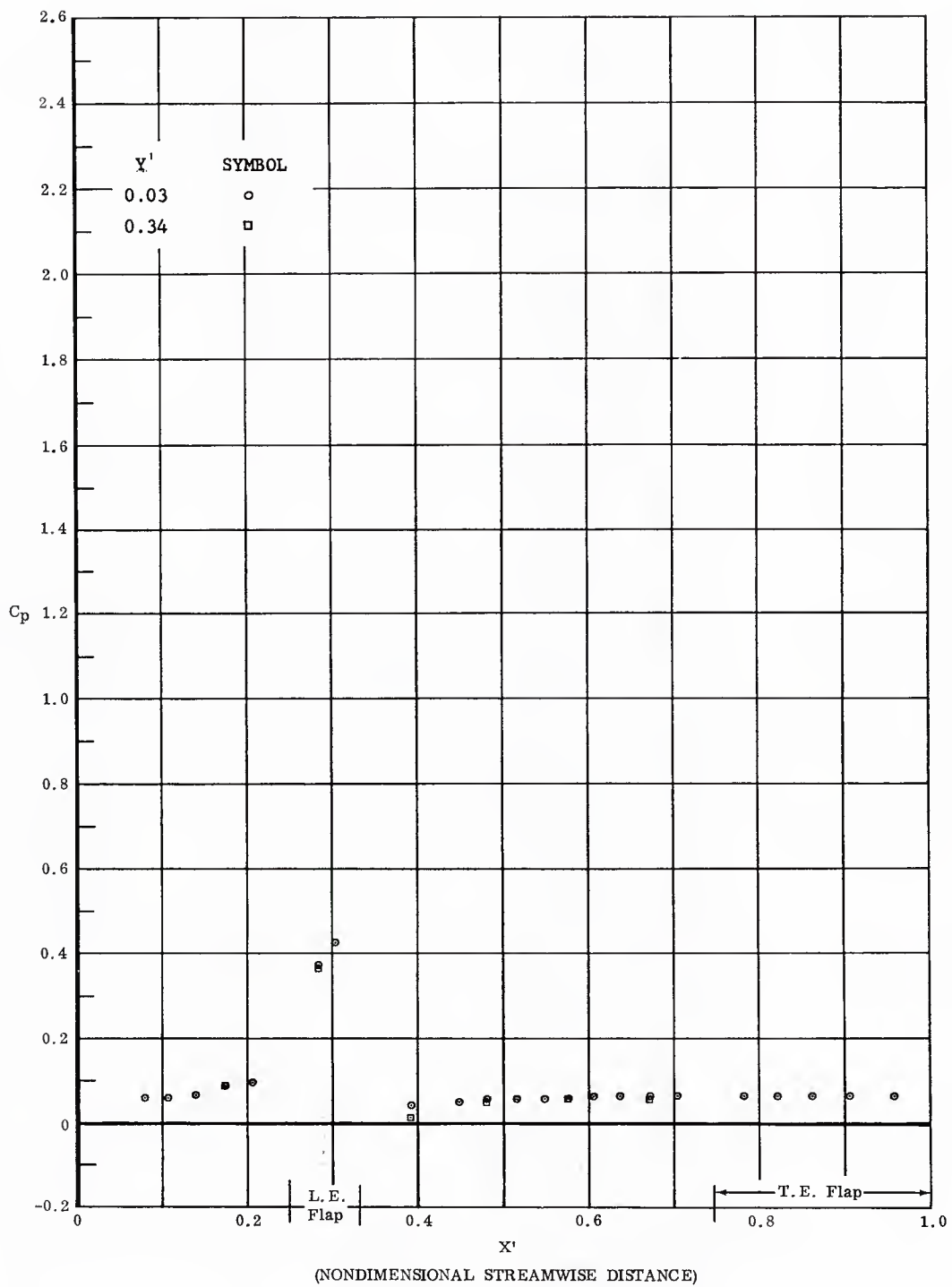


Fig. 39 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 15° , End
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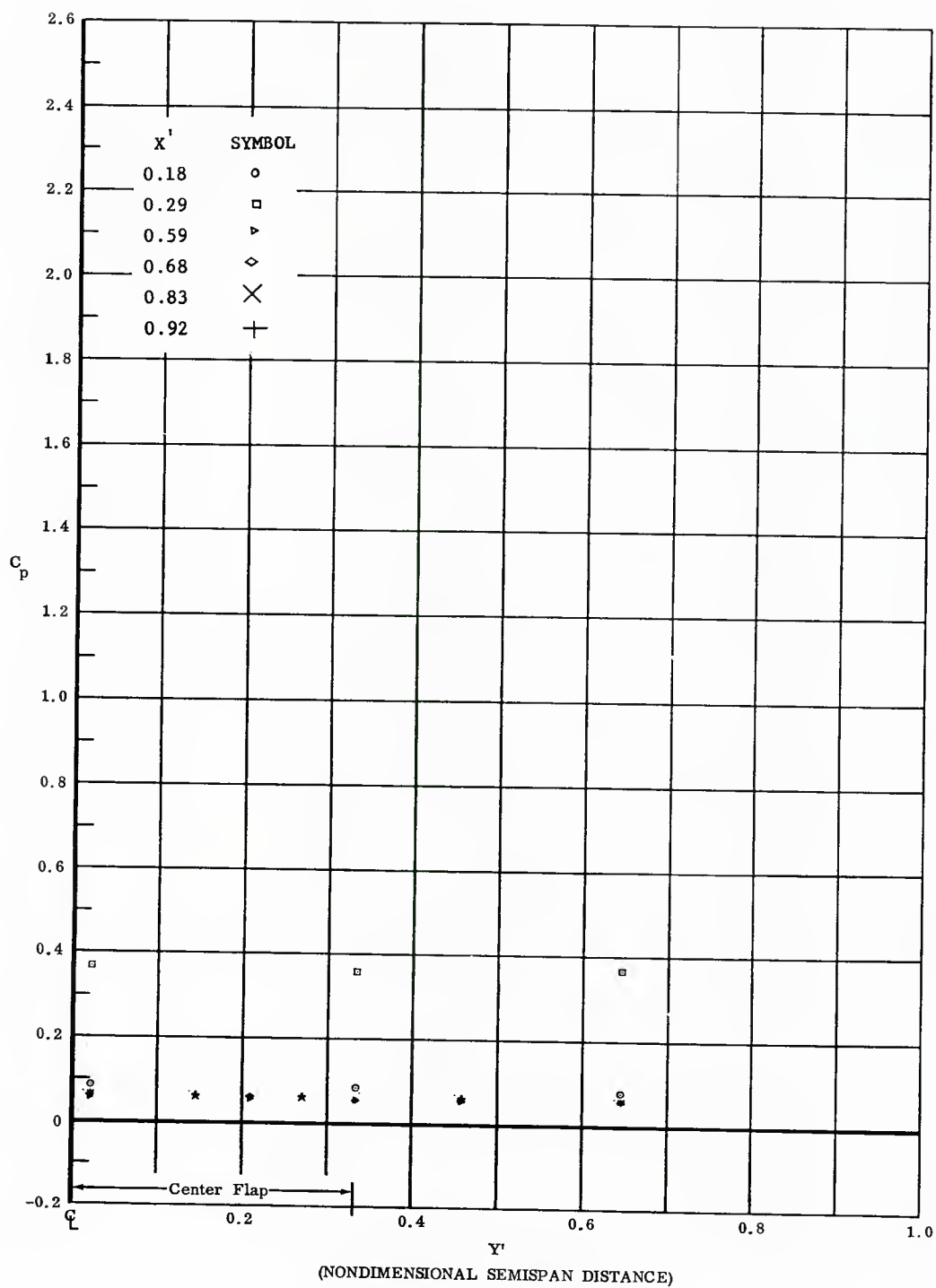


Fig. 39 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 15° , End
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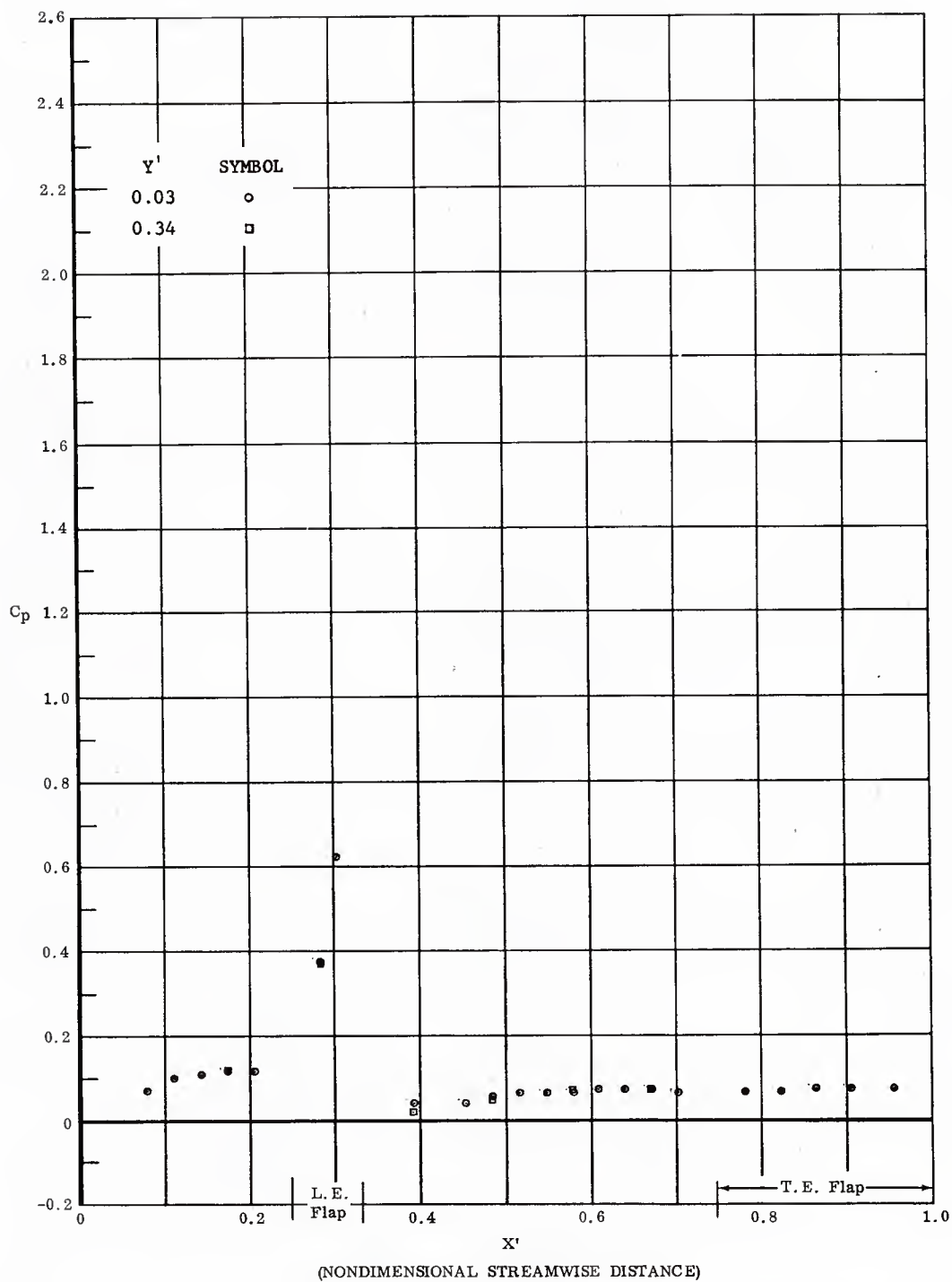


Fig. 40 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 20° , End
 Plates Off

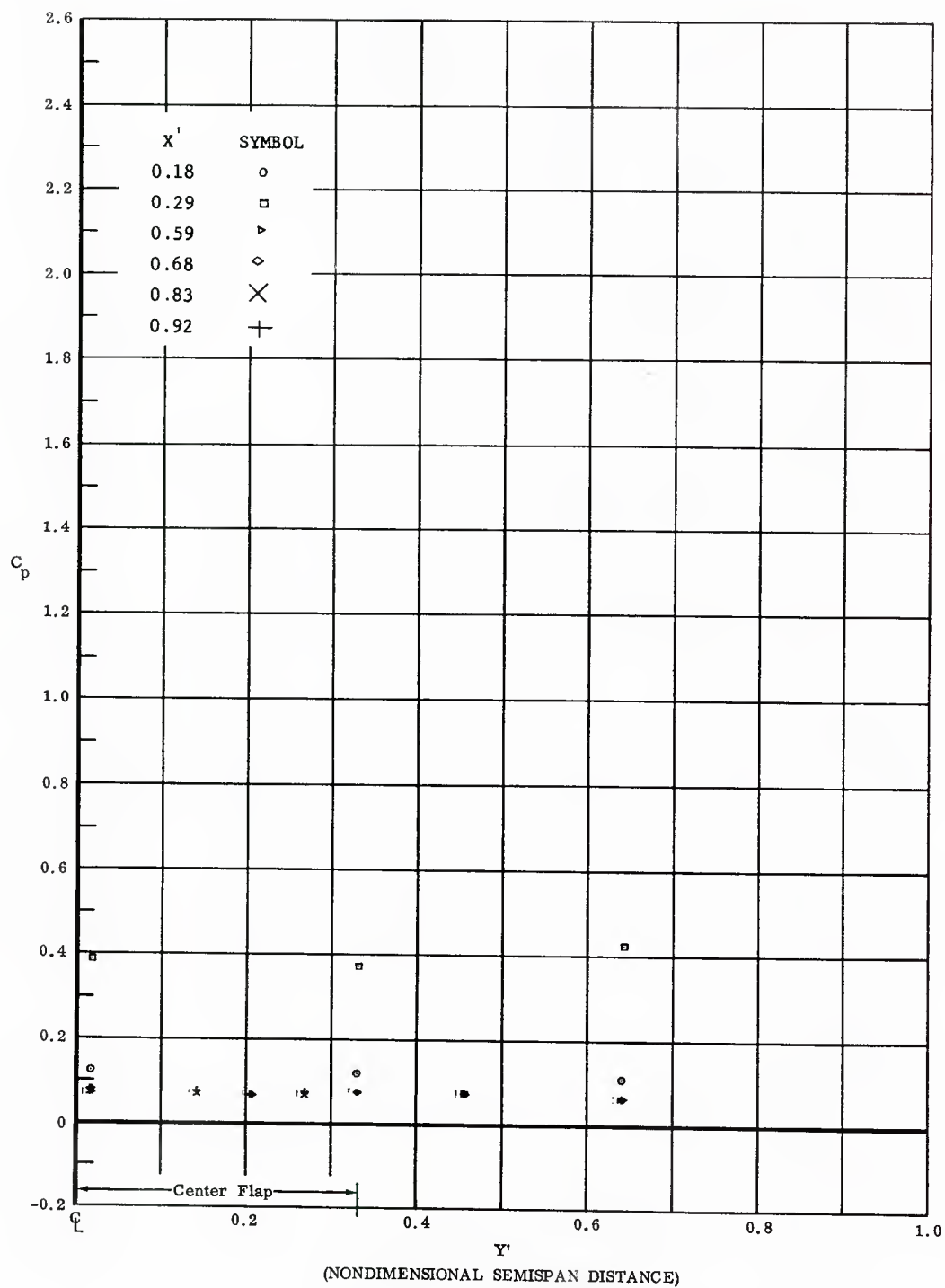


Fig. 40 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 20° , End
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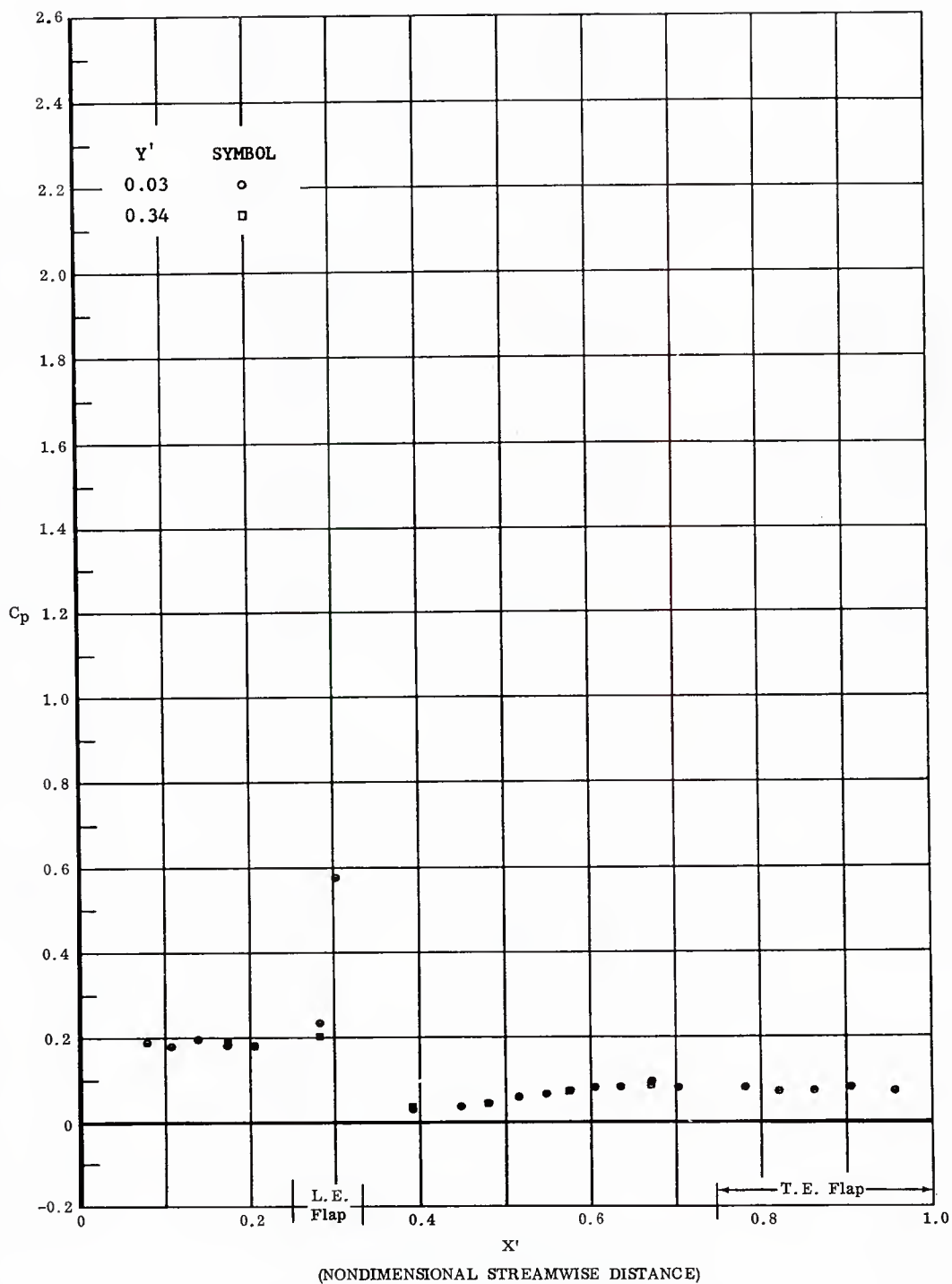


Fig. 41 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Forward Flap at 30° , End
 Plates Off

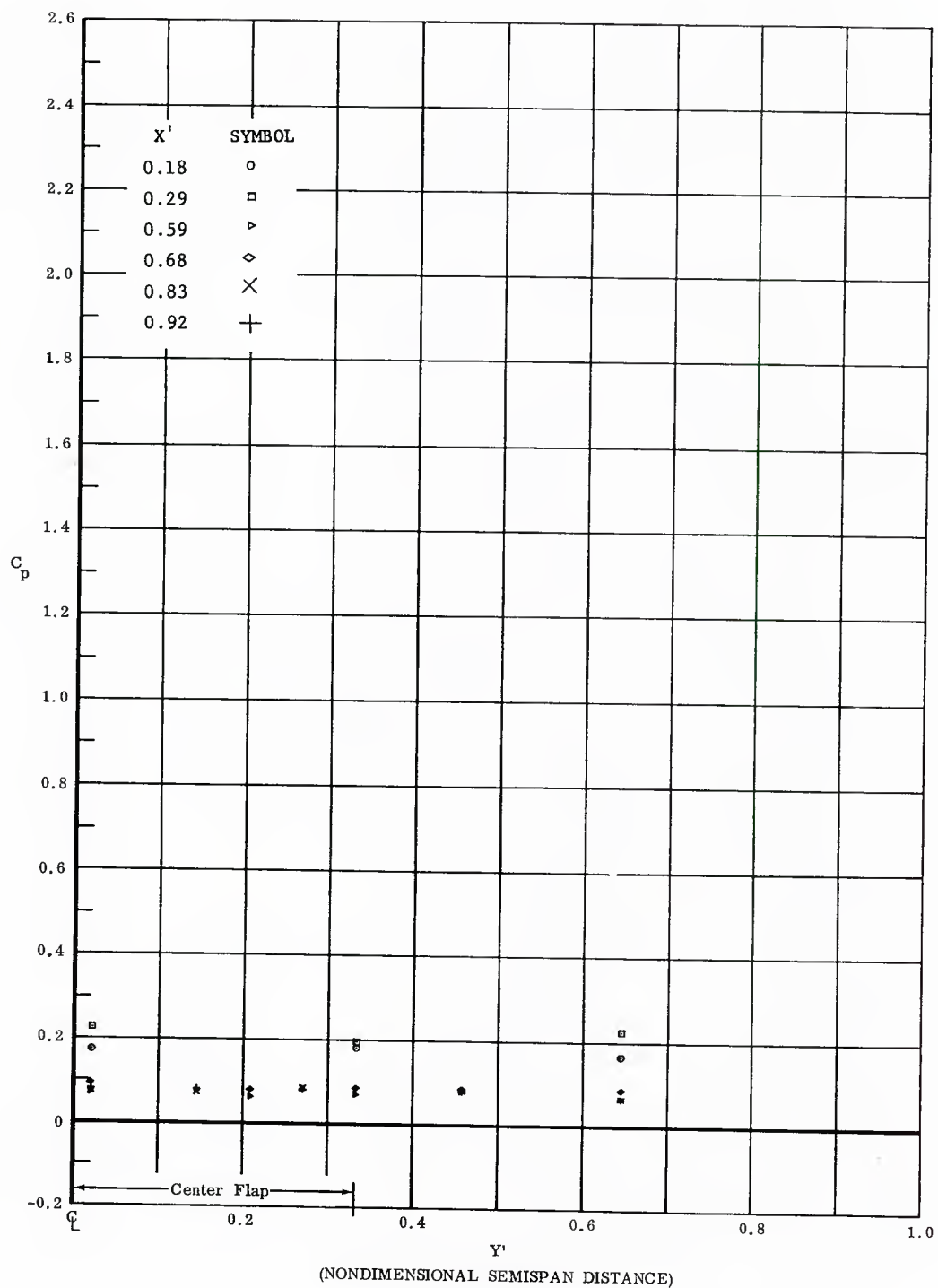


Fig. 41 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ft} = 1.1$, Forward Flap at 30° , End
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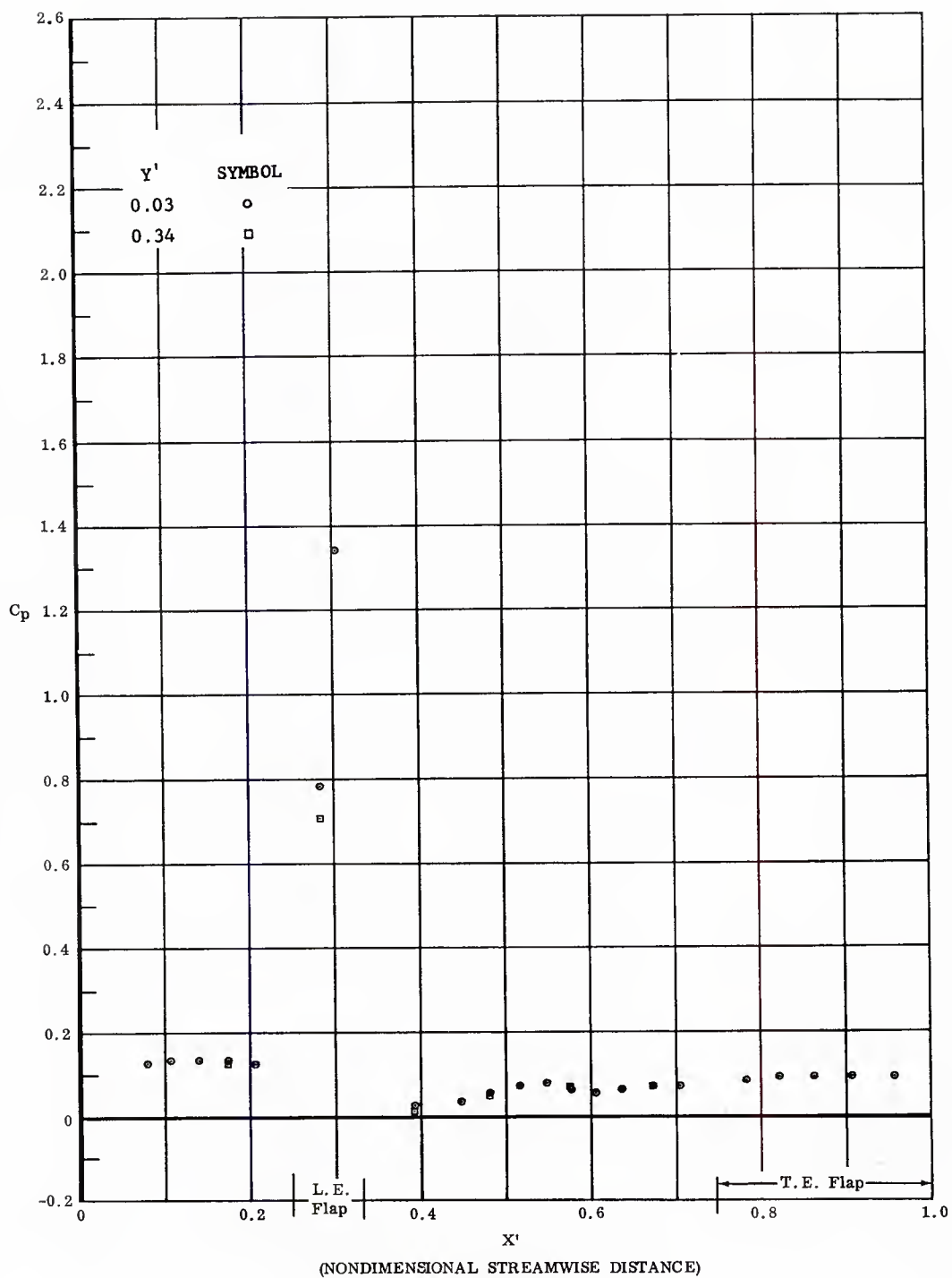


Fig. 42 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 30° , End
 Plates Off

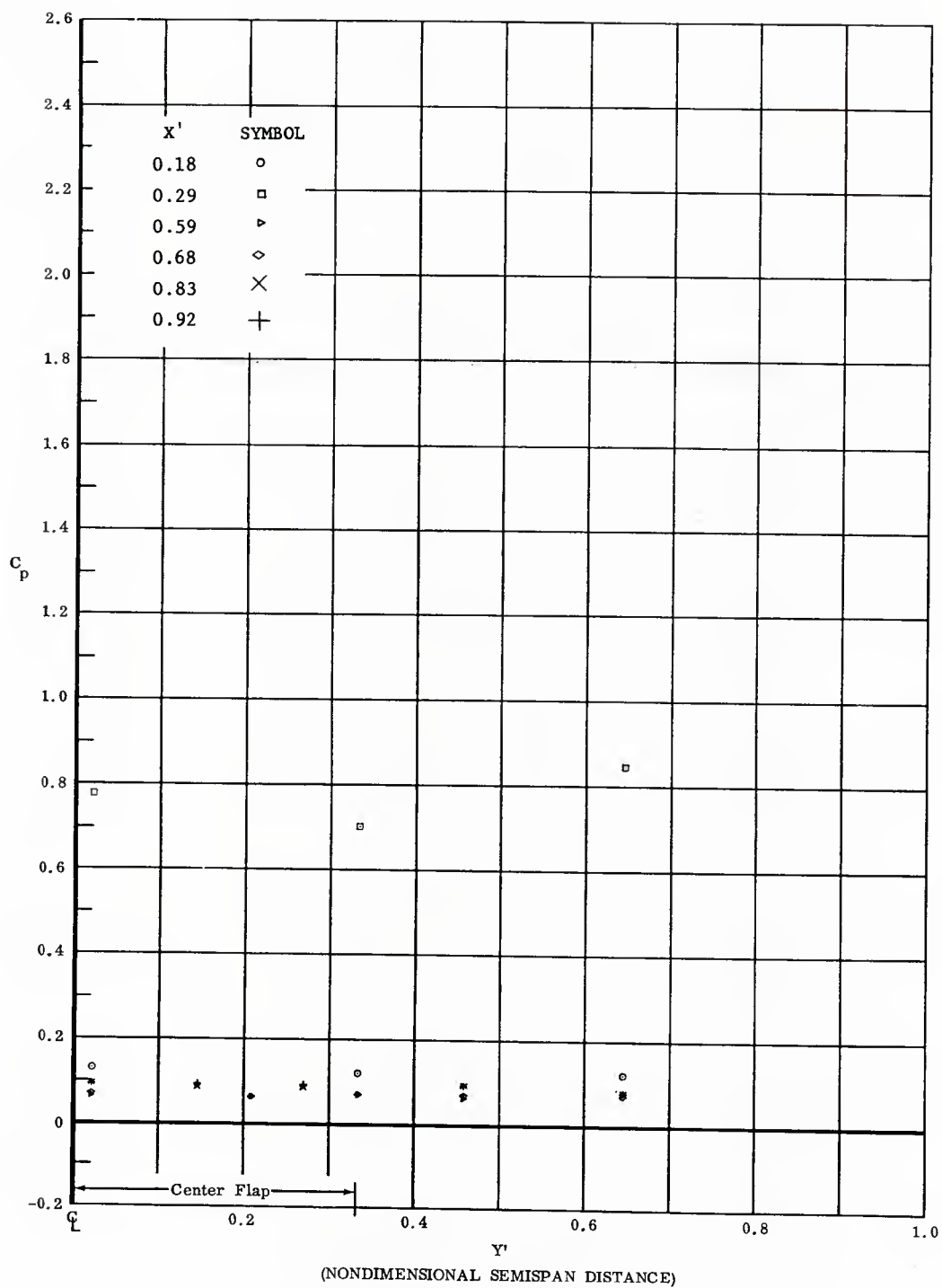


Fig. 42 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, Forward Flap at 30° , End
 Plates Off

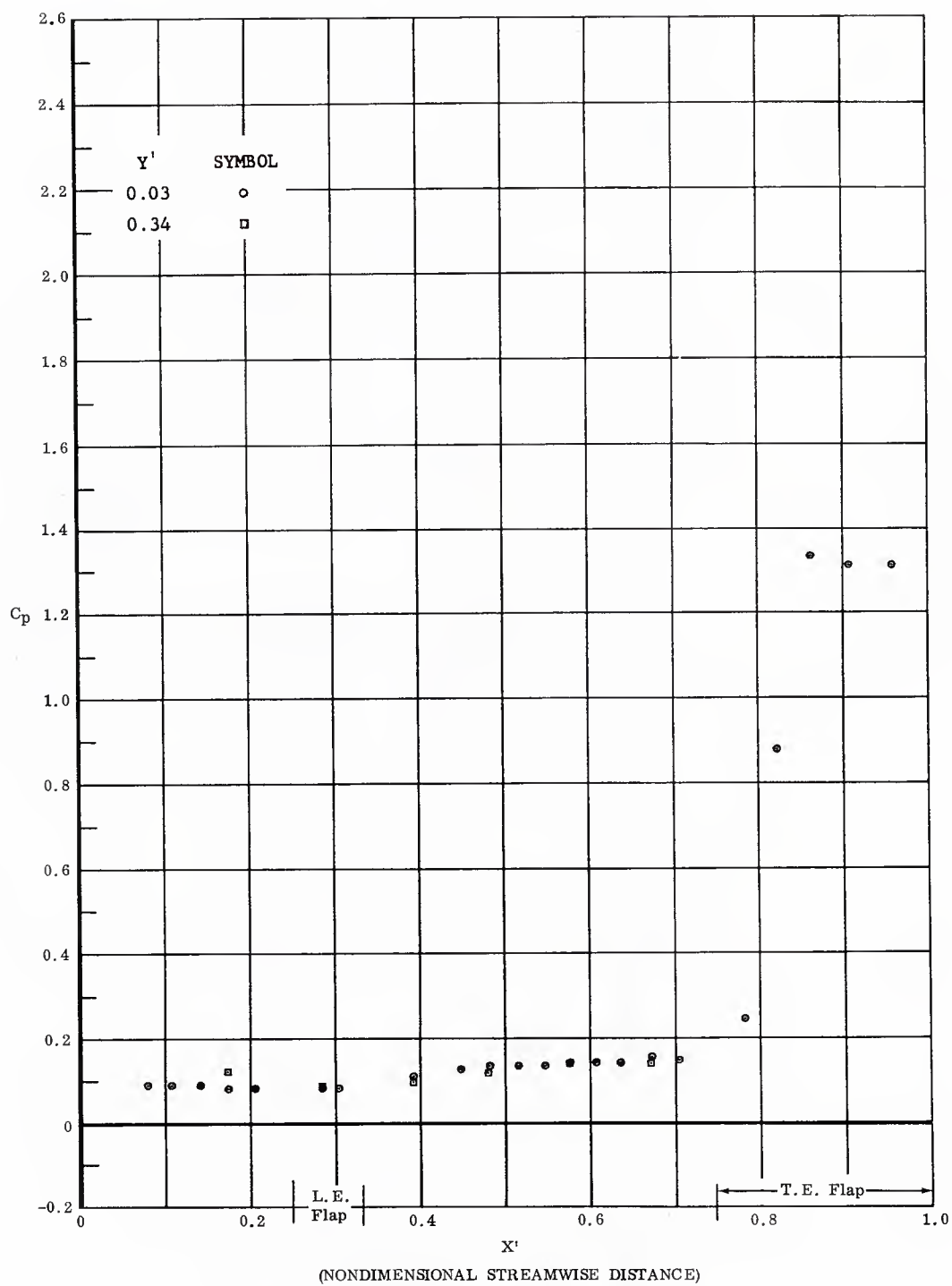


Fig. 43 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plate Off

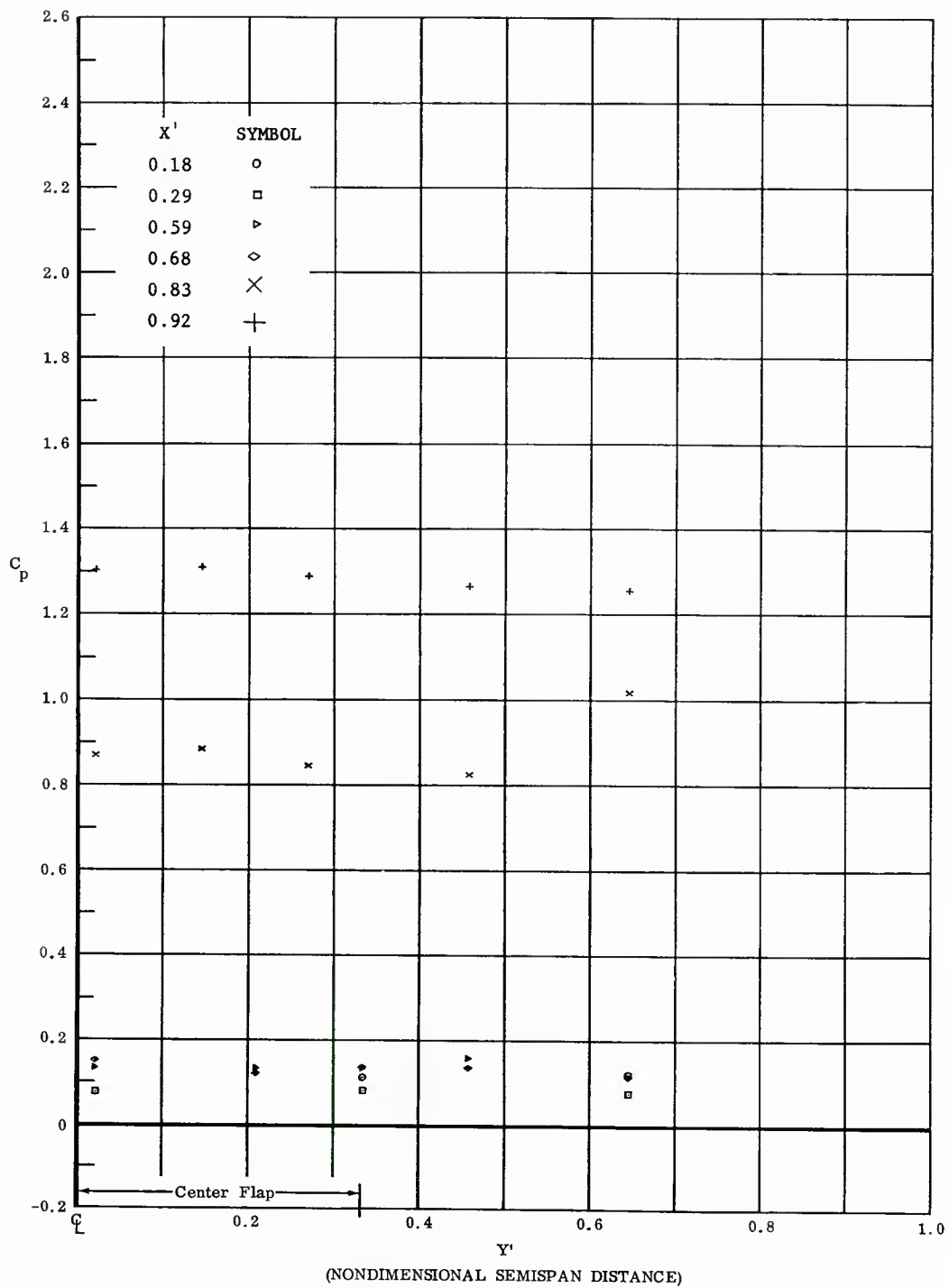


Fig. 43 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plate Off

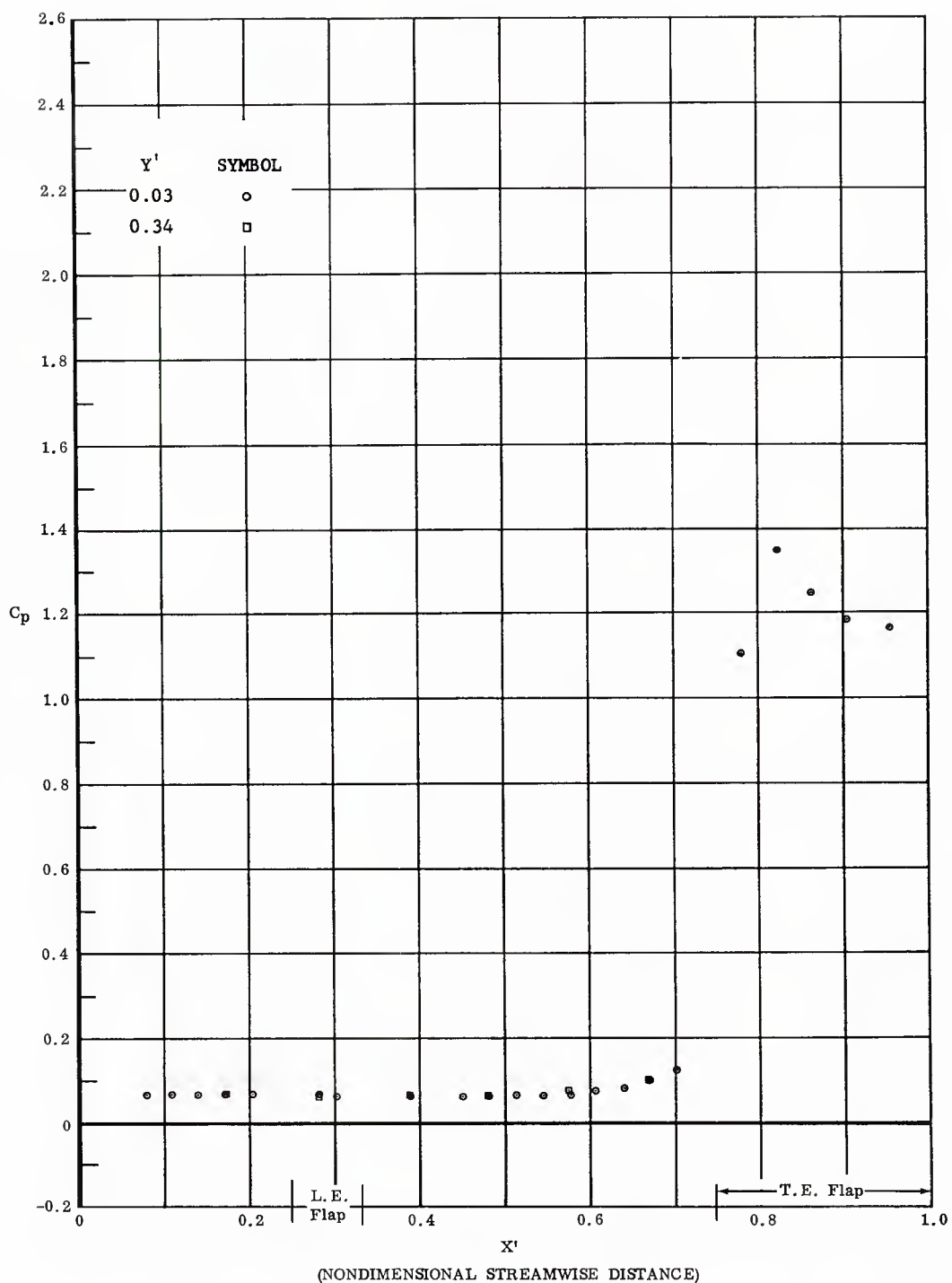


Fig. 44 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30° ,
 End Plates Off

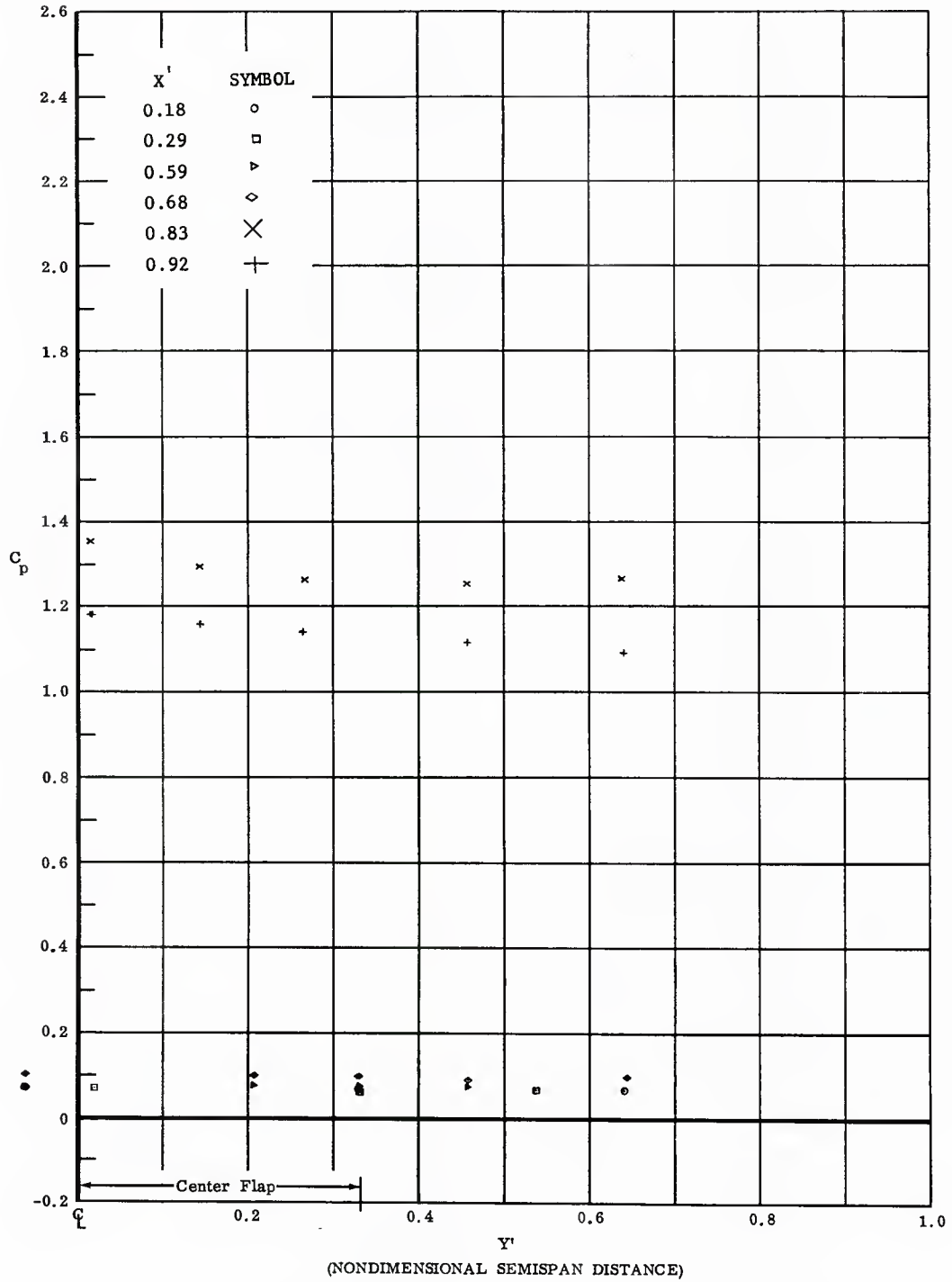


Fig. 44 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30° ,
 End Plates Off

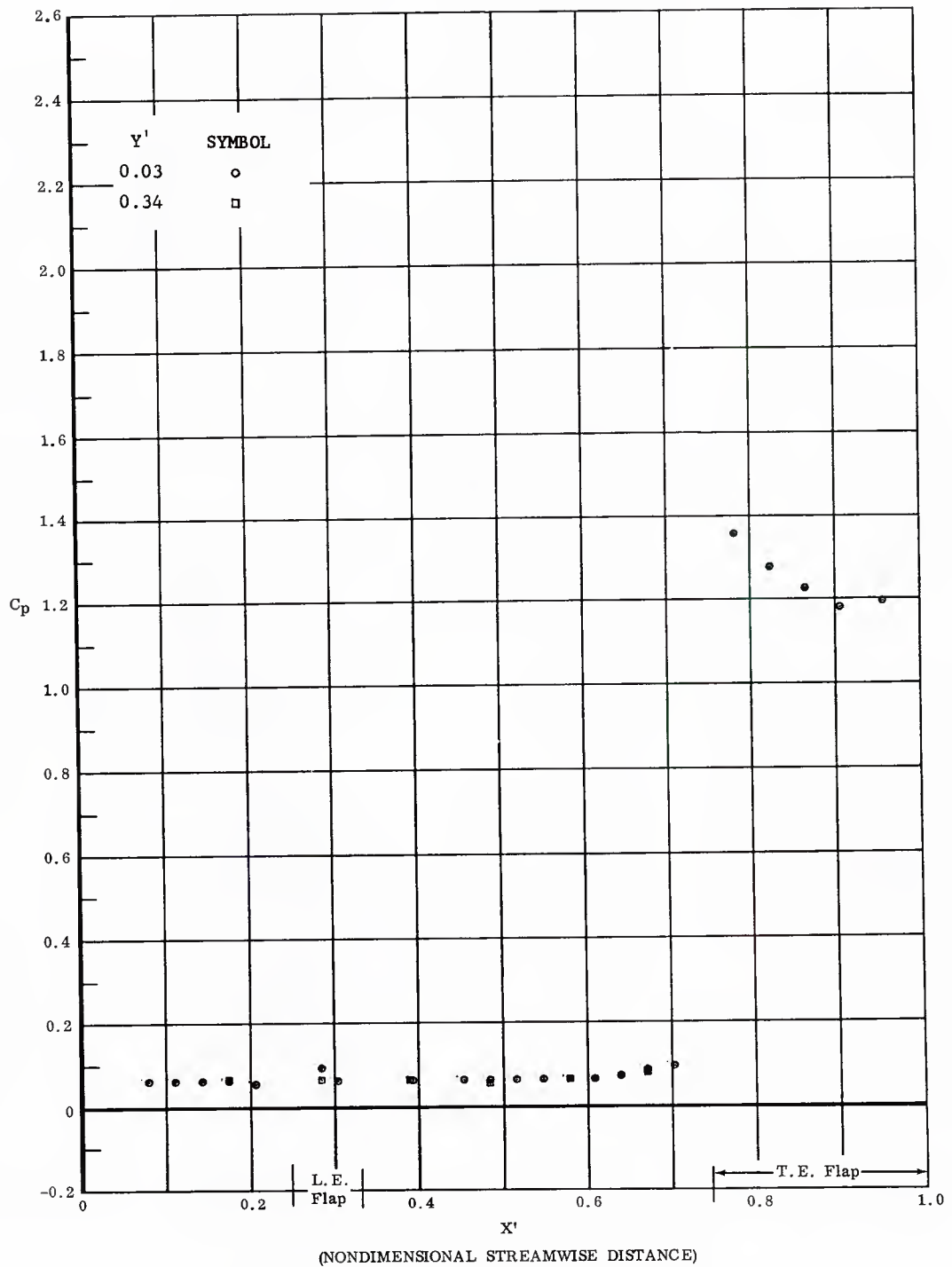


Fig. 45 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plates Off

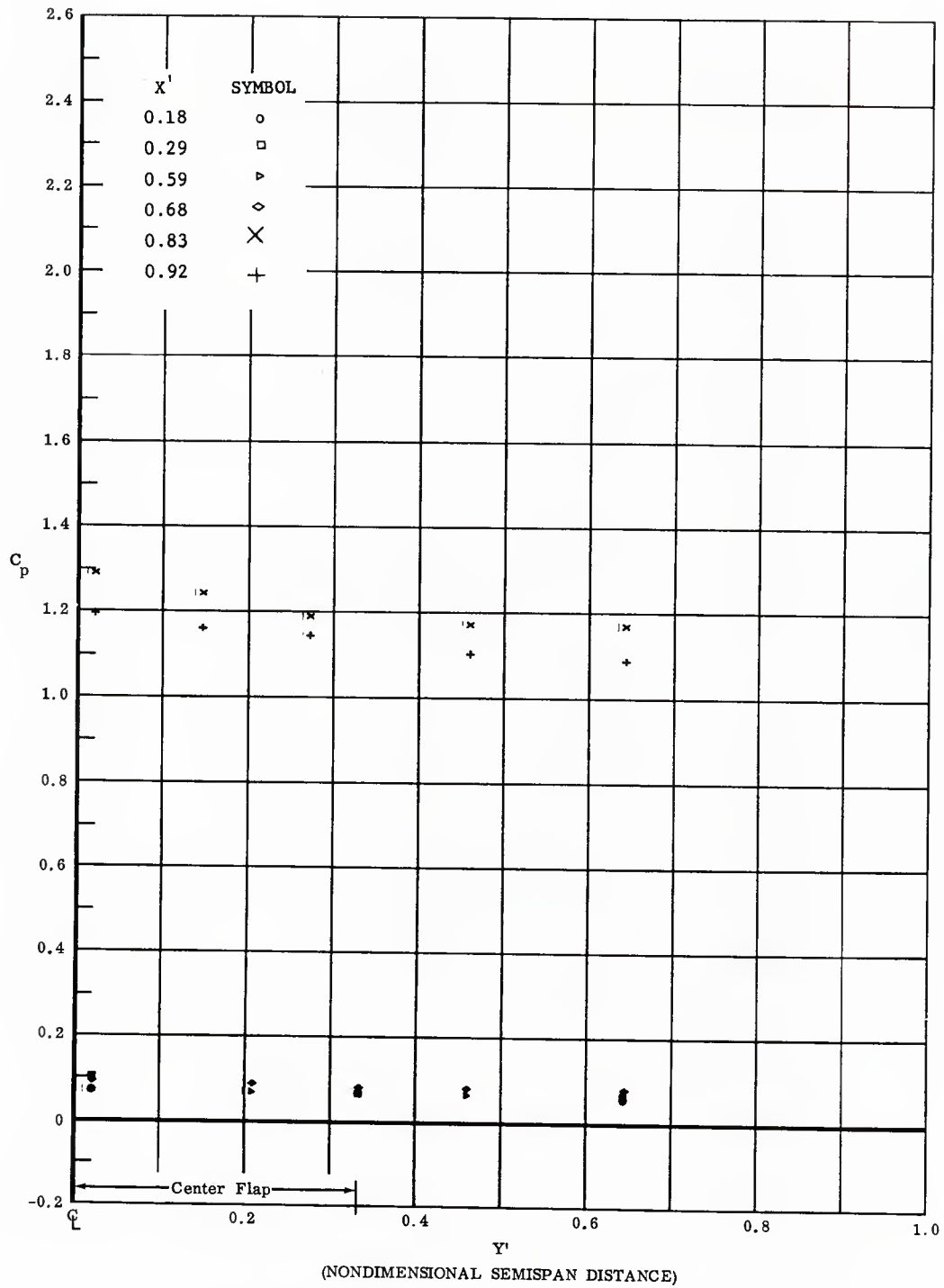


Fig. 45 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plates Off

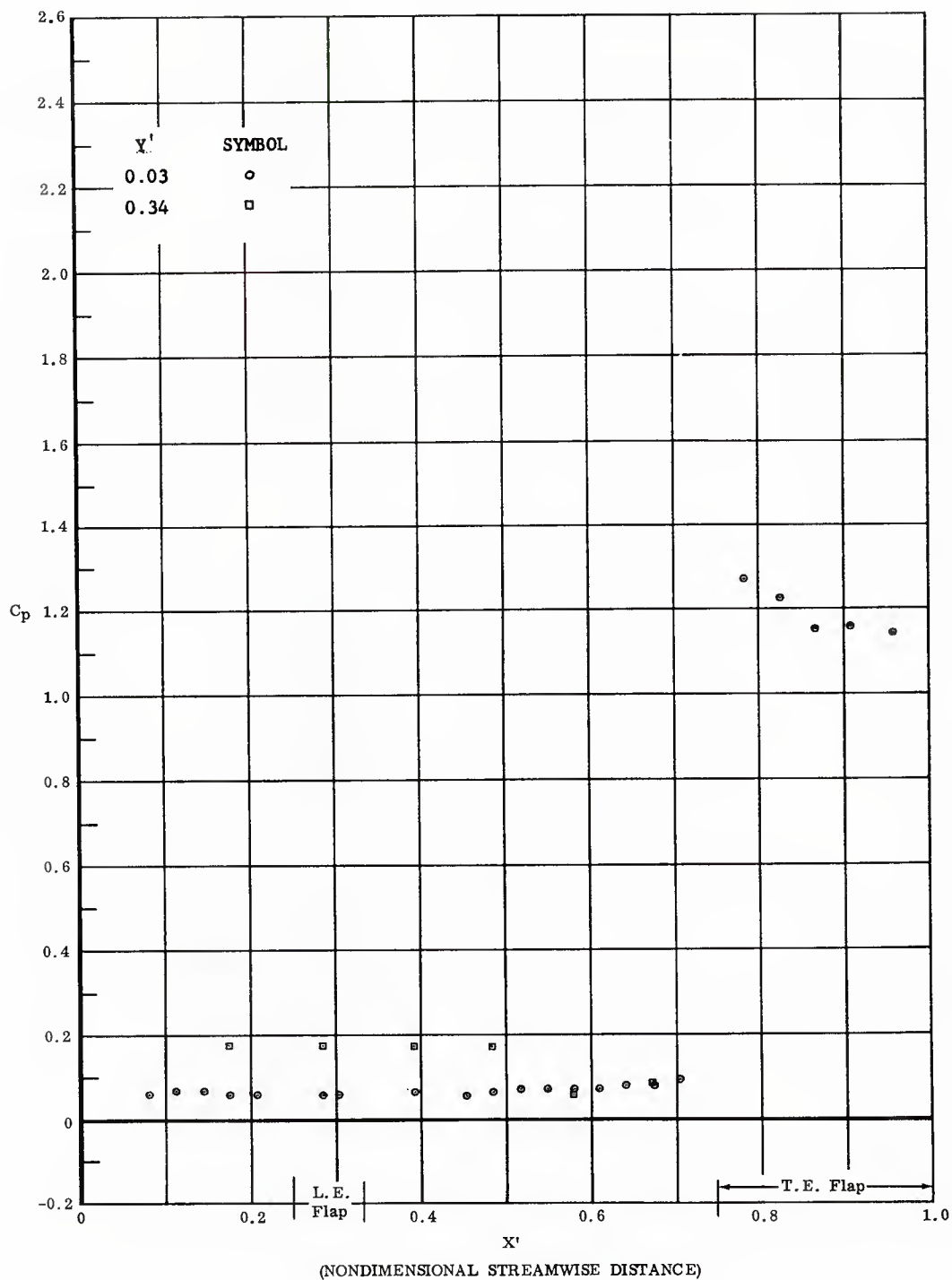


Fig. 46 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plates Off

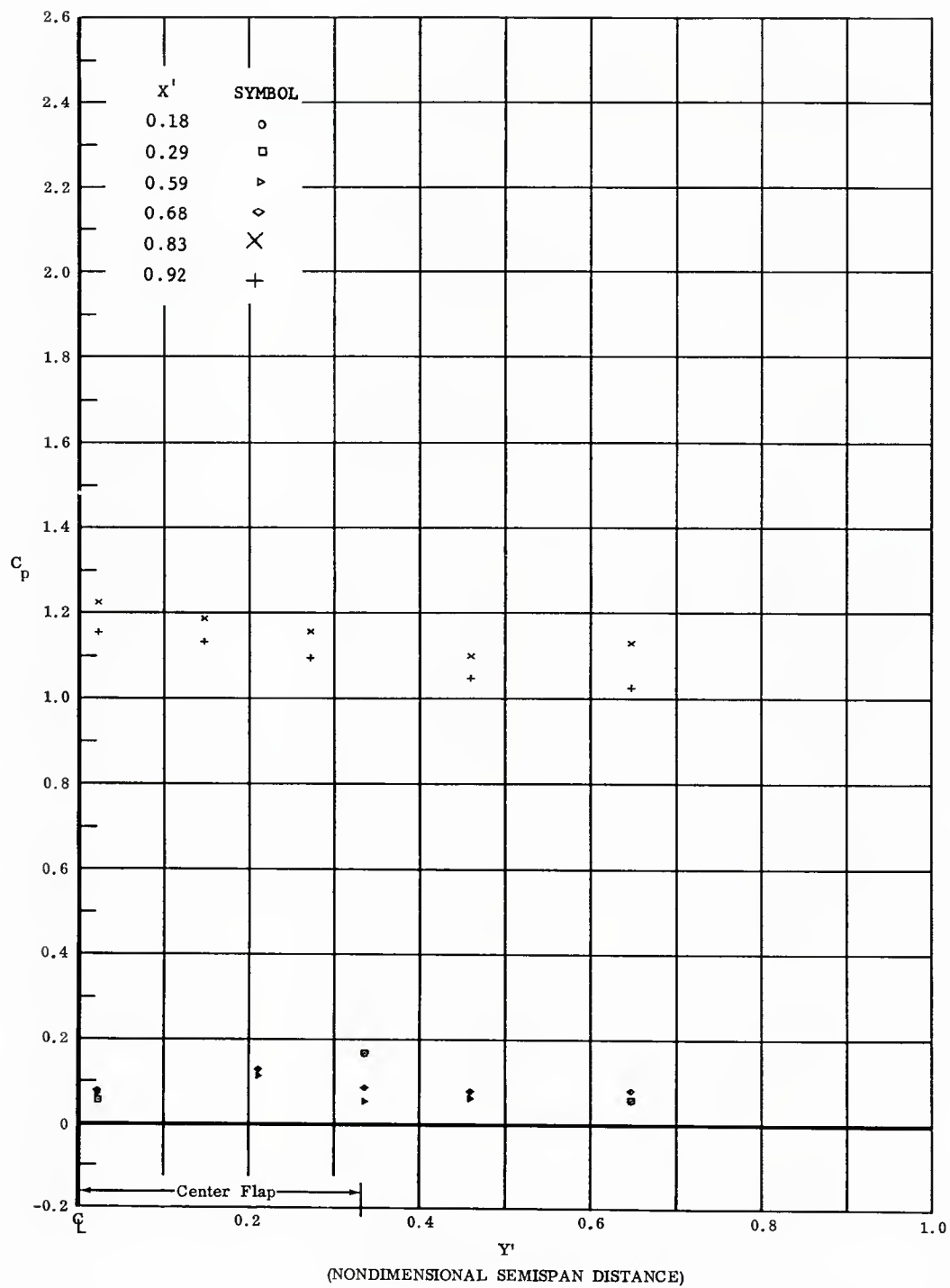


Fig. 46 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plates Off

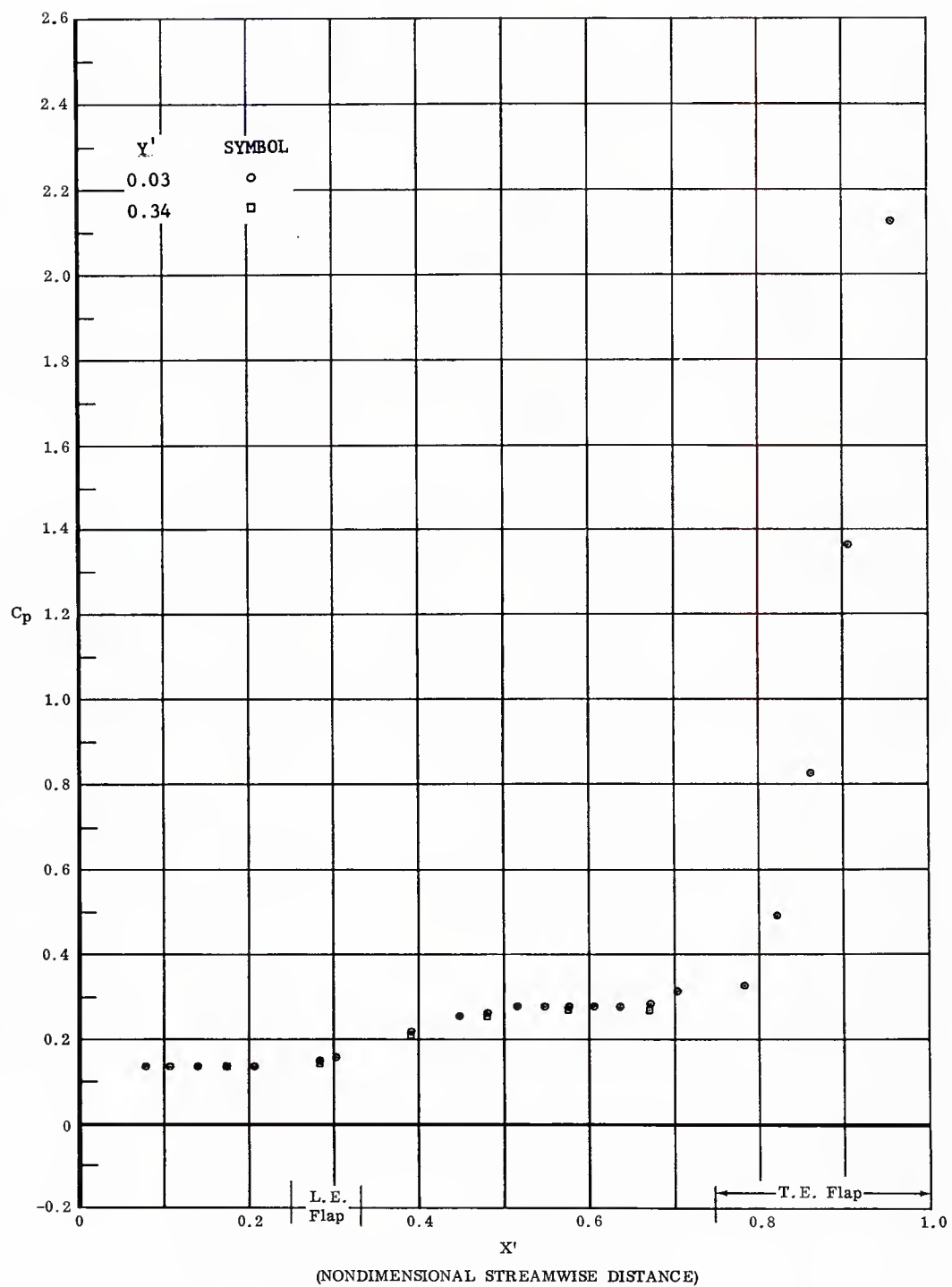


Fig. 47 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, Aft Full Span Flap at 45° ,
 End Plates Off

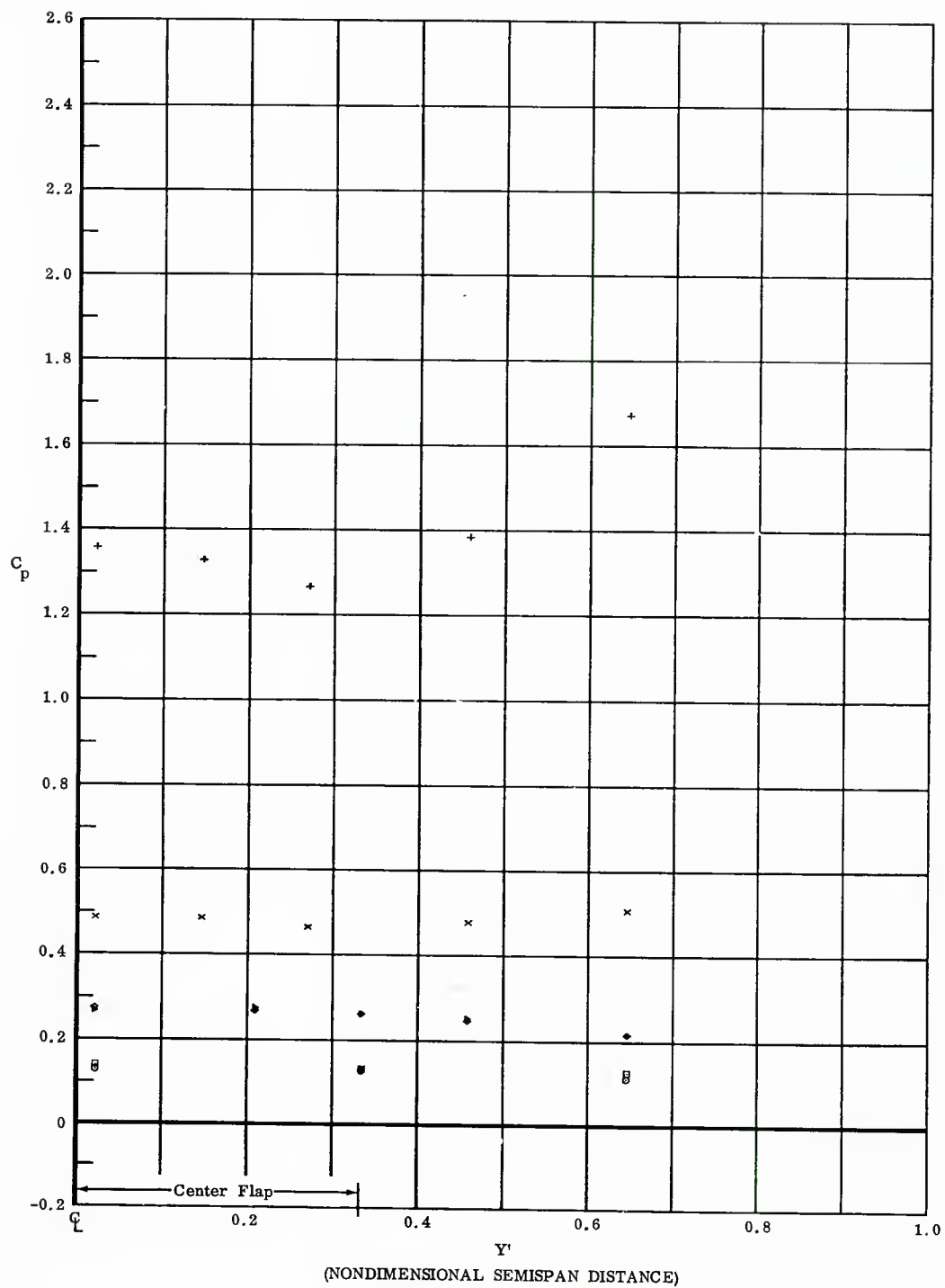


Fig. 47 Pressure Coefficient Data Plots; $\alpha = -5$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, Aft Full Span Flap at 45° ,
 End Plates Off

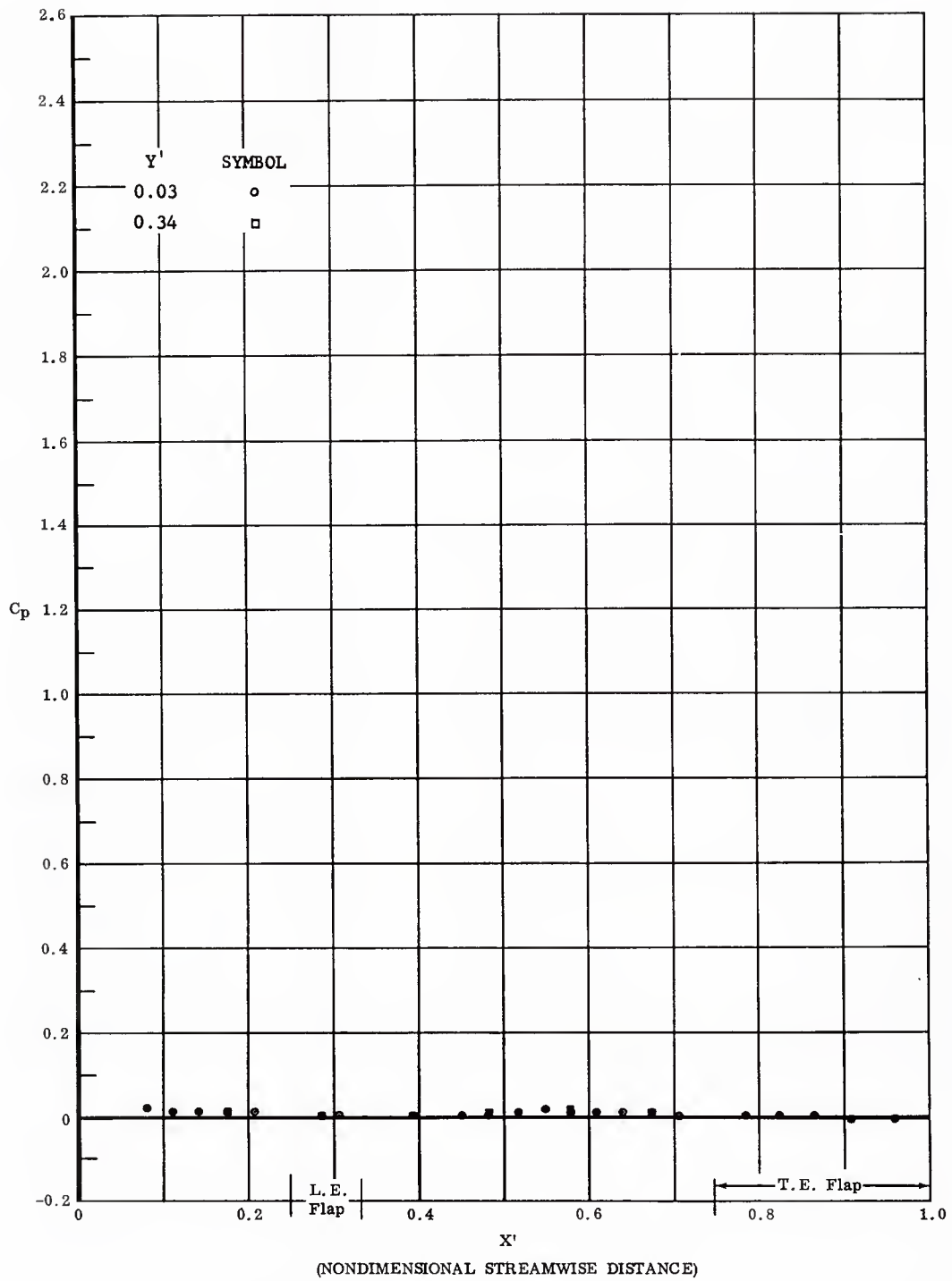


Fig. 48 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, No Flap Deflection, End
 Plates Off

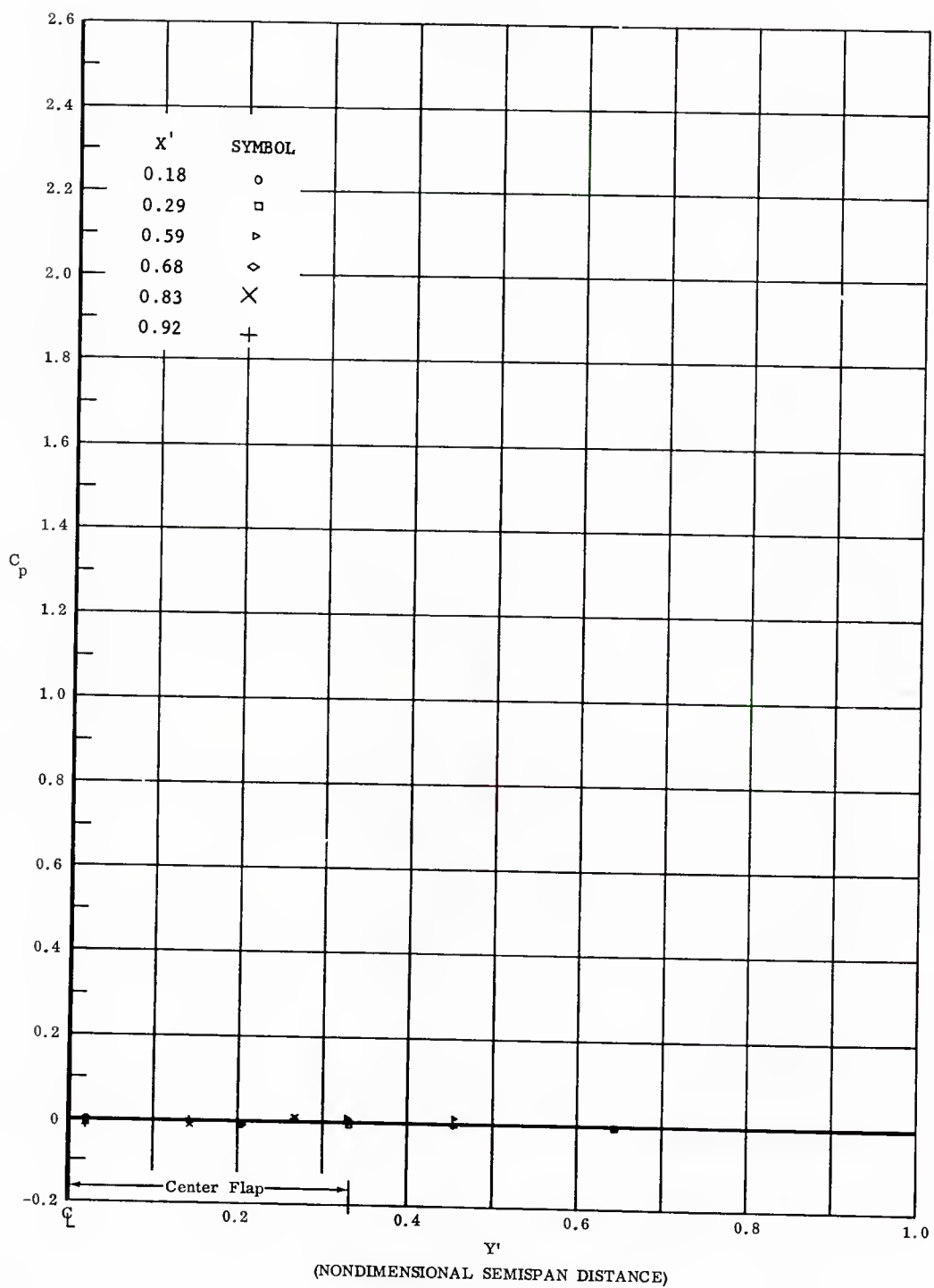


Fig. 48 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, No Flap Deflection, End
 Plates Off

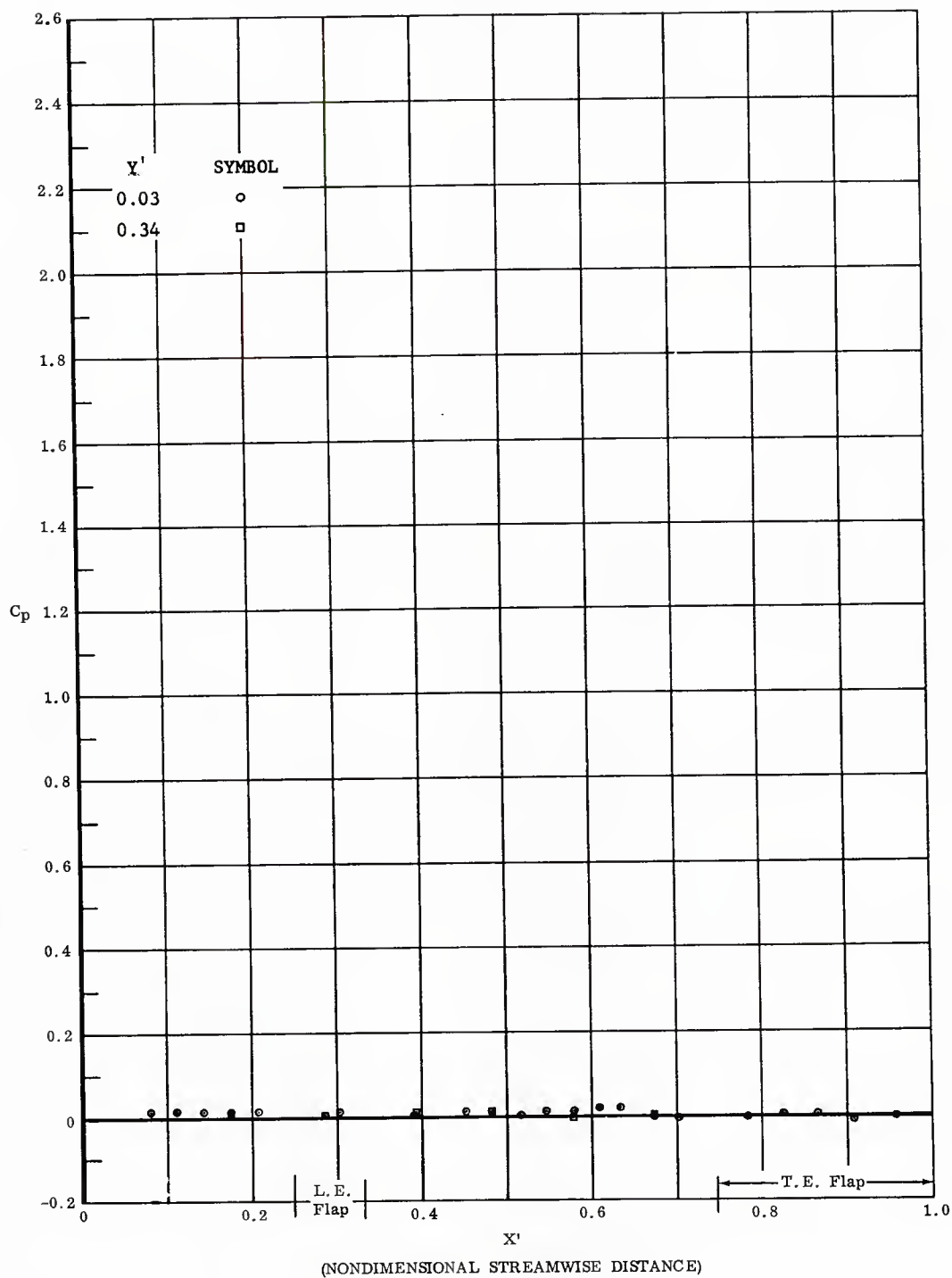


Fig. 49 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, No Flap Deflection, End
 Plate On

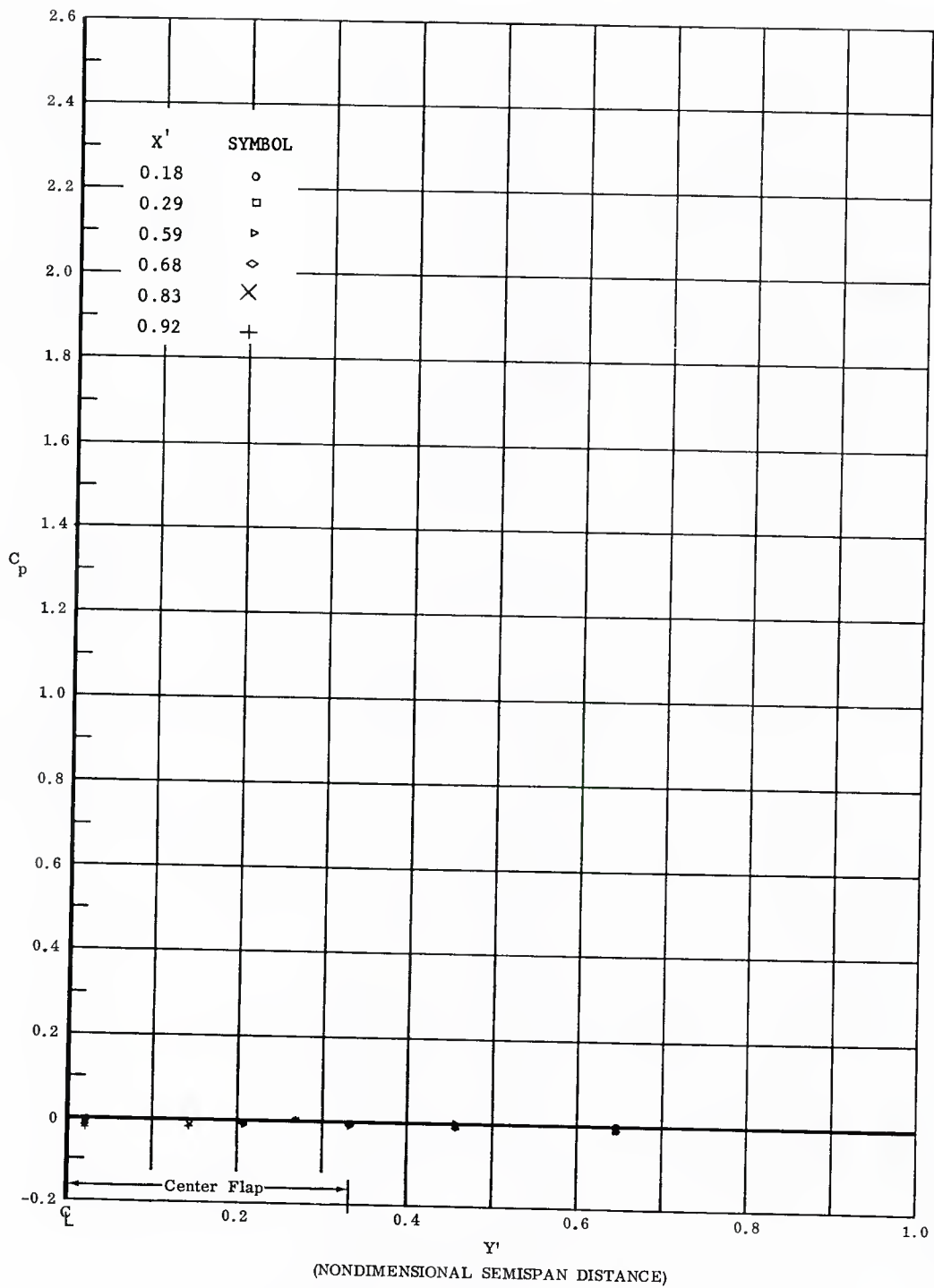


Fig. 49 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, No Flap Deflection, End
 Plate On

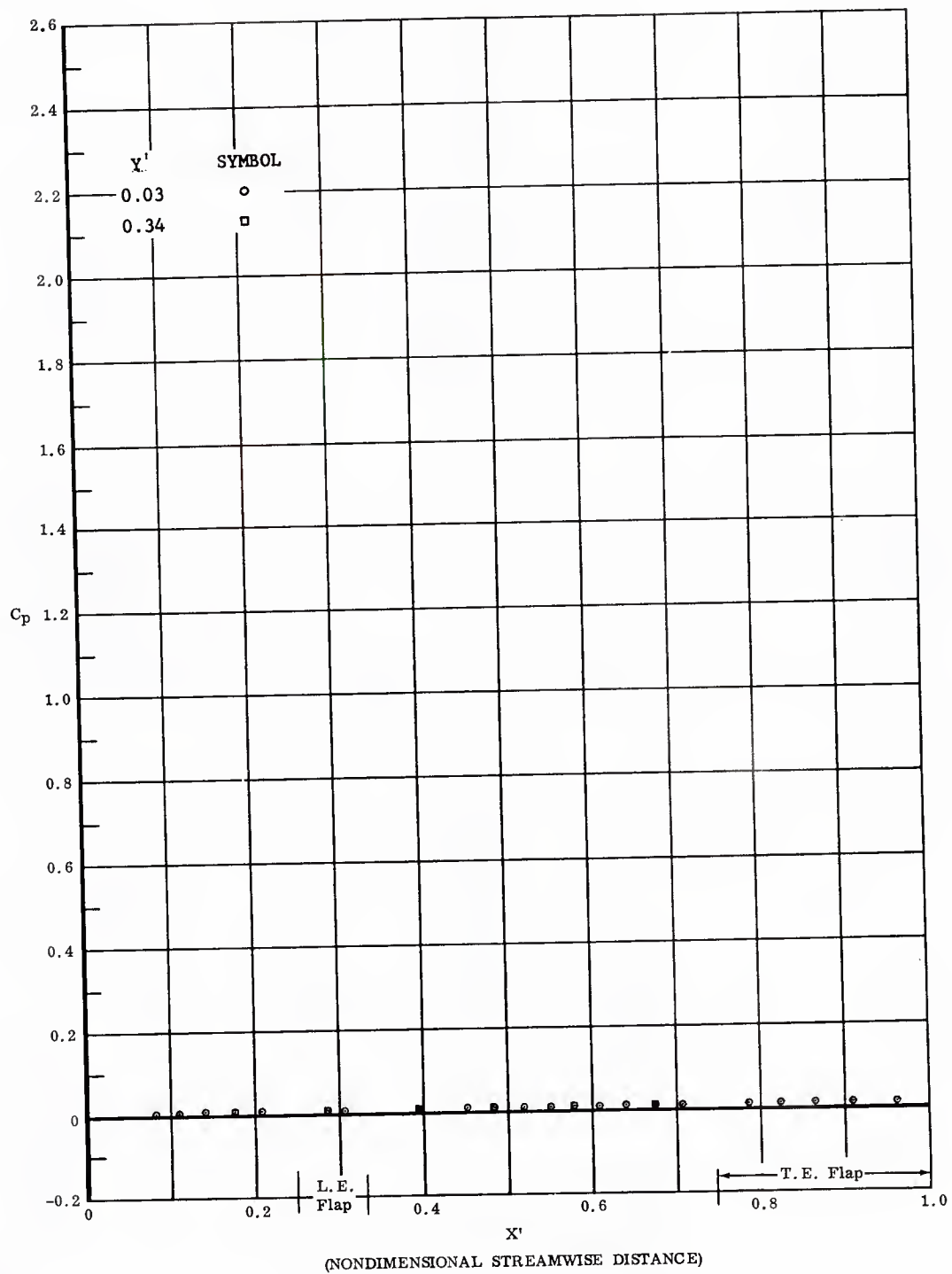


Fig. 50 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, No Flap Deflection, End
 Plate Off

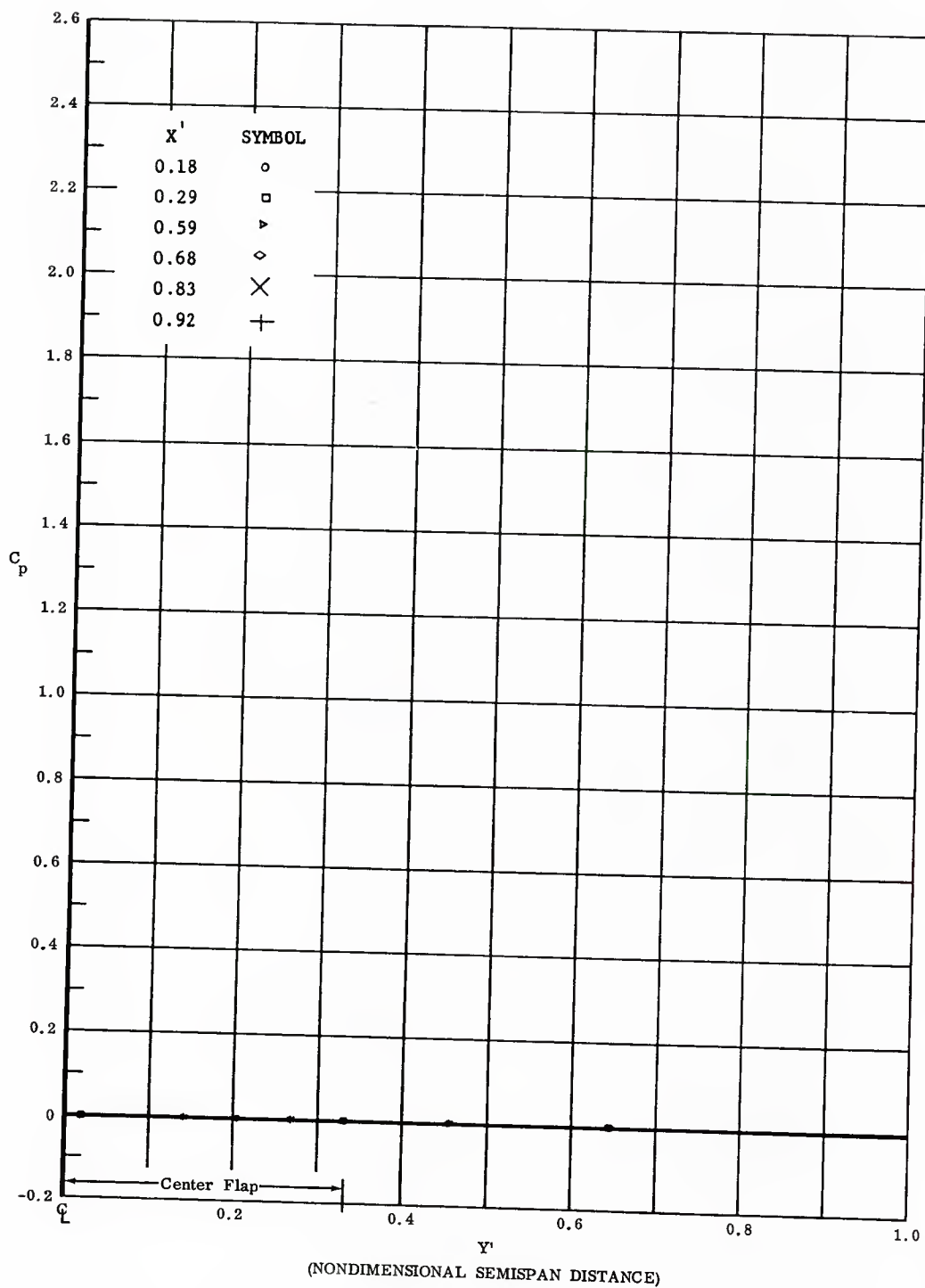


Fig. 50 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, No Flap Deflection, End
 Plate Off

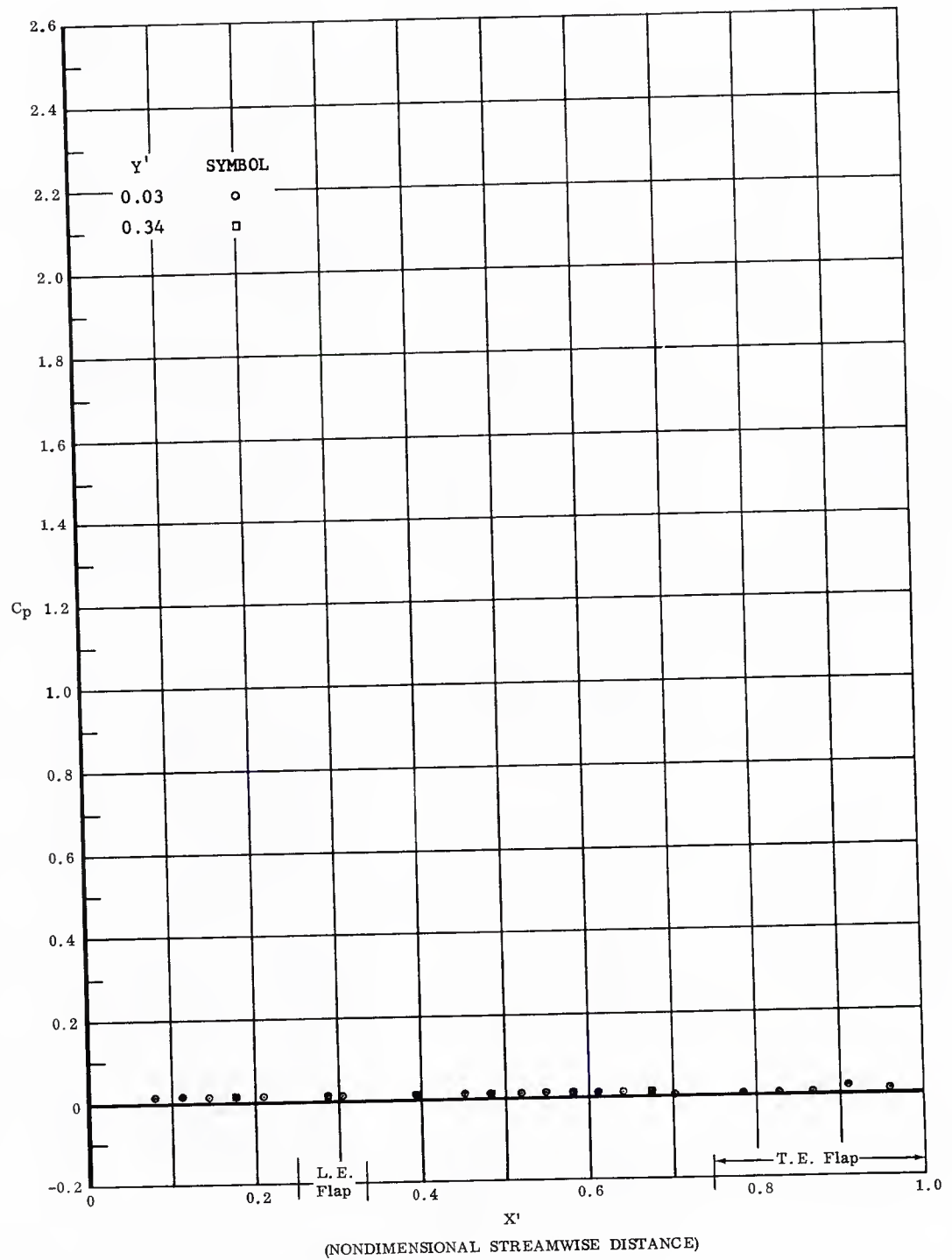


Fig. 51 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, No Flap Deflection, End
 Plate On

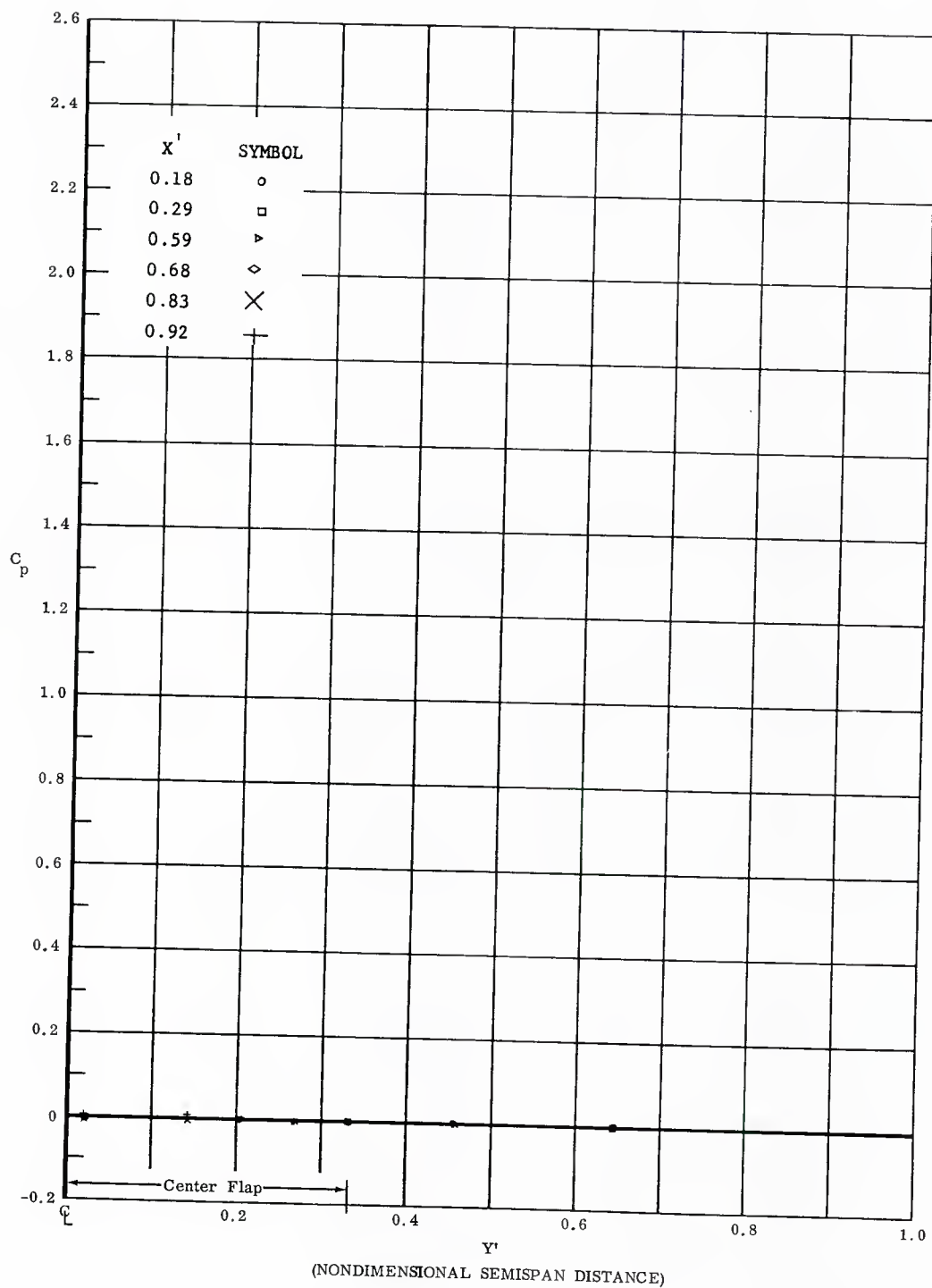


Fig. 51 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, No Flap Deflection, End
 Plate On

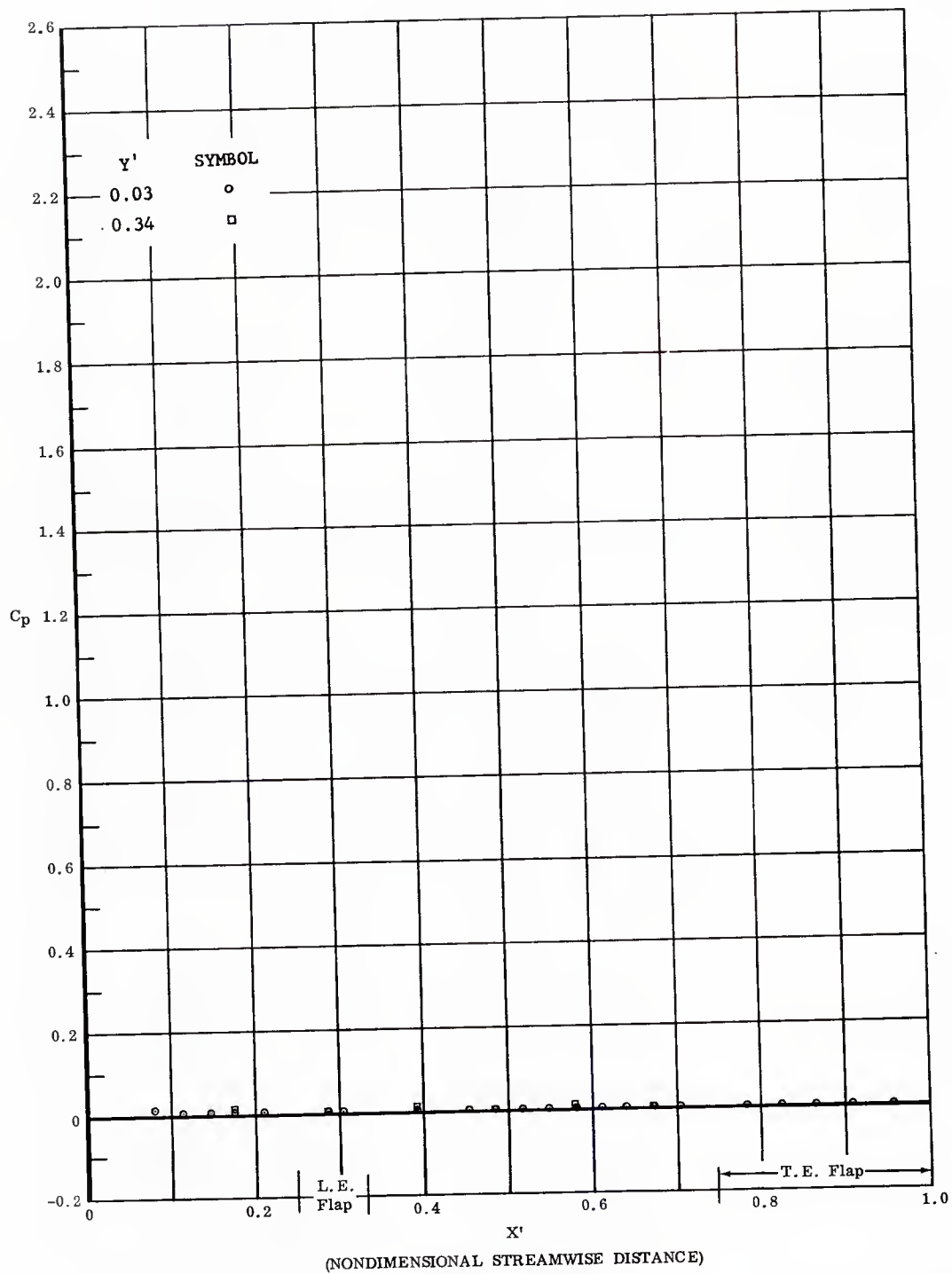


Fig. 52 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Flap Deflection, End
 Plate Off

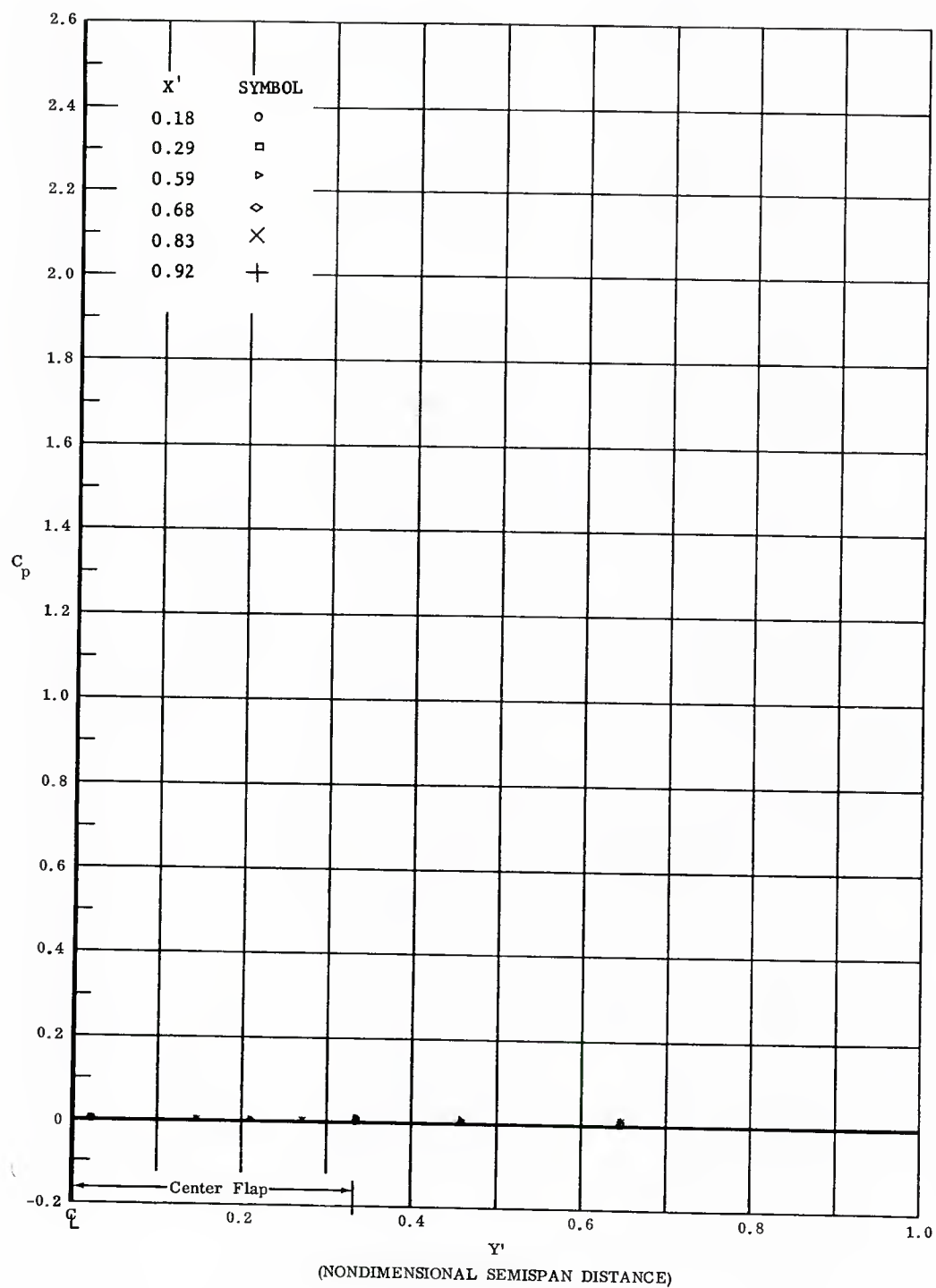


Fig. 52 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Flap Deflection, End
 Plate Off

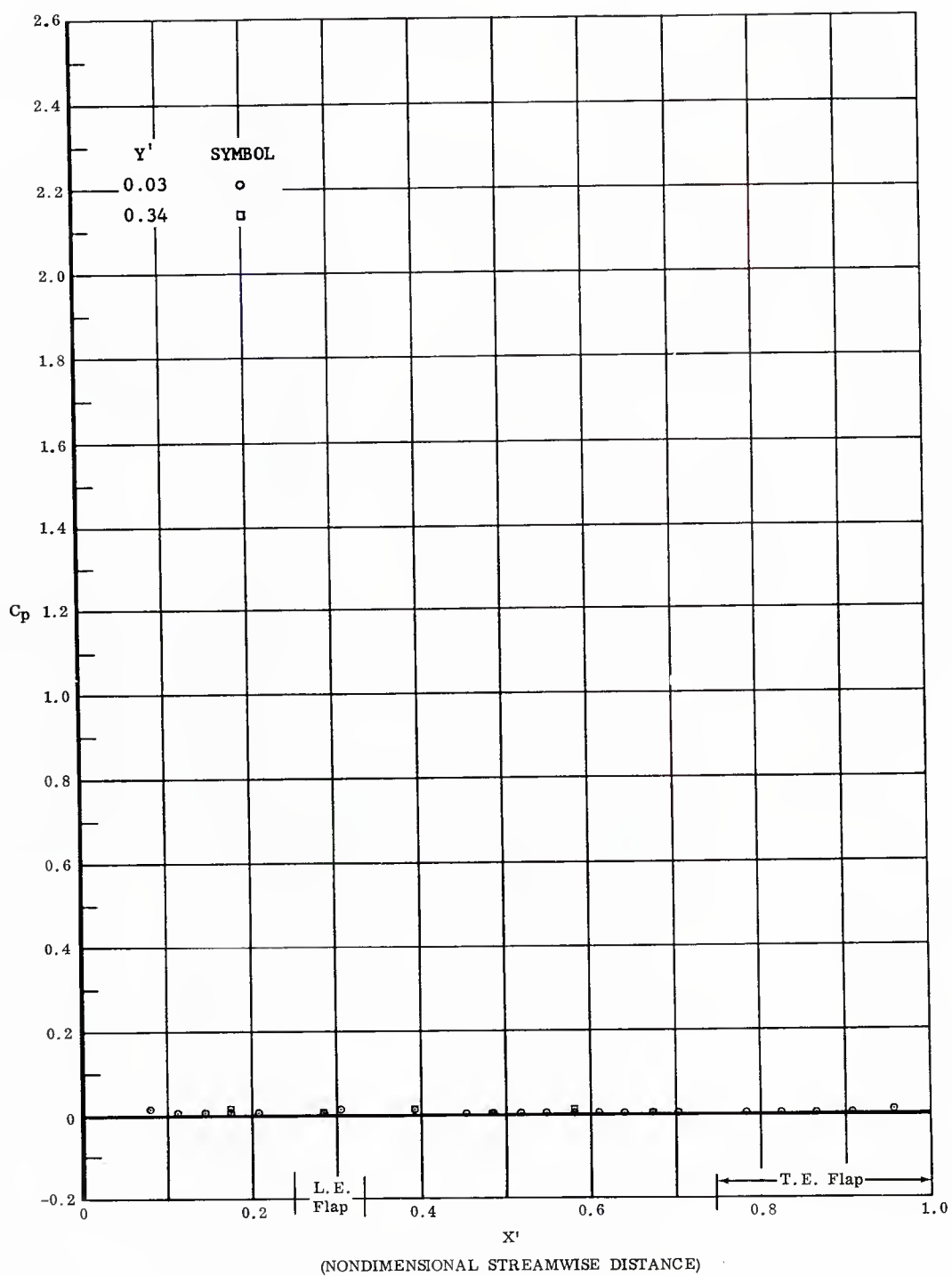


Fig. 53 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Flap Deflection, End
 Plate On

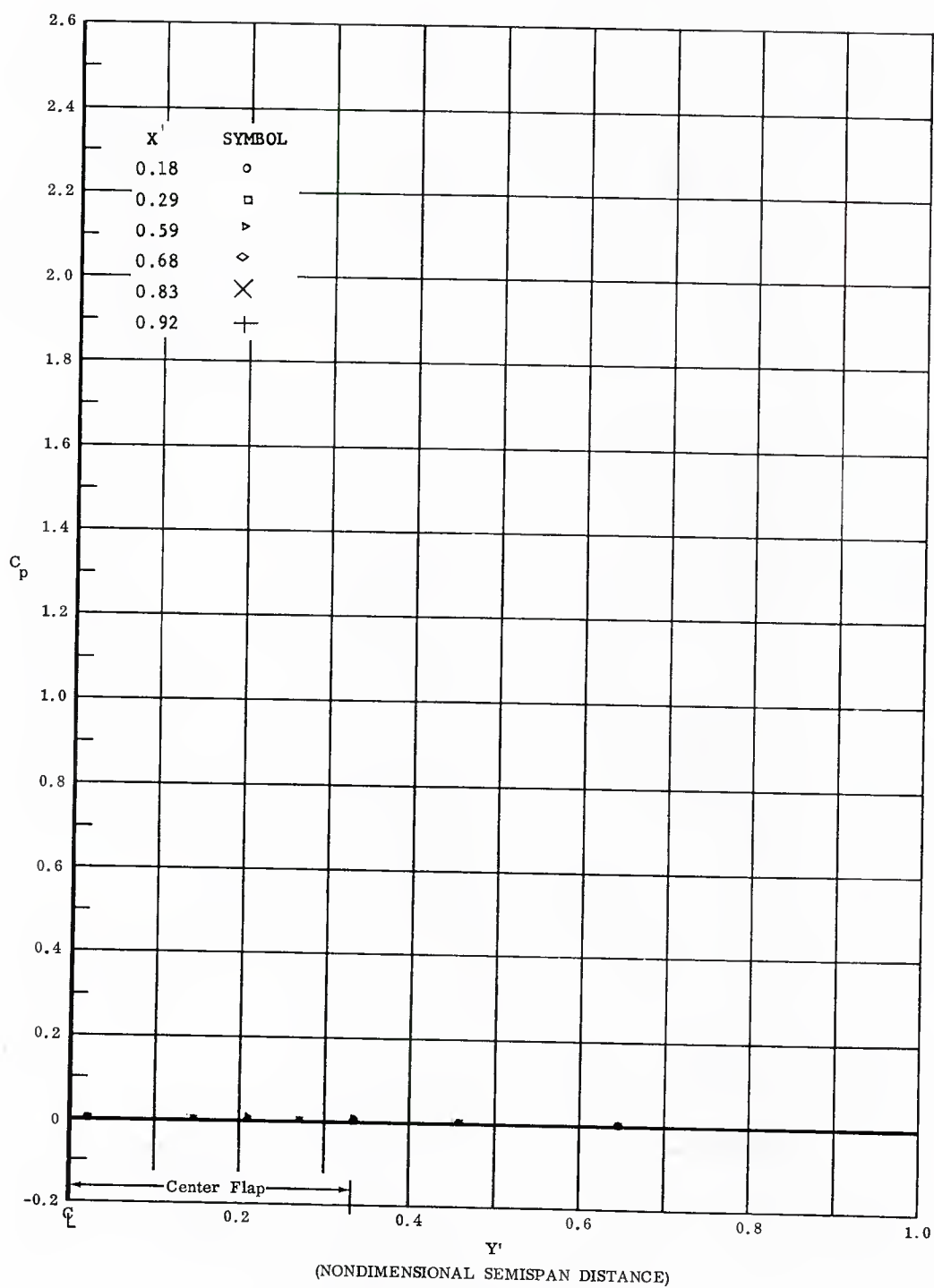


Fig. 53 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Flap Deflection, End
 Plate On

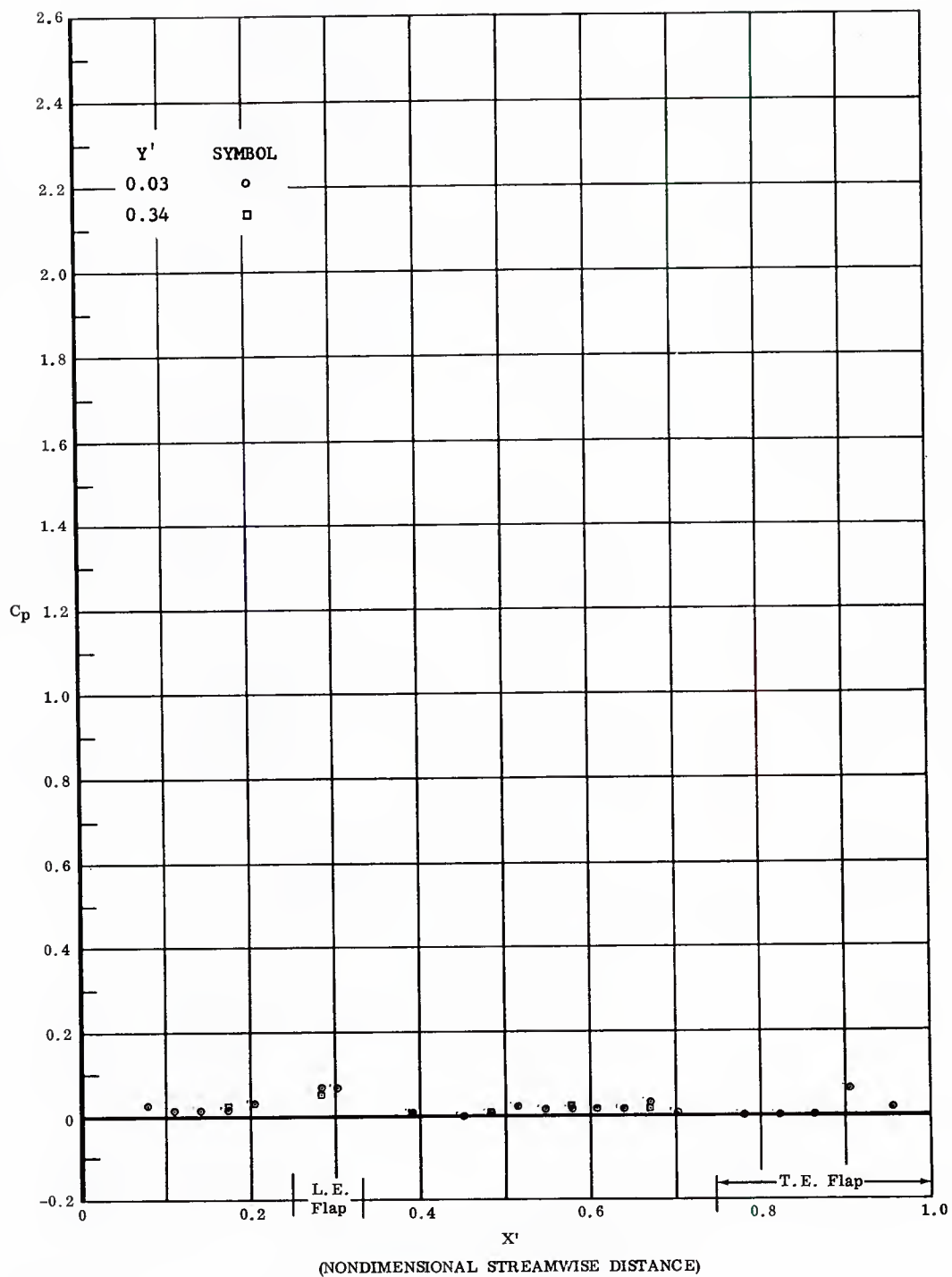


Fig. 54 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Forward Flap at 10° , End
 Plate On

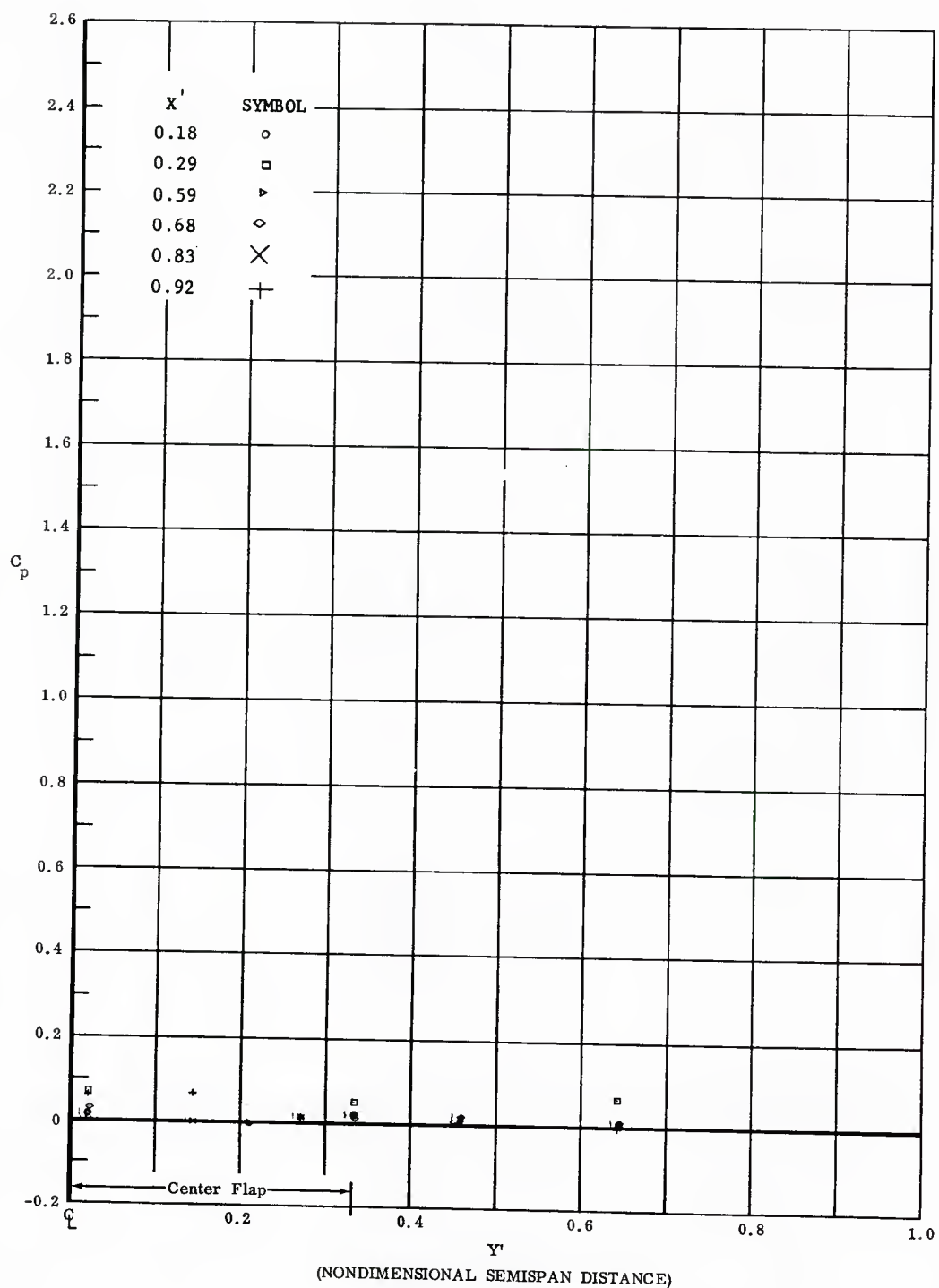


Fig. 54 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 1.1$, Forward Flap at 10° , End
 Plate On

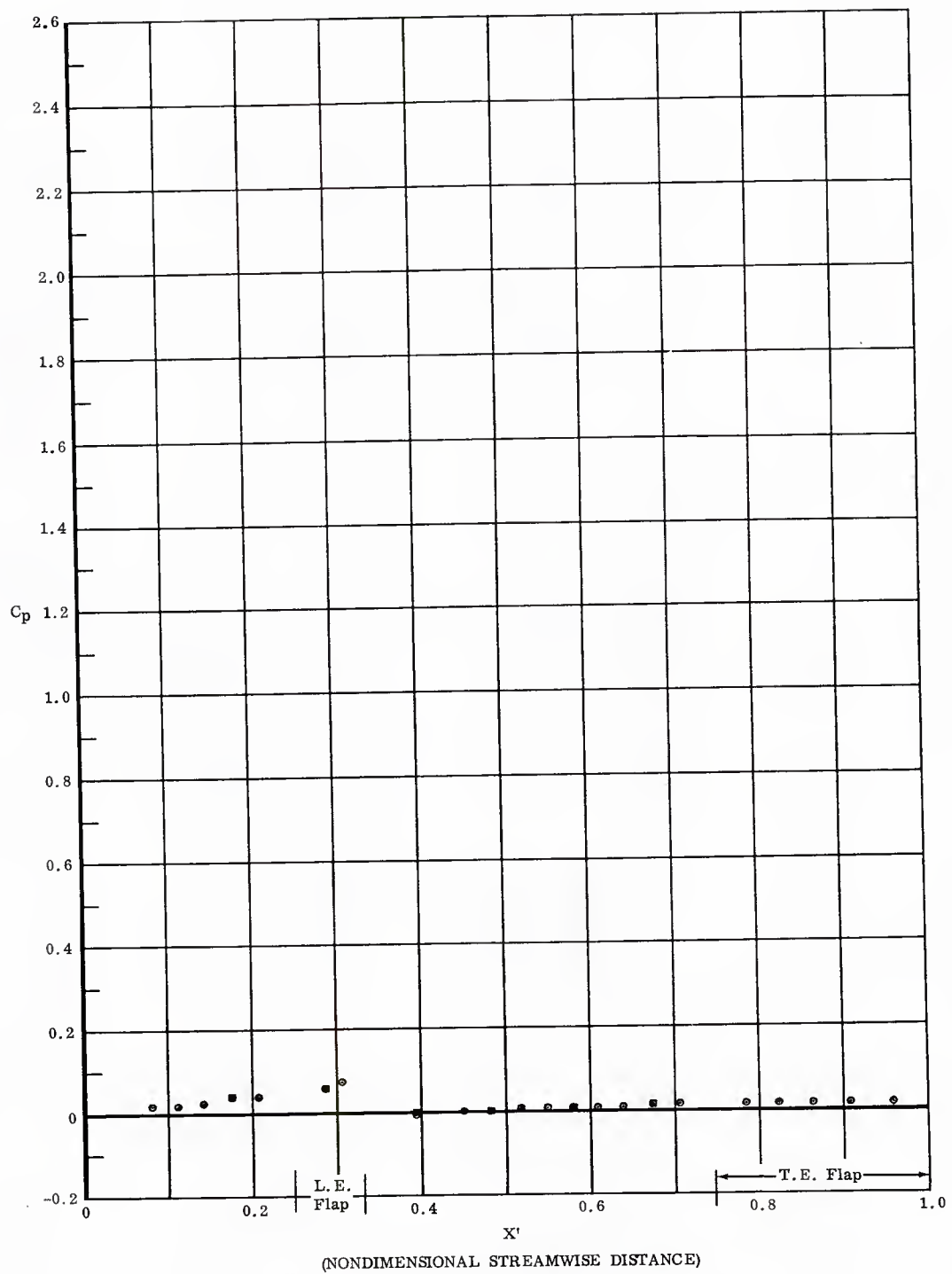


Fig. 55 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 10° , End
 Plate Off

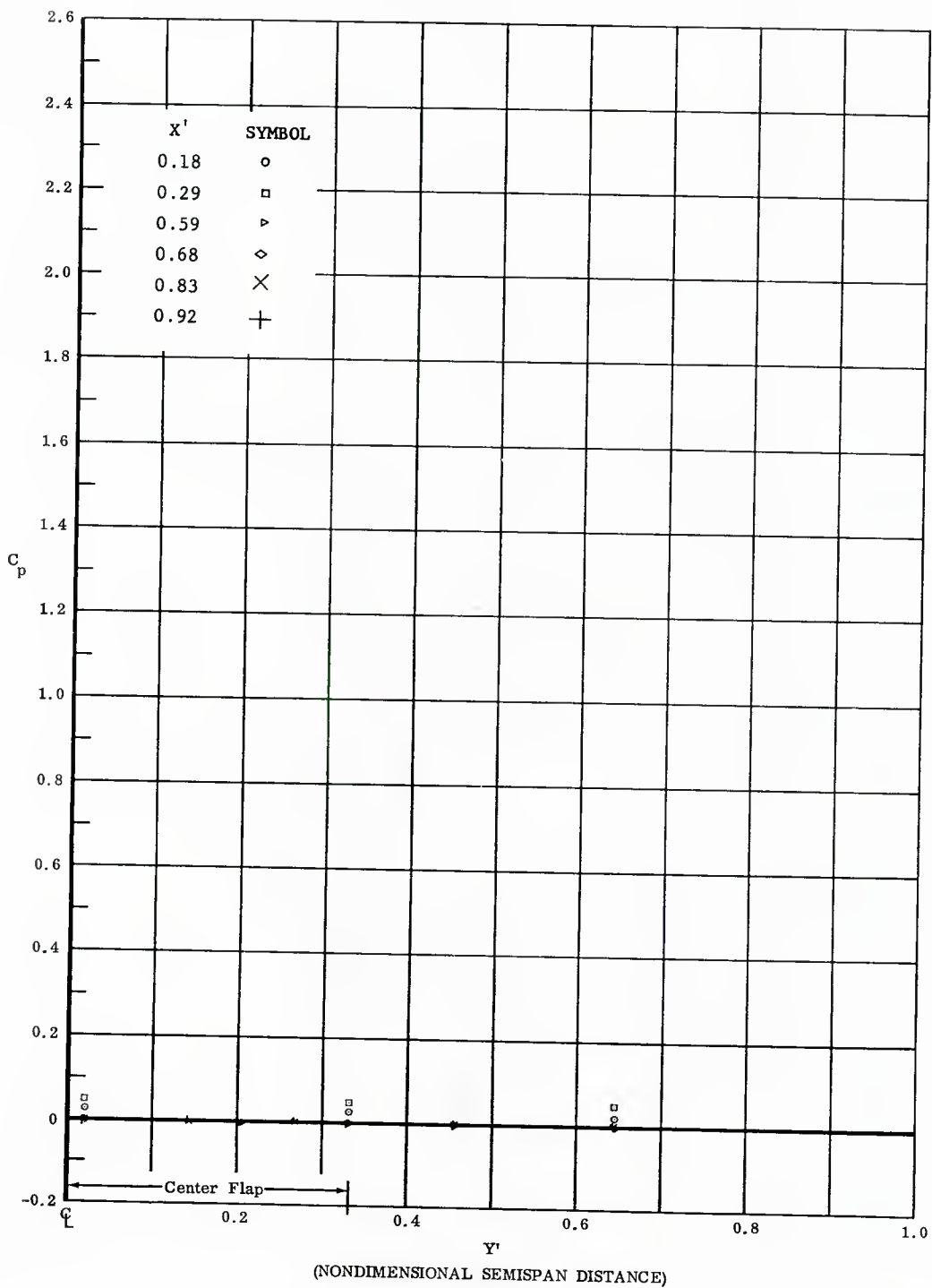


Fig. 55 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_\infty / 10^6 \text{ ft} = 3.3$, Forward Flap at 10° , End
 Plate Off

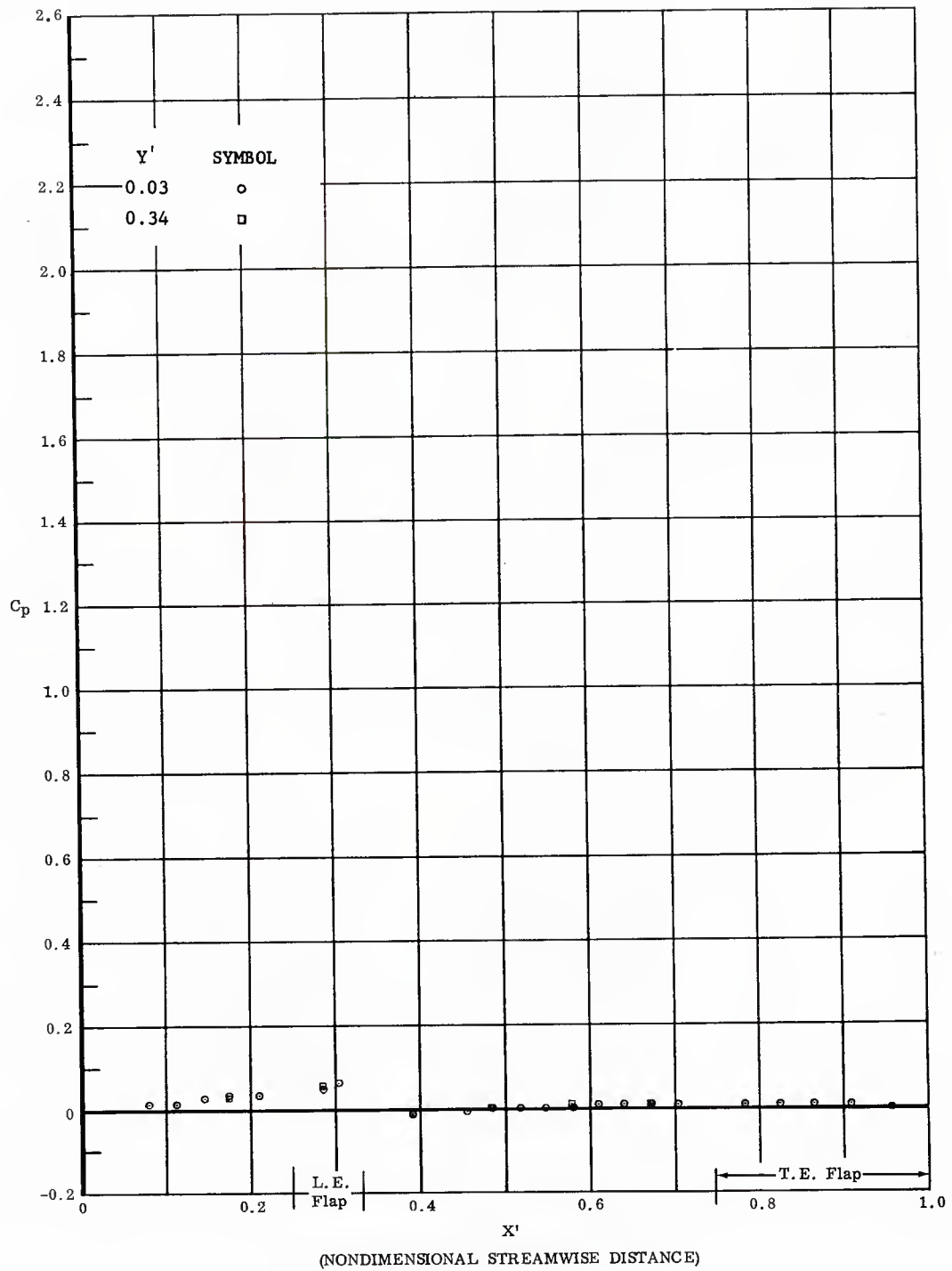


Fig. 56 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flaps at 10° , End
 Plate Off

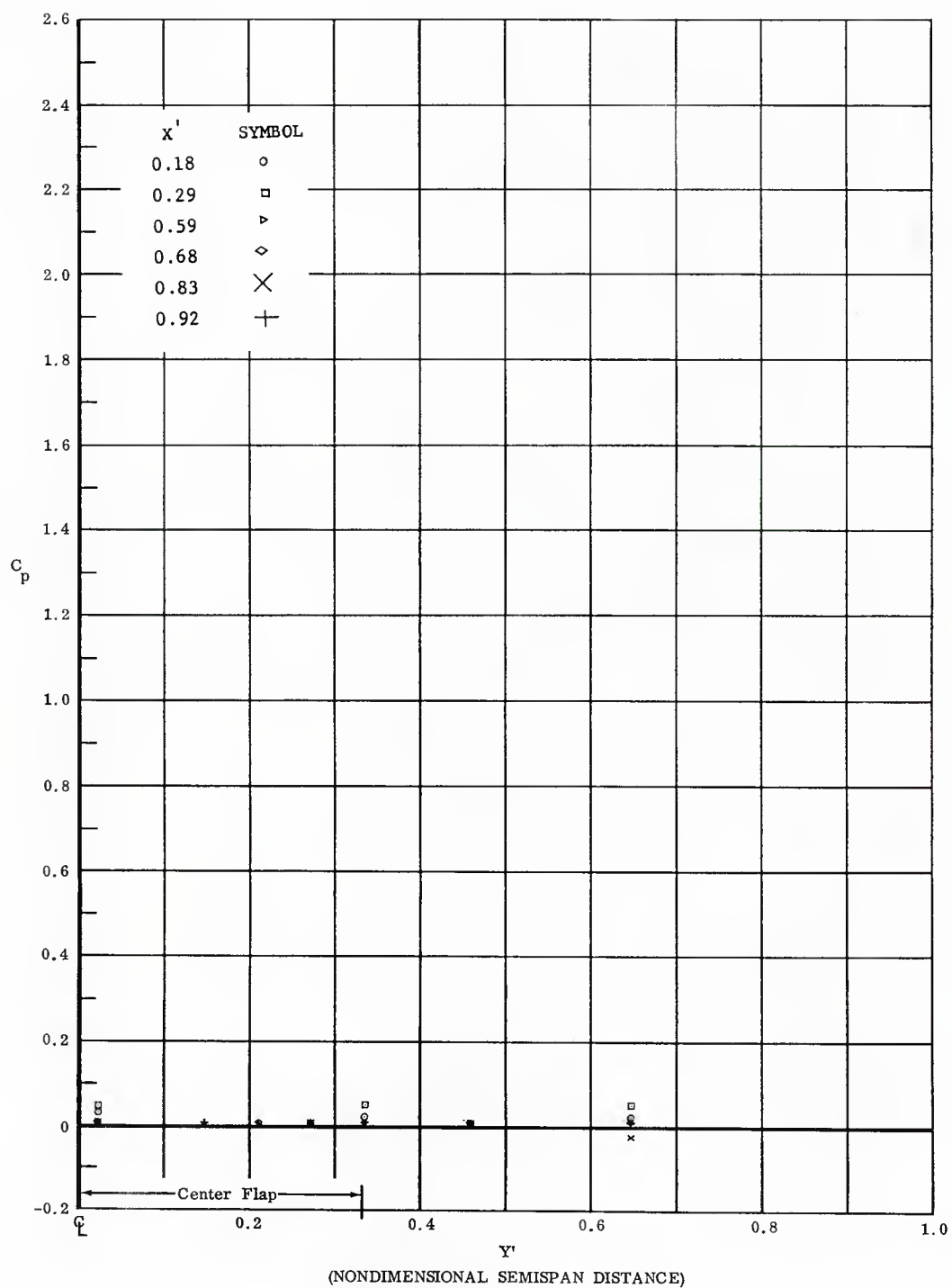


Fig. 56 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flaps at 10° , End
 Plate Off

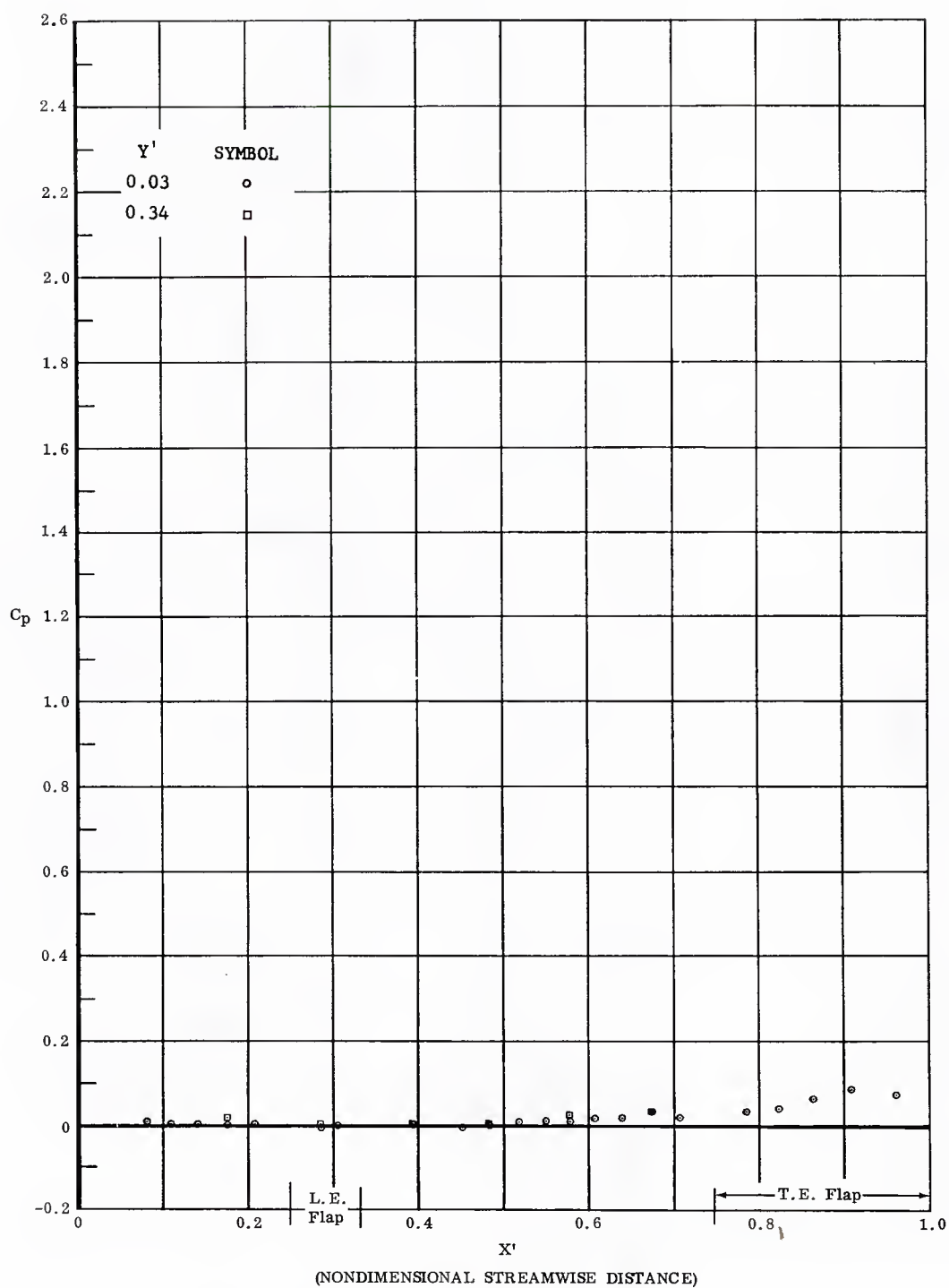


Fig. 57 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 10° ,
 End Plate Off

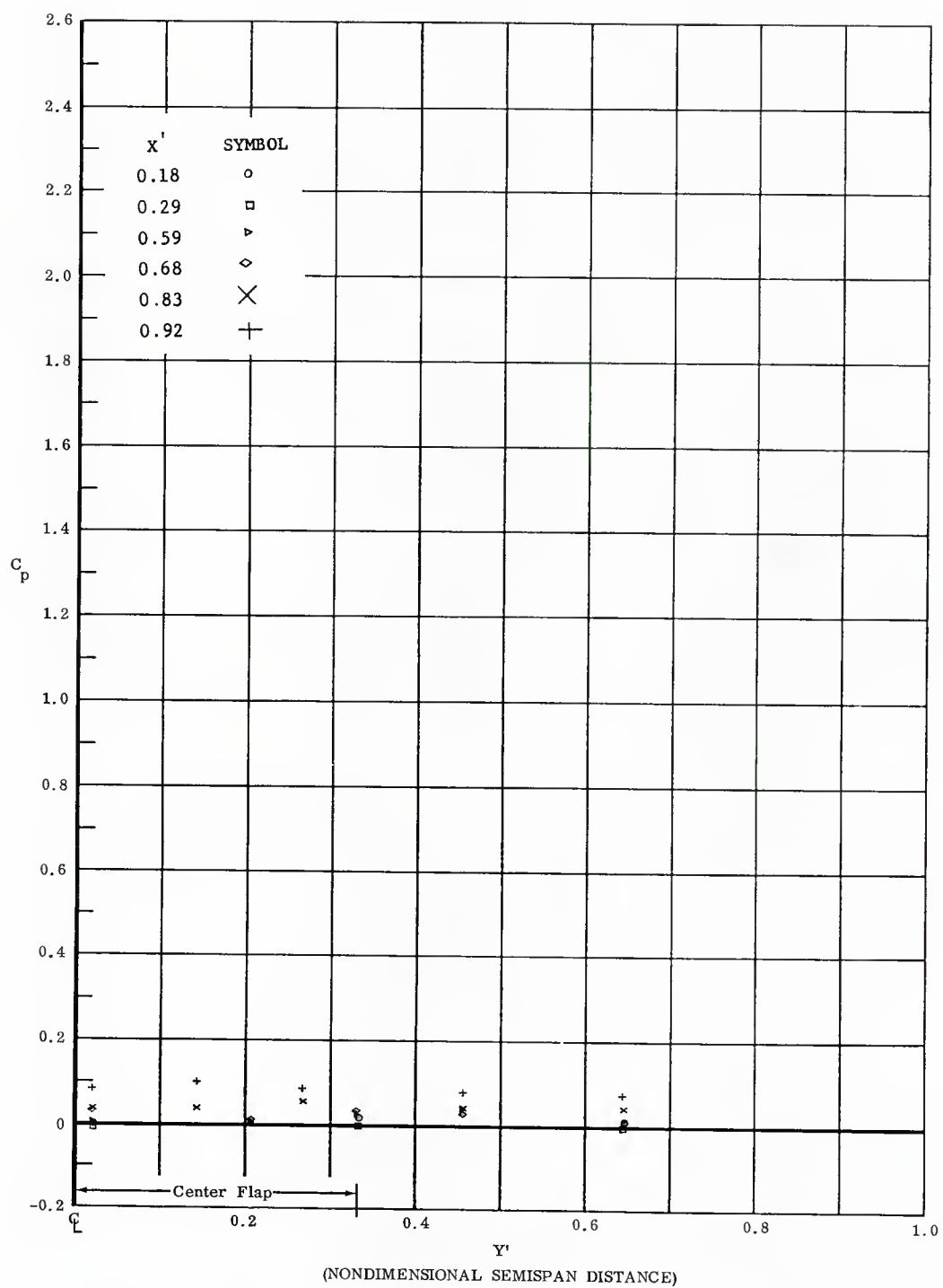


Fig. 57 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re / 10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 10° ,
 End Plate Off

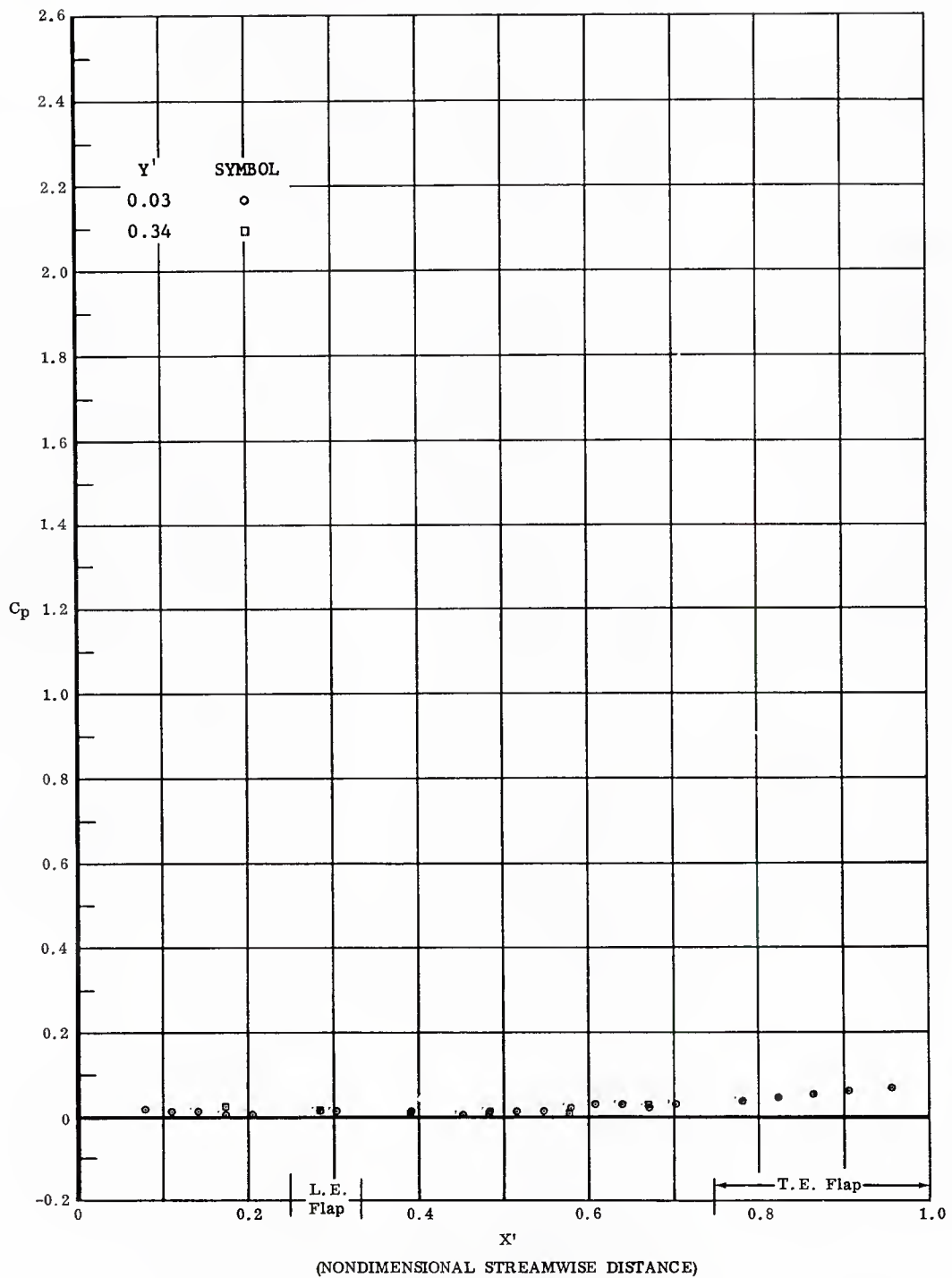


Fig. 58 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 10° ,
 End Plate On

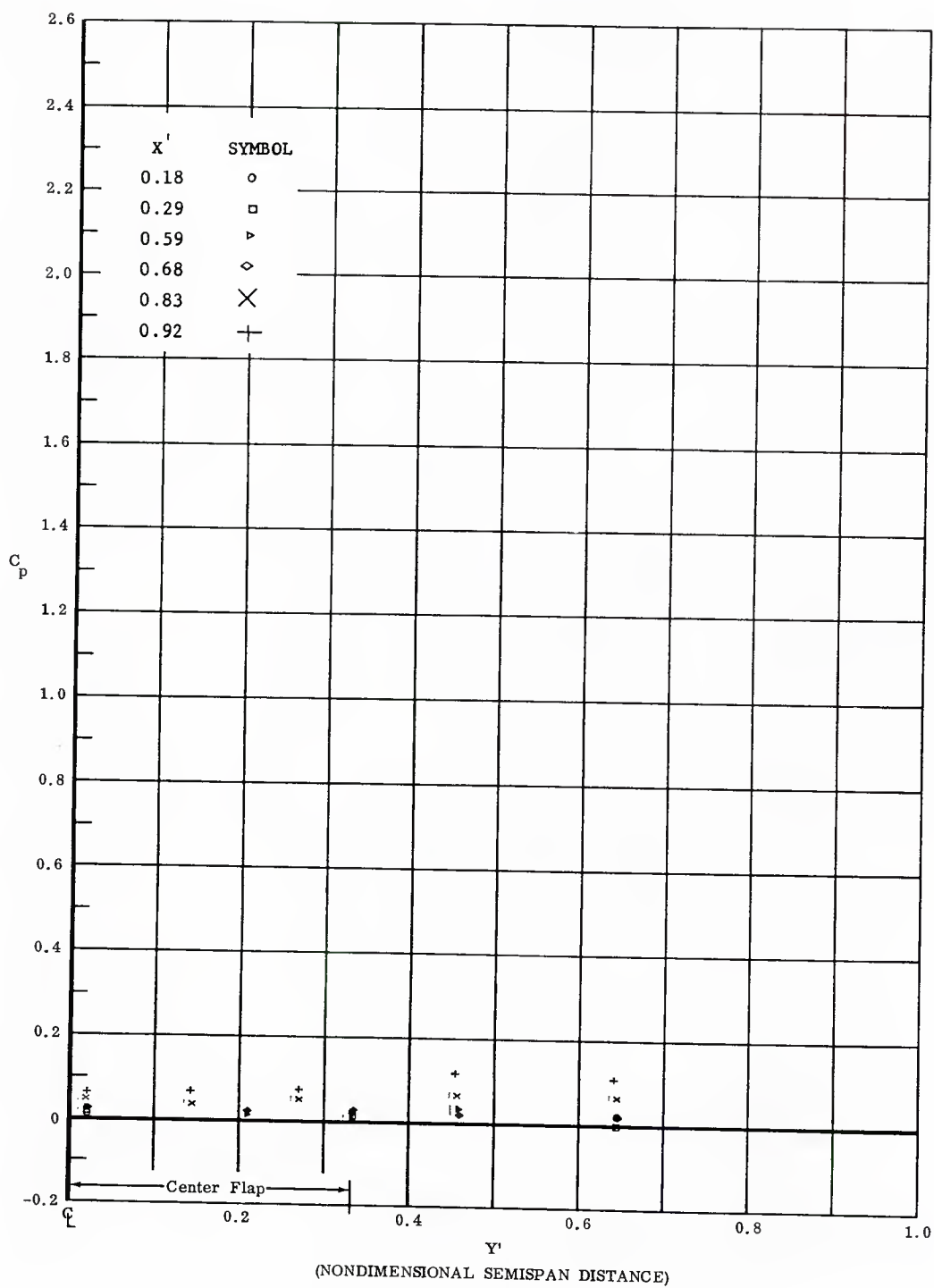


Fig. 58 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 1.1$, Aft Full Span Flap at 10° ,
 End Plate On

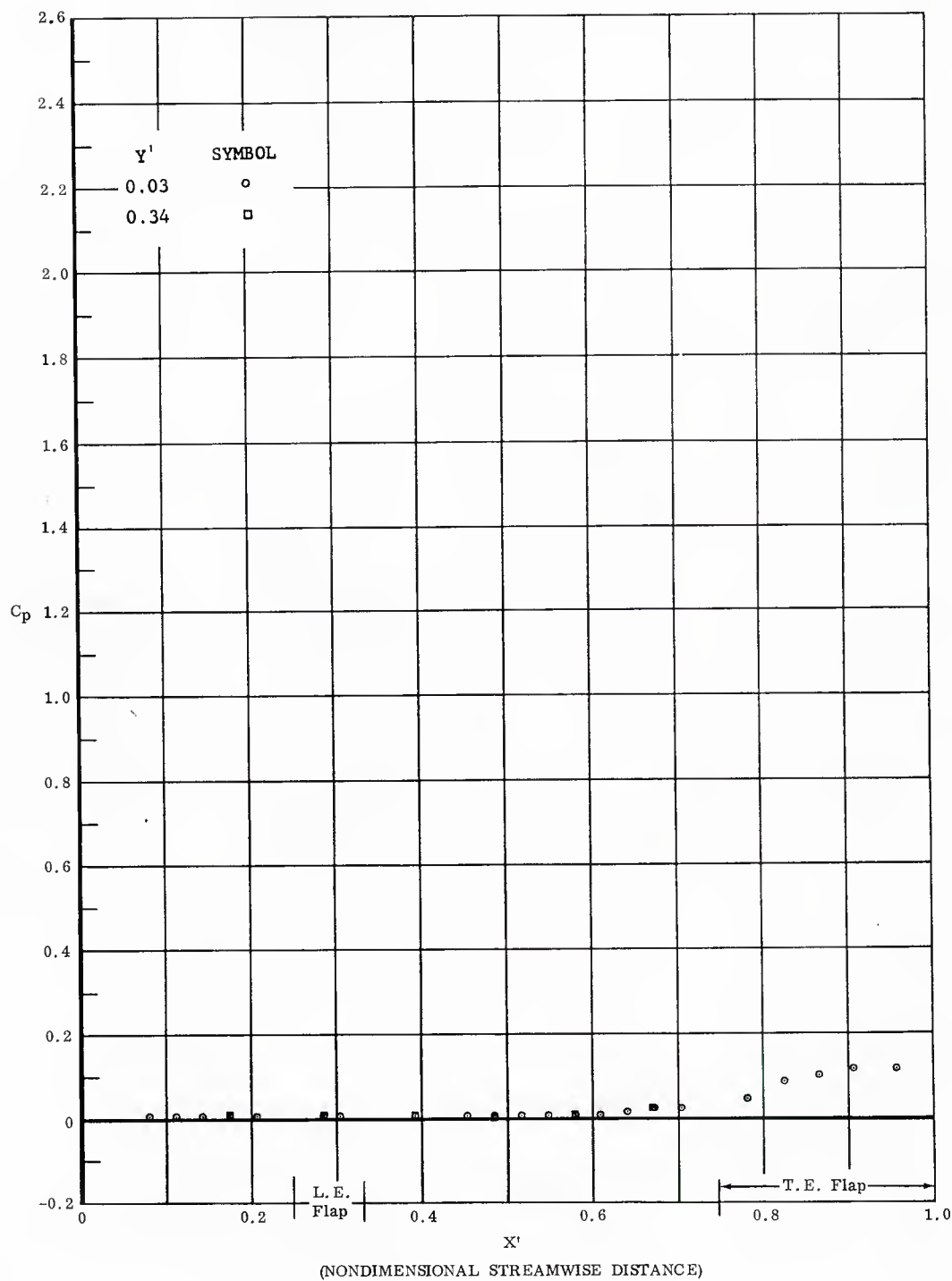


Fig. 59 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, Aft Full Span Flap at 10° ,
 End Plate Off

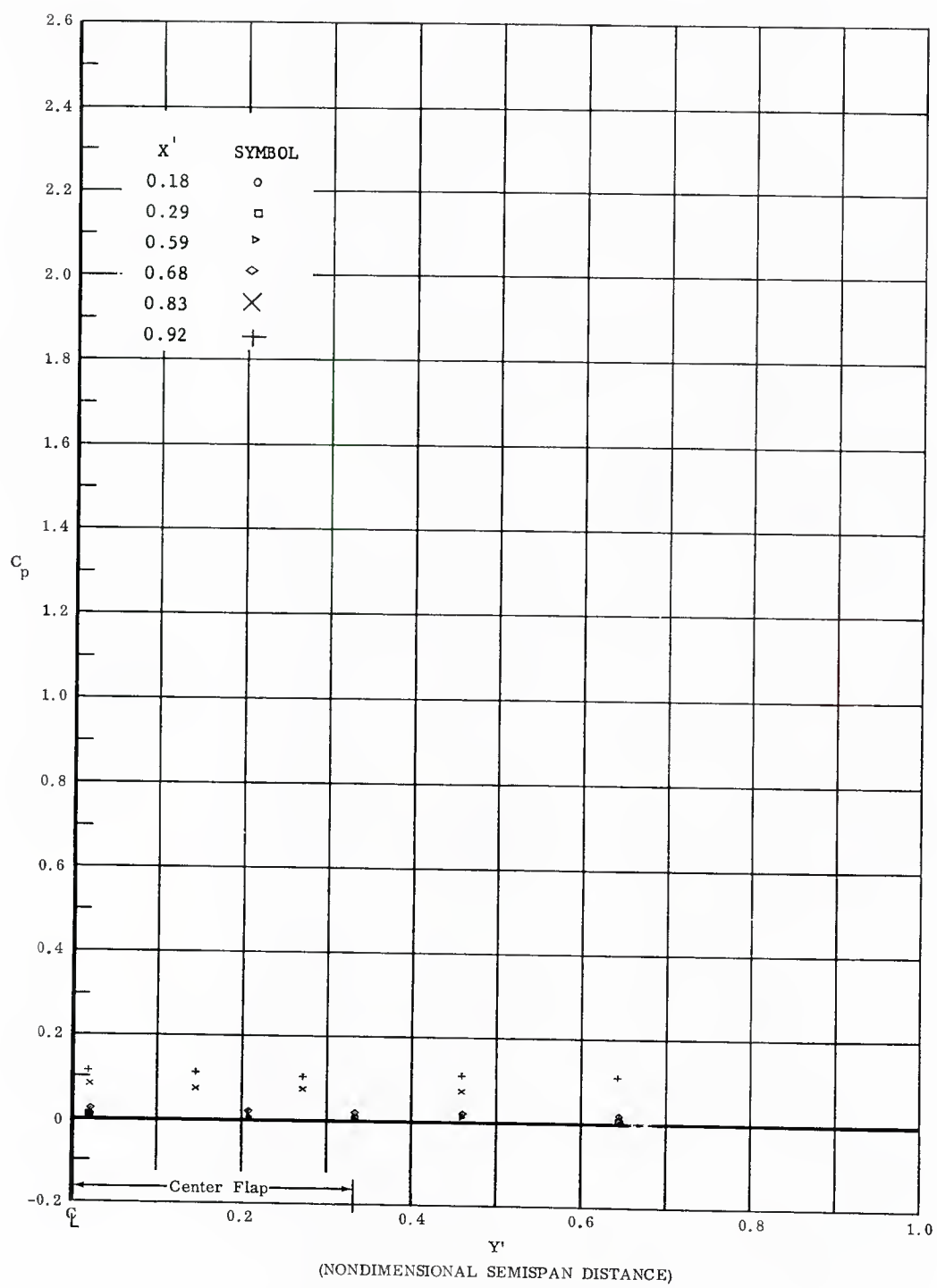


Fig. 59 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 ft = 3.3$, Aft Full Span Flap at 10° ,
 End Plate Off

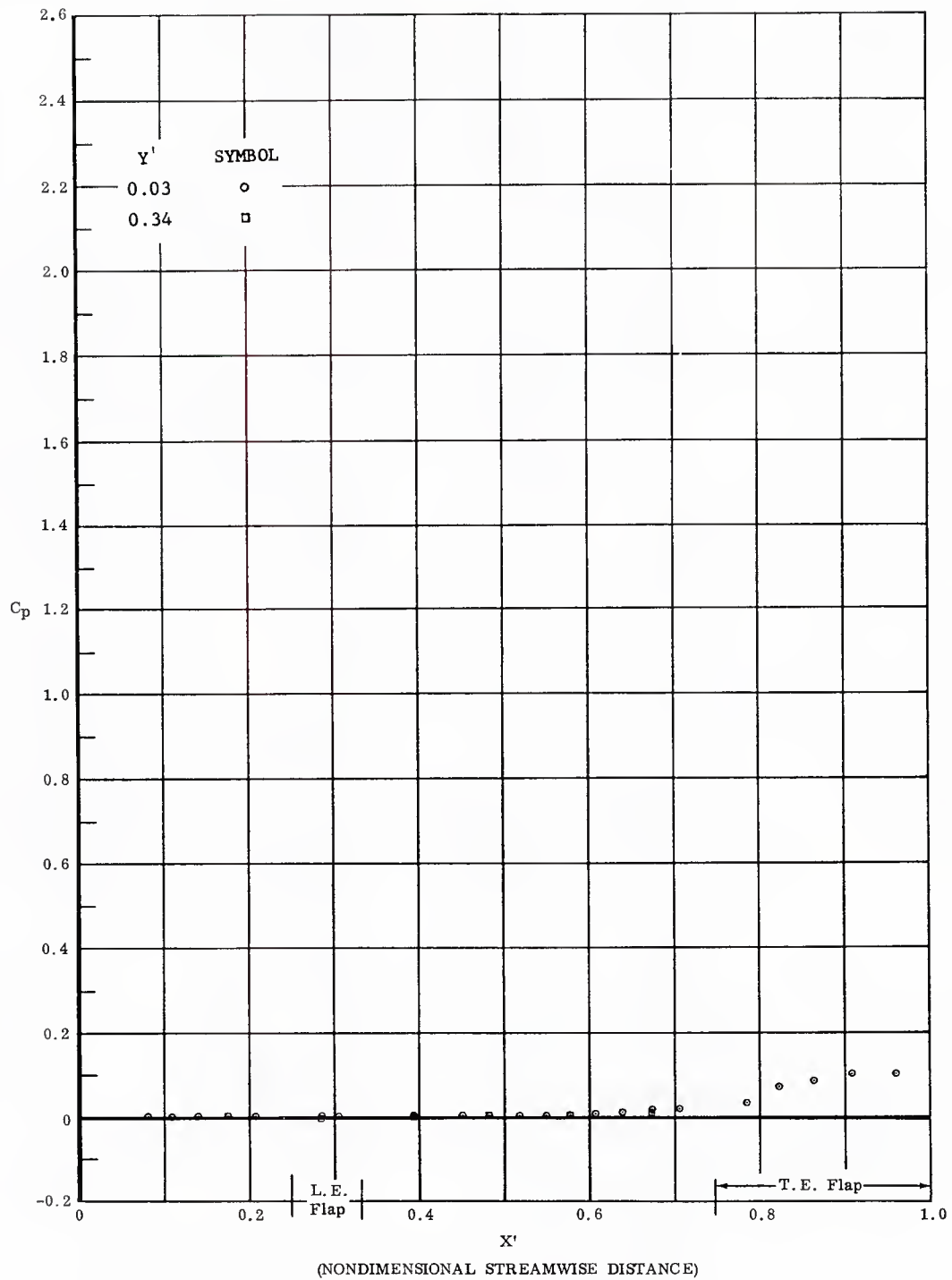


Fig. 60 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 10° ,
 End Plate On

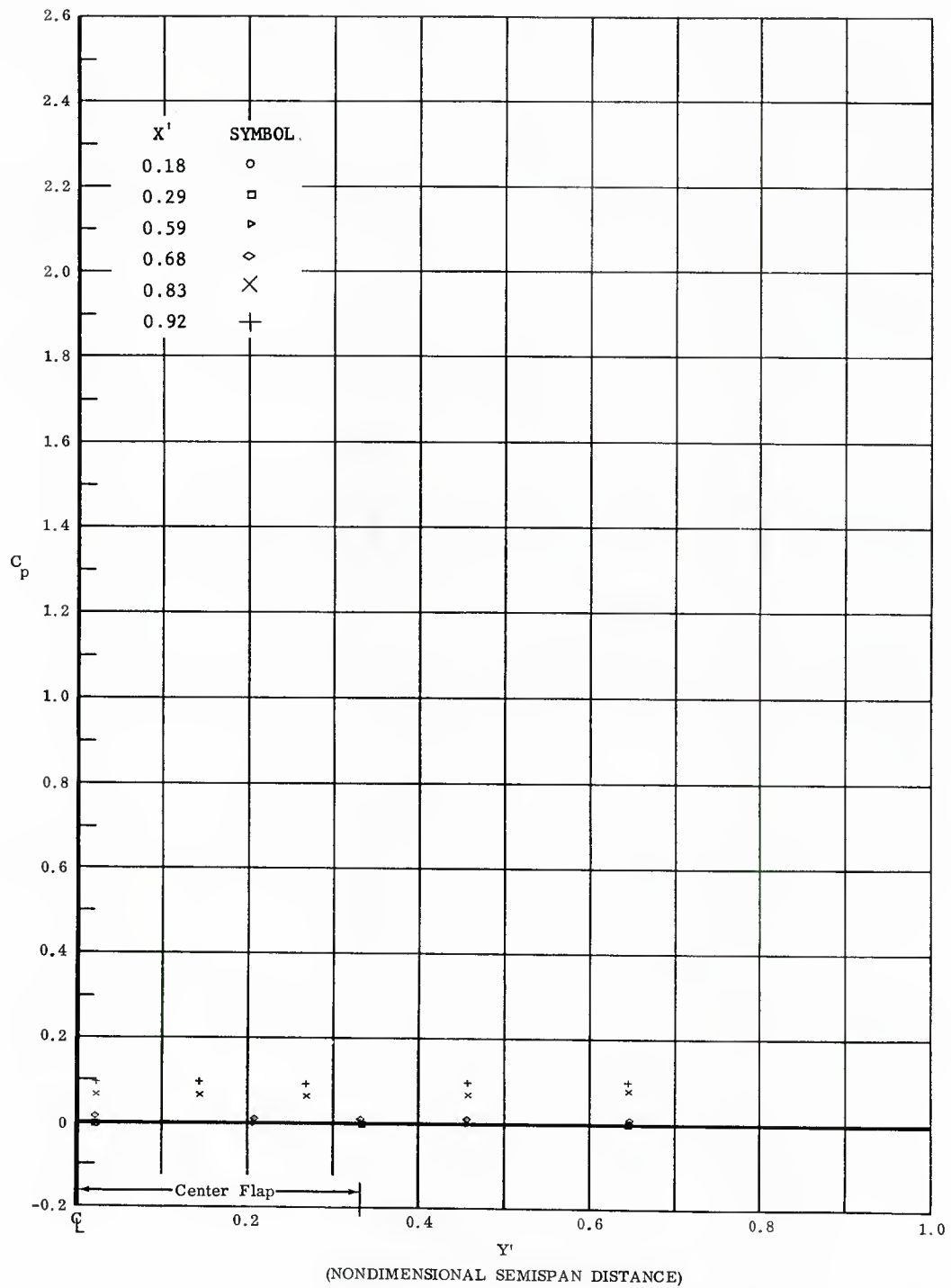


Fig. 60 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 10° ,
 End Plate On

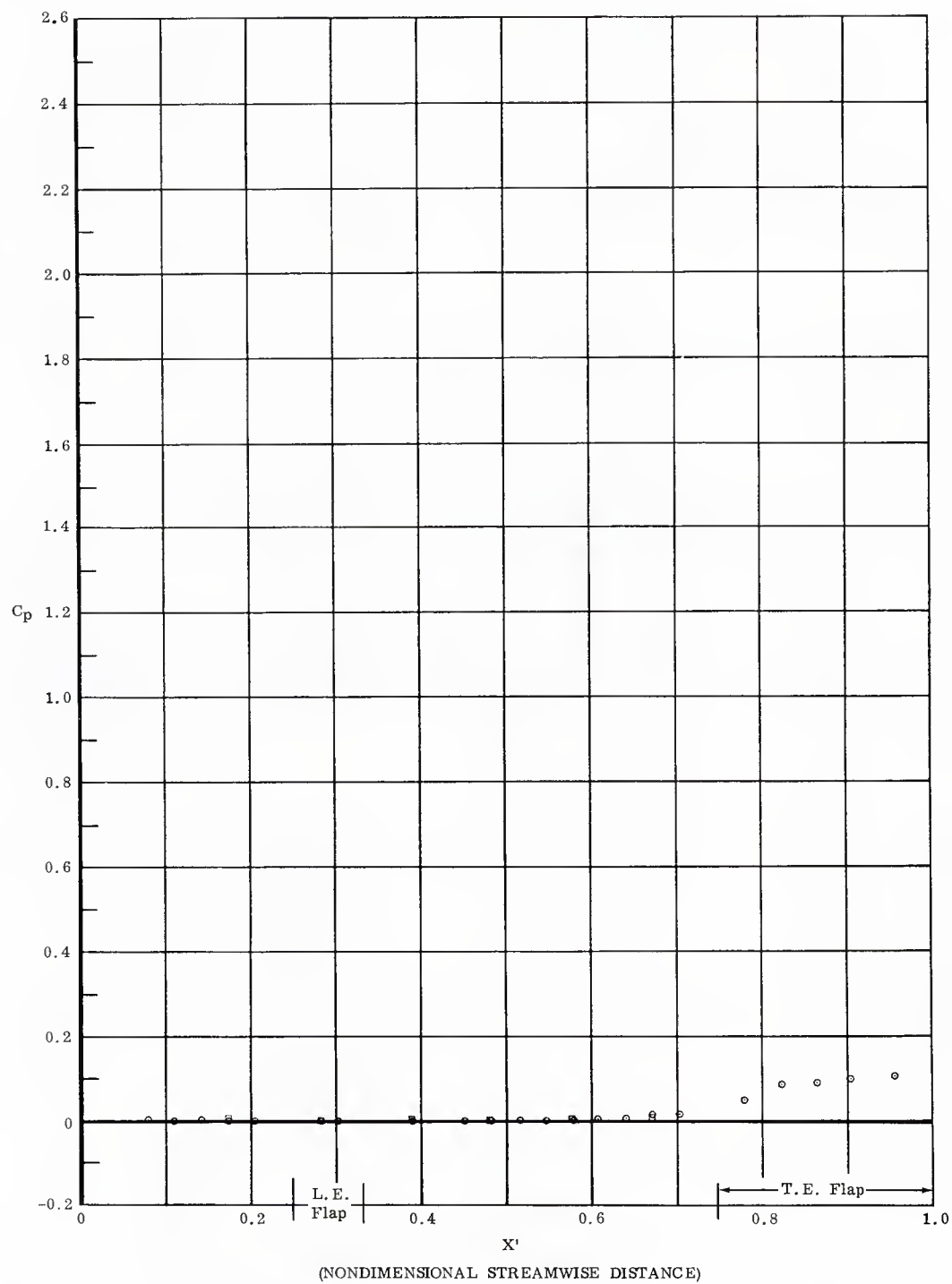


Fig. 61 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 10° ,
 End Plate Off

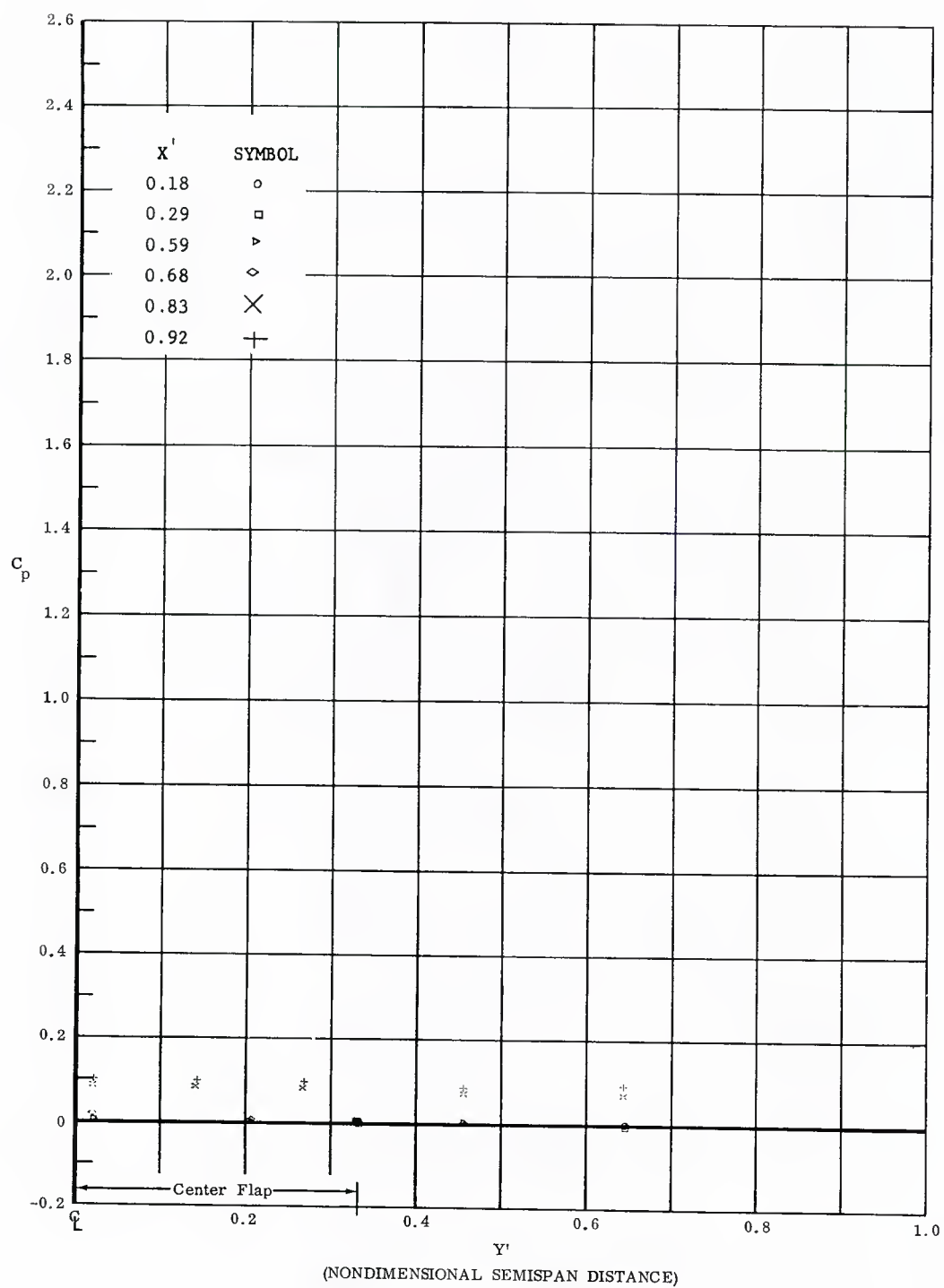


Fig. 61 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 10° ,
 End Plate Off

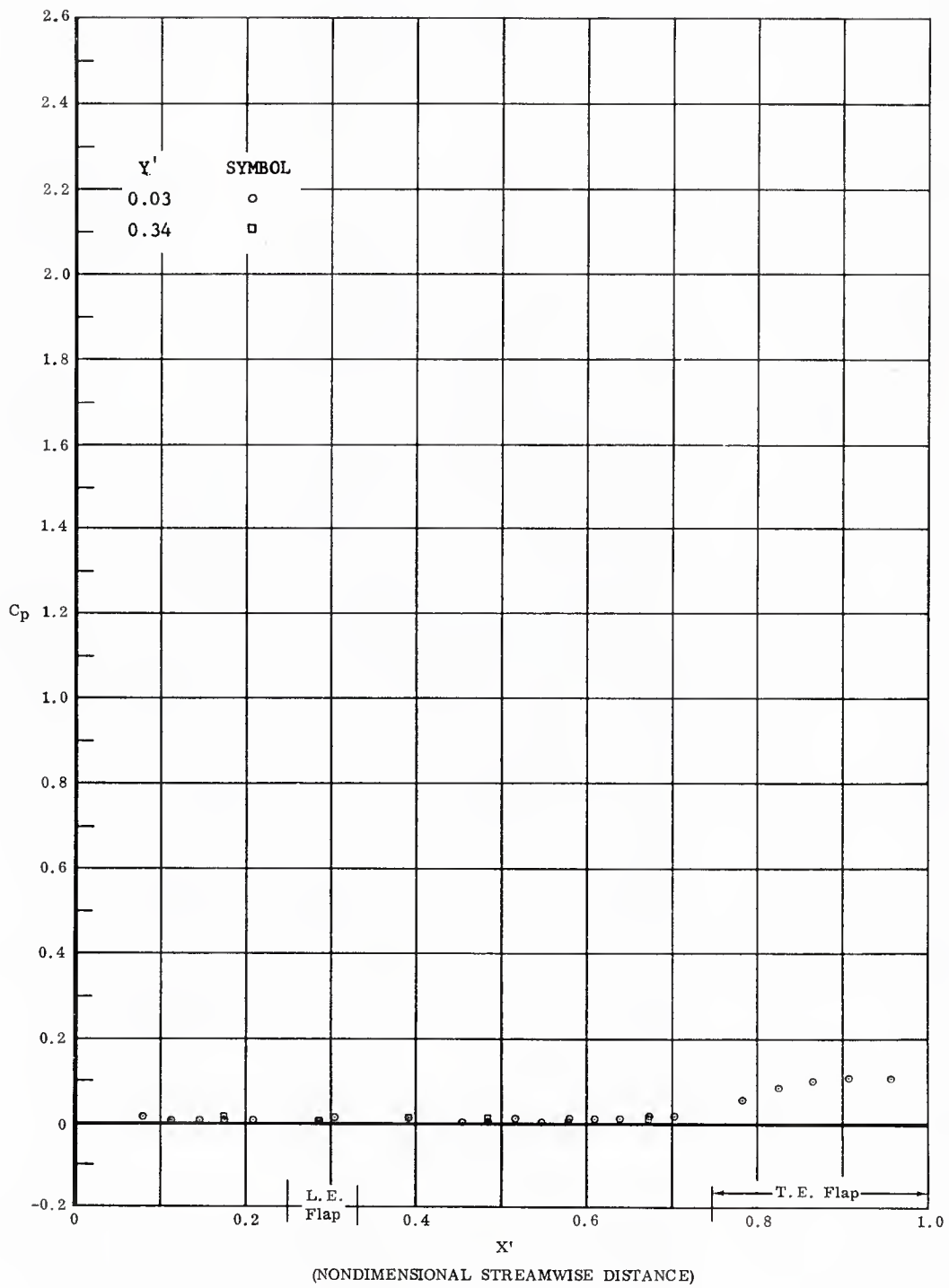


Fig. 62 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, Aft Full Span Flap at 10° ,
 End Plate On

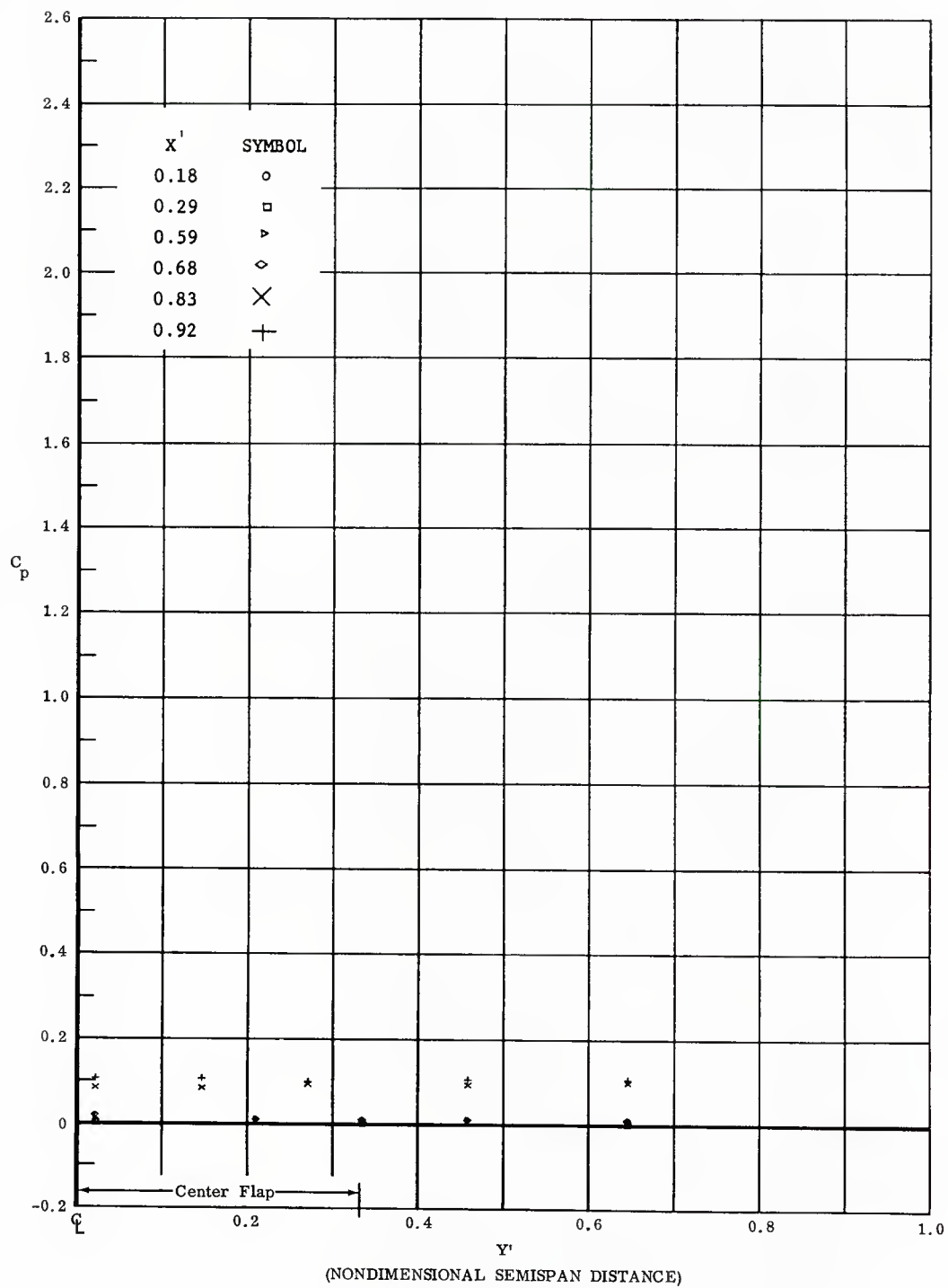


Fig. 62 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 10° ,
 End Plate On

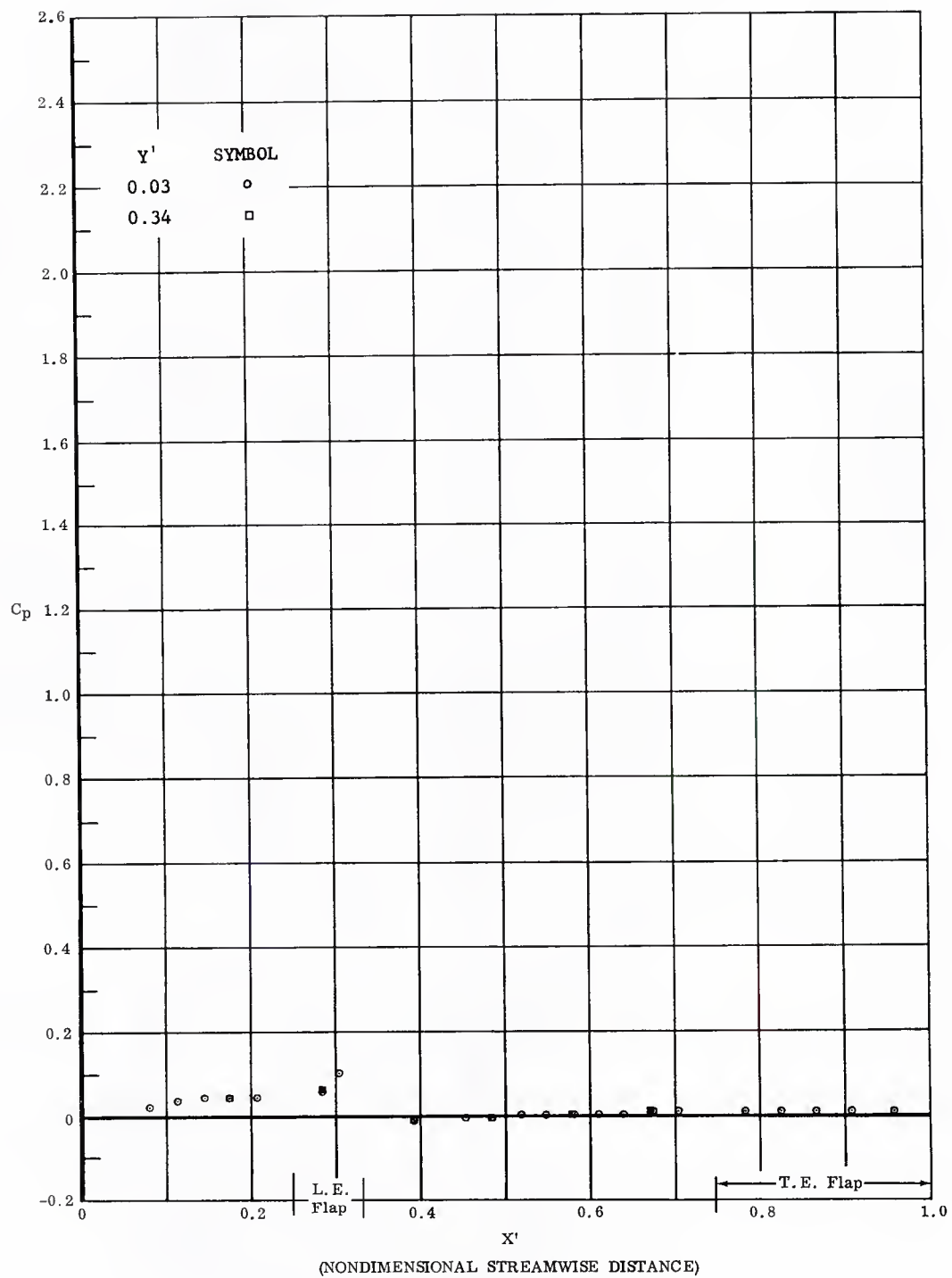


Fig. 63 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flaps at 15° ,
 End Plate Off

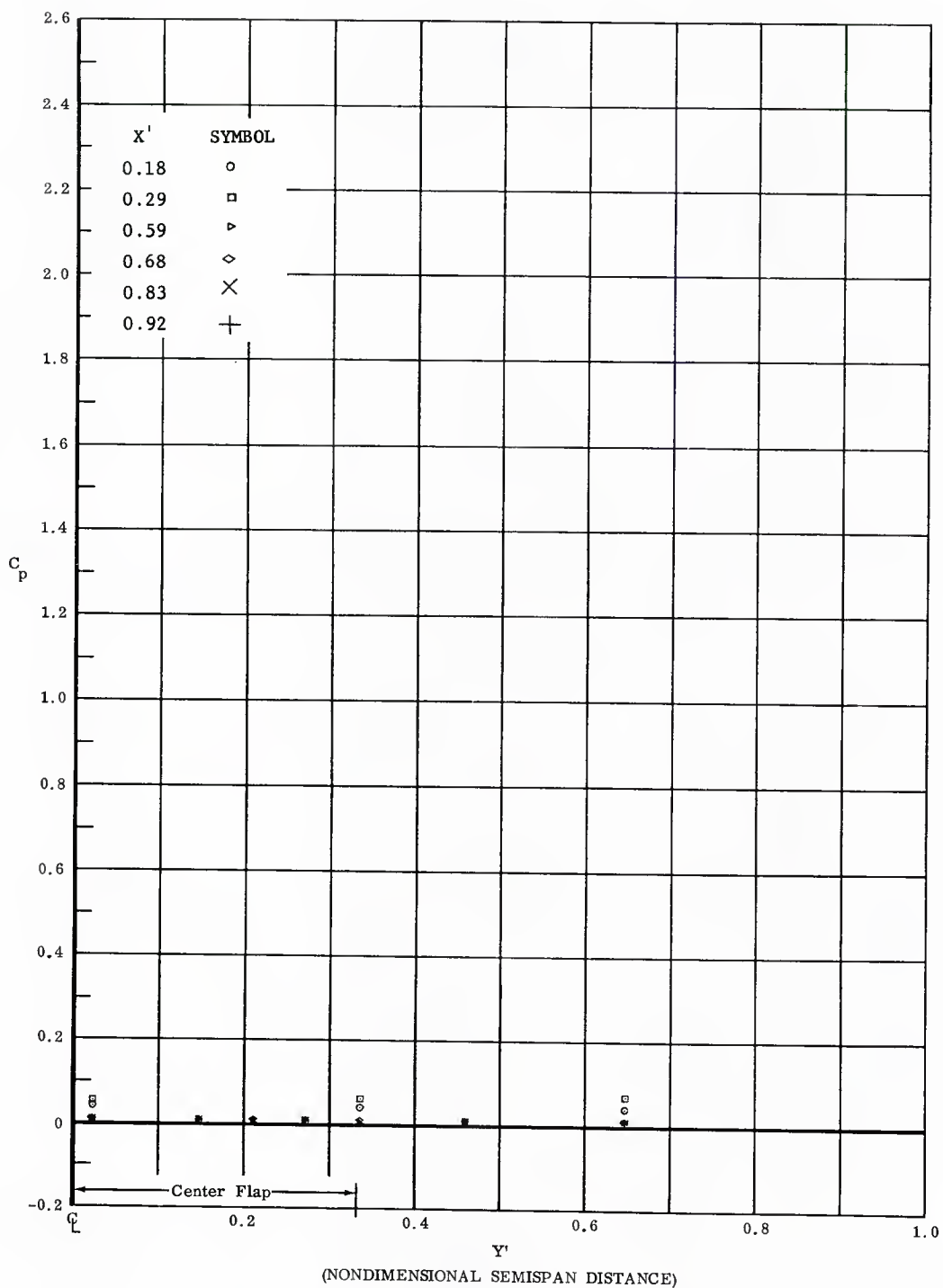


Fig. 63 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flaps at 15° ,
 End Plate Off

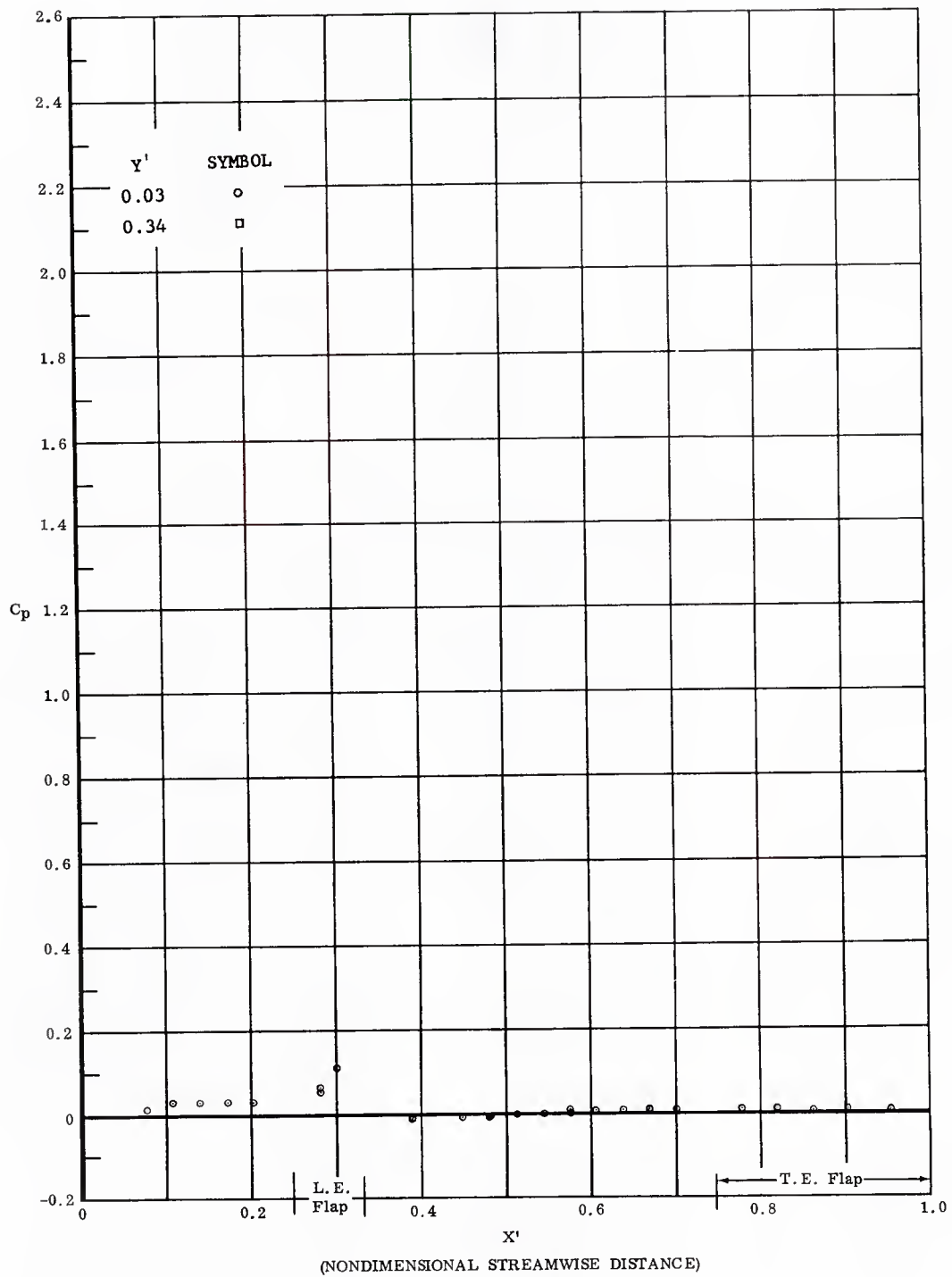


Fig. 64 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 15° ,
 End Plates Off

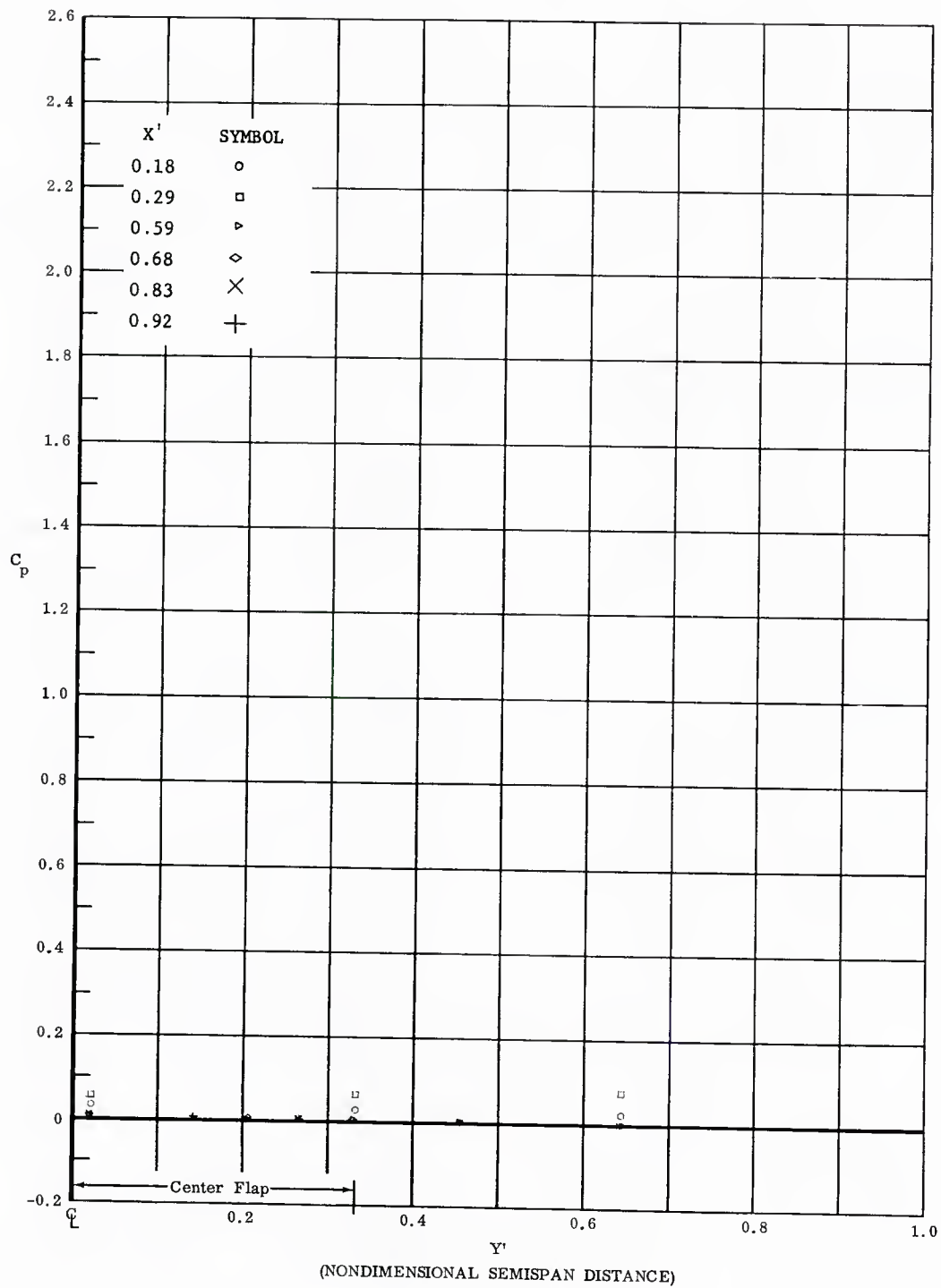


Fig. 64 Pressure Coefficient Data Plots; $\alpha = 0$,
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 15° ,
 End Plates Off

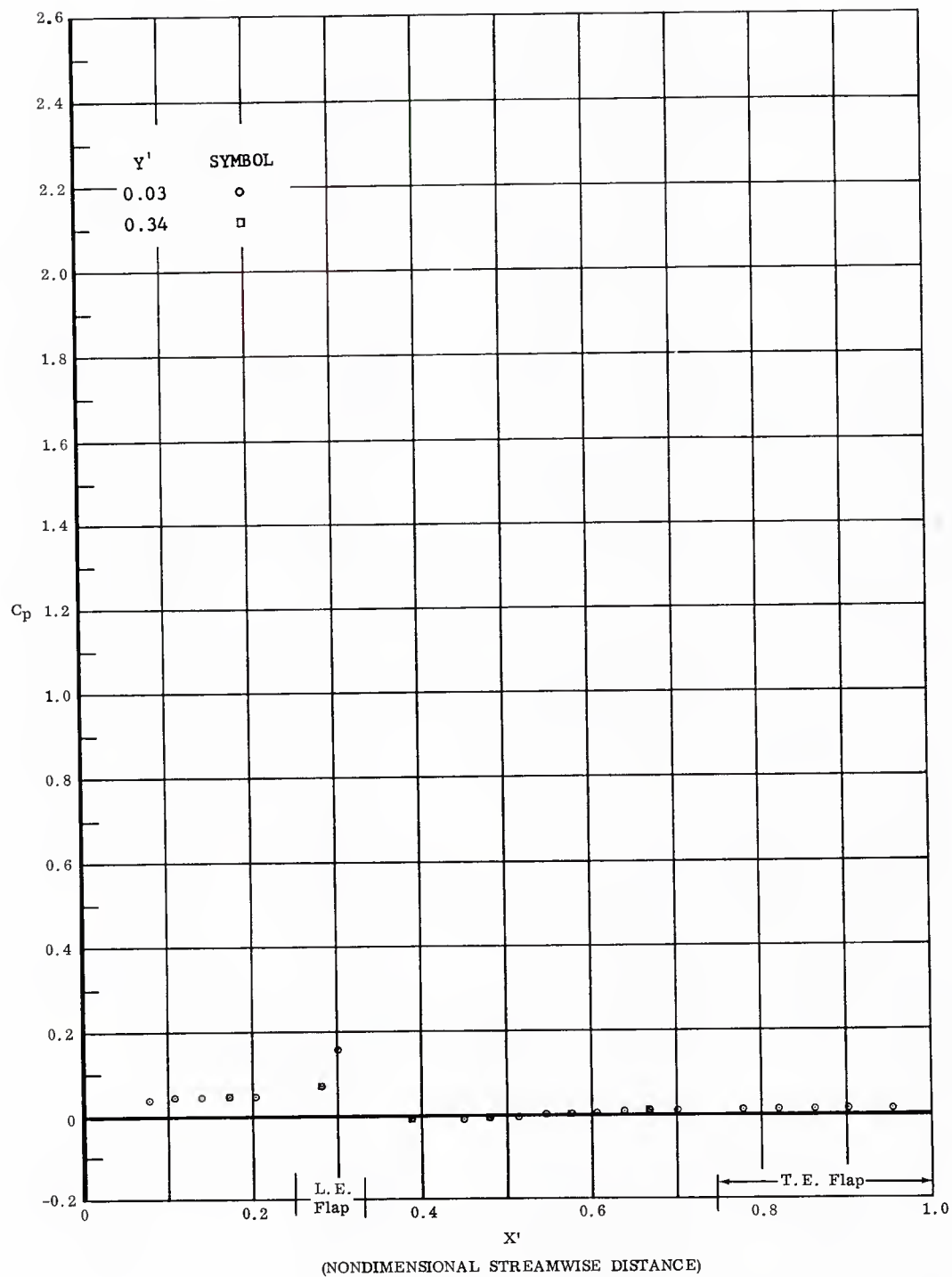


Fig. 65 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 20° , End
 Plate Off

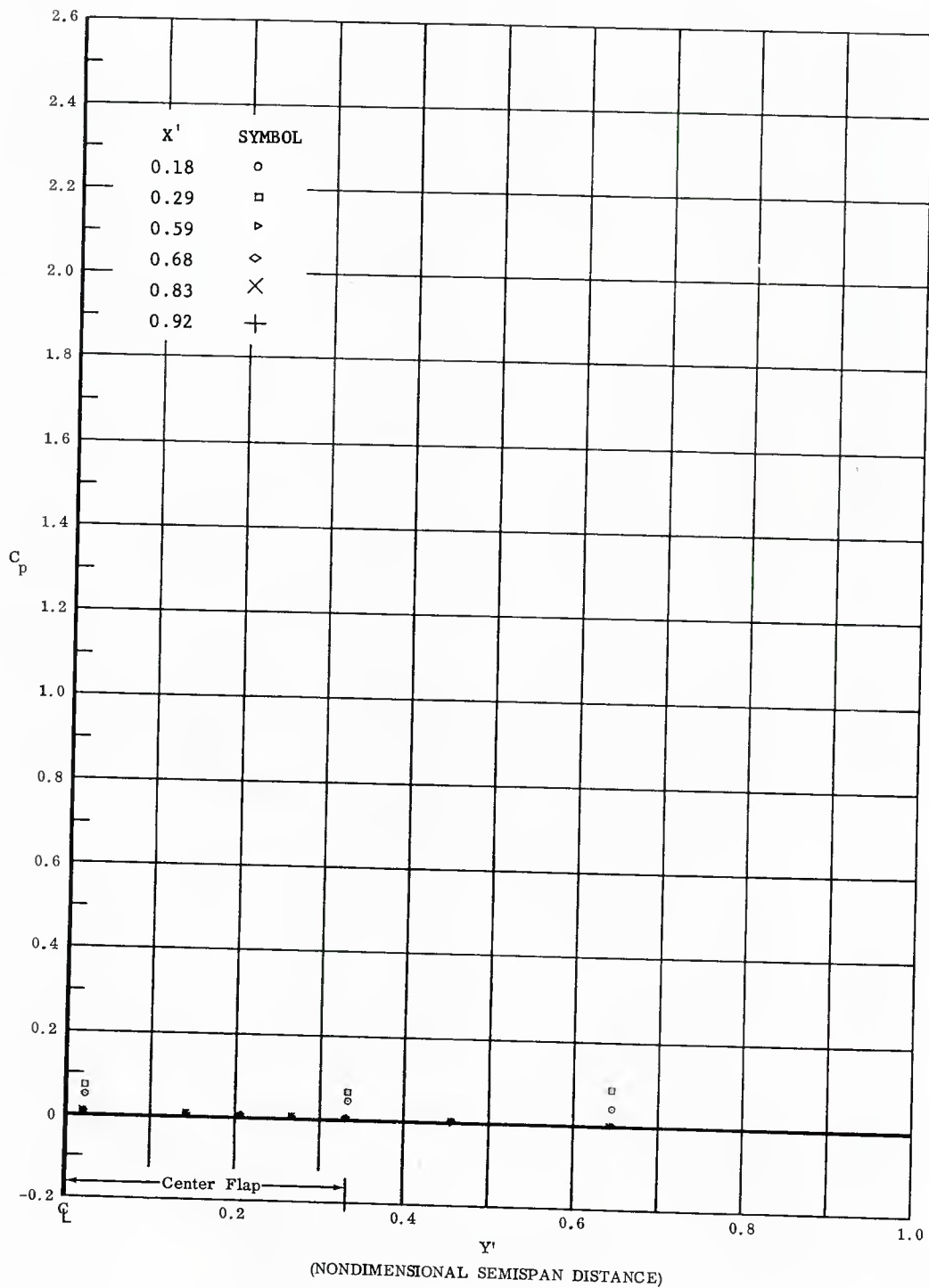


Fig. 65 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 20° , End
 Plate Off

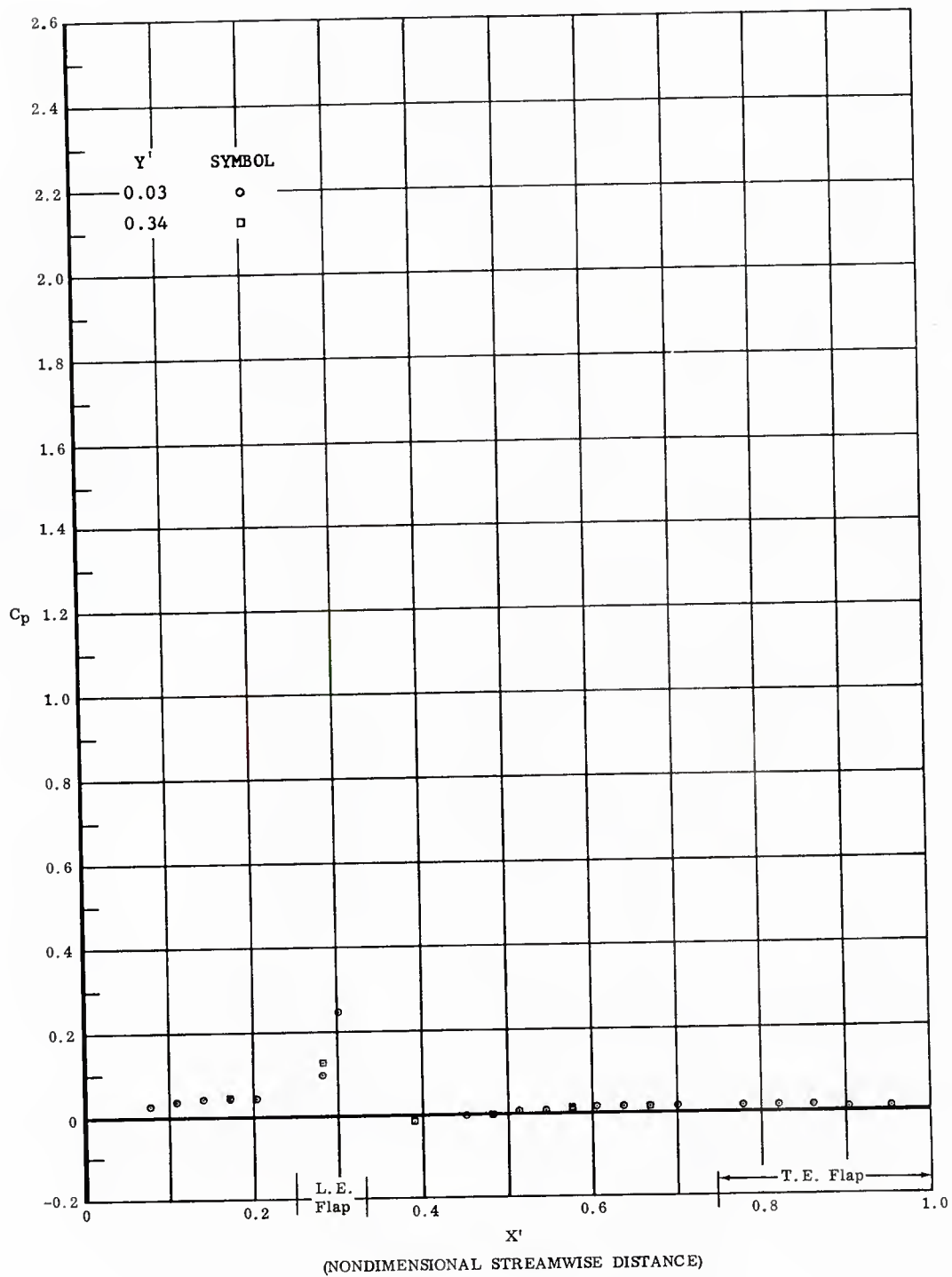


Fig. 66 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_\infty / 10^6 \text{ ft} = 6.6$, Forward Flap at 20° , End
 Plate Off

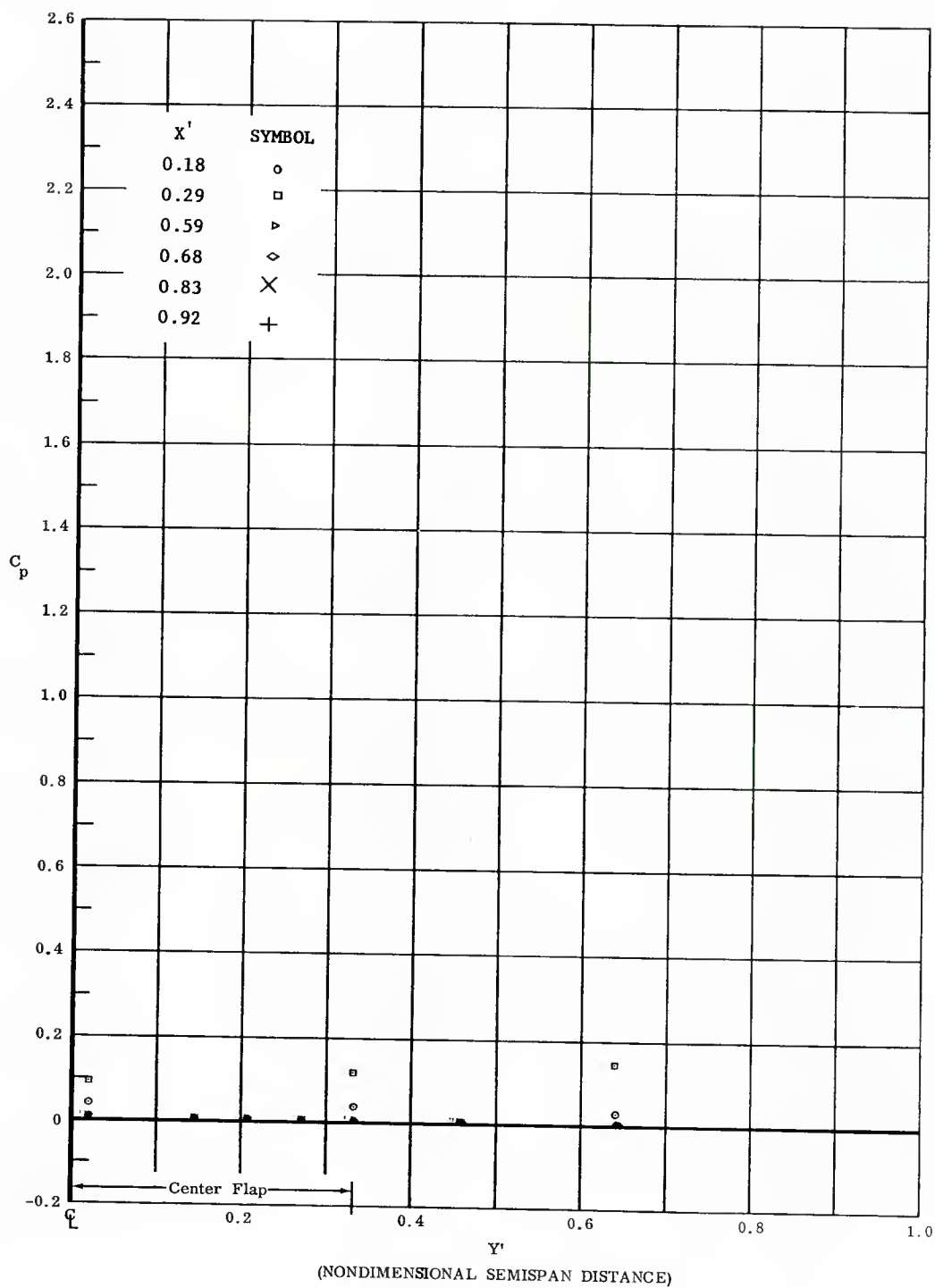


Fig. 66 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 20° , End
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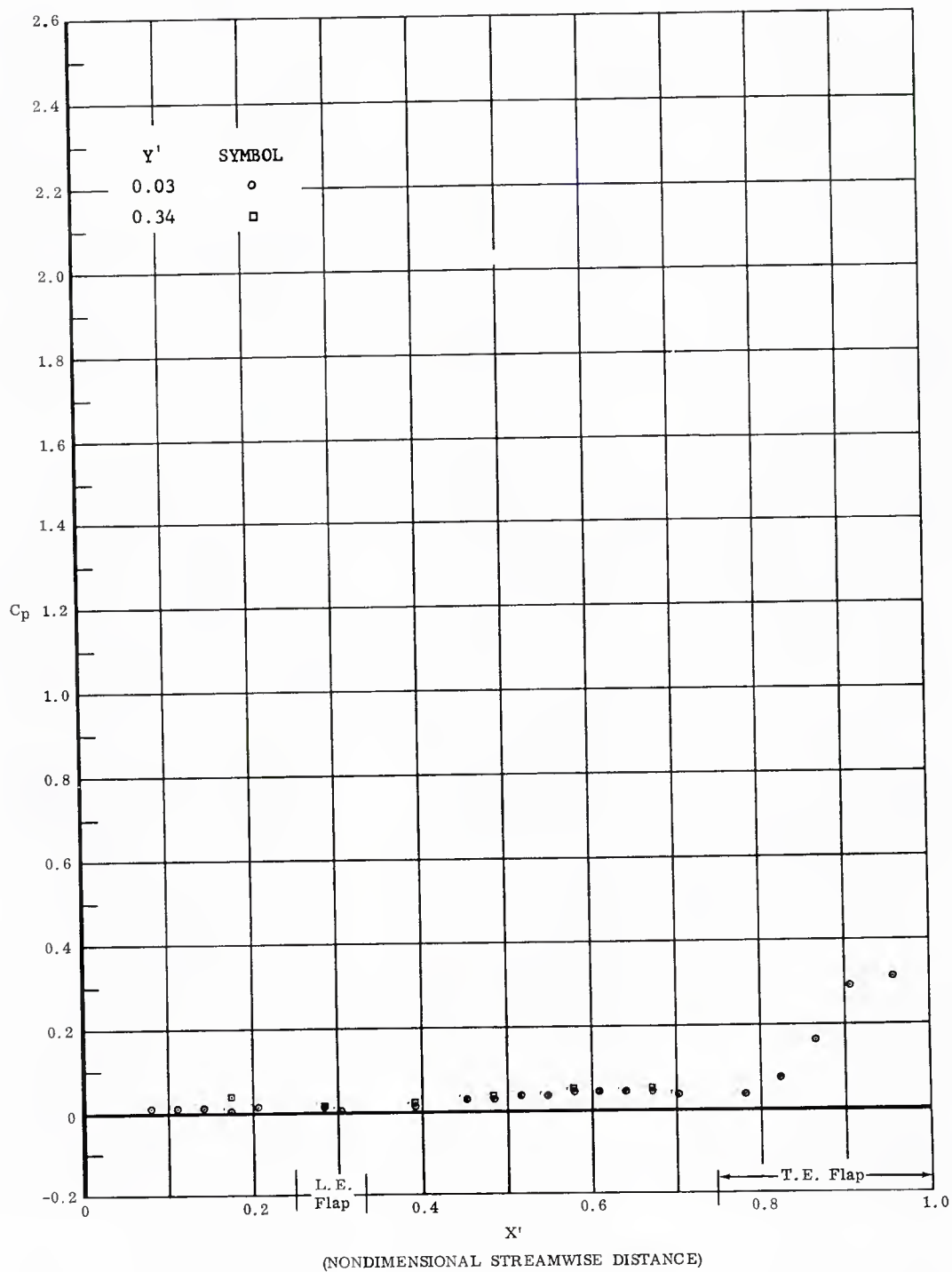


Fig. 67 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 20° ,
 End Plates Off

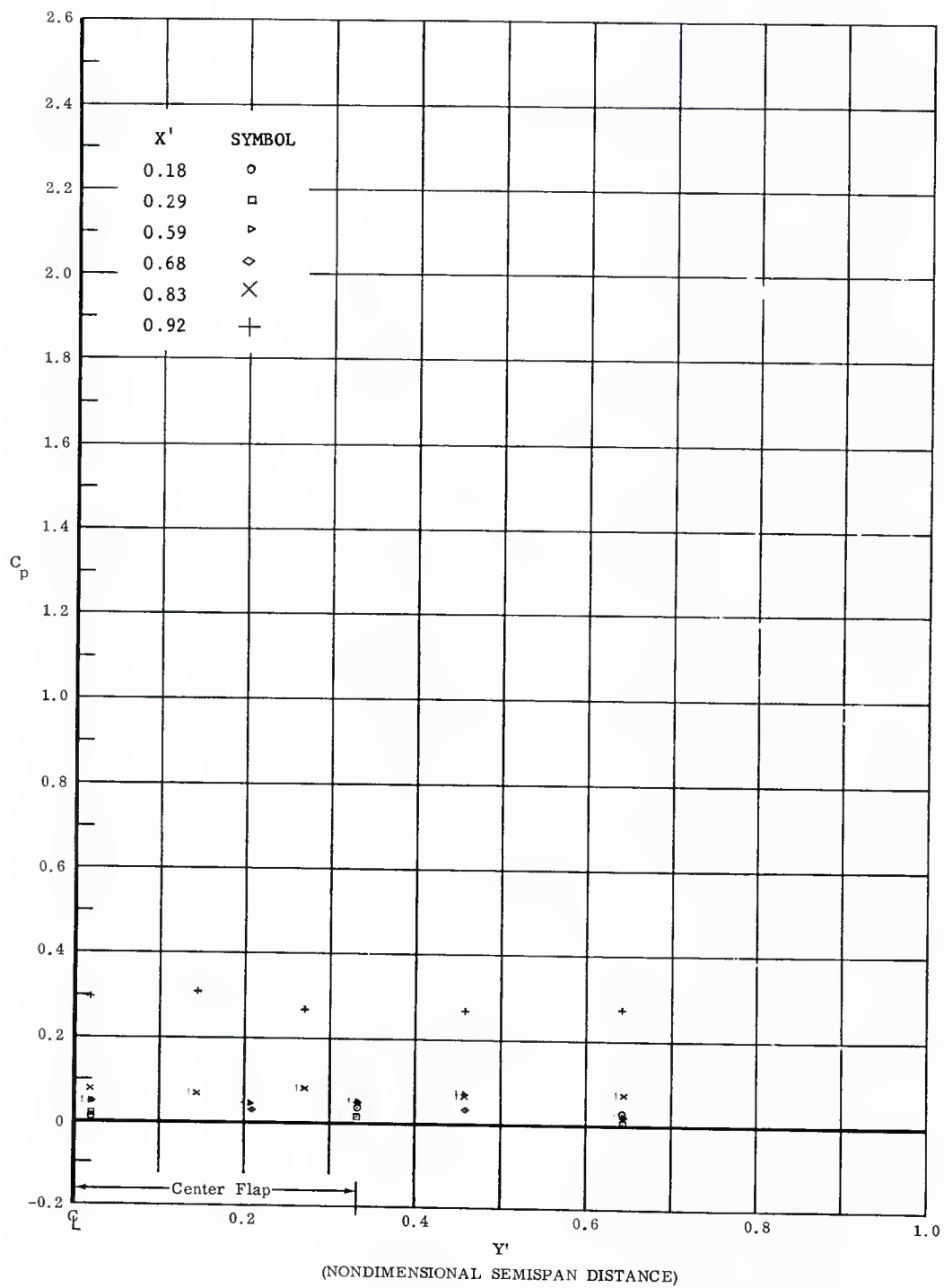


Fig. 67 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 1.1$, Aft Full Span Flap at 20° ,
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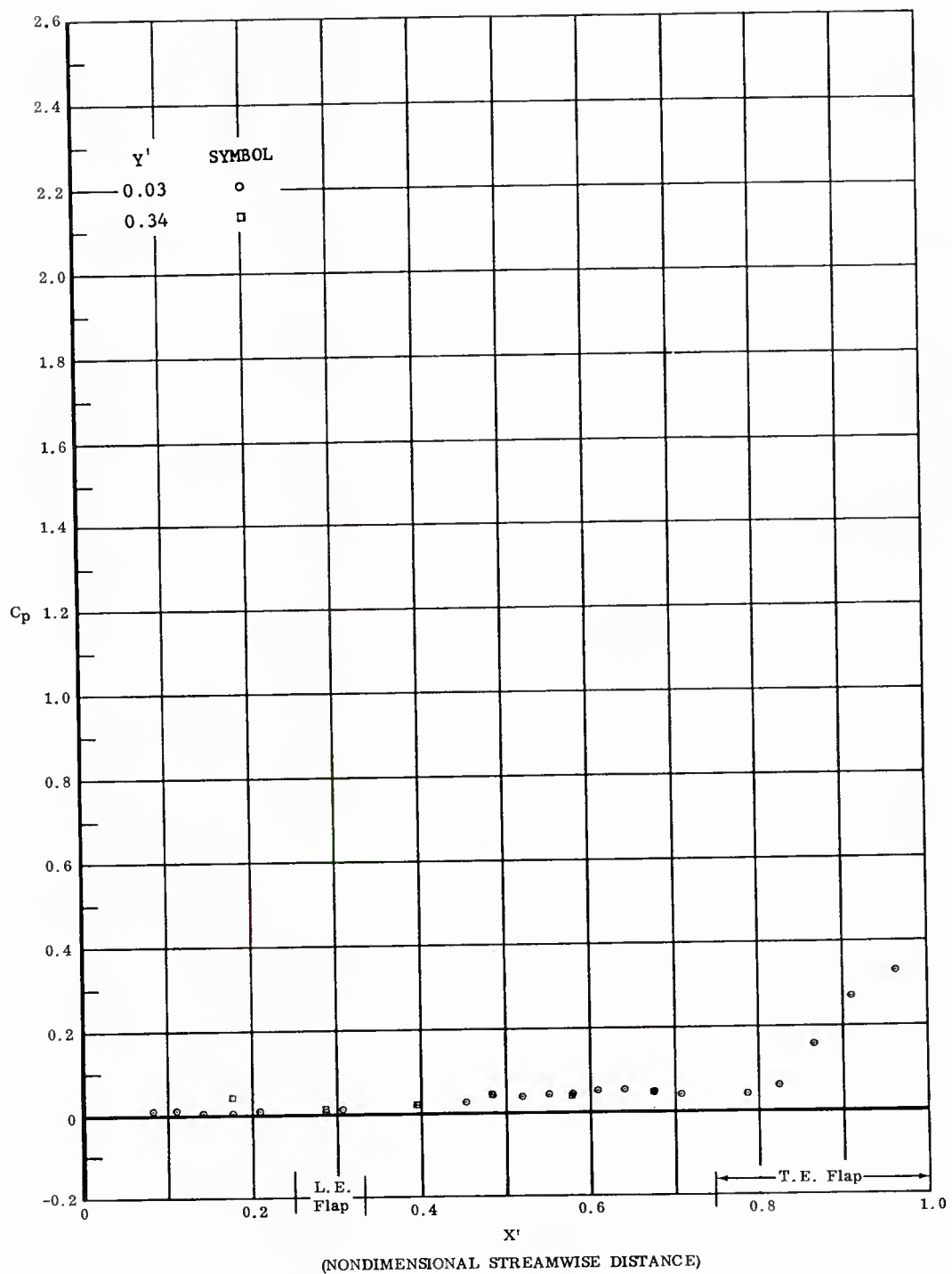


Fig. 68 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty} / 10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 20° ,
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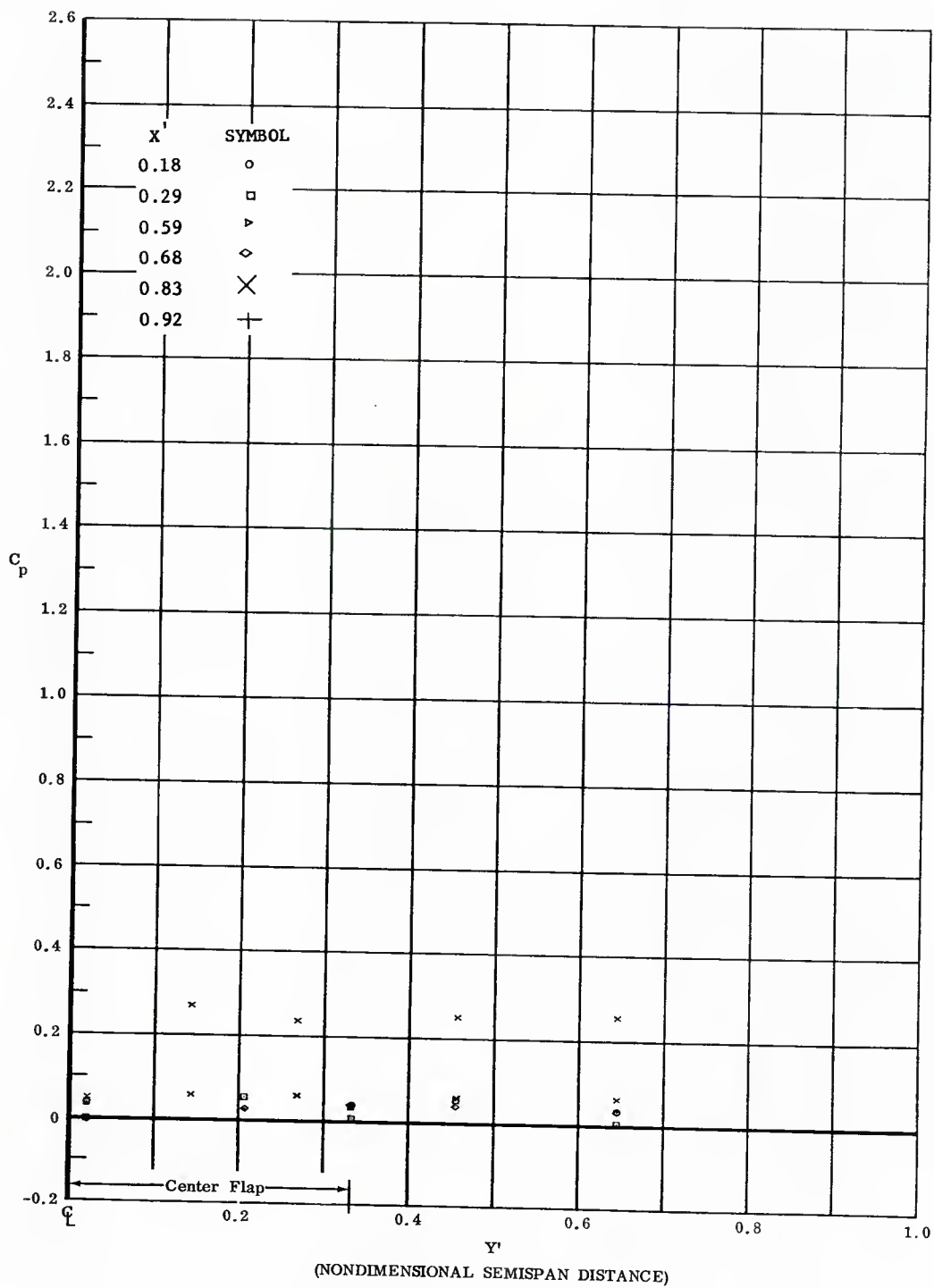


Fig. 68 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 20° ,
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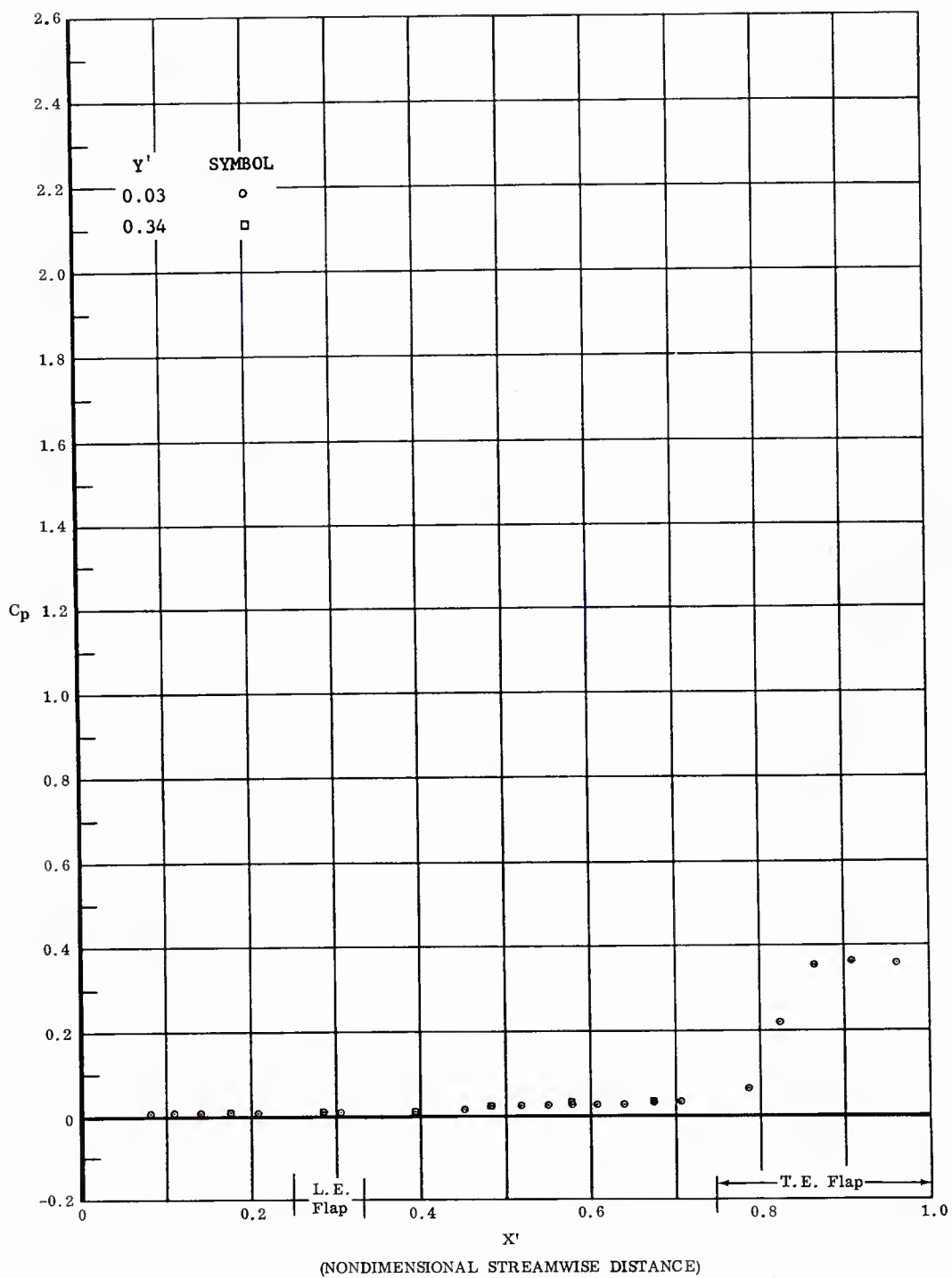


Fig. 69 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 20° ,
 End Plates Off

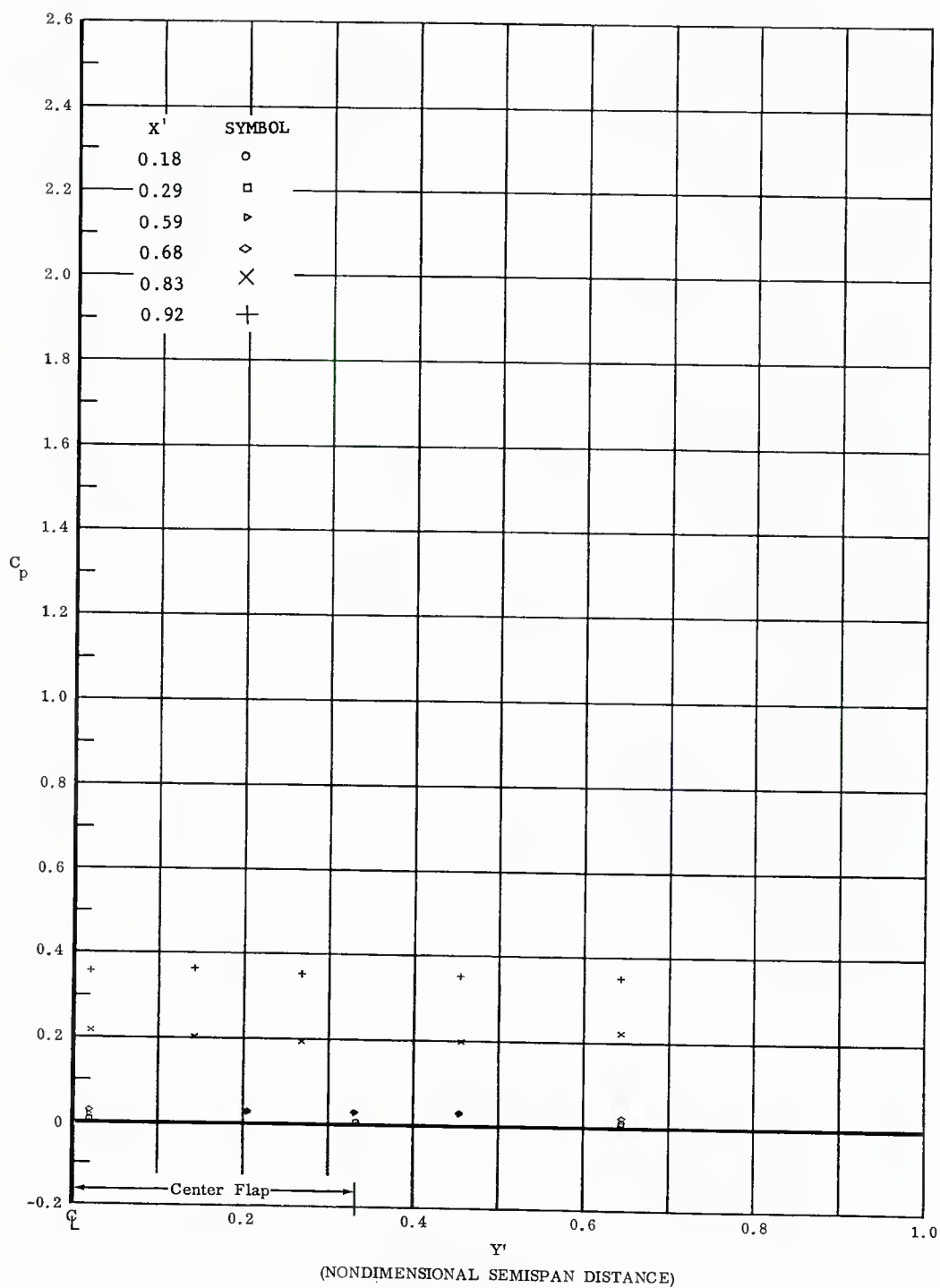


Fig. 69 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 20° ,
 End Plates Off

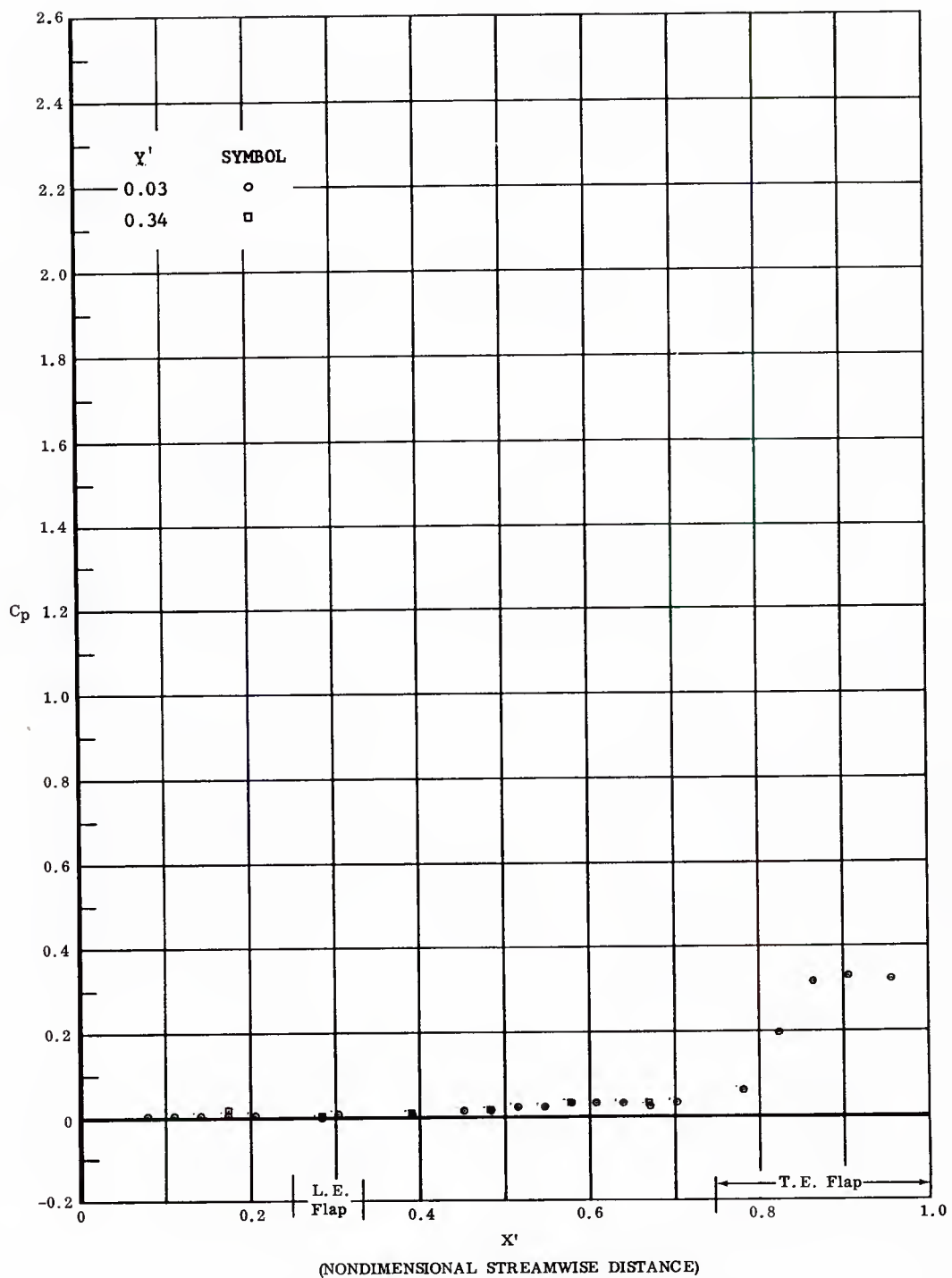


Fig. 70 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, Aft Full Span Flap at 20° ,
 End Plates On

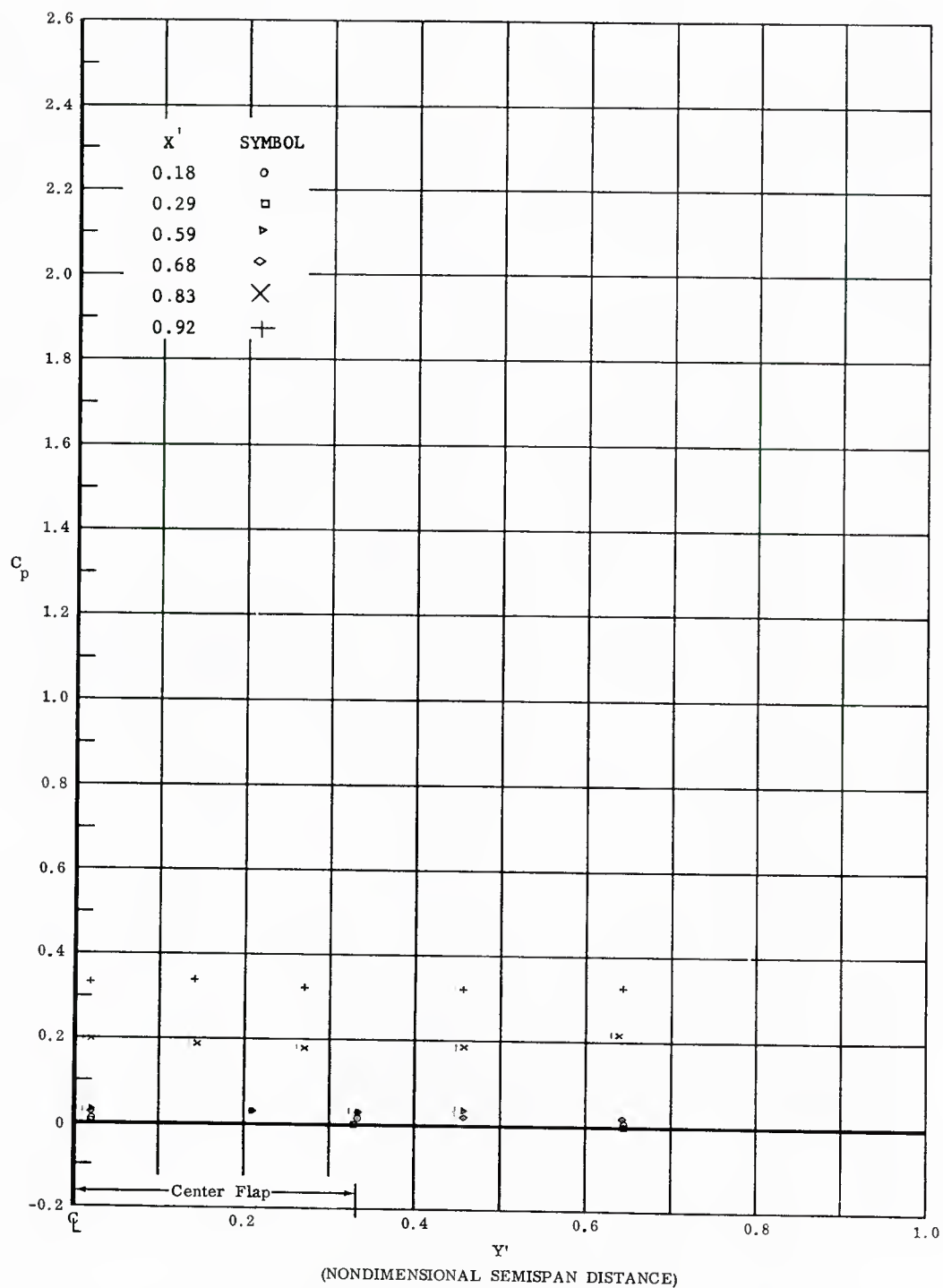


Fig. 70 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 20° ,
 End Plates On

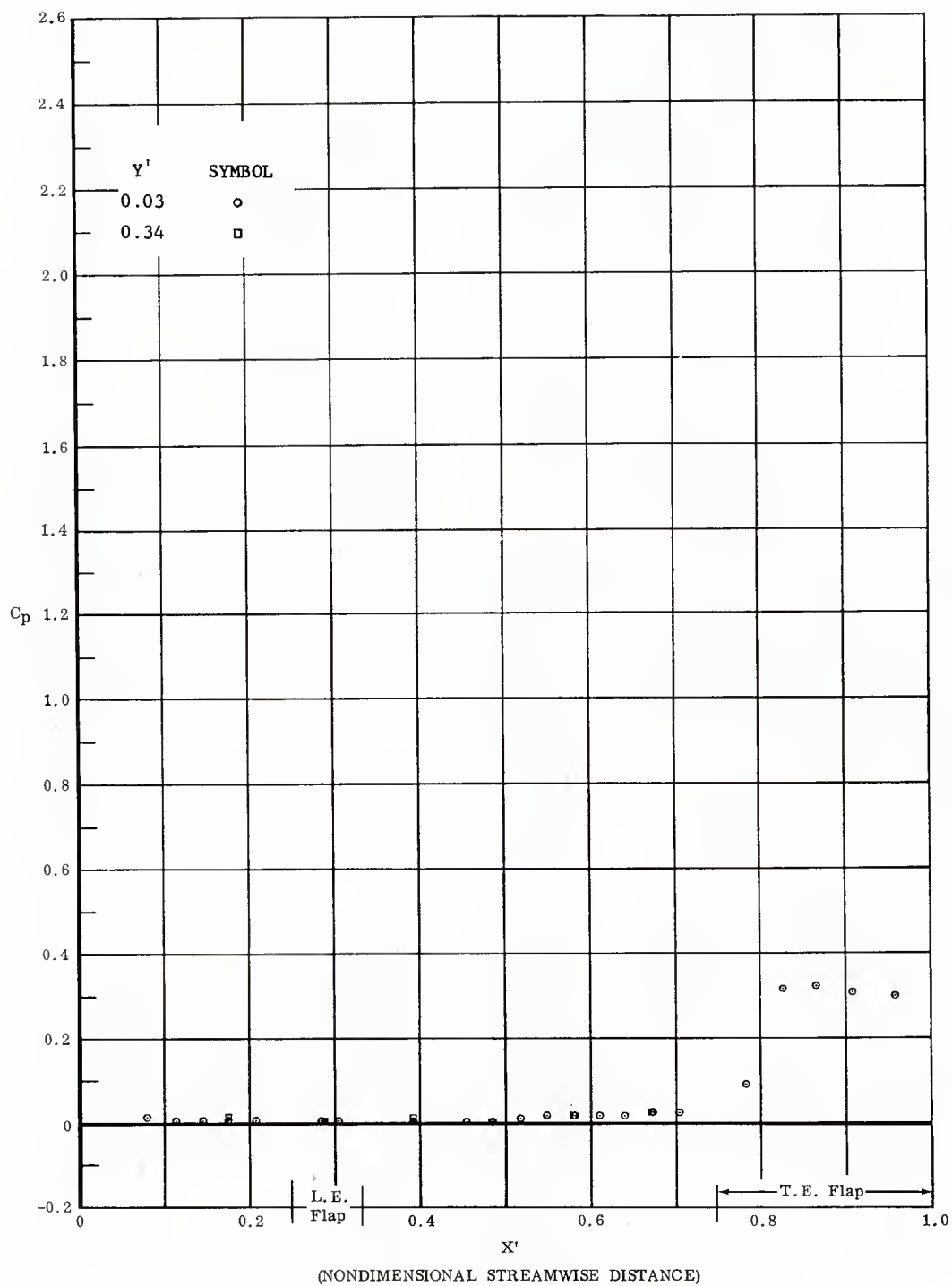


Fig. 71 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 20° ,
 End Plates Off

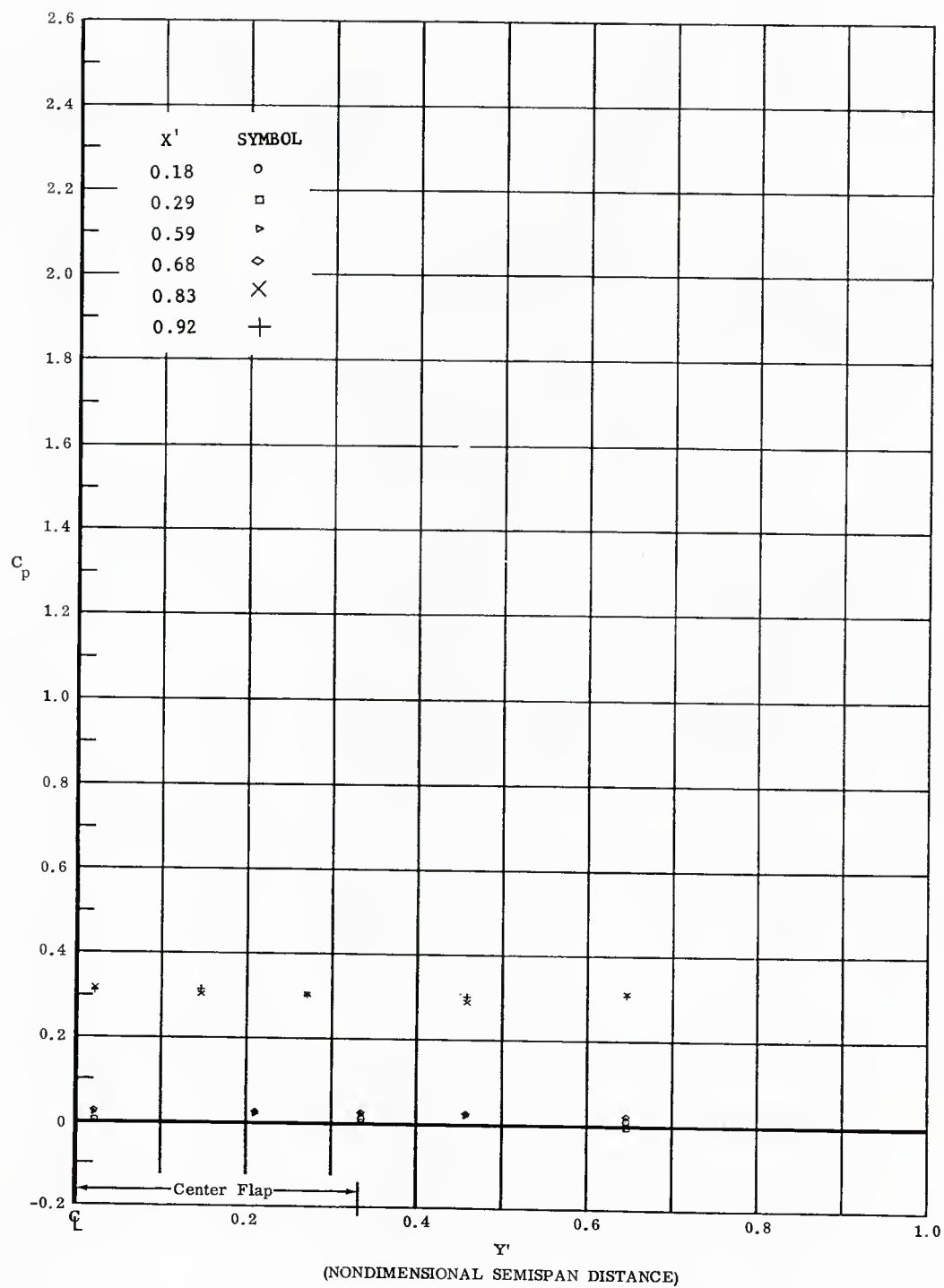


Fig. 71 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 20° ,
 End Plates Off

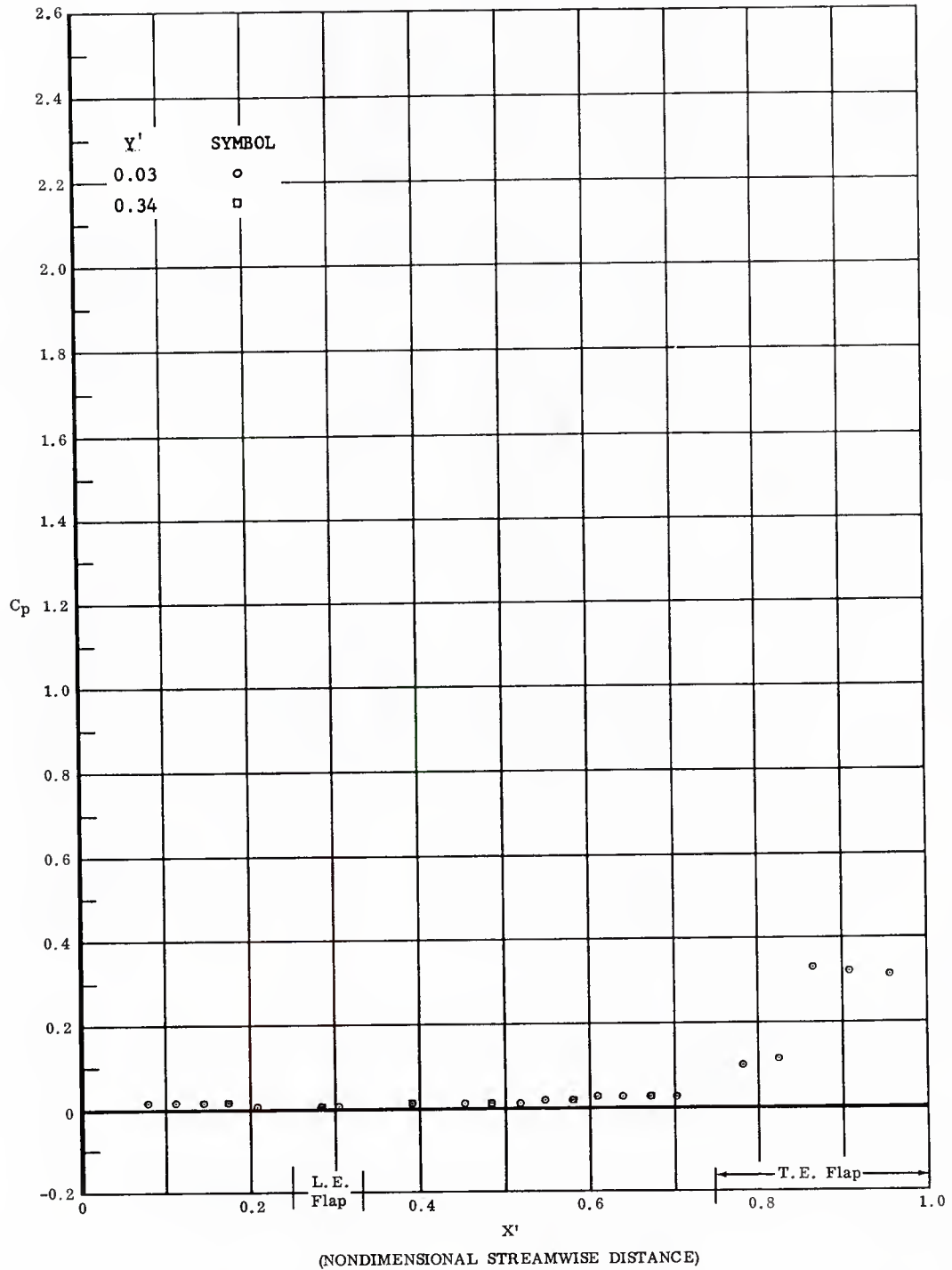


Fig. 72 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, Aft Full Span Flap at 20° ,
 End Plates On

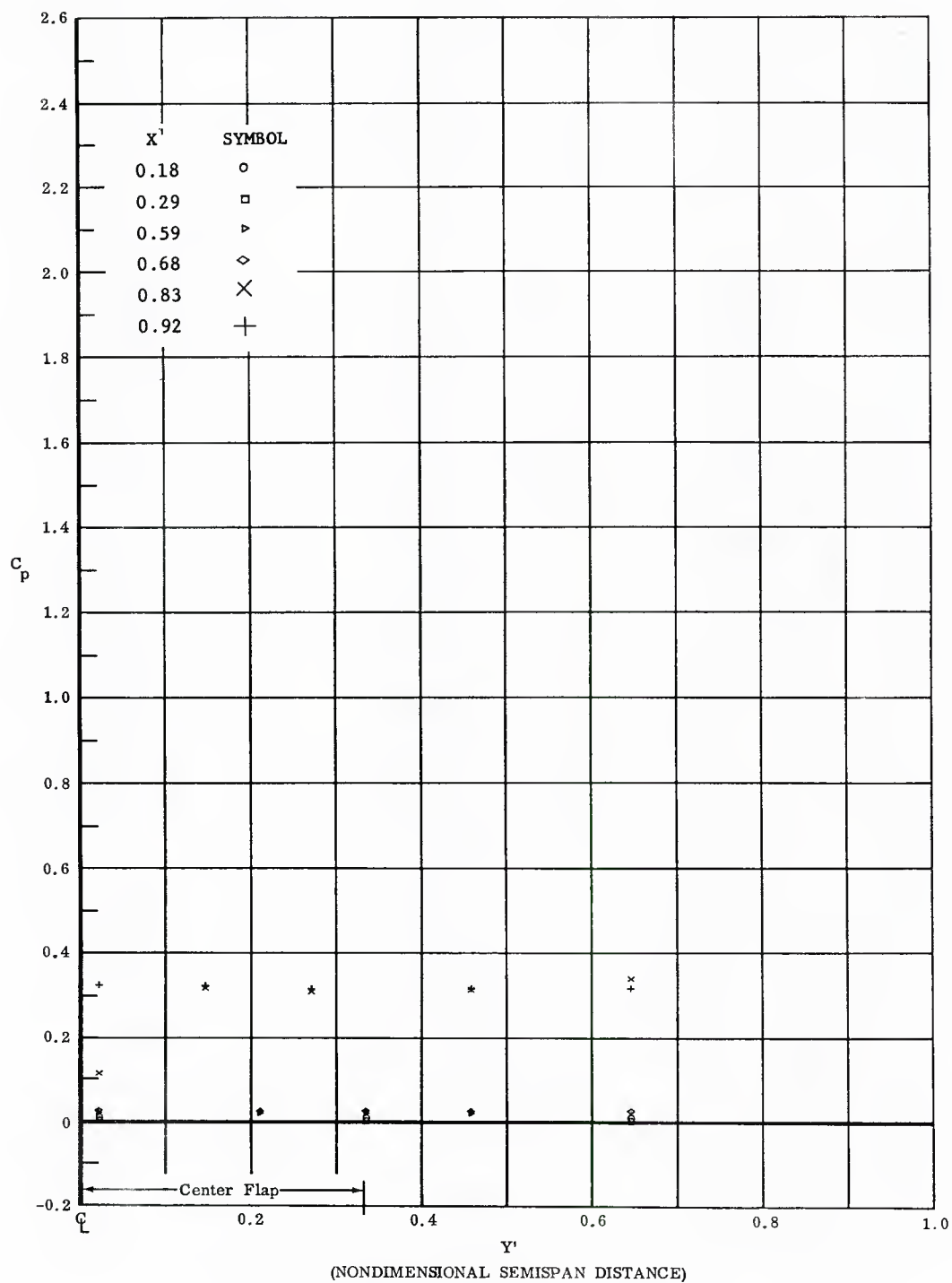


Fig. 72 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 20° ,
 End Plates On

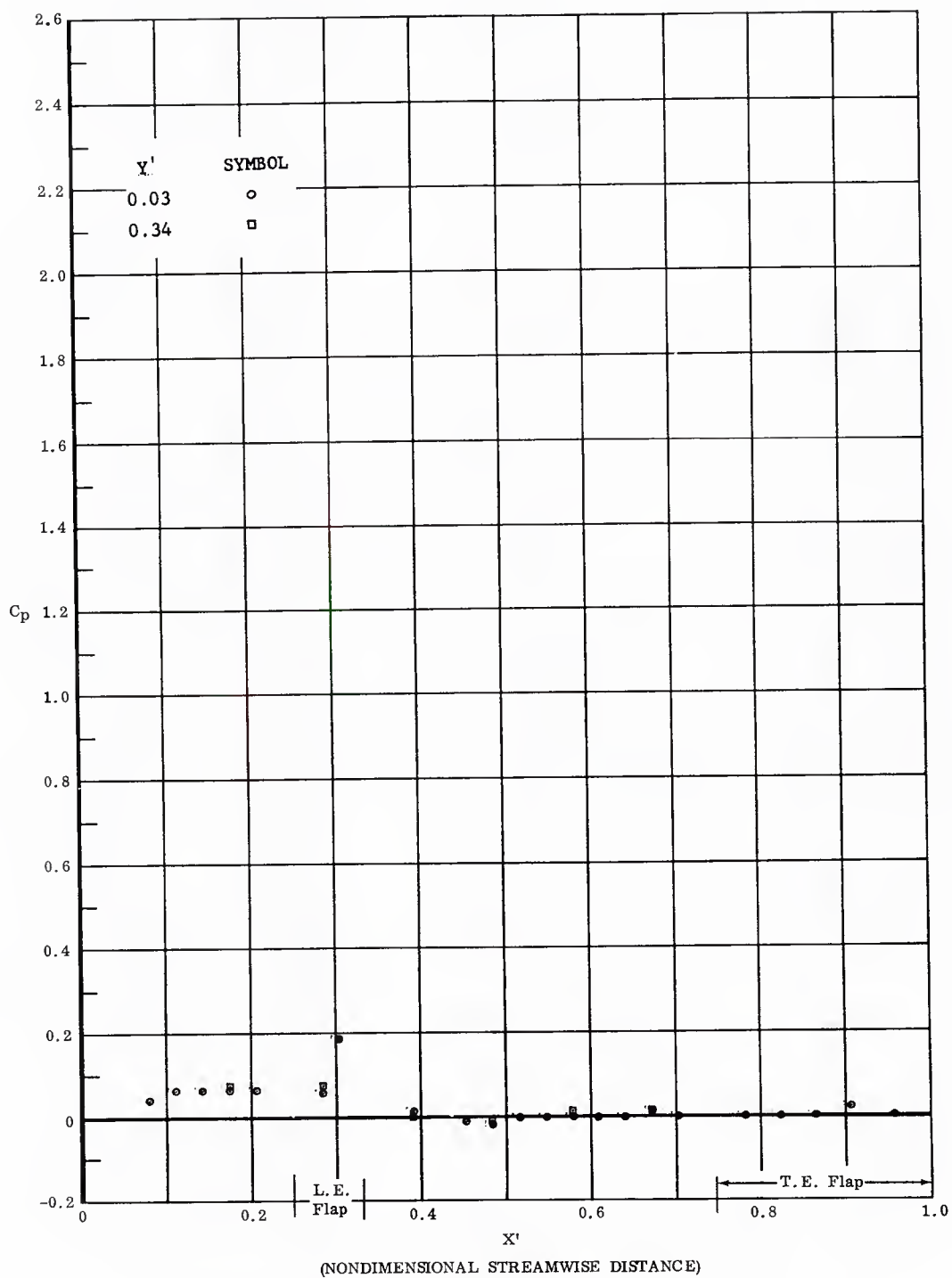


Fig. 73 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Forward Flap at 30° , End
 Plate Off

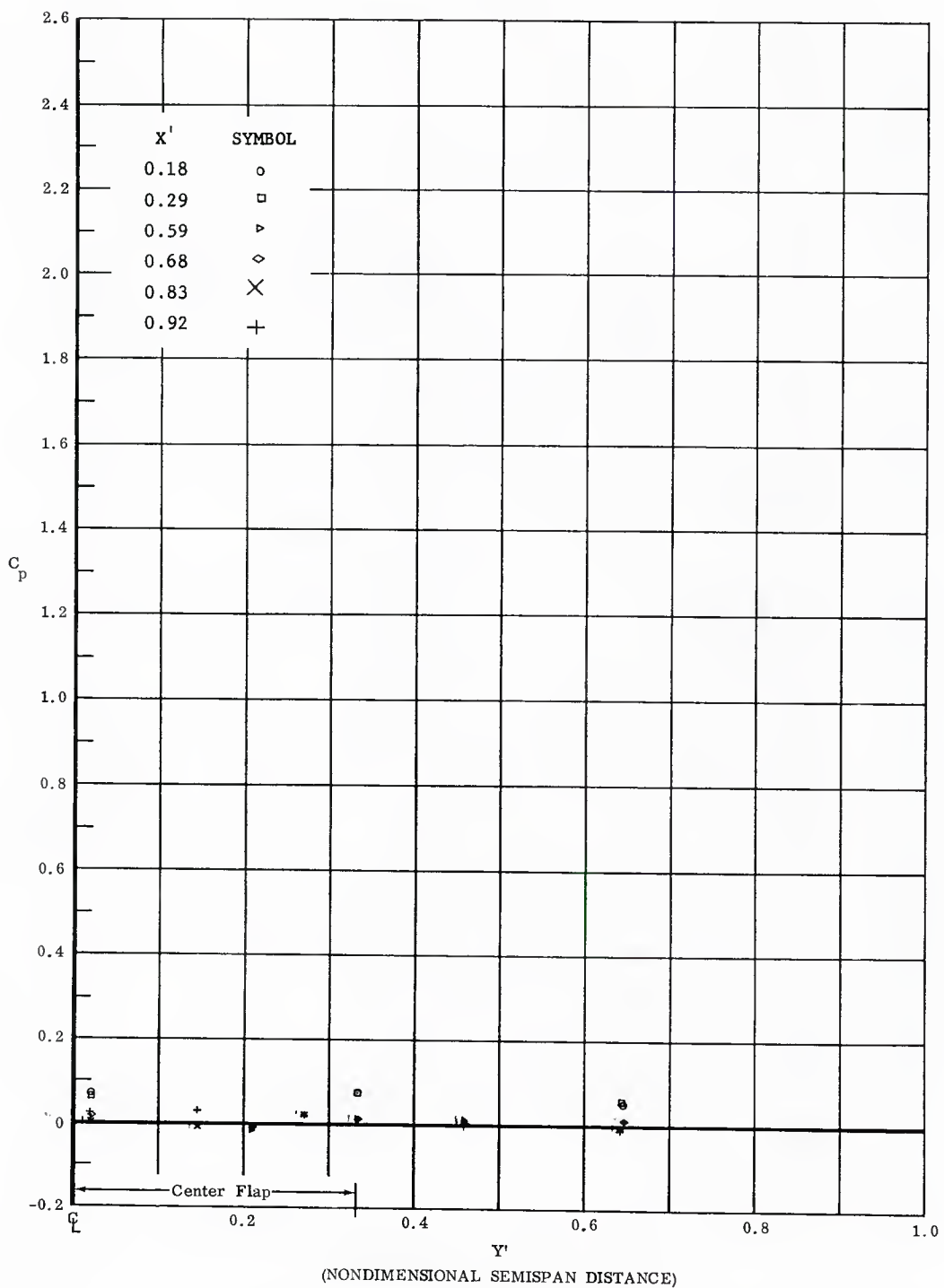


Fig. 73 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Forward Flap at 30° , End
 Plate Off

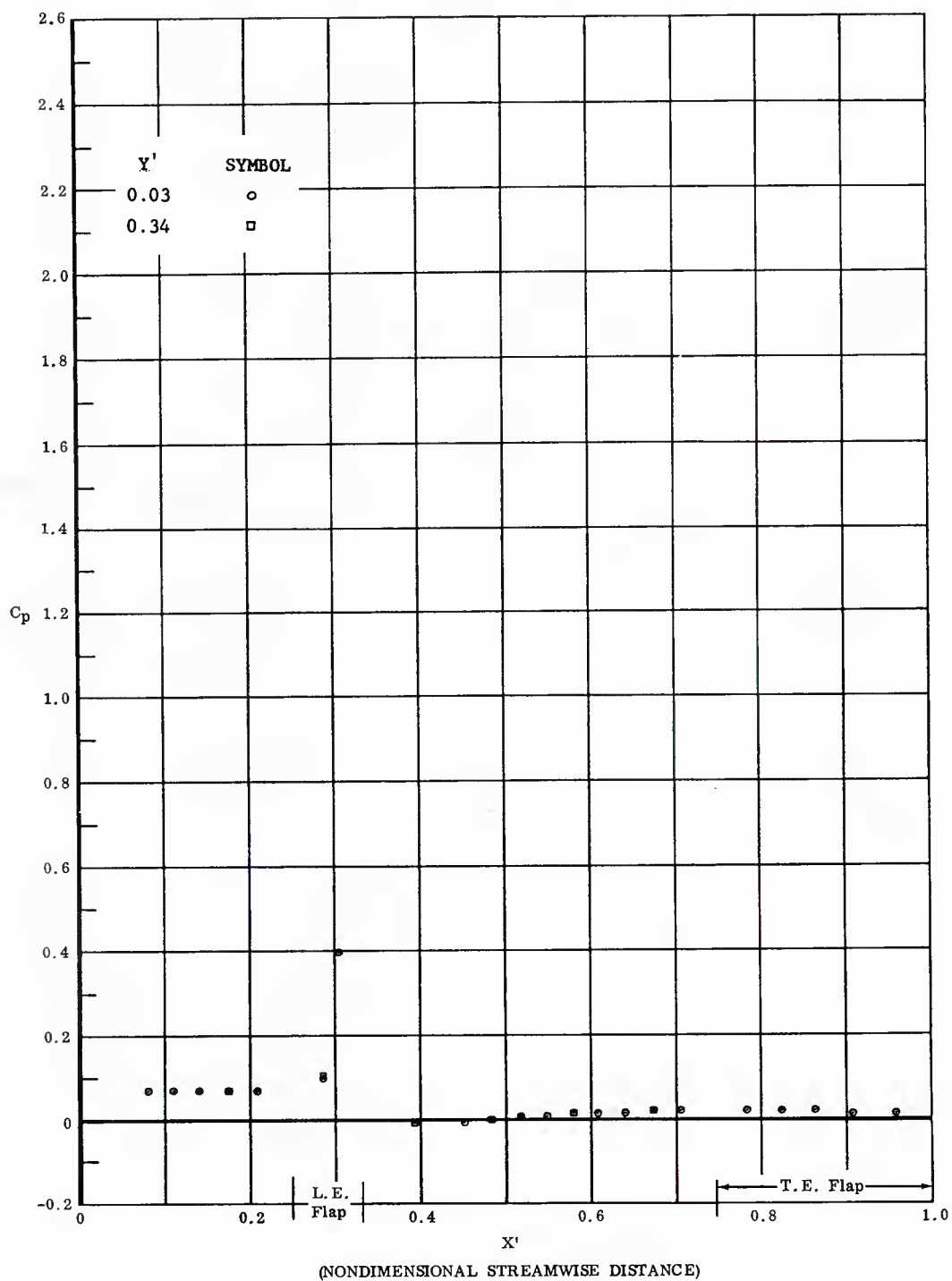


Fig. 74 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 30° , End
 Plate Off

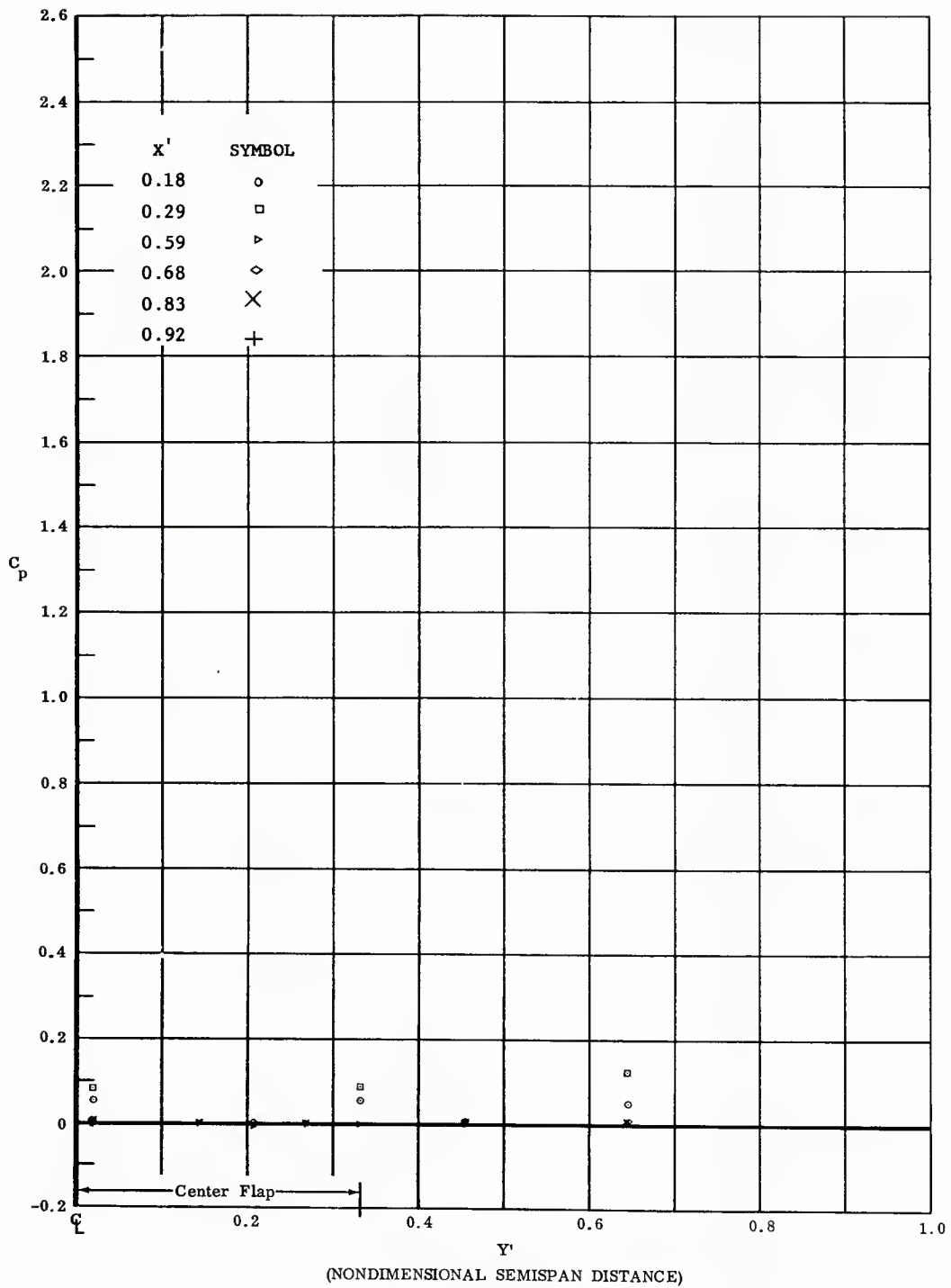


Fig. 74 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 30° , End
 Plate Off

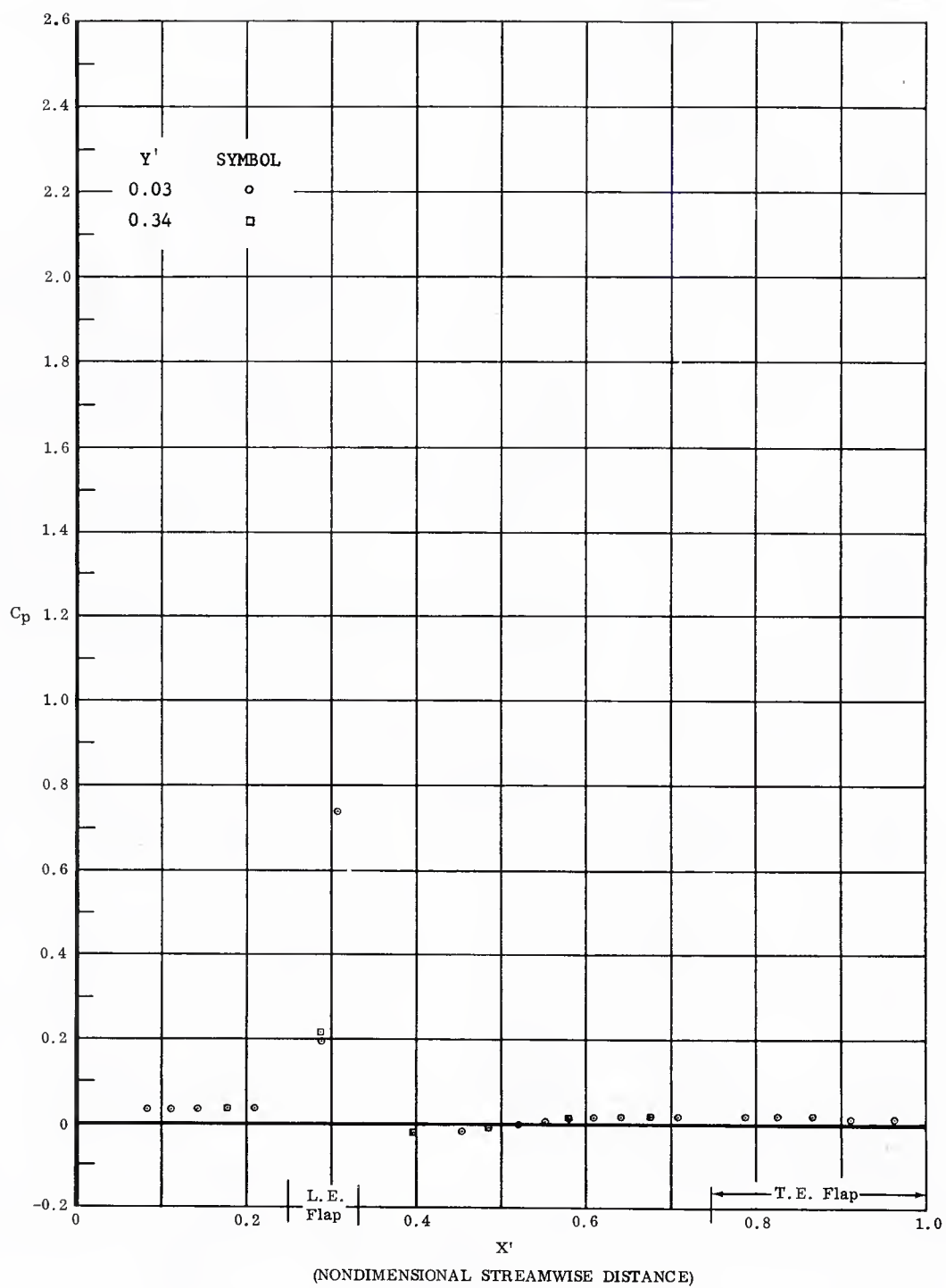


Fig. 75 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, Forward Flap at 30° , End
 Plates Off

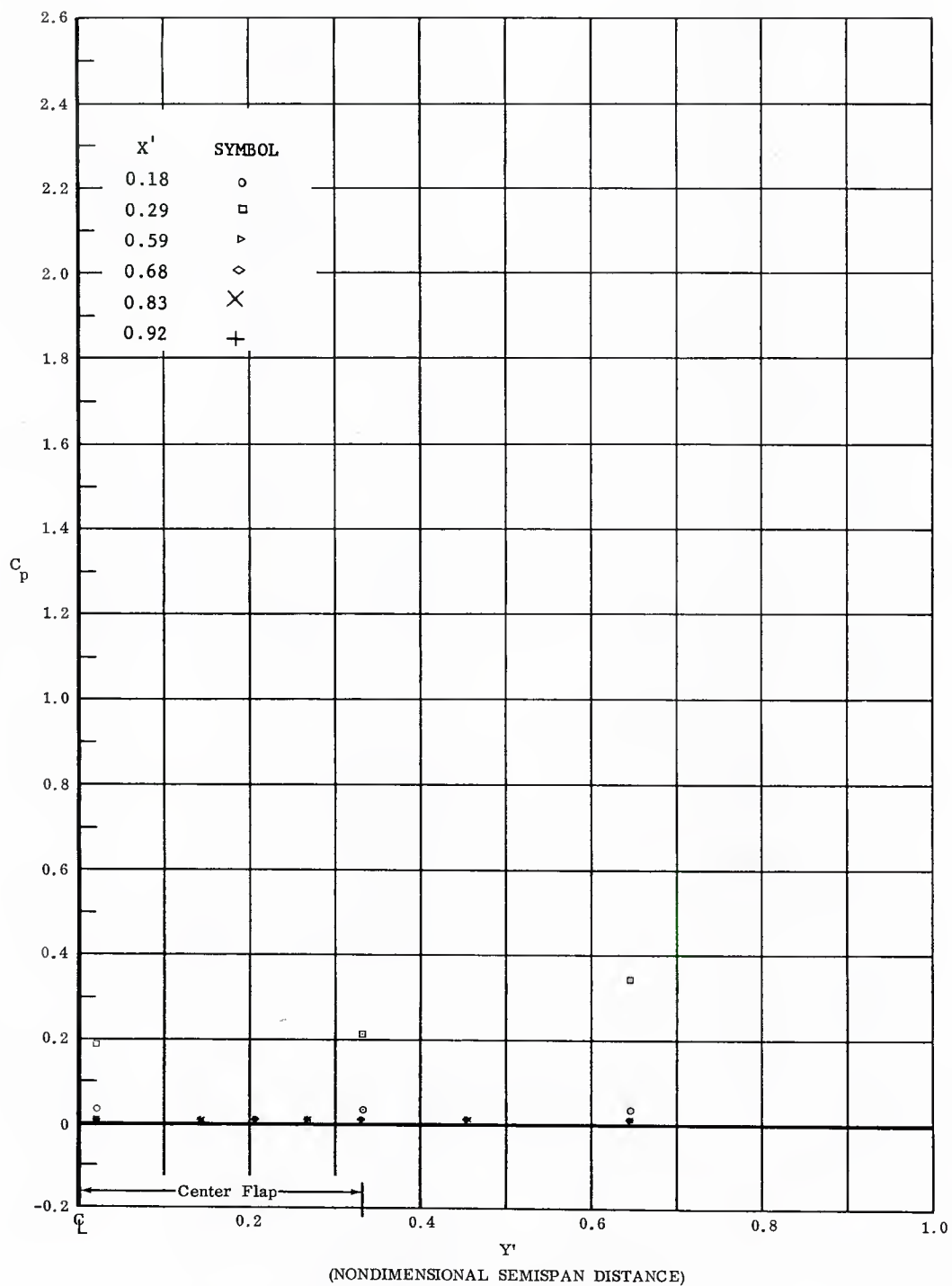


Fig. 75 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 30° , End
 Plates Off

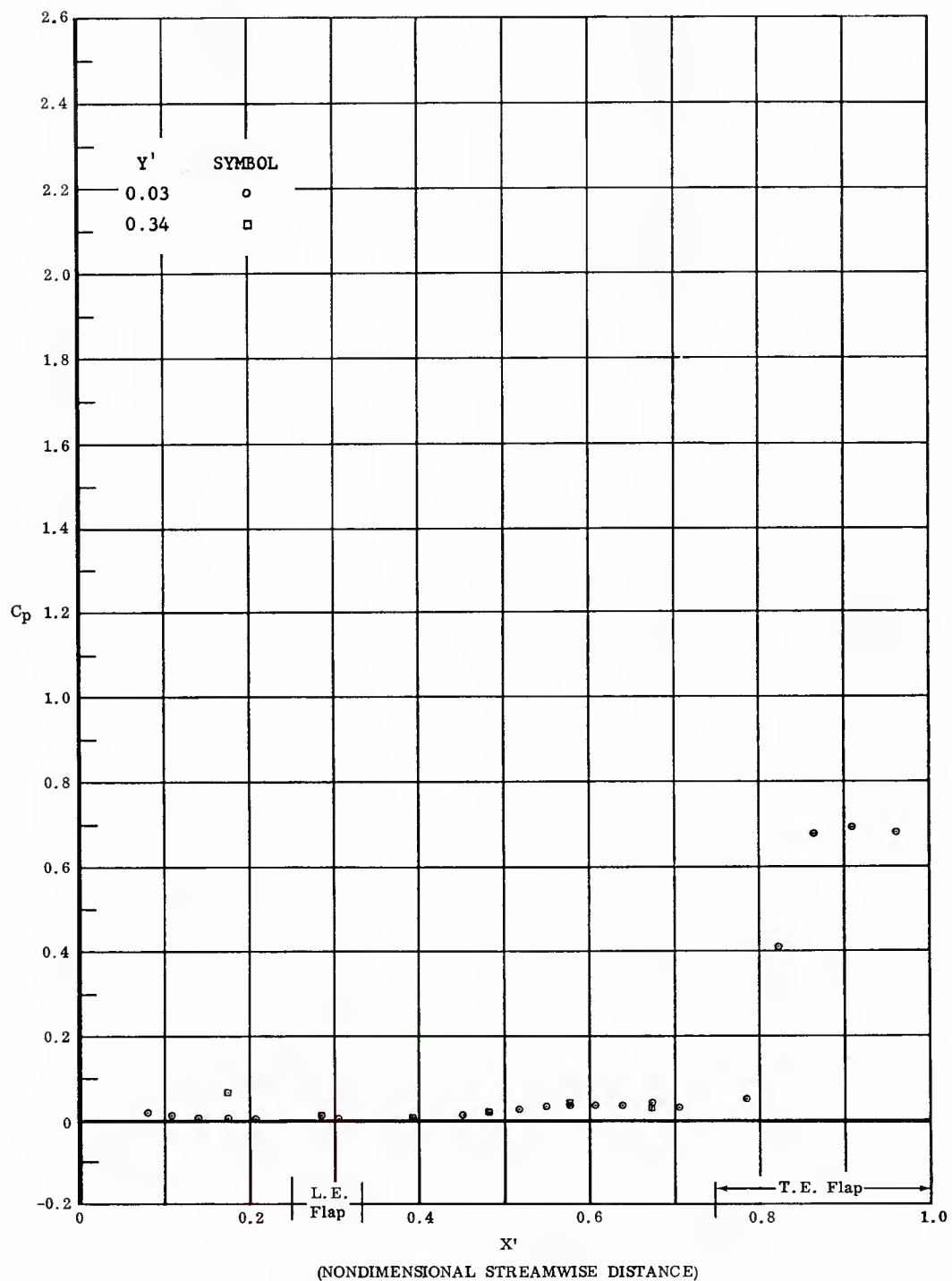


Fig. 76 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Center Flap at 30° ,
 End Plates Off

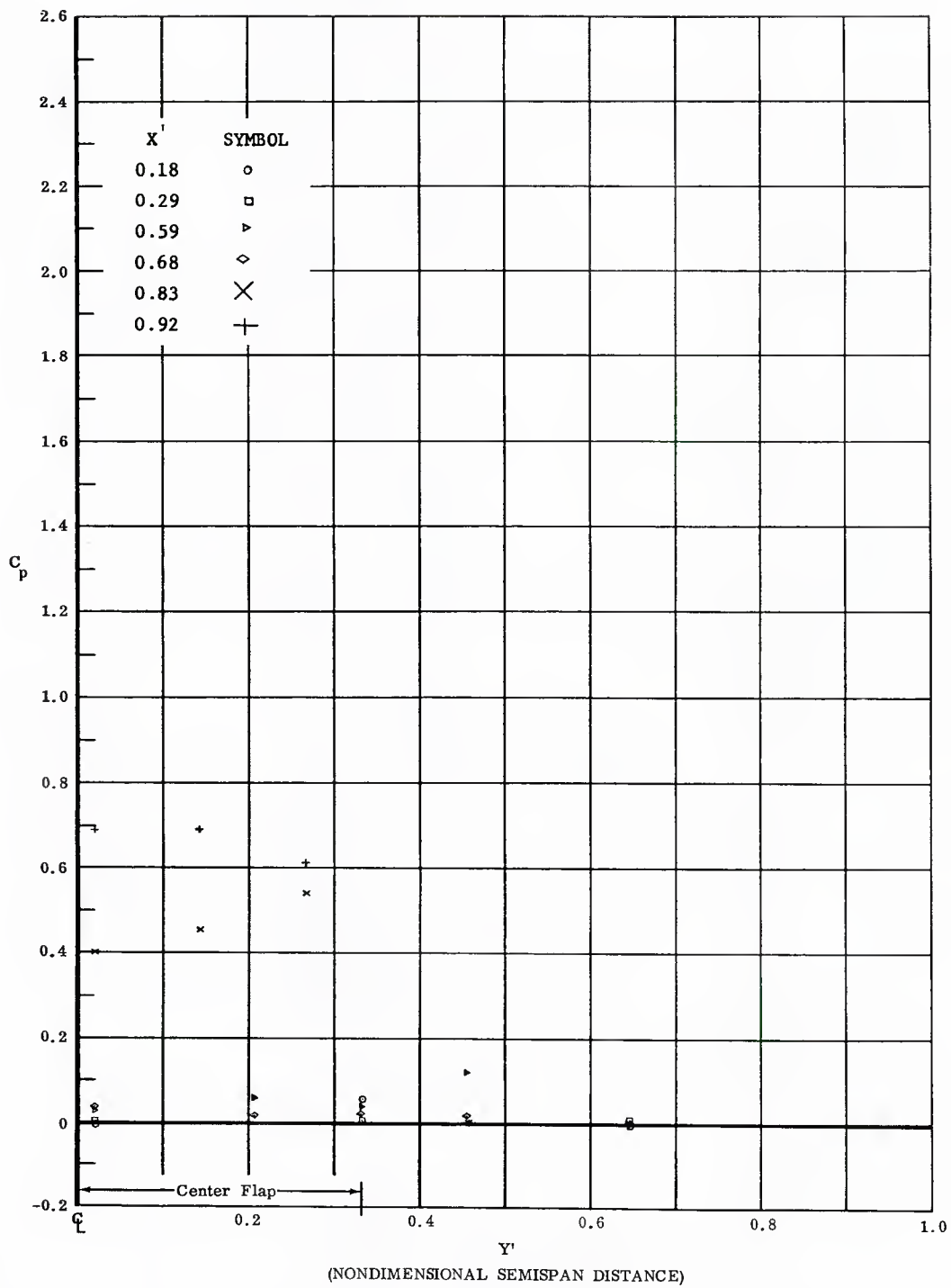


Fig. 76 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Center Flap at 30° ,
 End Plates Off

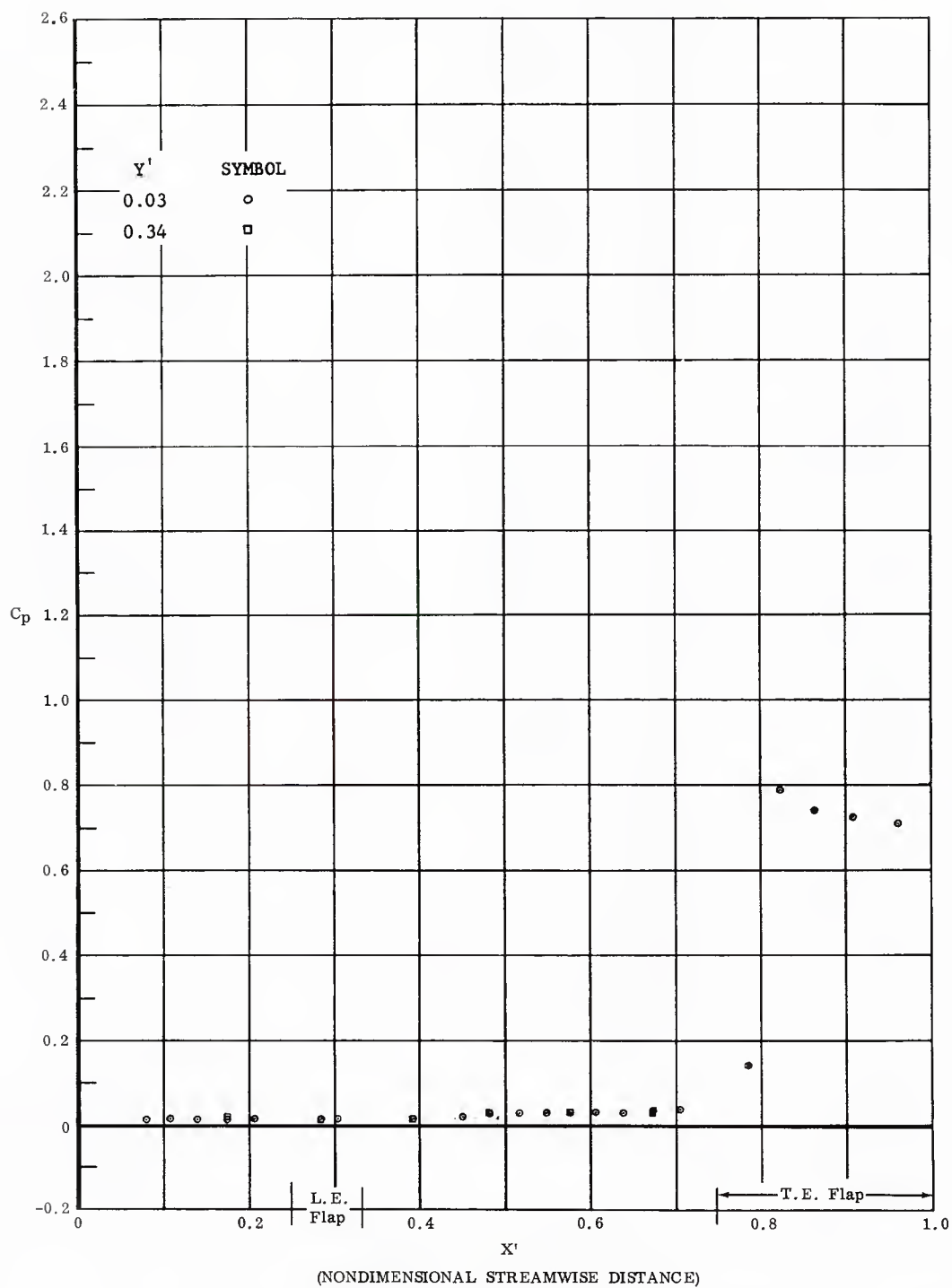


Fig. 77 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Center Flap at 30° ,
 End Plates Off

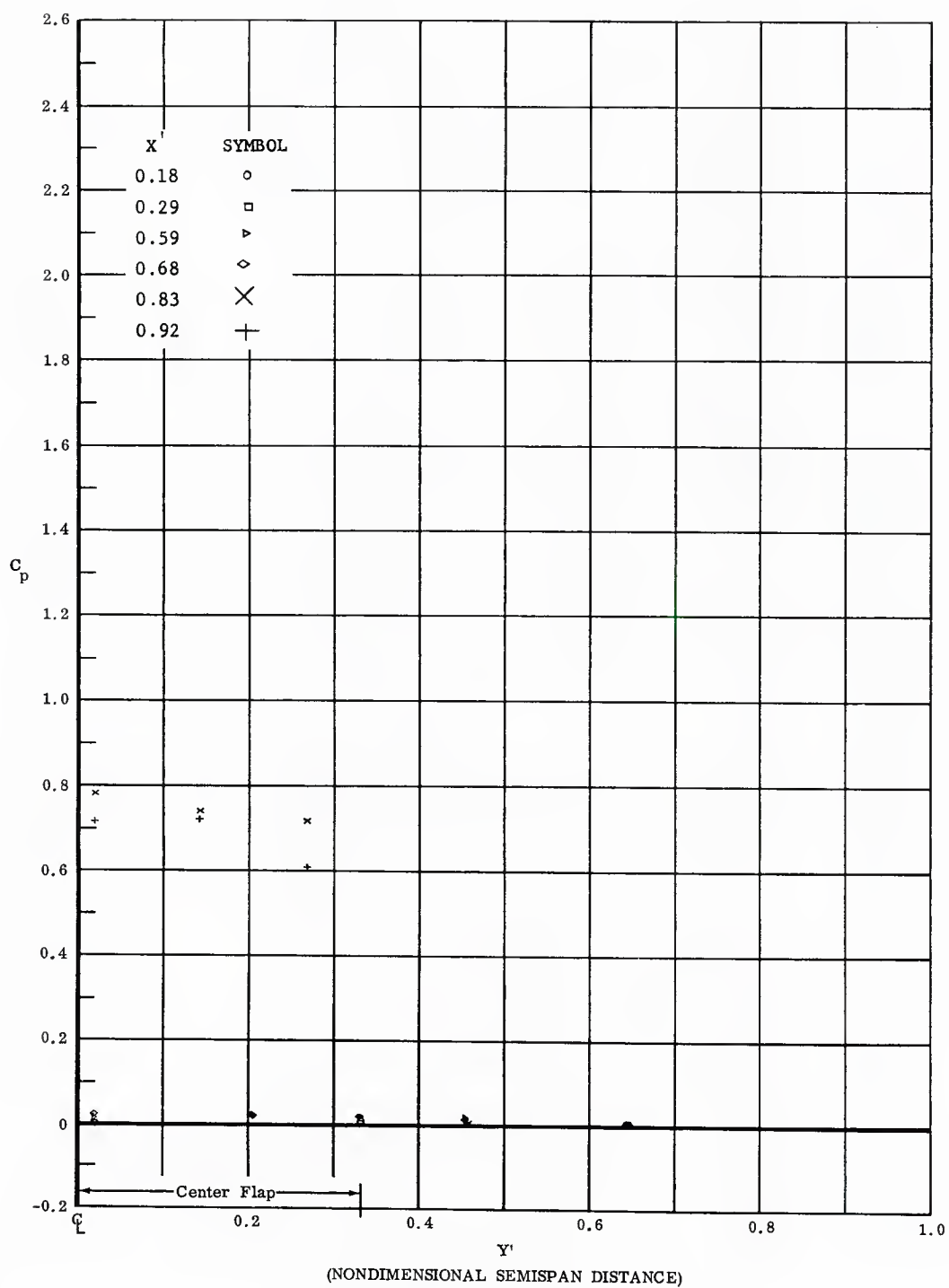


Fig. 77 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Center Flap at 30° ,
 End Plates Off

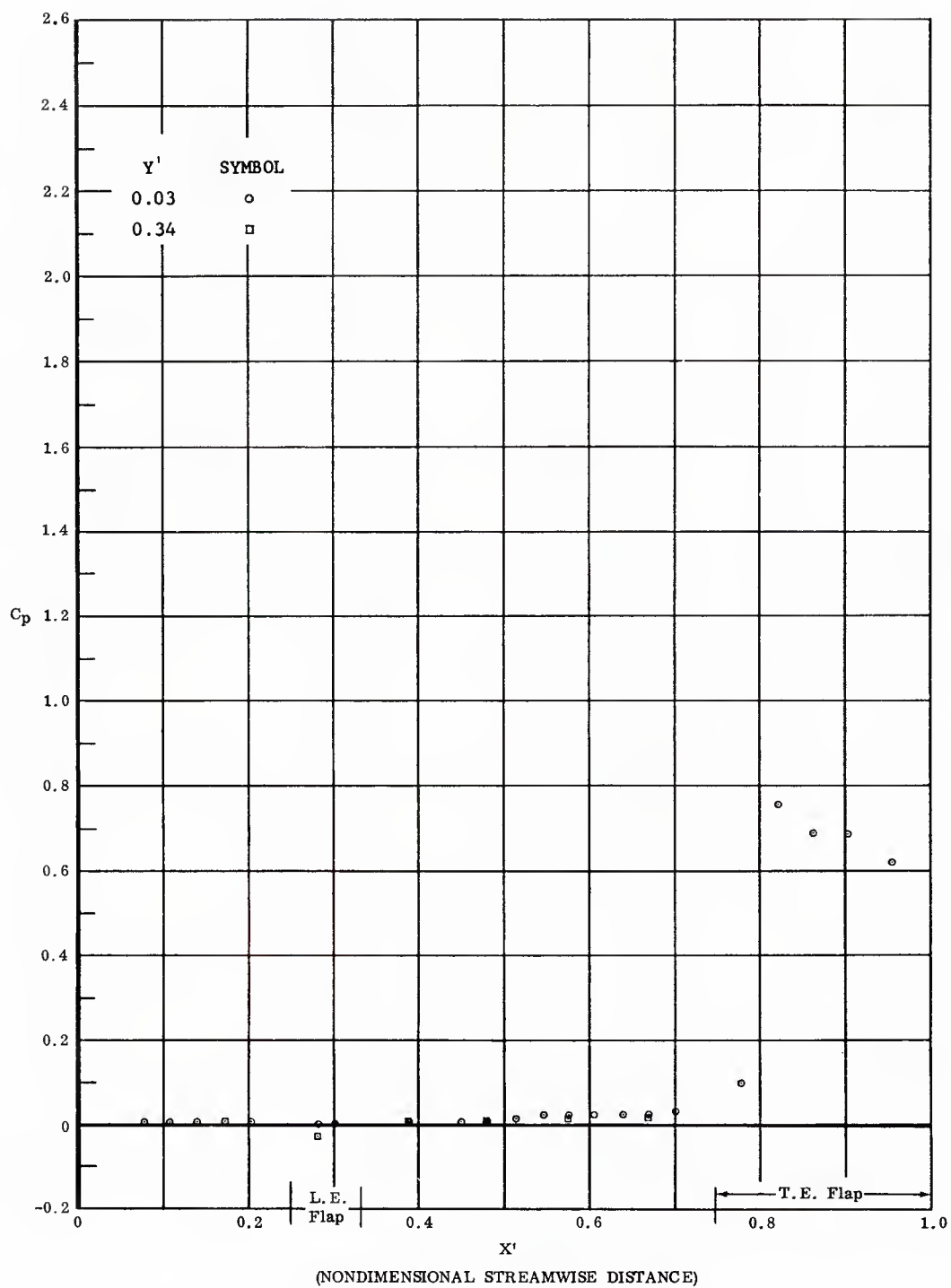


Fig. 78 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Center Flap at 30° ,
 End Plates Off

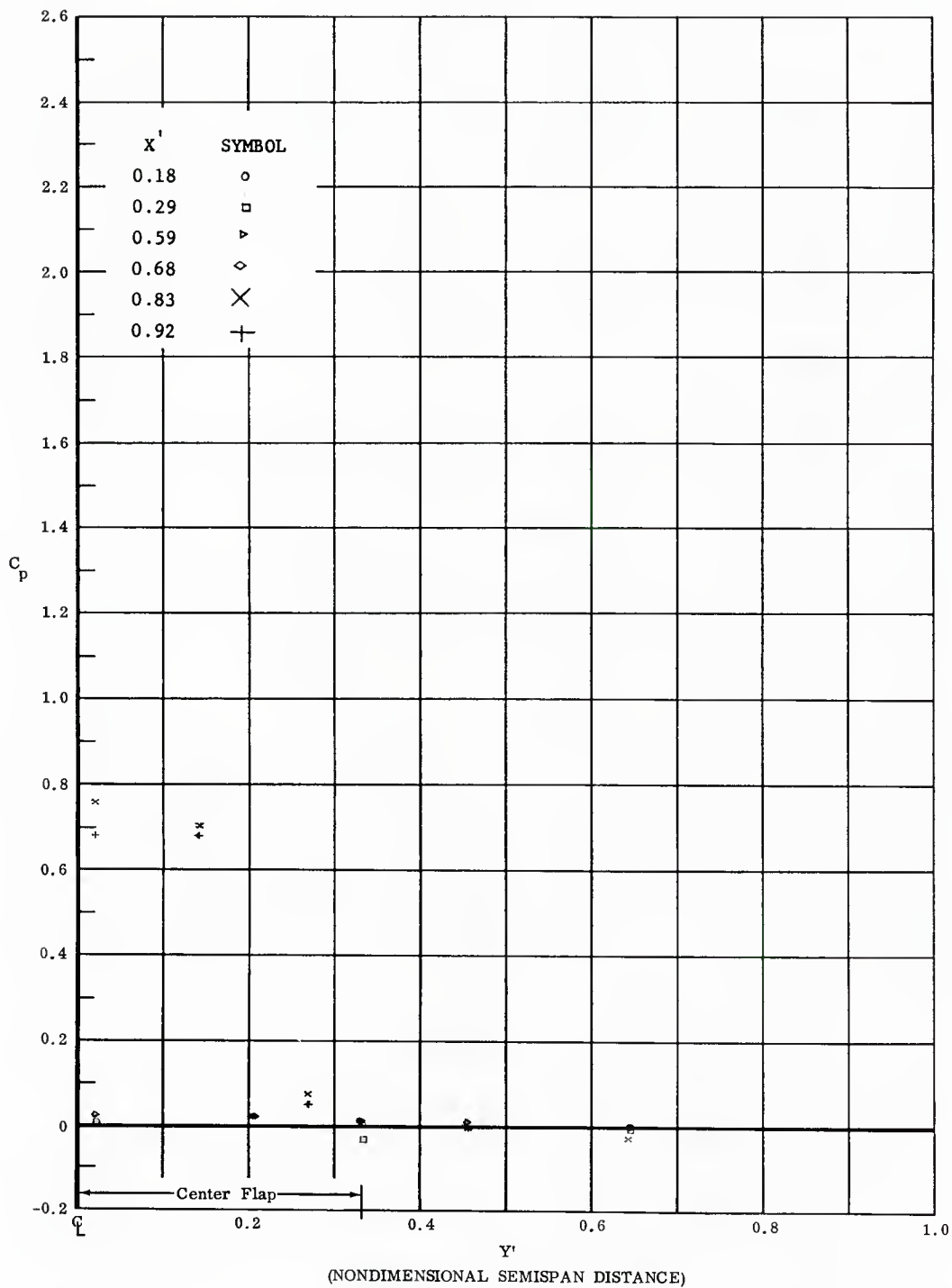


Fig. 78 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Center Flap at 30° ,
 End Plates Off

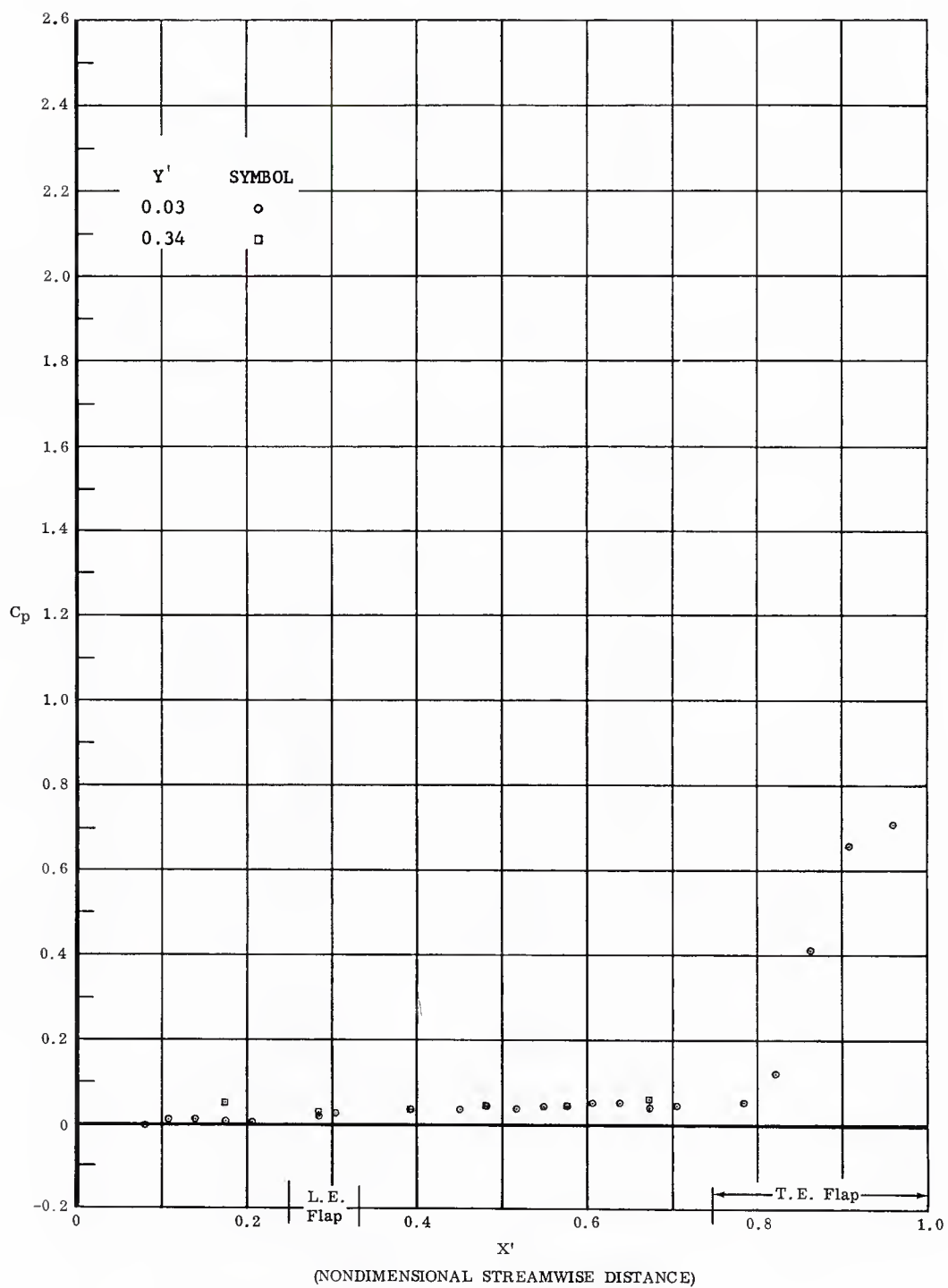


Fig. 79 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty} / 10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plates Off

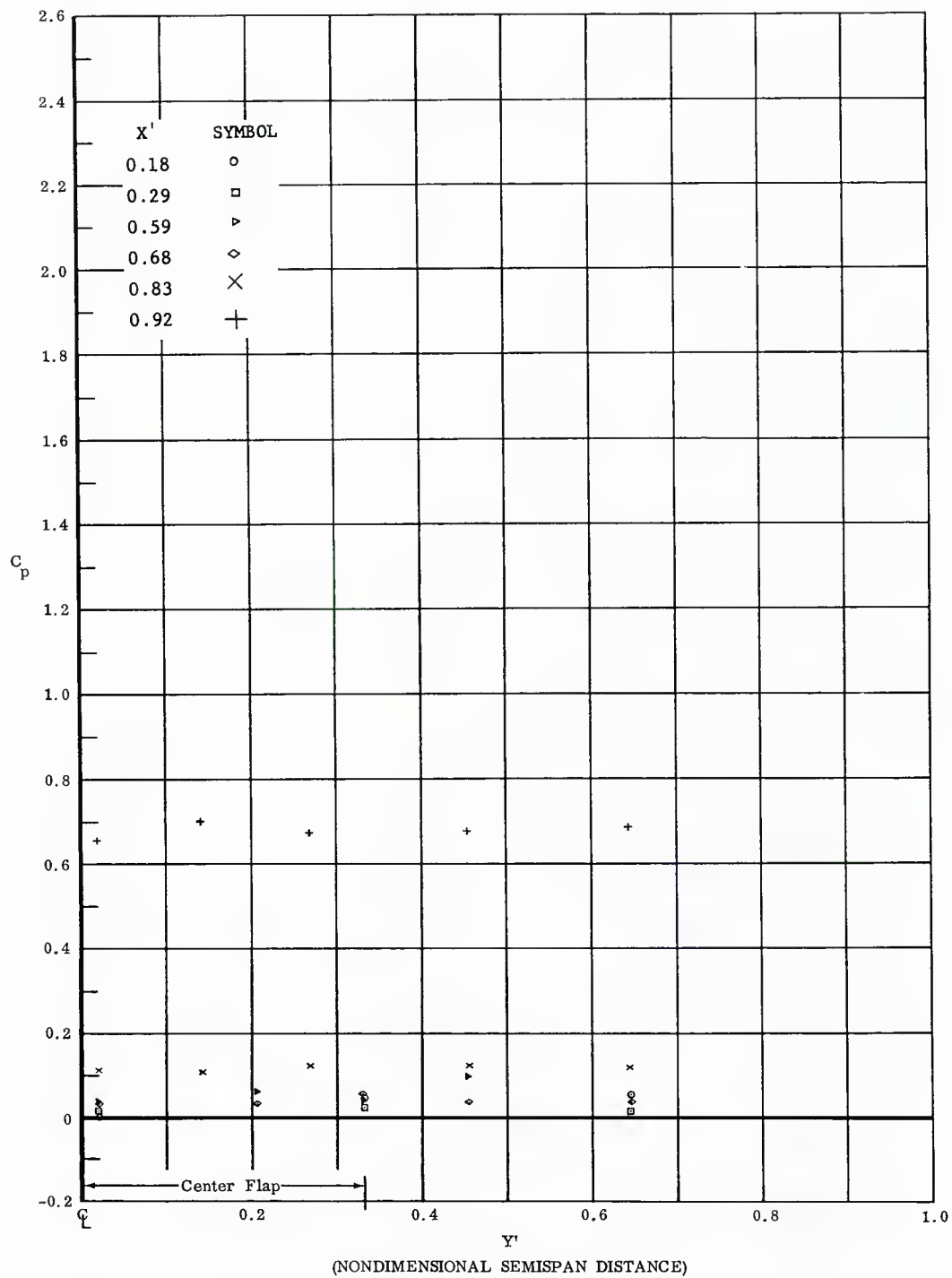


Fig. 79 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plates Off

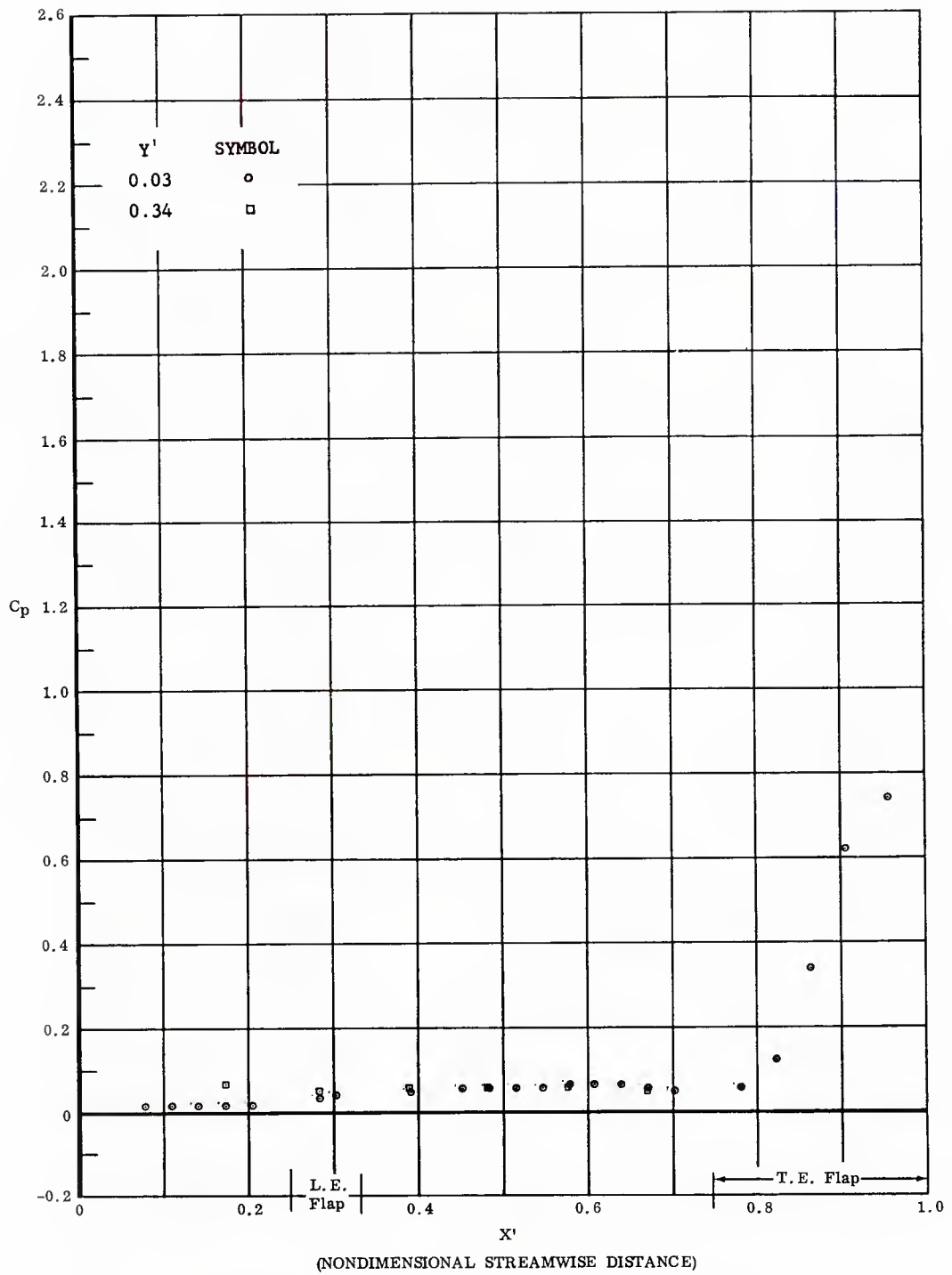


Fig. 80 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plate On

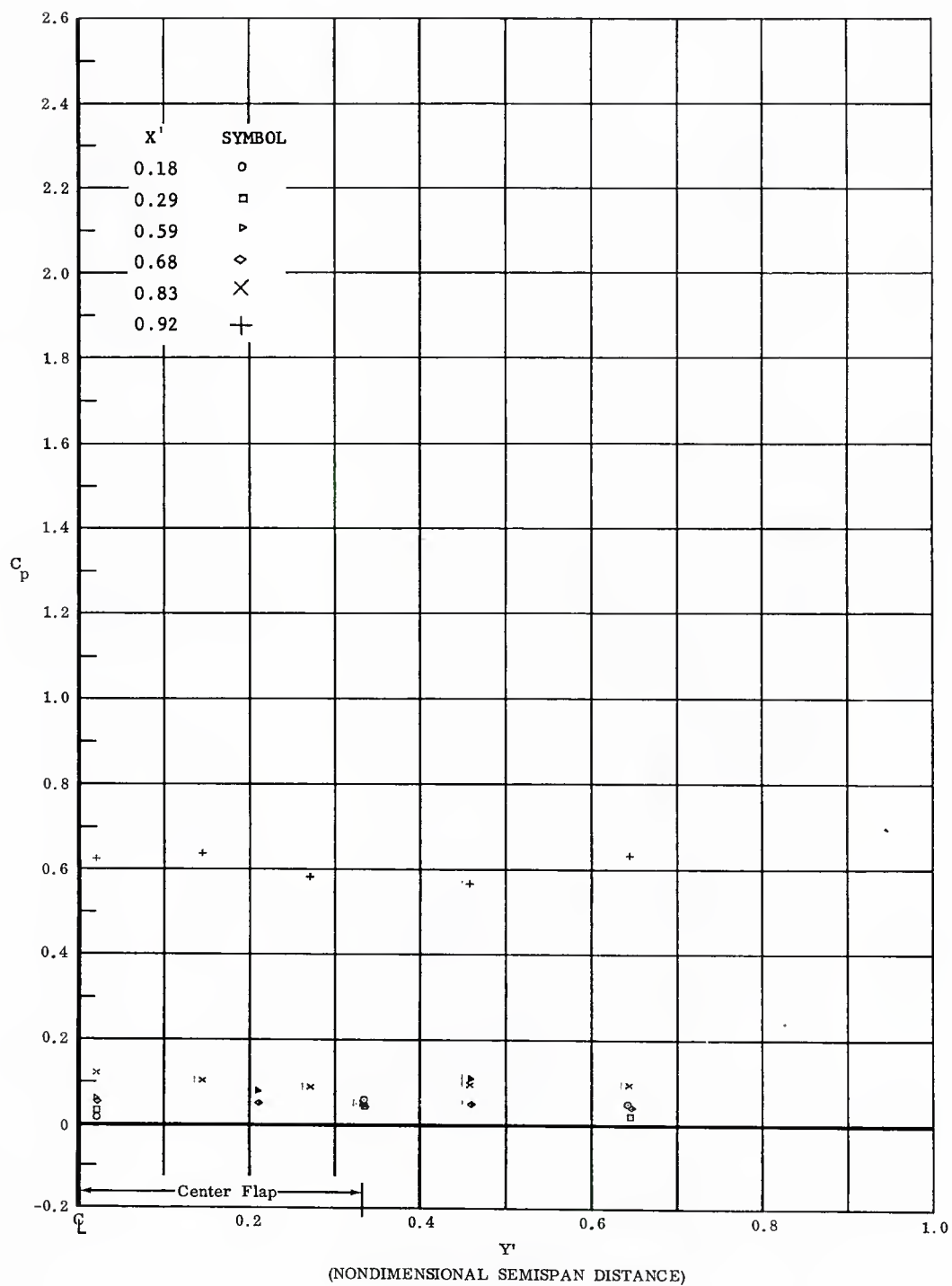


Fig. 80 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plate On

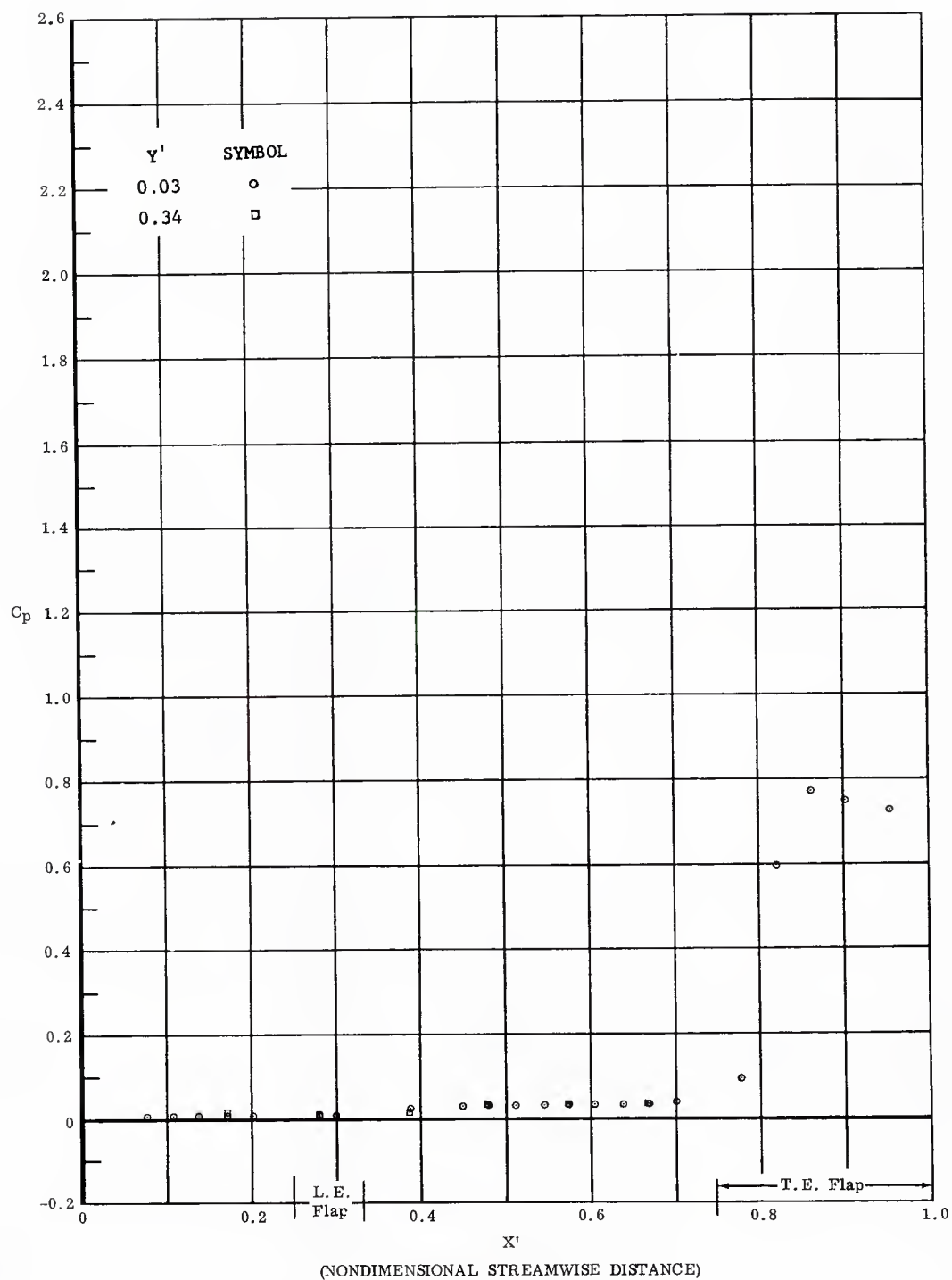


Fig. 81 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30° ,
 End Plates Off

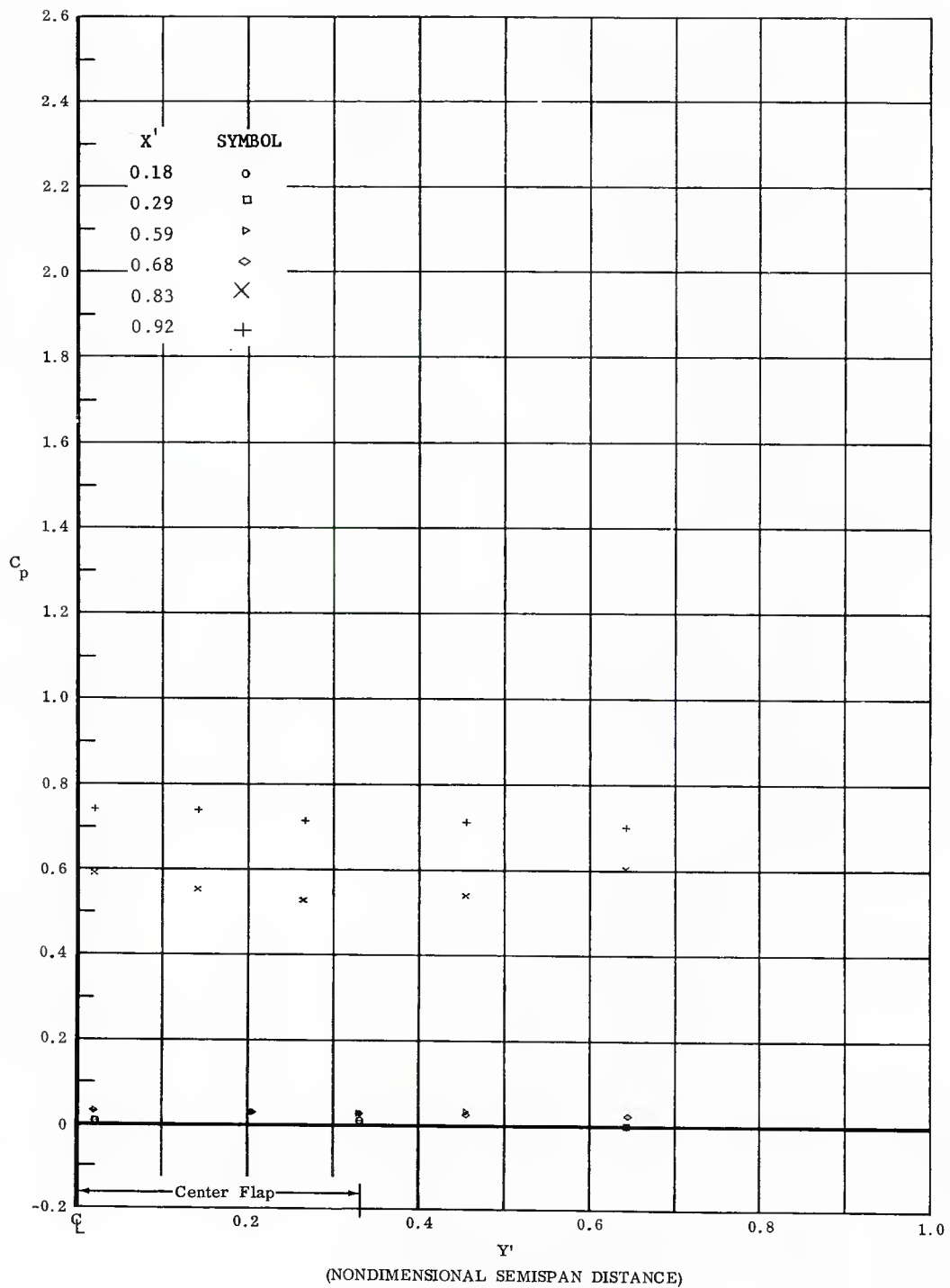


Fig. 81 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30° ,
 End Plate Off

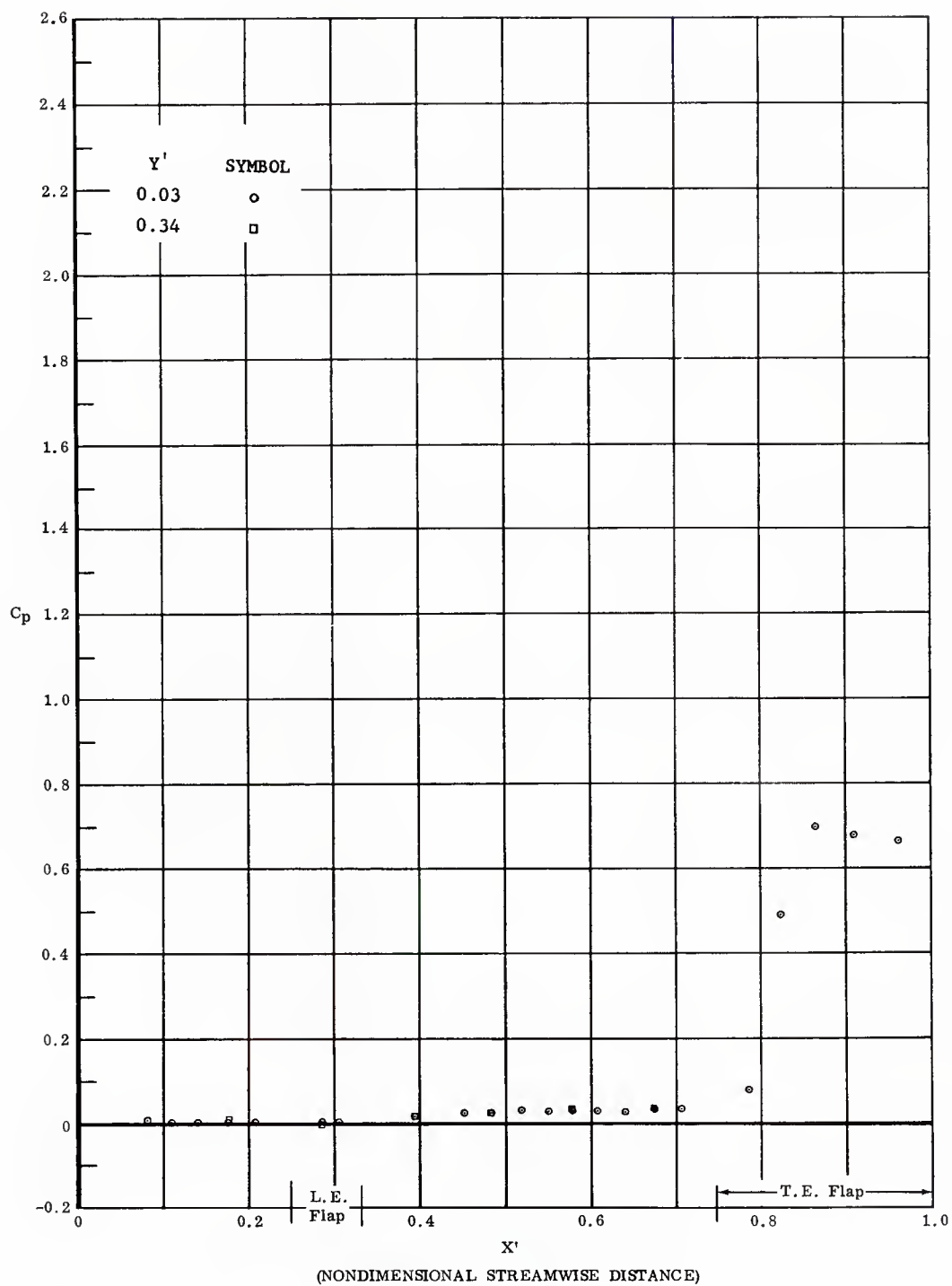


Fig. 82 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, Aft Full Span Flap at 30° ,
 End Plate On

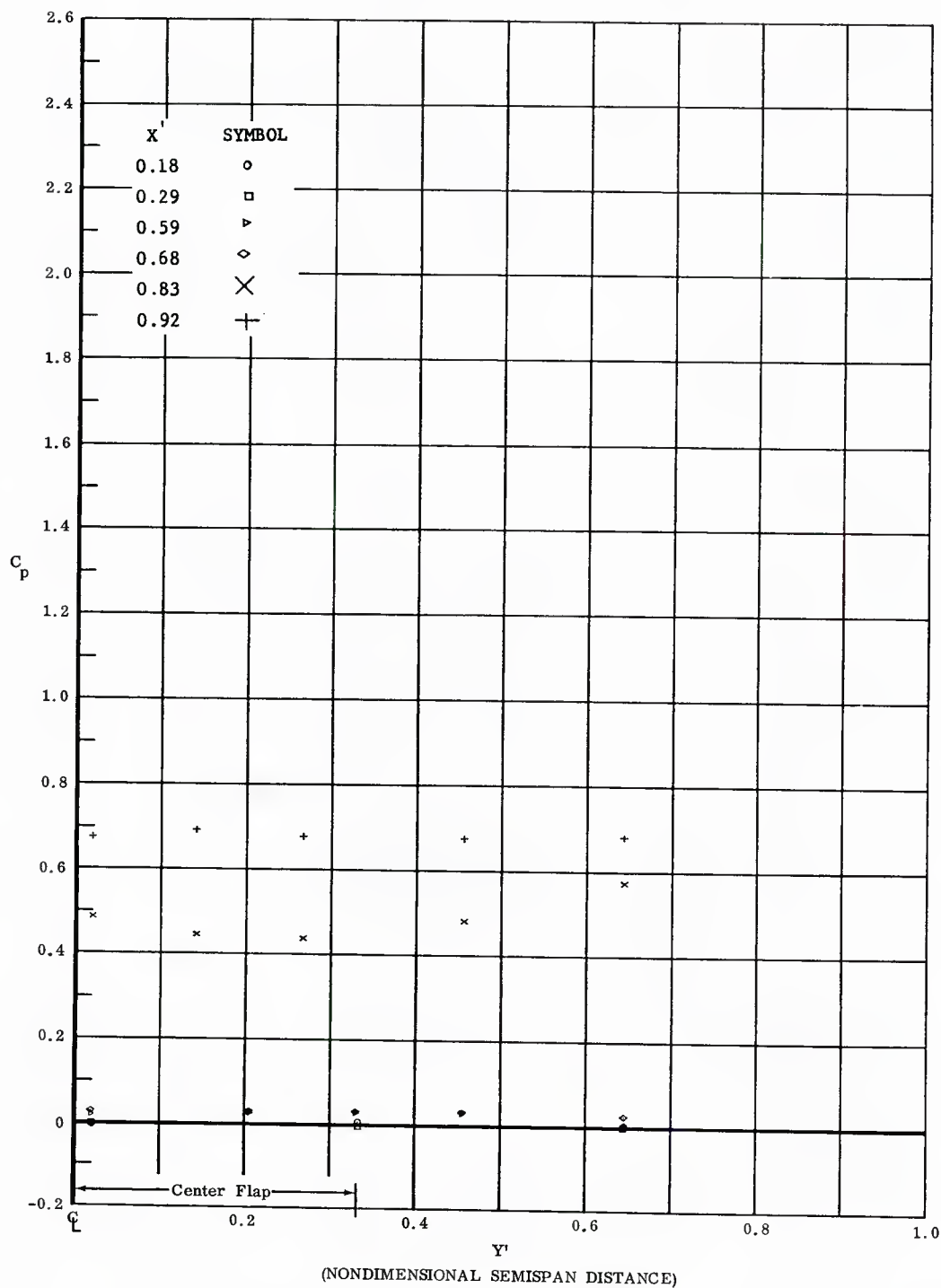


Fig. 82 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, Aft Full Span Flap at 30° ,
 End Plate On

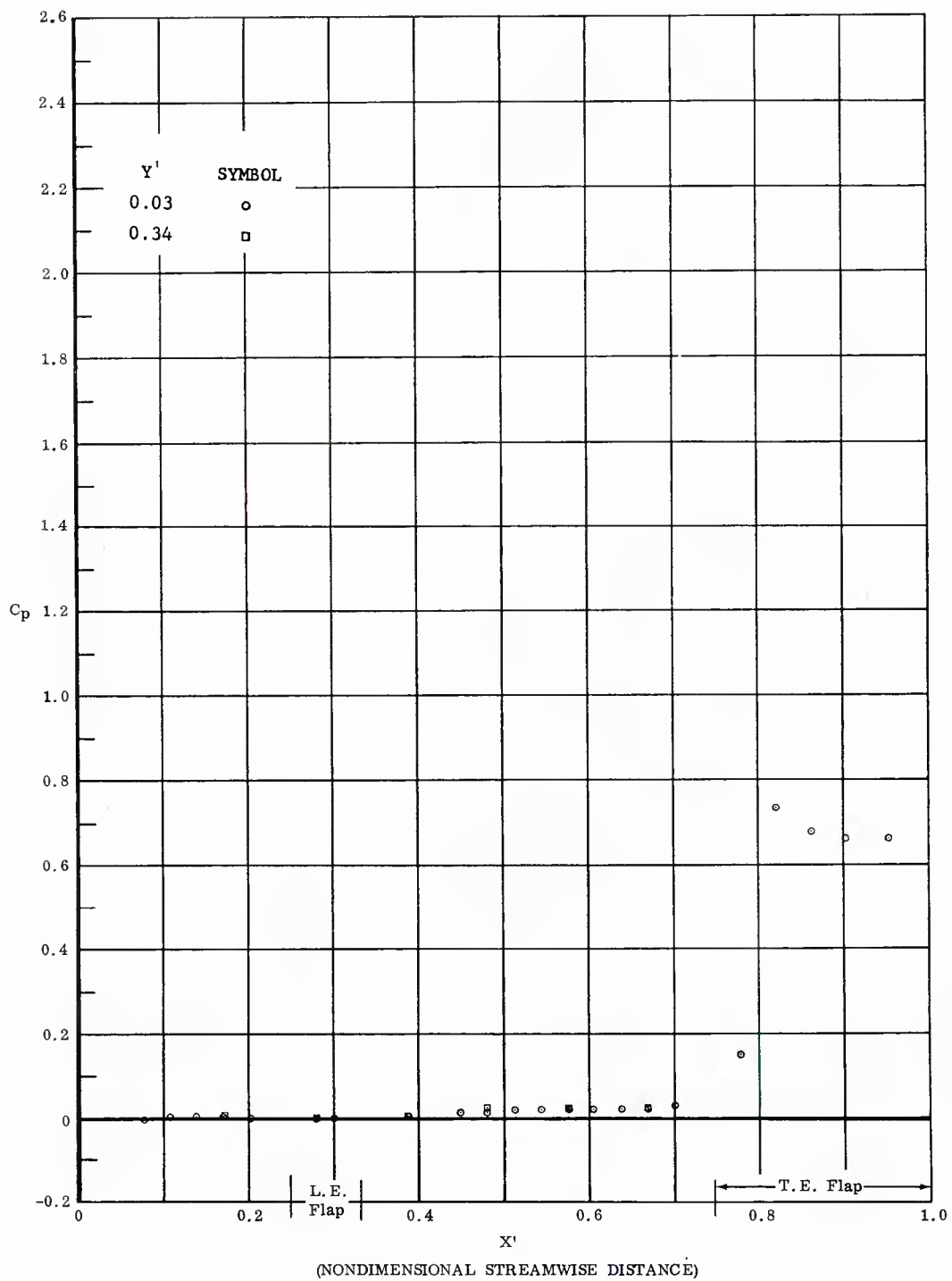


Fig. 83 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plate Off

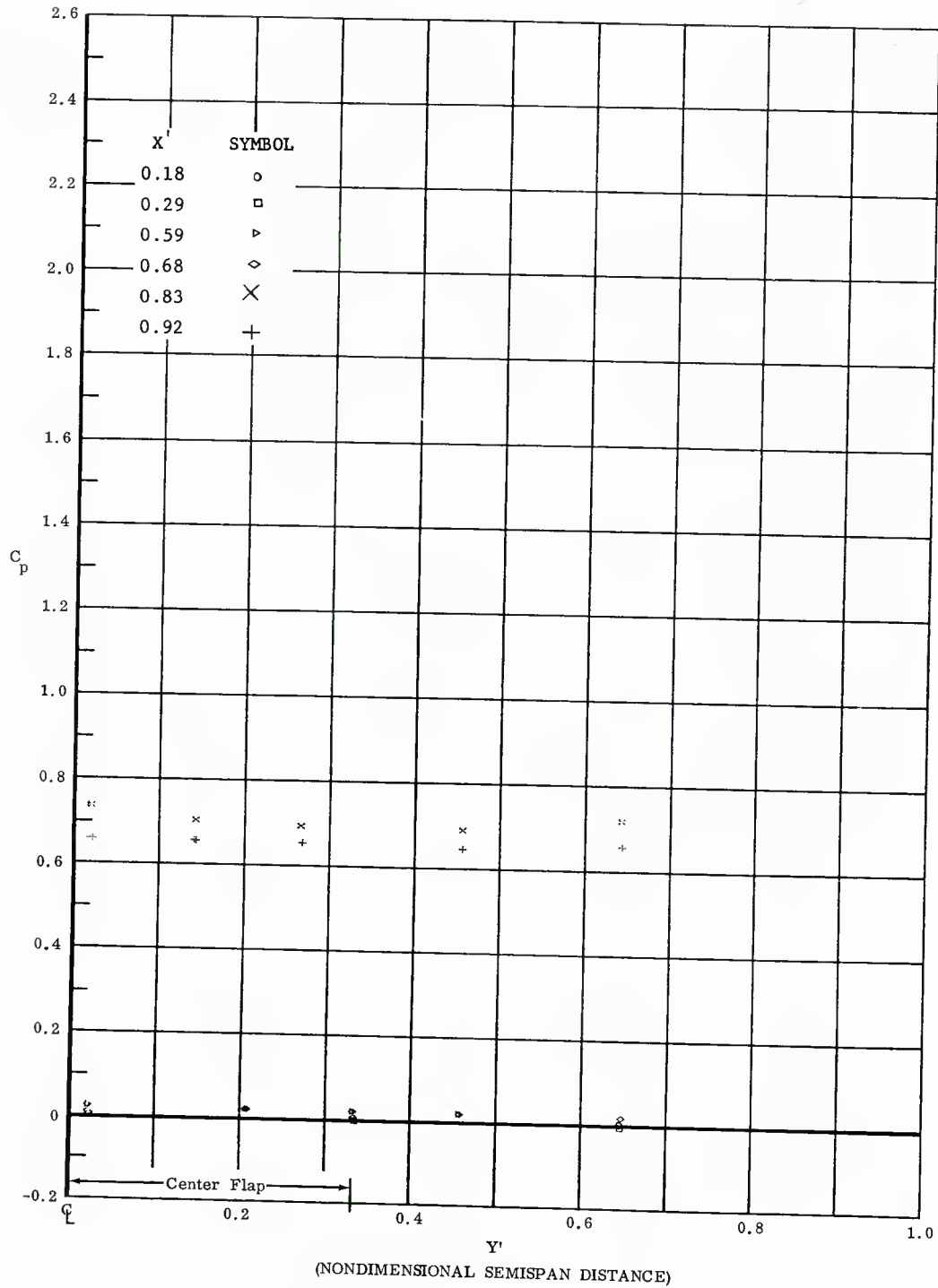


Fig. 83 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plate Off

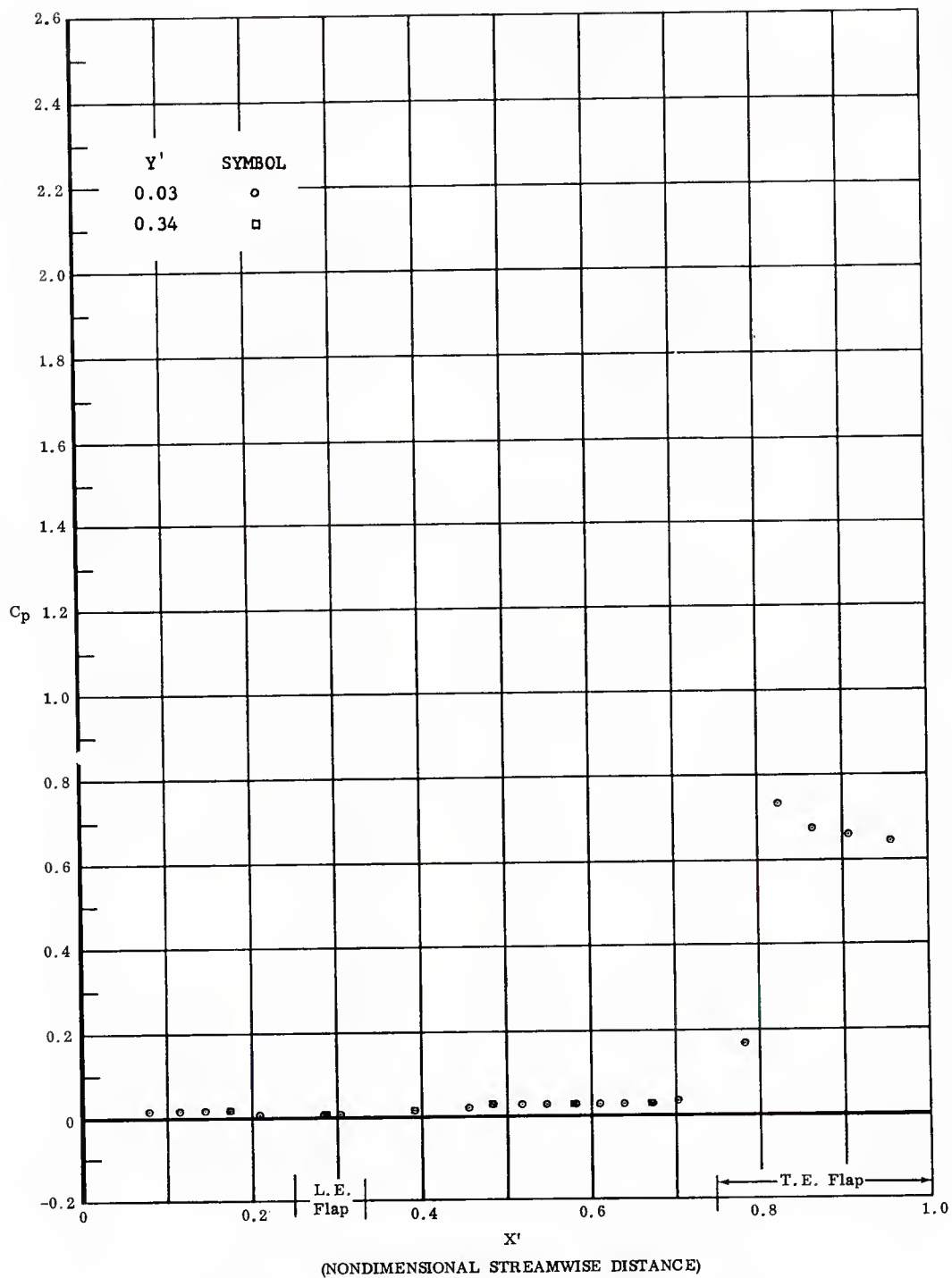


Fig. 84 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plate On

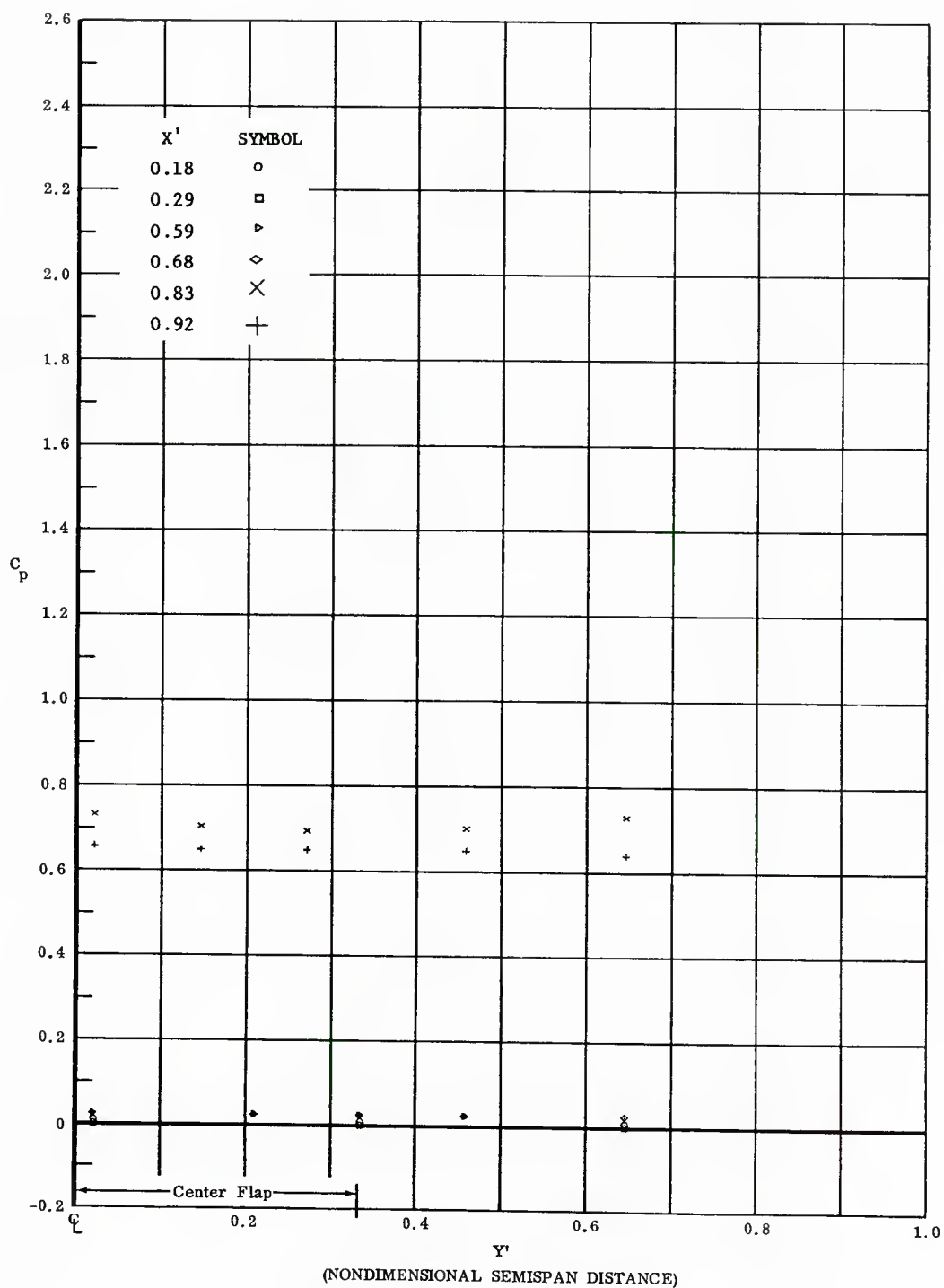


Fig. 84 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30°
 End Plate On

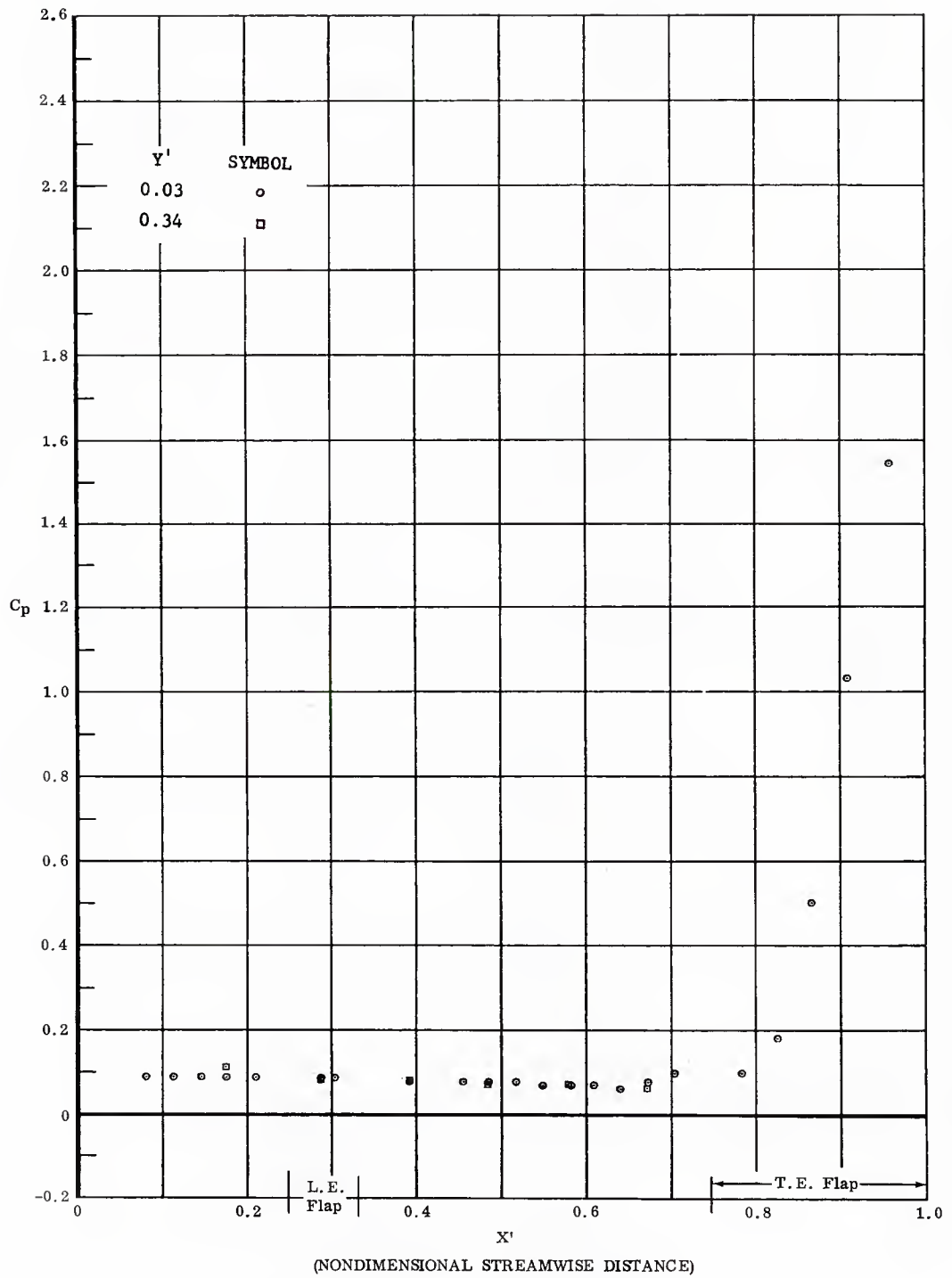


Fig. 85 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 45° ,
 End Plate Off

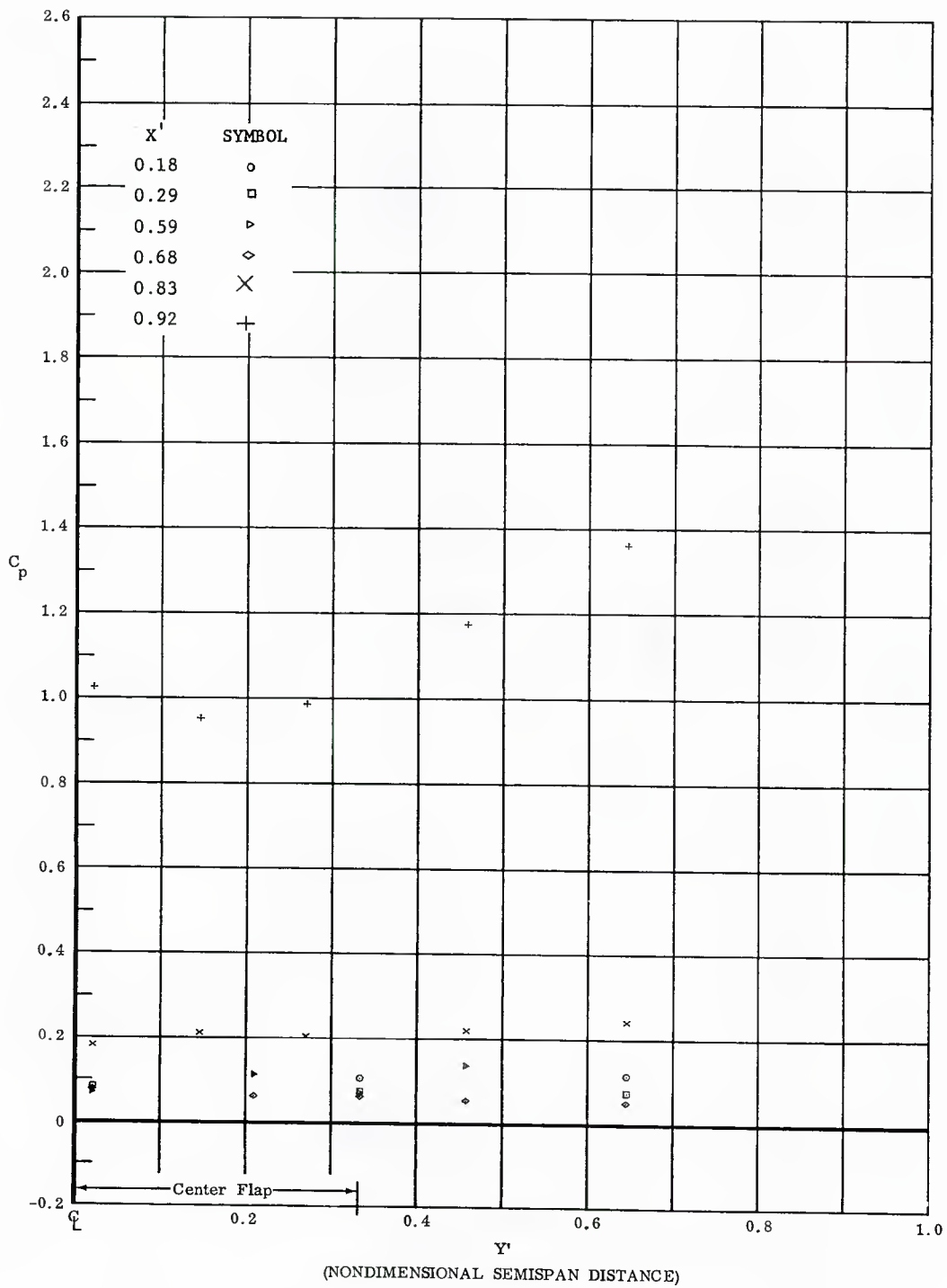


Fig. 85 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 45° ,
 End Plate Off

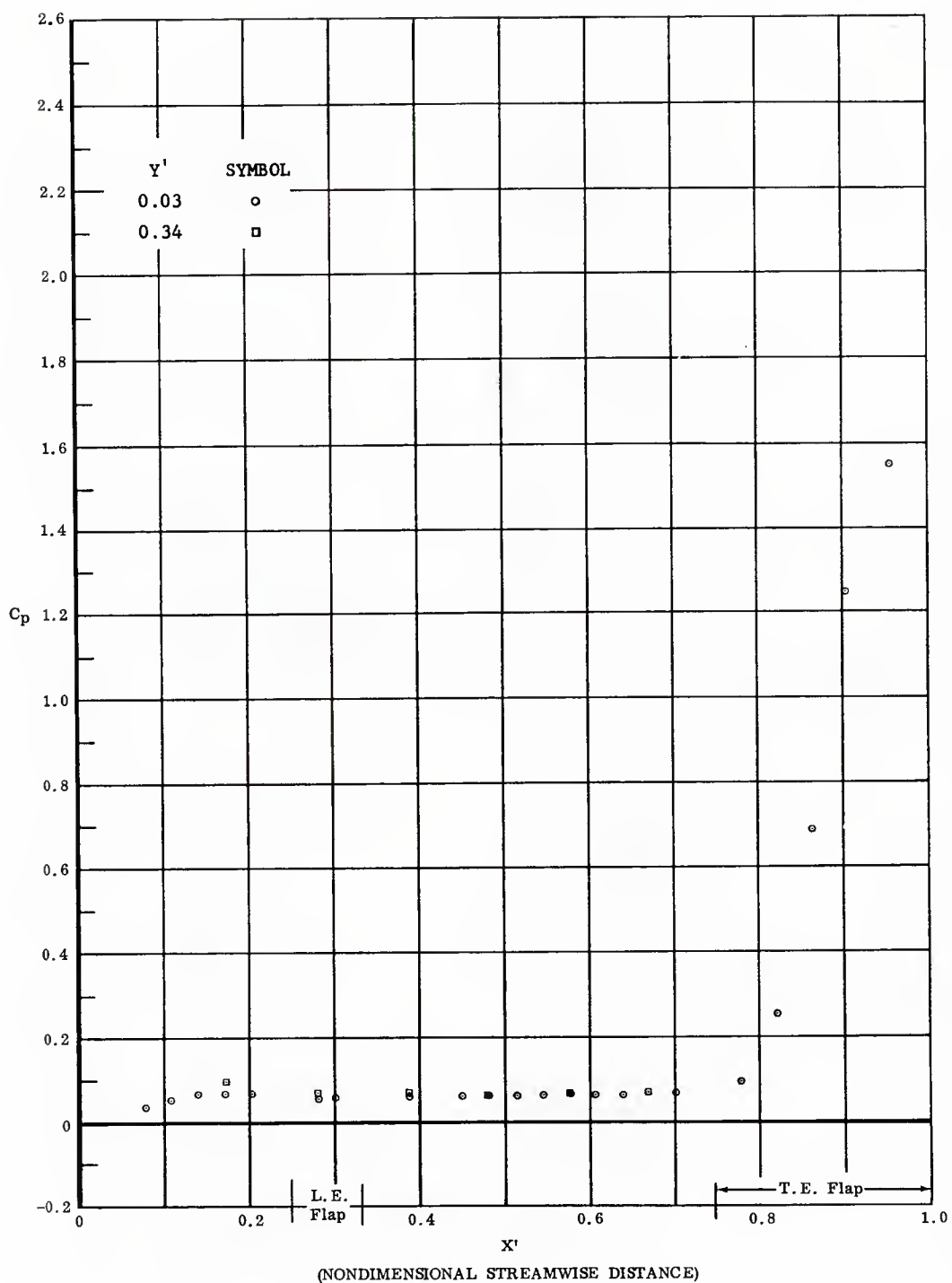


Fig. 86 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 45° ,
 End Plate Off

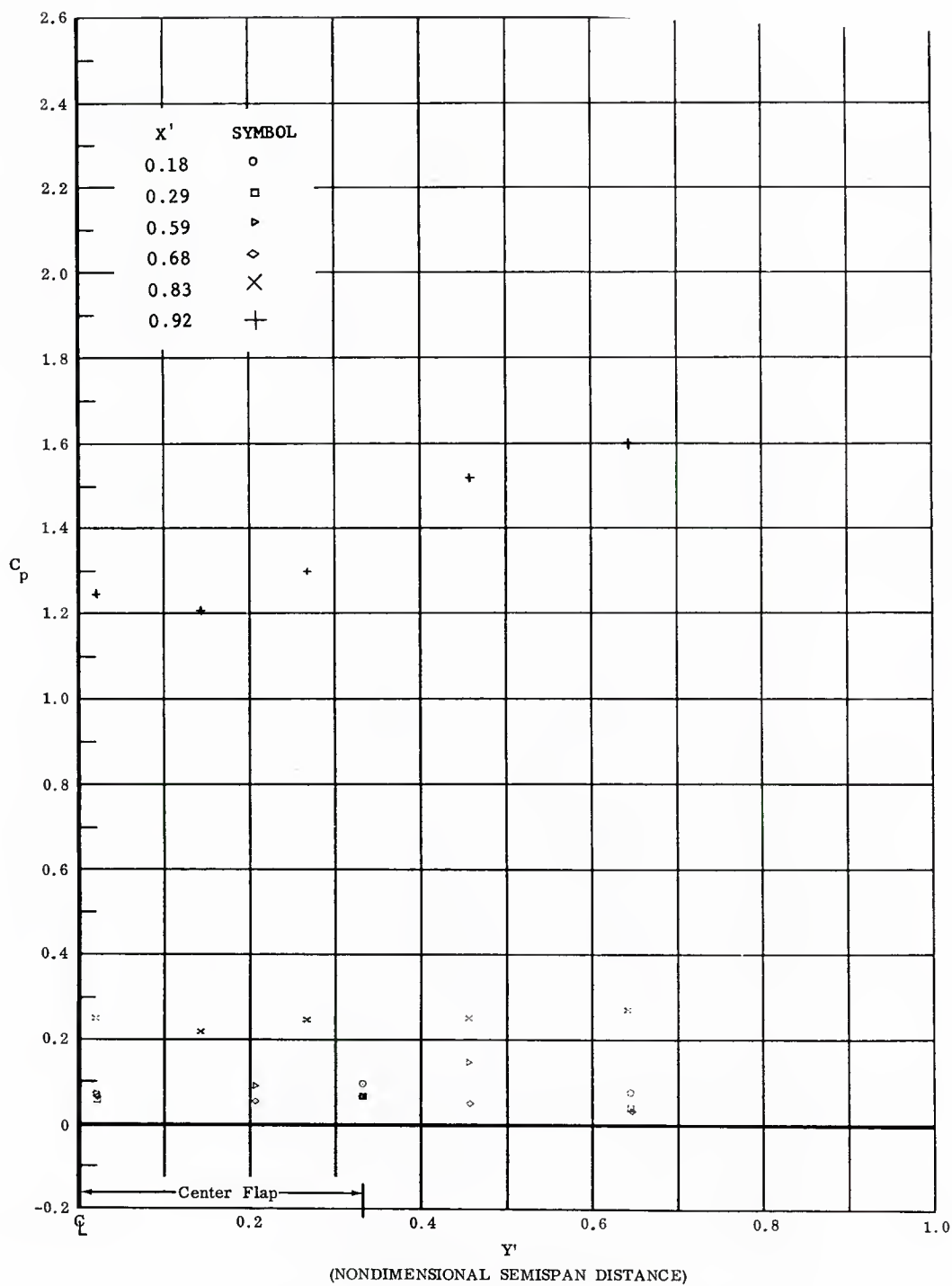


Fig. 86 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 45° ,
 End Plate Off

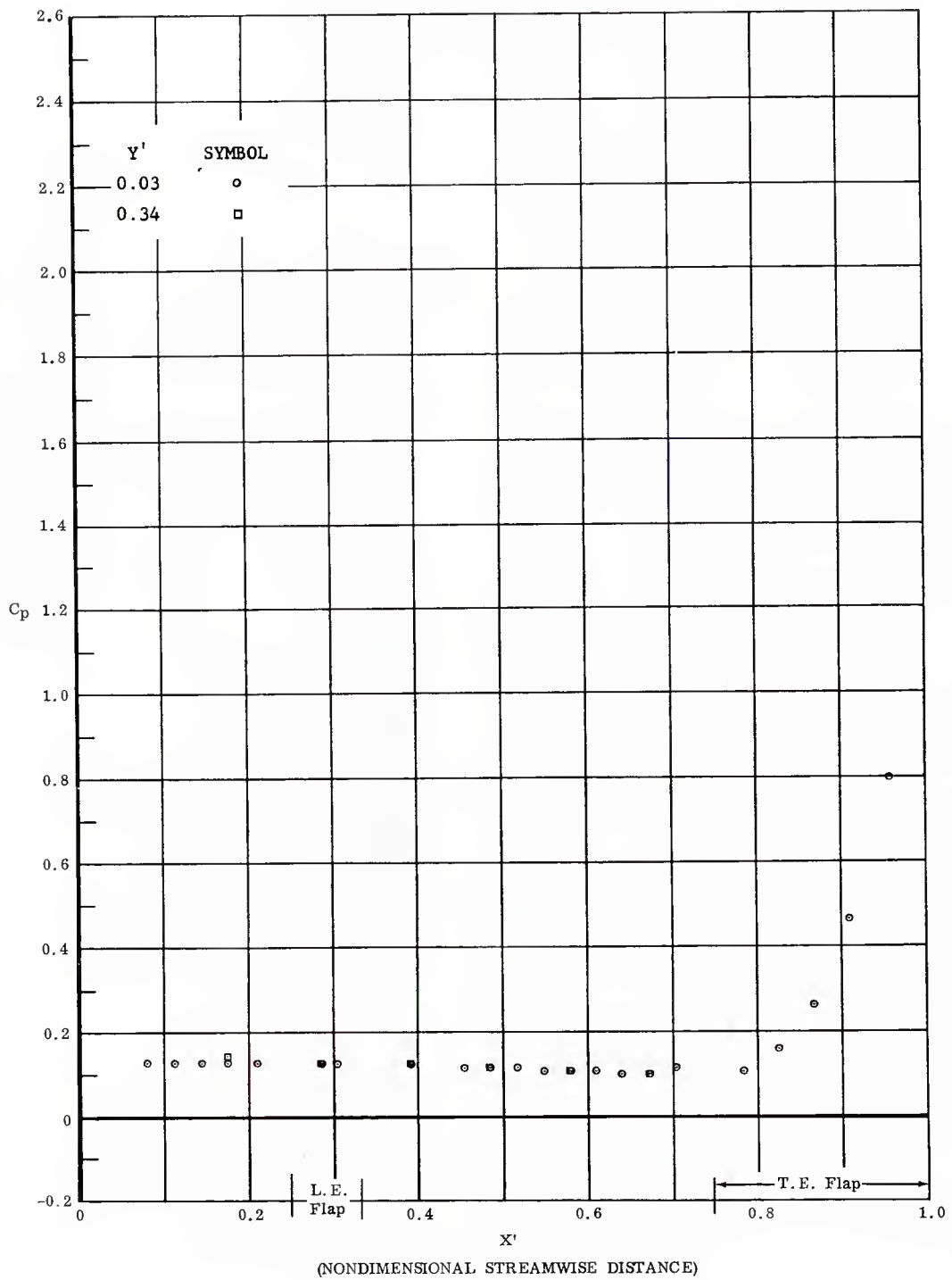


Fig. 87 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 45° ,
 End Plate On

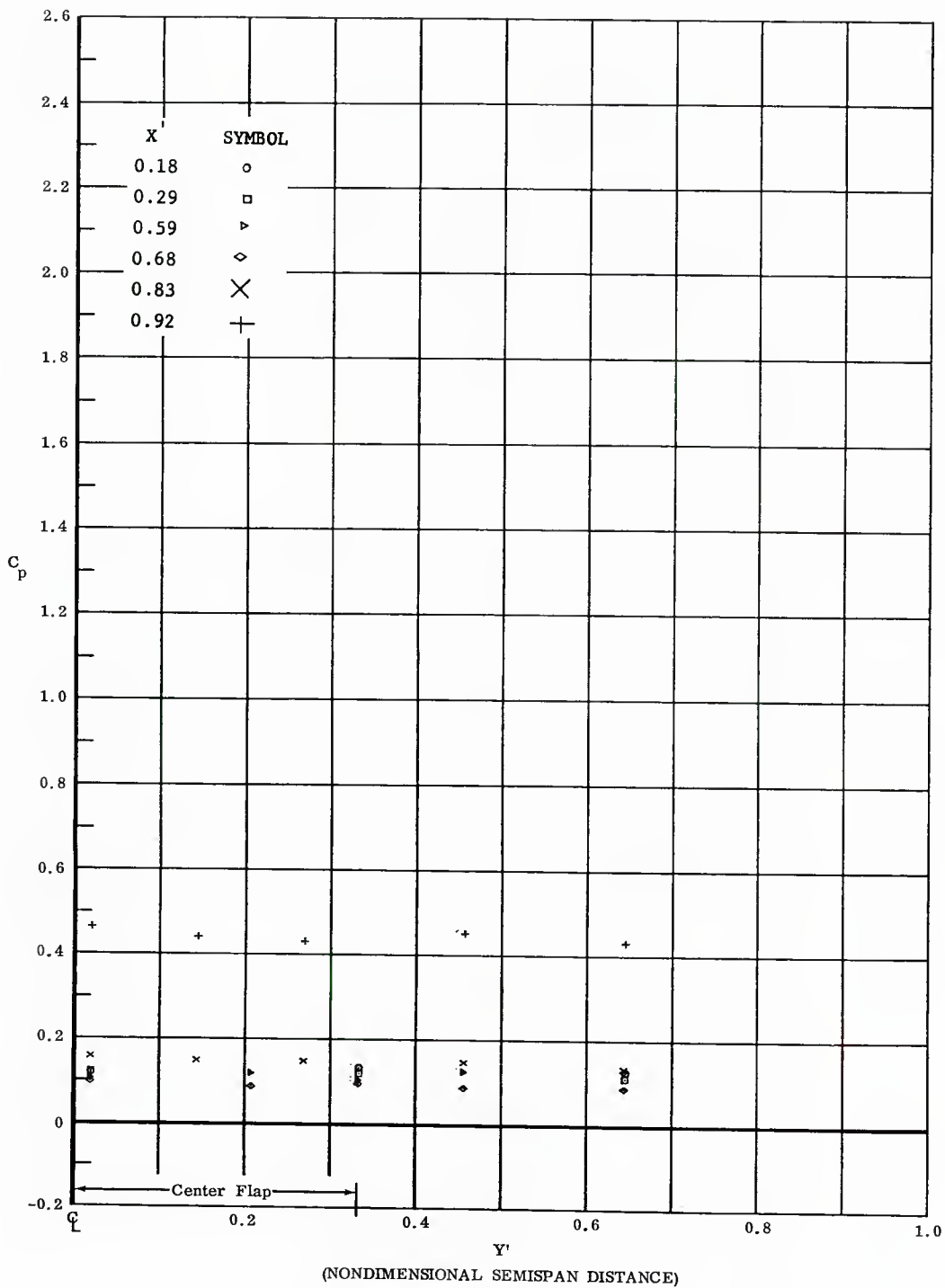


Fig. 87 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 45° ,
 End Plate On

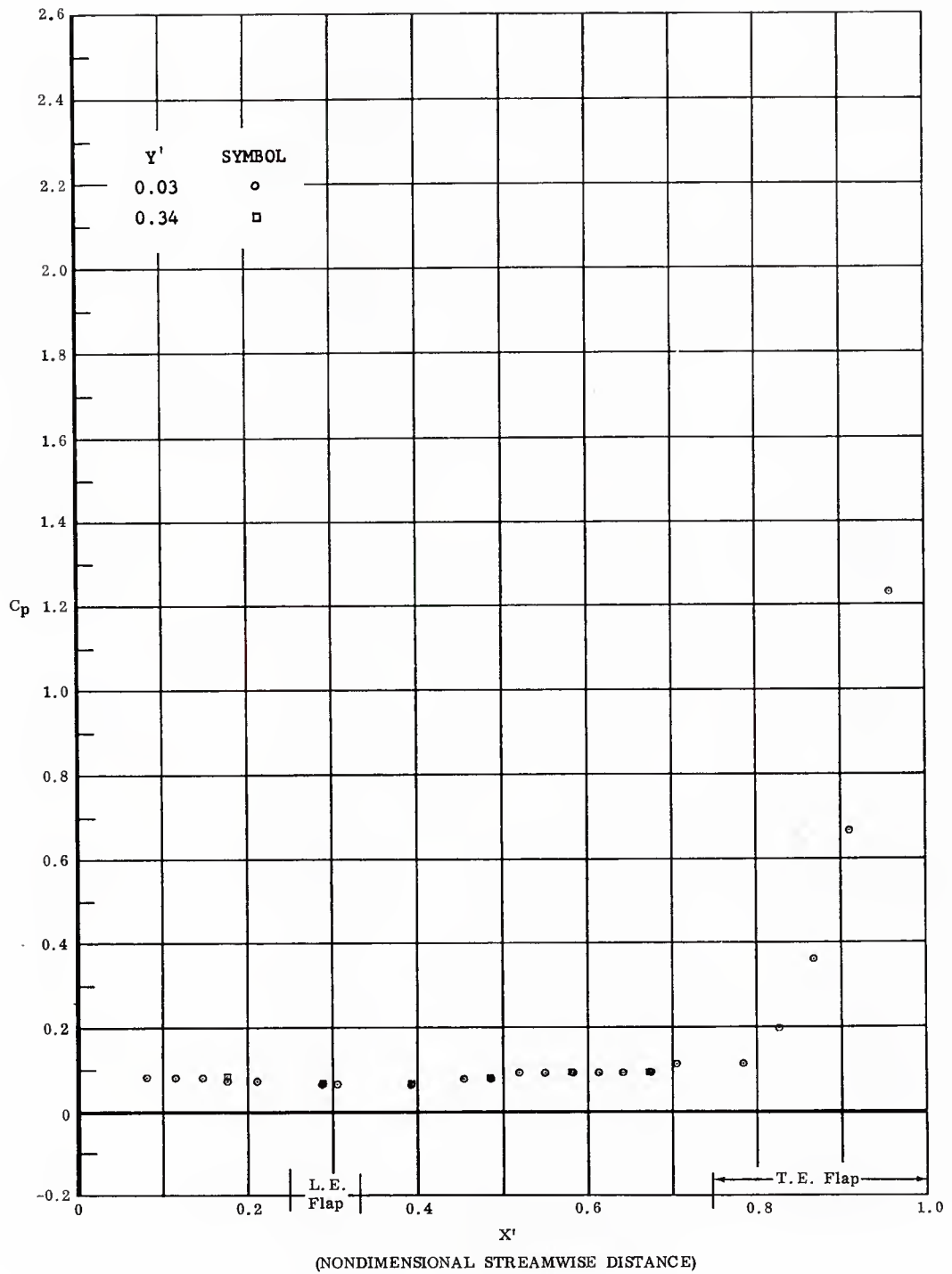


Fig. 88 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 45° ,
 End Plates Off

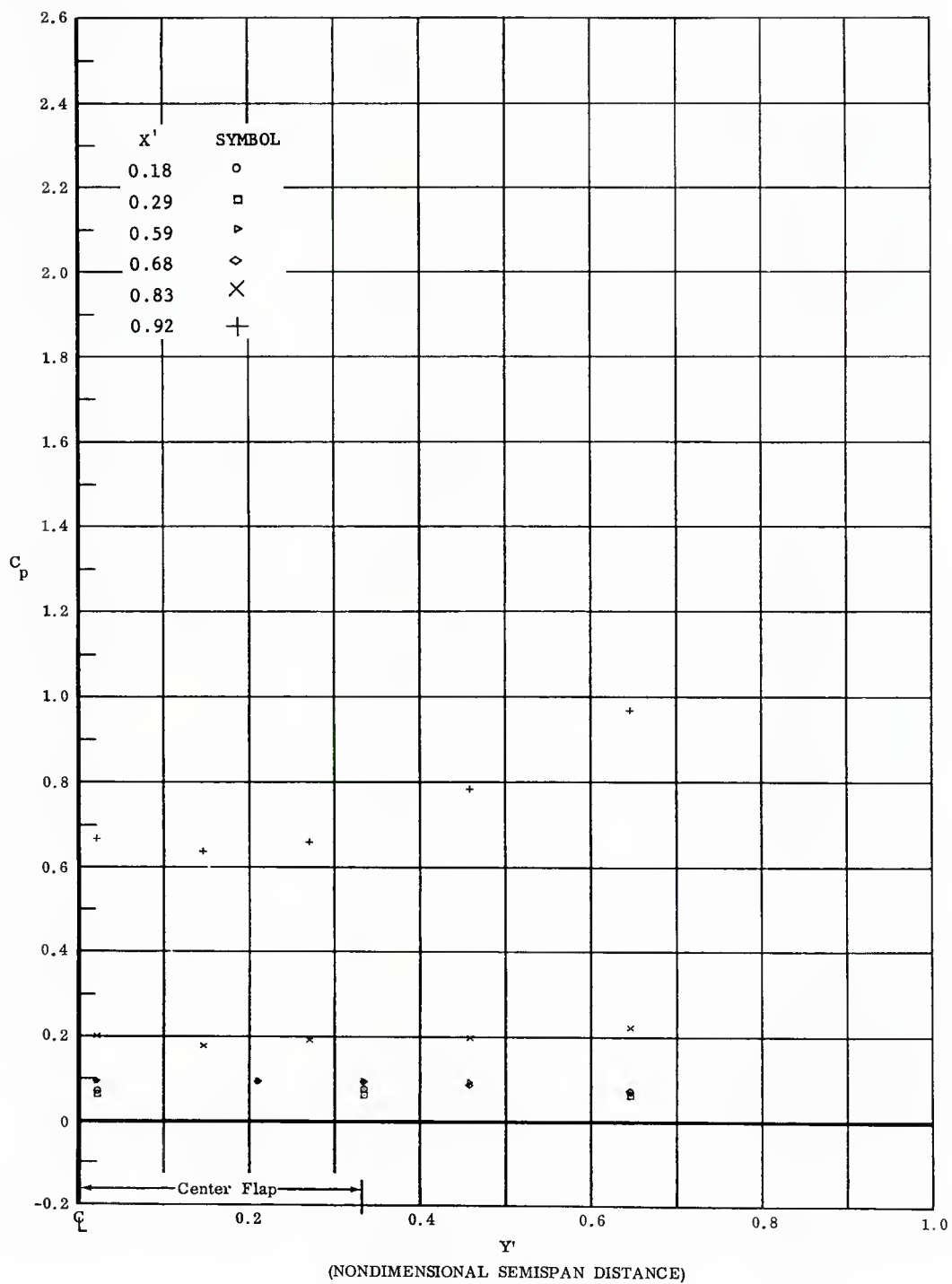


Fig. 88 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 45° ,
 End Plates Off

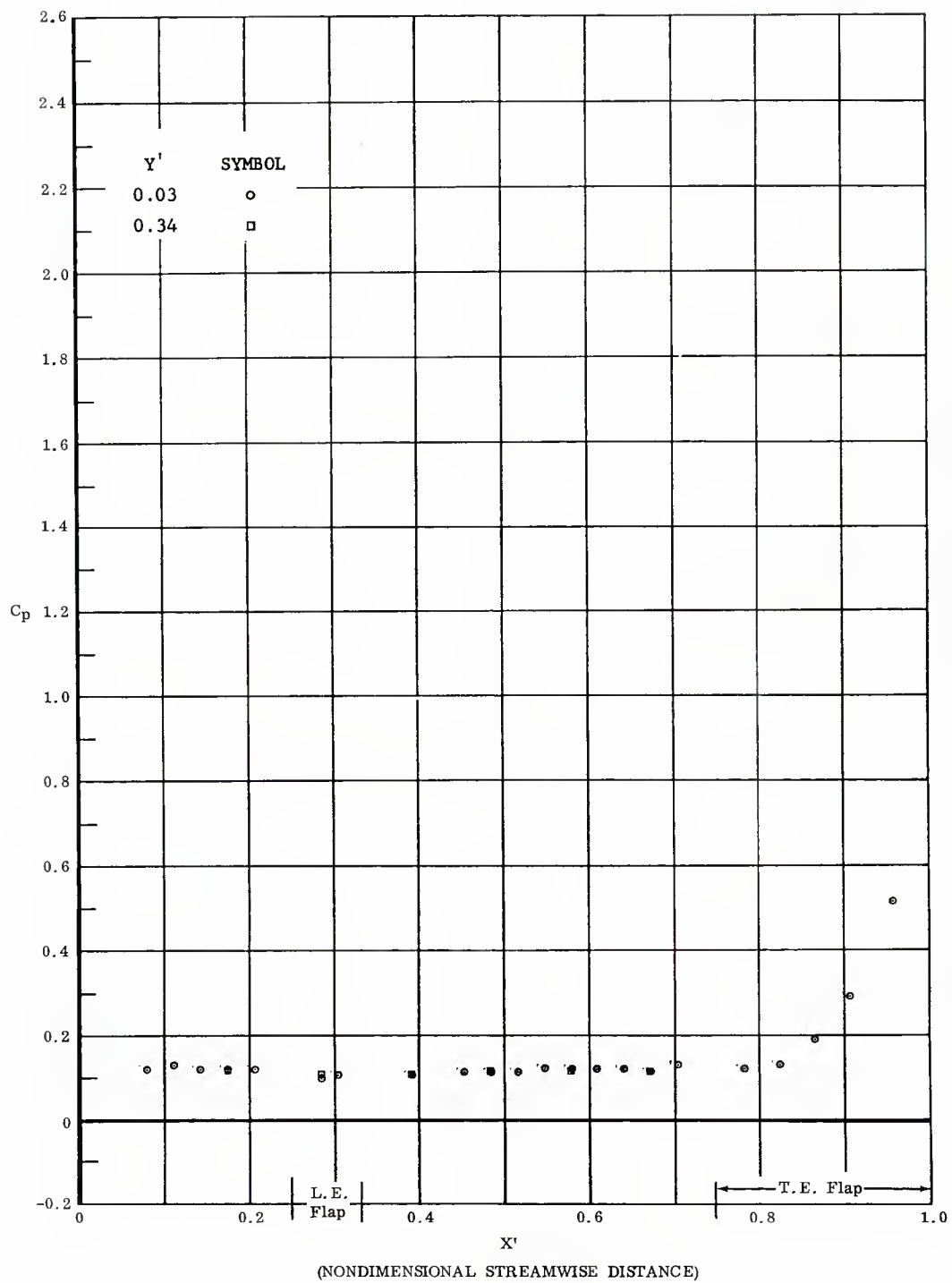


Fig. 89 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 45° ,
 End Plates On

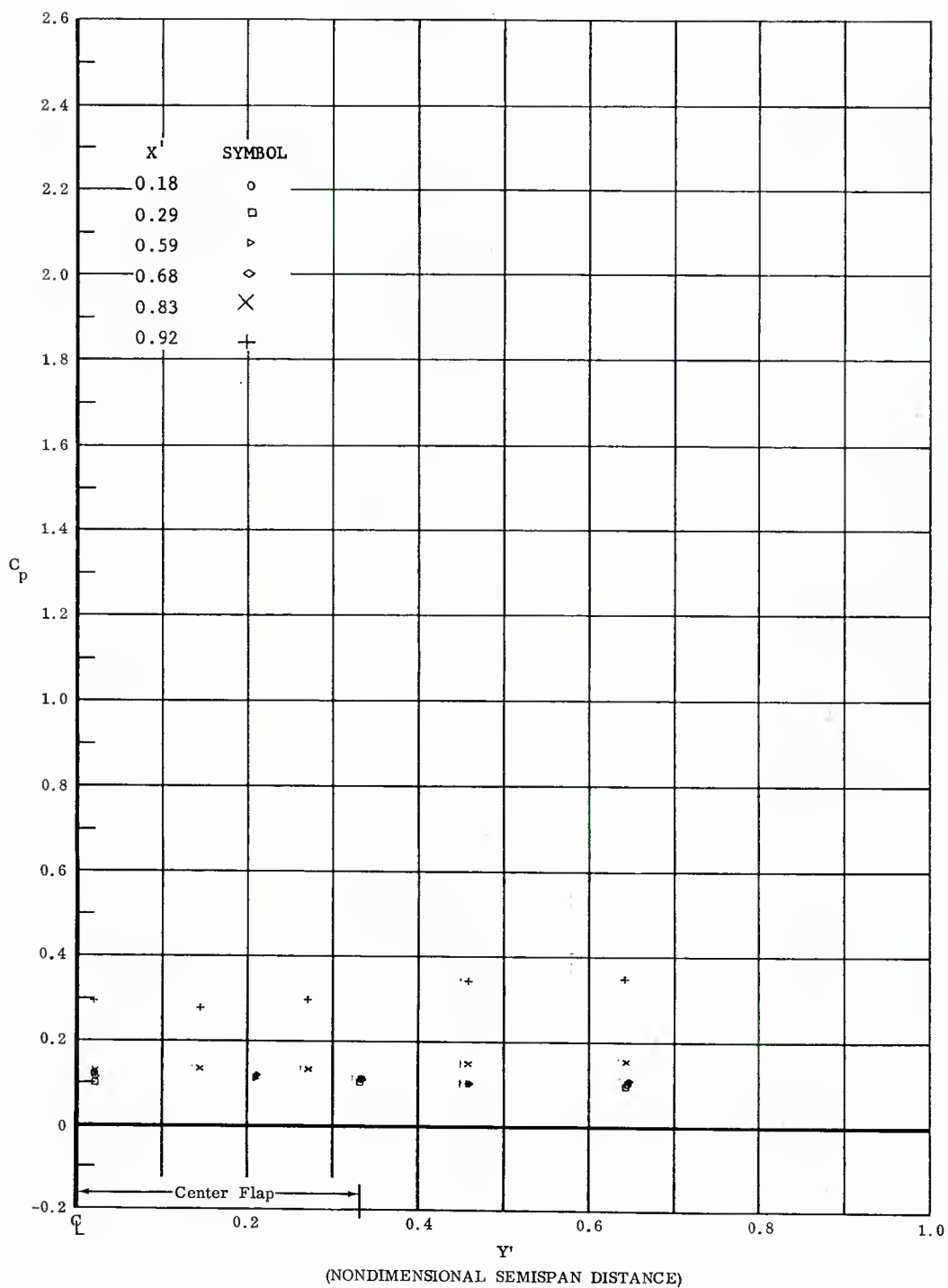


Fig. 89 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 45° ,
 End Plates On

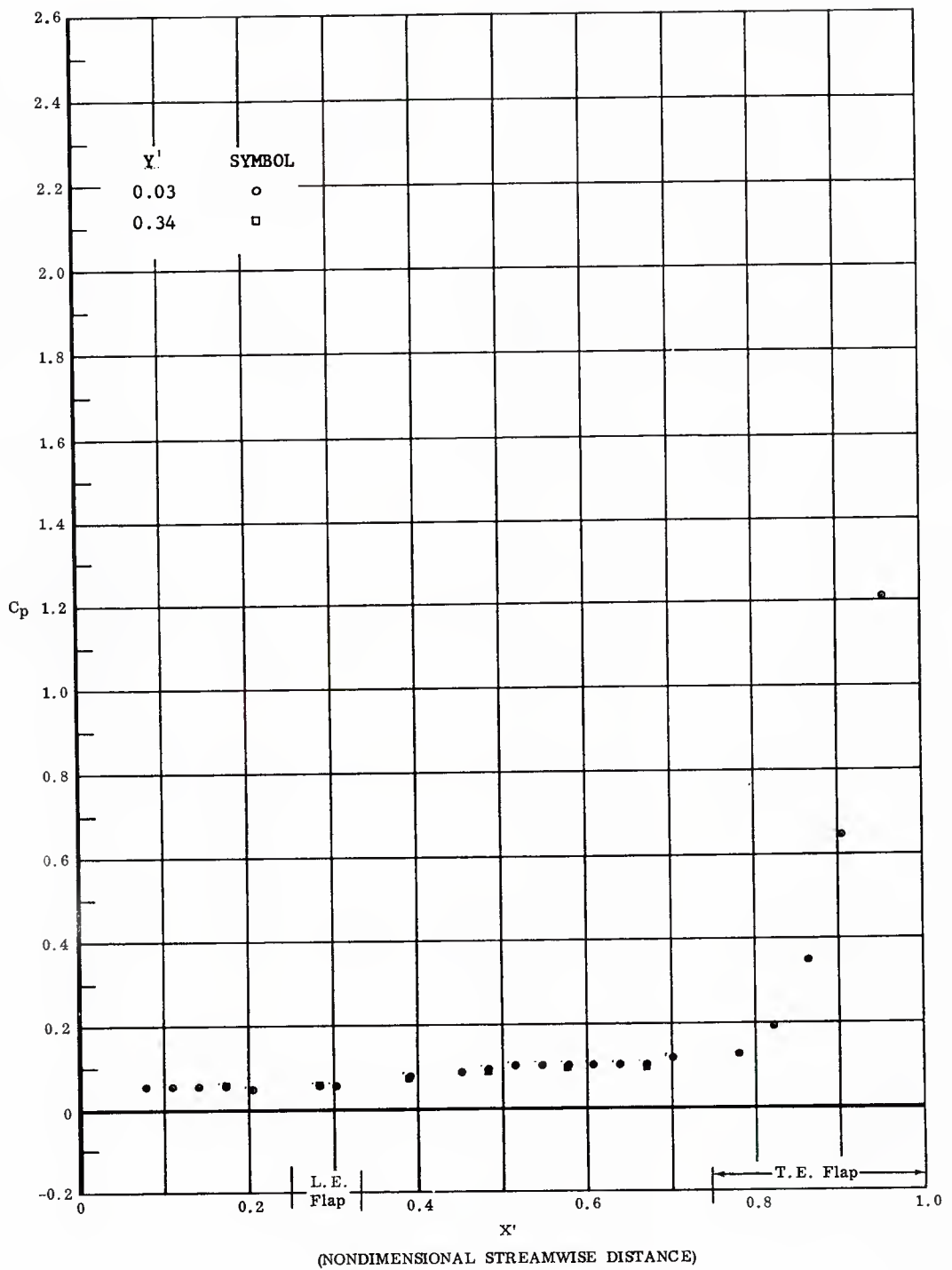


Fig. 90 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty} / 10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 45° ,
 End Plates Off

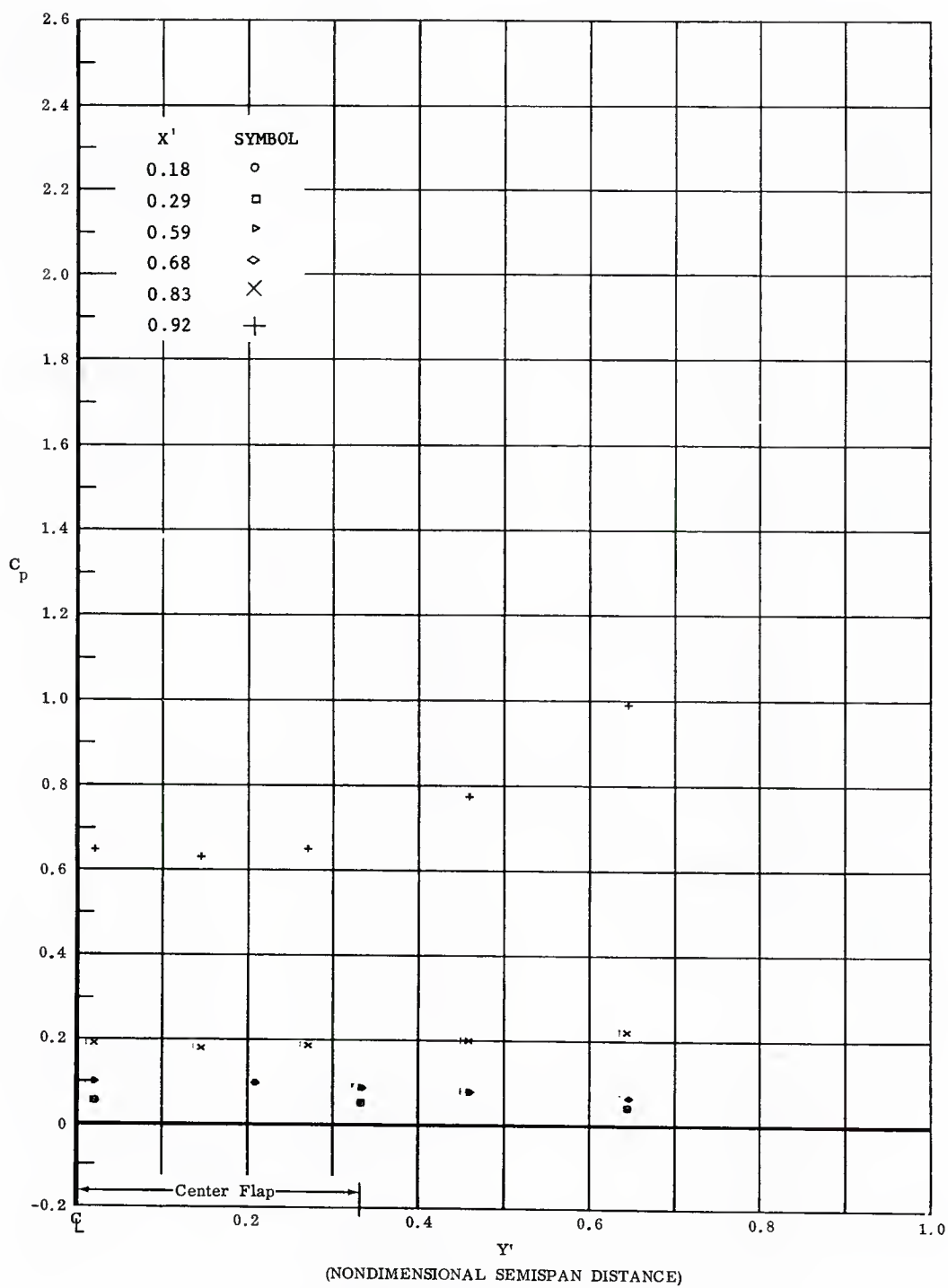


Fig. 90 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 45° ,
 End Plates Off

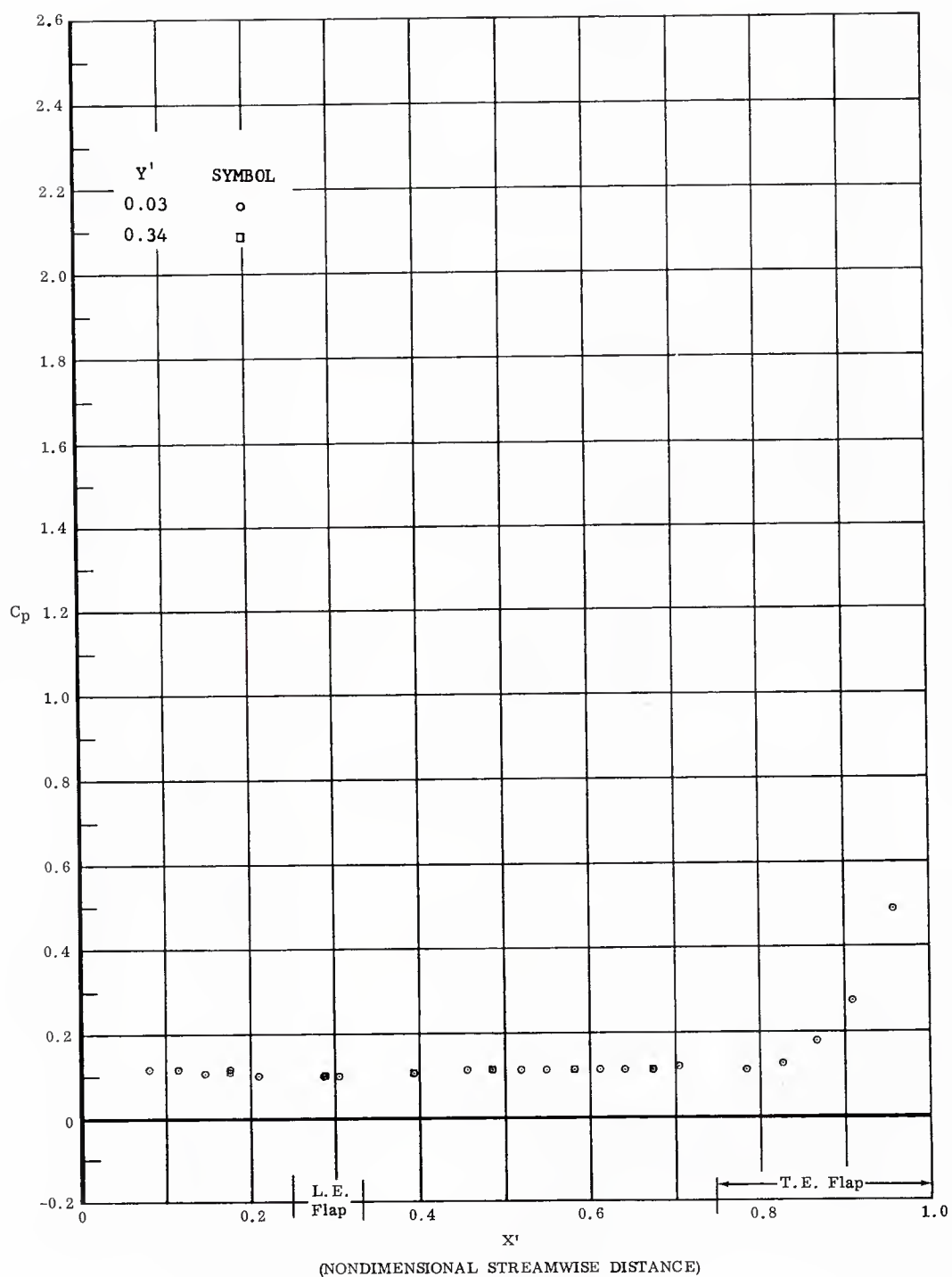


Fig. 91 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 45° ,
 End Plates On

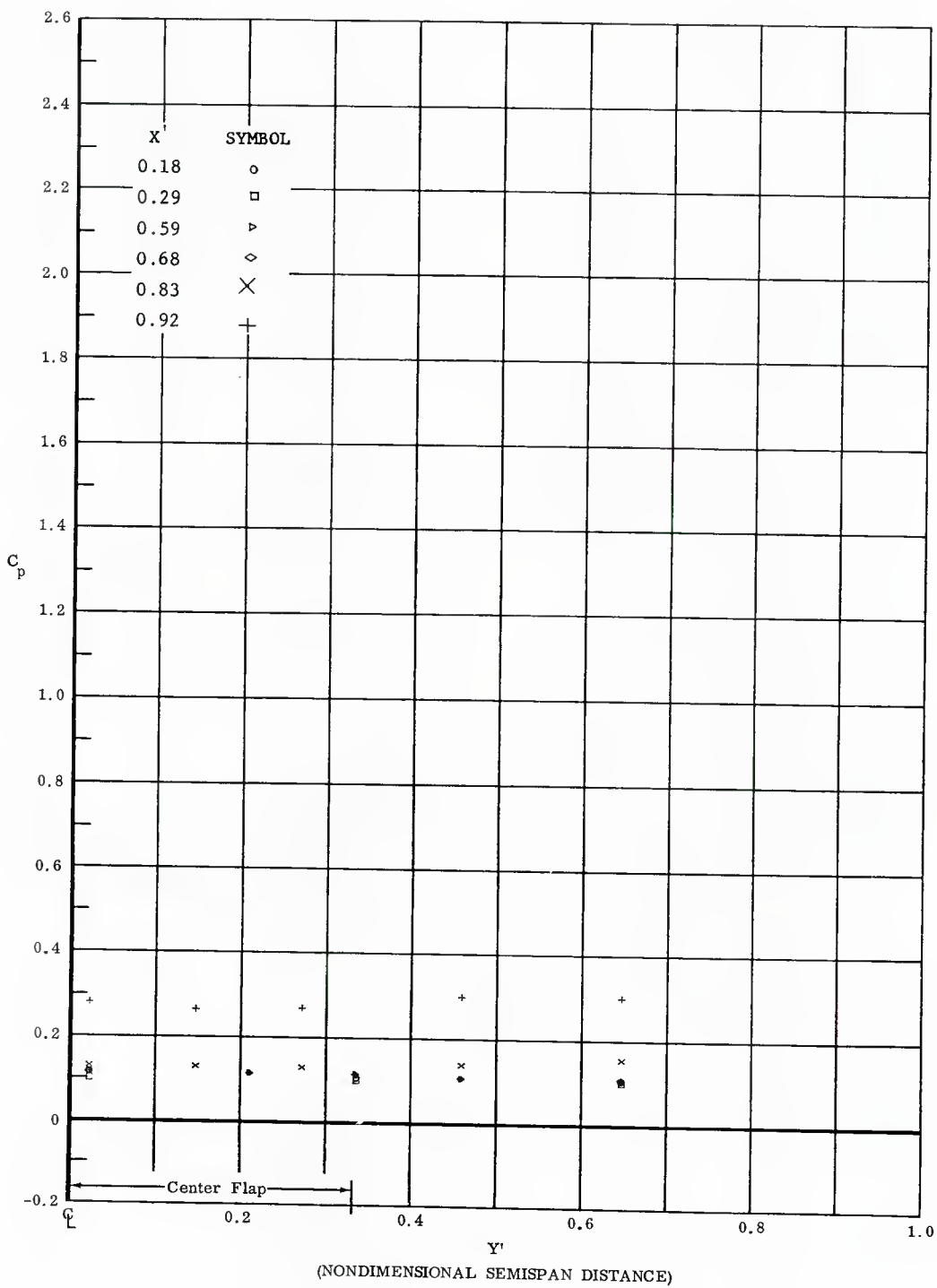


Fig. 91 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, Aft Full Span Flap at 45° ,
 End Plates On

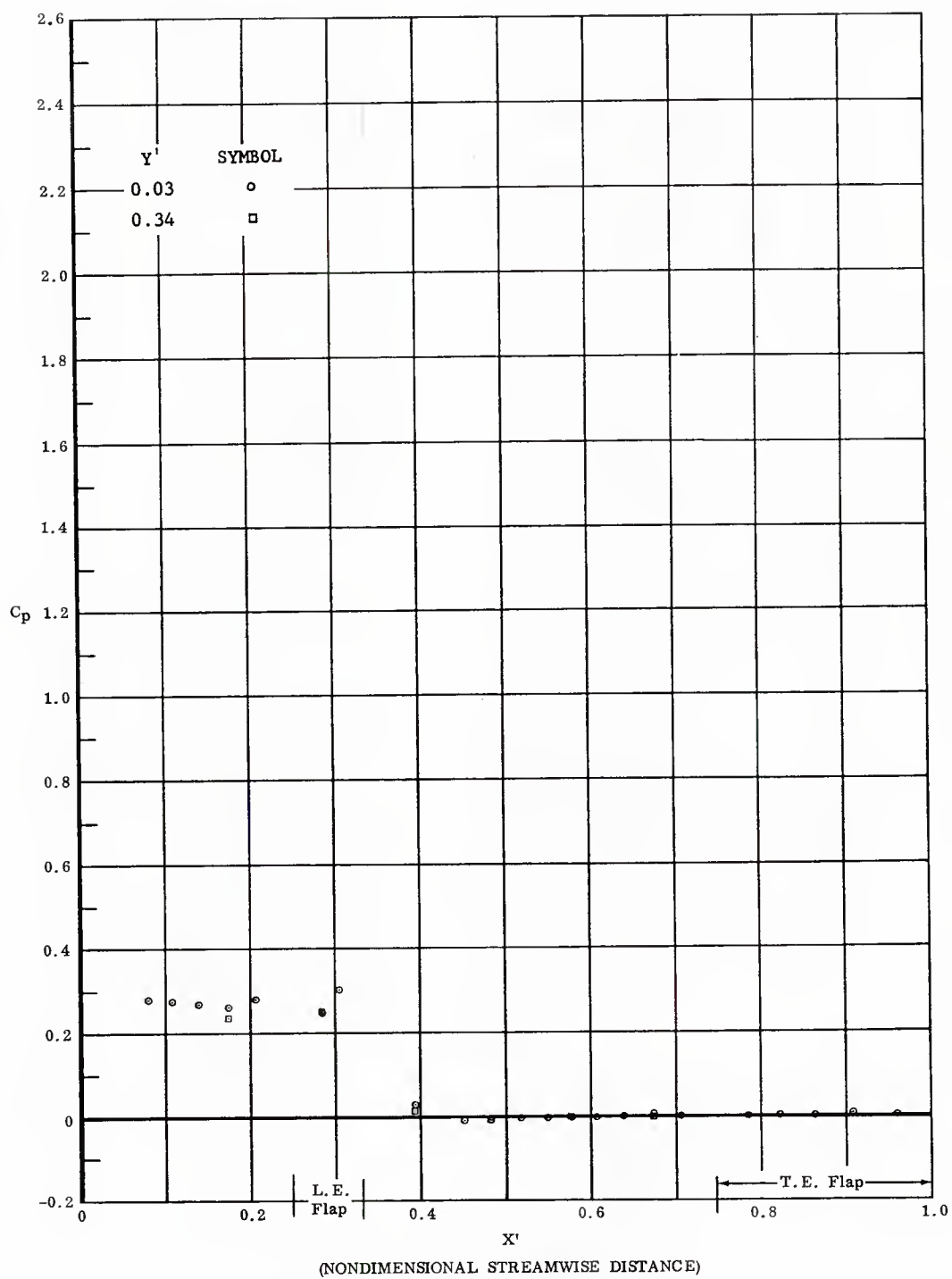


Fig. 92 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Forward Flap at 90° , End
 Plates On

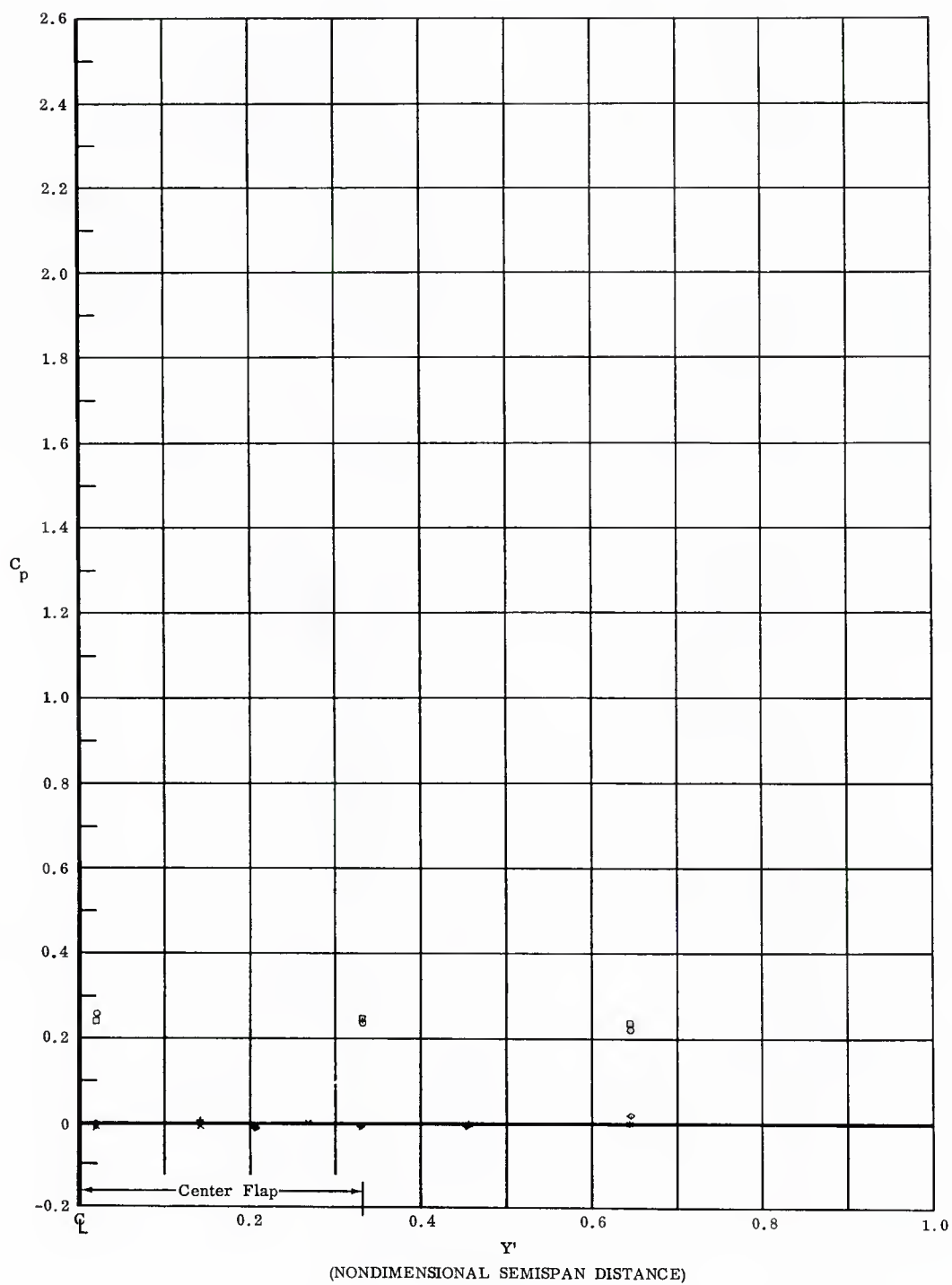


Fig. 92 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_\infty / 10^6 \text{ ft} = 1.1$, Forward Flap at 90° , End
 Plates On

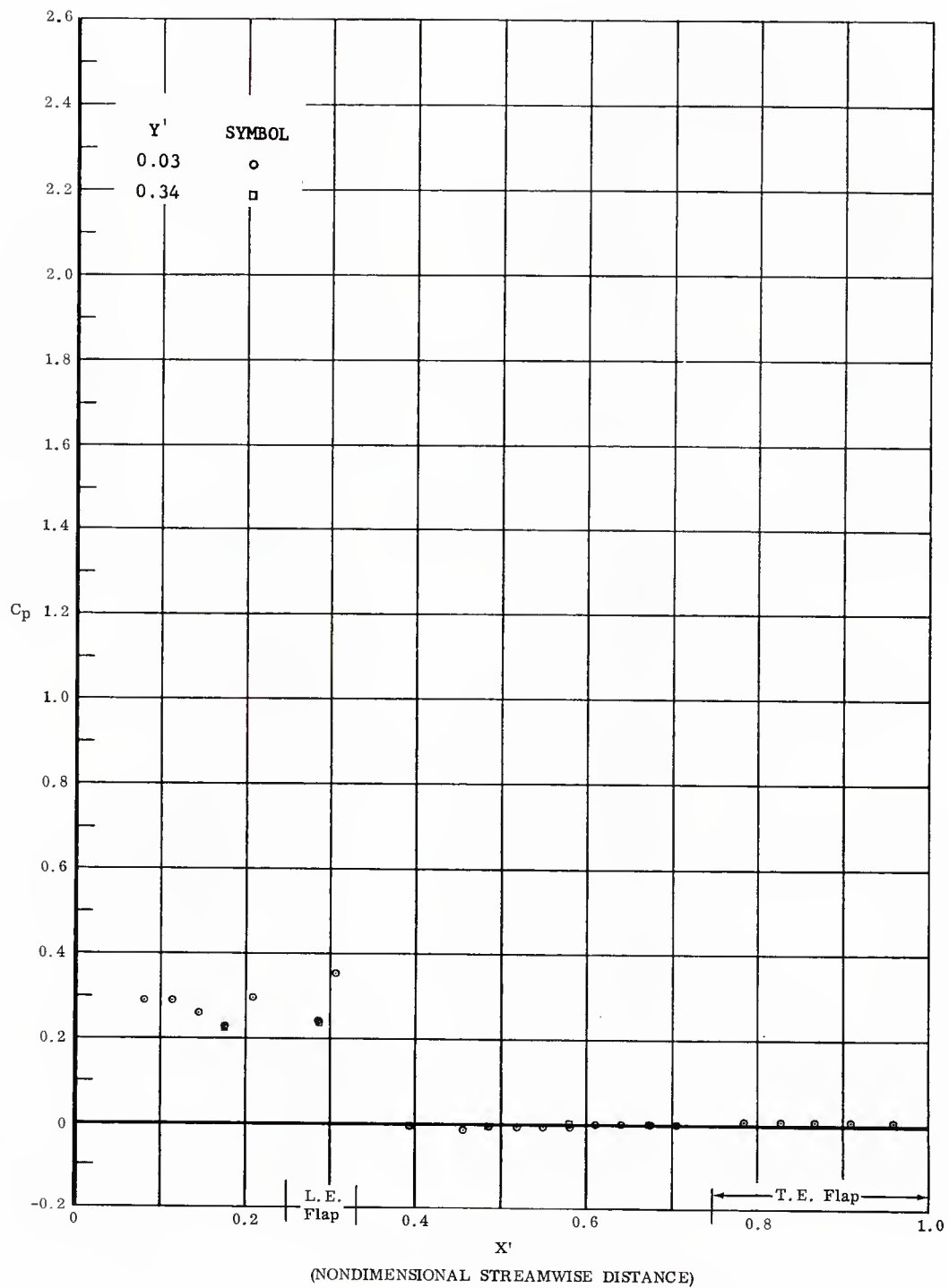


Fig. 93 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 90° , End
 Plates Off

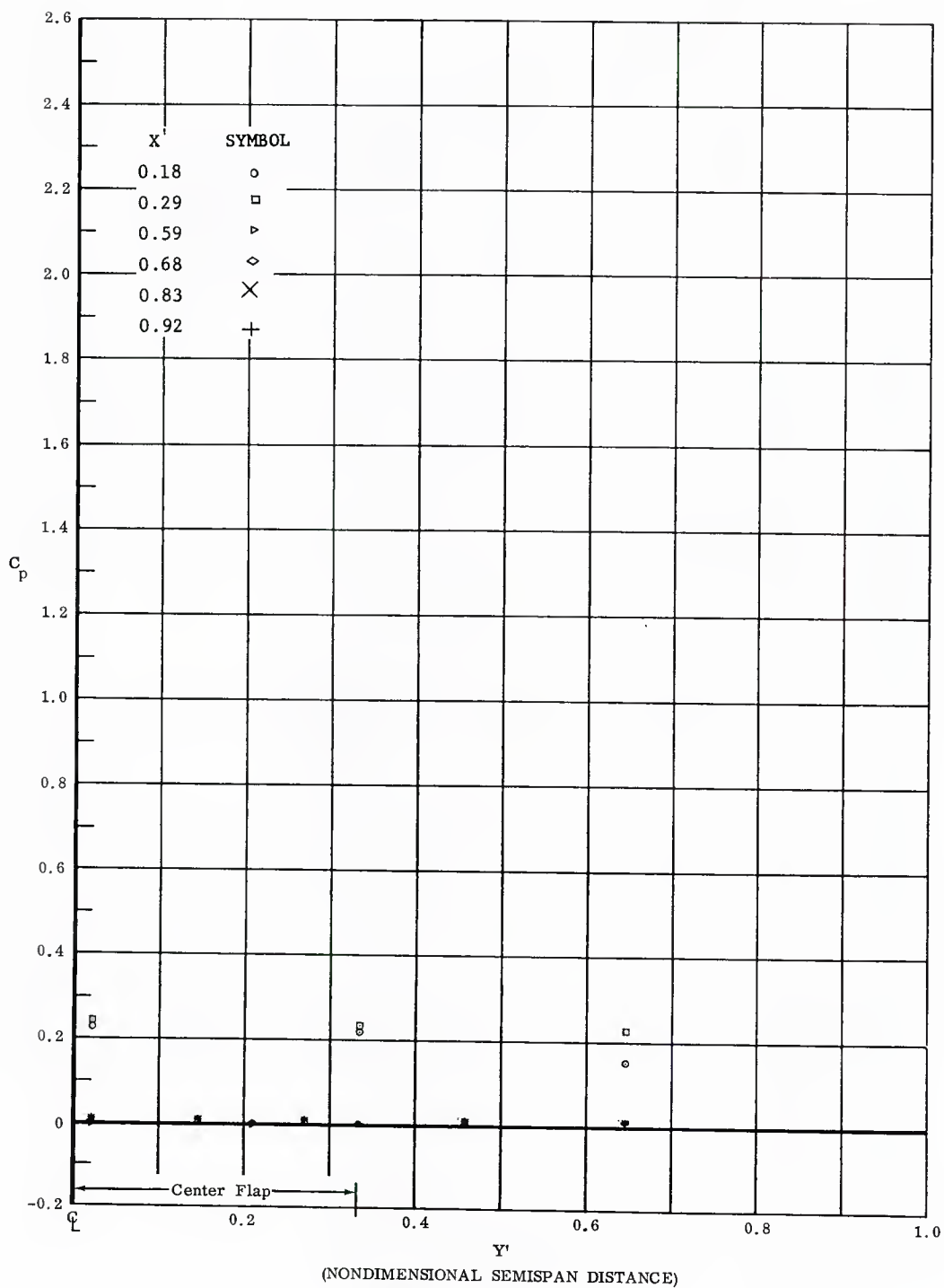


Fig. 93 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 90° , End
 Plates Off

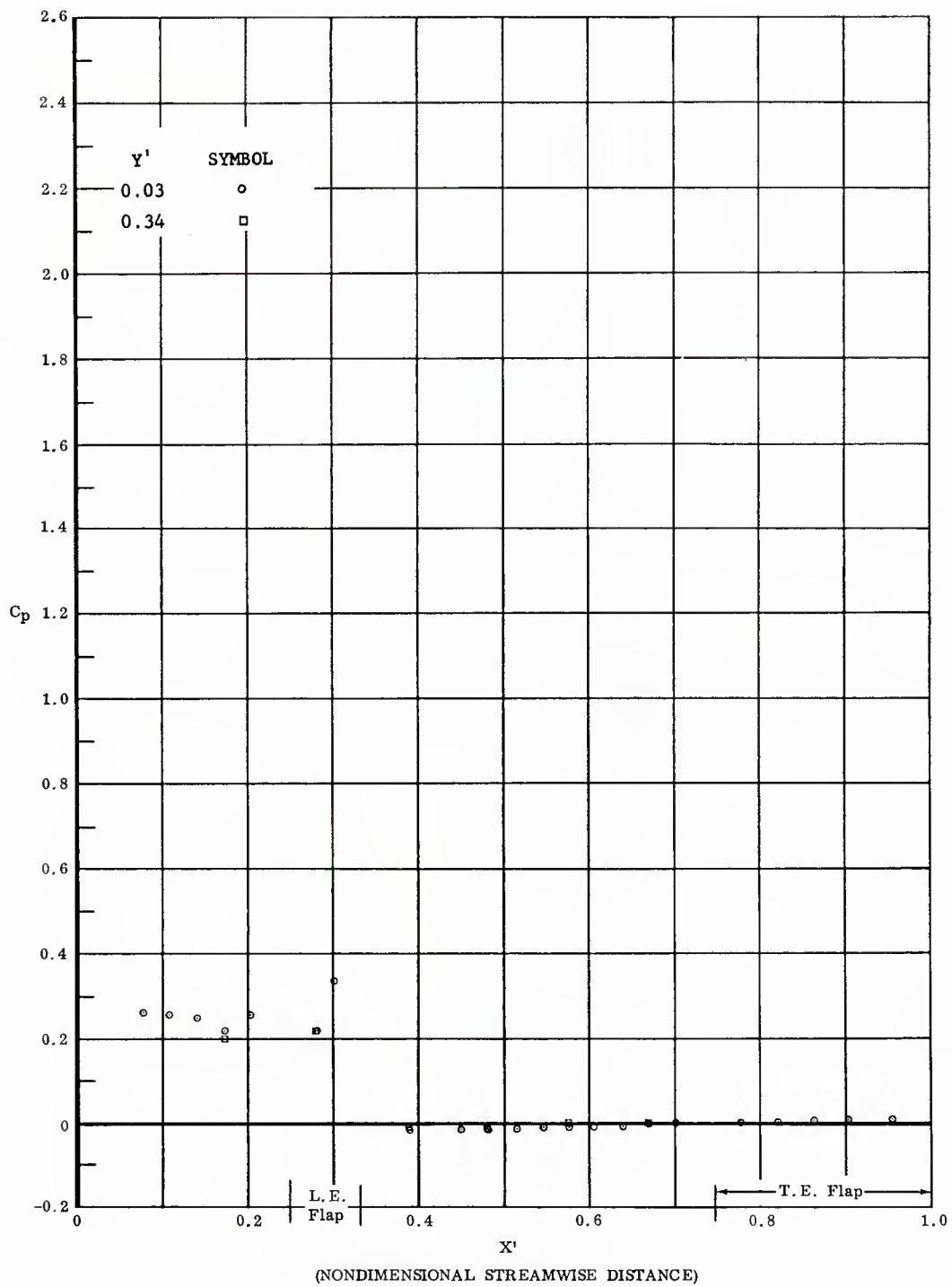


Fig. 94 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 90° , End
 Plates Off

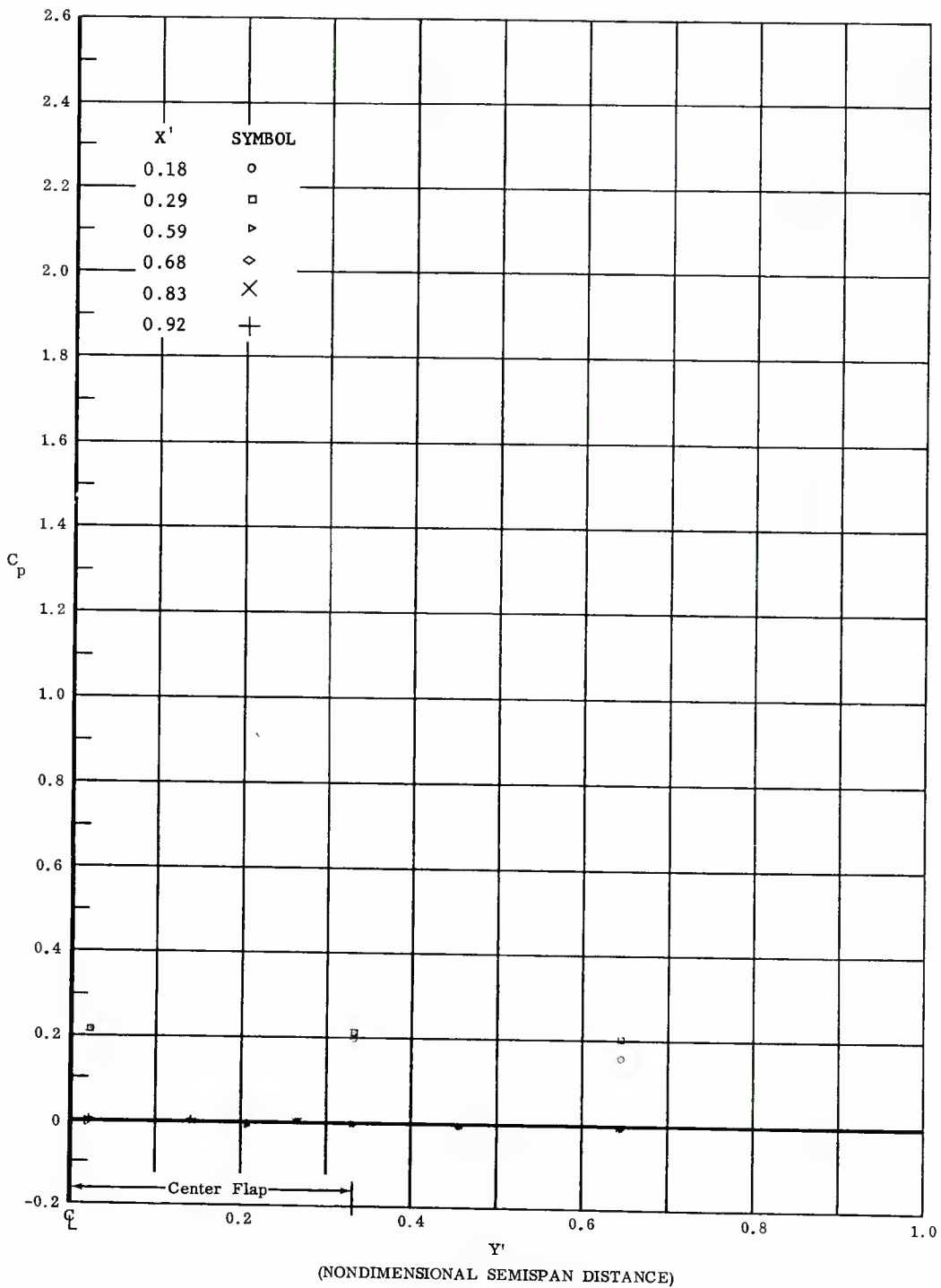


Fig. 94 Pressure Coefficient Data Plots; $\alpha = 0$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 90° , End
 Plates Off

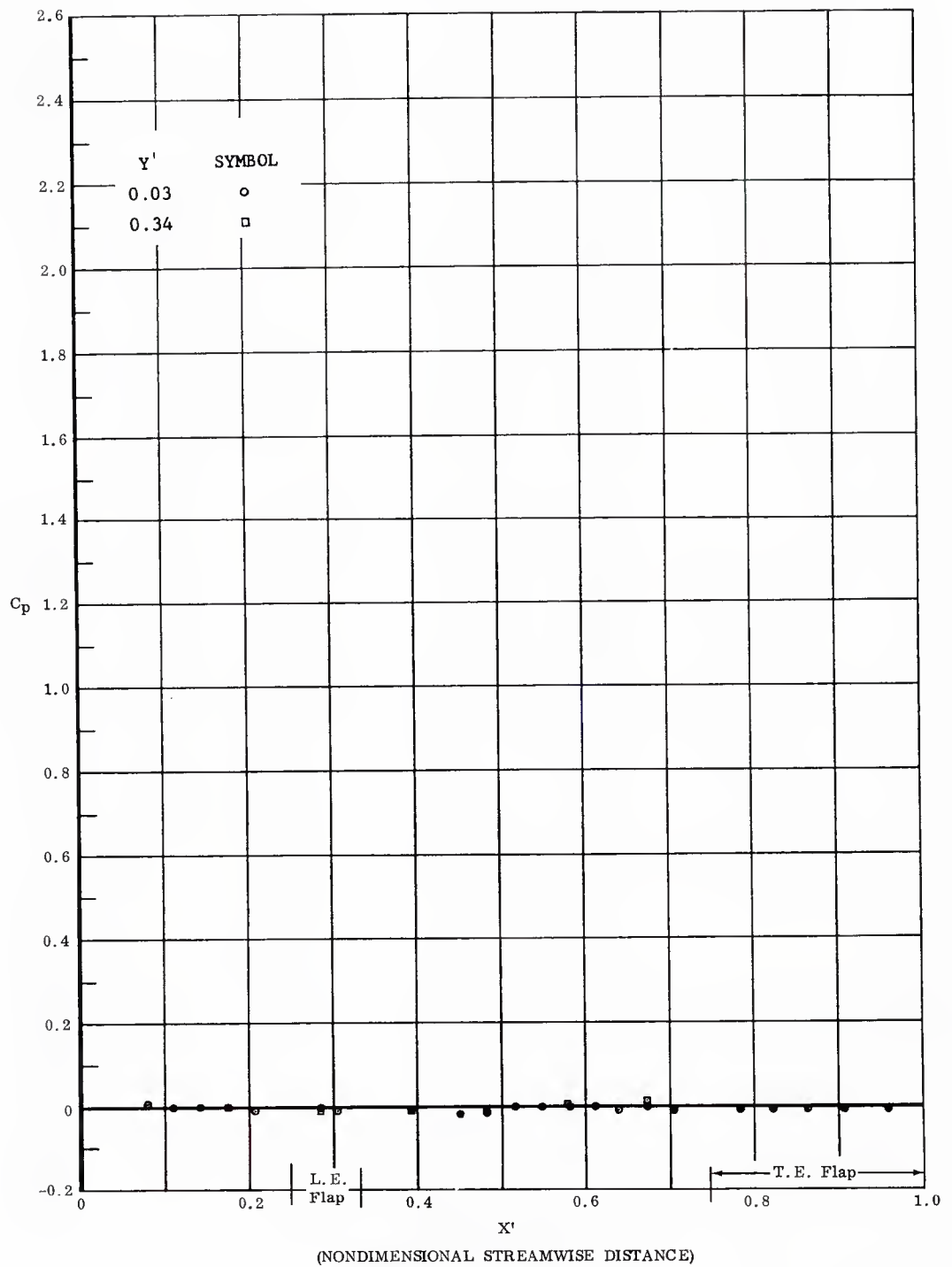


Fig. 95 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, No Flap Deflection, End
 Plates Off

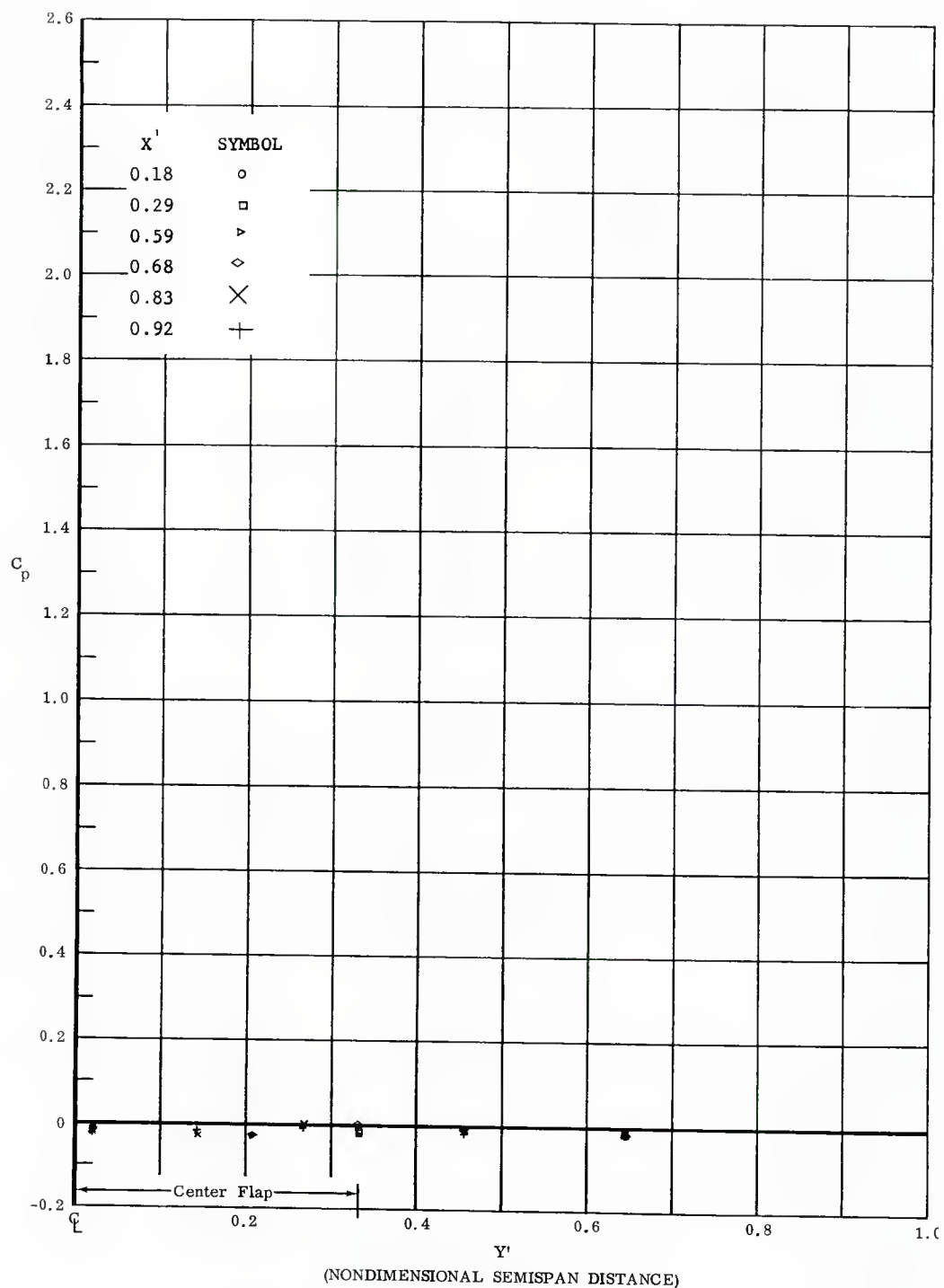


Fig. 95 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_\infty / 10^6 \text{ ft} = 1.1$, No Flap Deflection, End
 Plates Off

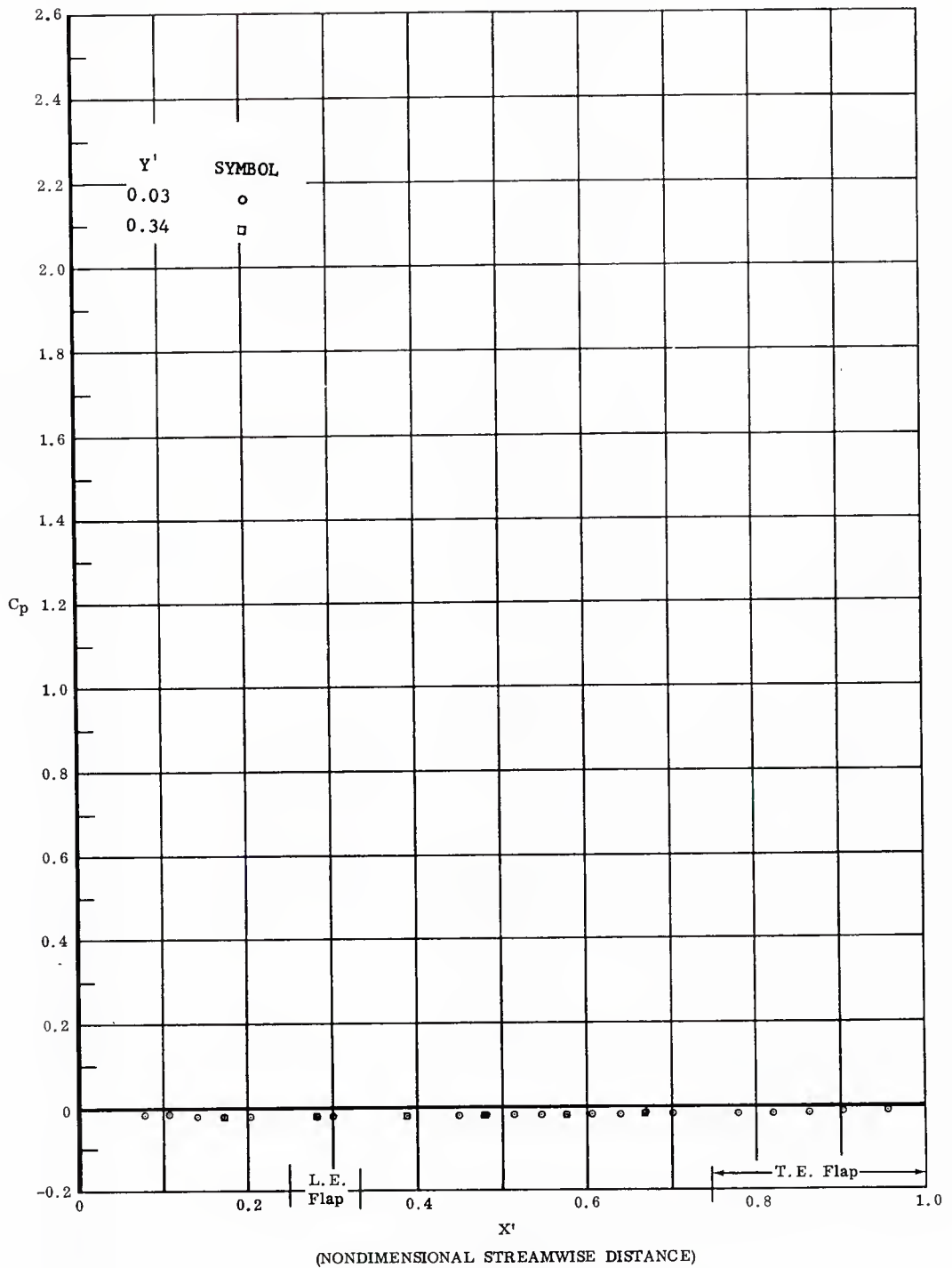


Fig. 96 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, No Flap Deflection, End
 Plates Off

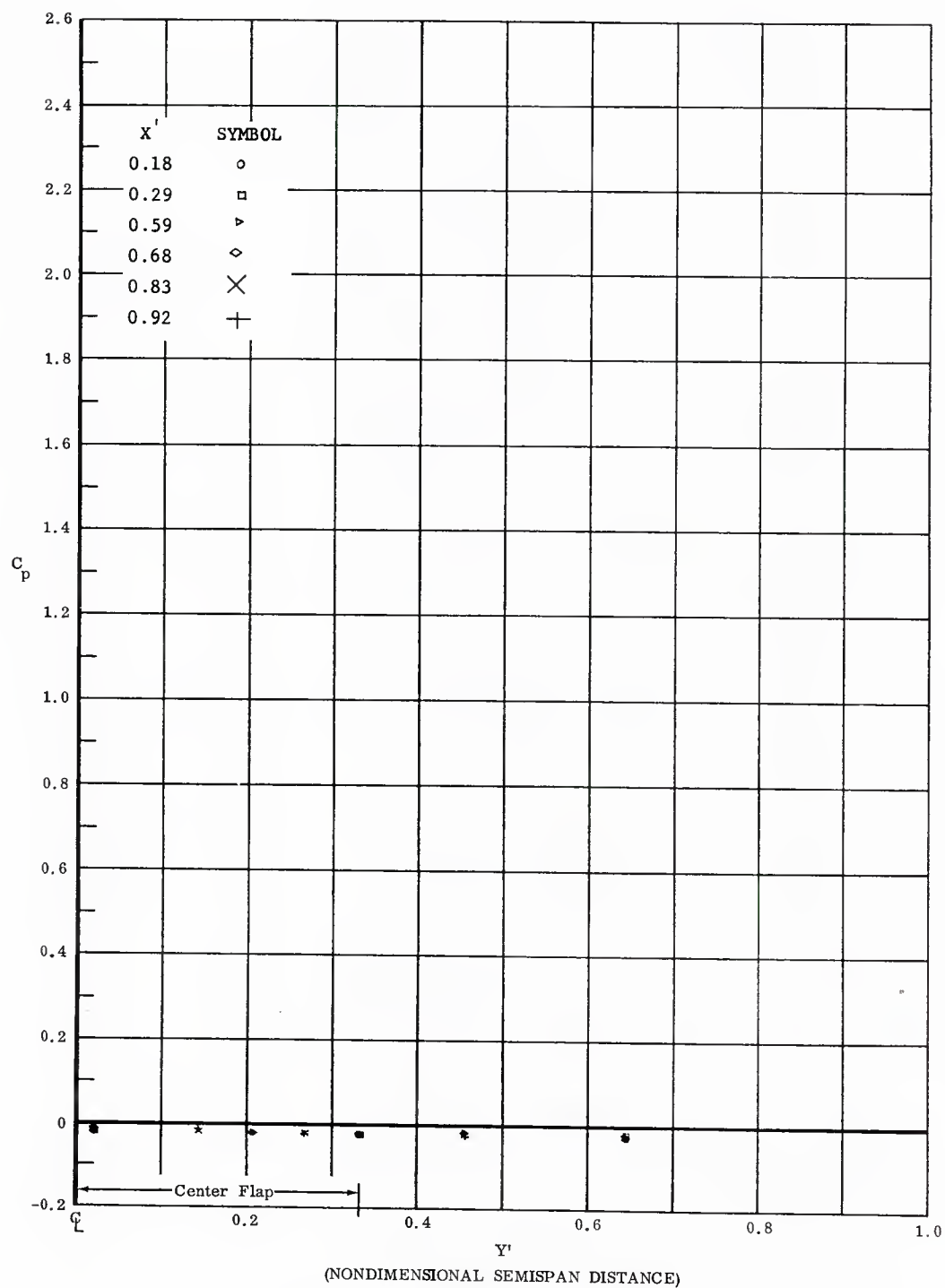


Fig. 96 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, No Flap Deflection, End
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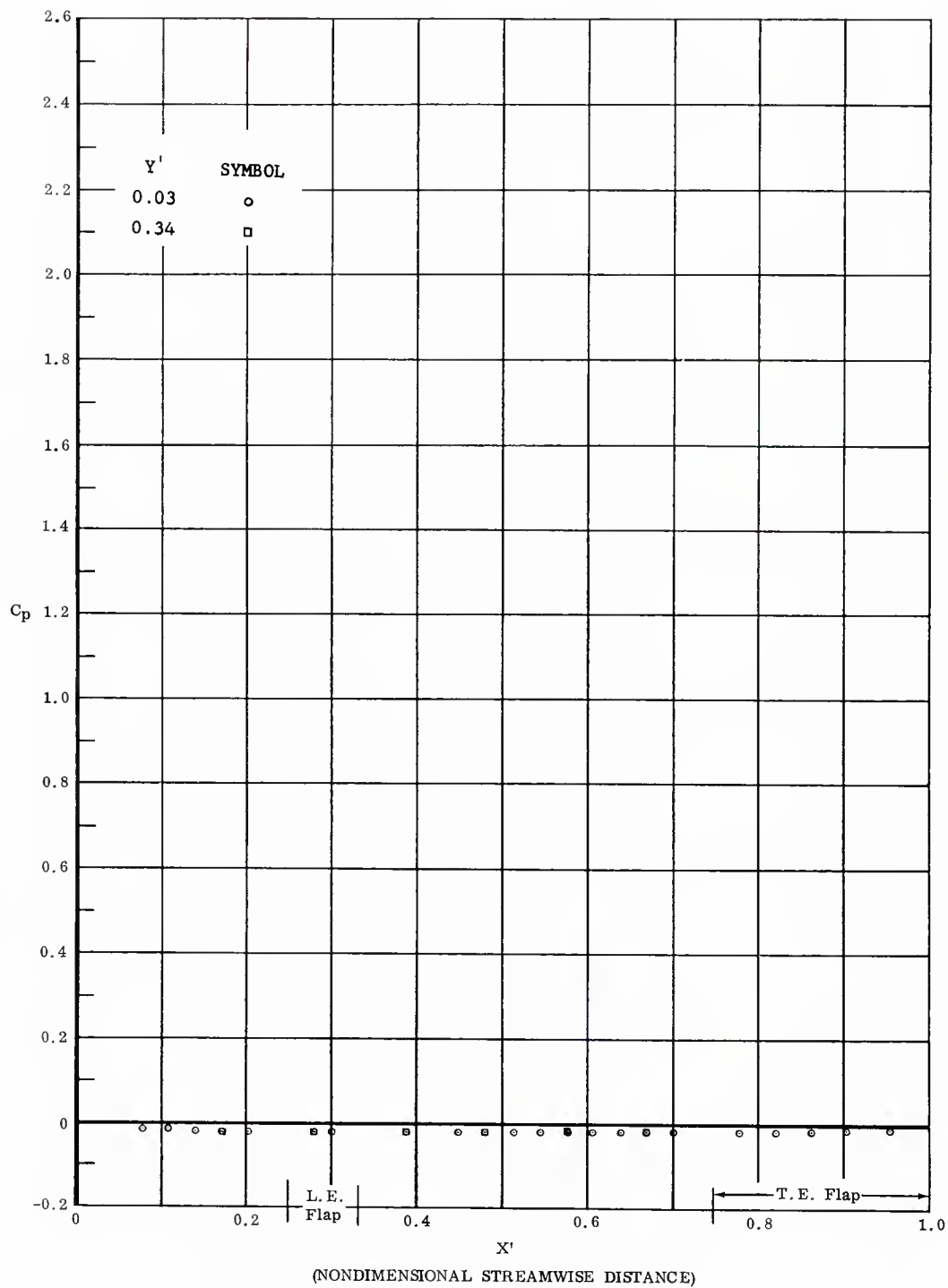


Fig. 97 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, No Flap Deflection, End
 Plates Off

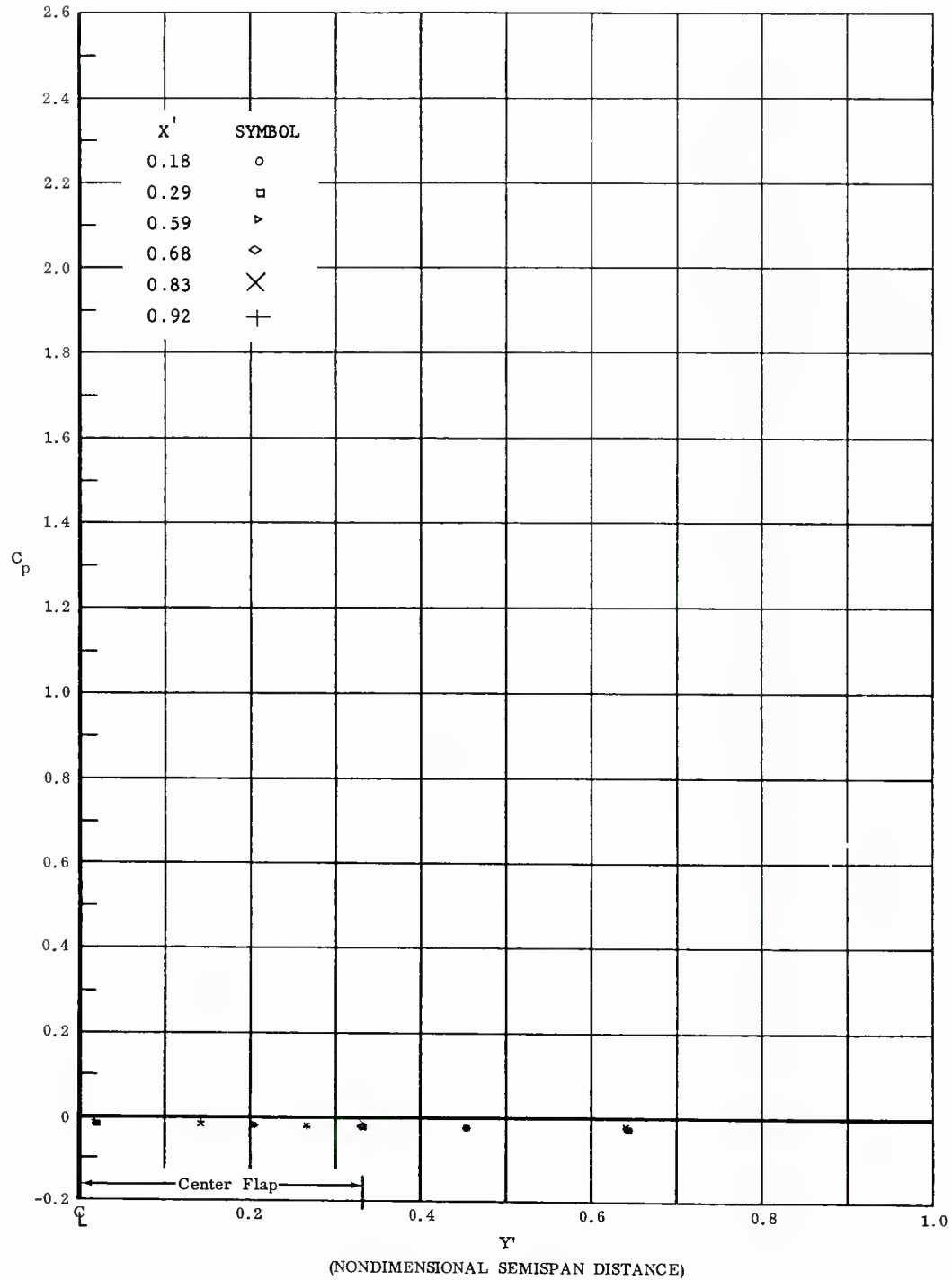


Fig. 97 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Flap Deflection, End
 Plates Off

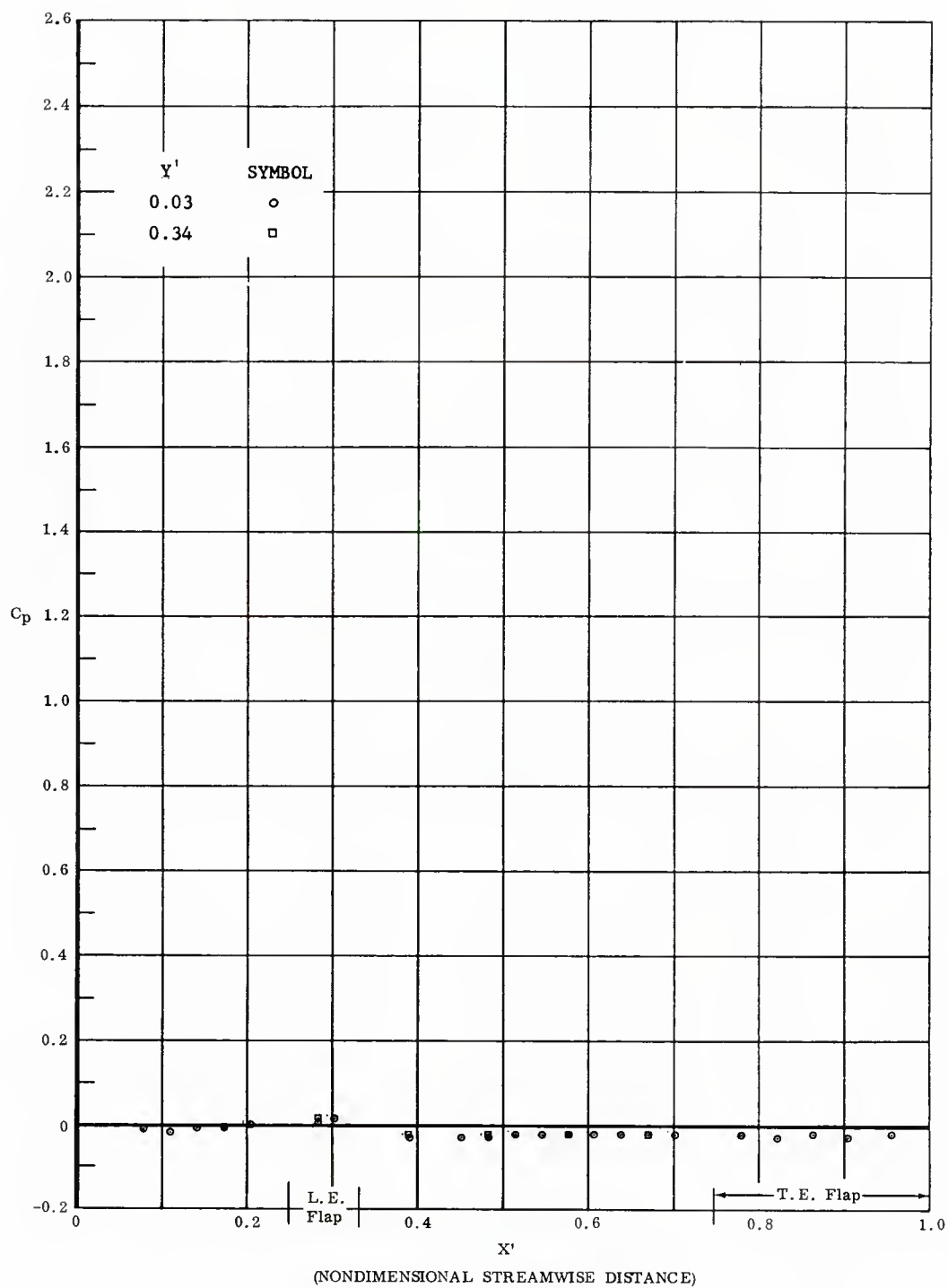


Fig. 98 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 15° , End
 Plates Off

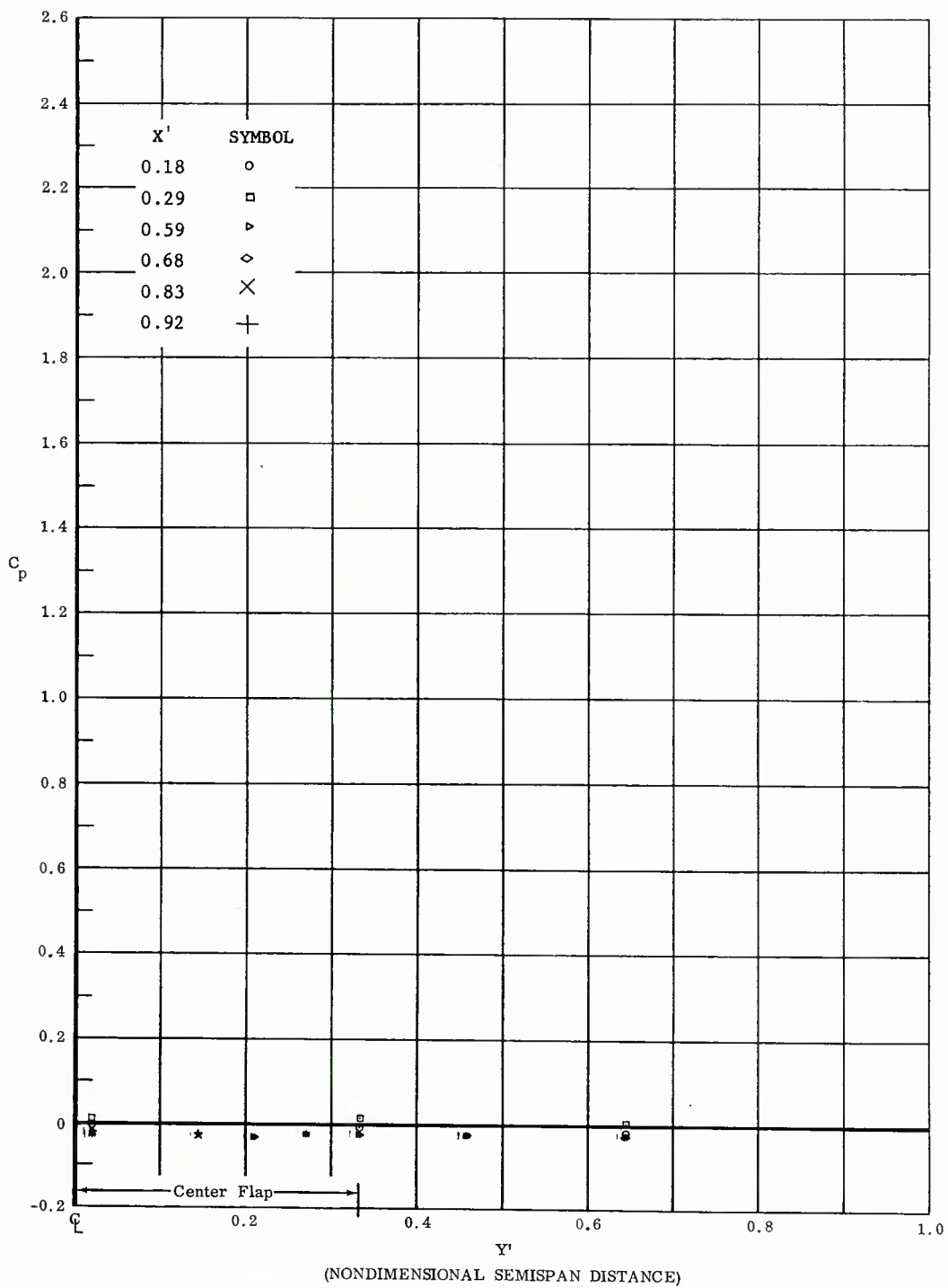


Fig. 98 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re / 10^6 \text{ ft} = 3.3$, Forward Flap at 15° , End
 Plates Off

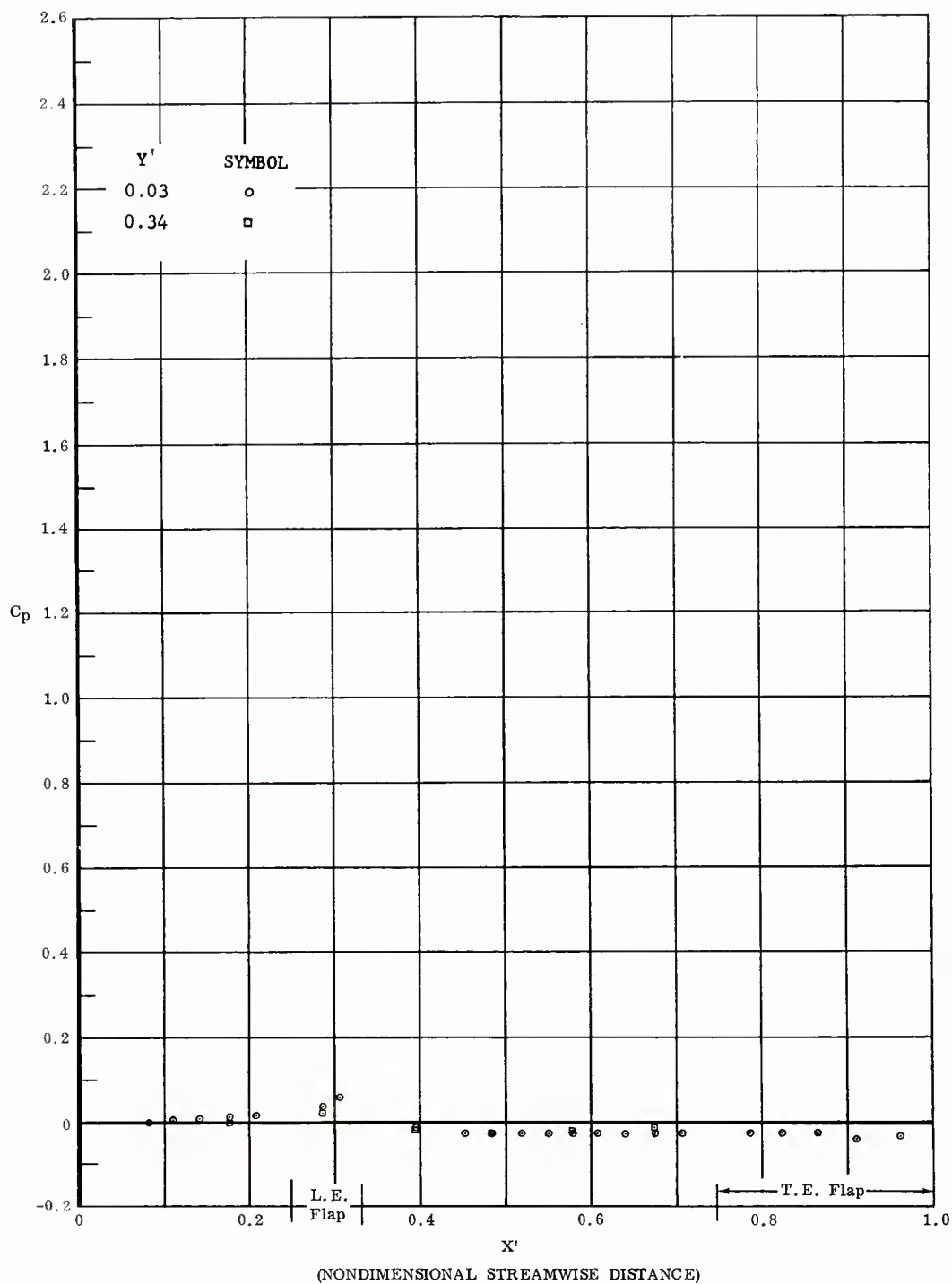


Fig. 99 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Forward Flap at 30° , End
 Plates Off

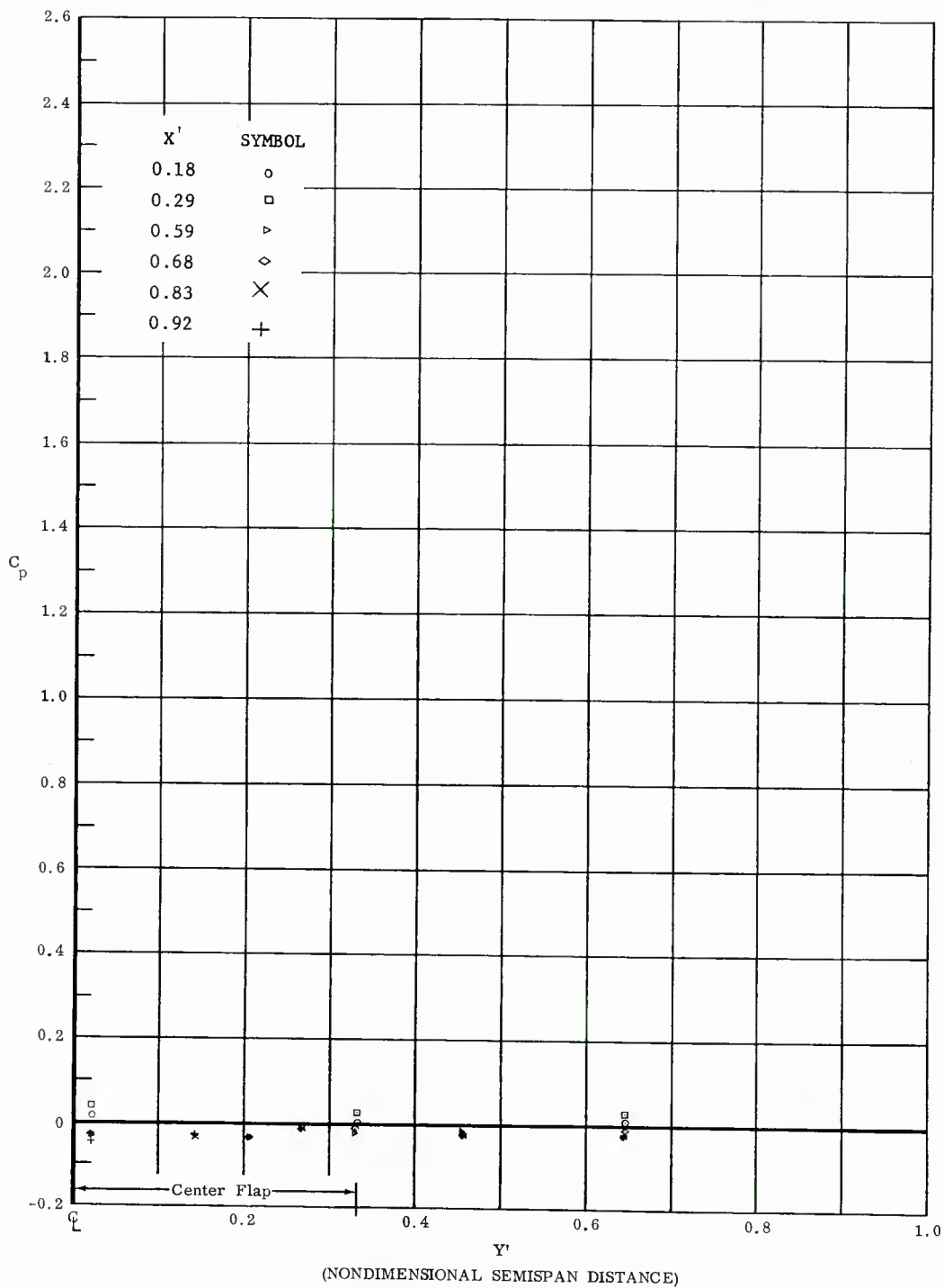


Fig. 99 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Forward Flap at 30° , End
 Plates Off

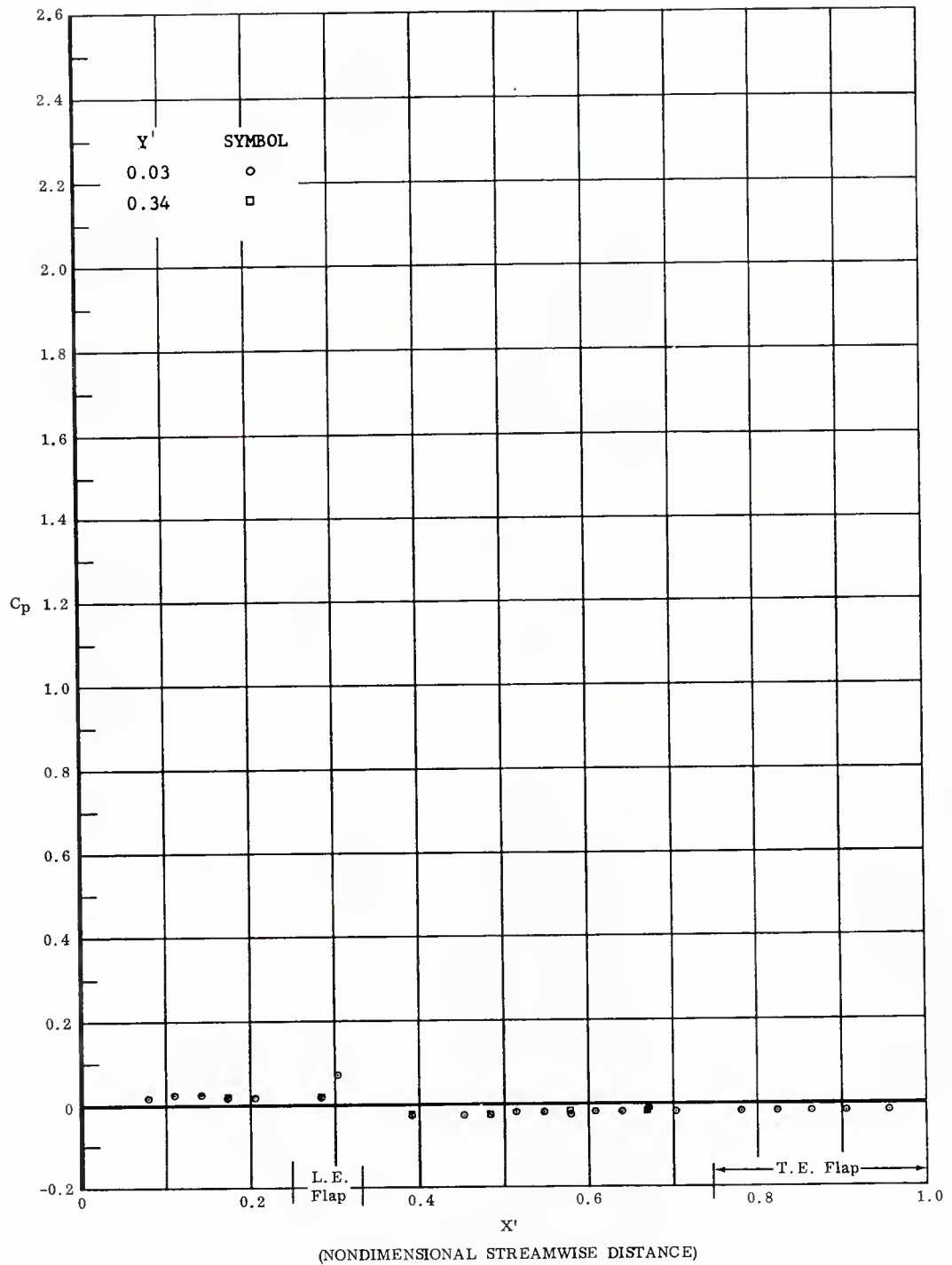


Fig. 100 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 30° , End
 Plates Off

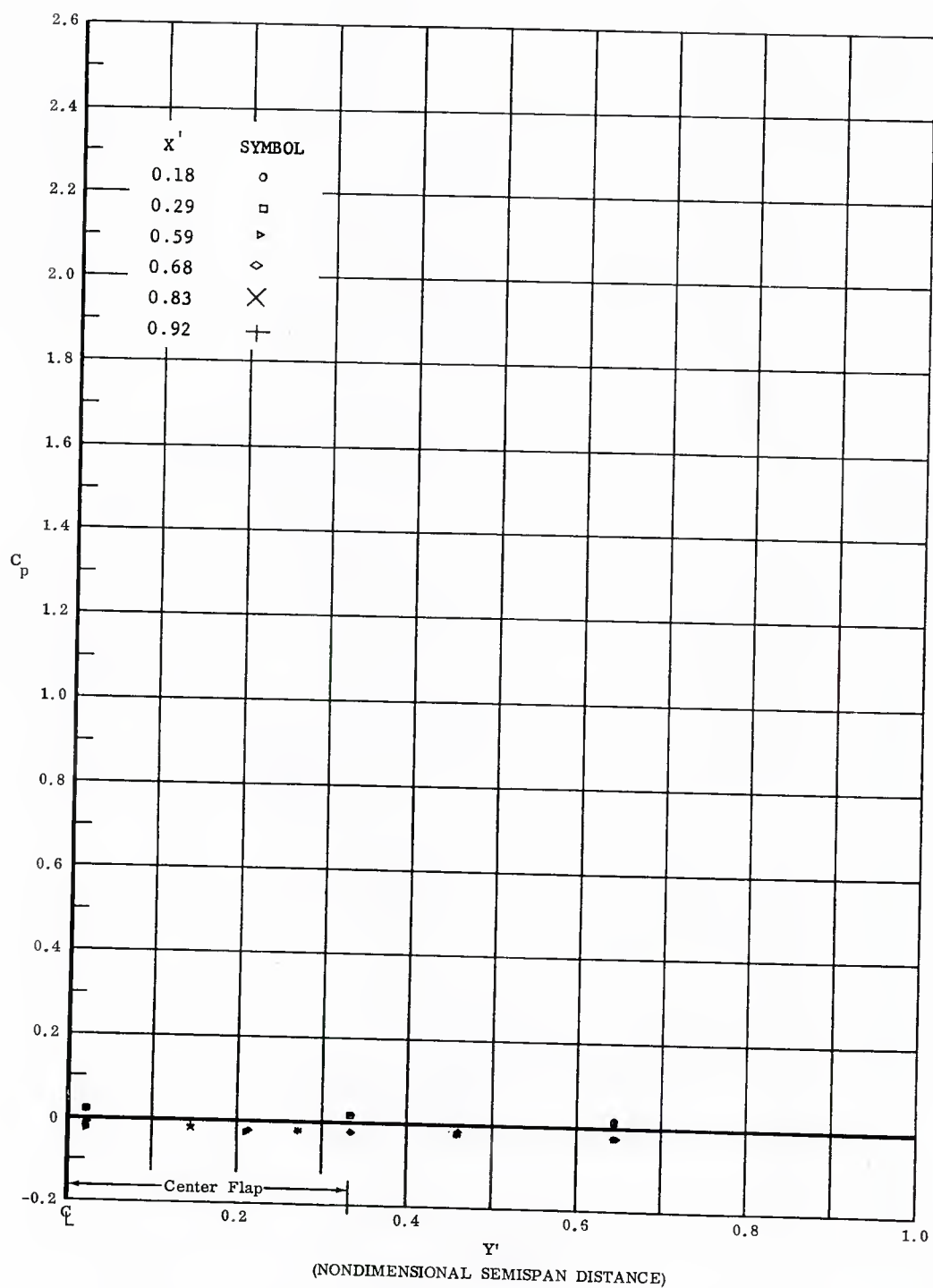


Fig. 100 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty} 10^6 \text{ ft} = 3.3$, Forward Flap at 30° , End
 Plates Off

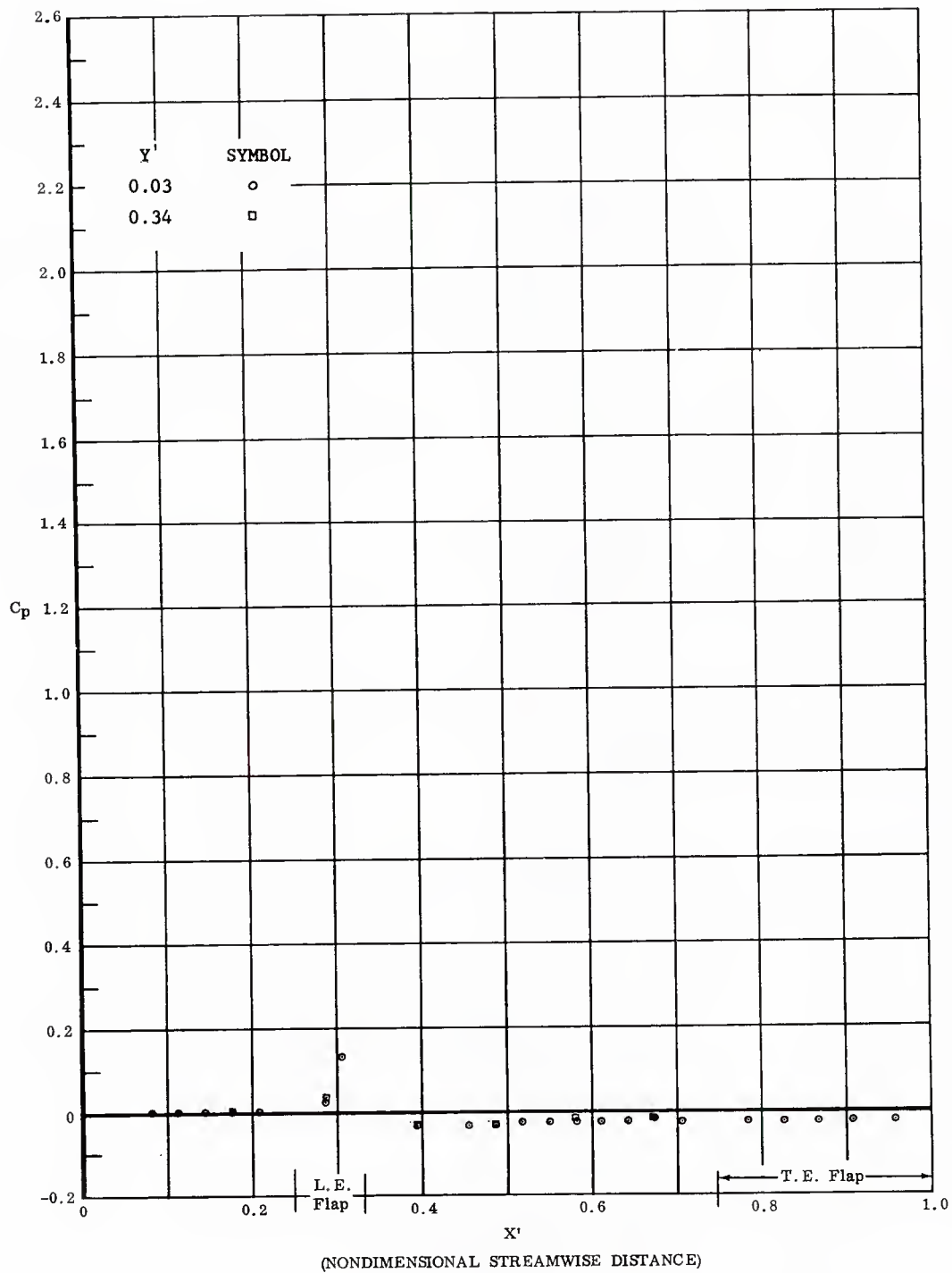


Fig. 101 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ft} = 6.6$, Forward Flap at 30° , End
 Plates Off

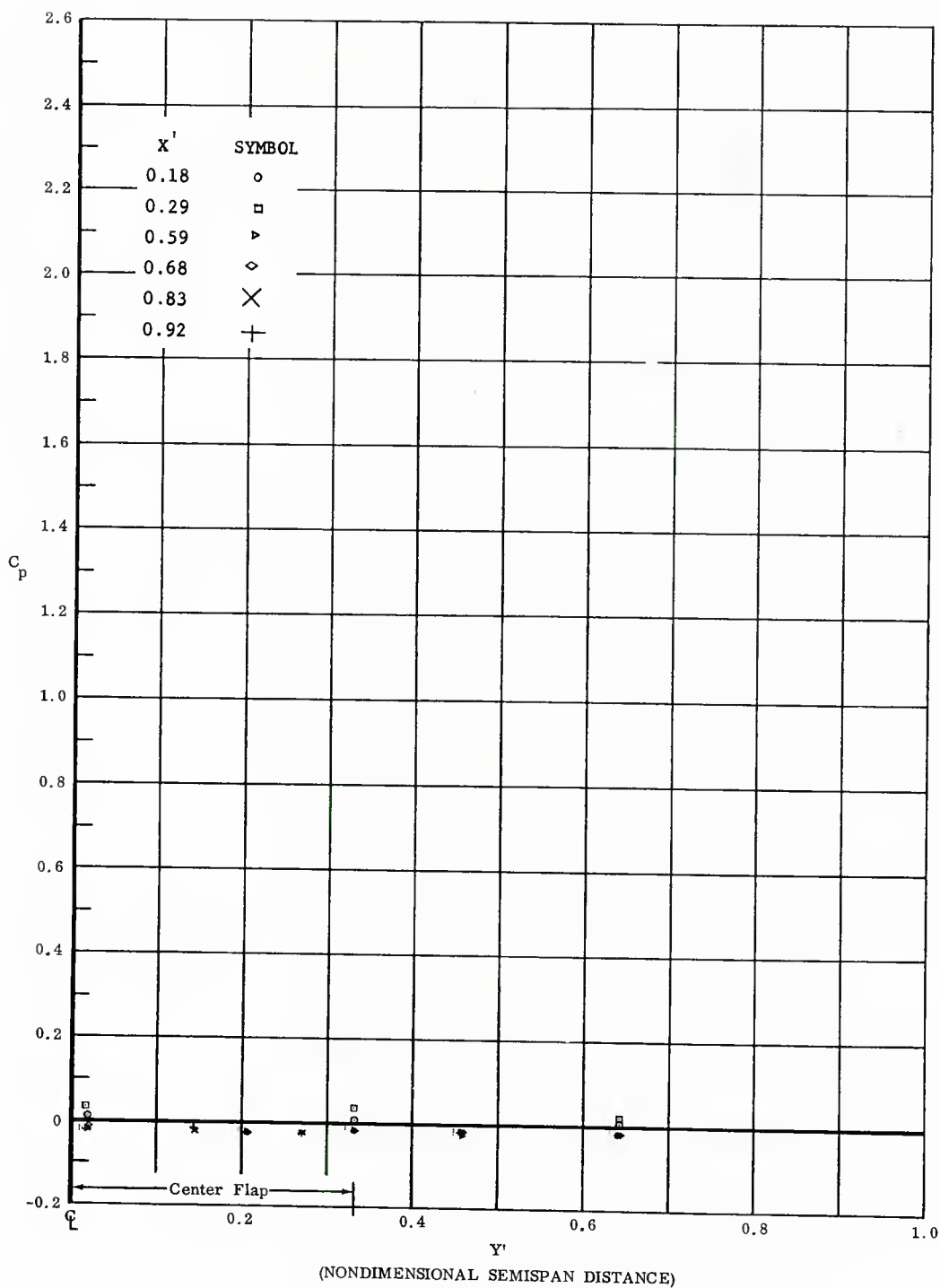


Fig. 101 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 30° , End
 Plates Off

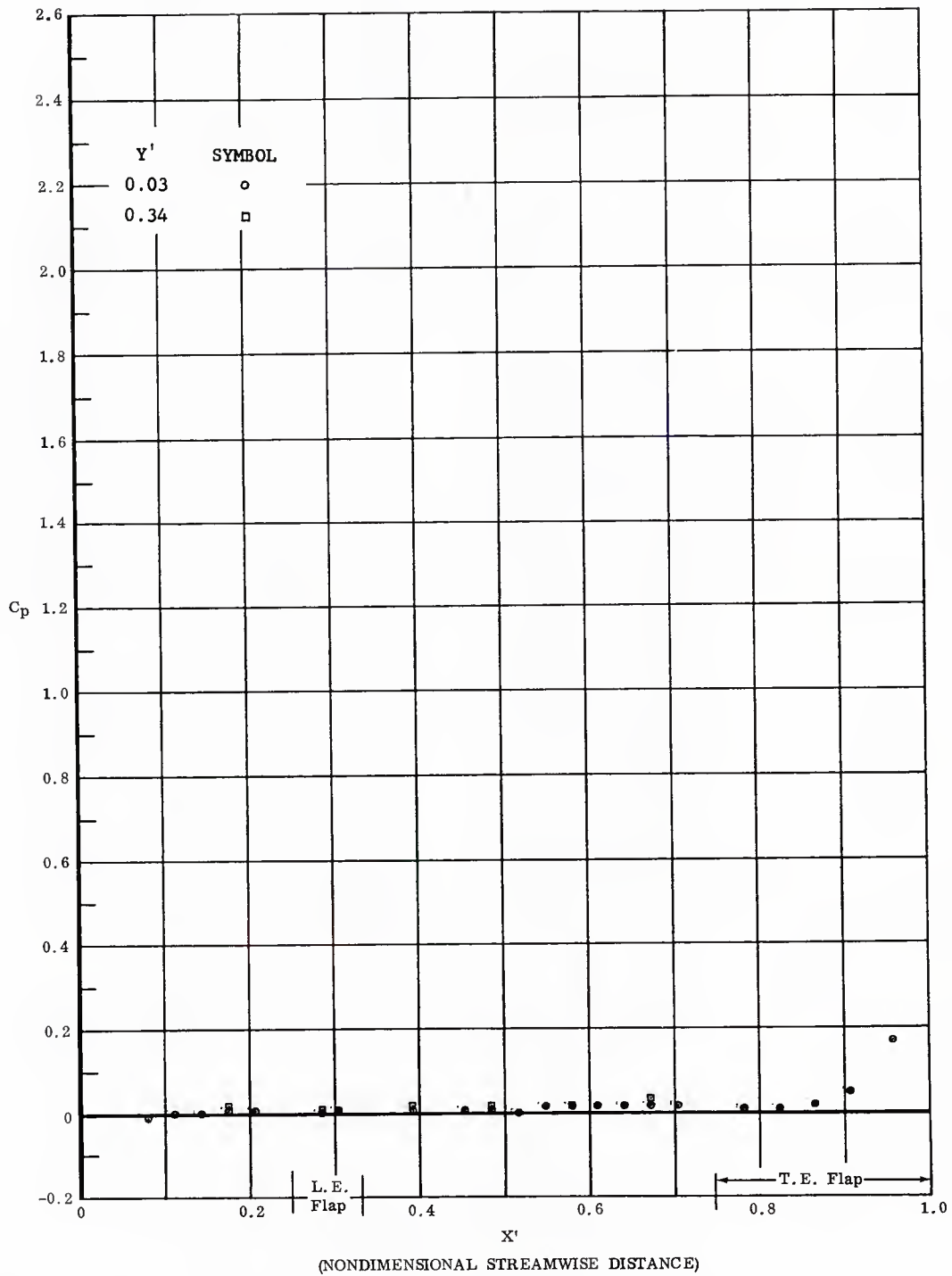


Fig. 102 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plates Off

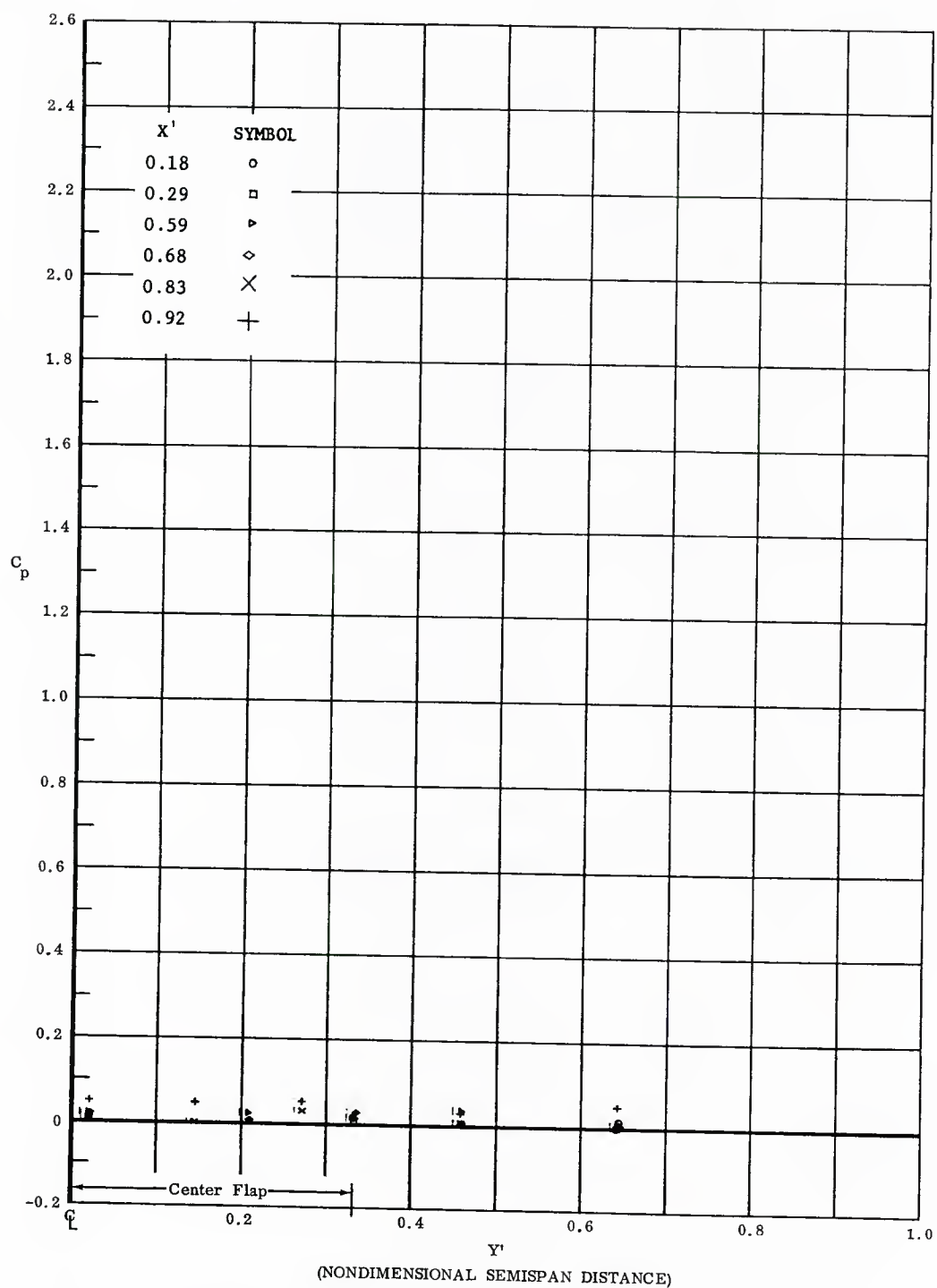


Fig. 102 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plates Off

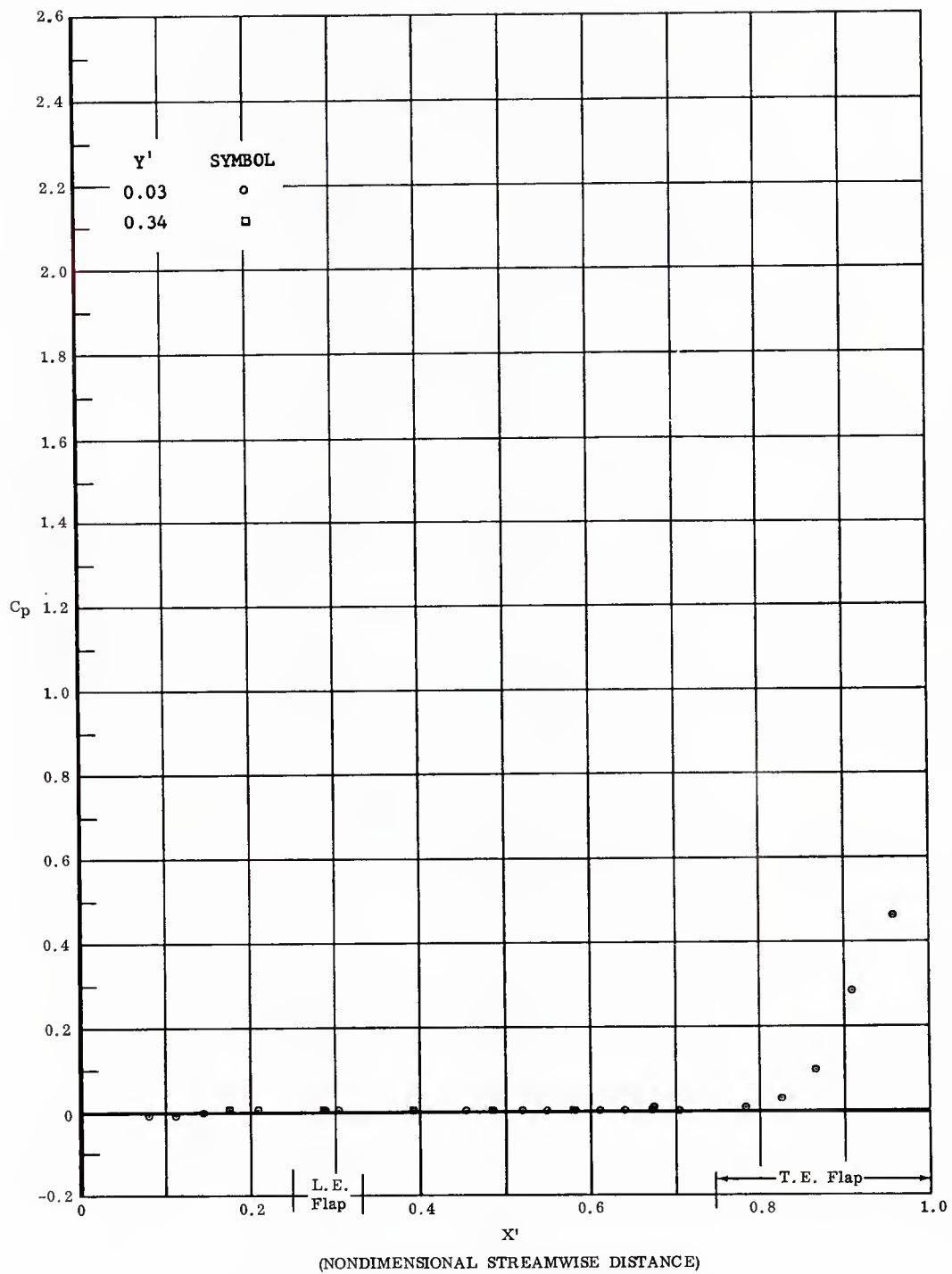


Fig. 103 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30° ,
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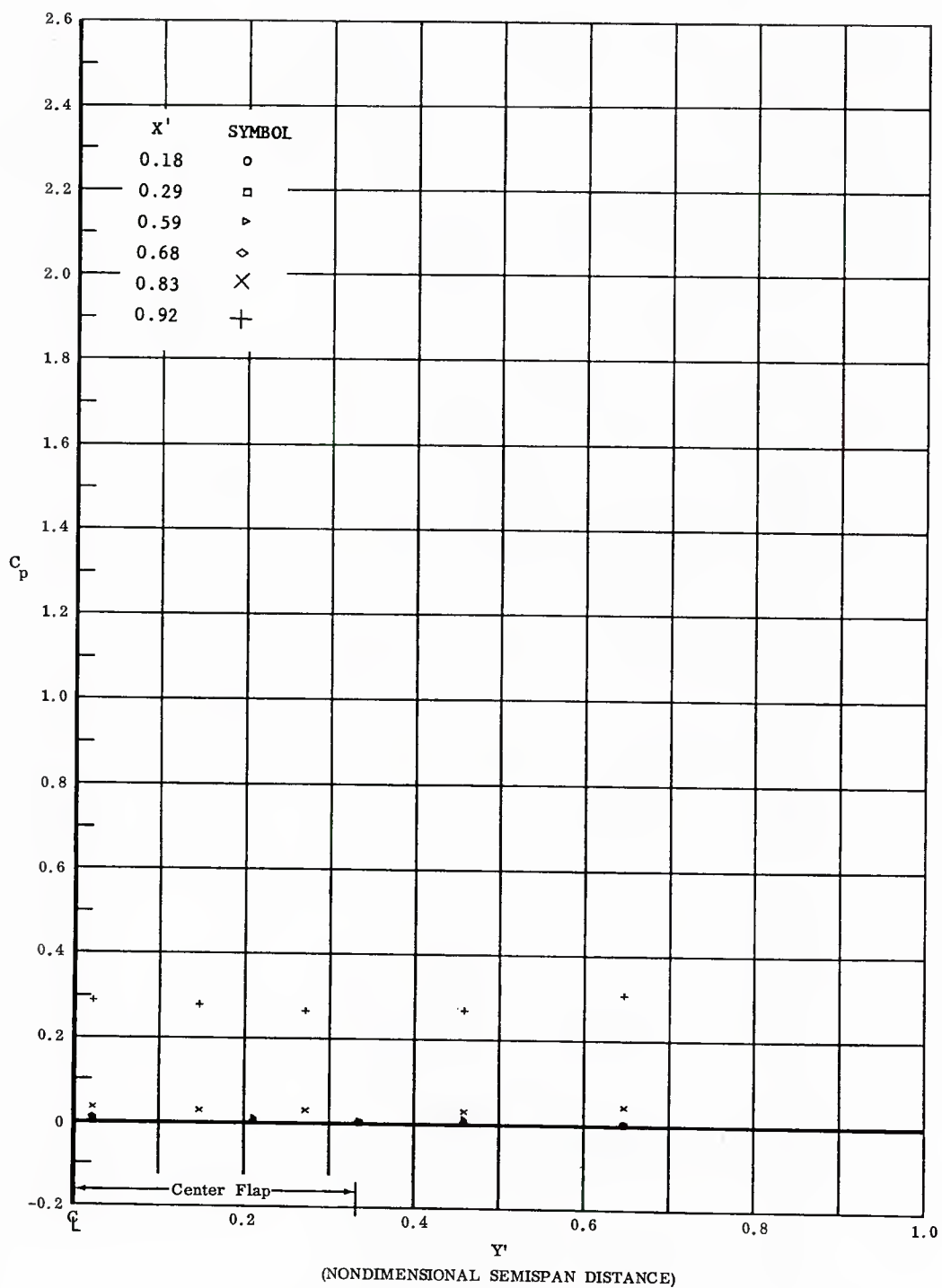


Fig. 103 Pressure Coefficient Data Plots; $\alpha = +5$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30° ,
 End Plates Off

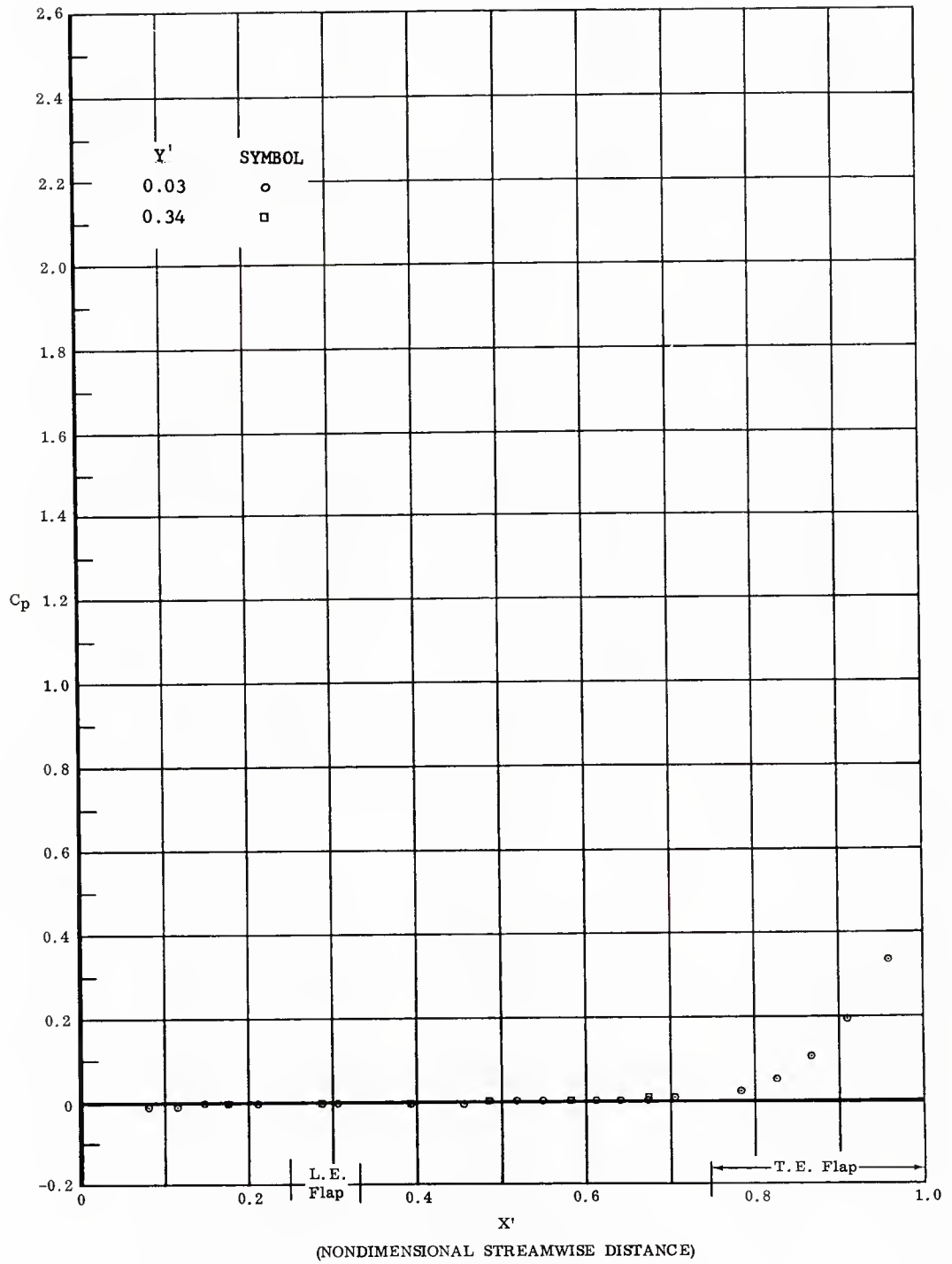


Fig. 104 Pressure Coefficient Data Plots; $\alpha = +5^\circ$
 $Re_\infty/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plates Off

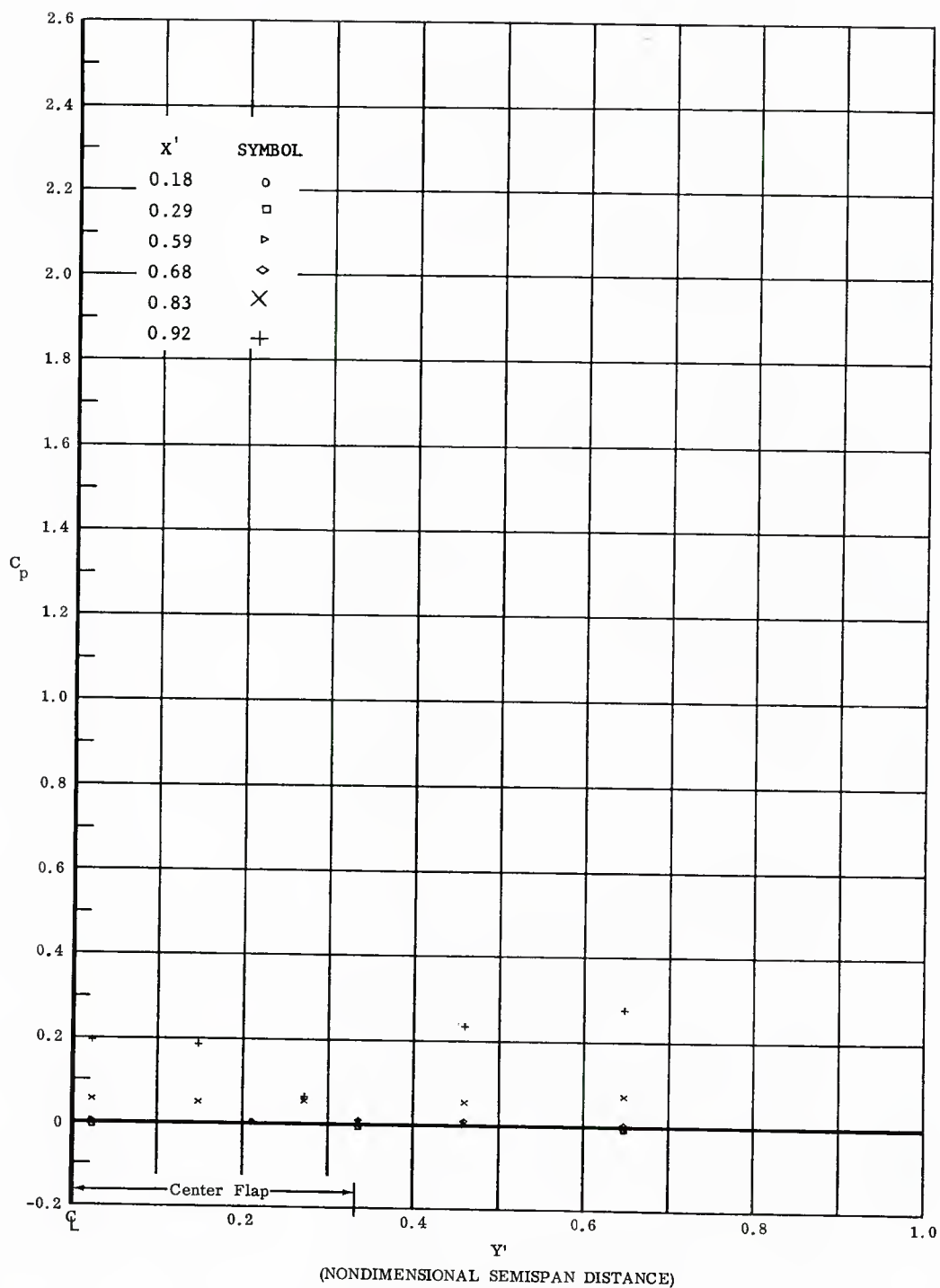


Fig. 104 Pressure Coefficient Data Plots; $\alpha = +5^\circ$
 $Re_\infty/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plates Off

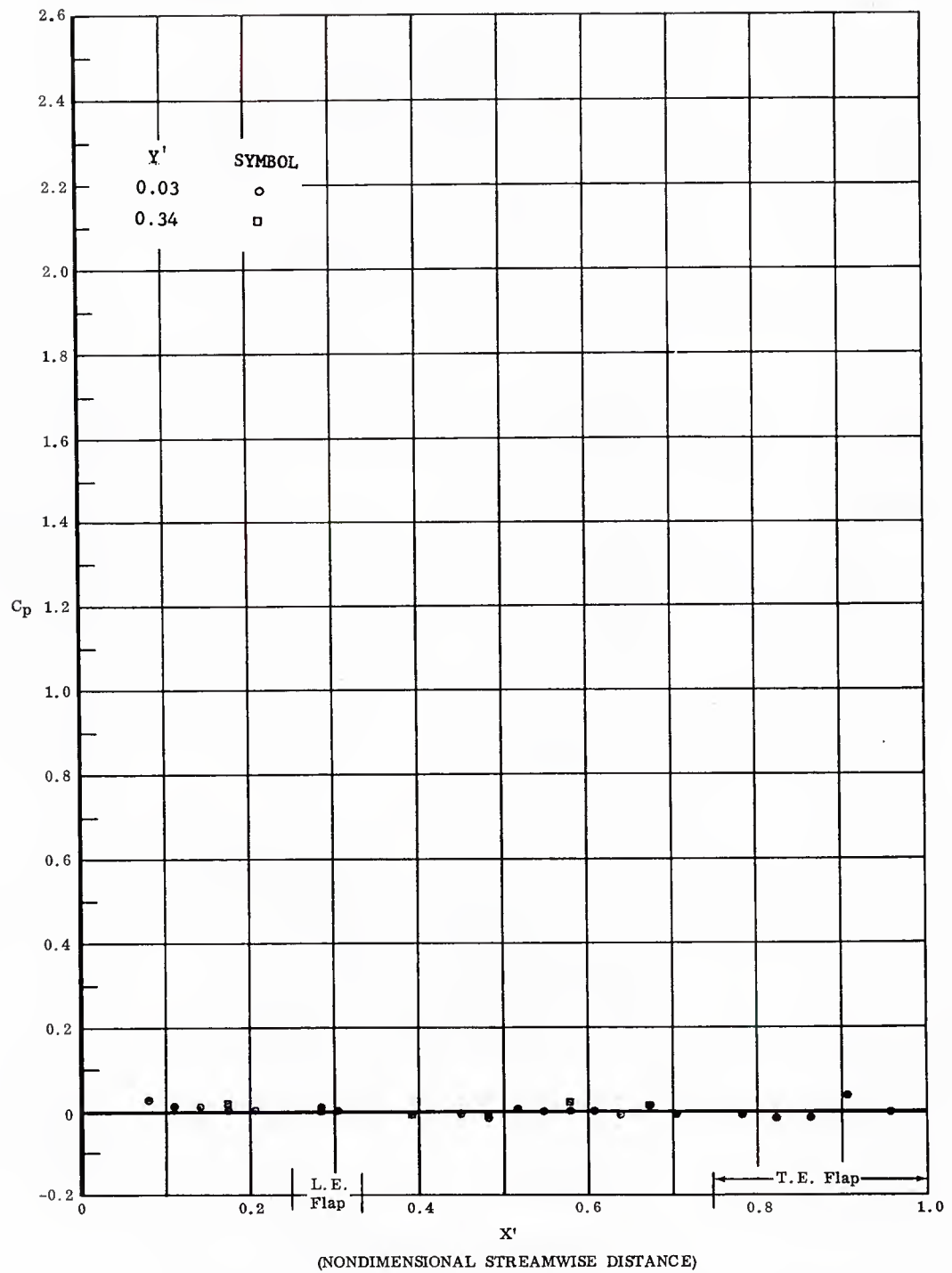


Fig. 105 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, No Deflection Flaps, End
 Plates Off

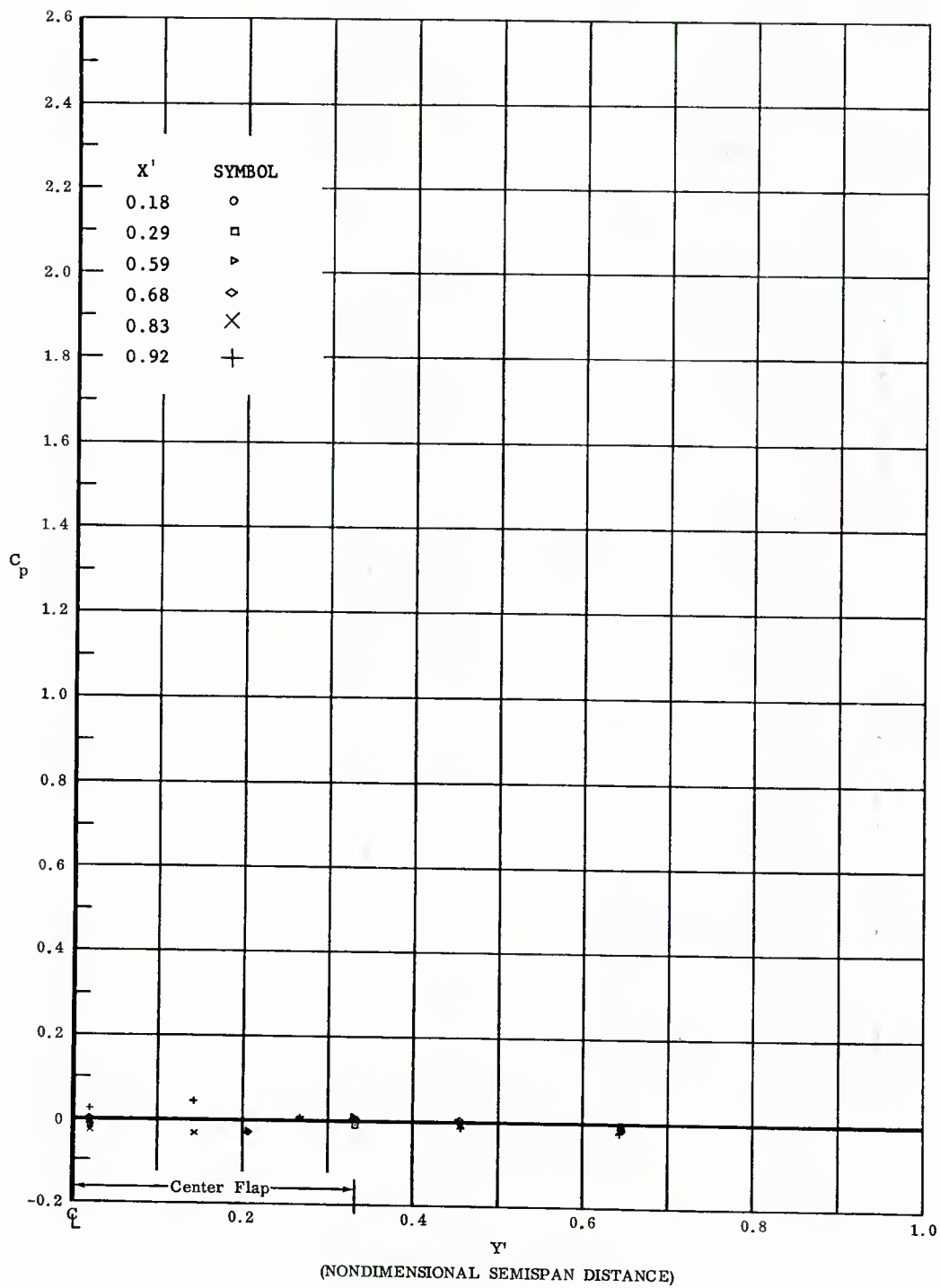


Fig. 105 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, No Deflection Flaps, End
 Plates Off

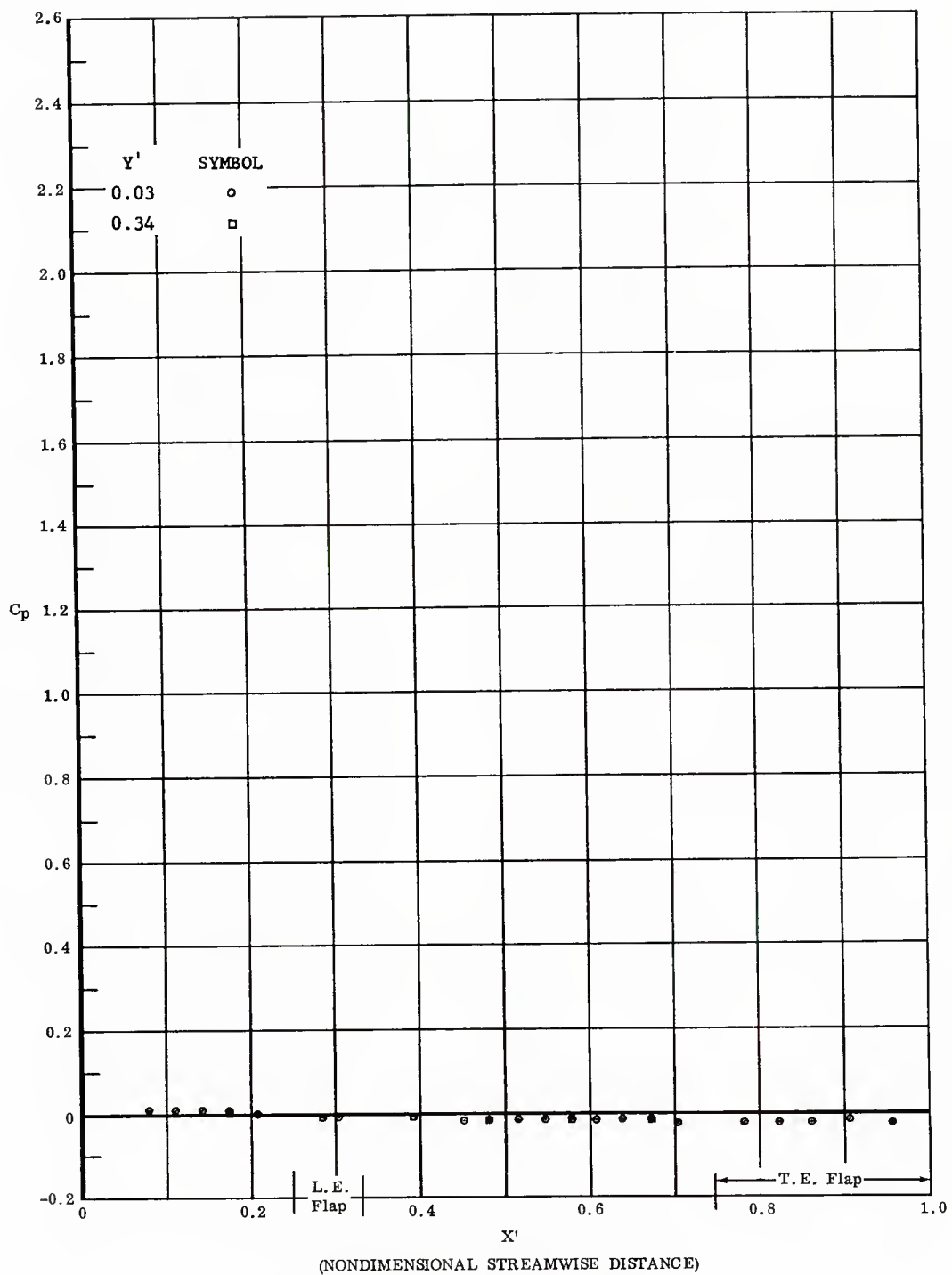


Fig. 106 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, No Deflection Flaps, End
 Plates Off

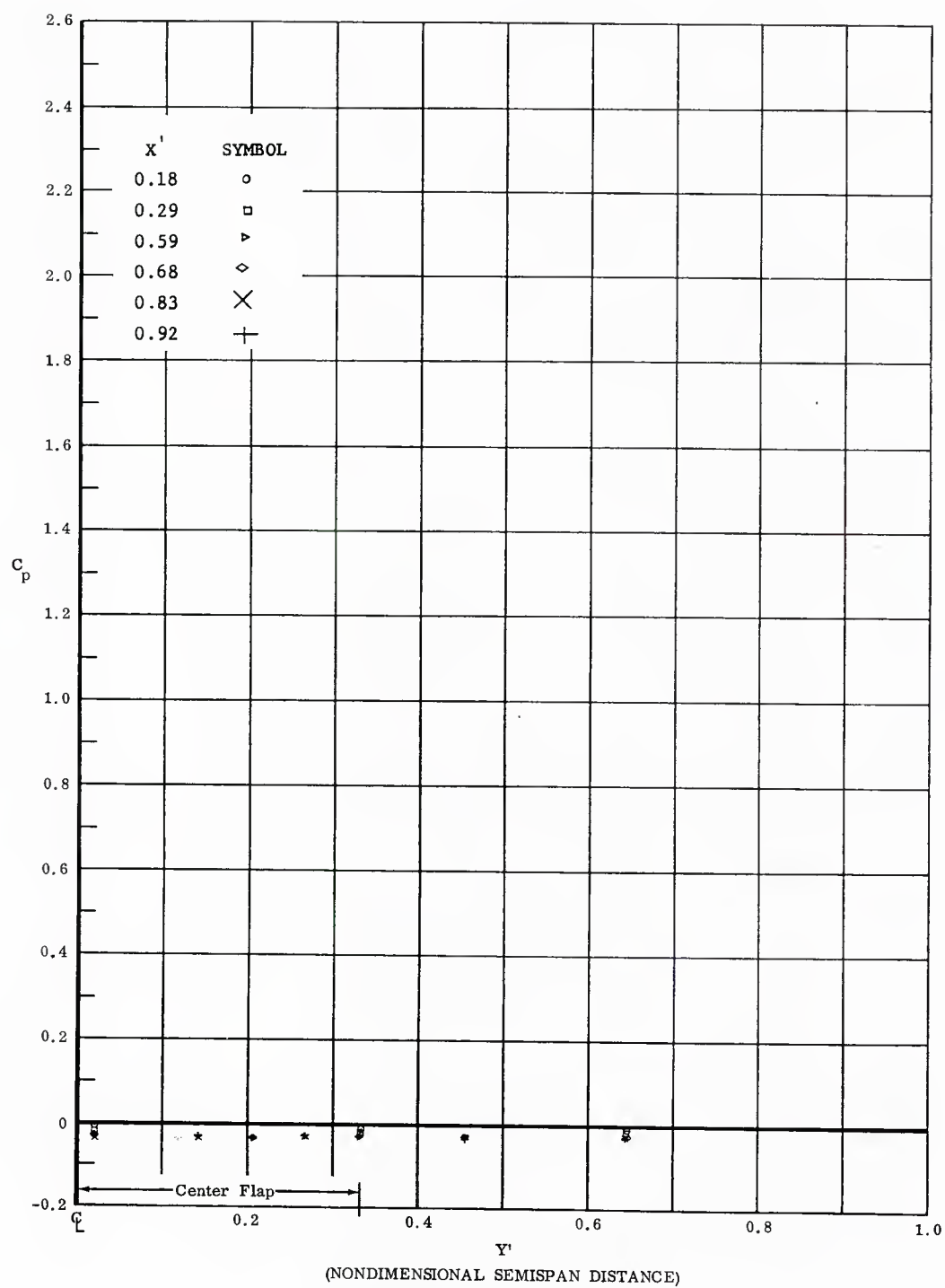


Fig. 106 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, No Deflection Flaps, End
 Plates Off

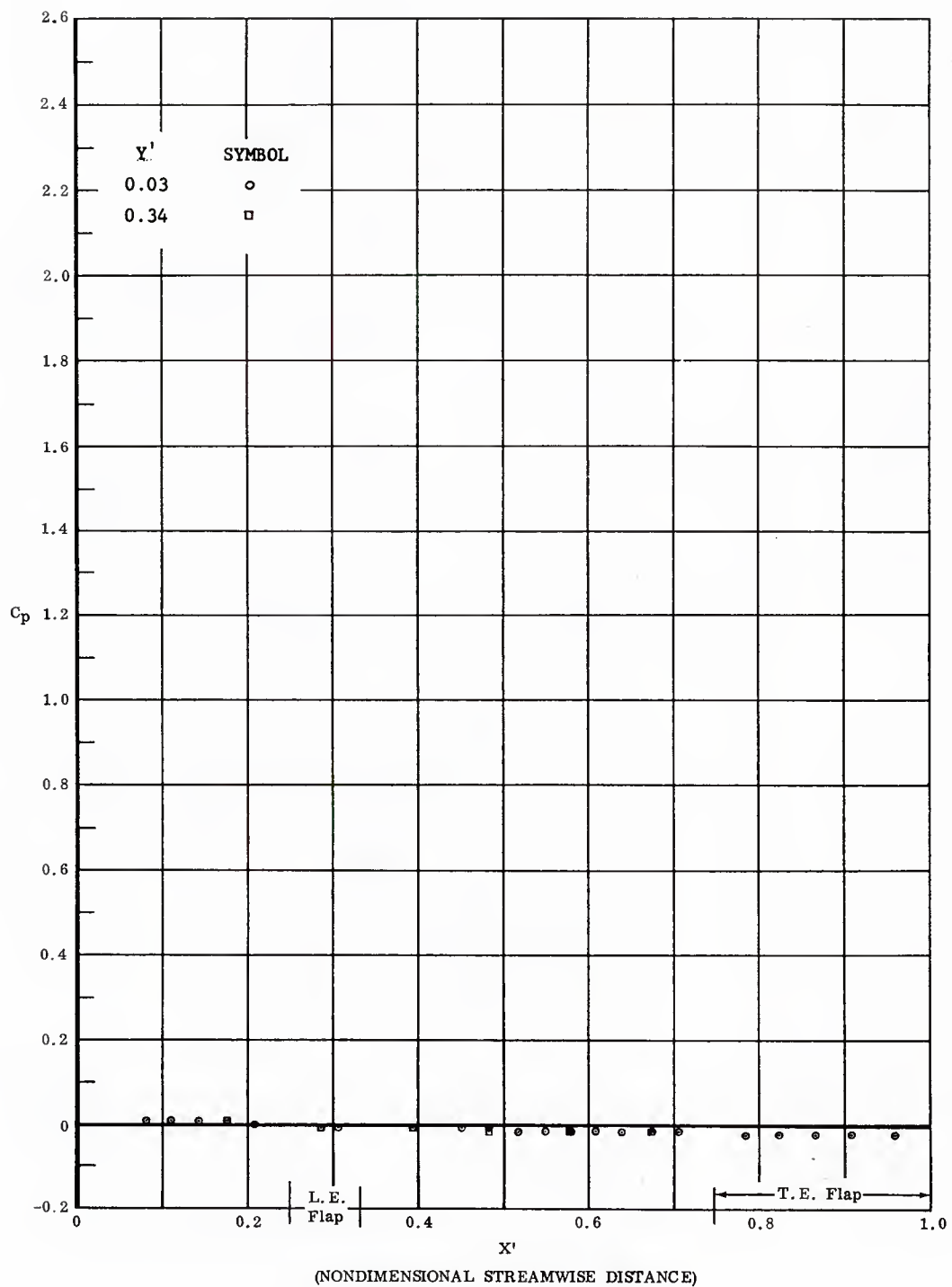


Fig. 107 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Deflection Flaps, End
 Plates Off

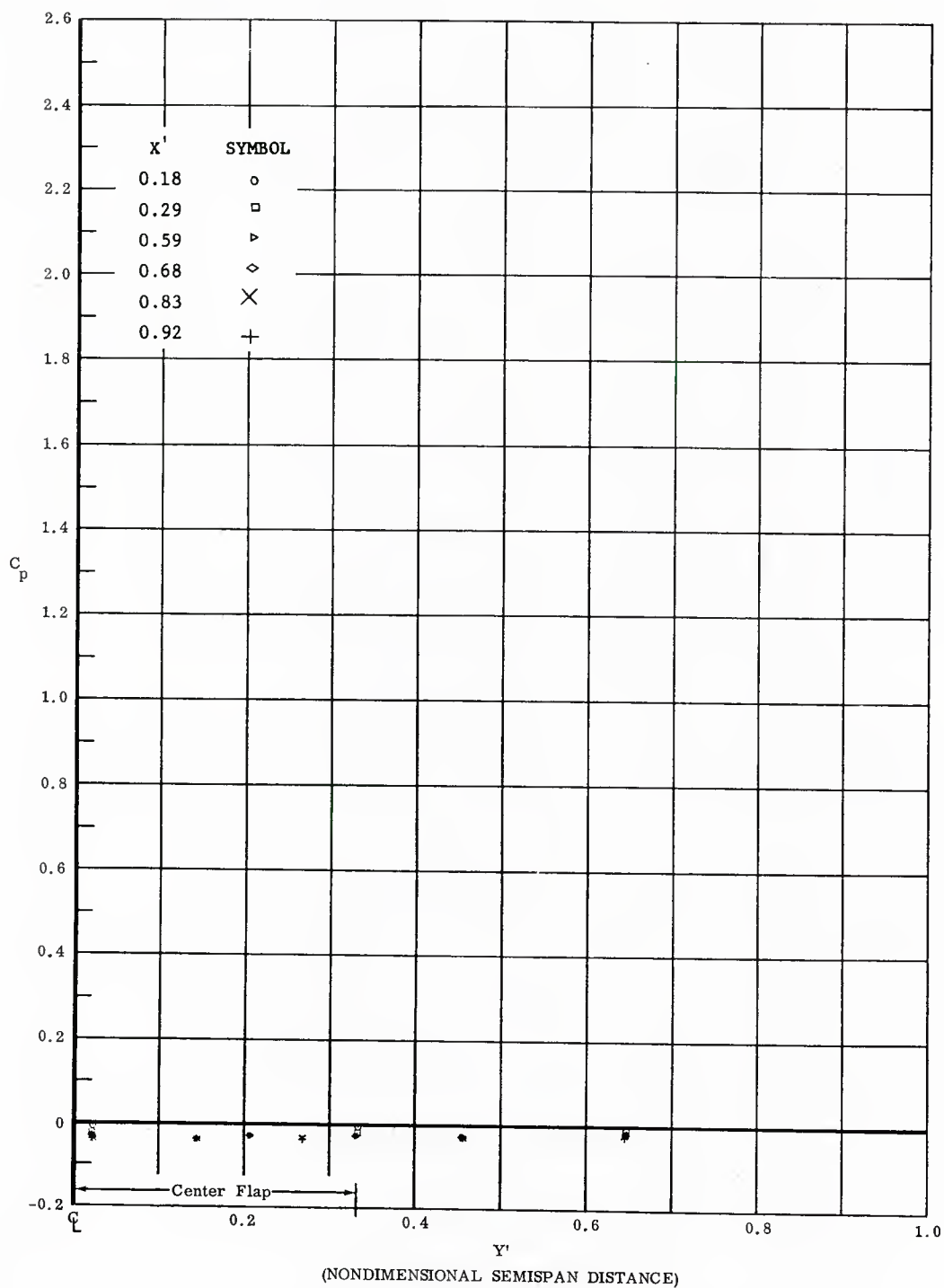


Fig. 107 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, No Deflection Flaps, End
 Plates Off

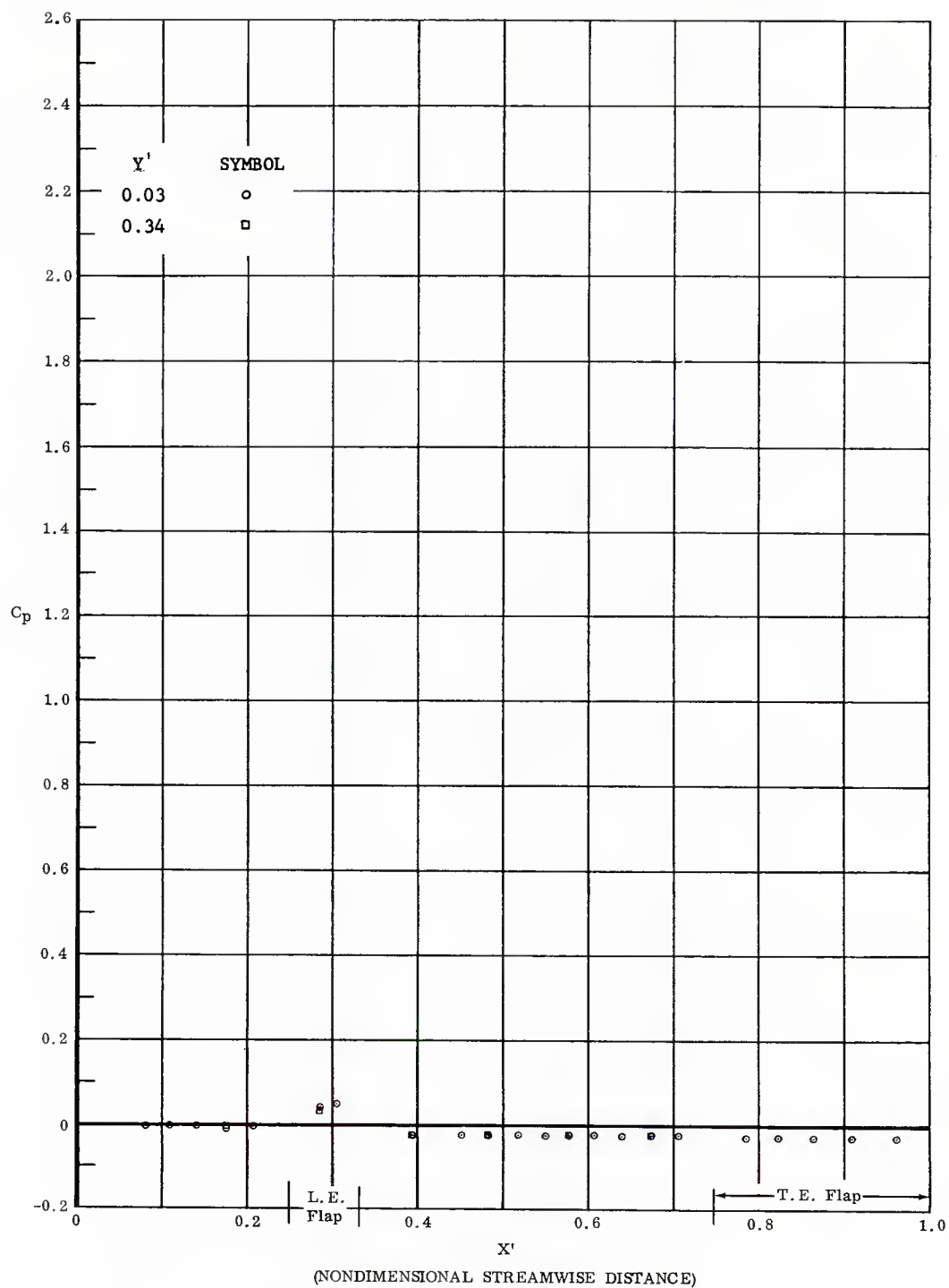


Fig. 108 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 15° , End
 Plates Off

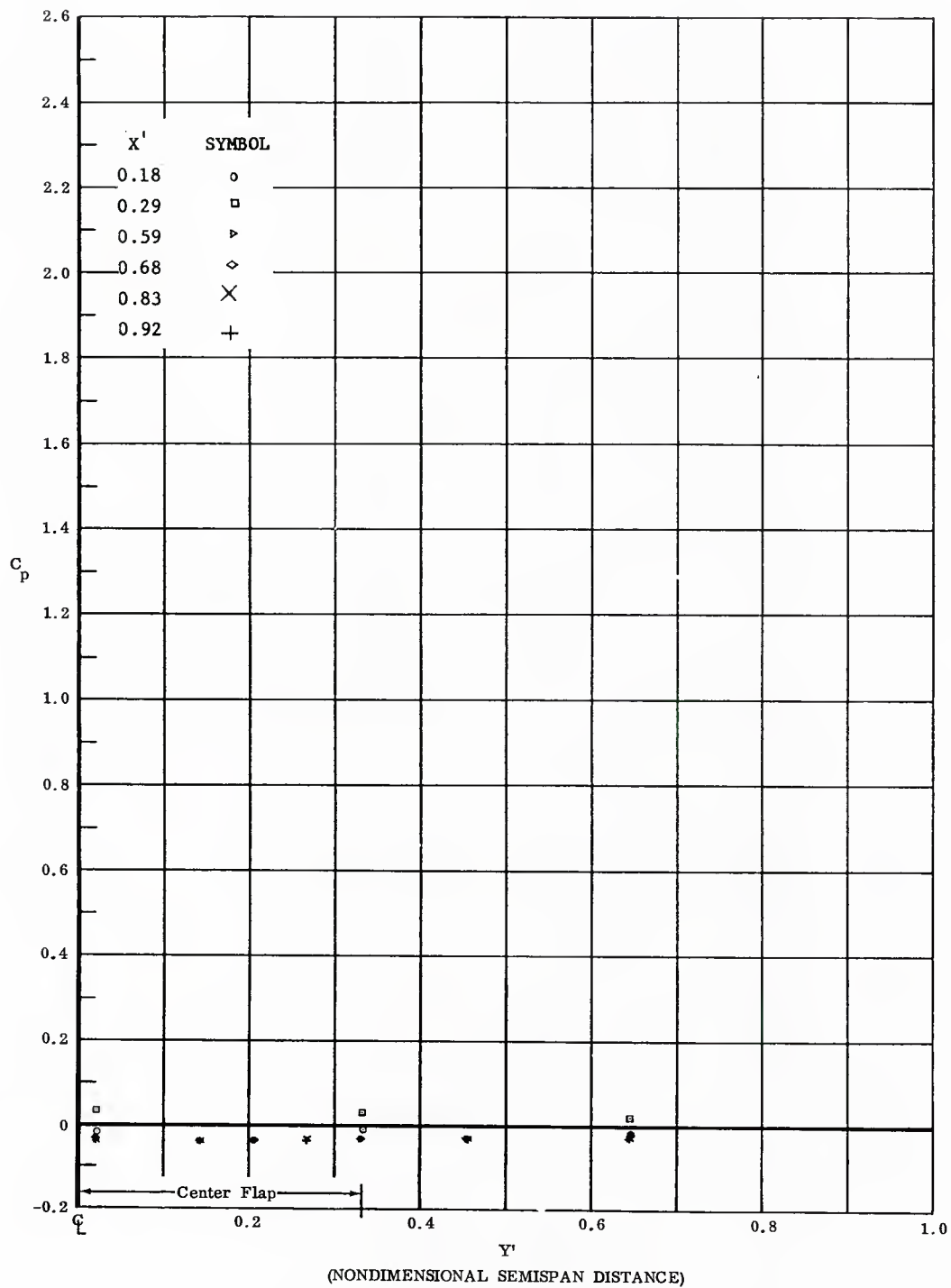


Fig. 108 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, Forward Flap at 15° , End
 Plates Off

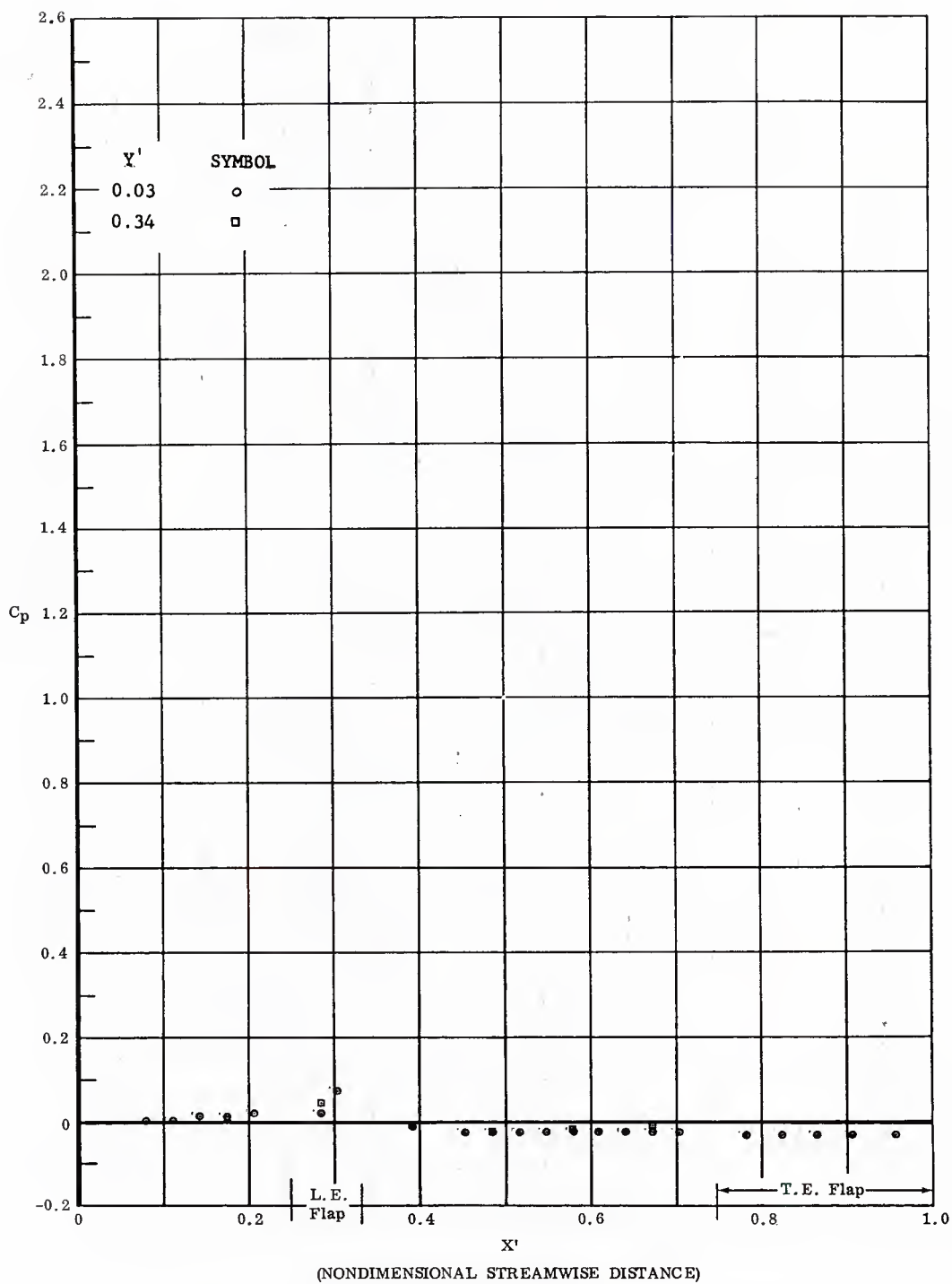


Fig. 109 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Forward Flap at 30° , End
 Plates Off

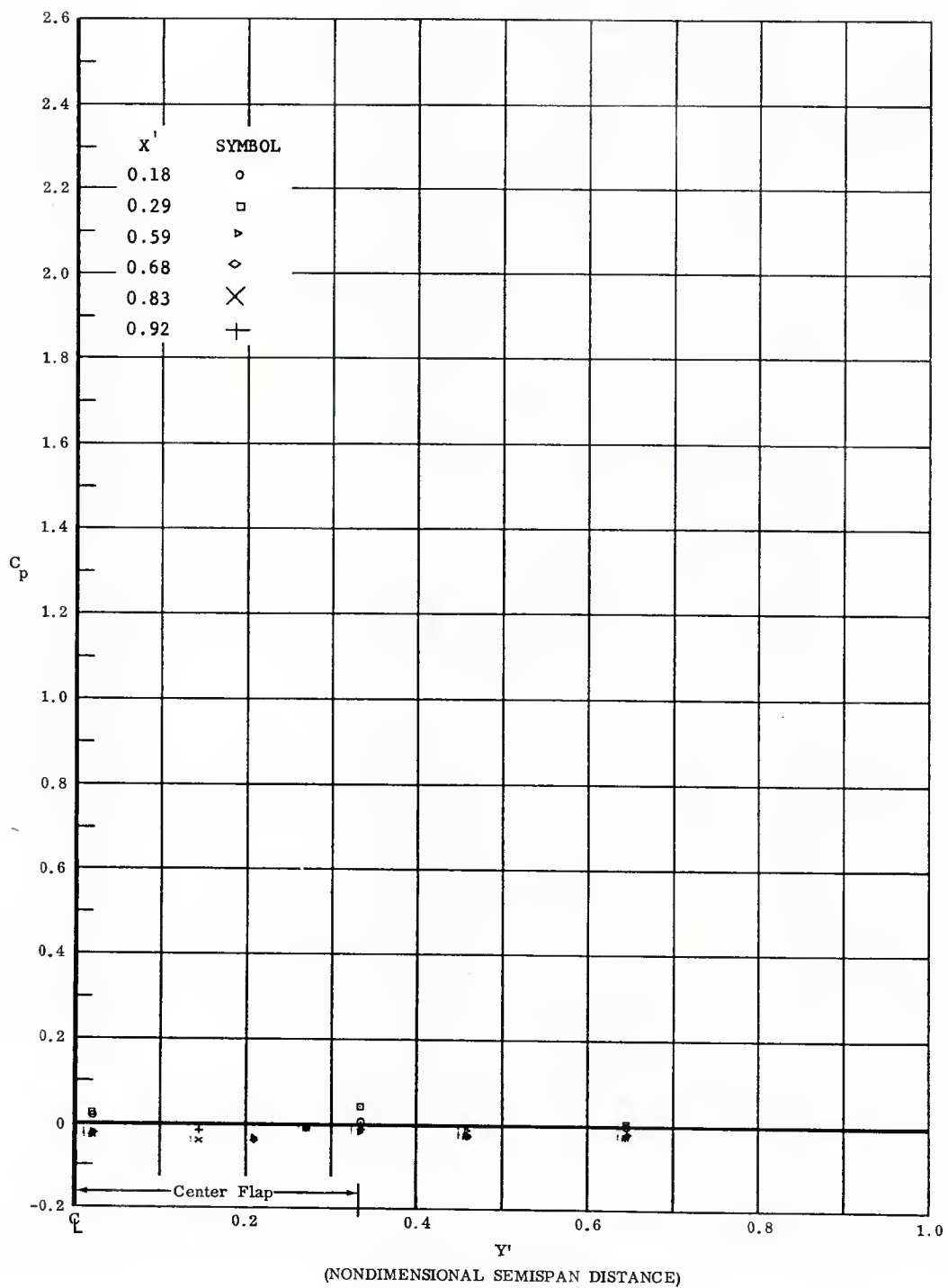


Fig. 109 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Forward Flap at 30° , End
 Plates Off

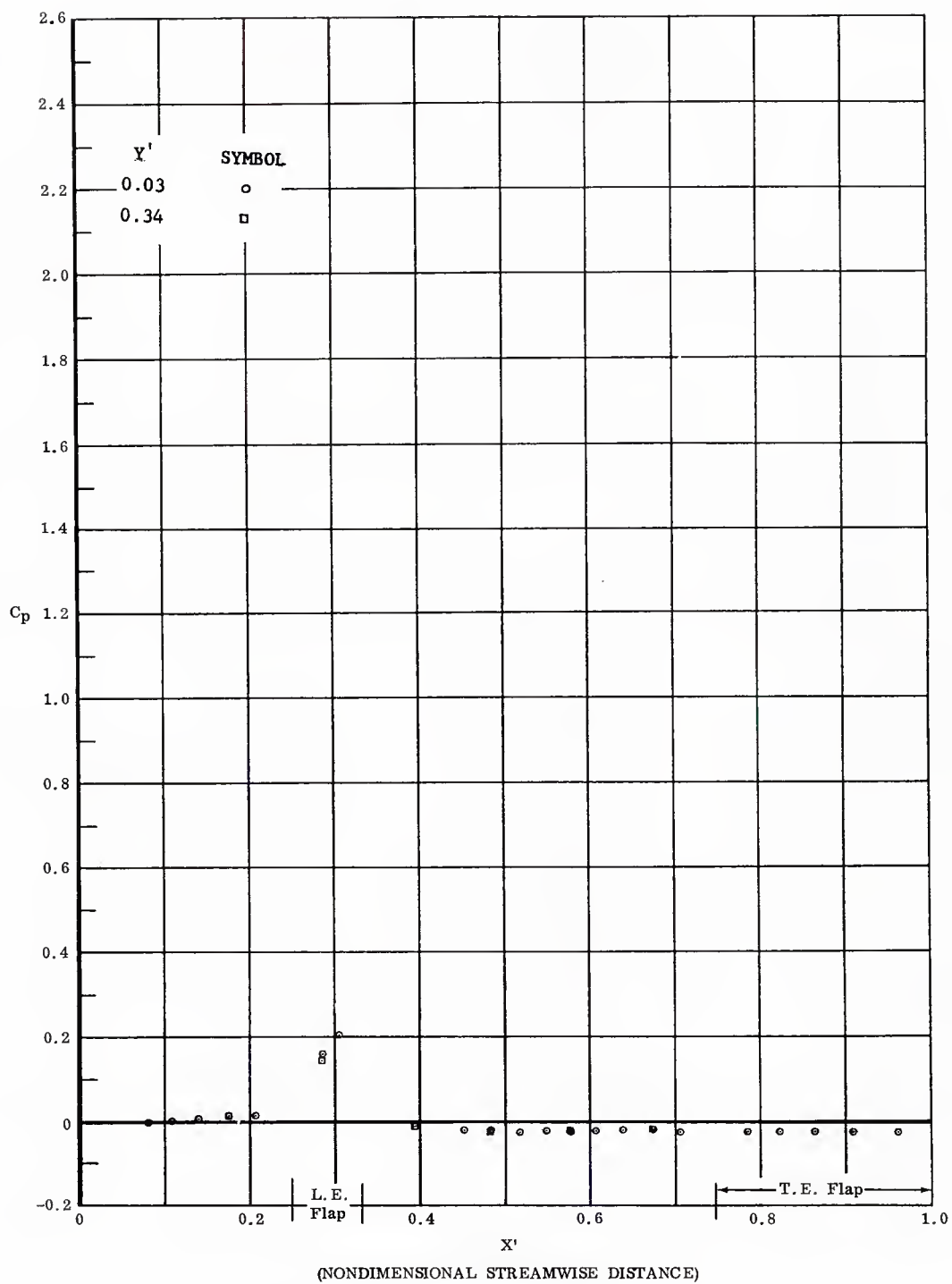


Fig. 110 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 30° , End
 Plates Off

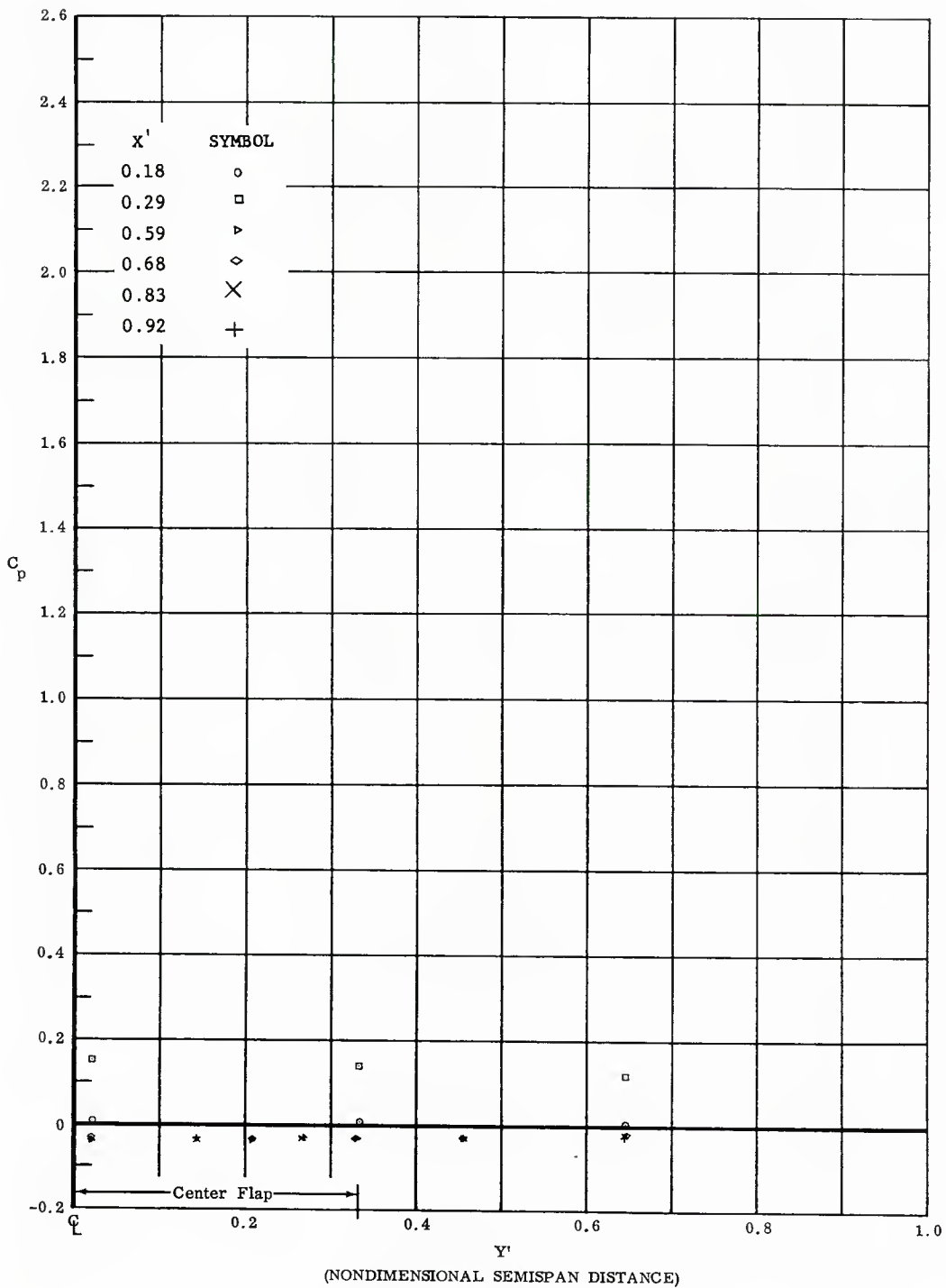


Fig. 110 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Forward Flap at 30° , End
 Plates Off

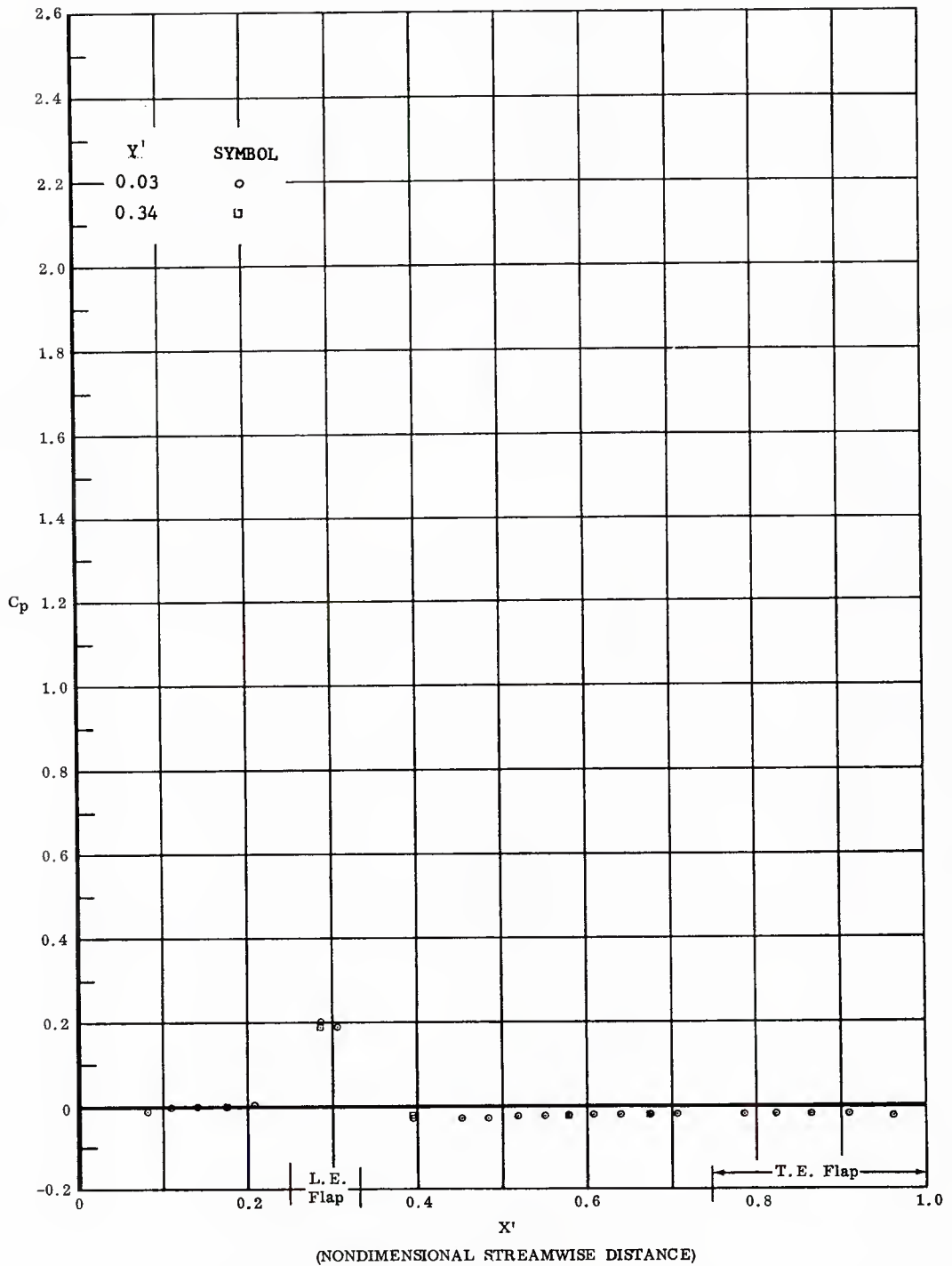


Fig. 111 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 30° , End
 Plates Off

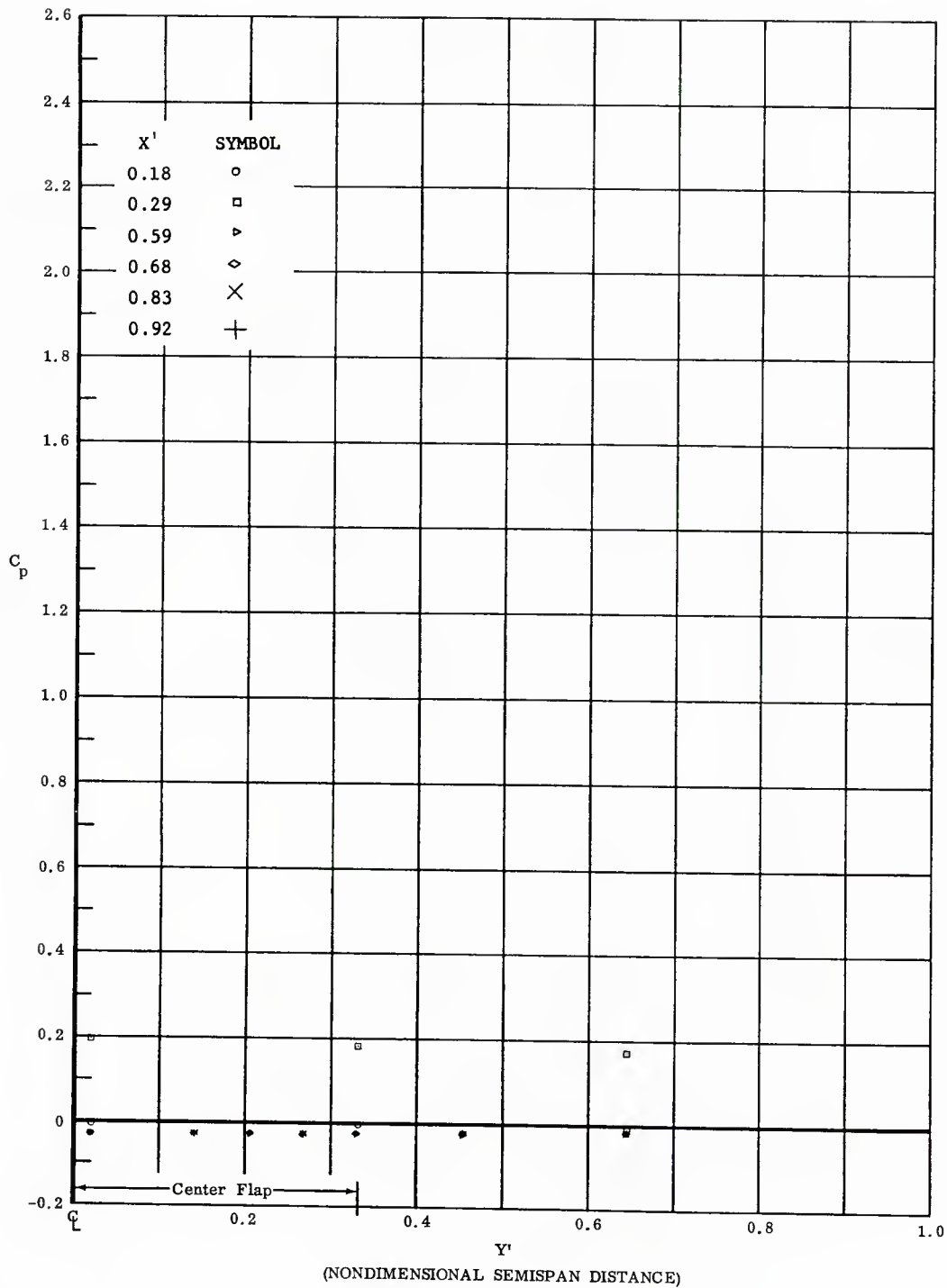


Fig. 111 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Forward Flap at 30° , End
 Plates Off

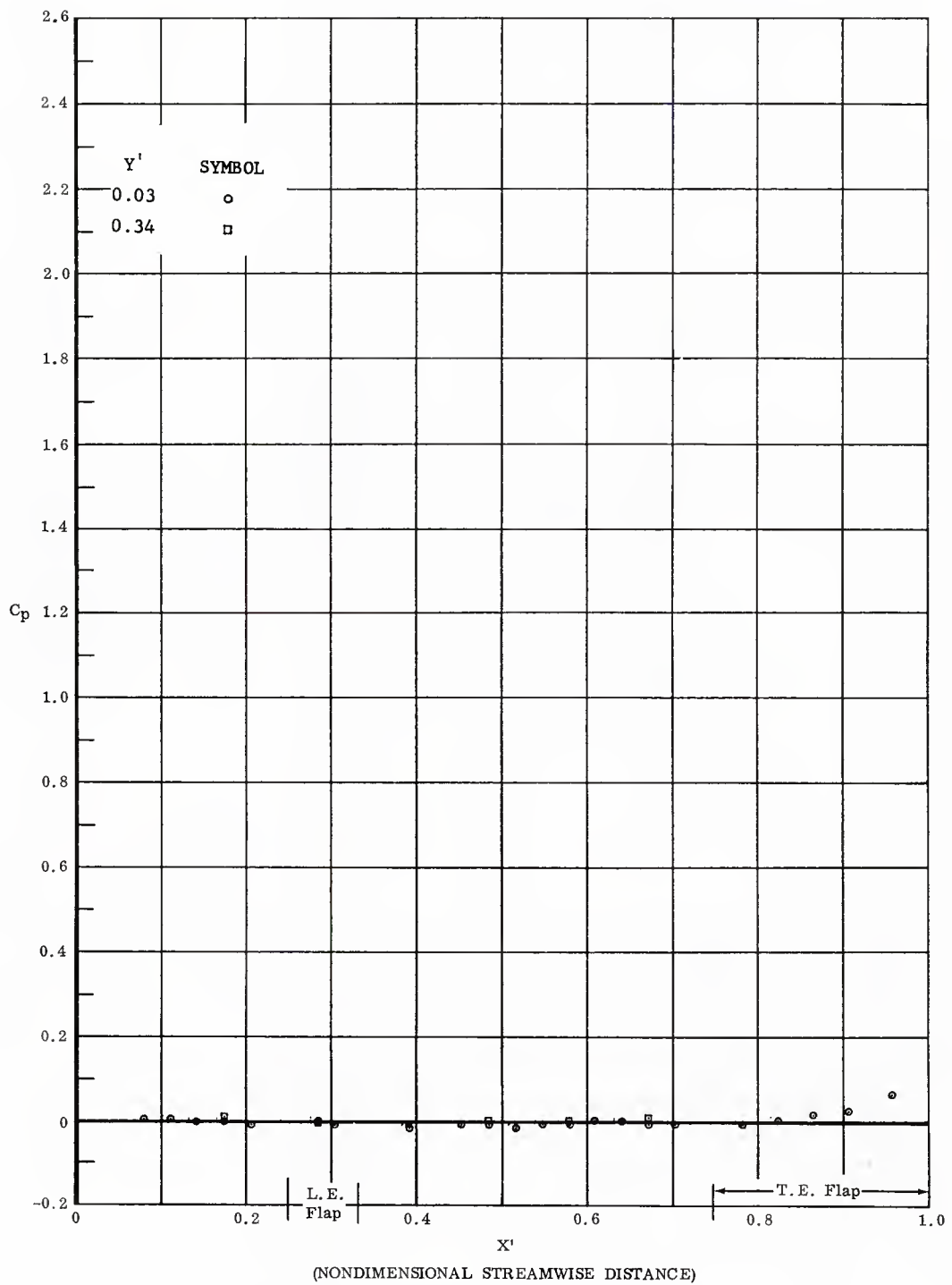


Fig. 112 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plates Off

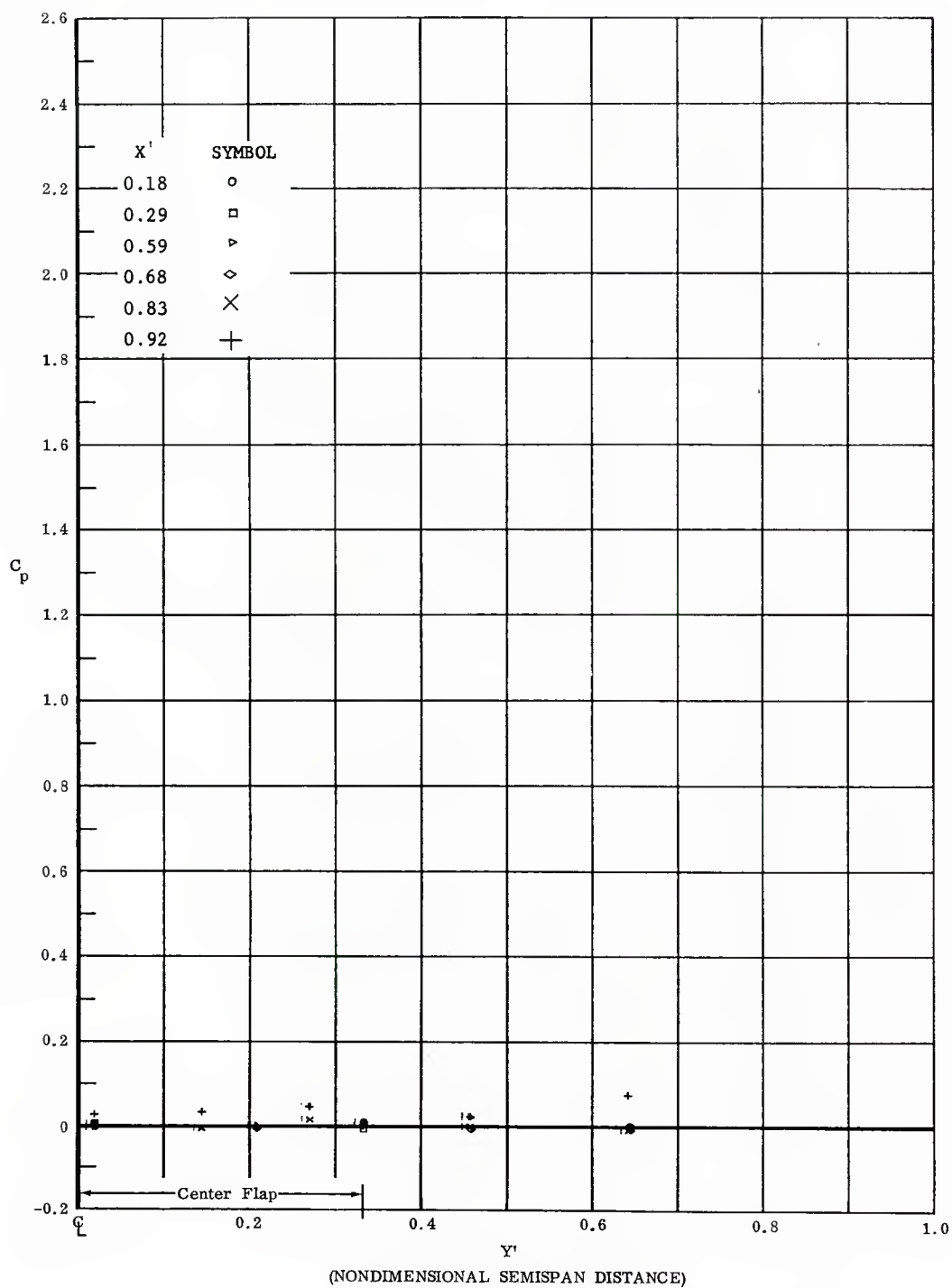


Fig. 112 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ft} = 1.1$, Aft Full Span Flap at 30° ,
 End Plates Off

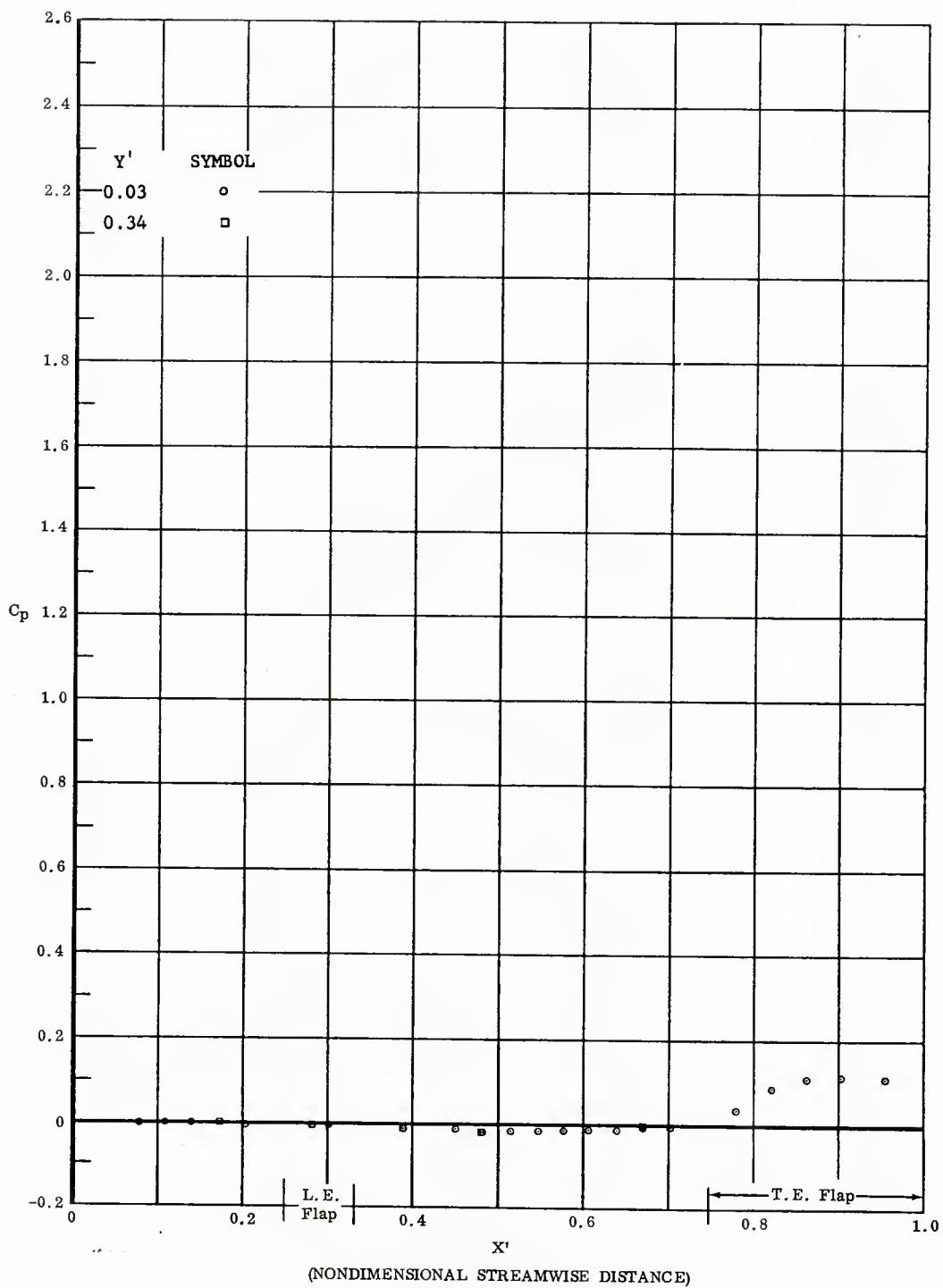


Fig. 113 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30° ,
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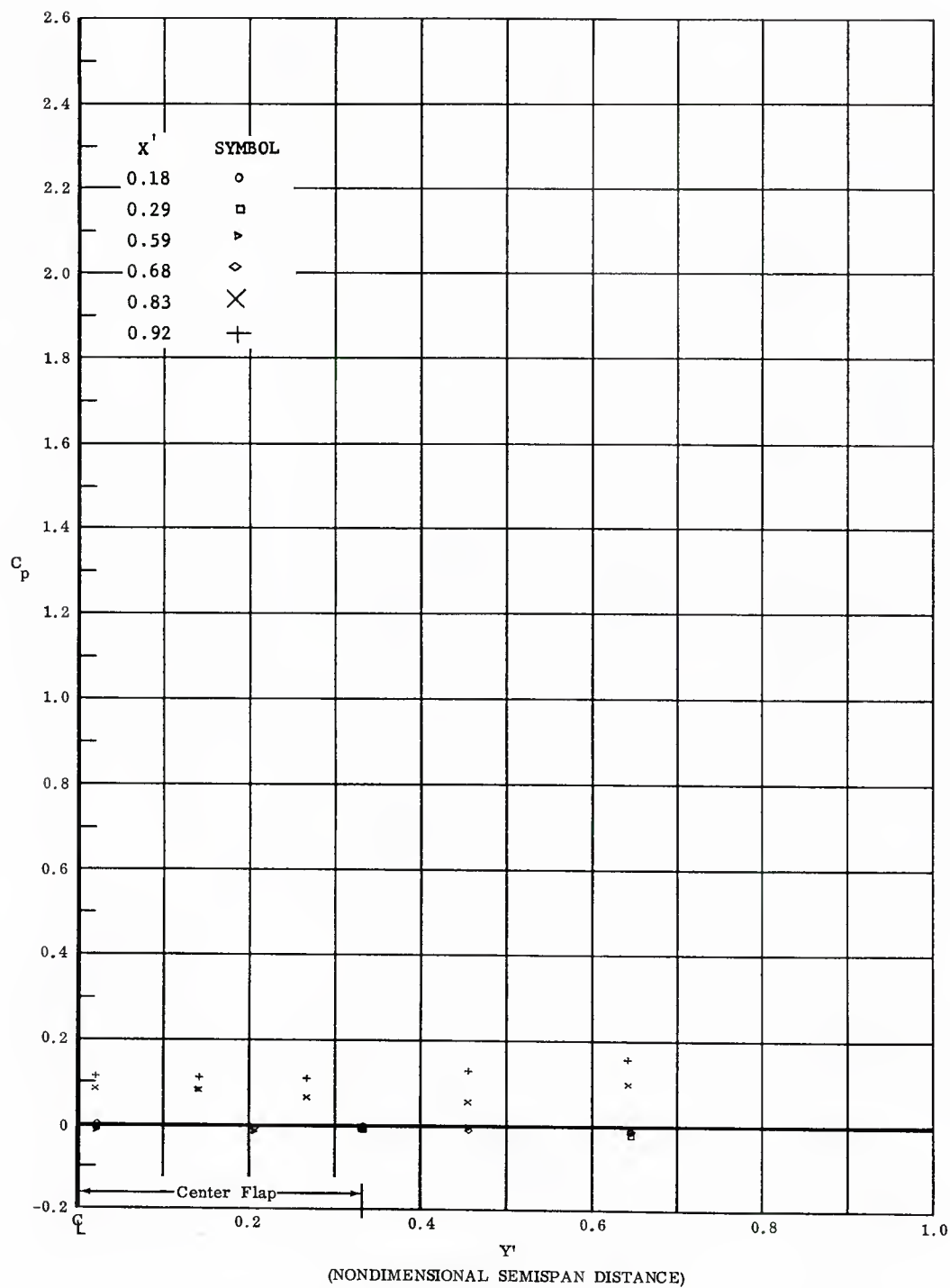


Fig. 113 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 30° ,
 End Plates Off

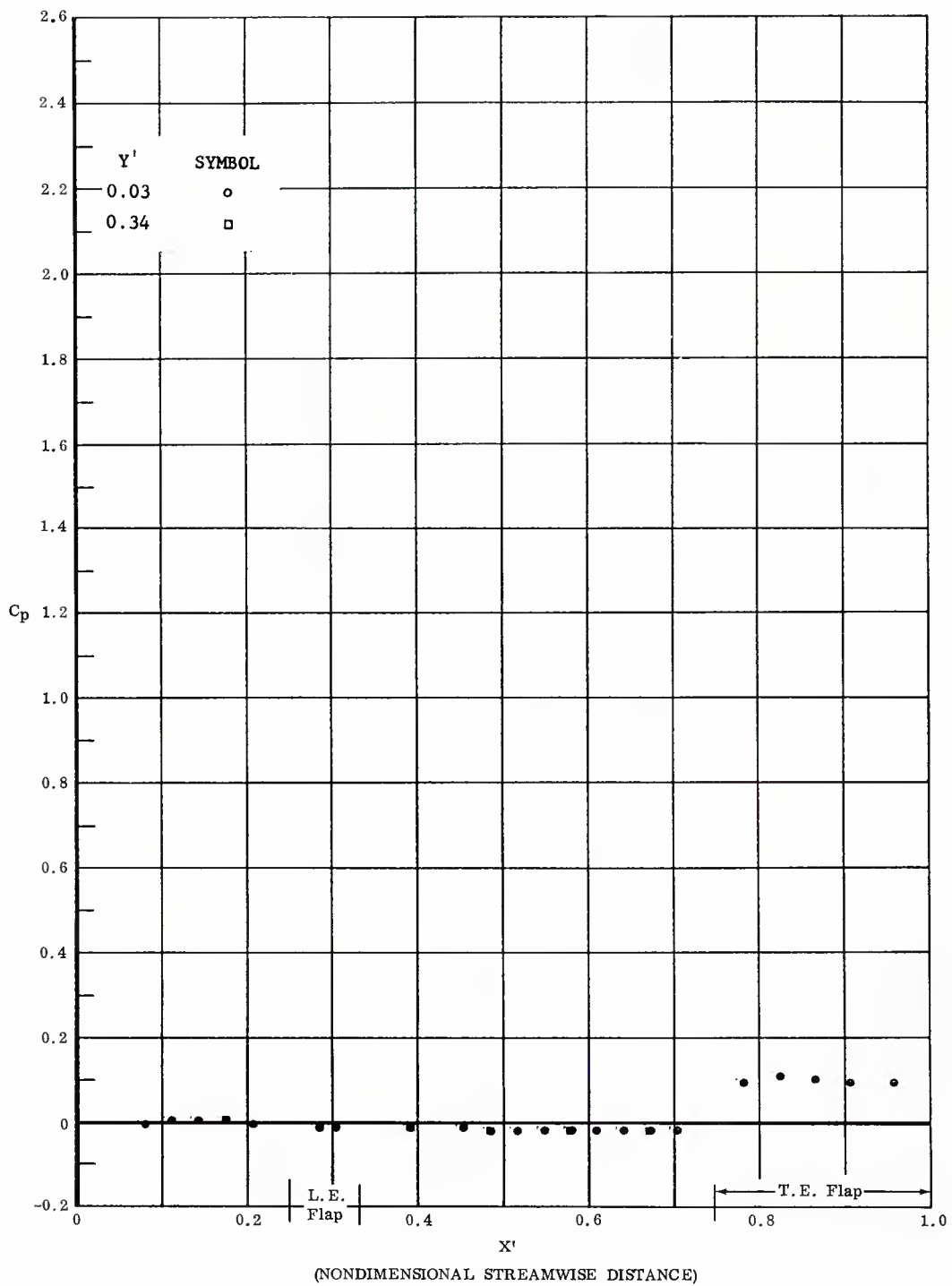


Fig. 114 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plates Off

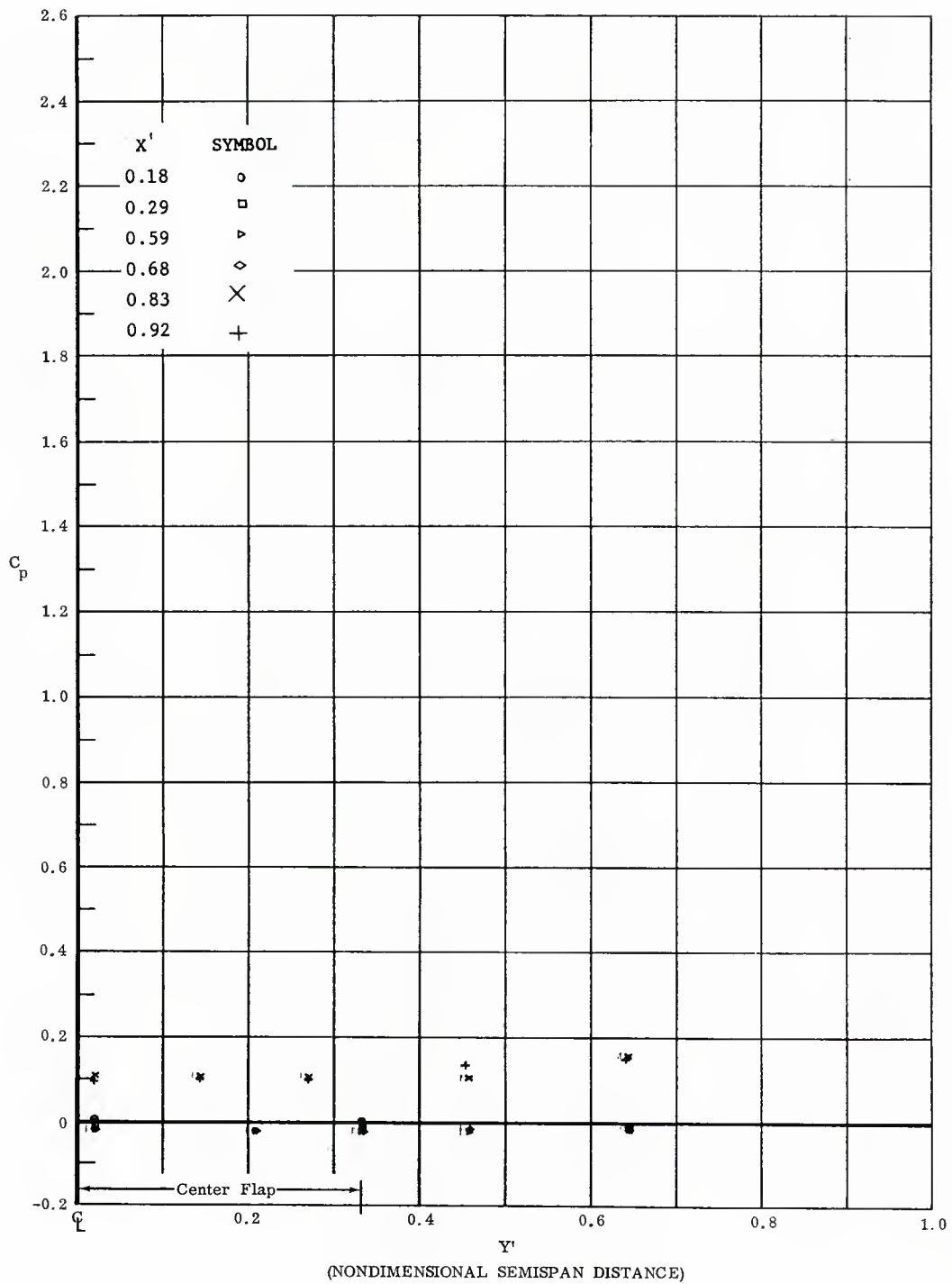


Fig. 114 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 30° ,
 End Plates Off

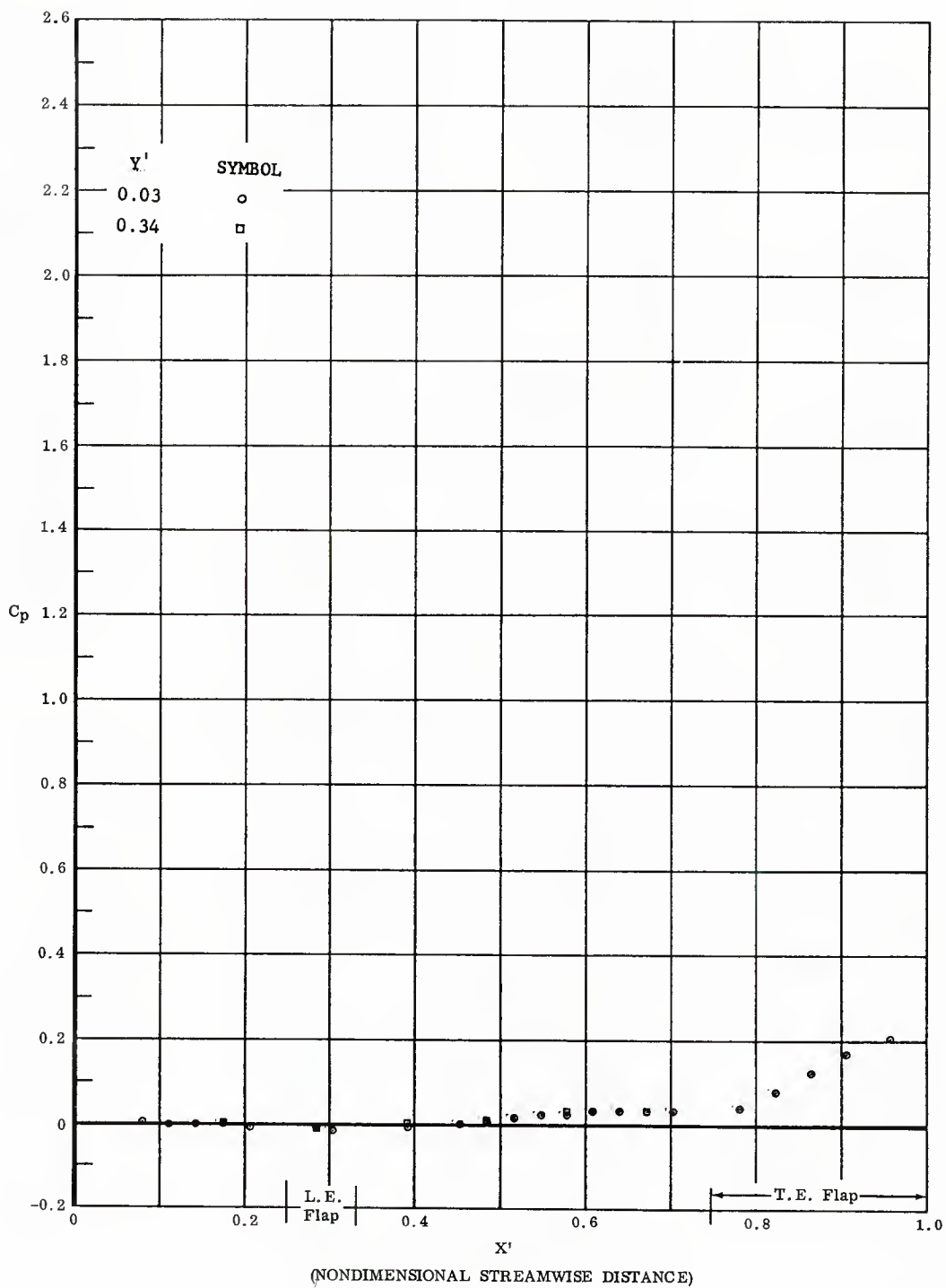


Fig. 115 Pressure Coefficient Data Plots; $\alpha = +15^\circ$
 $Re_\infty / 10^6 \text{ ft} = 3.3$, Aft Full Span Flap at 45° ,
 End Plates Off

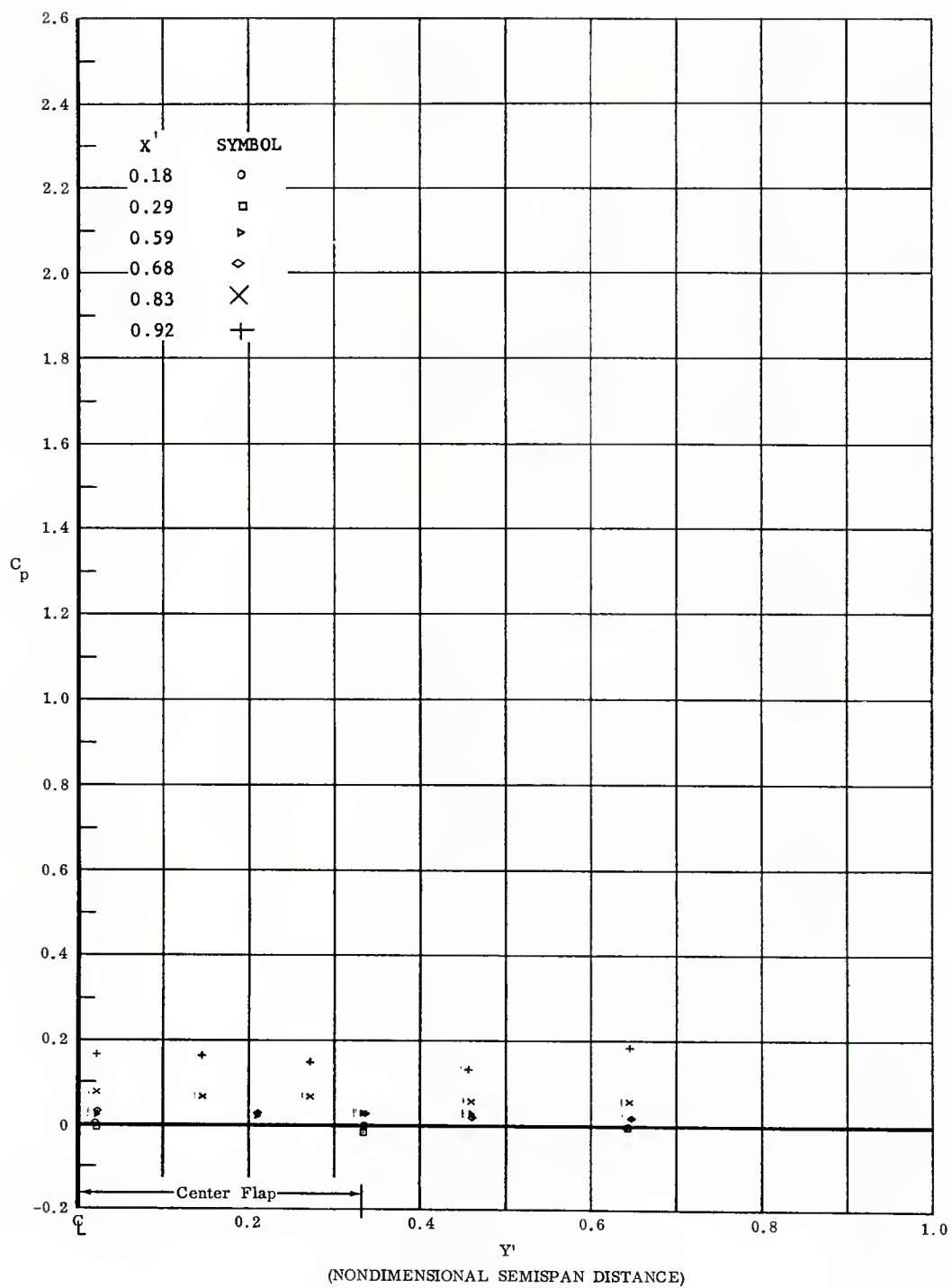


Fig. 115 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ft} = 3.3$, Aft Full Span Flap at 45° ,
 End Plates Off

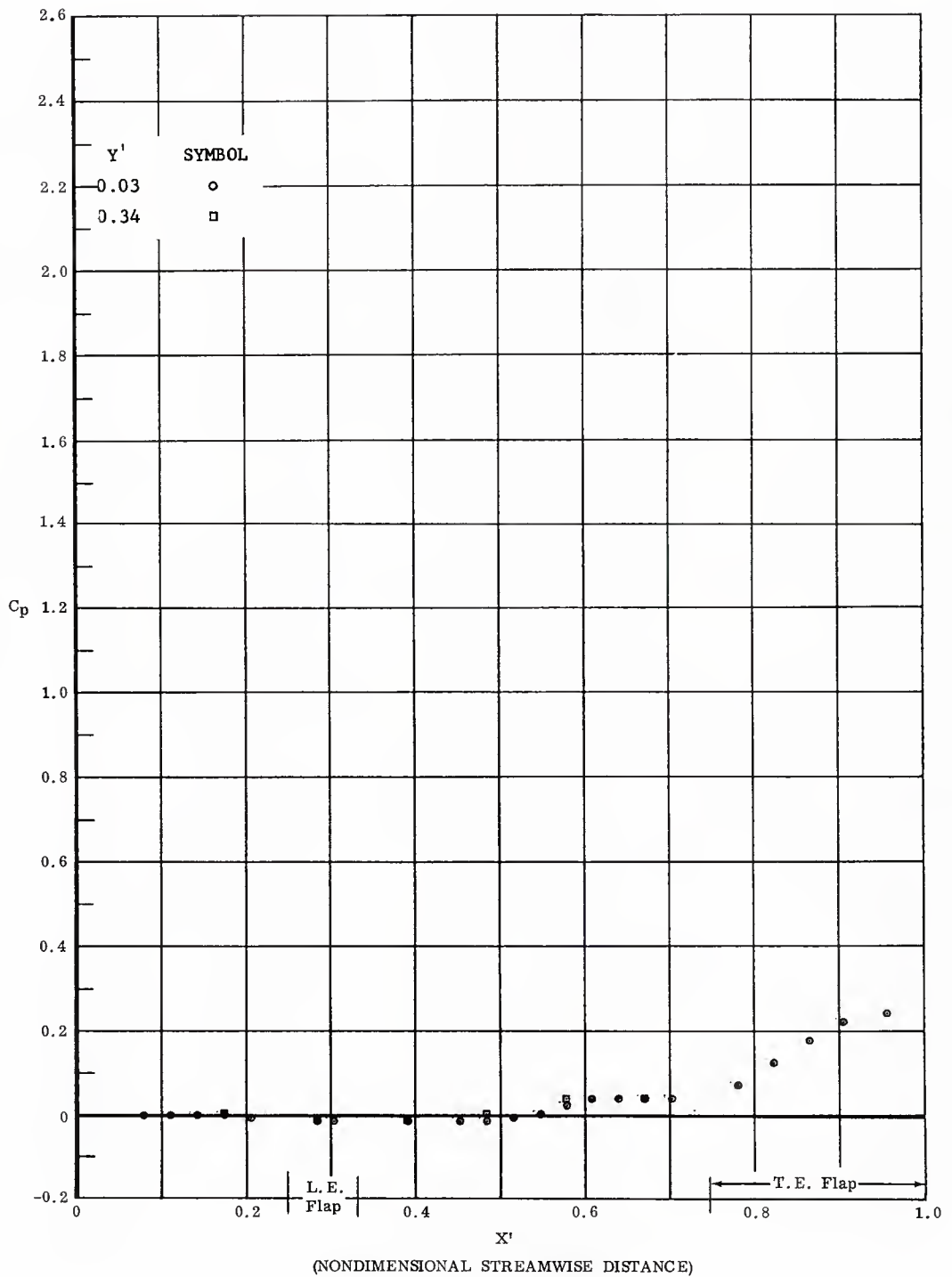


Fig. 116 Pressure Coefficient Data Plots; $\alpha = +15$
 $Re_{\infty}/10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 45° ,
 End Plates Off

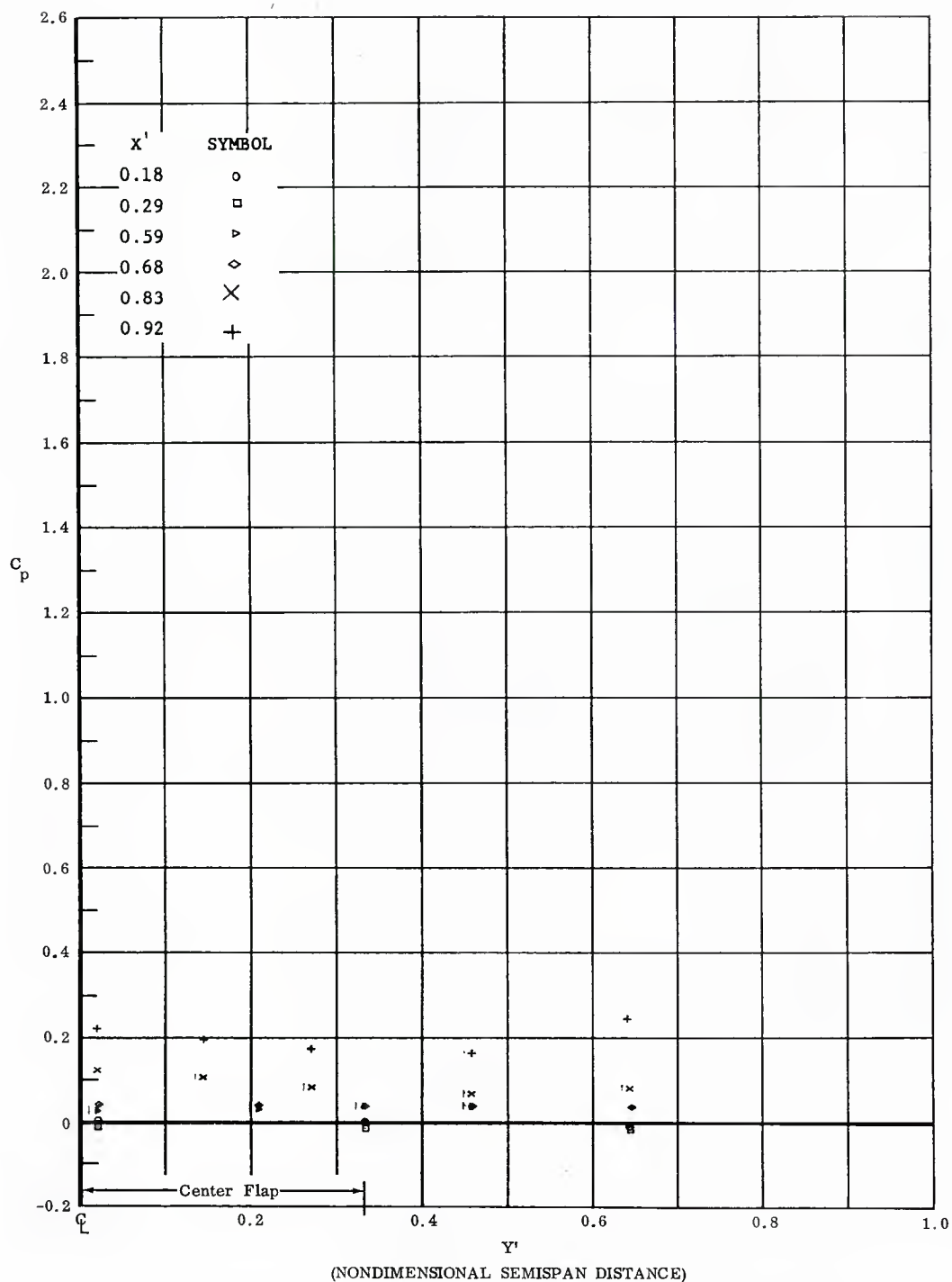


Fig. 116 Pressure Coefficient Data Plots; $\alpha = +15^\circ$
 $Re_\infty / 10^6 \text{ ft} = 6.6$, Aft Full Span Flap at 45° ,
 End Plates Off