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USAAVLABS TECHNICAL REPORT 65-73

WIND TUNNEL TEST OF 1/7 SCALE MODEL OV-1

By

F. W. Shepheard

December 1965

U. S. ARMY AVIATION MATERIEL LABORATORIES
FORT EUSTIS, VIRGINIA

CONTRACT DA 44-177-AMC-271(T)
GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, NEW YORK

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This report has been reviewed by the U. S. Army Aviation Materiel Laboratories and is judged to be technically sound.

The reported effort was undertaken to determine the power-off drag, lift, and pitching moment of the OV-1 model, and to examine the effect of certain aerodynamic improvements, not as a prelude to modification of the Mohawk as a quantity item, but as a study to better understand flow phenomena associated with similar vehicles of this size and power class.

The report shows the aircraft to be relatively insensitive to any changes short of major redesign. The area of power effects, such as slipstream, nacelle, engine inlet, and propeller studies, not performed on this model, can be examined only on large-scale powered models.

Consideration is being given to such follow-on work.

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Contract DA 44-177-AMC-271(T)
USAAVLABS Technical Report No. 65-73
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By

F. W. Shepheard

Prepared by

Grumman Aircraft Engineering Corporation
Bethpage, New York

For

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SUMMARY

Wind tunnel tests were conducted on a 1/7 scale model of the OV-1 airplane to determine the power-off drag, lift, and pitching moment coefficients of the model and its various components, in standard production configuration, and with the following modifications:

a. Faired fuselage shape, with canopy removed.

b. Faired nacelles, both with and without cant.

c. Various combinations of tail surfaces.

d. Various fairings.

In addition, tufted flow studies were performed on certain configurations.

The only areas where modifications to the model brought about significant drag changes are the canopy and the nacelles.

CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS (Cont)

TABLES

SYMBOLS

W	Standard OV-1 Wing - Short Span Version
W^{F1}	Standard OV-1 Wing - Filleted at Fuselage Juncture
W^{F2}	Standard OV-1 Wing - Filleted at Fuselage and Nacelle Junctures
F_1	Standard OV-1 Fuselage
F_2	Modified (Faired) Fuselage
N_1	Standard OV-1 Nacelle - Production Cant
N_2	N_1 With Faired Ellipsoid Nose
N_3	N_2 With Zero Cant
T-H	Horizontal Tail
$T\text{-}HV_1$	Horizontal Tail + Center Fin and Rudder
$T\text{-}HV_2$	Horizontal Tail + Tip Fins and Rudders
$T\text{-}HV_3$	Horizontal Tail + Center + Tip Fins
I.S.	Image System
STAT	Wind Off Test for Static Balance Forces
q = 40	Wind on Test at Uncorrected Tunnel Dynamic Pressure of 40 p.s.f.
S	Wing Area - square feet
C_L	Lift Coefficient - $\frac{\text{lift}}{qs}$
C_D	Drag Coefficient - $\frac{\text{drag}}{qs}$
ΔC_L	Increment of Lift Coefficient
ΔC_m	Increment of Pitching Moment Coefficient
C_{L_α}	Slope of Lift Coefficient versus Angle of Attack

INTRODUCTION

This report, submitted in compliance with Contract DA 44-177-AMC-271(T), presents the results of wind tunnel tests of a 1/7-scale unpowered model of the OV-1 airplane. The tests were conducted in the Grumman Aircraft Engineering Corporation 7- by 10-foot subsonic wind tunnel during the period from 1 June to 14 June 1965.

The tests were run to determine the power-off drag, lift, and pitching moment coefficients of the OV-1 model and its various components at the request of the U. S. Army Aviation Materiel Laboratories.

DESCRIPTION OF MODEL

The model tested was a 1/7-scale unpowered model of the production (short wing) OV-1. A three-view drawing of the model is included as Figure 1, and a typical photograph of the model installed in the wind tunnel is shown as Figure 2.

The symbols describing the various model components are explained in Table II. Sketches of the streamlined (F_2) and production (F_1) fuselages are shown in Figures 3 and 4; and sketches of the streamlined (N_3) and production (N_1) nacelles are included as Figures 5 and 6. Note that the production nacelles incorporated flow through, with no attempt made to control or measure the mass flow.

Transition was fixed on all surfaces for all runs by means of "pinked" plastic electrical tape - a typical installation is shown in Figure 2. To define the effect of these transition strips on drag values, additional tunnel runs were performed. Data from these tests are presented as Appendix III.

The flap brackets shown in Figure 7 were on the model for all runs except where the bracket increment was measured.

The wing-fuselage and wing-nacelle fillets which were tested are depicted in Figures 8 and 9.

TESTING PROCEDURE

The test program consisted of the runs listed in Table 2. The model was pitched through an angle of attack range from -6 degrees to stall plus 2 degrees in 2 degree increments except near the stall where the data was taken at 1 degree increments. All force data was measured at a dynamic pressure of 41.1 pounds per square foot (corrected for blocking). The nominal test Reynold's number RN = 1.186×10^6 per foot, which, adjusted for a wind tunnel turbulence factor of 1.36 yields an effective Reynolds number of 1.612×10^6 per foot.

DATA REDUCTION

All data were reduced to standard NASA coefficient form using the factors presented in Table 3. The data were corrected for support tare and interference wind tunnel flow alignment. All moments were transferred from the balance resolving center (trunnion point) to a model center of gravity located at fuselage station 159.5 and water line 80.9. The transfer diagram is shown on page 11.

No correction for internal drag has been made to data obtained with the OV-1 (F_1) nacelle. Further, none of the data were adjusted for the flap bracket increment. It should be noted, however, that the increment due to brackets was determined and is shown on Figure 15.

PRESENTATION OF DATA

The force data, corrected, transferred, and reduced to standard NASA wind axis coefficients, are listed in Appendix I, pages 65 - 71. The raw balance data, recorded to a base of 50,000, from which the coefficients were derived are listed on Appendix II, pages 72 - 84.

Plots of the final data are presented as a function of angle of attack in Figures 10 to 16, and as a function of lift coefficient in Figures 17 to 23.

The tuft study photographs are included as Figures 24 to 36.

DISCUSSION OF RESULTS

Table I indicates the increments in drag due to configuration differences. In general, the increments were taken at a C_L of 0.600, however, where configuration differences were taken between a tail-on and a tail-off run, the increments were taken at an angle of attack where the tail-on and tail-off pitching moments crossed (where ΔC_m, and consequently ΔC_L due to tail was zero).

In general, the data indicate that:

1. The canopy fuselage has 0.0020 C_D higher drag than the streamlined nose.

2. Uncanting the streamlined nacelles accounts for only 0.0010 C_D.

3. The complete tail assembly adds 0.0060 C_D.

4. The OV-1 nacelles (with flow through) have 0.0045 to 0.0055 higher C_D than the uncanted streamlined nacelles (without flow through).

5. Although the fillets appeared to cause some flow improvement a drag improvement of only 0.0010 C_D is indicated from the force data.

A brief comparison of the data with theory indicates that the angle for zero lift checks at -2 degrees, the lift curve slope is in reasonable agreement (test C_{L_α} = 0.0750, theoretical C_{L_α} = 0.0760 to 0.0770, depending on whether smooth or rough section C_{L_α} is used), and Oswald's efficiency factor "e" was measured to be 0.8700 to 0.8800 dependent on configuration which also compares reasonably with the theoretical value of 0.9100.

TABLE 1
INCREMENTAL DRAG

Configuration Difference	ΔC_D @ $C_L \approx 0.6$	Additional Comments
$[W + F_1] - [W + F_2]$	+ 0.0020	-
$[W + F_1 + N_1] - [W + F_2 + N_1]$	+ 0.0020	-
$[W + F_2 + N_1] - [W + F_2]$	+ 0.0090	Not corrected for internal drag
$[W + F_2 + N_2] - [W + F_2]$	+ 0.0055	-
$[W + F_2 + N_3] - [W + F_2]$	+ 0.0045	-
$[W + F_1 + N_1] - [W + F_1]$	+ 0.0100	Not corrected for internal drag
$[W + F_1 + N_1 + (T - HV_3)] - [W + F_1 + N_1]$	+ 0.0058	Increment taken at α = 4.1 degrees where C_M due to tail is zero.
$[W + F_2 + N_1 + (T - H)] - [W + F_2 + N_1]$	+ 0.0040	-
$[W + F_2 + N_1 + (T - HV_1)] - [W + F_2 + N_1 + (T-HV)]$	0	-
$[W + F_2 + N_1 + (T - HV_2)] - [W + F_2 + N_1 + (T-HV_1)]$	+ 0.0010	Increments taken at α = 4.5 degrees
$[W + F_2 + N_1 + (T - HV_3)] - [W + F_2 + N_1 + (T-HV_2)]$	+ 0.0020	
$[W + F_2 + N_1 + (T - HV_3)] - [W + F_2 + N_1]$	+ 0.0060	-

CONCLUSIONS AND RECOMMENDATIONS

The only areas for which significant drag differences were measured were in the canopy area and nacelle area. It should be noted, however, that reductions in frontal and wetted areas accompanied the streamlining of the fuselage thereby accentuating the effect of streamlining. The increment in drag assigned to the OV-1 nacelles configuration is also not realistic since the mass flow through was neither controlled or measured, and thus internal drag could not be accounted for. In addition, the airplane nacelle-wing area is immersed in a slipstream which is not represented by power-off testing. It is thus recommended that further investigation of nacelle drag be conducted with a powered model instrumented for thrust and mass flow measurements before conclusions regarding nacelle drag are drawn.

TABLE 2
RUN SCHEDULE

Tunnel Run No.	Configuration	Run Type	Remarks
1	$W + F_2 + N_3$ (inv)	STAT	
2		q = 40	
3	$W + F_2 + N_3$ (inv) + I.S.	STAT	Tare, Interference & Alignment Runs
4		q = 40	
5	$W + F_2 + N_3$ + I.S.	STAT	
6		q = 40	
7	$W + F_2 + N_3$	STAT	Nacelle Variation
8		q = 40	
9	$W + F_2 + N_2$	q = 40	
10	$W + F_2 + N_2 + (T\text{-}HV_3)$		
11	$W + F_1 + N_1 + (T\text{-}HV_3)$		Tuft Runs
12	$W + F_1 + N_1 + (T\text{-}HV_3)$ - 0 degrees CANT		
13	$W + F_2 + N_3 + (T\text{-}HV_3)$		
14	$W + F_2$	STAT	Model Buildup
15		q = 40	
16	$W + F_2 + N_1$	q = 40	
17	$W + F_2 + N_1 + (T\text{-}H)$	STAT	F_2 Fuselage
18		q = 40	

TABLE 2
(continued)

Tunnel Run No.	Configuration	Run Type	Remarks
19	$W + F_2 + N_1 + (T\text{-}HV_1)$	STAT	
20		q = 40	(cont'd)
21	$W + F_2 + N_1 + (T\text{-}HV_2)$	STAT	Model Buildup F_2 Fuselage
22		q = 40	
23	$W + F_2 + N_1 + (T\text{-}HV_3)$	STAT	
24		q = 40	
25	$W + F_1 + N_1 + (T\text{-}HV_3)$	STAT	
26		q = 40	Model Buildup
27	$W + F_1 + N_1$	STAT	F_1 Fuselage
28		q = 40	
29	$W + F_1$	STAT	
30		q = 40	
31	$W + F_1$ (Flap Brackets Removed)	STAT	Effect of
32		q = 40	Flap Brackets
33	$T\text{-}HV_3$		Tuft
34	$W^{F1} + F_1 + N_1 + (T\text{-}HV_3)$		Runs
35	$W^{F2} + F_1 + N_1 + (T\text{-}HV_3)$		
36	$W + F_1 + N_1 + (T\text{-}HV_3)$		Repeat Tuft
37	$W + F_2 + N_2 + (T\text{-}HV_3)$		Runs

TABLE 2
(continued)

Tunnel Run No.	Configuration	Run Type	Remarks
38	$W^{F1} + F_1 + N_1 + (T\text{-}HV_3)$	STAT	Effect
39		q = 40	of
40	$W^{F2} + F_1 + N_1 + (T\text{-}HV_3)$	STAT	Fillets
41		q = 40	

TABLE 3
DATA REDUCTION FACTORS AND CORRECTIONS

Model Dimensions

Wing Area (S) = 6.735 square feet

Wing Span (b) = 6.000 feet

Wing Chord (c) = 1.170 feet

Moment Transfer Diagram - Page 11

Moment Transfer Equation

$$C_{m_{c_g}} = C_{m_{TR}} - C_L \frac{h}{c} \sin(\beta - \alpha) - C_D \frac{h}{c} \cos(\beta - \alpha)$$

$$= C_{m_{TR}} - 0.1119 \left[C_L \sin(\beta - \alpha) + C_D \cos(\beta - \alpha) \right]$$

Tunnel Wall Corrections

$\Delta \alpha_{(DEG)} = 0.7450\ C_L$

$\Delta C_D = 0.0110\ C_L^2$

$\Delta C_m = 0.0245\ C_L$ (applied to Tail On data only)

Blockage Correction

q corrected = 1.0281 q uncorrected

Support and Alignment Corrections

$\Delta \alpha$ = +0.0300 degrees

ΔC_m = +0.0025

$\Delta C_{D_{align}} = 0.0041\ C_L$

$\Delta C_{D_{support}}$ - Page

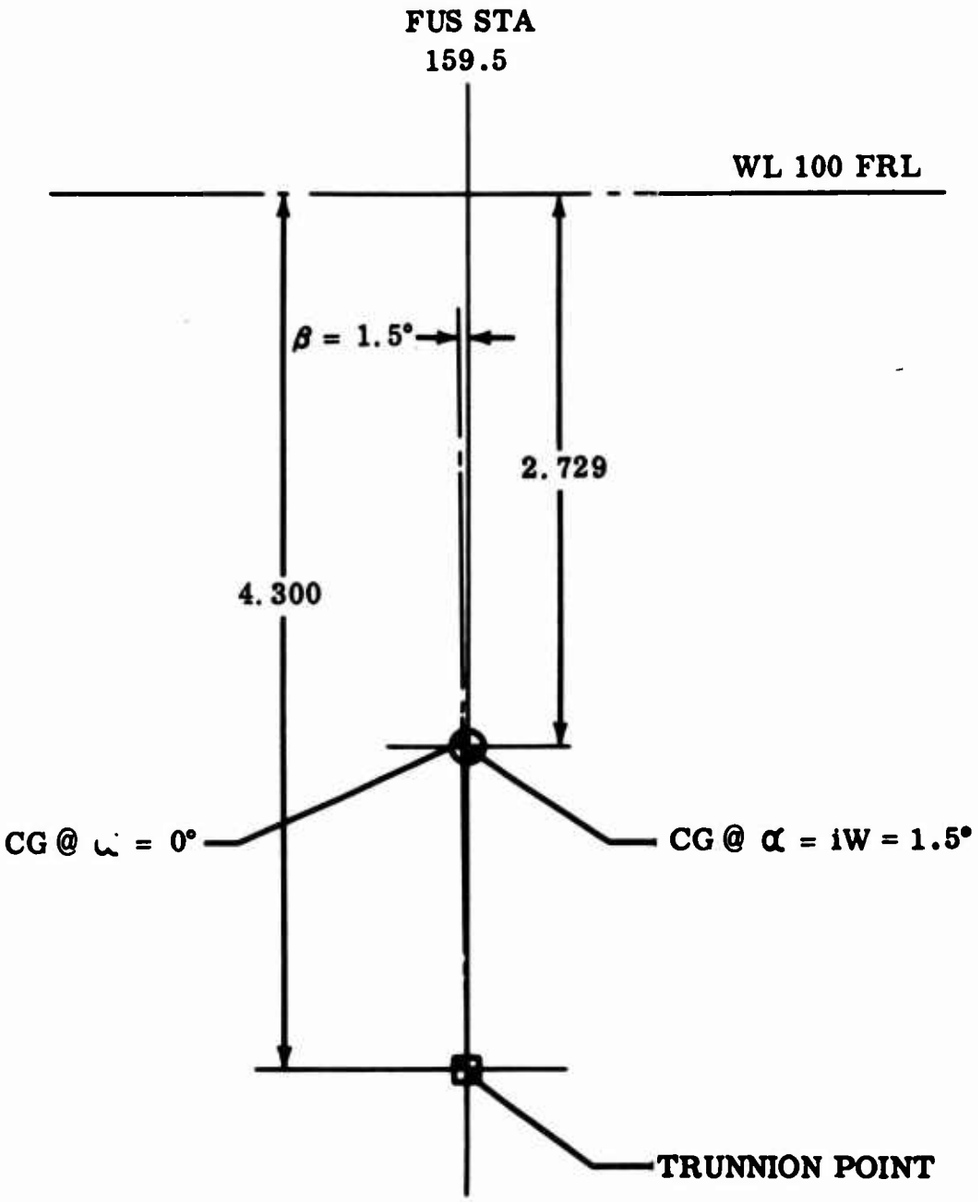


DIAGRAM: FULL MODEL SCALE - DIMENSIONS IN INCHES

Figure 1. OV-1 Moment Transfer Diagram, Model Upright.

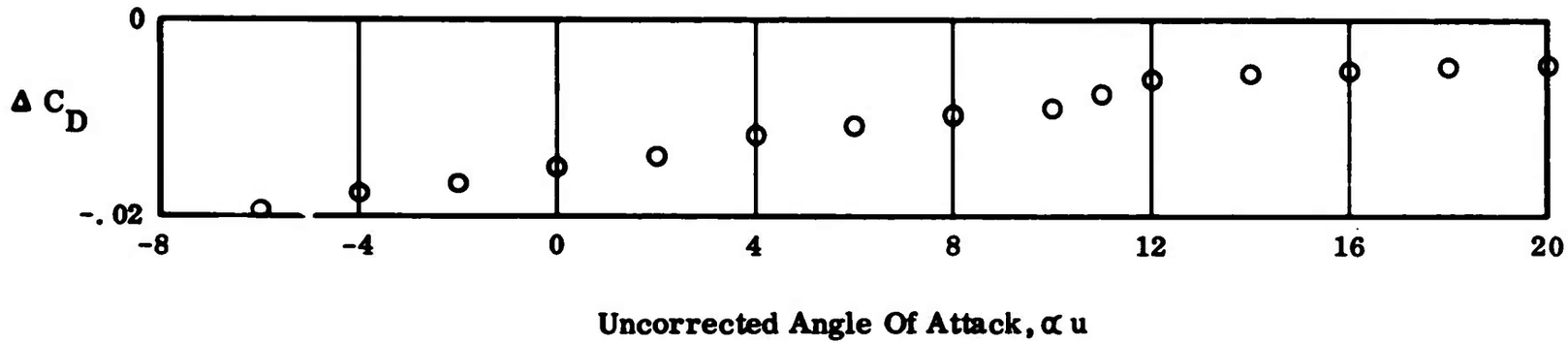


Figure 2. Support and Interference Correction to Drag.

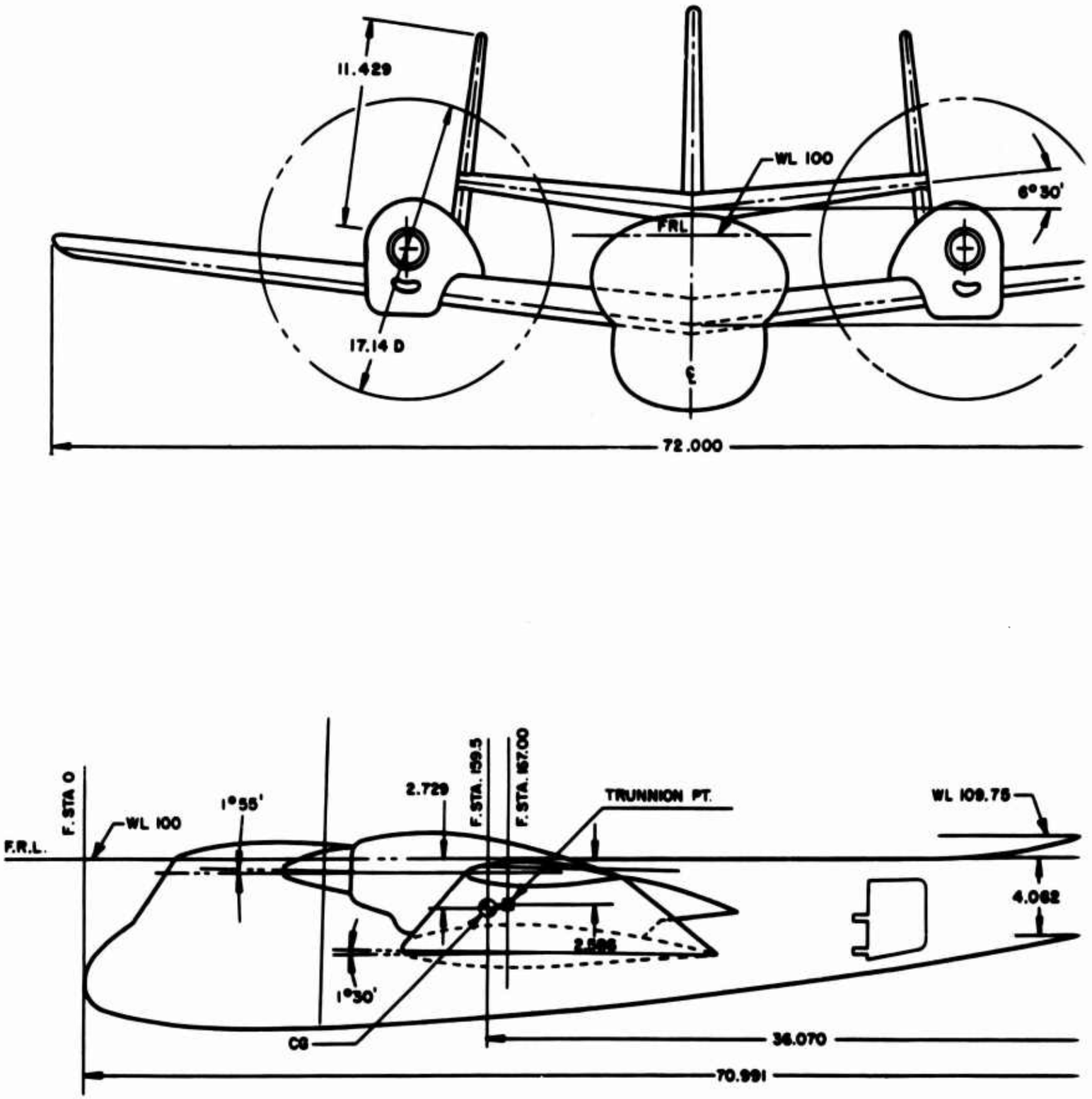
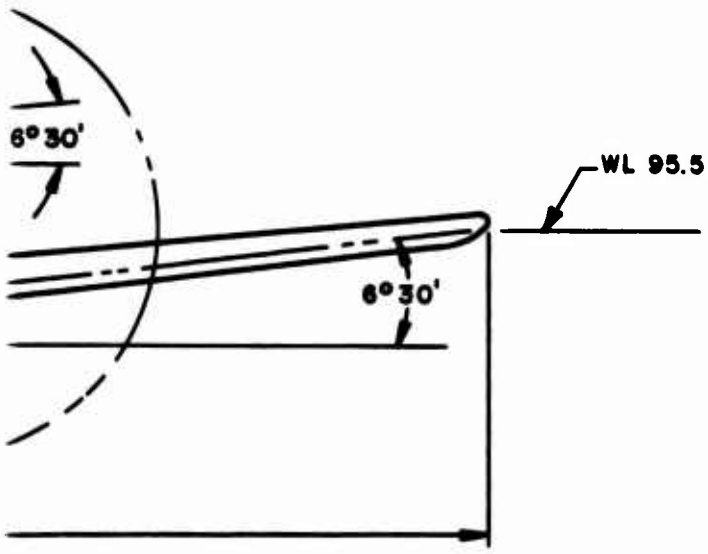
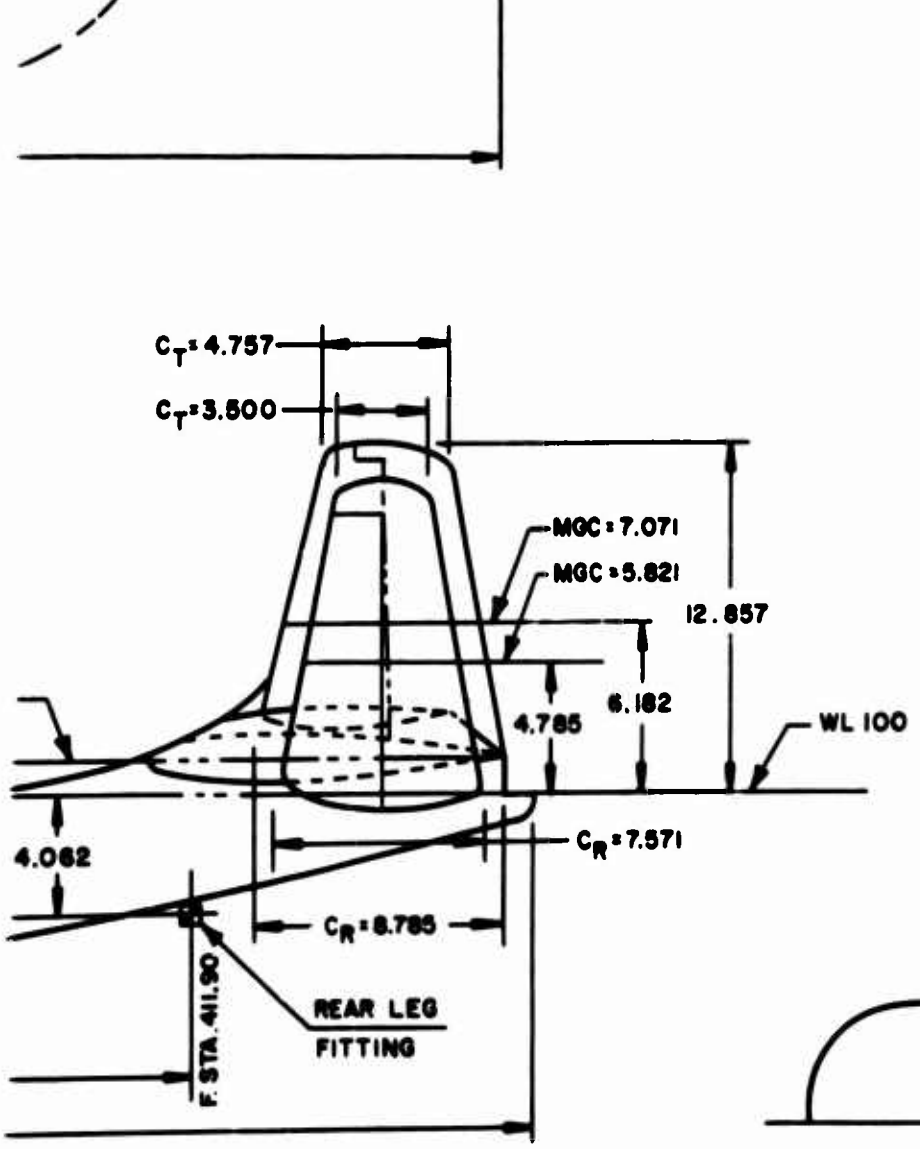
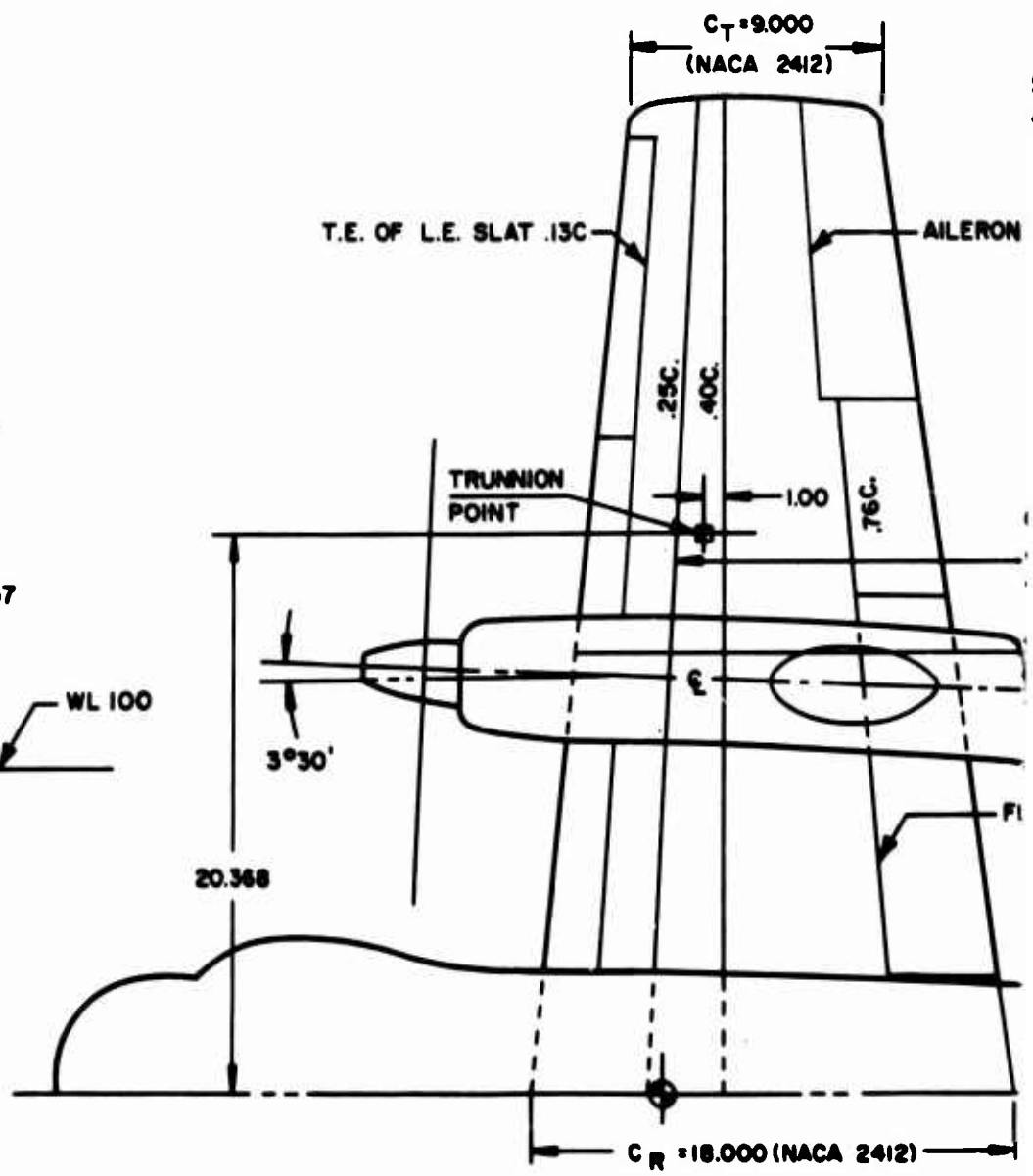


Figure 3. 1/7 Scale Wind Tunnel Model Drawing, 1/50 Full Scale Airplane.

A

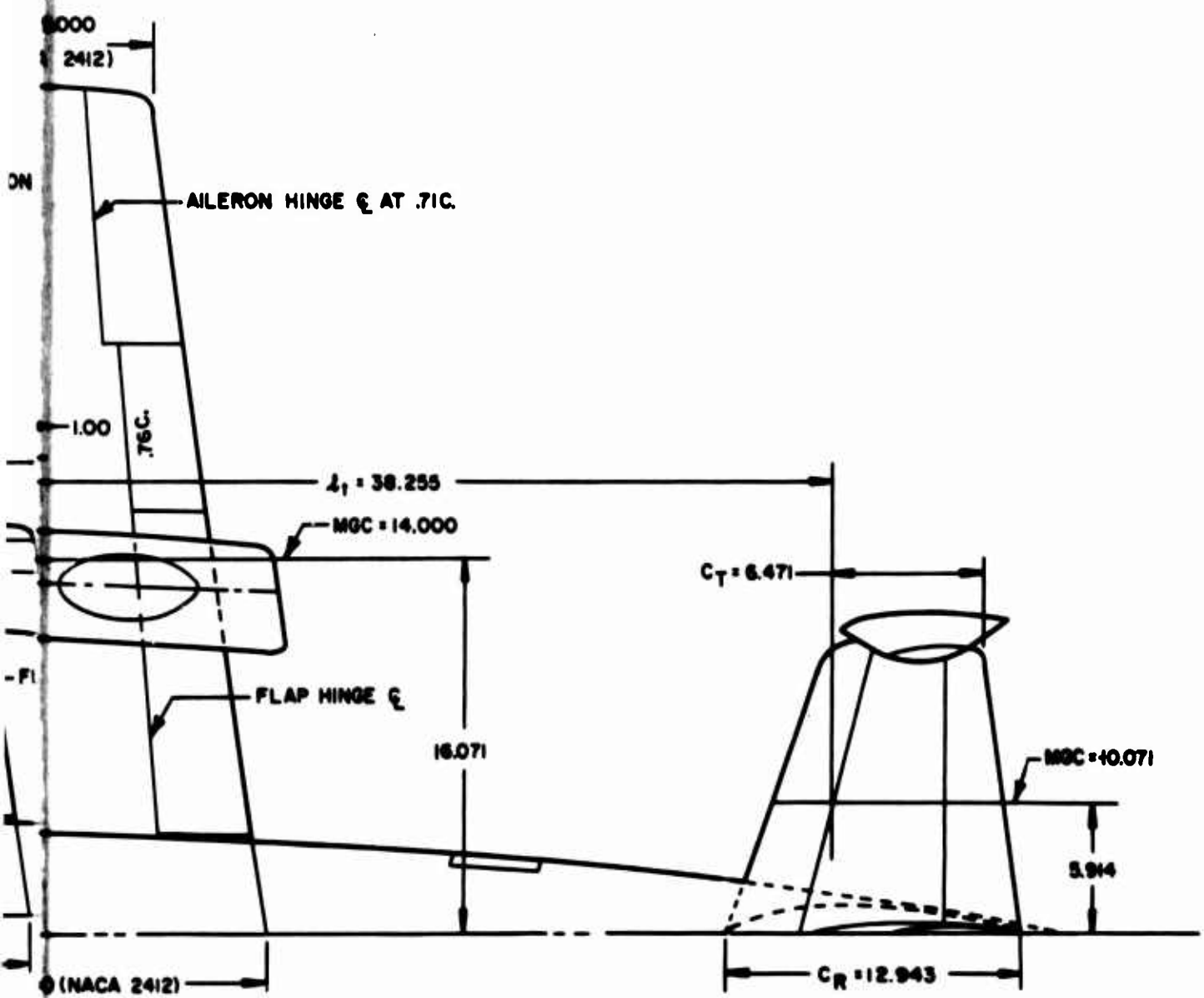

6°30'
WL 95.5
6°30'


C_T=4.757
C_T=3.500
MGC=7.071
MGC=5.821
12.857
6.182
4.785
WL 100
4.062
C_R=7.571
C_R=8.785
F. STA. 411.90
REAR LEG
FITTING


C_T=9.000
(NACA 2412)
T.E. OF L.E. SLAT .13C
AILERON
.25C.
.40C.
.76C.
TRUNNION
POINT
1.00
3°30'
20.368
C_R=18.000 (NACA 2412)

B

NOTE:
DIMENSIONS IN INCHES
MODEL SCALE



C

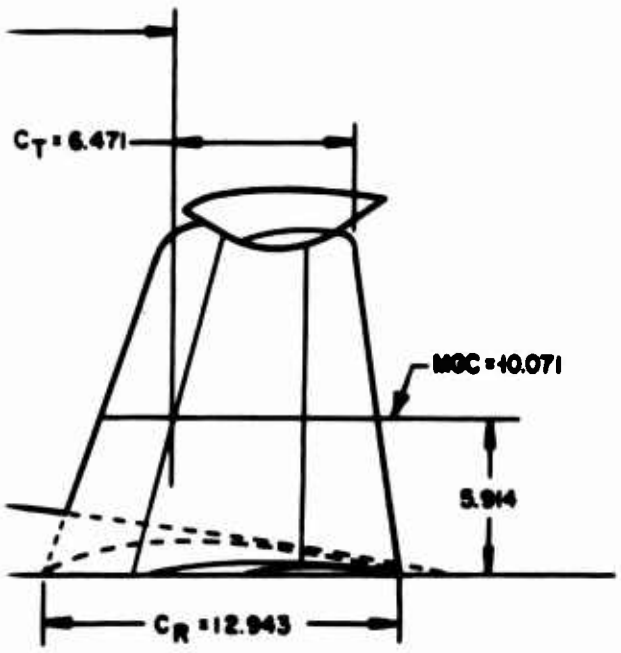
AREA	
A.R.	
T.R.	
SWEEP @ 0.40C.	
C_R	
C_T	
SECTION	
DIHEDRAL	
INCIDENCE	
FLAP AREA (TOT.	
DROOPED AILER(	
AILERON AREA (T	
L.E. SLAT AREA	
	VE
AREA	
A.R.	
SWEEP @ 0.55C.	
T.R.	
C_R	
C_T	
SECTION	
RUDDER AREA	
	VE
AREA	
A.R.	
SWEEP @ 0.60C.	
T.R.	
C_R	
C_T	
SECTION	
RUDDER AREA	
AREA	
A.R.	
SWEEP @ 0.75C.	
T.R.	
C_R	
C_T	
SECTION	
DIHEDRAL	
ELEV. AREA (T(	

WING	
AREA	6.734 ft.^{2}
A.R.	5.35
T.R.	0.5
SWEEP @ 0.40C.	0°
C_R	18 inches
C_T	9 inches
SECTION	NACA 2412
DIHEDRAL	6° 30'
INCIDENCE	1° 30'
FLAP AREA (TOTAL)	0.889 ft.^{2}
DROOPED AILERON AREA (TOTAL)	0.357 ft.^{2}
AILERON AREA (TOTAL)	0.463 ft.^{2}
L.E. SLAT AREA (TOTAL)	0.836 ft.^{2}

VERTICAL TAIL (OUTB'D)	
AREA	0.438 ft.^{2} (each)
A.R.	2.06
SWEEP @ 0.55C.	0°
T.R.	0.46
C_R	7.571 inches
C_T	3.500 inches
SECTION	NACA 0012
RUDDER AREA	0.197 ft.^{2} (each)

VERTICAL TAIL (CENTER)	
AREA	0.526 ft.^{2}
A.R.	1.64
SWEEP @ 0.60C.	0°
T.R.	0.54
C_R	8.785 inches
C_T	4.757 inches
SECTION	NACA 0012
RUDDER AREA	0.231 ft.^{2}

HORIZONTAL TAIL	
AREA	1.734 ft.^{2}
A.R.	2.65
SWEEP @ 0.75C.	0°
T.R.	0.5
C_R	12.942 inches
C_T	6.471 inches
SECTION	NACA 0012
DIHEDRAL	6° 30'
ELEV. AREA (TOTAL)	0.459 ft.^{2}



D

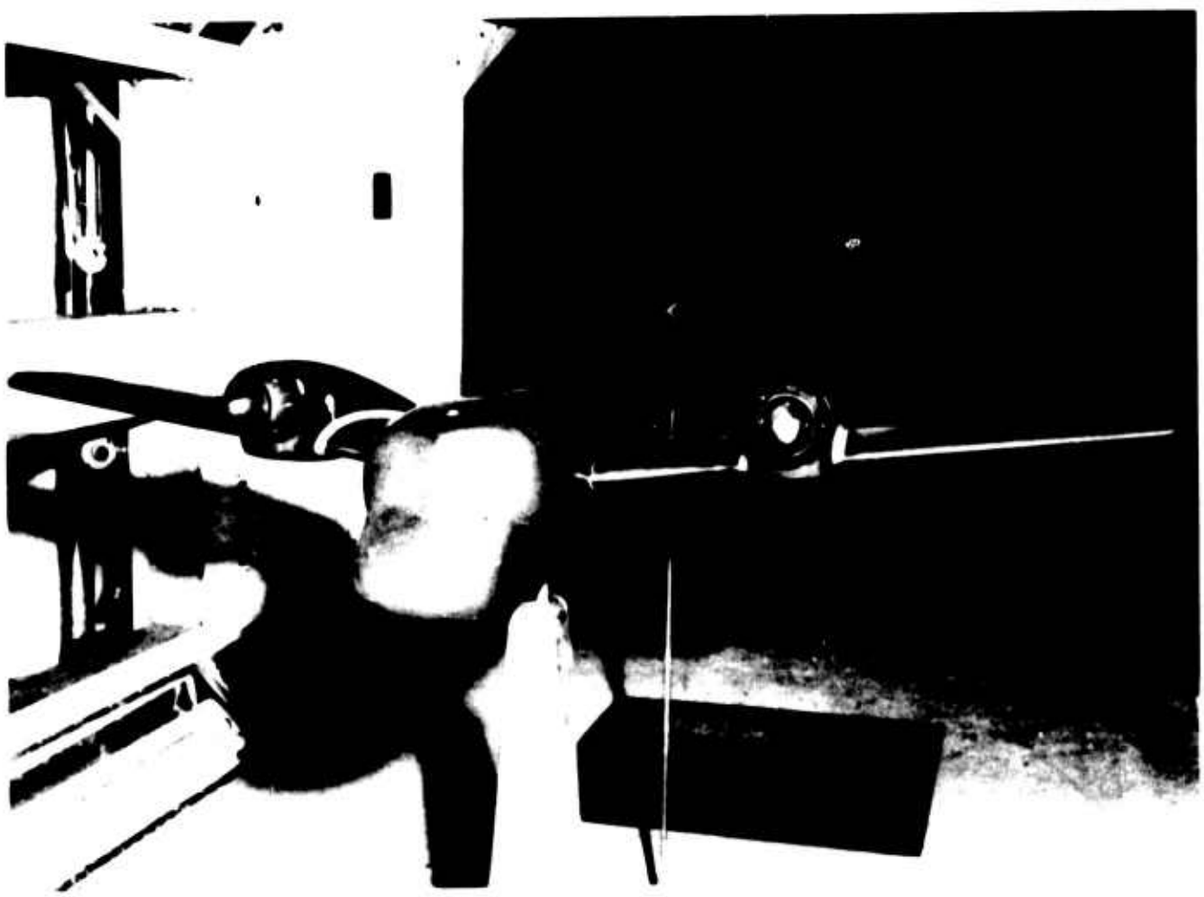


Figure 4. OV-1 Model, $W^{F_2} + F_1 + N_1 + (T - HV_3)$.

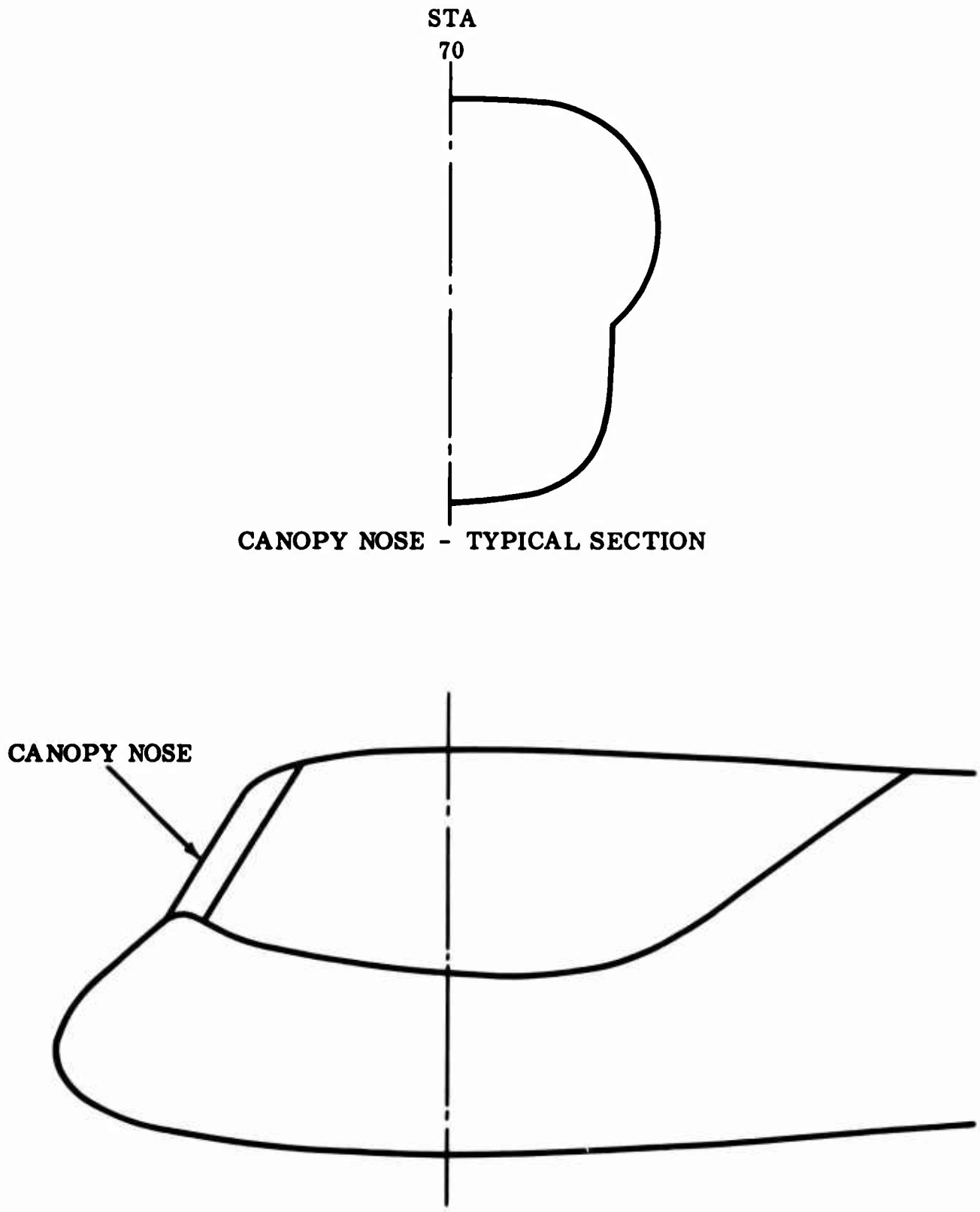


Figure 5. F_1 Fuselage.

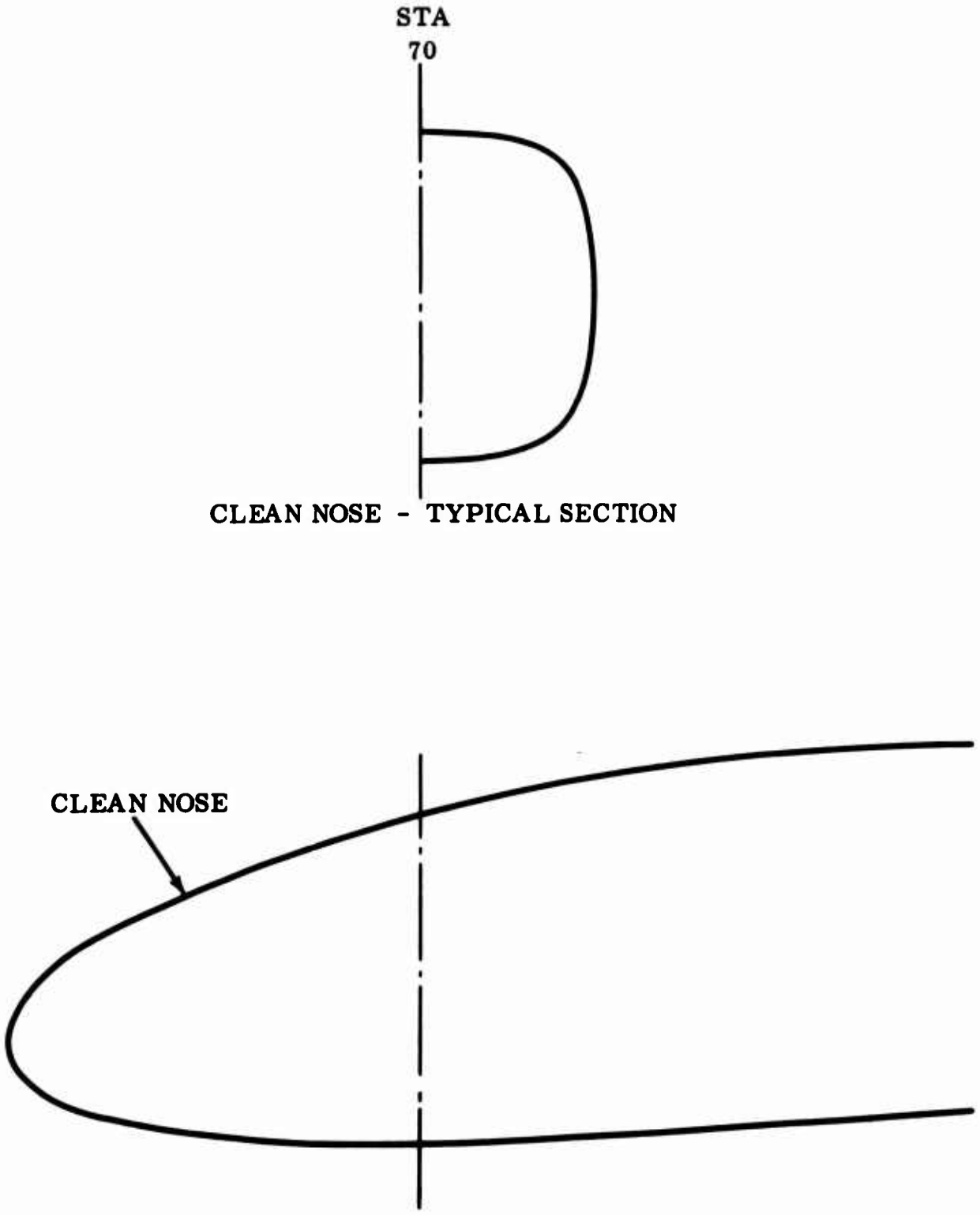


Figure 6. F_2 Fuselage.

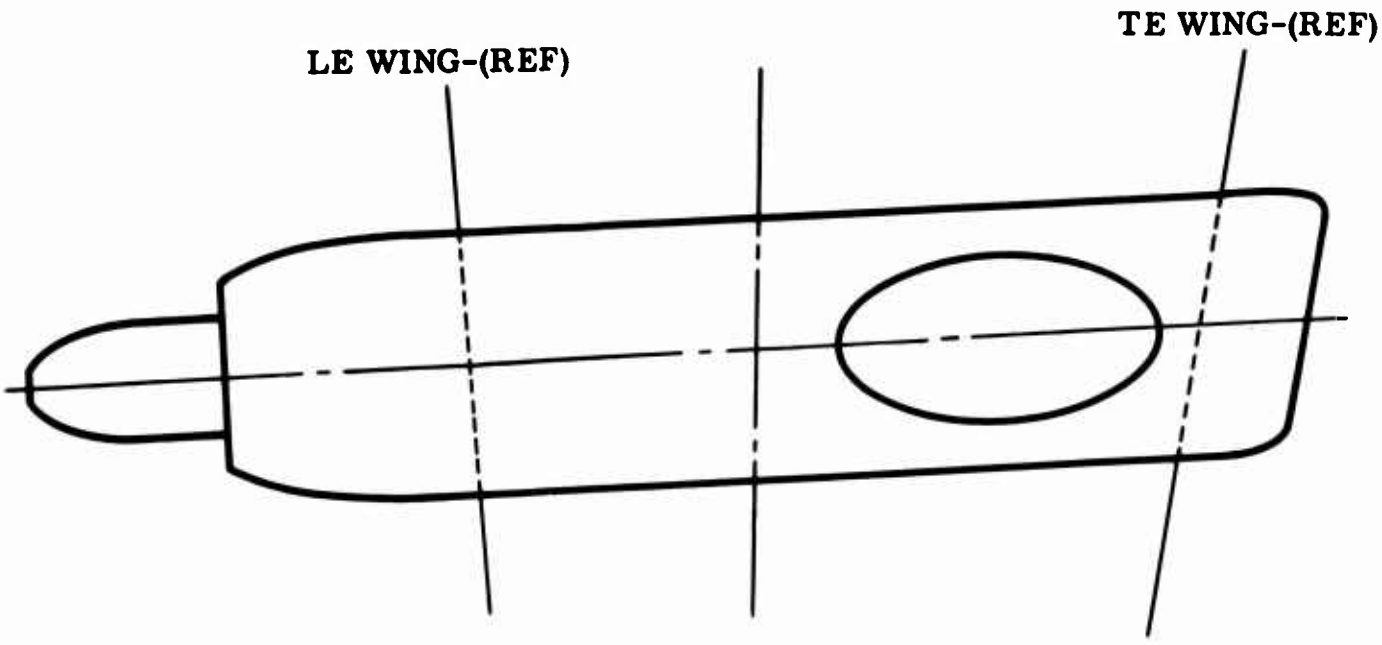
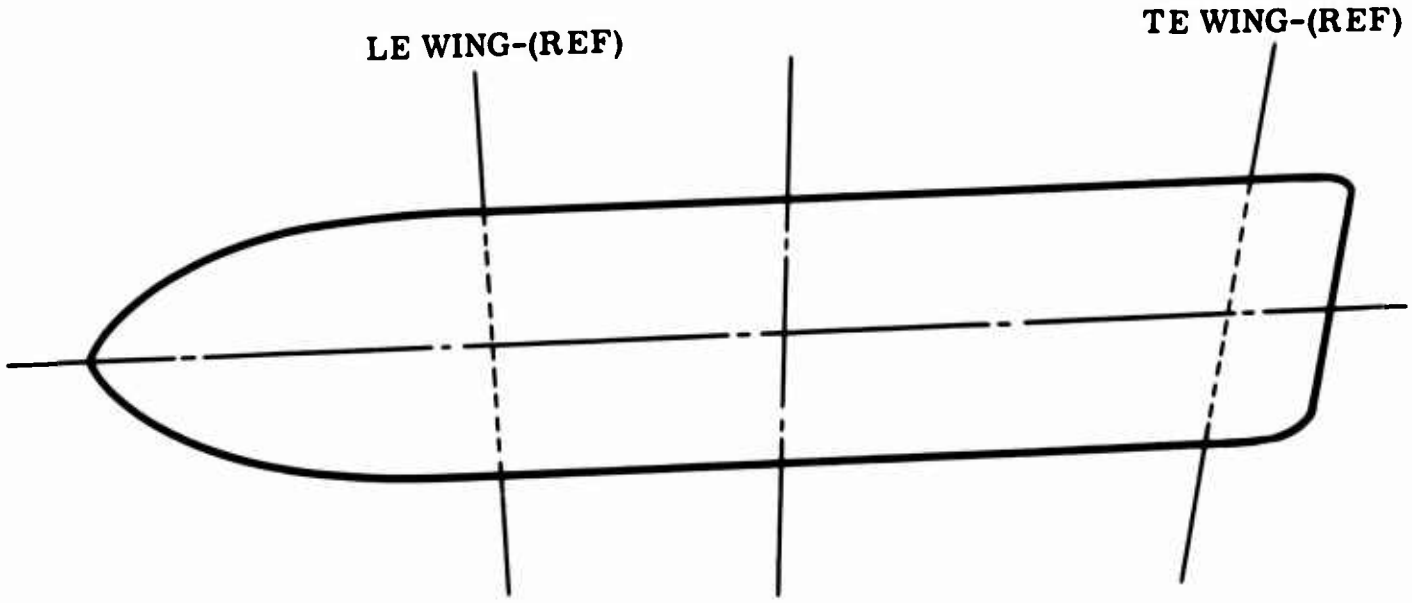


Figure 7. N_1 Nacelle.



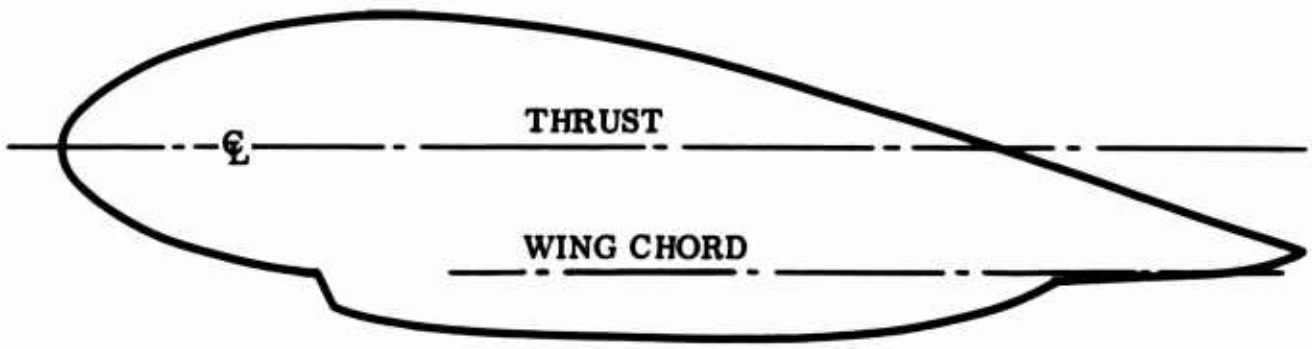


Figure 8. N_2 Nacelle.

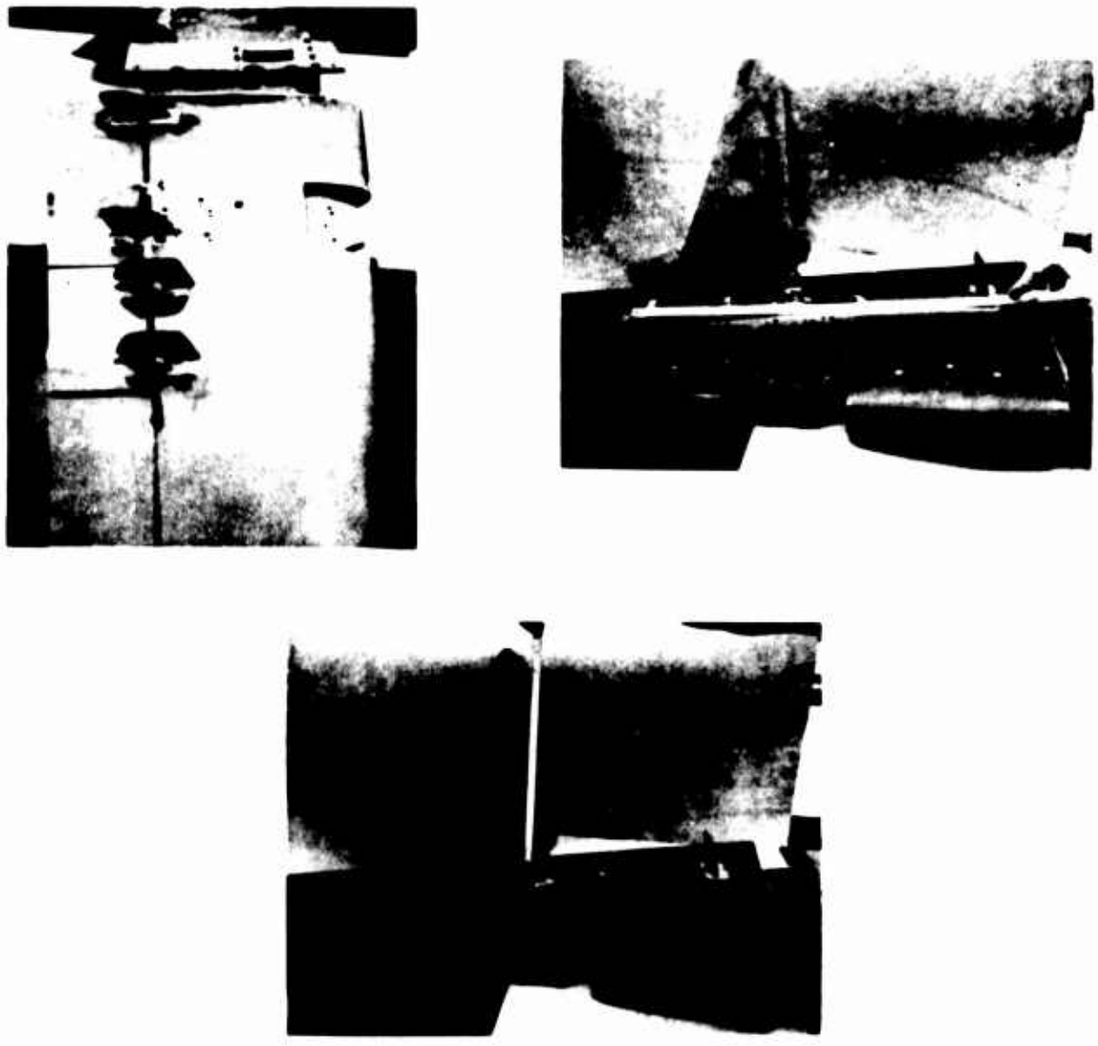


Figure 9. Flap Brackets.

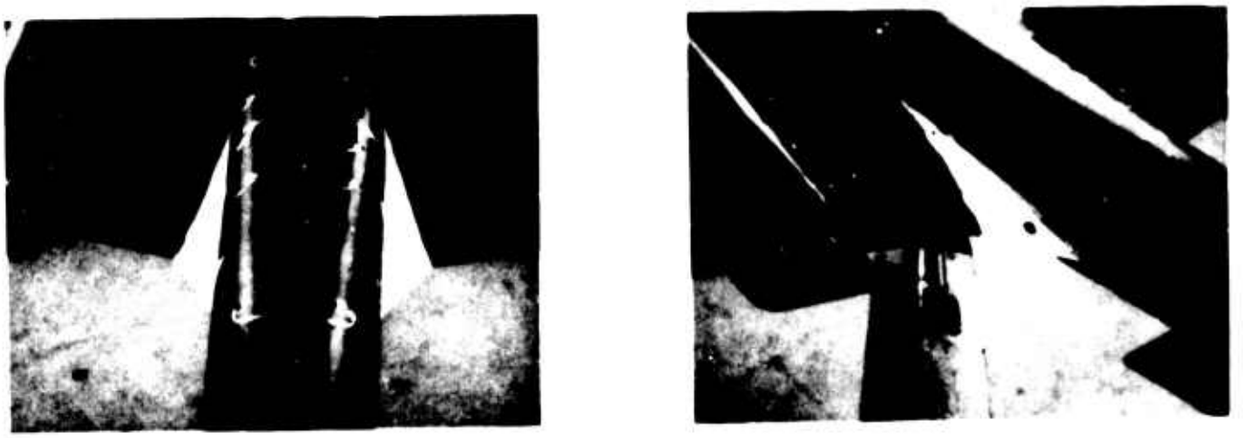
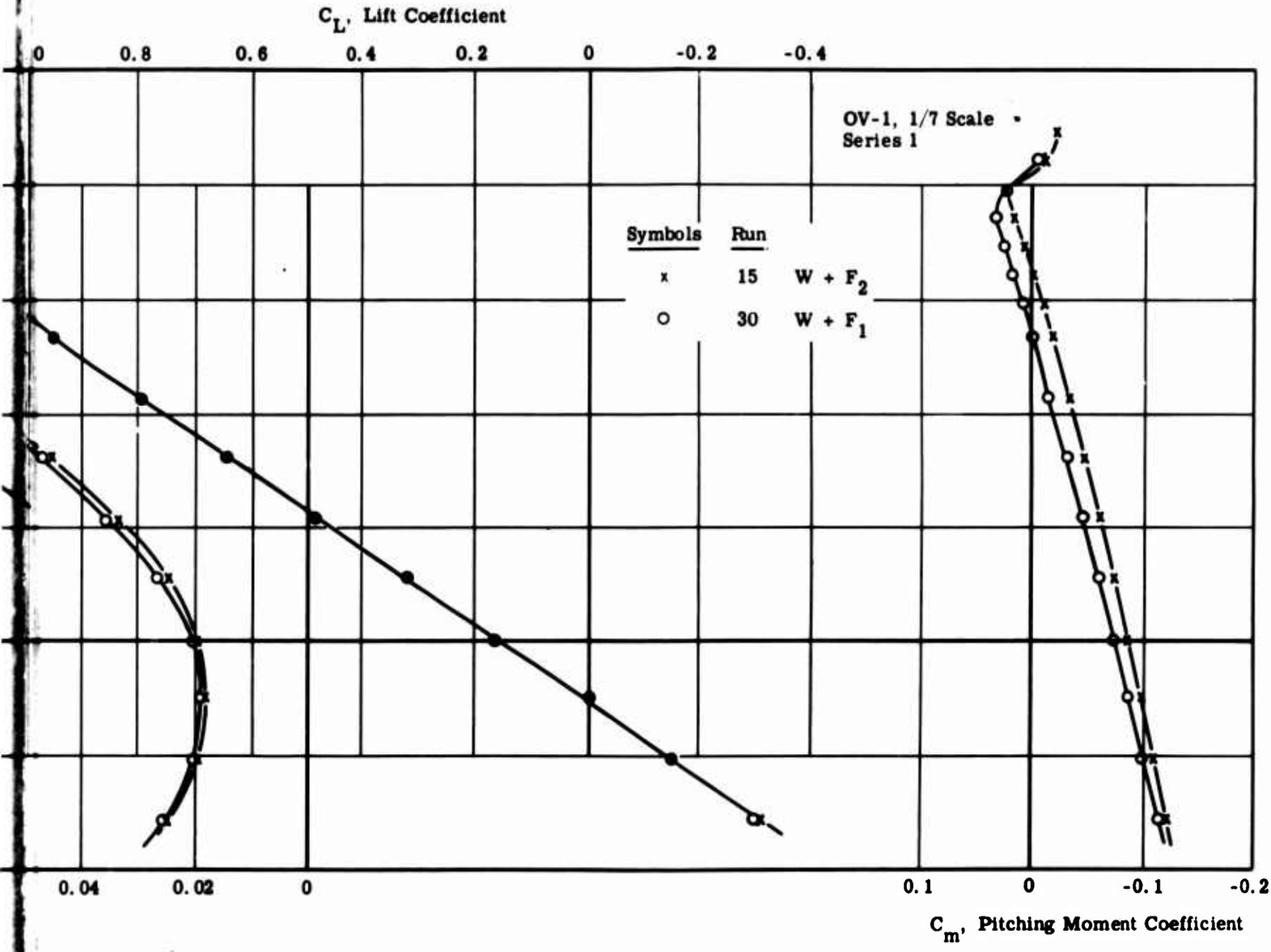


Figure 10. Wing-Fuselage Fillet $\left(W^{F_1}\right)$.

Figure 11. Wing-Nacelle Fillet $\left(W^{F_2}\right)$.


C_L, Lift Coefficient
0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
OV-1, 1/7 Scale
Series 1
Symbols
Run
x
15
W + F_2
o
30
W + F_1
0.04
0.02
0
0.1
0
-0.1
-0.2
C_m, Pitching Moment Coefficient

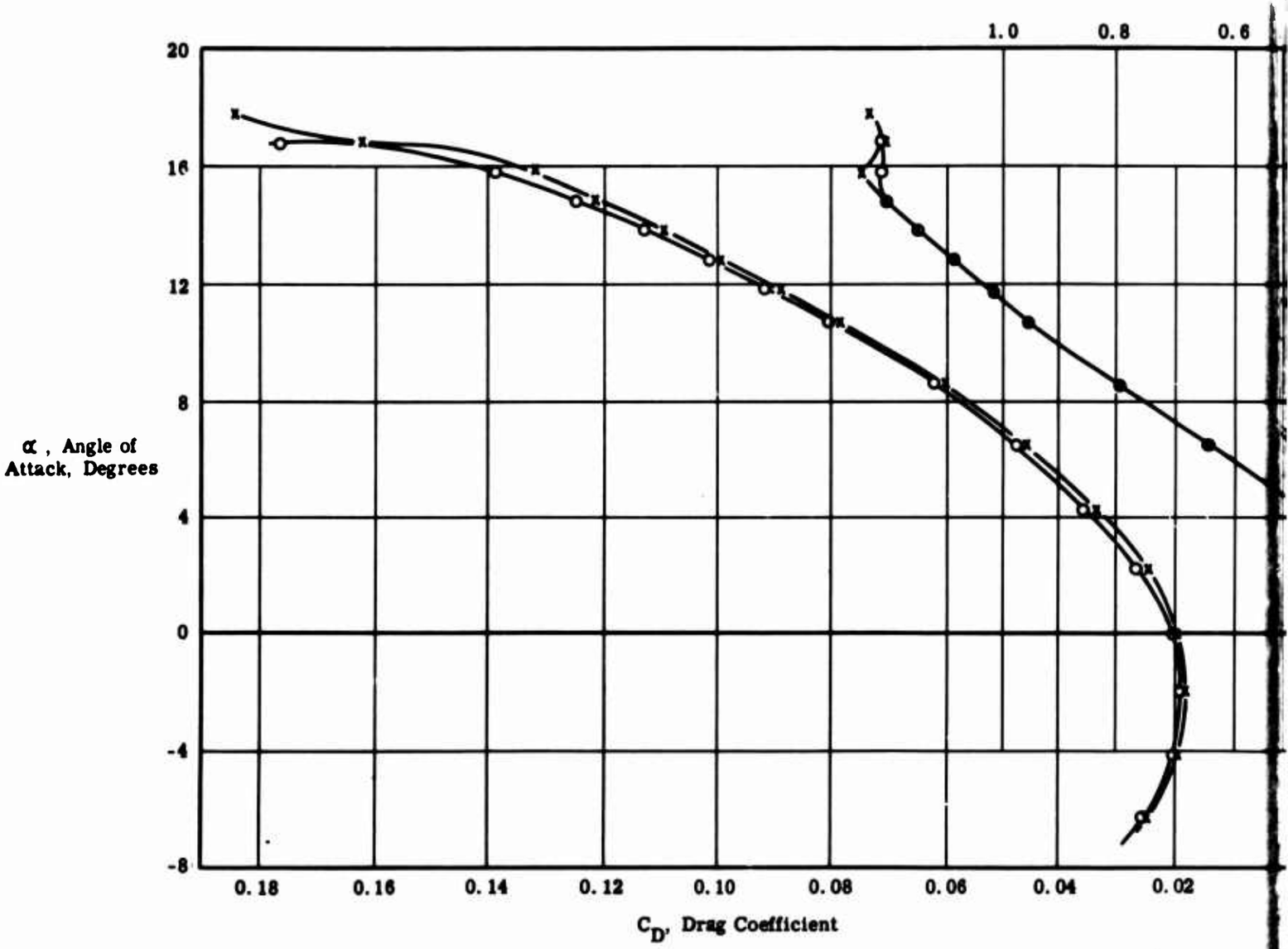


Figure 12. Effect of Fuselage, Nacelles Off.

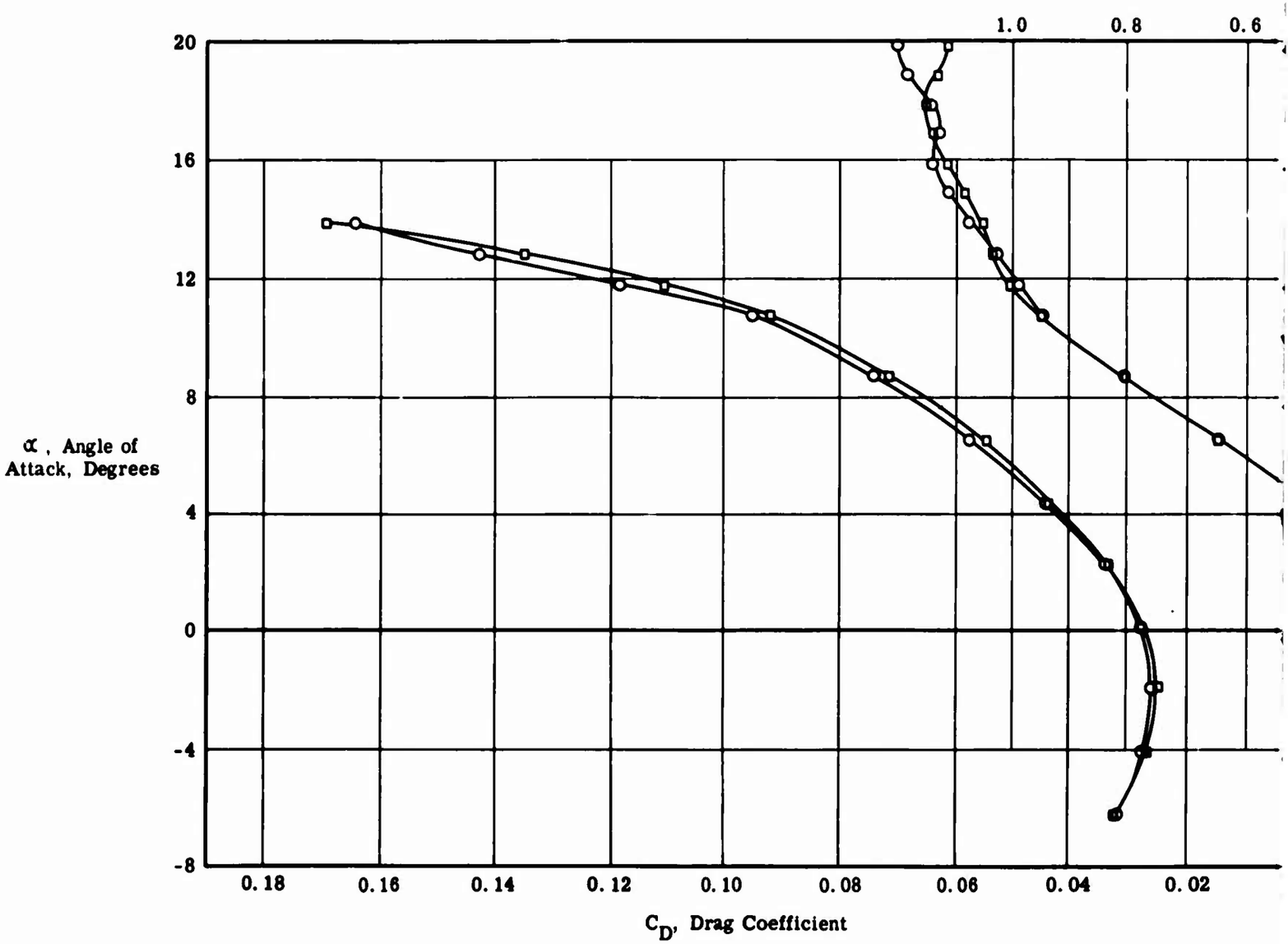
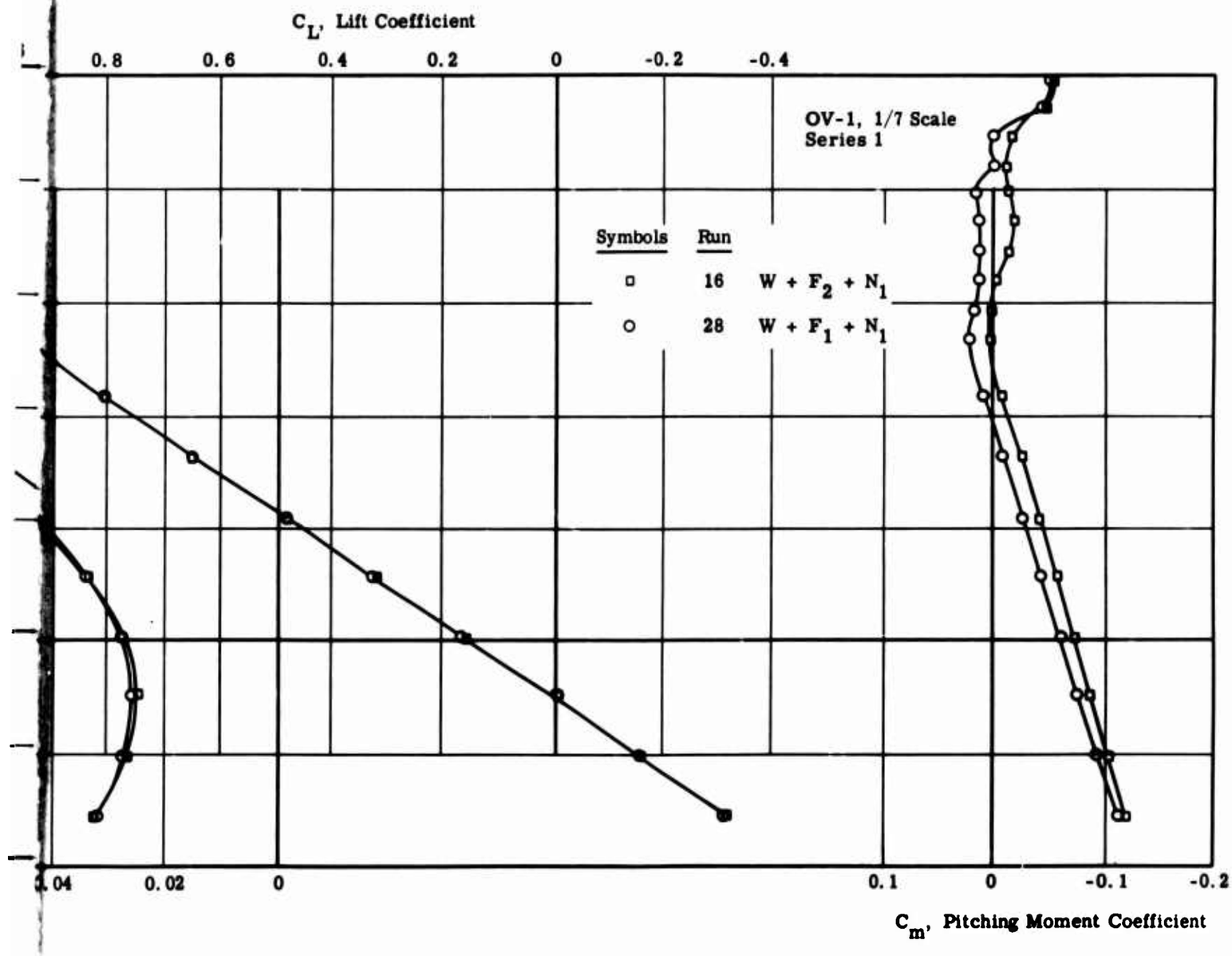


Figure 13. Effect of Fuselage, N_1 Nacelles On.

A


C_L, Lift Coefficient
0.8
0.6
0.4
0.2
0
-0.2
-0.4
OV-1, 1/7 Scale
Series 1
Symbols
Run
16
W + F_2 + N_1
28
W + F_1 + N_1
0.04
0.02
0
0.1
0
-0.1
-0.2
C_m, Pitching Moment Coefficient

B

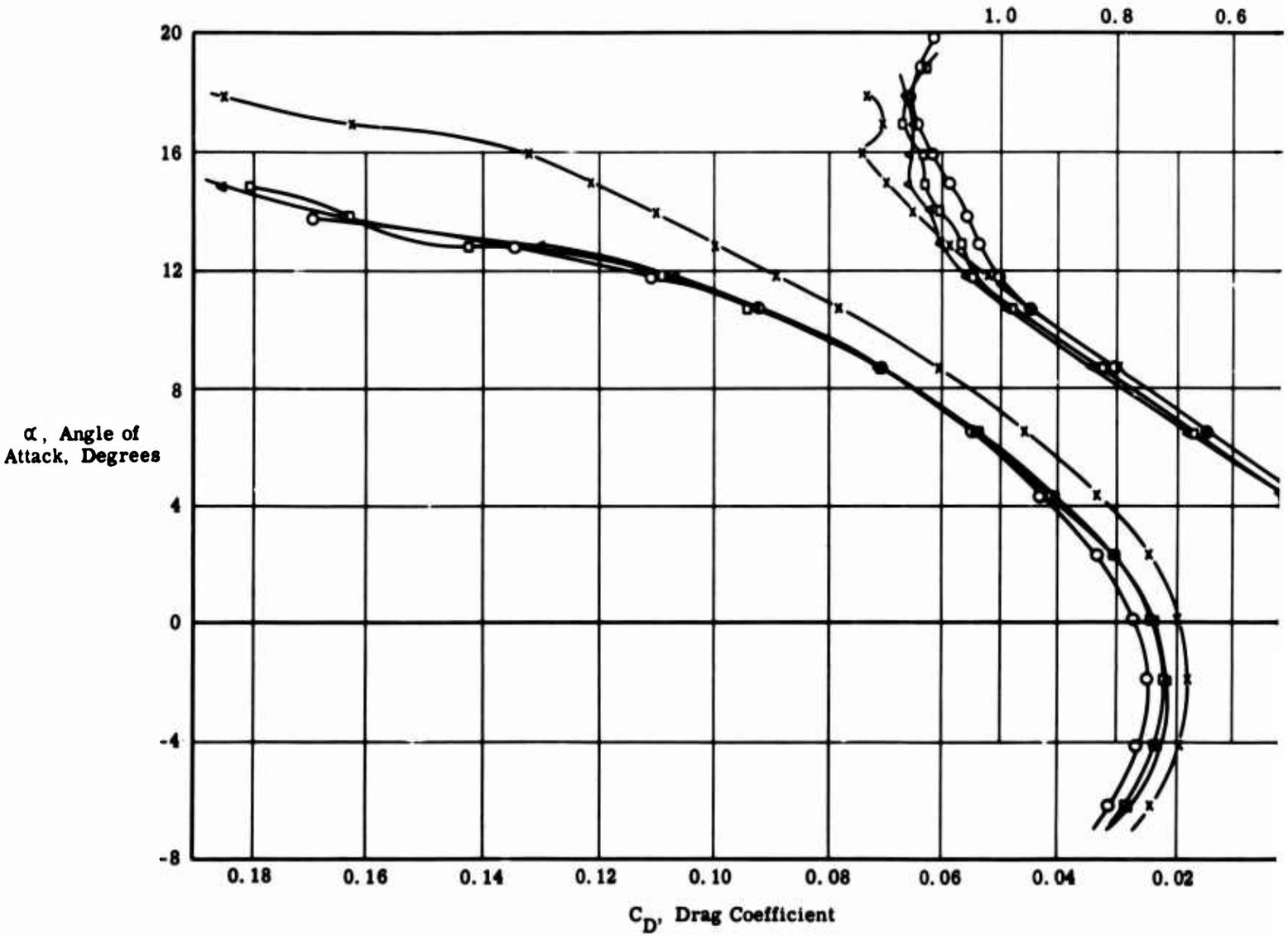
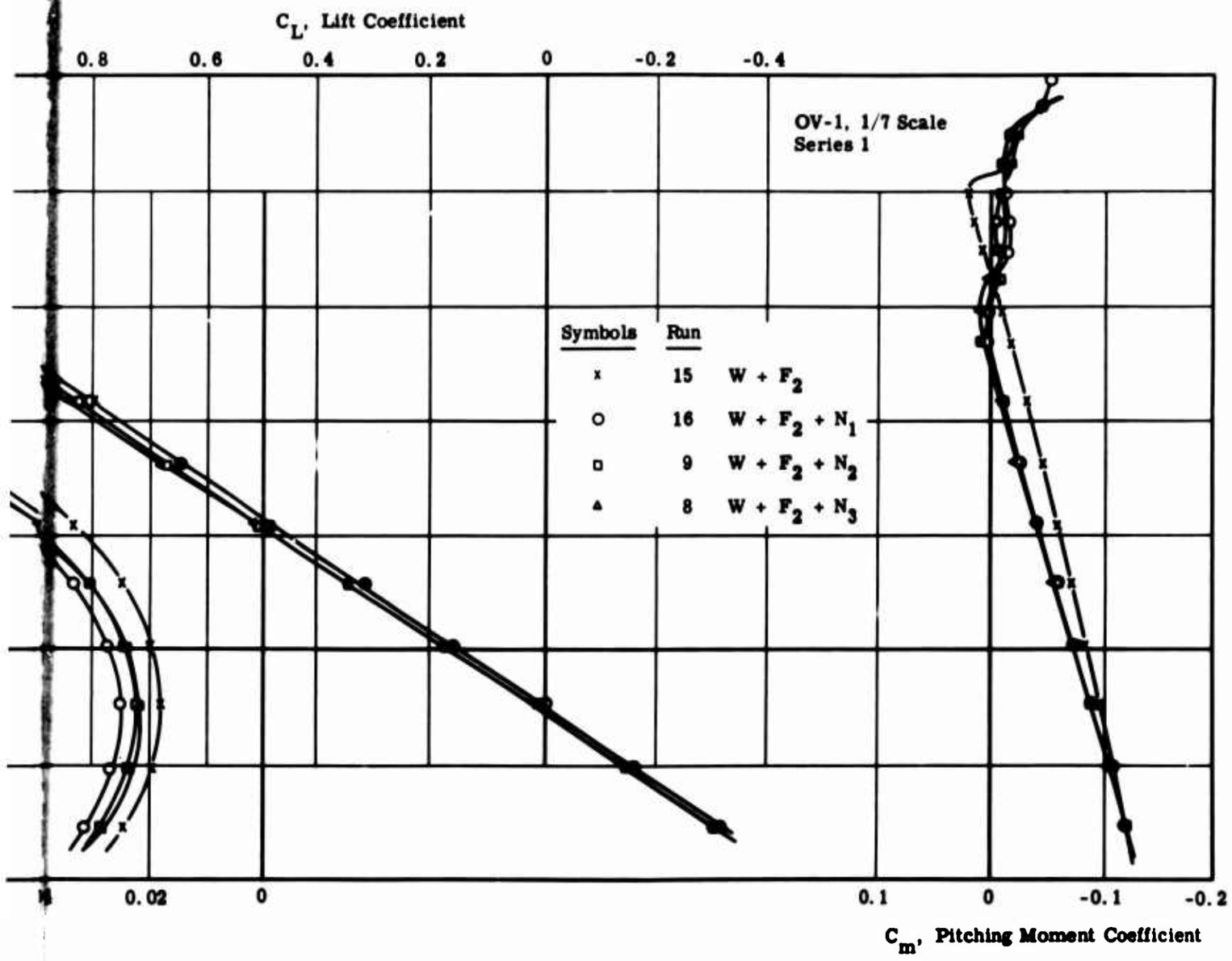


Figure 14. Effect of Nacelles, F_2 Fuselage.

A


C_L, Lift Coefficient
0.8
0.6
0.4
0.2
0
-0.2
-0.4
OV-1, 1/7 Scale
Series 1
Symbols
Run
x 15 W + F_2
○ 16 W + F_2 + N_1
□ 9 W + F_2 + N_2
△ 8 W + F_2 + N_3
0.02
0
0.1
0
-0.1
-0.2
C_m, Pitching Moment Coefficient

B

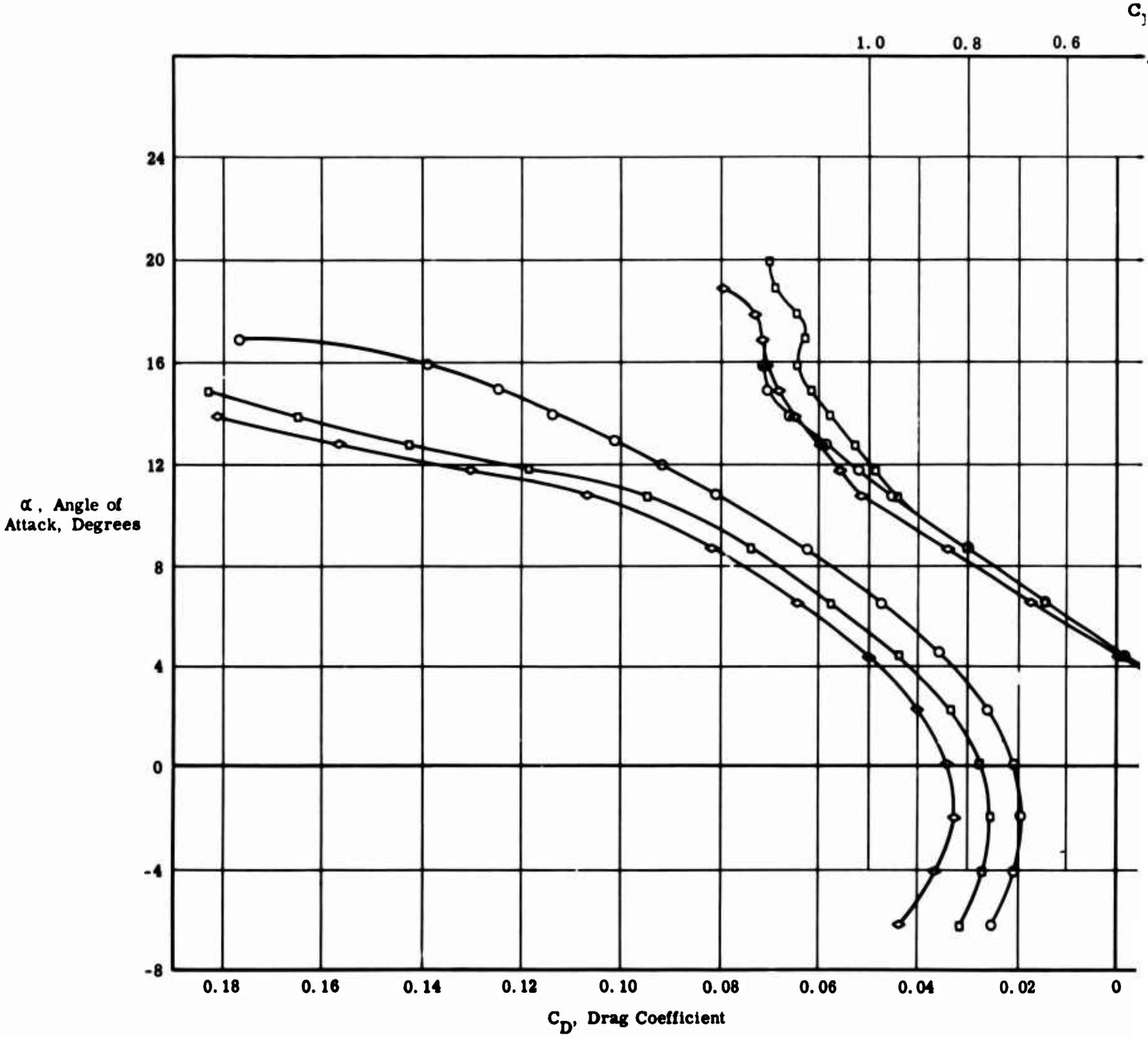
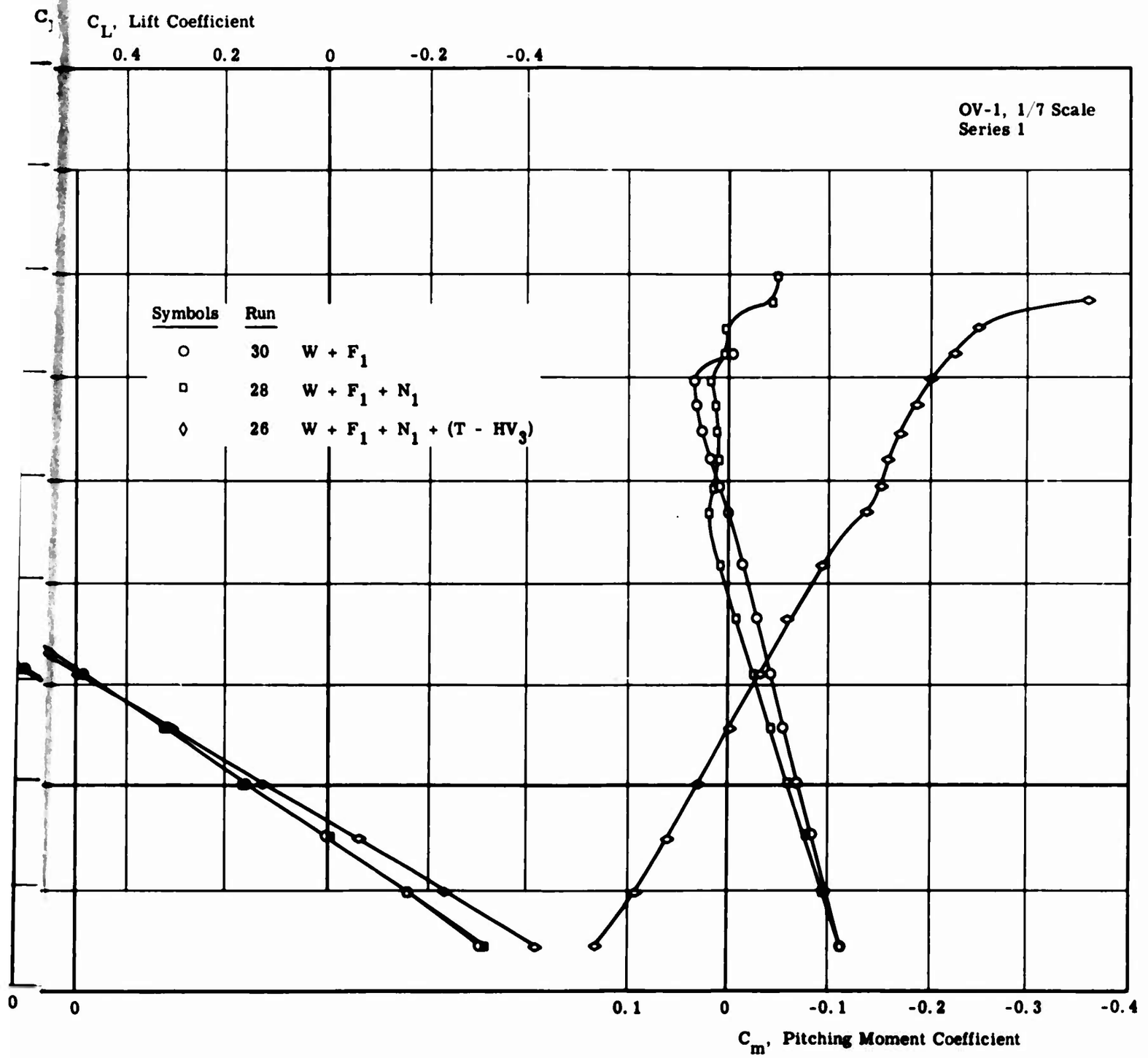


Figure 15. Model Buildup, F_1 Fuselage.


C_L, Lift Coefficient
0.4
0.2
0
-0.2
-0.4
OV-1, 1/7 Scale
Series 1
Symbols
Run
○ 30 W + F_1
□ 28 W + F_1 + N_1
◇ 26 W + F_1 + N_1 + (T - HV_3)
0
0
0.1
0
-0.1
-0.2
-0.3
-0.4
C_m, Pitching Moment Coefficient

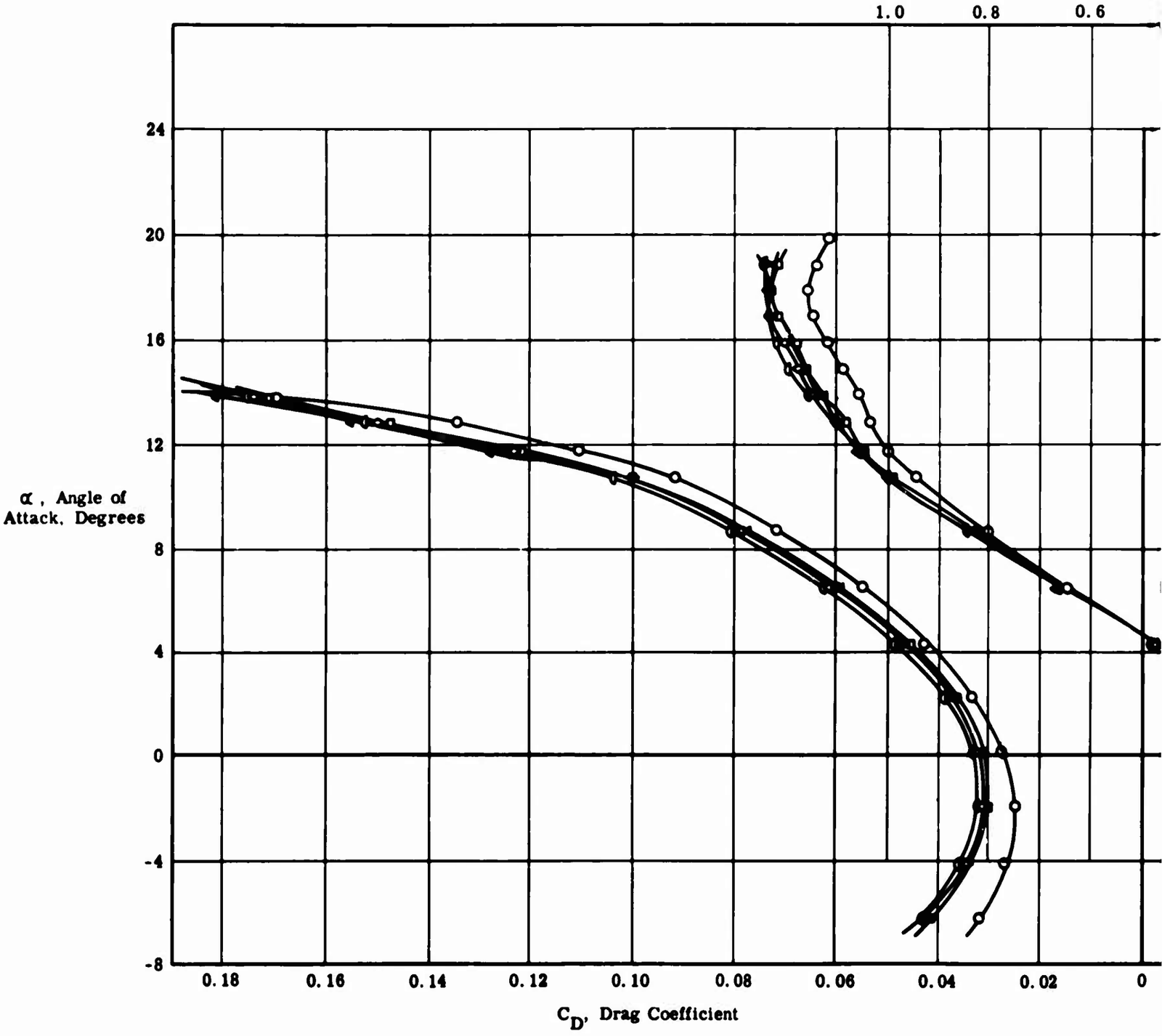
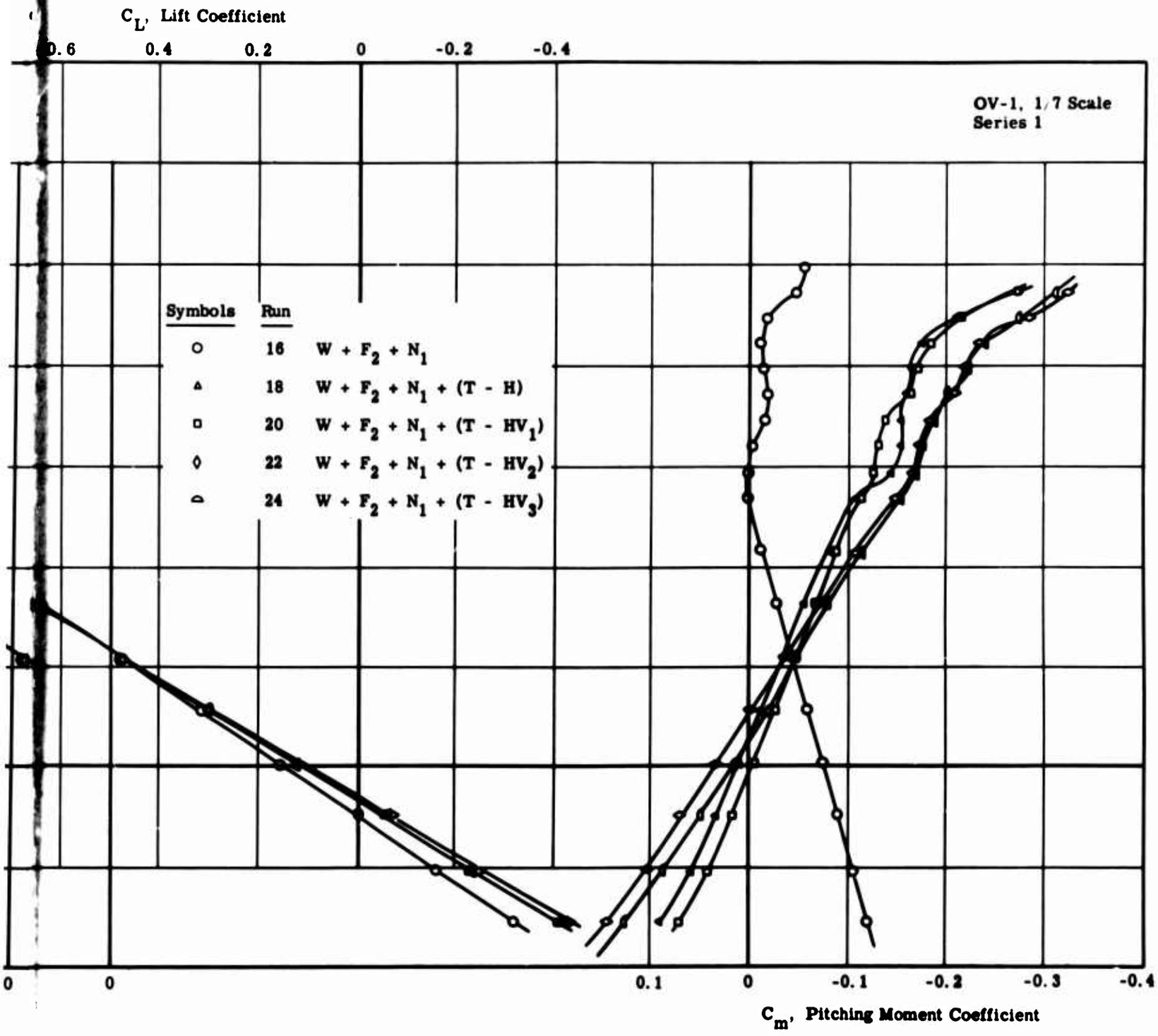


Figure 16. Model Buildup, F_2 Fuselage.

A


C_L, Lift Coefficient
0.6
0.4
0.2
0
-0.2
-0.4
OV-1, 1/7 Scale
Series 1
Symbols
Run
○ 16 W + F_2 + N_1
△ 18 W + F_2 + N_1 + (T - H)
□ 20 W + F_2 + N_1 + (T - HV_1)
◇ 22 W + F_2 + N_1 + (T - HV_2)
▷ 24 W + F_2 + N_1 + (T - HV_3)
0
0
0.1
0
-0.1
-0.2
-0.3
-0.4
C_m, Pitching Moment Coefficient

B

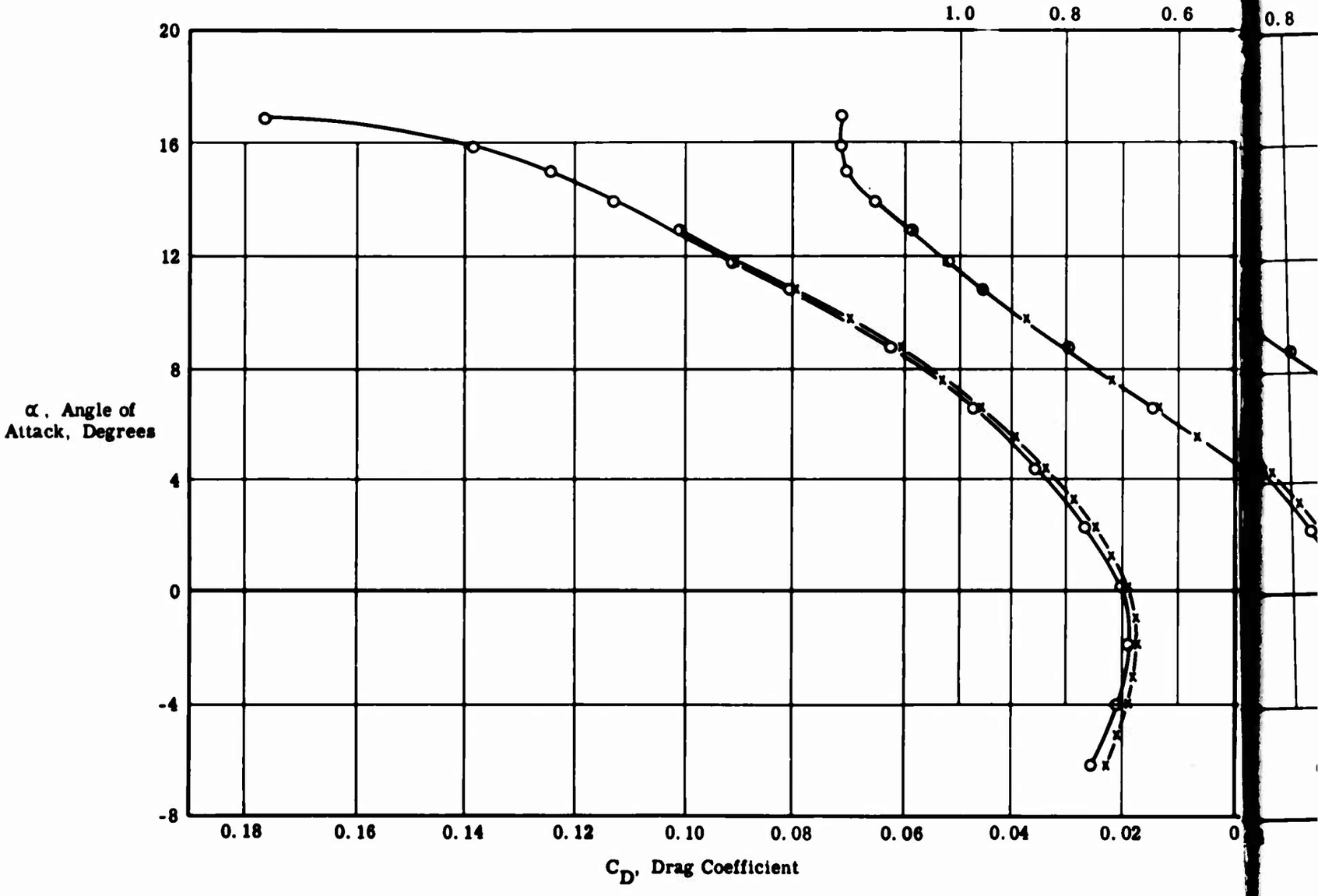
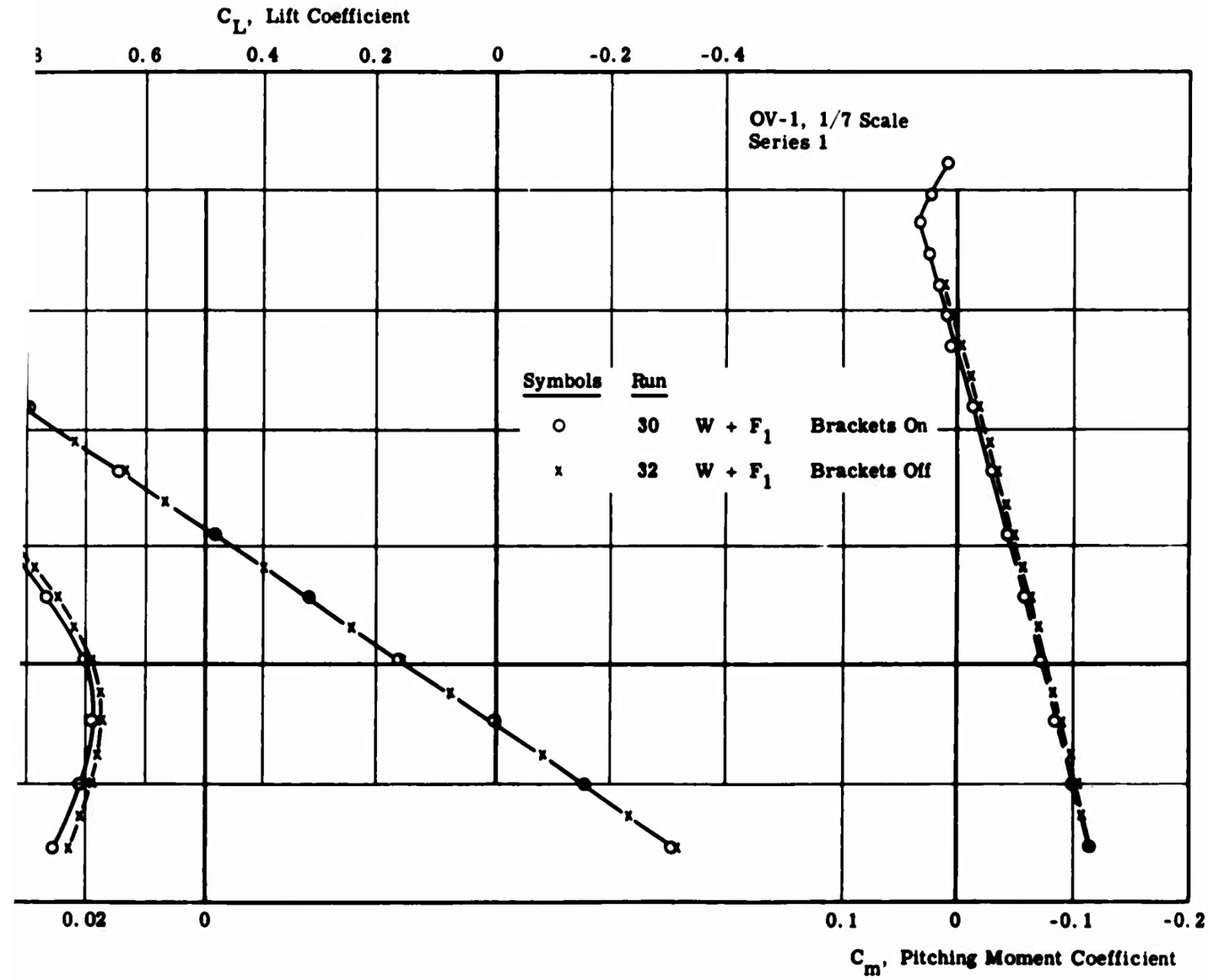


Figure 17. Effect of Flap Brackets.

A


C_L, Lift Coefficient
3
0.6
0.4
0.2
0
-0.2
-0.4
OV-1, 1/7 Scale
Series 1
Symbols
Run
○ 30 W + F_1 Brackets On
x 32 W + F_1 Brackets Off
0.02
0
0.1
0
-0.1
-0.2
C_m, Pitching Moment Coefficient

B

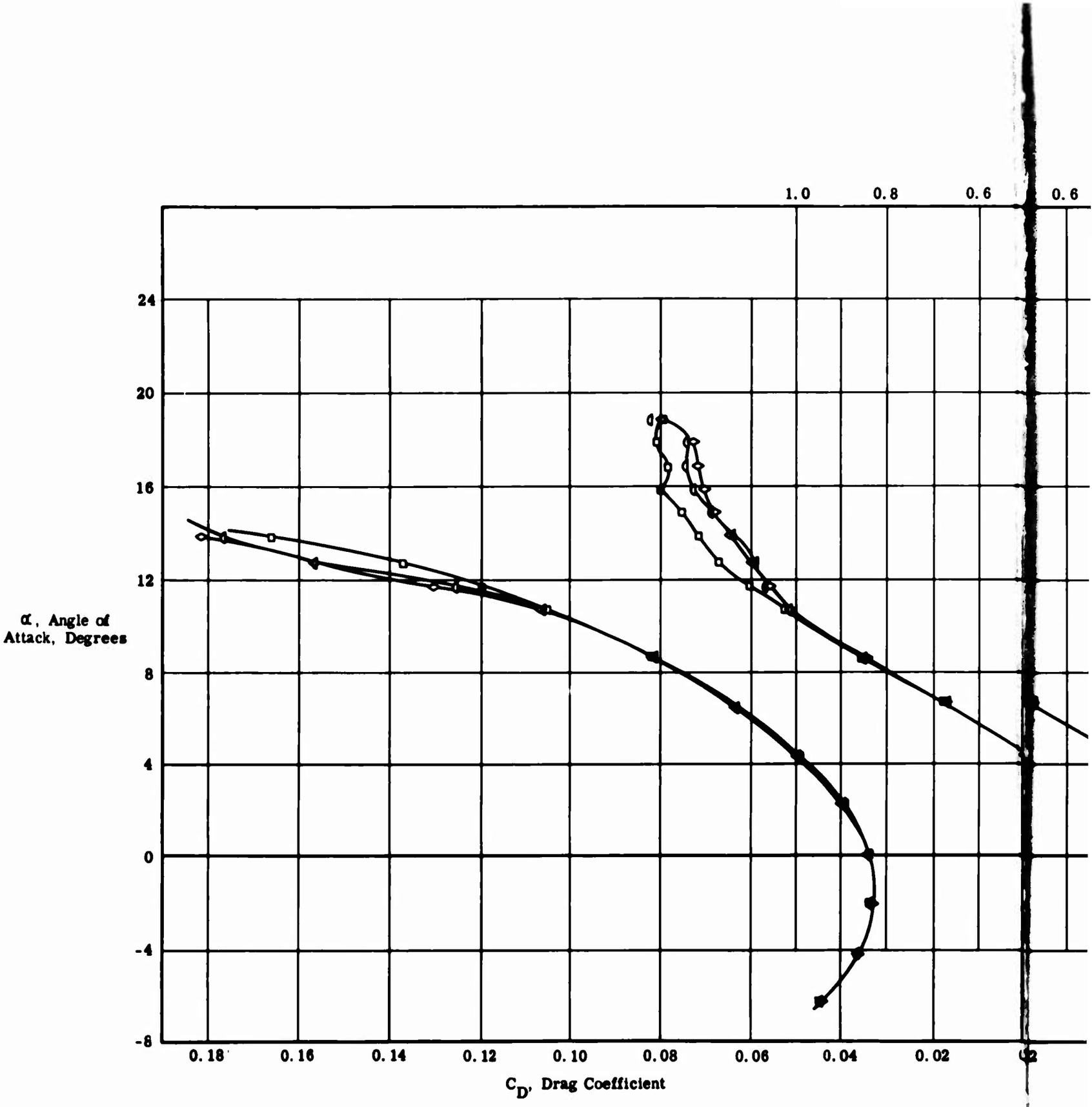
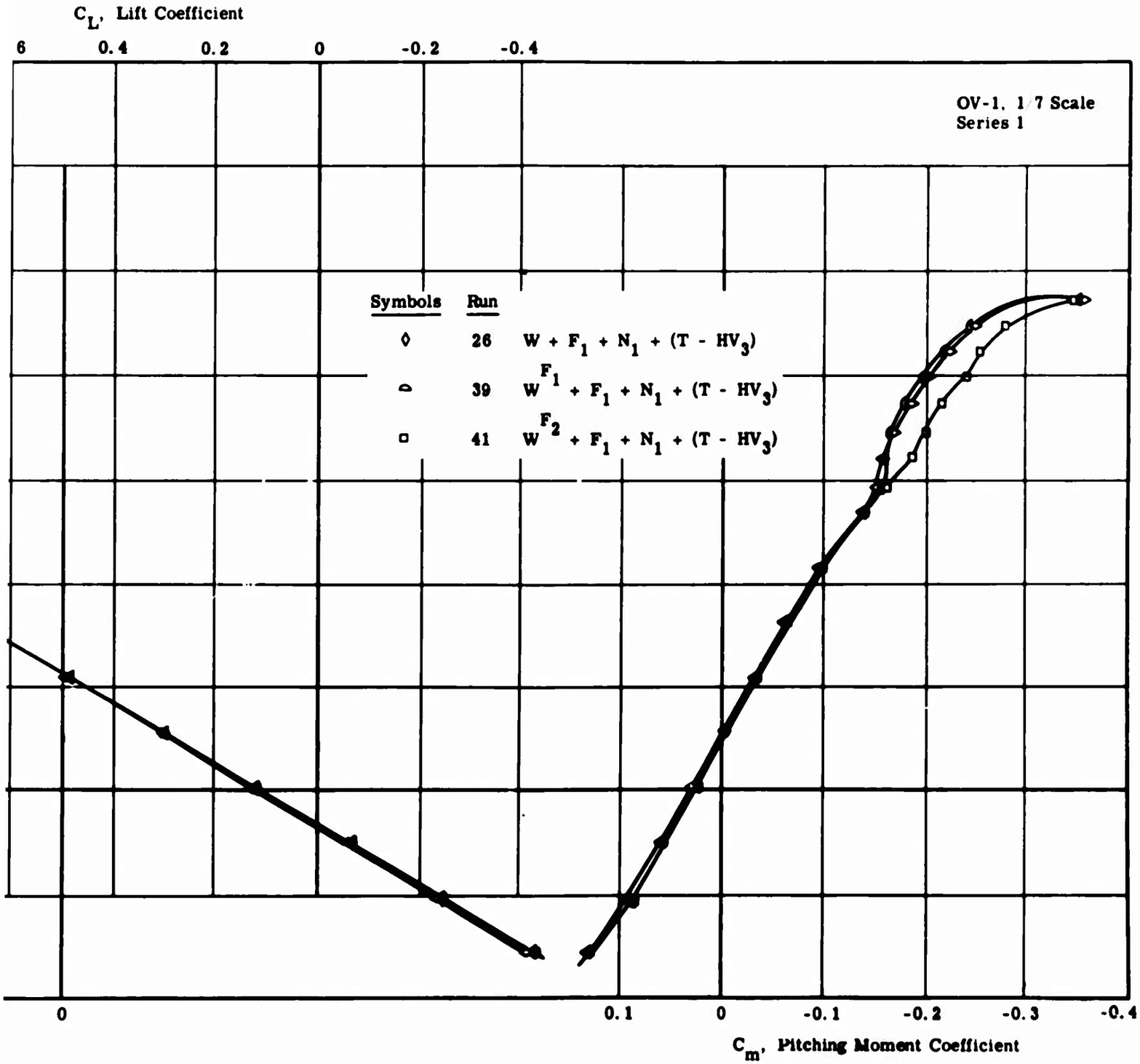


Figure 18. Effect of Fillets.

A


C_L, Lift Coefficient
6
0.4
0.2
0
-0.2
-0.4
OV-1, 1/7 Scale
Series 1
Symbols
Run
◊ 26 $W + F_1 + N_1 + (T - HV_3)$
○ 39 $W^{F_1} + F_1 + N_1 + (T - HV_3)$
□ 41 $W^{F_2} + F_1 + N_1 + (T - HV_3)$
0
0.1
0
-0.1
-0.2
-0.3
-0.4
C_m, Pitching Moment Coefficient

B

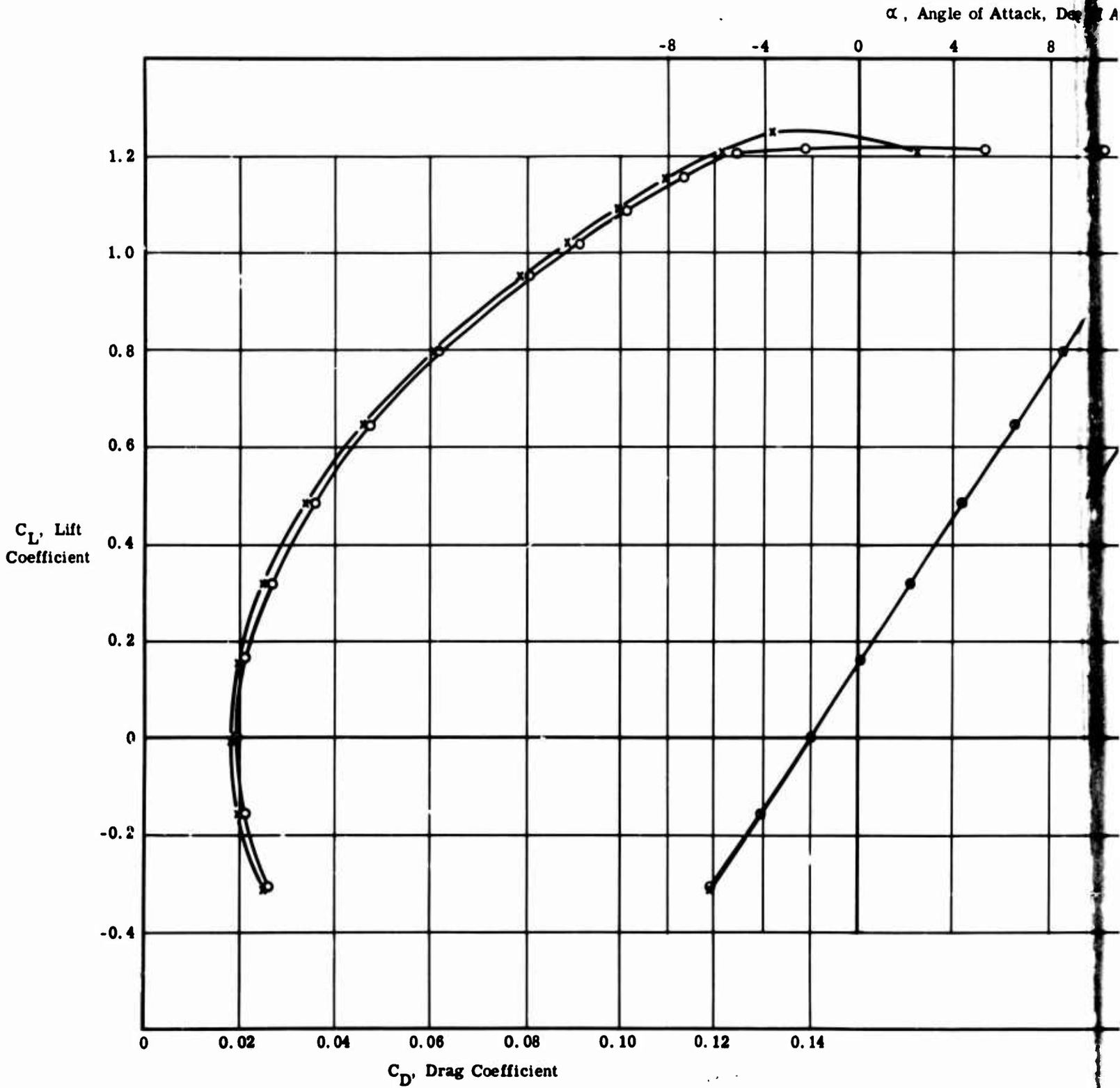
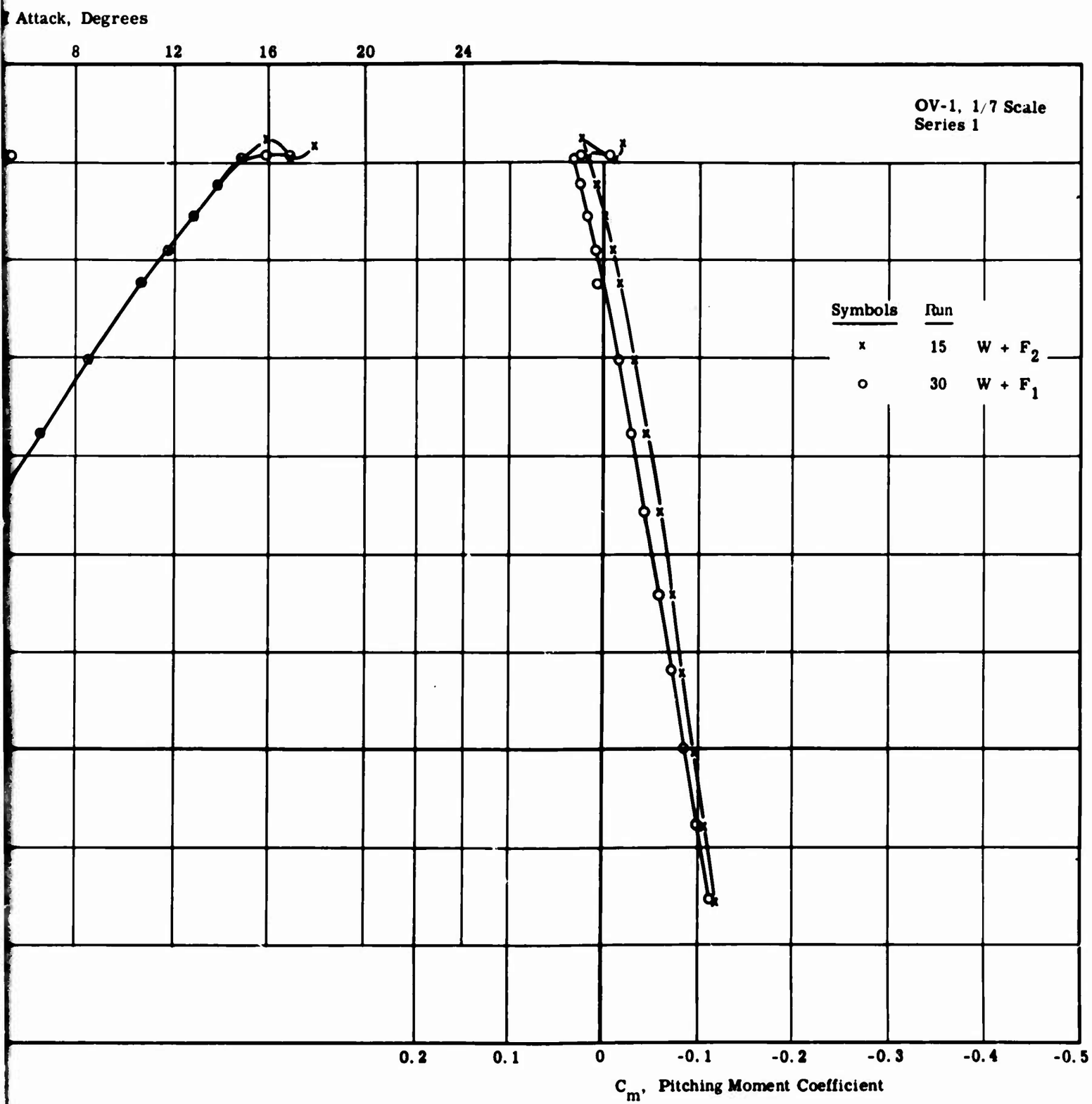


Figure 19. Effect of Fuselage, Nacelles Off.

A


Attack, Degrees
8
12
16
20
24
OV-1, 1/7 Scale
Series 1
Symbols
Run
x
15
W + F2
o
30
W + F1
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
Cm, Pitching Moment Coefficient

B

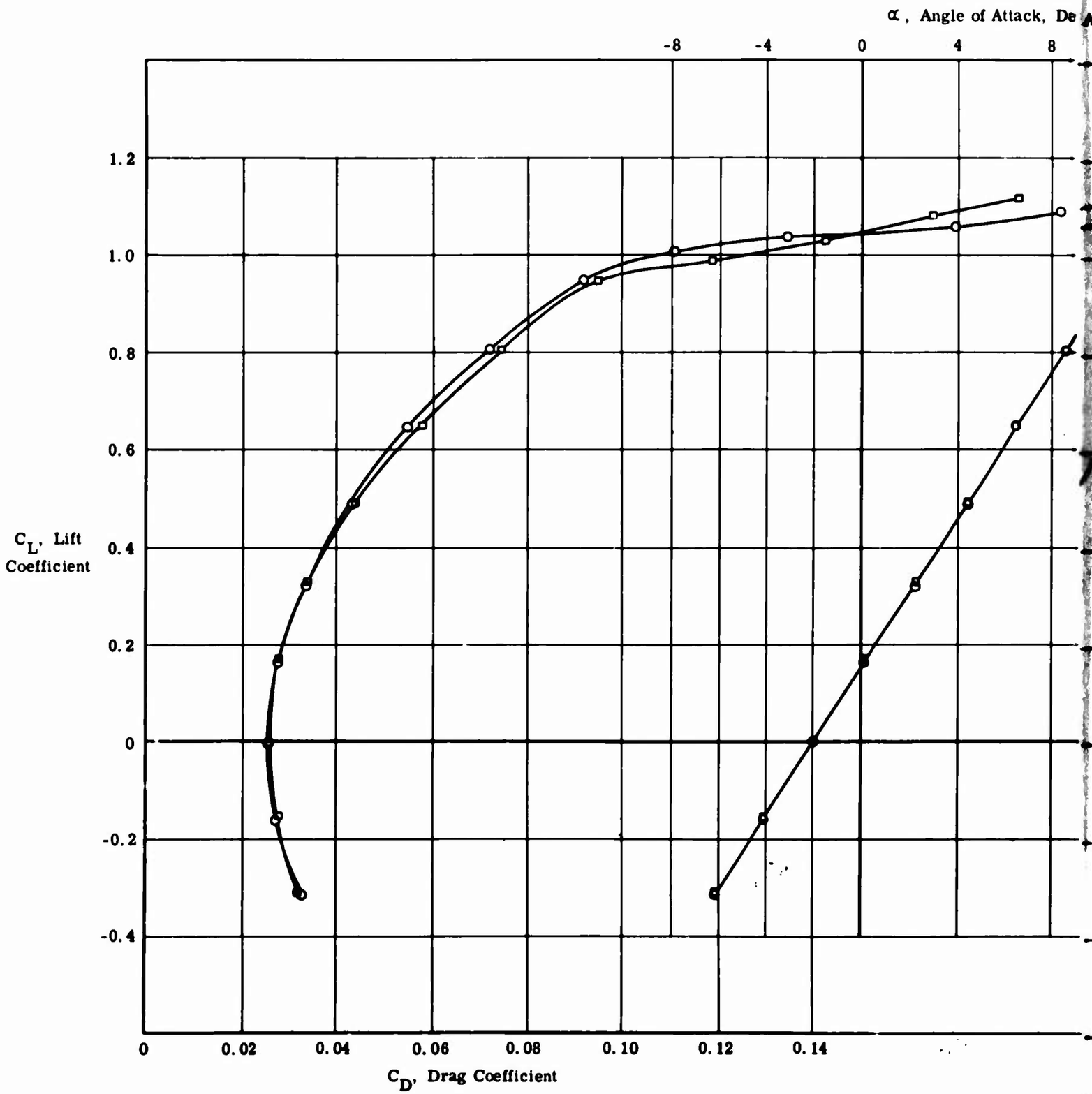
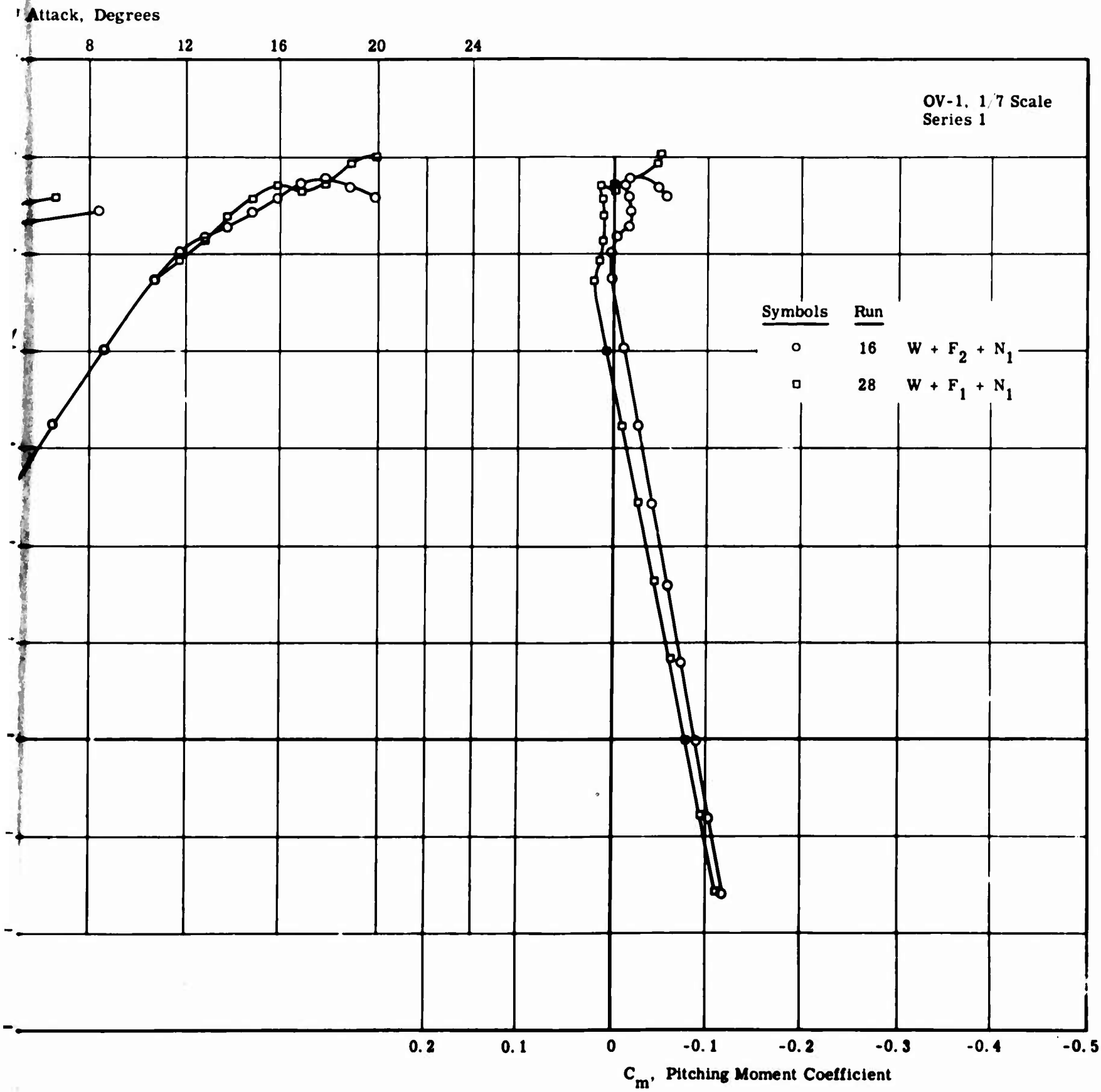


Figure 20. Effect of Fuselage, N_1 Nacelles On.


Attack, Degrees
8
12
16
20
24
OV-1, 1/7 Scale
Series 1
Symbols
Run
16
W + F2 + N1
28
W + F1 + N1
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
Cm, Pitching Moment Coefficient

B

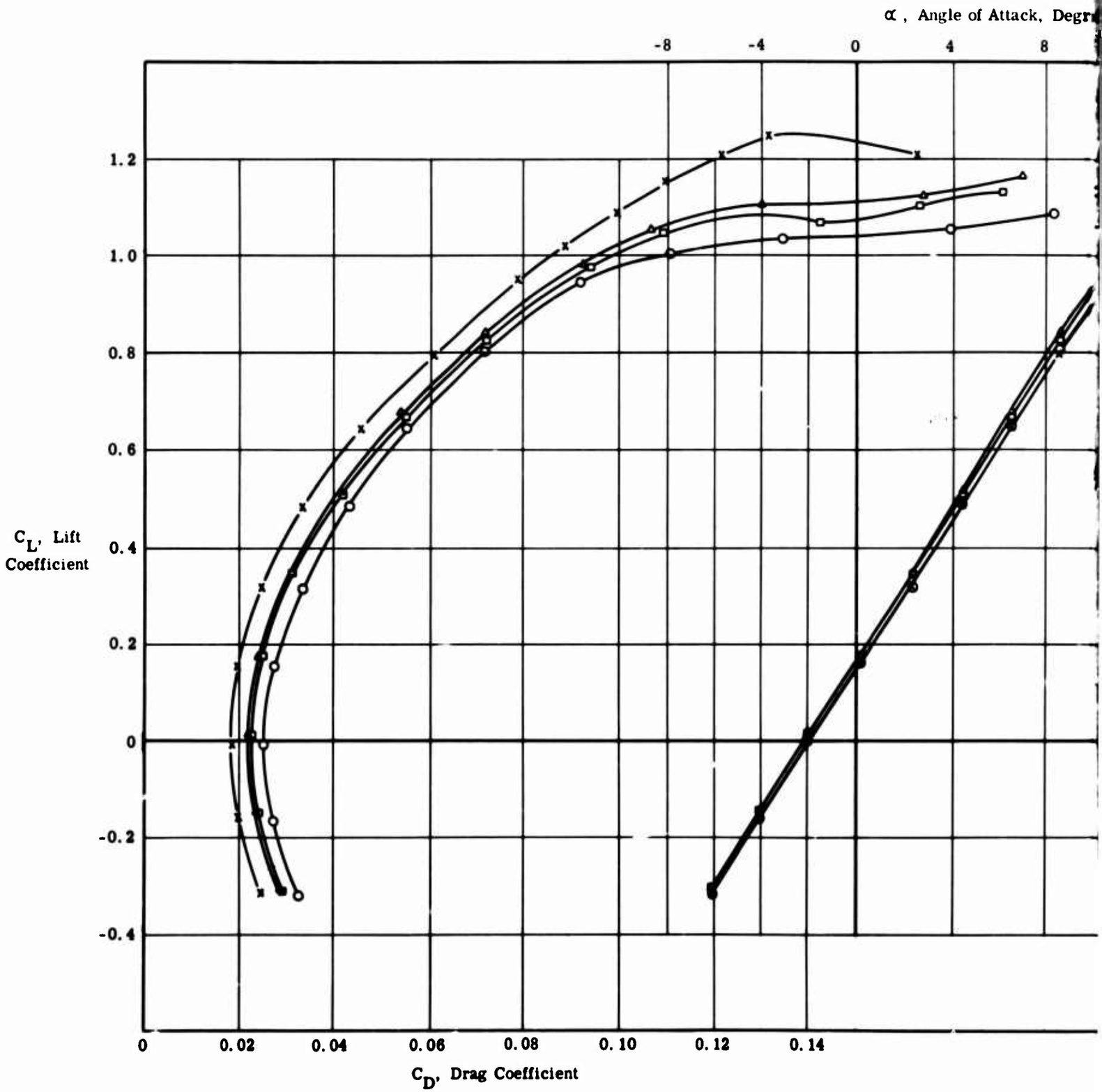


Figure 21. Effect of Nacelles, F_2 Fuselage.

A

;r Attack, Degrees

8 12 16 20

OV-1, 1/7 Scale
Series 1

Symbols	Run	
x	15	W + F_2
O	16	W + F_2 + N_1
□	9	W + F_2 + N_2
△	8	W + F_2 + N_3

0.2 0.1 0 -0.1 -0.2 -0.3 -0.4 -0.5

C_m, Pitching Moment Coefficient

B

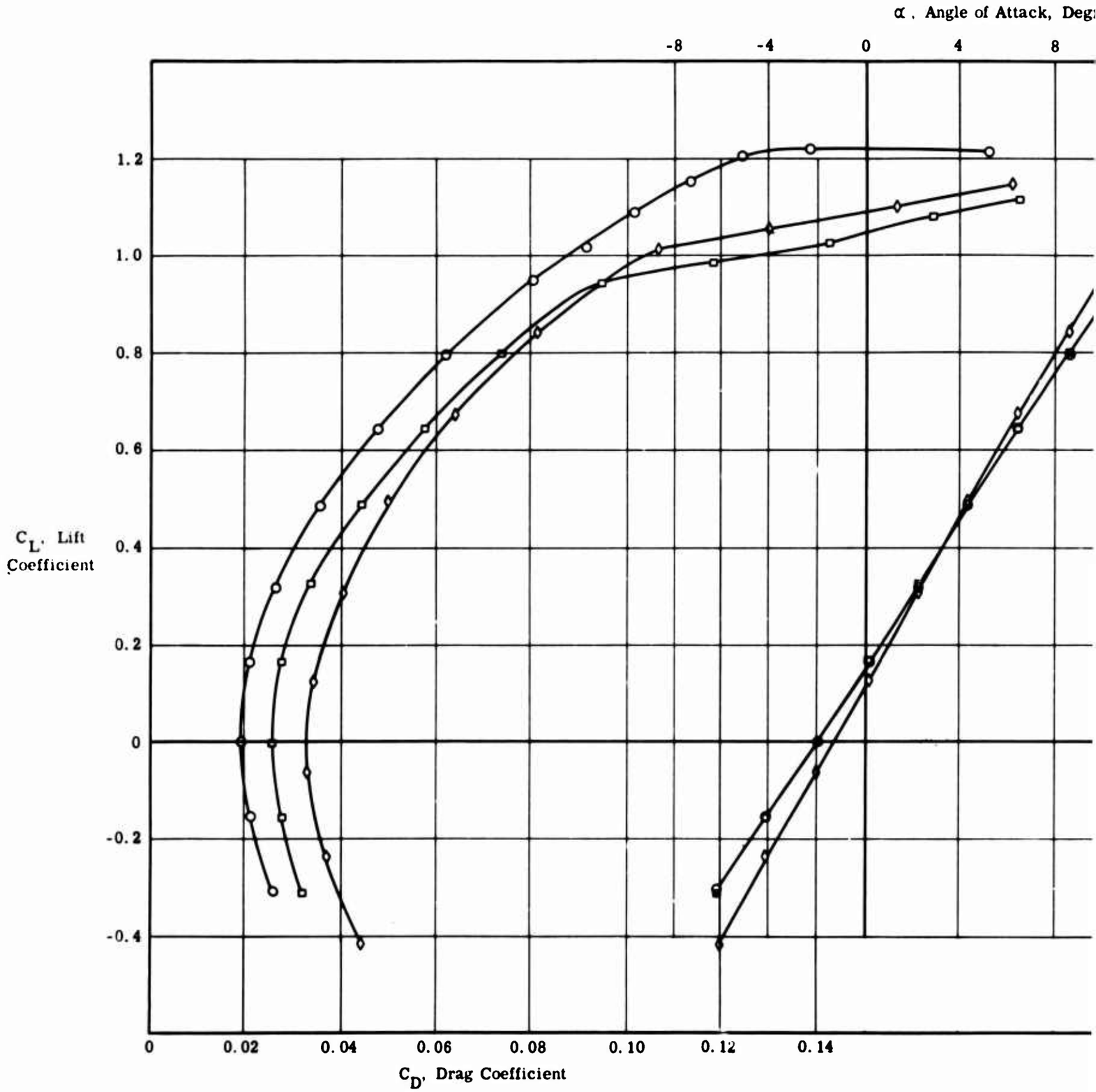
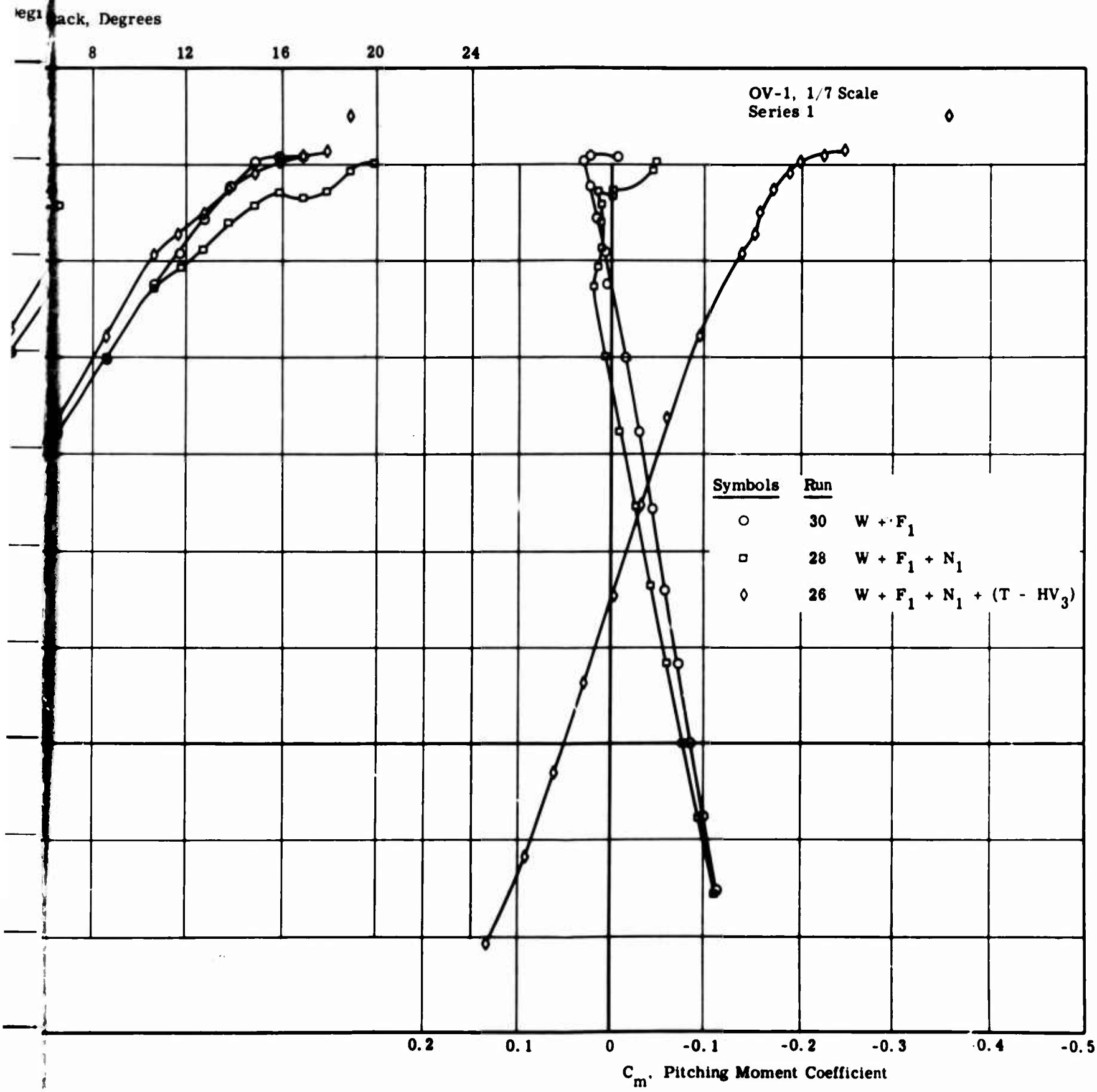


Figure 22. Model Buildup, F_1 Fuselage.

A


Angle of Attack, Degrees
8
12
16
20
24
OV-1, 1/7 Scale
Series 1
Symbols
Run
○ 30 W + F1
□ 28 W + F1 + N1
◊ 26 W + F1 + N1 + (T - HV3)
0.2
0.1
0
-0.1
-0.2
-0.3
0.4
-0.5
Cm, Pitching Moment Coefficient

B

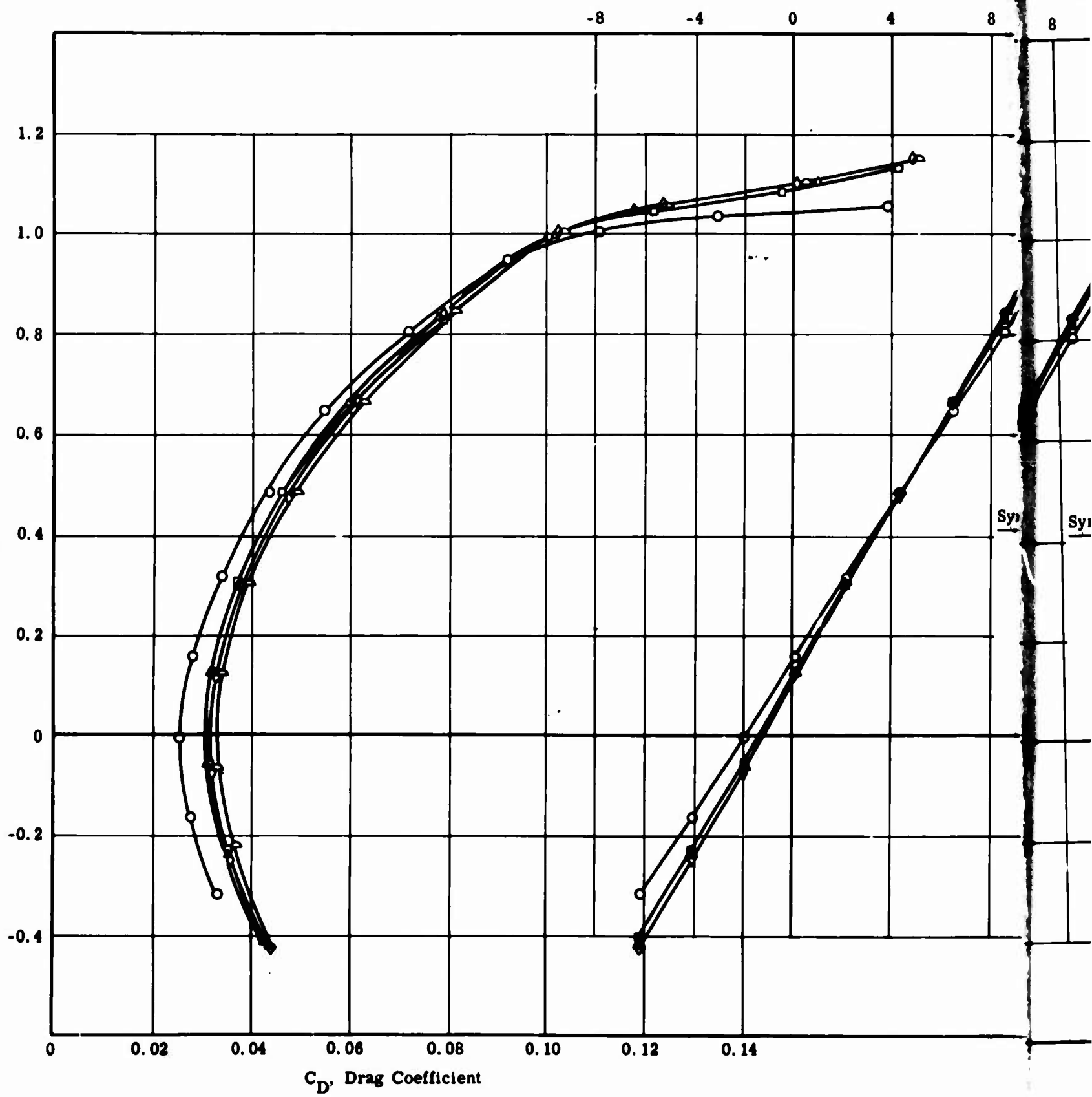
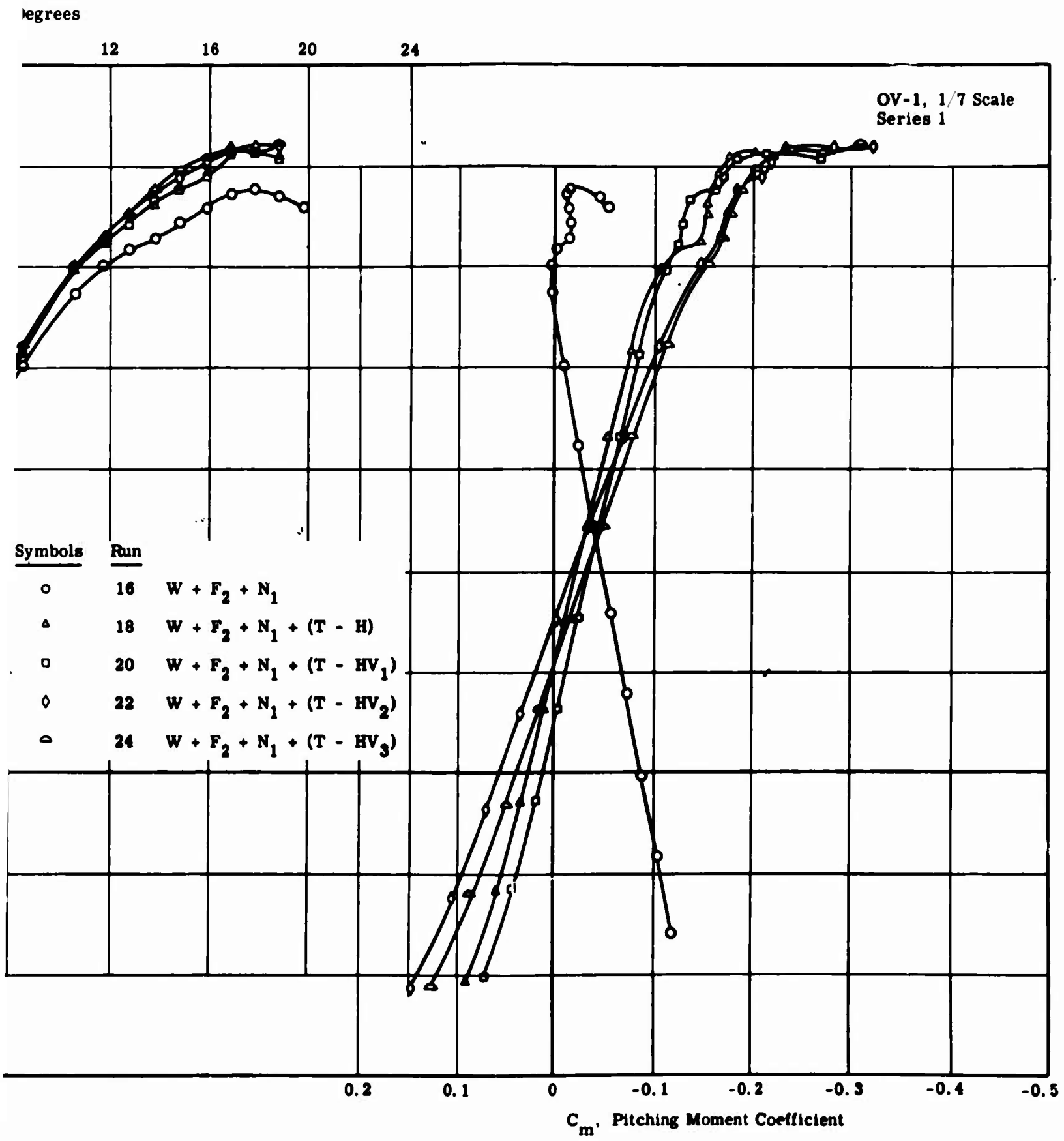


Figure 23. Model Buildup, F_2 Fuselage.

A


egrees
12
16
20
24
OV-1, 1/7 Scale
Series 1
Symbols
Run
16 W + F2 + N1
18 W + F2 + N1 + (T - H)
20 W + F2 + N1 + (T - HV1)
22 W + F2 + N1 + (T - HV2)
24 W + F2 + N1 + (T - HV3)
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
Cm, Pitching Moment Coefficient

B

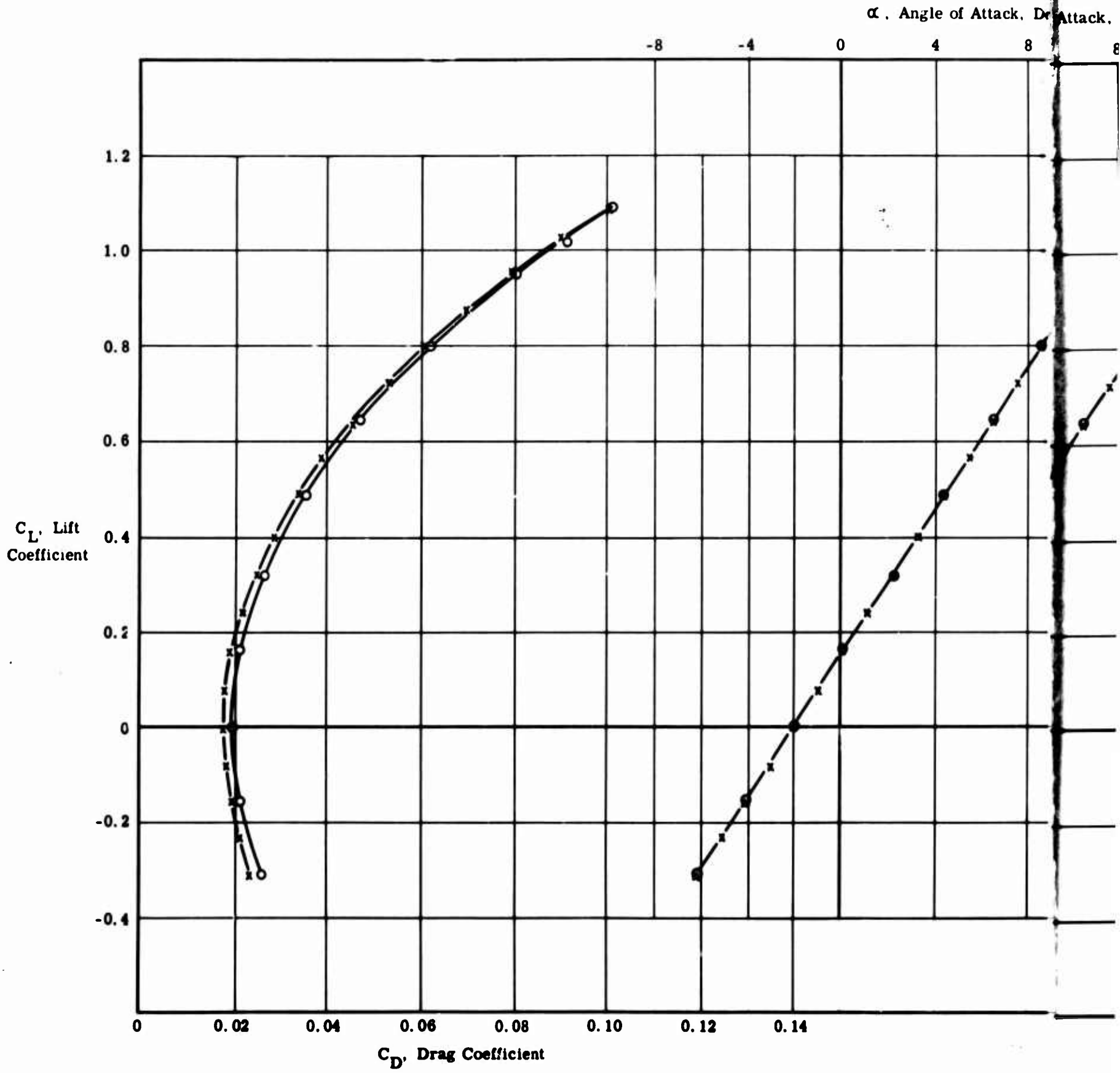
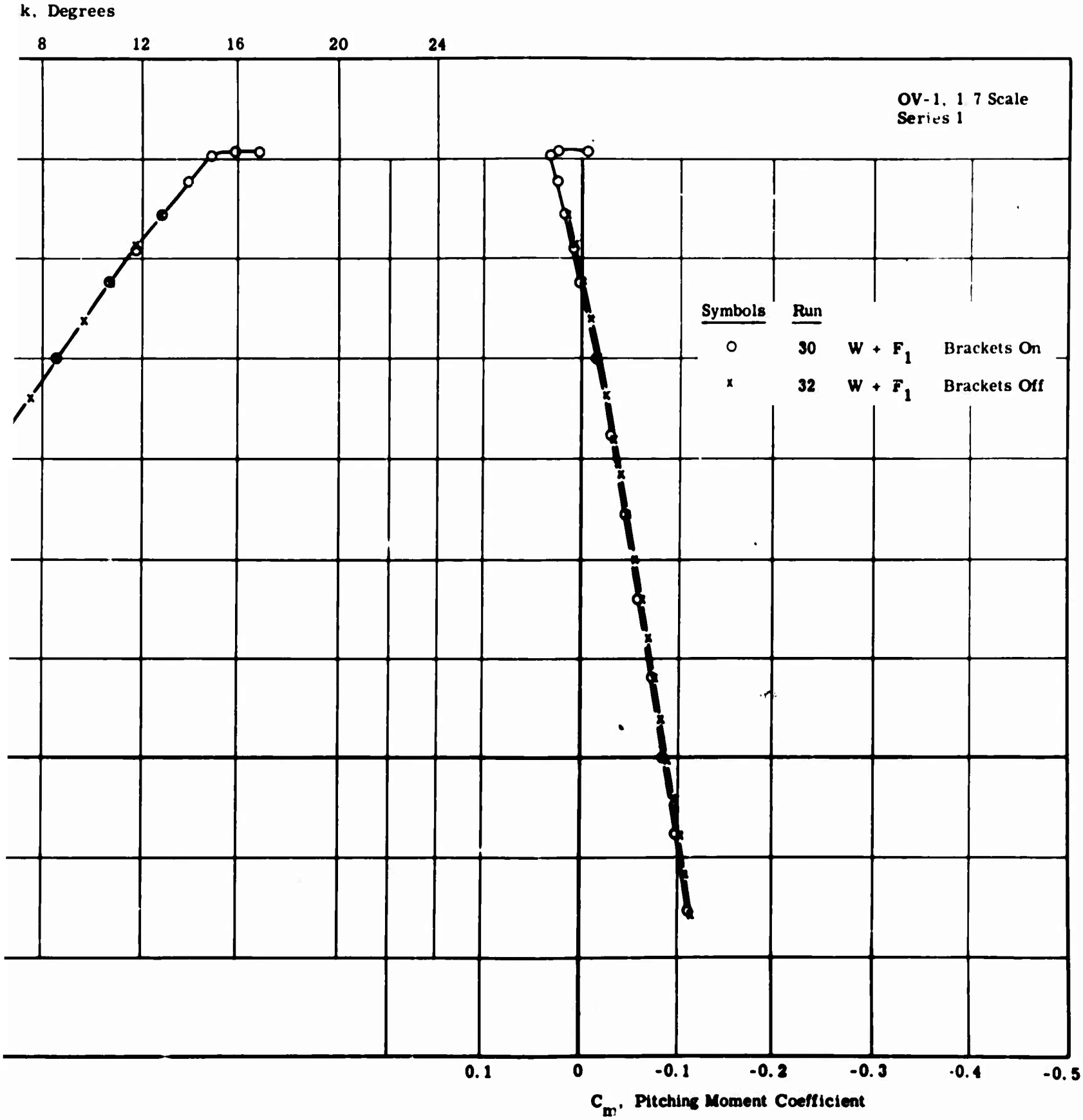


Figure 24. Effect of Flap Brackets.

A


k, Degrees
8
12
16
20
24
OV-1, 1/7 Scale
Series 1
Symbols
Run
○ 30 W + F1 Brackets On
x 32 W + F1 Brackets Off
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
Cm, Pitching Moment Coefficient

B

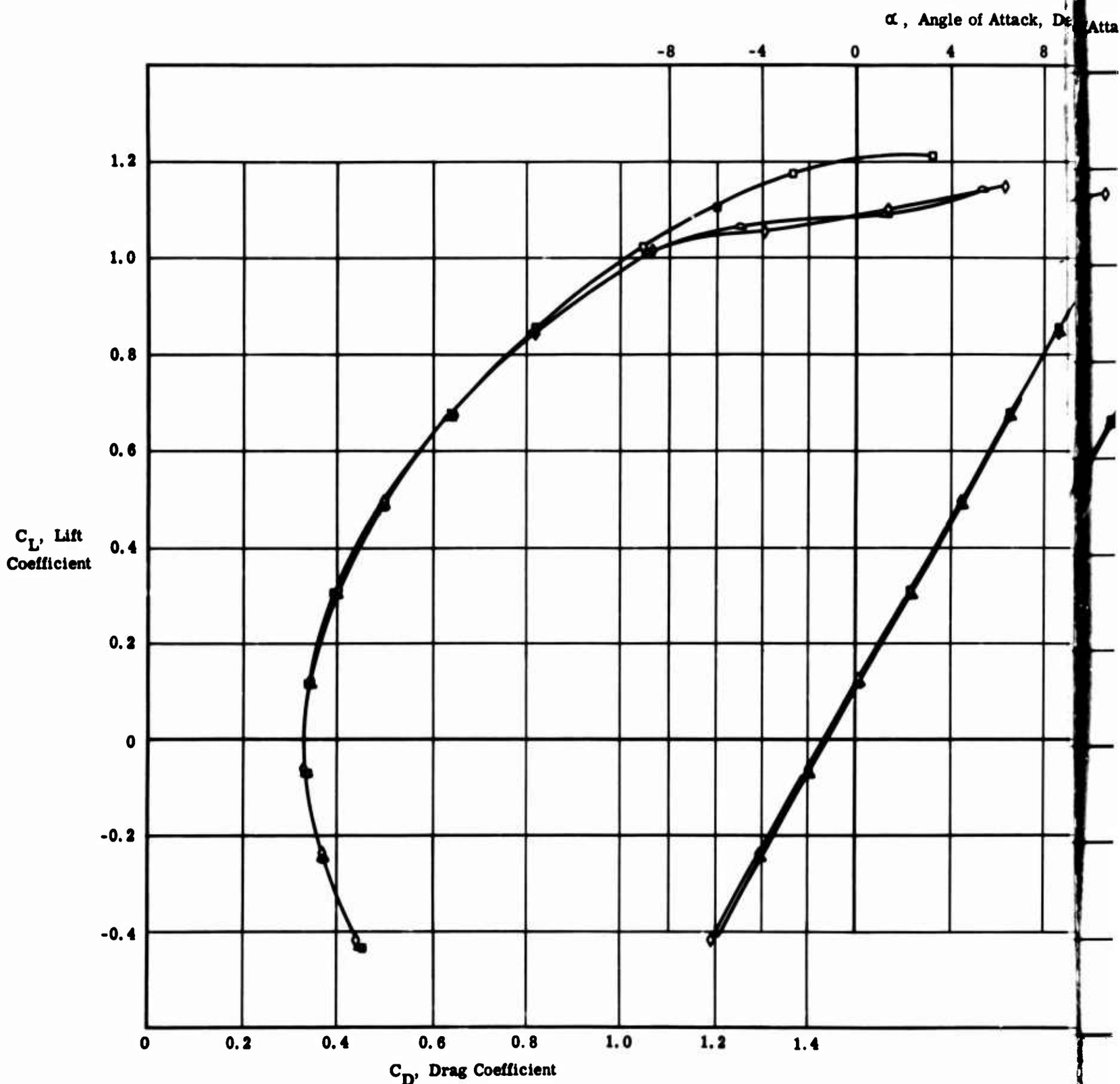
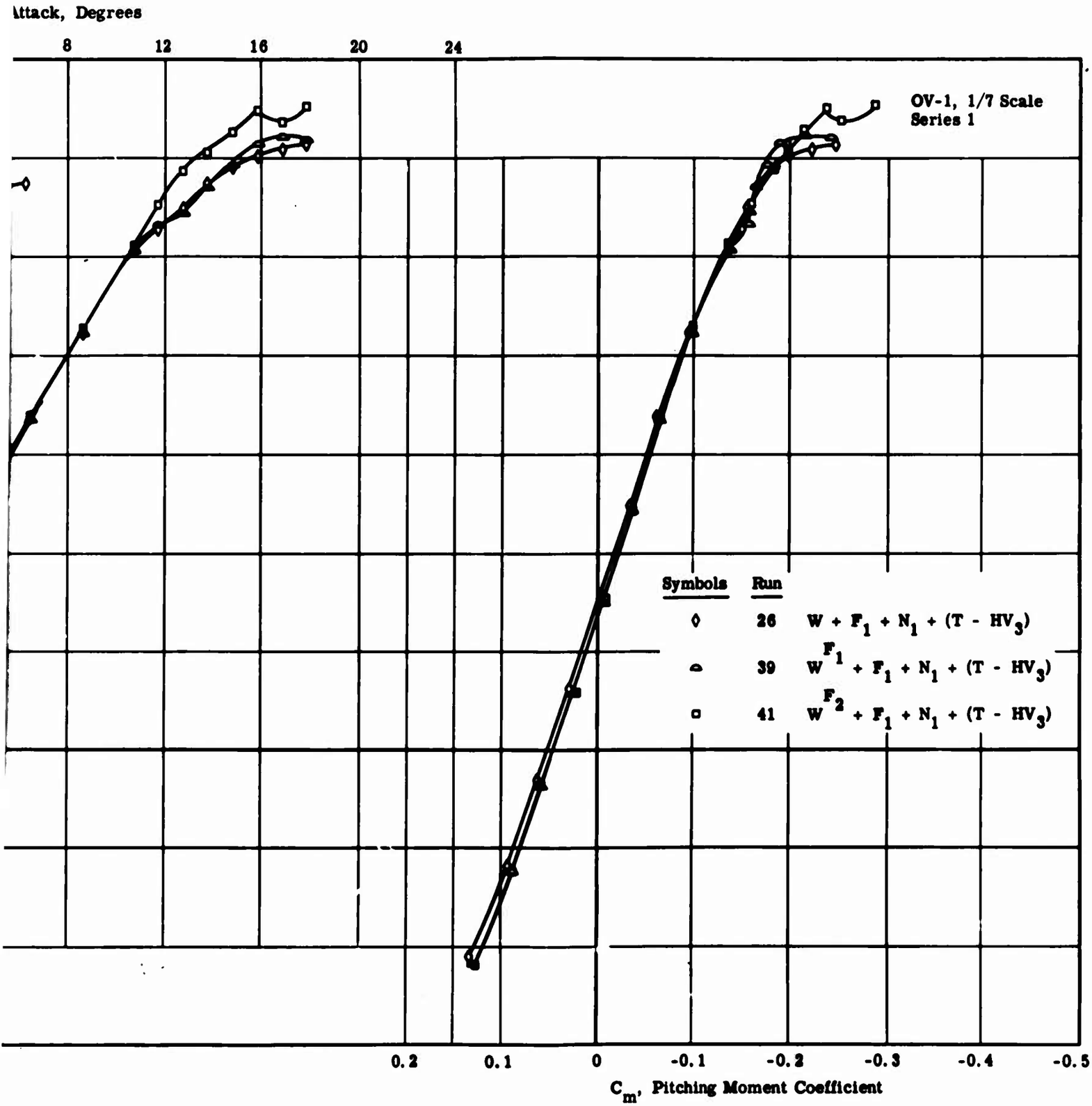
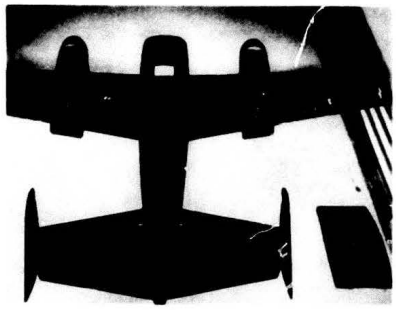
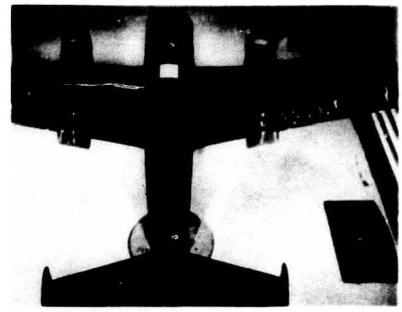


Figure 25. Effect of Fillets.

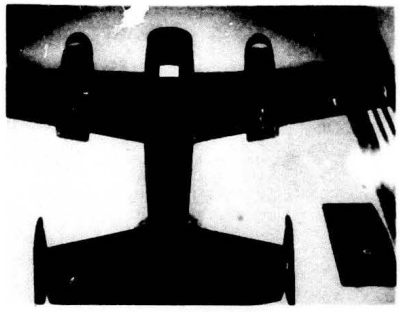

ttack, Degrees
8
12
16
20
24
OV-1, 1/7 Scale
Series 1
Symbols
Run
◊ 26 W + F1 + N1 + (T - HV3)
39 W F1 + F1 + N1 + (T - HV3)
41 W F2 + F1 + N1 + (T - HV3)
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
Cm, Pitching Moment Coefficient



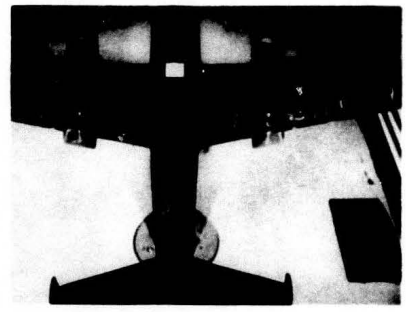
α = -4.1°



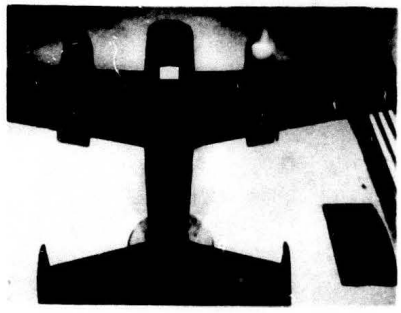
α = 8.6°



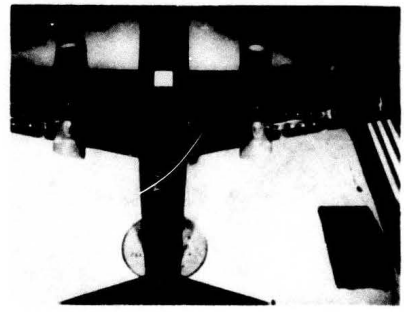
α = 0.1°



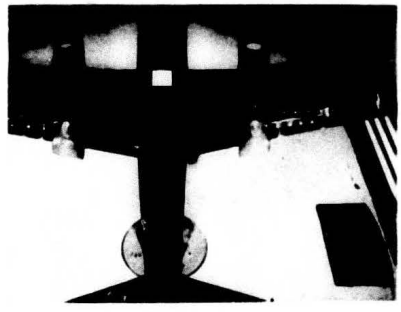
α = 10.7°



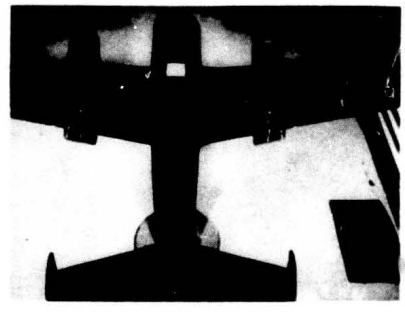
α = 4.4°



α = 12.8°

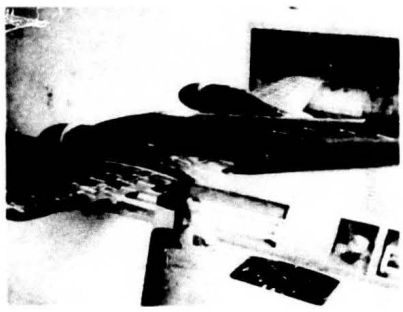


α = 6.5°



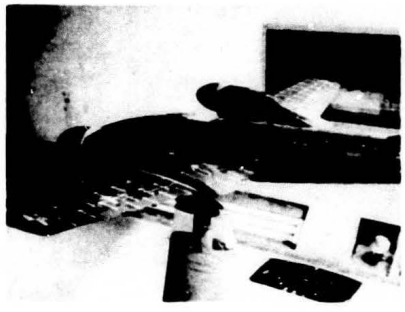
α = 14.8°

Figure 26. Run 10, W + F_2 + N_2 + (T - HV_3), Top View.



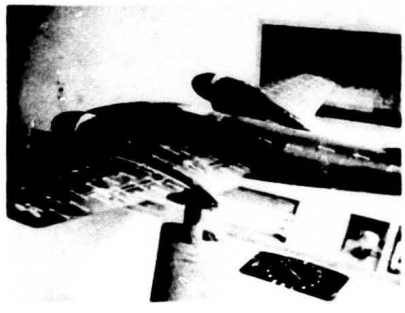
α = -4.1°

α = 8.6°



α = 0.1°

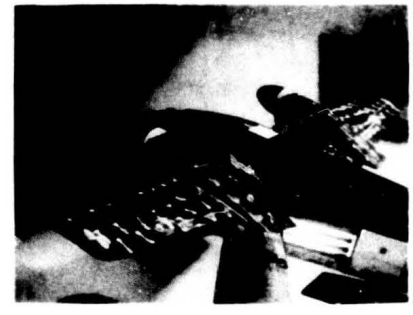
α = 10.7°



α = 4.4°

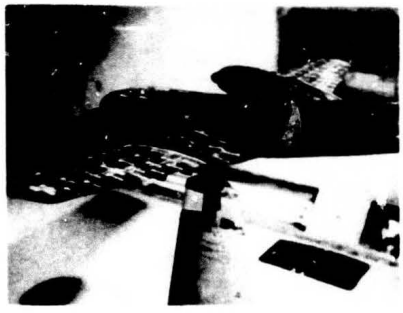
α = 12.8°

α = 6.5°

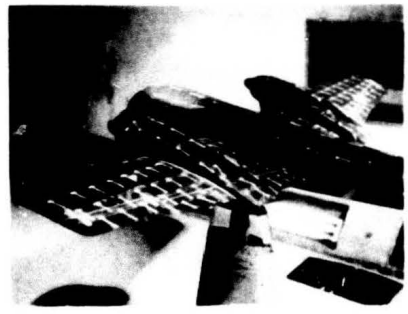


α = 14.8°

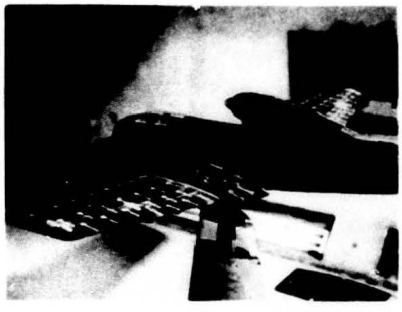
Figure 27. Run 10, W + F_2 + N_2 + (T - HV_3), Side View.



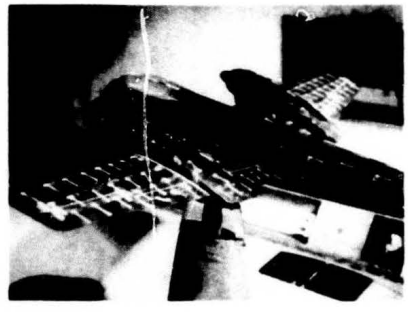
α = -4.1°



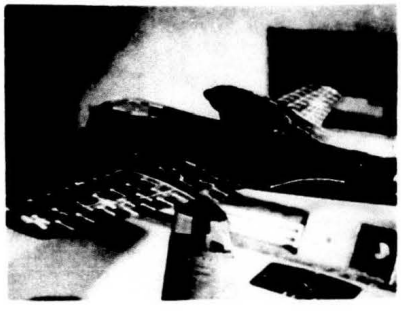
α = 8.6°



α = 0.1°

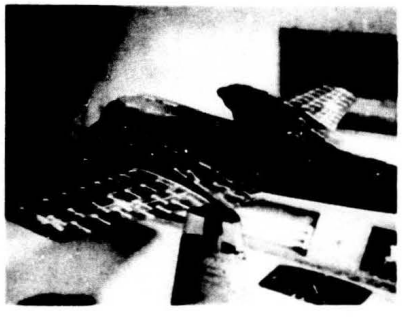


α = 10.7°

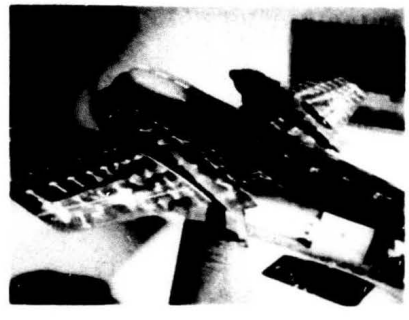


α = 4.4°

α = 12.8°

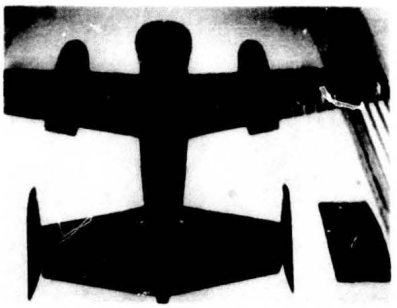


α = 6.5°

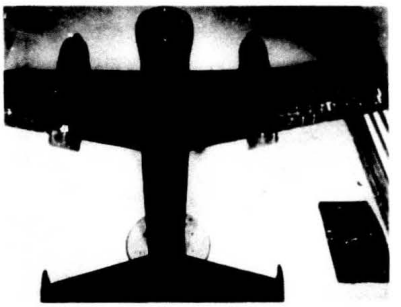


α = 14.8°

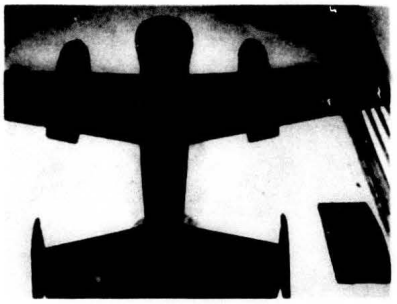
Figure 28. Run 11, W + F_1 + N_1 + (T - HV_3), Side View.



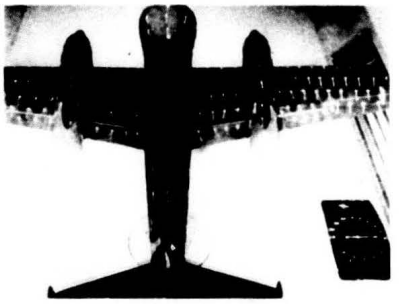
α = -4.1°



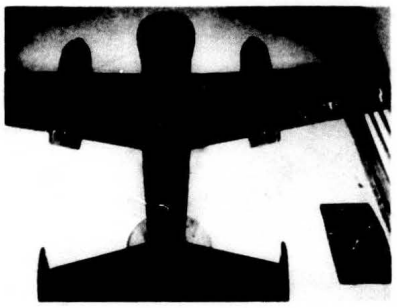
α = 8.6°



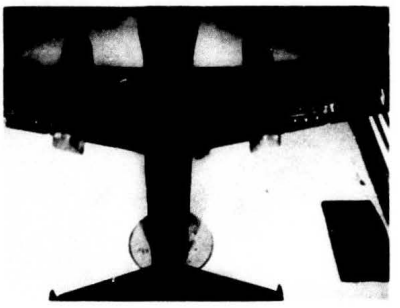
α = 0.1°



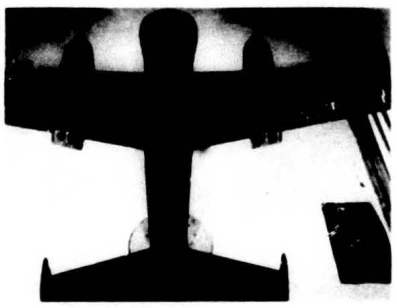
α = 10.7°



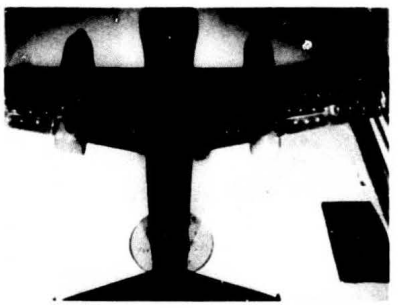
α = 4.4°



α = 12.8°



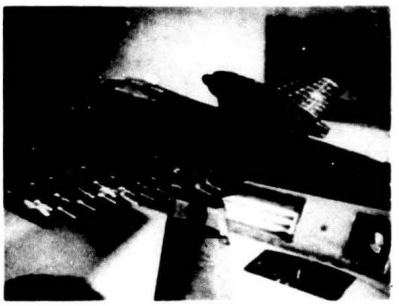
α = 6.5°



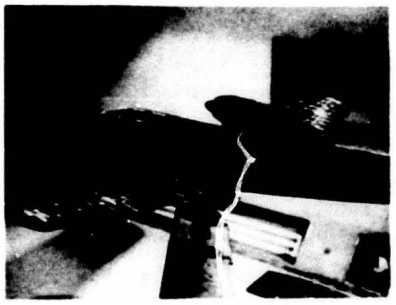
α = 14.9°

Figure 29. Run 12, W + F_1 + N_1 + (T - HV_3), Top View.

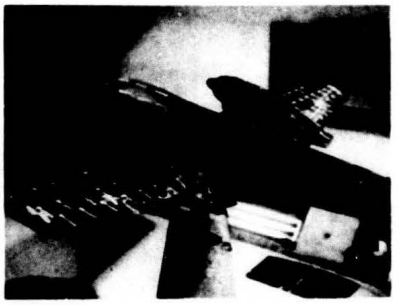
α = -4.1°



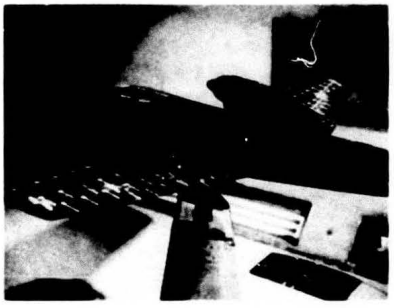
α = 8.6°



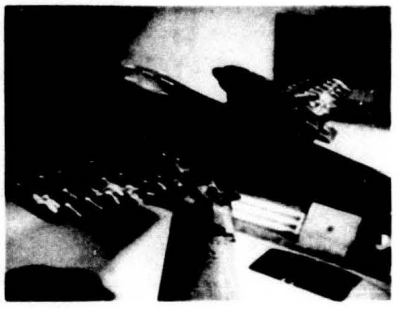
α = 0.1°



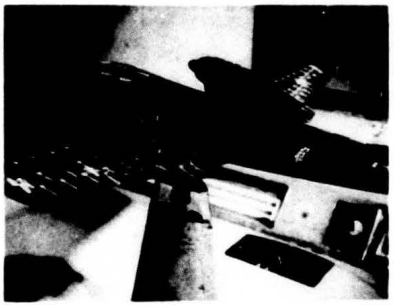
α = 10.7°



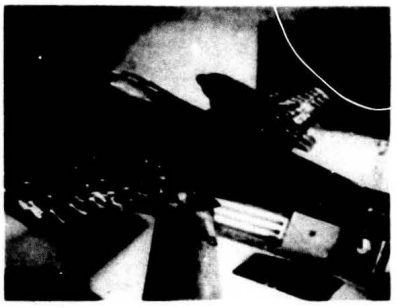
α = 4.4°



α = 12.8°

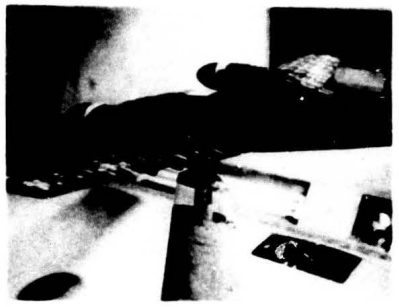


α = 6.5°

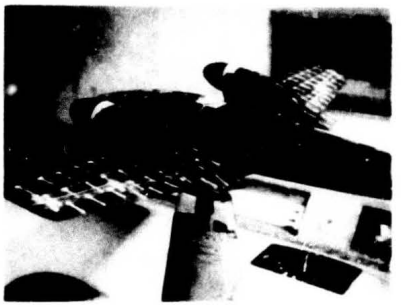


α = 14.8°

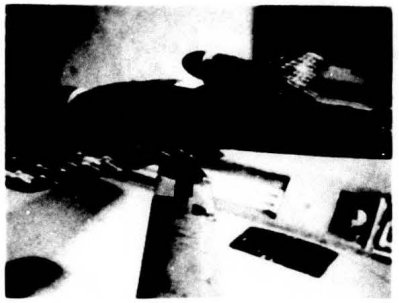
Figure 30. Run 12, W + F_1 + N_1 + (T - HV_3), Side View.



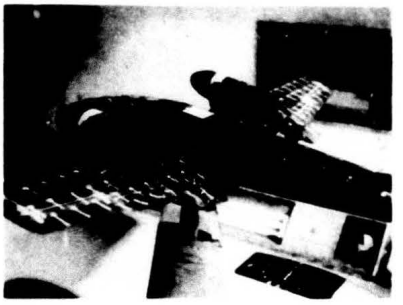
α = -4.1°



α = 8.6°

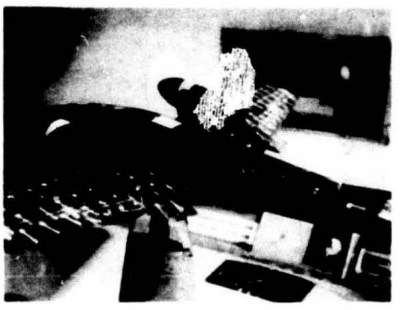


α = 0.1°



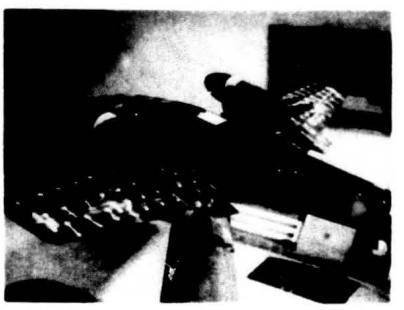
α = 10.7°

α = 4.4°



α = 12.8°

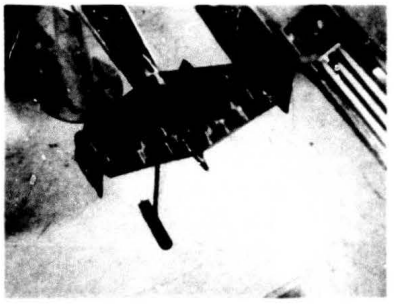
α = 6.5°



α = 14.8°

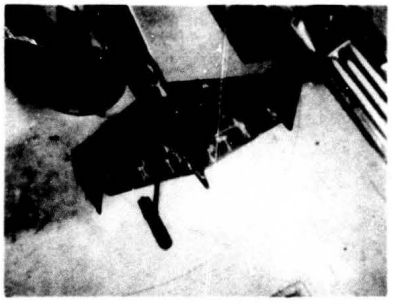
Figure 31. Run 13, W + F_2 + N_3 + (T - HV_3), Side View.

α = -4.1°

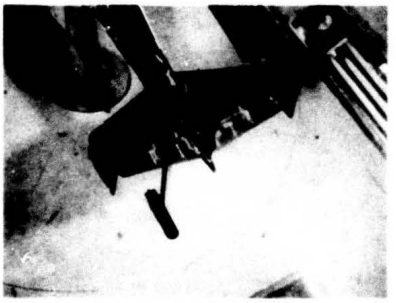


α = 4.4°

α = 0.1°



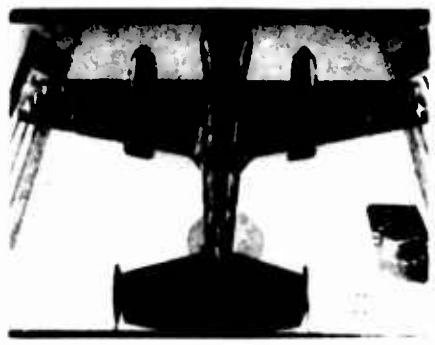
α = 6.5°



α = 8.6°

Figure 32. Run 33, T - HV_3, Top View.

α = -4.1°

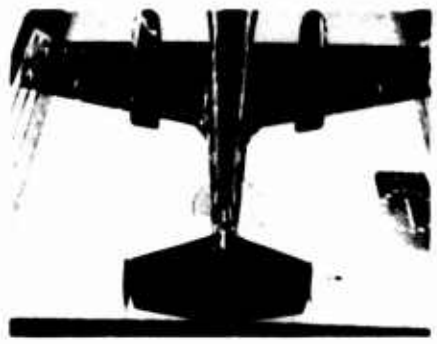


α = 8.6°

α = 0.1°

α = 12.8°

α = 6.5°



α = 14.8°

Figure 33. Run 34, $W^{F_1} + F_1 + N_1 + (T - HV_3)$, Top View.

α = -4.1°

α = 8.6°

α = 0.1°

α = 10.7°

α = 4.4°

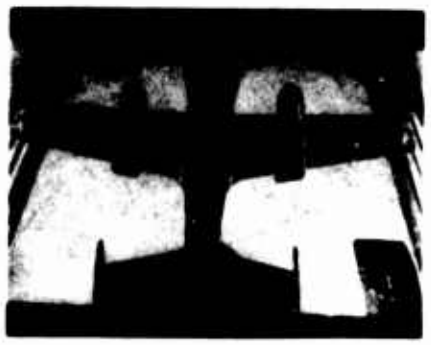
α = 12.8°

α = 6.5°

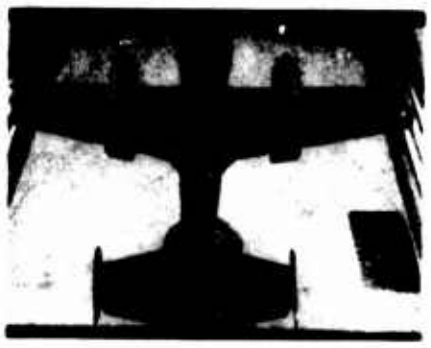
α = 14.8°

Figure 34. Run 34, $W^{F_1} + F_1 + N_1 + (T - HV_3)$, Side View.

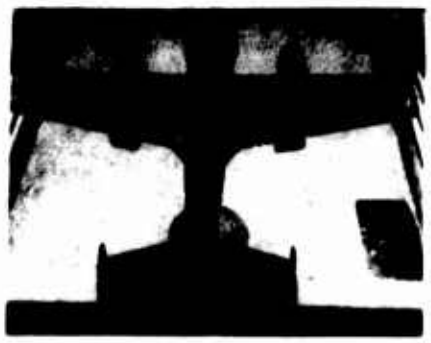
α = -4.1°



α = 0.1°

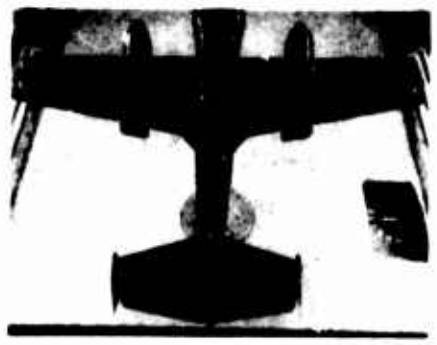


α = 4.4°

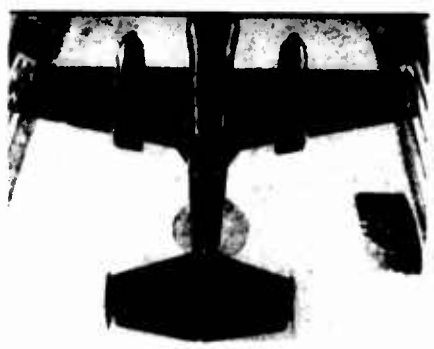


α = 6.5°

α = 8.6°



α = 10.7°



α = 12.8°

α = 14.8°

Figure 35. Run 35, $W^{F_2} + F_1 + N_1 + (T - HV_3)$, Top View.

α = -4.1°

α = 8.6°

α = 0.1°

α = 10.7°

α = 4.4°

α = 12.8°

α = 6.5°

α = 14.8°

Figure 36. Run 35, $W^{F_2} + F_1 + N_1 + (T - HV_3)$, Side View.

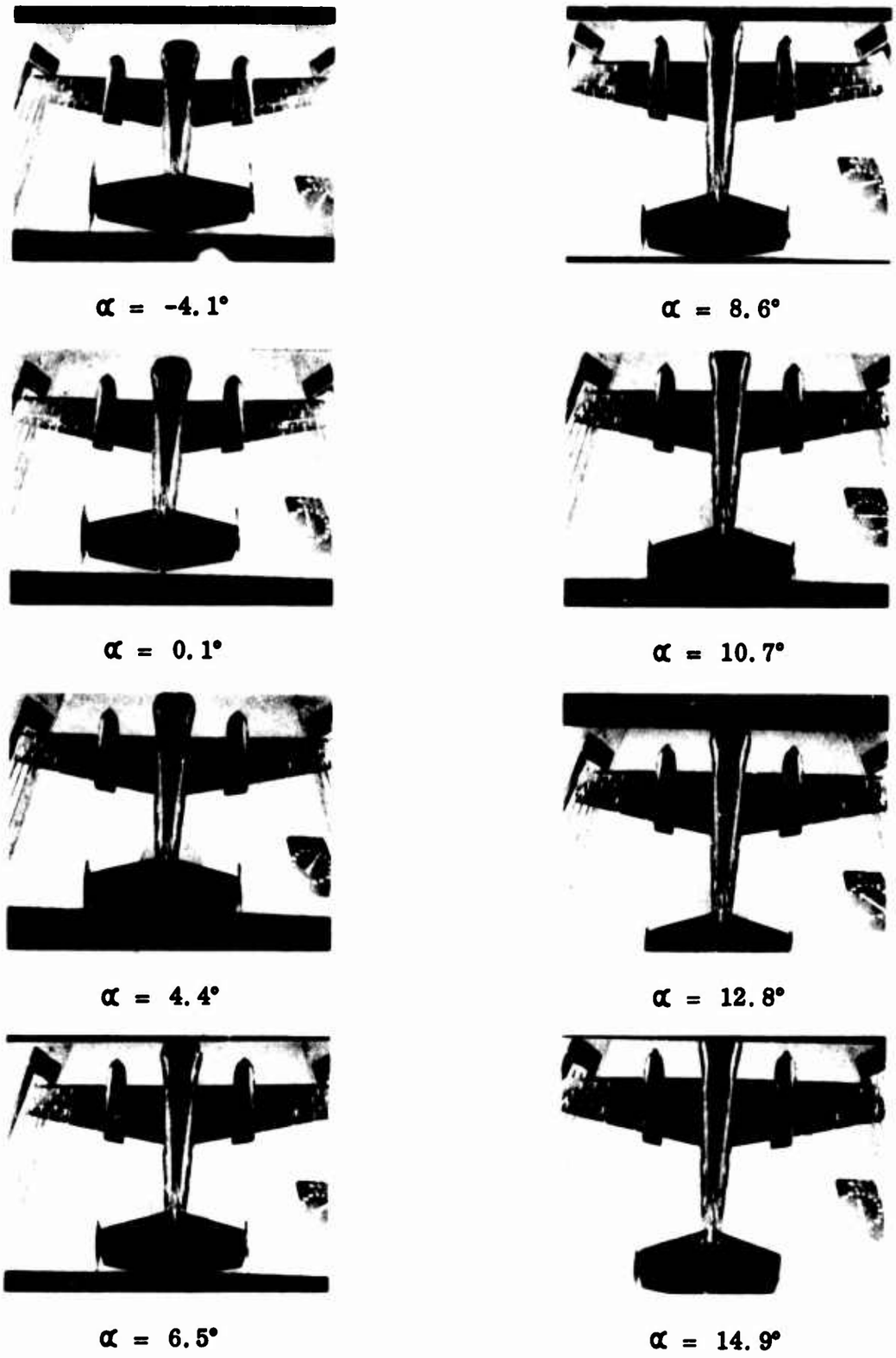
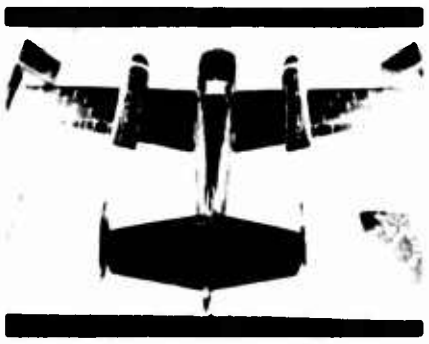
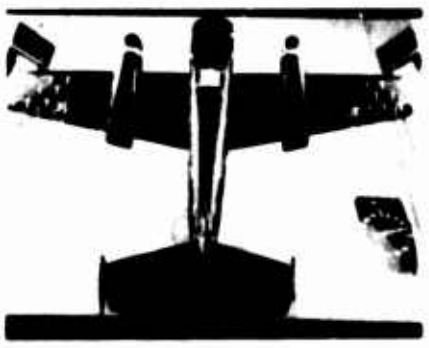


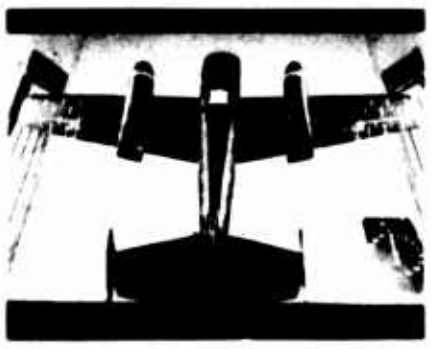
Figure 37. Run 36, W + F_1 + N_1 + (T - HV_3), Top View.



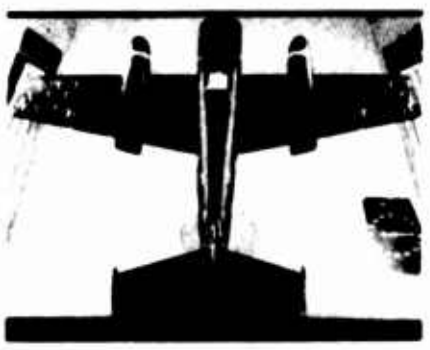
α = -4.1°



α = 8.6°

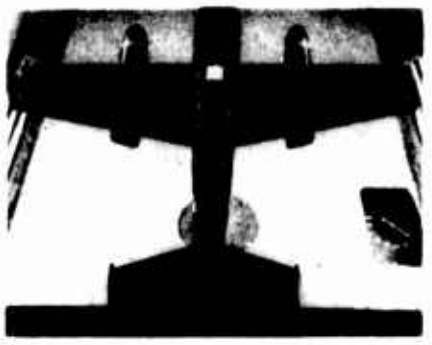


α = 0.1°

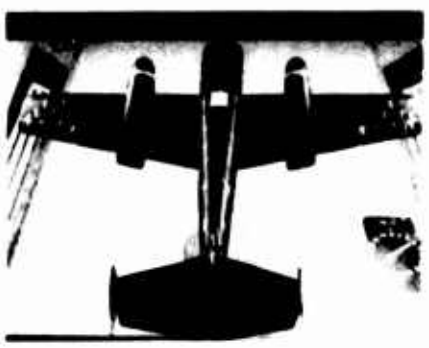


α = 10.7°

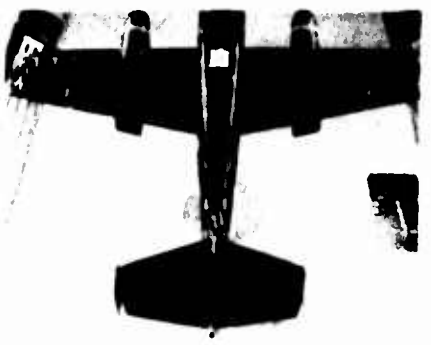
α = 4.4°



α = 12.8°



α = 6.5°



α = 14.8°

Figure 38. Run 37, W + F_2 + N_2 + (T - HV_3), Top View.

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US Army Limited War Laboratory	1
US Army Research Office-Durham	1
US Army Test and Evaluation Command	1
US Army Medical R&D Command	1
US Army Engineer Waterways Experiment Station	1
US Army Combat Developments Command, Fort Belvoir	2
US Army Combat Developments Command Experimentation Command	3
US Army Command and General Staff College	1
US Army Transportation School	1
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Deputy Chief of Staff for Logistics, DA	1
US Army Infantry Center	2
US Army Aviation Maintenance Center	2
US Army Aviation Test Board	3
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US Army Electronics Command	2
US Army Aviation Test Activity	2
Air Force Flight Test Center, Edwards AFB	1
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US Naval Aviation Safety Center	1
Federal Aviation Agency, Washington, D. C.	1
The Surgeon General	1
Defense Documentation Center	20
US Patent Office	1

APPENDIX I
CORRECTED COEFFICIENTS

RUN 8

AXIS ANGLES		GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z FORCES			MOMENTSZ				AXIS
	ATTACK	YAW	LIFT	DRAG	SIDE	PITCH	YAW	ROLL RUNZ	,
W	-06.19	00.00	-00.3046	00.0282	00.0010	-00.1189	00.0016	00.0003	008Z
W	-04.07	00.00	-00.1436	00.0231	00.0010	-00.1044	00.0016	00.0003	008Z
W	-01.95	00.00	00.0158	00.0217	00.0007	-00.0888	00.0018	-00.0003	008Z
W	00.16	00.00	00.1776	00.0239	-00.0003	-00.0734	00.0018	-00.0005	008Z
W	02.28	00.00	00.3465	00.0306	-00.0014	-00.0569	00.0019	00.0000	008Z
W	04.41	00.00	00.5147	00.0407	-00.0003	-00.0406	00.0021	-00.0001	008Z
W	10.76	00.00	00.9826	00.0923	-00.0010	00.0049	00.0025	-00.0003	008Z
W	11.81	00.00	01.0523	00.1065	00.0000	00.0106	00.0029	00.0005	008Z
W	12.85	00.00	01.1046	00.1300	00.0014	00.0027	00.0019	00.0011	008Z
W	13.86	00.00	01.1219	00.1639	-00.0158	-00.0090	00.0027	00.0125	008Z
W	14.89	00.00	01.1645	00.1851	-00.0191	-00.0119	00.0031	00.0153	008Z
W	15.89	00.00	01.1584	00.2059	-00.0133	-00.0090	00.0025	00.0044	008Z
W	16.88	00.00	01.1508	00.2408	00.0000	-00.0193	00.0013	00.0055	008Z
W	17.89	00.00	01.1620	00.2630	-00.0028	-00.0238	00.0008	00.0066	008Z
W	06.53	00.00	00.6794	00.0536	-00.0003	-00.0246	00.0022	00.0000	008Z
W	08.65	00.00	00.8411	00.0716	-00.0018	-00.0087	00.0022	-00.0001	008Z

RUN 9

AXIS ANGLES		GRUMMAN LOW SPEED WIND TUNNEL TEST NO 021QZ FORCES			MOMENTSZ				AXIS
	ATTACK	YAW	LIFT	DRAG	SIDE	PITCH	YAW	ROLL RUNZ	,
W	-06.19	00.00	-00.3075	00.0289	-00.0003	-00.1196	00.0013	00.0004	009Z
W	-04.08	00.00	-00.1480	00.0238	00.0000	-00.1057	00.0012	00.0001	009Z
W	-01.96	00.00	00.0122	00.0224	-00.0007	-00.0895	00.0013	00.0001	009Z
W	00.15	00.00	00.1740	00.0249	-00.0007	-00.0748	00.0014	00.0000	009Z
W	02.28	00.00	00.3436	00.0306	-00.0014	-00.0588	00.0015	00.0000	009Z
W	04.40	00.00	00.5082	00.0416	-00.0003	-00.0411	00.0017	00.0001	009Z
W	06.52	00.00	00.6685	00.0545	-00.0007	-00.0251	00.0017	00.0002	009Z
W	08.64	00.00	00.8223	00.0719	-00.0021	-00.0112	00.0018	-00.0001	009Z
W	10.75	00.00	00.9768	00.0940	-00.0018	00.0009	00.0022	-00.0003	009Z
W	11.80	00.00	01.0465	00.1089	-00.0003	00.0031	00.0017	-00.0008	009Z
W	12.82	00.00	01.064[illegible]	00.1423	00.0003	-00.0066	00.0012	00.0040	009Z
W	13.85	00.00	01.1053	00.1630	-00.0003	-00.0059	00.0010	00.0045	009Z
W	14.87	00.00	01.1306	00.1808	00.0003	-00.0037	00.0010	00.0048	009Z
W	15.87	00.00	01.1360	00.2060	-00.0064	-00.0090	00.0011	00.0022	009Z
W	16.90	00.00	01.1732	00.2274	-00.0086	-00.0094	00.0015	00.0013	009Z
W	17.89	00.00	01.1613	00.2546	-00.0039	-00.0152	00.0014	00.0022	009Z
W	18.87	00.00	01.1400	00.2845	-00.0176	-00.0463	00.0035	00.0038	009Z

RUN 15

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	FORCES YAW	LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS
W	-06.20	00.00	-00.3119	00.0246	-00.0010	-00.1181	00.0012	-00.0016		015Z
W	-04.08	00.00	-00.1595	00.0195	-00.0028	-00.1063	00.0013	-00.0012		015Z
W	-01.97	00.00	-00.0021	00.0180	-00.0014	-00.0957	00.0013	-00.0017		015Z
W	00.14	00.00	00.1573	00.0197	-00.0021	-00.0834	00.0013	-00.0010		015Z
W	02.26	00.00	00.3176	00.0245	-00.0021	-00.0720	00.0014	-00.0015		015Z
W	04.38	00.00	00.4822	00.0333	-00.0014	-00.0579	00.0015	-00.0011		015Z
W	06.50	00.00	00.6440	00.0457	-00.0036	-00.0451	00.0015	-00.0018		015Z
W	08.62	00.00	00.7978	00.0605	-00.0025	-00.0322	00.0015	-00.0015		015Z
W	10.73	00.00	00.9508	00.0785	-00.0036	-00.0170	00.0015	-00.0017		015Z
W	11.79	00.00	01.0201	00.0887	-00.0032	-00.0090	00.0015	-00.0015		015Z
W	12.84	00.00	01.0880	00.0996	-00.0028	-00.0013	00.0015	-00.0015		015Z
W	13.88	00.00	01.1515	00.1095	-00.0025	00.0078	00.0016	-00.0006		015Z
W	14.92	00.00	01.2071	00.1214	-00.0028	00.0168	00.0011	-00.0007		015Z
W	15.96	00.00	01.2490	00.1318	-00.0014	00.0234	00.0012	00.0000		015Z
W	16.93	00.00	01.2086	00.1624	00.0129	-00.0124	-00.0028	00.0076		015Z
W	17.95	00.00	01.2367	00.1847	00.0115	-00.0201	-00.0025	00.0096		015Z

RUN 16

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	FORCES YAW	LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS
W	-06.20	00.00	-00.3191	00.0322	-00.0010	-00.1182	00.0013	-00.0018		016Z
W	-04.09	00.00	-00.1617	00.0270	-00.0018	-00.1044	00.0013	-00.0023		016Z
W	-01.97	00.00	-00.0050	00.0249	-00.0014	-00.0887	00.0013	-00.0024		016Z
W	00.14	00.00	00.1581	00.0273	-00.0021	-00.0738	00.0014	-00.0026		016Z
W	02.26	00.00	00.3169	00.0332	-00.0025	-00.0573	00.0015	-00.0025		016Z
W	04.39	00.00	00.4866	00.0431	-00.0021	-00.0414	00.0015	-00.0018		016Z
W	06.51	00.00	00.6483	00.0548	-00.0025	-00.0254	00.0017	-00.0023		016Z
W	08.62	00.00	00.8028	00.0715	-00.0018	-00.0093	00.0017	-00.0021		016Z
W	10.73	00.00	00.9487	00.0918	-00.0021	00.0030	00.0021	-00.0014		016Z
W	11.77	00.00	01.0024	00.1106	-00.0032	00.0026	00.0023	00.0019		016Z
W	12.80	00.00	01.0346	00.1346	-00.0043	-00.0021	00.0020	00.0038		016Z
W	13.81	00.00	01.0541	00.1695	-00.0090	-00.0148	00.0006	00.0061		016Z
W	14.84	00.00	01.0887	00.1919	-00.0086	-00.0163	00.0004	00.0054		016Z
W	15.86	00.00	01.1172	00.2083	-00.0101	-00.0135	00.0001	00.0038		016Z
W	16.88	00.00	01.1436	00.2262	-00.0111	-00.0118	00.0008	00.0024		016Z
W	17.89	00.00	01.1548	00.2461	-00.0158	-00.0161	00.0018	00.0021		016Z
W	18.87	00.00	01.1378	00.2812	-00.0209	-00.0457	00.0036	00.0052		016Z
W	19.86	00.00	01.1187	00.3053	00.0162	-00.0543	-00.0040	00.0036		016Z

RUN 18

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	YAW	FORCES LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS
W	-04.09	00.00	-00.2368	00.0347	-00.0018	00.0592	00.0013	-00.0018		018Z
W	-01.97	00.00	-00.0599	00.0301	-00.0010	00.0344	00.0013	-00.0016		018Z
W	00.14	00.00	00.1227	00.0312	-00.0014	00.0109	00.0015	-00.0015		018Z
W	02.26	00.00	00.2981	00.0364	-00.0025	-00.0119	00.0016	-00.0022		018Z
W	04.39	00.00	00.4830	00.0464	-00.0028	-00.0338	00.0016	-00.0016		018Z
W	06.51	00.00	00.6613	00.0593	-00.0028	-00.0545	00.0014	-00.0024		018Z
W	08.62	00.00	00.8303	00.0774	-00.0025	-00.0778	00.0016	-00.0011		018Z
W	10.73	00.00	00.9970	00.1018	-00.0018	-00.1056	00.0017	-00.0014		018Z
W	11.77	00.00	01.0497	00.1278	-00.0054	-00.1411	-00.0003	00.0010		018Z
W	12.80	00.00	01.1017	00.1551	-00.0104	-00.1522	-00.0001	00.0080		018Z
W	13.81	00.00	01.1209	00.1814	-00.0079	-00.1527	-00.0004	00.0063		018Z
W	14.84	00.00	01.1588	00.2041	-00.0083	-00.1589	-00.0005	00.0042		018Z
W	15.86	00.00	01.1873	00.2209	-00.0054	-00.1633	-00.0005	00.0036		018Z
W	16.88	00.00	01.2194	00.2398	-00.0068	-00.1747	-00.0002	00.0021		018Z
W	17.88	00.00	01.2266	00.2717	-00.0046	-00.2014	00.0012	00.0028		018Z
W	18.87	00.00	01.2209	00.3006	-00.0212	-00.2687	00.0038	00.0077		018Z

RUN 20

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	YAW	FORCES LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS
W	-04.09	00.00	-00.2295	00.0347	00.0003	00.0424	00.0002	-00.0019		020Z
W	-01.97	00.00	-00.0555	00.0308	00.0000	00.0180	00.0003	-00.0022		020Z
W	00.14	00.00	00.1270	00.0315	-00.0003	-00.0045	00.0004	-00.0022		020Z
W	02.26	00.00	00.3039	00.0368	-00.0010	-00.0258	00.0003	-00.0025		020Z
W	04.39	00.00	00.4873	00.0460	00.0007	-00.0461	00.0004	-00.0020		020Z
W	06.51	00.00	00.6649	00.0607	-00.0003	-00.0655	00.0007	-00.0022		020Z
W	08.62	00.00	00.8295	00.0788	00.0000	-00.0851	00.0004	-00.0019		020Z
W	10.73	00.00	00.9934	00.1003	-00.0007	-00.1111	00.0006	-00.0022		020Z
W	11.77	00.00	01.0469	00.1213	-00.0003	-00.1244	00.0004	00.0002		020Z
W	12.80	00.00	01.0815	00.1478	-00.0014	-00.1284	00.0004	00.0038		020Z
W	13.81	00.00	01.1320	00.1710	00.0010	-00.1355	00.0001	00.0048		020Z
W	14.84	00.00	01.1508	00.2019	-00.0010	-00.1613	-00.0022	00.0027		020Z
W	15.86	00.00	01.1797	00.2196	-00.0010	-00.1700	-00.0023	00.0018		020Z
W	16.88	00.00	01.2129	00.2402	-00.0028	-00.1832	-00.0025	00.0006		020Z
W	17.88	00.00	01.2237	00.2726	-00.0010	-00.2139	-00.0007	00.0024		020Z
W	18.87	00.00	01.2144	00.2981	-00.0137	-00.2705	00.0013	00.0051		020Z

RUN 22

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	FORCES YAW	LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS
W	-04.09	00.00	-00.2498	00.0350	-00.0025	00.1049	00.0009	-00.0028		022Z
W	-01.97	00.00	-00.0743	00.0315	-00.0010	00.0704	00.0011	-00.0026		022Z
W	00.14	00.00	00.1169	00.0322	-00.0021	00.0342	00.0011	-00.0021		022Z
W	02.26	00.00	00.2996	00.0375	-00.0025	-00.0012	00.0013	-00.0023		022Z
W	04.39	00.00	00.4772	00.0474	-00.0025	-00.0346	00.0012	-00.0023		022Z
W	06.51	00.00	00.6671	00.0614	-00.0028	-00.0701	00.0011	-00.0016		022Z
W	08.62	00.00	00.8411	00.0785	-00.0028	-00.1052	00.0013	-00.0013		022Z
W	10.73	00.00	01.0028	00.1025	-00.0032	-00.1460	00.0011	-00.0026		022Z
W	11.77	00.00	01.0591	00.1235	-00.0064	-00.1653	00.0019	00.0023		022Z
W	12.80	00.00	01.1010	00.1508	-00.0028	-00.1724	00.0011	00.0039		022Z
W	13.81	00.00	01.1508	00.1743	-00.0021	-00.1831	00.0010	00.0046		022Z
W	14.84	00.00	01.1768	00.2020	-00.0050	-00.2094	-00.0009	00.0040		022Z
W	15.86	00.00	01.2071	00.2199	-00.0039	-00.2195	-00.0010	00.0027		022Z
W	16.88	00.00	01.2367	00.2403	-00.0050	-00.2328	-00.0004	00.0017		022Z
W	17.88	00.00	01.2382	00.2679	-00.0151	-00.2825	00.0003	00.0038		022Z
W	18.87	00.00	01.2382	00.3003	-00.0148	-00.3212	00.0009	00.0056		022Z

RUN 24

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	FORCES YAW	LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS
W	-04.09	00.00	-00.2404	00.0365	-00.0007	00.0871	00.0003	-00.0021		024Z
W	-01.97	00.00	-00.0635	00.0326	-00.0003	00.0484	00.0001	-00.0021		024Z
W	00.14	00.00	00.1220	00.0333	-00.0014	00.0143	00.0004	-00.0021		024Z
W	02.26	00.00	00.3010	00.0393	-00.0021	-00.0181	00.0001	-00.0024		024Z
W	04.39	00.00	00.4873	00.0493	-00.0003	-00.0492	00.0003	-00.0027		024Z
W	06.51	00.00	00.6649	00.0629	-00.0018	-00.0777	00.0004	-00.0020		024Z
W	08.62	00.00	00.8476	00.0811	-00.0025	-00.1131	00.0004	-00.0016		024Z
W	10.73	00.00	01.0064	00.1040	-00.0007	-00.1532	00.0002	-00.0017		024Z
W	11.77	00.00	01.0577	00.1242	-00.0010	-00.1674	00.0007	00.0013		024Z
W	12.80	00.00	01.1032	00.1529	-00.0010	-00.1754	00.0005	00.0033		024Z
W	13.81	00.00	01.1508	00.1755	-00.0003	-00.1881	00.0000	00.0042		024Z
W	14.84	00.00	01.1949	00.1960	00.0007	-00.2015	00.0000	00.0039		024Z
W	15.86	00.00	01.2194	00.2180	00.0000	-00.2203	-00.0012	00.0020		024Z
W	16.88	00.00	01.2317	00.2406	-00.0014	-00.2398	-00.0025	00.0011		024Z
W	17.88	00.00	01.2288	00.2730	-00.0014	-00.2720	-00.0006	00.0015		024Z
W	18.87	00.00	01.2447	00.3043	-00.0036	-00.3091	00.0007	00.0029		024Z

RUN 26

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	YAW	FORCES LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS
W	-04.09	00.00	-00.2360	00.0365	00.0014	00.0930	00.0005	-00.0018		026Z
W	00.15	00.00	00.1249	00.0341	-00.0010	00.0305	00.0005	-00.0017		026Z
W	02.27	00.00	00.3075	00.0401	-00.0010	-00.0022	00.0006	-00.0023		026Z
W	04.39	00.00	00.4952	00.0497	-00.0018	-00.0322	00.0010	-00.0020		026Z
W	06.51	00.00	00.6736	00.0640	-00.0007	-00.0609	00.0009	-00.0017		026Z
W	08.62	00.00	00.8425	00.0817	-00.0025	-00.0945	00.0008	-00.0018		026Z
W	10.73	00.00	01.0129	00.1064	-00.0003	-00.1378	00.0009	-00.0021		026Z
W	11.76	00.00	01.0541	00.1301	-00.0021	-00.1507	00.0013	00.0022		026Z
W	12.79	00.00	01.0996	00.1564	-00.0010	-00.1563	00.0008	00.0035		026Z
W	13.83	00.00	01.1487	00.1812	00.0010	-00.1698	00.0002	00.0039		026Z
W	14.86	00.00	01.1804	00.2063	00.0003	-00.1869	-00.0009	00.0033		026Z
W	15.88	00.00	01.2035	00.2262	00.0014	-00.1985	-00.0017	00.0023		026Z
W	16.87	00.00	01.2180	00.2557	00.0007	-00.2231	00.0002	00.0026		026Z
W	17.88	00.00	01.2281	00.2787	-00.0003	-00.2470	-00.0001	00.0038		026Z
W	18.91	00.00	01.2996	00.3188	-00.0205	-00.3568	-00.0042	00.0287		026Z

RUN 28

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	YAW	FORCES LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS
W	-06.20	00.00	-00.3133	00.0318	-00.0003	-00.1109	00.0015	-00.0020		028Z
W	-04.08	00.00	-00.1573	00.0274	-00.0021	-00.0943	00.0016	-00.0015		028Z
W	-01.97	00.00	-00.0007	00.0253	-00.0010	-00.0777	00.0016	-00.0018		028Z
W	00.15	00.00	00.1660	00.0277	-00.0036	-00.0612	00.0016	-00.0025		028Z
W	02.27	00.00	00.3241	00.0336	-00.0018	-00.0431	00.0017	-00.0021		028Z
W	04.39	00.00	00.4887	00.0439	-00.0021	-00.0257	00.0017	-00.0024		028Z
W	06.51	00.00	00.6461	00.0573	-00.0039	-00.0084	00.0018	-00.0017		028Z
W	08.62	00.00	00.8006	00.0739	-00.0039	00.0085	00.0019	-00.0018		028Z
W	10.73	00.00	00.9443	00.0946	-00.0021	00.0208	00.0021	-00.0019		028Z
W	11.76	00.00	00.9855	00.1183	-00.0046	00.0156	00.0024	00.0033		028Z
W	12.79	00.00	01.0266	00.1423	-00.0036	00.0119	00.0023	00.0042		028Z
W	13.83	00.00	01.0793	00.1646	-00.0023	00.0125	00.0019	00.0039		028Z
W	14.86	00.00	01.1147	00.1829	-00.0018	00.0125	00.0019	00.0039		028Z
W	15.88	00.00	01.1414	00.1991	-00.0014	00.0156	00.0018	00.0035		028Z
W	16.87	00.00	01.1292	00.2391	-00.0025	-00.0007	00.0017	00.0028		028Z
W	17.88	00.00	01.1429	00.2615	-00.0003	-00.0005	00.0018	00.0030		028Z
W	18.91	00.00	01.1876	00.3007	00.0321	-00.0445	-00.0057	-00.0195		028Z
W	19.92	00.00	01.2006	00.3221	00.0332	-00.0495	-00.0054	-00.0254		028Z

RUN 30

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	YAW	FORCES LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS ,
W	-06.19	00.00	-00.3082	00.0253	-00.0018	-00.1121	00.0016	-00.0018		030Z
W	-04.08	00.00	-00.1523	00.0209	-00.0014	-00.0979	00.0016	-00.0014		030Z
W	-01.97	00.00	00.0000	00.0191	-00.0014	-00.0850	00.0016	-00.0023		030Z
W	00.15	00.00	00.1617	00.0209	-00.0032	-00.0718	00.0017	-00.0022		030Z
W	02.26	00.00	00.3184	00.0263	-00.0032	-00.0577	00.0019	-00.0023		030Z
W	04.39	00.00	00.4851	00.0355	-00.0028	-00.0439	00.0019	-00.0024		030Z
W	06.50	00.00	00.6433	00.0472	-00.0043	-00.0304	00.0020	-00.0019		030Z
W	08.62	00.00	00.7985	00.0620	-00.0043	-00.0148	00.0018	-00.0018		030Z
W	10.73	00.00	00.9501	00.0803	-00.0025	00.0006	00.0020	-00.0022		030Z
W	11.78	00.00	01.0172	00.0913	-00.0032	00.0084	00.0019	-00.0014		030Z
W	12.84	00.00	01.0887	00.1011	-00.0032	00.0176	00.0017	-00.0011		030Z
W	13.88	00.00	01.1515	00.1133	-00.0036	00.0251	00.0019	-00.0011		030Z
W	14.92	00.00	01.2035	00.1245	-00.0032	00.0321	00.0019	-00.0009		030Z
W	15.93	00.00	01.2129	00.1386	-00.0010	00.0246	00.0007	00.0009		030Z
W	16.93	00.00	01.2122	00.1766	00.0068	-00.0058	-00.0018	00.0079		030Z

RUN 32

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	YAW	FORCES LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS ,
W	-06.20	00.00	-00.3133	00.0228	-00.0010	-00.1148	00.0016	-00.0007		032Z
W	-05.14	00.00	-00.2339	00.0209	-00.0003	-00.1084	00.0016	-00.0006		032Z
W	-04.08	00.00	-00.1581	00.0191	-00.0010	-00.1020	00.0016	-00.0010		032Z
W	-03.03	00.00	-00.0808	00.0180	-00.0007	-00.0957	00.0016	-00.0014		032Z
W	-01.97	00.00	-00.0021	00.0173	-00.0018	-00.0891	00.0018	-00.0011		032Z
W	-00.91	00.00	00.0772	00.0177	-00.0010	-00.0817	00.0018	-00.0013		032Z
W	00.14	00.00	00.1588	00.0190	-00.0025	-00.0747	00.0018	-00.0015		032Z
W	01.20	00.00	00.2404	00.0212	-00.0021	-00.0685	00.0018	-00.0015		032Z
W	02.26	00.00	00.3198	00.0246	-00.0021	-00.0622	00.0018	-00.0012		032Z
W	03.32	00.00	00.3999	00.0288	-00.0025	-00.0551	00.0018	-00.0010		032Z
W	04.39	00.00	00.4837	00.0337	-00.0025	-00.0474	00.0019	-00.0009		032Z
W	05.45	00.00	00.5646	00.0395	-00.0025	-00.0402	00.0019	-00.0009		032Z
W	06.50	00.00	00.6360	00.0459	-00.0028	-00.0331	00.0018	-00.0012		032Z
W	07.56	00.00	00.7205	00.0531	-00.0028	-00.0254	00.0018	-00.0010		032Z
W	08.62	00.00	00.7985	00.0605	-00.0021	-00.0174	00.0020	-00.0012		032Z
W	09.68	00.00	00.8728	00.0698	-00.0025	-00.0101	00.0019	-00.0013		032Z
W	10.73	00.00	00.9508	00.0792	-00.0028	-00.0025	00.0018	-00.0015		032Z
W	11.79	00.00	01.0252	00.0901	-00.0018	00.0058	00.0017	-00.0008		032Z
W	12.83	00.00	01.0830	00.1005	-00.0021	00.0132	00.0016	-00.0009		032Z

RUN 39

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	YAW	FORCES LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS ,
W	-04.09	00.00	-00.2483	00.0368	-00.0007	00.0882	00.0012	-00.0008		039Z
W	00.15	00.00	00.1162	00.0340	-00.0021	00.0249	00.0011	-00.0019		039Z
W	02.27	00.00	00.2989	00.0393	-00.0021	-00.0049	00.0013	-00.0026		039Z
W	04.39	00.00	00.4822	00.0493	-00.0025	-00.0350	00.0011	-00.0023		039Z
W	06.51	00.00	00.6692	00.0632	-00.0014	-00.0642	00.0013	-00.0020		039Z
W	08.62	00.00	00.8454	00.0810	-00.0007	-00.0990	00.0012	-00.0014		039Z
W	10.73	00.00	01.0115	00.1054	-00.0018	-00.1380	00.0013	-00.0014		039Z
W	11.76	00.00	01.0671	00.1251	00.0021	-00.1576	-00.0006	-00.0040		039Z
W	12.79	00.00	01.0894	00.1560	-00.0007	-00.1586	00.0011	00.0012		039Z
W	13.83	00.00	01.1407	00.1765	00.0007	-00.1649	00.0007	00.0027		039Z
W	14.86	00.00	01.1869	00.1966	00.0010	-00.1776	00.0006	00.0034		039Z
W	15.88	00.00	01.2295	00.2166	00.0003	-00.1900	00.0008	00.0030		039Z
W	16.87	00.00	01.2452	00.2461	00.0010	-00.2158	00.0032	00.0045		039Z
W	17.88	00.00	01.2396	00.2794	00.0018	-00.2413	00.0004	00.0044		039Z
W	18.91	00.00	01.3198	00.3153	00.0169	-00.3509	00.0022	-00.0202		039Z

RUN 41

GRUMMAN LOW SPEED WIND TUNNEL TEST NO 0210Z

AXIS	ANGLES ATTACK	YAW	FORCES LIFT	DRAG	SIDE	MOMENTSZ PITCH	YAW	ROLL	RUNZ	AXIS ,
W	-04.09	00.00	-00.2469	00.0368	-00.0021	00.0885	00.0014	-00.0019		041Z
W	00.15	00.00	00.1176	00.0337	-00.0032	00.0231	00.0014	-00.0023		041Z
W	02.27	00.00	00.3039	00.0390	-00.0025	-00.0071	00.0015	-00.0018		041Z
W	04.39	00.00	00.4873	00.0493	-00.0028	-00.0350	00.0016	-00.0018		041Z
W	06.51	00.00	00.6750	00.0636	-00.0028	-00.0648	00.0015	-00.0020		041Z
W	08.62	00.00	00.8577	00.0818	-00.0028	-00.0990	00.0012	-00.0023		041Z
W	10.73	00.00	01.0290	00.1047	-00.0021	-00.1359	00.0011	-00.0021		041Z
W	11.76	00.00	01.1039	00.1199	-00.0018	-00.1611	00.0010	-00.0019		041Z
W	12.79	00.00	01.1739	00.1365	-00.0018	-00.1849	00.0010	00.0005		041Z
W	13.83	00.00	01.2115	00.1659	-00.0036	-00.1976	00.0022	00.0065		041Z
W	14.86	00.00	01.2519	00.1993	00.0000	-00.2143	00.0003	00.0044		041Z
W	15.88	00.00	01.2981	00.2281	-00.0025	-00.2383	-00.0023	00.0057		041Z
W	16.87	00.00	01.2743	00.2693	-00.0021	-00.2517	-00.0044	00.0201		041Z
W	17.88	00.00	01.3068	00.3010	-00.0050	-00.2772	-00.0032	00.0243		041Z
W	18.91	00.00	01.2952	00.3343	00.0101	-00.3438	-00.0009	-00.0434		041Z
W	6618.91	0%.00	01.2952	00.3343	8YY.0101	-00.T438	-00.0009	-00.04VU		041Z

APPENDIX II
RAW DATA

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
007	49940	50000	49999	49948	50000	50000	50000	50000
007	49960	50000	50000	49972	50000	50002	50000	50000
007	49980	50000	49999	49987	50000	50002	50000	50000
007	50000	50000	49999	50001	50000	50003	50000	50000
007	50020	50000	49999	50009	50000	50002	50000	50000
007	50040	50000	49999	50014	50000	50003	50000	50000
007	50060	50000	50000	50016	49999	50003	50000	50000
007	50080	50000	50000	50013	49999	50003	50000	50000
007	50100	50002	49999	50006	49998	50003	50000	50000
007	50120	50000	50000	49992	49998	50003	50000	50000
007	50140	50000	49999	49978	50000	50004	50000	50000
007	50160	50002	49999	49956	50000	50003	50000	50000
007	50180	50000	49999	49933	49999	50003	50000	50000
007	50200	50002	49999	49904	49999	50004	50000	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
008	49940	49156	50131	49557	50027	50006	50003	50000
008	49960	49602	50113	49635	50028	50008	50003	50000
008	49980	50044	50104	49705	50030	49997	50002	50000
008	50000	50492	50103	49770	50030	49994	49999	50000
008	50020	50960	50113	49830	50033	50003	49996	50000
008	50040	51426	50130	49883	50035	50000	49999	50000
008	50060	51882	50156	49929	50036	50003	49999	50000
008	50080	52330	50194	49967	50036	50000	49995	50000
008	50100	52724	50239	49992	50040	49996	49997	50000
008	50110	52916	50269	49997	50047	50012	50000	50000
008	50120	53060	50329	49962	50031	50023	50004	50000
008	50130	53108	50419	49920	50046	50206	49956	50000
008	50140	53226	50472	49900	50053	50252	49947	50000
008	50150	53210	50530	49899	50043	50072	49963	50000
008	50160	53190	50627	49860	50022	50095	50000	50000
008	50170	53220	50687	49833	50014	50112	49992	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
009	49940	49148	50133	49555	50022	50007	49999	50000
009	49960	49590	50115	49631	50021	50005	50000	50000
009	49980	50034	50106	49703	50023	50004	49998	50000
009	50000	50482	50106	49766	50024	50004	49998	50000
009	50020	50952	50113	49824	50025	50000	49996	50000
009	50040	51408	50133	49882	50029	50006	49999	50000
009	50060	51852	50159	49928	50028	50007	49998	50000
009	50080	52278	50196	49960	50030	50000	49994	50000
009	50100	52708	50244	49980	50036	49997	49995	50000
009	50110	52900	50276	49974	50027	49988	49999	50000
009	50120	52950	50366	49939	50018	50071	50001	50000
009	50130	53062	50418	49931	50017	50079	49999	50000
009	50140	53132	50463	49928	50018	50085	50001	50000
009	50150	53148	50532	49901	50020	50039	49982	50000
009	50160	53252	50588	49885	50026	50022	49976	50000
009	50170	53218	50664	49858	50024	50039	49989	50000
009	50180	53158	50748	49751	50059	50061	49951	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
014	49940	50000	49999	49948	50000	50001	50001	50000
014	49960	50000	50000	49969	50000	50001	50001	50000
014	49980	50000	49999	49987	50000	50001	50002	50000
014	50000	50000	49999	49999	50000	50001	50001	50000
014	50020	50000	50000	50009	50000	50002	50001	50000
014	50040	50000	50000	50011	50000	50002	50001	50000
014	50060	50000	50000	50012	50000	50002	50001	50000
014	50080	50000	49999	50011	50000	50002	50001	50000
014	50100	50000	49999	50000	50000	50002	50001	50000
014	50120	50000	50000	49990	50000	50003	50001	50000
014	50140	50000	49999	49972	50000	50003	50001	50000
014	50160	50000	49999	49951	50000	50003	50001	50000
014	50180	50000	49999	49923	50000	50004	50001	50000
014	50200	50000	50000	49897	50000	50004	50001	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
015	49940	49136	50121	49558	50020	49973	49998	50000
015	49960	49558	50103	49624	50022	49980	49993	50000
015	49980	49994	50094	49681	50023	49972	49998	50000
015	50000	50436	50092	49734	50023	49982	49995	50000
015	50020	50880	50098	49779	50024	49975	49995	50000
015	50040	51336	50112	49822	50026	49982	49997	50000
015	50060	51784	50136	49857	50026	49970	49991	50000
015	50080	52210	50165	49887	50026	49976	49994	50000
015	50100	52634	50203	49912	50026	49972	49991	50000
015	50110	52826	50222	49925	50026	49976	49992	50000
015	50120	53014	50246	49937	50026	49977	49993	50000
015	50130	53190	50266	49949	50027	49991	49994	50000
015	50140	53344	50292	49961	50020	49989	49993	50000
015	50150	53460	50317	49964	50021	50004	49997	50000
015	50160	53348	50405	49844	49951	50135	50037	50000
015	50170	53426	50464	49802	49957	50167	50033	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
016	49940	49116	50142	49560	50022	49969	49997	50000
016	49960	49552	50124	49636	50023	49963	49995	50000
016	49980	49986	50113	49706	50023	49960	49996	50000
016	50000	50438	50113	49770	50024	49958	49994	50000
016	50020	50878	50121	49830	50025	49958	49993	50000
016	50040	51348	50138	49882	50026	49972	49994	50000
016	50060	51796	50161	49928	50028	49963	49993	50000
016	50080	52224	50196	49967	50028	49966	49995	50000
016	50100	52630	50240	49988	50034	49978	49994	50000
016	50110	52778	50284	49976	50037	50034	49991	50000
016	50120	52866	50347	49953	50033	50065	49988	50000
016	50130	52920	50440	49909	50011	50103	49975	50000
016	50140	53016	50497	49895	50008	50092	49976	50000
016	50150	53096	50540	49889	50004	50064	49972	50000
016	50160	53170	50587	49880	50015	50040	49969	50000
016	50170	53200	50641	49853	50031	50033	49956	50000
016	50180	53152	50739	49752	50061	50083	49942	50000
016	50190	53100	50807	49713	49930	50070	50045	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
017	49940	50000	49999	49943	50002	49998	50001	50000
017	49960	50000	49999	49966	50002	49998	50001	50000
017	49980	50002	49999	49986	50002	49998	50001	50000
017	50000	50000	49999	49999	49999	49998	50001	50000
017	50020	50000	49999	50010	50000	49998	50001	50000
017	50040	50000	49999	50016	50000	49998	50001	50000
017	50060	50002	50000	50016	50002	49998	50001	50000
017	50080	50000	50000	50014	50001	49998	50001	50000
017	50100	50000	50000	50007	50001	49999	50001	50000
017	50120	50000	49999	49996	50001	49999	50001	50000
017	50140	50002	50000	49977	50002	49999	50001	50000
017	50160	50000	50000	49957	50001	49999	50001	50000
017	50180	50000	50000	49931	50002	49999	50001	50000
017	50200	50000	50000	49901	50002	49999	50001	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
018	49940	48856	50170	50250	50026	49962	49996	50000
018	49960	49344	50145	50174	50024	49966	49996	50000
018	49980	49836	50128	50106	50025	49970	49998	50000
018	50000	50340	50124	50031	50025	49971	49997	50000
018	50020	50826	50130	49954	50028	49959	49994	50000
018	50040	51338	50147	49871	50028	49969	49993	50000
018	50060	51834	50173	49783	50026	49957	49993	50000
018	50080	52300	50212	49683	50028	49978	49994	50000
018	50100	52762	50268	49562	50030	49974	49996	50000
018	50110	52908	50331	49436	49996	50014	49986	50000
018	50120	53052	50402	49391	50000	50129	49972	50000
018	50130	53106	50472	49379	49995	50102	49979	50000
018	50140	53212	50531	49344	49993	50067	49978	50000
018	50150	53290	50575	49313	49993	50058	49986	50000
018	50160	53378	50625	49260	49997	50033	49982	50000
018	50170	53398	50712	49162	50022	50044	49988	50000
018	50180	53382	50793	48935	50068	50121	49942	50000
018	50190	53376	50864	48857	49934	50072	50053	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
019	49940	50000	50000	49941	50001	50000	50000	50000
019	49960	50000	50000	49967	50002	50000	50000	50000
019	49980	50000	50000	49984	50000	50000	50000	50000
019	50000	50000	50000	49998	50000	50000	50000	50000
019	50020	50000	50000	50008	50000	50000	50000	50000
019	50040	50000	50000	50014	50000	50000	50000	50000
019	50060	50000	50000	50017	50000	50000	50000	50000
019	50080	50000	50000	50014	50000	50000	50000	50000
019	50100	50000	50000	50006	50000	50001	50000	50000
019	50120	50000	49999	49995	50000	50002	50000	50000
019	50140	50000	50000	49978	50000	50003	50000	50000
019	50160	50000	49999	49957	50000	50003	50000	50000
019	50180	50000	50000	49931	50000	50003	50000	50000
019	50200	50000	50000	49901	50000	50003	50000	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
020	49940	48886	50170	50186	50006	49958	49999	50000
020	49960	49364	50146	50121	50006	49968	50001	50000
020	49980	49846	50131	50051	50006	49962	50000	50000
020	50000	50352	50126	49980	50008	49962	49999	50000
020	50020	50842	50132	49907	50006	49957	49997	50000
020	50040	51350	50147	49829	50007	49967	50002	50000
020	50060	51842	50177	49749	50013	49963	49999	50000
020	50080	52298	50216	49660	50007	49967	50000	50000
020	50100	52752	50264	49543	50010	49963	49998	50000
020	50110	52900	50313	49487	50008	50006	49999	50000
020	50120	52996	50382	49466	50007	50065	49996	50000
020	50130	53136	50443	49430	50002	50083	50003	50000
020	50140	53188	50525	49337	49963	50048	49997	50000
020	50150	53268	50571	49292	49961	50034	49997	50000
020	50160	53360	50625	49233	49958	50012	49992	50000
020	50170	53390	50714	49122	49988	50043	49997	50000
020	50180	53364	50786	48929	50024	50083	49962	50000
020	50190	53390	50851	48833	50039	50107	49954	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
021	49940	50000	50000	49939	50000	50001	50001	50000
021	49960	50000	50001	49964	50000	50001	50001	50000
021	49980	50000	50000	49984	49999	50001	50001	50000
021	50000	50000	50000	49999	49999	50001	50003	50000
021	50020	50000	50000	50009	49999	50000	50002	50000
021	50040	50000	50000	50017	50000	50000	50002	50000
021	50060	50000	50000	50019	50000	50000	50002	50000
021	50080	50000	50000	50015	49999	50000	50002	50000
021	50100	50000	50000	50005	50000	50000	50002	50000
021	50120	50000	49999	49995	49999	50000	50002	50000
021	50140	50000	50000	49979	49999	50000	50002	50000
021	50160	50000	50000	49957	49998	50000	50002	50000
021	50180	50000	49999	49932	49999	50000	50002	50000
021	50200	50000	50000	49901	49998	50000	50002	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
022	49940	48812	50175	50431	50014	49953	49997	50000
022	49960	49308	50148	50320	50015	49953	49994	50000
022	49980	49794	50133	50221	50018	49956	49998	50000
022	50000	50324	50128	50107	50018	49965	49997	50000
022	50020	50830	50134	49988	50022	49960	49995	50000
022	50040	51322	50151	49870	50020	49960	49995	50000
022	50060	51848	50179	49736	50019	49972	49994	50000
022	50080	52330	50215	49595	50022	49976	49994	50000
022	50100	52778	50270	49429	50020	49955	49993	50000
022	50110	52934	50319	49354	50033	50037	49984	50000
022	50120	53050	50390	49323	50019	50065	49994	50000
022	50130	53188	50452	49276	50016	50077	49996	50000
022	50140	53260	50525	49180	49984	50066	49988	50000
022	50150	53344	50572	49130	49982	50045	49991	50000
022	50160	53426	50626	49070	49991	50028	49988	50000
022	50170	53430	50701	48897	50006	50059	49960	50000
022	50180	53430	50791	48764	50017	50088	49961	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
023	49940	50000	49999	49939	50001	50002	50001	50000
023	49960	50000	50000	49965	50002	50002	50001	50000
023	49980	50000	49999	49984	50002	50002	50001	50000
023	50000	50000	49999	49999	50000	50002	50001	50000
023	50020	50000	49999	50011	50000	50002	50001	50000
023	50040	50000	49999	50015	50000	50002	50001	50000
023	50060	50000	49999	50017	50000	50002	50001	50000
023	50080	50000	49999	50014	50000	50002	50001	50000
023	50100	50000	50000	50009	49999	50003	50001	50000
023	50120	50000	49999	49996	49999	50003	50001	50000
023	50140	50000	49999	49979	49999	50003	50001	50000
023	50160	50000	50000	49958	49999	50003	50001	50000
023	50180	50000	49999	49933	49999	50003	50001	50000
023	50200	50000	49999	49902	49999	50003	50001	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
024	49940	48832	50175	50359	49999	49959	50000	50000
024	49960	49334	50151	50264	50008	49966	49999	50000
024	49980	49824	50135	50150	50004	49967	50000	50000
024	50000	50338	50130	50043	50008	49965	49997	50000
024	50020	50834	50138	49936	50003	49960	49995	50000
024	50040	51350	50155	49821	50005	49957	50000	50000
024	50060	51842	50182	49710	50007	49968	49996	50000
024	50080	52348	50221	49569	50008	49974	49994	50000
024	50100	52788	50274	49410	50003	49973	49999	50000
024	50110	52930	50321	49350	50011	50025	49998	50000
024	50120	53056	50396	49315	50008	50059	49998	50000
024	50130	53188	50455	49261	49998	50074	50000	50000
024	50140	53310	50507	49202	49998	50068	50003	50000
024	50150	53378	50566	49128	49979	50037	50001	50000
024	50160	53412	50627	49049	49956	50022	49997	50000
024	50170	53404	50715	48935	49989	50028	49997	50000
024	50180	53448	50802	48805	50011	50050	49991	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
025	49940	50000	50000	49939	50000	50000	50000	50000
025	49960	50002	50000	49968	50000	50000	50000	50000
025	49980	50000	50000	49986	50000	50000	50000	50000
025	50000	50000	50000	50002	50000	50000	50000	50000
025	50020	50000	49999	50014	50000	50000	50000	50000
025	50040	50000	50000	50020	50000	50000	50000	50000
025	50060	50000	50000	50022	50000	50000	50000	50000
025	50080	50000	50000	50022	50000	50001	50000	50000
025	50100	50000	50000	50015	49999	50002	50000	50000
025	50120	50000	50000	50002	49999	50002	50000	50000
025	50140	50000	50000	49987	49999	50002	50000	50000
025	50160	50000	50000	49968	49999	50002	50000	50000
025	50180	50000	50000	49943	49999	50002	50000	50000
025	50200	50000	50000	49912	49999	50002	50000	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
026	49940	48844	50175	50382	50010	49978	49996	50000
026	49960	49348	50151	50284	50009	49970	50004	50000
026	49980	49830	50136	50192	50006	49973	50002	50000
026	50000	50346	50133	50093	50009	49970	49997	50000
026	50020	50852	50140	49990	50011	49960	49997	50000
026	50040	51372	50157	49881	50017	49965	49995	50000
026	50060	51866	50186	49770	50015	49970	49998	50000
026	50080	52334	50224	49638	50015	49969	49993	50000
026	50100	52806	50281	49467	50015	49966	49999	50000
026	50110	52920	50339	49414	50022	50039	49994	50000
026	50120	53046	50407	49385	50014	50060	49997	50000
026	50130	53182	50470	49327	50003	50068	50003	50000
026	50140	53270	50535	49260	49983	50058	50001	50000
026	50150	53334	50588	49208	49970	50042	50004	50000
026	50160	53374	50670	49121	50003	50046	50002	50000
026	50170	53402	50732	49029	49997	50065	49999	50000
026	50180	53600	50839	48655	49930	50472	49943	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
027	49940	50000	50000	49948	50000	50001	50000	50000
027	49960	50000	49999	49970	50000	50001	50000	50000
027	49980	50002	50000	49988	50000	50001	50000	50000
027	50000	50000	50000	50002	50000	50001	50000	50000
027	50020	50002	50000	50009	50001	50001	50000	50000
027	50040	50000	50000	50015	50001	50002	50000	50000
027	50060	50000	50000	50016	50001	50002	50000	50000
027	50080	50000	49999	50012	50000	50002	50000	50000
027	50100	50000	50000	50008	50000	50002	50000	50000
027	50120	50000	50000	49994	50000	50002	50000	50000
027	50140	50000	50000	49978	50000	50002	50001	50000
027	50160	50000	50001	49960	50000	50000	50001	50000
027	50180	50000	50000	49935	50000	50000	50001	50000
027	50200	50000	50000	49907	50000	50000	50001	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
028	49940	49132	50142	49584	50026	49967	49999	50000
028	49960	49564	50124	49667	50028	49975	49994	50000
028	49980	50000	50115	49743	50027	49970	49997	50000
028	50000	50460	50115	49812	50028	49958	49990	50000
028	50020	50900	50123	49876	50030	49965	49995	50000
028	50040	51354	50141	49934	50030	49960	49994	50000
028	50060	51790	50168	49984	50032	49971	49989	50000
028	50080	52218	50202	50025	50032	49970	49989	50000
028	50100	52616	50249	50049	50035	49969	49994	50000
028	50110	52730	50307	50024	50041	50056	49987	50000
028	50120	52844	50369	50004	50039	50071	49990	50000
028	50130	52990	50425	49995	50033	50066	49994	50000
028	50140	53088	50471	49983	50032	50067	49996	50000
028	50150	53162	50514	49980	50031	50060	49997	50000
028	50160	53128	50626	49926	50029	50046	49994	50000
028	50170	53166	50686	49913	50020	50050	50000	50000
028	50180	53290	50790	49759	49901	49966	50090	50000
028	50190	53326	50848	49727	49906	49969	50093	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
029	49940	50000	50000	49951	49998	50002	50000	50000
029	49960	50000	50000	49969	49999	50002	50000	50000
029	49980	50000	50000	49987	49999	50002	50000	50000
029	50000	50000	50000	50002	49999	50002	50000	50000
029	50020	50000	50000	50009	49998	50002	50000	50000
029	50040	50000	49999	50014	49998	50002	49999	50000
029	50060	50000	50000	50017	49998	50002	50000	50000
029	50080	50000	50000	50012	49999	50002	50000	50000
029	50100	50000	50000	50006	49998	50002	50001	50000
029	50120	50000	50000	49992	49998	50002	50001	50000
029	50140	50000	50000	49977	49998	50002	50001	50000
029	50160	50000	50000	49955	49997	50002	50001	50000
029	50180	50000	49999	49933	49998	50002	50003	50000
029	50200	50000	50000	49904	49997	50001	50001	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
030	49940	49146	50124	49581	50026	49971	49995	50000
030	49960	49578	50107	49652	50027	49978	49996	50000
030	49980	50000	50098	49716	50027	49963	49996	50000
030	50000	50448	50096	49775	50028	49964	49991	50000
030	50020	50882	50103	49826	50031	49962	49991	50000
030	50040	51344	50117	49871	50030	49960	49991	50000
030	50060	51782	50140	49910	50032	49968	49988	50000
030	50080	52212	50170	49945	50030	49969	49988	50000
030	50100	52632	50209	49976	50032	49964	49994	50000
030	50110	52818	50230	49987	50030	49977	49992	50000
030	50120	53016	50250	50001	50027	49982	49992	50000
030	50130	53190	50277	50010	50030	49982	49991	50000
030	50140	53334	50302	50017	50031	49985	49992	50000
030	50150	53360	50340	49978	50010	50017	49990	50000
030	50160	53358	50445	49874	49966	50137	50020	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
031	49940	50000	50001	49947	49998	50000	50000	50000
031	49960	50000	50000	49969	49998	50000	50000	50000
031	49980	50000	50000	49987	49998	50000	50000	50000
031	50000	50000	50000	49999	49998	50000	50000	50000
031	50020	50000	50000	50010	49998	50000	50000	50000
031	50040	50000	50000	50014	49998	50000	50000	50000
031	50060	50000	50000	50014	49998	50000	50000	50000
031	50080	50000	50000	50010	49998	50000	50000	50000
031	50100	50000	50000	50005	49998	50000	50000	50000
031	50120	50000	50000	49992	49998	50001	50000	50000
031	50140	50000	50000	49976	49998	50001	50000	50000
031	50160	50000	50000	49956	49998	50002	50000	50000
031	50180	50000	50000	49931	49998	50002	50000	50000
031	50200	50000	50000	49904	49998	50002	50000	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
032	49940	49132	50118	49567	50025	49987	49997	50000
032	49950	49352	50110	49603	50026	49989	49999	50000
032	49960	49562	50102	49638	50025	49983	49997	50000
032	49970	49776	50097	49670	50025	49976	49998	50000
032	49980	49994	50093	49702	50028	49980	49995	50000
032	49990	50214	50091	49733	50028	49978	49997	50000
032	50000	50440	50091	49762	50028	49974	49993	50000
032	50010	50666	50093	49787	50028	49973	49994	50000
032	50020	50886	50098	49812	50028	49978	49994	50000
032	50030	51108	50105	49835	50029	49981	49993	50000
032	50040	51340	50113	49859	50031	49983	49993	50000
032	50050	51564	50124	49879	50031	49984	49993	50000
032	50060	51762	50137	49898	50028	49978	49992	50000
032	50070	51998	50151	49916	50028	49981	49992	50000
032	50080	52212	50166	49934	50032	49979	49994	50000
032	50090	52418	50186	49949	50031	49976	49993	50000
032	50100	52634	50206	49964	50029	49973	49992	50000
032	50110	52840	50226	49977	50027	49986	49995	50000
032	50120	53000	50249	49987	50026	49984	49994	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
038	49940	50000	50000	49936	50000	50000	50000	50000
038	49960	50000	50000	49962	50001	50000	50000	50000
038	49980	50000	50000	49982	50001	50000	50000	50000
038	50000	50000	50000	49999	50001	50000	50000	50000
038	50020	50000	50000	50011	50001	50000	50000	50000
038	50040	50000	50000	50017	50001	50000	50000	50000
038	50060	50000	50000	50018	50001	50000	50000	50000
038	50080	50000	50000	50017	50001	50000	50000	50000
038	50100	50000	50000	50009	50001	50000	50000	50000
038	50120	50000	50000	49998	50001	50000	50000	50000
038	50140	50000	50000	49983	50001	50000	50000	50000
038	50160	50000	50000	49962	50001	50000	50000	50000
038	50180	50000	50000	49938	50001	50000	50000	50000
038	50200	50000	50000	49908	50001	50000	50000	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
039	49940	48798	50177	50365	50018	49958	49995	50000
039	49960	49312	50152	50264	50021	49985	49998	50000
039	49980	49800	50137	50174	50012	49968	49999	50000
039	50000	50322	50133	50077	50020	49967	49994	50000
039	50020	50828	50139	49978	50024	49955	49994	50000
039	50040	51336	50156	49869	50020	49960	49993	50000
039	50060	51854	50184	49755	50023	49966	49996	50000
039	50080	52342	50222	49618	50022	49975	49998	50000
039	50100	52802	50278	49460	50023	49976	49995	50000
039	50110	52956	50325	49384	49990	49933	50006	50000
039	50120	53018	50406	49374	50020	50021	49998	50000
039	50130	53160	50457	49338	50014	50046	50002	50000
039	50140	53288	50508	49282	50011	50057	50003	50000
039	50150	53406	50561	49225	50015	50051	50001	50000
039	50160	53444	50643	49133	50055	50076	50003	50000
039	50170	53434	50734	49041	50009	50074	50005	50000
039	50180	53656	50829	48666	50036	49669	50047	50000
039	50190	53738	50907	48566	50059	49576	50045	50000
039	50200	53658	51042	48459	50040	49052	50060	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
040	49940	50000	50000	49941	50000	50002	50002	50000
040	49960	50000	50000	49966	50000	50002	50002	50000
040	49980	50000	50000	49985	50000	50002	50002	50000
040	50000	50000	50000	50001	50000	50002	50002	50000
040	50020	50000	50001	50012	50000	50002	50002	50000
040	50040	50000	50001	50019	50000	50002	50002	50000
040	50060	50000	50001	50021	50000	50002	50002	50000
040	50080	50000	50001	50019	50000	50002	50002	50000
040	50100	50000	50001	50012	50000	50002	50002	50000
040	50120	50000	50001	50000	50000	50002	50002	50000
040	50140	50000	50001	49985	50000	50002	50002	50000
040	50160	50000	50001	49965	50000	50002	50002	50000
040	50180	50000	50001	49940	50000	50002	50002	50000
040	50200	50002	50001	49910	50000	50002	50002	50000

RUN	A ANGLE	LIFT	DRAG	PITCH	YAW	ROLL	SIDE	Y ANGLE
041	49940	48798	50178	50361	50024	49974	49996	50000
041	49960	49316	50152	50269	50024	49969	49996	50000
041	49980	49806	50137	50179	50024	49970	49995	50000
041	50000	50326	50132	50073	50024	49961	49993	50000
041	50020	50842	50139	49972	50026	49971	49995	50000
041	50040	51350	50157	49871	50027	49971	49994	50000
041	50060	51870	50186	49756	50026	49967	49994	50000
041	50080	52376	50225	49620	50021	49962	49994	50000
041	50100	52834	50277	49469	50020	49966	49996	50000
041	50110	53058	50311	49371	50018	49969	49997	50000
041	50120	53252	50352	49278	50017	50010	49997	50000
041	50130	53396	50428	49225	50038	50109	49992	50000
041	50140	53468	50516	49161	50006	50076	50002	50000
041	50150	53596	50593	49069	49962	50098	49995	50000
041	50160	53530	50708	49025	49926	50336	49996	50000
041	50170	53620	50794	48928	49947	50404	49988	50000
041	50180	53988	50883	48700	49983	49251	50030	50000

APPENDIX III
EFFECT OF TRANSITION STRIPS

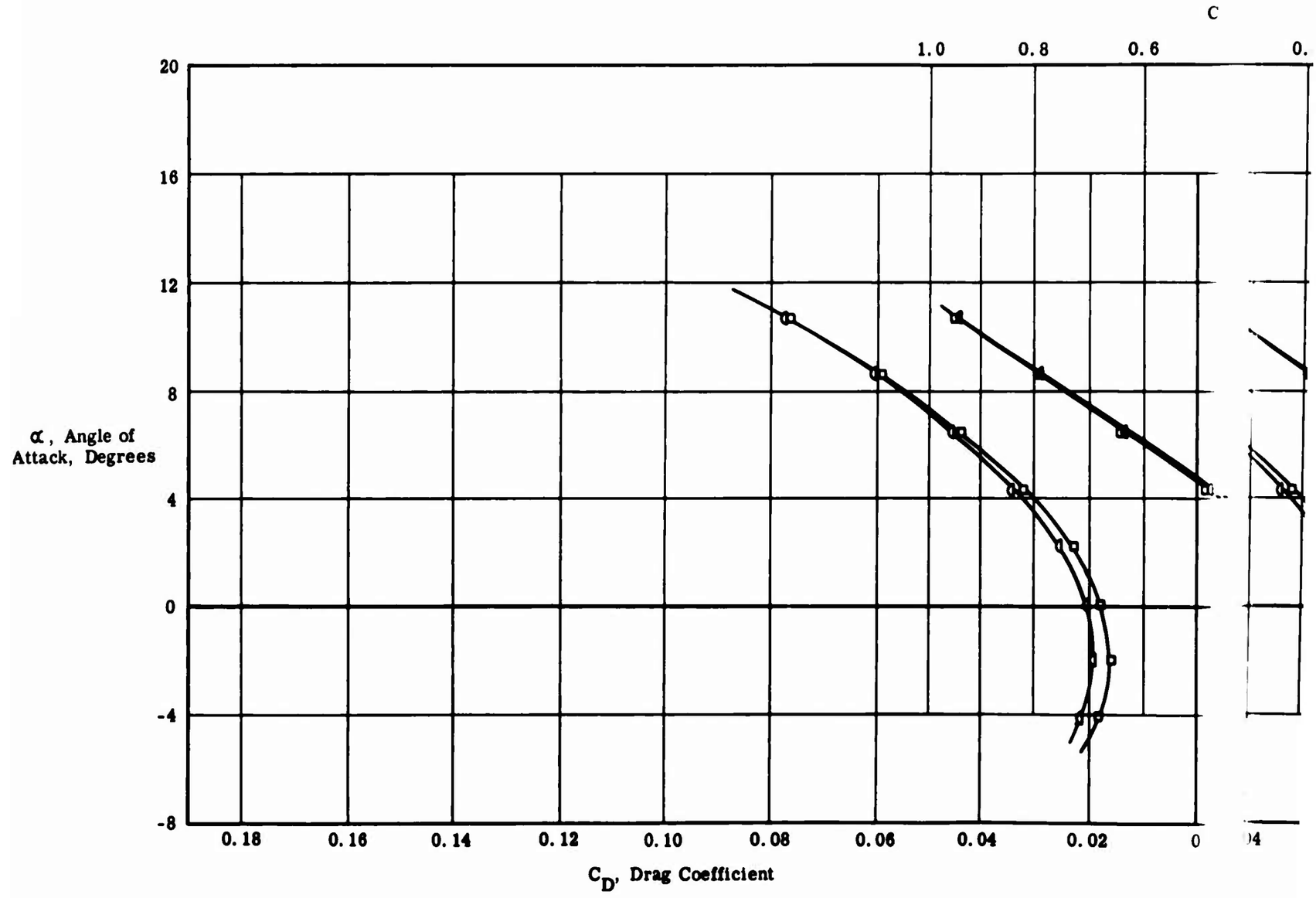
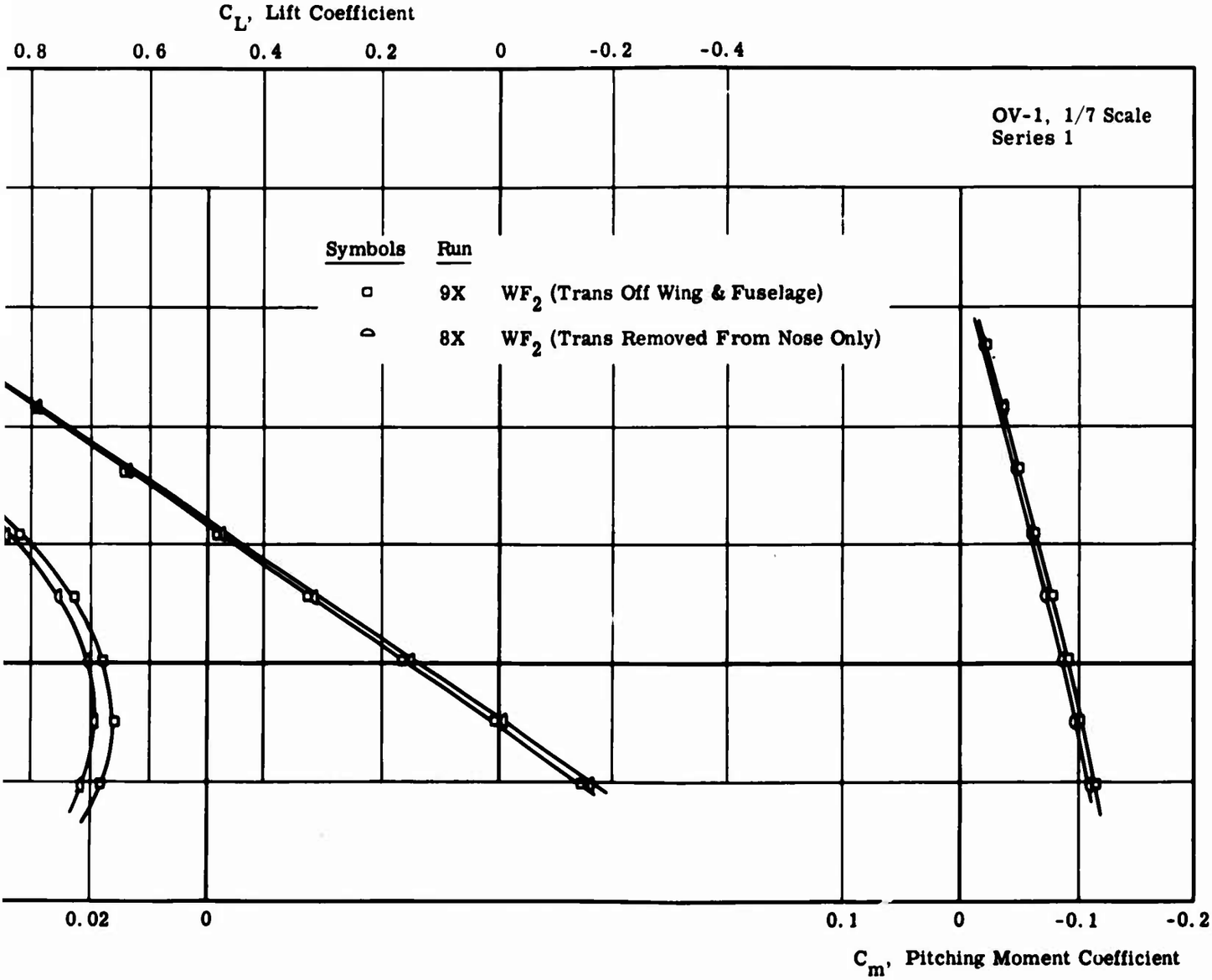


Figure 39. Effect of Transition Strips on Wing.
(To Be Used For Increments Between "X" Series Runs Only)


C_L, Lift Coefficient
0.8
0.6
0.4
0.2
0
-0.2
-0.4
OV-1, 1/7 Scale
Series 1
Symbols
Run
9X
WF_2 (Trans Off Wing & Fuselage)
8X
WF_2 (Trans Removed From Nose Only)
0.02
0
0.1
0
-0.1
-0.2
C_m, Pitching Moment Coefficient

B

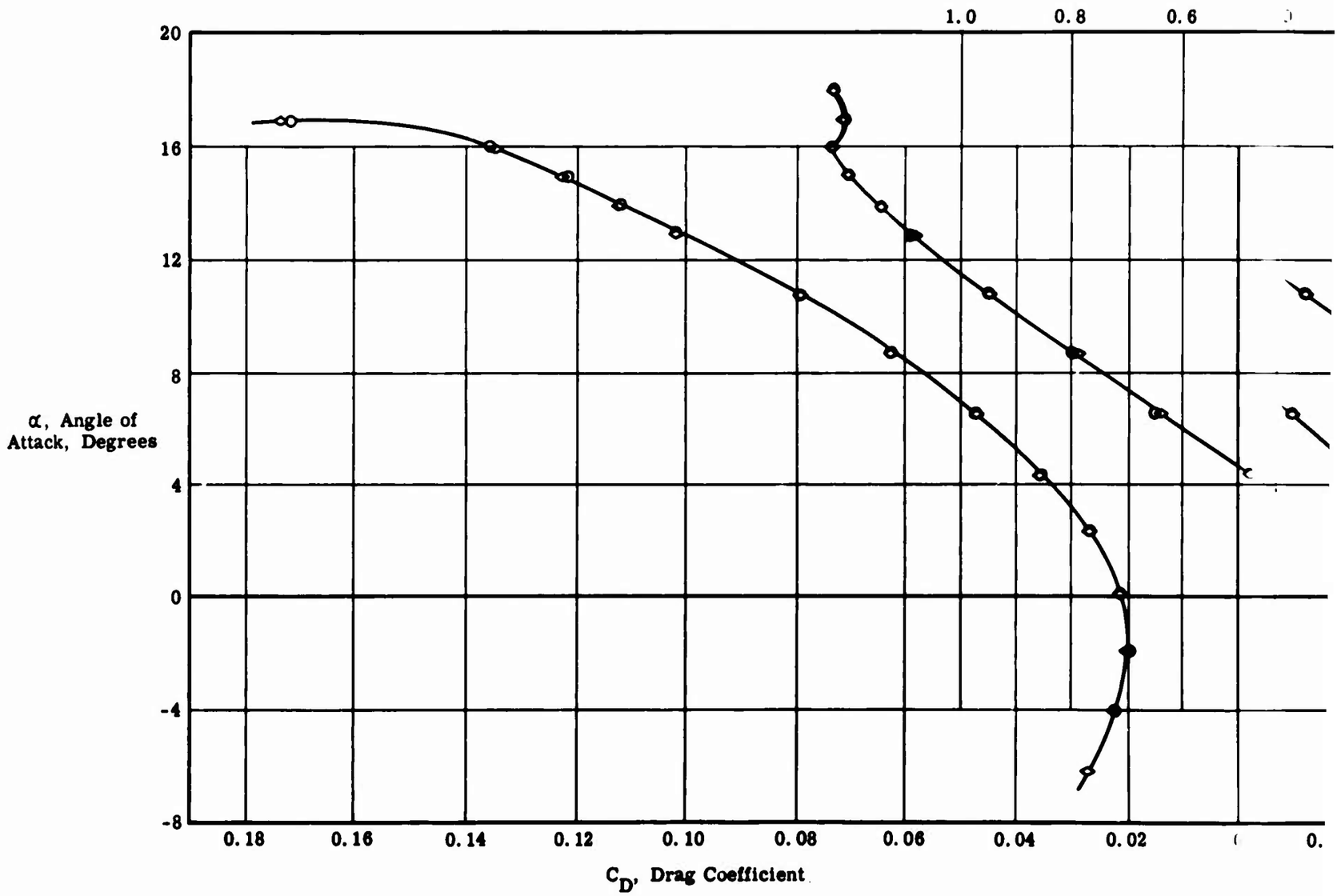
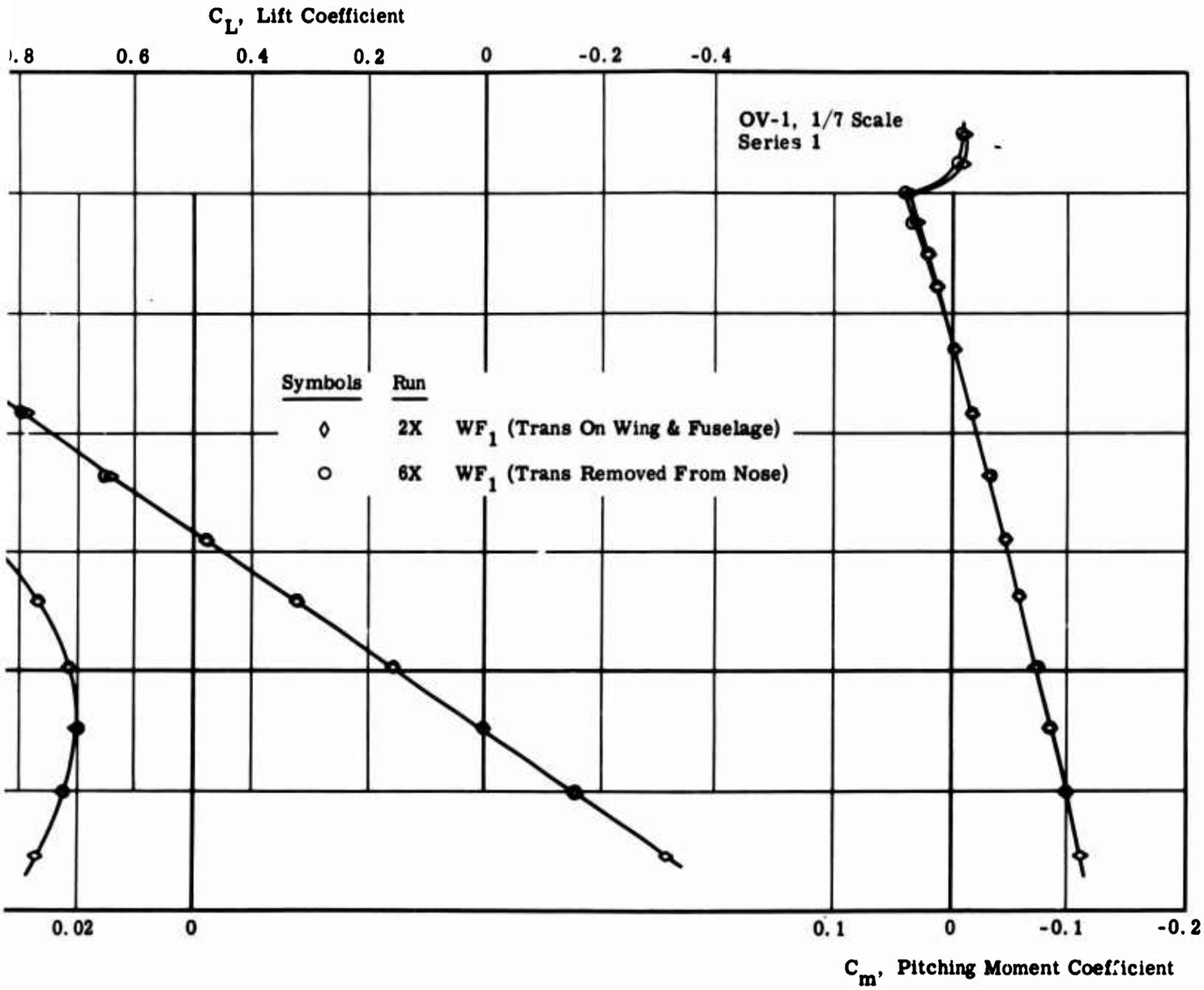


Figure 40. Effect of Transition Strips on Fuselage.
(To Be Used For Increments Between "X" Series Runs Only)


C_L, Lift Coefficient
.8
0.6
0.4
0.2
0
-0.2
-0.4
OV-1, 1/7 Scale
Series 1
Symbols
Run
◊ 2X WF_1 (Trans On Wing & Fuselage)
○ 6X WF_1 (Trans Removed From Nose)
0.02
0
0.1
0
-0.1
-0.2
C_m, Pitching Moment Coefficient

B

Unclassified

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10. AVAILABILITY/LIMITATION NOTICES

Distribution of this document is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	US Army Aviation Materiel Laboratories Fort Eustis, Virginia

13. ABSTRACT

Wind tunnel tests were conducted on a 1/7 scale model of the OV-1 airplane to determine the power-off drag, lift, and pitching moment coefficients of the model and its various components. Significant drag differences were measured between production canopy and nacelle configurations and streamlined fuselage and nacelle configurations, but are not considered applicable for reasons explained in the report. No other significant drag differences were measured.

DD FORM 1 JAN 64 1473

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