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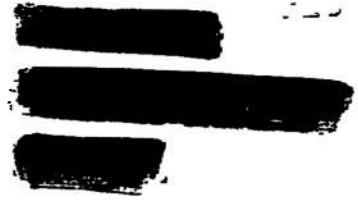
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# AERODYNAMIC CHARACTERISTICS OF A 0.12-SCALE MODEL OF THE A-9A AIRCRAFT AT MACH NUMBERS FROM 0.30 TO 0.80

Warren E. White

ARO, Inc.

December 1971

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**AERODYNAMIC CHARACTERISTICS OF A  
0.12-SCALE MODEL OF THE A-9A AIRCRAFT  
AT MACH NUMBERS FROM 0.30 TO 0.80**

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## FOREWORD

The work reported herein was done at the request of the Aeronautical Systems Division (ASD), Air Force Systems Command (AFSC), for the Northrop Corporation, Hawthorne, California, under Program Element 64211F, System 329A.

The results of the test presented were obtained by ARO, Inc. (a subsidiary of Sverdrup & Parcel and Associates, Inc.), contract operator of the Arnold Engineering Development Center (AEDC), AFSC, Arnold Air Force Station, Tennessee, under Contract F40600-72-C-0003. The tests were conducted from August 17 through 24, 1971, under ARO Project No. PB0190. The manuscript was submitted for publication on November 1, 1971.

This technical report has been reviewed and is approved.

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Colonel, USAF  
Director of Test

**ABSTRACT**

Wind tunnel tests were conducted at Mach numbers from 0.30 to 0.80 and Reynolds numbers from 2.3 to 7.0 million on a 0.12-scale model of the A-9A aircraft to determine the effects of control surface deflections on the aerodynamic characteristics of the airplane. The results showed that the horizontal stabilizer was 20 to 50 percent more effective in pitching moment per degree of deflection than the elevator, the rudder remained effective at all Mach numbers, and the aileron deflections produced significant effects on lift, drag, and pitching and rolling moment. Minimum drag was increased by approximately 100 and 600 percent for speed brake deflections of 20 and 60 deg, respectively, at Mach numbers from 0.70 to 0.80.

Distribution limited to U.S. Government agencies only; this report contains information on test and evaluation of military hardware; December 1971; other requests for this document must be referred to Aeronautical Systems Division (SDXT), Wright-Patterson AFB, OH 45433.

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## NOMENCLATURE

<b>b</b>	Reference wing span, 82.08 in.
<b>BETA</b>	Sideslip angle, deg
<b>BL</b>	Buttock line, in.
<b>C<sub>D</sub></b>	Drag coefficient, drag/ $q_{\infty}S$
<b>C<sub>L</sub></b>	Lift coefficient, lift/ $q_{\infty}S$
<b>C<sub>l</sub></b>	Rolling-moment coefficient, rolling moment/ $q_{\infty}Sb$
<b>C<sub>m</sub></b>	Pitching-moment coefficient, pitching moment/ $q_{\infty}S\bar{c}$
<b>C<sub>n</sub></b>	Yawing-moment coefficient, yawing moment/ $q_{\infty}Sb$
<b>C<sub>Y</sub></b>	Side-force coefficient, side force/ $q_{\infty}S$
<b><math>\bar{c}</math></b>	Reference chord, 14.46 in.
<b>F.S.</b>	Fuselage station, in.
<b>H<sub>L</sub></b>	Control surface hinge line
<b>M<sub>∞</sub></b>	Free-stream Mach number
<b>q<sub>∞</sub></b>	Free-stream dynamic pressure, psf
<b>Re</b>	Reynolds number based on model $\bar{c}$
<b>S</b>	Reference wing area, 8.064 sq ft
<b>WL</b>	Waterline, in.
<b><math>\alpha</math></b>	Angle of attack, deg
<b><math>\delta_{AL}</math></b>	Left aileron only, positive, trailing edge down, deg
<b><math>\delta_B</math></b>	Speedbrake deflection, measured from the centerline of the aileron trailing edge, deg
<b><math>\delta_E</math></b>	Elevator deflection, positive, trailing edge down, deg
<b><math>\delta_H</math></b>	Horizontal stabilizer incidence angle, positive, leading edge up, deg
<b><math>\delta_R</math></b>	Rudder deflection, positive, trailing edge left, deg



## SECTION I INTRODUCTION

Wind tunnel investigations of a 0.12-scale model of the A-9A aircraft were conducted in the Propulsion Wind Tunnel (16T) for the Northrop Corporation at Mach numbers of 0.30, 0.60, 0.70, 0.75, and 0.80 at angles of attack and sideslip from -10 to 20 deg and 0 to 5 deg, respectively. Configuration variables included elevator, rudder, aileron, and speed brake deflections, horizontal tail dihedral angles, horizontal stabilizer incidence angles, external stores, and exit-nozzle core cowls. In addition, internal-duct drag was determined from the pressure data obtained from the exit nozzle and core cowl rakes. The primary purpose of the test was to obtain data at high subsonic Mach numbers at high Reynolds numbers.

## SECTION II APPARATUS

### 2.1 TEST FACILITY

Tunnel 16T is a continuous flow, closed-circuit, variable density wind tunnel capable of operating at Mach numbers from 0.15 to 1.60. The test section is 16 by 16 ft in cross section and 40 ft long. Perforated walls in the test section allow continuous operation through the Mach number range with a minimum of wall interference. A more extensive description of the test facility is given in the Test Facilities Handbook.<sup>1</sup> The sting support system was composed of a vertical support strut, sting support boom, and the high-angle-of-attack sting support system with an auxiliary roll mechanism.

The high-angle-of-attack sting support system was utilized to obtain angles of attack from -12 to 20 deg and also enable variations in sideslip by rolling the sting. Location of the model in the test section and details of the perforated walls are shown in Fig. 1 (Appendix I). Photographs of the model are presented in Fig. 2.

### 2.2 TEST ARTICLE

#### 2.2.1 Aircraft Model

The test article was a 0.12-scale model of the A-9A aircraft which represented the prototype configuration. Details of the model are presented in Figs. 3 and 4 where the complete configuration is shown and the individual components are identified. The aileron (left wing only), elevators, and rudder were remotely controlled, whereas the speed brakes, horizontal tail dihedral, and horizontal stabilizer incidence angles were set manually during configuration changes. The model had flow-through inlets with ducts to simulate exit nozzles. The wing incidence angle was 0 deg with respect to the fuselage waterline. A 0.10-in.-wide boundary-layer trip was composed of number 80 grit and was located 0.80 in. from the leading edge of both surfaces of the wings and vertical and horizontal

---

<sup>1</sup>Test Facilities Handbook (Ninth Edition). "Propulsion Wind Tunnel Facility, Vol. 4." Arnold Engineering Development Center, July 1971.

stabilizers. In addition, a 0.10-in.-wide boundary-layer trip was affixed 0.80 in. aft of the nose. The index to model components and the configurations tested are listed in Table I (Appendix II).

### 2.2.2 Pylons and Store Models

The stores tested during this investigation were the MK-82 500-lb Bomb and the BLU-1/B Napalm Bomb. Sketches of these stores, associated pylons, and dispenser racks are presented in Figs. 4e, f, g, and h. All stores and pylons were nonmetric and were installed symmetrically on the parent model about its plane of symmetry.

## 2.3 INSTRUMENTATION

The overall aerodynamic forces and moments on the model were measured with a six-component, internal, strain-gage balance. The sensing components of the balance consisted of forward and aft normal-force elements (for determination of normal force and pitching moment), forward and aft side-force elements (for determination of side force and yawing moment), an axial-force element, and a rolling-moment element. Static pressures were measured at the sting entrance to the model and within the model cavity. A rake was attached to the model and positioned to measure pressures at the exit plane of the engine duct. The sting pitch angle was determined from the output of a strain-gaged angular position indicator. Sting roll angle was determined from the output of a potentiometer. The aileron, elevator, and rudder were instrumented with strain-gage hinge moment beams. The rotational angle of these surfaces was determined from the outputs of potentiometers. Electrical signals from the balances, pressure transducers, model attitude systems, and hinge-moment beams were digitized and recorded on magnetic tape, as well as fed directly to a computer for on-line data reduction. The balance and hinge-moment outputs were also recorded on an oscillograph for monitoring model dynamics.

## SECTION III TEST CONDITIONS AND PROCEDURE

### 3.1 TEST DESCRIPTION

The test was conducted at Mach numbers from 0.30 to 0.80 and Reynolds numbers of 2.3, 4.5, and 7.0 million based on the wing mean aerodynamic chord. The total pressure ranged from approximately 3660 psfa at  $M_\infty = 0.60$  and  $Re = 7.0 \times 10^6$  to 1071 psfa at  $M_\infty = 0.8$  and  $Re = 2.3 \times 10^6$ . Total temperature was maintained at approximately 105°F for all Mach numbers.

Tunnel conditions were held constant at each Mach number, while the angle of attack was varied from -10 to 20 deg. For related configurations, combinations of a constant beta of 5 deg and angles of attack were obtained by pitching and rolling the model. The maximum angle of attack was limited to lower values in certain cases because of reaching dynamic load limits. Model variables included remotely controlled aileron, elevator, and rudder angles of 0,  $\pm 5$ ,  $\pm 10$ ,  $\pm 20$ , and  $\pm 30$  deg; 0,  $\pm 5$ , and  $\pm 10$  deg; and 0, 10, 20, and 30 deg, respectively. Additional configurations consisted of manually controlled

speedbrake, horizontal tail dihedral, and horizontal stabilizer incidence angles of 0, -20, and -60 deg; 0 and 10 deg; and 0 and  $\pm 2$  deg, respectively.

### 3.2 ACCURACY OF MEASUREMENTS

The precision of setting and maintaining Mach number is estimated to be within  $\pm 0.004$  for Mach numbers of 0.3 and  $\pm 0.003$  and for Mach numbers from 0.60 to 0.80. Flow angularity corrections in the vertical plane of the tunnel, deduced from the upright and inverted runs, have been applied. Measured force and moment data on the balance were corrected for weight tares. No corrections have been made for cavity pressure base drag; however, internal duct drag-force data were measured and subtracted from the total drag force of the model. In addition to the measured drag values, interpolated values were used where measured data were not available.

The estimated uncertainties in the static-force data are given in the following table and are based on 95-percent probability.

<u>Parameter</u>	<u>M<sub>∞</sub></u>				
	<u>0.30</u>	<u>0.60</u>	<u>0.70</u>	<u>0.75</u>	<u>0.80</u>
<i>a</i>	$\pm 0.1$	$\pm 0.1$	$\pm 0.1$	$\pm 0.1$	$\pm 0.1$
<i>β</i>	$\pm 0.1$	$\pm 0.1$	$\pm 0.1$	$\pm 0.1$	$\pm 0.1$
<i>C<sub>L</sub></i>	$\pm 0.0158$	$\pm 0.0083$	$\pm 0.0060$	$\pm 0.0047$	$\pm 0.0037$
<i>C<sub>m</sub></i>	$\pm 0.0031$	$\pm 0.0082$	$\pm 0.0010$	$\pm 0.0011$	$\pm 0.0011$
<i>C<sub>Y</sub></i>	$\pm 0.0104$	$\pm 0.0028$	$\pm 0.0025$	$\pm 0.0023$	$\pm 0.0022$
<i>C<sub>n</sub></i>	$\pm 0.0006$	$\pm 0.0002$	$\pm 0.0002$	$\pm 0.0008$	$\pm 0.0002$
<i>C<sub>q</sub></i>	$\pm 0.0004$	$\pm 0.0001$	$\pm 0.0001$	$\pm 0.0005$	$\pm 0.0001$
<i>C<sub>D</sub></i>	$\pm 0.0031$	$\pm 0.0019$	$\pm 0.0020$	$\pm 0.0012$	$\pm 0.0011$

## SECTION IV RESULTS AND DISCUSSION

### 4.1 GENERAL

The primary purpose of this investigation was to determine the effects of deflecting the aileron, elevator, rudder, and speed brakes on the aerodynamic forces and moments. These forces and moments were reduced to aerodynamic coefficients in the stability axes system about a moment reference center that was located at the quarter chord of the mean aerodynamic chord. The large volume of data obtained during this test precludes making detailed analysis of all the test data. Consequently, this report includes only the analysis of data from aileron, elevator, rudder, and speed brake deflections of the basic model with and without the empennage for nominal Reynolds numbers of 2.3 and 4.5 million at Mach numbers 0.3 and from 0.60 to 0.80, respectively. The complete test is documented in Table II where the part numbers are presented for each model configuration and test conditions for which data were obtained.

## 4.2 LONGITUDINAL STABILITY AND CONTROL

Presented in Fig. 5 are the curves of  $C_N$ ,  $C_m$ , and  $C_D$  obtained during the tail component buildup tests. The ailerons, elevator, and rudder remained at zero, whereas the horizontal tail was installed at -2-deg incidence angle. As expected, Configurations XD<sub>6</sub> and XD<sub>6</sub>S<sub>1-5</sub> V<sub>2</sub> d<sub>2</sub> r<sub>3</sub> (see Table I) were statically unstable, since these configurations were without a horizontal tail. The complete model was longitudinally statically stable for the Mach numbers and Reynolds numbers shown. The increase in drag at a lift coefficient of zero for the addition of the vertical tail and the horizontal tail were approximately 11 and 40 percent, 11 and 31 percent, 11 and 33 percent, 4 and 20 percent, and 0 and 10 percent for Mach numbers of 0.30, 0.60, 0.70, 0.75, and 0.80, respectively.

Presented in Fig. 6 are data showing the effectiveness of the horizontal stabilizer for providing longitudinal control as well as the increase in drag because of the change in incidence angle of the horizontal stabilizer. The data showed that linear changes in  $C_m$  were produced by deflecting the horizontal stabilizer at Mach numbers of 0.30, 0.60, and 0.70 until buffet onset or stall occurred. The stabilizer effectiveness remained unchanged as free-stream Mach number was increased from 0.30 to 0.70 but decreased with further increases in Mach number. The deflection of the horizontal tail to  $\pm 2$  deg showed an incremental shift in the lift curve.

The effects of deflecting the elevator on the aerodynamic characteristics of the A-9A model are presented in Fig. 7. Deflections of the horizontal stabilizer and the elevator showed similar effects in pitching moments but with different orders of magnitude which were attributable to the difference in surface areas. The stabilizer was 20 to 50 percent more effective in pitching moment per degree of deflection than the elevator.

## 4.3 LATERAL STABILITY AND CONTROL

Figure 8 shows a noticeable effect on the lift, drag, pitching moment, and rolling-moment coefficients attributable to aileron deflections. The data showed that as the aileron on the left wing was deflected  $\pm 10$  deg a proportional increase occurred in  $C_l$  at  $M_\infty = 0.30, 0.60,$  and  $0.70$ . However, at  $M_\infty = 0.75$  and  $0.80$ , the negative 10-deg (trailing edge up) deflection did not produce an equivalent  $\Delta C_l$  to the values obtained for the positive aileron deflection. At  $M_\infty = 0.80$ , a reversal in the sign of the rolling moment occurred for model angles of attack between 1 and 9 deg for  $\delta_{AL} = -10$  deg. This anomaly in the data was eliminated when the speed brakes were deflected 20 and 60 deg at  $M_\infty = 0.75$  and  $0.80$  for  $\delta_{AL} = -10$  deg as shown in Figs. 8f and g. Therefore, the reversal in rolling moment at  $M_\infty = 0.80$  for the negative 10-deg aileron deflection is attributed to some type of local flow separation which reduced the aileron's effectiveness.

## 4.4 DIRECTIONAL STABILITY AND CONTROL

The changes in aerodynamic coefficients resulting from rudder deflections at  $\beta = 0$  deg are presented in Fig. 9. These data show that the rudder effectiveness was essentially

constant for  $C_Y$ ,  $C_n$ , and  $C_q$  up to 20 deg. At rudder deflection angles greater than 20 deg, there was less rudder effectiveness. The rudder remained effective for all Mach numbers.

#### 4.5 SPEED BRAKE EFFECTIVENESS

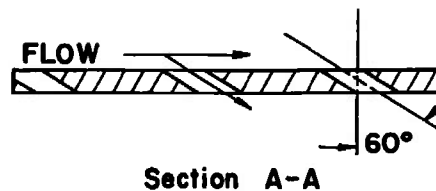
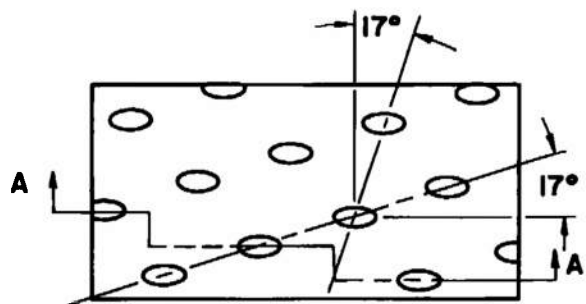
For data presented in Fig. 10 with the speed brakes deflected, the elevator and the rudder were at 0 deg, whereas the horizontal stabilizer incidence angle was at -2 deg. Deflecting the speed brake 60 deg reduced the value of the lift curve slope and significantly delayed the onset of buffet at Mach numbers of 0.70, 0.75, and 0.80. The speed brake deflection angle of 20 and 60 deg increased the minimum drag by 100 and 600 percent, respectively. The deflection of the speed brake from 20 to 60 deg produced a large destabilizing moment.

### SECTION V CONCLUSIONS

The results of a test conducted at Mach numbers from 0.3 to 0.8 to determine the aerodynamic characteristics of the A-9A aircraft led to the following remarks:

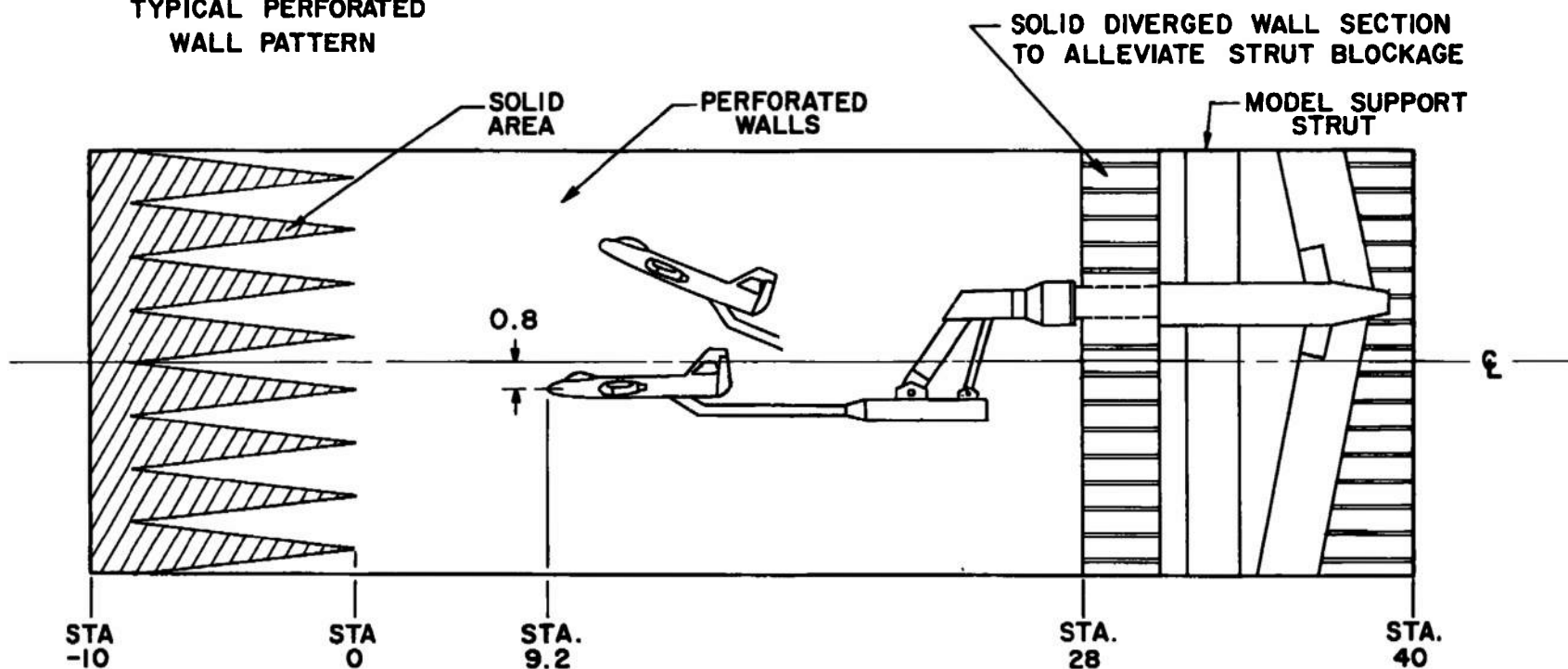
1. The stabilizer effectiveness remained unchanged as free-stream Mach number was increased from 0.30 to 0.70 but decreased with a further increase in free-stream Mach number.
2. The effectiveness of the aileron to produce a corresponding rolling moment for a negative aileron deflection was reduced to zero for angles of attack from approximately 1 to 9 deg at Mach number 0.80.
3. The rudder remained effective for all Mach numbers from 0.30 to 0.80.
4. Increasing the deflection angle of the speed brakes produced a destabilizing pitching moment and delayed the onset of wing buffet.
5. Minimum drag was increased by factors of approximately 100 and 600 percent for speed brake deflection angles of 20 and 60 deg, respectively, at Mach numbers from 0.70 to 0.80.
6. The horizontal stabilizer was 20 to 50 percent more effective in pitching moment per deg of deflection than the elevator.

**APPENDIXES**  
**I. ILLUSTRATIONS**  
**II. TABLES**



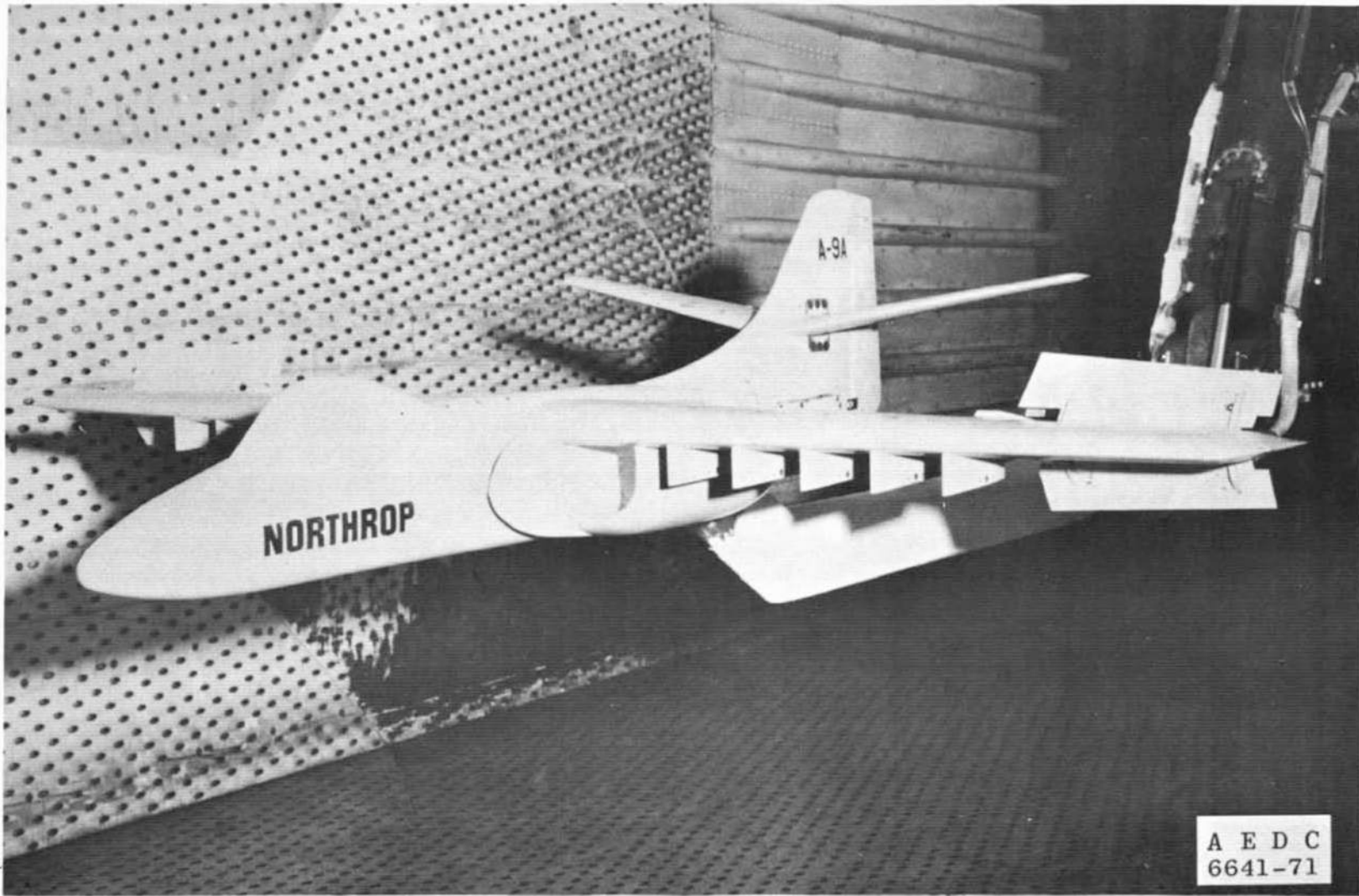
6% Open Area  
 Hole Diameter = 0.75 In.  
 Plate Thickness = 0.75 In.

9



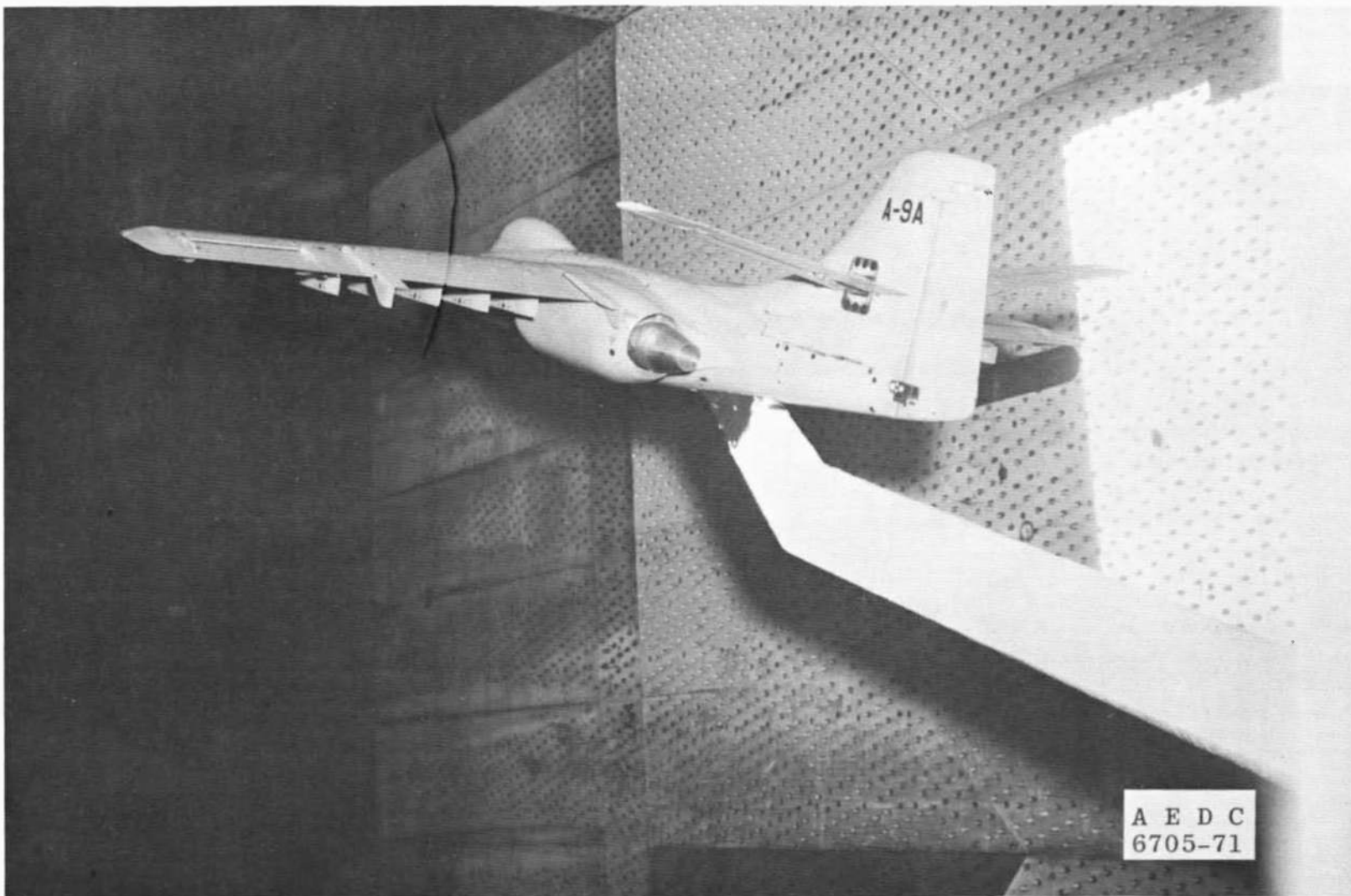
DIMENSIONS AND STATIONS IN FEET

Fig. 1 Schematic of Model Installation



a. Speed Brake Extended  
Fig. 2 Photograph of Model Installation





b. Speed Brake Retracted  
Fig. 2 Concluded

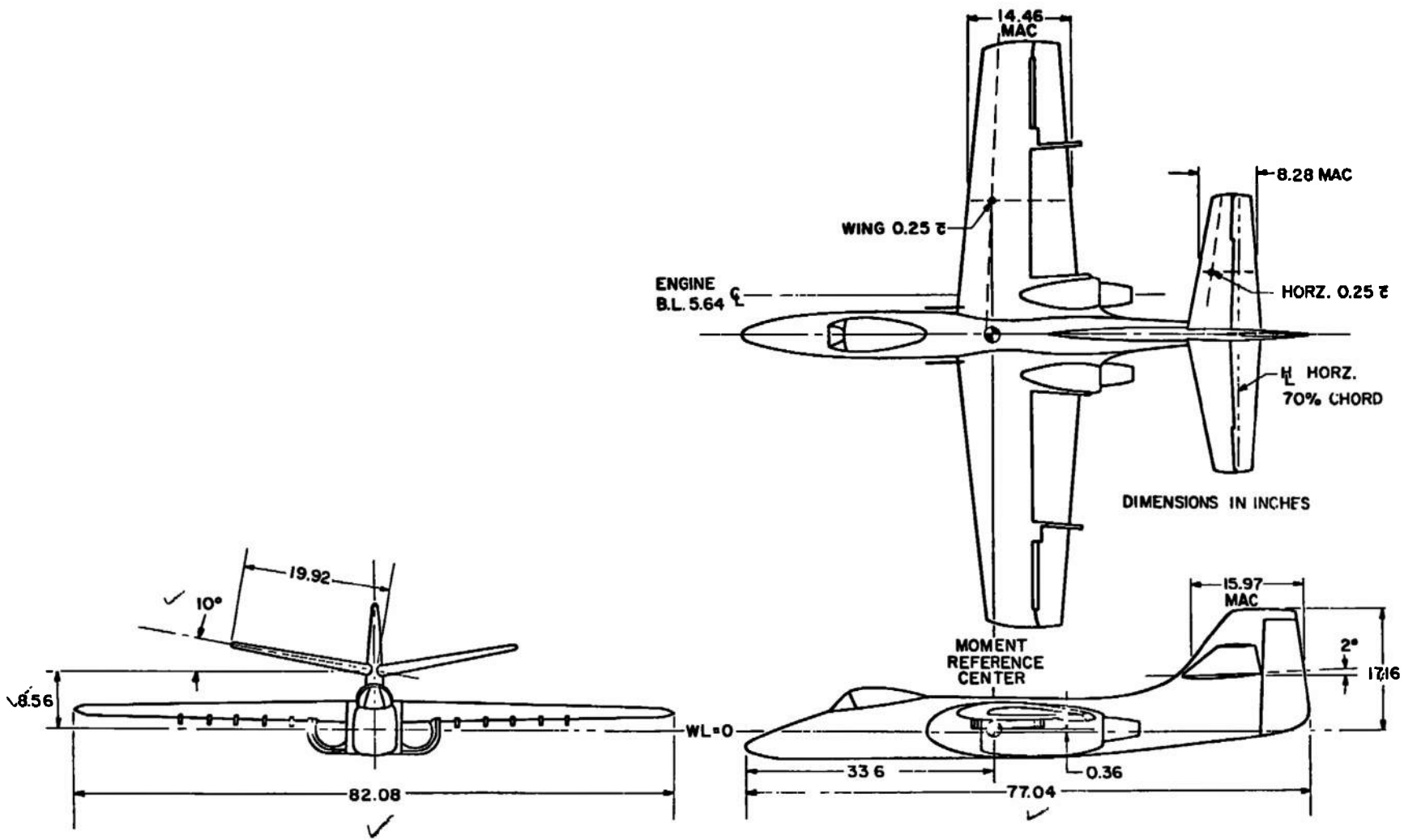
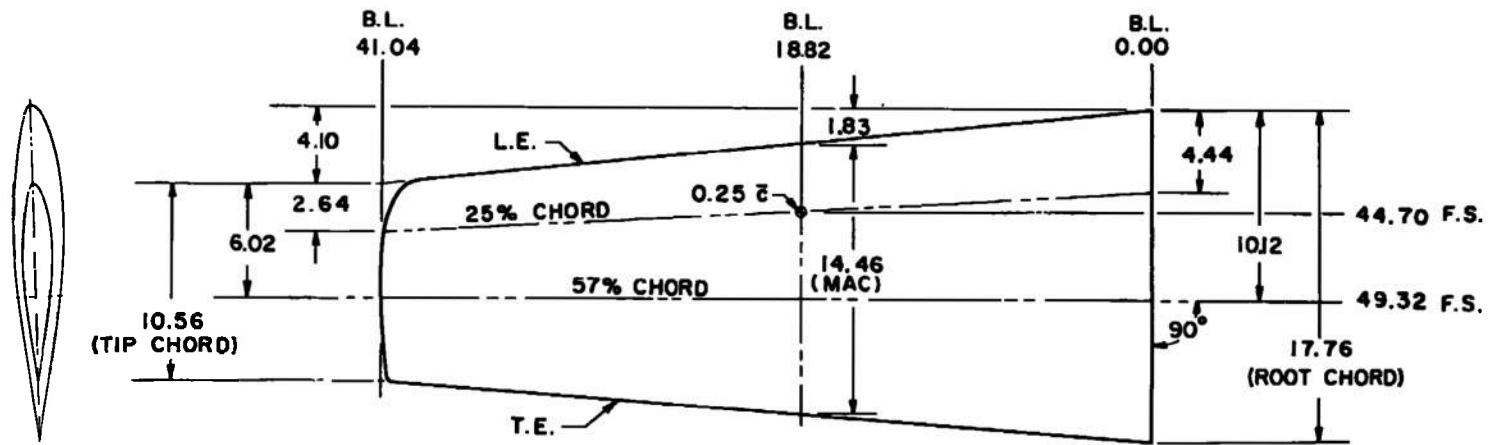


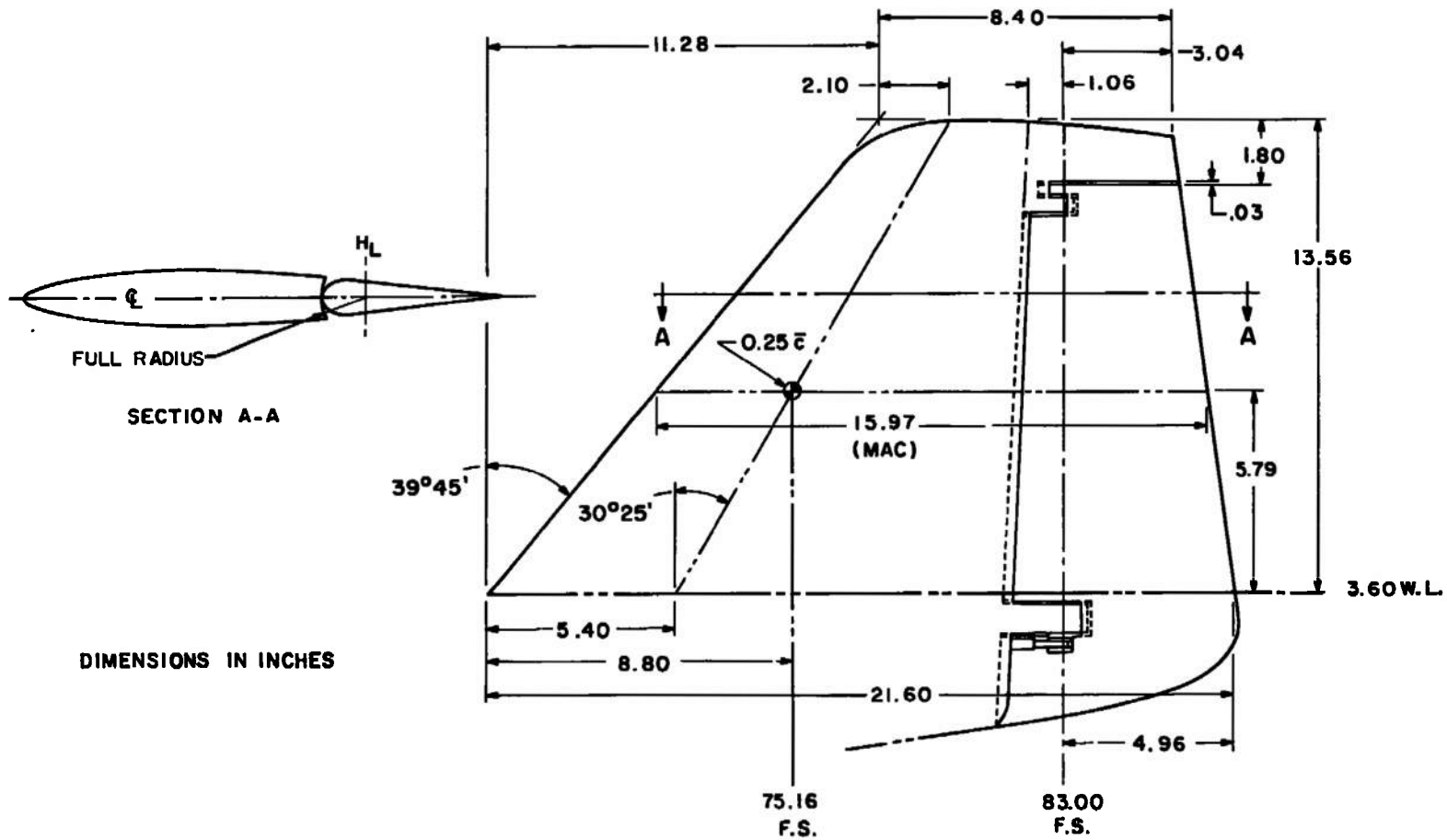
Fig. 3 Model Sketch



DIMENSIONS IN INCHES

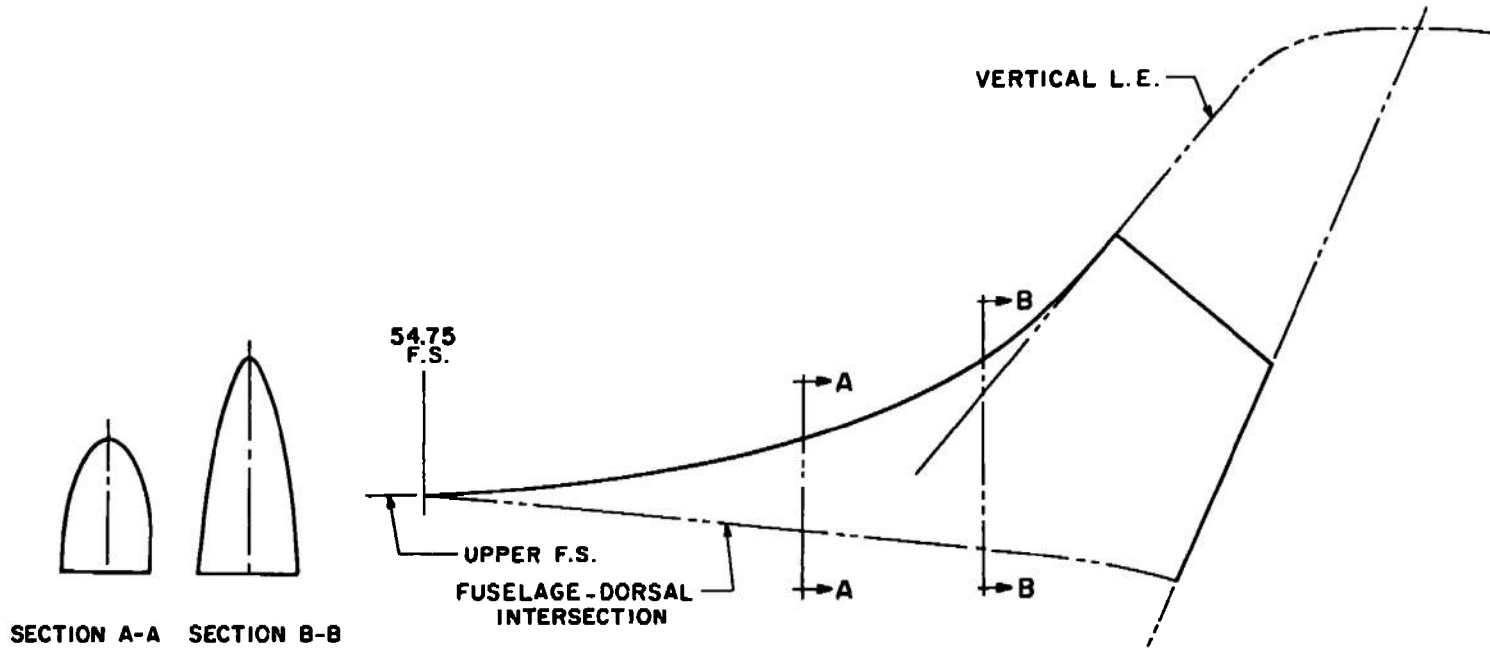
a. Wing

Fig. 4 Dimensional Sketches of Model Components



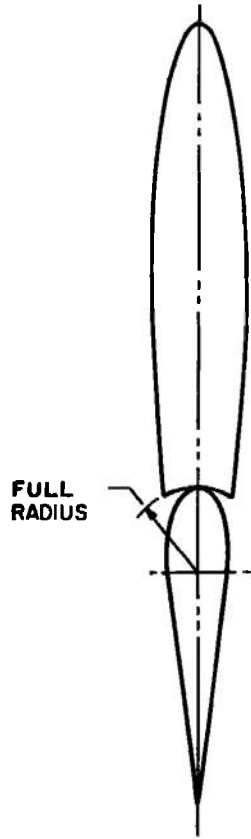
DIMENSIONS IN INCHES

b. Vertical Tail  
Fig. 4 Continued

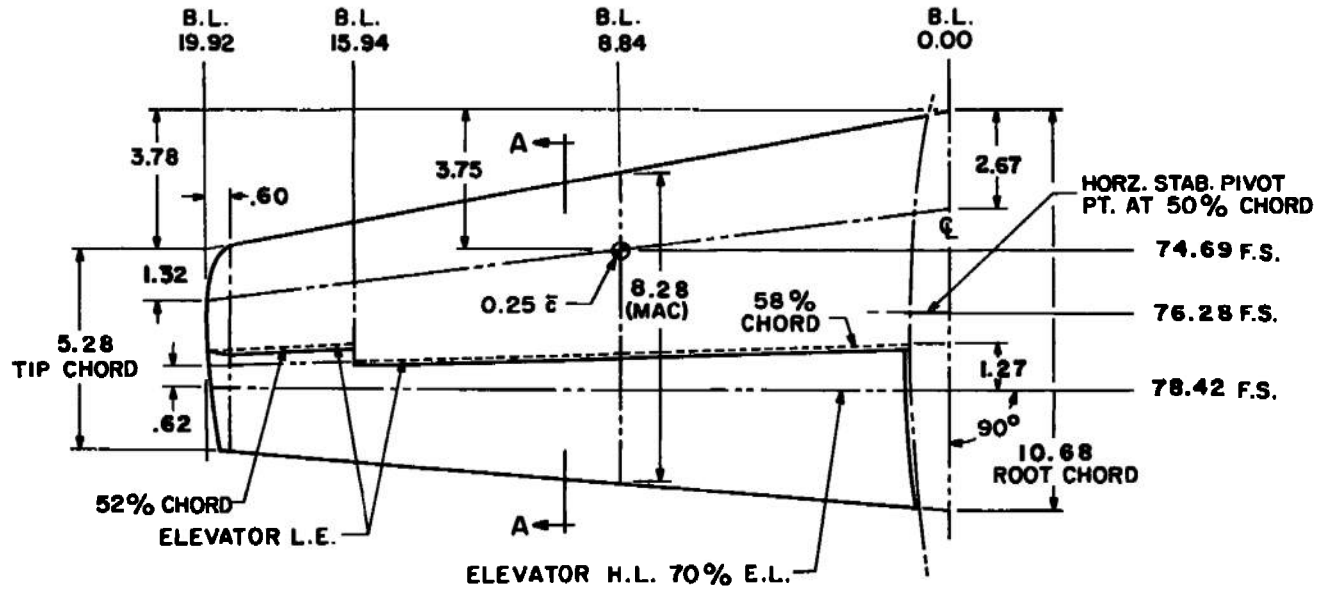


DIMENSIONS IN INCHES

c. Dorsal Fin  
Fig. 4 Continued



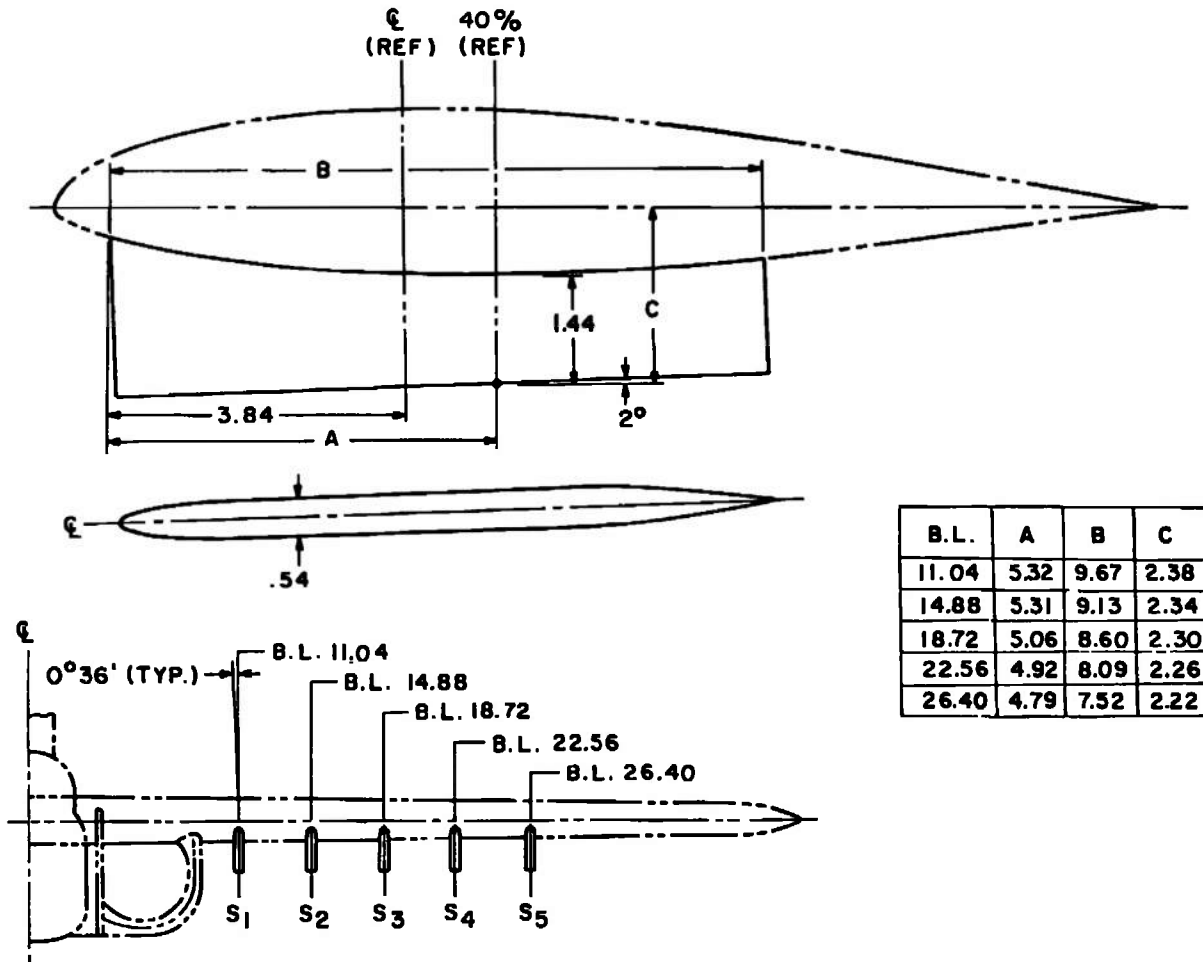
SECTION A-A



DIMENSIONS IN INCHES

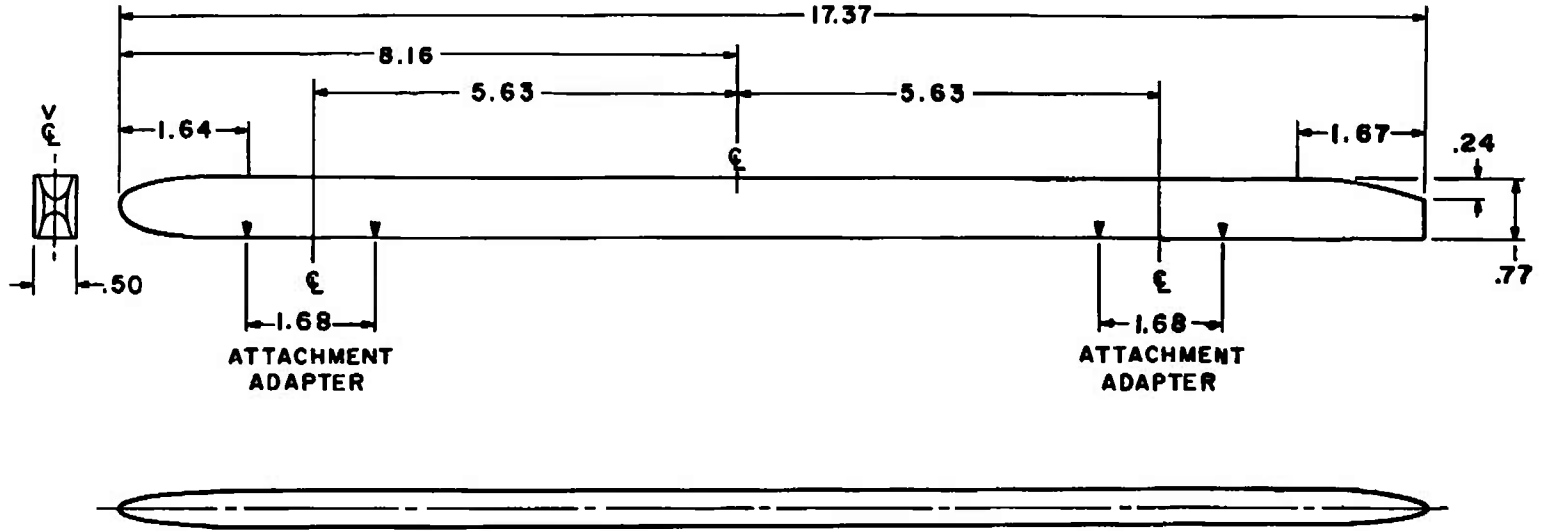


d. Horizontal Tail  
Fig. 4 Continued



DIMENSIONS IN INCHES

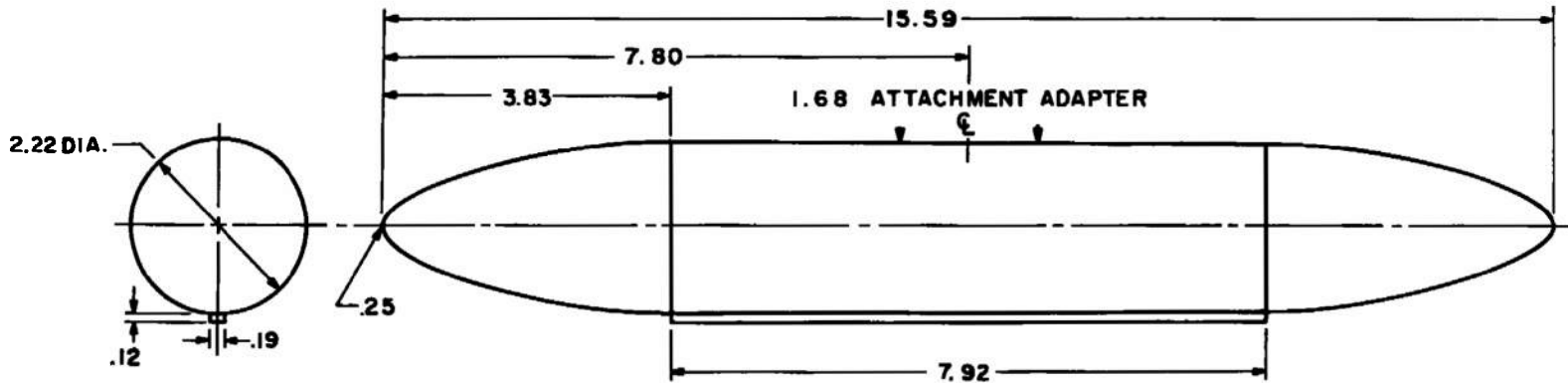
e. Wing Pylon Locations  
Fig. 4 Continued



DIMENSIONS IN INCHES

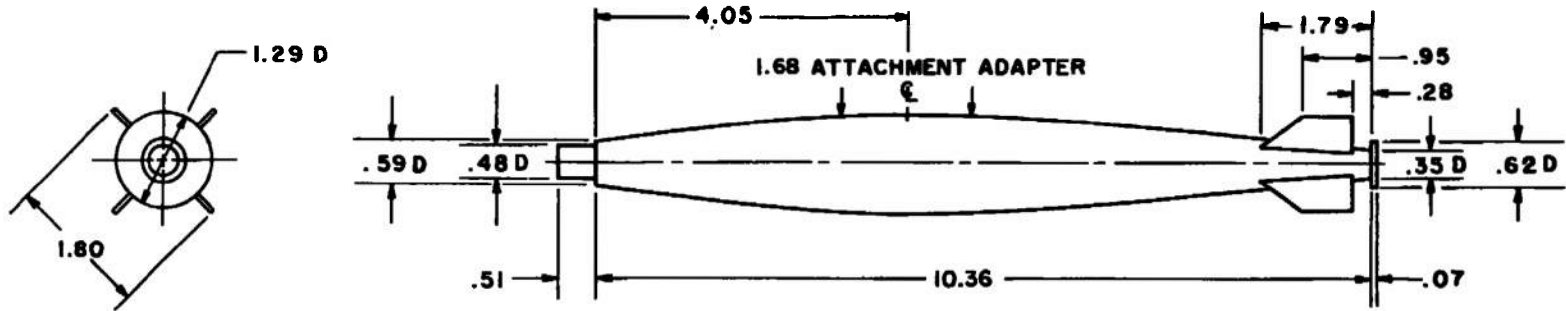
f. Pylon Extension Rack  
Fig. 4 Continued





DIMENSIONS IN INCHES

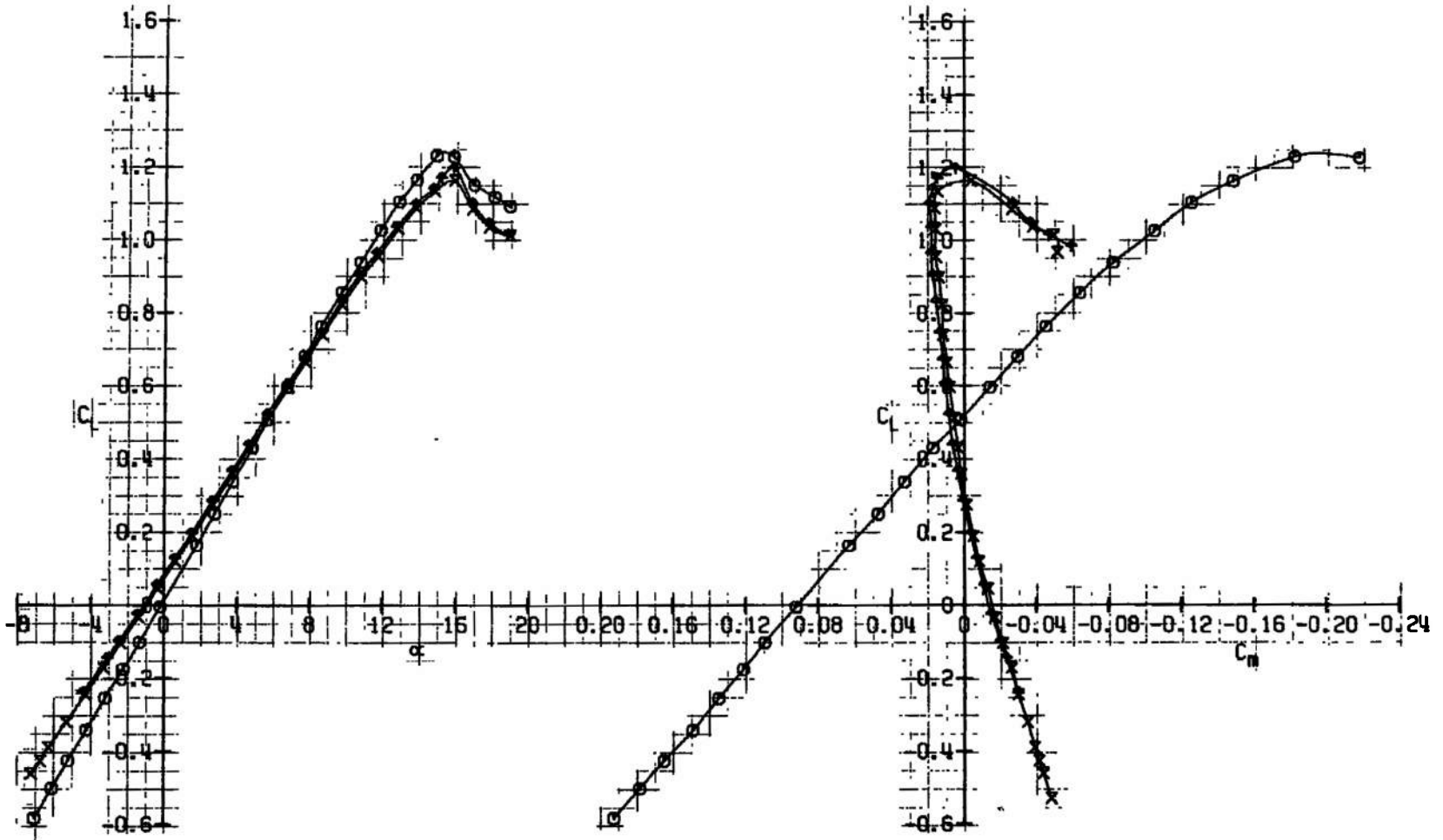
g. BLU-1/B  
Fig. 4 Continued



DIMENSIONS IN INCHES

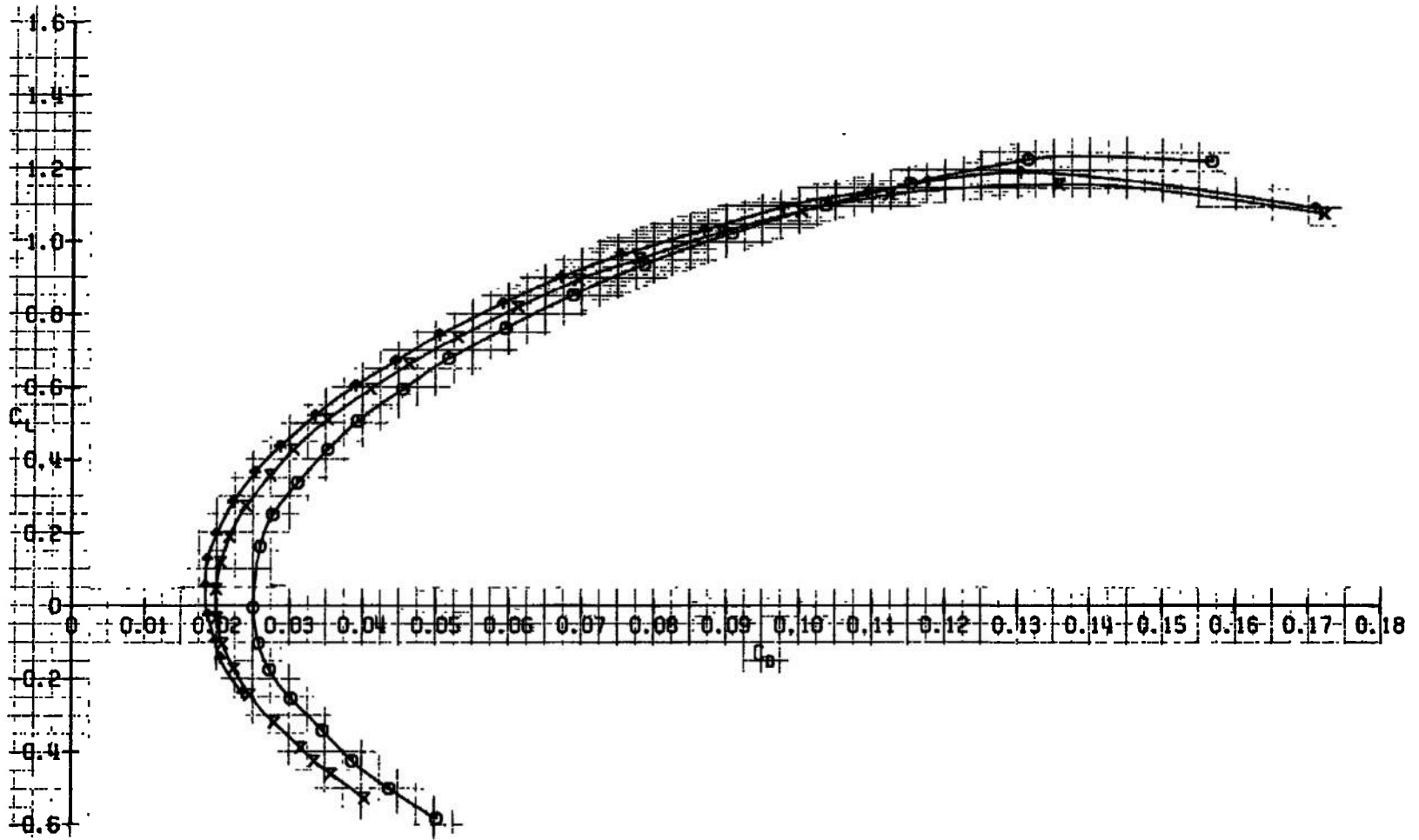
h. MK-82  
Fig. 4 Concluded

CONFIGURATION: $H_2, \alpha_2, \beta_1, H_2, \beta_2, C_2, H_2$									
SYM	CONFIGURATION	$N_{\alpha}$	$Re$	BETA	$\beta H$	$\beta F$	$\beta R$	$\beta C$	$\beta M$
+	$D_1 S_{1,5}$	0.30	2.3	0			0	0	427
X	$D_1 S_{1,5} - V_2 \beta_2 r_3$	0.30	2.3	0			0	0	337
O	$D_1 S_{1,5} - V_2 \beta_2 r_3 - H_2 \beta_2$	0.30	2.3	0	-2	0	0	0	46



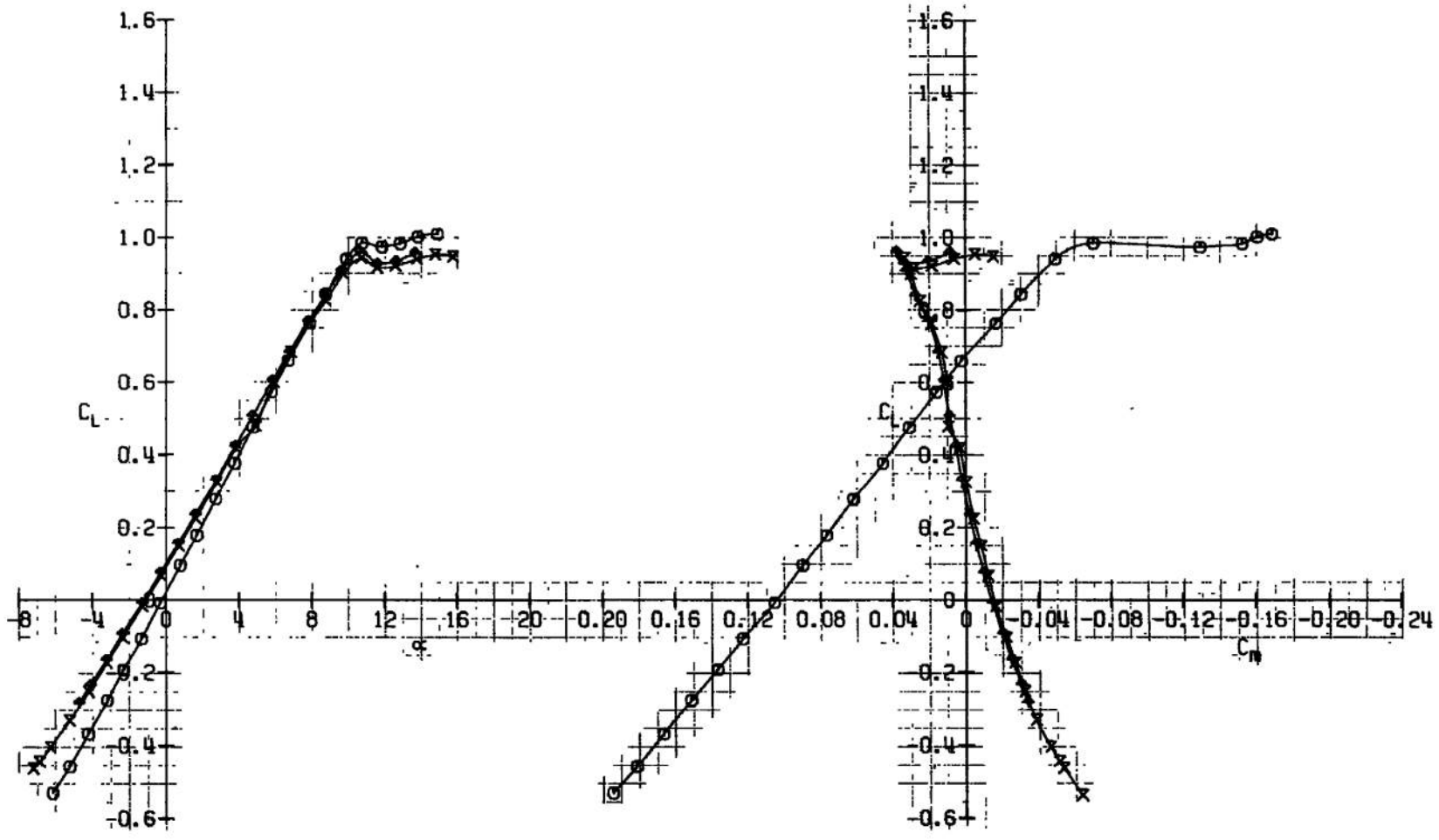
a.  $M_\infty = 0.30$   
 Fig. 5 Effect of Tail Components

CONFIGURATION: $H_2, O_2, H_2O, D_2, He, B_2, C_2, N_2$										
SYM	CONFIGURATION	$M_\infty$	$Re$	BETA	AM	AF	AP	APM	APD	PM
+	$D_2, S_{1,2}$	0.90	2.3	0	-	-	-	0	0	127
x	$D_2, S_{1,2}, V_2, O_2, S_2$	0.90	2.3	0	-	-	-	0	0	937
o	$D_2, S_{1,2}, V_2, O_2, S_2, H_2, He$	0.90	2.3	0	-	-	-	0	0	46



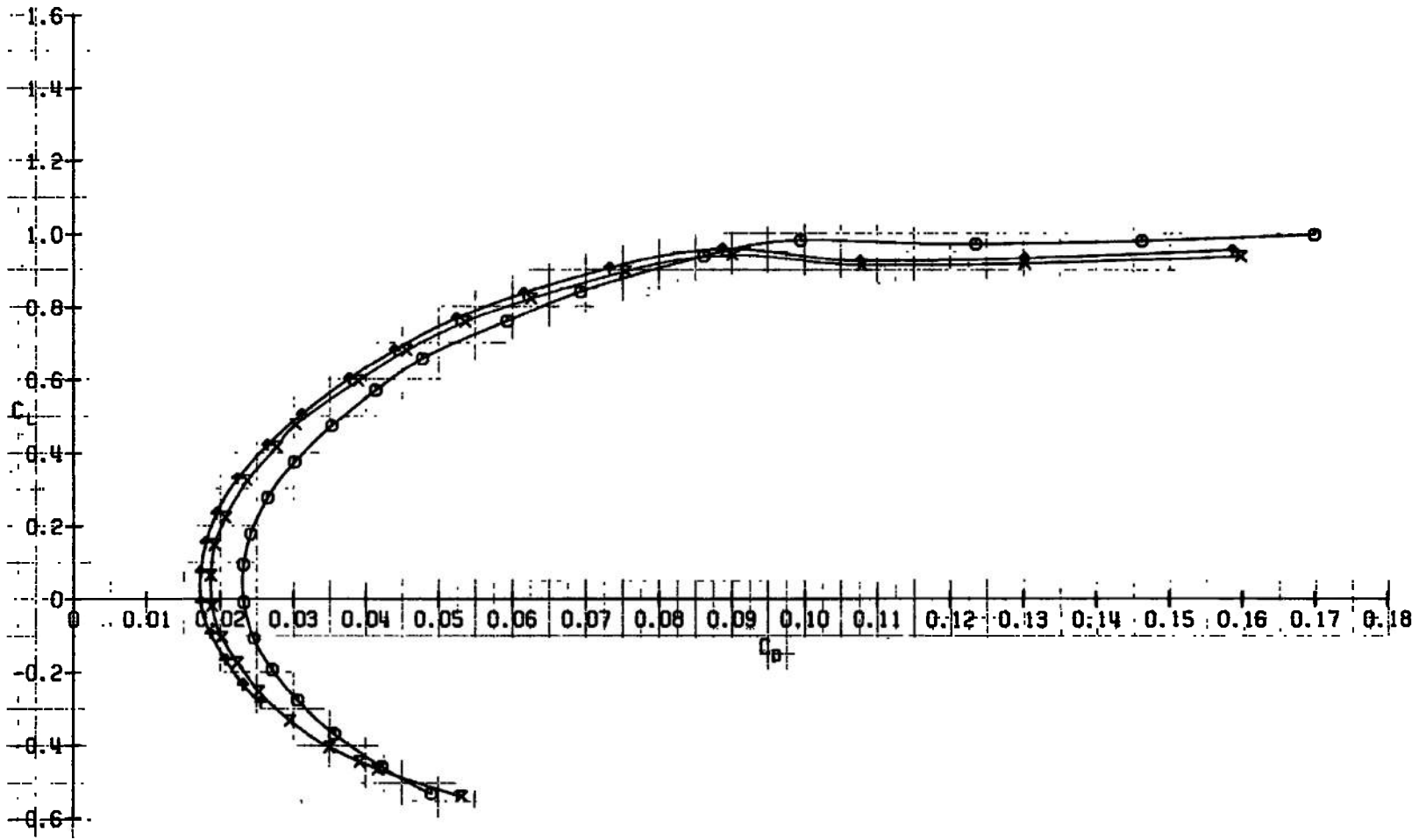
a. Concluded  
Fig. 5 Continued

CONFIGURATION: $W_3 e_3 b_4 r_3 B_3 C_2 N_3$		$M_\infty$	$Re$	BETA	GH	SE	FR	FL	SR	PM
SYM	CONFIGURATION +									
+	$D_6 S_{1.5}$	0.60	4.5	0				0	0	431
x	$D_6 S_{1.5} V_2 d_2 r_3$	0.60	4.5	-0				0	0	341
o	$D_6 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.60	4.5	0	-2	0	0	0	0	50



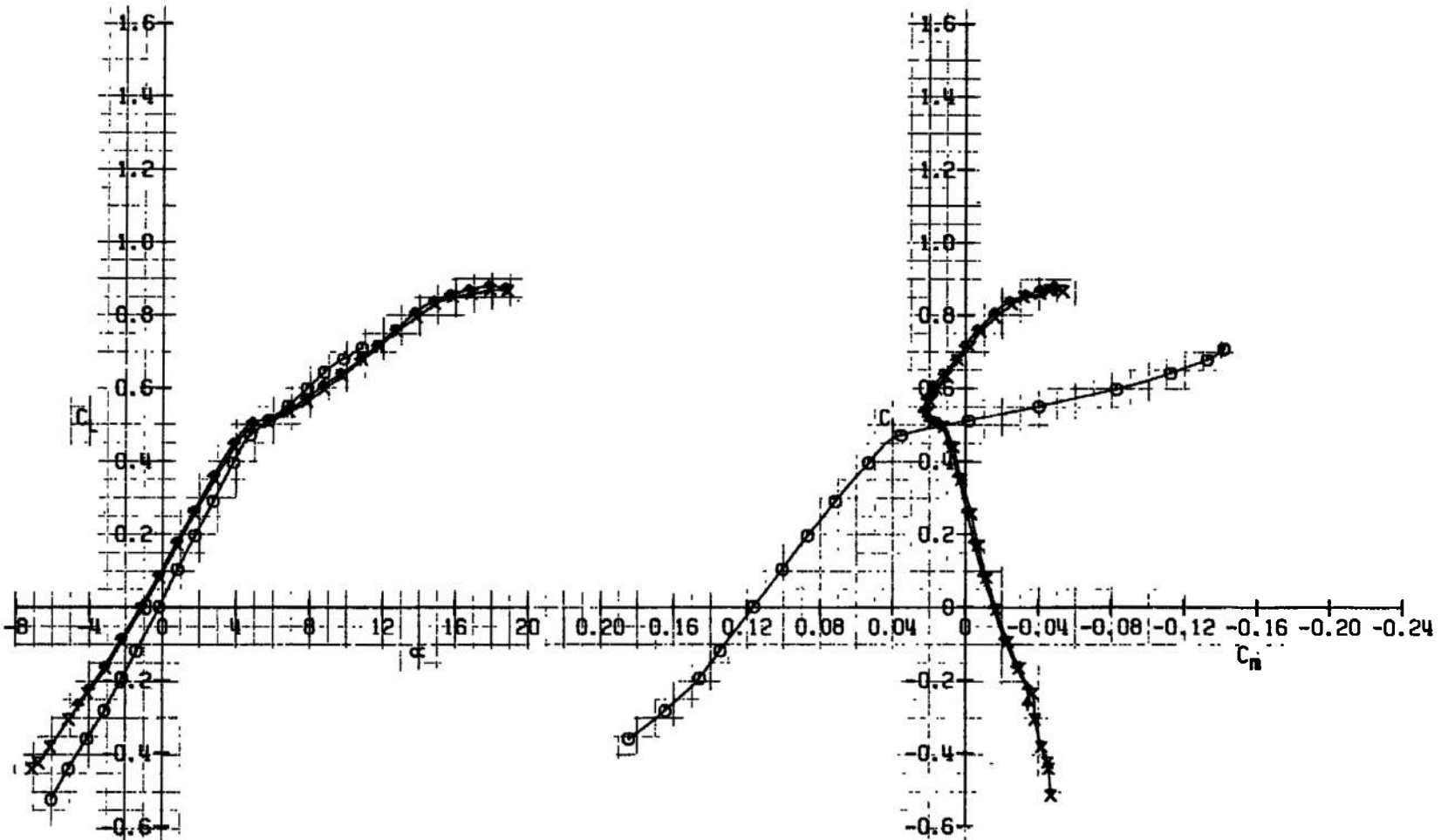
b.  $M_\infty = 0.60$   
Fig. 5 Continued

CONFIGURATION: $H_2, O_2, CO_2, H_2O, CO, C_2, N_2$										
SYM	CONFIGURATION	$M_\infty$	Re	BETA	$\Delta H$	$\Delta E$	$\Delta R$	$\Delta AL$	$\Delta B$	PM
+	$D_0 S_{1-s}$	0.60	4.5	0	—	—	—	0	0	43
x	$D_0 S_{1-s} V_2 d_2 r_2$	0.60	4.5	0	—	—	0	0	0	94
o	$D_0 S_{1-s} V_2 d_2 r_2 h_2 e_2$	0.60	4.5	0	-2	0	0	0	0	50



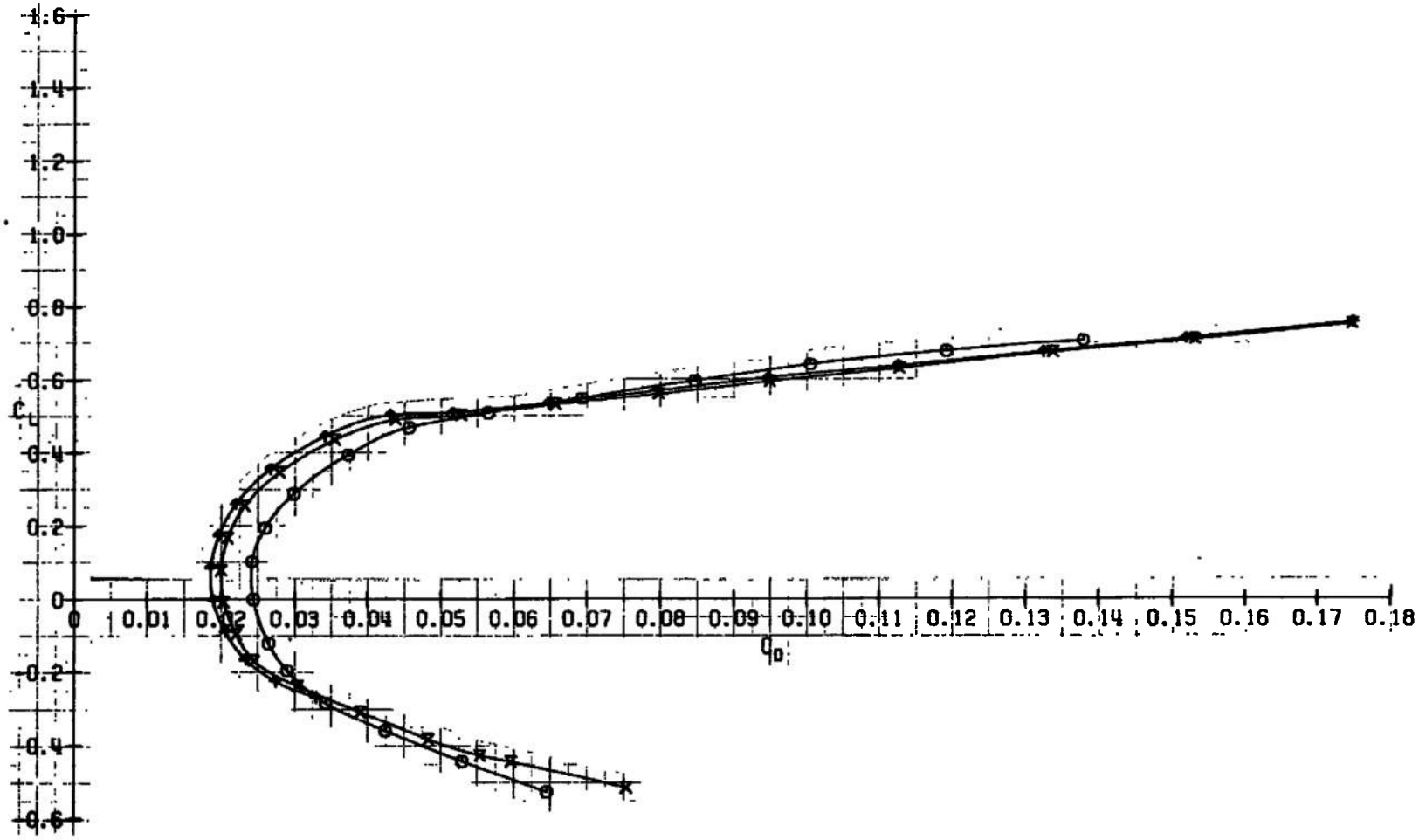
b. Concluded  
Fig. 5 Continued

CONFIGURATION: $H_1, \theta_1, H_2, \theta_2, H_3, \theta_3, C_2, H_3$													
SYM	CONFIGURATION	$M_\infty$	$Re$	BETA	$\theta_1$	$\theta_2$	$\theta_3$	$\theta_4$	$\theta_5$	$\theta_6$	$\theta_7$	$\theta_8$	PN
+	$D_0 S_{1,4}$	0.70	4.5	0						0	0	0	438
X	$D_0 S_{1,4} - V_2 d_0 r_3$	0.70	4.5	0						0	0	0	543
O	$D_0 S_{1,4} - V_2 d_0 r_3 H_3 \theta_3$	0.70	4.5	0	4	0	0	0	0	0	0	0	52



c.  $M_\infty = 0.70$   
Fig. 5 Continued

CONFIGURATION: $H_2$ $e_3$ $D_1$ $H_2$ $H_2$ $D_2$ $N_2$		$M_\infty$	$Re$	BETA	MI	ME	MR	ML	MR	PM
+	$D_2 S_{1.5}$	0.70	4.5	0	-	-	0	0	0	435
x	$D_2 S_{1.5} V_2 D_2 r_3$	0.70	4.5	0	-	-	0	0	0	345
o	$D_2 S_{1.5} V_2 D_2 r_3 H_2 e_3$	0.70	4.5	0	-2	0	0	0	0	52

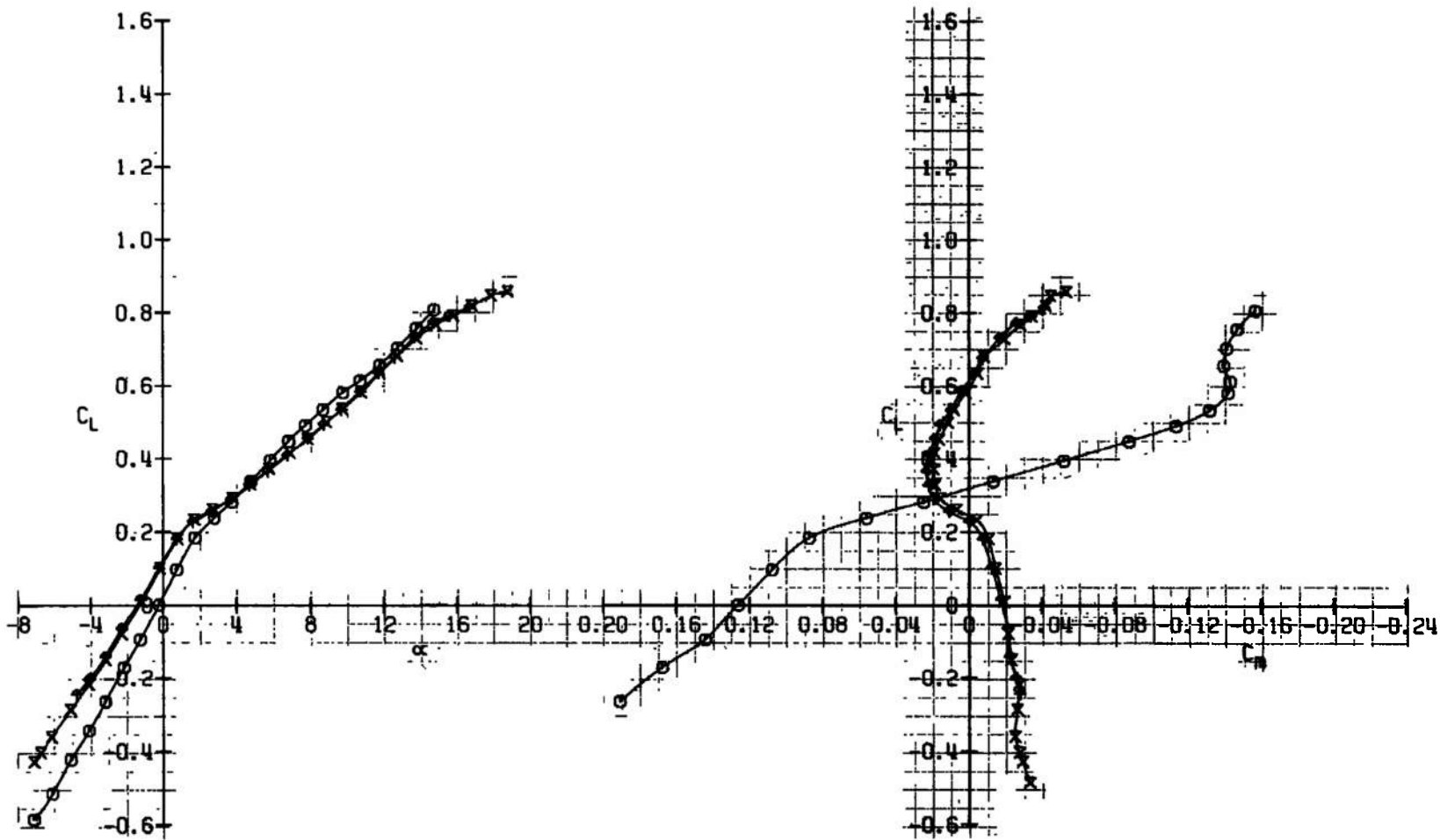


c. Concluded  
Fig. 5 Continued



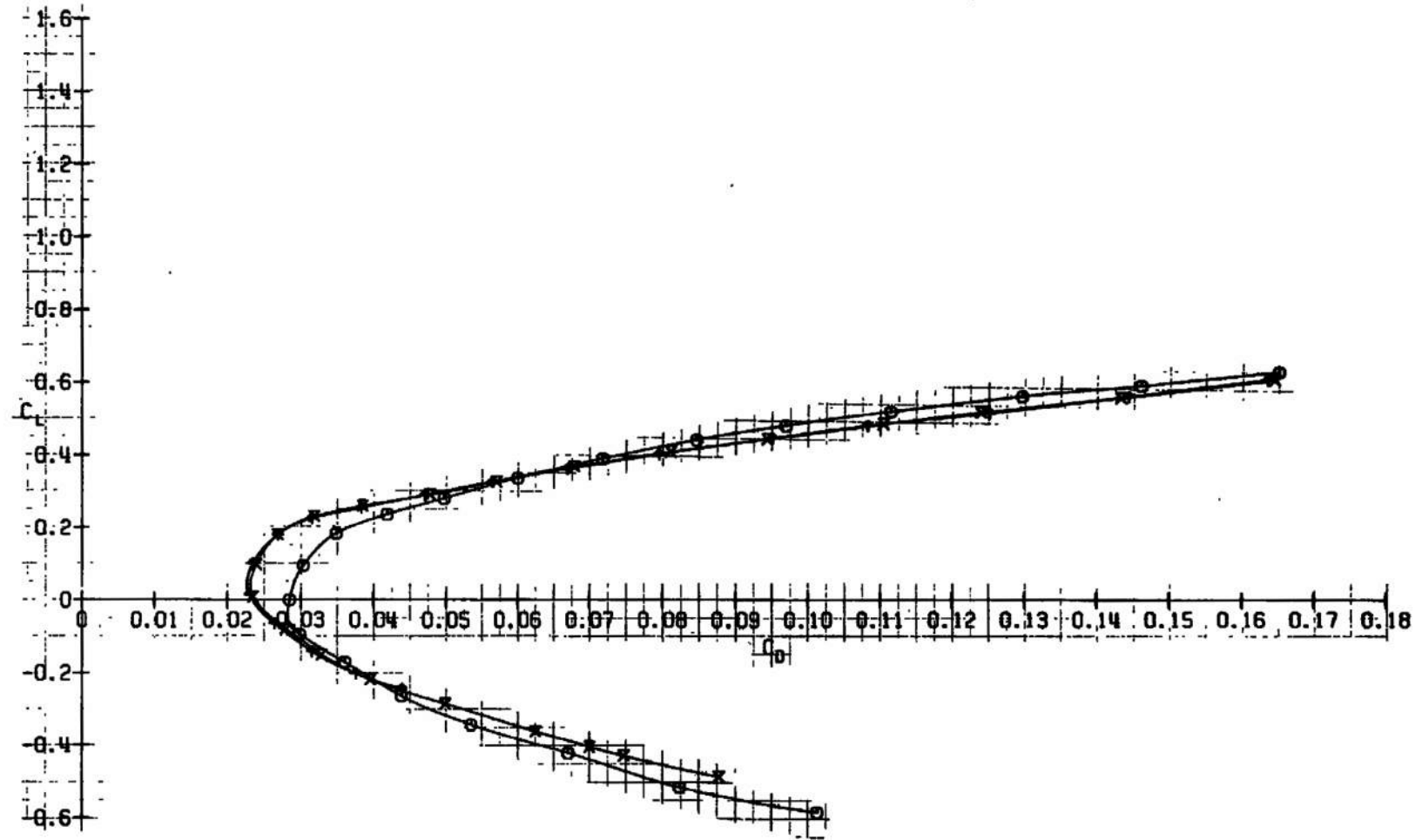
CONFIGURATION:  $H_3 O_3 D_4 r_3 H_3 O_3 C_2 N_3$

SYM	CONFIGURATION	M <sub>∞</sub>	Re	BETR	α1	αF	αR	αB	αB	PM
+	$D_0 S_{1-5}$	0.75	4.5	0			0	0	0	435
x	$D_0 S_{1-6} V_2 d_2 r_2$	0.75	4.5	0			0	0	0	345
o	$D_0 S_{1-6} V_2 d_2 r_2 H_3 O_3$	0.75	4.5	0	2	0	0	0	0	54



d.  $M_\infty = 0.75$   
 Fig. 5 Continued

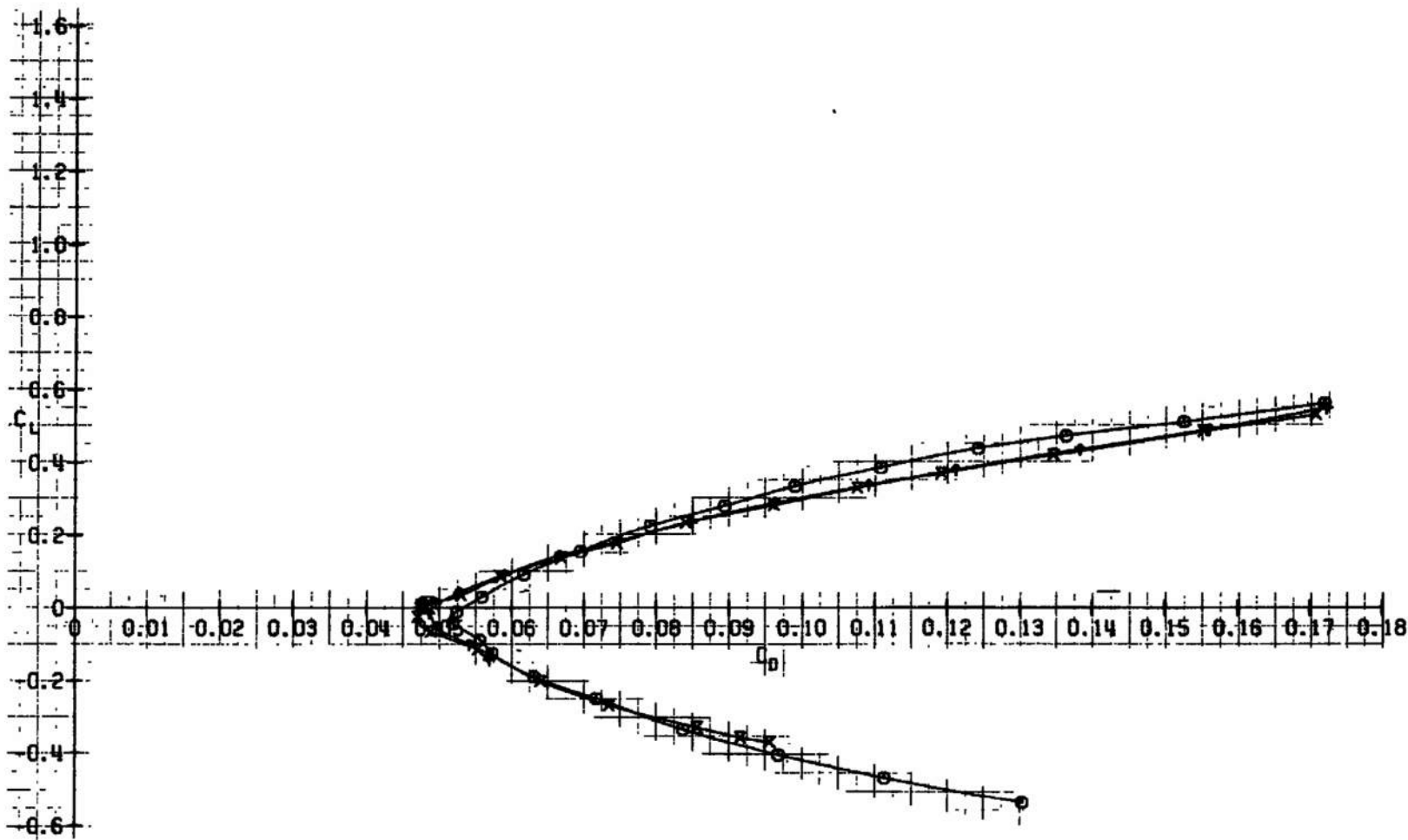
CONFIGURATION: $V_2$ $D_0$ $S_{1-3}$ $V_2$ $D_0$ $S_{1-3}$		$M_\infty$	$Re$	BETA	$\theta_1$	$\theta_2$	$\theta_3$	$\theta_4$	$\theta_5$	$\theta_6$	$\theta_7$	$\theta_8$	$\theta_9$	$\theta_{10}$
+	$D_0 S_{1-3}$	0.75	4:5	0				0	0	0	0	0	0	135
x	$D_0 S_{1-3} V_2$	0.75	4:5	0				0	0	0	0	0	0	135
o	$D_0 S_{1-3} V_2$	0.75	4:5	0	2	0	0	0	0	0	0	0	0	5



d. Concluded  
Fig. 5 Continued



SYN.	CONFIGURATION	$M_\infty$	$Re$	BETA	$\alpha$	$\beta$	$\gamma$	$\delta$	$\epsilon$	$\zeta$	$\eta$	$\theta$
+	$D_0 S_{1,5}$	0.80	4.5	0					0	0	0	4.97
x	$D_0 S_{1,5} V_2 d_2 r_3$	0.80	4.5	0					0	0	0	5.97
o	$D_0 S_{1,5} V_2 d_2 r_3 H_2 c_1$	0.80	4.5	0	-2	0	0	0	0	0	0	5.97

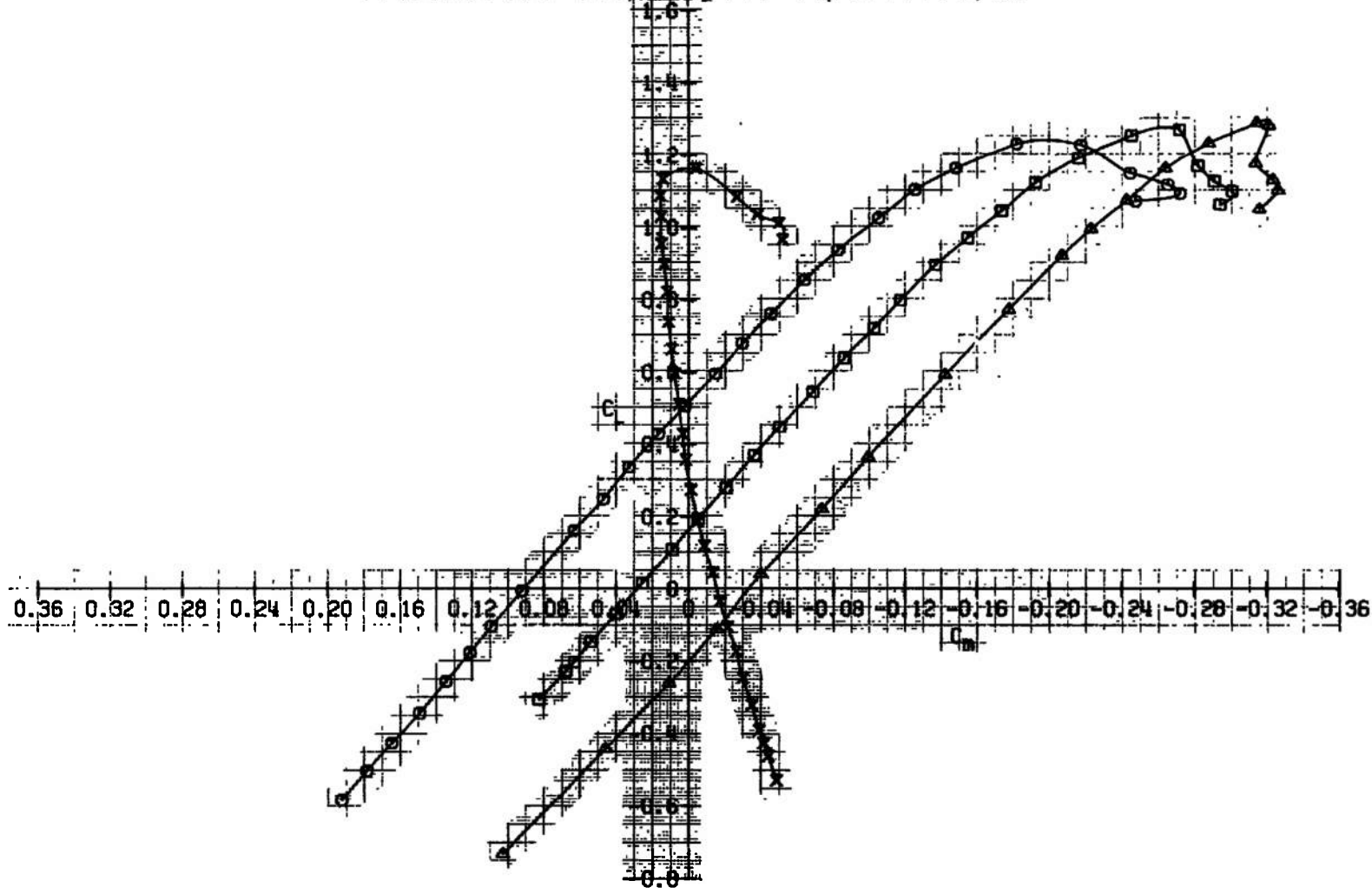


e. Concluded  
Fig. 5 Concluded



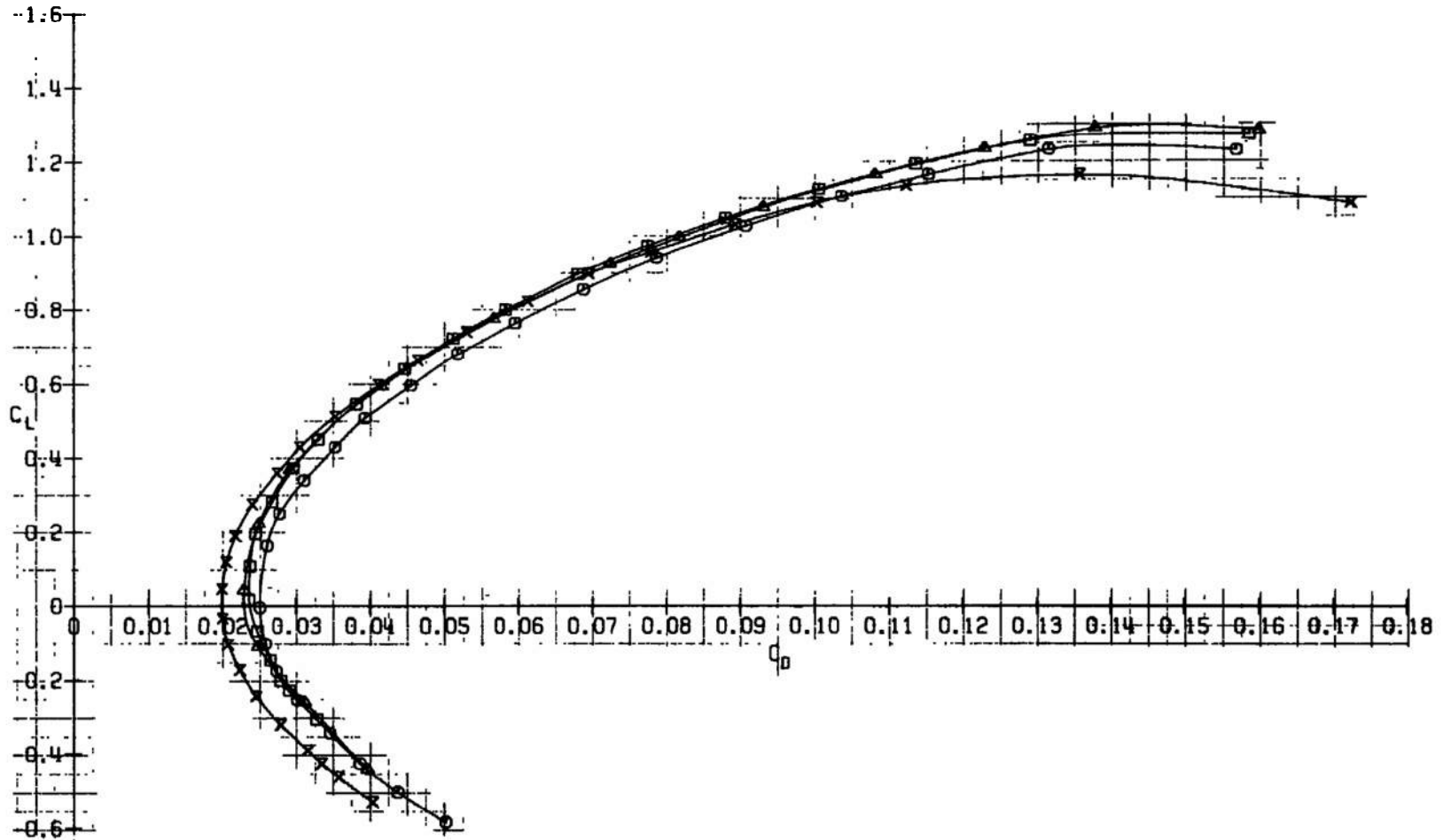
CONFIGURATION:  $V_0, \theta_0, r_0, h_0, \theta_3, C_2, N_3$

SYM	CONFIGURATION	$M_\infty$	$Re$	BETR	$\alpha_1$	$\alpha_2$	$\alpha_3$	$\alpha_4$	$\alpha_5$	$\alpha_6$	$\alpha_7$
X	$D_0 S_{1,6} V_0 \theta_0 r_0$	0.80	2.30	0.0	0	0	0	0	0	0	937
○	$D_0 S_{1,6} V_0 \theta_0 r_0 h_0 \theta_3$	0.80	2.30	0.0	2	0	0	0	0	0	94
□	$D_0 S_{1,6} V_0 \theta_0 r_0 h_0 \theta_3 N_3$	0.80	2.30	0.0	0	0	0	0	0	0	927
△	$D_0 S_{1,6} V_0 \theta_0 r_0 h_0 \theta_3 N_3$	0.80	2.30	0.0	2	0	0	0	0	0	919



a. Continued  
Fig. 6 Continued

CONFIGURATION: $W_3 e_3 h_4 h_5 h_6 B_3 C_2 N_3$											
SYM	CONFIGURATION		$M_{sp}$	$Re$	BETB	$\phi H$	$\phi E$	$\phi R$	$\phi AL$	$\phi B$	PN
X	$D_6 S_{1-5}$	$V_2 d_2 r_3$	0.90	2.30	0.0	+	-	0	0	0	337
O	$D_6 S_{1-5}$	$V_2 d_2 r_3 h_3 e_3$	0.90	2.30	0.0	-2	0	0	0	0	46
□	$D_6 S_{1-5}$	$V_2 d_2 r_3 h_3 e_3$	0.90	2.30	0.0	0	0	0	0	0	327
△	$D_6 S_{1-5}$	$V_2 d_2 r_3 h_3 e_3$	0.90	2.30	0.0	+2	0	0	0	0	318

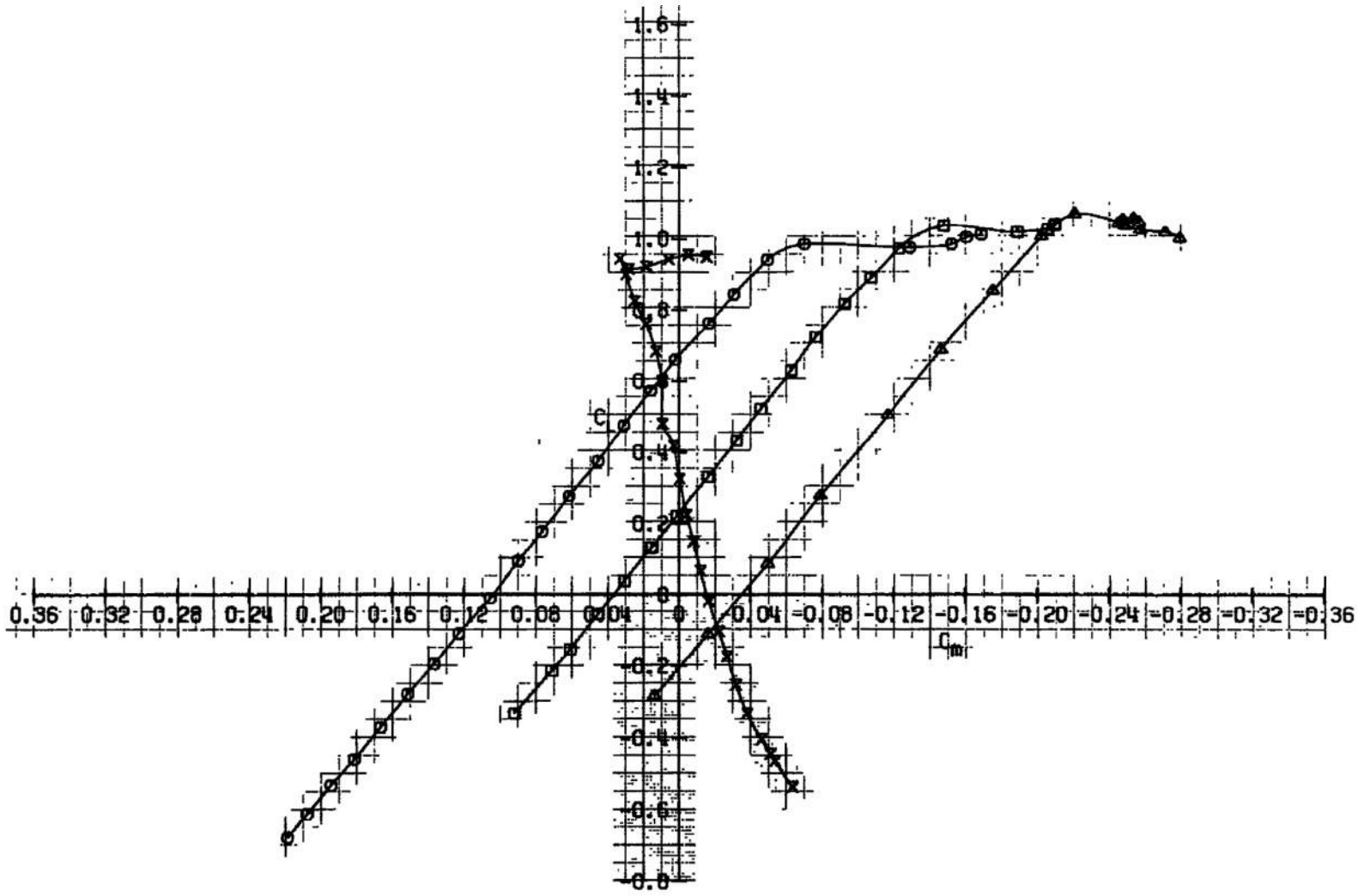


a. Concluded  
Fig. 6 Continued

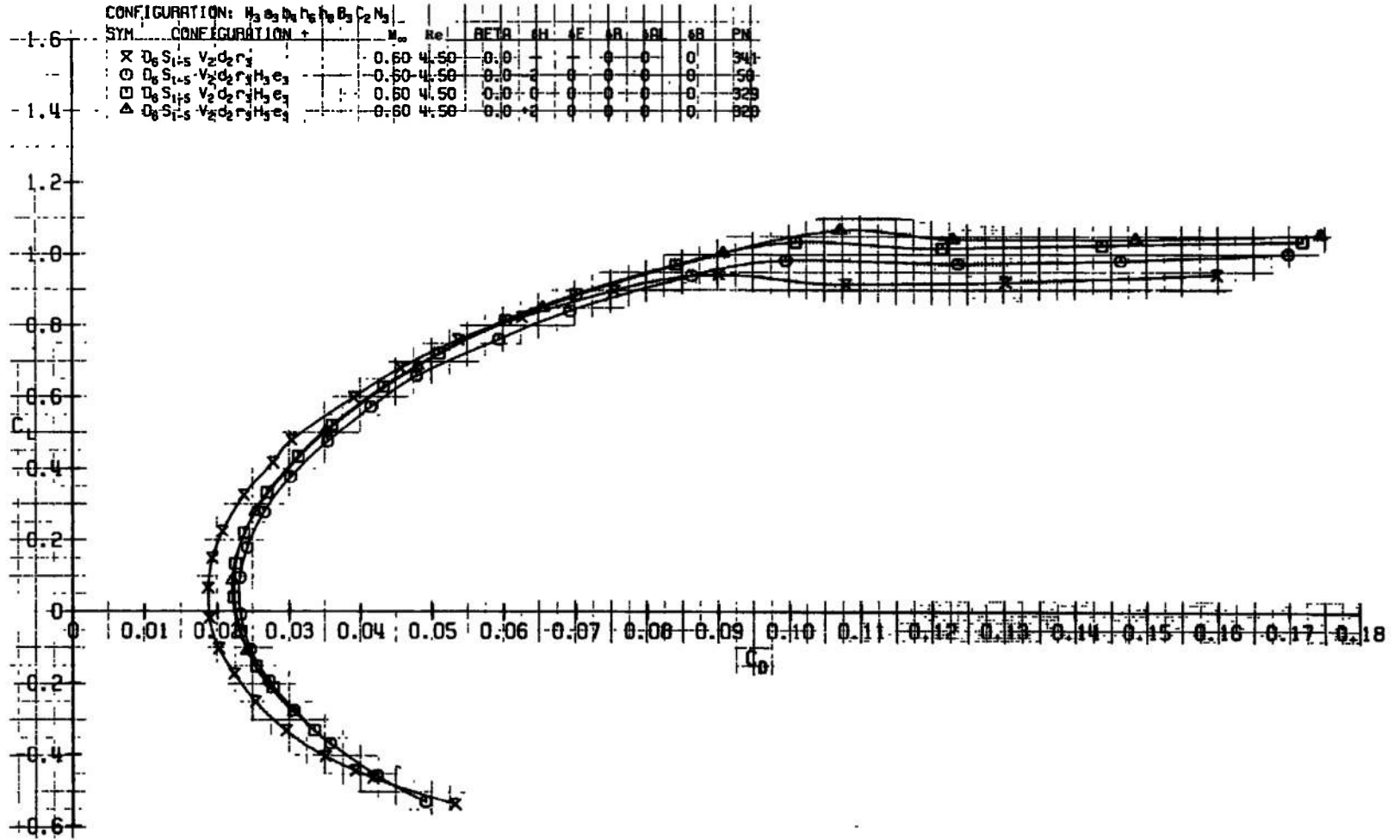




CONFIGURATION: $H_2 O_2 H_2 H_2 H_2 B_2 C_2 N_2$		$M_\infty$	Re	GETP	41	4E	4N	4OL	48	PN
SYN	CONFIGURATION									
X	$D_6 S_{115} V_2 d_2 r_3$	0.60	4.50	0.0	2	0	0	0	0	341
O	$D_6 S_{115} V_2 d_2 r_3 H_2 e_3$	0.60	4.50	0.0	2	0	0	0	0	50
U	$D_6 S_{115} V_2 d_2 r_3 H_2 e_3$	0.60	4.50	0.0	0	0	0	0	0	329
Δ	$D_6 S_{115} V_2 d_2 r_3 H_2 e_3$	0.60	4.50	0.0	2	0	0	0	0	320

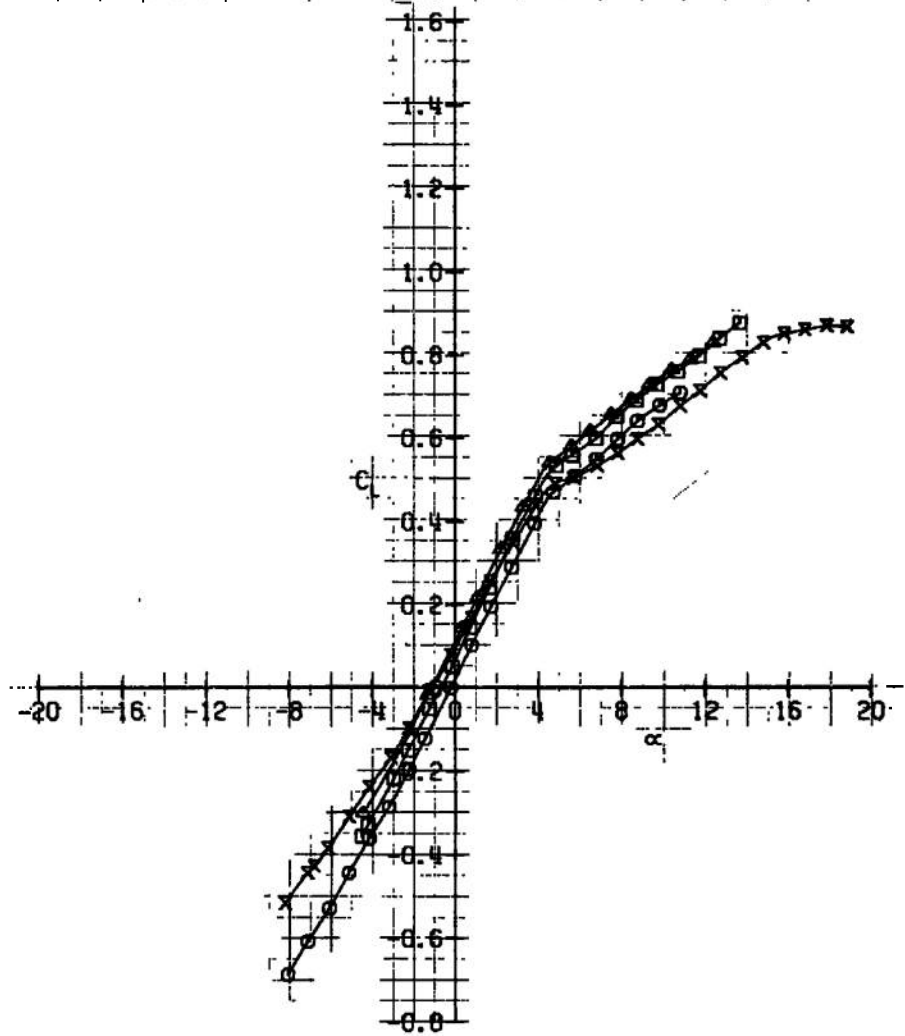


b. Continued  
Fig. 6 Continued



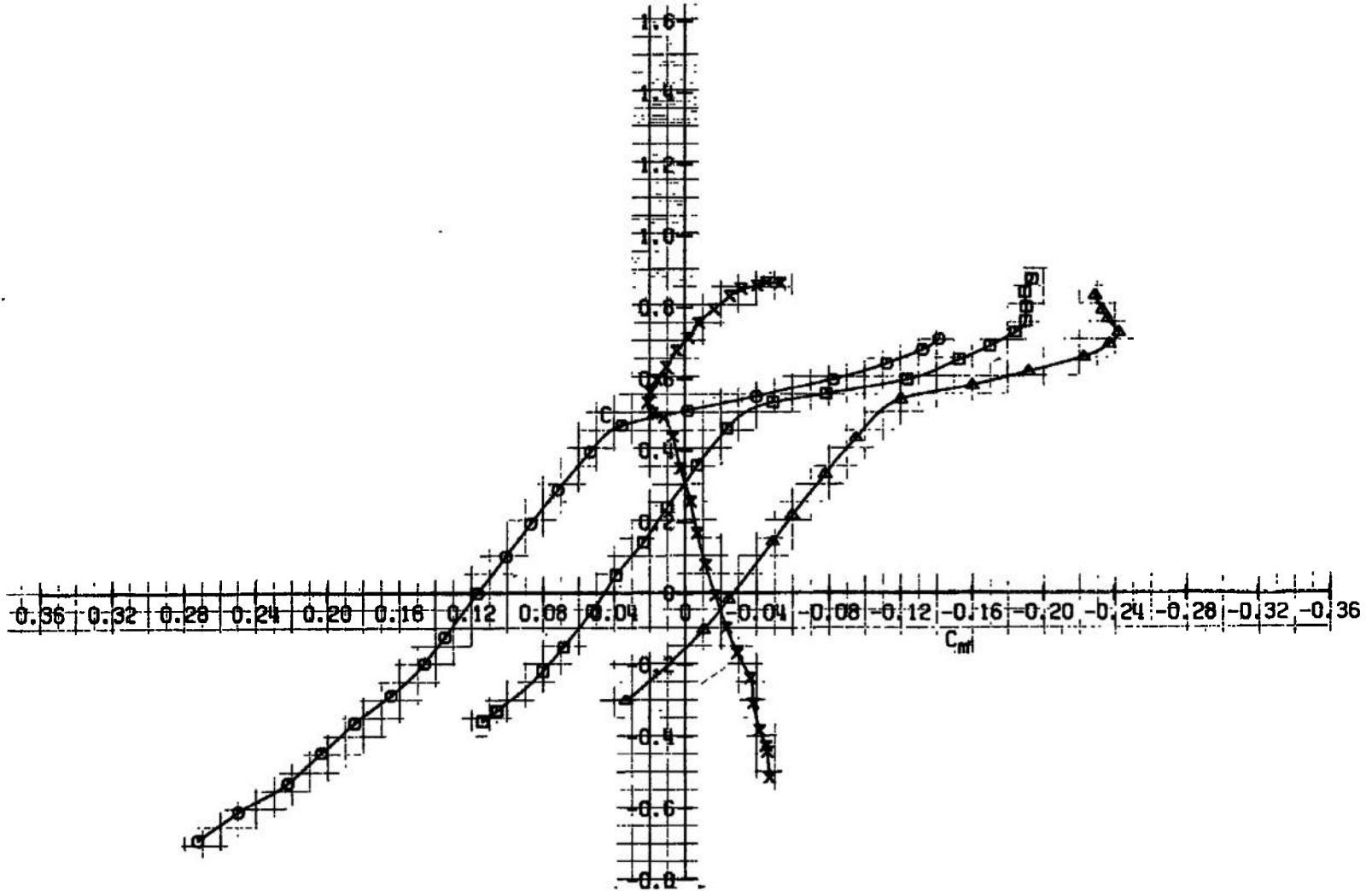
b. Concluded  
Fig. 6 Continued

SYMBOL	CONFIGURATION	$M_\infty$	Re	BETA	#1	#E	#B	#PL	#B	PN
X	D <sub>0</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub>	0.70	4,50	0.0	0	0	0	0	0	549
O	D <sub>0</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	0.70	4,50	0.0	-2	0	0	0	0	52
□	D <sub>0</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	0.70	4,50	0.0	0	0	0	0	0	530
△	D <sub>0</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	0.70	4,50	0.0	-2	0	0	0	0	521



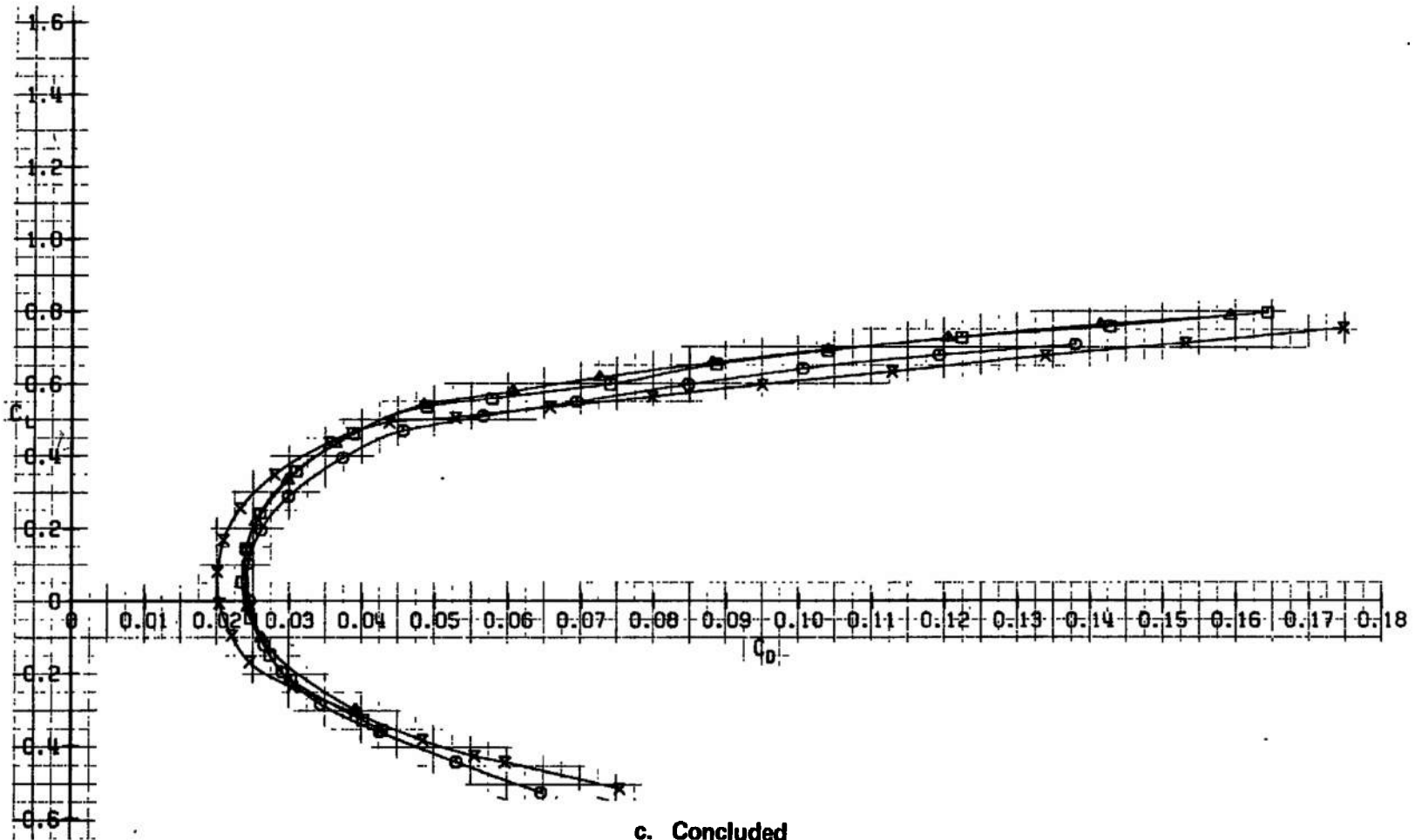
c.  $M_\infty = 0.70$   
 Fig. 6 Continued

CONFIGURATION: $H_2, O_2, N_2, CO_2, H_2O$		$M_\infty$	Re	BETA	$\alpha_1$	$\alpha_2$	$\alpha_3$	$\alpha_4$	$\alpha_5$
SYM	CONFIGURATION								
○	$D_0 S_{1,2} V_2 d_2 r_3$	0.70	4.50	0.0	0	0	0	0	0
□	$D_0 S_{1,2} V_2 d_2 r_3 H_2 e_3$	0.70	4.50	0.0	0	0	0	0	0
△	$D_0 S_{1,2} V_2 d_2 r_3 H_2 e_3$	0.70	4.50	0.0	0	0	0	0	0



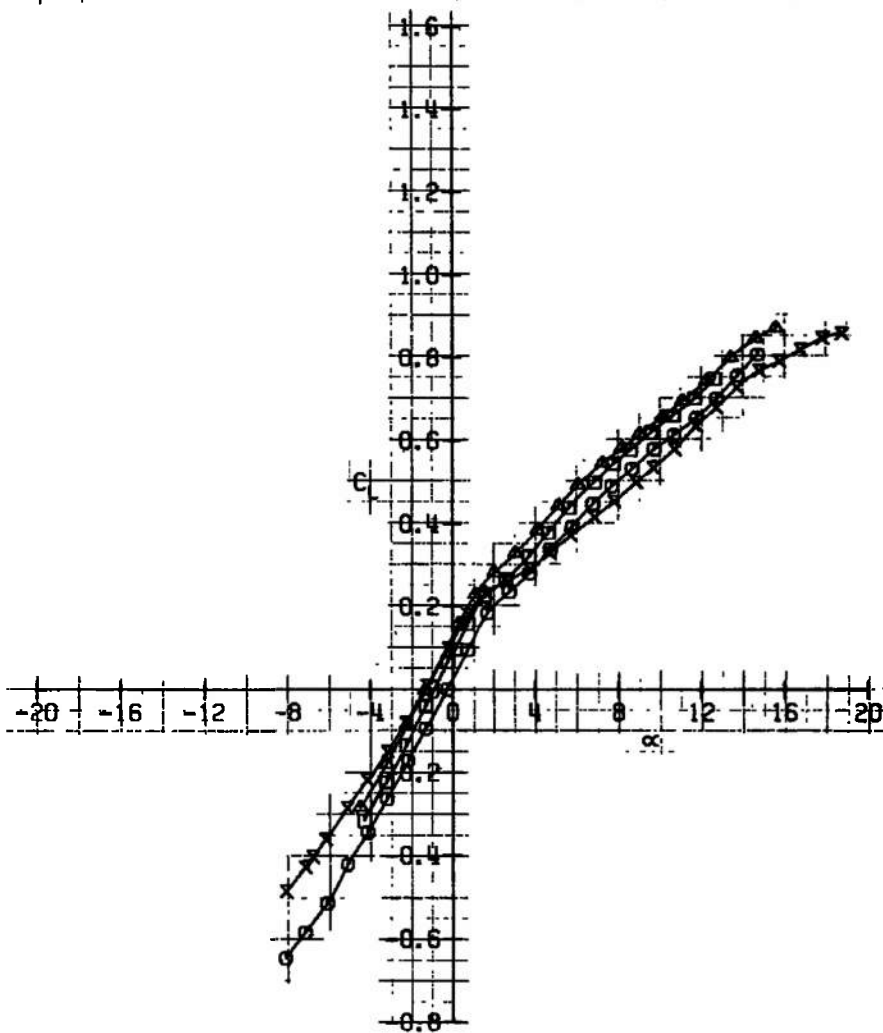
c. Continued  
Fig. 6 Continued

SYN	CONF	LIBRATION	$M_0$	Re	BETA	ΔH	ΔF	ΔR	ΔBL	ΔB	FN
X	D <sub>5</sub> S <sub>11</sub> S	V <sub>2</sub> D <sub>2</sub> R <sub>1</sub>	0.70	4.50	0.0	-	-	0	0	0	343
○	D <sub>5</sub> S <sub>11</sub> S	V <sub>2</sub> D <sub>2</sub> R <sub>1</sub> M <sub>3</sub> C <sub>1</sub>	0.70	4.50	0.0	-2	-	0	0	0	52
□	D <sub>5</sub> S <sub>11</sub> S	V <sub>2</sub> D <sub>2</sub> R <sub>1</sub> M <sub>3</sub> C <sub>1</sub>	0.70	4.50	0.0	0	0	0	0	0	330
△	D <sub>5</sub> S <sub>11</sub> S	V <sub>2</sub> D <sub>2</sub> R <sub>1</sub> M <sub>3</sub> C <sub>1</sub>	0.70	4.50	0.0	-2	-	0	0	0	321



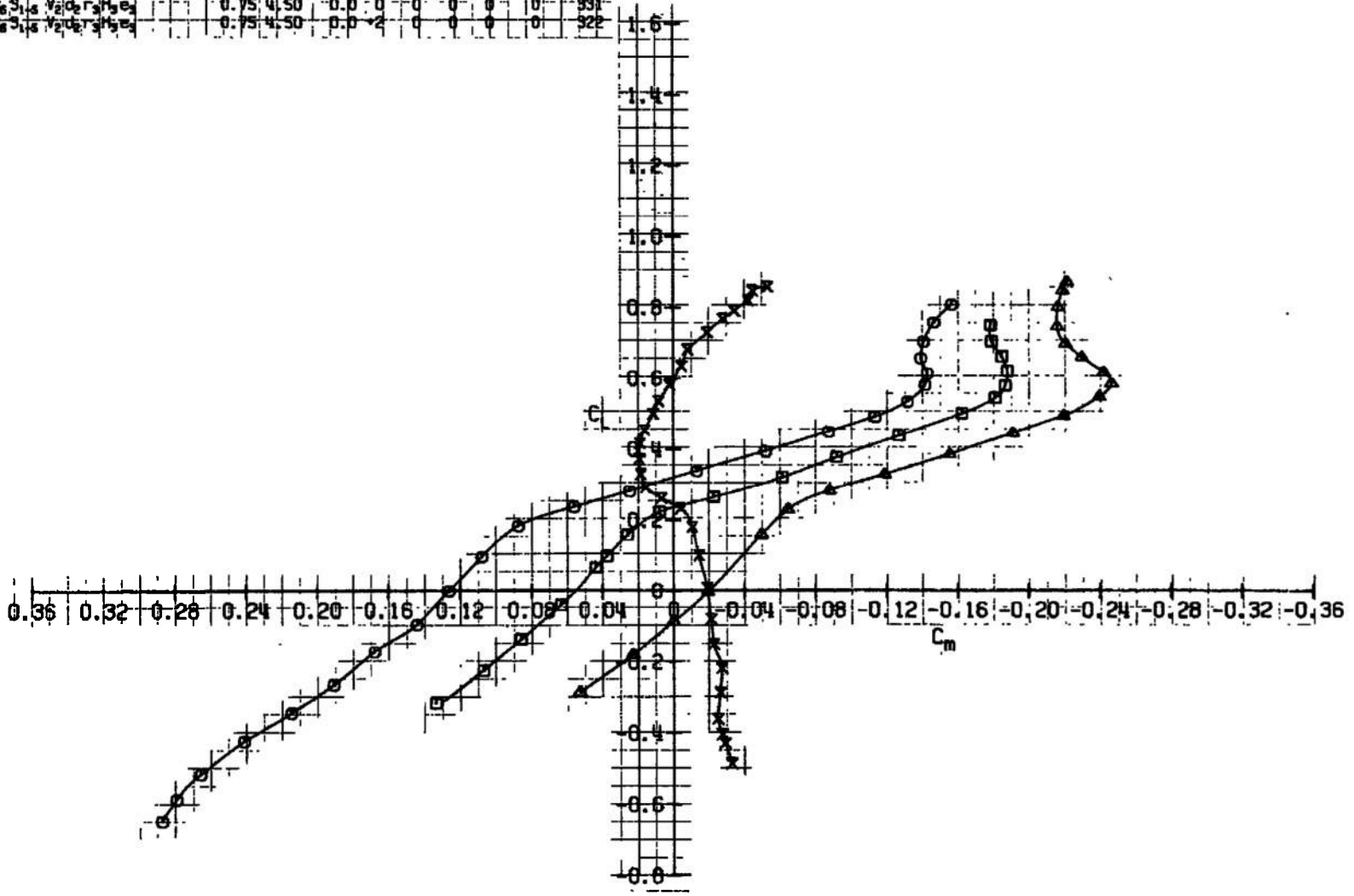
c. Concluded  
Fig. 6 Continued

CONFIGURATION: $W_3 a_3 b_4 h_5 h_6 B_3 C_2 N_3$				$M_{\infty}$	Re	BETA	AM	AE	AR	AL	AR	PR
SYM	CONFIGURATION +											
X	$D_6$	$S_{1-5}$	$V_2 d_2 r_3$	0.75	4.50	0.0	-	-	0	0	0	345
O	$B_3$	$S_{1-5}$	$V_2 d_2 r_3 h_3 e_3$	0.75	4.50	0.0	-2	0	0	0	0	54
□	$D_6$	$S_{1-5}$	$V_2 d_2 r_3 h_3 e_3$	0.75	4.50	0.0	0	0	0	0	0	331
△	$D_6$	$S_{1-5}$	$V_2 d_2 r_3 h_3 e_3$	0.75	4.50	0.0	-2	0	0	0	0	322



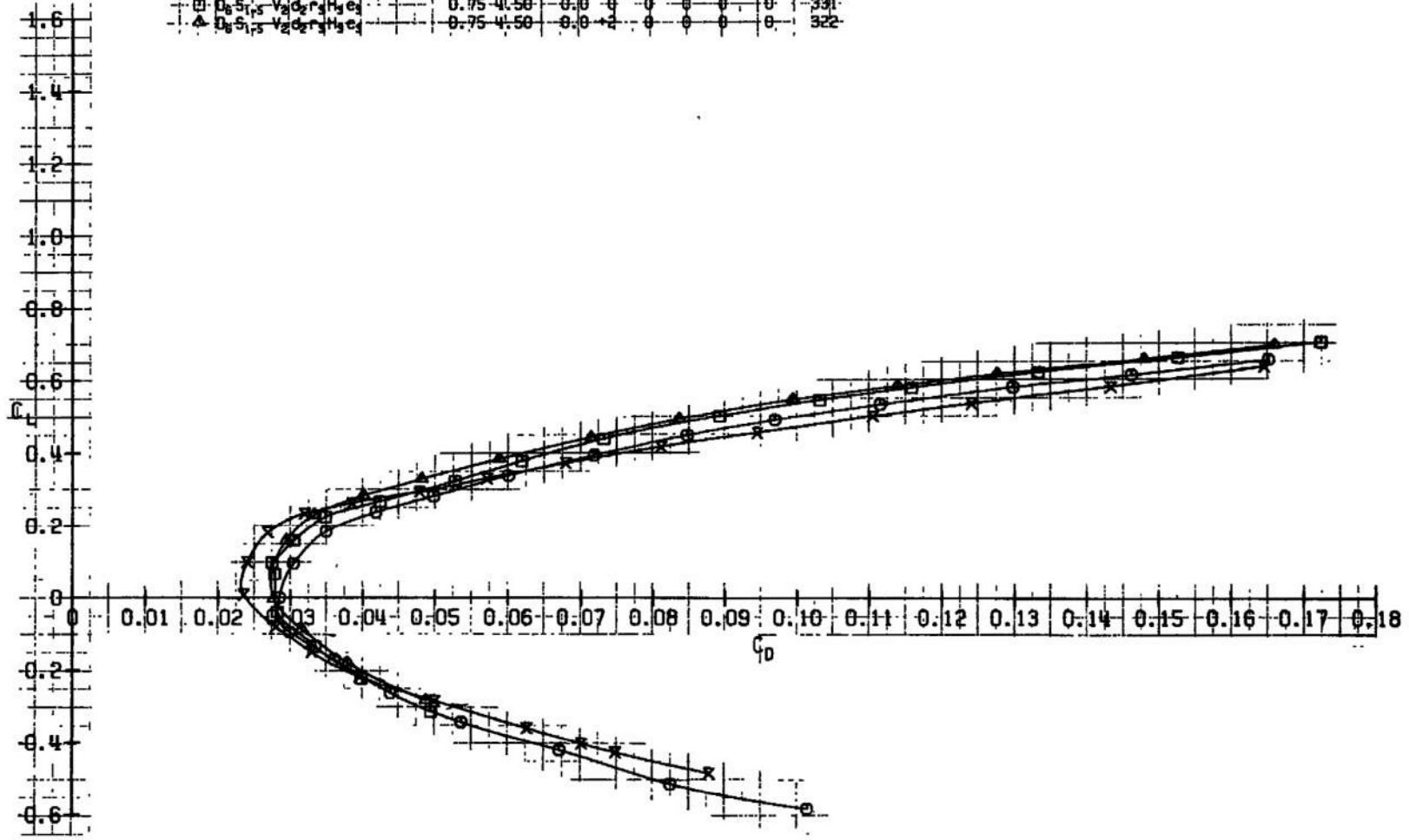
d.  $M_{\infty} = 0.75$   
 Fig. 6 Continued

CONFIGURATION: $H_2 O_2 C_1 H_2 H_2 B_3 C_2 N_3$												
SYM	CONFIGURATION				$M_\infty$	$Re$	BETA	$\alpha$	$\epsilon$	$\delta$	$\theta$	$\beta$
K	$D_1$	$S_1$	$V_2$	$C_1$	0.75	450	0.0	2	0	0	0	915
Q	$D_1$	$S_1$	$V_2$	$C_1$	0.75	450	0.0	2	0	0	0	915
Q	$D_1$	$S_1$	$V_2$	$C_1$	0.75	450	0.0	2	0	0	0	933
Q	$D_1$	$S_1$	$V_2$	$C_1$	0.75	450	0.0	2	0	0	0	922



d. Continued  
Fig. 6 Continued

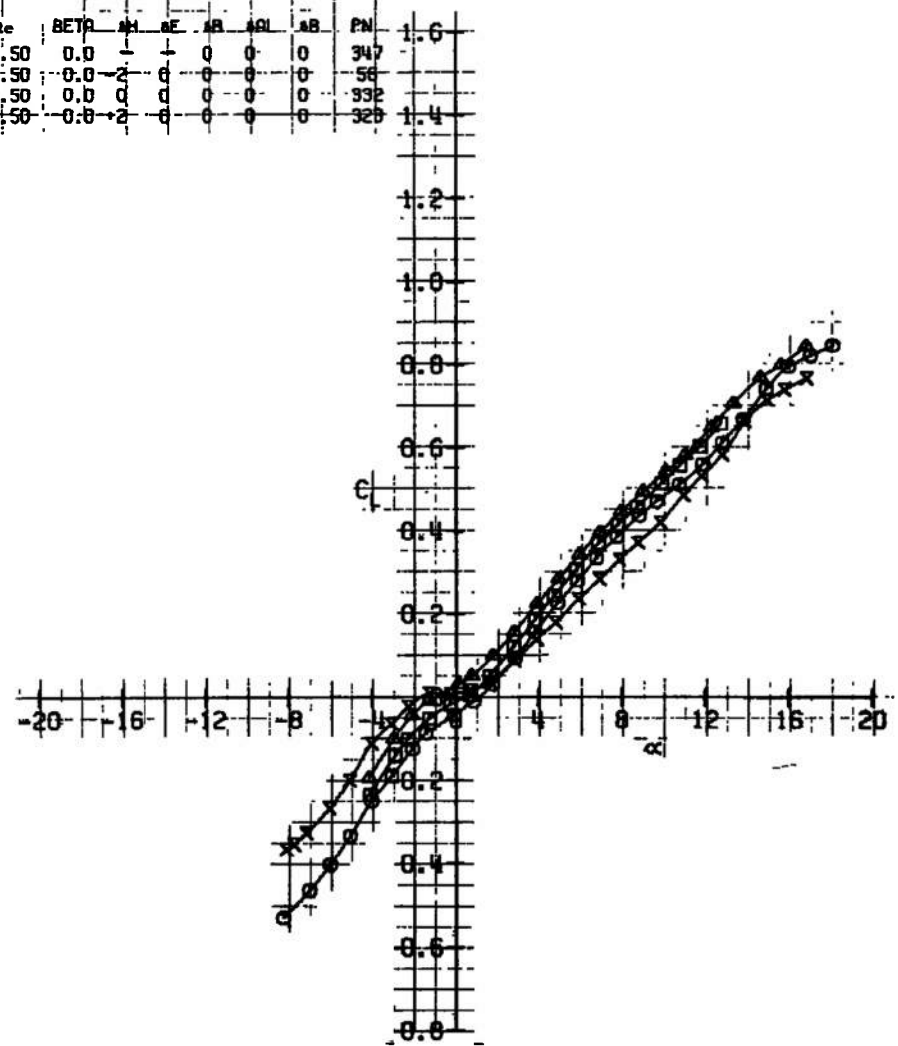
CONFIGURATION		$M_\infty$	$Re$	BETA	$\Delta H$	$\Delta E$	$\Delta R$	$\Delta I$	$\Delta B$	PN
SYM	CONFIGURATION									
X	$D_8 S_{1.5} V_2 D_2 C_2$	0.75	4.50	0.0	0	0	0	0	0	345
o	$D_8 S_{1.5} V_2 D_2 r_3 H_3 e_3$	0.75	4.50	0.0	1	0	0	0	0	54
□	$D_8 S_{1.5} V_2 D_2 r_3 H_3 e_3$	0.75	4.50	0.0	0	0	0	0	0	331
△	$D_8 S_{1.5} V_2 D_2 r_3 H_3 e_3$	0.75	4.50	0.0	2	0	0	0	0	322



d. Concluded  
Fig. 6 Continued



CONFIGURATION: $M_0 e_3 b_4 r_5 M_0 B_3 C_2 N_3$										
SYN	CONFIGURATION	$M_0$	$Re$	BETA	$M$	$\alpha E$	$\alpha B$	$\alpha Q$	$\alpha B$	PN
X	$D_4 S_{1.5} V_2 d_2 r_3$	0.80	4.50	0.0	1	d	0	0	0	347
o	$D_6 S_{1.5} V_2 d_2 r_3 M_3 e_3$	0.80	4.50	0.0	2	d	0	0	0	56
□	$D_8 S_{1.5} V_2 d_2 r_3 M_3 e_3$	0.80	4.50	0.0	0	d	0	0	0	332
△	$D_6 S_{1.5} V_2 d_2 r_3 M_3 e_3$	0.80	4.50	0.0	2	d	0	0	0	328

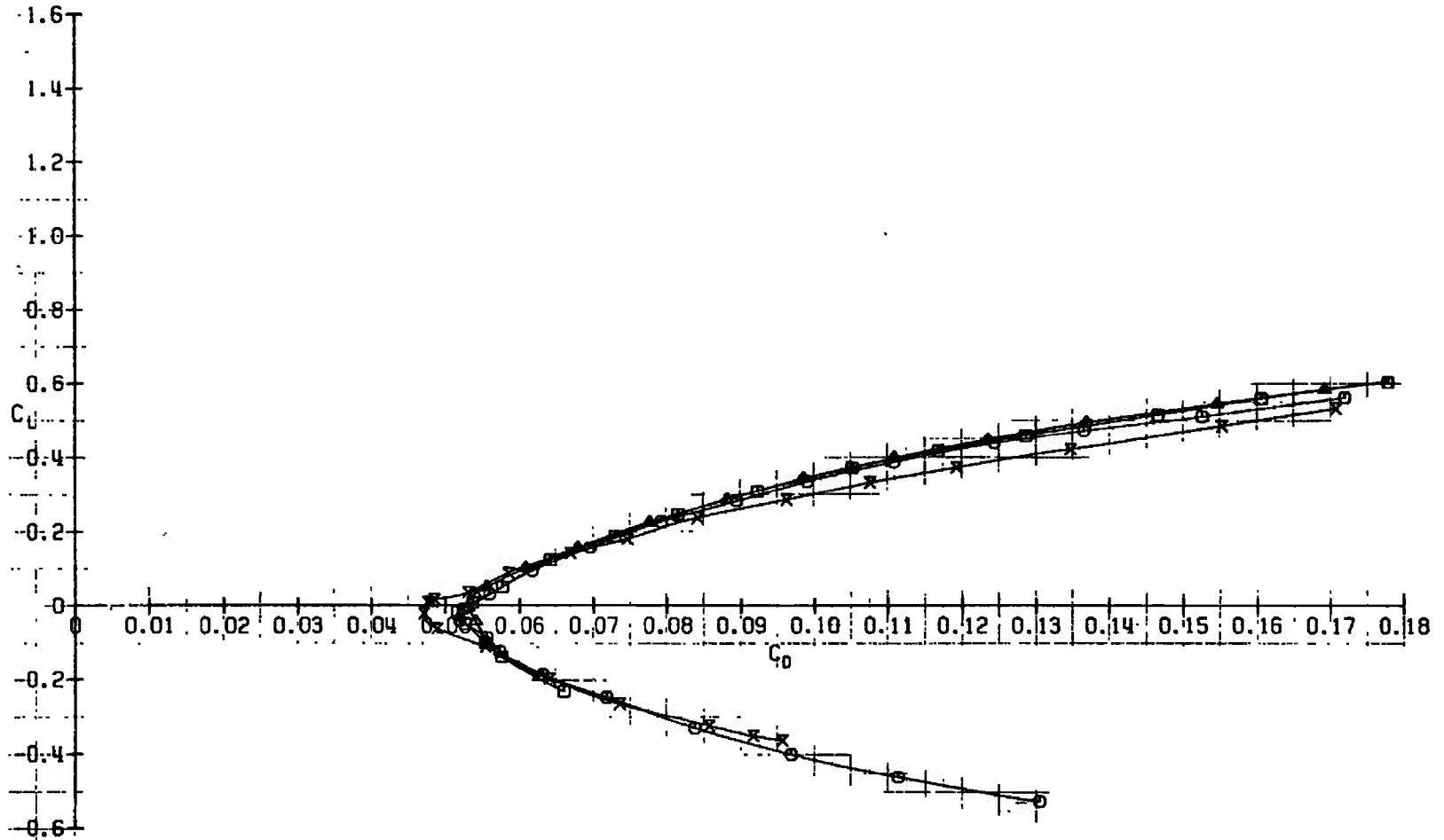


e.  $M_0 = 0.80$   
Fig. 6 Continued



CONFIGURATION:  $W_3, a_3, b_4, h_6, f_6, B_3, C_2, N_3$

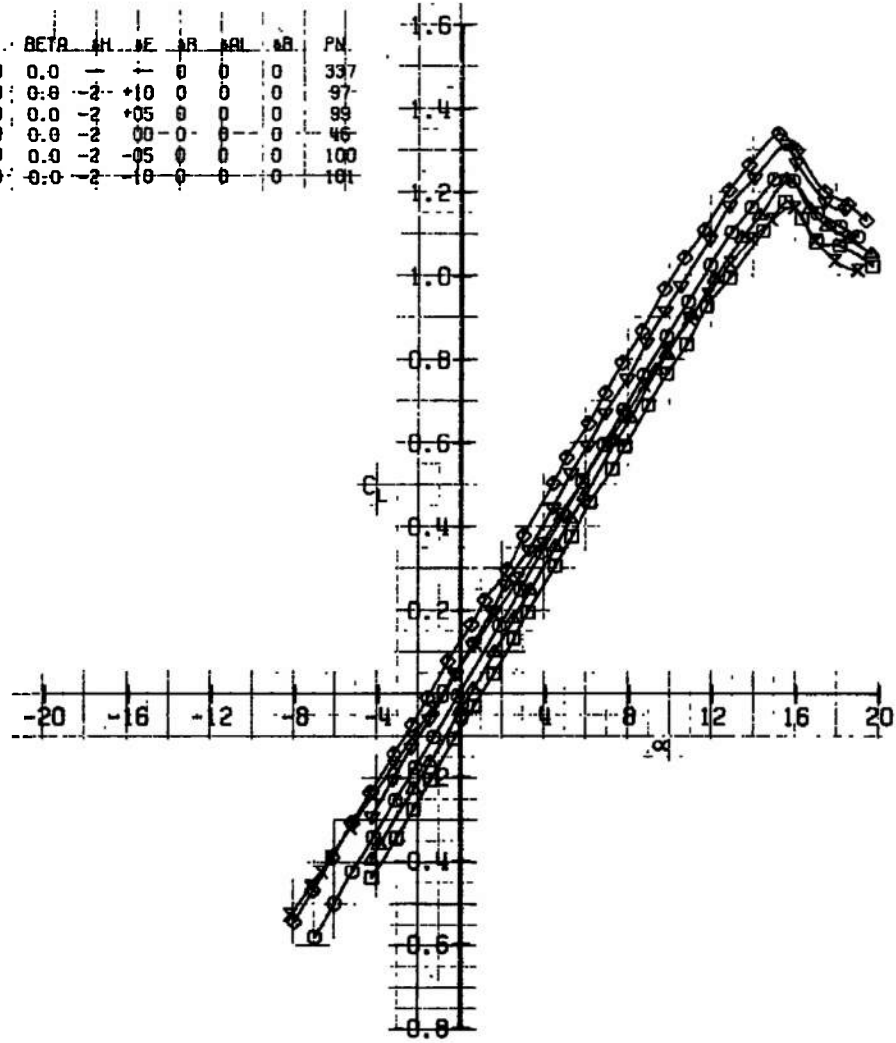
SYM	CONFIGURATION +	$M_\infty$	Re	BETA	$\delta H$	$\delta F$	$\delta R$	$\delta P$	$\delta B$	PN
X	$D_5 S_{1.5} V_2 d_2 r_3$	0.80	4,50	0.0	+	+	0	0	0	347
O	$I_5 S_{1.5} V_2 d_2 r_3 h_3 e_3$	0.80	4,50	0.10	-	0	0	0	0	56
□	$C_2 S_{1.5} V_2 d_2 r_3 h_3 e_3$	0.80	4,50	0.0	0	0	0	0	0	332
△	$I_5 S_{1.5} V_2 d_2 r_3 h_3 e_3$	0.80	4,50	0.0	+2	0	0	0	0	323



e. Concluded  
Fig. 6 Concluded

CONFIGURATION:  $H_3 e_3 b_4 h_5 f_6 B_3 C_2 N_3$

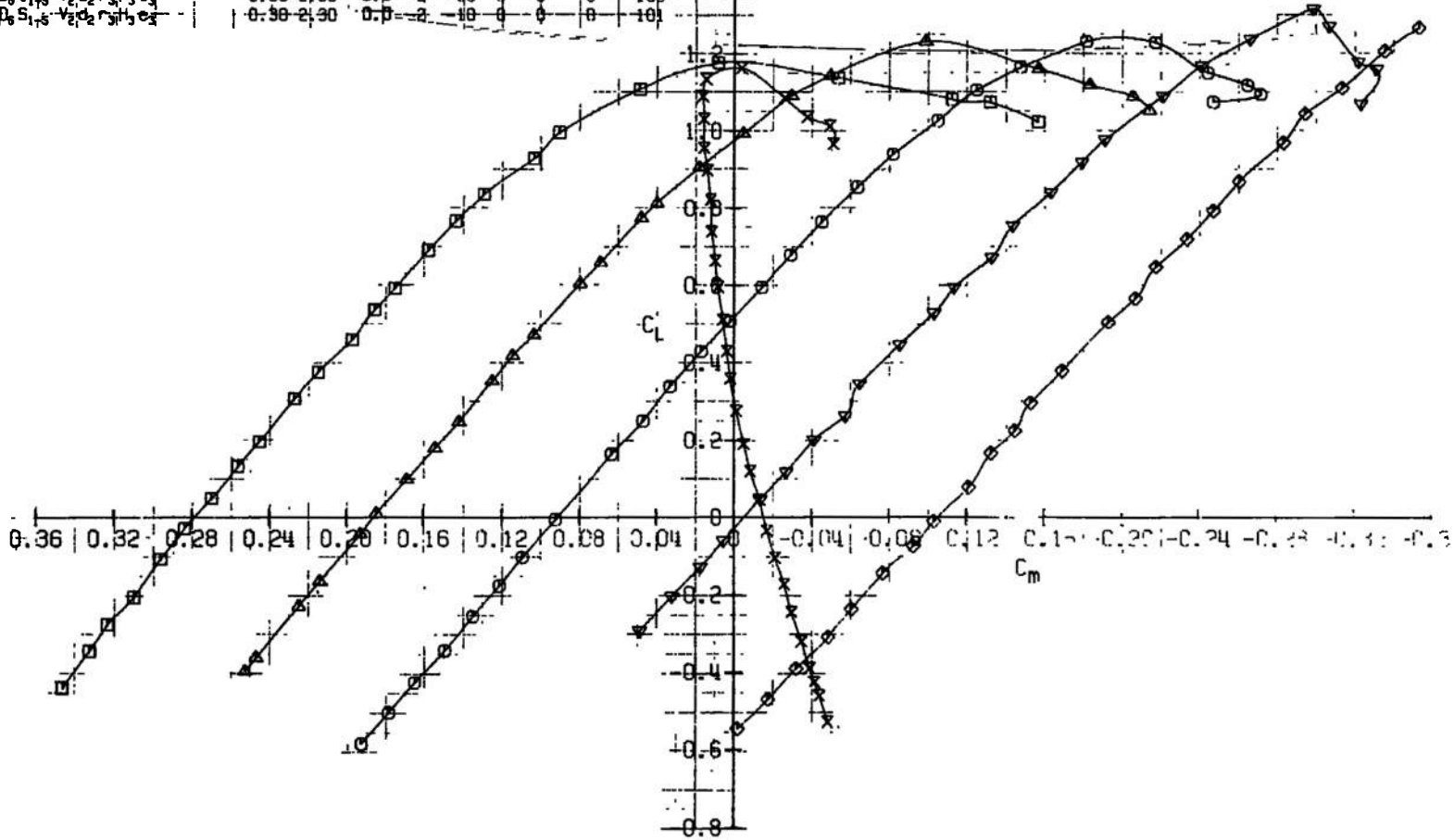
SYM	CONFIGURATION	$M_\infty$	Re	BETA	$\Delta H$	$\Delta E$	$\Delta R$	$\Delta AL$	$\Delta B$	PN
X	$D_6 S_{1-5} V_2 d_2 r_3$	0.30	2.30	0.0	-	-	0	0	0	337
◇	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	+10	0	0	0	97
▽	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	+05	0	0	0	99
⊖	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	00	0	0	0	46
△	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	-05	0	0	0	100
□	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	-10	0	0	0	101



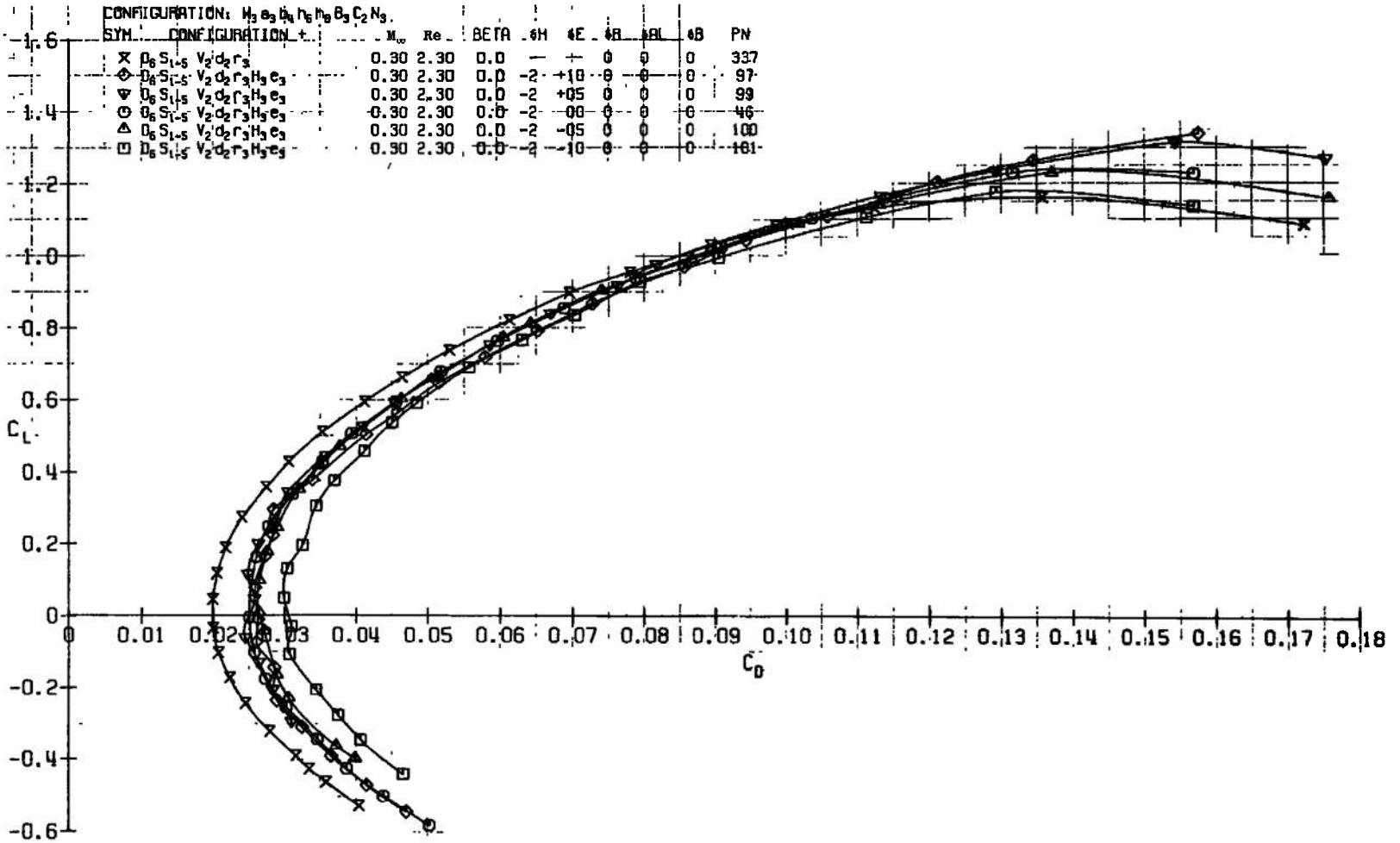
a.  $M_\infty = 0.30$   
 Fig. 7 Elevator Effectiveness

CONFIGURATION:  $W_3 a_3 b_4 r_5 W_6 B_3 C_2 N_3$

SYM	CONFIGURATION	$M_\infty$	Re	BETA	$\phi_1$	$\phi_2$	$\phi_R$	$\phi_{AL}$	$\phi_B$	PN	$\Gamma$
X	$D_6 S_{1,5} V_2 d_2 r_3$	0.30	2,30	0.0	-	-	0	0	0	337	1.6
◇	$D_6 S_{1,5} V_2 d_2 r_3 h_3 e_3$	0.30	2,30	0.0	-	+10	0	0	0	97	1.4
▽	$D_6 S_{1,5} V_2 d_2 r_3 h_3 e_3$	0.30	2,30	0.0	-	+05	0	0	0	95	1.4
⊖	$D_6 S_{1,5} V_2 d_2 r_3 h_3 e_3$	0.30	2,30	0.0	-	00	0	0	0	46	1.4
△	$D_6 S_{1,5} V_2 d_2 r_3 h_3 e_3$	0.30	2,30	0.0	-	-05	0	0	0	100	1.4
□	$D_6 S_{1,5} V_2 d_2 r_3 h_3 e_3$	0.30	2,30	0.0	-	-10	0	0	0	101	1.4



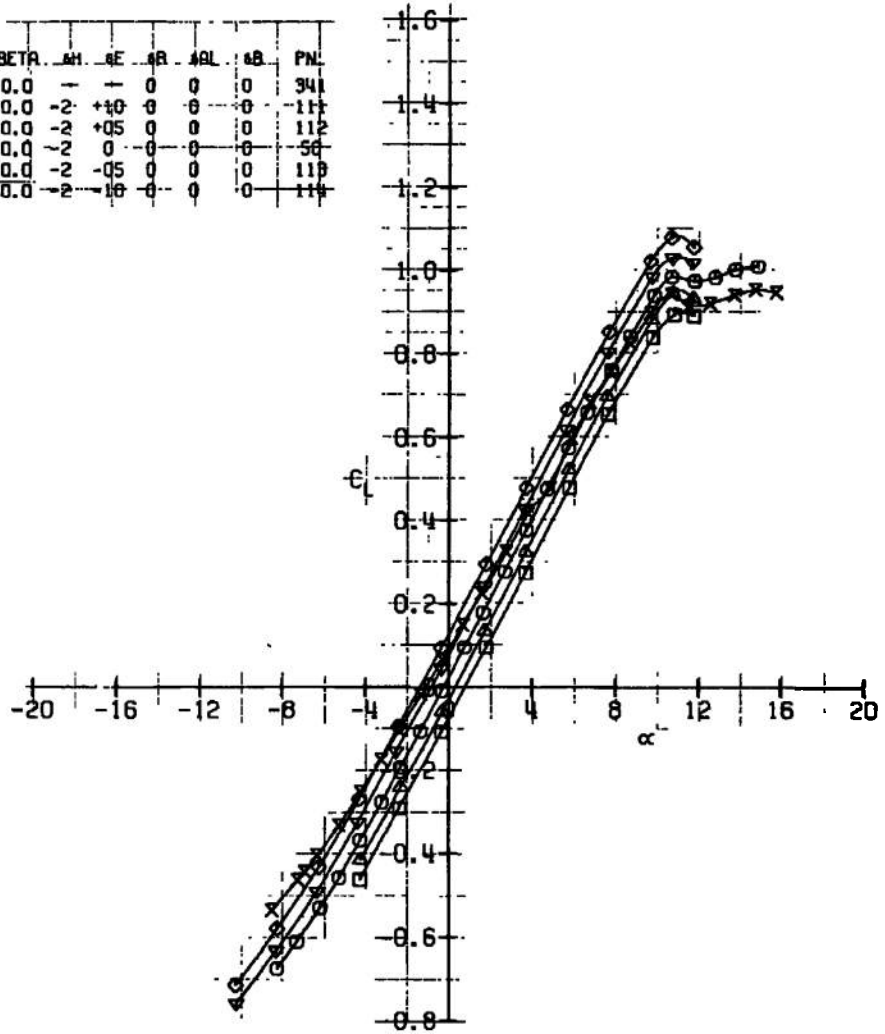
a. Continued  
Fig. 7 Continued



a. Concluded  
Fig. 7 Continued

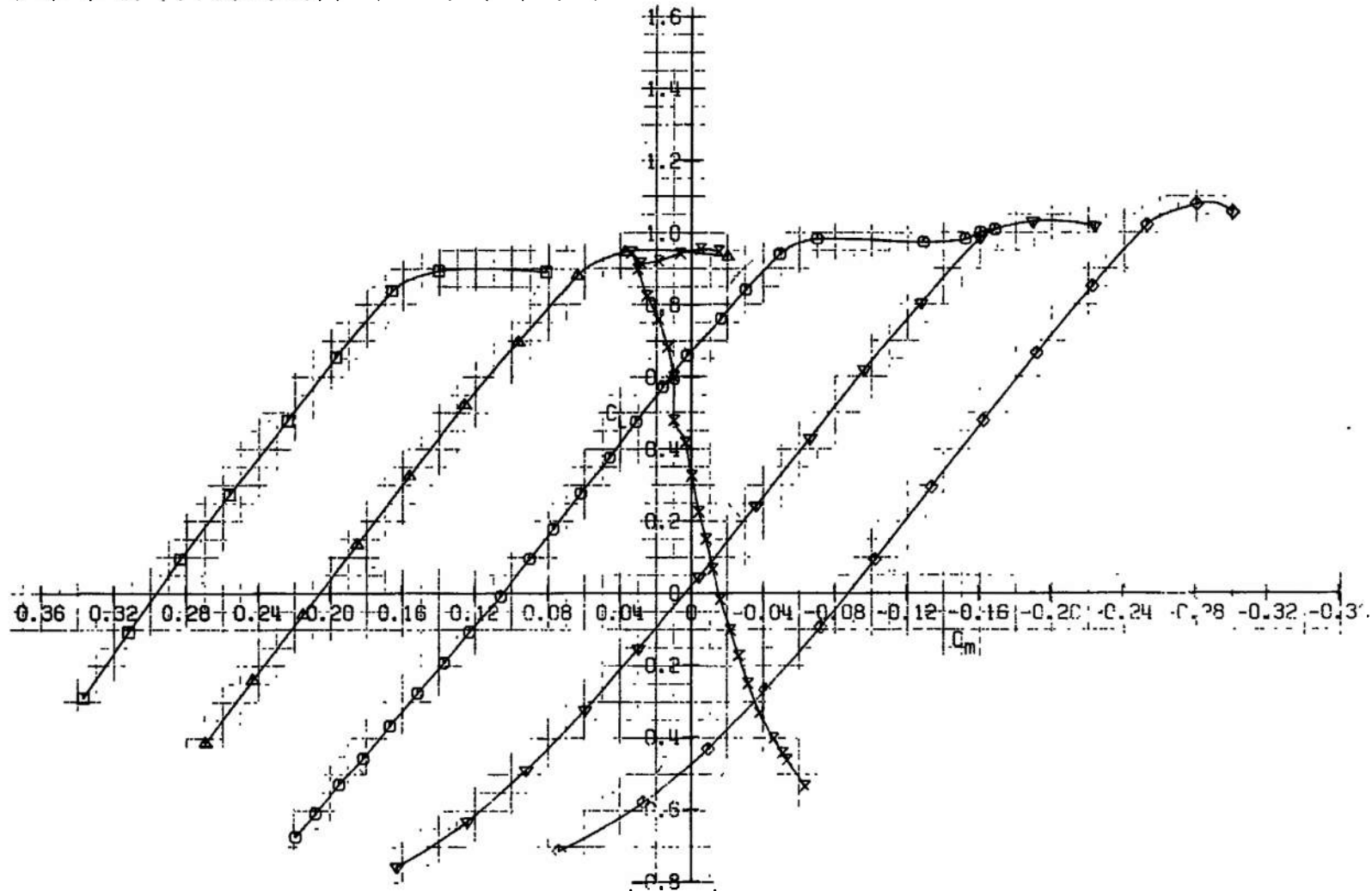
CONFIGURATION:  $H_3 O_3 U_4 T_5 H_6 B_3 C_2 N_3$

SYM	CONFIGURATION	$M_\infty$	$Re$	BETA	$\Delta H$	$\Delta E$	$\Delta R$	$\Delta Q$	$\Delta B$	PNL
X	$D_8 S_{1-5} V_2 d_2 r_3$	0.60	4.50	0.0	-	-	0	0	0	341
◇	$D_8 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.60	4.50	0.0	-2	+10	0	0	0	111
▽	$D_8 S_{1-5} V_2 d_2 r_3 H_3 e_2$	0.60	4.50	0.0	-2	+05	0	0	0	112
○	$D_8 S_{1-5} V_2 d_2 r_3 H_3 e_3$	-0.60	4.50	0.0	-2	0	0	0	0	56
△	$D_8 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.60	4.50	0.0	-2	-05	0	0	0	113
□	$D_8 S_{1-5} V_2 d_2 r_3 H_3 e_3$	-0.60	4.50	0.0	-2	-10	0	0	0	114



b.  $M_\infty = 0.60$   
Fig. 7 Continued

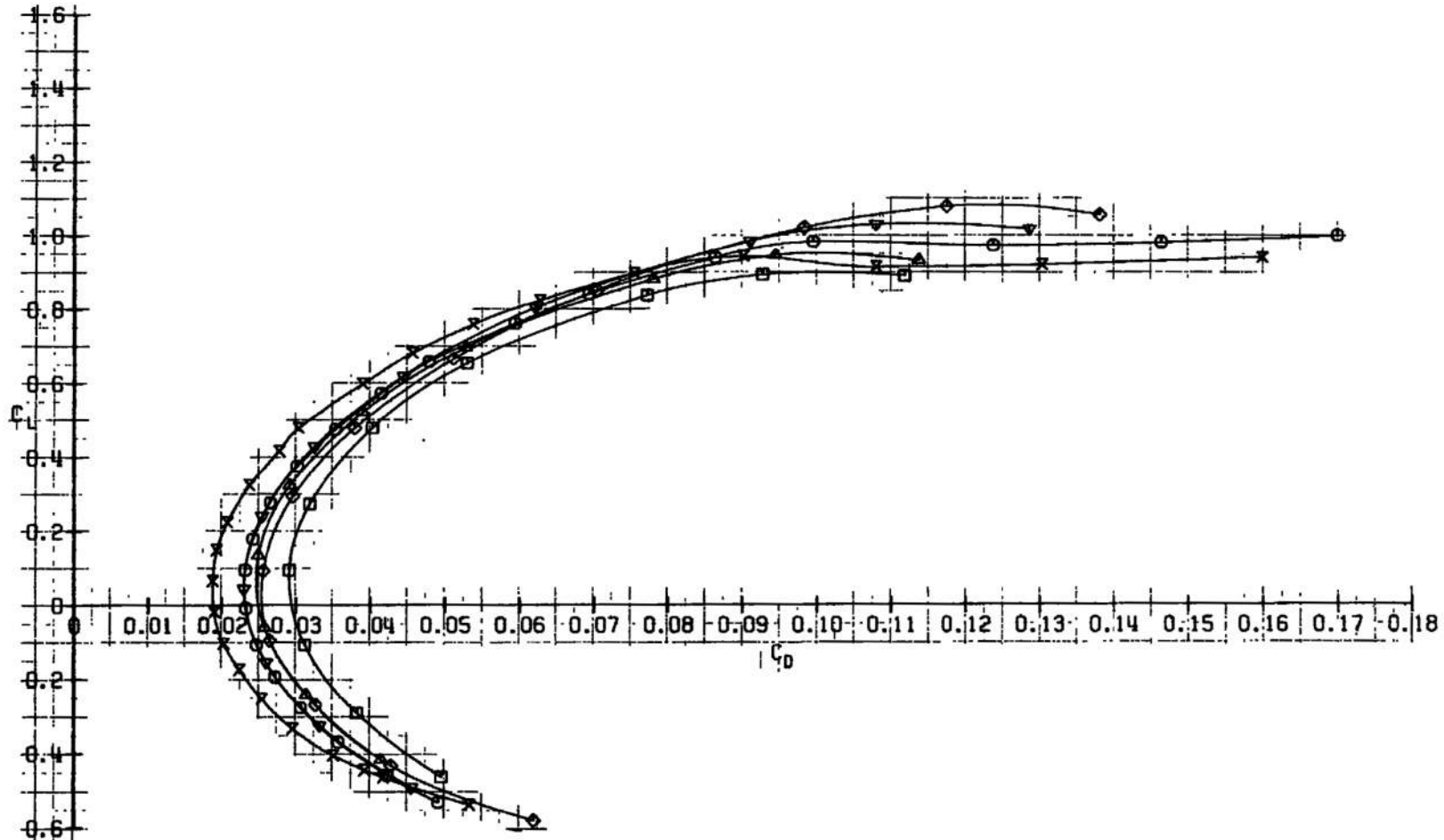
SYM	CONFIGURATION	$M_\infty$	$Re$	$BE$	$CF$	$SR$	$ABL$	$LR$	$FN$
X	$D_6 S_{1/6} V_2 D_2 R_3$	0.60	4,50	0.0	0	0	0	0	34
◇	$D_6 S_{1/6} V_2 D_2 R_3$	0.60	4,50	0.0	0	0	0	0	111
▽	$D_6 S_{1/6} V_2 D_2 R_3$	0.60	4,50	0.0	0	0	0	0	112
○	$D_6 S_{1/6} V_2 D_2 R_3$	0.60	4,50	0.0	0	0	0	0	50
△	$D_6 S_{1/6} V_2 D_2 R_3$	0.60	4,50	0.0	0	0	0	0	113
□	$D_6 S_{1/6} V_2 D_2 R_3$	0.60	4,50	0.0	0	0	0	0	114



b. Continued  
Fig. 7 Continued



CONFIGURATION: $M_2, \theta_2, \delta_2, r_2, \beta_2, F_2, N_2$													
SYM	CONFIGURATION				$M_\infty$	Re	BETA	H	F	R	RI	6B	PN
X	$D_6 S_{1.5}$	$V_2$	$d_2 r_3$		0.60	4.50	0.0			0	0	0	341
◇	$D_6 S_{1.5}$	$V_2$	$d_2 r_3 H_3 e_3$		0.60	4.50	0.0	-2	+10	0	0	0	111
▽	$D_6 S_{1.5}$	$V_2$	$d_2 r_3 H_3 e_3$		0.60	4.50	0.0	-2	+05	0	0	0	112
○	$D_6 S_{1.5}$	$V_2$	$d_2 r_3 H_3 e_3$		0.60	4.50	0.0	-2	0	0	0	0	50
△	$D_6 S_{1.5}$	$V_2$	$d_2 r_3 H_3 e_3$		0.60	4.50	0.0	-2	-05	0	0	0	113
□	$D_6 S_{1.5}$	$V_2$	$d_2 r_3 H_3 e_3$		0.60	4.50	0.0	-2	+0	0	0	0	114

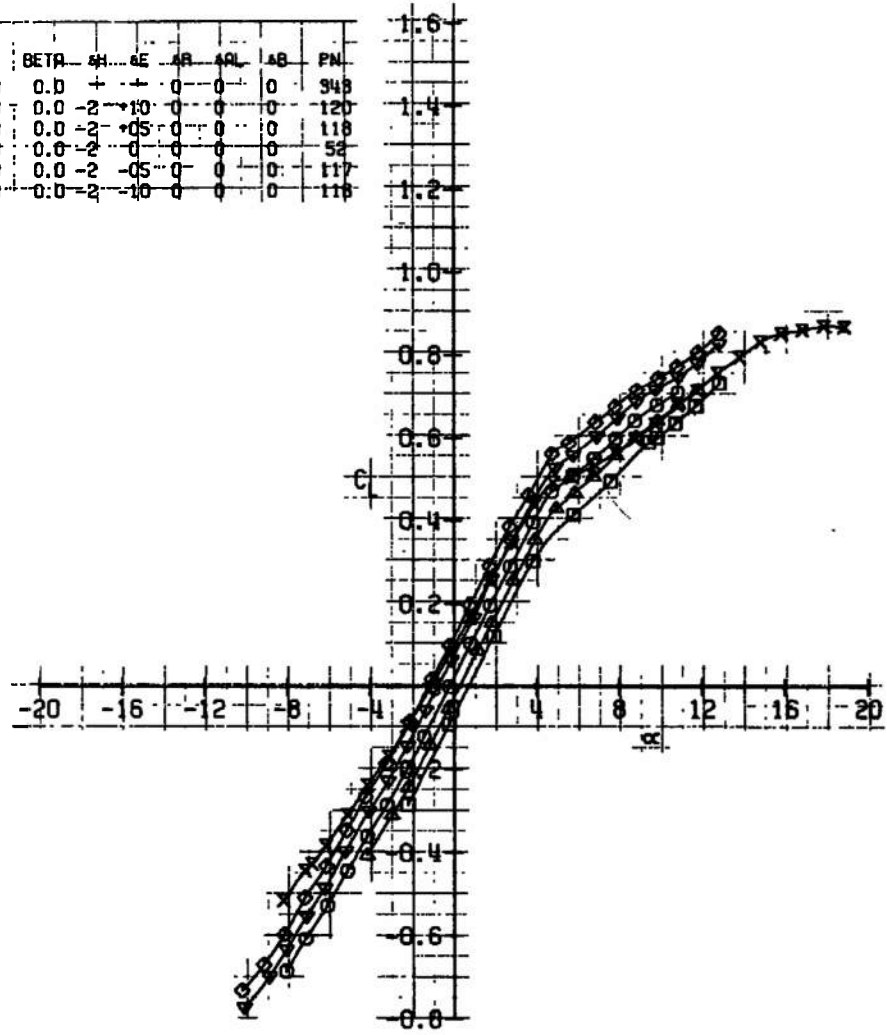


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b. Concluded  
Fig. 7 Continued

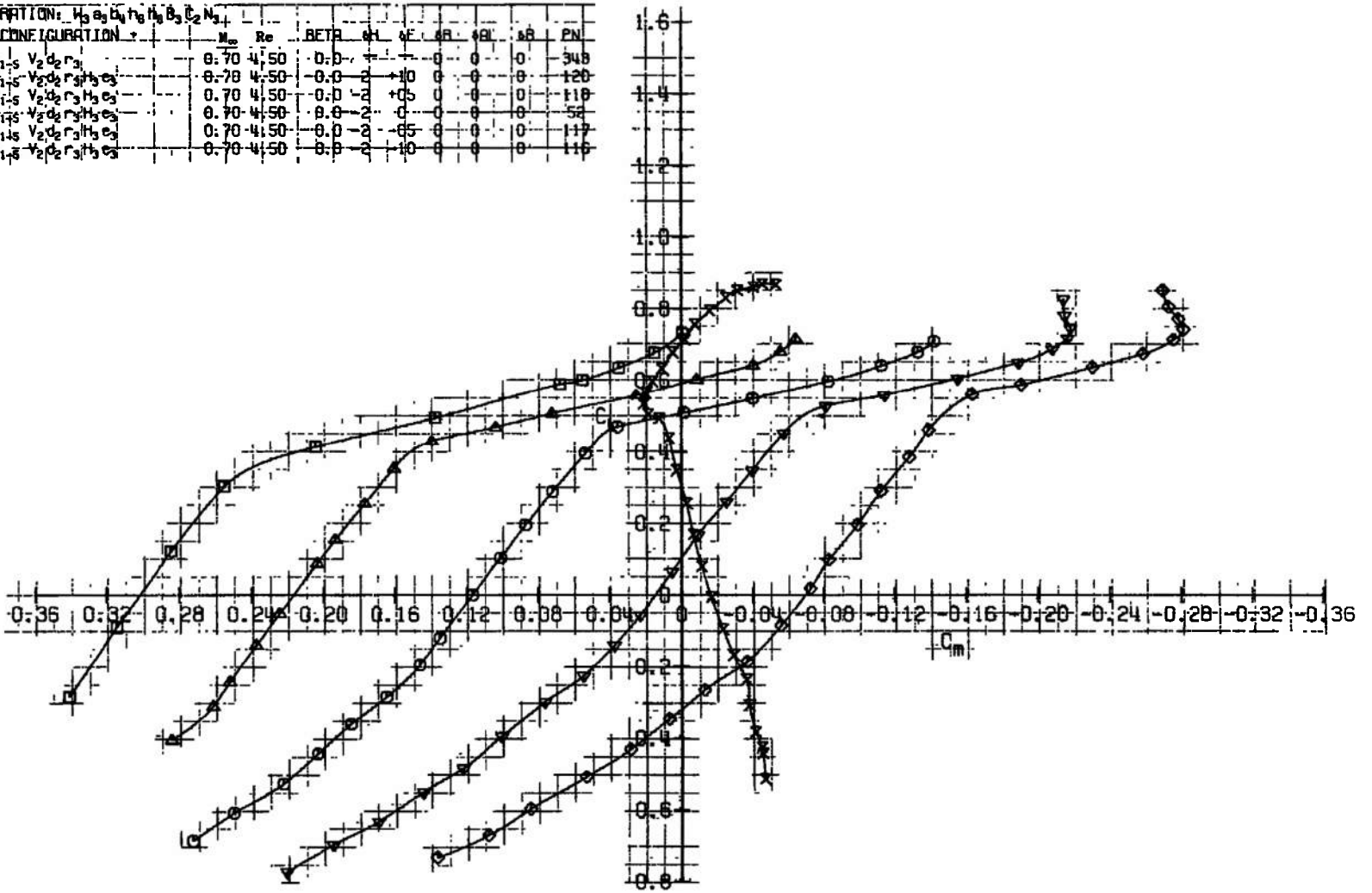
CONFIGURATION:  $H_3 e_3 d_4 r_6 h_3 e_3 C_2 N_3$

SYM	CONFIGURATION	$M_\infty$	$Re$	BETA	$\delta H$	$\delta E$	$\delta R$	$\delta AL$	$\delta B$	PM
X	$D_6 S_{1-5} V_2 d_2 r_3$	0.70	4.50	0.0	+	+	0	0	0	348
◇	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.70	4.50	0.0	-2	+10	0	0	0	120
▽	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.70	4.50	0.0	-2	+5	0	0	0	118
○	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.70	4.50	0.0	-2	0	0	0	0	52
△	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.70	4.50	0.0	-2	-5	0	0	0	117
□	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.70	4.50	0.0	-2	-10	0	0	0	118



c.  $M_\infty = 0.70$   
 Fig. 7 Continued

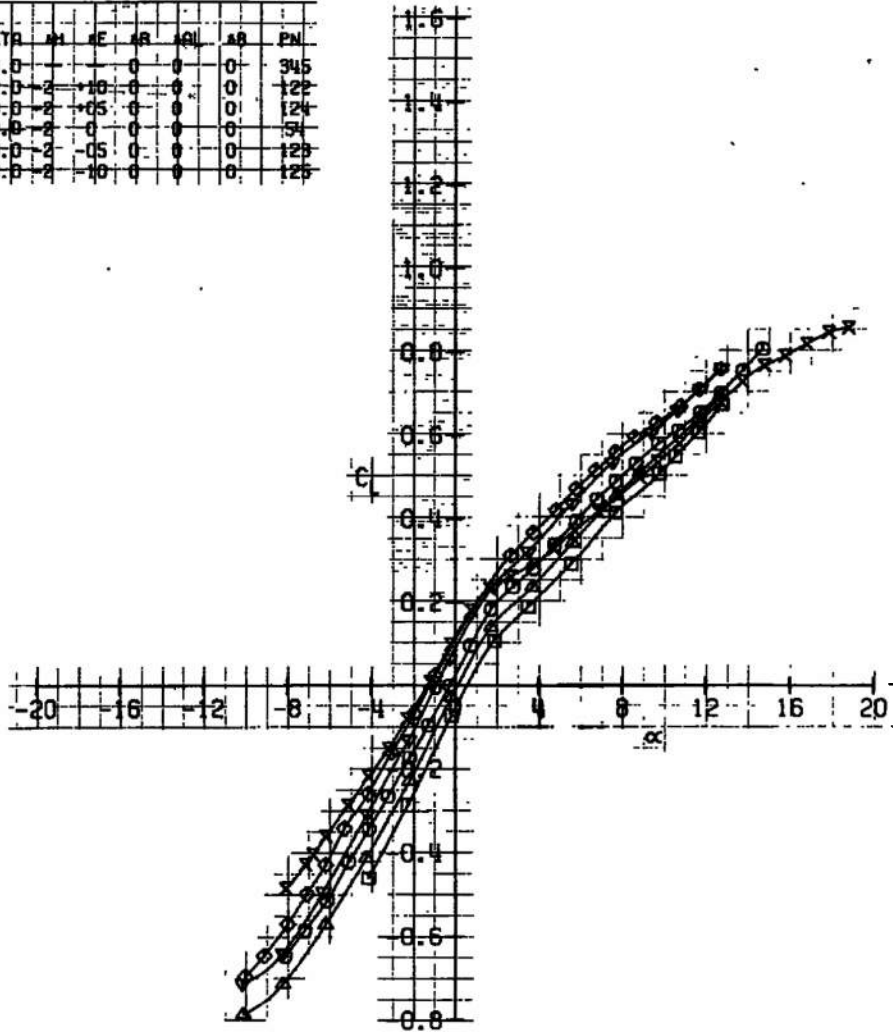
CONFIGURATION: $H_2, a_3, b_1, r_3, H_3, \theta_3, C_2, N_3$		$M_\infty$	Re	BETA	$\theta_1$	$\theta_2$	$\theta_3$	$\theta_4$	$\theta_5$	PN
SYM	CONFIGURATION									
X	$D_6 S_{1-5} V_2 d_2 r_3$	0.70	4:50	0.0	0	0	0	0	0	348
◇	$D_6 S_{1-5} V_2 d_2 r_3 H_3 \theta_3$	0.70	4:50	0.0	0	10	0	0	0	120
▽	$D_6 S_{1-5} V_2 d_2 r_3 H_3 \theta_3$	0.70	4:50	0.0	0	0	0	0	0	110
△	$D_6 S_{1-5} V_2 d_2 r_3 H_3 \theta_3$	0.70	4:50	0.0	0	0	0	0	0	55
○	$D_6 S_{1-5} V_2 d_2 r_3 H_3 \theta_3$	0.70	4:50	0.0	0	0	0	0	0	117
□	$D_6 S_{1-5} V_2 d_2 r_3 H_3 \theta_3$	0.70	4:50	0.0	0	0	0	0	0	116



c. Continued  
Fig. 7 Continued

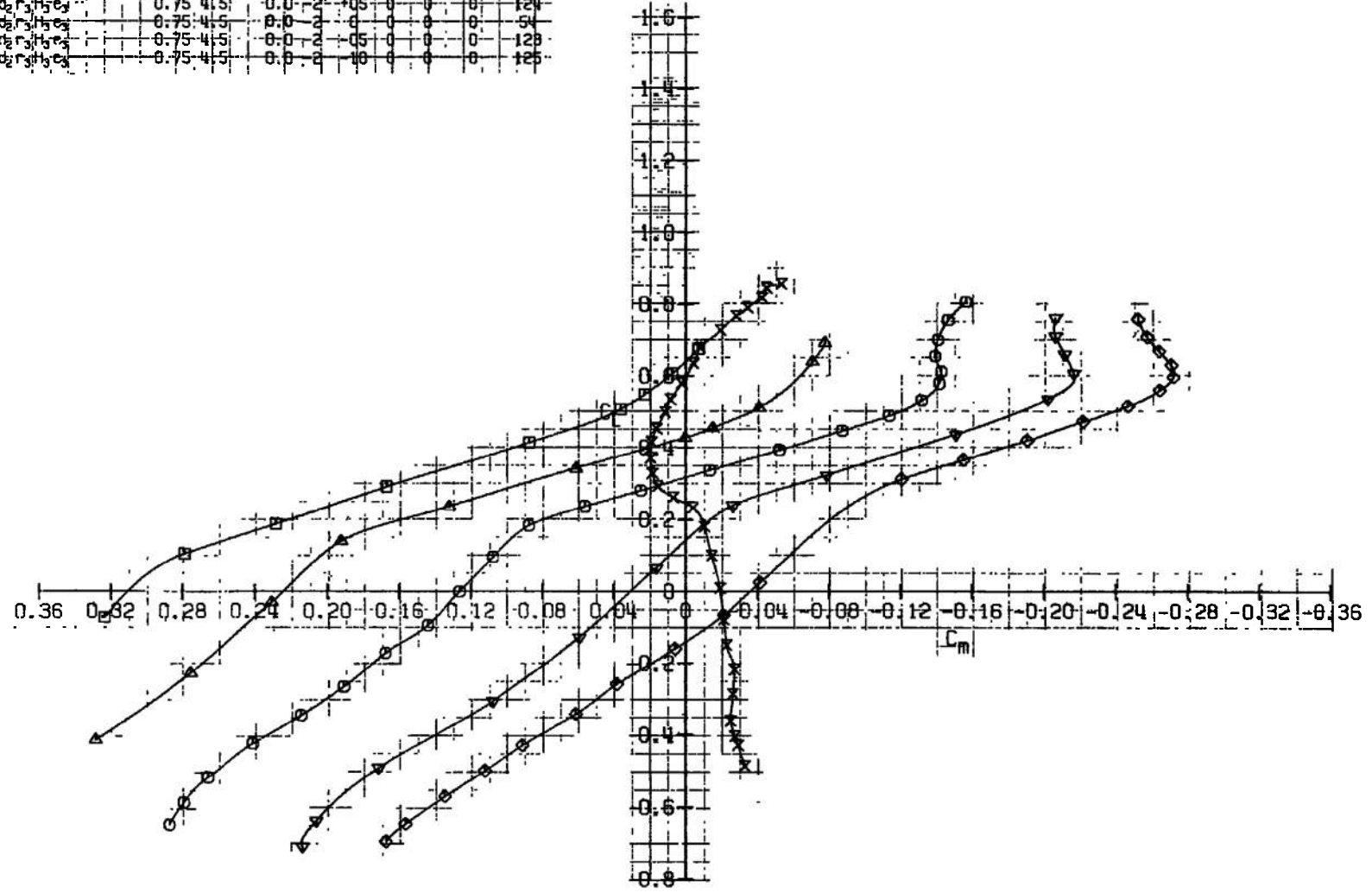


CONFIGURATION		$M_u$	$R_u$	BETP	$\mu_1$	$\mu_F$	$\mu_R$	$\mu_{SI}$	$\mu_B$	FN
* $\diamond$	$D_5 S_{1.5} N_2 O_3$	0.75	4.50	0.0	2	10	0	0	0	345
$\diamond$	$D_5 S_{1.5} V_2 O_3$	0.75	4.5	0.0	2	10	0	0	0	122
$\square$	$D_5 S_{1.5} V_2 O_3$	0.75	4.5	0.0	2	05	0	0	0	124
$\square$	$D_5 S_{1.5} V_2 O_3$	0.75	4.5	0.0	2	0	0	0	0	54
$\square$	$D_5 S_{1.5} V_2 O_3$	0.75	4.5	0.0	2	05	0	0	0	123
$\square$	$D_5 S_{1.5} V_2 O_3$	0.75	4.5	0.0	2	10	0	0	0	125



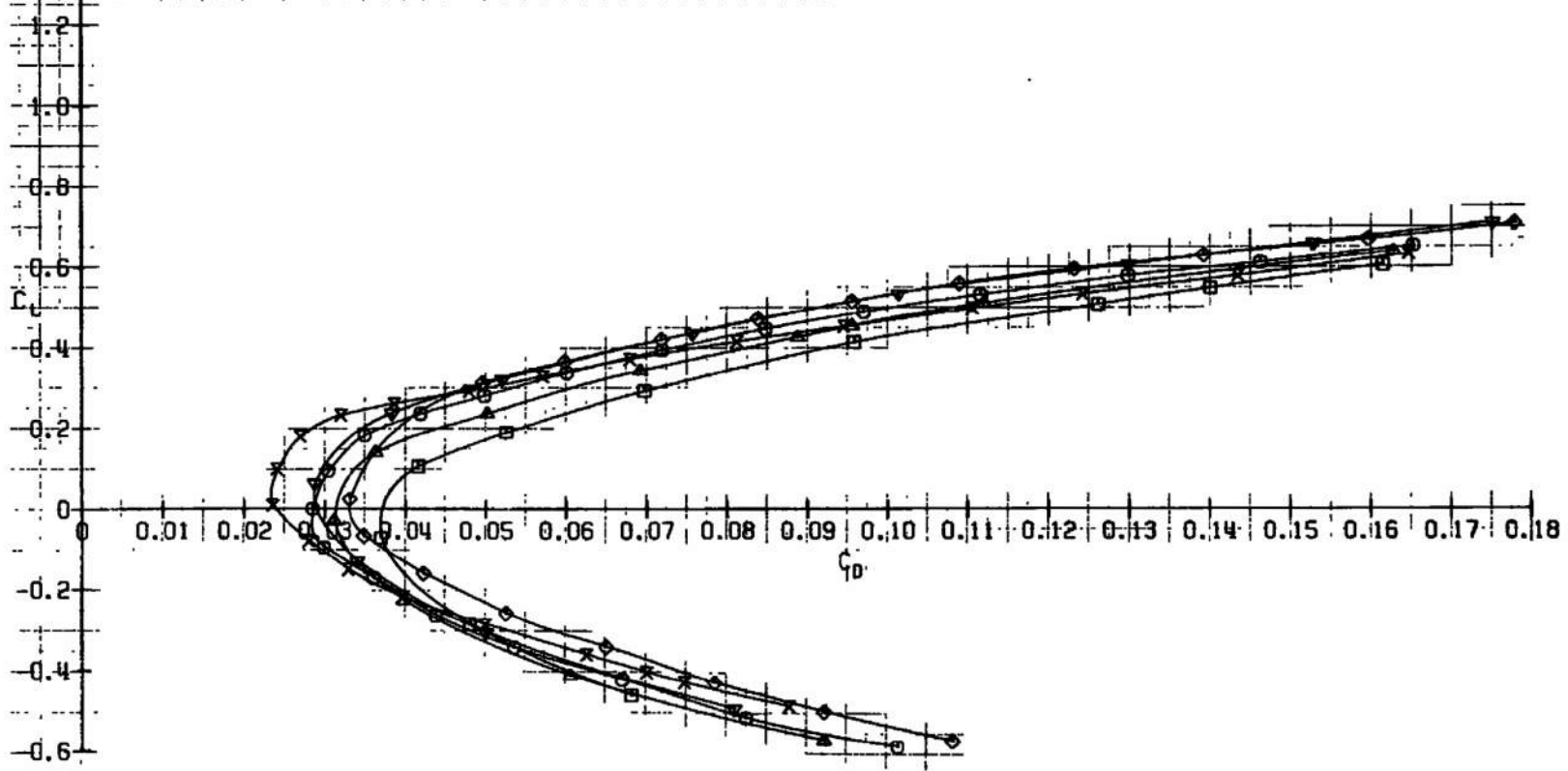
d.  $M_u = 0.75$   
Fig. 7 Continued

CONFIGURATION: H <sub>3</sub> a <sub>3</sub> b <sub>3</sub> H <sub>5</sub> H <sub>6</sub> B <sub>3</sub> C <sub>2</sub> N <sub>3</sub>													
SYM	CONFIGURATION				M <sub>0</sub>	Re	BETA	ΔI	ΔF	ΔR	ΔD	ΔB	PN
X	D <sub>6</sub>	S <sub>1.45</sub>	V <sub>2</sub>	C <sub>3</sub>	0.75	4.5	0.0	0	0	0	0	0	345
◇	D <sub>6</sub>	S <sub>1.45</sub>	V <sub>2</sub>	C <sub>3</sub>	0.75	4.5	0.8	2	10	0	0	0	122
▽	D <sub>6</sub>	S <sub>1.45</sub>	V <sub>2</sub>	C <sub>3</sub>	0.75	4.5	0.0	2	05	0	0	0	124
○	D <sub>6</sub>	S <sub>1.45</sub>	V <sub>2</sub>	C <sub>3</sub>	0.75	4.5	0.0	2	0	0	0	0	54
△	D <sub>6</sub>	S <sub>1.45</sub>	V <sub>2</sub>	C <sub>3</sub>	0.75	4.5	0.0	2	05	0	0	0	123
□	D <sub>6</sub>	S <sub>1.45</sub>	V <sub>2</sub>	C <sub>3</sub>	0.75	4.5	0.8	2	10	0	0	0	125



d. Continued  
Fig. 7 Continued

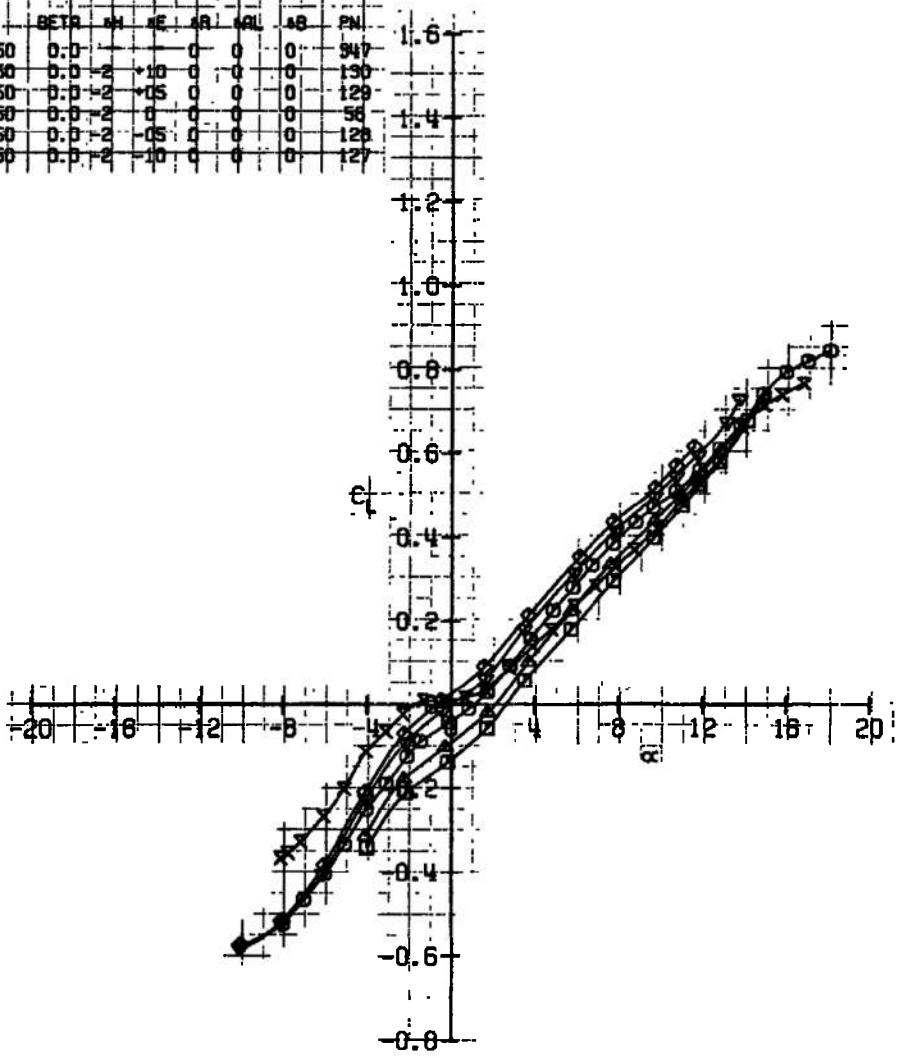
CONFIGURATION: $B_1 B_2 B_3 B_4 B_5 B_6 C_1 C_2 N_1$		$M_\infty$	$Re$	BETA	GM	GF	GR	GS	GB	PN
SYM	CONFIGURATION									
X	D <sub>0</sub> S <sub>1</sub> S <sub>1</sub> V <sub>2</sub> d <sub>0</sub> r <sub>3</sub>	0.75	4.50	0.0	0	0	0	0	0	345
◇	D <sub>0</sub> S <sub>1</sub> S <sub>1</sub> V <sub>2</sub> d <sub>0</sub> r <sub>3</sub> H <sub>1</sub> e <sub>3</sub>	0.75	4.50	0.0	2	10	0	0	0	120
▽	D <sub>0</sub> S <sub>1</sub> S <sub>1</sub> V <sub>2</sub> d <sub>0</sub> r <sub>3</sub> H <sub>1</sub> e <sub>3</sub>	0.75	4.50	0.0	2	05	0	0	0	124
○	D <sub>0</sub> S <sub>1</sub> S <sub>1</sub> V <sub>2</sub> d <sub>0</sub> r <sub>3</sub> H <sub>1</sub> e <sub>3</sub>	0.75	4.50	0.0	2	0	0	0	0	54
△	D <sub>0</sub> S <sub>1</sub> S <sub>1</sub> V <sub>2</sub> d <sub>0</sub> r <sub>3</sub> H <sub>1</sub> e <sub>3</sub>	0.75	4.50	0.0	2	05	0	0	0	123
□	D <sub>0</sub> S <sub>1</sub> S <sub>1</sub> V <sub>2</sub> d <sub>0</sub> r <sub>3</sub> H <sub>1</sub> e <sub>3</sub>	0.75	4.5	0.0	2	0	0	0	0	125



d. Concluded  
Fig. 7 Continued

CONFIGURATION:  $V_2, \theta_2, \alpha_2, \beta_2, \gamma_2, \delta_2, \epsilon_2, \zeta_2, \eta_2, \theta_2, \rho_2, \sigma_2, \tau_2, \nu_2, \xi_2, \omega_2$

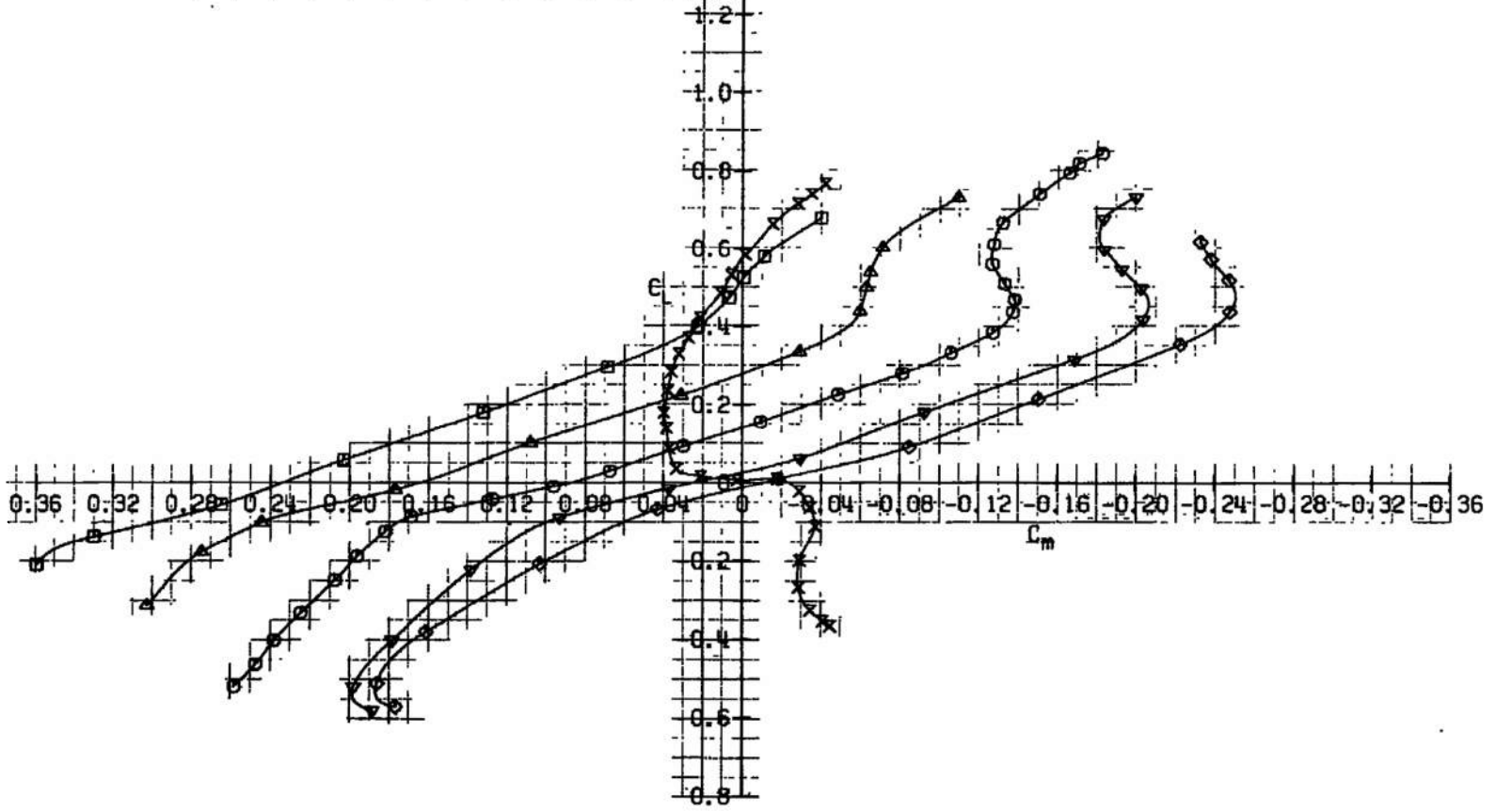
S/N	CONFIGURATION	$M_\infty$	Re	BETA	$\alpha_1$	$\alpha_2$	$\alpha_3$	$\alpha_4$	$\alpha_5$	$\alpha_6$	$\alpha_7$	$\alpha_8$	$\alpha_9$	$\alpha_{10}$
X	$V_2, \theta_2, \alpha_2, \beta_2, \gamma_2, \delta_2, \epsilon_2, \zeta_2, \eta_2, \theta_2, \rho_2, \sigma_2, \tau_2, \nu_2, \xi_2, \omega_2$	0.80	4,50	0.0	-	-	-	-	-	-	-	-	-	-
◇	$V_2, \theta_2, \alpha_2, \beta_2, \gamma_2, \delta_2, \epsilon_2, \zeta_2, \eta_2, \theta_2, \rho_2, \sigma_2, \tau_2, \nu_2, \xi_2, \omega_2$	0.80	4,50	0.0	-2	-10	0	0	0	0	0	0	0	0
◊	$V_2, \theta_2, \alpha_2, \beta_2, \gamma_2, \delta_2, \epsilon_2, \zeta_2, \eta_2, \theta_2, \rho_2, \sigma_2, \tau_2, \nu_2, \xi_2, \omega_2$	0.80	4,50	0.0	-2	-10	0	0	0	0	0	0	0	0
◊	$V_2, \theta_2, \alpha_2, \beta_2, \gamma_2, \delta_2, \epsilon_2, \zeta_2, \eta_2, \theta_2, \rho_2, \sigma_2, \tau_2, \nu_2, \xi_2, \omega_2$	0.80	4,50	0.0	-2	-10	0	0	0	0	0	0	0	0
◊	$V_2, \theta_2, \alpha_2, \beta_2, \gamma_2, \delta_2, \epsilon_2, \zeta_2, \eta_2, \theta_2, \rho_2, \sigma_2, \tau_2, \nu_2, \xi_2, \omega_2$	0.80	4,50	0.0	-2	-10	0	0	0	0	0	0	0	0
◊	$V_2, \theta_2, \alpha_2, \beta_2, \gamma_2, \delta_2, \epsilon_2, \zeta_2, \eta_2, \theta_2, \rho_2, \sigma_2, \tau_2, \nu_2, \xi_2, \omega_2$	0.80	4,50	0.0	-2	-10	0	0	0	0	0	0	0	0



e.  $M_\infty = 0.80$   
 Fig. 7 Continued



CONFIGURATION: $V_2 d_2 r_2 H_2 e_2$		$M_\infty$	$Re$	BETA	ML	AF	AR	AOI	NR	PN	1.0
X	$D_0 S_{1.5} V_2 d_2 r_2$	0.80	4,50	0.0	-	-	0	0	0	347	
◇	$D_0 S_{1.5} V_2 d_2 r_2 H_2 e_2$	0.80	4,50	0.0	-2	+10	0	0	0	138	
▽	$D_0 S_{1.5} V_2 d_2 r_2 H_2 e_2$	0.80	4,50	0.0	-2	+5	0	0	0	129	
○	$D_0 S_{1.5} V_2 d_2 r_2 H_2 e_2$	0.80	4,50	0.0	-2	0	0	0	0	56	1.4
△	$D_0 S_{1.5} V_2 d_2 r_2 H_2 e_2$	0.80	4,50	0.0	-2	-5	0	0	0	128	
□	$D_0 S_{1.5} V_2 d_2 r_2 H_2 e_2$	0.80	4,50	0.0	-2	-10	0	0	0	127	

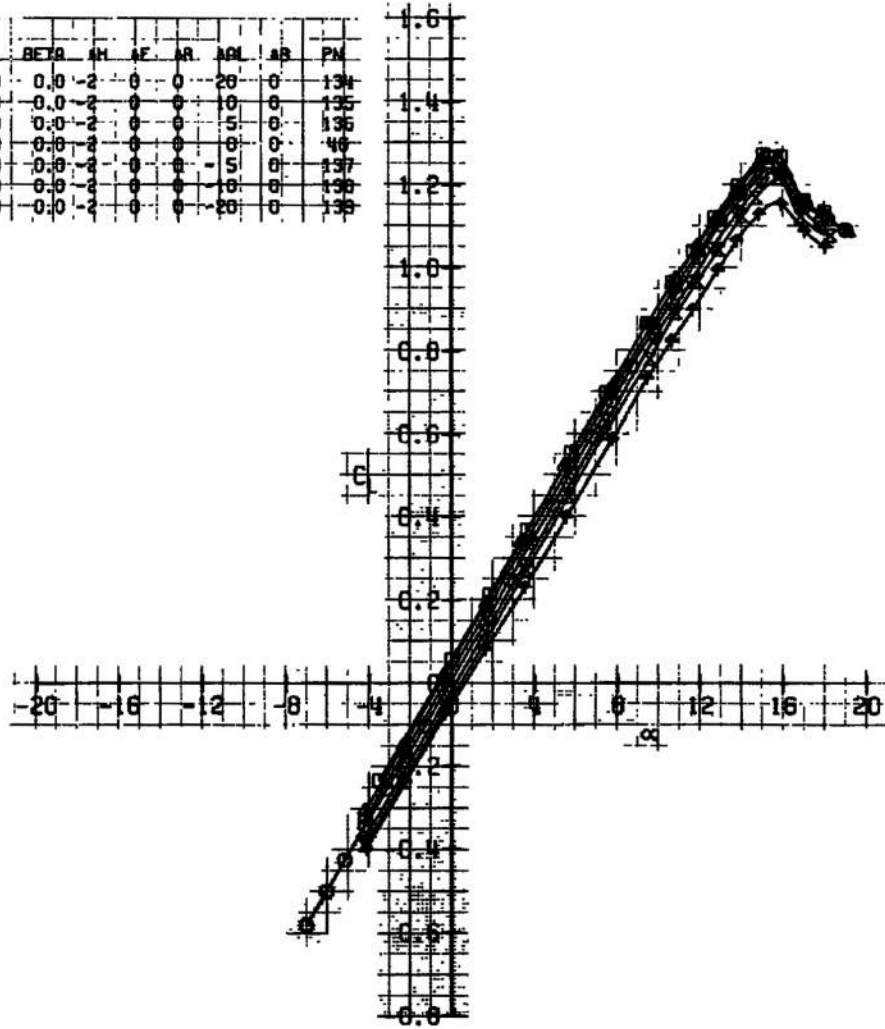


e. Continued  
Fig. 7 Continued

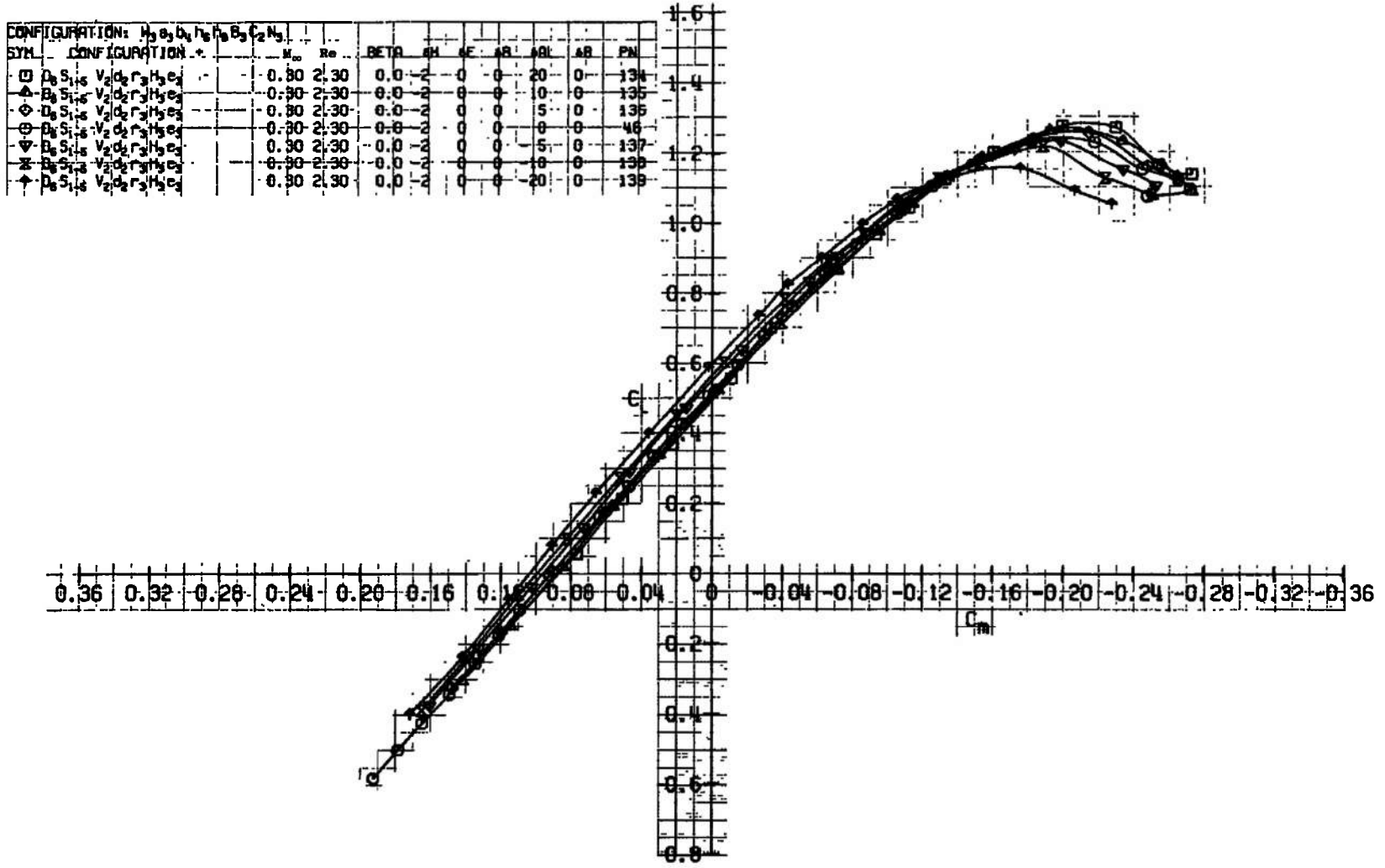


CONFIGURATION:  $M_0, \theta_0, D_0, \eta_0, \beta_0, C_2, N_0$

SYN	CONFIGURATION	$M_\infty$	$Re$	BETA	AM	AF	AR	ADM	AD	PM
□	$D_0 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	0	0	20	0	134
△	$D_0 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	0	0	10	0	135
◇	$D_0 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	0	0	5	0	136
○	$D_0 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	0	0	0	0	40
⊙	$D_0 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	0	0	5	0	137
⊗	$D_0 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	0	0	10	0	138
+	$D_0 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	0	0	20	0	139

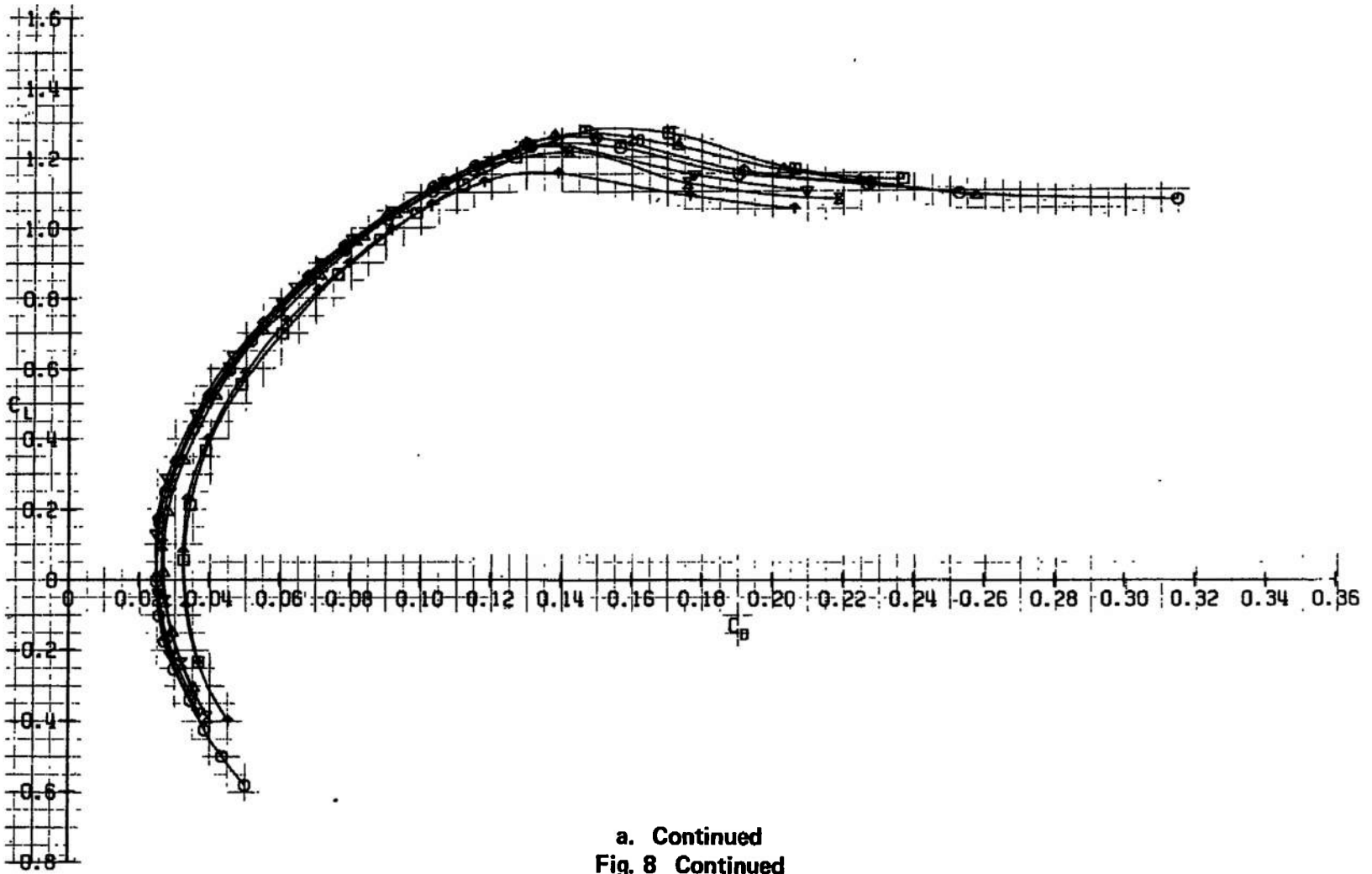


a.  $M_\infty = 0.30$   
 Fig. 8 Aileron Effectiveness



a. Continued  
Fig. 8 Continued

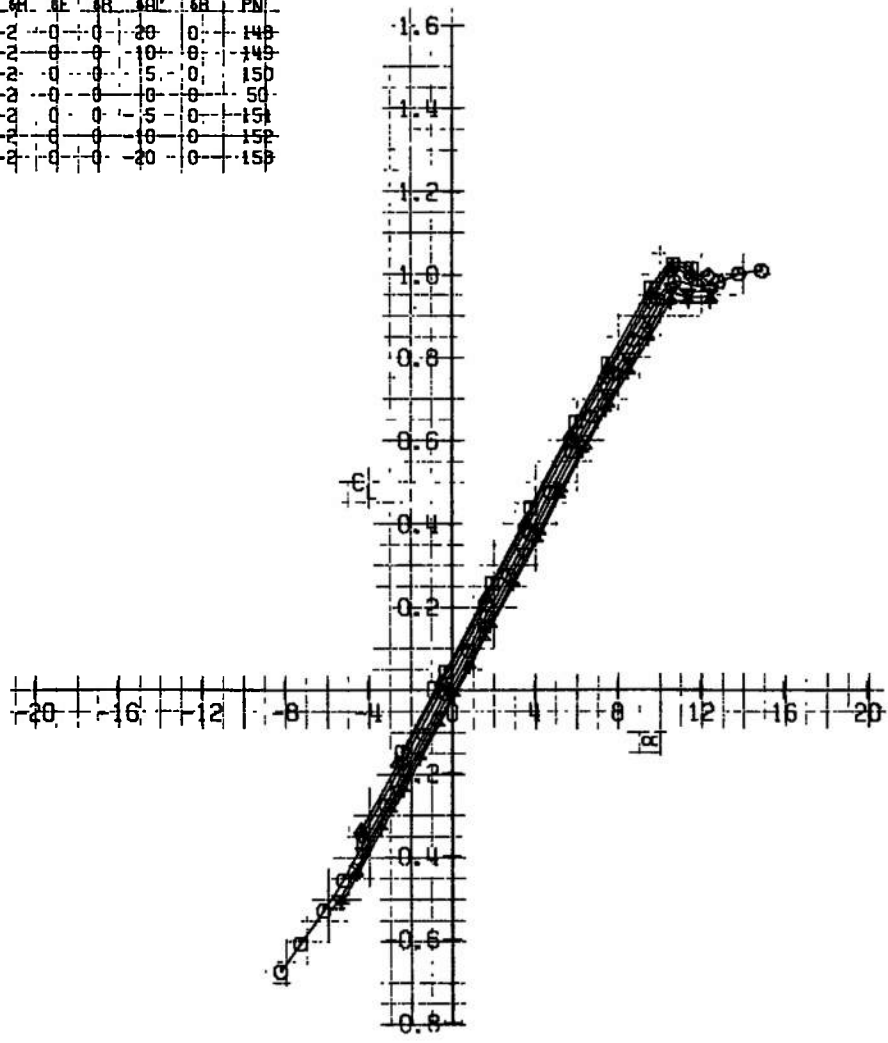
CONFIGURATION: $H_1, e_1, H_2, e_2, H_3, e_3, B_1, C_1, M_1$													
SYM	CONFIGURATION			$\epsilon$	$M_1$	$Re$	RETR	AM	AF	AR	ARI	AR	PN
⊕	$D_0$	$S_{1,6}$	$V_2$	$D_2$	$r_3$	$e_3$	0.0	2	0	0	20	0	134
⊙	$D_0$	$S_{1,6}$	$V_2$	$D_2$	$r_3$	$e_3$	0.0	2	0	0	10	0	135
◇	$D_0$	$S_{1,6}$	$V_2$	$D_2$	$r_3$	$e_3$	0.0	2	0	0	5	0	136
⊖	$D_0$	$S_{1,6}$	$V_2$	$D_2$	$r_3$	$e_3$	0.0	2	0	0	0	0	138
▽	$D_0$	$S_{1,6}$	$V_2$	$D_2$	$r_3$	$e_3$	0.0	2	0	0	5	0	137
*	$D_0$	$S_{1,6}$	$V_2$	$D_2$	$r_3$	$e_3$	0.0	2	0	0	-10	0	139
†	$D_0$	$S_{1,6}$	$V_2$	$D_2$	$r_3$	$e_3$	0.0	2	0	0	-20	0	139



a. Continued  
Fig. 8 Continued



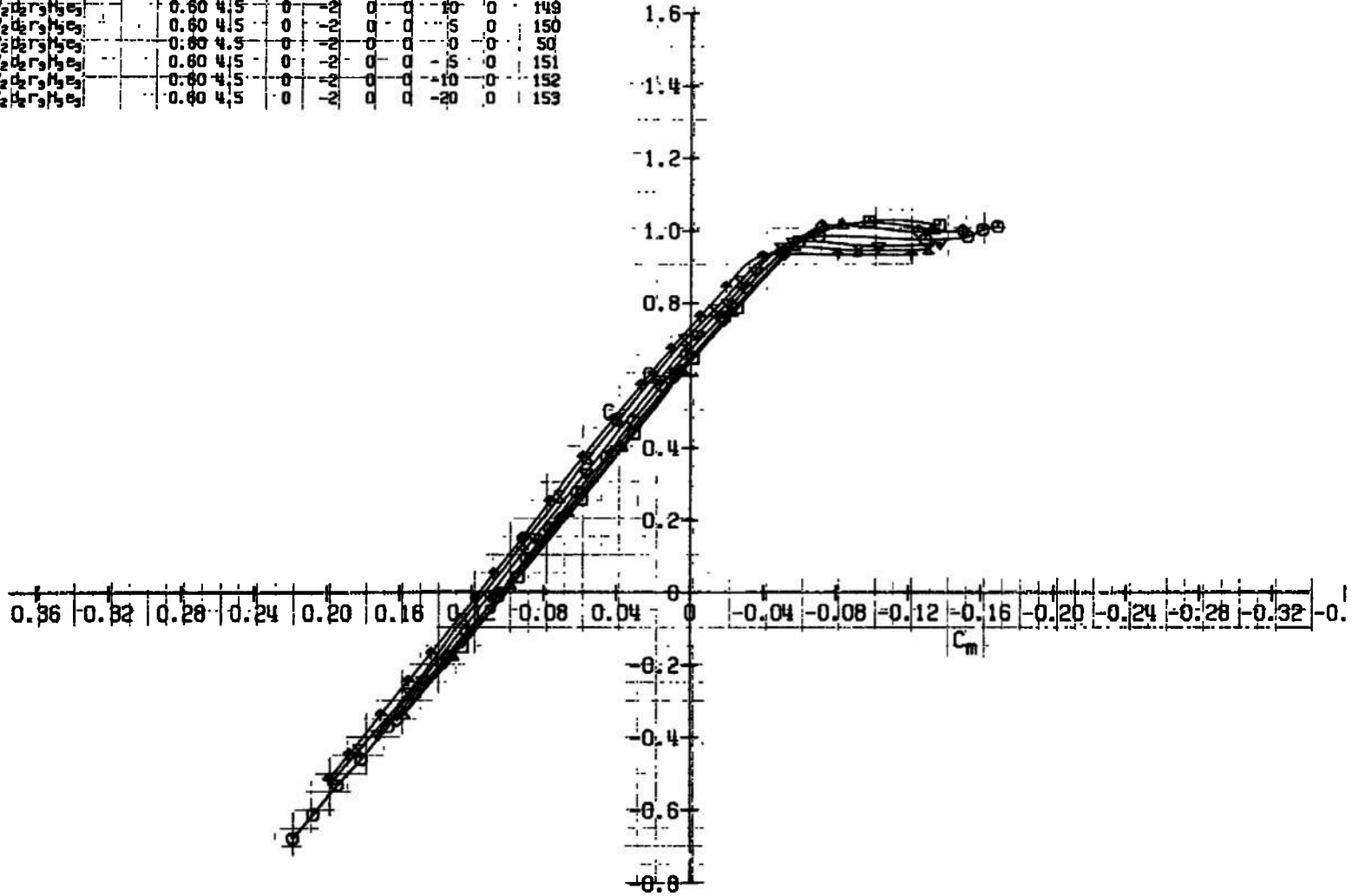
CONFIGURATION: $H_3 a_3 b_1 H_6 H_6 B_3 C_2 N_3$											
SYM	CONFIGURATION	$M_\infty$	Re	BETA	$\phi_1$	$\phi_2$	$\phi_3$	$\phi_4$	$\phi_5$	$\phi_6$	PN
□	$D_6 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.60	4.5	0	-2	0	0	20	0	0	148
△	$D_6 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.60	4.5	0	-2	0	0	10	0	0	148
◇	$D_6 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.60	4.5	0	-2	0	0	5	0	0	150
○	$D_6 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.60	4.5	0	-2	0	0	0	0	0	50
▽	$D_6 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.60	4.5	0	-2	0	0	5	0	0	151
×	$D_6 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.60	4.5	0	-2	0	0	10	0	0	152
+	$D_6 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.60	4.5	0	-2	0	0	20	0	0	153



b.  $M_\infty = 0.60$   
Fig. 8 Continued

CONFIGURATION:  $H_3 O_3 D_3 R_3 B_3 C_2 N_3$

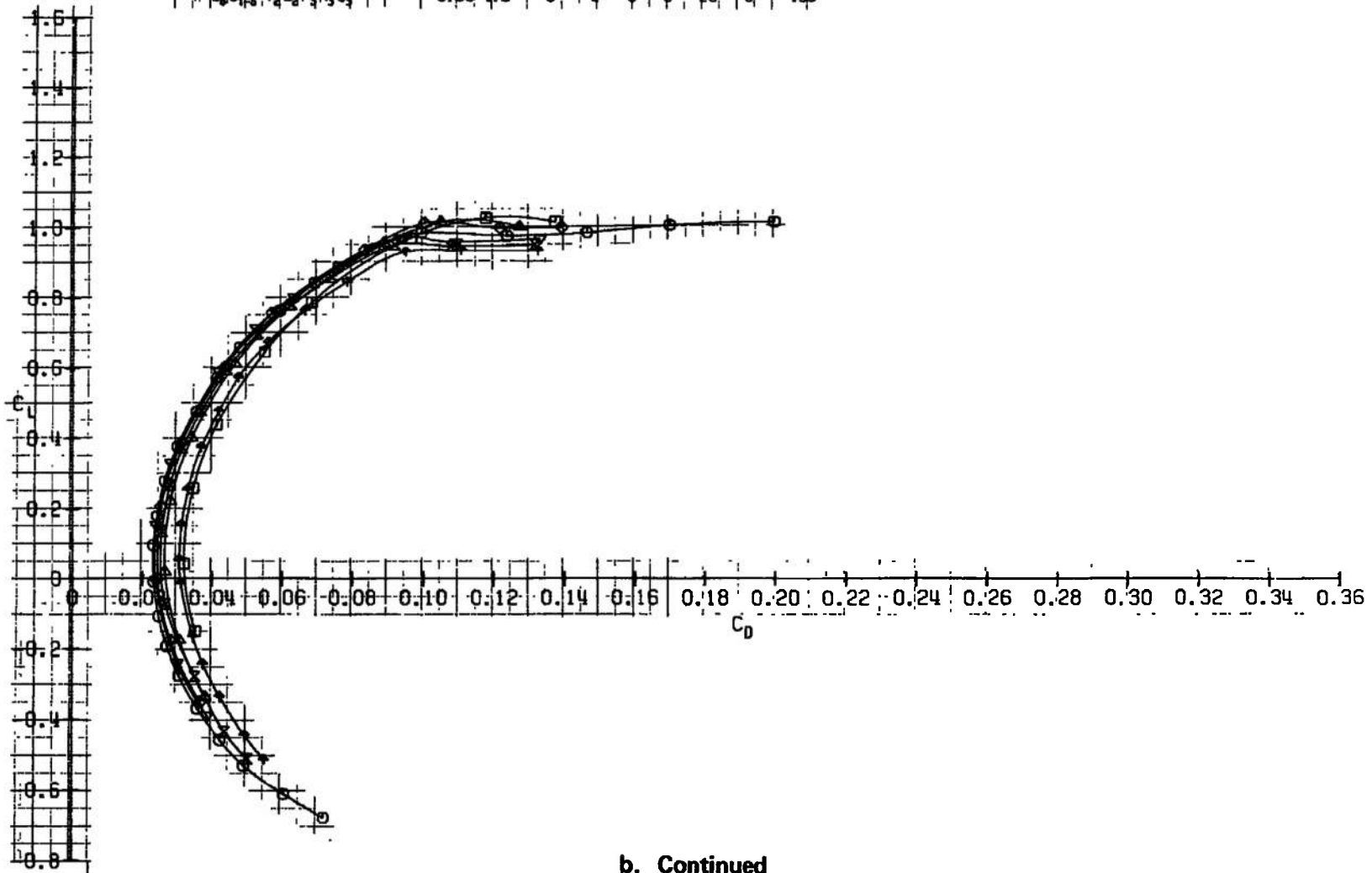
SYM	CONFIGURATION	$M_\infty$	Re	BETA	PH	ME	MR	MR	MR	MR	PN
□	$D_3 S_{1.6} V_2 D_3 R_3 H_3 O_3$	0.60	4.5	0	-2	0	0	0	20	0	148
△	$D_3 S_{1.6} V_2 D_3 R_3 H_3 O_3$	0.60	4.5	0	-2	0	0	0	20	0	149
◇	$D_3 S_{1.6} V_2 D_3 R_3 H_3 O_3$	0.60	4.5	0	-2	0	0	0	5	0	150
○	$D_3 S_{1.6} V_2 D_3 R_3 H_3 O_3$	0.60	4.5	0	-2	0	0	0	0	0	151
+	$D_3 S_{1.6} V_2 D_3 R_3 H_3 O_3$	0.60	4.5	0	-2	0	0	0	0	0	152
×	$D_3 S_{1.6} V_2 D_3 R_3 H_3 O_3$	0.60	4.5	0	-2	0	0	0	-20	0	153



b. Continued  
Fig. 8 Continued



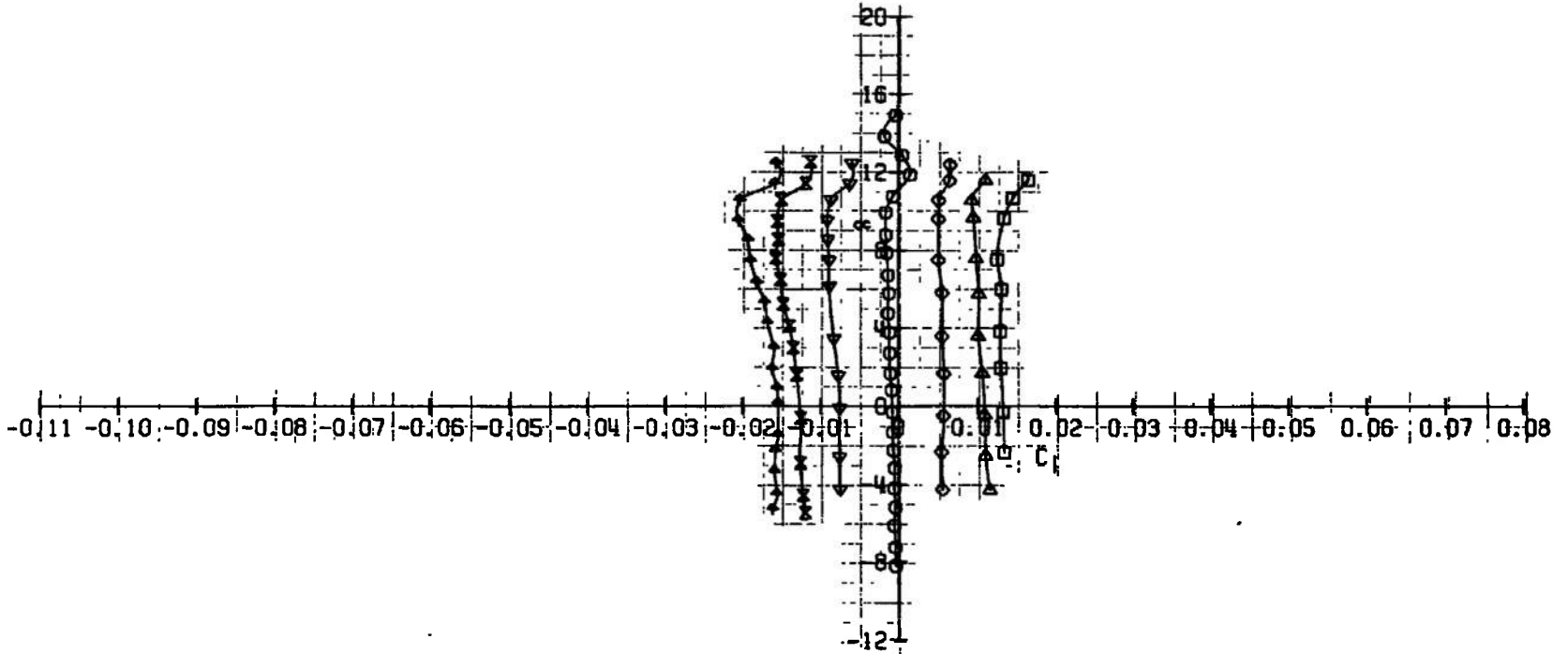
SYN	CONFIGURATION	$M_\infty$	$Re$	BETA	SH	AF	FR	SD	SB	PN
□	$D_3 S_1 S_3 V_2 d_2 r_2 H_2 e_3$	0.50	4.5	0	-2	0	0	20	0	148
△	$D_3 S_1 S_3 V_2 d_2 r_2 H_2 e_3$	0.50	4.5	0	-2	0	0	10	0	149
◇	$D_3 S_1 S_3 V_2 d_2 r_2 H_2 e_3$	0.50	4.5	0	-2	0	0	5	0	150
○	$D_3 S_1 S_3 V_2 d_2 r_2 H_2 e_3$	0.50	4.5	0	-2	0	0	0	0	50
▽	$D_3 S_1 S_3 V_2 d_2 r_2 H_2 e_3$	0.50	4.5	0	-2	0	0	5	0	151
×	$D_3 S_1 S_3 V_2 d_2 r_2 H_2 e_3$	0.50	4.5	0	-2	0	0	10	0	152
+	$D_3 S_1 S_3 V_2 d_2 r_2 H_2 e_3$	0.50	4.5	0	-2	0	0	20	0	153



b. Continued  
Fig. 8 Continued

CONFIGURATION:  $V_2 d_2 r_3 M_2 C_2 N_2$

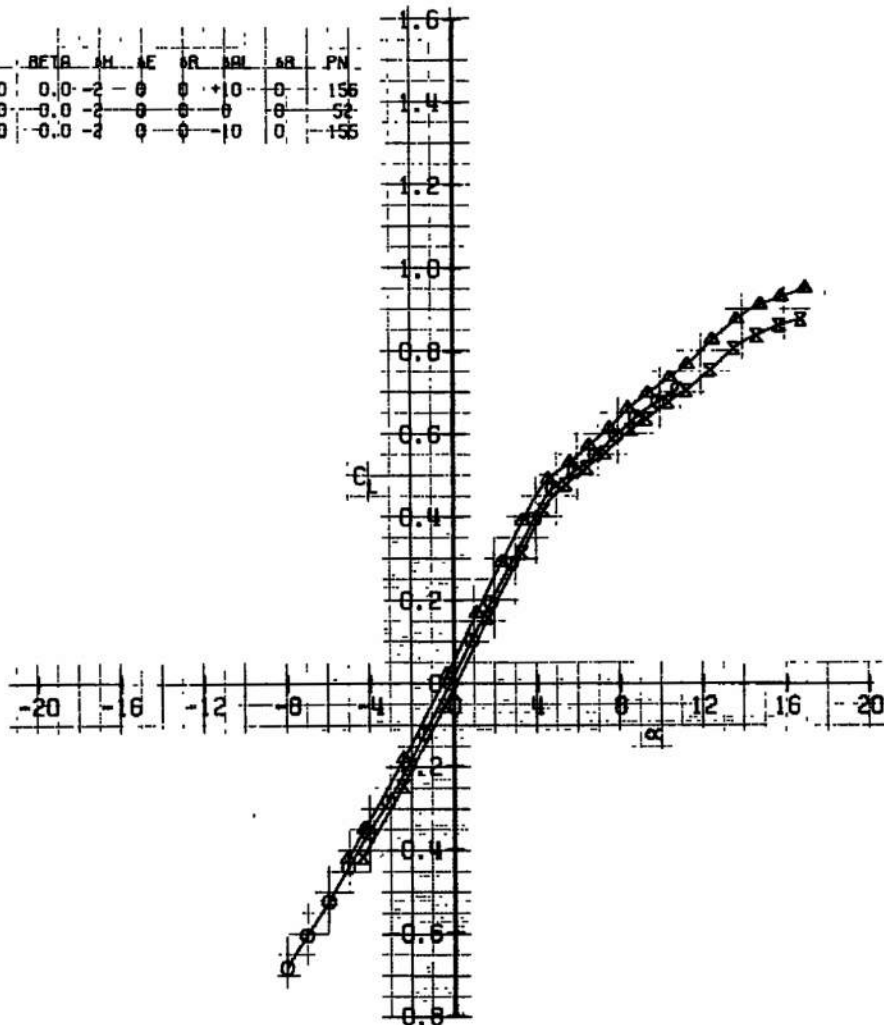
SYM	CONFIGURATION	$M_2$	No	REF	$\theta_1$	$\theta_2$	$\theta_3$	$\theta_4$	$\theta_5$	PN
□	$P_8 S_{14} V_2 d_2 r_3 M_2 C_2 N_2$	0.60	4	5	0	0	0	0	20	0
△	$P_8 S_{14} V_2 d_2 r_3 M_2 C_2 N_2$	0.60	4	5	0	0	0	0	10	0
◇	$P_8 S_{14} V_2 d_2 r_3 M_2 C_2 N_2$	0.60	4	5	0	0	0	0	5	0
○	$P_8 S_{14} V_2 d_2 r_3 M_2 C_2 N_2$	0.60	4	5	0	0	0	0	0	0
×	$P_8 S_{14} V_2 d_2 r_3 M_2 C_2 N_2$	0.60	4	5	0	0	0	0	5	0
+	$P_8 S_{14} V_2 d_2 r_3 M_2 C_2 N_2$	0.60	4	5	0	0	0	0	10	0
•	$P_8 S_{14} V_2 d_2 r_3 M_2 C_2 N_2$	0.60	4	5	0	0	0	0	20	0



b. Concluded  
Fig. 8 Continued

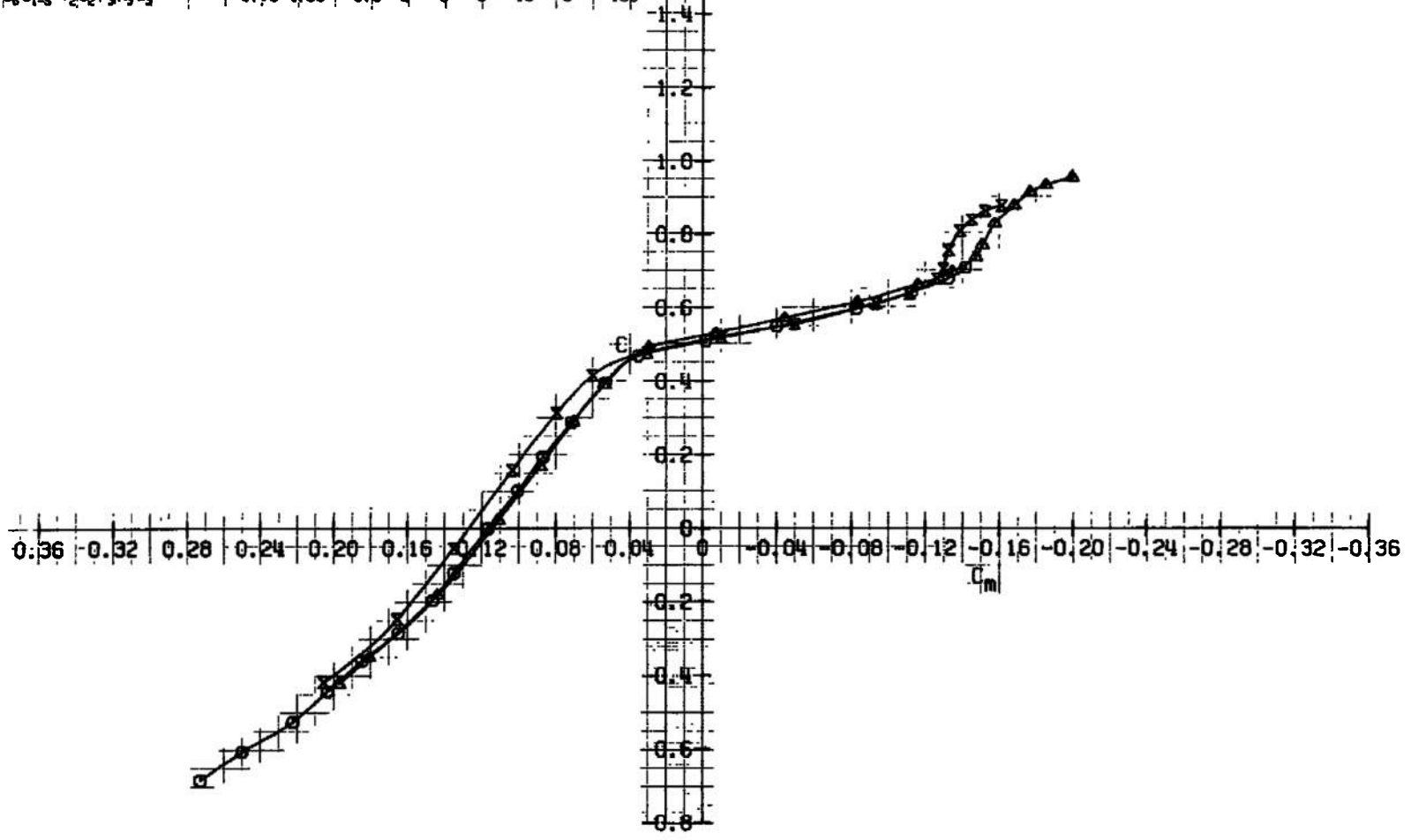
CONFIGURATION:  $M_3 e_3 b_4 h_6 h_8 E_3 C_2 N_3$

SYM	CONFIGURATION	$X_{00}$	Re	RETA	M	AE	AR	APL	AR	PN
▲	$D_6 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.70	4.50	0.0	-2	0	0	+10	0	156
○	$B_6 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.70	4.50	0.0	-2	0	0	0	0	52
Σ	$D_6 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.70	4.50	0.0	-2	0	0	-10	0	156



c.  $M_\infty = 0.70$   
 Fig. 8 Continued

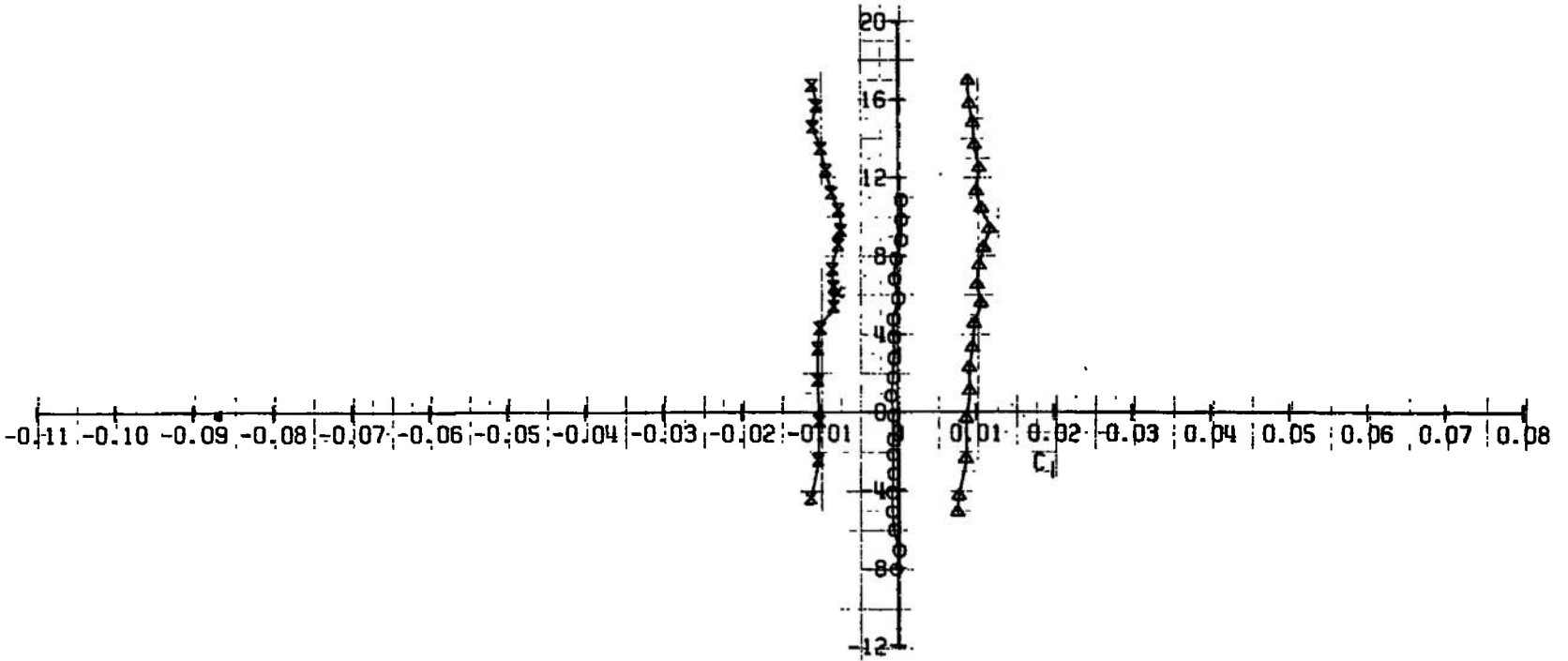
CONFIGURATION: $H_2O_2, O_2, H_2, H_2O, B_3, C_2H_2$		$M_\infty$	$Re$	BETA	$\alpha$	$\alpha F$	$\alpha B$	$\alpha L$	$\alpha R$	PN
$\Delta$	$D_6 S_{1-5} V_2 d_2 r_3 H_2 e_3$	0.70	4,50	0.0	-2	0	0	+10	0	156
$\ominus$	$D_6 S_{1-5} V_2 d_2 r_3 H_2 e_3$	0.70	4,50	0.0	-2	0	0	0	0	52
$\times$	$D_6 S_{1-5} V_2 d_2 r_3 H_2 e_3$	0.70	4,50	0.0	-2	0	0	-10	0	155



c. Continued  
Fig. 8 Continued

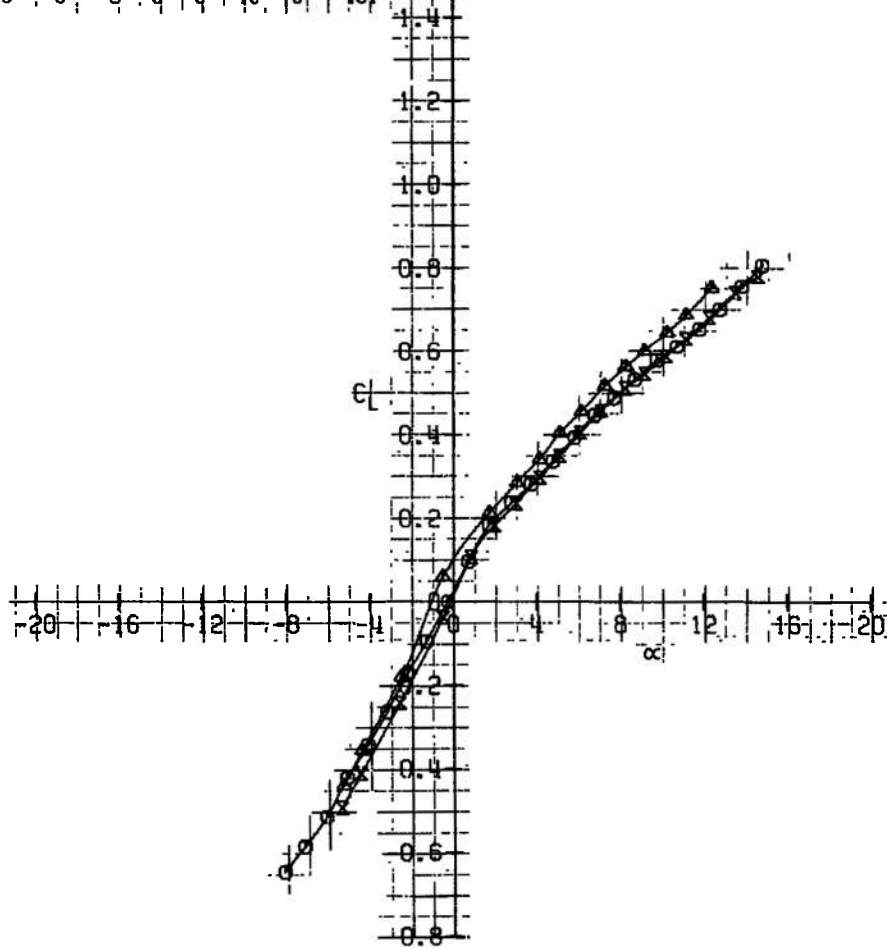


SYN.	CONFIGURATION	$M_\infty$	$Re$	BETA	$\theta_1$	$\theta_2$	$\theta_3$	$\theta_4$	$\theta_5$	$\theta_6$	$\theta_7$	PN
Δ	$D_0 S_{1-6} V_2 D_2 r_3 H_3 C_3$	0.70	4,50	0.0	2	0	0	+10	0	0	0	156
○	$D_0 S_{1-6} V_2 D_2 r_3 H_3 C_3$	0.70	4,50	0.0	2	0	0	0	0	0	0	155
×	$D_0 S_{1-6} V_2 D_2 r_3 H_3 C_3$	0.70	4,50	0.0	2	0	0	-10	0	0	0	155



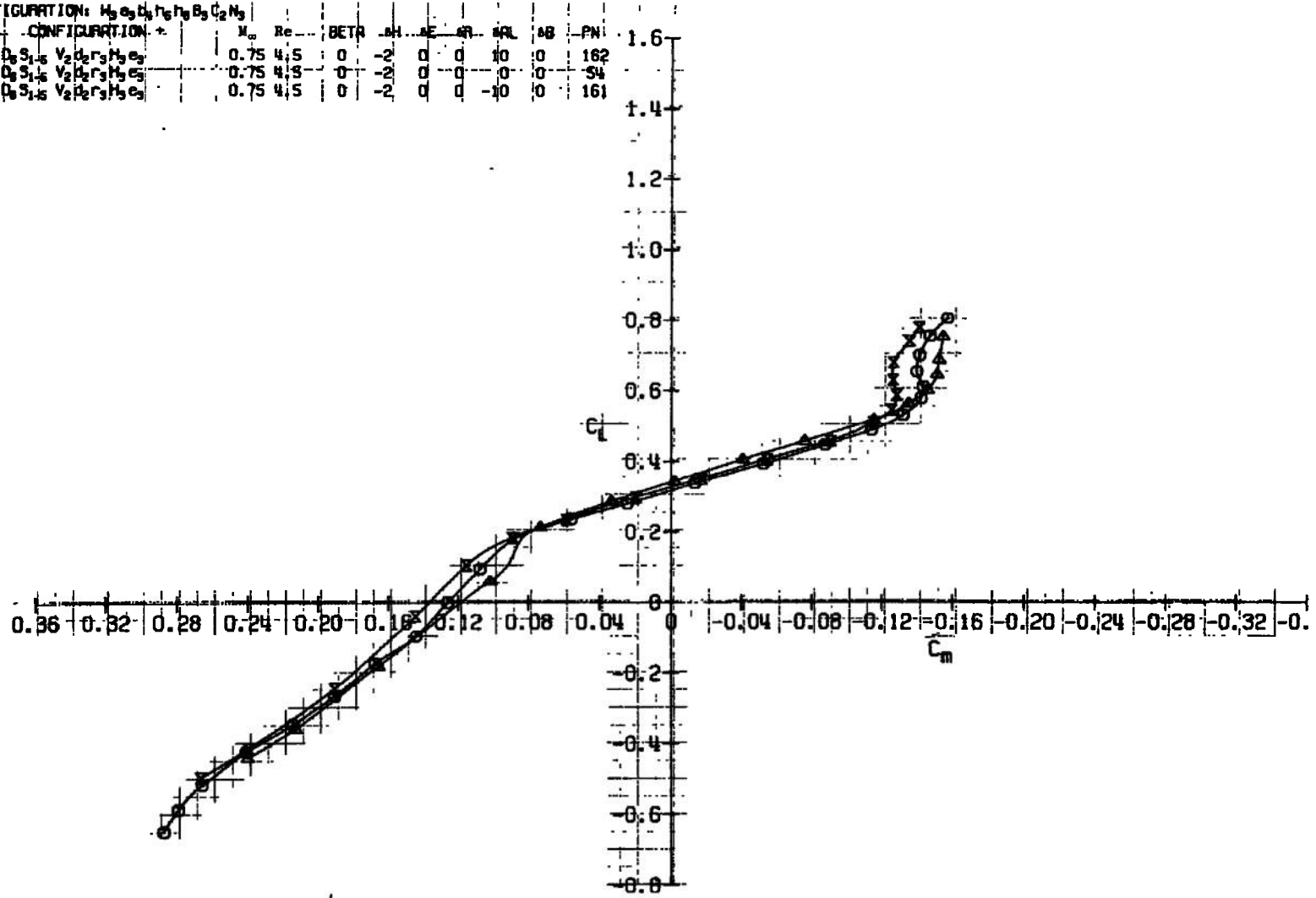
c. Concluded  
Fig. 8 Continued

CONFIGURATION: $W_3 a_3 b_4 h_6 h_3 B_3 C_2 N_3$											
SYM	CONFIGURATION	$M_\infty$	Re	BETA	$\phi_1$	$\phi_F$	$\phi_R$	$\phi_D$	$\phi_B$	PN	
$\Delta$	$D_6 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.75	4,5	0	-2	0	0	10	0	162	1.6
$\circ$	$D_6 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.75	4,5	0	-2	0	0	0	0	54	
$\times$	$D_6 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.75	4,5	0	-2	0	0	10	0	162	



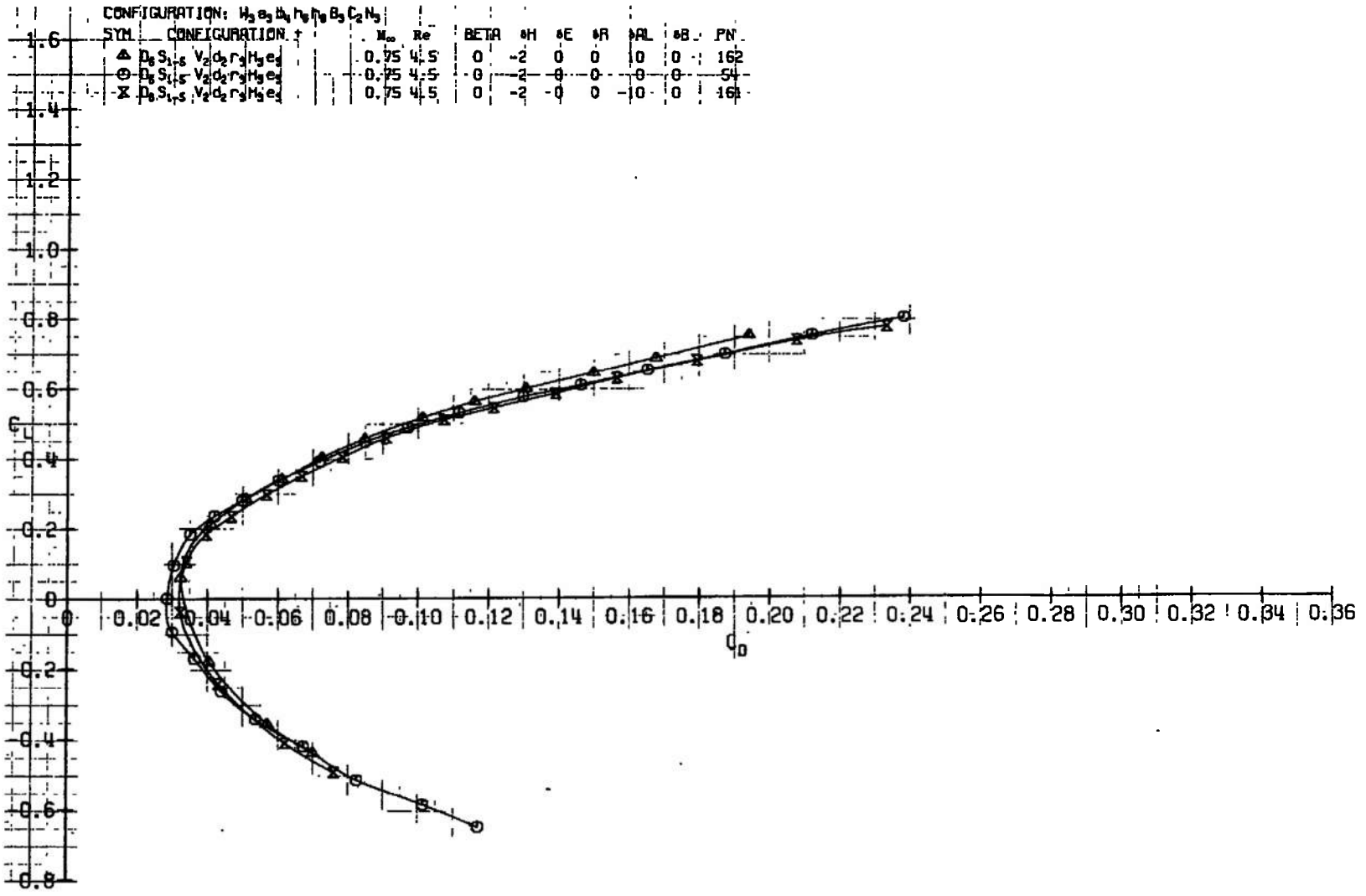
d.  $M_\infty = 0.75$   
Fig. 8 Continued

SYN	CONFIGURATION	$M_\infty$	Re	BETR	$\alpha$	$\beta$	$\gamma$	$\delta$	$\epsilon$	$\zeta$	$\eta$	$\theta$	$\phi$	PN
▲	D <sub>0</sub> S <sub>1.5</sub> V <sub>2</sub> D <sub>2</sub> R <sub>3</sub> H <sub>3</sub> E <sub>3</sub>	0.75	4.5	0	-2	0	0	0	0	0	0	0	0	162
○	D <sub>0</sub> S <sub>1.5</sub> V <sub>2</sub> D <sub>2</sub> R <sub>3</sub> H <sub>3</sub> E <sub>3</sub>	0.75	4.5	0	-2	0	0	0	0	0	0	0	0	161
×	D <sub>0</sub> S <sub>1.5</sub> V <sub>2</sub> D <sub>2</sub> R <sub>3</sub> H <sub>3</sub> E <sub>3</sub>	0.75	4.5	0	-2	0	0	0	0	0	0	0	0	161



d. Continued  
Fig. 8 Continued

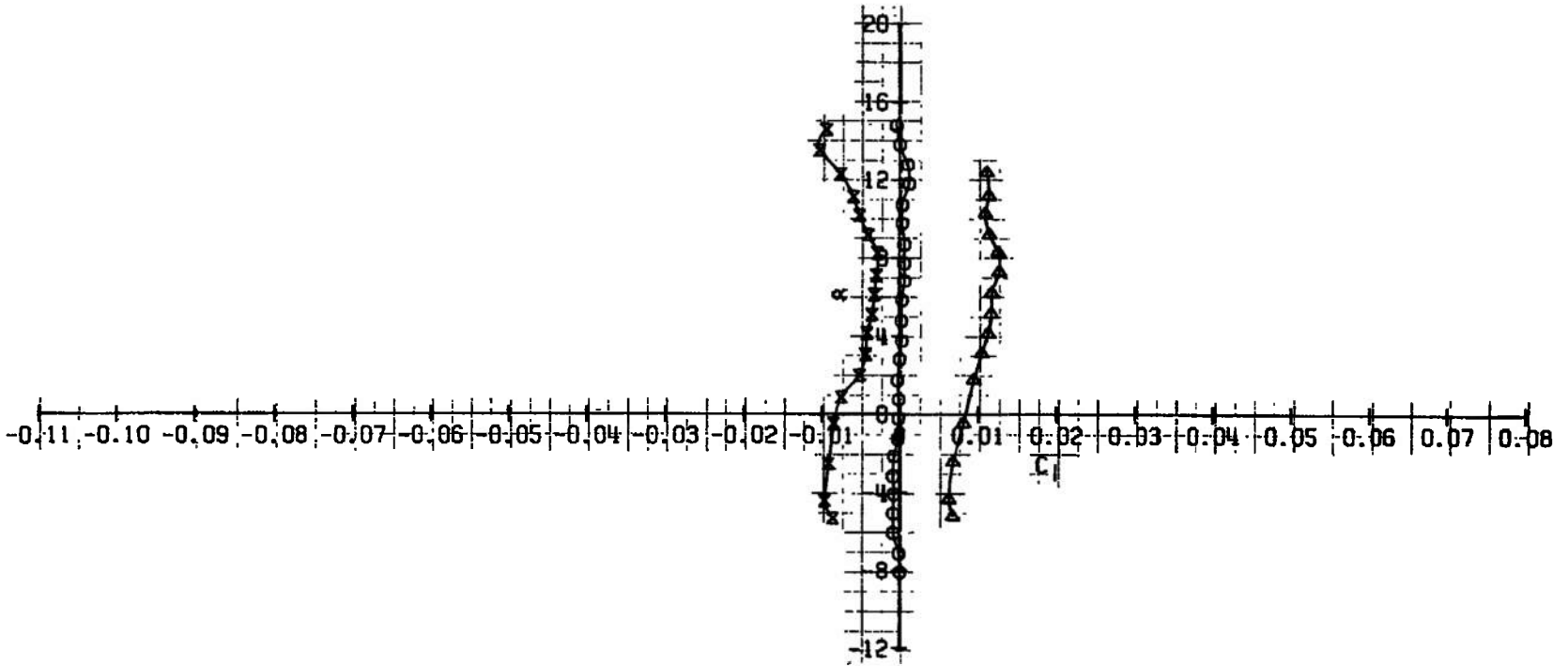




d. Continued  
Fig. 8 Continued

CONFIGURATION:  $V_2, S_{1-6}, V_2, D_2, r_2, h_2, e_2$

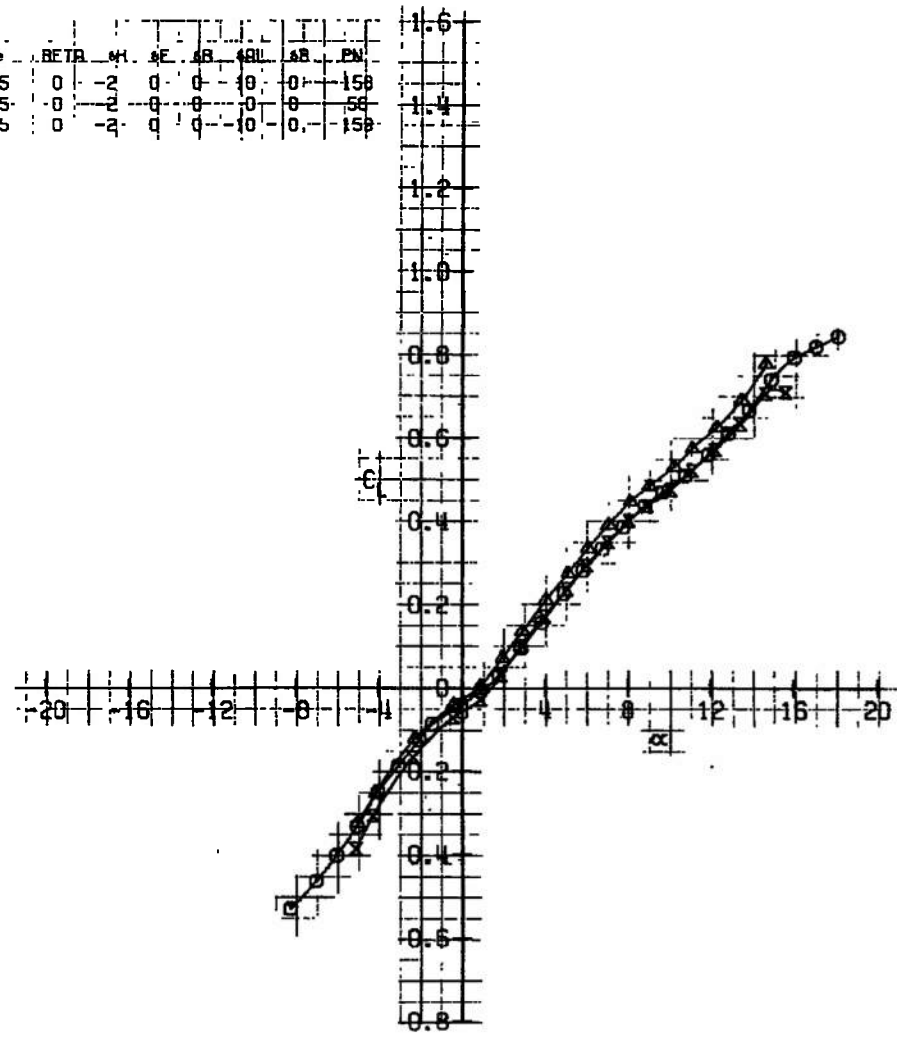
SYN	CONFIGURATION	$M_\infty$	$Re$	BETA	$\phi_1$	$\phi_2$	$\phi_3$	$\phi_4$	$\phi_5$	$\phi_6$
A	$D_2, S_{1-6}, V_2, D_2, r_2, h_2, e_2$	0.75	4.5	0	0	0	0	0	0	0
O	$D_2, S_{1-6}, V_2, D_2, r_2, h_2, e_2$	0.75	4.5	0	0	0	0	0	0	0
X	$D_2, S_{1-6}, V_2, D_2, r_2, h_2, e_2$	0.75	4.5	0	0	0	0	0	0	0



d. Concluded  
Fig. 8 Continued

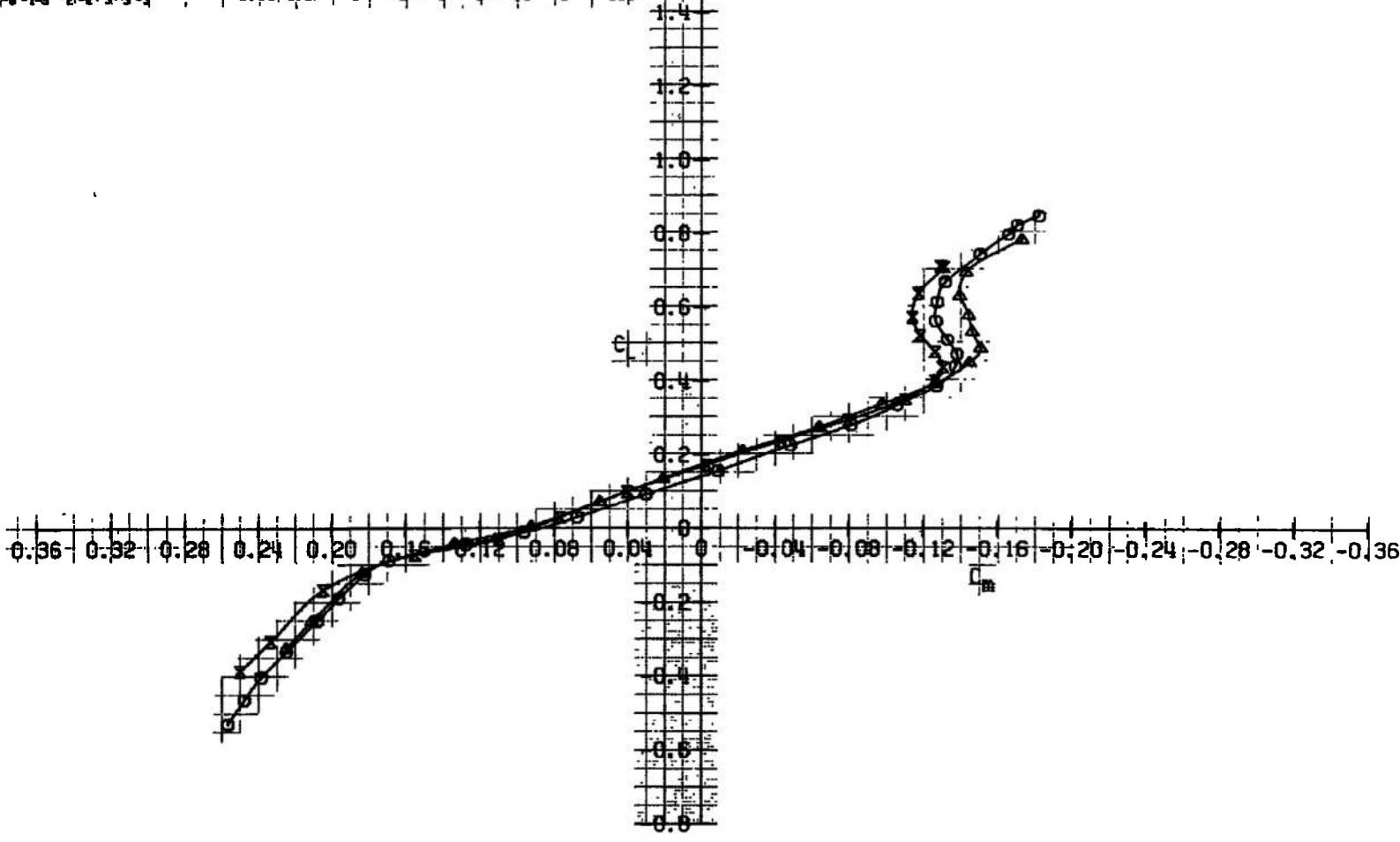
CONFIGURATION:  $M_3 e_3 b_4 h_5 h_6 B_3 C_2 N_3$

SYM	CONFIGURATION	$M_\infty$	$R_e$	BETA	$M_1$	$\delta F$	$\delta B$	$\delta B_1$	$\delta B_2$	$\delta B_3$
$\Delta$	$D_6 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.80	4.5	0	-2	0	0	0	0	150
$\ominus$	$D_6 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.80	4.5	0	-2	0	0	0	0	50
$\times$	$D_6 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.80	4.5	0	-2	0	0	0	0	150

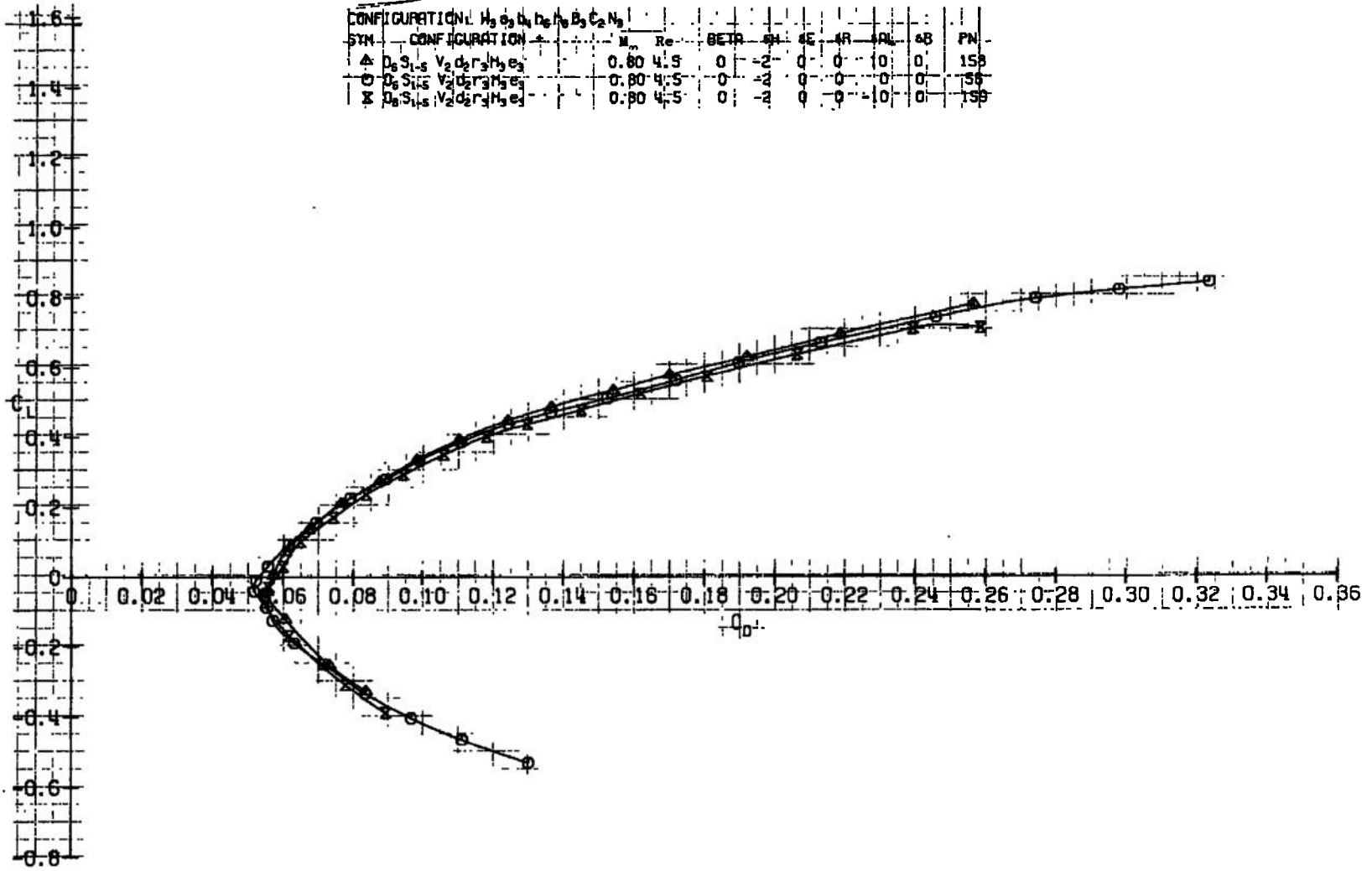


e.  $M_\infty = 0.80$   
 Fig. 8 Continued

CONFIGURATION: $H_2, O_2, H_2O, H_2, H_2O, H_2O, CO_2, N_2$													
SYM	CONFIGURATION				$M_\infty$	$Re$	BETA	$\alpha$	$\delta$	AR	APL	AB	PM
△	$D_1 S_{1.5}$	$V_2 d_2 r_3 H_2 e_1$			0.80	4.5	0	-2	0	0	0	0	158
○	$D_1 S_{1.5}$	$V_2 d_2 r_3 H_2 e_2$			0.80	4.5	0	-2	0	0	0	0	58
×	$D_1 S_{1.5}$	$V_2 d_2 r_3 H_2 e_3$			0.80	4.5	0	-2	0	0	-10	0	158



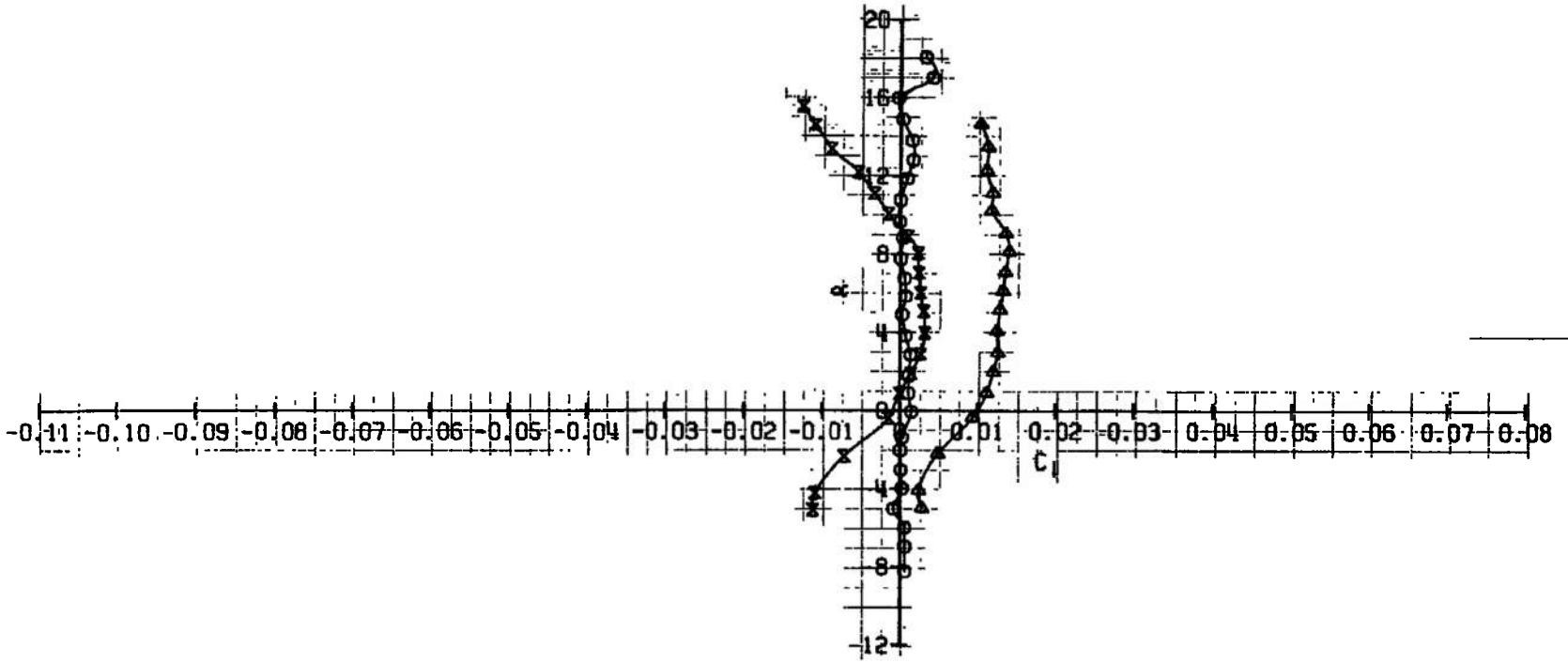
e. Continued  
Fig. 8 Continued



e. Continued  
Fig. 8 Continued

CONFIGURATION:  $H_2, O_2, H_2O, CO_2, N_2$

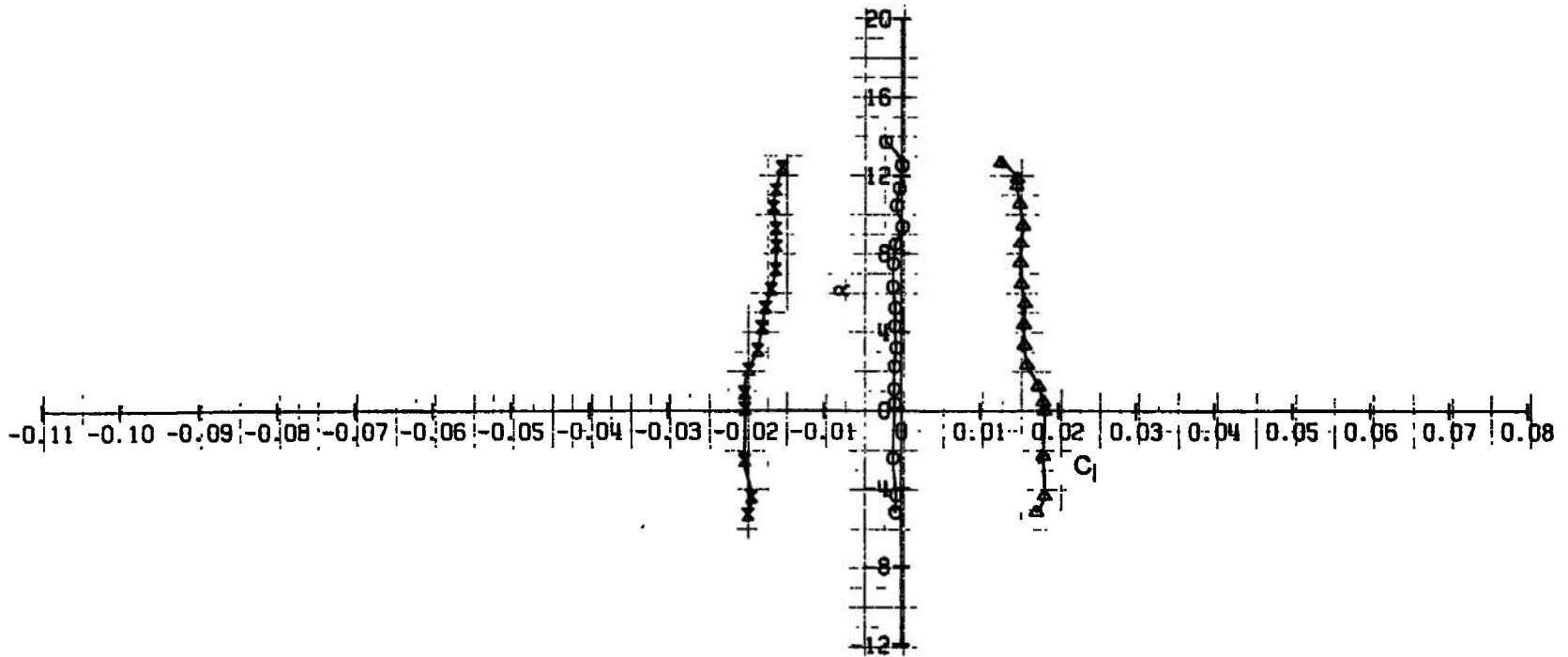
SYM	CONFIGURATION	$M_\infty$	$Re$	RETR	$\theta_1$	$\theta_2$	$\theta_3$	$\theta_4$	$\theta_5$	PM
$\Delta$	$D_0 S_{1-5} V_2 d_2 r_3 H_2 e_3$	0.80	4.5	0	0	0	0	0	0	158
$\circ$	$D_0 S_{1-5} V_2 d_2 r_3 H_2 e_3$	0.80	4.5	0	0	0	0	0	0	58
$\times$	$D_0 S_{1-5} V_2 d_2 r_3 H_2 e_3$	0.80	4.5	0	0	0	0	0	0	158



e. Concluded  
Fig. 8 Continued

CONFIGURATION:  $H_2, S_1, V_2, C_2, N_3$

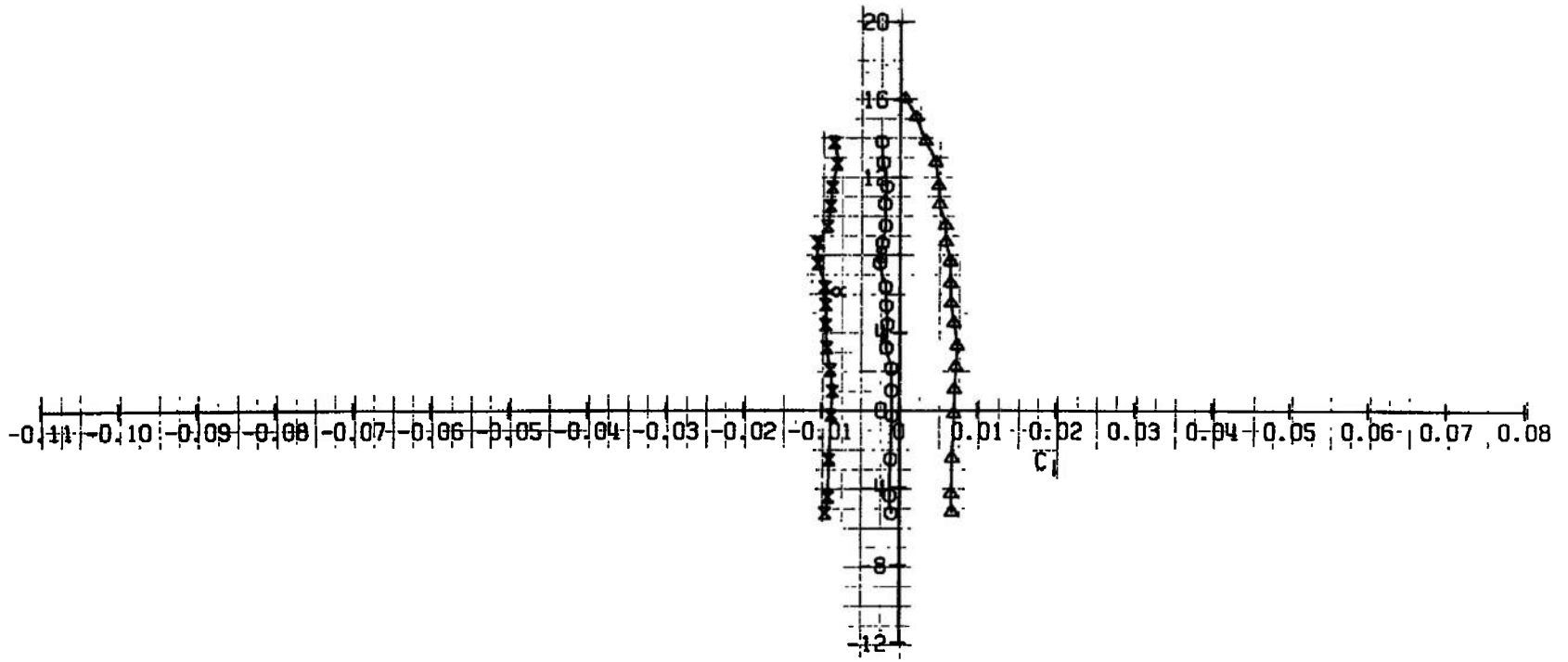
SYN.	CONFIGURATION	$M_\infty$	Re	BETA	PH	SE	SL	SP	SR	FN
A	$D_8 S_{1-4} V_2 C_2 r_3 h_3 e_3$	0.75	4,5	0	-2	0	0	10	20	180
G	$D_8 S_{1-4} V_2 C_2 r_3 h_3 e_3$	0.75	4,5	0	-2	0	0	10	20	178
M	$D_8 S_{1-4} V_2 C_2 r_3 h_3 e_3$	0.75	4,5	0	-2	0	0	10	20	178



f.  $M_\infty = 0.75$   
Fig. 8 Continued

CONFIGURATION:  $H_2, S_1, S_2, V_2, D_1, R_1, M_2, C_2, N_2$

SYM	CONFIGURATION	$M_\infty$	Re	BETA	PH	PF	PR	POI	SP	PN
△	$D_0 S_{1/2} V_2 D_1 R_1 M_2 C_2$	0.75	4.5	0	0.0	0	0	10	60	196
○	$D_0 S_{1/2} V_2 D_1 R_1 M_2 C_2$	0.75	4.5	0	0.0	0	0	0	60	196
X	$D_0 S_{1/2} V_2 D_1 R_1 M_2 C_2$	0.75	4.5	0	0.0	0	0	0	60	194

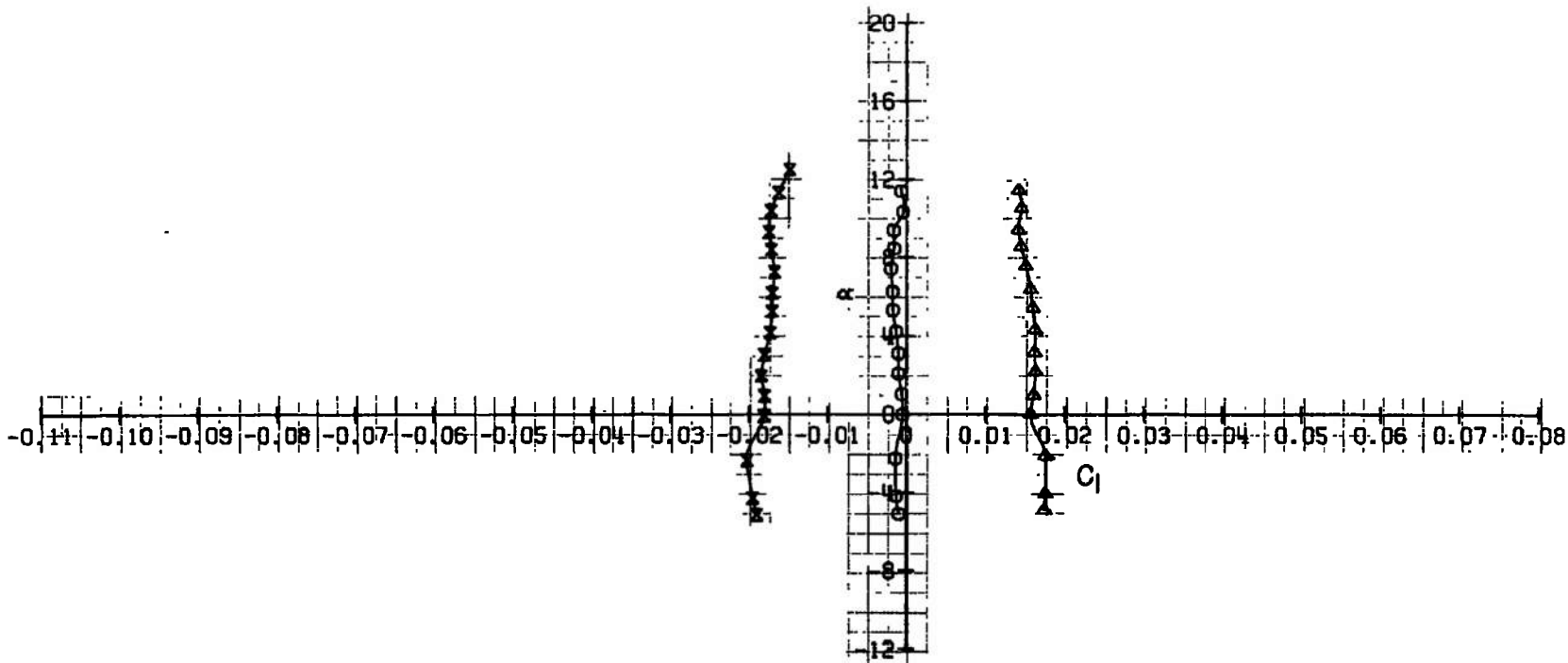


f. Concluded  
Fig. 8 Continued



CONFIGURATION:  $M_3, a_3, h_3, r_3, B_3, C_2, N_3$

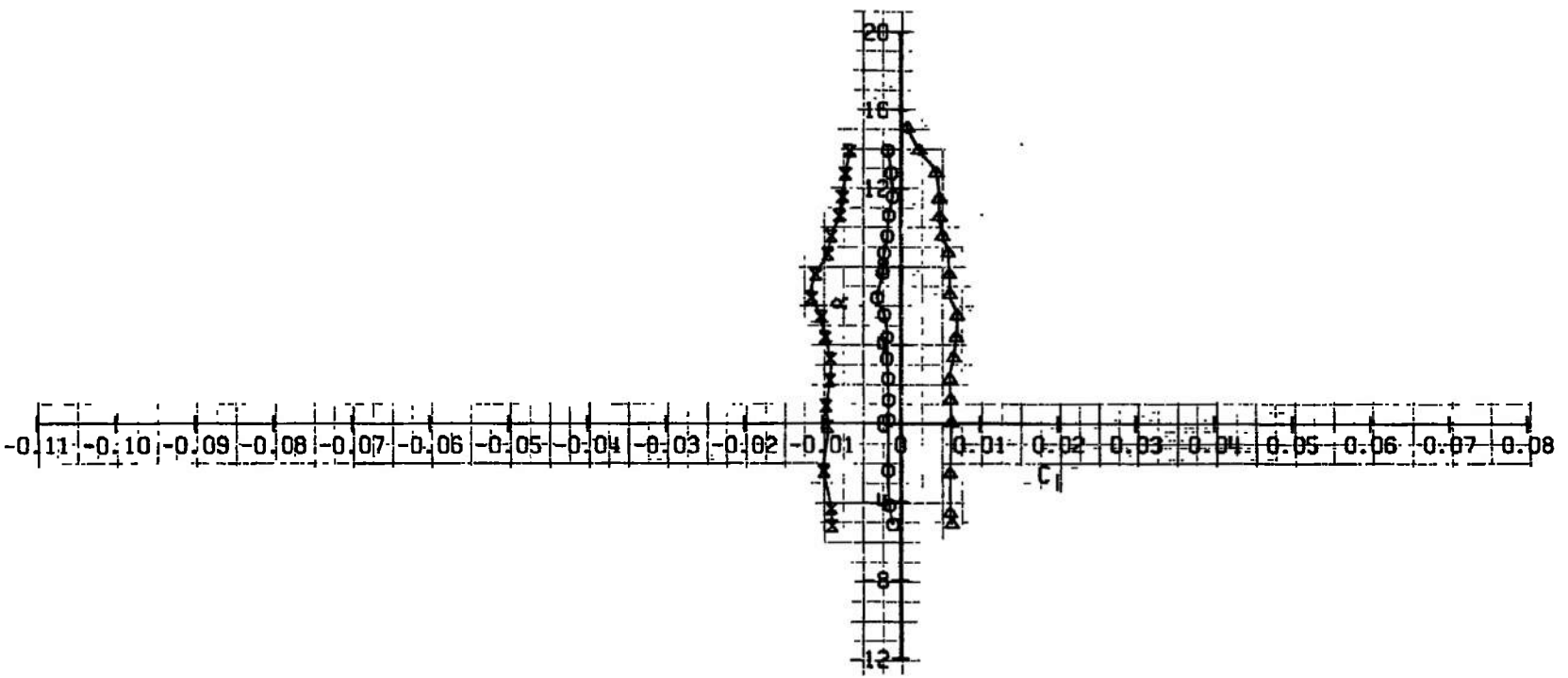
SYM	CONFIGURATION	$M_\infty$	Re	BETA	$\beta_1$	$\beta_2$	$\beta_3$	$\beta_4$	$\beta_5$	PN
A	$P_0 S_{1-6} V_2 d_2 r_3 h_3 e_3$	0.80	4.5	0	-2	0	0	10	20	181
M	$P_0 S_{1-6} V_2 d_2 r_3 h_3 e_3$	0.80	4.5	0	-2	0	0	0	20	182
M	$P_0 S_{1-6} V_2 d_2 r_3 h_3 e_3$	0.80	4.5	0	-2	0	0	-10	20	183



g.  $M_\infty = 0.80$   
Fig. 8 Continued

CONFIGURATION:  $W_3 a_3 d_3 h_3 B_3 C_2 N_3$

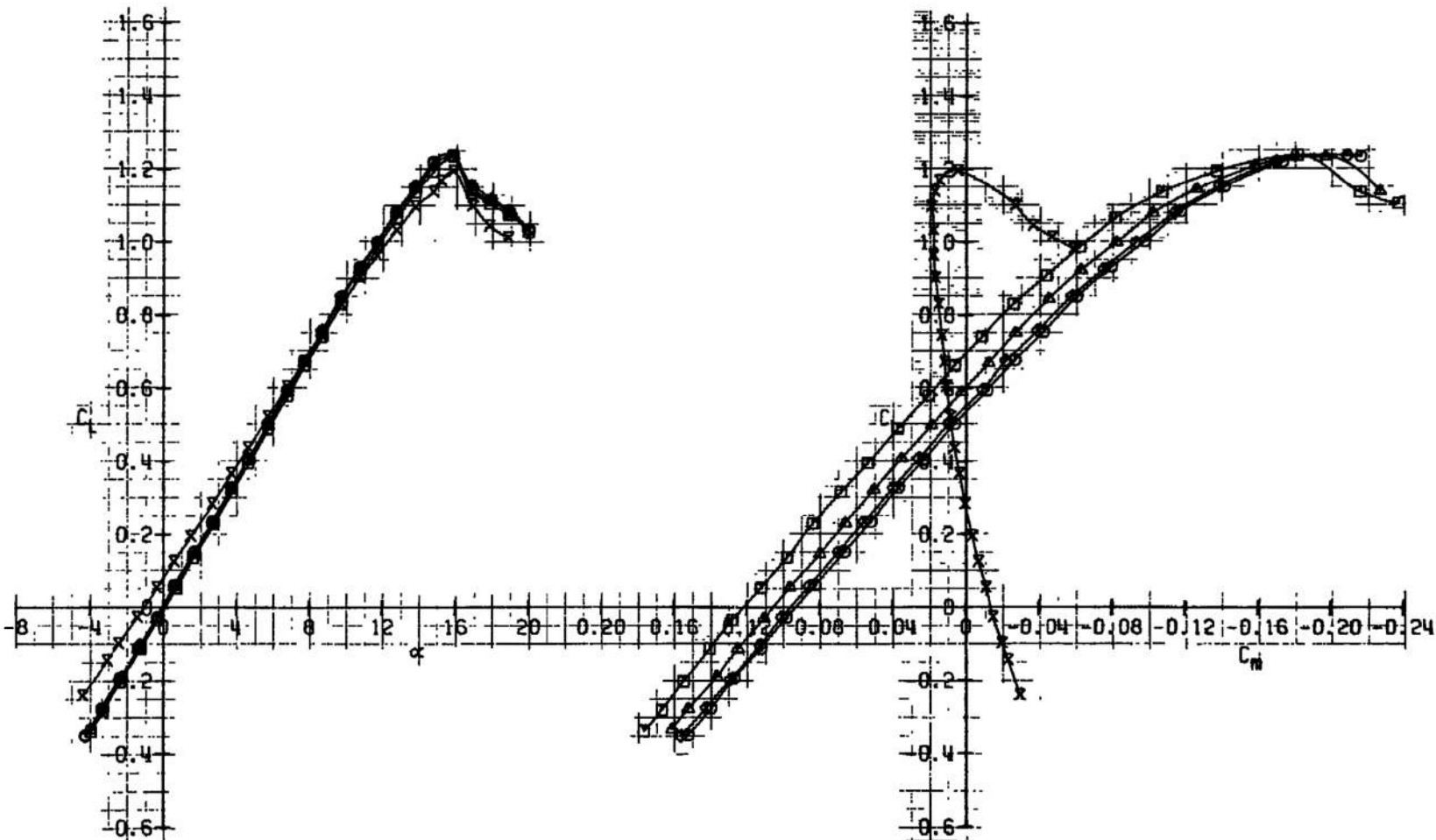
SYM	CONFIGURATION	$M_\infty$	Re	BETA	$\alpha_1$	$\alpha_2$	$\alpha_3$	$\alpha_4$	$\alpha_5$	$\alpha_6$
$\Delta$	$D_3 S_{1-6} V_2 d_2 r_3 H_3 e_3$	0.80	4	S	0	2	0	0	10	60
$\circ$	$D_3 S_{1-6} V_2 d_2 r_3 H_3 e_3$	0.80	4	S	0	2	0	0	0	60
$\times$	$D_3 S_{1-6} V_2 d_2 r_3 H_3 e_3$	0.80	4	S	0	2	0	0	10	60



g. Concluded  
 Fig. 8 Concluded

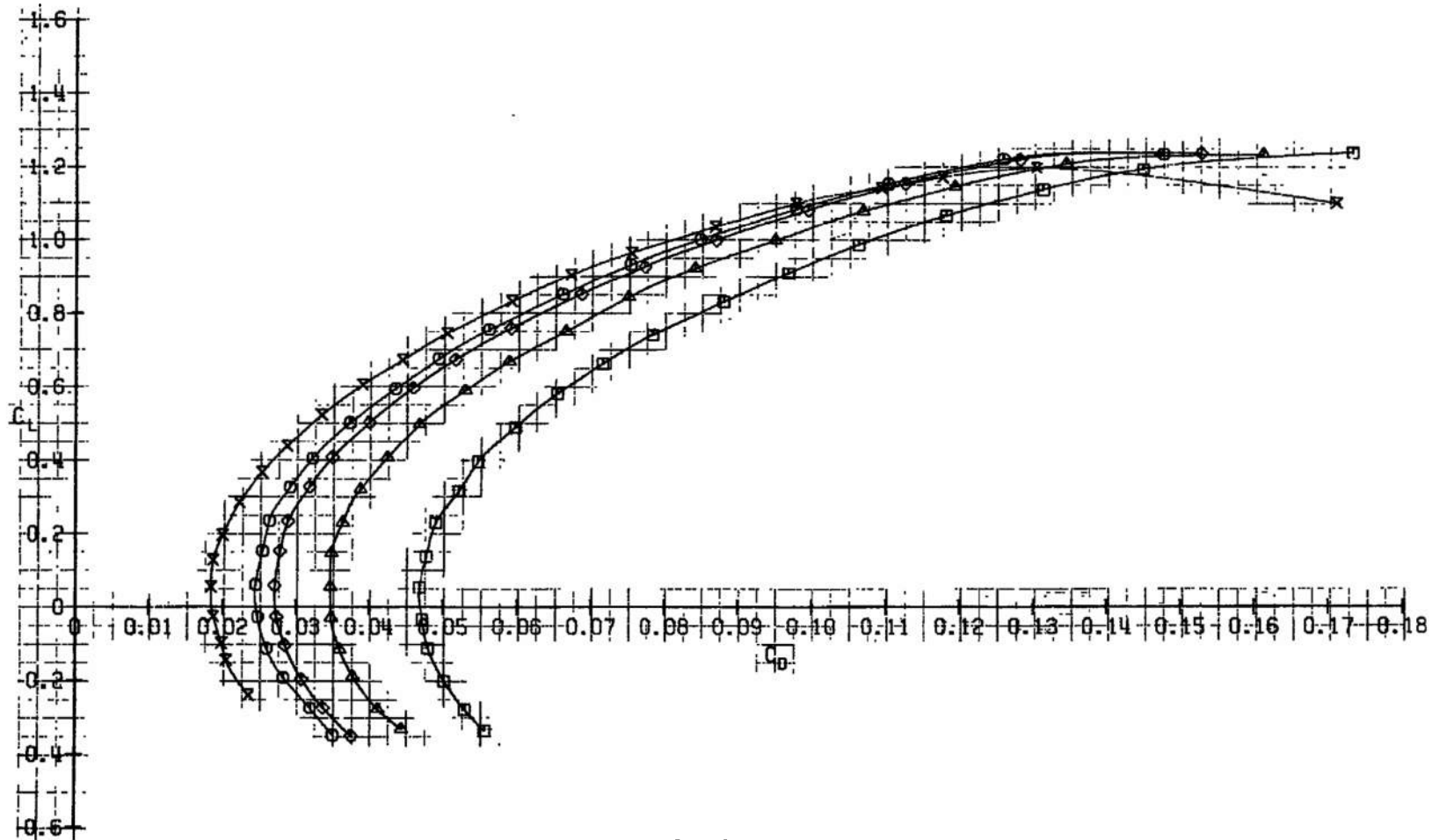
CONFIGURATION:  $V_2, a_1, t_1, V_2, a_2, t_2, V_2, a_3, t_3$

SYM	CONFIGURATION	$M_\infty$	Re	REF	MT	CF	CR	CL	CM	PN
X	$D_6 S_{1.5}$	0.30	2.3	0	0	0	0	0	0	127
○	$D_6 S_{1.5} V_2 D_2 r_3 t_3 e_3$	0.30	2.3	0	0	0	0	0	0	171
◇	$D_6 S_{1.5} V_2 D_2 r_3 t_3 e_3$	0.30	2.3	0	0	0	0	0	0	172
△	$D_6 S_{1.5} V_2 D_2 r_3 t_3 e_3$	0.30	2.3	0	0	0	0	0	0	173
□	$D_6 S_{1.5} V_2 D_2 r_3 t_3 e_3$	0.30	2.3	0	0	0	0	0	0	174



a.  $M_\infty = 0.30$   
**Fig. 9 Rudder Effectiveness**

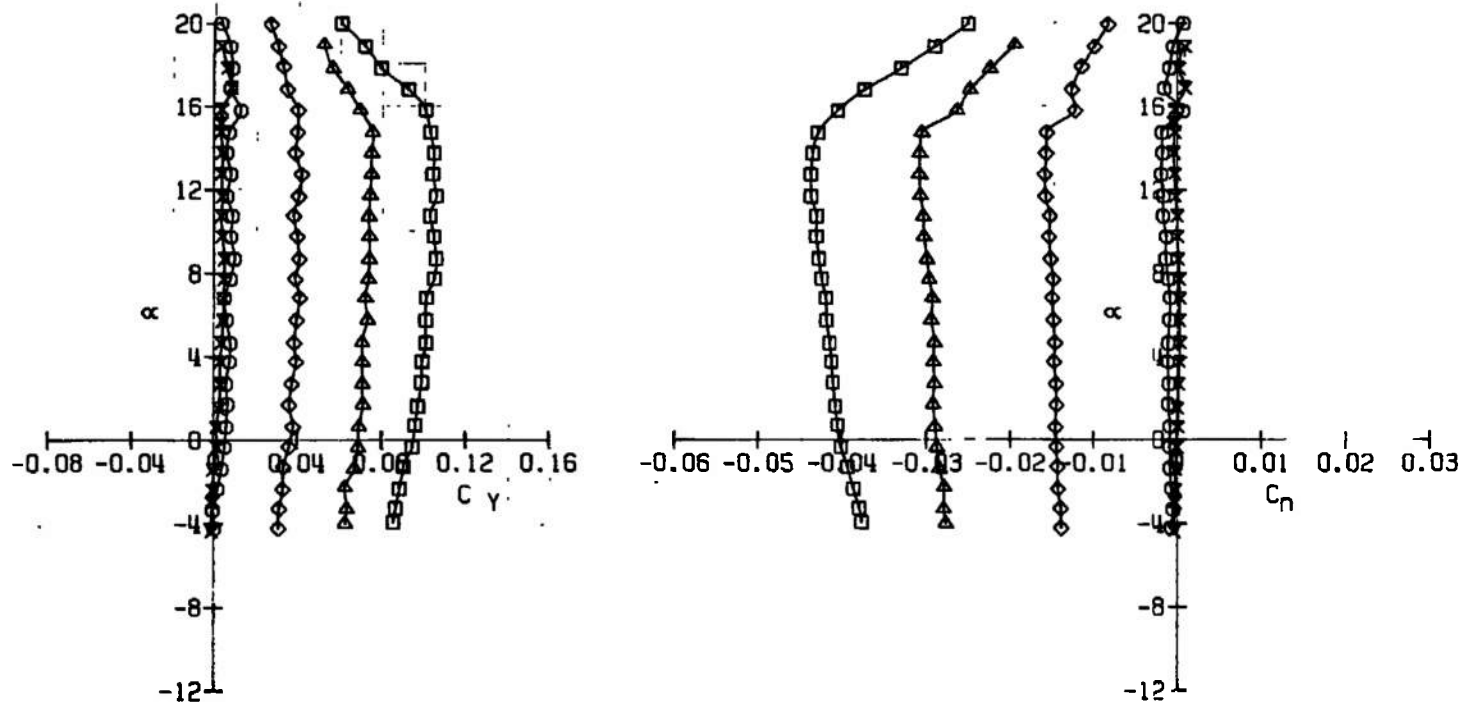
CONFIGURATION: $H_2, a_2, b_1, h_2, h_3, B_3, C_2, N_2$											
SYM.	CONFIGURATION *	$M_\infty$	$Re$	BL	TR	SH	SC	SR	SL	SB	PN
X	$D_6 S_{1.5}$	0.30	2.3	0	0	0	0	0	0	0	427
⊙	$D_6 S_{1.5} V_2 d_2 r_3 H_2 e_2$	0.30	2.3	0	0	0	0	0	0	0	274
△	$D_6 S_{1.5} V_2 d_2 r_3 H_2 e_2$	0.30	2.3	0	0	0	10	0	0	0	272
△	$D_6 S_{1.5} V_2 d_2 r_3 H_2 e_2$	0.30	2.3	0	0	0	20	0	0	0	273
□	$D_6 S_{1.5} V_2 d_2 r_3 H_2 e_2$	0.30	2.3	0	0	0	30	0	0	0	274



a. Continued  
Fig. 9 Continued

CONFIGURATION:  $H_3 e_3 b_4 h_8 h_8 B_3 C_2 N_3$

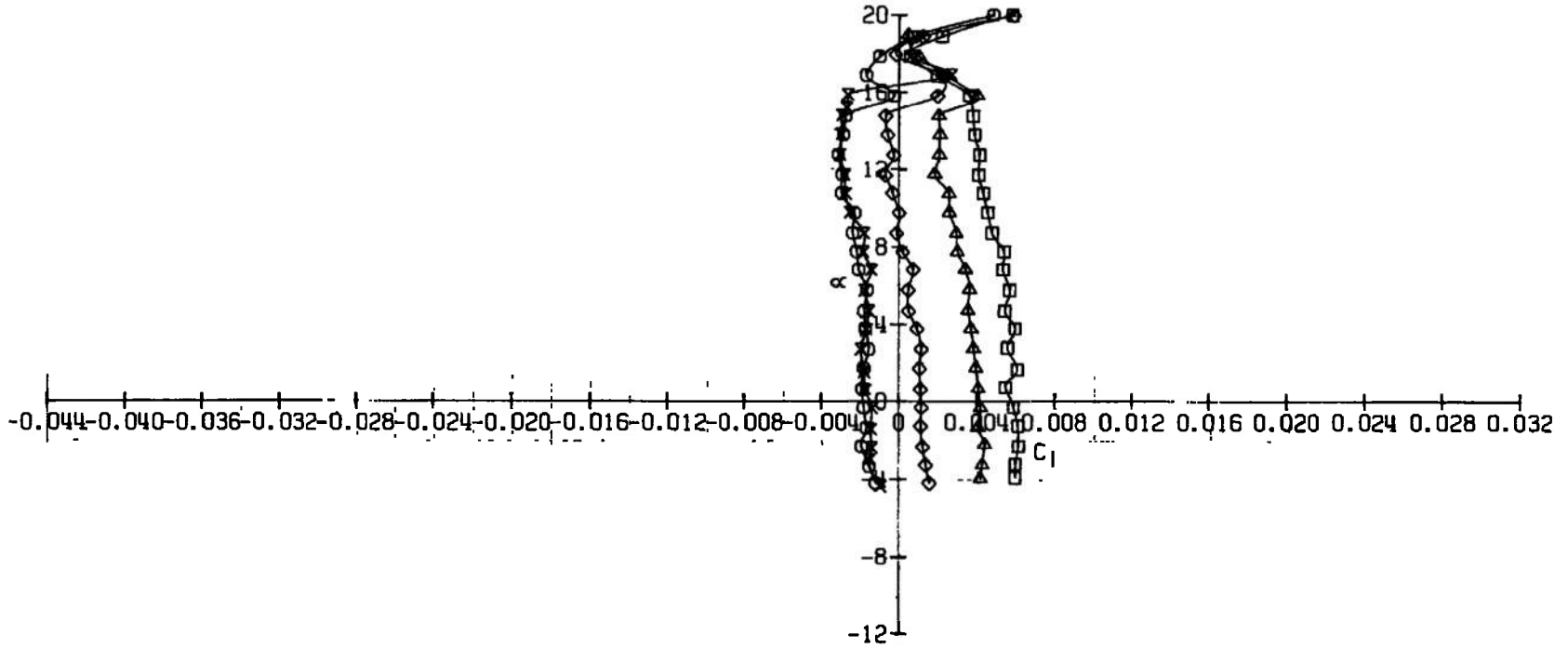
SYM	CONFIGURATION *	M <sub>∞</sub>	Re	BETA	#H	#E	#R	#AL	#B	PN
X	D <sub>0</sub> S <sub>1-5</sub>	0.30	2.3	0	-	-	0	0	0	427
○	D <sub>0</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>0</sub> r <sub>3</sub> h <sub>3</sub> e <sub>3</sub>	0.30	2.3	0	-2	0	0	0	0	271
◇	D <sub>0</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>0</sub> r <sub>3</sub> h <sub>3</sub> e <sub>3</sub>	0.30	2.3	0	-2	0	10	0	0	272
△	D <sub>0</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>0</sub> r <sub>3</sub> h <sub>3</sub> e <sub>3</sub>	0.30	2.3	0	-2	0	20	0	0	273
□	D <sub>0</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>0</sub> r <sub>3</sub> h <sub>3</sub> e <sub>3</sub>	0.30	2.3	0	-2	0	30	0	0	274



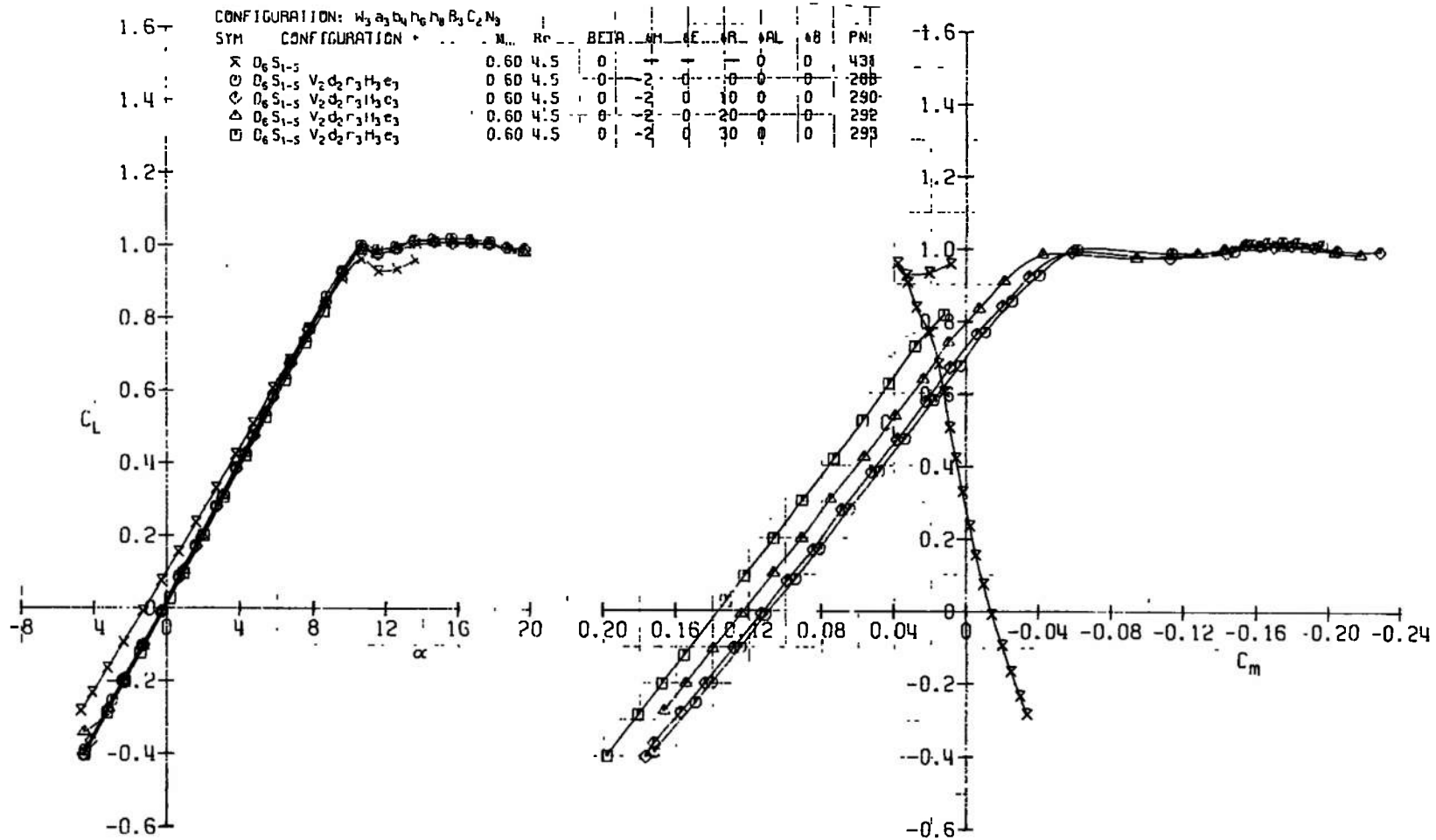
a. Continued  
Fig. 9 Continued

CONFIGURATION:  $H_3 e_3 b_4 h_6 h_8 B_3 C_2 N_3$

SYM	CONFIGURATION +	$M_\infty$	$Re$	BETA	$\delta H$	$\delta E$	$\delta A$	$\delta AL$	$\delta B$	PN
X	$D_6 S_{1-5}$	0.30	2.3	0	-	-	0	0	0	427
○	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.3	0	-2	0	0	0	0	271
◇	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.3	0	-2	0	10	0	0	272
△	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.3	0	-2	0	20	0	0	273
□	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.30	2.3	0	-2	0	30	0	0	274

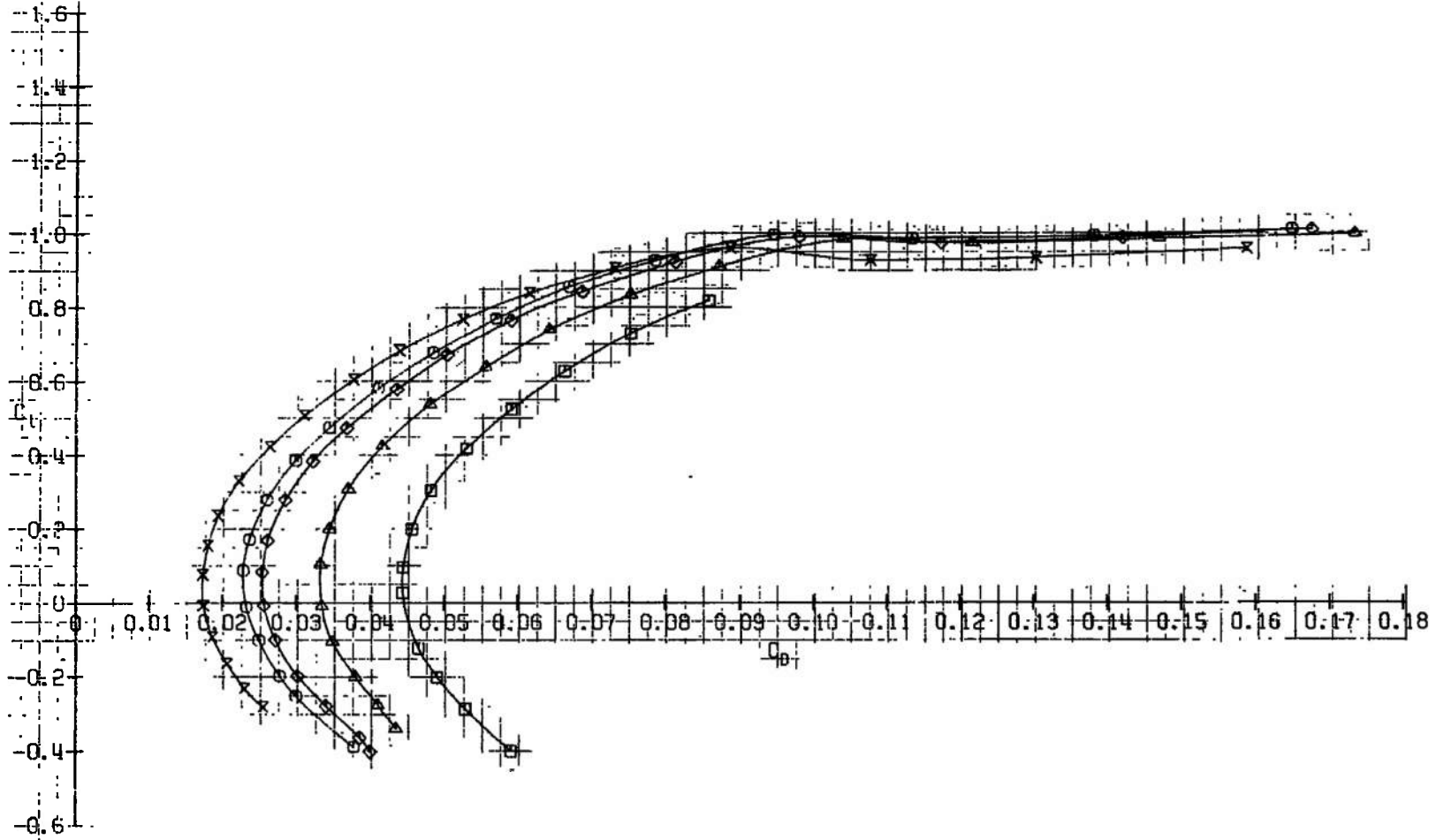


a. Concluded  
Fig. 9 Continued



b.  $M_\infty = 0.60$   
Fig. 9 Continued

CONFIGURATION: $H_1, \theta_1, H_2, \theta_2, H_3, \theta_3, C_2, H_3$		$M_\infty$	Re	REF	AF	BF	CF	DF	EF	FN
SYMBOL	CONFIGURATION									
x	$D_8 S_{1.5}$	0.60	4.5	D	0	0	0	0	0	431
o	$D_8 S_{1.5} V_2 d_2 r_3 H_1 e_3$	0.60	4.5	D	2	0	0	0	0	296
o	$D_8 S_{1.5} V_2 d_2 r_3 H_1 e_3$	0.60	4.5	D	2	0	0	0	0	290
o	$D_8 S_{1.5} V_2 d_2 r_3 H_1 e_3$	0.60	4.5	D	2	0	0	0	0	292
o	$D_8 S_{1.5} V_2 d_2 r_3 H_1 e_3$	0.60	4.5	D	2	0	0	0	0	295

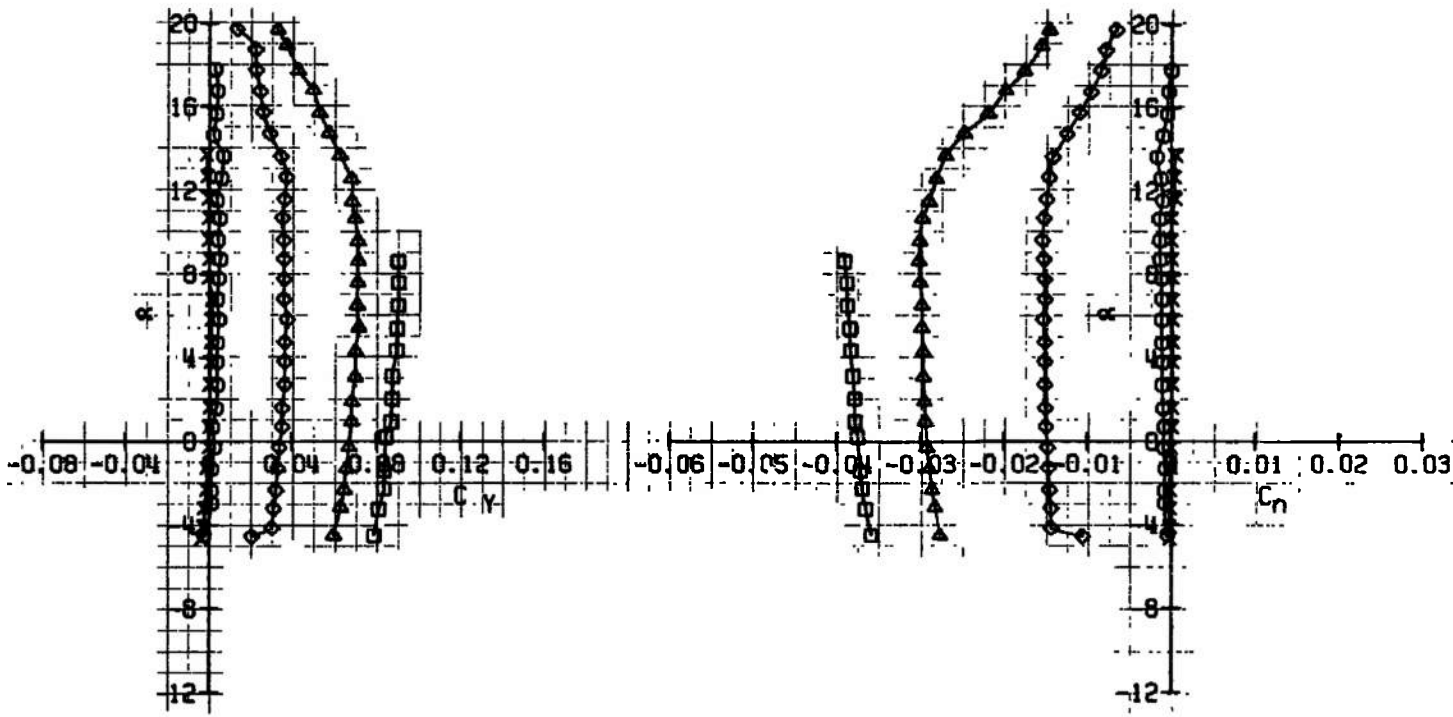


b. Continued  
Fig. 9 Continued



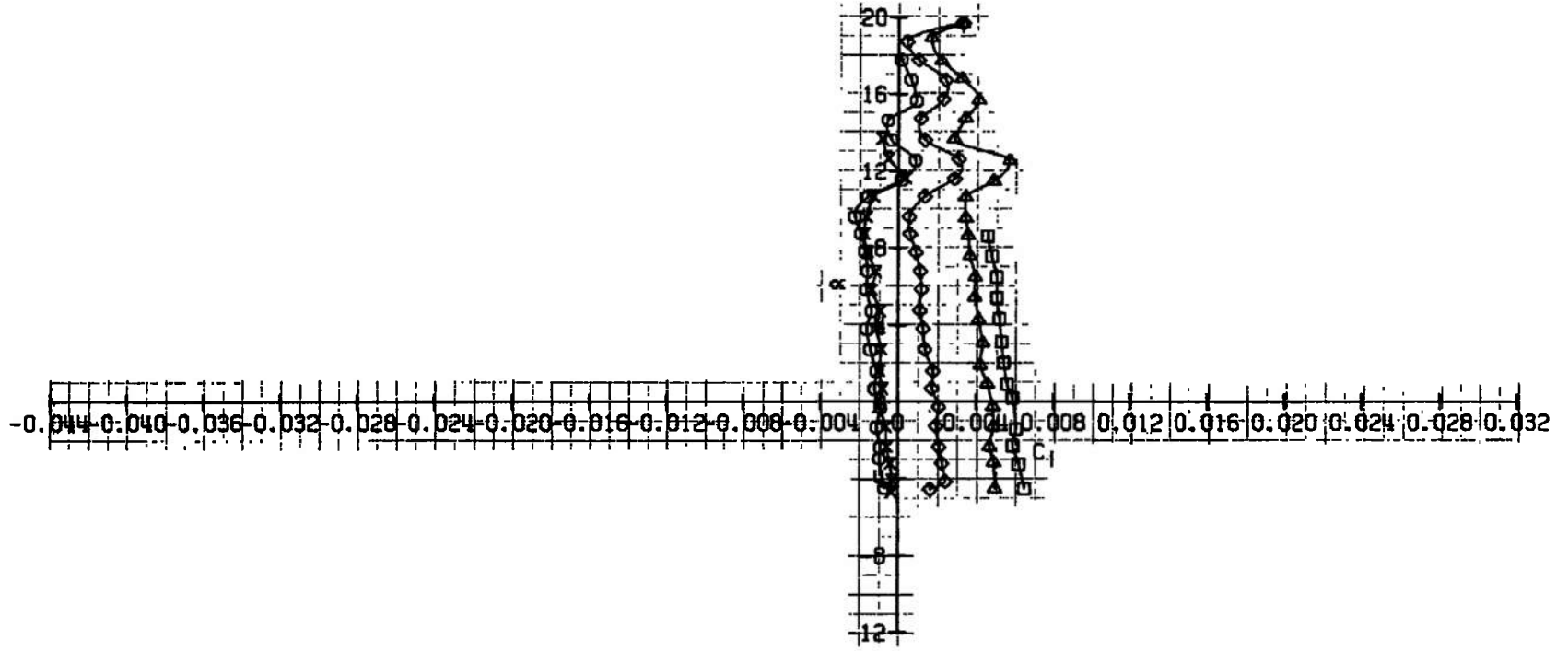
CONFIGURATION:  $N_3, \theta_3, \delta_3, N_2, \theta_2, \delta_2, N_1, \theta_1, \delta_1$

SYM	CONFIGURATION	$M_\infty$	$Re$	BETA	$\theta_1$	$\theta_2$	$\theta_3$	$\delta_1$	$\delta_2$	$\delta_3$	PN
X	$D_{\theta_1, \theta_2, \theta_3}$	0.60	4.5	0	0	0	0	0	0	0	45
◇	$D_{\theta_1, \theta_2, \theta_3} V_{\theta_1, \theta_2, \theta_3}$	0.60	4.5	0	0	0	0	0	0	0	200
◇	$D_{\theta_1, \theta_2, \theta_3} V_{\theta_1, \theta_2, \theta_3} r_{\theta_1, \theta_2, \theta_3}$	0.60	4.5	0	0	0	0	0	0	0	200
◇	$D_{\theta_1, \theta_2, \theta_3} V_{\theta_1, \theta_2, \theta_3} r_{\theta_1, \theta_2, \theta_3} \theta_1, \theta_2, \theta_3$	0.60	4.5	0	0	0	0	0	0	0	200
◇	$D_{\theta_1, \theta_2, \theta_3} V_{\theta_1, \theta_2, \theta_3} r_{\theta_1, \theta_2, \theta_3} \theta_1, \theta_2, \theta_3 \delta_1, \delta_2, \delta_3$	0.60	4.5	0	0	0	0	0	0	0	200



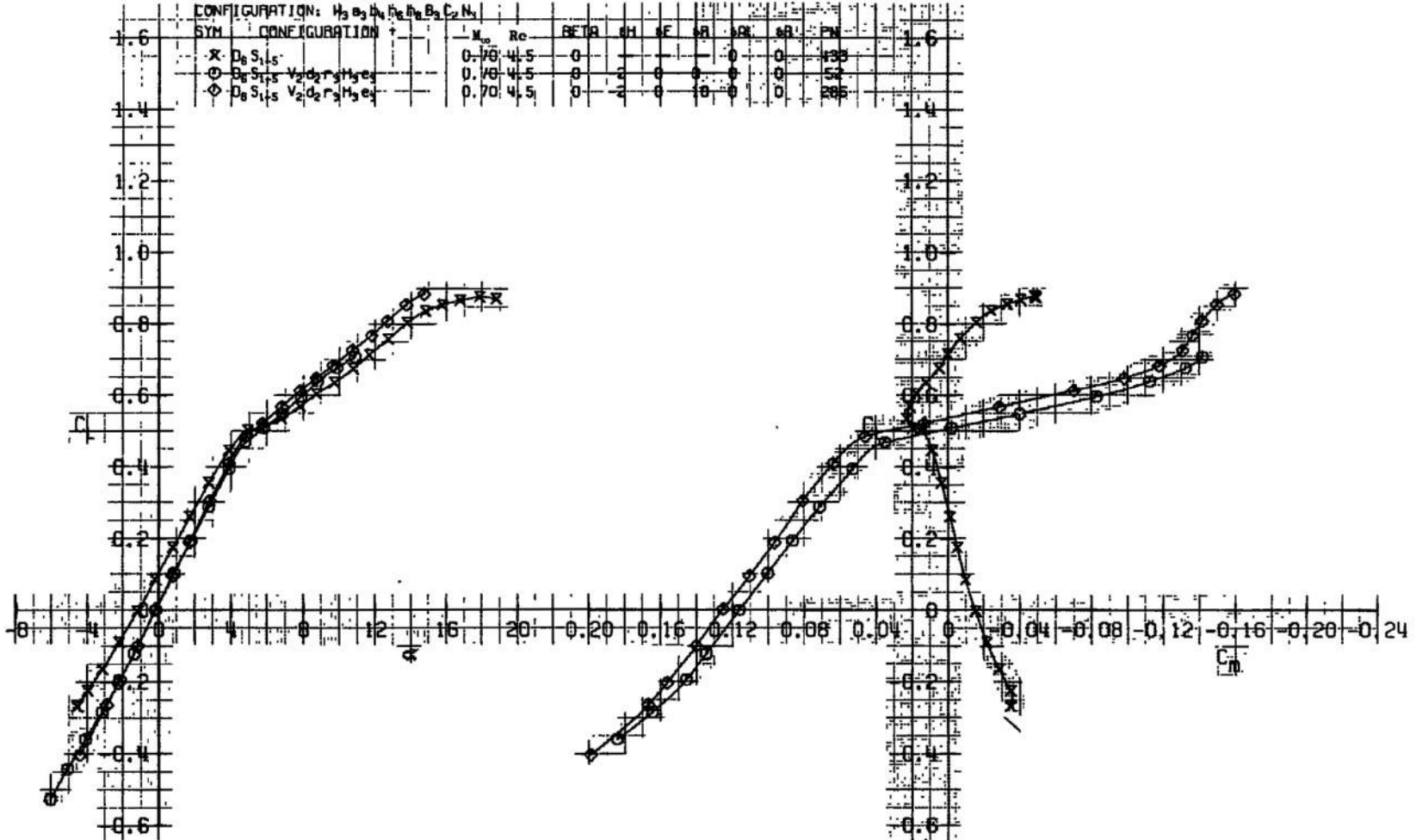
b. Continued  
Fig. 9 Continued

CONFIGURATION: $H_2, O_2, H_2O, H, OH, NO, CO_2, N_2$		$M_\infty$	Re	BETA	AM	SE	AR	AL	AB	PN
SYM	CONFIGURATION									
X	$D_0 S_{1,5}$	0.60	41.5	0			0	0	0	431
○	$D_0 S_{1,5} V_2 d_2 r_3 H_2 O_2$	0.60	41.5	0			10	0	0	288
◇	$D_0 S_{1,5} V_2 d_2 r_3 H_2 O_2$	0.60	41.5	0			0	0	0	290
△	$D_0 S_{1,5} V_2 d_2 r_3 H_2 O_2$	0.60	41.5	0			20	0	0	289
□	$D_0 S_{1,5} V_2 d_2 r_3 H_2 O_2$	0.60	41.5	0			30	0	0	299



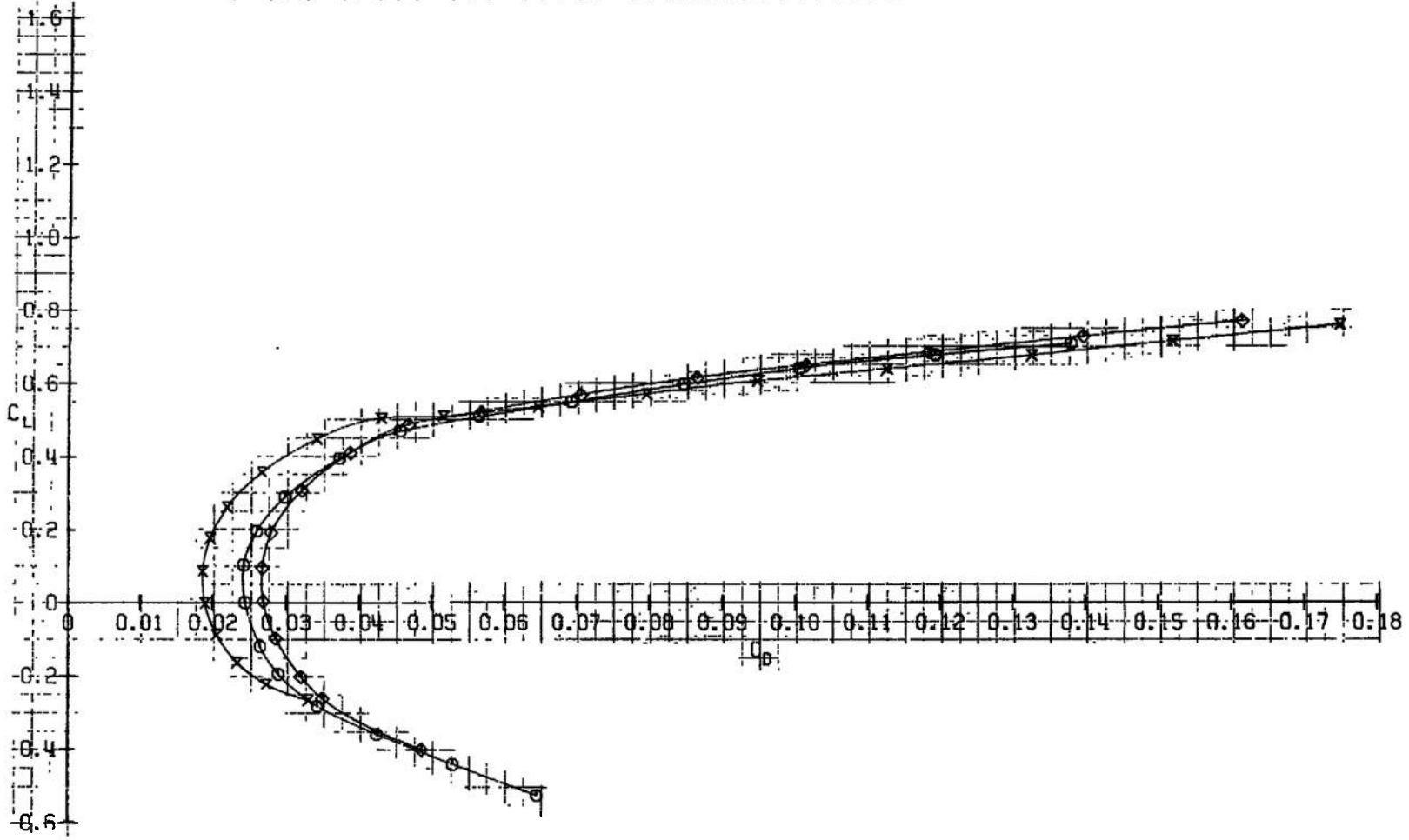
b. Concluded  
Fig. 9 Continued

CONFIGURATION: $M_3 a_3 b_4 r_4 c_4 b_3 B_3 C_2 N_1$										
SYM	CONFIGURATION	$M_\infty$	$Re$	BETA	OH	AF	AR	OR	BR	PN
X	$D_0 S_{1.5}$	0.70	4.5	0	1	0	0	0	0	133
○	$D_0 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.70	4.5	0	2	0	0	0	0	52
◇	$D_0 S_{1.5} V_2 d_2 r_3 H_3 e_3$	0.70	4.5	0	2	0	0	0	0	285



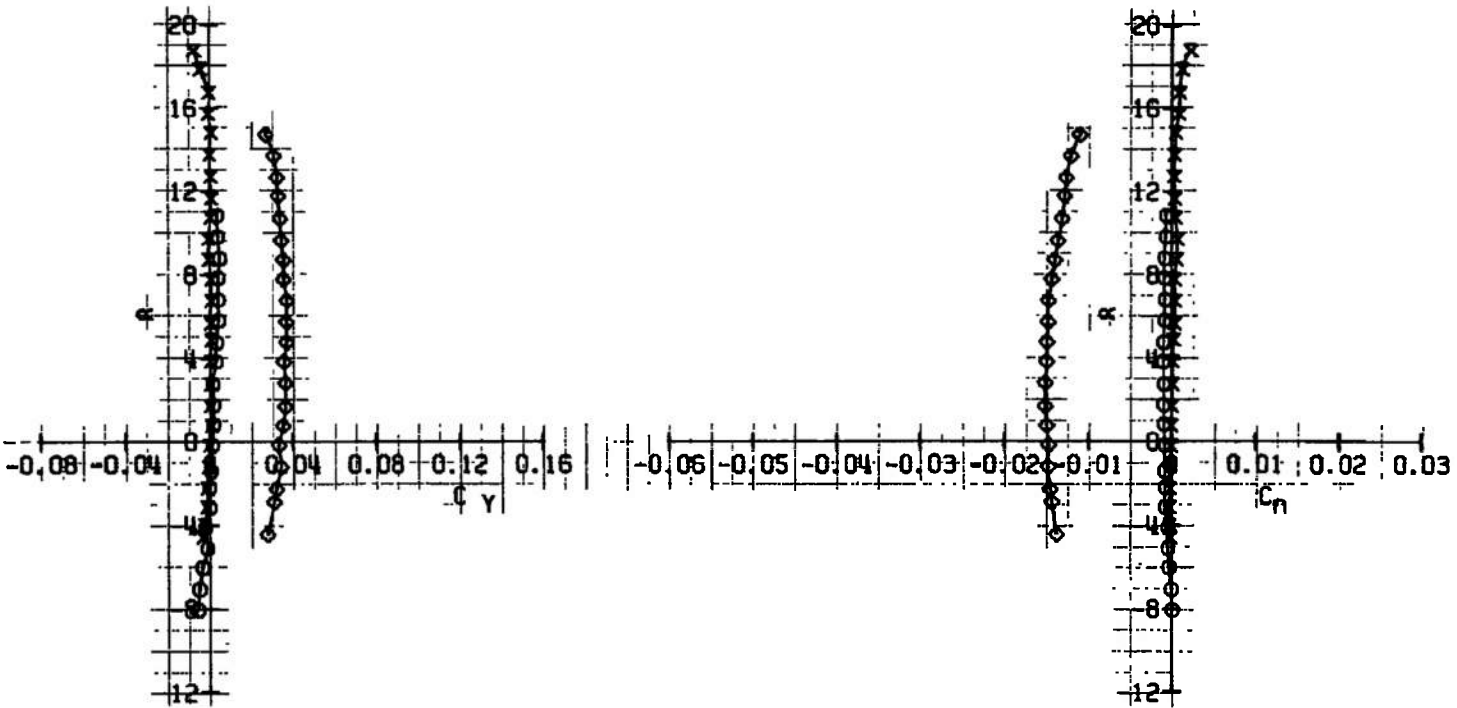
c.  $M_\infty = 0.70$   
 Fig. 9 Continued

CONFIGURATION: $H_1, a_2, b_1, r_2, r_3, B_3, C_2, S_2$											
SYM	CONFIGURATION		$M_\infty$	Re	REF	$\alpha$	$\beta$	$\gamma$	$\delta$	$\epsilon$	PN
-x	$D_2$	$S_{1,2}$	0.70	4.5	D	0	0	0	0	0	43
o	$D_2$	$S_{1,2}$	0.70	4.5	D	0	0	0	0	0	54
o	$D_2$	$S_{1,2}$	0.70	4.5	D	0	0	0	0	0	55



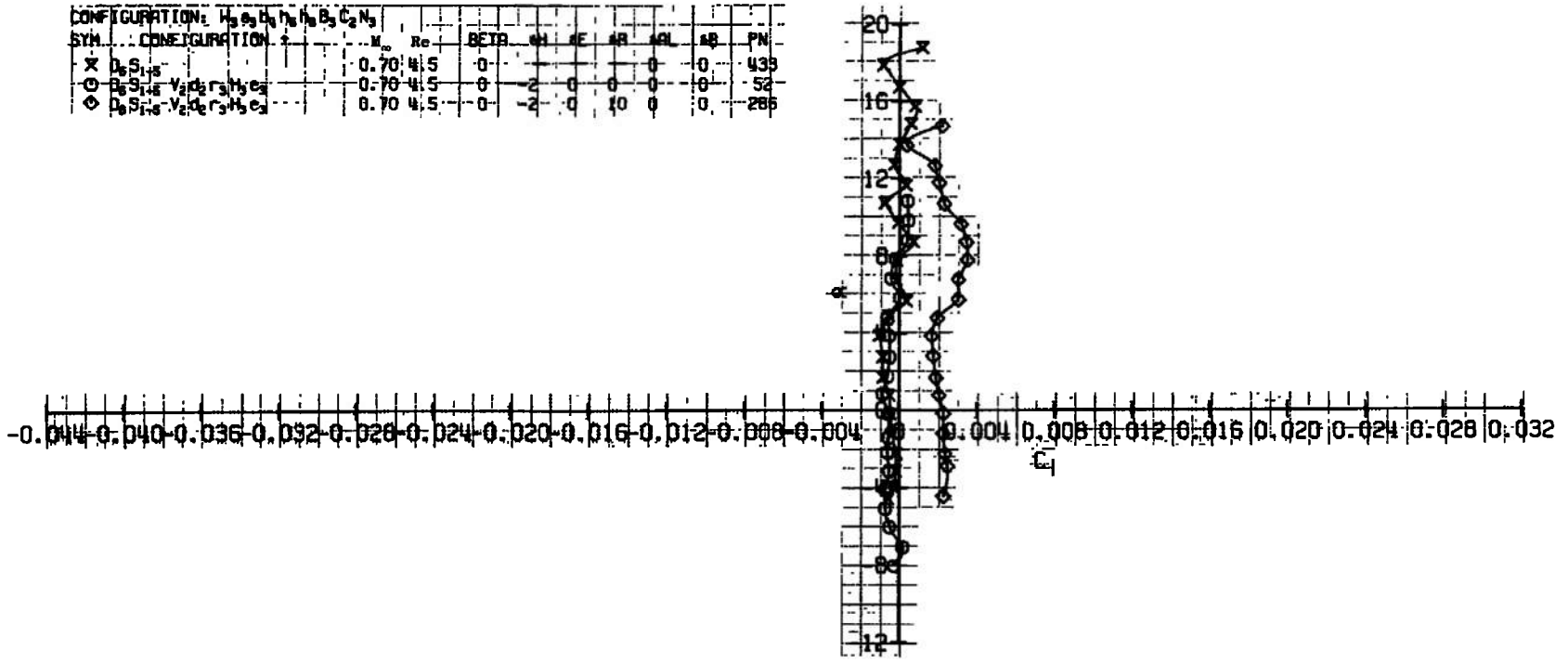
c. Continued  
Fig. 9 Continued

CONFIGURATION: $H_2, O_2, N_2, H_2O, CO_2, H_2$												
SYM	CONFIGURATION					$M_\infty$	$Re$	$\beta$	$\theta$	$\alpha$	$\beta$	$\gamma$
X	$H_2$	$O_2$	$N_2$	$H_2O$	$CO_2$	0.70	4.5	0	0	0	0	435
O	$H_2$	$O_2$	$N_2$	$H_2O$	$CO_2$	0.70	4.5	0	0	0	0	52
◇	$H_2$	$O_2$	$N_2$	$H_2O$	$CO_2$	0.70	4.5	0	0	10	0	285

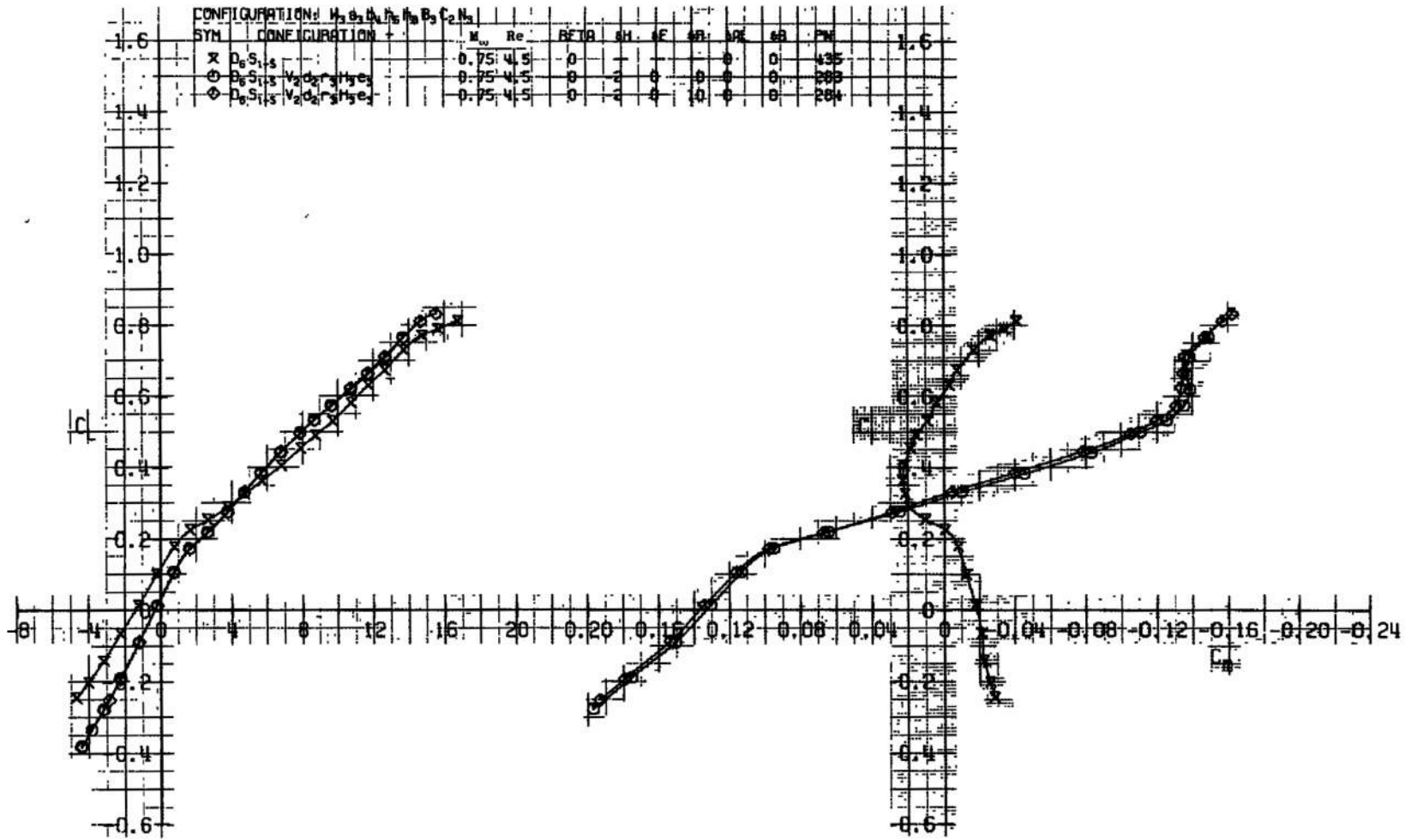


c. Continued  
 Fig. 9 Continued

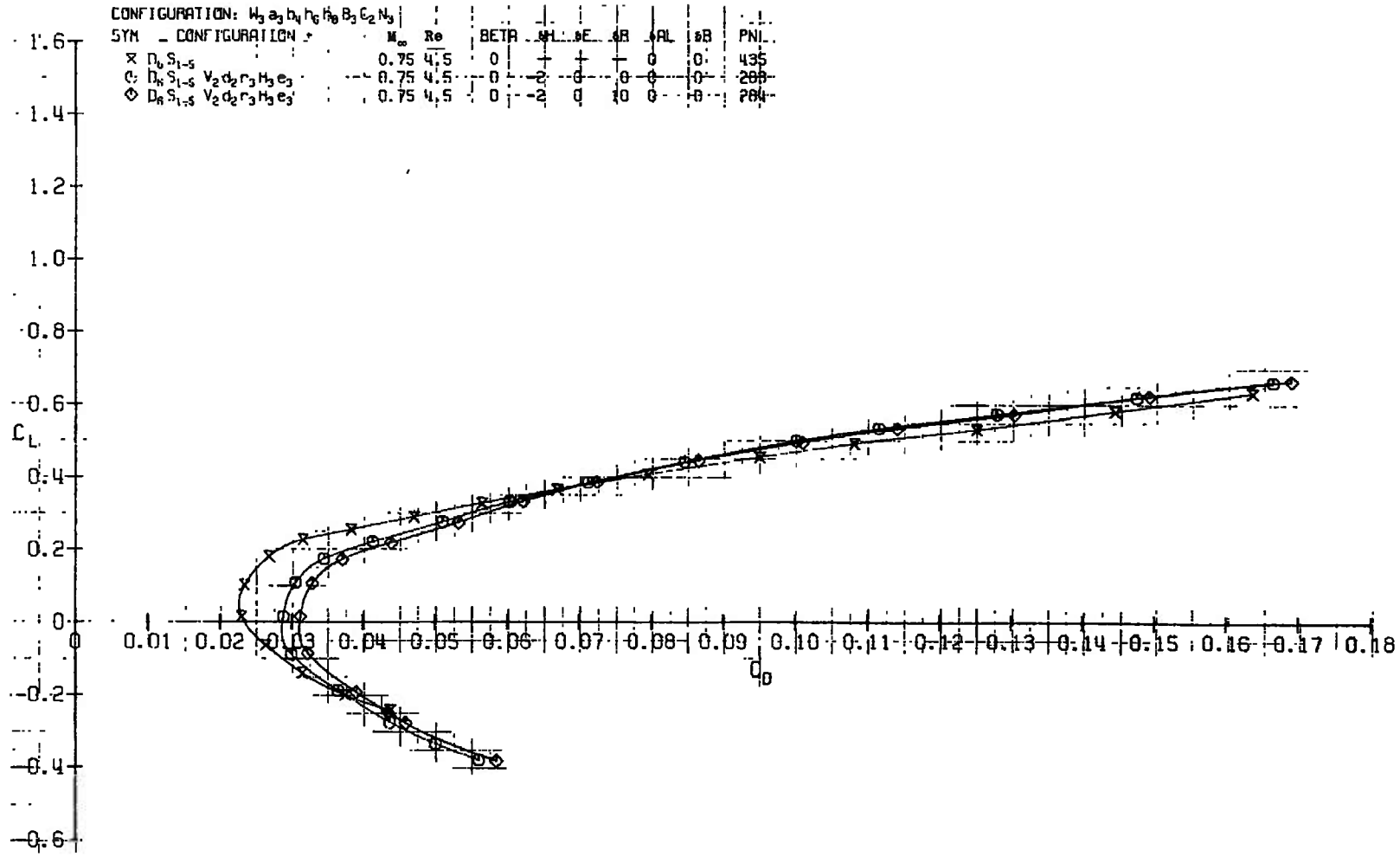
CONFIGURATION:		$H_3$	$\theta_3$	$D_3$	$H_2$	$\theta_2$	$B_3$	$C_2$	$N_3$	$M_\infty$	$Re$	BETA	41	4E	4R	4Q	4B	PN
X	$D_3 S_{1-3}$									0.70	4.5	0						439
○	$D_3 S_{1-3} - V_2 r_3 H_3 e_3$									0.70	4.5	0	-2	0	0	0	0	52
◇	$D_3 S_{1-3} - V_2 r_3 H_3 e_2$									0.70	4.5	0	-2	0	10	0	0	286



c. Concluded  
Fig. 9 Continued



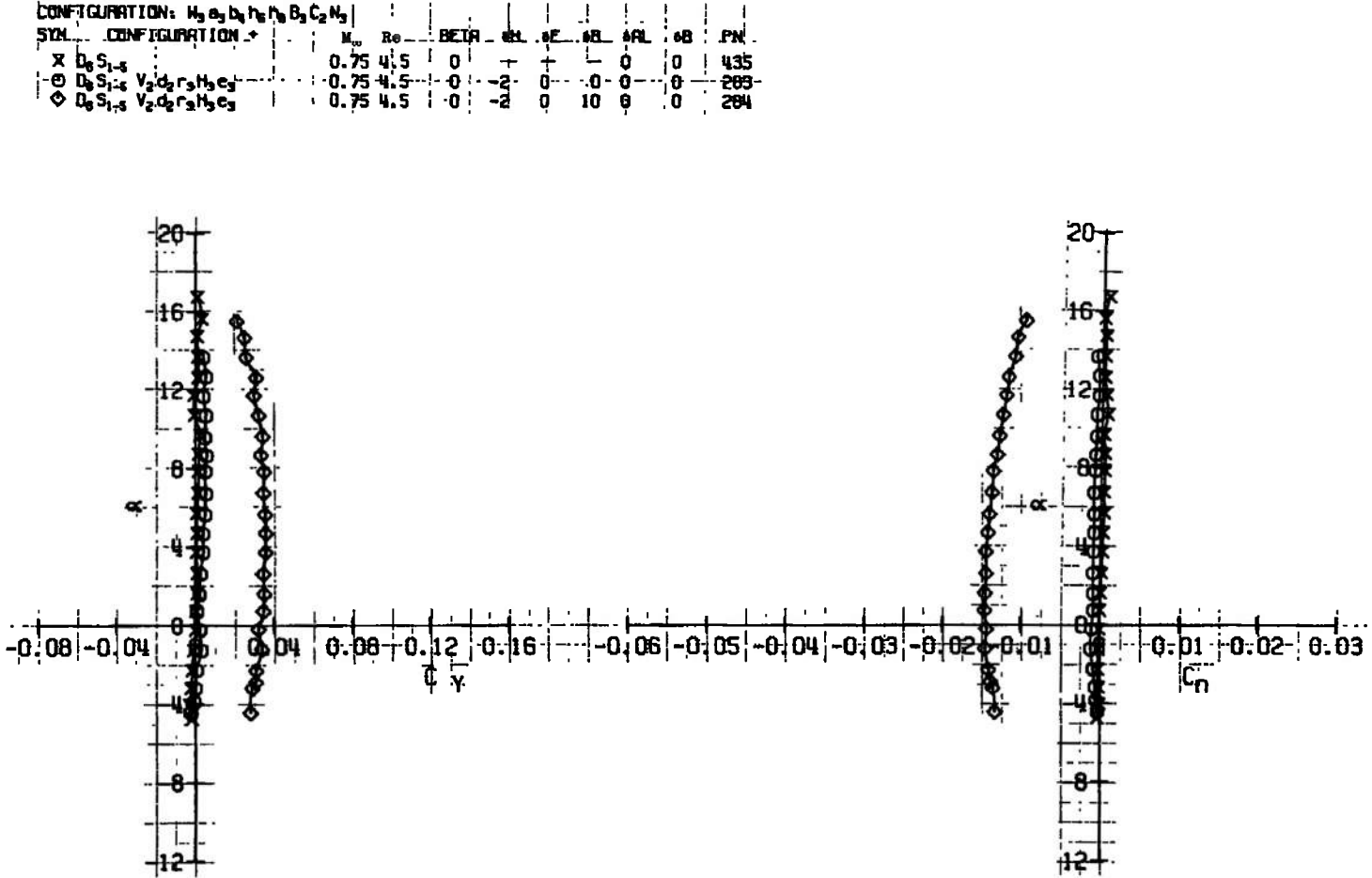
d.  $M_\infty = 0.75$   
 Fig. 9 Continued



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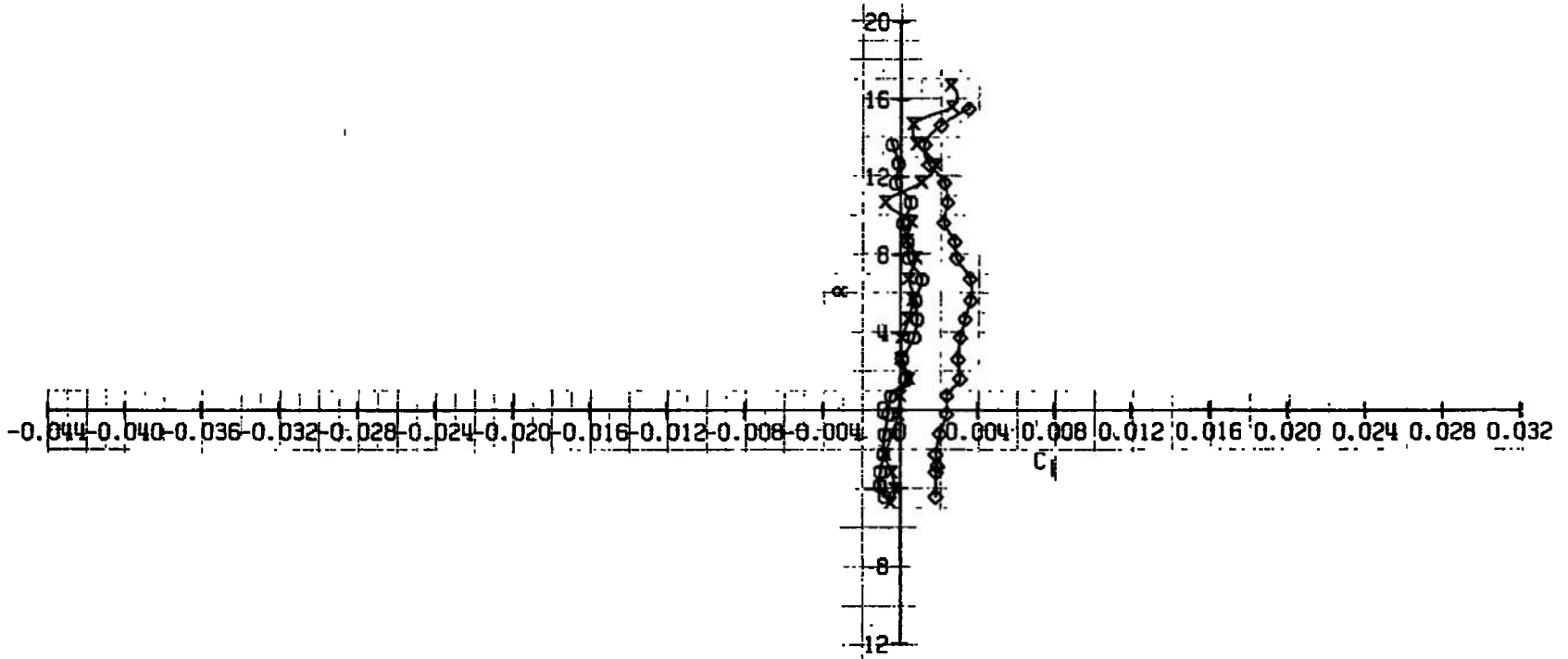
d. Continued  
Fig. 9 Continued





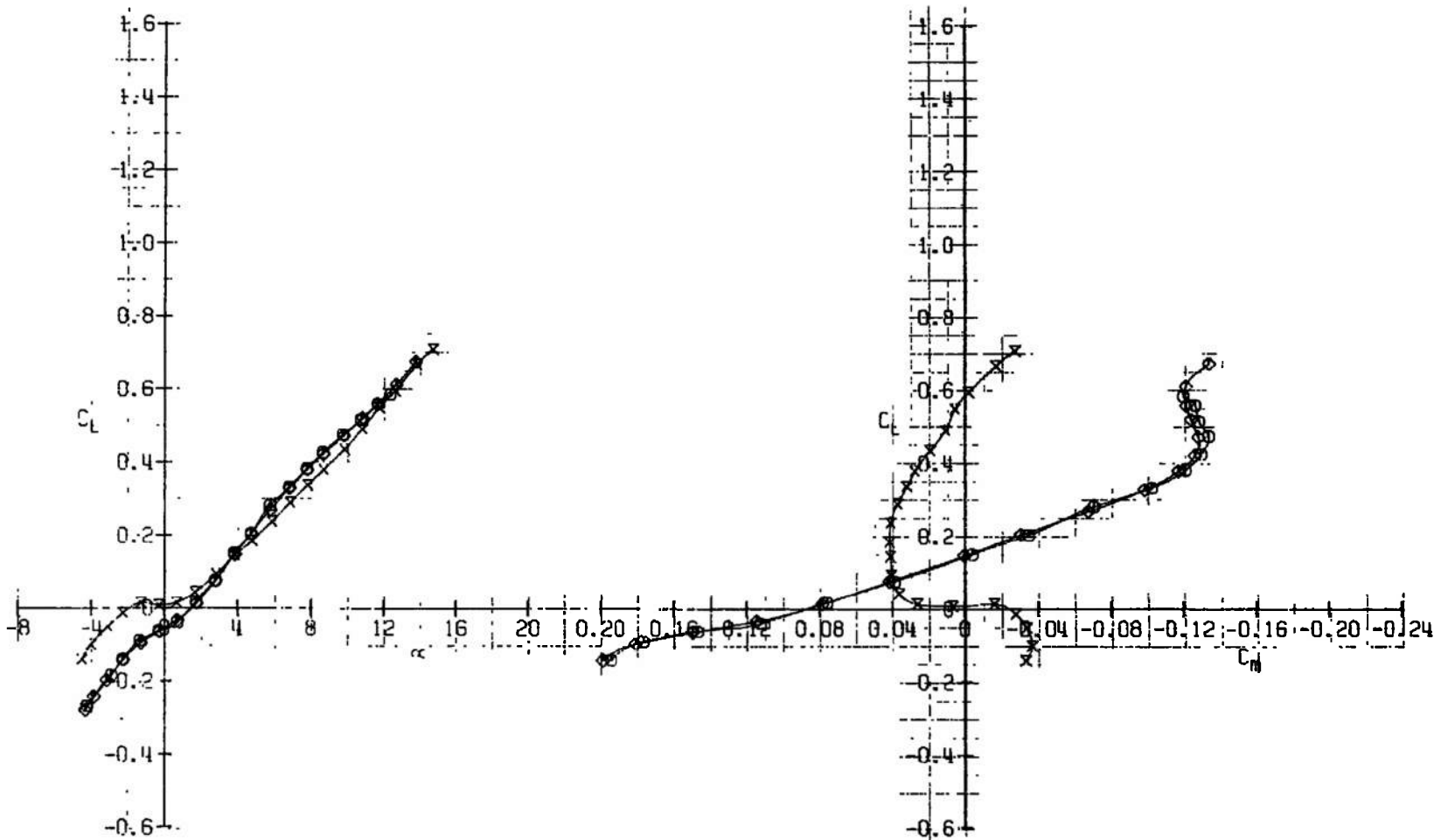
d. Continued  
Fig. 9 Continued

CONFIGURATION	$M_2$	$e_2$	$b_2$	$M_3$	$e_3$	$b_3$	$C_2$	$M_3$									
SYN.	CONFIGURATION						$M_2$	$Re$	BETA	$M_1$	$M_2$	$M_3$	$M_4$	$M_5$	$M_6$	$M_7$	
-X	$B_0$	$B_{1.5}$						0.75	4.5	0			0	0	0	0	435
○	$B_0$	$B_{1.5}$	$M_2$	$e_2$	$M_3$	$e_3$		0.75	4.5	0	2	0	0	0	0	0	283
◇	$B_0$	$B_{1.5}$	$M_2$	$e_2$	$M_3$	$e_3$		0.75	4.5	0	2	0	10	0	0	0	284



d. Concluded  
Fig. 9 Continued

CONFIGURATION: $W_1, a_1, b_1, c_1, h_1, B_1, C_1, N_1$		$M_\infty$	Re	BETA	$\alpha_1$	$\alpha_F$	$\alpha_R$	$\alpha_{PI}$	$\alpha_R$	PN
SYM	CONFIGURATION									
x	$D_6 S_{1,5}$	0.80	4.5	0				0	0	437
o	$D_6 S_{1,5} V_2 D_2 r_3 h_3 e_3$	0.80	4.5	0				0	0	280
◇	$D_6 S_{1,5} V_2 D_2 r_3 h_3 e_3$	0.80	4.5	0				0	0	280

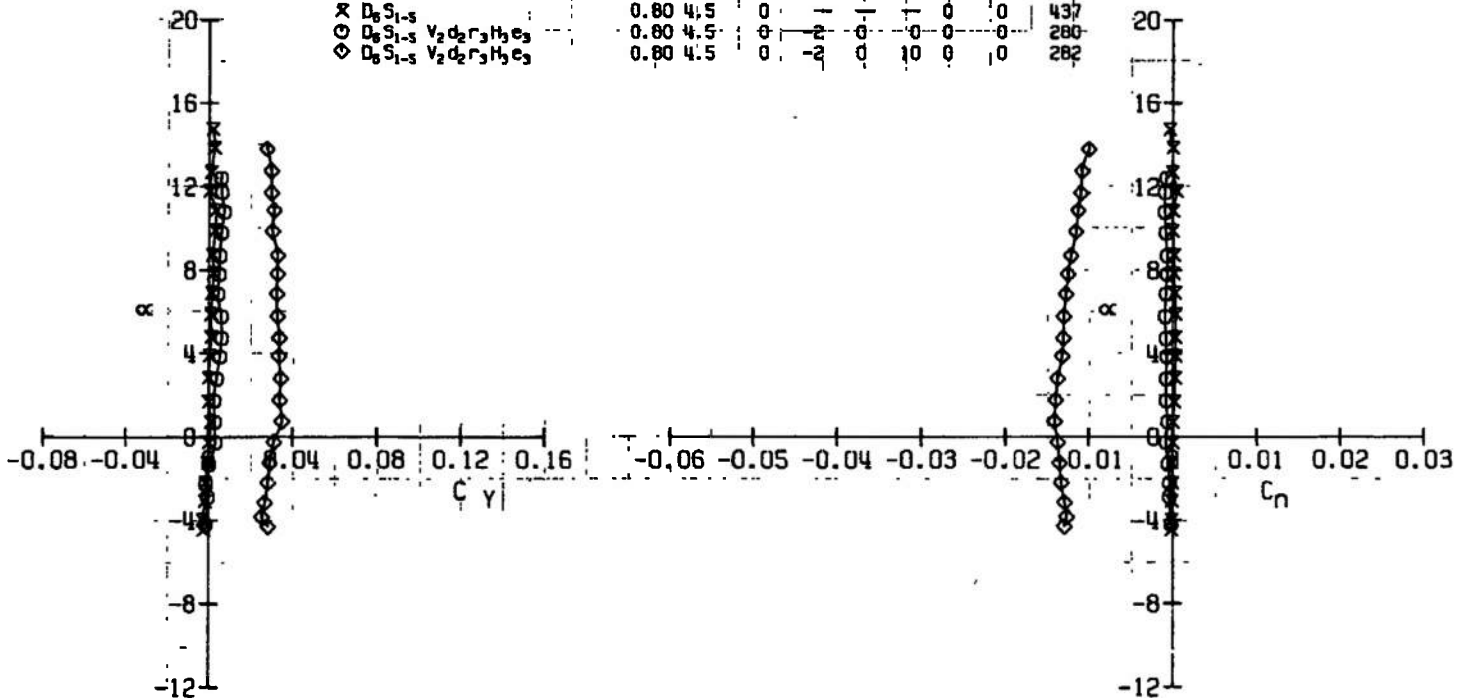


e.  $M_\infty = 0.80$   
Fig. 9 Continued



CONFIGURATION:  $H_3 e_3 b_4 h_6 h_8 B_3 C_2 N_3$

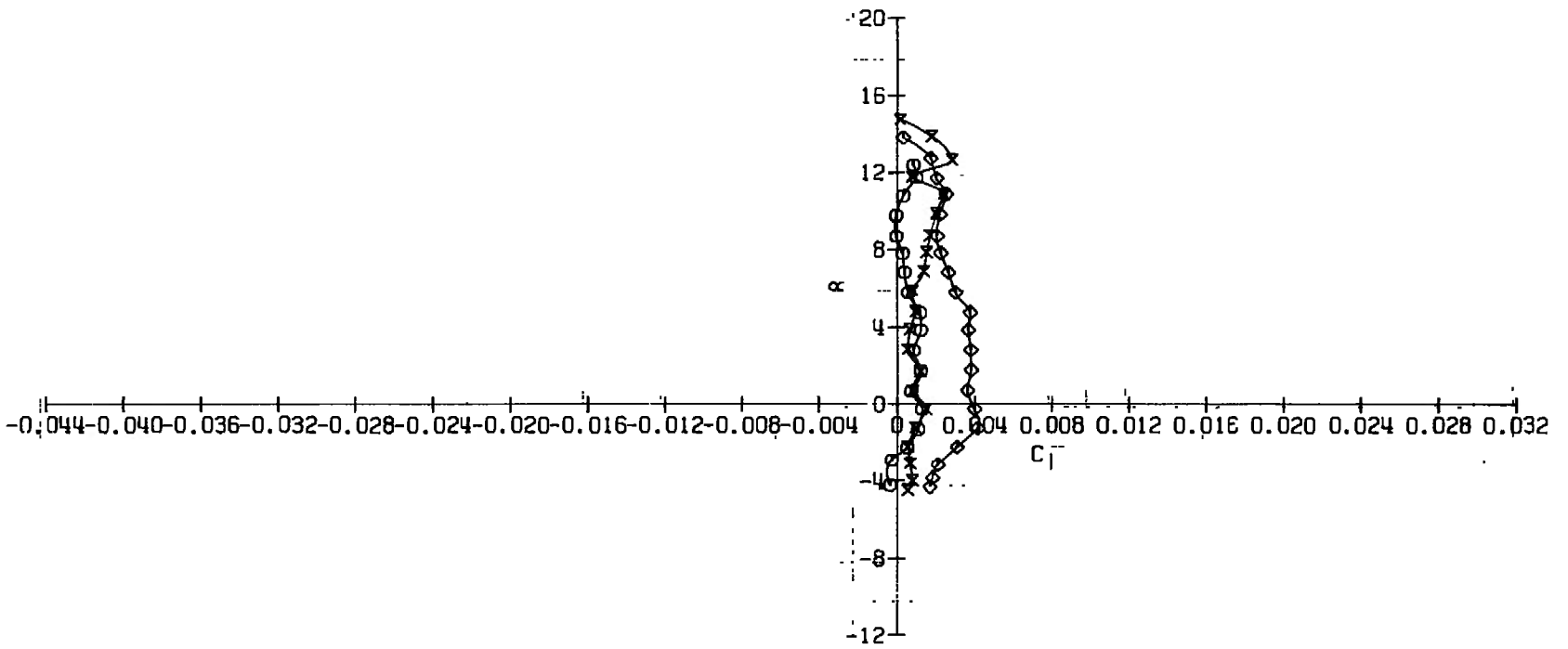
CONFIGURATION	$M_{\infty}$	Re	BETA	PH	SE	SB	SAL	SB	PN
x $D_6 S_{1-5}$	0.80	4.5	0	-	-	0	0	0	437
o $D_6 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.80	4.5	0	-2	0	0	0	0	280
◇ $D_6 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.80	4.5	0	-2	0	10	0	0	282



e. Continued  
Fig. 9 Continued

CONFIGURATION:  $M_3 \theta_3 b_4 r_5 h_6 B_3 C_2 N_3$

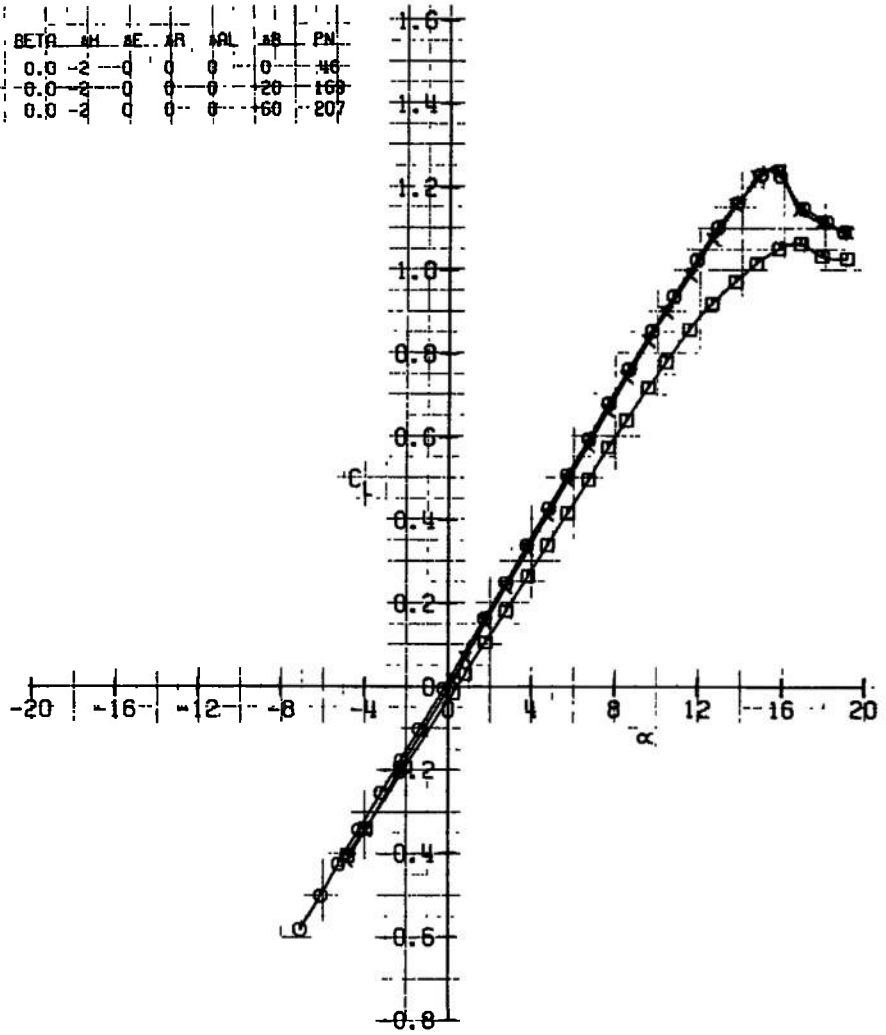
SYM	CONFIGURATION	$M_{in}$	Re	BETA	$\delta H$	$\delta E$	$\delta R$	$\delta AL$	$\delta B$	PN
X	$D_6 S_{1-5}$	0.80	4.5	0	—	—	—	0	0	437
○	$D_6 S_{1-5} V_2 d_2 r_3 h_3 \theta_3$	0.80	4.5	0	-2	0	0	0	0	280
◇	$D_6 S_{1-5} V_2 d_2 r_3 h_3 \theta_3$	0.80	4.5	0	-2	0	10	0	0	282



e. Concluded  
Fig. 9 Concluded

CONFIGURATION:  $W_3 B_3 D_4 H_6 H_6 B_3 C_2 N_3$

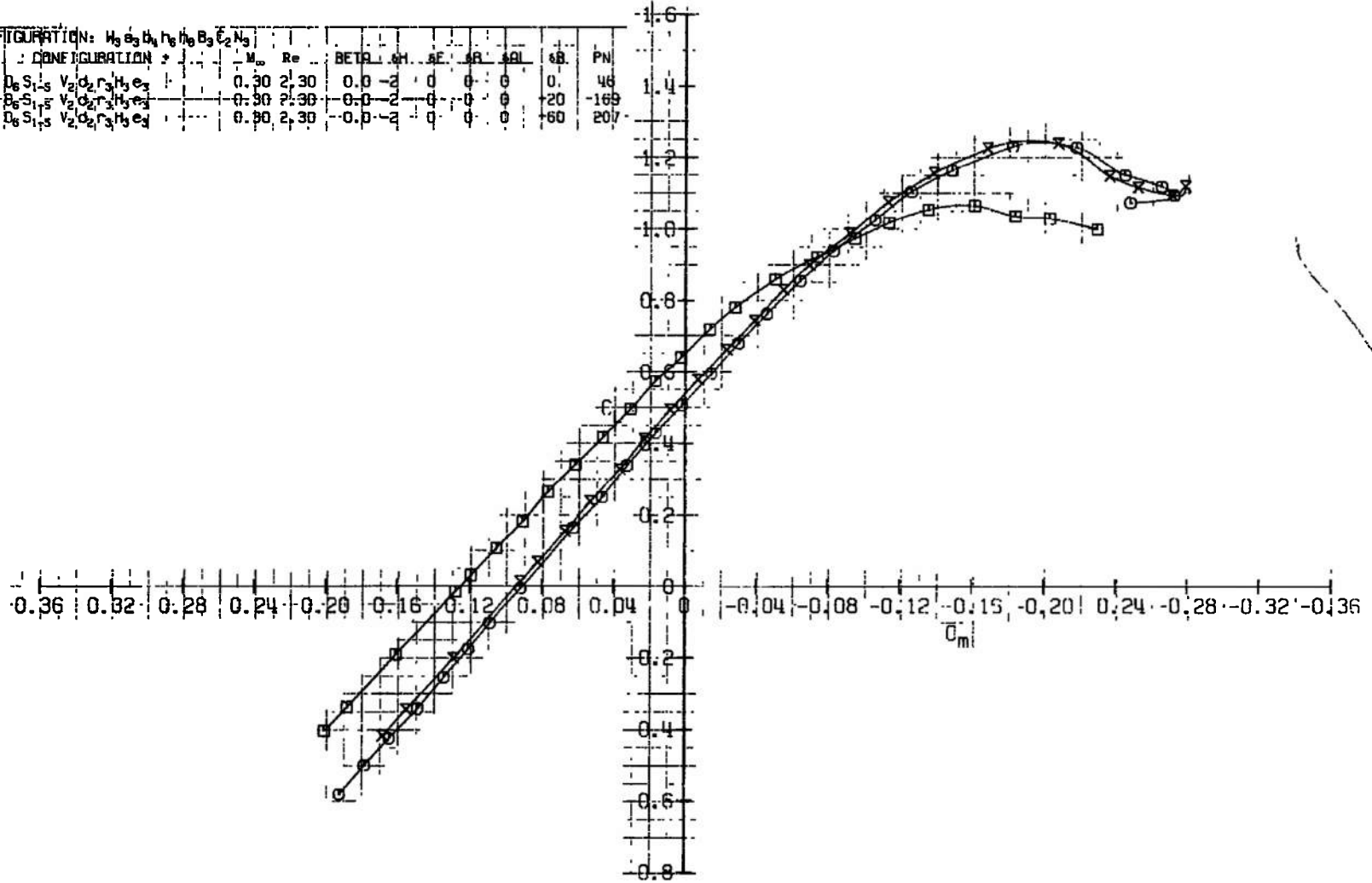
SYM	CONFIGURATION	$M_\infty$	Re	BETA	PH	SE	AR	VAL	AS	PN
O	$D_6 S_{1-5} V_2 D_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	0	0	0	0	16
X	$D_6 S_{1-5} V_2 D_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	0	0	0	20	160
□	$D_6 S_{1-5} V_2 D_2 r_3 H_3 e_3$	0.30	2.30	0.0	-2	0	0	0	60	207



a.  $M_\infty = 0.30$   
 Fig. 10 Speed Brake Effectiveness

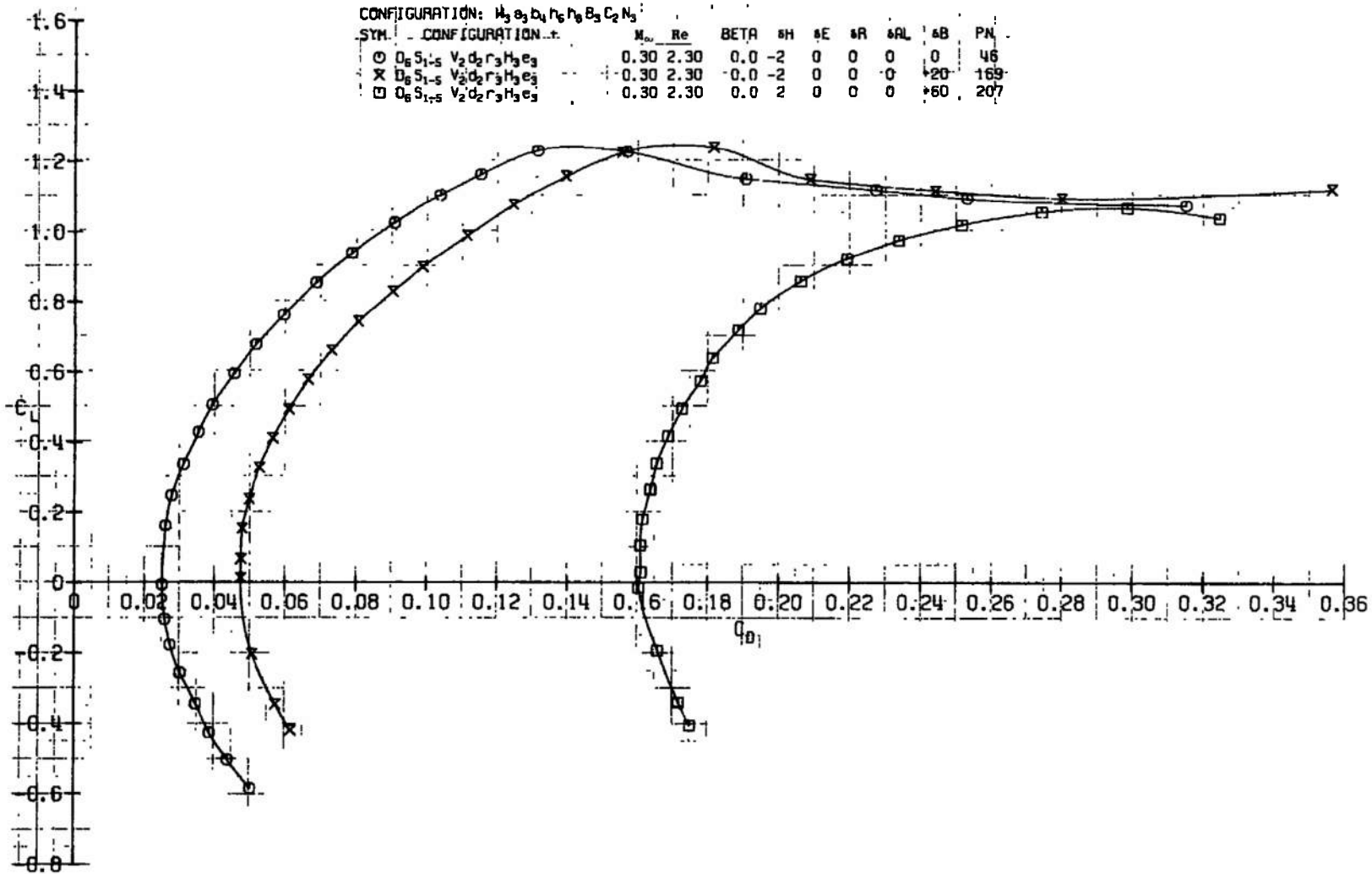
CONFIGURATION:  $M_0 e_3 d_4 r_5 h_6 B_3 C_2 N_3$

SYM	CONFIGURATION	$M_\infty$	Re	BETA	OH	AE	AR	AOI	AB	PN
○	$D_6 S_{1,5} V_2 d_4 r_3 h_3 e_3$	0.30	2.30	0.0	-2	0	0	0	0	46
x	$D_6 S_{1,5} V_2 d_4 r_3 h_3 e_3$	0.30	2.30	0.0	-2	0	0	0	20	169
□	$D_6 S_{1,5} V_2 d_4 r_3 h_3 e_4$	0.30	2.30	0.0	-2	0	0	0	60	207



a. Continued  
Fig. 10 Continued

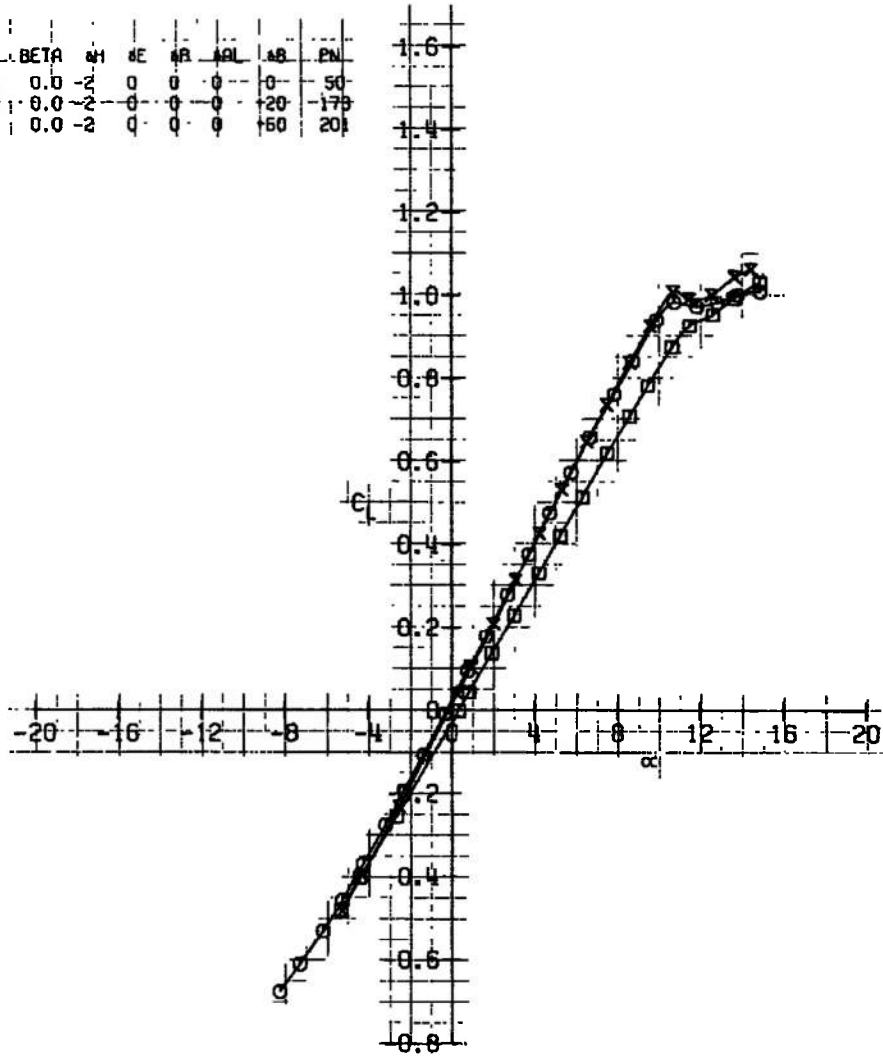




a. Concluded  
Fig. 10 Continued

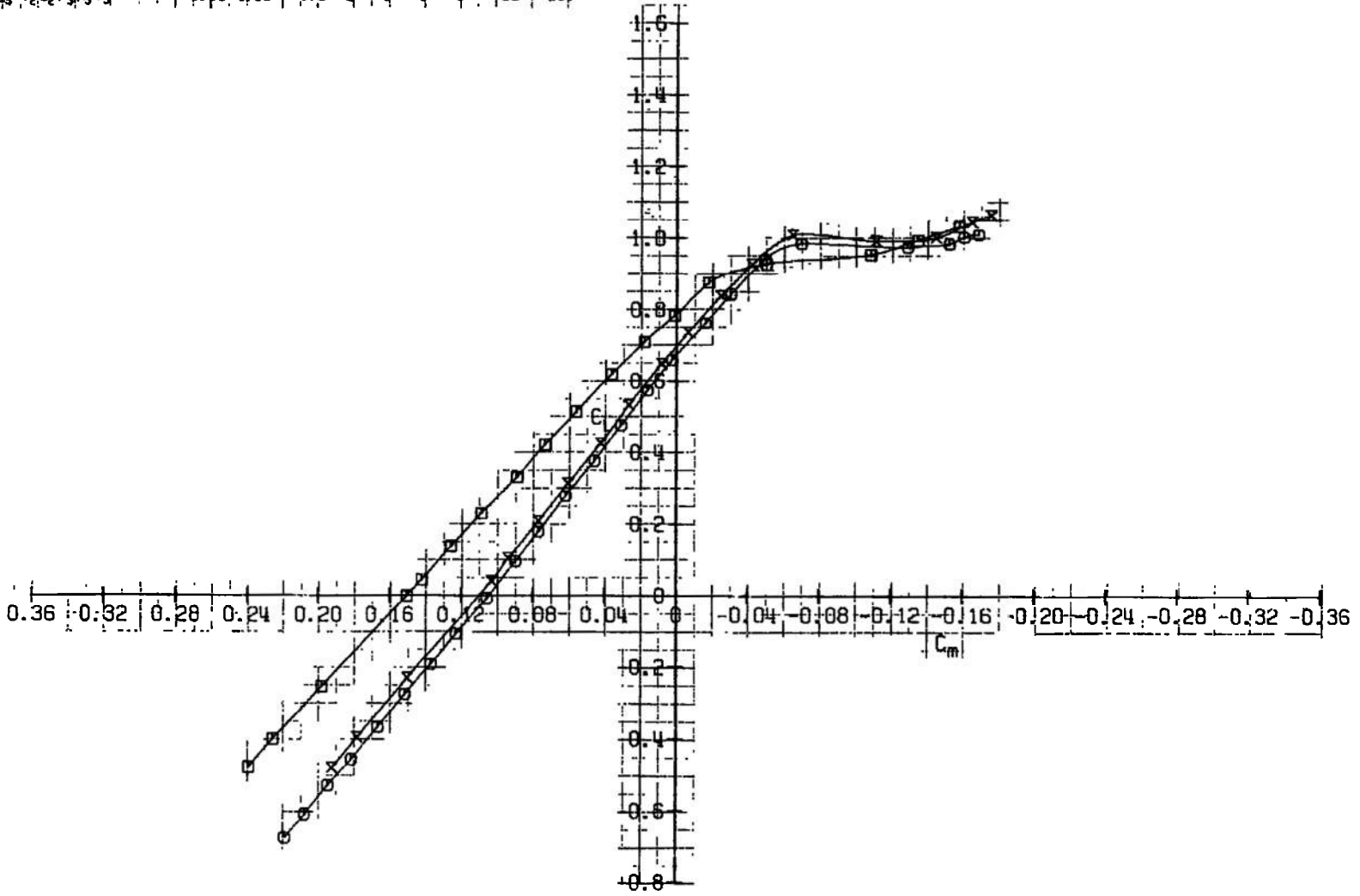
CONFIGURATION:  $h_3 e_3 b_4 h_6 h_6 B_3 C_2 N_3$

SYM	CONFIGURATION	$M_\infty$	Re	BETA	$\alpha$	$\delta E$	$\delta R$	$\delta PL$	$\delta B$	PN
O	$D_6 S_{1-3} V_2 d_2 r_3 h_3 e_3$	0.60	4.50	0.0	-2	0	0	0	0	50
X	$h_3 S_{1-6} V_2 d_2 r_3 h_3 e_3$	0.60	4.50	0.0	-2	0	0	0	20	179
□	$D_6 S_{1-6} V_2 d_2 r_3 h_3 e_3$	0.60	4.50	0.0	-2	0	0	0	60	201



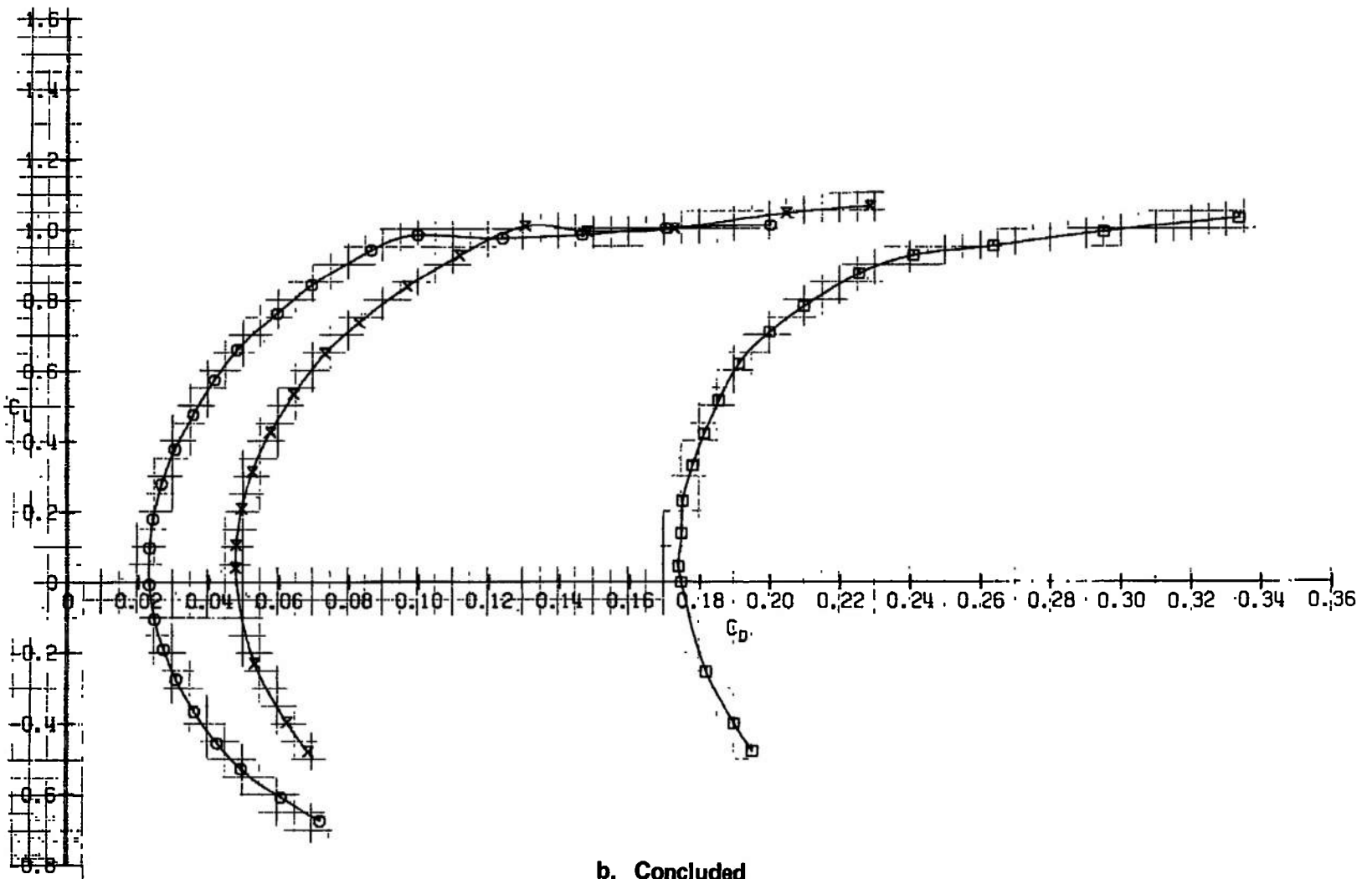
b.  $M_\infty = 0.60$   
 Fig. 10 Continued

CONFIGURATION: $V_3, \theta_3, D_4, r_5, h_6, B_3, C_2, M_3$									
SYM.	CONFIGURATION	$M_\infty$	Re	BETA	$\theta_1$	$\theta_2$	$\theta_3$	$\theta_4$	PN
X O	$D_6, S_{1-5}, V_2, D_2, r_3, h_3, \theta_3$	0.60	4.50	0.0	2	0	0	0	50
	$D_6, S_{1-5}, V_2, D_2, r_3, h_3, \theta_3$	0.60	4.50	0.0	2	0	0	0	20
B X	$D_6, S_{1-5}, V_2, D_2, r_3, h_3, \theta_3$	0.60	4.50	0.0	2	0	0	0	60
	$D_6, S_{1-5}, V_2, D_2, r_3, h_3, \theta_3$	0.60	4.50	0.0	2	0	0	0	20



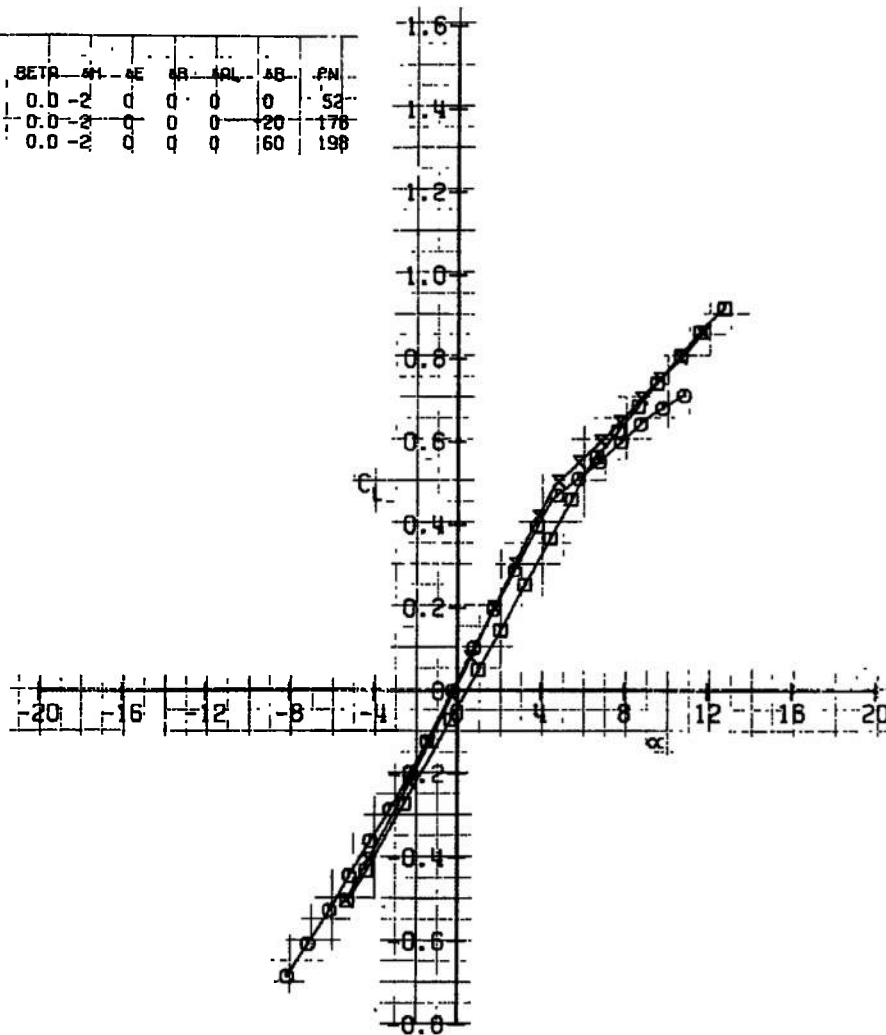
b. Continued  
Fig. 10 Continued

SYN	CONFIGURATION	$M_{\infty}$	$Re$	REF	$\Delta H$	$\Delta F$	$\Delta R$	$\Delta Q$	$\Delta S$	PN
0	$S_{1.5} V_2 D_2 r_3 M_3 E_3$	0.60	4.50	0:0:2	0	0	0	0	0	59
X	$S_{1.5} V_2 D_2 r_3 M_3 E_3$	0.60	4.50	0:0:2	0	0	0	120	175	
0	$S_{1.5} V_2 D_2 r_3 M_3 E_3$	0.60	4.50	0:0:2	0	0	0	60	201	



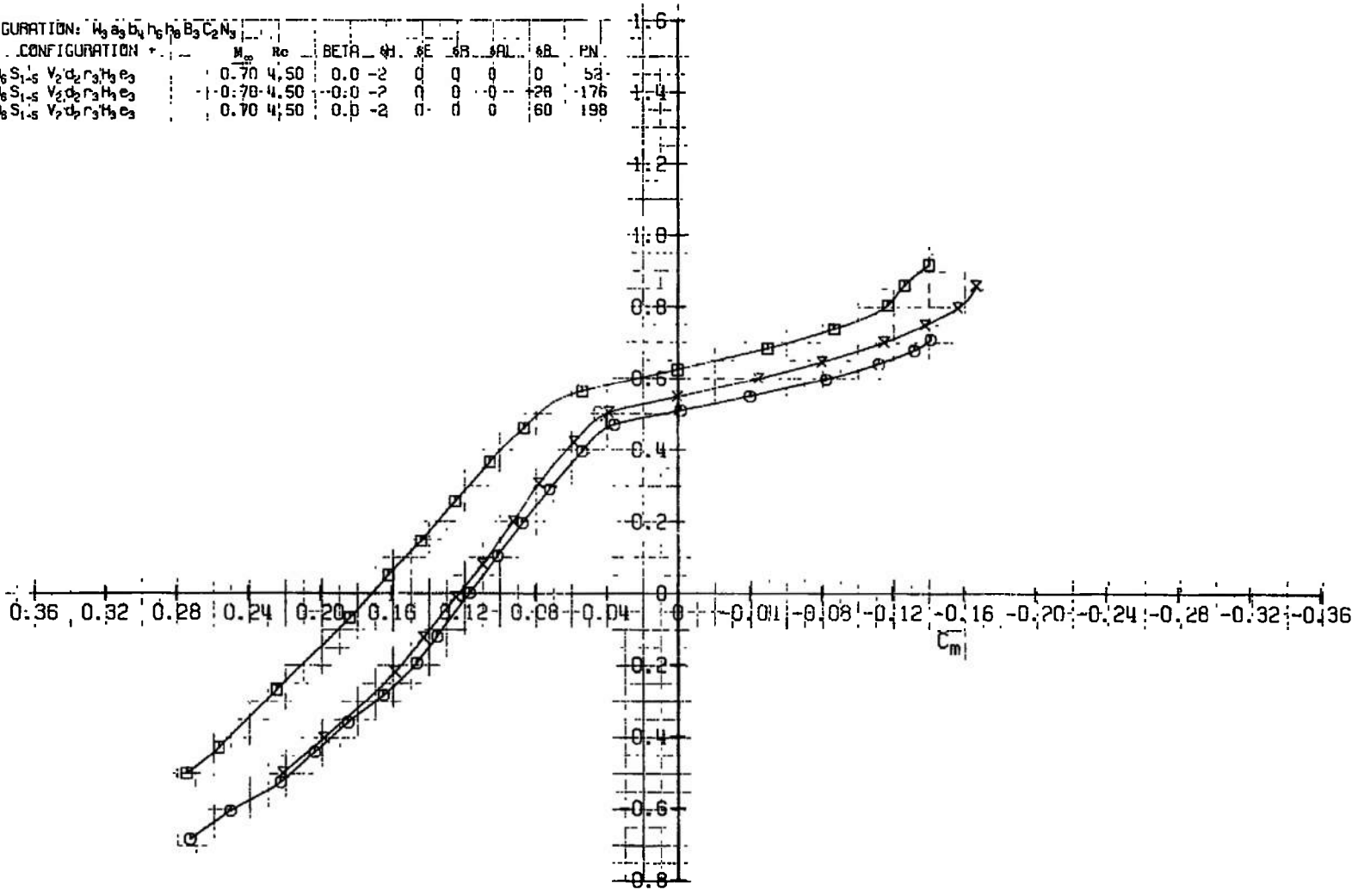
b. Concluded  
Fig. 10 Continued

CONFIGURATION: $H_2, O_2, H_2O, H_2, O_2, H_2O$		$M_\infty$	$Re$	BETR	$\alpha_1$	$\alpha_2$	$\alpha_3$	$\alpha_4$	$\alpha_5$	$\alpha_6$	$\alpha_7$
SYM	CONFIGURATION										
○	$D_5 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.70	4,50	0.0	-2	0	0	0	0	0	52
×	$D_5 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.70	4,50	0.0	-2	0	0	0	20	178	
□	$D_5 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.70	4,50	0.0	-2	0	0	0	60	198	

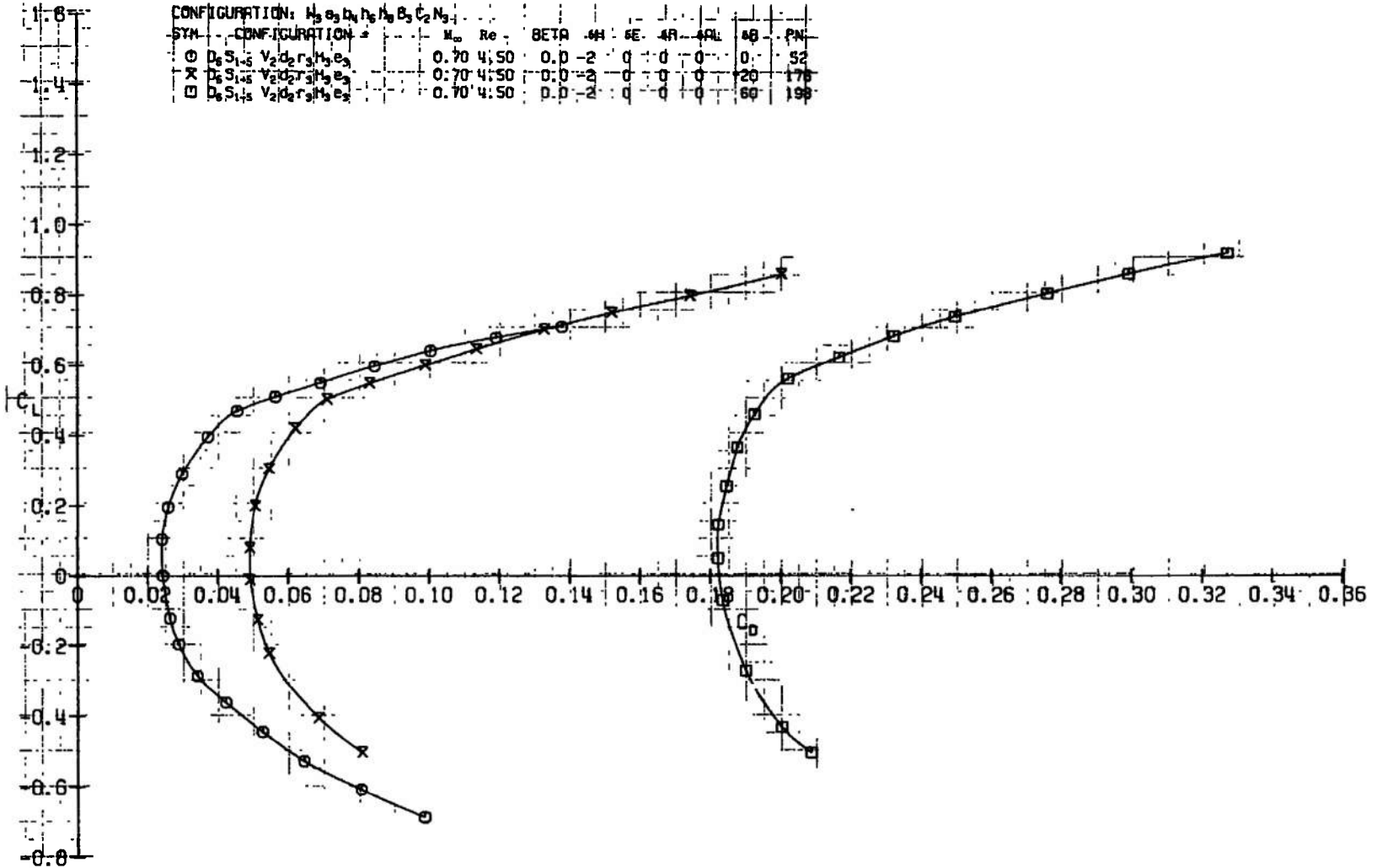


c.  $M_\infty = 0.70$   
 Fig. 10 Continued

CONFIGURATION: $W_3 a_3 b_4 h_6 h_8 B_3 C_2 N_3$										
SYM	CONFIGURATION	$M_\infty$	Re	BETA	$\psi$	$\delta E$	$\delta R$	$\delta AL$	$\delta B$	PN
○	$D_6 S_{1.5} V_2 d_2 r_3 h_3 e_3$	0.70	4,50	0.0	-2	0	0	0	0	53
×	$D_6 S_{1.5} V_2 d_2 r_3 h_3 e_3$	1.0	70	4,50	-0.0	-2	0	0	20	176
□	$D_6 S_{1.5} V_2 d_2 r_3 h_3 e_3$	0.70	4,50	0.0	-2	0	0	0	60	198

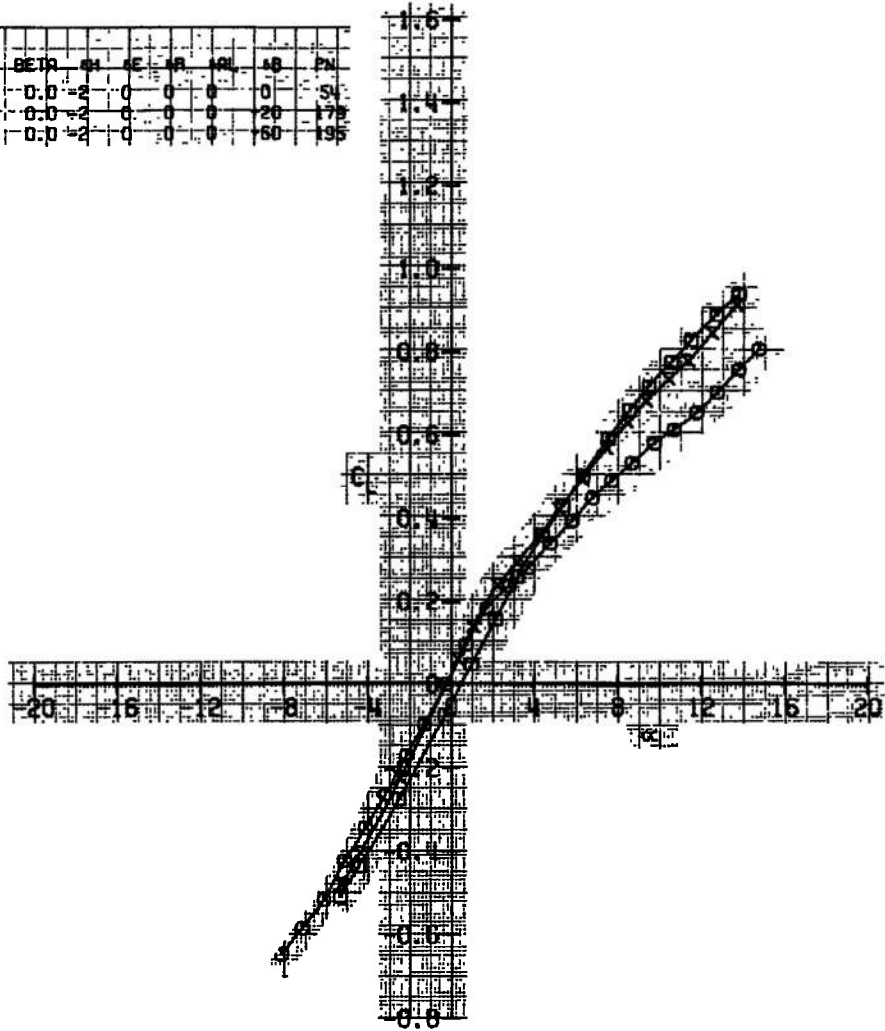


c. Continued  
Fig. 10 Continued



c. Concluded  
Fig. 10 Continued

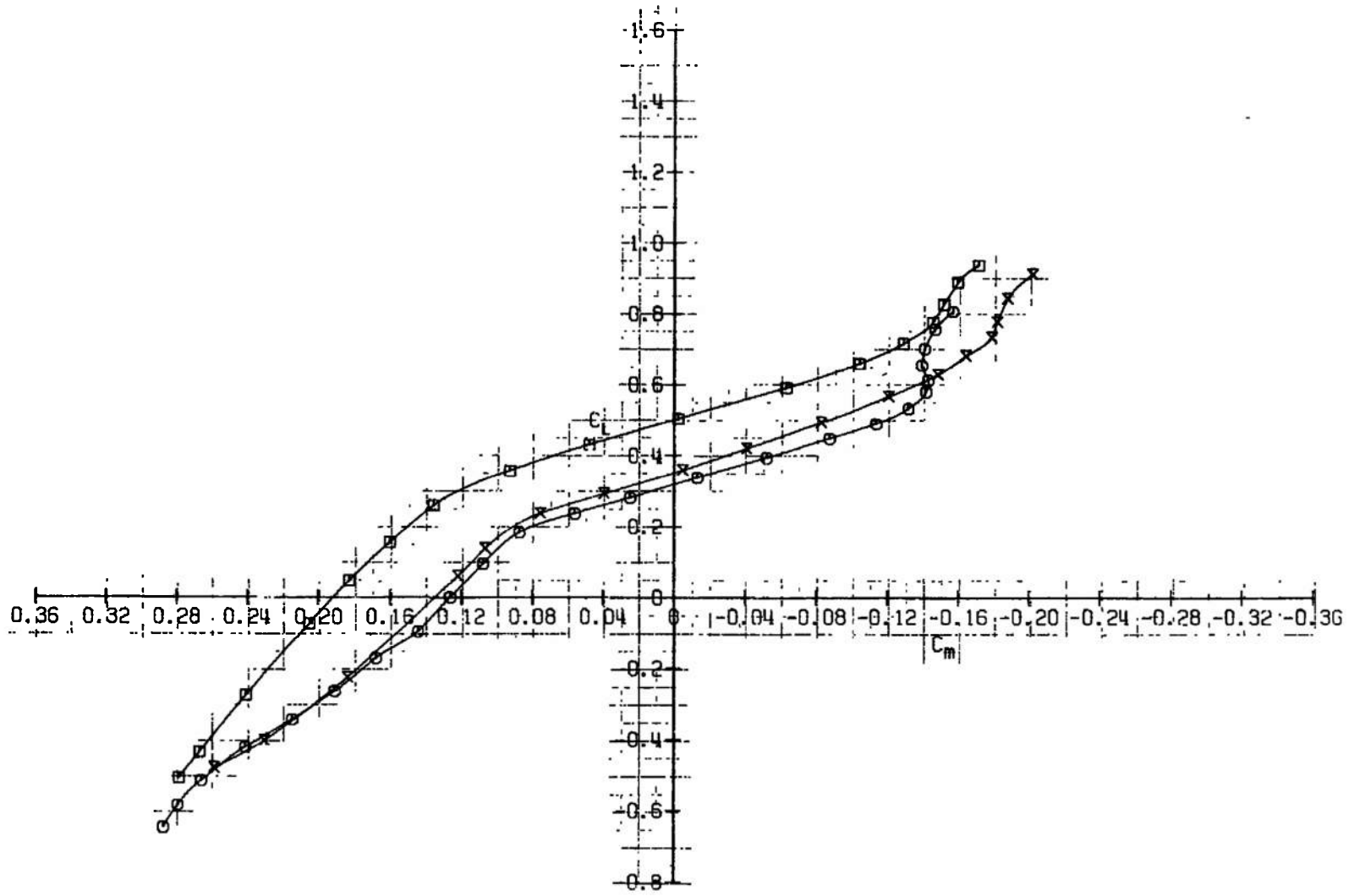
SYMBOL	CONFIGURATION	$M_\infty$	$Re$	BETA	$\alpha$	$\epsilon$	$\mu$	$\nu$	$\lambda$	$\beta$	$\gamma$
○	$D_0 S_{1/6} V_{2/6} r_3 H_3 e_3$	0.75	4,50	0.0	-2	0	0	0	0	0	54
×	$D_0 S_{1/6} V_{2/6} r_3 H_3 e_3$	0.75	4,50	0.0	-2	0	0	0	20	175	
□	$D_0 S_{1/6} V_{2/6} r_3 H_3 e_3$	0.75	4,50	0.0	-2	0	0	0	60	195	



d.  $M_\infty = 0.75$   
 Fig. 10 Continued

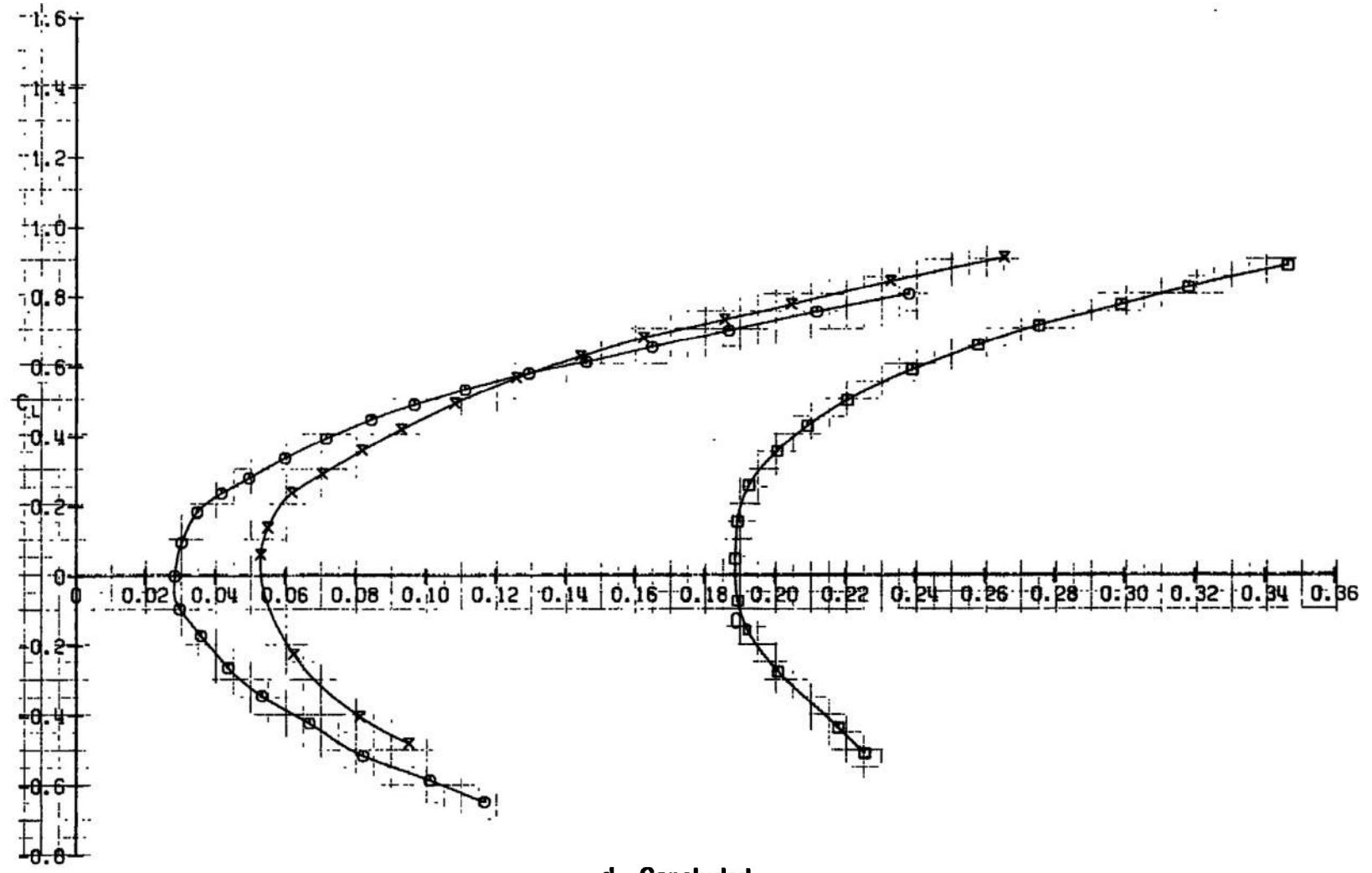


CONFIGURATION: $W_3 a_3 D_4 r_4 h_4 B_3 C_2 N_3$										
SYM	CONFIGURATION	$M_\infty$	Re	BETA	$\delta H$	$\delta E$	$\delta B$	$\delta AL$	$\delta B$	PN
○	$D_3 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.75	4.50	0.0	-2	0	0	0	0	54
×	$D_3 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.75	4.50	0.0	-2	0	0	0	+20	179
□	$D_3 S_{1-5} V_2 d_2 r_3 h_3 e_3$	0.75	4.50	0.0	-2	0	0	0	+60	195



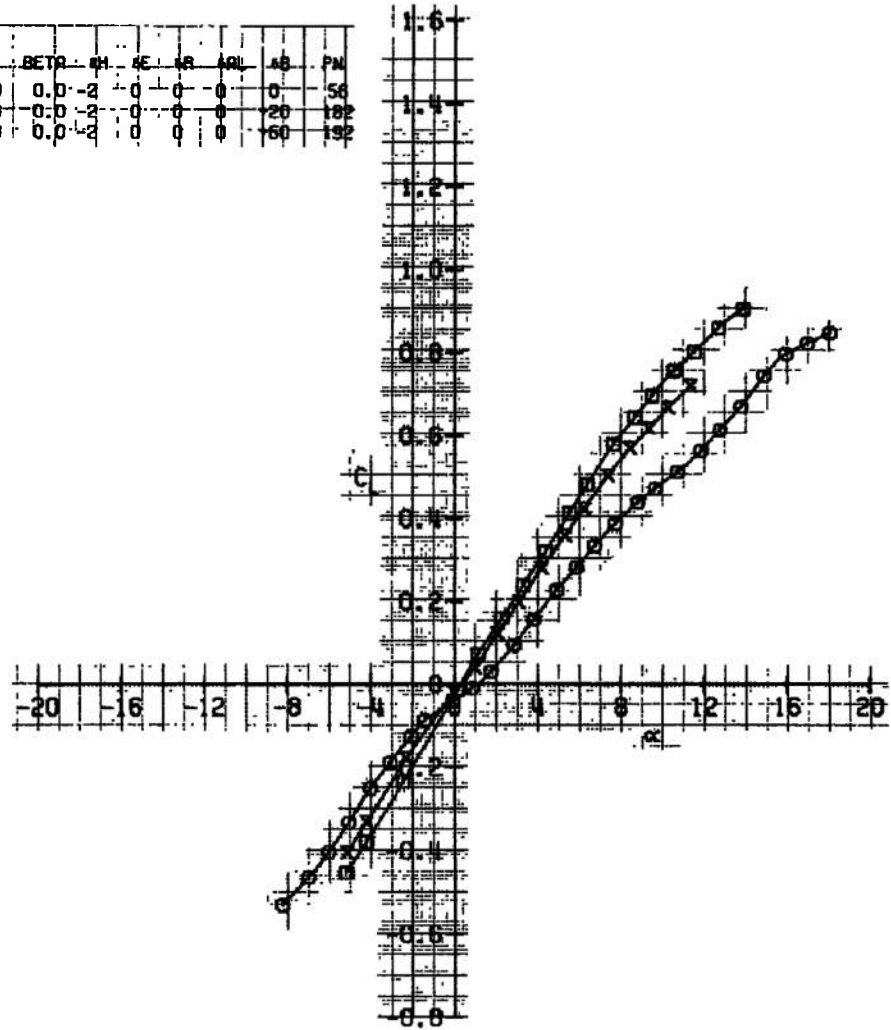
d. Continued  
Fig. 10 Continued

SYM	CONFIGURATION	$M_{\infty}$	Re	BETA	$\delta H$	$\delta E$	$\delta R$	$\delta AL$	$\delta B$	PN
O	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.75	4.50	0.0	-2	0	0	0	0	54
X	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.75	4.50	0.0	-2	0	0	0	+20	178
□	$D_6 S_{1-5} V_2 d_2 r_3 H_3 e_3$	0.75	4.50	0.0	-2	0	0	0	+60	195



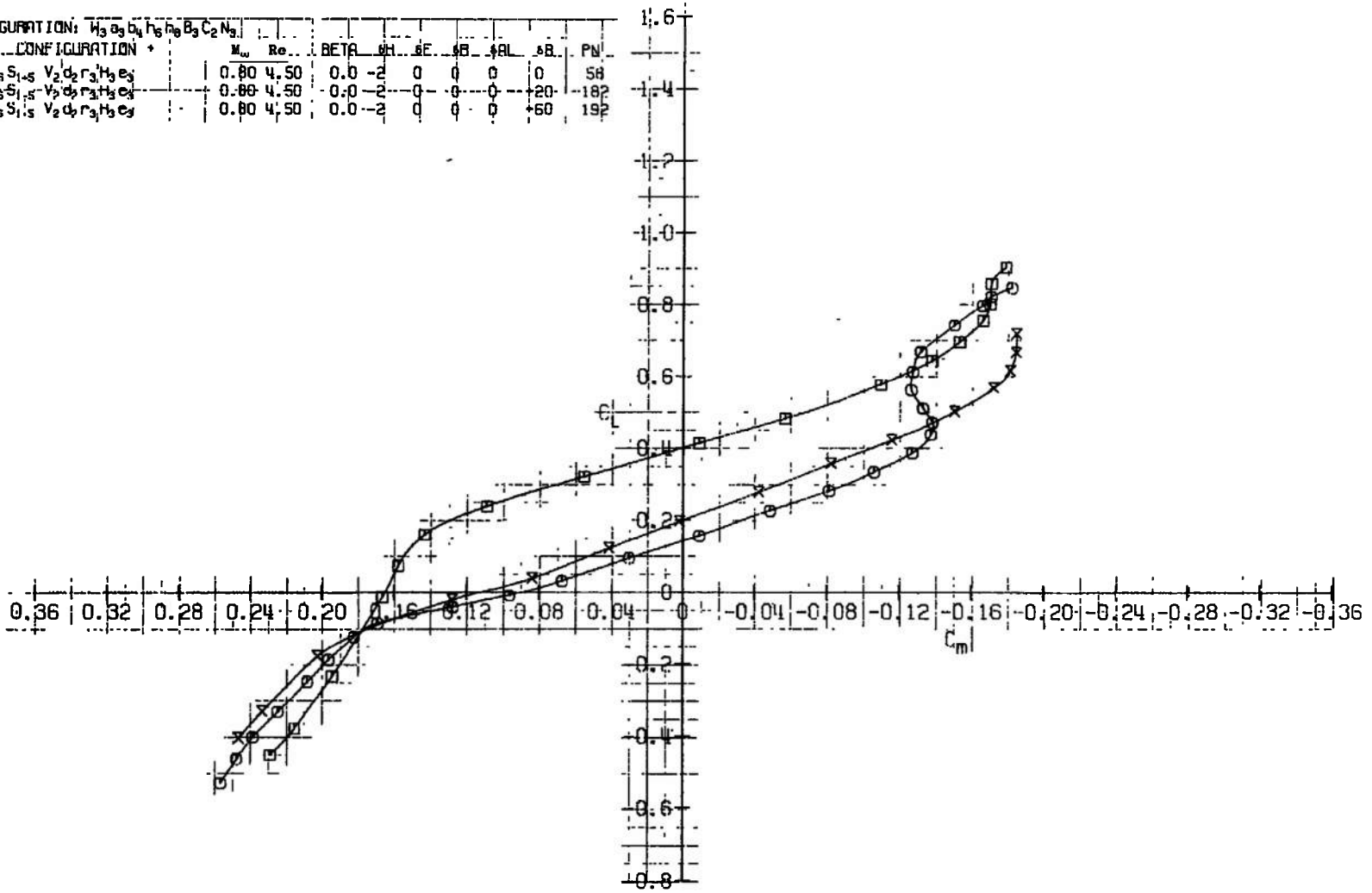
d. Concluded  
Fig. 10 Continued

CONFIGURATION: $M_2, \theta_2, b_2, h_2, N_2, \theta_3, r_3, N_3$		$M_\infty$	Re	BETR	M	AE	AR	AGL	AB	PM
○	$S_{1-5}, V_2, d_2, r_3, h_3, e_3$	0.80	4,50	0.0	-2	0	0	0	0	56
×	$D_6, S_{1-6}, V_2, d_2, r_3, h_3, e_3$	0.80	4,50	0.0	-2	0	0	0	20	182
□	$D_6, S_{1-5}, V_2, d_2, r_3, h_3, e_3$	0.80	4,50	0.0	-2	0	0	0	60	192

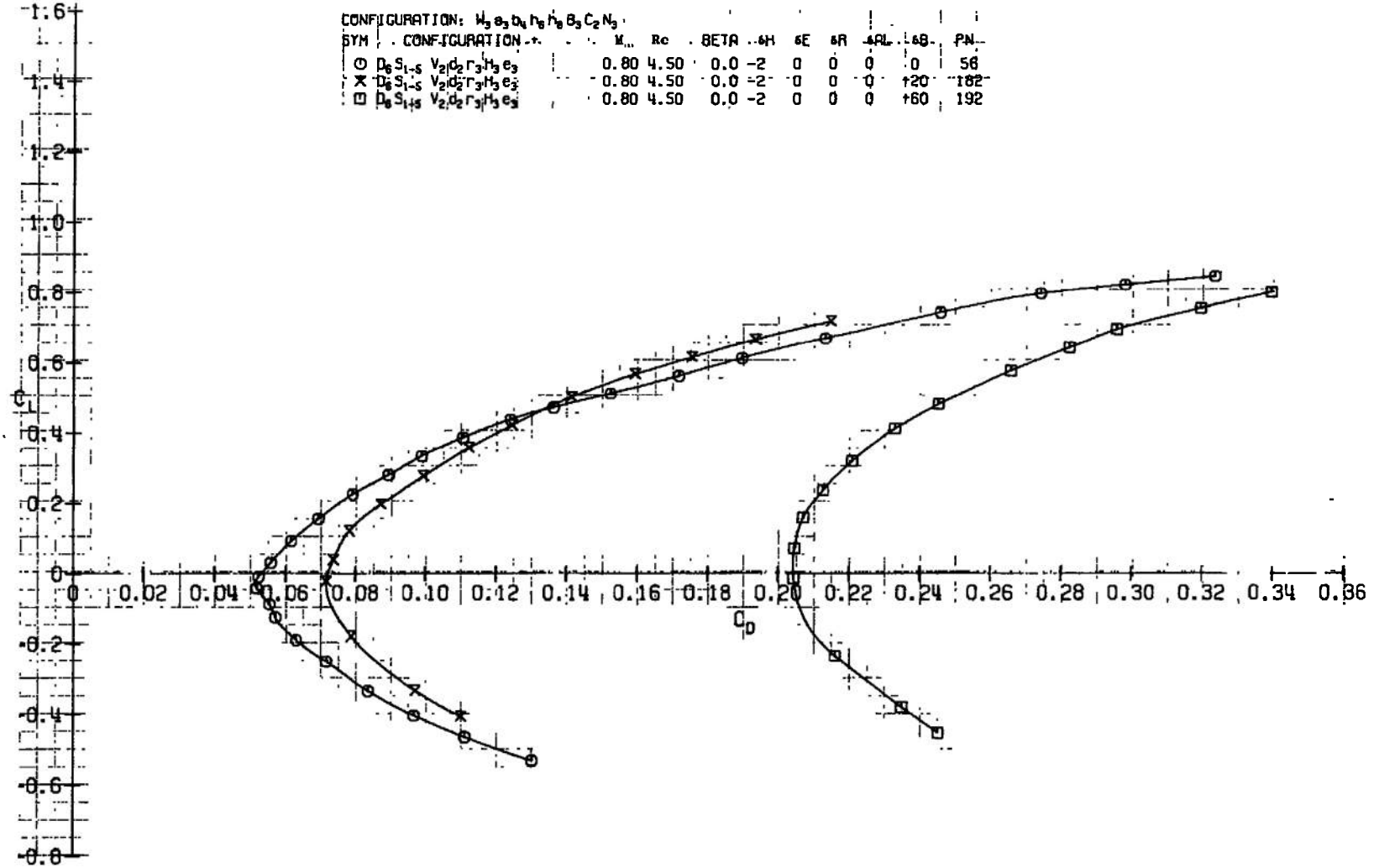


e.  $M_\infty = 0.80$   
Fig. 10 Continued

CONFIGURATION: $W_3 a_3 b_4 h_5 h_6 B_3 C_2 N_3$		$M_w$	$Re_w$	BETA	$\delta H$	$\delta F$	$\delta B$	$\delta AL$	$\delta R$	PN
○	$D_8 S_{1.5} V_2 d_2 r_3 h_3 e_3$	0.80	4.50	0.0	-2	0	0	0	0	58
×	$D_6 S_{1.5} V_2 d_3 r_3 h_3 e_3$	0.80	4.50	0.0	-2	0	0	0	+20	182
□	$D_6 S_{1.5} V_2 d_2 r_3 h_3 e_3$	0.80	4.50	0.0	-2	0	0	0	+60	192



e. Continued  
Fig. 10 Continued



e. Concluded  
Fig. 10 Concluded

**TABLE I**  
**INDEX TO MODEL COMPONENTS**

<b>Symbol</b>	<b>Components</b>
$a_3$	Aileron
$B_3$	Body
$b_4$	Speed Brake
$C_2$	Canopy
$d_2$	Dorsal
$D_6$	Duct
$D_7$	Duct with Core Cowl
$h_1$	Dual Ejecton Rack
$H_3e_3$	Horizontal Tail with Elevator
$h_{6, 8}$	Flap Track
$N_3$	Nacelle
$S_{1-5}$	Pylons
$V_2r_3$	Vertical Tail with Rudder
$w_1^6$	500-lb Bomb, six, MK82
$w_1^{18}$	500-lb Bomb, eighteen, MK82
$w_2^{10}$	Napalm Bomb, ten, BLU-1/B
$W_3$	Wing

TABLE I (Concluded)

X	$W_3a_3h_6h_8B_3C_2N_3$ (Basic Configuration)
XD <sub>6</sub>	
XD <sub>6</sub> S <sub>1-5</sub>	
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub>	
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	
XD <sub>7</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>4</sub> e <sub>3</sub>	
XD <sub>6</sub> S <sub>1-5</sub> w <sub>1</sub> <sup>6</sup> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	
XD <sub>6</sub> S <sub>1-5</sub> w <sub>1</sub> <sup>18</sup> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	
XD <sub>6</sub> S <sub>1-5</sub> w <sub>2</sub> <sup>10</sup> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	

TABLE II  
SUMMARY OF TEST DATA

Configuration $X = W_3 a_3 b_4 h_6 h_8 B_3 C_2 N_3$	$\alpha$ , deg	$\beta$ , deg	$RN \times 10^{-6}$	Controls	Mach Number				
					0.30	0.60	0.70	0.75	0.80
					Part Number				
<u>Effect of <math>M_\infty</math> and <math>R_N</math></u>									
XD <sub>6</sub>	V	0	2.3		454	453	---	---	---
XD <sub>6</sub> S <sub>1-5</sub>			↓		427	429	445	444	443
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> r <sub>3</sub>			↓		337	340	---	---	---
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>			↓		49/271	28/279	90	92	91
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> r <sub>3</sub> H <sub>4</sub> e <sub>3</sub>			↓		369	377	411	409	---
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>			2.7		---	---	58	60	62
XD <sub>6</sub> S <sub>1-5</sub>			4.5		---	431	433	435	437
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> r <sub>3</sub>			↓		---	341	343	345	347
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>			↓		---	50/288	52/119	54/283	56/280
XD <sub>6</sub>			7.0		---	449	450	451	452
XD <sub>6</sub> S <sub>1-5</sub>			↓		---	438	440	441	442
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> r <sub>3</sub>			↓		---	350	351	352	353
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>			↓		---	56	68	70	72
<u>Effect of Stores</u>									
				$\delta E$ , deg					
XD <sub>6</sub> S <sub>1-5</sub> w <sub>1-3</sub> <sup>6</sup> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>			2.3	10	260	261	263	266	267
XD <sub>6</sub> S <sub>1-5</sub> h <sub>1-4</sub> w <sub>1-5</sub> <sup>18</sup> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>			2.3	↓	241	243	245	247	249
			4.5	↓	---	---	253	251	---
XD <sub>6</sub> S <sub>1-5</sub> w <sub>2-5</sub> <sup>10</sup> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>			2.3	↓	215	217	235	233	231
↓			4.5	↓	---	225	227	223	229
			7.0	↓	---	219	221	---	---
<u>Elevator Effectiveness</u>									
				$\delta E$ , deg					
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>			2.3	10	97	109	---	---	---
↓				5	99	104	---	---	---
				0	46*	48*	---	---	---
				-5	100	103	---	---	---
				-10	101	102	---	---	---



TABLE II (Continued)

Configuration $X = W_3 a_3 b_4 h_6 h_8 B_3 C_2 N_3$	$\alpha$ , deg	$\beta$ , deg	RN x $10^{-6}$	Controls	Mach Number					
					0.30	0.50	0.70	0.75	0.80	
					Part Number					
<u>Elevator Effectiveness (continued)</u>					$\delta_E$ , deg					
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	V	0	4.5	10	---	111	120	122	130	
				5	---	112	118	124	129	
				0	---	50*	52*	54*	56*	
			↓	4.5	-5	---	113	117	123	128
					-10	---	114	116	125	127
					2.3	10	367	381	---	---
			↓	4.5	5	368	380	---	---	---
					0	369	377	---	---	---
					-5	371	376	---	---	---
			↓	4.5	-10	372	375	---	---	---
					10	---	383	395	397	---
					5	---	384	394	398	407
			↓	4.5	C	---	385	392	399	406
					-5	---	387	391	401	405
					-10	---	388	390	402	404
<u>Horizontal Stabilizer Effectiveness</u>					$\delta_H$ , deg					
XD <sub>5</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	V	0	2.3	2	318	319	---	---	---	
				0	327	328	---	---	---	
			↓	4.5	-2	46*	48*	---	---	---
					2	---	320	321	322	323
			↓	4.5	0	---	329	330	331	332
↓	4.5	-2	---	50*	52*	54*	56*			
<u>Aileron Effectiveness</u>					$\delta_A$ , deg	$\delta_B$ , deg				
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	V	0	2.3	20	134	146	---	---	---	
				10	135	145	299	296	---	
				5	136	144	---	---	---	

TABLE II (Continued)

Configuration $X = W_3 a_3 b_4 n_6 h_8 B_3 C_2 N_3$	$\alpha$ , deg	$\beta$ , deg	RN x $10^{-5}$	Controls		Macr Number						
						0.30	0.60	0.70	0.75	0.80		
						Part Number						
<u>Aileron Effectiveness (continued)</u>												
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>	V	0	2.3	0	0	46*	48*	80*	92*	91*		
						-5	137	143	---	---	---	
						-10	138	142	298	297	---	
						-20	139	141	---	---	---	
						4.5	20	---	148	---	---	
						10	---	149	156	162	158	
						5	---	150	---	---	---	
						0	50*	52*	52*	54*	56*	
						-5	---	151	---	---	---	
						-10	---	152	155	161	159	
						-20	---	153	---	---	---	
						2.3	30	20	167	---	---	
						20	---	188	---	---	---	
						10	168	187	---	---	---	
						0	169	186	---	---	---	
						-10	170	185	---	---	---	
						-20	---	184	---	---	---	
						-30	171	---	---	---	---	
						4.5	10	---	174	175	180	181
						0	---	173	176	179	182	
						-10	---	172	177	178	183	
						2.3	30	60	209	---	---	
						10	208	203	---	---	---	
						0	207	204	---	---	---	
						-10	206	---	---	---	---	
						-30	205	---	---	---	---	
						4.5	10	---	202	197	196	191

TABLE II (Continued)

Configuration X = W <sub>3</sub> a <sub>3</sub> b <sub>4</sub> h <sub>6</sub> h <sub>8</sub> B <sub>3</sub> C <sub>2</sub> N <sub>3</sub>	α, deg	β deg	RN 10 <sup>-6</sup>	Controls	Mach Number					
					0.30	0.60	0.70	0.75	0.80	
					Part Number					
<u>Aileron Effectiveness (continued)</u>										
				δ <sub>A</sub> , deg	δ <sub>B</sub> , deg					
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> l <sub>3</sub> e <sub>3</sub>	V	0	4.5	0	60	---	201	188	195	192
			4.5	-10		---	200	199	194	193
<u>Horizontal Tail Dihedral Effects</u>										
				δ <sub>H</sub> , deg	δ <sub>B</sub> , deg					
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>4</sub> e <sub>3</sub>			2.3	0	0	369*	---	---	---	---
			4.5	0	0	---	385*	392*	399	406*
			2.3	0	-60	414	---	---	---	---
			4.5	0	-60	---	418	420	421	422
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> l <sub>3</sub> e <sub>3</sub>			2.3	10	0	45*/271	---	---	---	---
			4.5	10	0	---	50*/288	52*	54*	56*/280
			2.3	10	-60	207*	---	---	---	---
			4.5	10	-60	---	201*	198*	195*	192*
<u>Rudder Effectiveness</u>										
					δ <sub>R</sub> , deg					
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> l <sub>3</sub> e <sub>3</sub>			2.3	0		46*/271	48*/279	---	92*	---
				10		272	278	---	295	---
				20		273	277	---	---	---
				30		274	275	---	---	---
			4.5	0		---	50*/286	52*	54*/283	56*/280
				10		---	290	286	284	282
				20		---	292	---	---	---
				30		---	293	---	---	---
<u>Lateral-Directional Characteristics</u>										
XD <sub>6</sub> S <sub>1-5</sub>			2.3			427*	429*	---	---	---
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub>						337*	340*	---	---	---
XD <sub>6</sub> S <sub>1-5</sub> V <sub>2</sub> d <sub>2</sub> r <sub>3</sub> H <sub>3</sub> e <sub>3</sub>						46*/271	48*/279	---	---	---

TABLE II (Concluded)

Configuration $X = W_3 a_3 b_4 r_6 h_8 B_3 C_2 N_3$	$\alpha$ , deg	$\beta$ , deg	RN x $10^{-6}$	Controls	Mach Number				
					0 30	0 60	0 70	0 75	0 80
					Part Number				
<u>Lateral-Directional Characteristics (continued)</u>									
$XD_6S_{1-5}V_2d_2r_3H_4e_3$	V	0	2 3		399*	377	---	---	---
$XD_6S_{1-5}$		5			428	430	---	---	---
$XD_6S_{1-5}V_2d_2r_3$					338	339	---	---	---
$XD_6S_{1-5}V_2d_2r_3H_3e_3$					270	294	---	---	---
$XD_6S_{1-5}V_2d_2r_3H_4e_3$					370	379	---	---	---
$XD_6S_{1-5}$		0	4 5		---	431*	433*	435*	437
$XD_6S_{1-5}V_2d_2r_3$					---	341*	343*	345*	247
$XD_6S_{1-5}V_2d_2r_3H_3e_3$					50*/288	52*	54*/283	54*/283	56*/280
$XD_6S_{1-5}V_2d_2r_3H_4e_3$					---	385	392*	399*	---
$XD_6S_{1-5}$		5			---	432	434	436	438
$XD_6S_{1-5}V_2d_2r_3$					---	342	344	346	348
$XD_6S_{1-5}V_2d_2r_3H_3e_3$					---	289	287	285	281
$XD_6S_{1-5}V_2d_2r_3H_4e_3$					---	380	393	400	---
<u>Effect of Core Cow:</u>									
$XD_6S_{1-5}V_2d_2r_3H_3e_3$		0	2.3		46*	48*	---	---	---
$XD_7S_{1-5}V_2d_2r_3H_3e_3$			2.3		304	305	---	---	---
$XD_6S_{1-5}V_2d_2r_3H_3e_3$			7 0		---	68*	68*	70*	72*
$XD_7S_{1-5}V_2d_2r_3H_3e_3$			7 0		---	309	307	312	313
<u>Pressure Data</u>									
$XD_{6R}D_{7L}S_{1-5}V_2d_2r_3H_3e_3$			2.3		22	7	---	---	---
			4.5		---	10	13	15	18
			7.0		---	9	---	---	20
<u>Internal Drag Data</u>									
$XD_6S_{1-5}V_2d_2r_3H_3e_3$			2.3		27	39	---	---	---
			4.5		---	38	36	---	---
			7.0		---	34	32	30	29

\* Listed Elsewhere

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13. ABSTRACT Wind tunnel tests were conducted at Mach numbers from 0.30 to 0.80 and Reynolds numbers from 2.3 to 7.0 million on a 0.12-scale model of the A-9A aircraft to determine the effects of control surface deflections on the aerodynamic characteristics of the airplane. The results showed that the horizontal stabilizer was 20 to 50 percent more effective in pitching moment per degree of deflection than the elevator, the rudder remained effective at all Mach numbers, and the aileron deflections produced significant effects on lift, drag, and pitching and rolling moment. Minimum drag was increased by approximately 100 and 600 percent for speed brake deflections of 20 and 60 deg, respectively, at Mach numbers from 0.70 to 0.80.  Distribution limited to U. S. Government agencies only; this report contains information on test and evaluation of military hardware; December 1971; other requests for this document must be referred to Aeronautical Systems Division (SDXT), Wright-Patterson AFB, OH 45433.			

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