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TRANSONIC WIND-TUNNEL TESTS OF A 1/15-SCALE MODEL OF THE TALOS --ETC(U)
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AERODYNAMICS LABORATORY
WASHINGTON 7. D.C.

TRANSONIC WIND-TUNNEL TESTS OF A 1/15-
SCALE MODEL OF THE TALOS 6c1 MISSILE

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by Michael J. McDonald

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TRANSONIC WIND-TUNNEL TESTS OF A 1/15-
SCALE MODEL OF THE TALOS 6c1 MISSILE

10 by
Michael E. McDonald

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SUMMARY

Tests of a 1/15-scale model of the TALOS 6c1 missile were performed in the TMB 7- by 10-Foot Transonic Wind Tunnel for a Mach number range of 0.7 to 1.17, at angles of attack of -4° to 10°, and roll angles of 0° and -45°.

The investigation included evaluation of the effects of ram-air bleed at the base of the second stage and the longitudinal stability and control effectiveness of the missile.

The data are presented without analysis.

SYMBOLS

The aerodynamic force and moment coefficients are based on the maximum area and diameter of the missile body and are referred to the axes system given in Figure 1.

- d reference length (1.868 inches)
- M free-stream Mach number
- q free-stream dynamic pressure, pounds per square foot
- R Reynolds number per foot

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- S_b area at the base of the model (0.0068 square foot)
- S_d area at the model maximum diameter (0.0190 square foot)
- C_A axial-force coefficient
- C_N normal-force coefficient
- C_m pitching-moment coefficient
- C_l rolling-moment coefficient
- C_n yawing-moment coefficient
- C_Y side-force coefficient
- i average incidence of wings b and d, in degrees (positive when the leading edges are deflected toward wing a) (See Figure 2)
- i' average incidence of wings a and c, in degrees (positive when the leading edges are deflected toward control panel d) (See Figure 2)
- δ differential deflection of wings b and d from the nominal incidence values, in degrees (a positive value indicates deflections that tend to produce a positive rolling moment)
- δ' differential deflection of wings a and c from the nominal incidence values, in degrees (a positive value indicates deflections that tend to produce a positive rolling moment)
- α angle of attack, in degrees (See Figure 1)
- φ angle of roll, in degrees (See Figure 1)

Configuration Notation

- B₂₂ vented missile body with the following:
 - homing and fuse antenna 4 each
 - pressure probe on cowl 1
 - beacon and beam rider antenna 1 each
 - flash signals on base 2
- R₅ booster body including:
 - launching lugs 4
 - vented head cap

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H ₁₀	longitudinal housing plus large turbine exhaust louvers	4 each
W	missile wings	
T ₁₀	missile tail (full-scale span, 23 inches)	4
F ₁₈	booster fins	4
C	internal vent cover	1

INTRODUCTION

The TALOS is a surface-to-air, supersonic guided missile and utilizes a ram-jet second stage, which is propelled to operating velocity by a solid-propellant booster rocket.

An investigation was conducted at the request of the Bureau of Weapons (Reference 1) to determine the effect, upon stability and control, of a ram-inlet bleed at the base of the second stage of a 1/15-scale model TALOS 6c1 missile. The longitudinal stability characteristics and effects of various components of the missile were also investigated.

The Mach number range of the tests was from 0.7 to 1.17, the angle-of-attack range was from -4° to 10°, and the roll angles were 0° and -45°.

The tests were performed at the David Taylor Model Basin in September 1960, under the technical direction of the Johns Hopkins Applied Physics Laboratory and the Bendix Corporation.

APPARATUS AND METHODS

TUNNEL

This test was conducted in the 7- by 10-Foot Transonic Wind Tunnel at the David Taylor Model Basin, which is described in Reference 2. Sketches of the major tunnel components and test section are presented in Figures 3 and 4, respectively.

The distribution of the center-line free-stream Mach number in the testing region is shown in Figure 5. The deviations from the free-stream Mach number in the testing region are generally less than ± 0.005 for Mach numbers below 1.0. The deviations increase with speed, but are never greater than ± 0.01 .

MODEL

A 1/15-scale model of the TALOS 6c1 was supplied for these tests. The missile body has a nearly constant circular cross section. It has four controllable wings and fixed tail surfaces on the second stage and four fixed booster fins on the first stage. Various protuberances, representing launching lugs, antennas, beacon lights, pressure probes, and external housings were attached to the model during the tests. Several of these configurations are shown in Figures 6 and 7. For the basic model configurations, the ram-inlet air was exhausted, by internal ducting of the second stage, through a series of bleed ports located around the circumference of the body (see Figure 8). An internal vent cover could be inserted to prevent the bleeding of ram air.

The small scale of the model dictated several internal modifications in adapting the model to an internal, six-component strain-gage balance. It was necessary for the balance to extend through the booster stage into the second stage. A flat-plate cross strut provided support for a balance locking screw. The upstream end of the screw and the exposed end of the balance were covered with conical fairings (see Figure 8). The depth to which the balance could be inserted into the model was restricted so that the effective cross-sectional area remained constant in the vicinity of the bleed passages. In this position, a small portion of the balance protruded from the rear of the model; however, all areas equipped with gages were inside the model.

TESTS AND MEASUREMENTS

As explained above, the model was attached to a six-component strain-gage balance. It was supported by a remotely controlled, cantilevered, sting support system. The angle of attack was measured by movement of the sting; it was adjusted for deflection due to aerodynamic loads. To obtain roll, the model was rotated manually on the strain-gage balance so that the forces and moments were always obtained in the axes system defined in Figure 1. Base pressure of the model was recorded by pressure transducers through static pressure orifices located inside the model base. A model fouling system was established by insulating the entire model from the support and balance system and providing a low-voltage circuit directly to the model. Schlieren photographs were taken at small angles of attack and several Mach numbers for representative configurations.

Various configurations of the model were investigated as shown in Table 1. Removable components consisted of internal vent cover, wings, tails, and booster fins.

The angle-of-attack range for the tests was from -4° to 10° . The angle of roll was either 0° (flight attitude) or -45° (launch attitude). The Mach numbers investigated were 0.70, 0.90, 1.06, and 1.17. The tests were conducted at a stagnation pressure of approximately one-half atmosphere and at a Reynolds number per foot of 1.6×10^6 to 2.2×10^6 .

CORRECTIONS AND ACCURACY

No corrections have been made for the effects of tunnel blockage, since it is generally accepted that this effect is negligible for small blockage ratios. The angle of attack has been corrected for deflection due to aerodynamic load and is believed to be accurate within $\pm 0.1^\circ$. However, no attempt has been made to correct for sting interference effects beyond

adjusting the axial force measurement to the condition of free-stream static pressure at the base of the model. No corrections have been made for internal losses due to bleed air flow through the missile.

The nominal Mach numbers given in the figures are accurate to within ± 0.003 . The repeatability and accuracy of the aerodynamic coefficients at three Mach numbers, taking into account calibrations of the strain-gage balance, are believed to be as follows:

Component	Mach number		
	0.7	0.9	1.17
C_A	± 0.08	± 0.07	± 0.05
C_N	± 0.25	± 0.20	± 0.14
C_m	± 0.14	± 0.12	± 0.08
C_n	± 0.14	± 0.12	± 0.08
C_Y	± 0.08	± 0.07	± 0.05
C_l	± 0.05	± 0.04	± 0.03

PRESENTATION OF RESULTS

The coefficients presented herein are referred to the missile axes system with the origin located at full-scale body station 241 (see Figures 1 and 2). The maximum body diameter and cross-sectional area were used as reference dimensions.

The variation of aerodynamic coefficients with angle of attack is presented for both roll angles in Figures 9 through 16. The pitching-moment coefficient is plotted versus the normal-force coefficient in Figures 17 through 24. In addition, the

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lateral coefficients for some tests are given in Figures 9 to 11, to show the effect of control-surface deflections. An index of the configurations, the test conditions, figure numbers, and page numbers is given in Table 1.

Schlieren photographs of various configurations for several Mach numbers and angles of attack are presented in Figures 25 to 30.

It has been observed that:

1. The effect of Mach number on the slope of the curves of normal-force coefficient and pitching-moment coefficient versus angle of attack is small.
2. The effect of bleed air on the longitudinal characteristics of the missile appears to be slight.
3. For several configurations an unexplainable change in the pitching-moment and normal-force coefficients occurred between an angle of attack of -3° and -1° at a Mach number of 0.90.

The results are presented without further analysis.

Aerodynamics Laboratory
David Taylor Model Basin
Washington, D. C.
March 1961

REFERENCES

1. BUWEPS CONF ltr RAAD-341:JM Ser 037212 of 19 Aug 1960
2. Thomas, Walter S. The David Taylor Model Basin 7- by 10-Foot Transonic Wind Tunnel Facility. Wash., Jul 1960. 35 l. illus. (David Taylor Model Basin. Aero Rpt. 985)

Table 1

Index to Test Conditions

Configuration	Roll Angle ϕ in degrees	Incidence Angle in degrees		Deflection Angle in degrees		Mach Number	Figure	Page
		1	1'	5	5'			
$B_{22}^R H_{10}^M$	-45	0	0	0	0	(a)	9a, 17a	17-23, 129
		-10	-10	0	0	(a)	9b, 17b	28-29, 130
		-15	-15	0	0	(b)	9c, 17c	27-29, 131
		0	0	5	5	(a)	9d, 17d	30-35, 132
	0	0	0	0	0	(a)	9e, 17e	36-38, 133
		-10	0	0	0	(a)	9f, 17f	39-41, 134
$B_{22}^R H_{10}^{MT} 10$	-45	0	0	0	0	(a)	10a, 18a	42-47, 135
		-10	-10	0	0	(a)	10b, 18b	49-50, 136
		-15	-15	0	0	(b)	10c, 18c	51-53, 137
		0	0	5	5	(a)	10d, 18d	54-59, 138
	0	0	0	0	0	(a)	10e, 18e	60-62, 139
		-10	0	0	0	(a)	10f, 18f	63-65, 140
$B_{22}^R H_{10}^{MT} 10^F 18$	-45	0	0	0	0	(a)	11a, 19a	66-71, 141
		-5	-5	0	0	(a)	11b, 19b	72-74, 142
		-10	-10	0	0	(a)	10c, 19c	75-77, 143
		-15	-15	0	0	(b)	11d, 19d	78-80, 144
		0	0	5	5	(a)	11e, 19e	81-96, 145
	0	0	0	0	0	(a)	11f, 19f	97-99, 146
		-5	0	0	0	(a)	11g, 19g	90-92, 147
		-10	0	0	0	(a)	11h, 19h	93-95, 148
		-	-	-	-	(c)	12, 20	96-101, 149-150
		-	-	-	-	(d)	13, 21	102-110, 151-153
$B_{22}^R H_{10}^T 10$	-45	-	-	-	(a)	14, 22	111-113, 154	
$B_{22}^R H_{10}^{MC}$	0	0	0	0	0	(a)	15a, 23a	114-116, 155
		-5	0	0	0	(E)	15b, 23b	117-119, 156
		-10	0	0	0	(a)	15c, 23c	120-122, 157
$B_{22}^R H_{10}^{MT} 10^F 18^C$	0	0	0	0	0	(F)	16a, 24a	123-125, 158
		-10	0	0	0	(F)	16b, 24b	126-129, 159

a 0.70, 0.90, 1.06, 1.17

b 0.70

c 0.70, 0.90, 0.95, 0.975, 1.00, 1.10, 1.17

d 0.70, 0.90, 0.95, 0.975, 1.00, 1.02, 1.04, 1.06, 1.17

e 0.90, 1.17

f 1.17

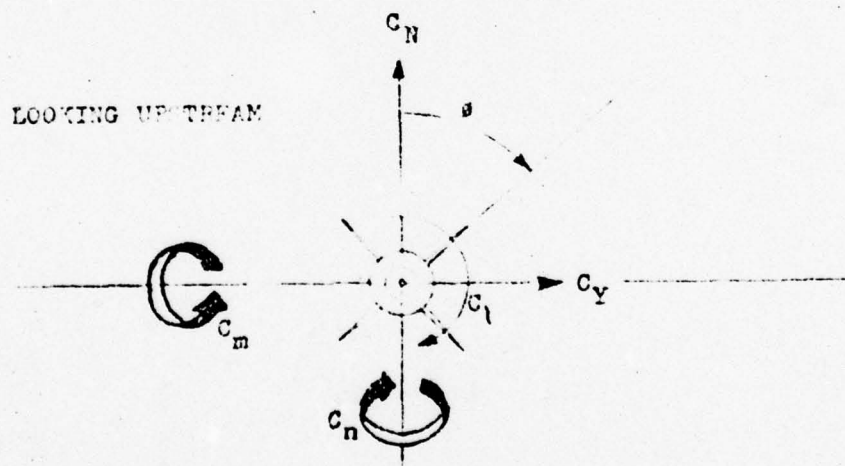
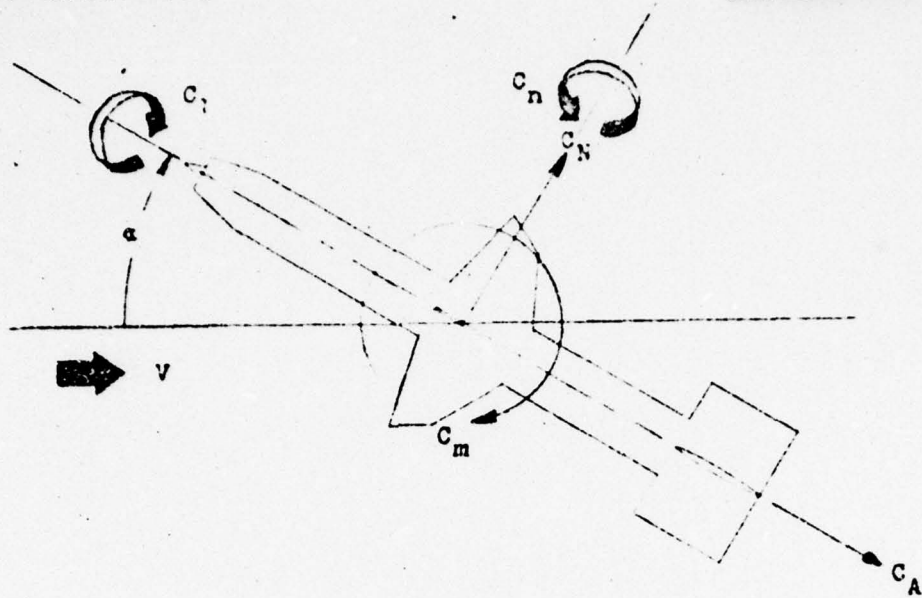
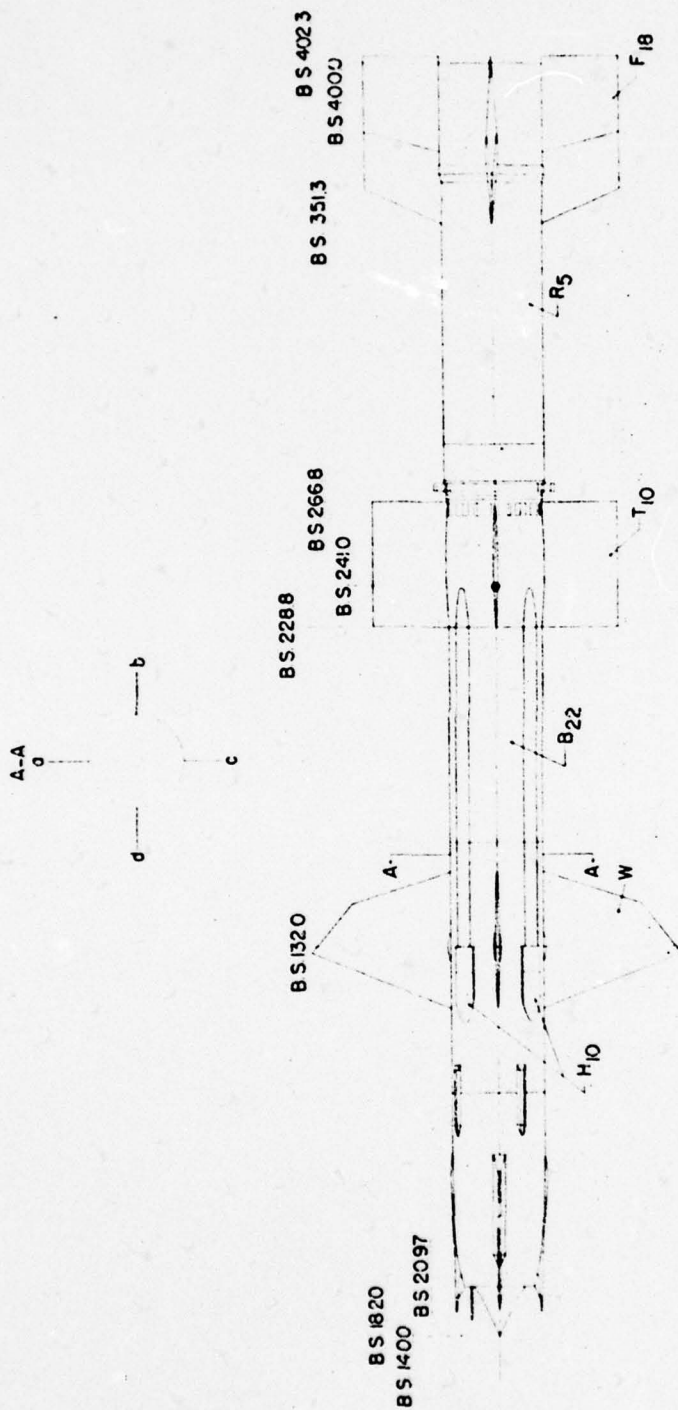


Figure 1 - Missile Axes Notation



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Figure 2

Figure 2 - Drawing of 1/15-Scale Model TALOS 6c1 Missile With Pertinent Dimensions and Components Indicated

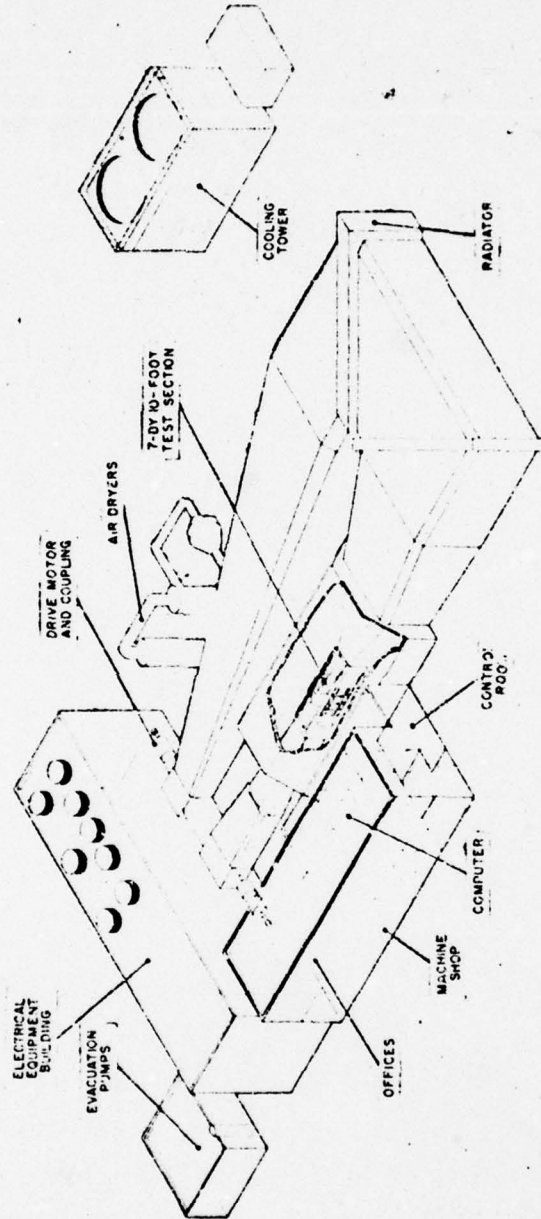


Figure 3 -- Principal Components of The Davia Taylor Model Basin 7-by-10-foot Transonic Wind Tunnel Facility

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Figure 3

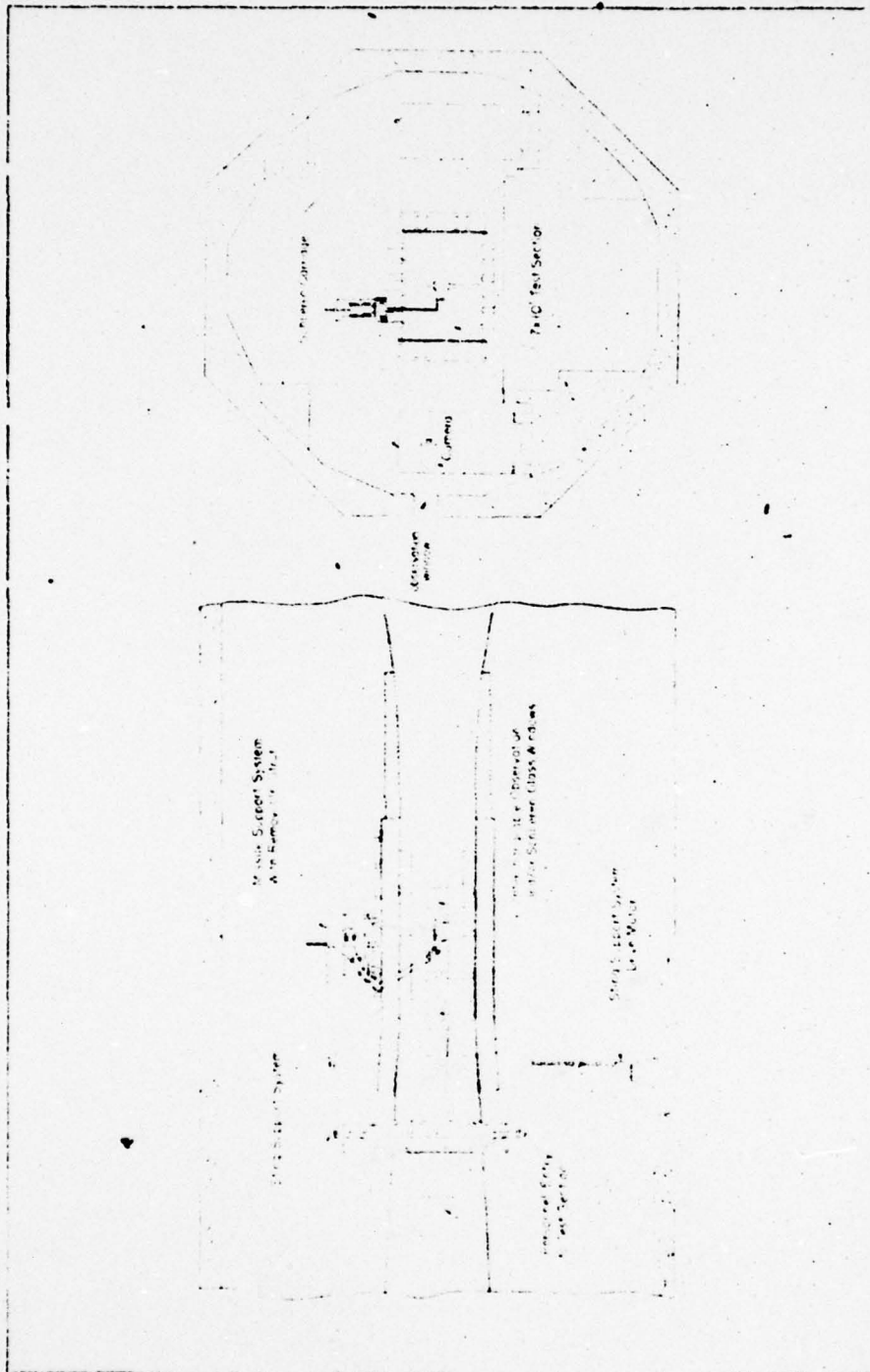


Figure 4 Details of the 7 by 10 Foot Temporary Wind Tunnel

Figure 4

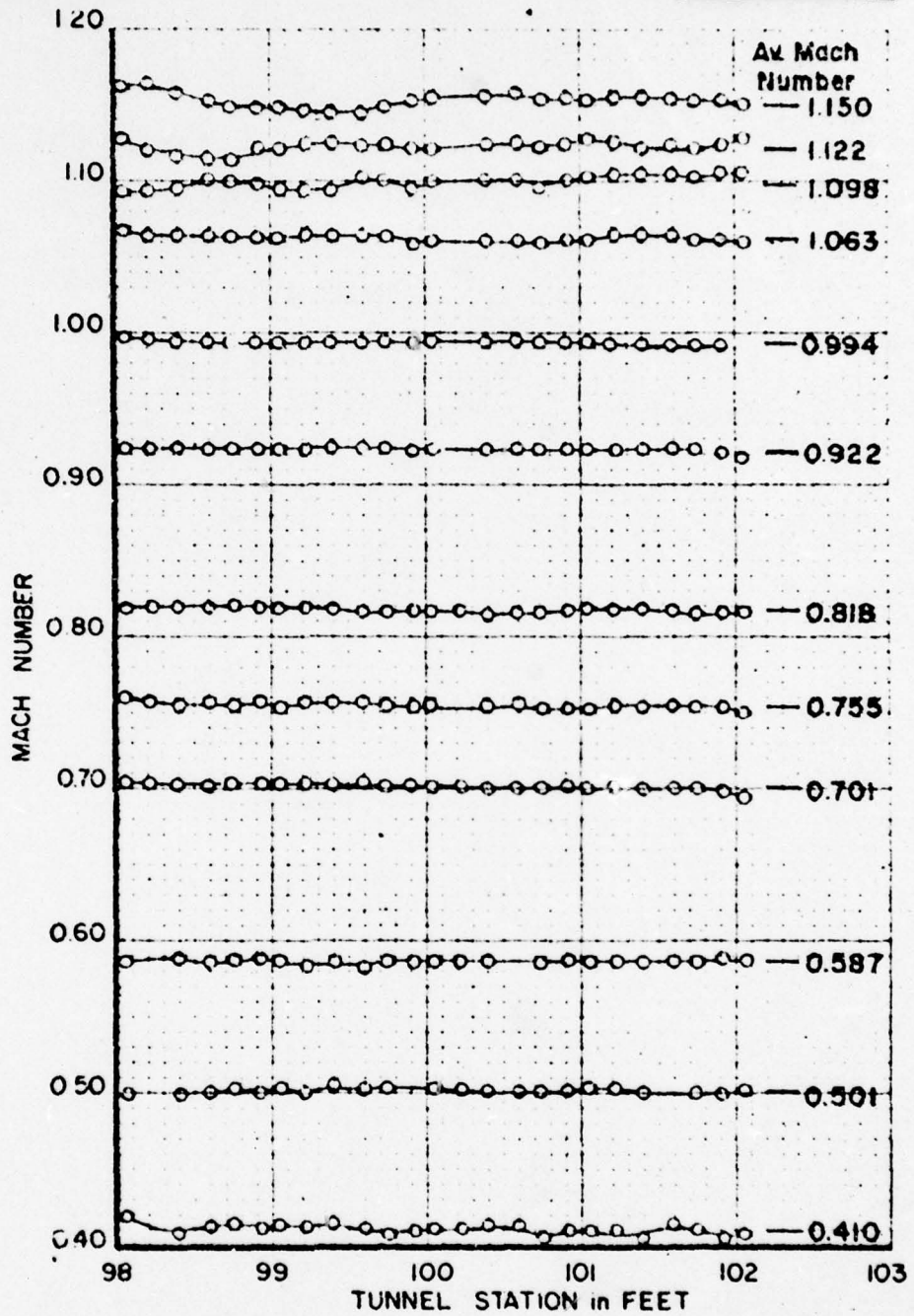
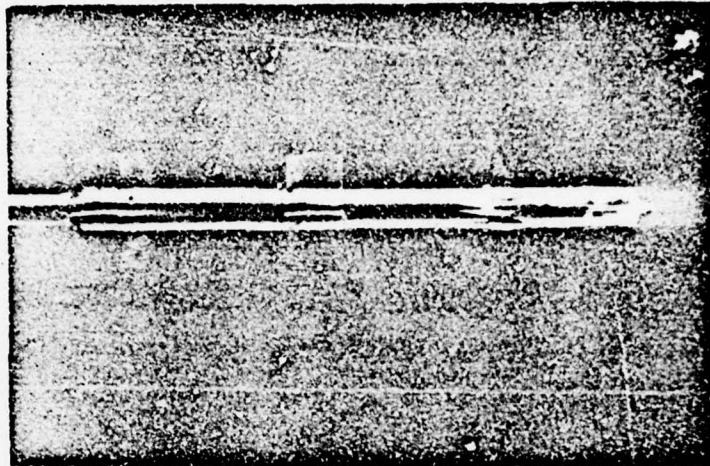
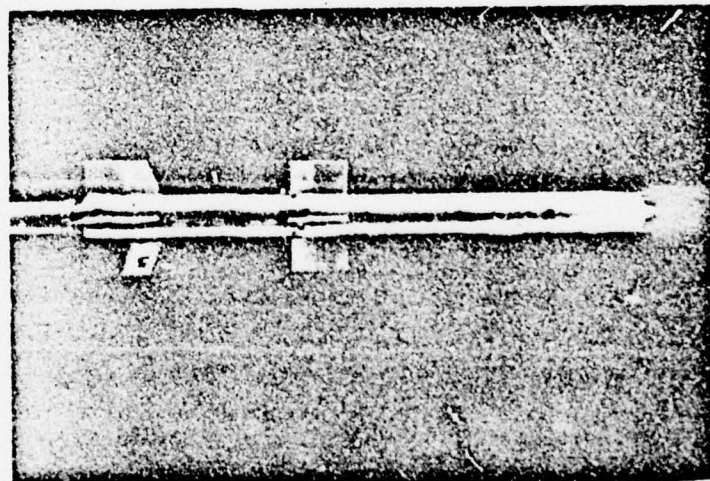


Figure 5 - Distribution of Mach Number in Model Region of Test Section

Figure 5



Configuration B₂₂R₅H₁₀^{WT}₁₀F₁₈

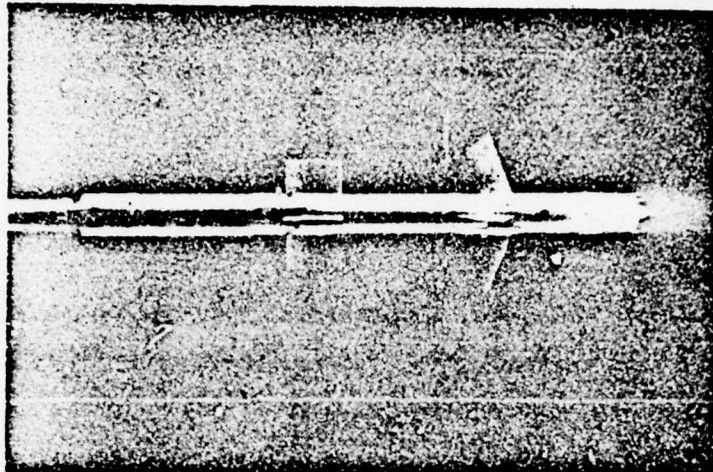


Configuration B₂₂R₅H₁₀^T₁₀F₁₈

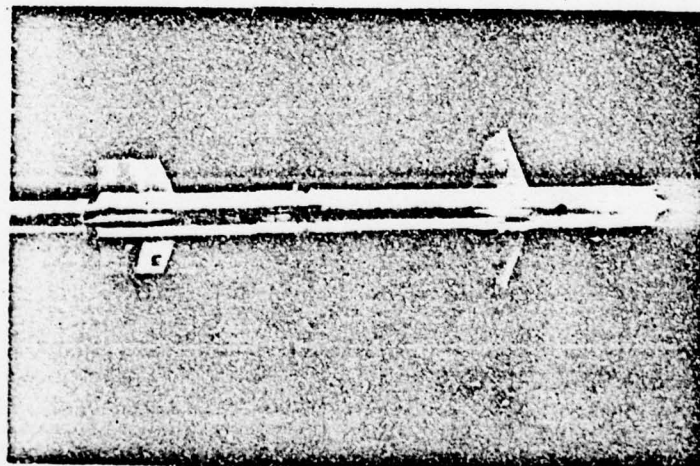
Figure 6 - Photographs of 1/15-Scale Model TALOS Model 601
PSD - 302,634

6 September 1960

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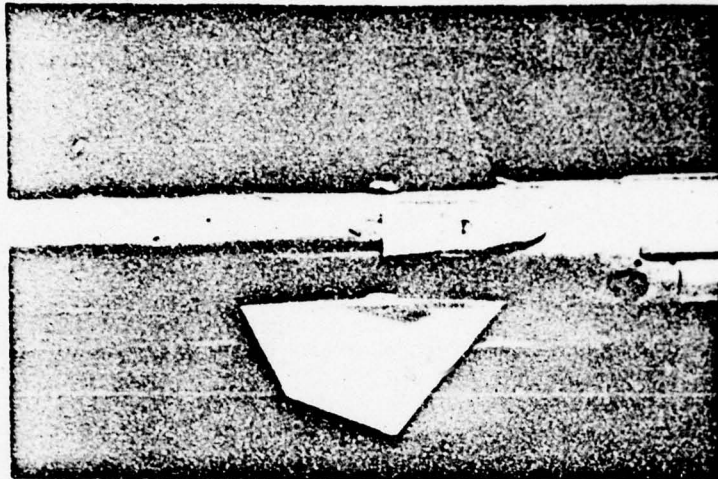


Configuration B₂₂R₅H₁₀WT₁₀

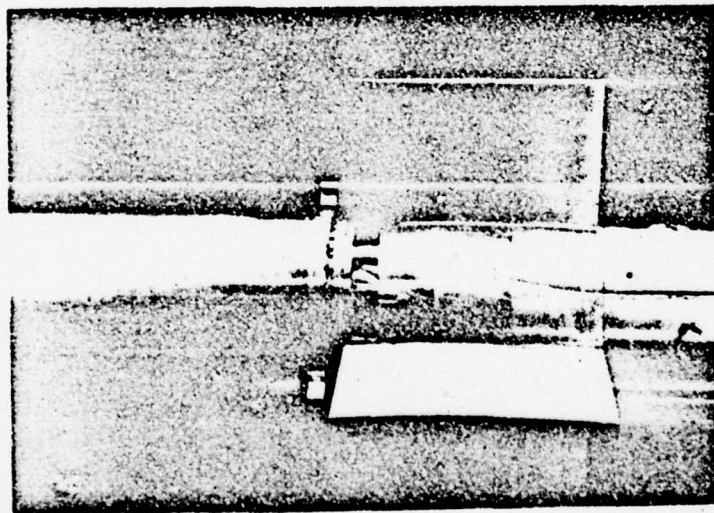


Configuration B₂₂R₅H₁₀WF₁₈

[REDACTED]



Close-Up Showing Missile Wings (W)
and Exhaust Louvers (H₁₀)



Missile Tail (T₁₀)

Figure 7 - Photographs Showing Details of the Model

PSD - 302.635

6 September 1960

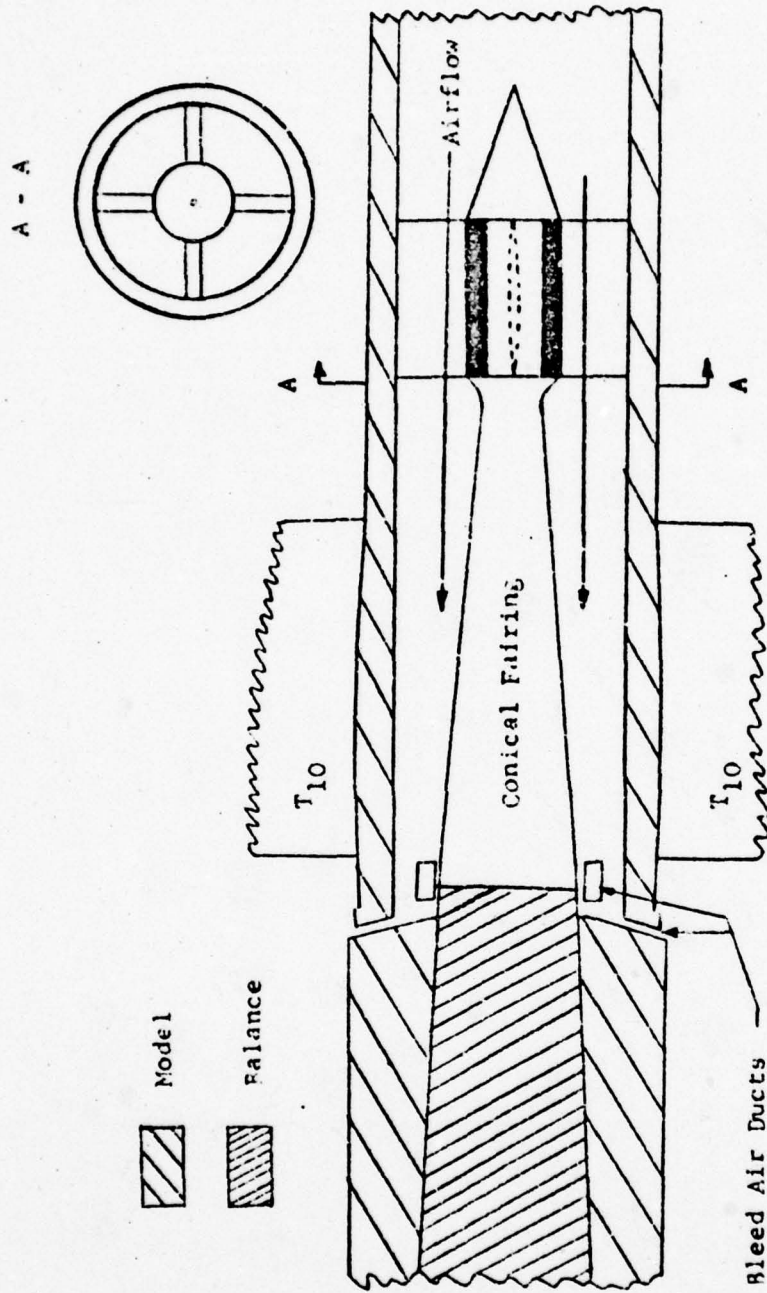


Figure 8 - Sketch Showing Details of the Internal Cross Strut and Conical Fairing for Ram Airflow

FIGURE 8

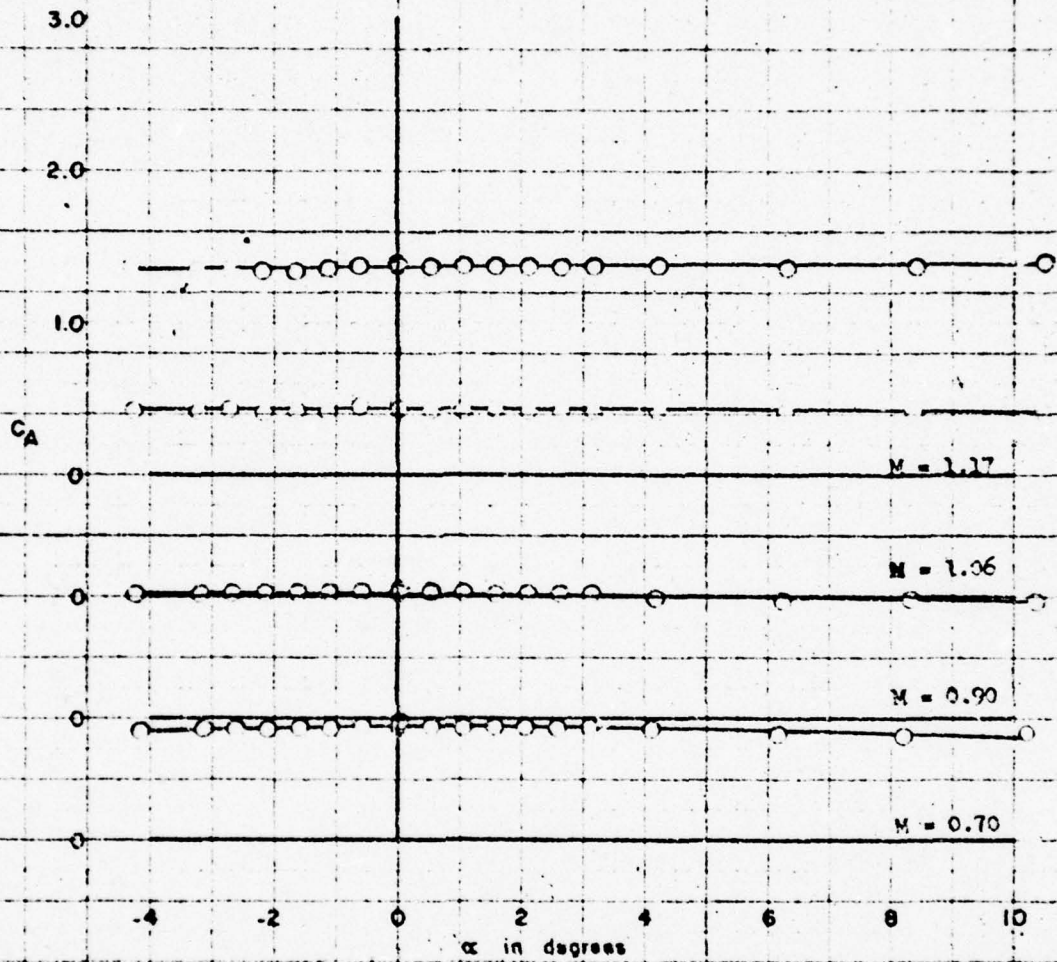


Figure 9 - Variation of the Aerodynamic Characteristics With Angle of Attack for Configuration B₂₂R₅10^W

(a) $\phi = -45^\circ$; $\iota = \iota' = 0^\circ$; $\delta = \delta' = 0^\circ$

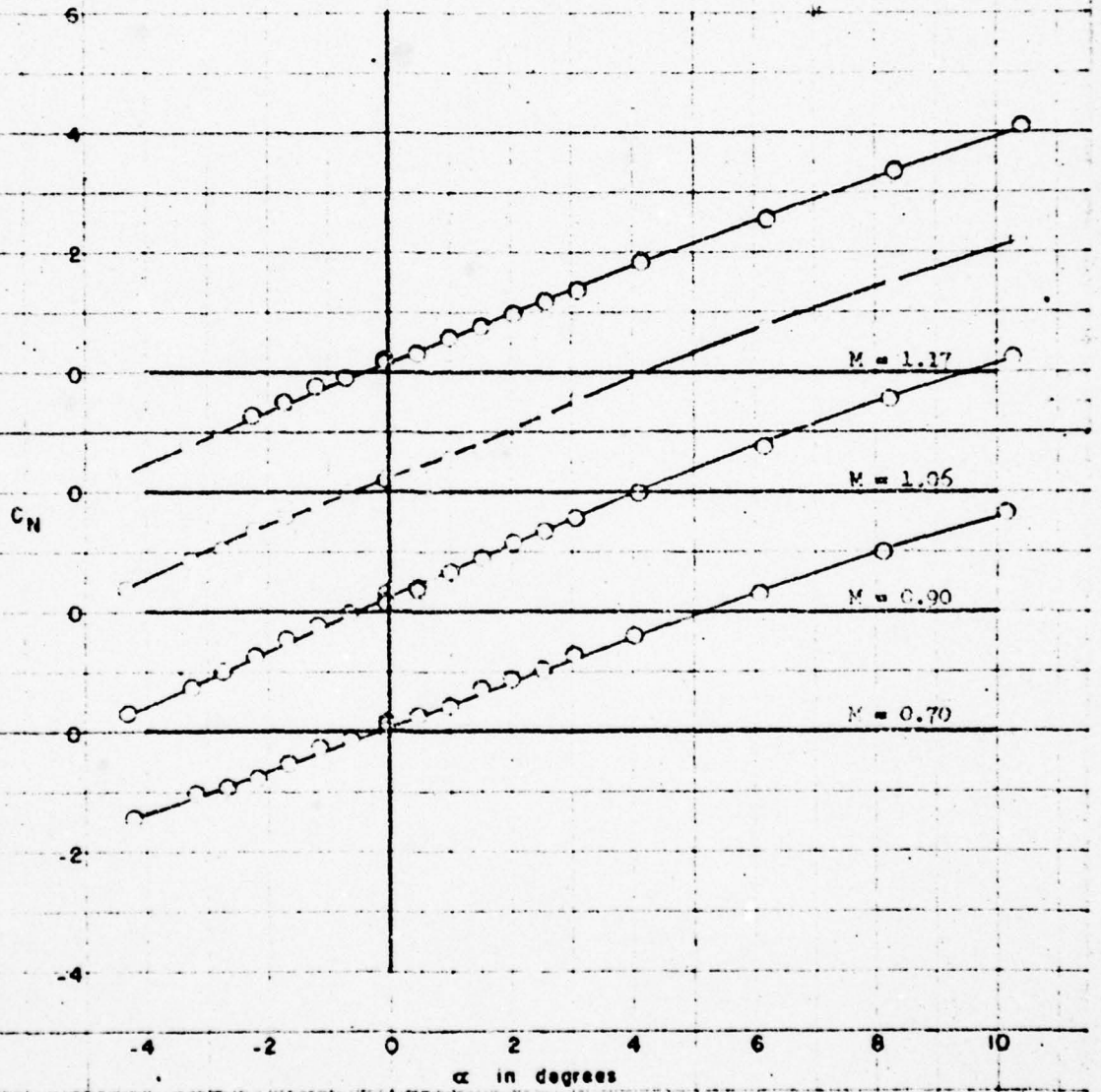


Figure 9 (Continued)

(a) Continued

FIGURE 9a (cont)

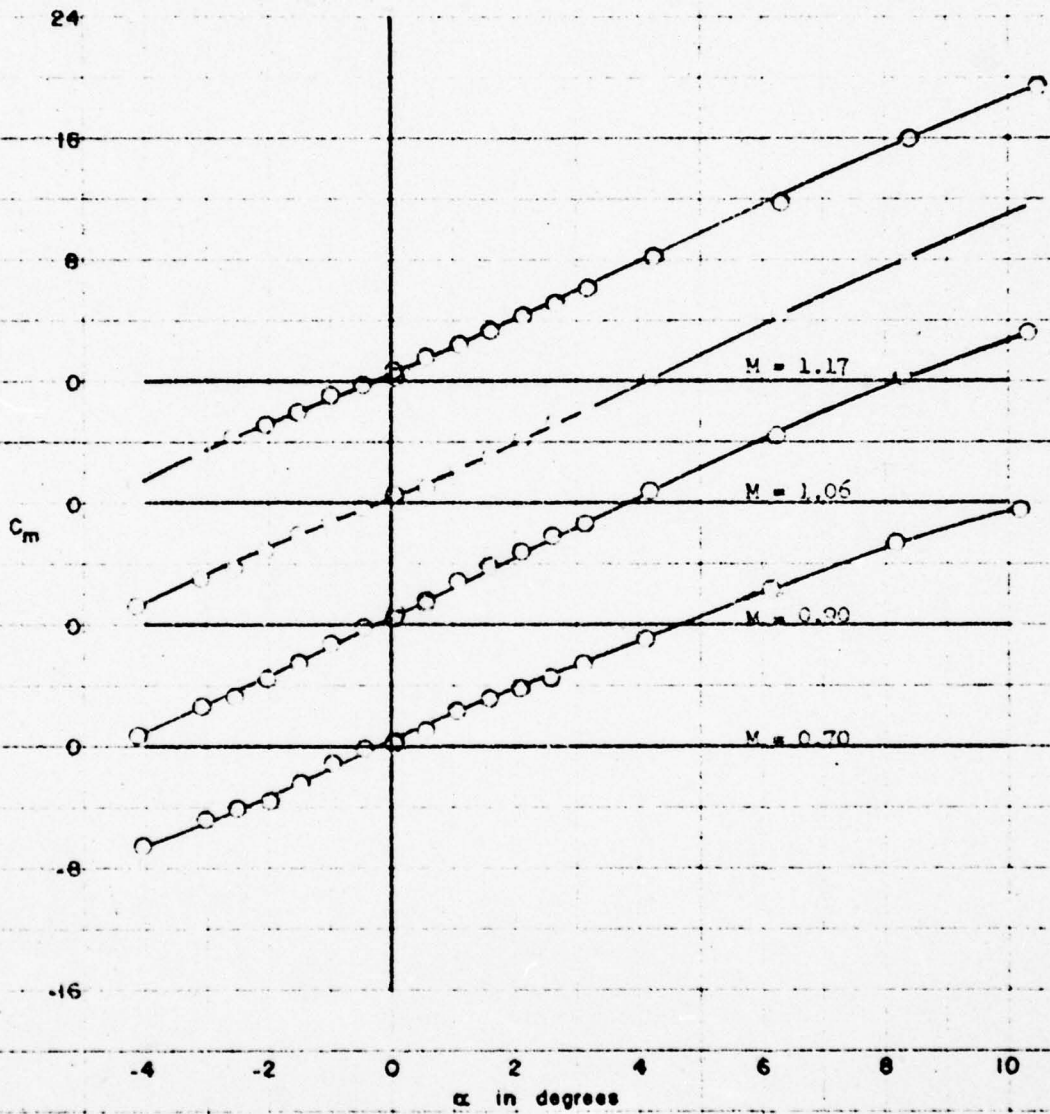


Figure 9- (Continued)

(a) Continued

FIGURE 9a (cont)

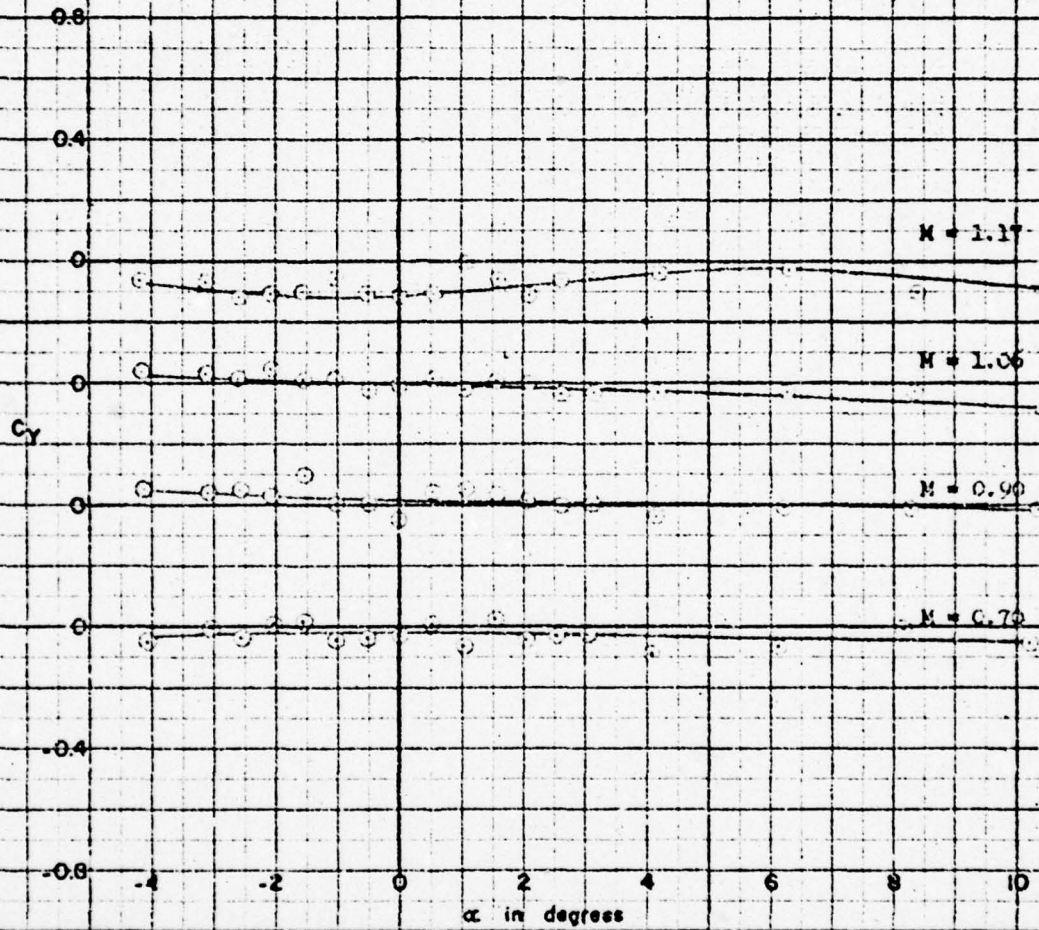
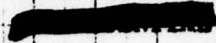


Figure 9 (Continued)
(a) Continued

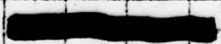


FIGURE 9a (cont)

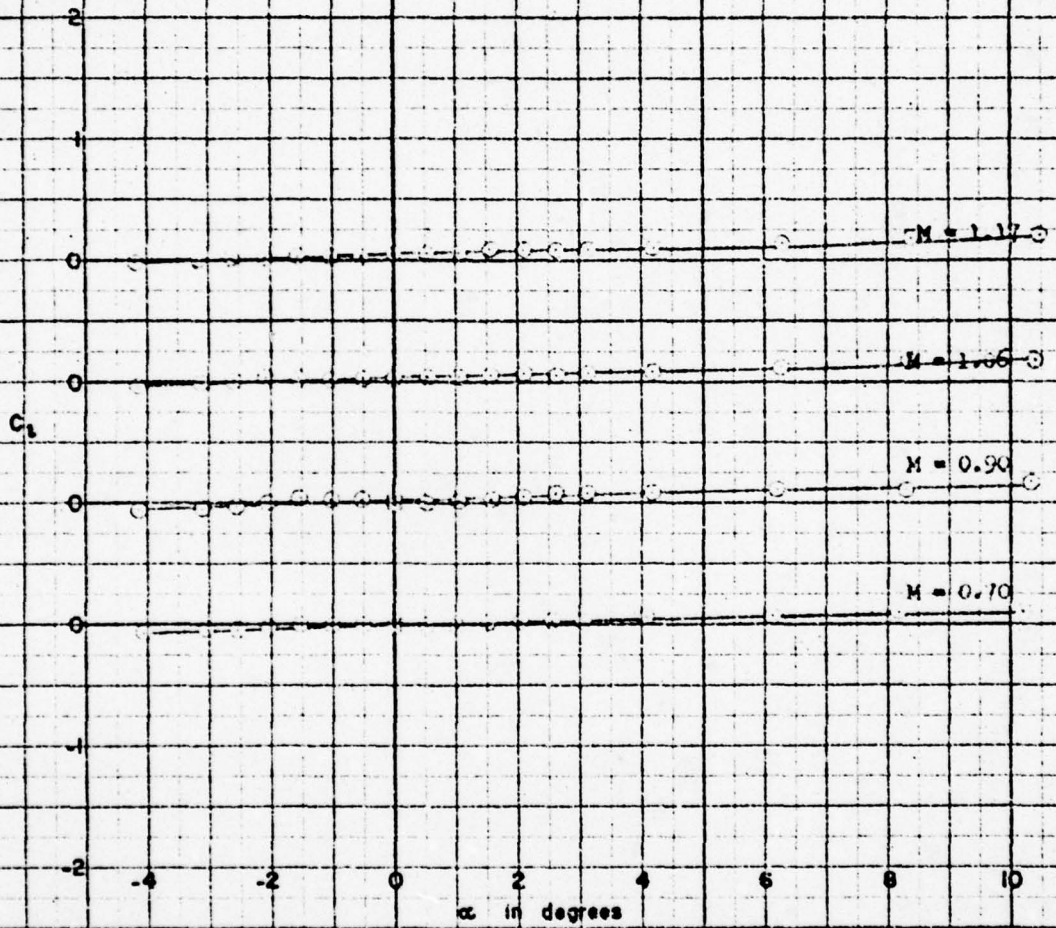
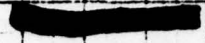


Figure 9 (Continued)
(a) Continued

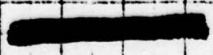


FIGURE 9a (cont)

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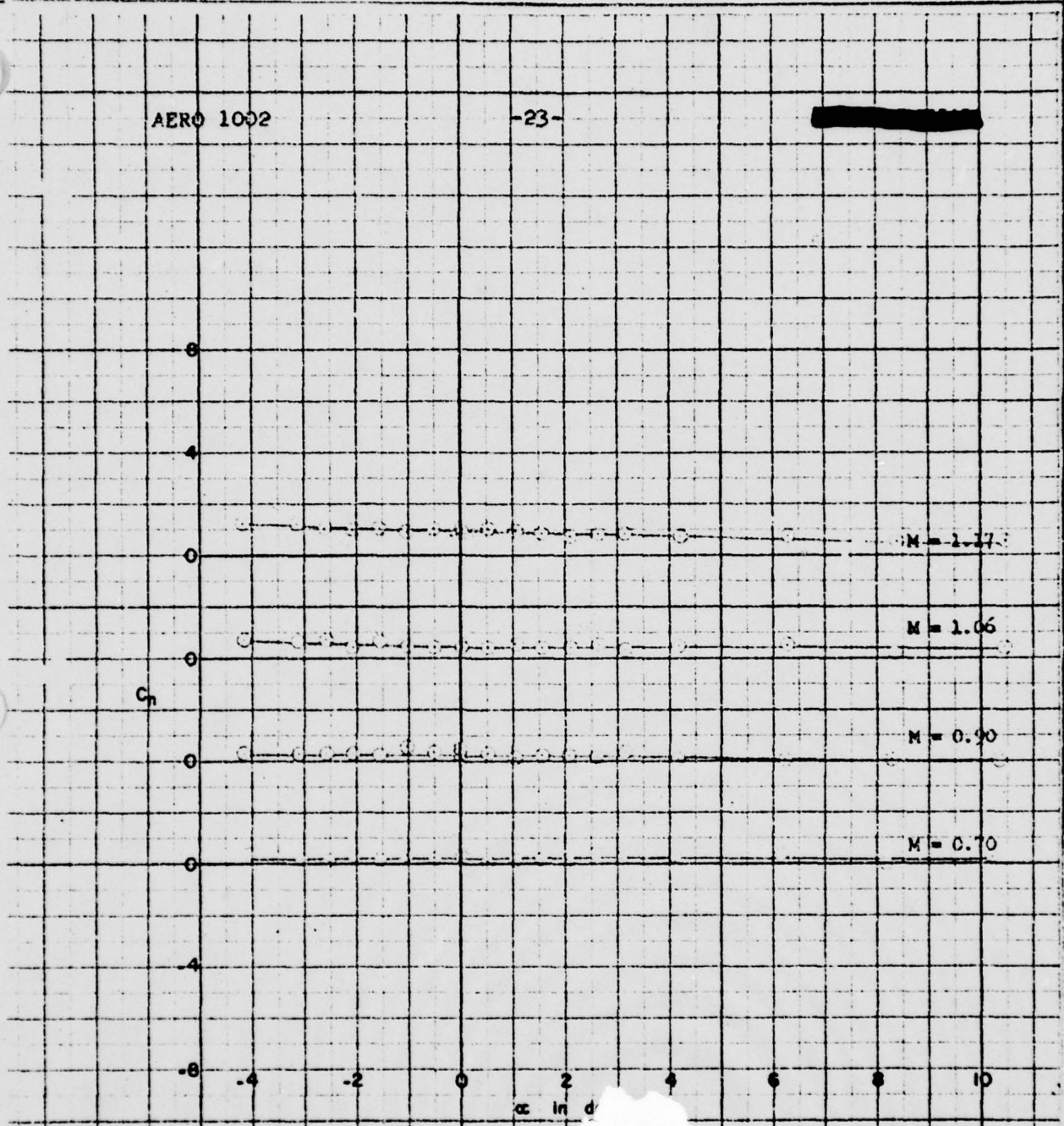


Figure 9 (Continued)
(a) Concluded

[REDACTED]

FIGURE 9a (concl)

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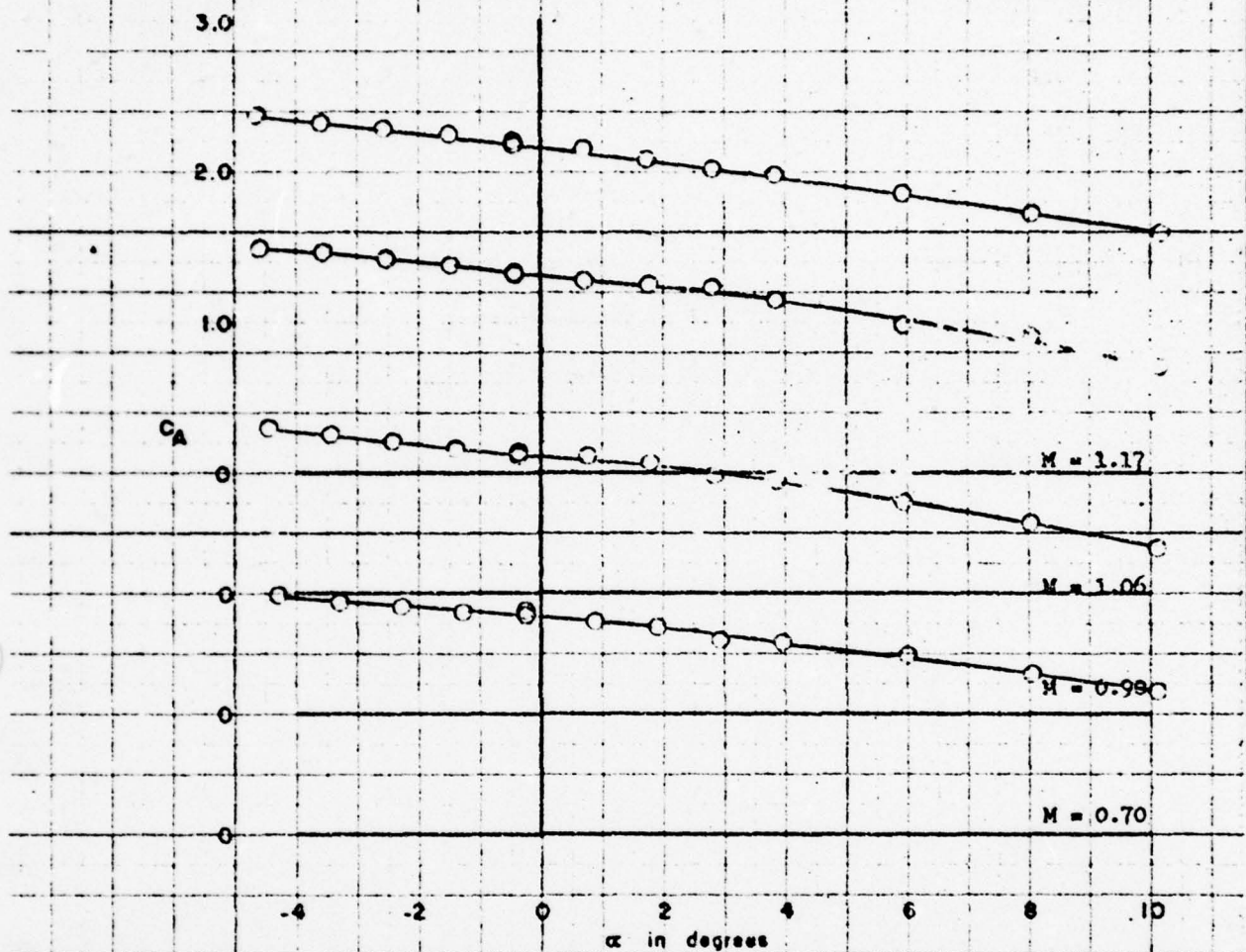


Figure 9 (Continued)

(b) $\phi = -45^\circ$; $i = i' = -10^\circ$; $\delta = \delta' = 0^\circ$

FIGURE 9b

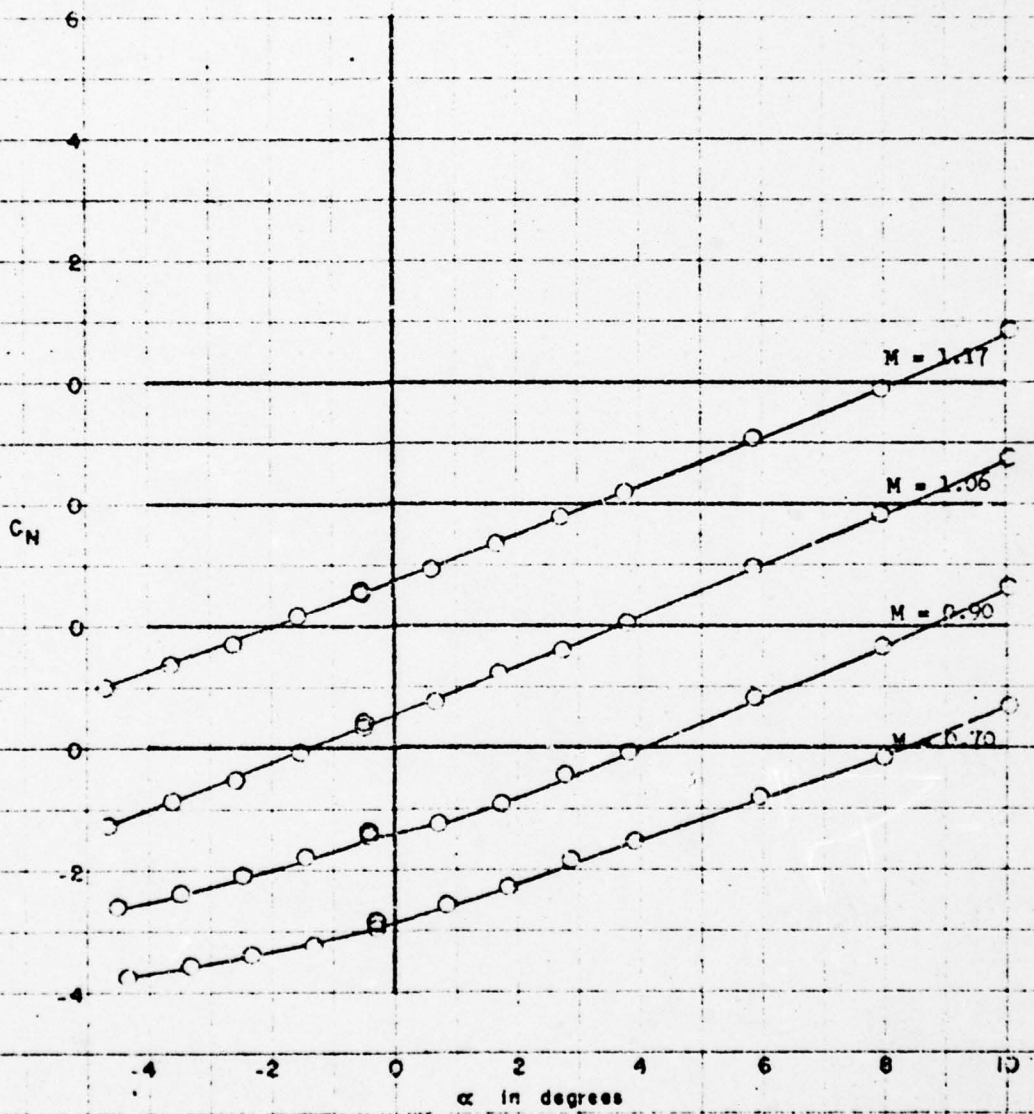


Figure 9 (Continued)

(b) Continued

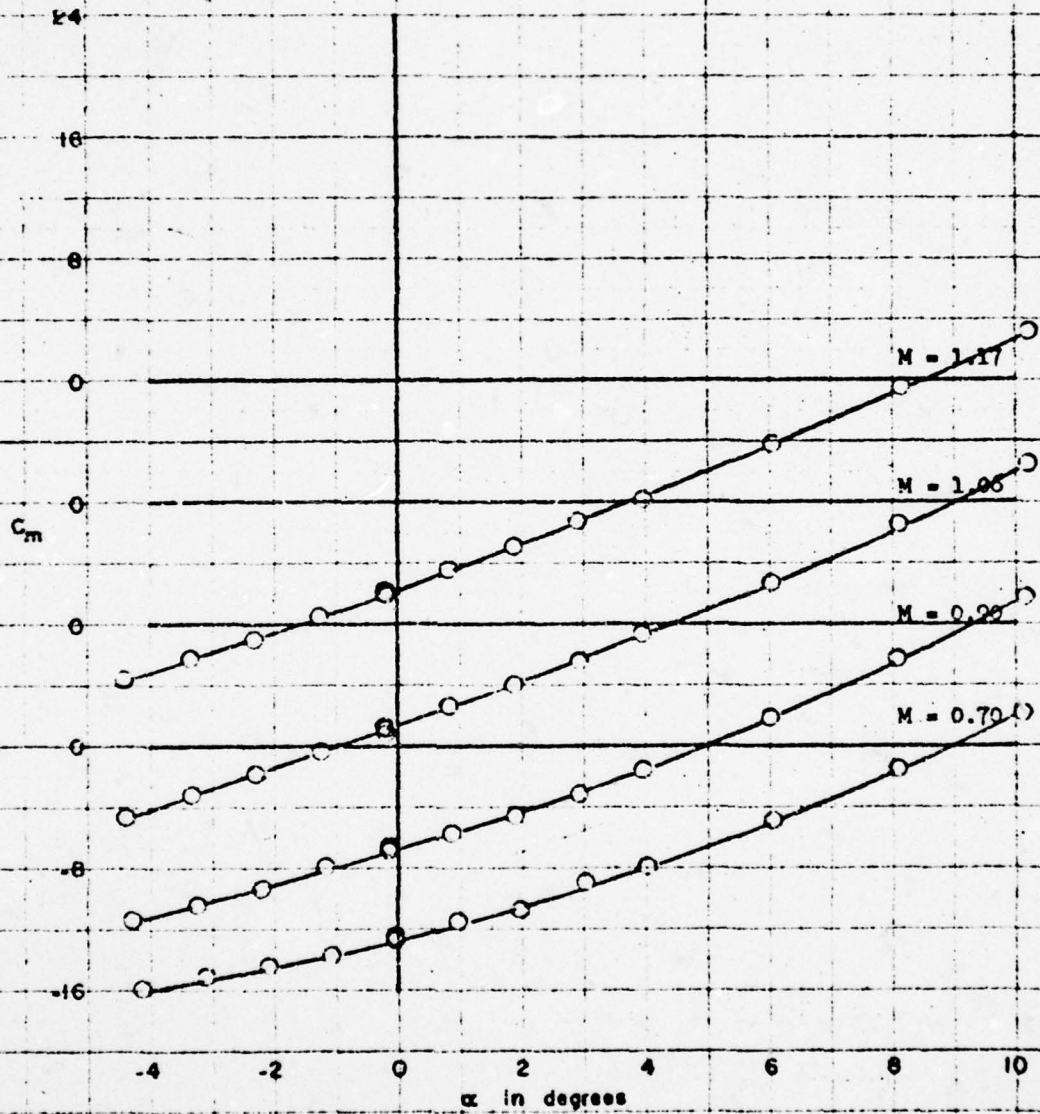
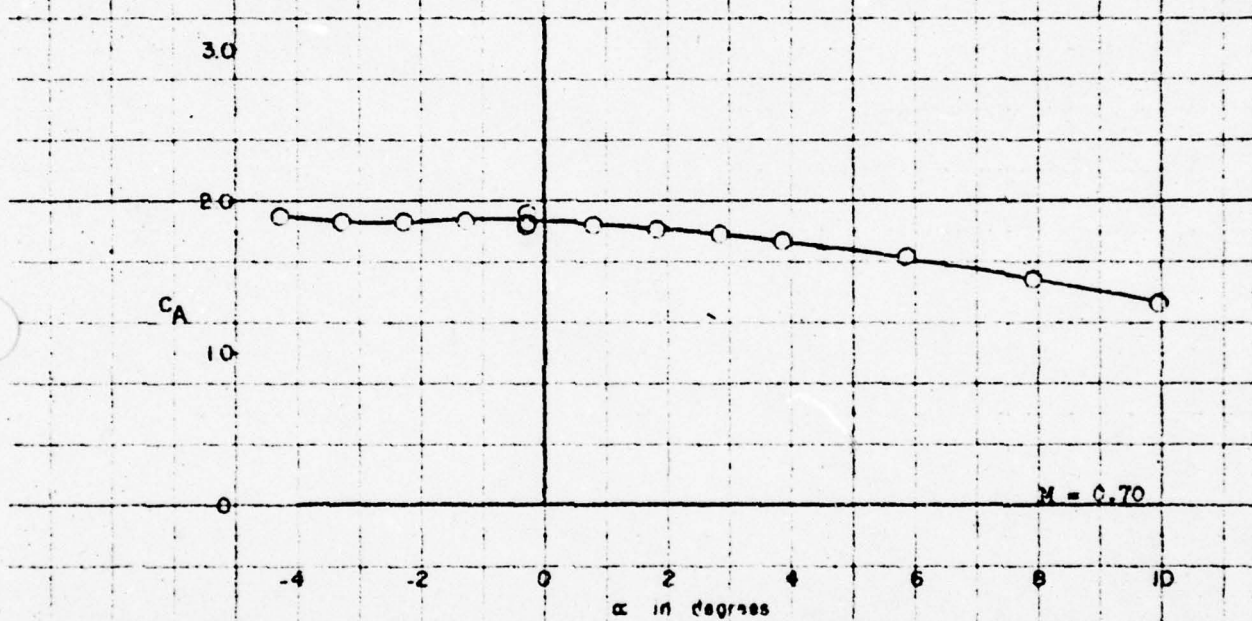
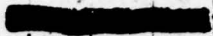


Figure 9 (Continued)

(b) Concluded

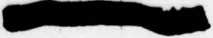
FIGURE 9b (concl)



$M = 0.70$

Figure 9 (Continued)

(c) $\phi = -45^\circ$; $i = i' = -15^\circ$; $\delta = \delta' = 0^\circ$



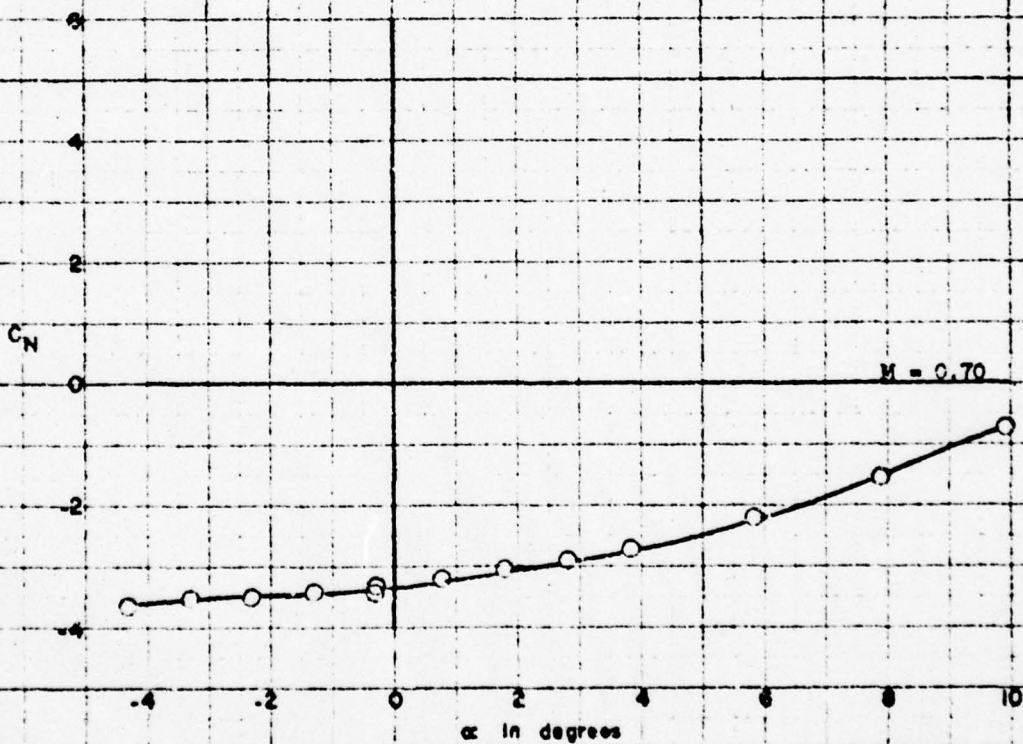
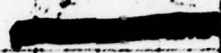


Figure 9 (Continued)

(c) Continued

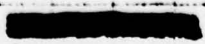


FIGURE 9c (cont)

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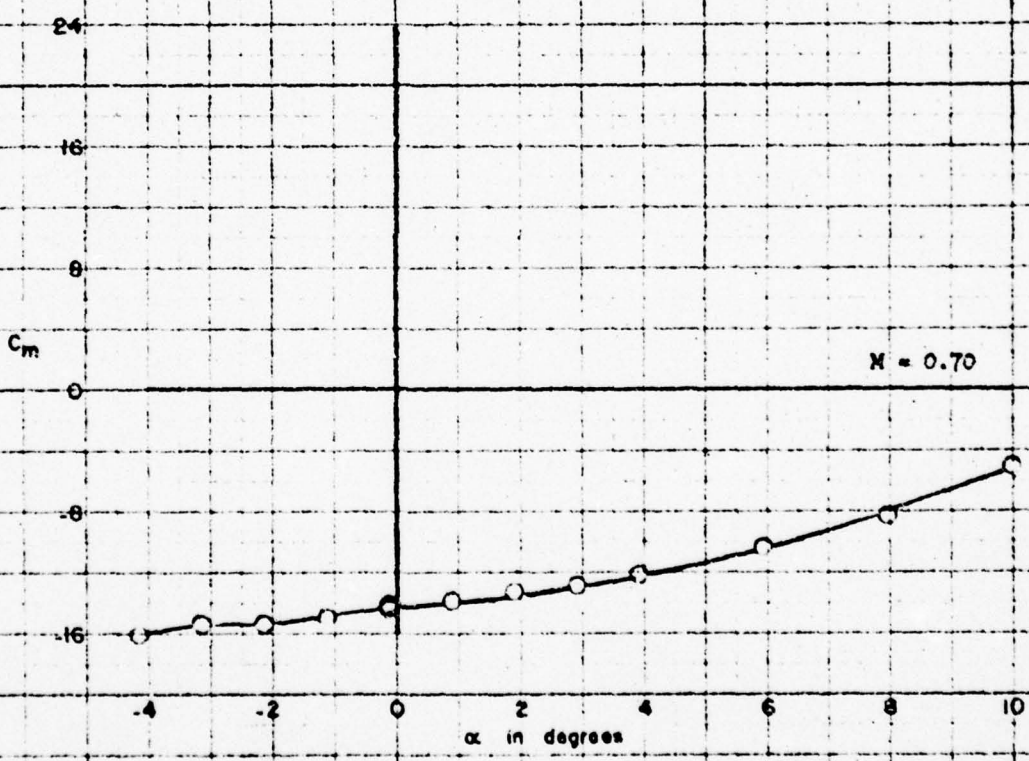


Figure 9 (Continued)
(c) Concluded

[REDACTED]

FIGURE 9c (concl)

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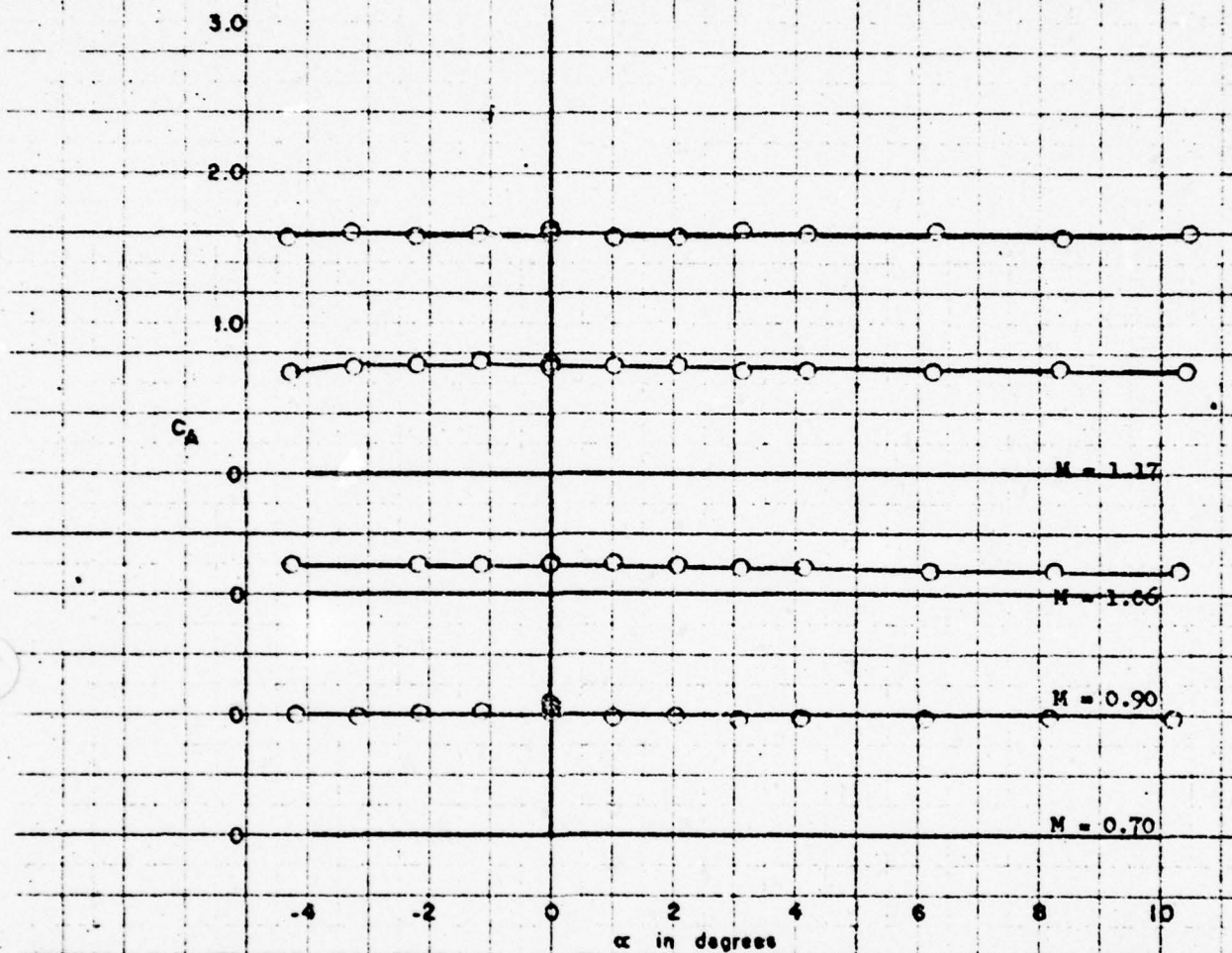


Figure 9 (Continued)

(d) $\phi = -45^\circ$; $i = 1' = 0^\circ$; $\delta = \delta' = 5^\circ$

FIGURE 9d

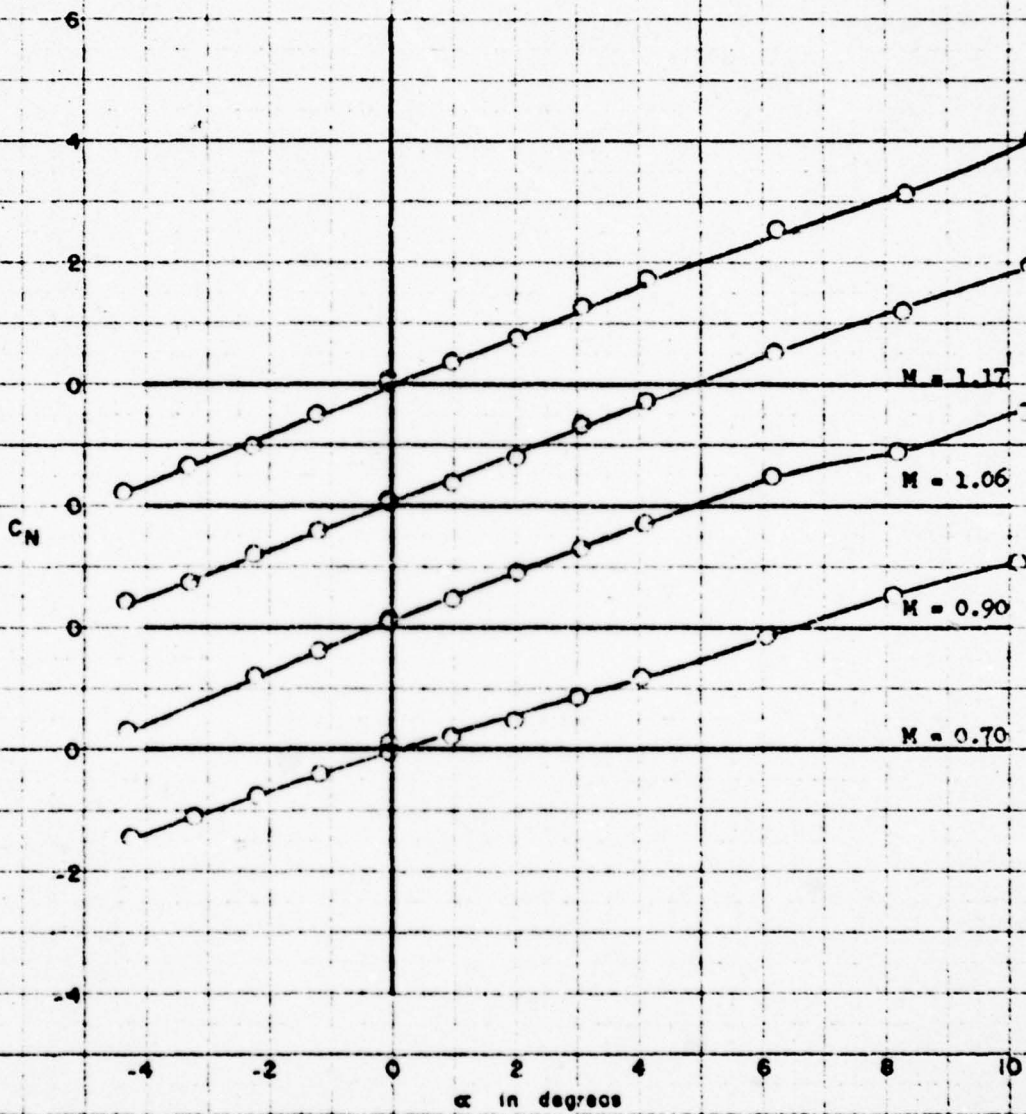


Figure 9 (Continued)

(d) Continued

FIGURE 9d (cont)

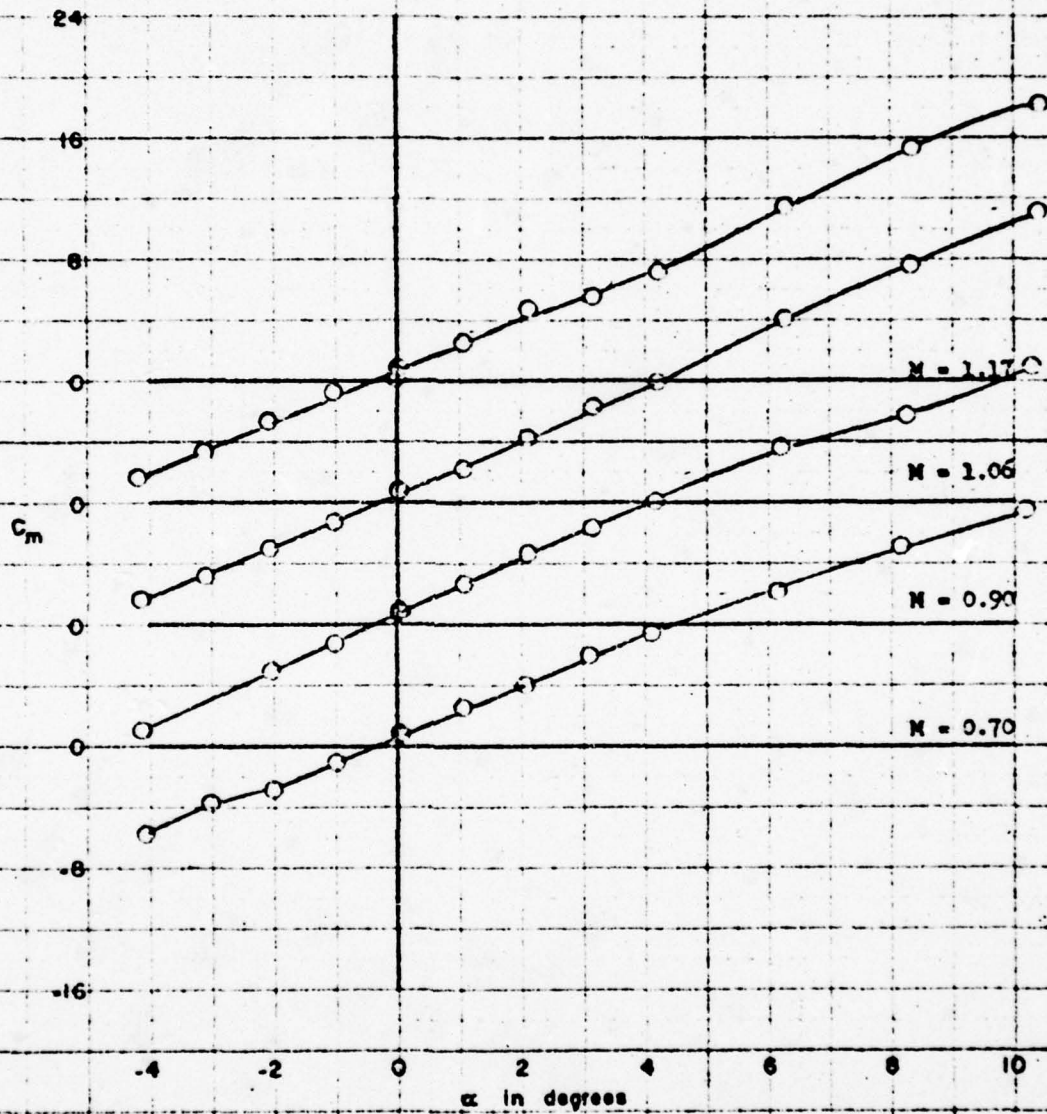
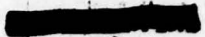


Figure 9; (Continued)

(d) Continued

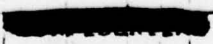


FIGURE 9d (cont)

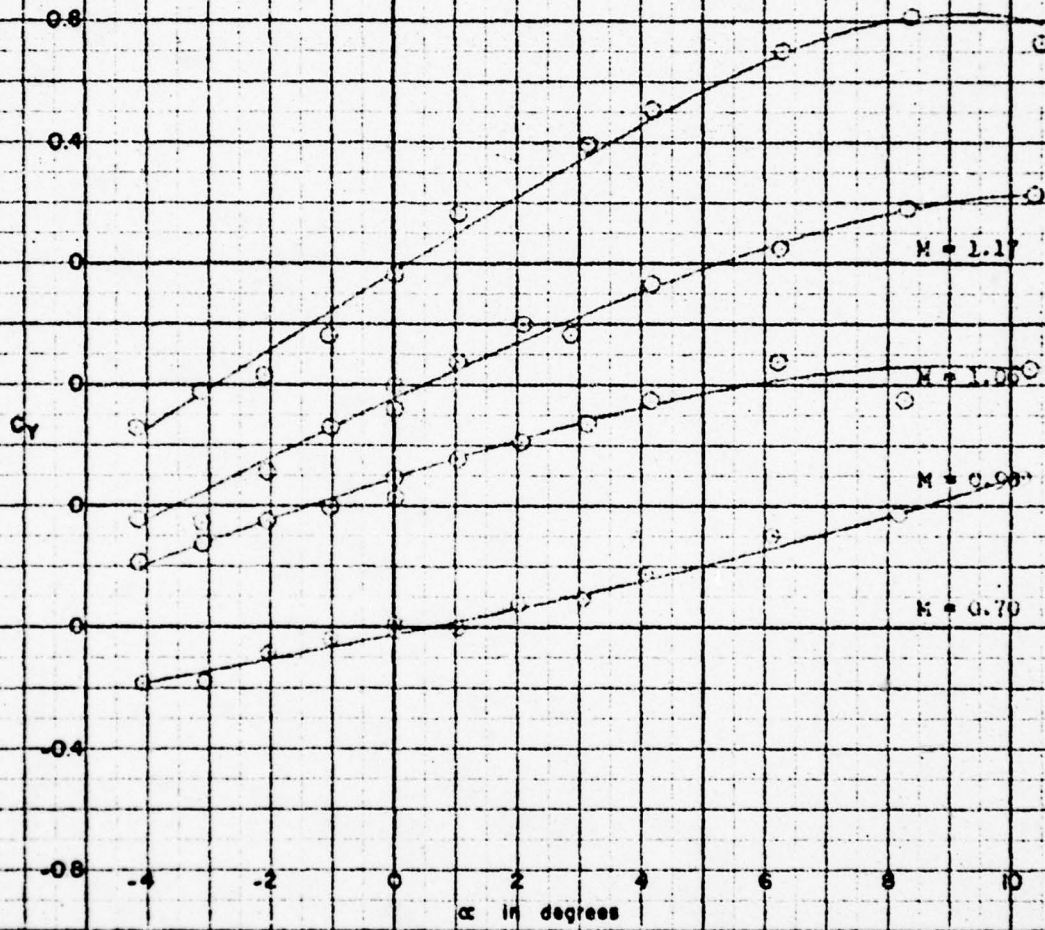
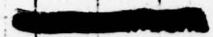


Figure 9 (Continued)

(d) Continued

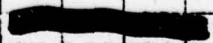


FIGURE 9d (cont)

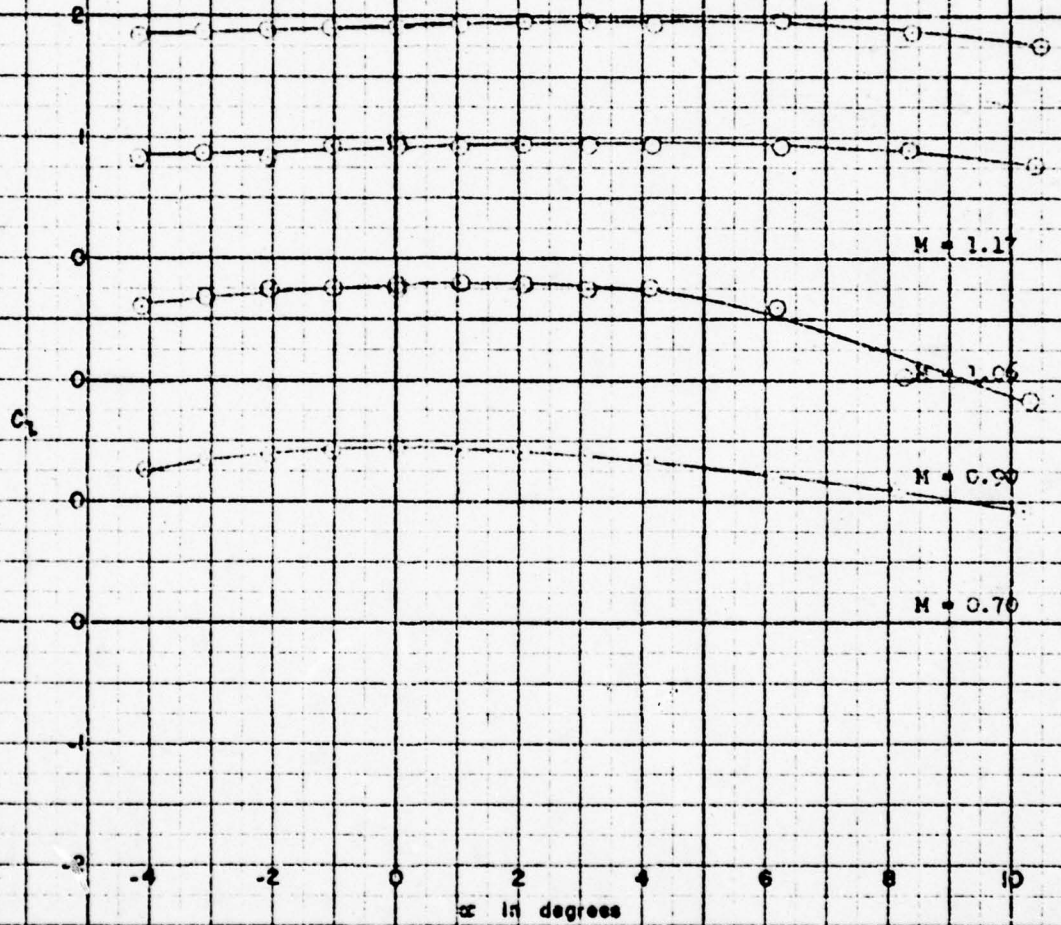


Figure 9 (Continued)

(d) Continued

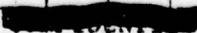


FIGURE 9d (cont.)

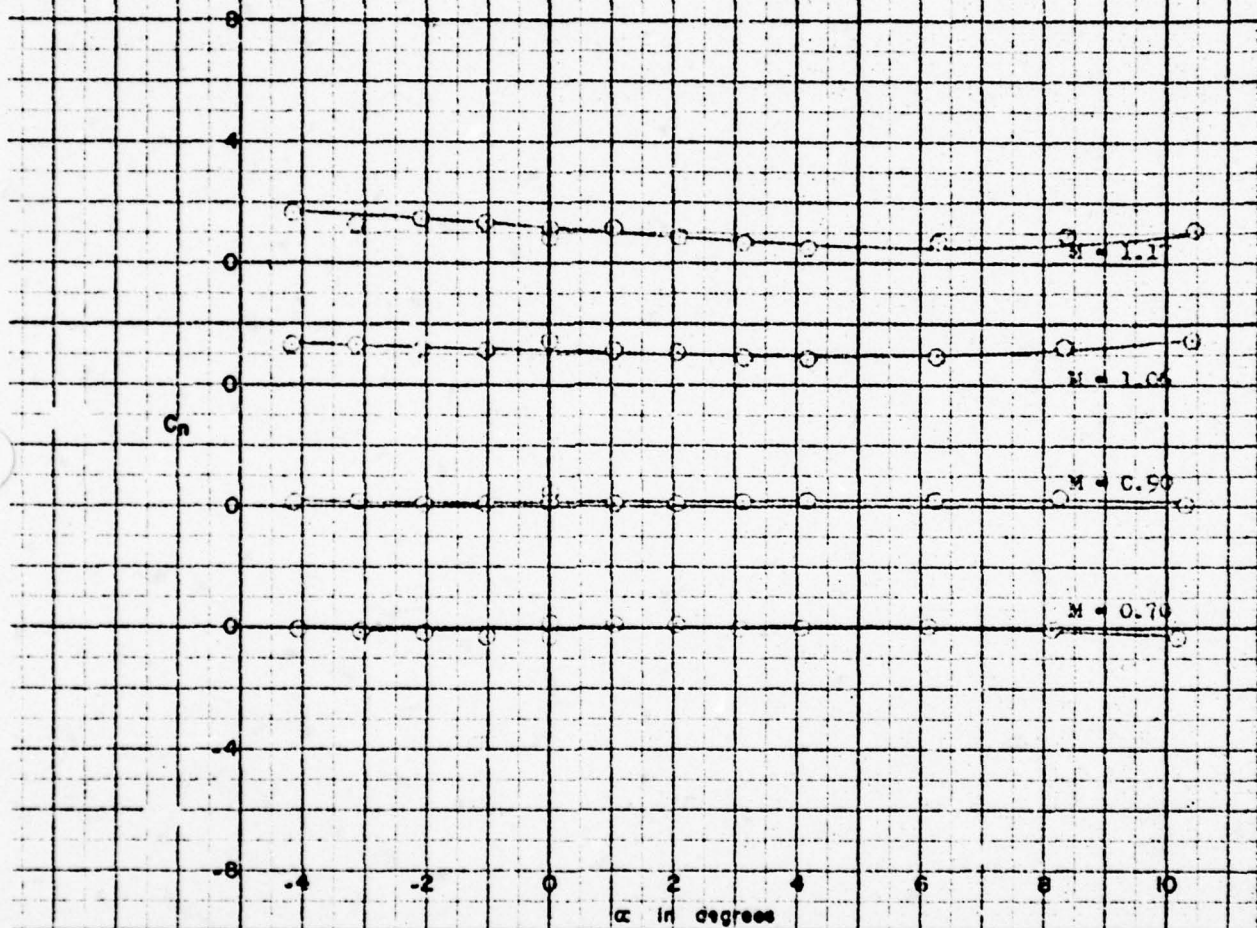
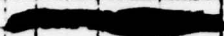


Figure 9 (Continued)

(1) Concluded

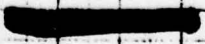


FIGURE 9d (concl)

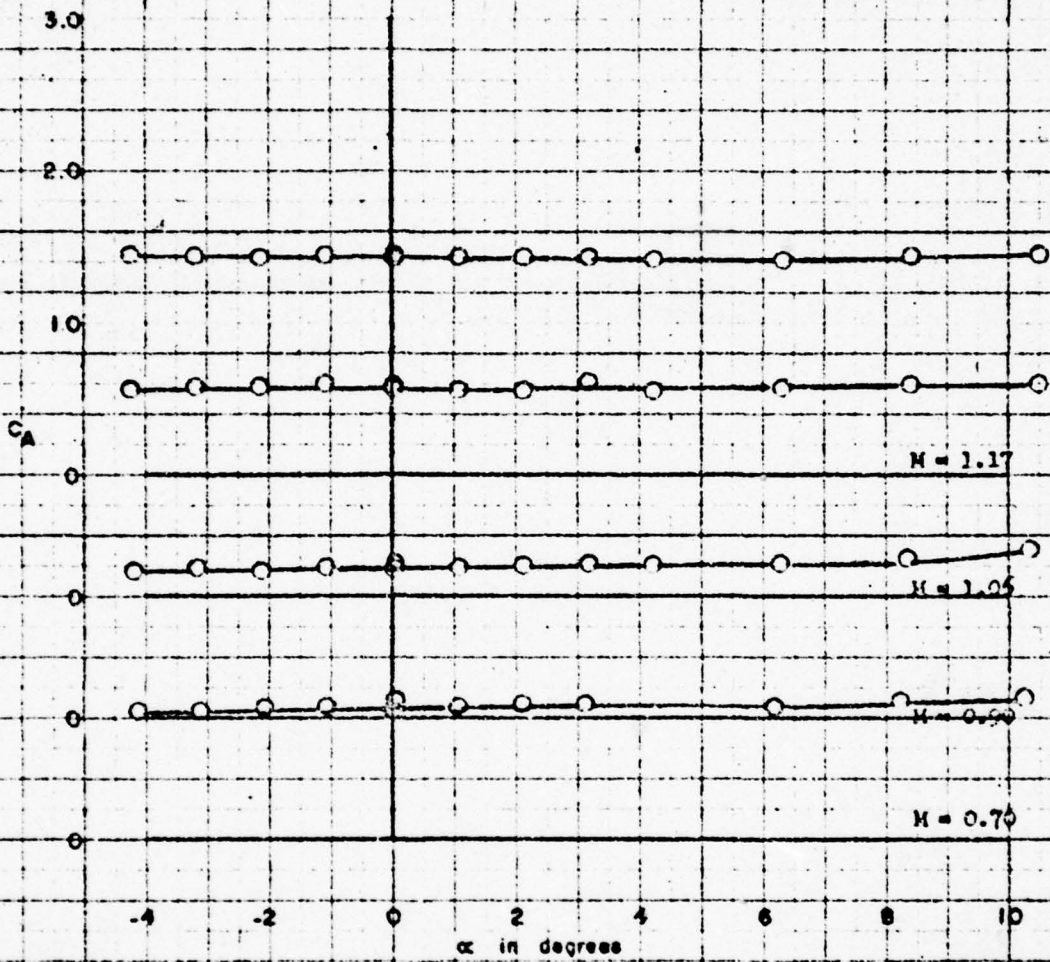


Figure 9 (Continued)

(e) $\phi=0^\circ$; $i=i'=0^\circ$; $\delta=\delta'=0^\circ$

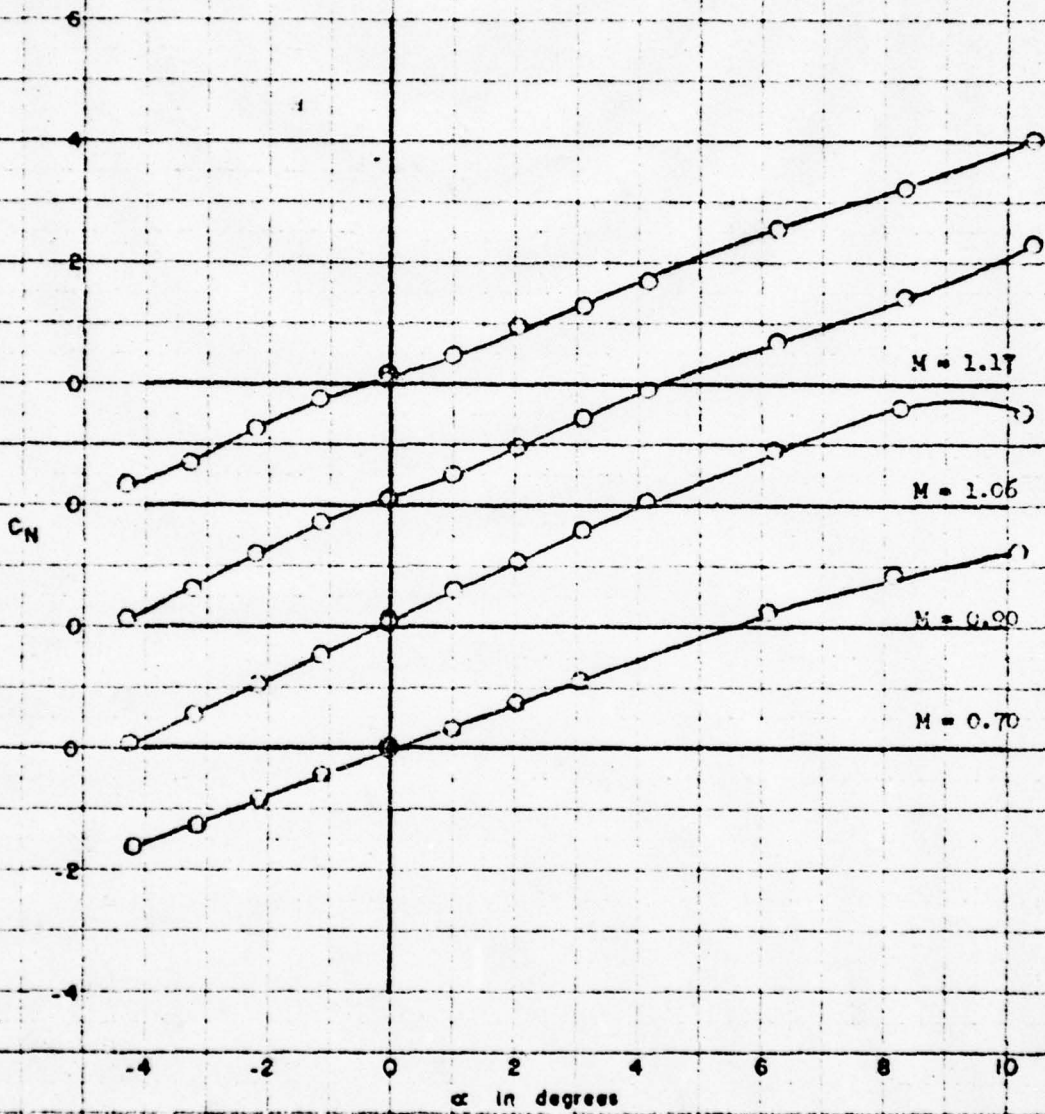
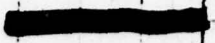


Figure 9 (Continued)

(e) Continued

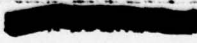


FIGURE 9e. (cont)

[REDACTED]

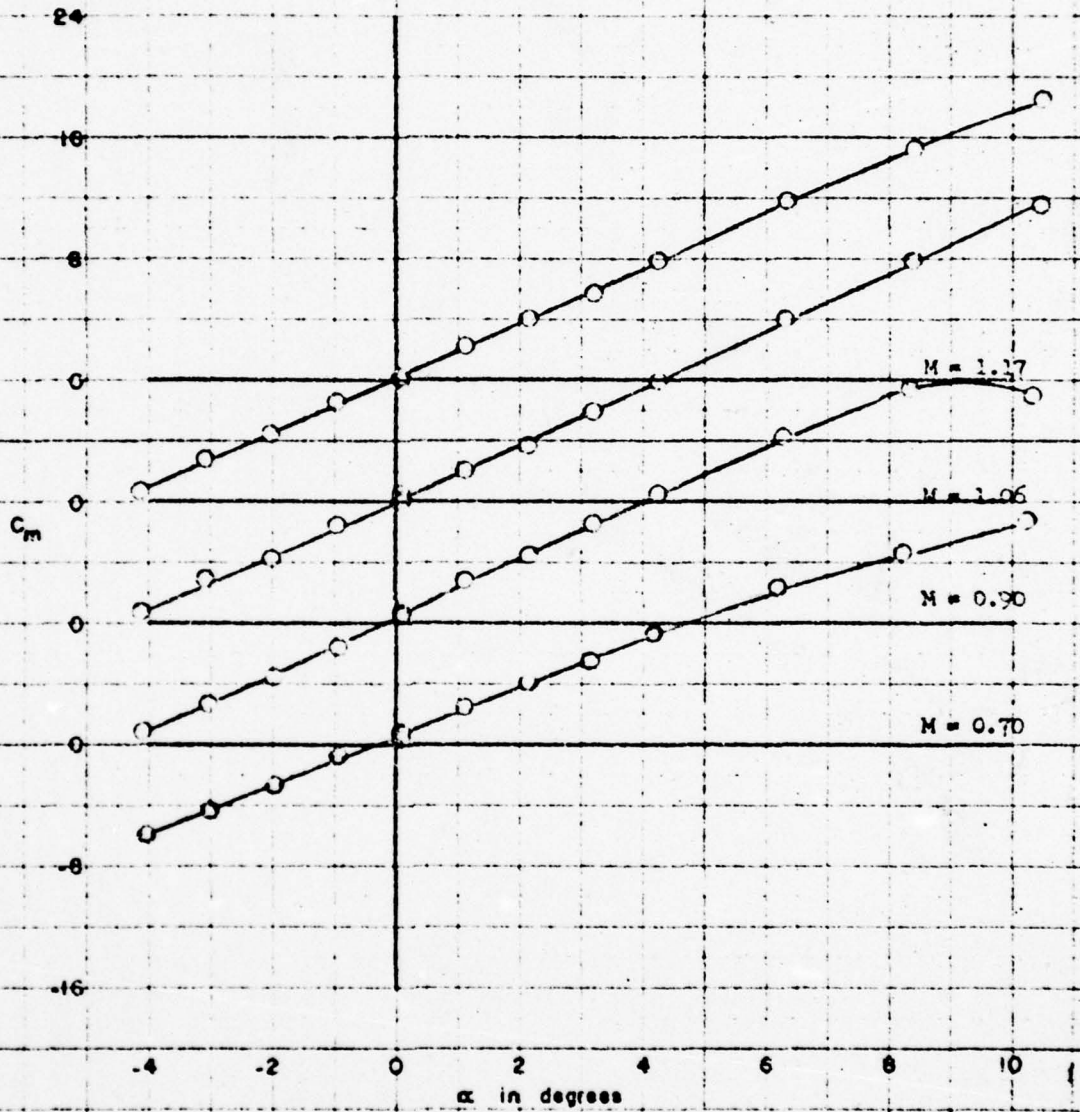


Figure 9 (Continued)

(e) Concluded

[REDACTED]

FIGURE 9e (concl)

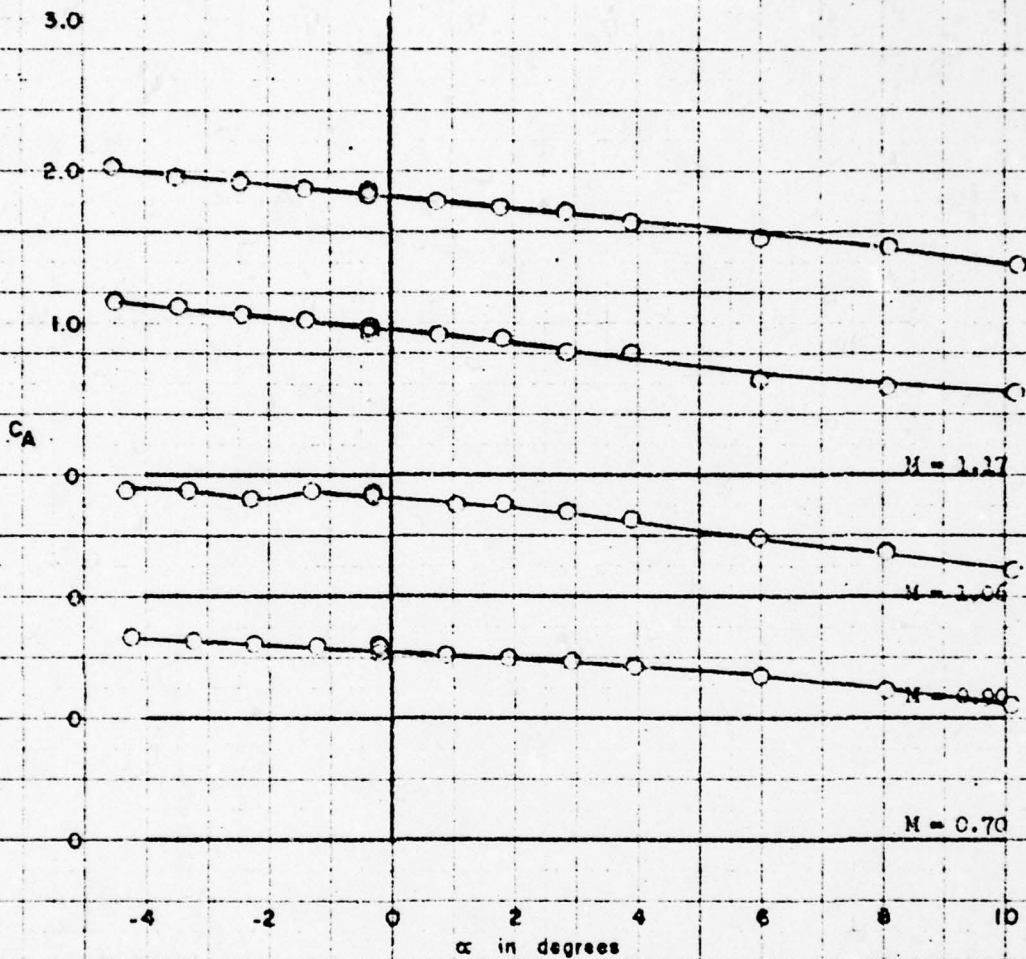


Figure 9 (Continued)

(f) $\phi = 0^\circ$; $i = -10^\circ$; $i' = 0^\circ$; $\delta = \delta' = 0^\circ$

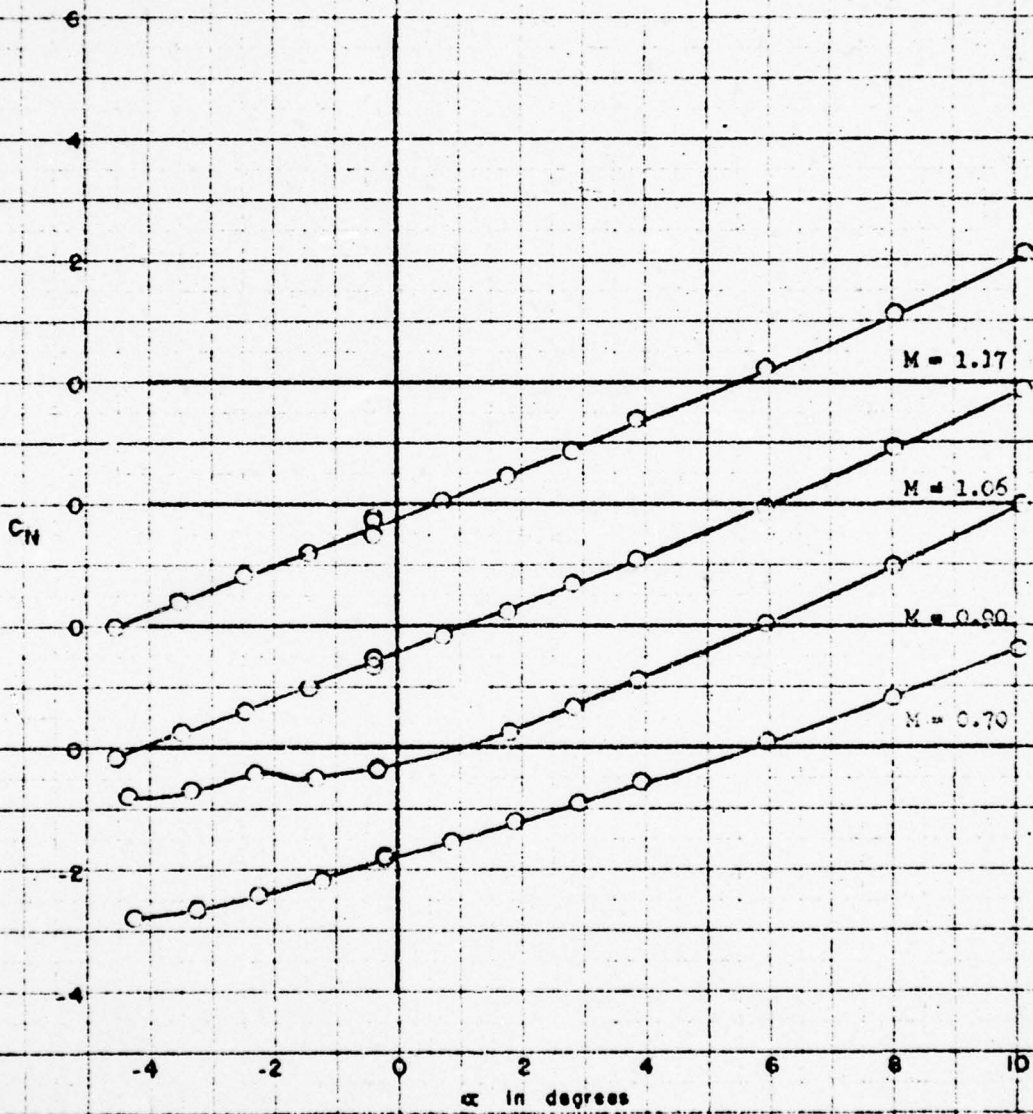


Figure 9 (Continued)

(f) Continued

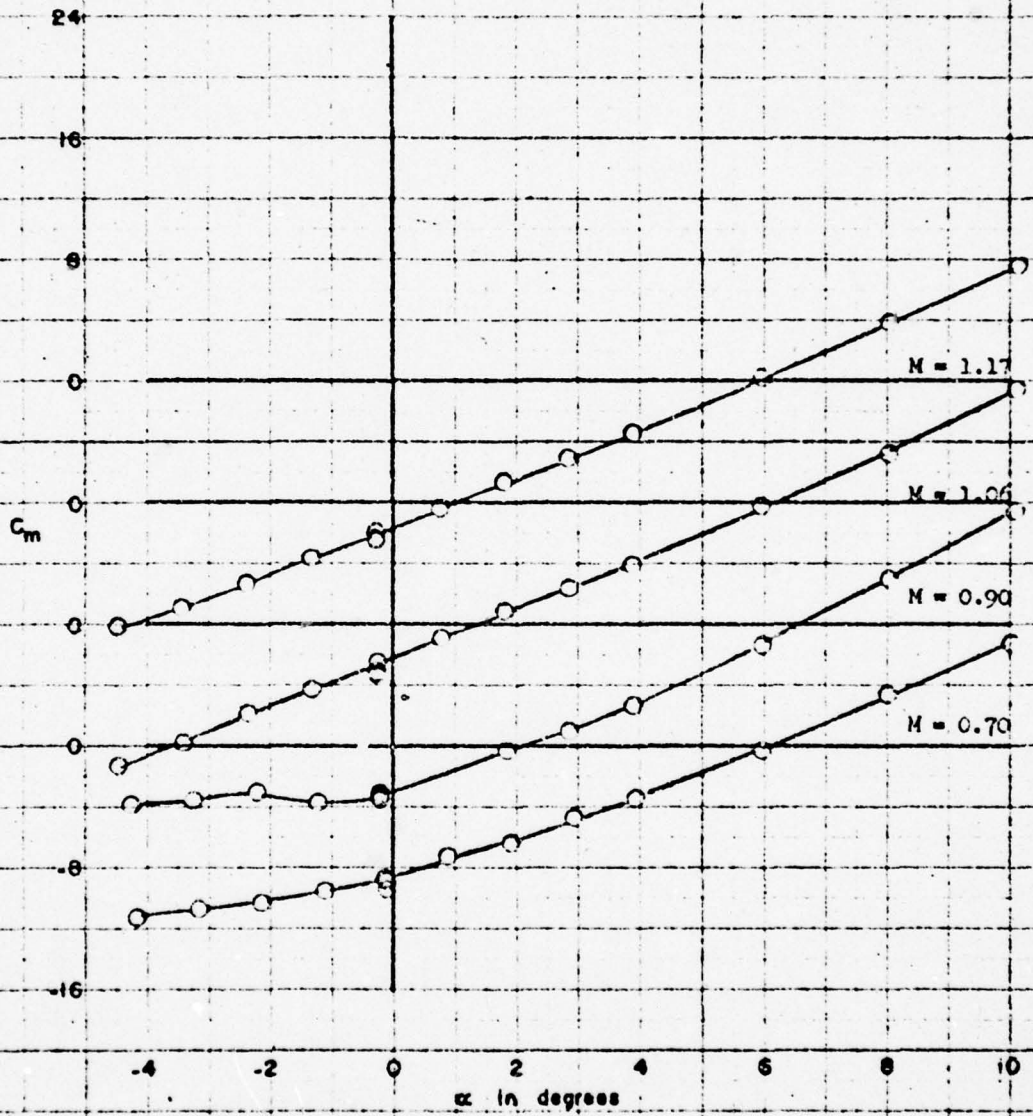
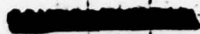


Figure 9 (Concluded)
(f) Concluded

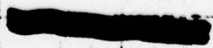


FIGURE 9f (concl)

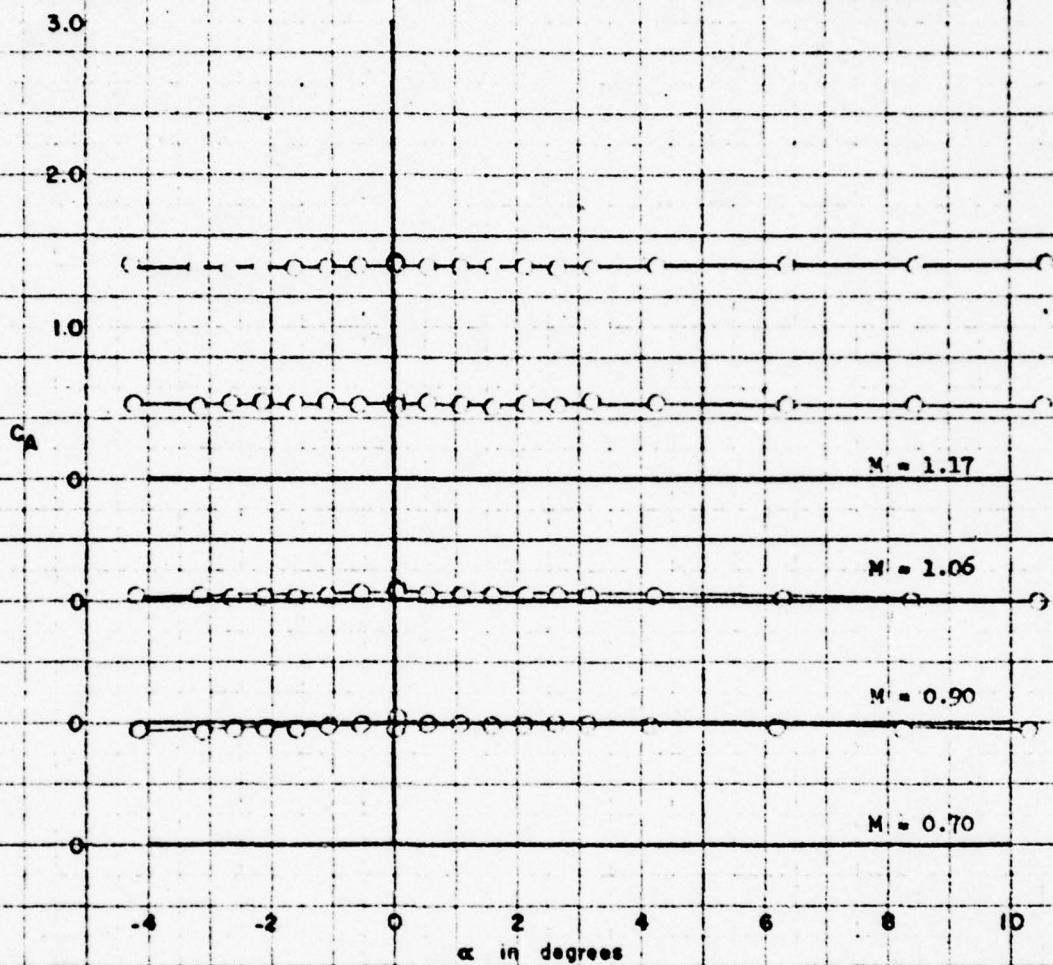


Figure 10 - Variation of the Aerodynamic Characteristics
With Angle of Attack for Configuration B_{22°5'10"} R.H. WT₁₀

(a) $\alpha = 15^\circ$; $\alpha = 1^\circ = 0^\circ$; $\alpha = 5^\circ = 0^\circ$

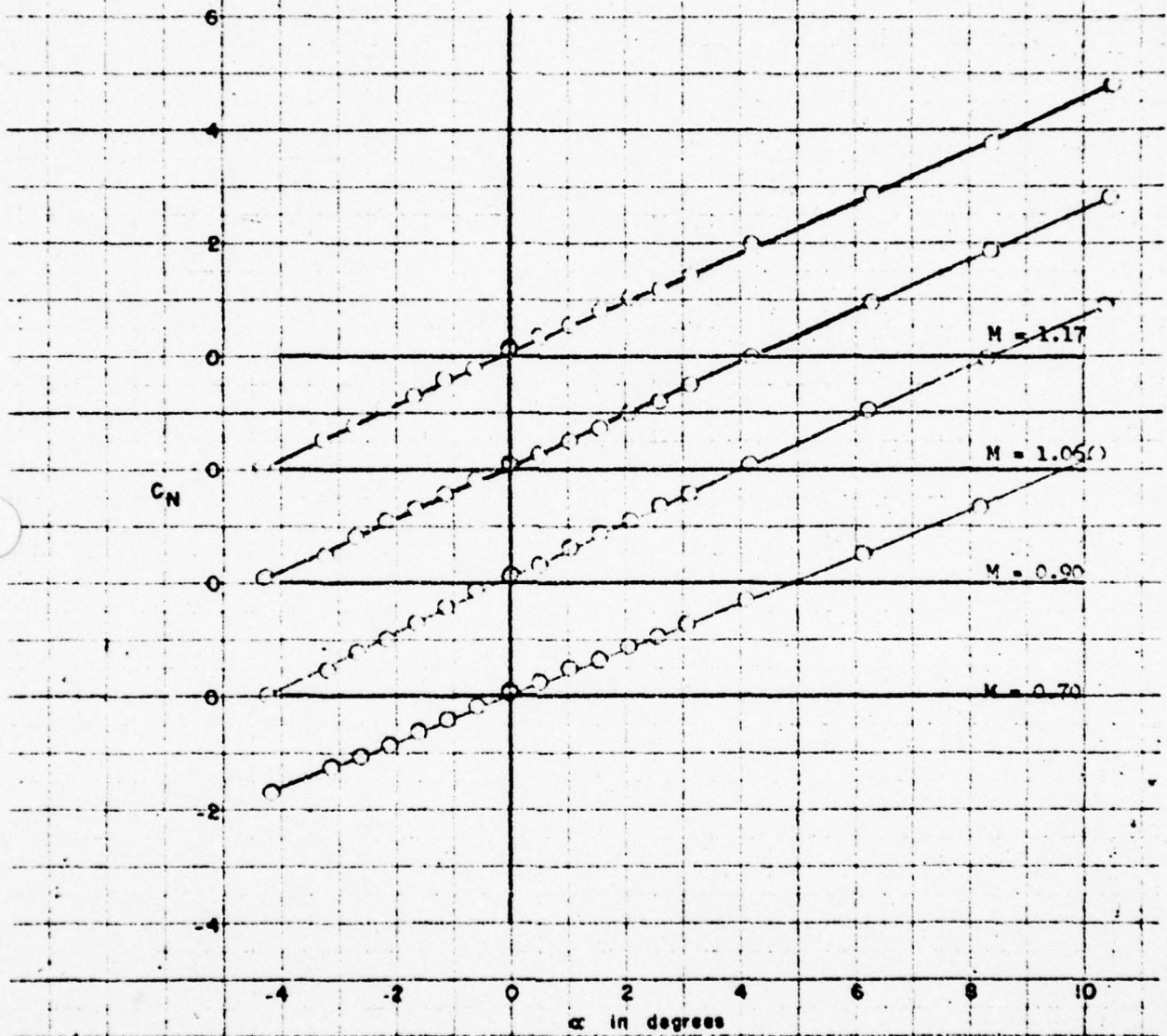


Figure 10 (Continued)

(a) Continued

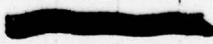


FIGURE 10a (cont)

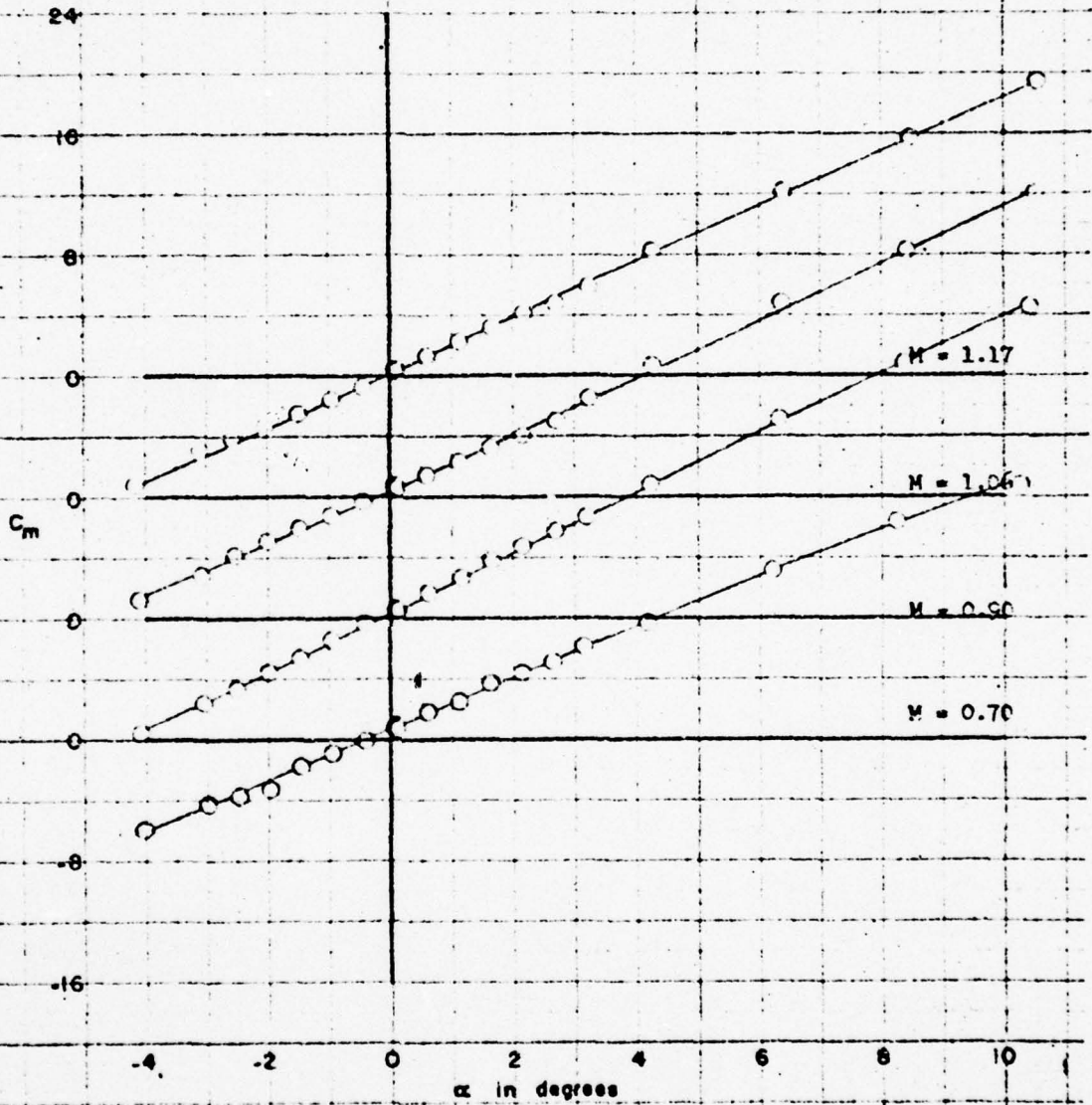
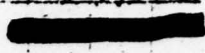


Figure 10 (Continued)

(a) Continued

FIGURE 10a (cont)

[REDACTED]

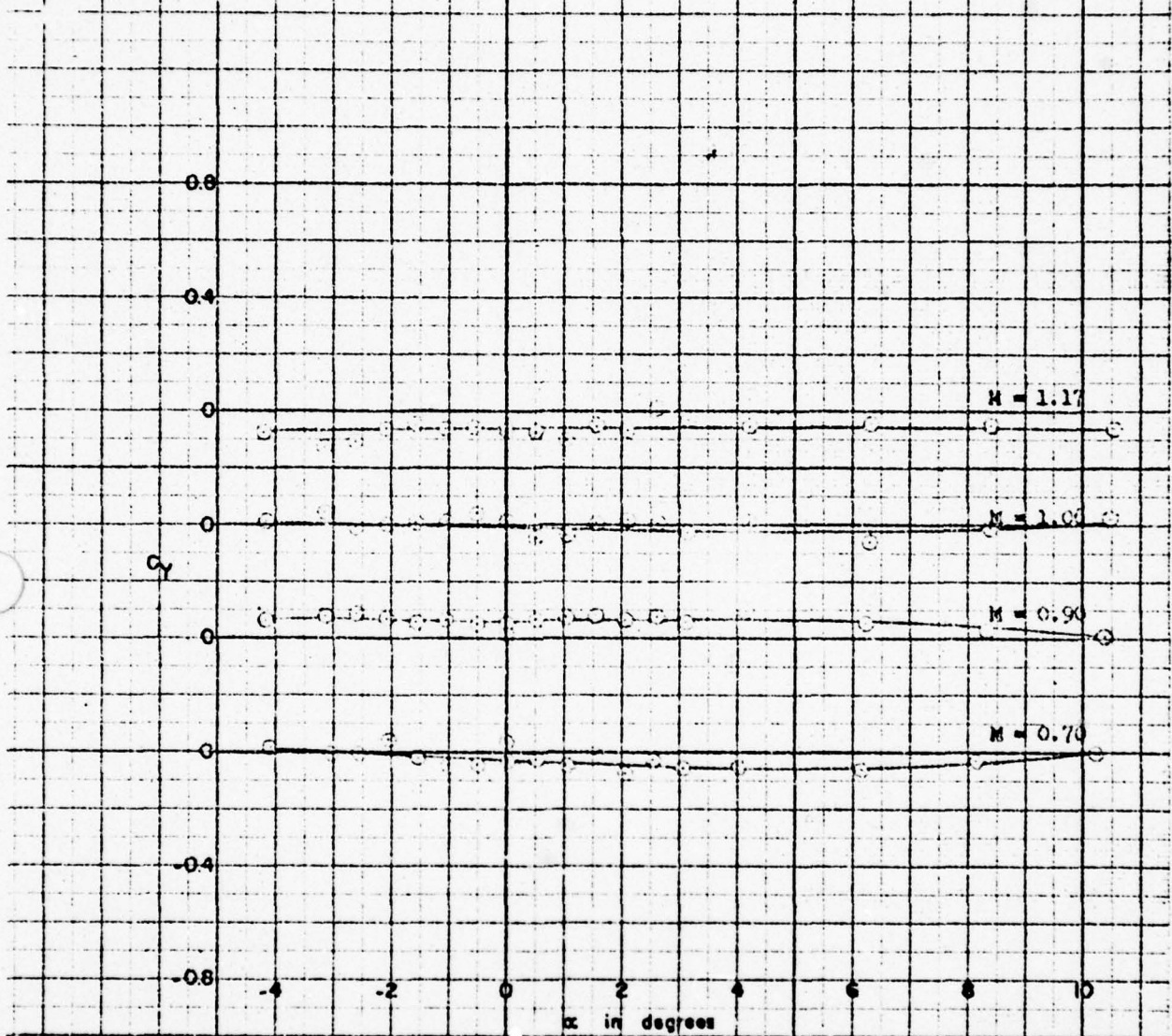


Figure 10 (Continued)

(a) Continued

[REDACTED]

FIGURE 10a (cont)

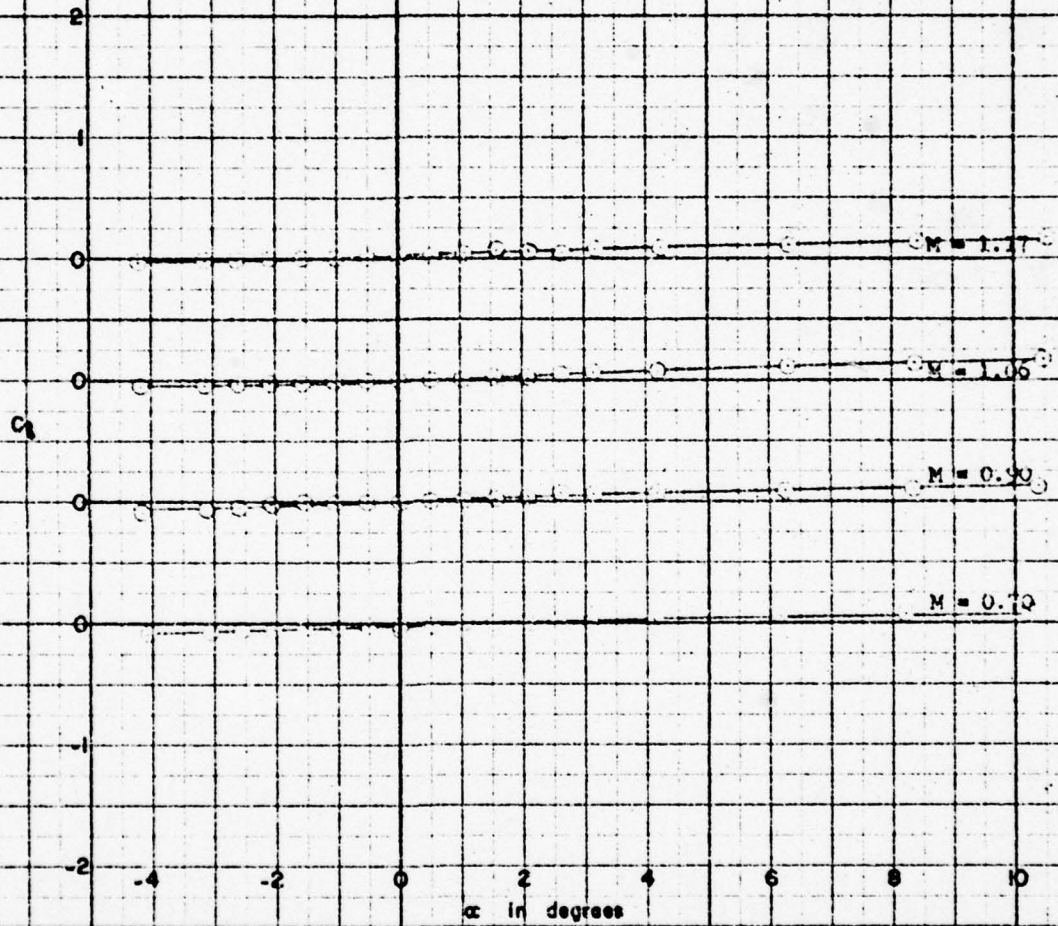
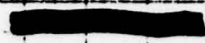


Figure 10 (Continued)

(a) Continued



FIGURE 10a (cont)

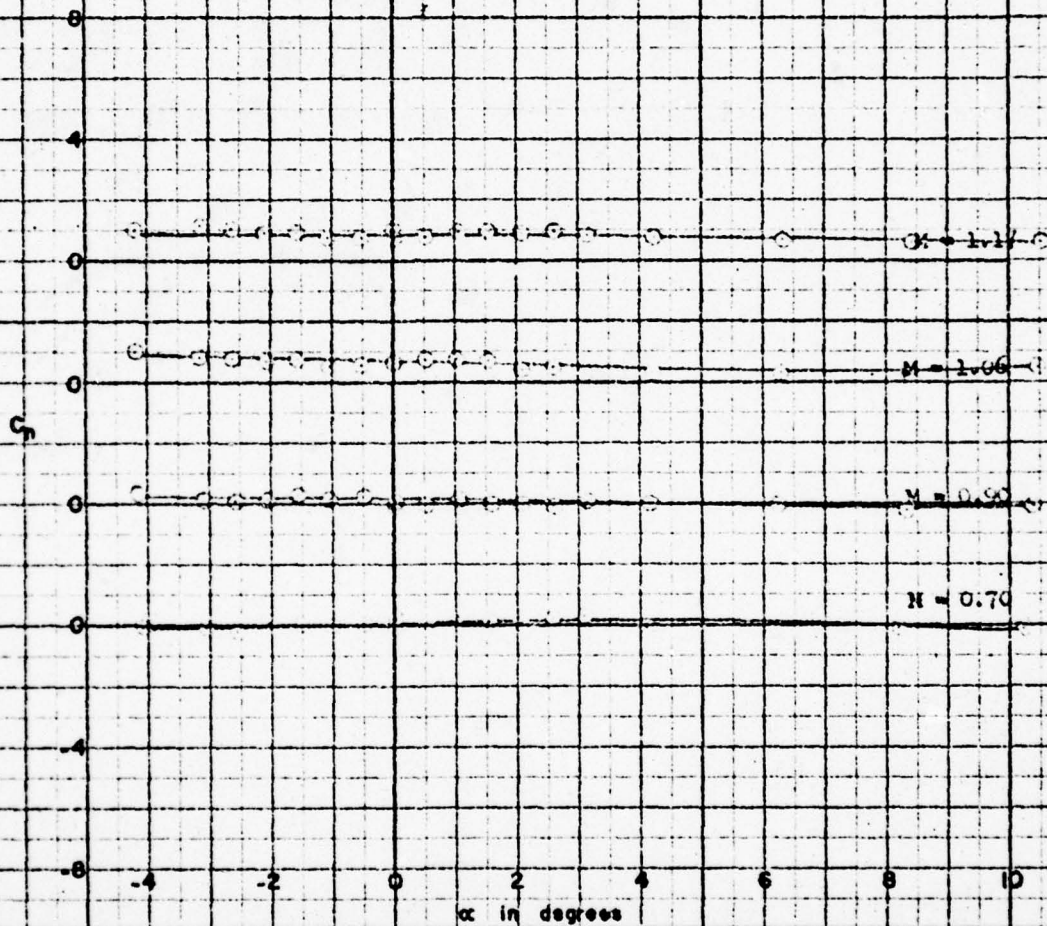
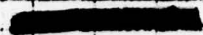


Figure 10 (Continued)

(a) Concluded

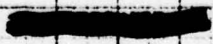


FIGURE 10a (concl)

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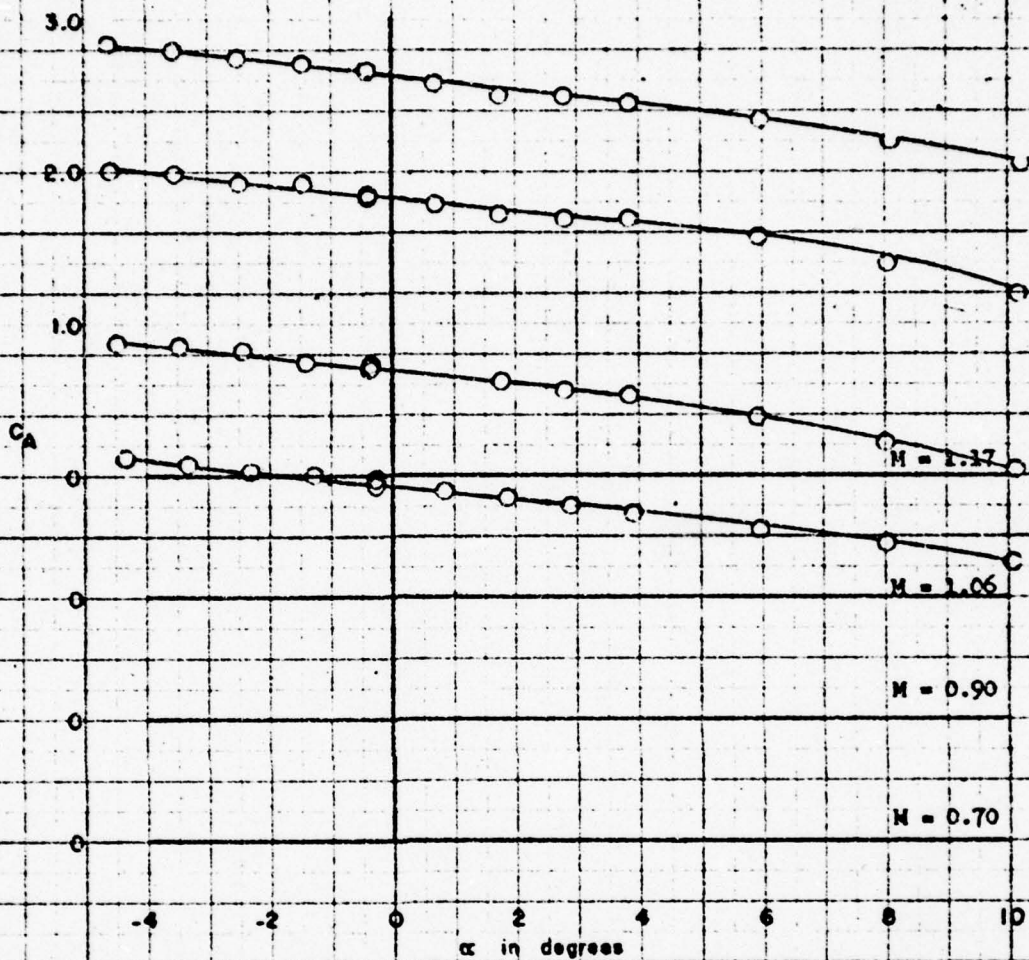


Figure 10 (Continued)

(b) $\phi = -45^\circ$; $i = 1^\circ = -10^\circ$; $\delta = 5^\circ = 0^\circ$

FIGURE 10b

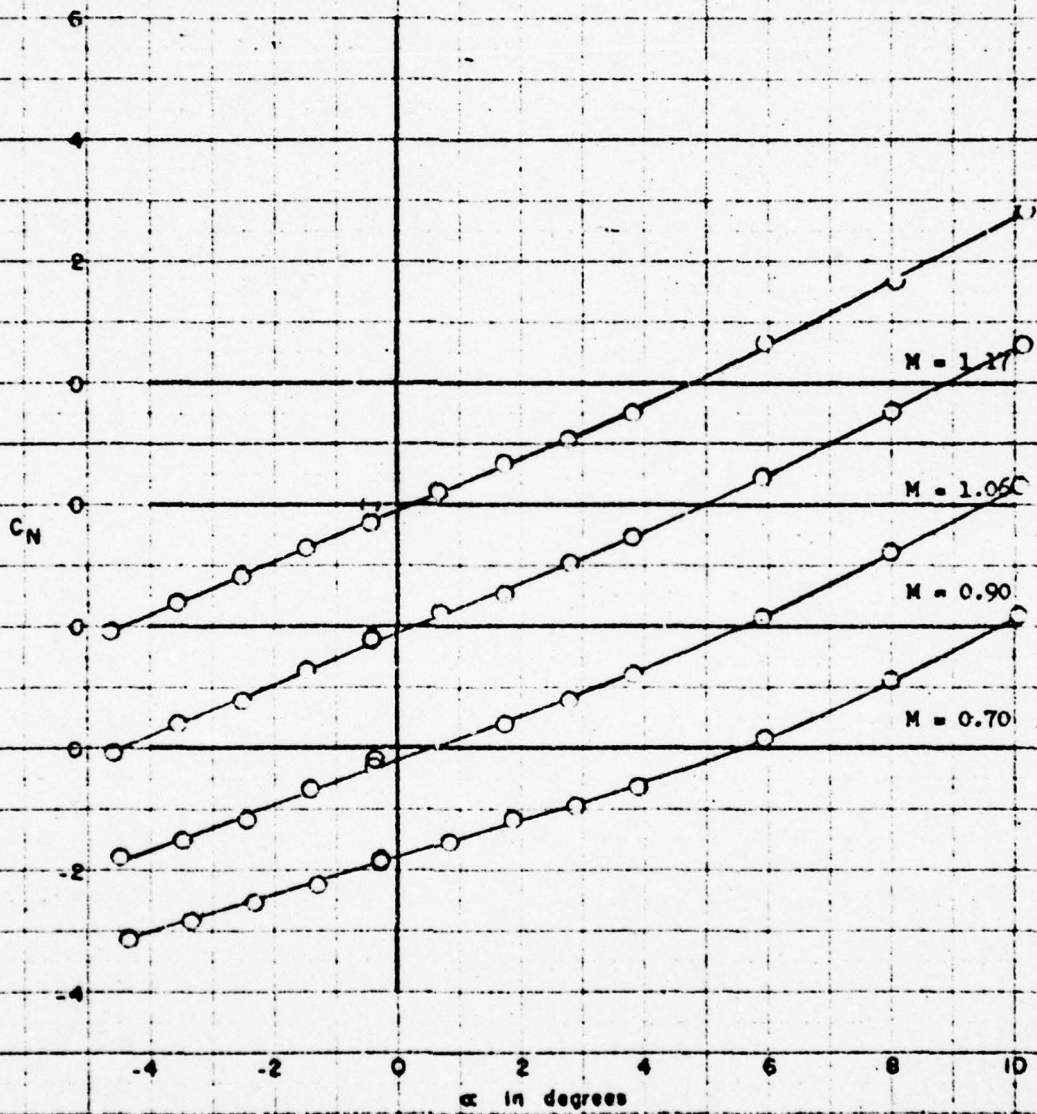


Figure 10 (Continued)

(b) Continued

FIGURE 10b (cont)

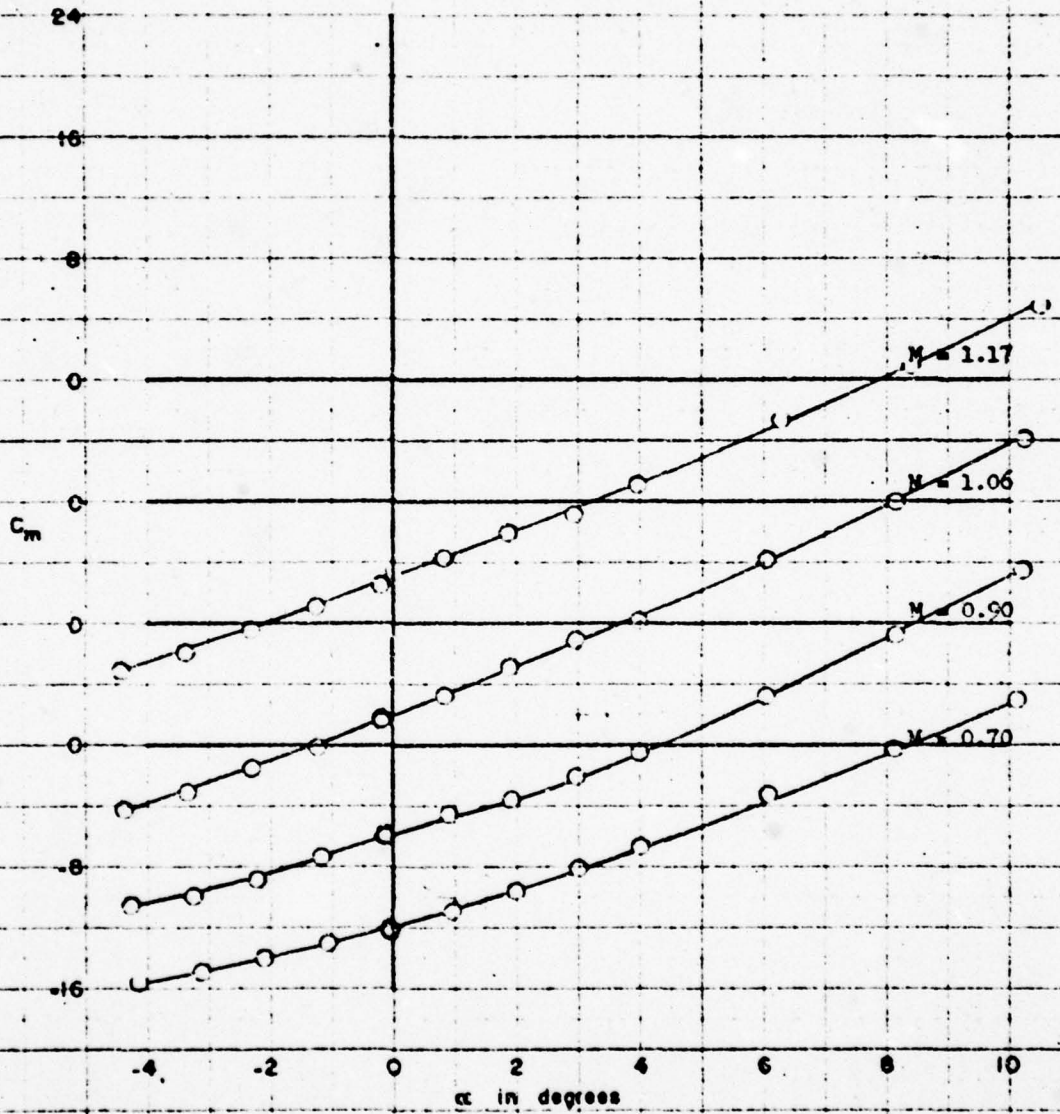
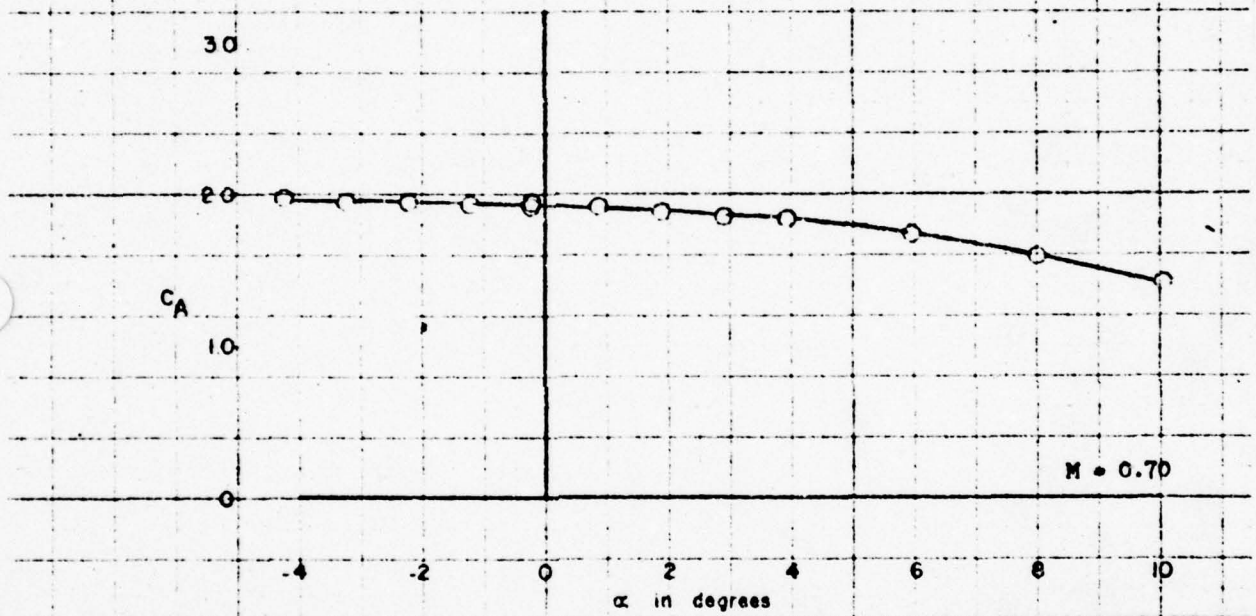
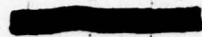


Figure 10 (Continued)

(b) Concluded

FIGURE 10b (concl)



$M = 0.70$

Figure 10 (Continued)

(c) $\phi = -45^\circ$; $i = i' = -15^\circ$; $\delta = \delta' = 0^\circ$

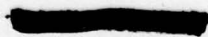


FIGURE 10c

[REDACTED]

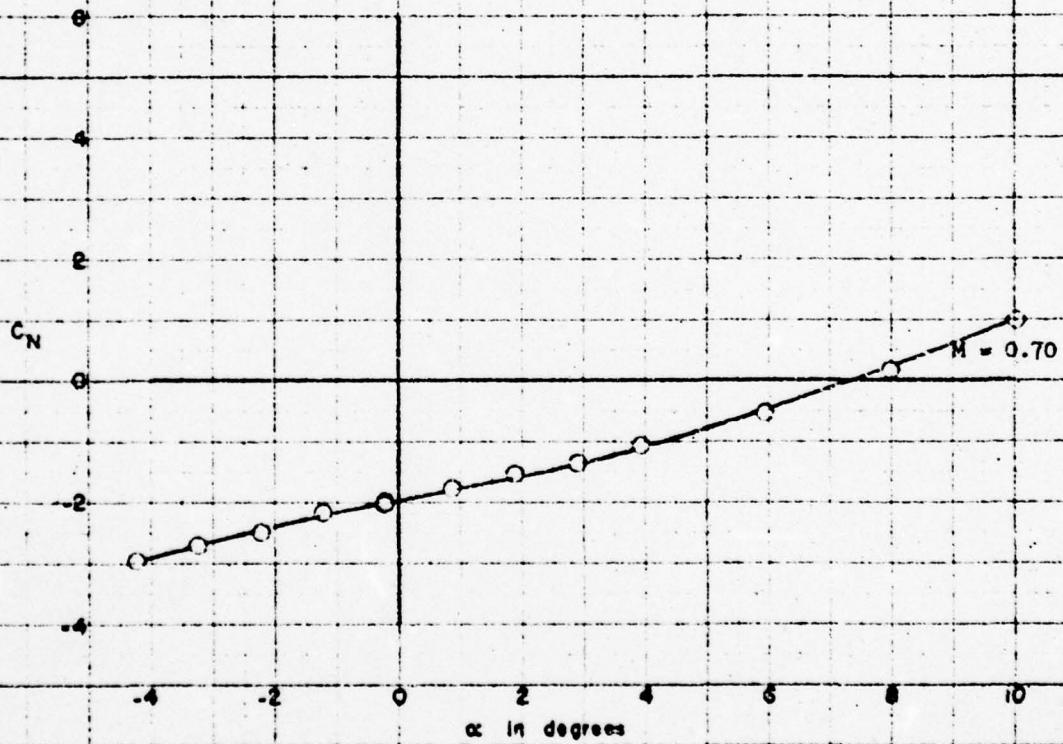


Figure 10 (Continued)

(c) Continued

[REDACTED]

FIGURE 10c (cont)

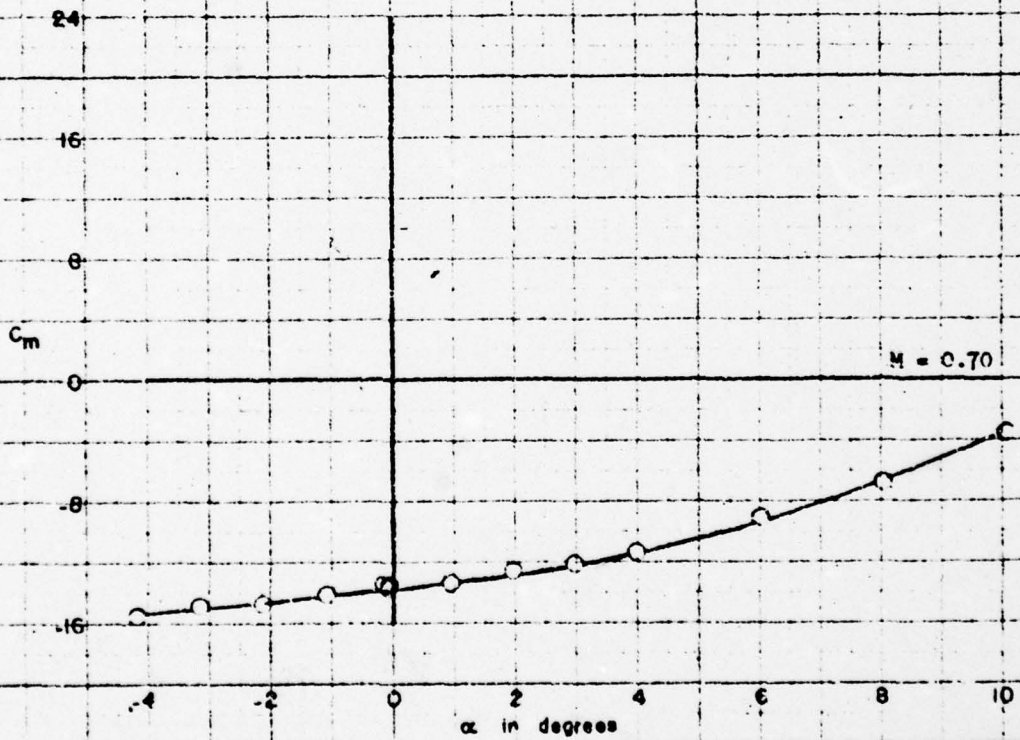


Figure 10 (Continued)

(c) Concluded

FIGURE 10c (cgnc1)

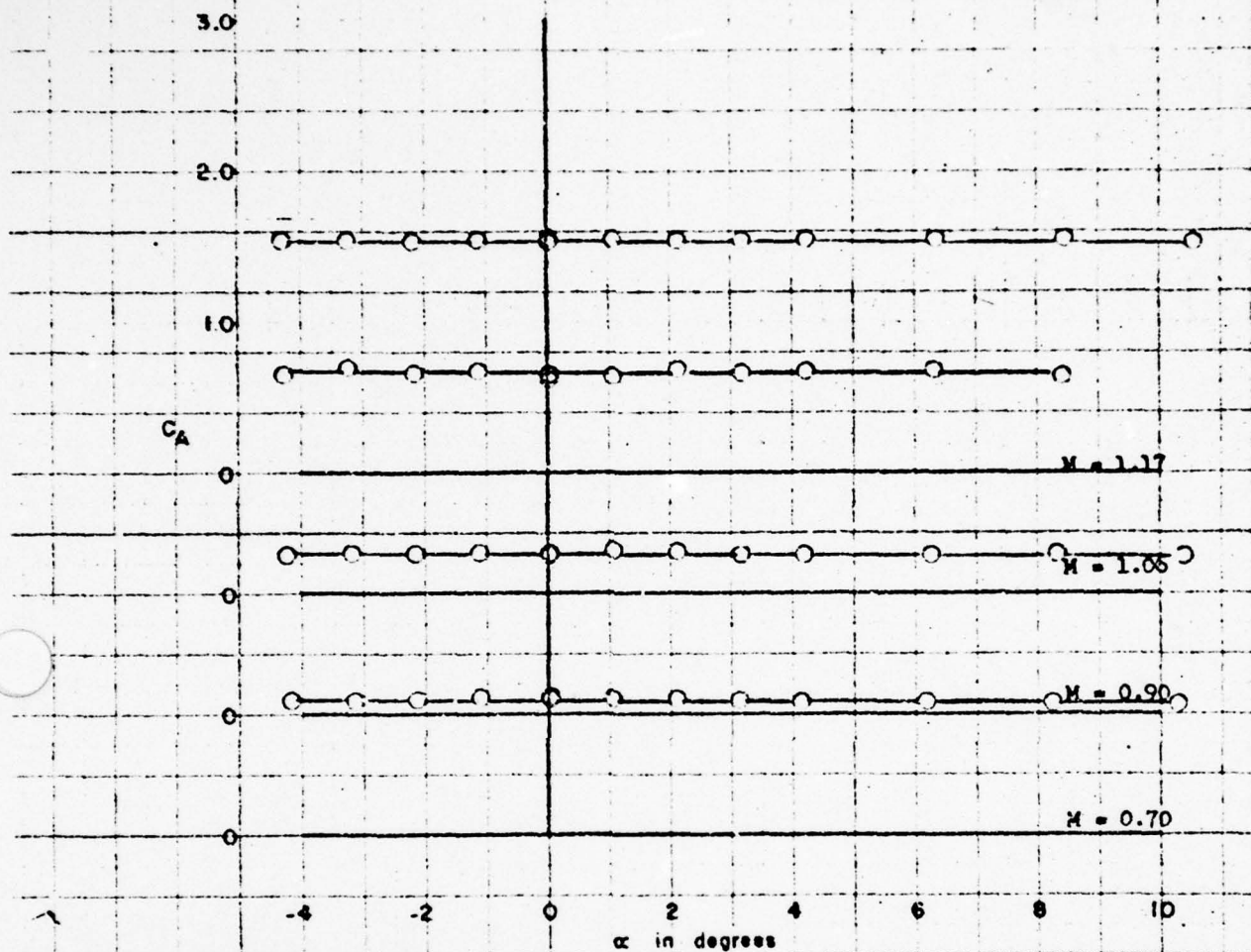


Figure 10 (Continued)

(d) $\delta = -45^\circ$; $l = 1' = 0^\circ$; $\delta = 6' = 5^\circ$

FIGURE 10d

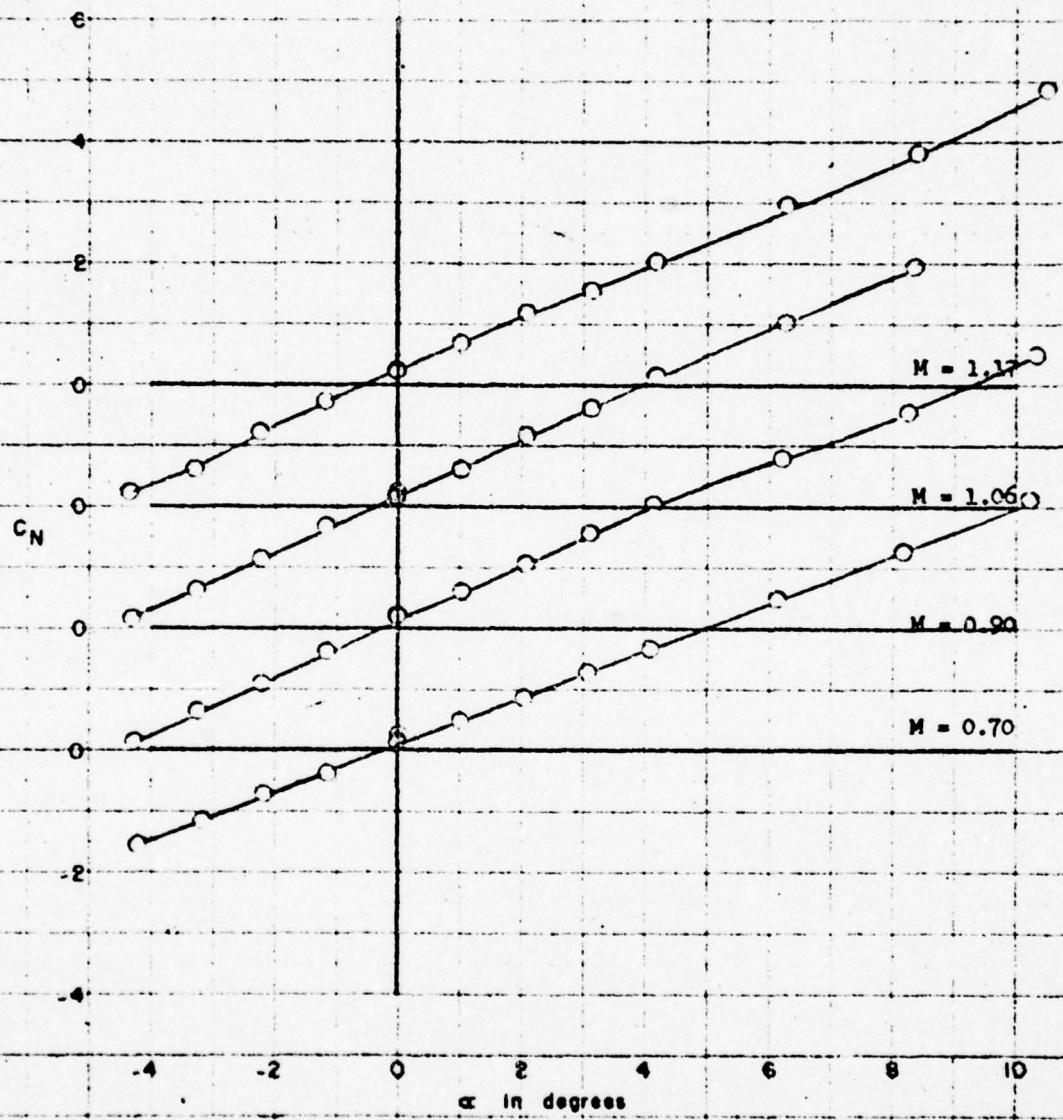


Figure 10 (Continued)

(d) Continued

FIGURE 10d (cont)

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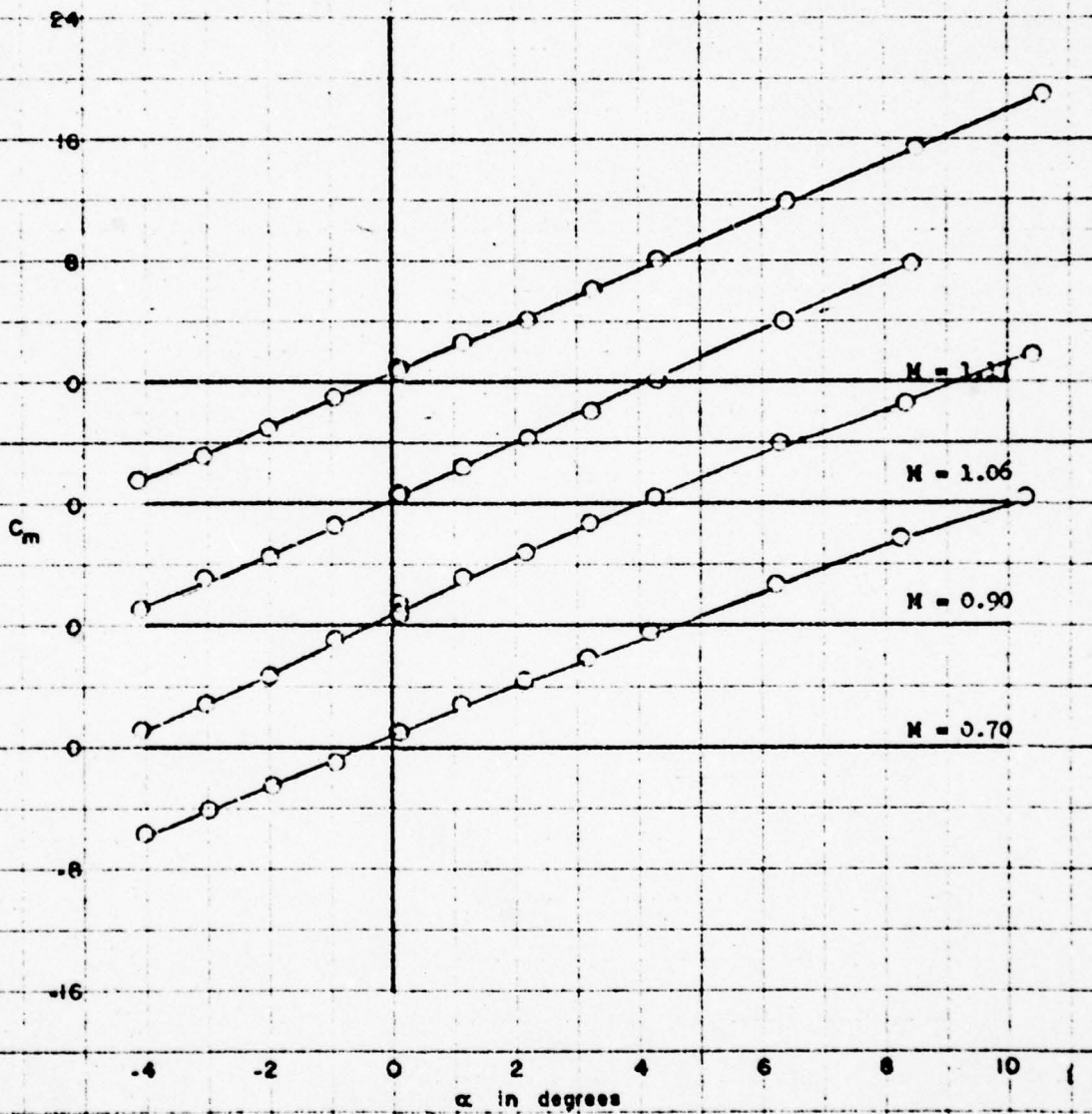


Figure 10 (Continued)

(d) Continued

~~CONFIDENTIAL~~

FIGURE 10d (cont)

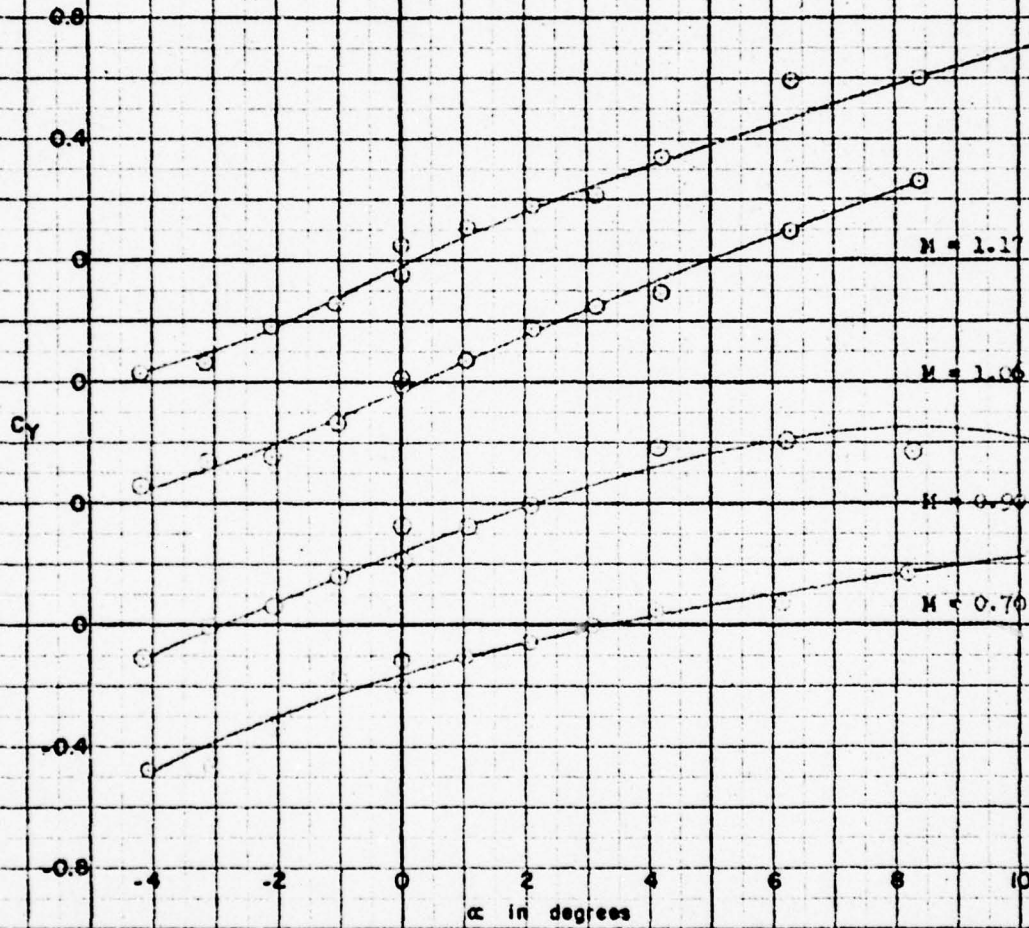


Figure 1D (Continued)

(d) Continued

FIGURE 10d (cont)

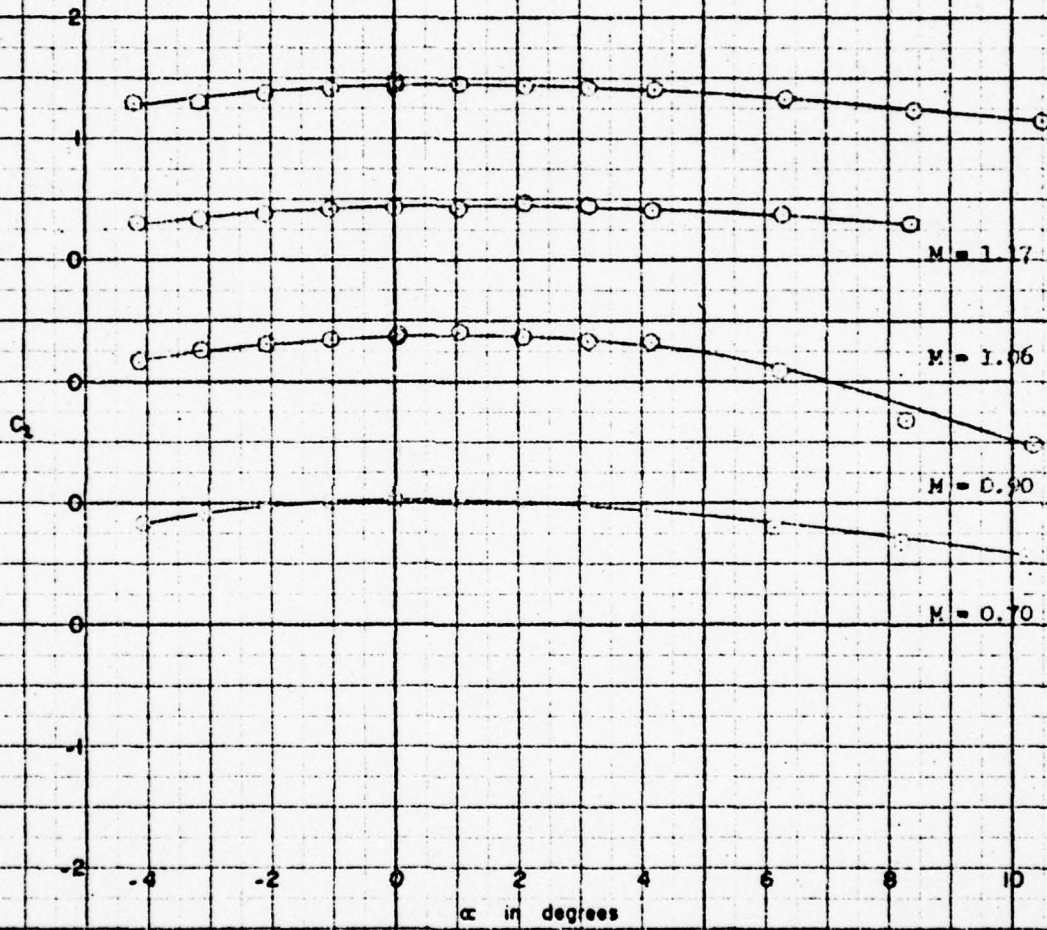
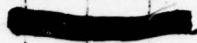


Figure 10 (Continued)
(d) Continued

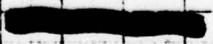


FIGURE 10.1 (cont)

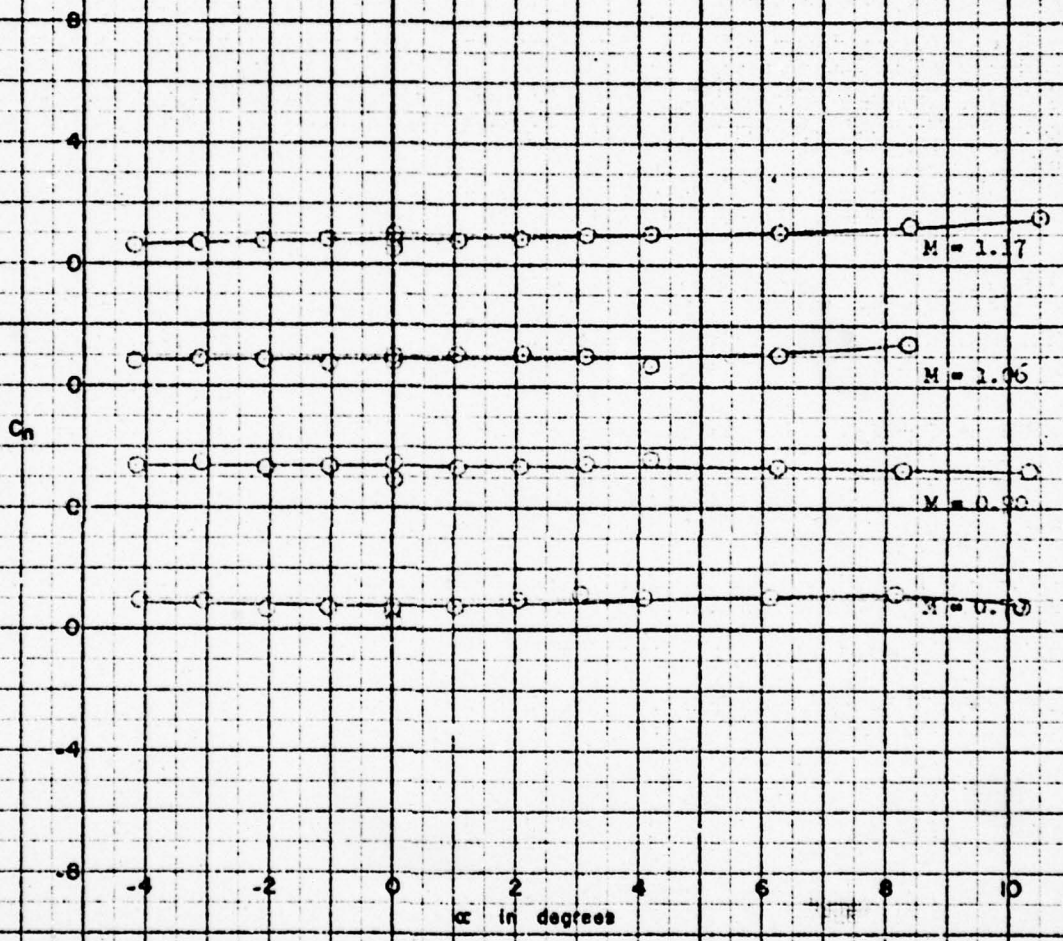
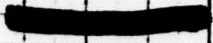


Figure 10 (Continued)

(d) Concluded

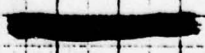


FIGURE 10a (concl)

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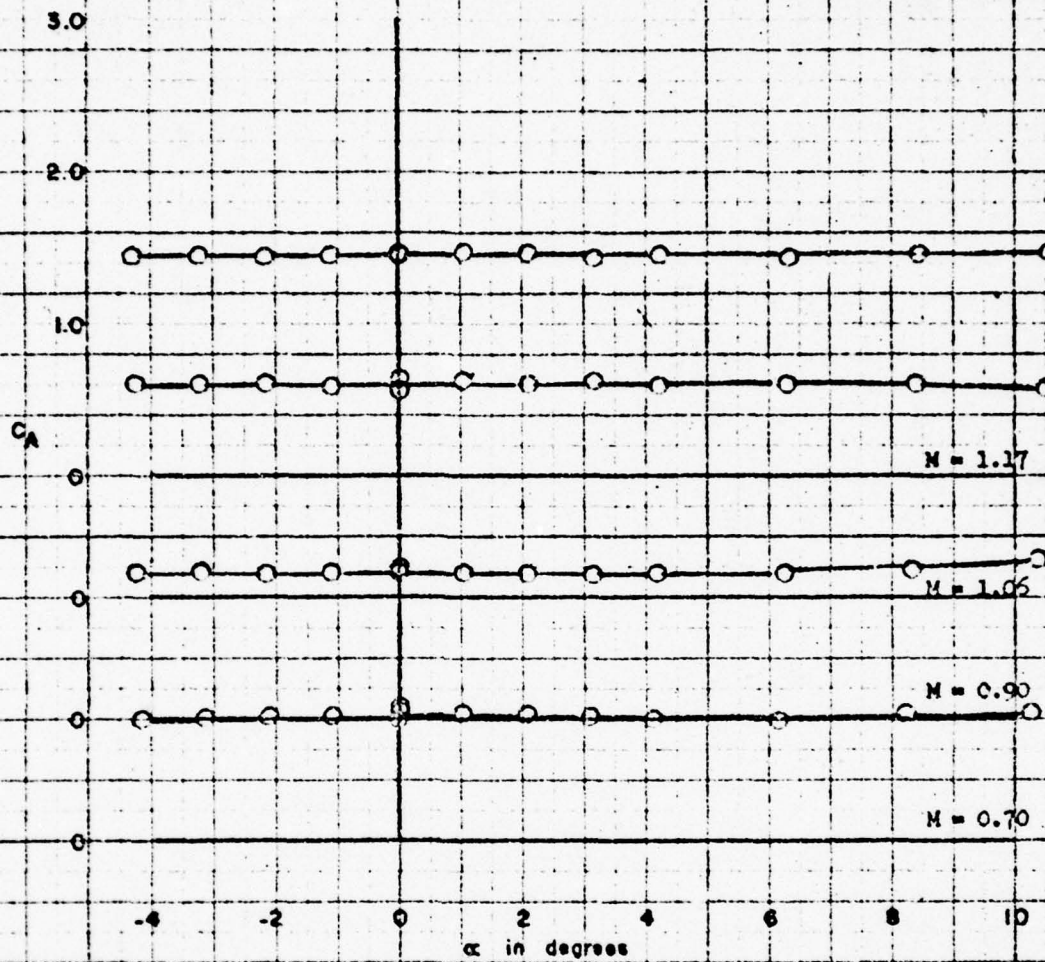


Figure 10 (Continued)
(e) $\phi=0^\circ$; $i=i'=0^\circ$; $\delta=\delta'=0^\circ$

~~CONFIDENTIAL~~

FIGURE 10e

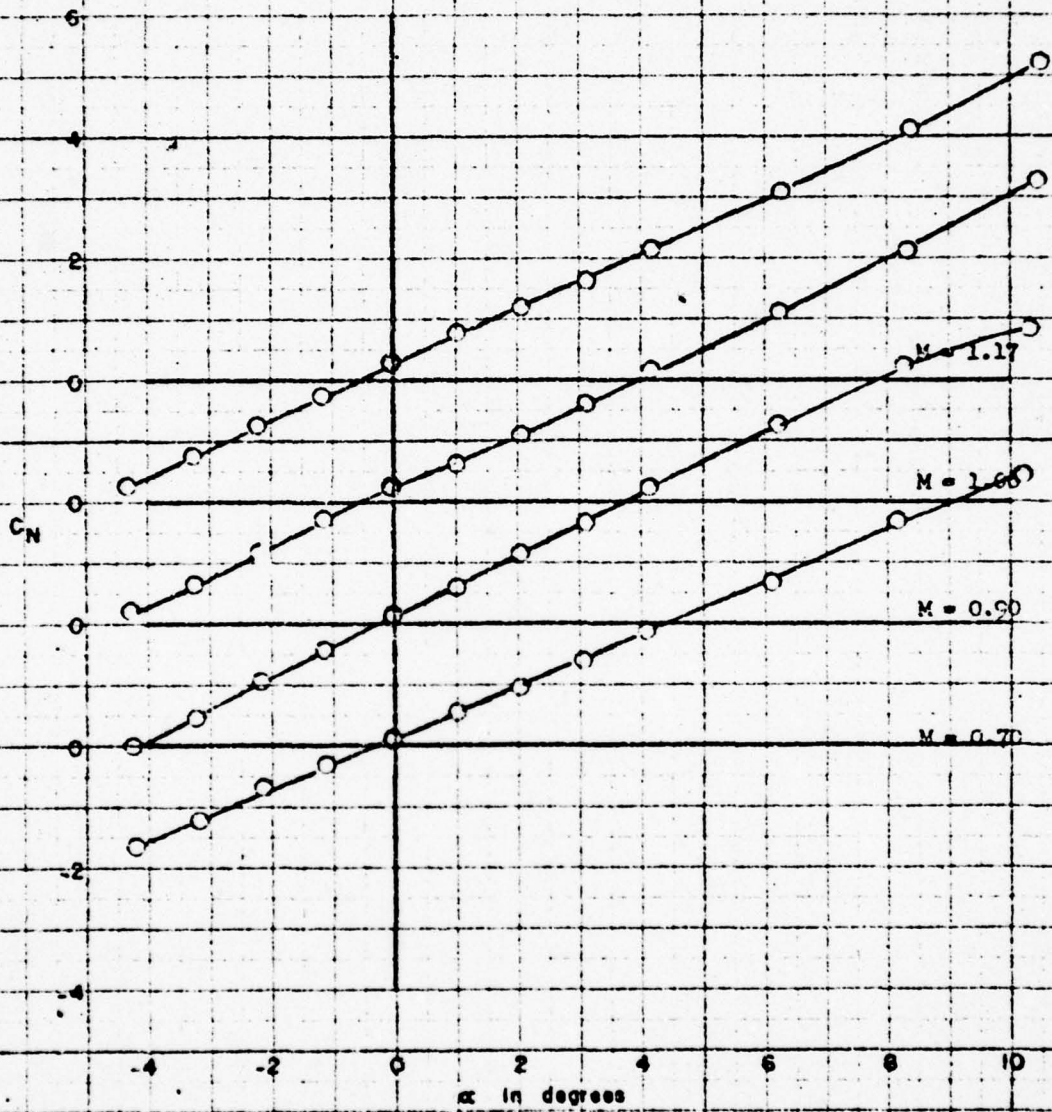


Figure 10 (Continued)

(e) Continued

FIGURE 10e (cont)

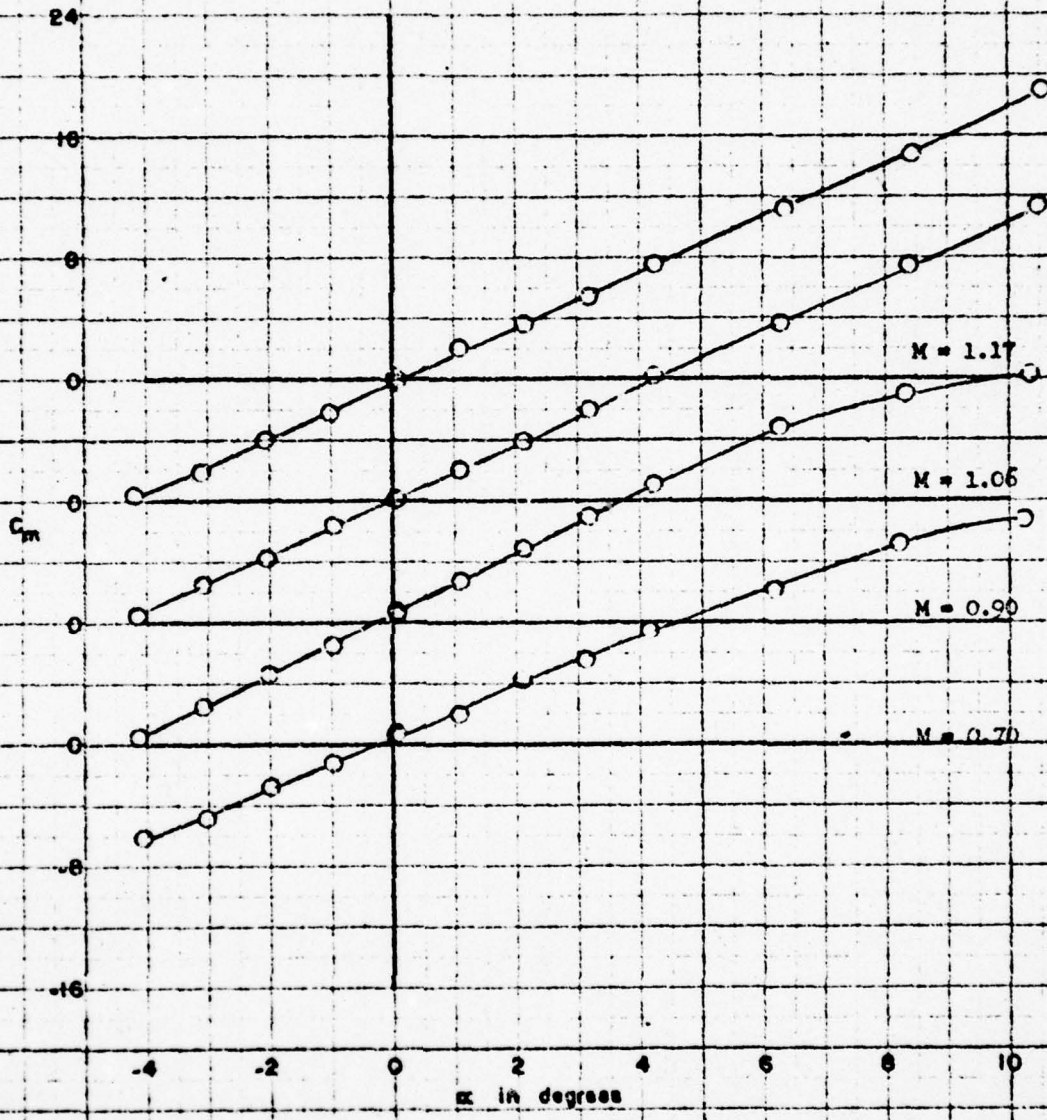
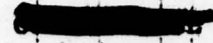


Figure 10 (Continued)

(e) Concluded

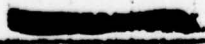


FIGURE 10e (concl)

AERO 1002

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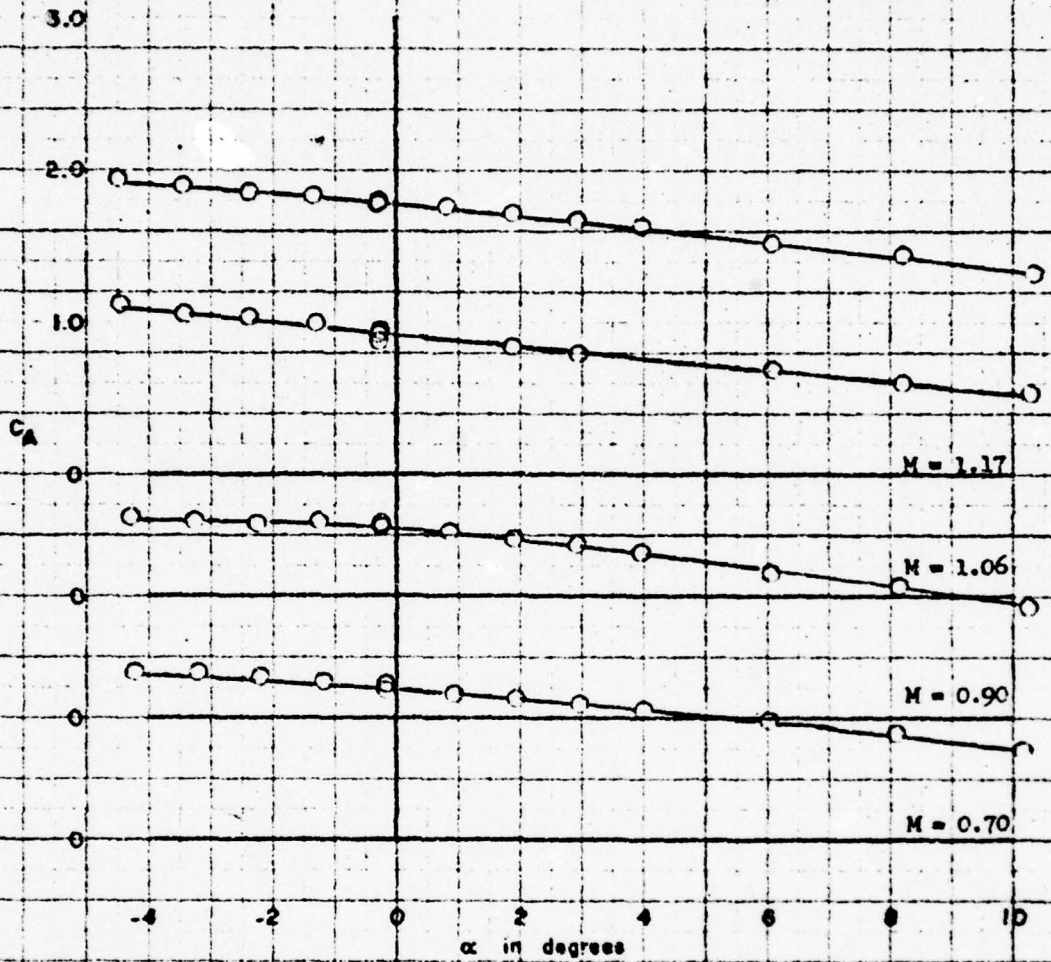


Figure 10 (Continued)

(f) $\phi = 0^\circ$; $i = -10^\circ$; $i' = 0^\circ$; $\delta = \delta' = 0^\circ$

FIGURE 10f

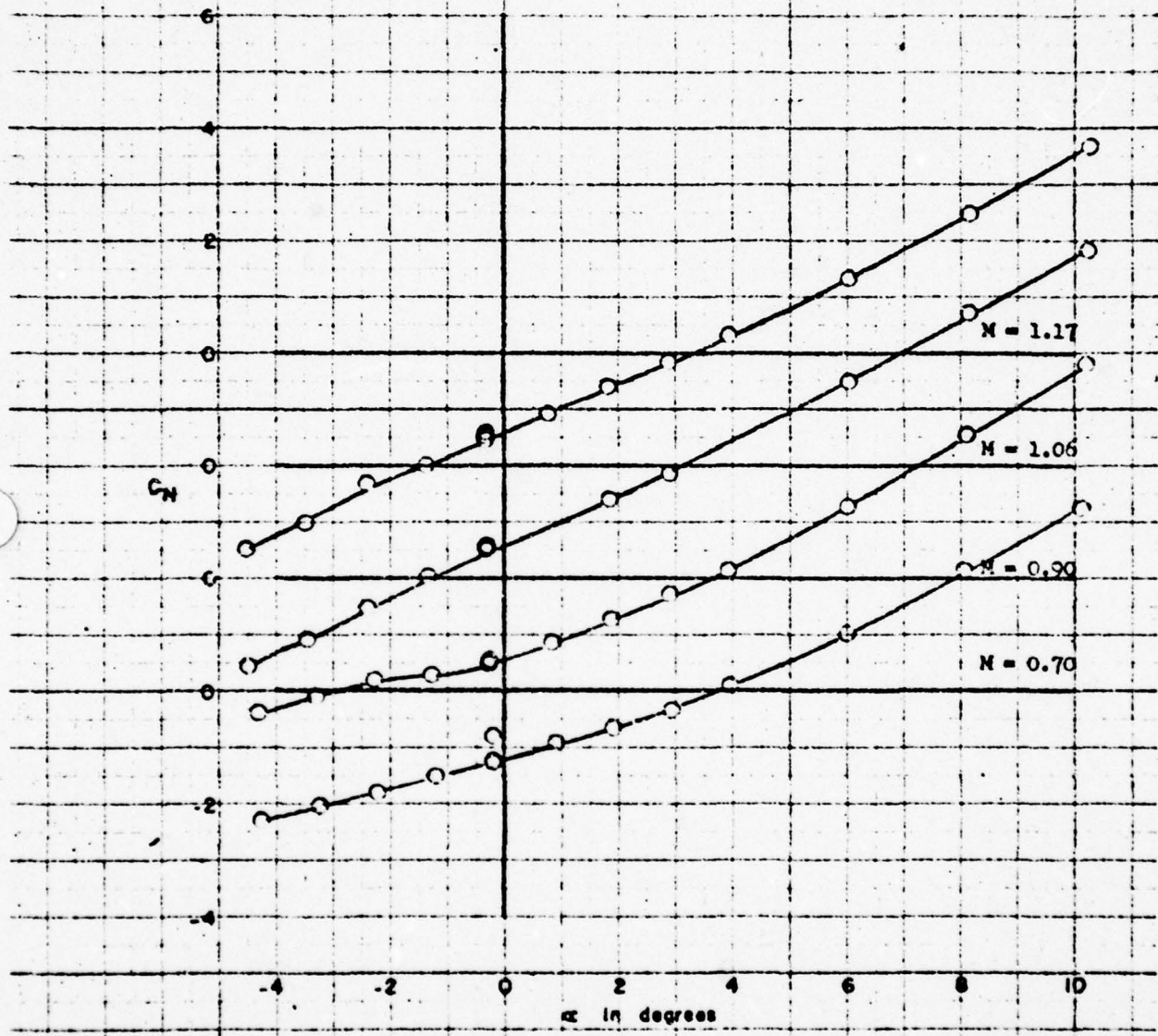
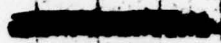


Figure 10 (Continued)

(f) Continued



FIGURE 10f (cont)

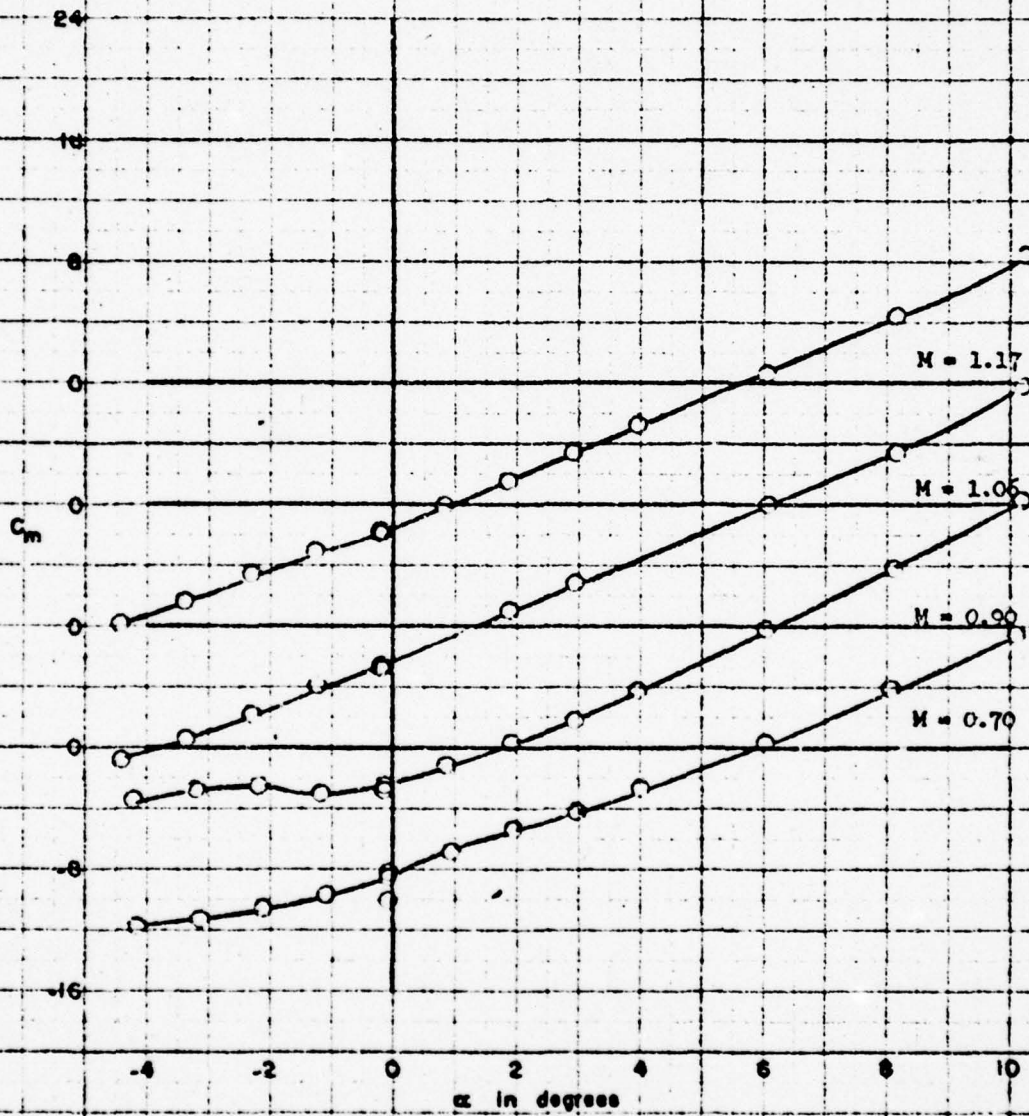


Figure 10 (Concluded)

(f) Concluded

FIGURE 10f (concl)

AERO 1002

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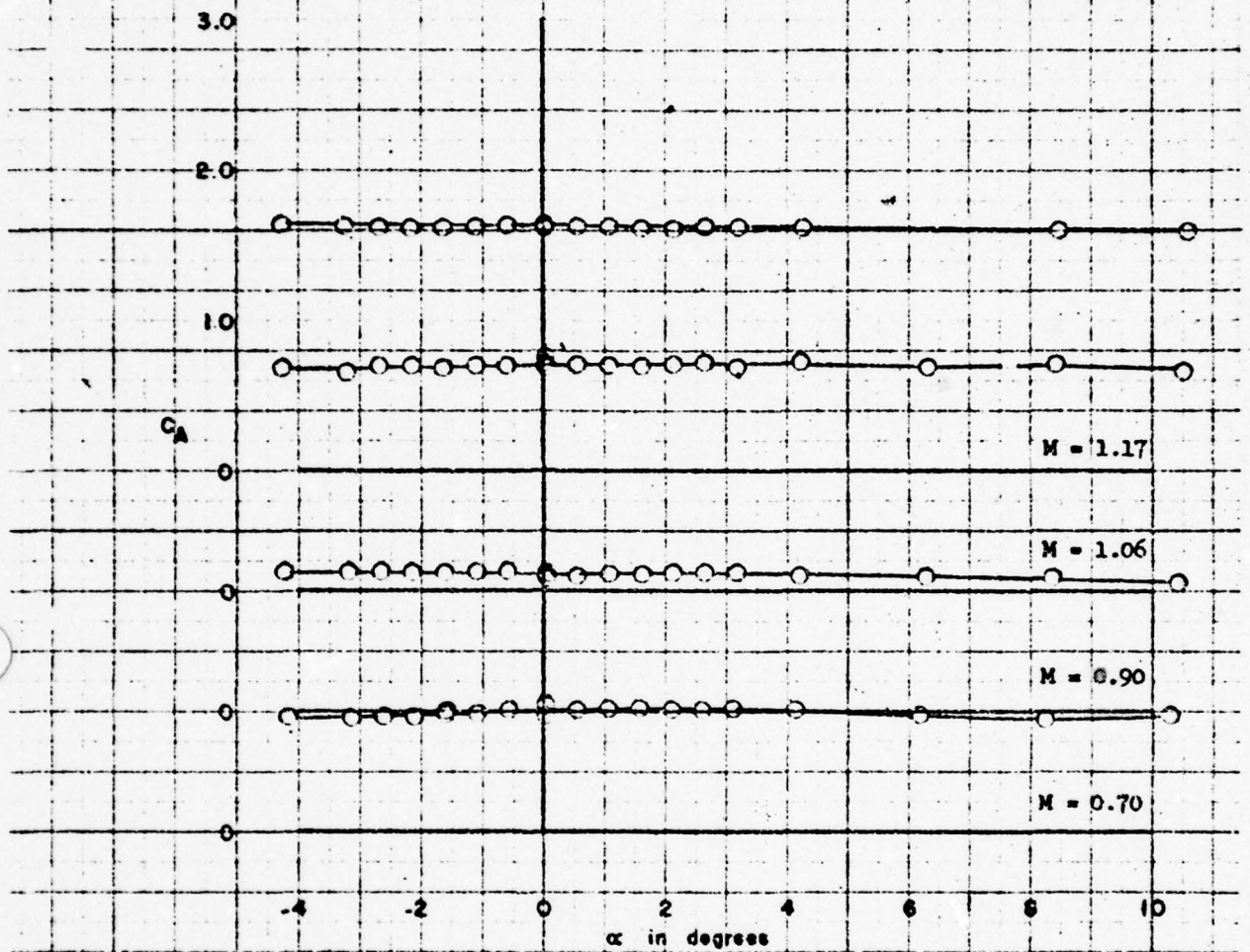


Figure 11 - Variation of the Aerodynamic Characteristics
With Angle of Attack for Configuration $B_{22} R_5 H_{10} WT_{10} F_{18}$

(a) $\phi = -45^\circ$; $i = 1' = 0^\circ$; $\delta = 5' = 0^\circ$

FIGURE 11a

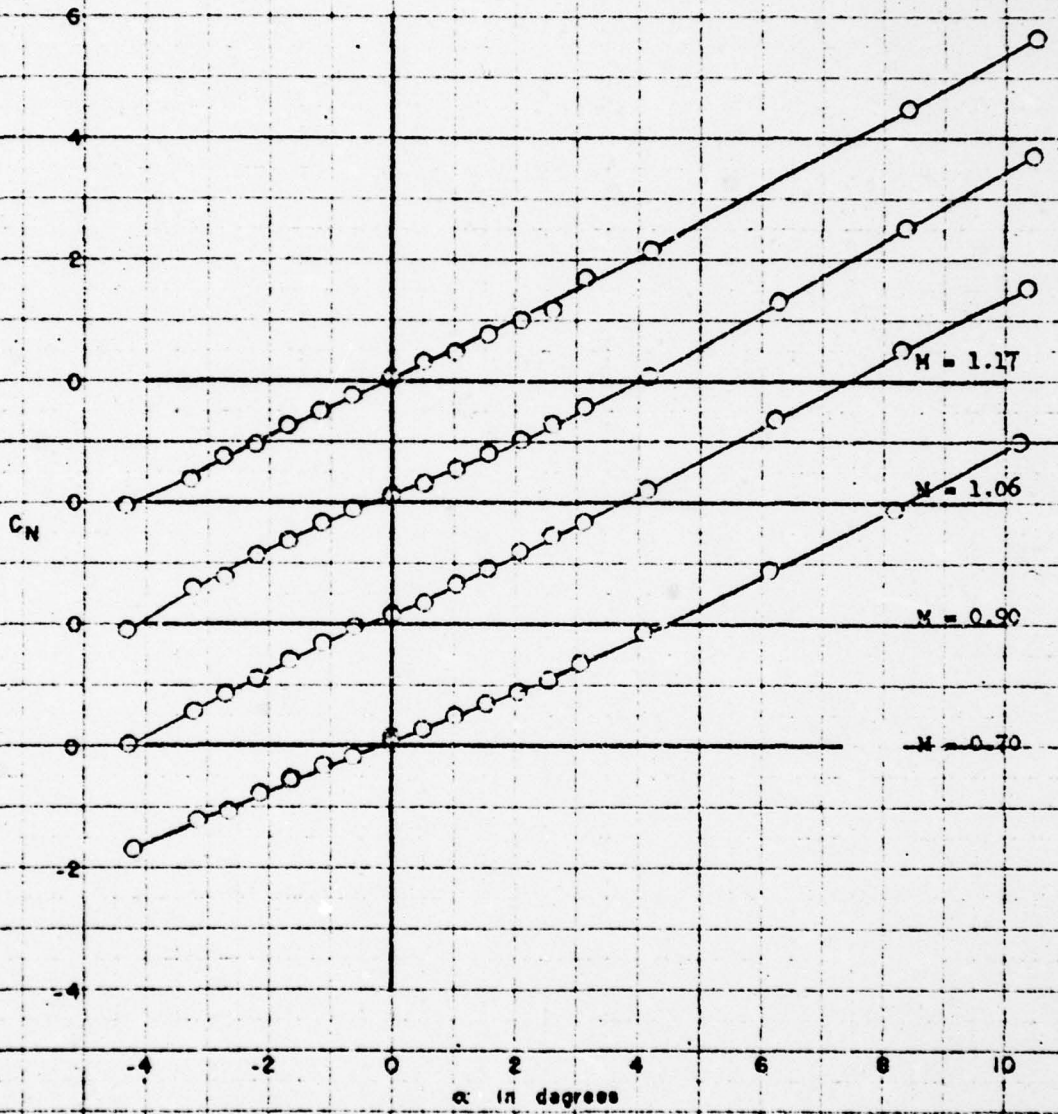


Figure 11 (Continued)
(a) Continued

FIGURE 11a (cont)

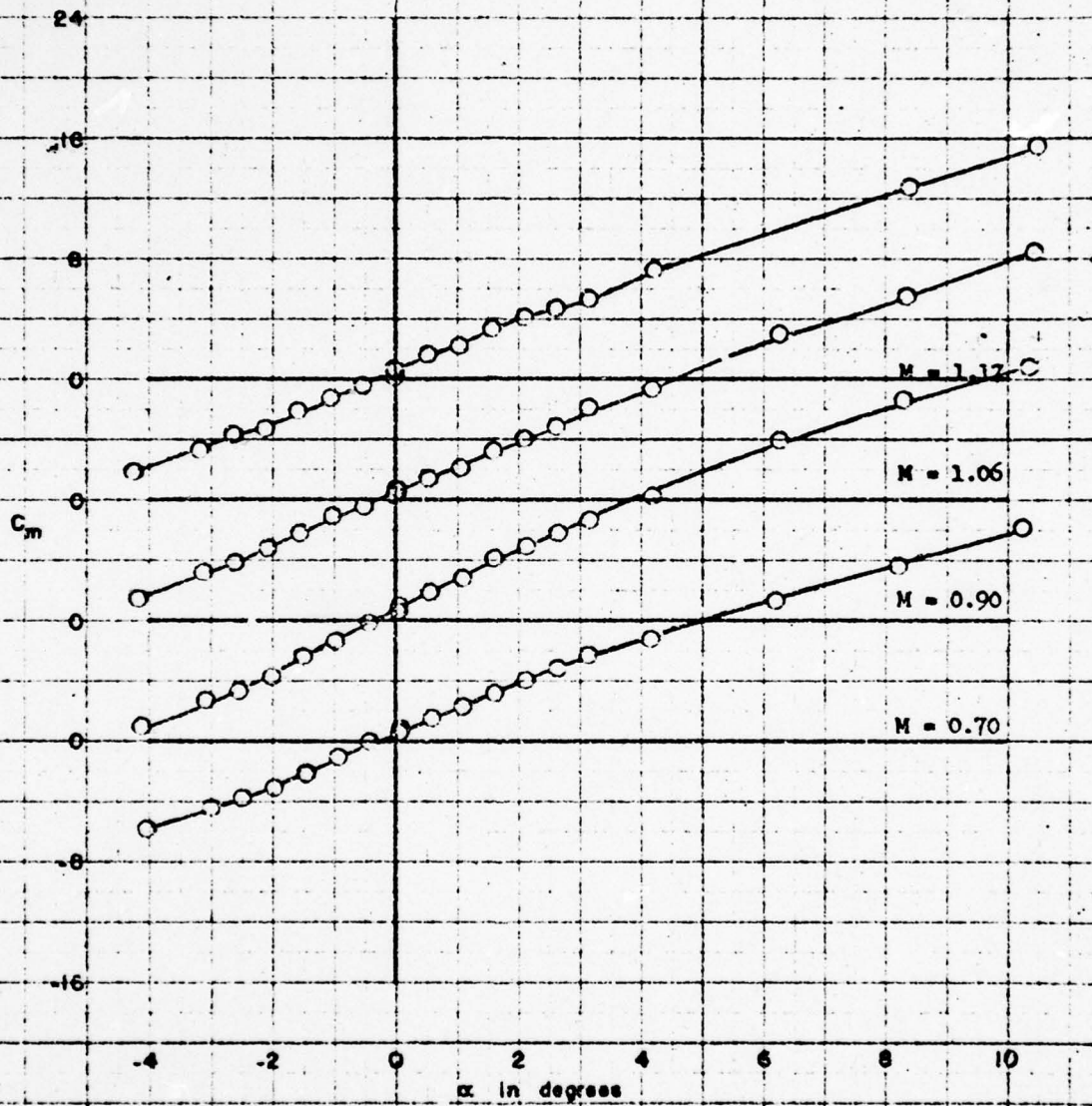


Figure 11 (Continued)

(a) Continued

FIGURE 11a (cont)

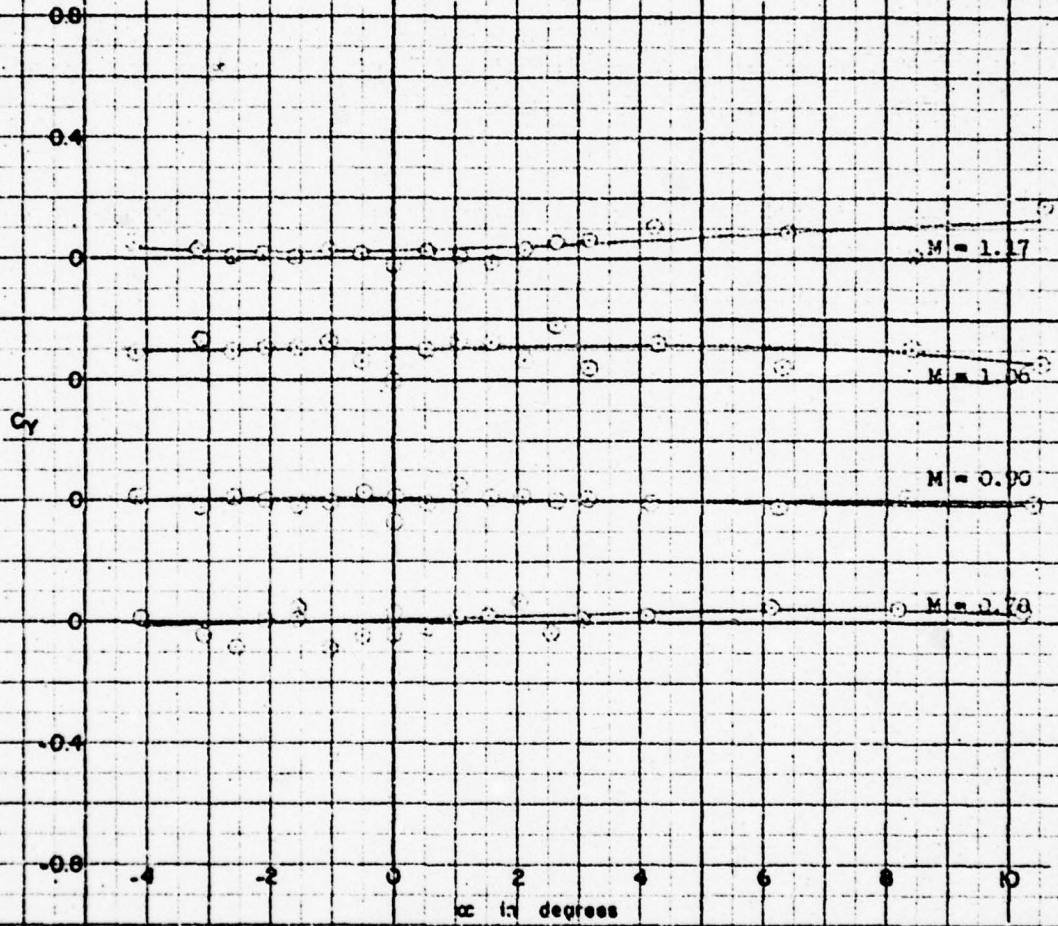
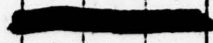


Figure 11 (Continued)

(a) Continued



FIGURE 11a (cont)

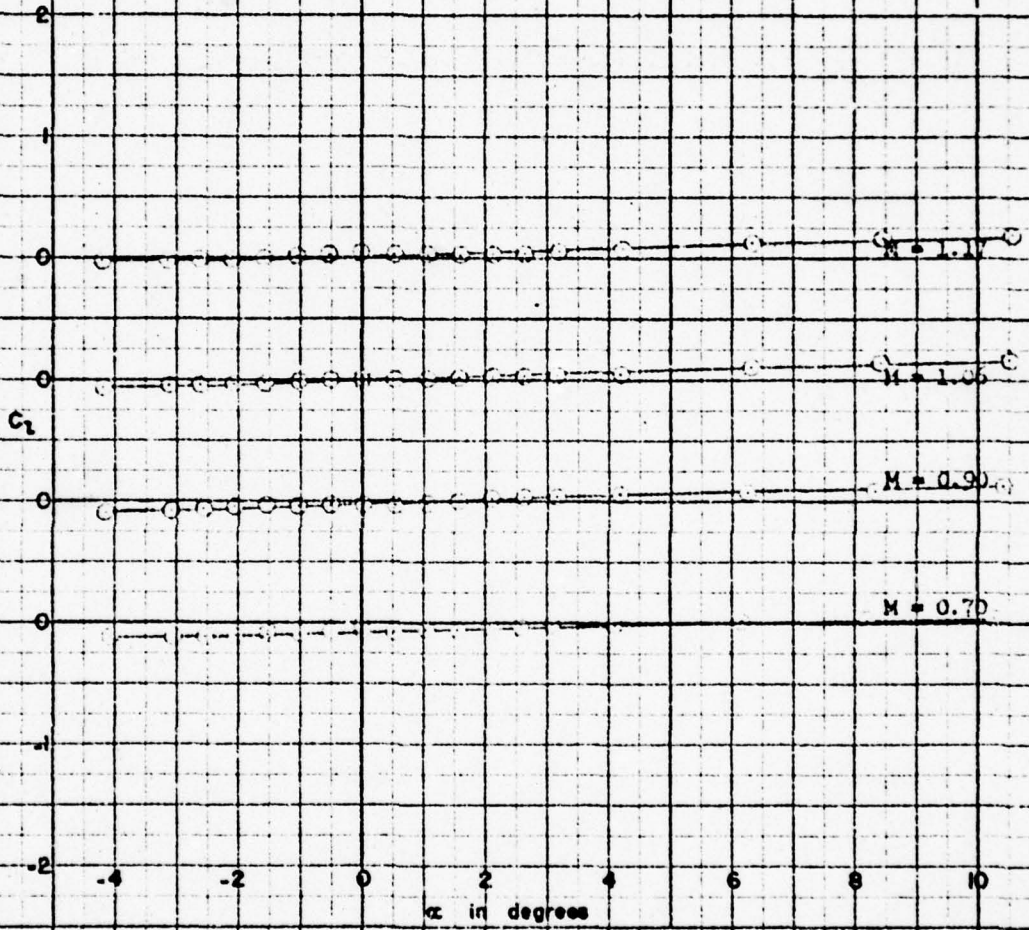
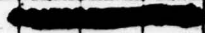


Figure 11 (Continued)
(a) Continued

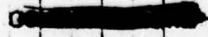


FIGURE 11a (cont)

[REDACTED]

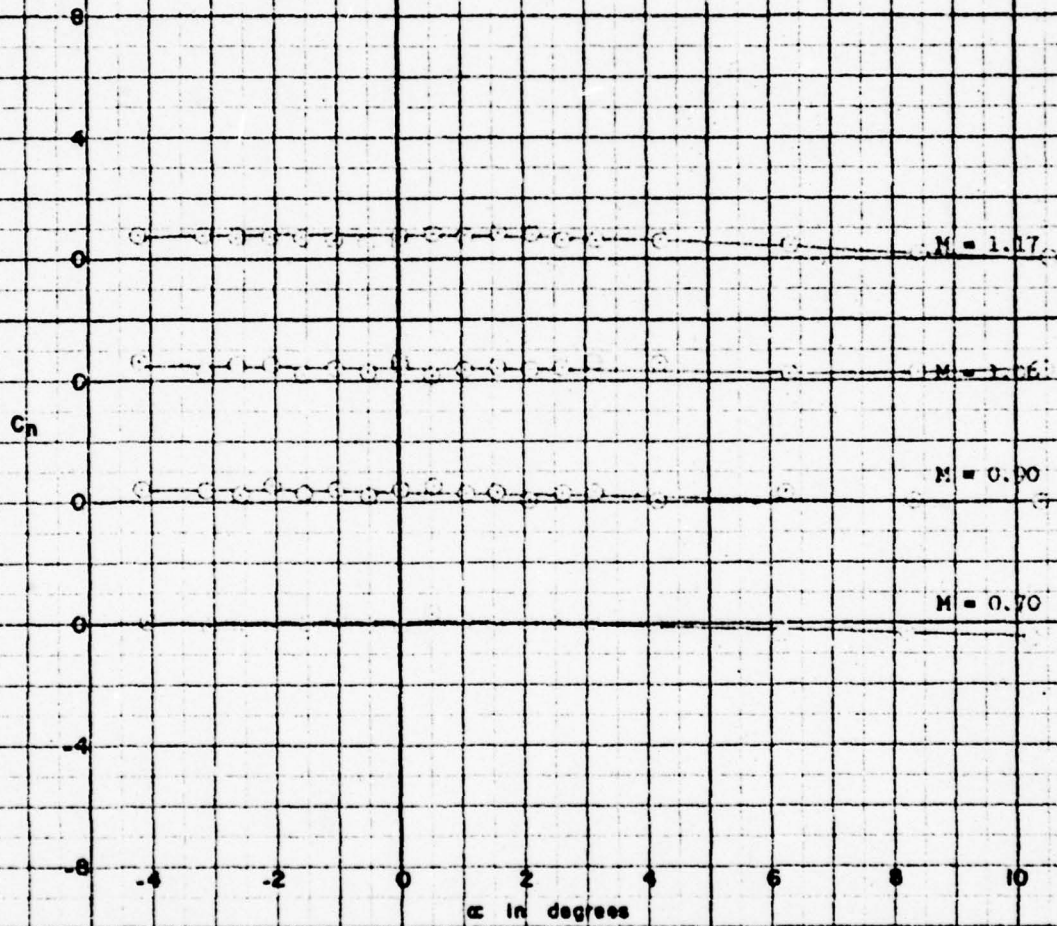


Figure 11 (Continued)

(a) Concluded

[REDACTED]

FIGURE 11a (concl)

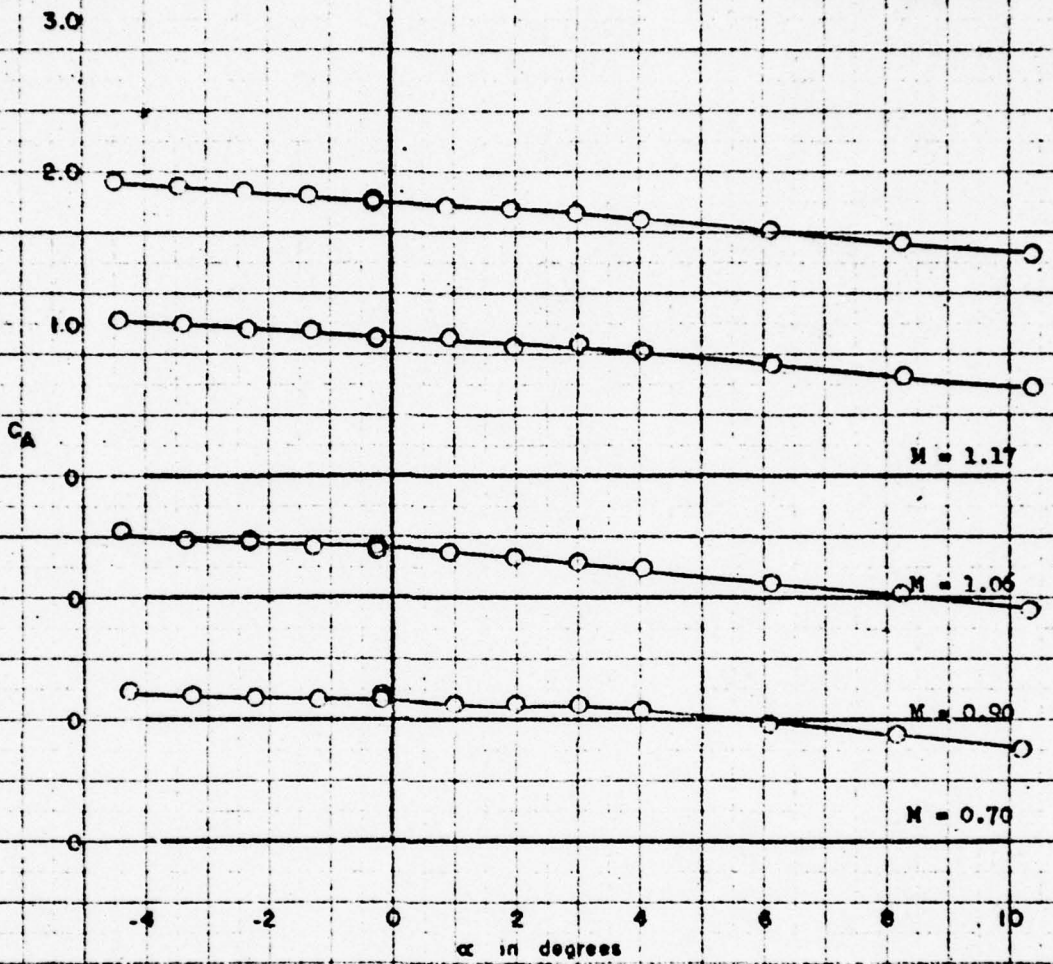


Figure 11 (Continued)

(b) $\delta = 45^\circ$; $i = 1^\circ$; $\delta = 5^\circ$; $\delta = 0^\circ$

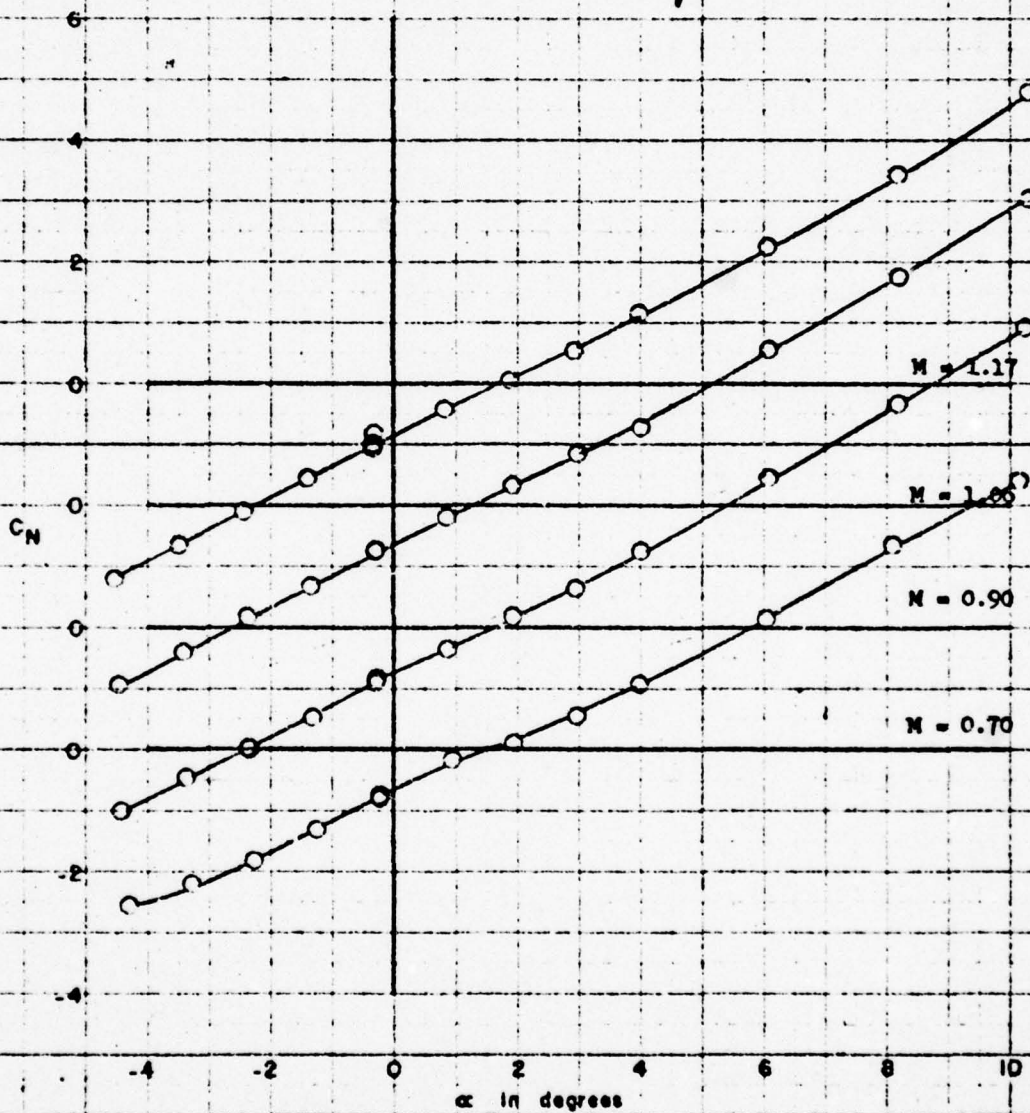


Figure 11 (Continued)

(b) Continued

FIGURE 11b (cont)

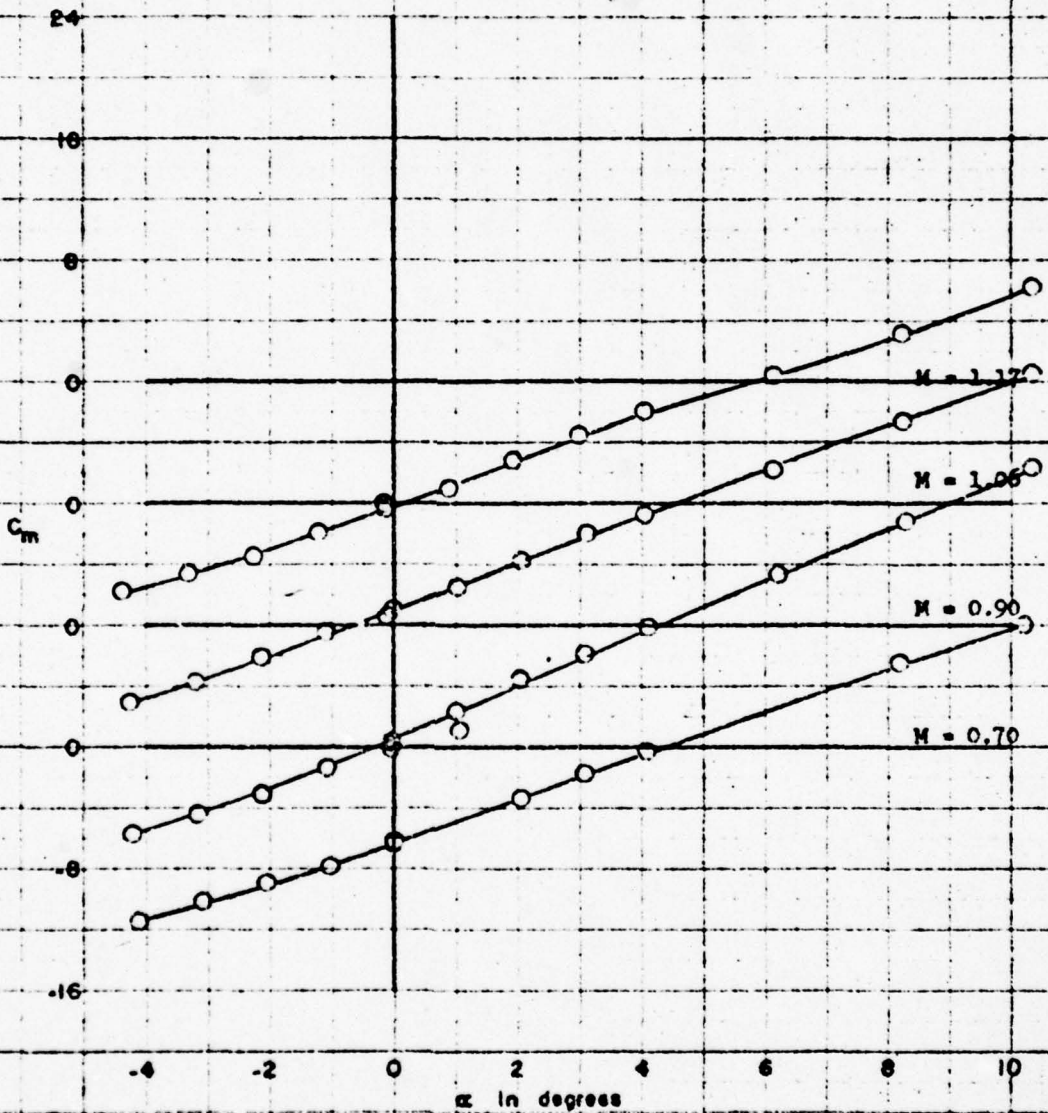


Figure 11 (Continued)

(b) Concluded

FIGURE 11b (concl)

AERO 1002

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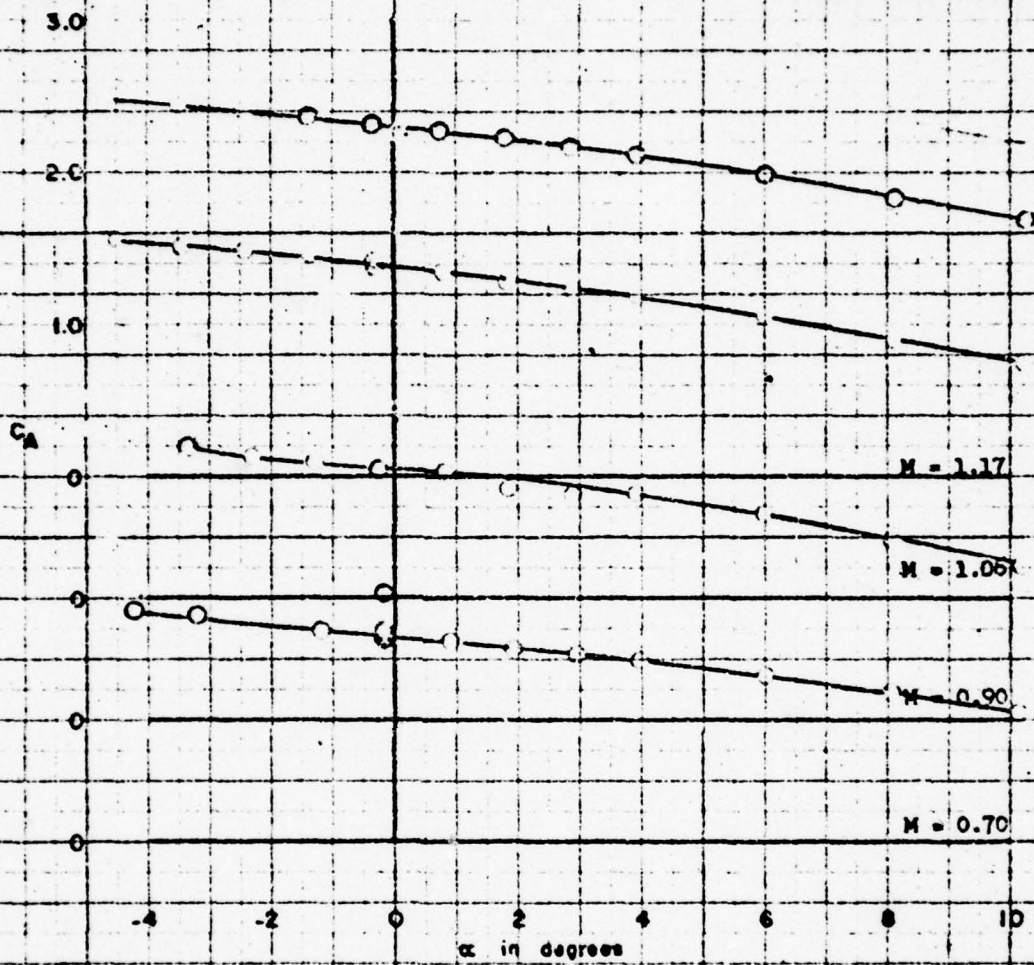


Figure 11 (Continued)

(c) $\phi = -45^\circ$; $i = i' = -10^\circ$; $\delta = \delta' = 0^\circ$

FIGURE 11c

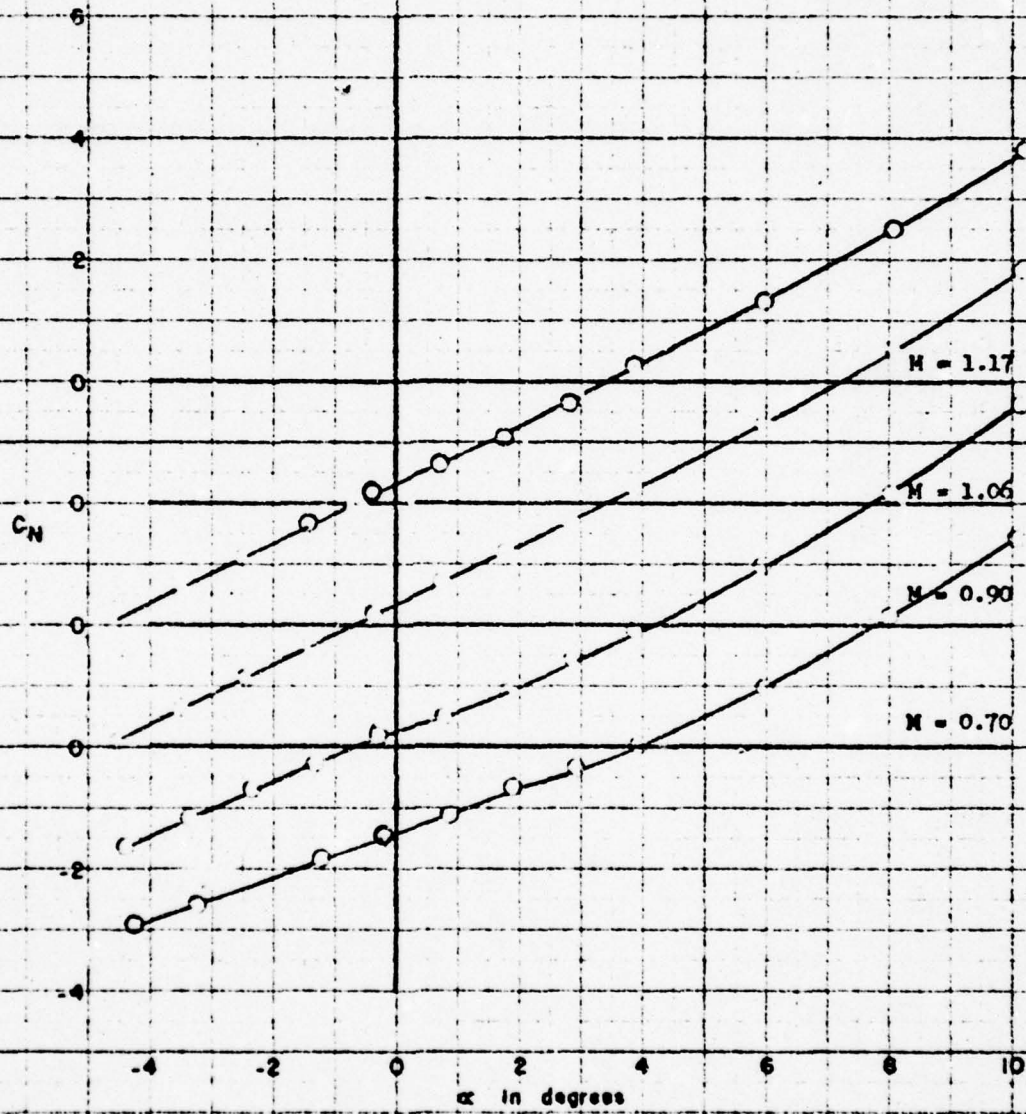
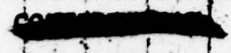


Figure 11 (Continued)

(c) Continued

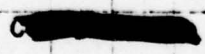


FIGURE 11c (cont)

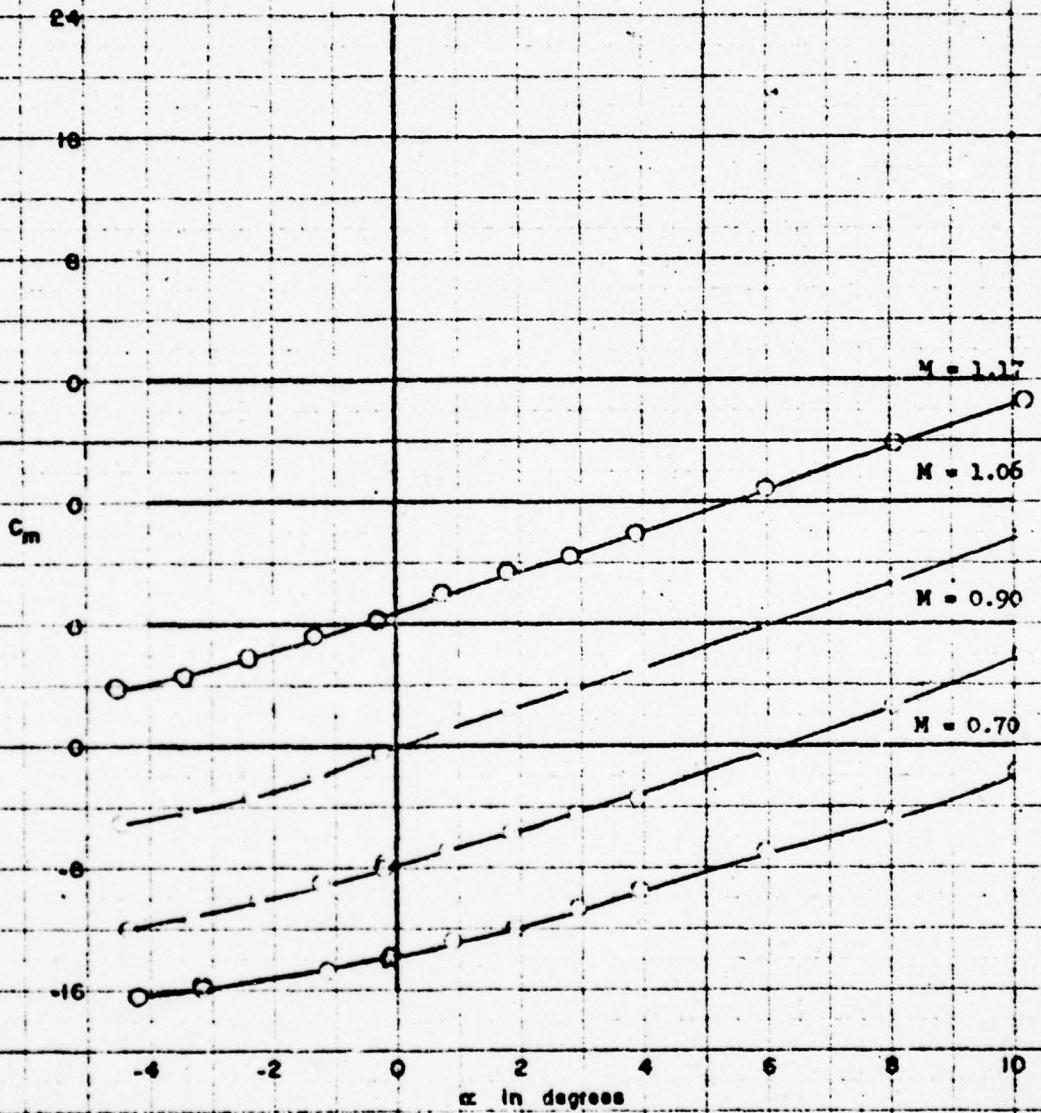
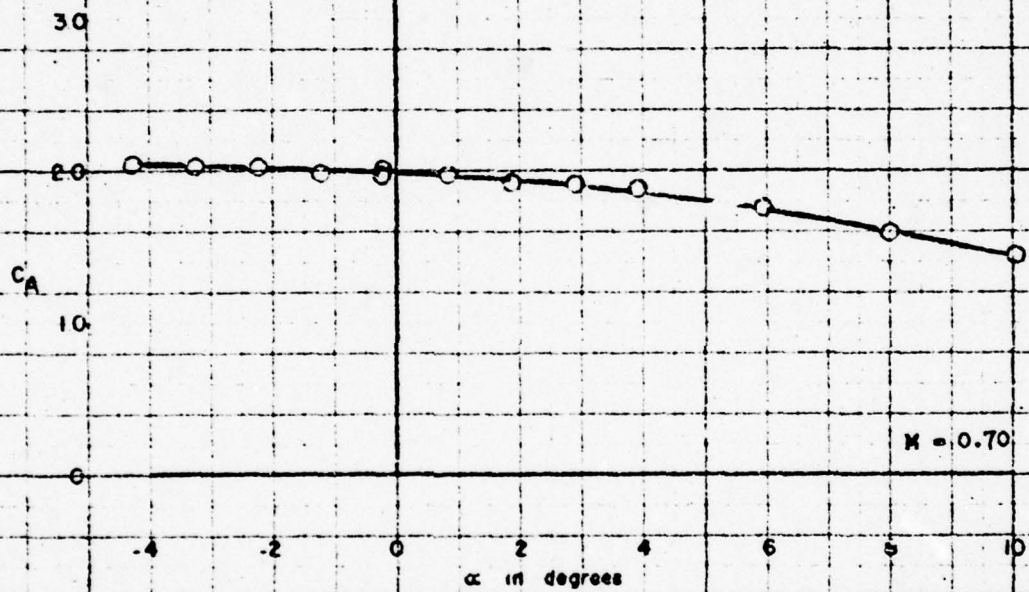
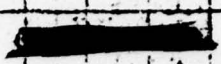


Figure 11 (Continued)

(c) Concluded



M = 0.70

Figure 11 (Continued)

(d) $\phi = -45^\circ$; $i = i' = -15^\circ$; $\delta = \delta' = 0^\circ$

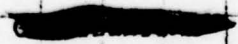


FIGURE 11d

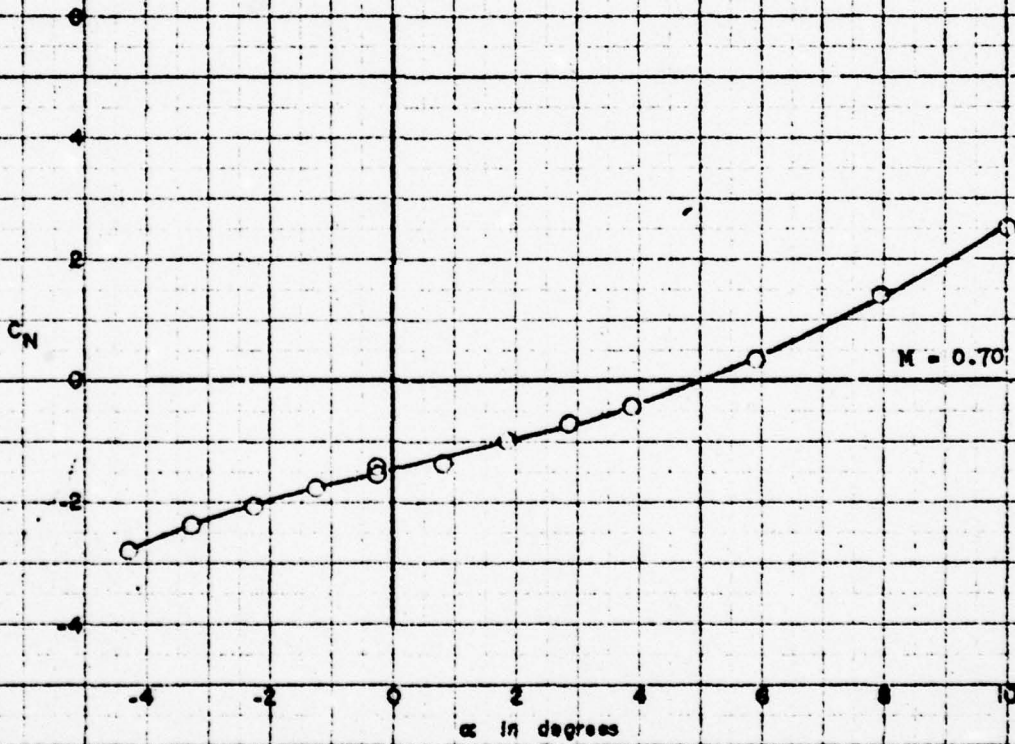
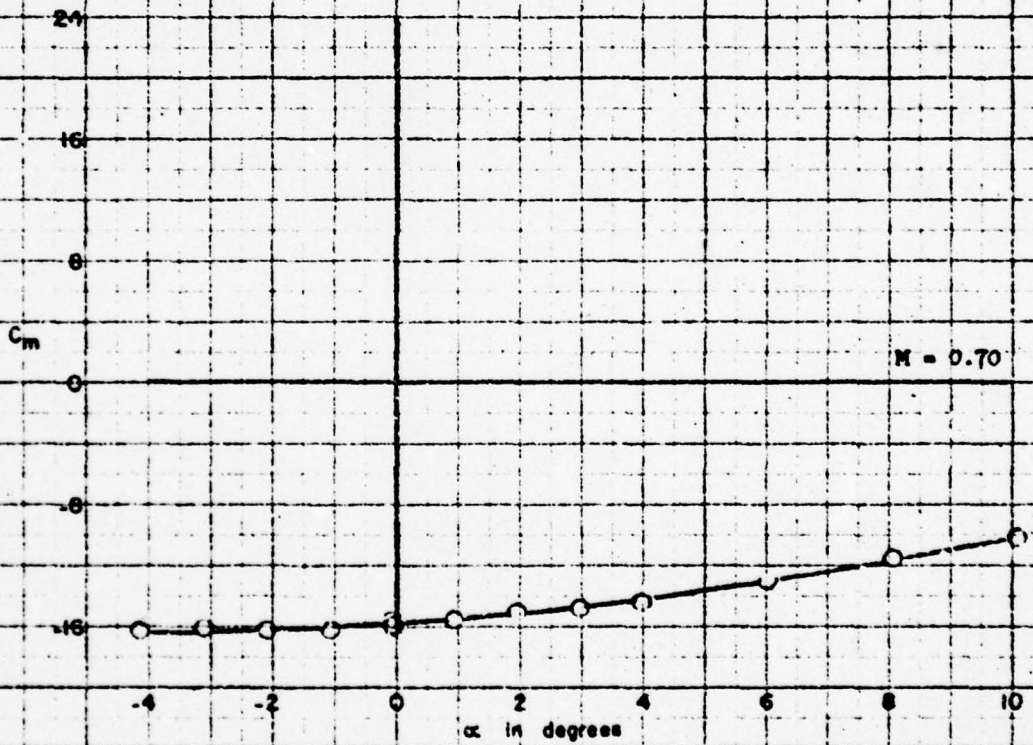
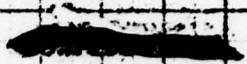


Figure 11 (Continued)

(d) Continued

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FIGURE 11d (cont.)



M = 0.70

Figure 11 (Continued)
(d) Concluded

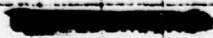


FIGURE 11d (concl

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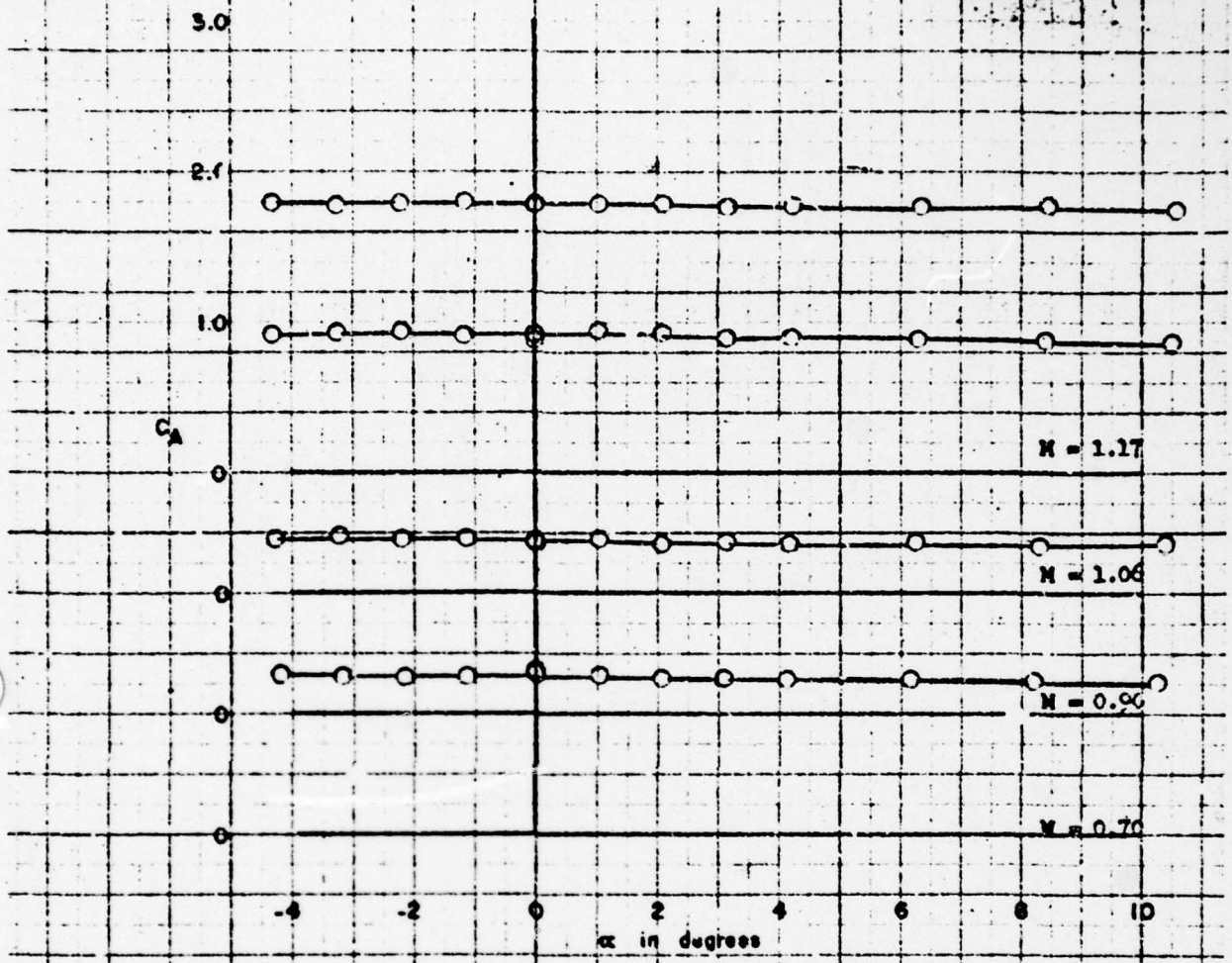
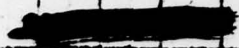


Figure 11 (Continued)

(e) $\phi = -45^\circ$; $i = 1^\circ - 0^\circ$; $\delta = 6^\circ - 5^\circ$

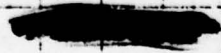


FIGURE 11e

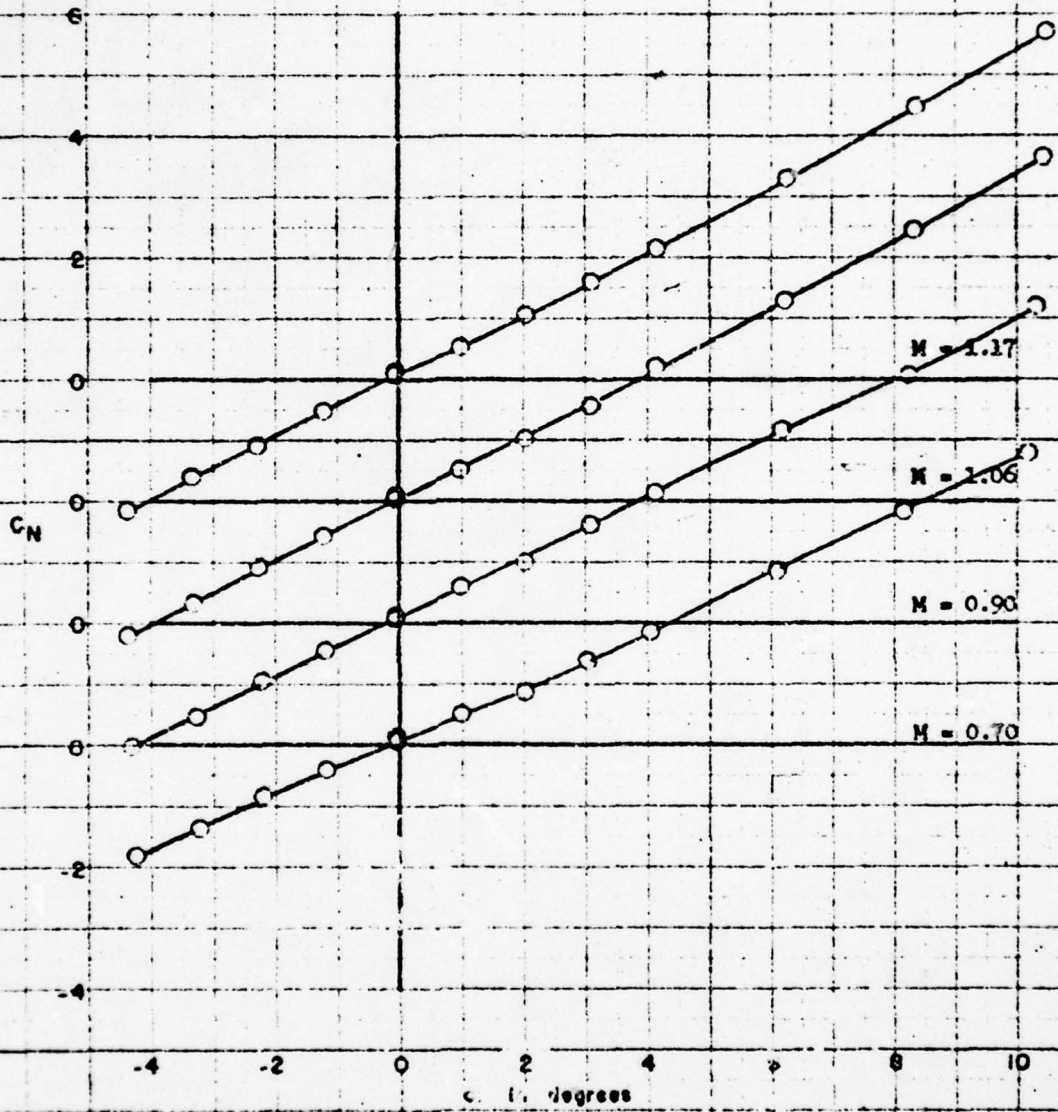


Figure 11 (Continued)

(c) Continued

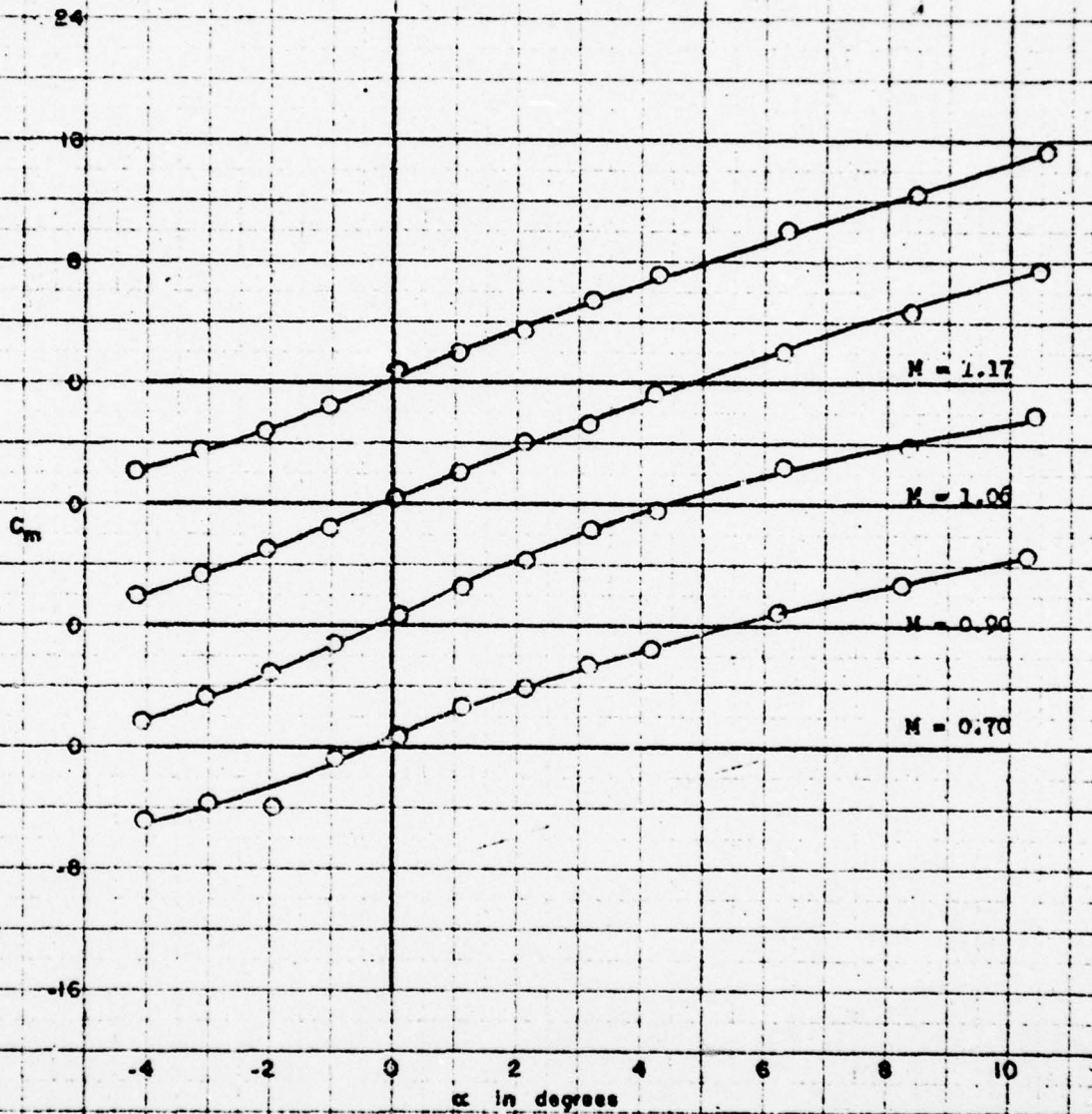


Figure 11 (Continued)

(e) Continued

FIGURE 11e (cont)

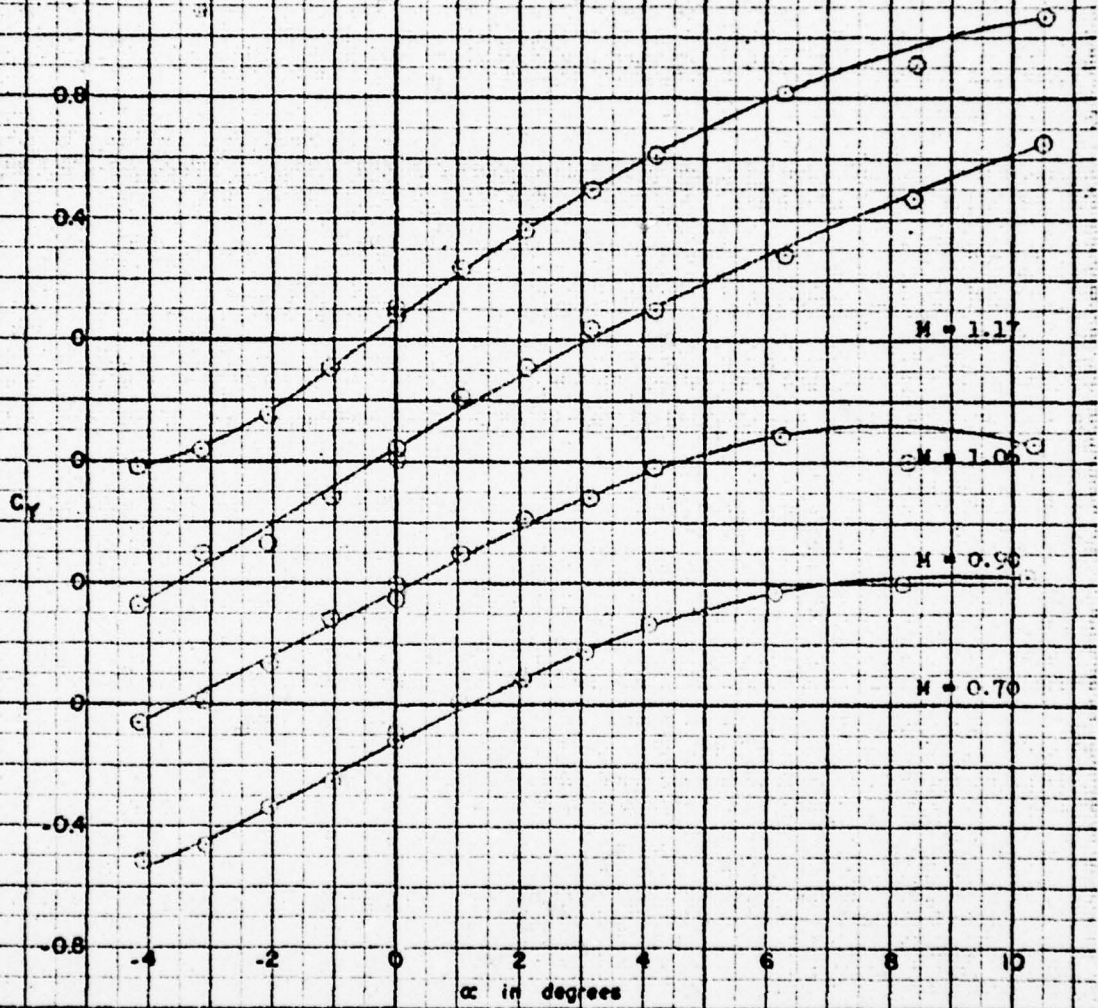


Figure 11 (Continued)
(e) Continued

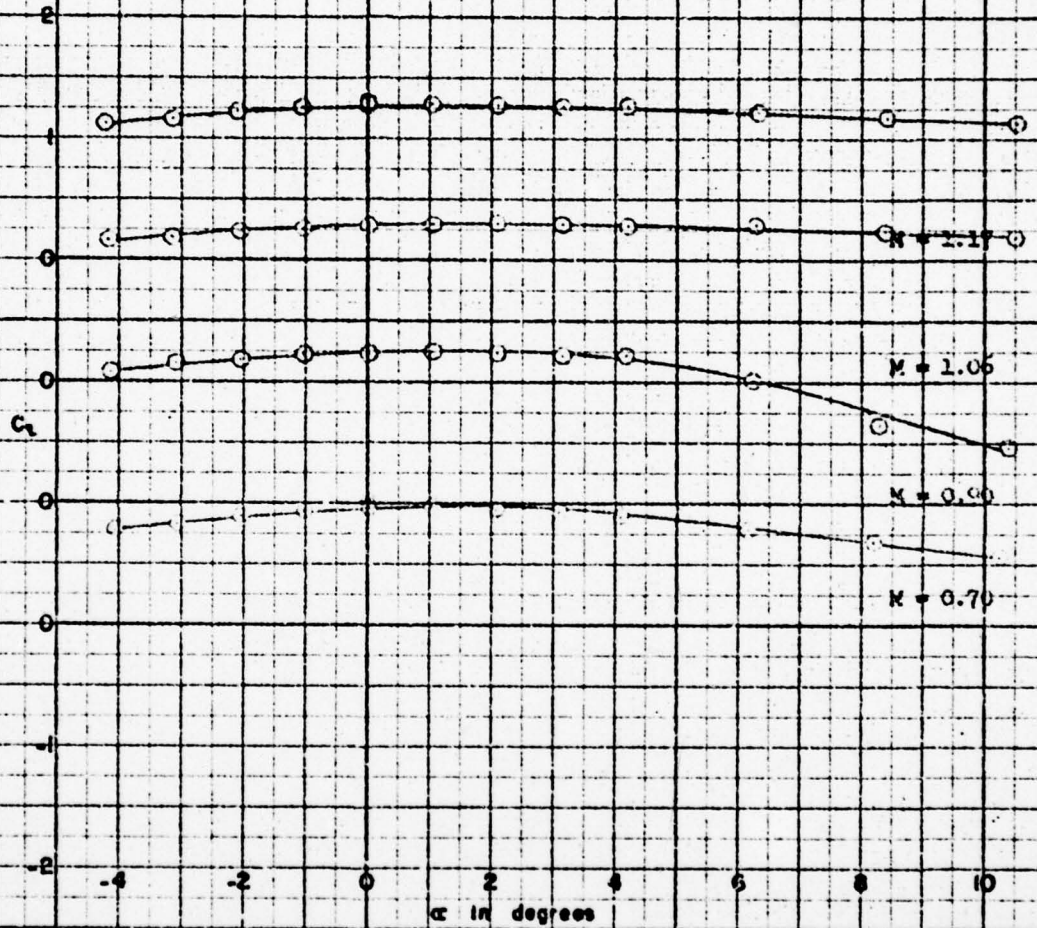


Figure 11 (Continued)

(a) Continued

FIGURE 11e (cont)

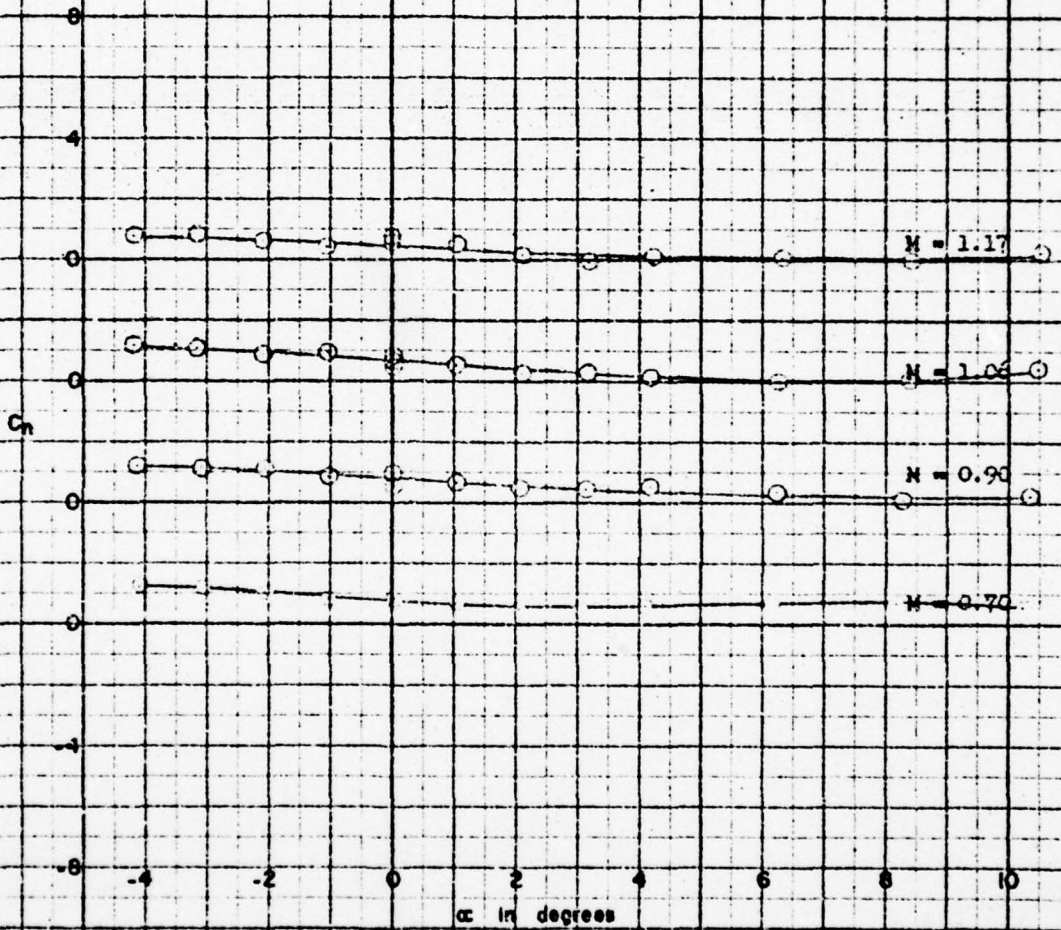
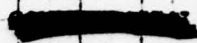


Figure 11 (Continued)
(e) Concluded



FIGURE 11e (concl)



Figure 11 (Continued)
(F) $\phi = 0^\circ$; $i = i' = 0^\circ$; $\delta = \delta' = 0^\circ$

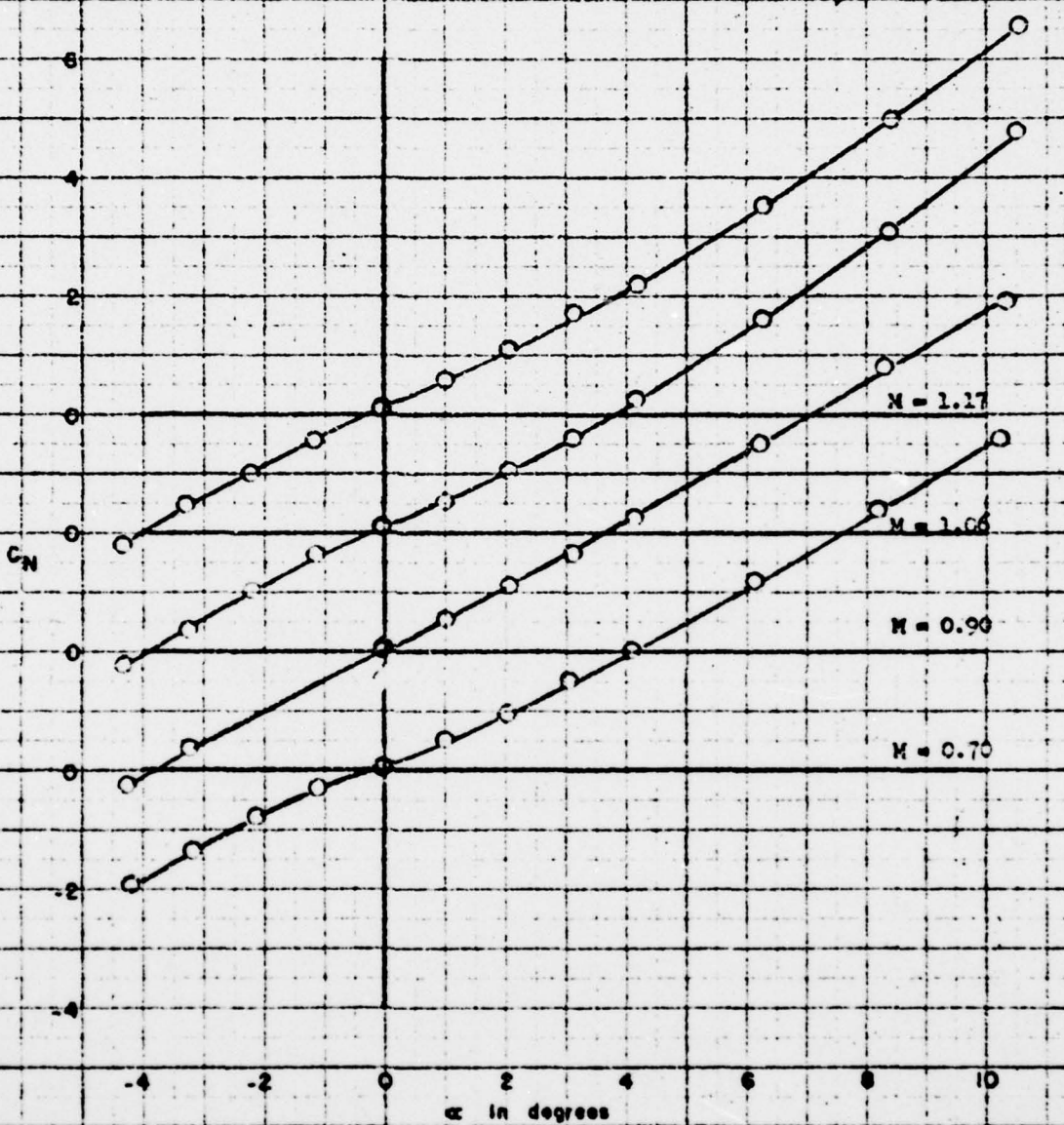


Figure 11 (Continued)

(f) Continued

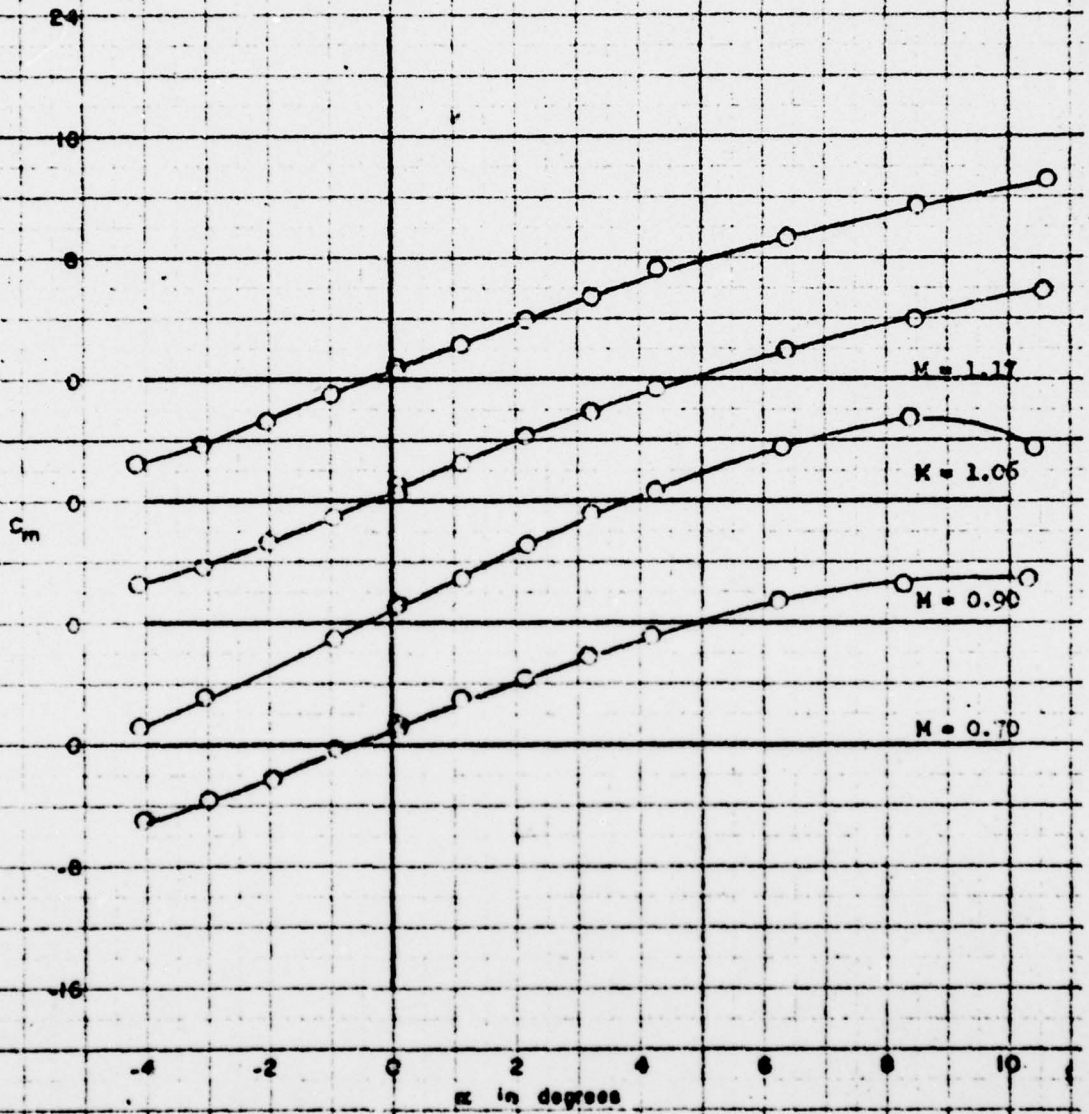


Figure II (Continued)
(f) Concluded

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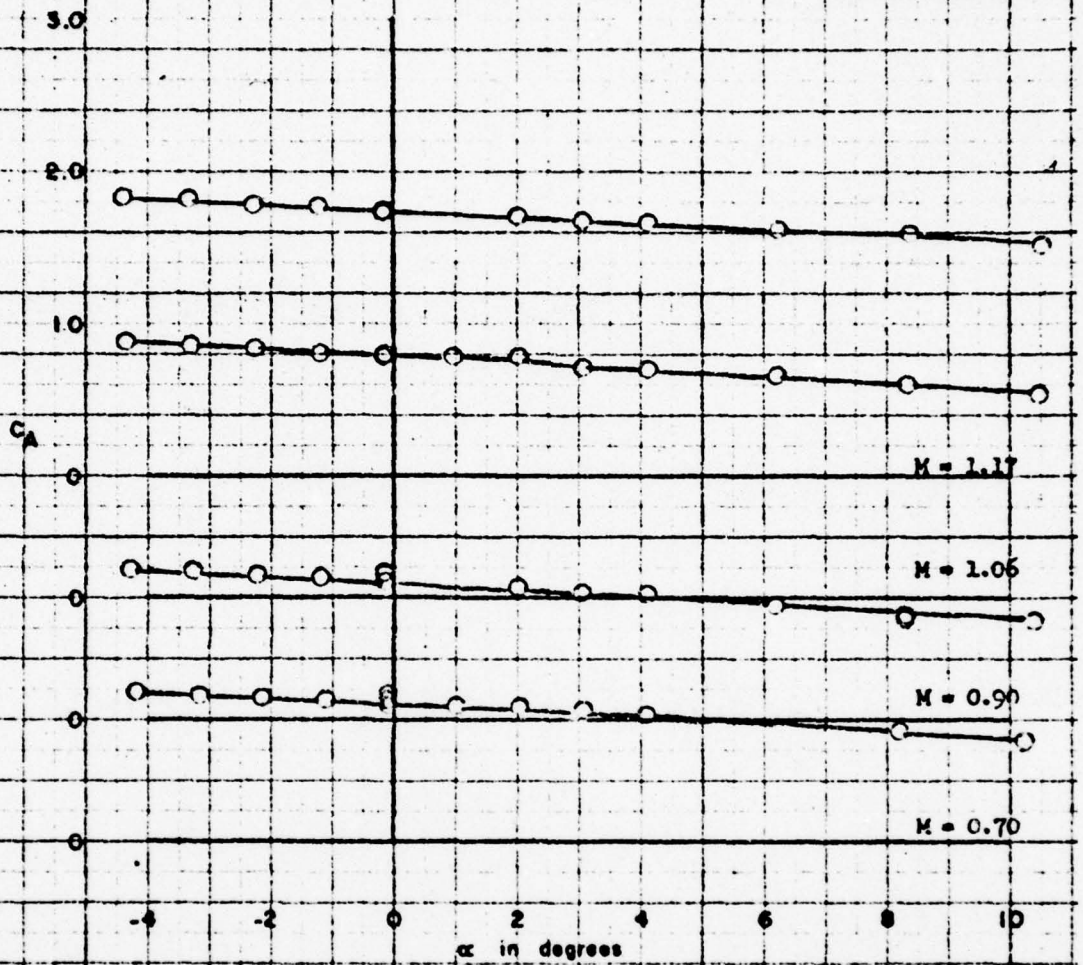


Figure 11 (Continued)

(g) $\phi = 0^\circ$; $i = -5^\circ$, $i' = 0^\circ$; $\delta = \delta' = 0^\circ$

FIGURE 11g

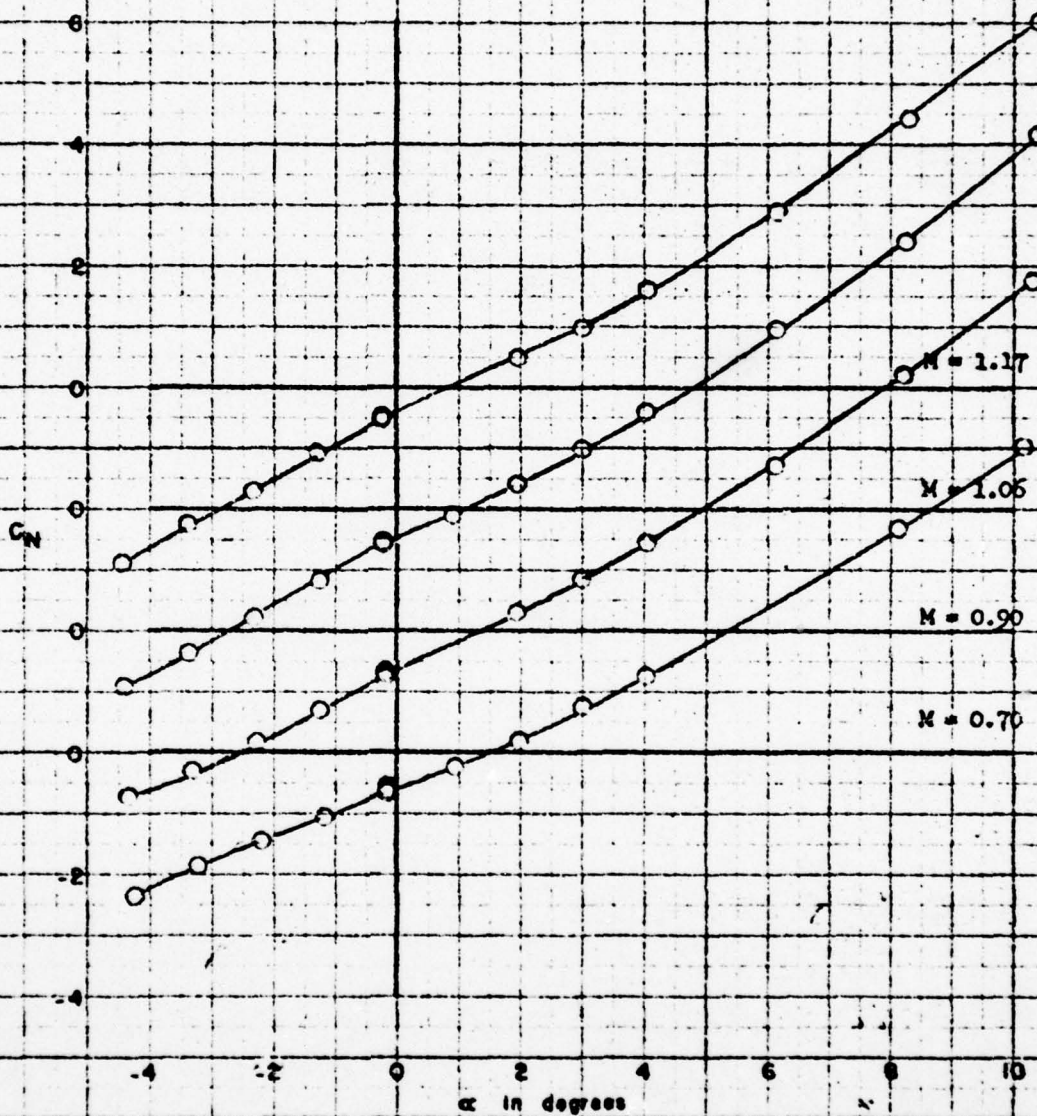


Figure 11 (Continued)
(g) Continued

FIGURE 11g (cont)

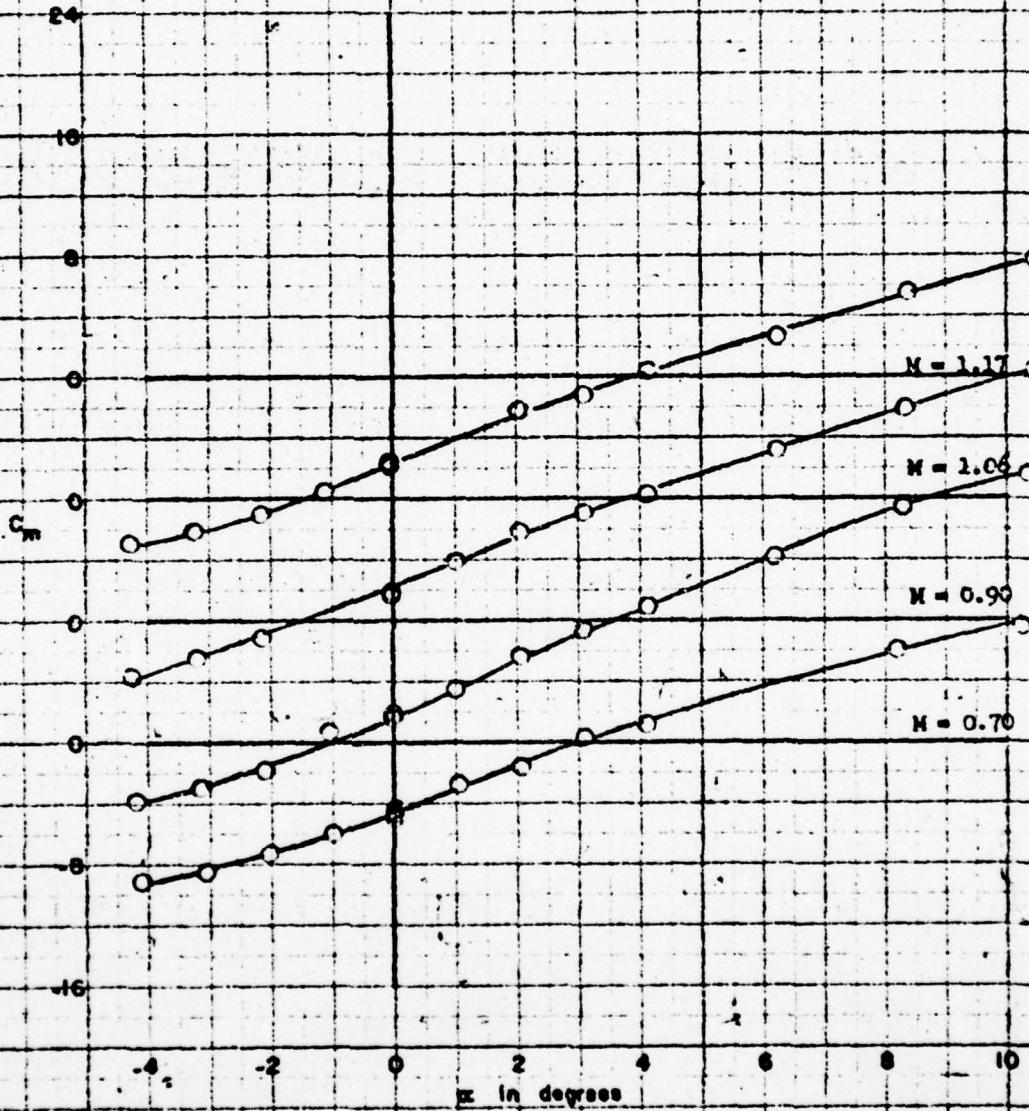


Figure 11 (Continued)

(g) Concluded

FIGURE 11g (concl)

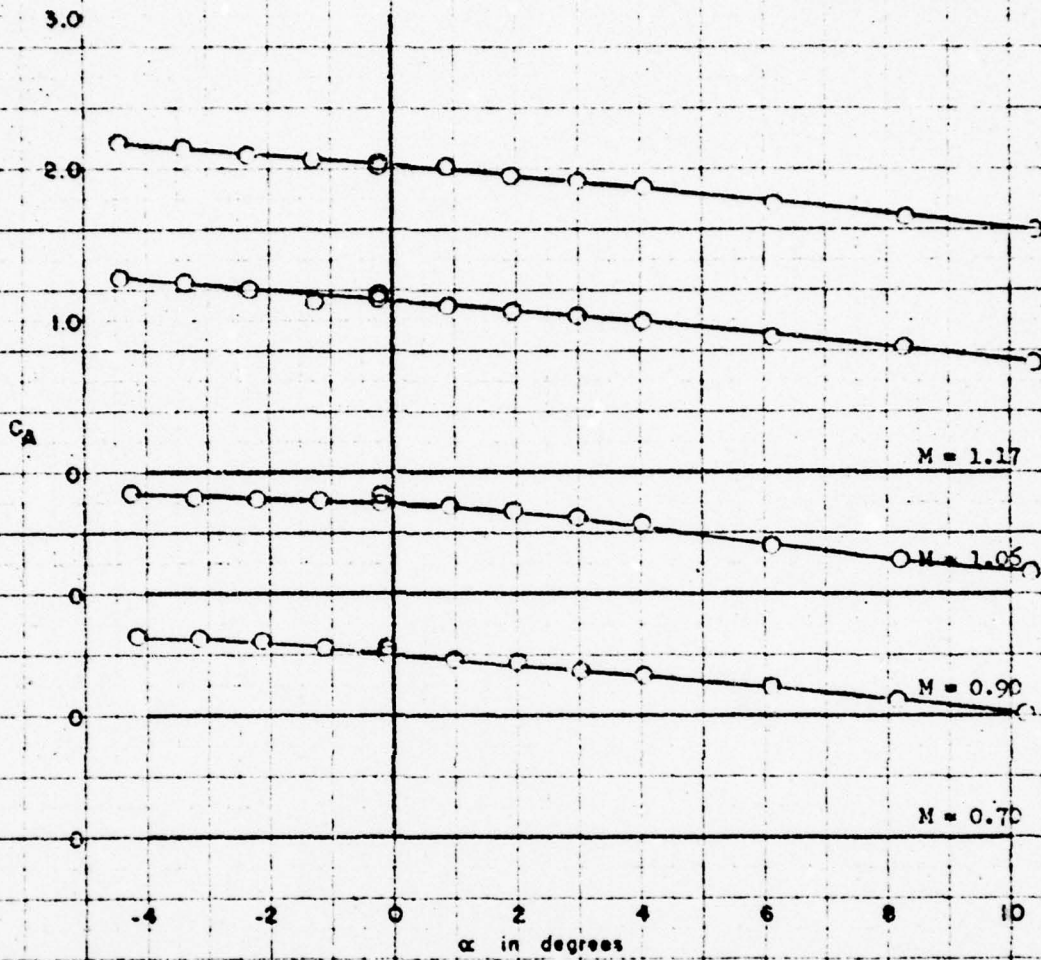


Figure 11 (Continued)

(h) $\phi = 0^\circ$; $i = -10^\circ$, $i' = 0^\circ$; $\delta = \delta' = 0^\circ$

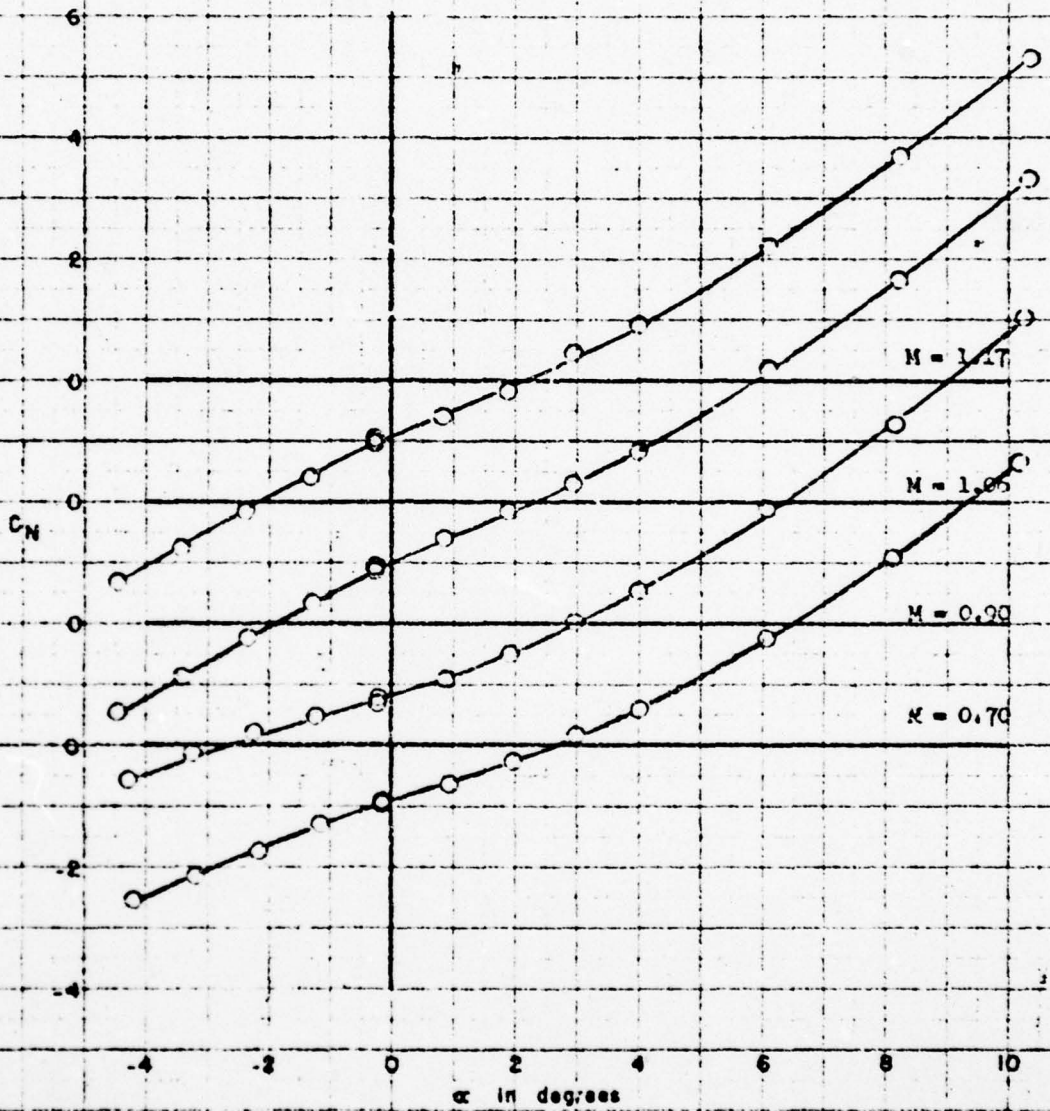


Figure 11 (Continued)
(h) Continued

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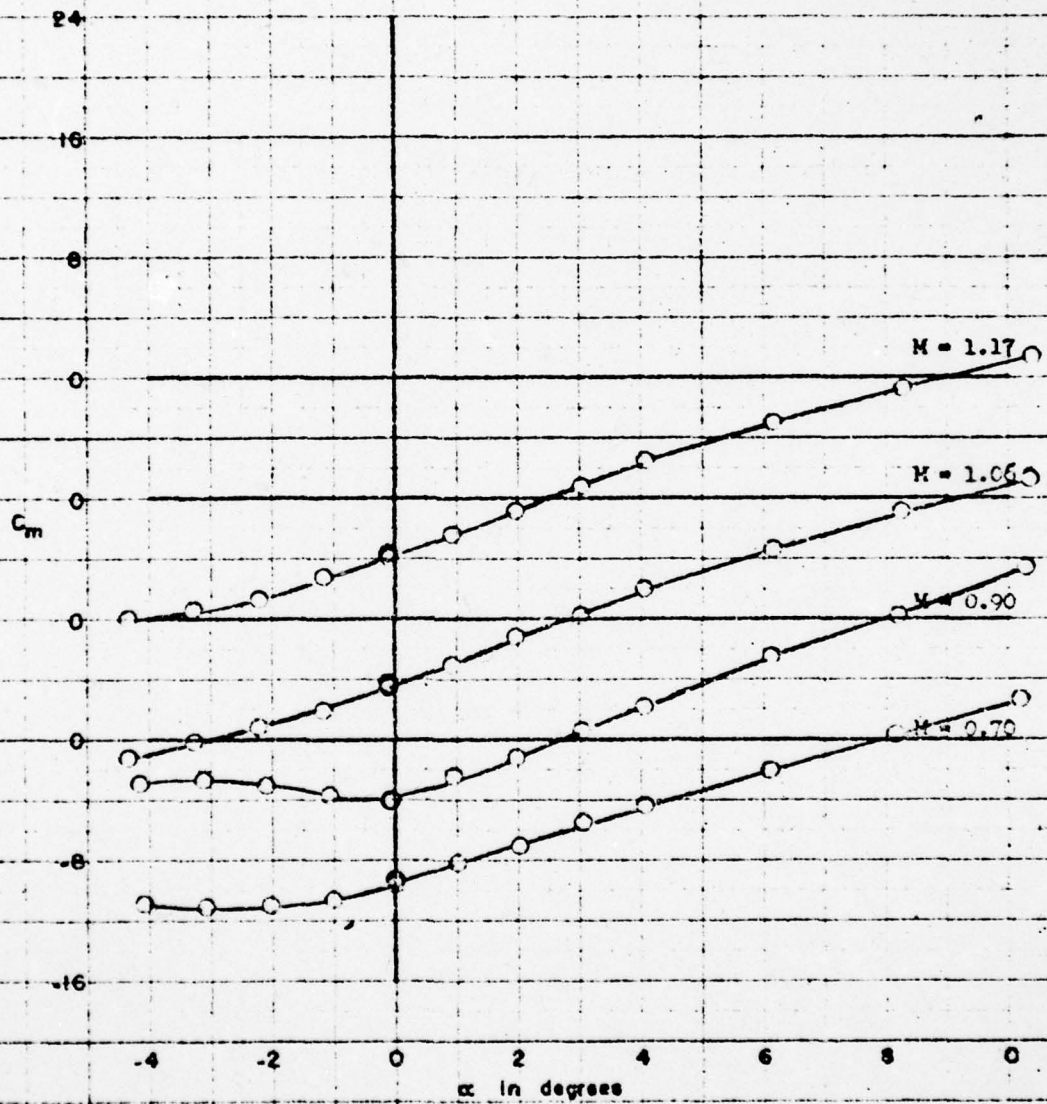


Figure 11 (Concluded)

(h) Concluded

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FIGURE 11h (concl)

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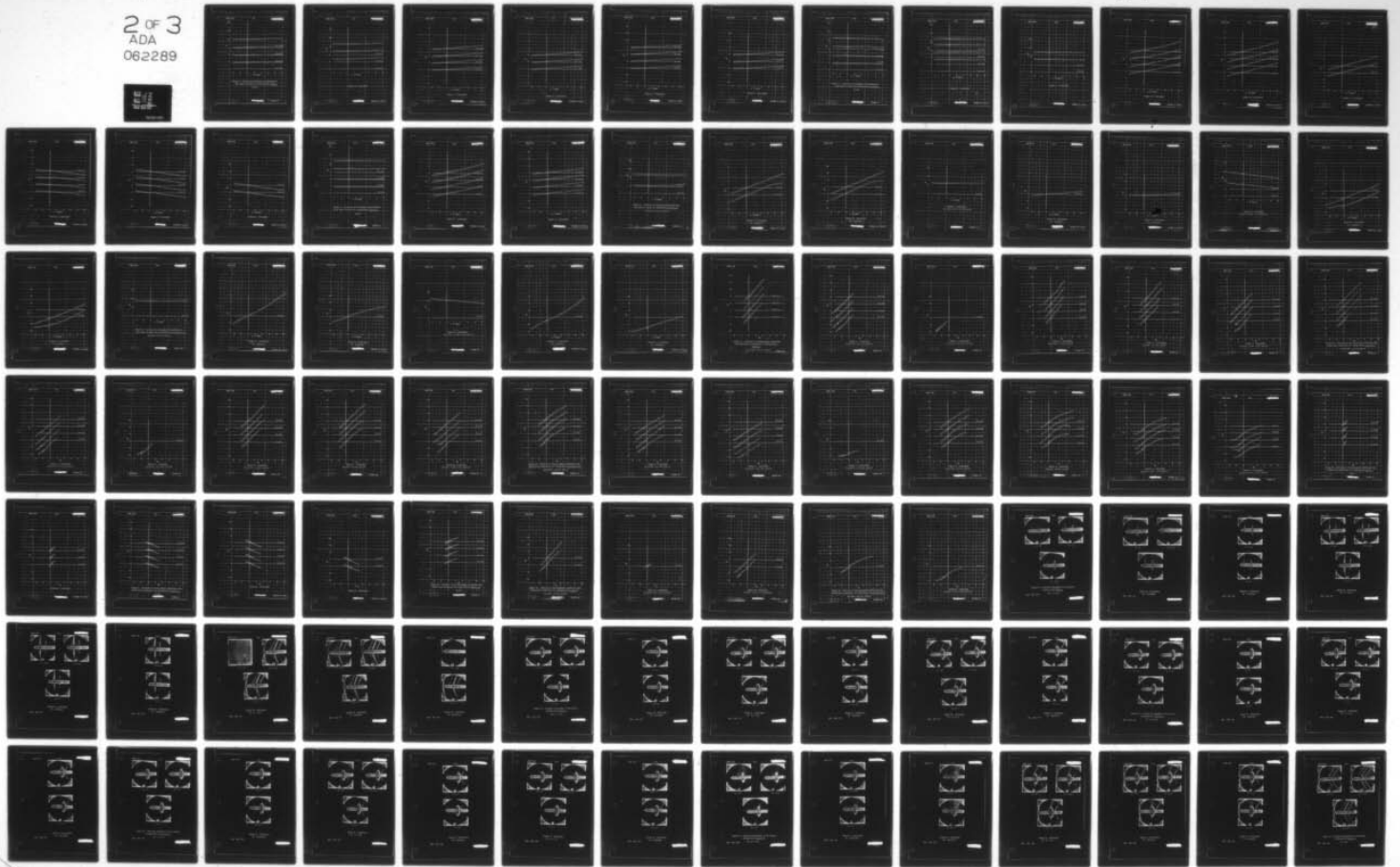
DAVID TAYLOR MODEL BASIN WASHINGTON D C AERODYNAMICS LAB F/G 16/4.2
TRANSONIC WIND-TUNNEL TESTS OF A 1/15-SCALE MODEL OF THE TALOS --ETC(U)
MAR 61 M E MCDONALD

UNCLASSIFIED

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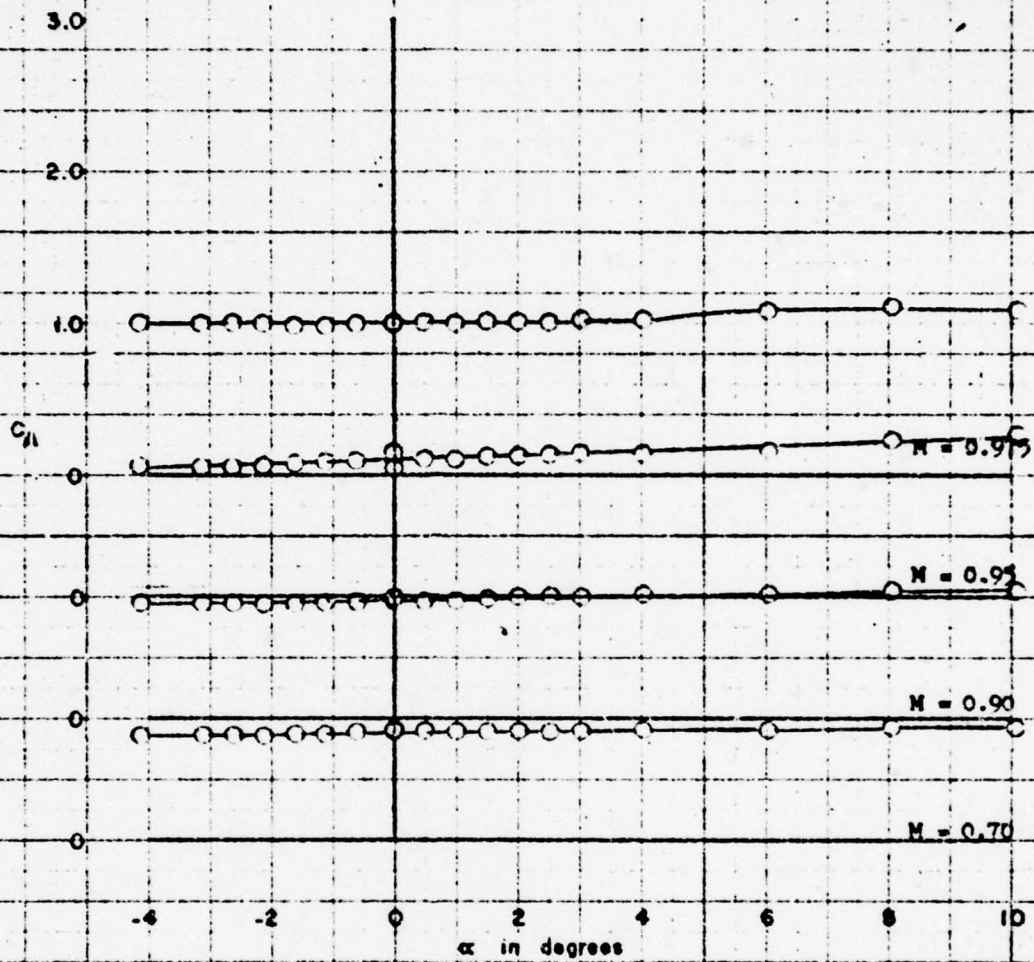


Figure 12 - Variation of Aerodynamic Characteristics
With Angle of Attack for Configuration $B_{22}R_5H_{10}$

$\phi = -45^\circ$

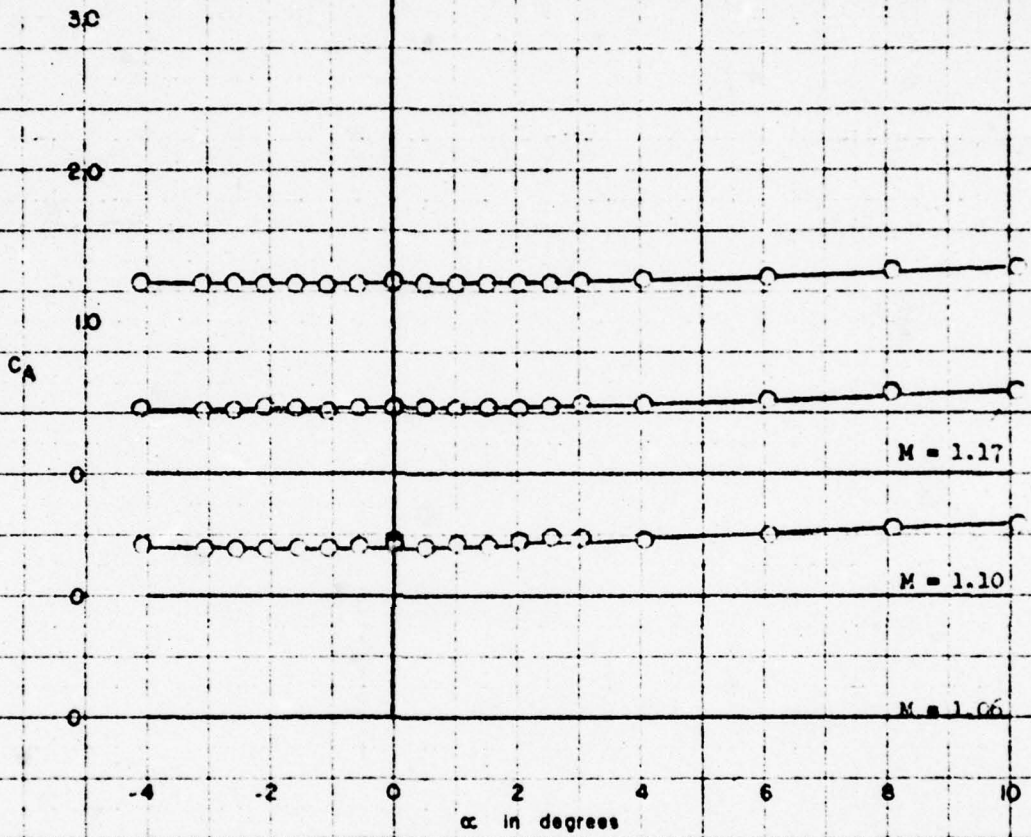
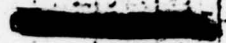
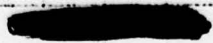


Figure 12 (Continued)

FIGURE 12 (cont)



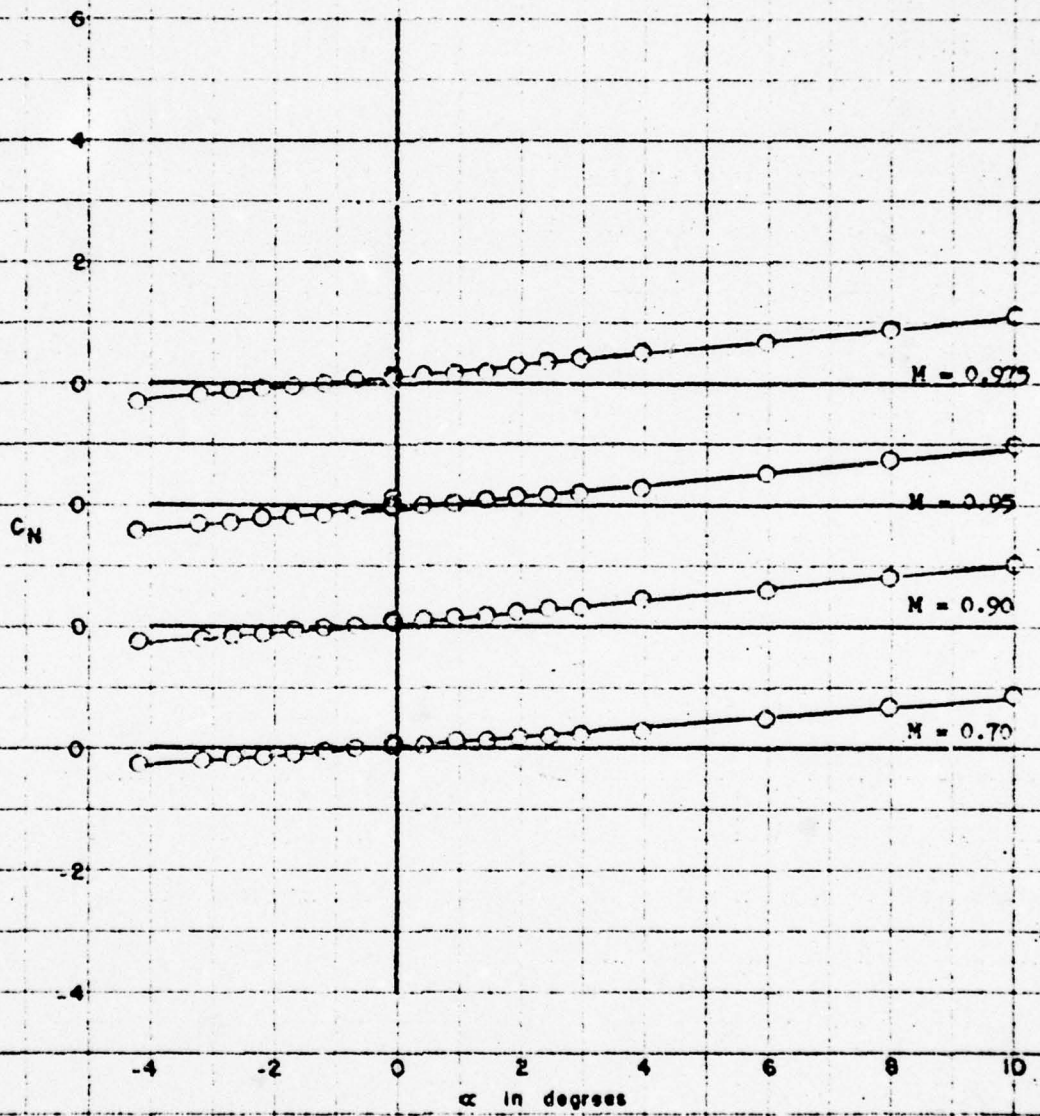
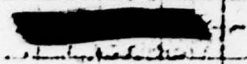


Figure 12 (Continued)

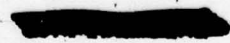


FIGURE 12 (cont)

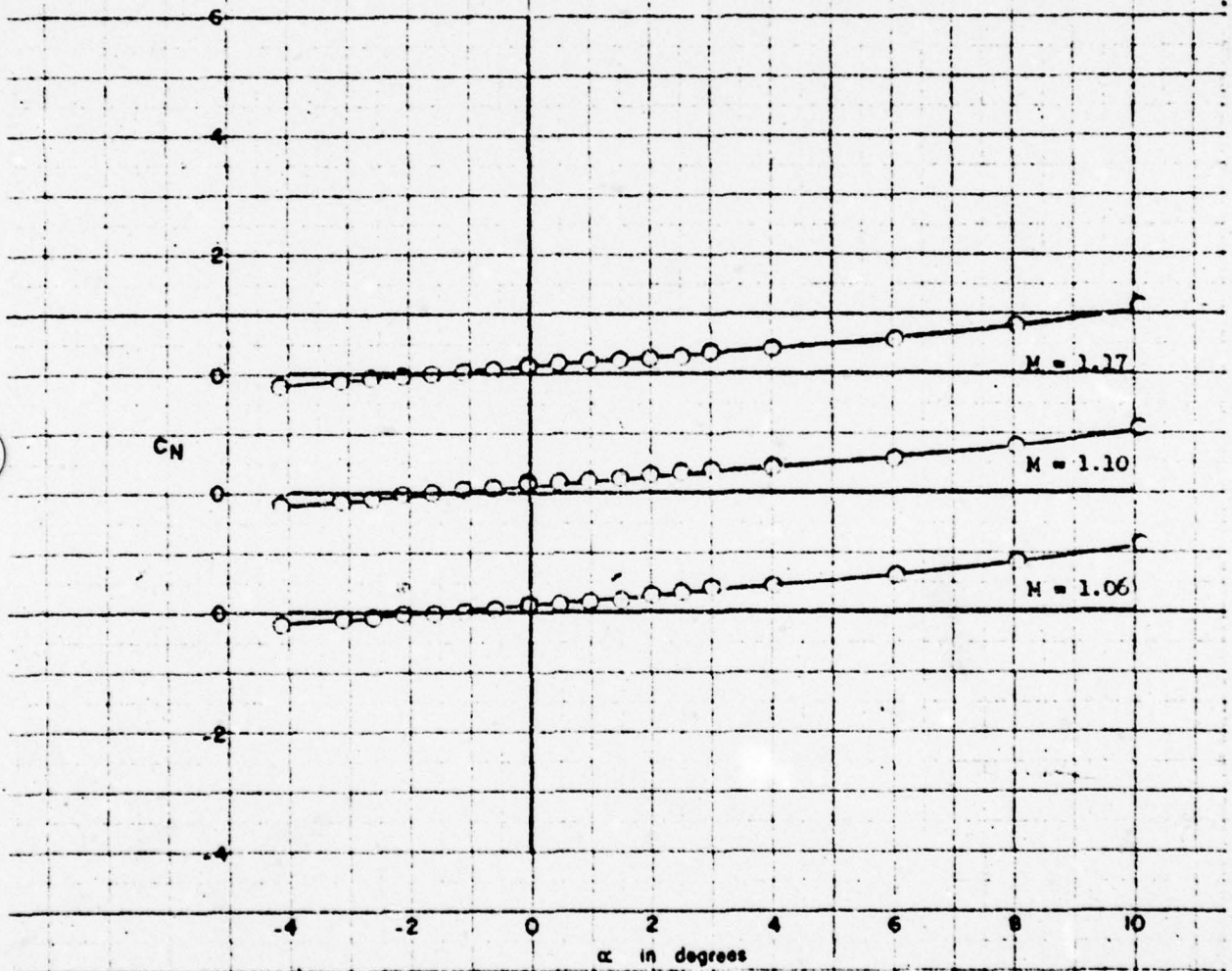
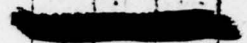


Figure 12 (Continued)

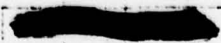


FIGURE 12 (cont)

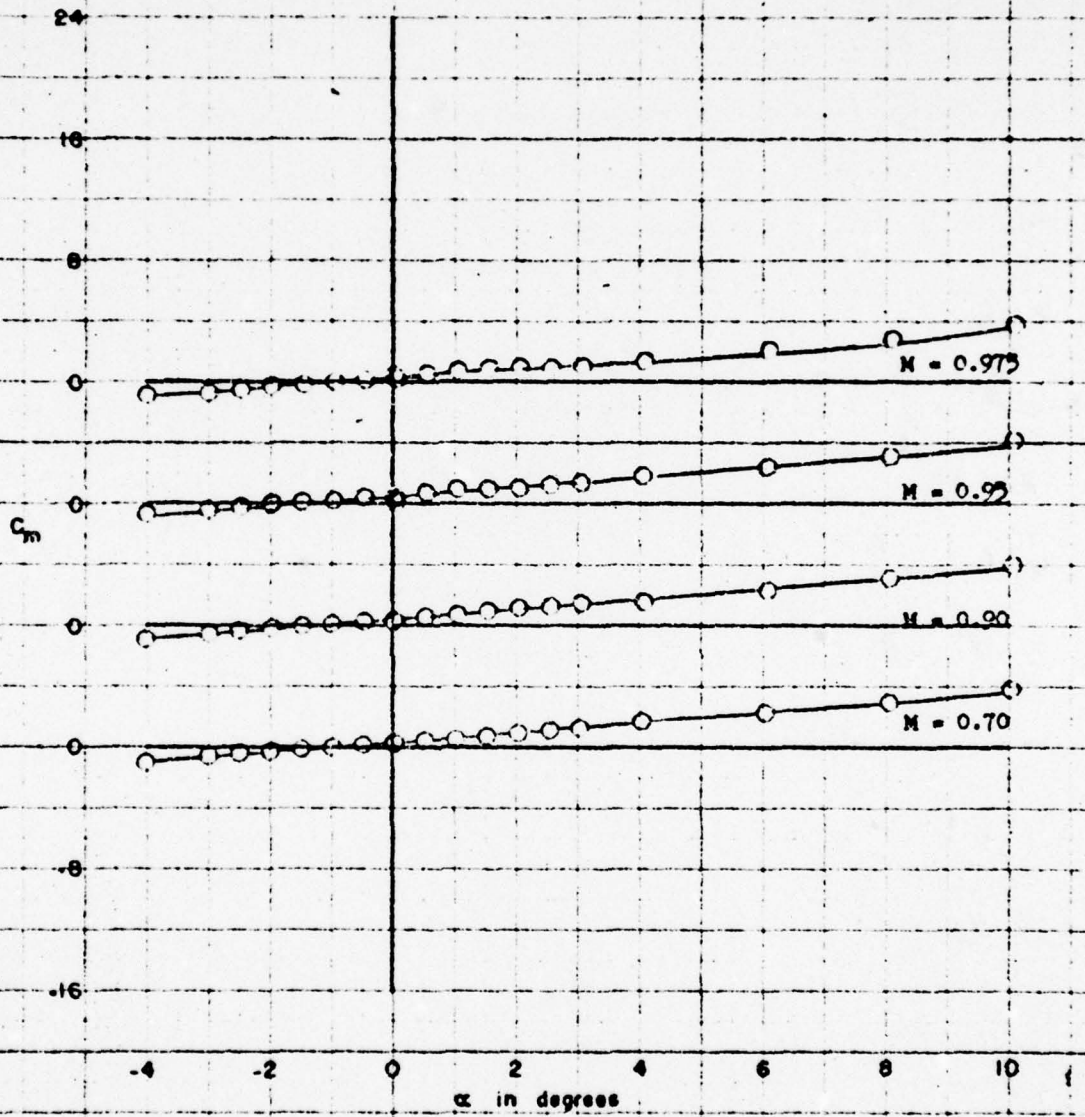


Figure 12 (Continued)

FIGURE 12 (cont)

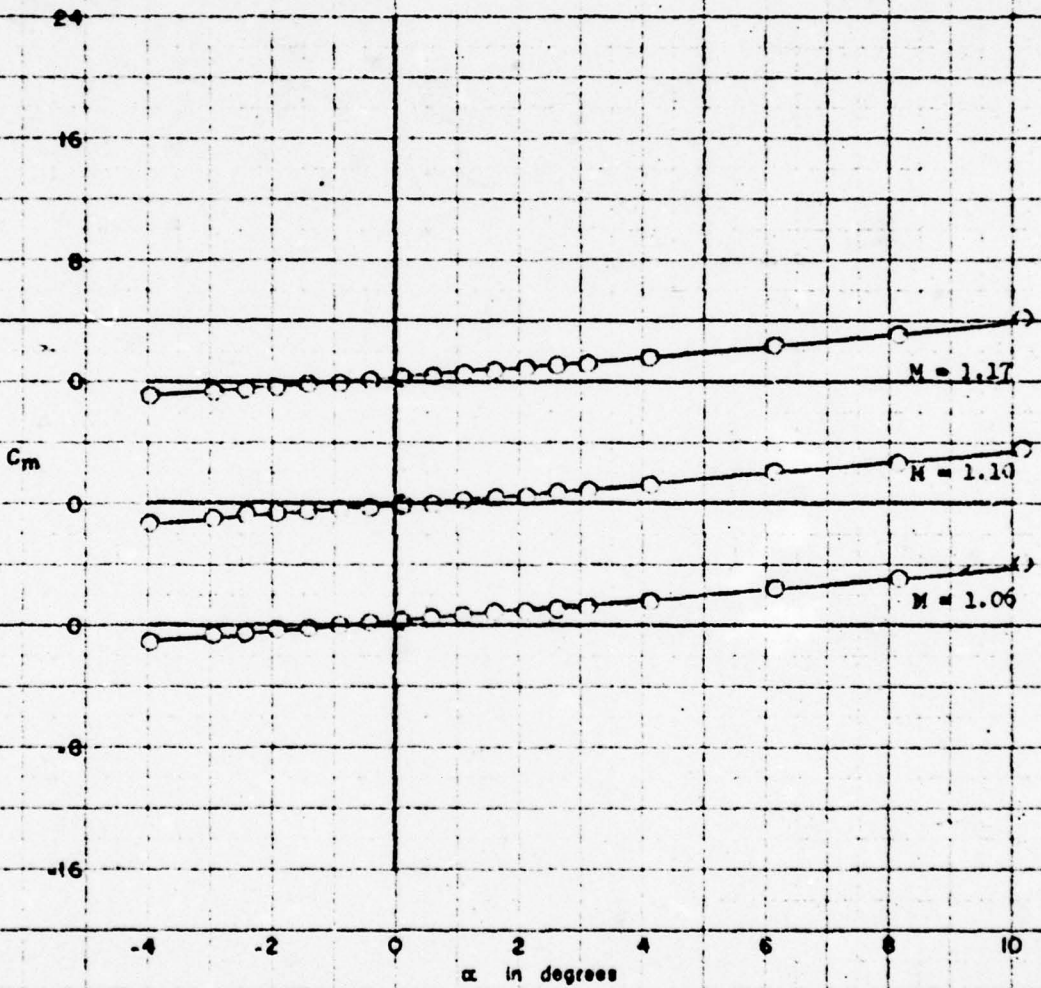
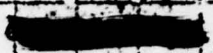


Figure 12 (Concluded)

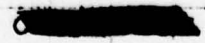


FIGURE 12 (concl)

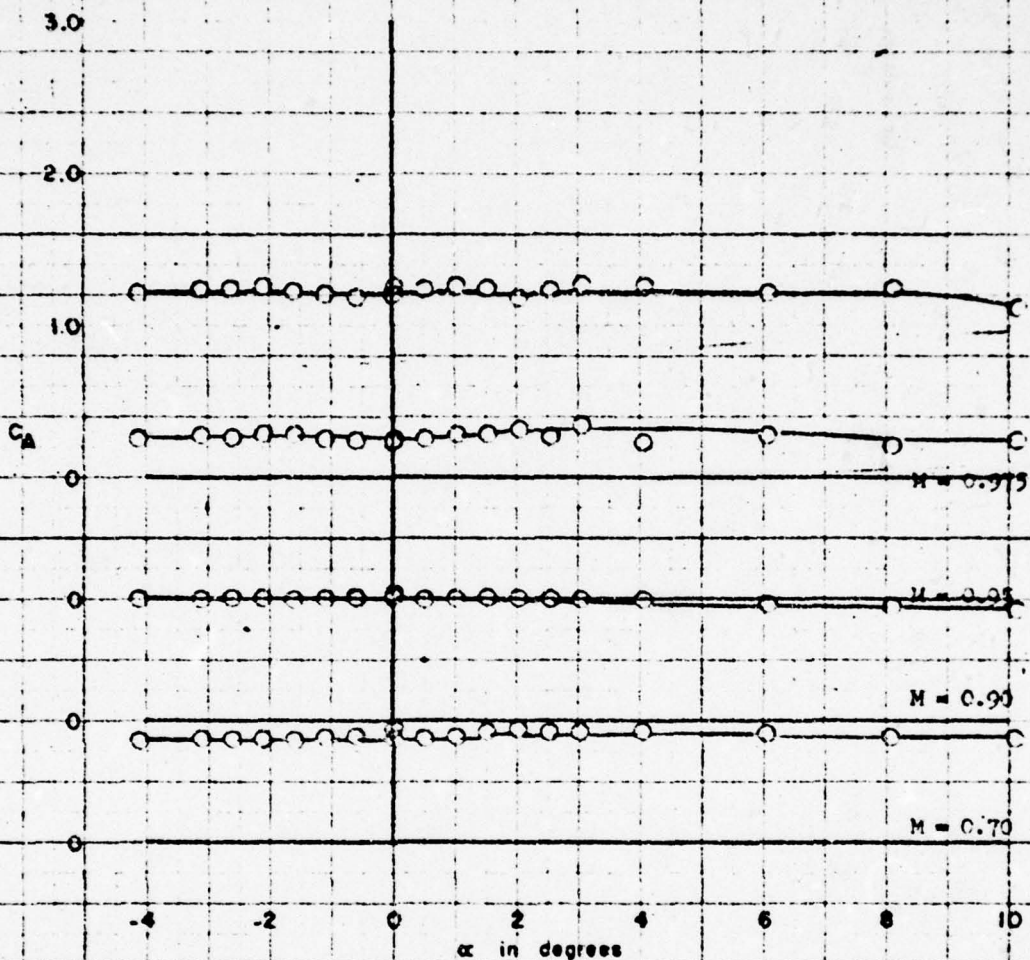


Figure 13 - Variation of Aerodynamic Characteristics
With Angle of Attack for Configuration B₂₂^{R.H.F.12}
 $\phi = -45^\circ$

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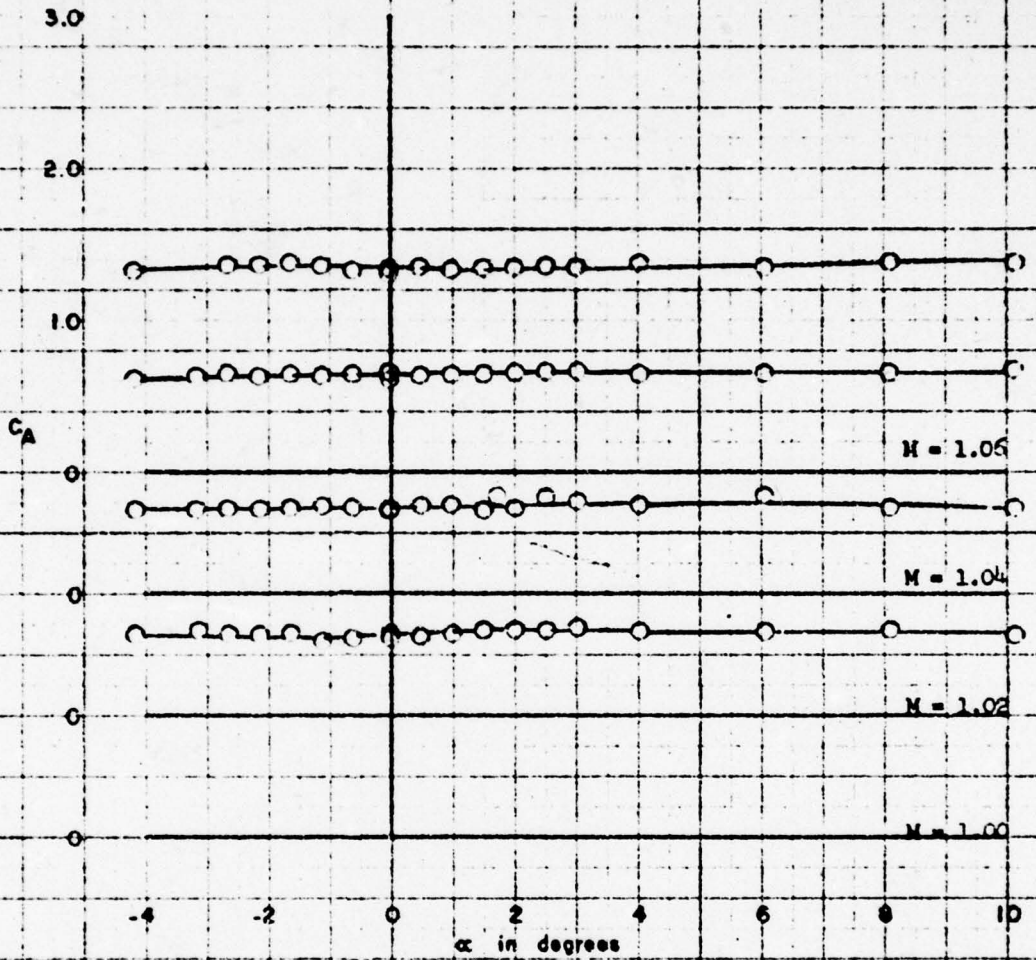


Figure 13 (Continued)

FIGURE 13 (cont)

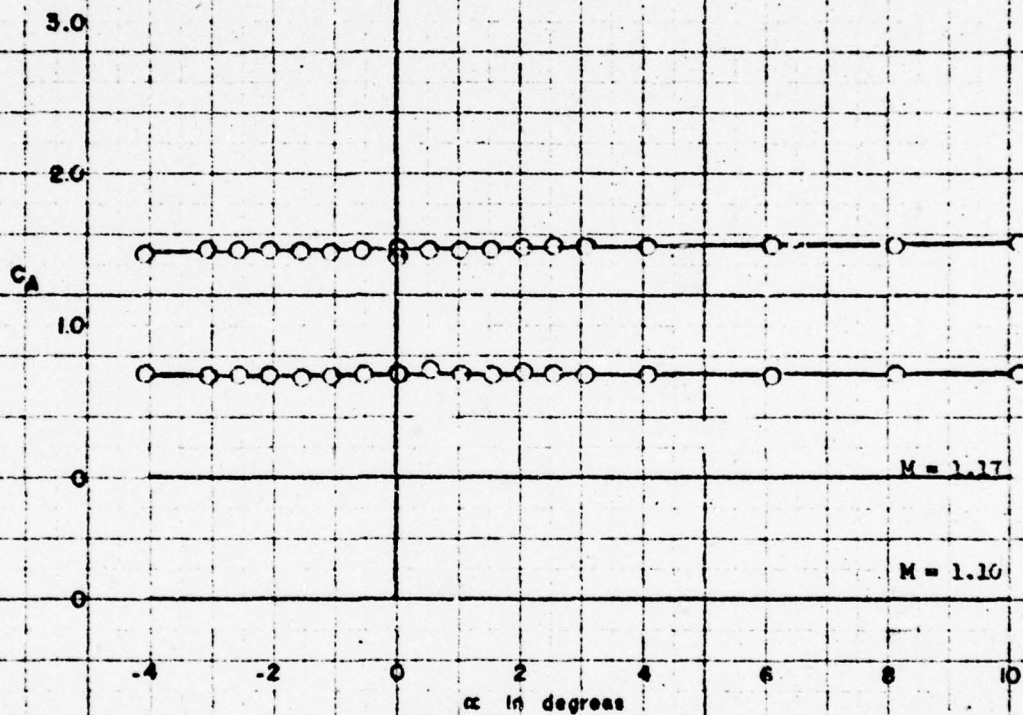


Figure 13 (Continued)

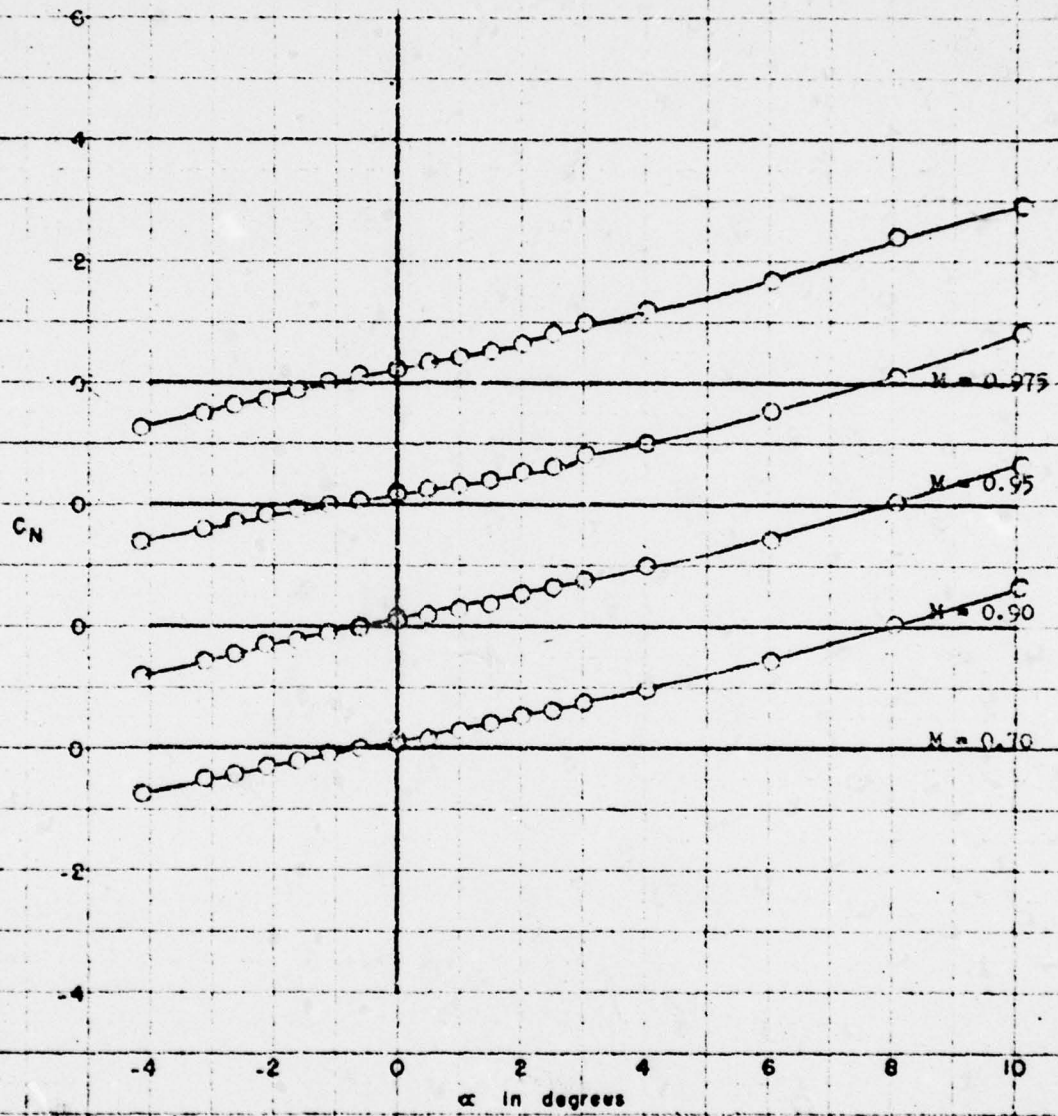


Figure 13 (Continued)

FIGURE 13 (cont)

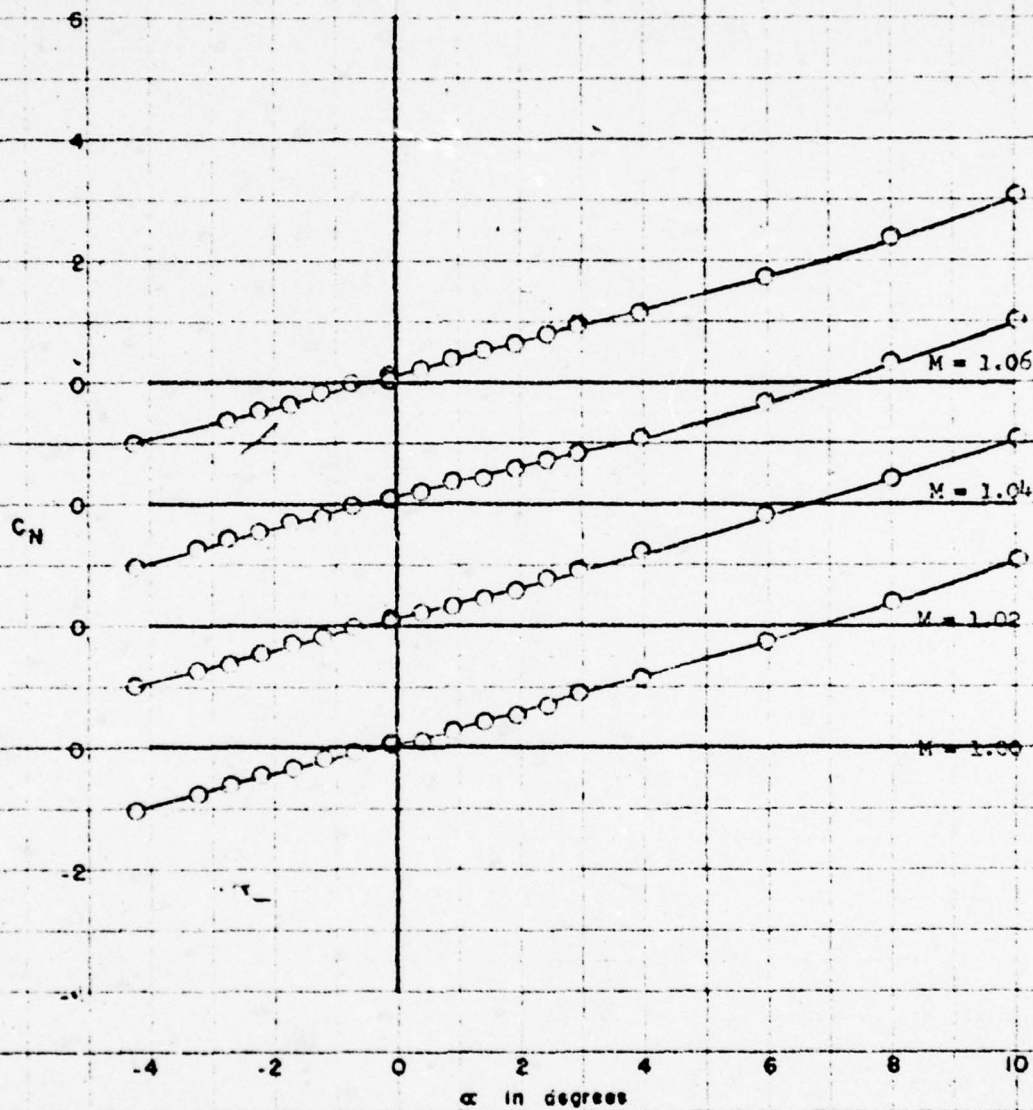


Figure 13 (Continued)

FIGURE 13 (cont)

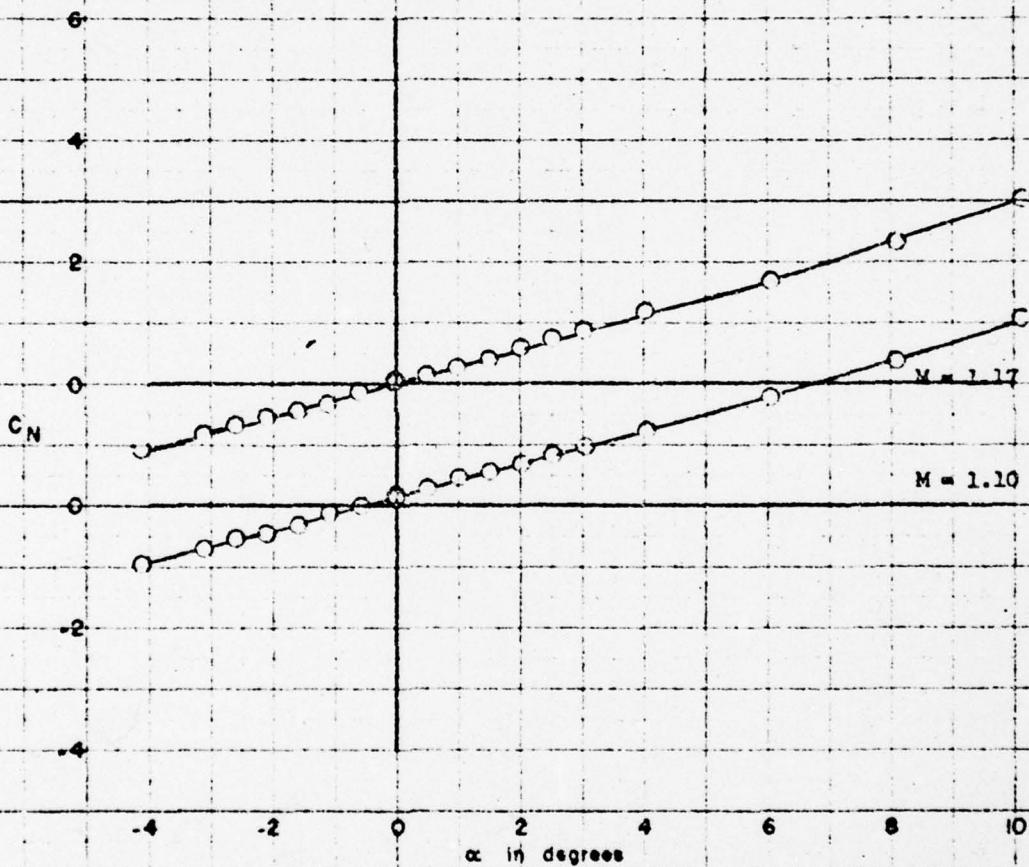
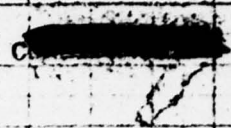


Figure 13 (Continued)

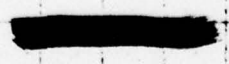


FIGURE 13 (cont)

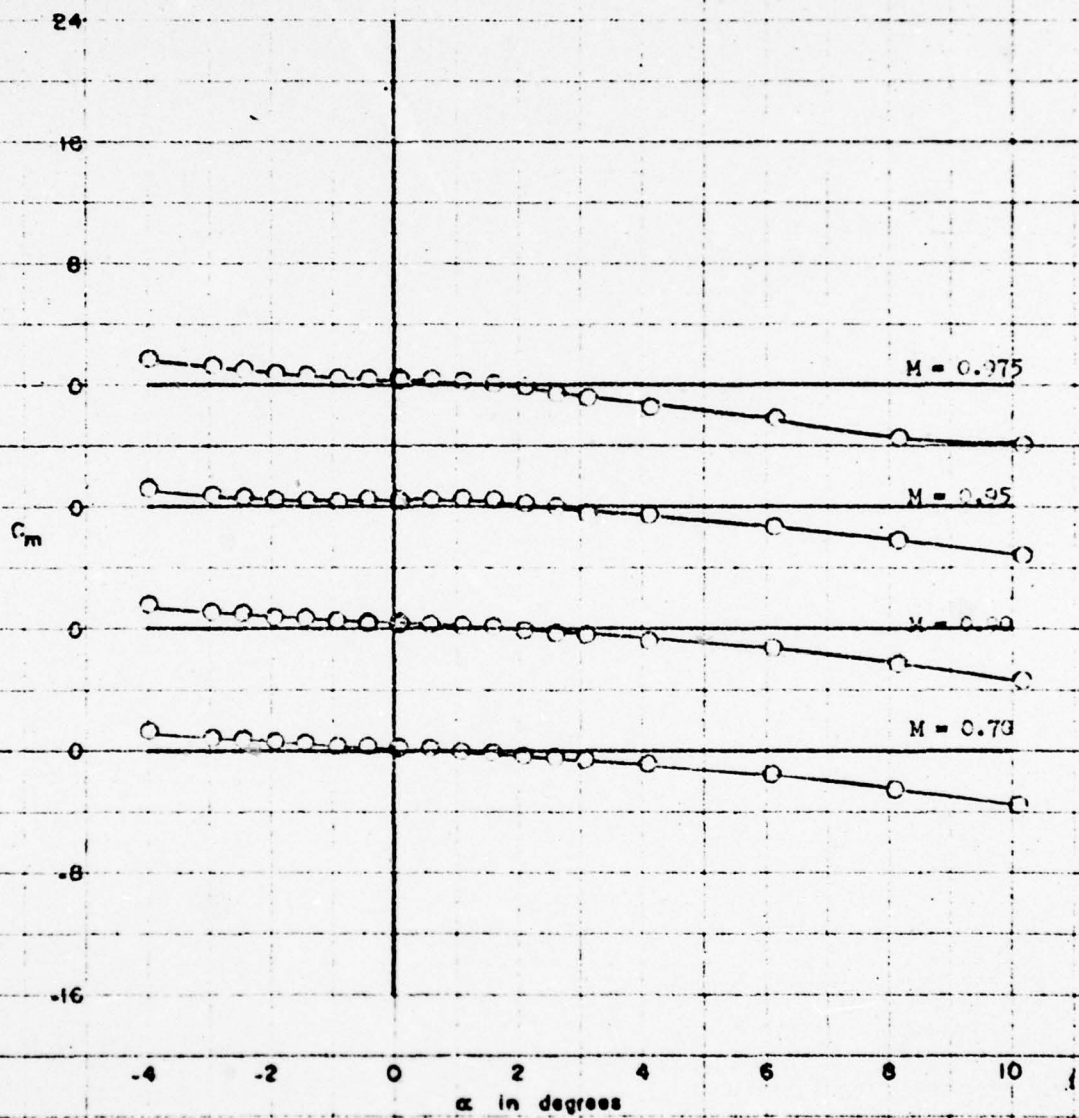


Figure 13 (Continued)

FIGURE 13 (cont)

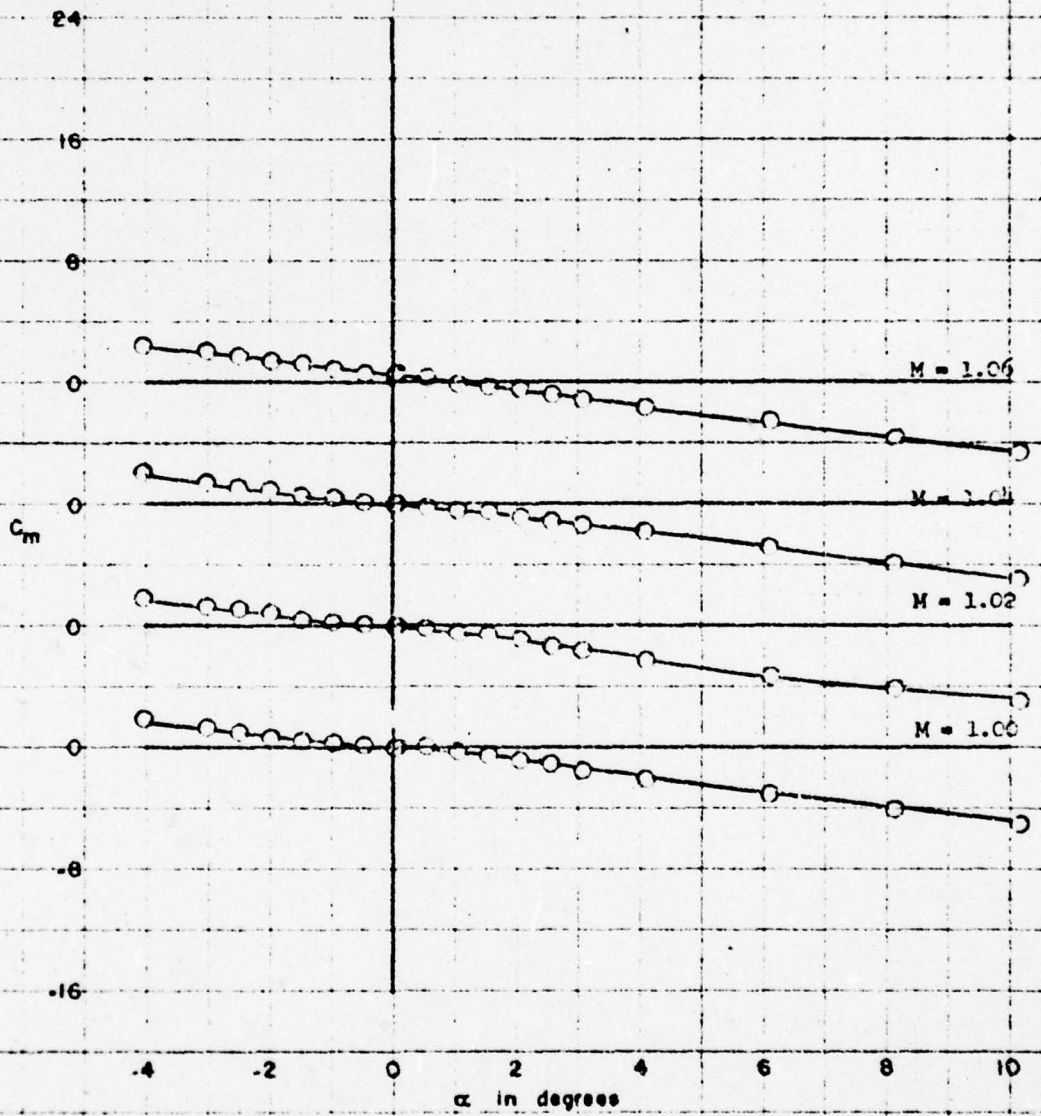


Figure 13 (Continued)

FIGURE 13 (cont)

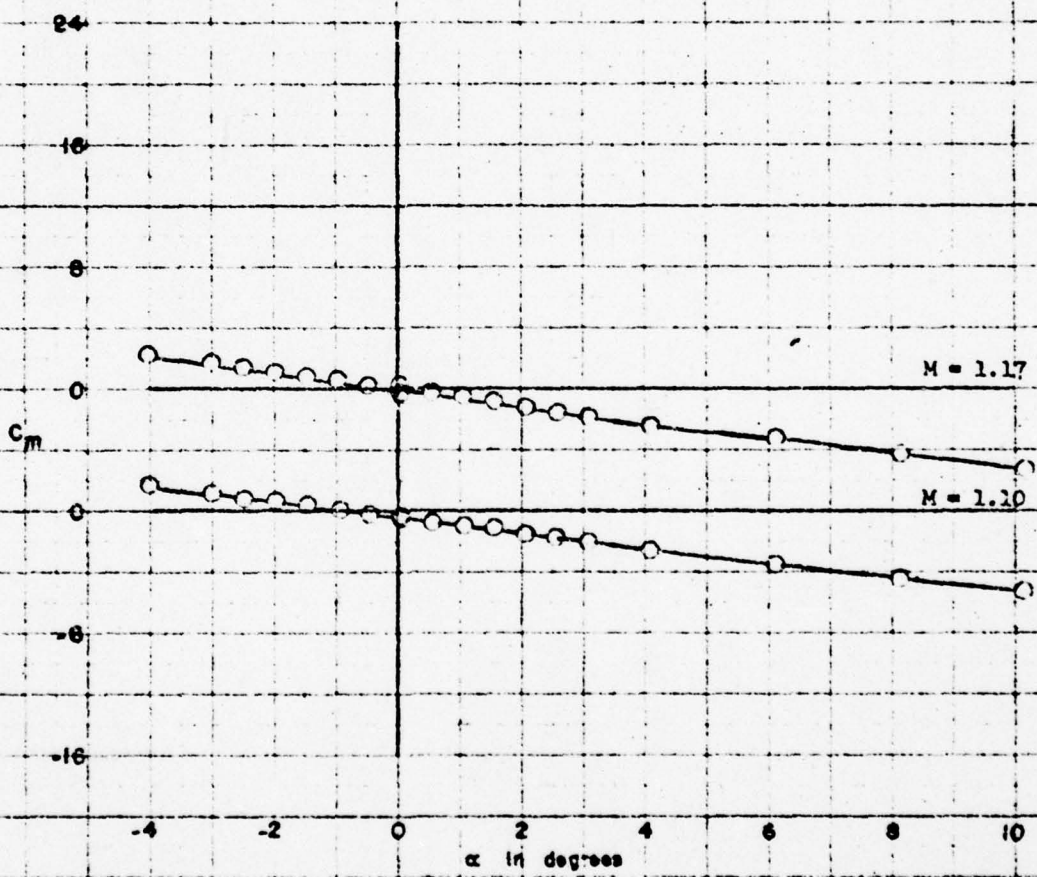


Figure 13 (Concluded)

FIGURE 13 (concl)

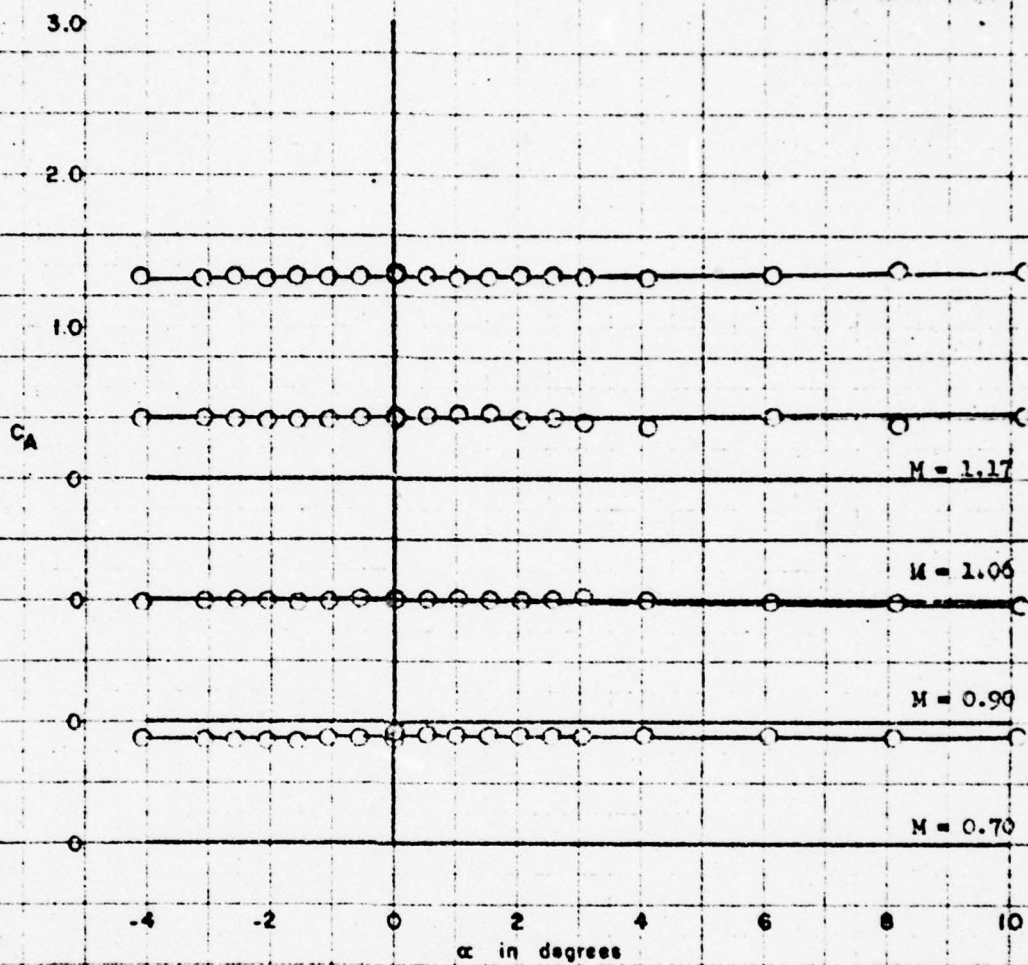


Figure 14 - Variations of Aerodynamic Characteristics With Angle of Attack for Configuration B₂₂R₅H₁₀T₁₀

◆ - 45°

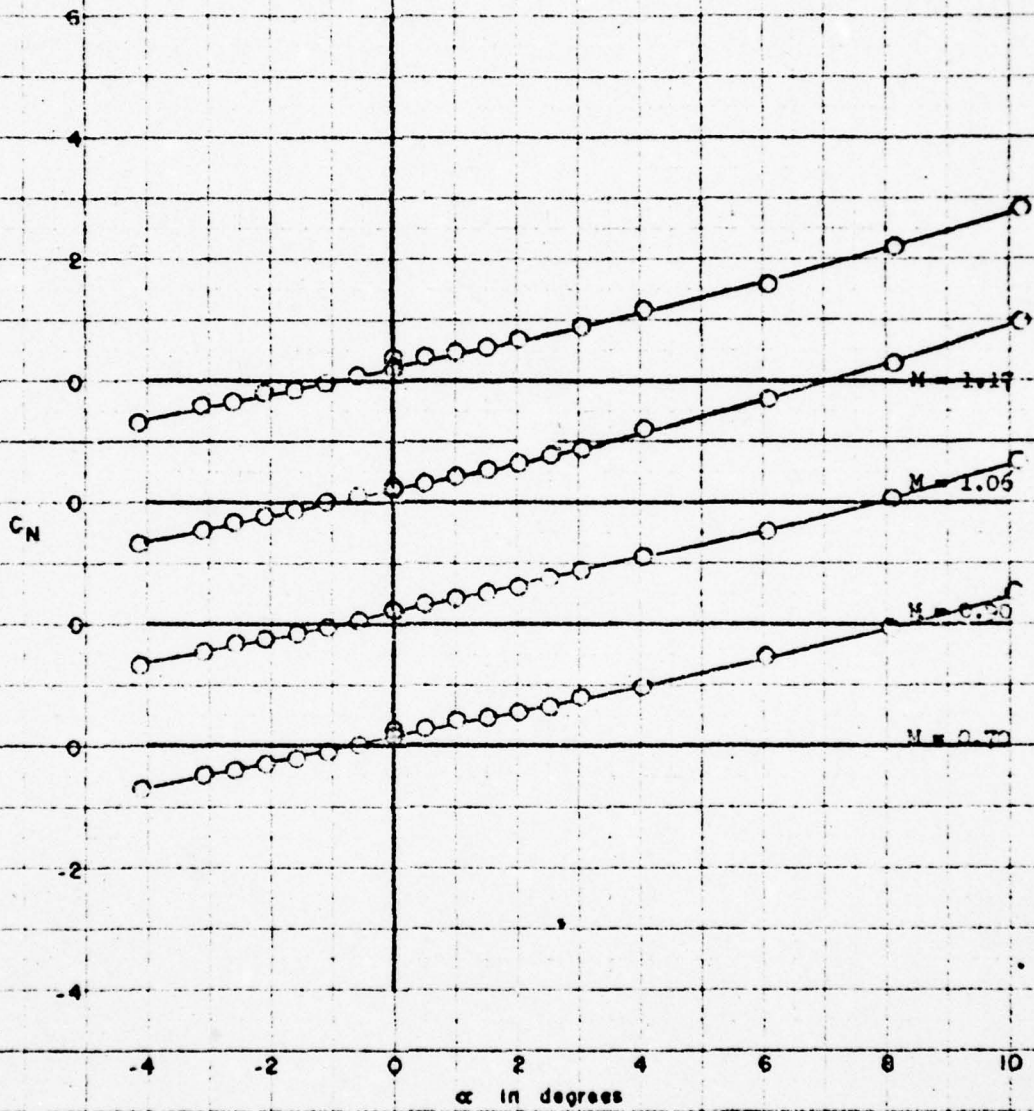
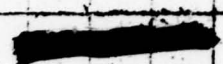


Figure 14 (Continued)



FIGURE 14 (cont)

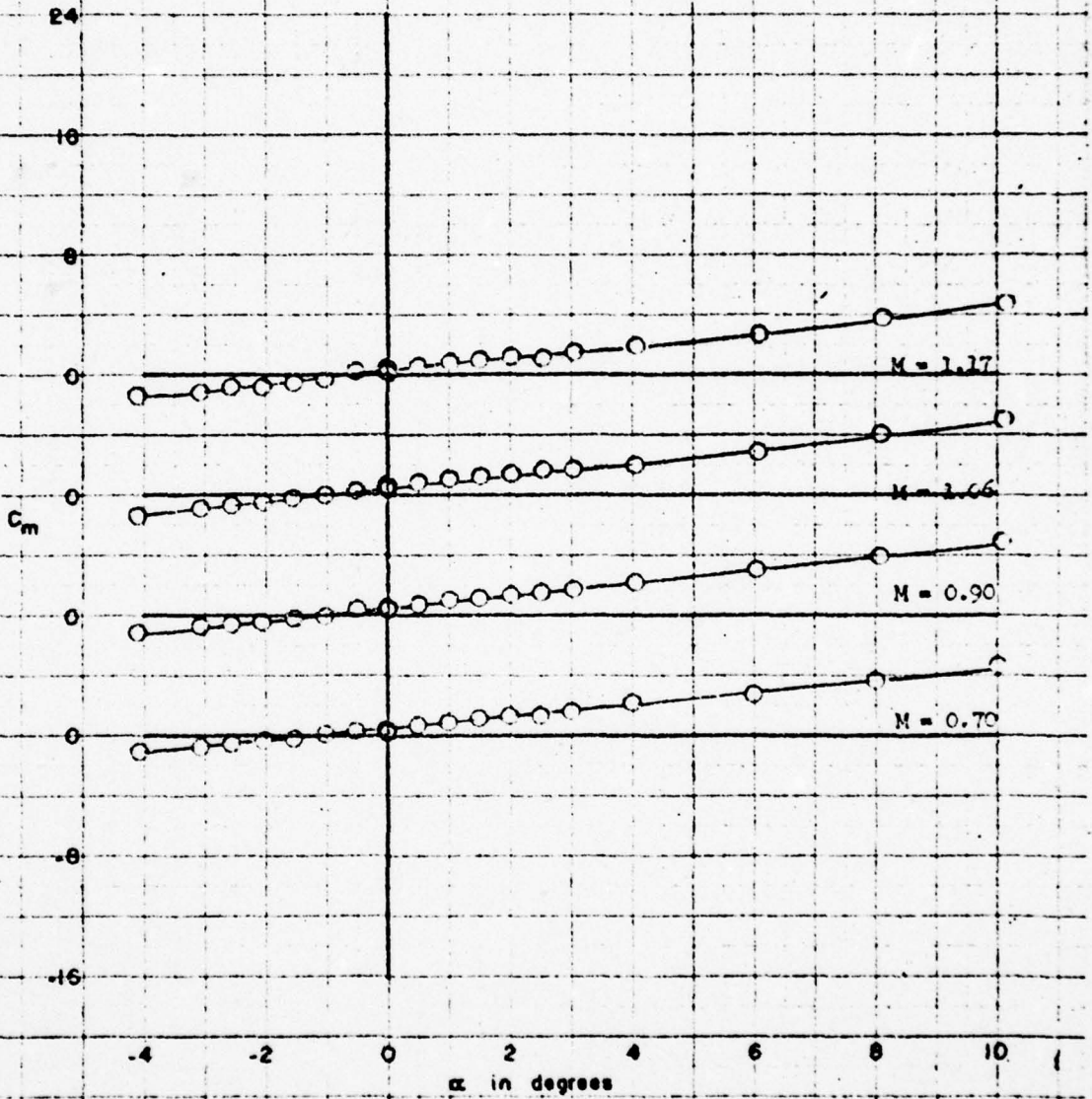
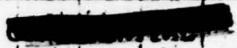
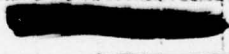


Figure 14 (Concluded)

FIGURE 14 (concl)



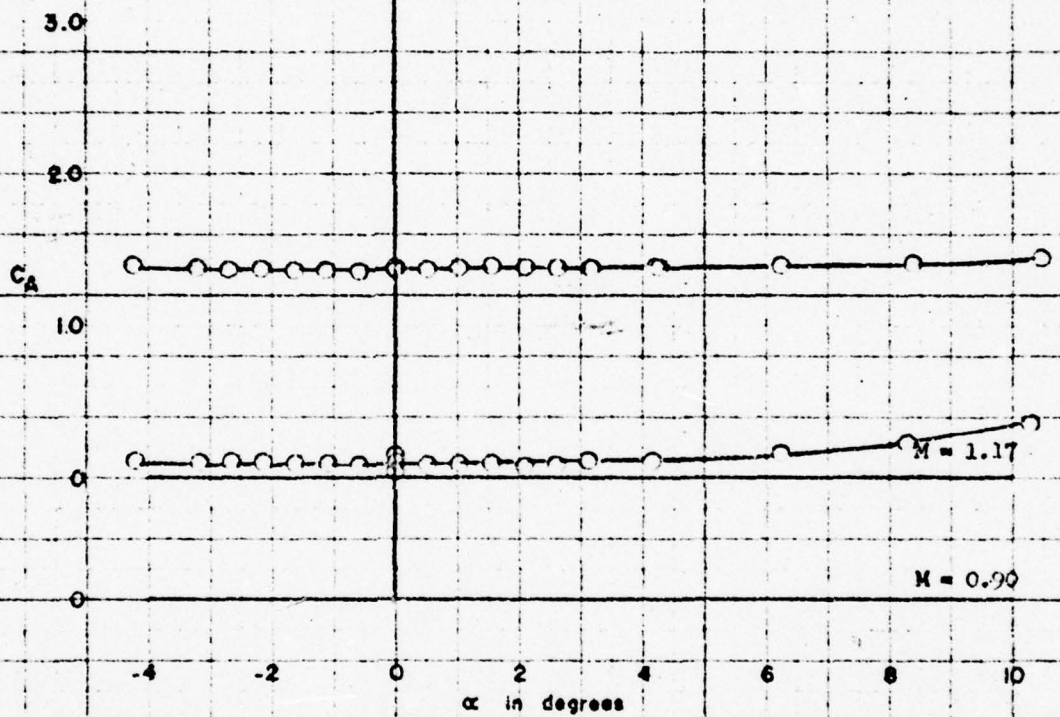


Figure 15 - Variation of Aerodynamic Characteristics
With Angle of Attack for Configuration B₂₂R₅H₁₀WC

(a) $\delta = 0^\circ$; $i = i' = 0^\circ$; $\delta = \delta' = 0^\circ$

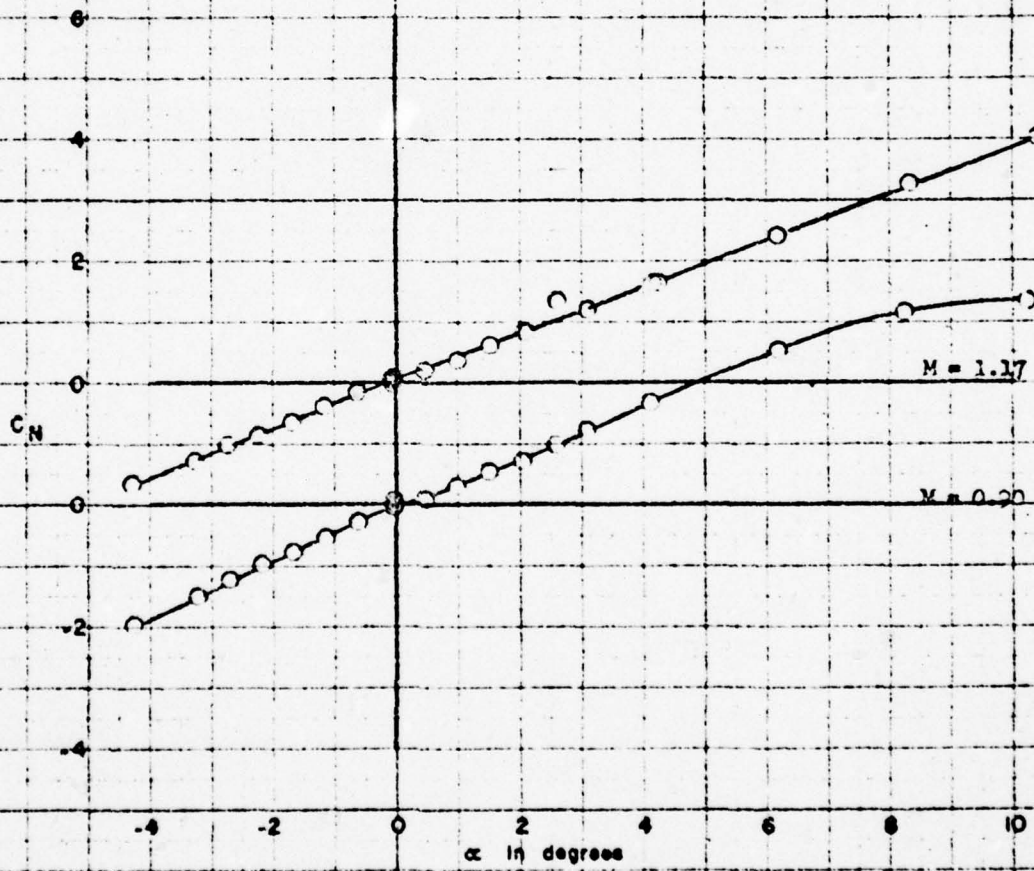


Figure 15 (Continued)

(a) Continued

FIGURE 15a (cont)

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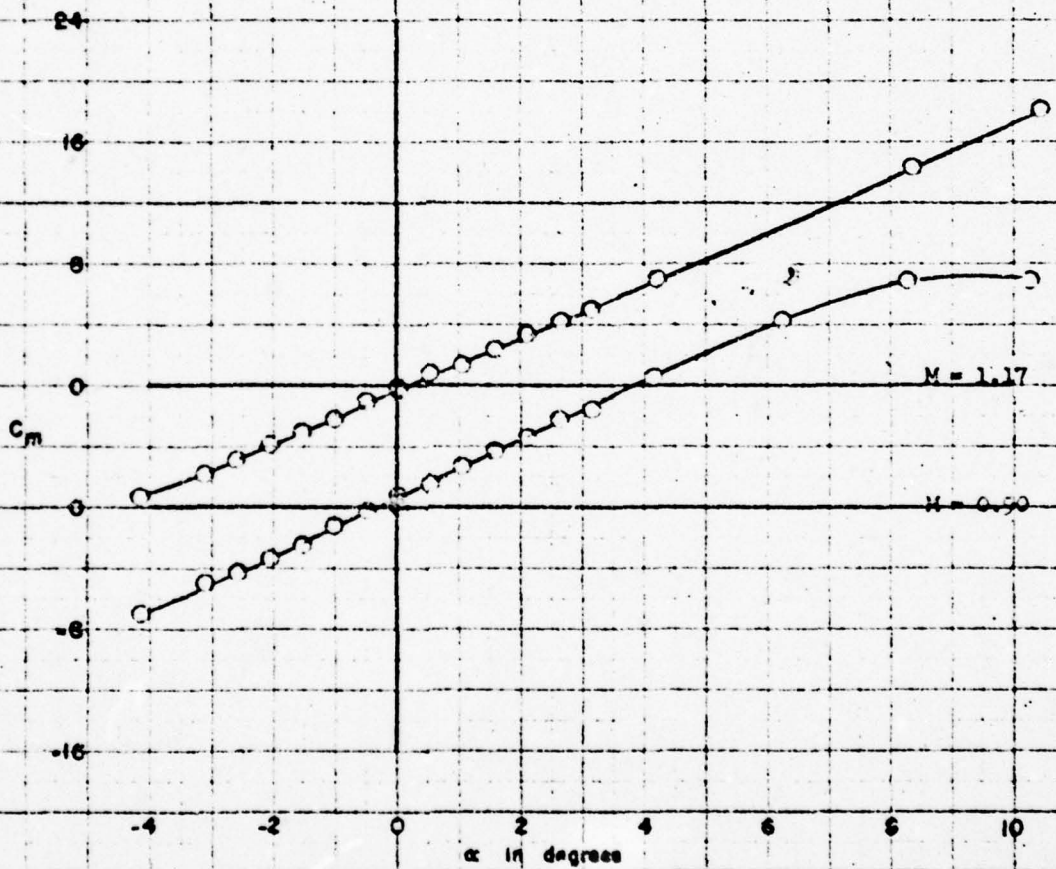
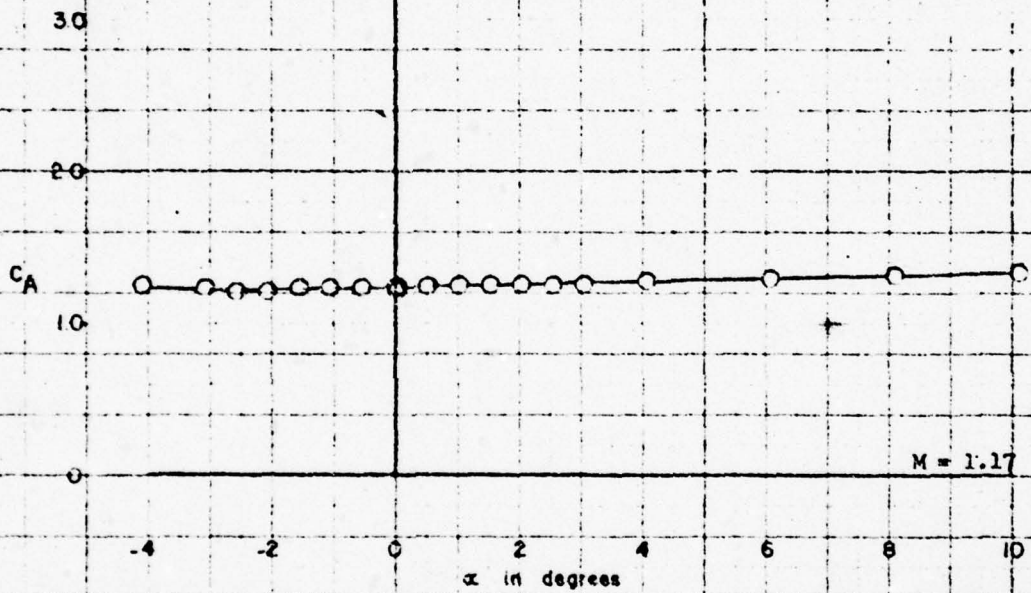
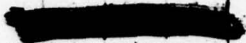


Figure 15 (Continued)
(a) Concluded

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FIGURE 15a (concl)



M = 1.17

Figure 15 (Continued)

(b) $\phi=0^\circ$; $i=-5^\circ$, $i'=0^\circ$; $\delta=\delta'=0^\circ$

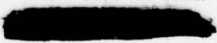


FIGURE 15b

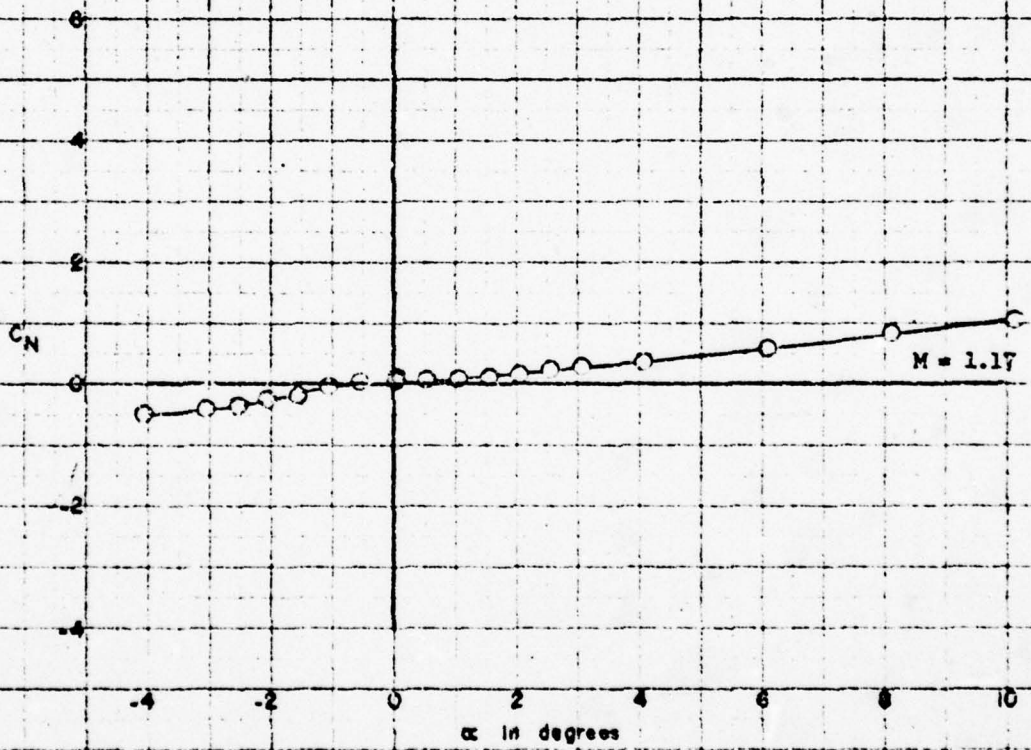
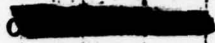


Figure 15 (Continued)

(b) Continued

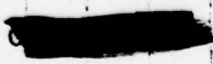


FIGURE 15b (cont)

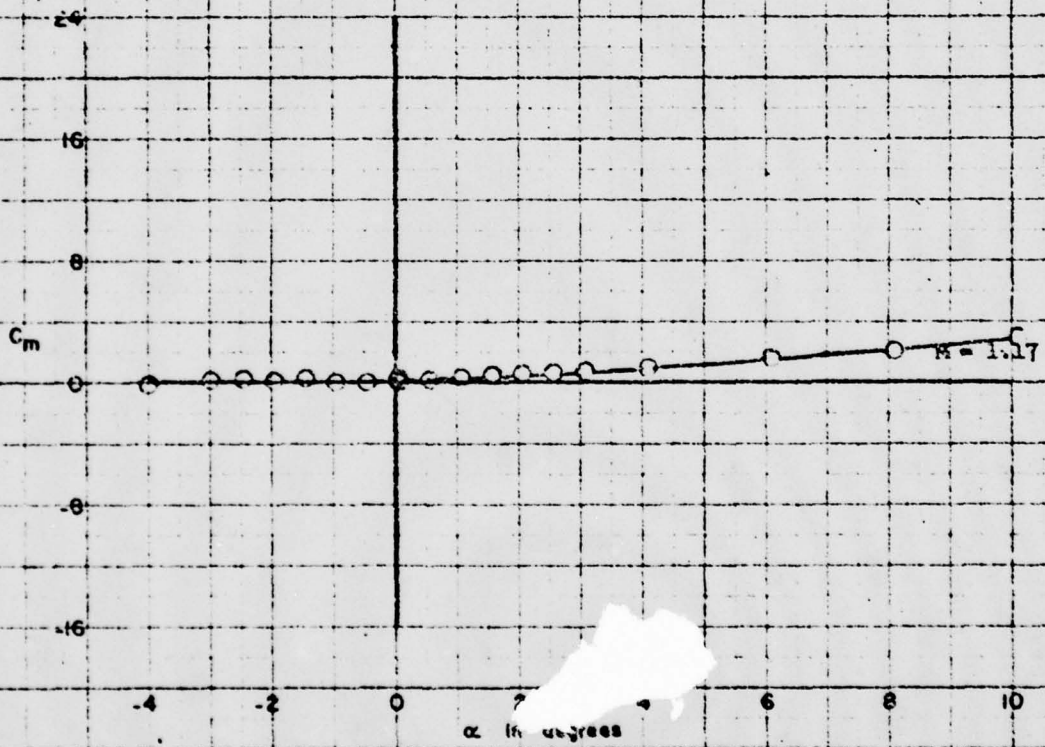
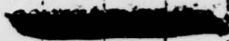


Figure 15 (Continued)

(b) Concluded

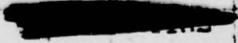


FIGURE 15b (concl.)

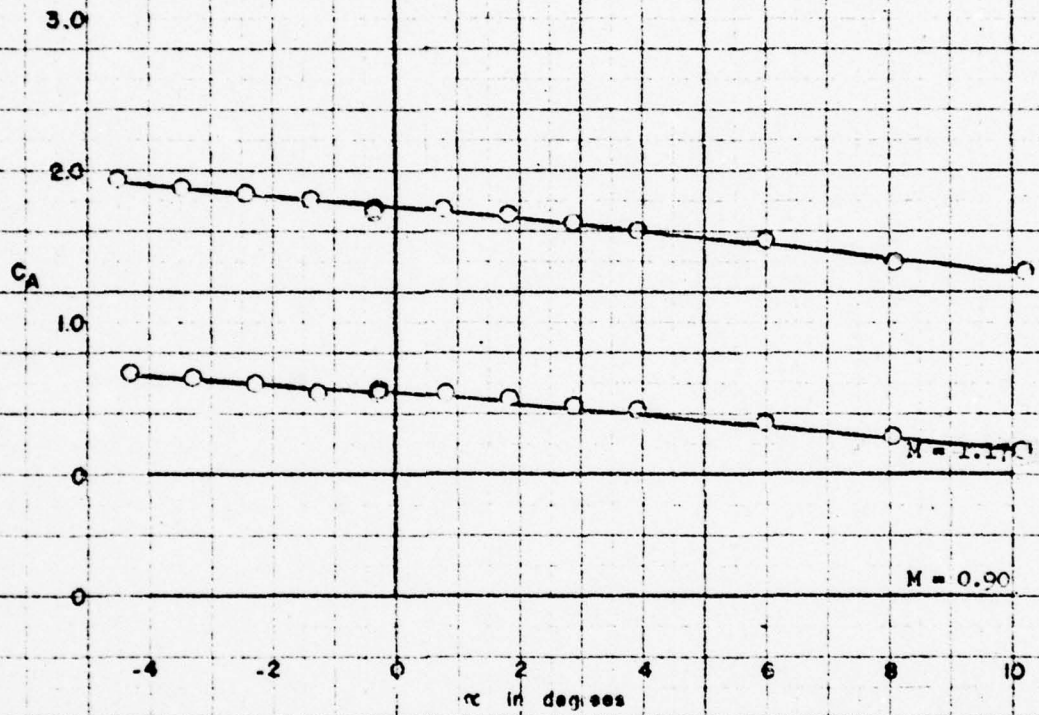


Figure 15 (Continued)

(c) $\phi = 0^\circ$; $i = -10^\circ$; $i' = 0^\circ$; $\delta = \delta' = 0^\circ$

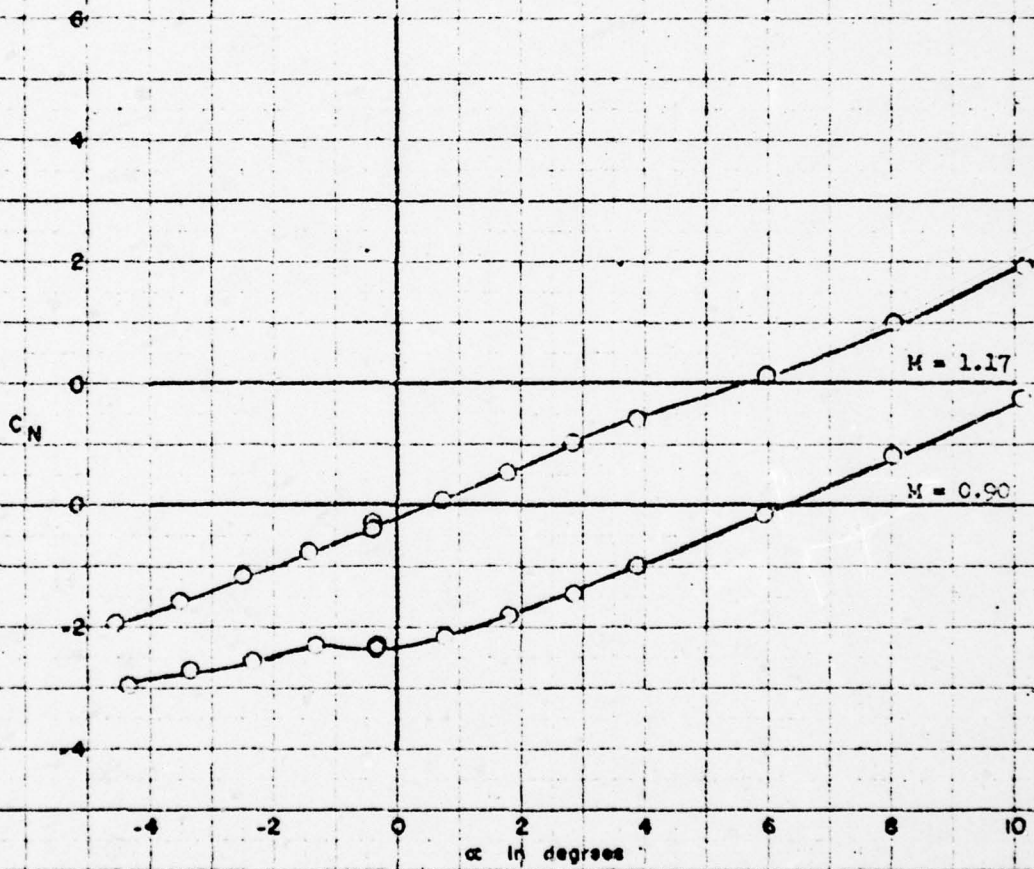
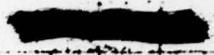


Figure 15 (Continued)

(c) Continued

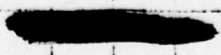


FIGURE 15c (cont)

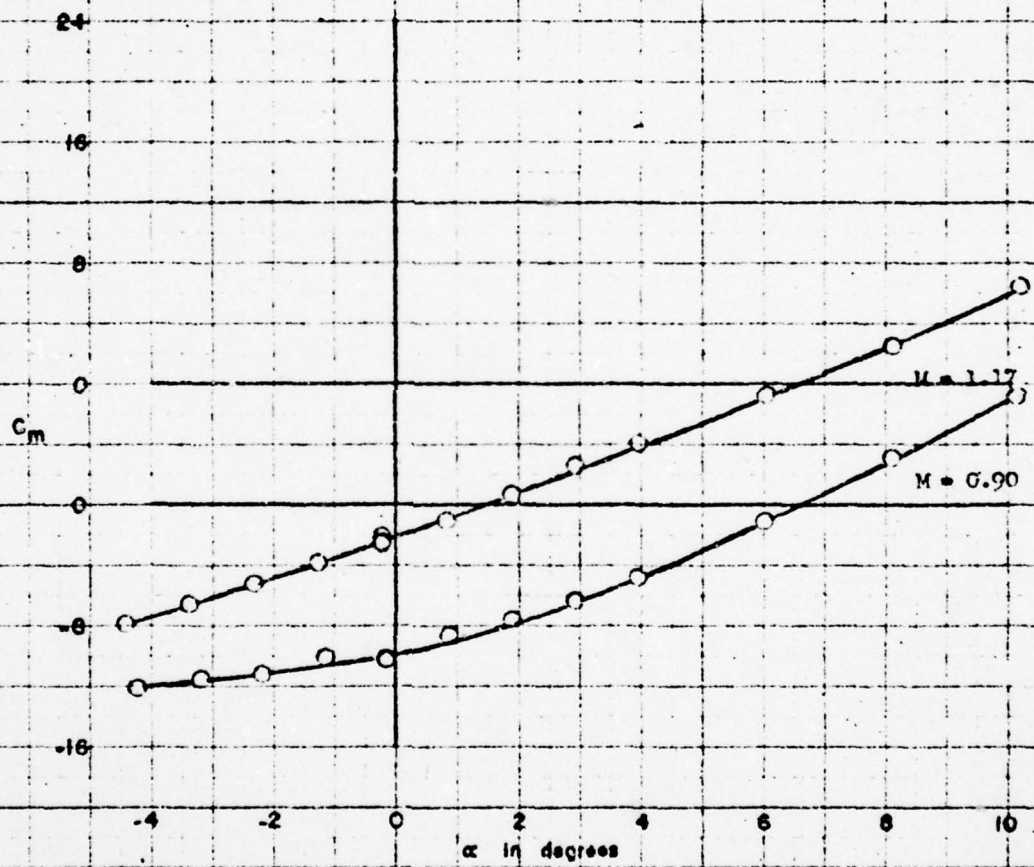


Figure 15 (Concluded)
(c) Concluded

FIGURE 15c (concl)

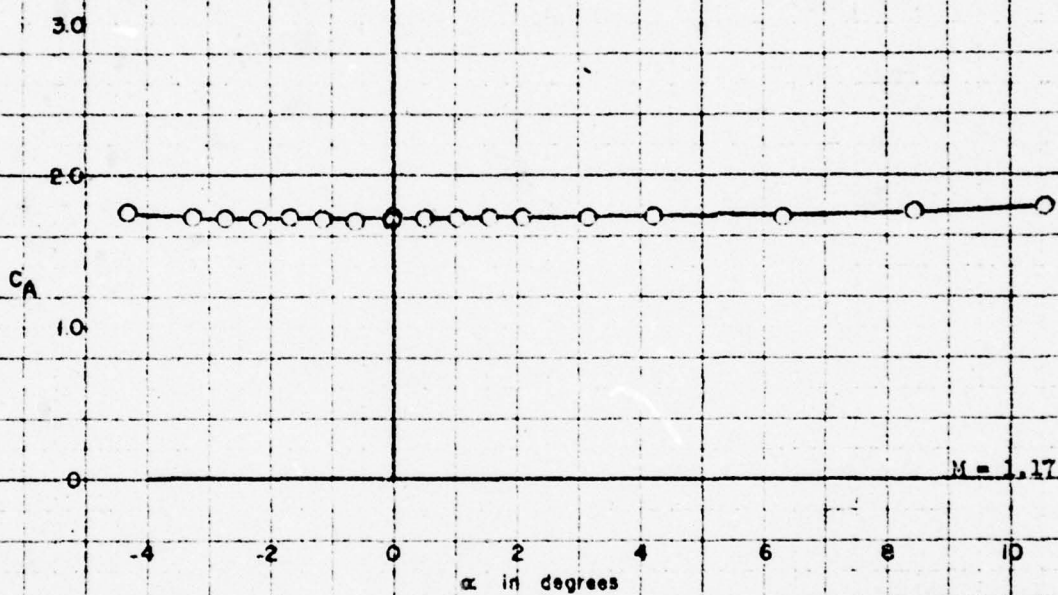


Figure 16 - Variation of Aerodynamic Characteristics
With Angle of Attack for Configuration B₂₂R₅H₁₀WT₁C_{F18}C

(a) $\phi=0^\circ$; $i=i'=0^\circ$; $\delta=\delta'=0^\circ$

FIGURE 16a

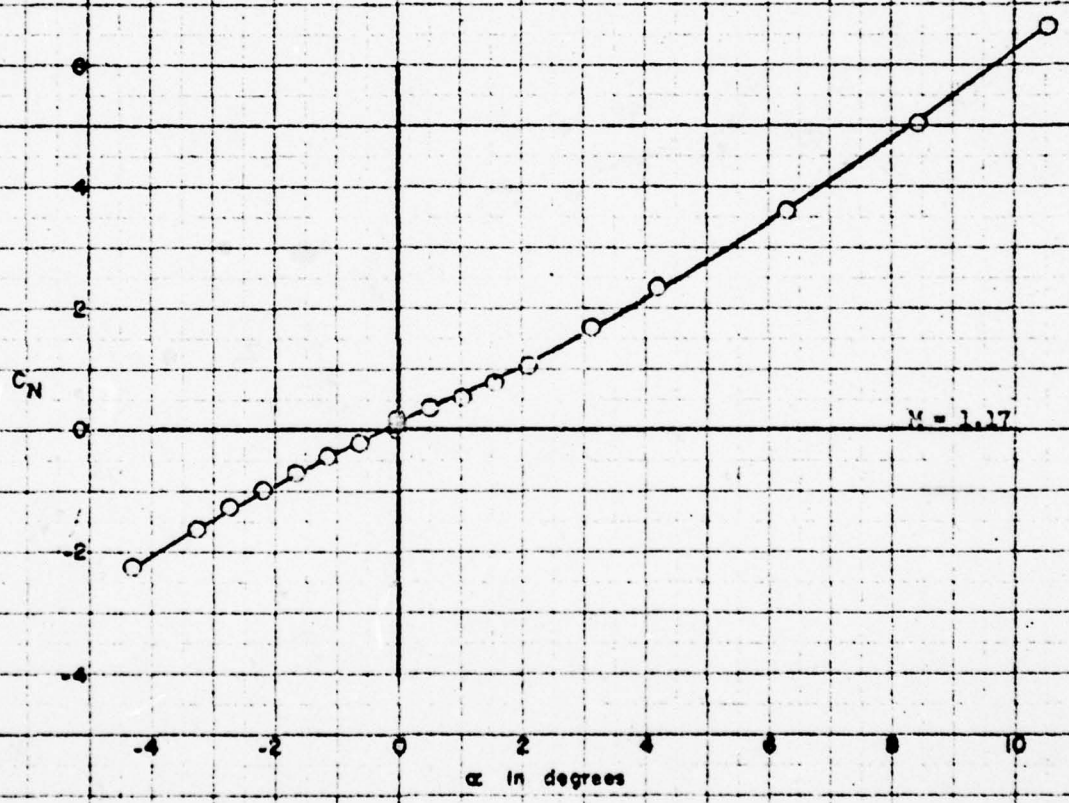
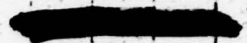


Figure 16 (Continued)

(a) Continued

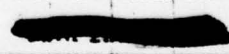


FIGURE 16a (cont)

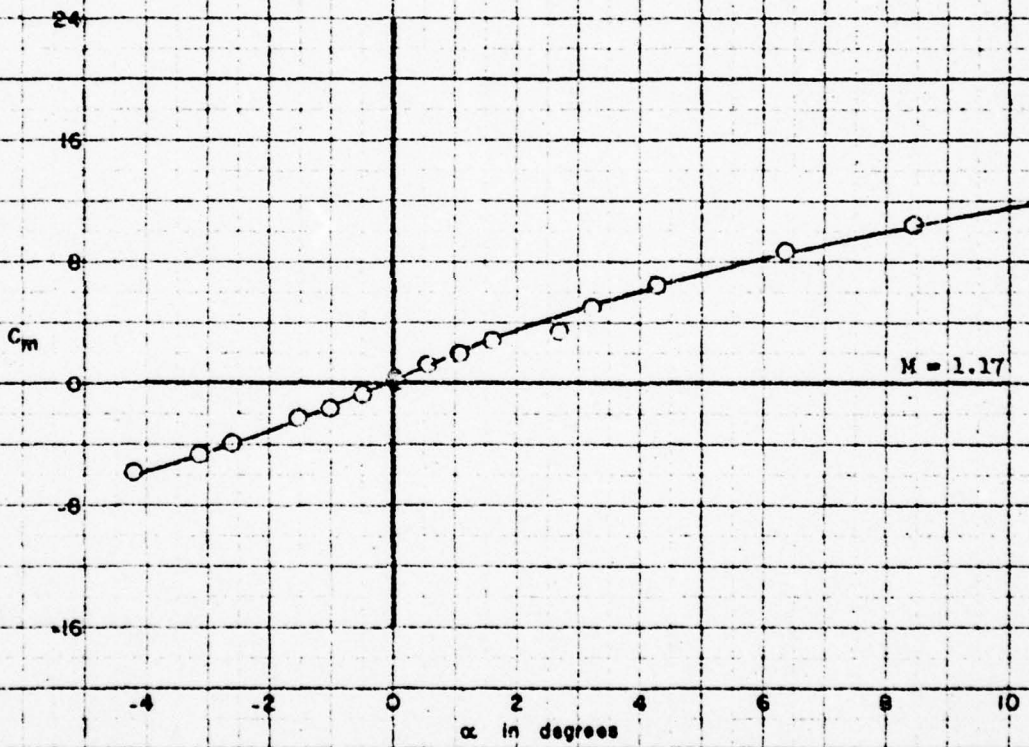


Figure 16 (Continued)

(a) Concluded

FIGURE 16a (concl.)

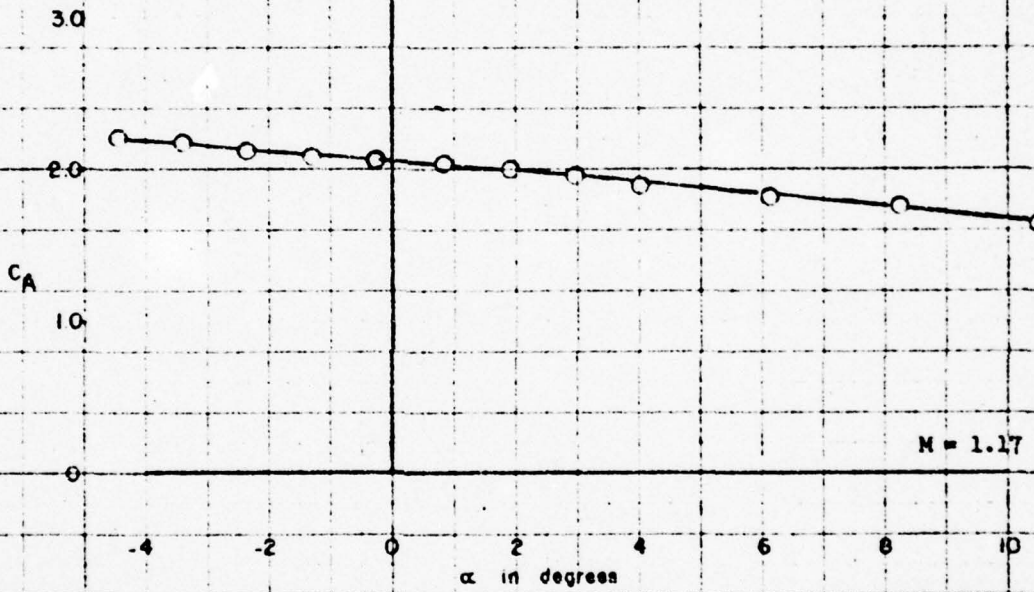


Figure 16 (Continued)

(b) $\phi=0^\circ$; $i=-10^\circ$, $i'=0^\circ$; $\delta=\delta'=-0^\circ$

FIGURE 16b

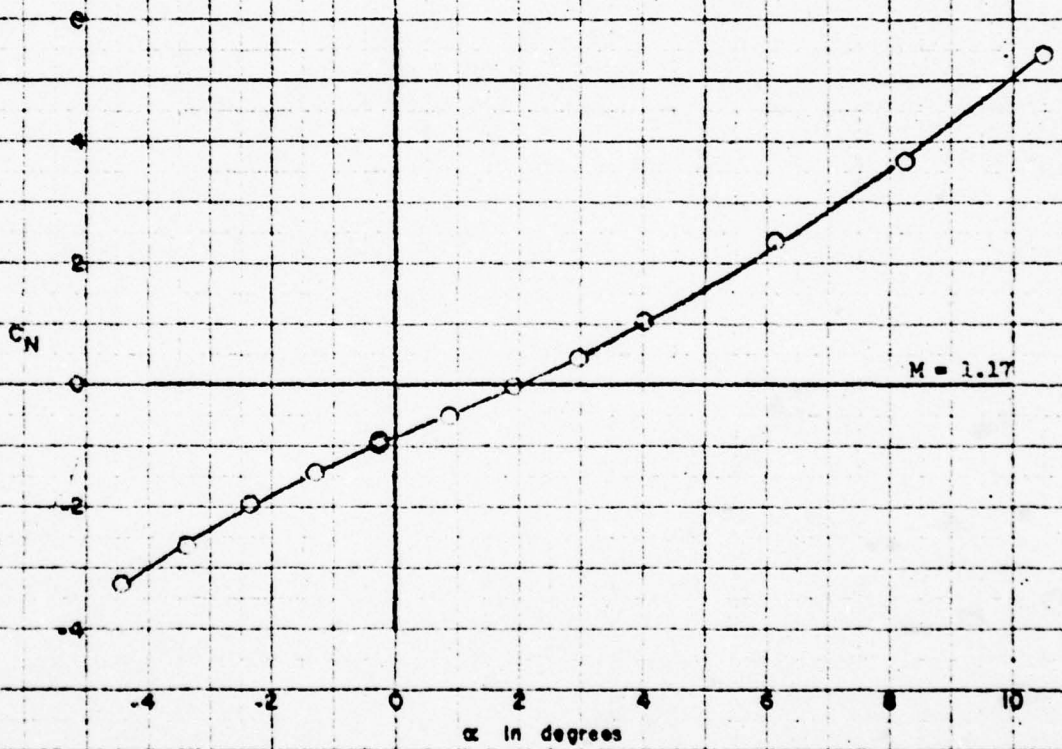


Figure 15 (Continued)

(b) Continued

15-1000

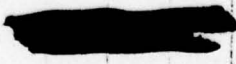


FIGURE 16b (cont)

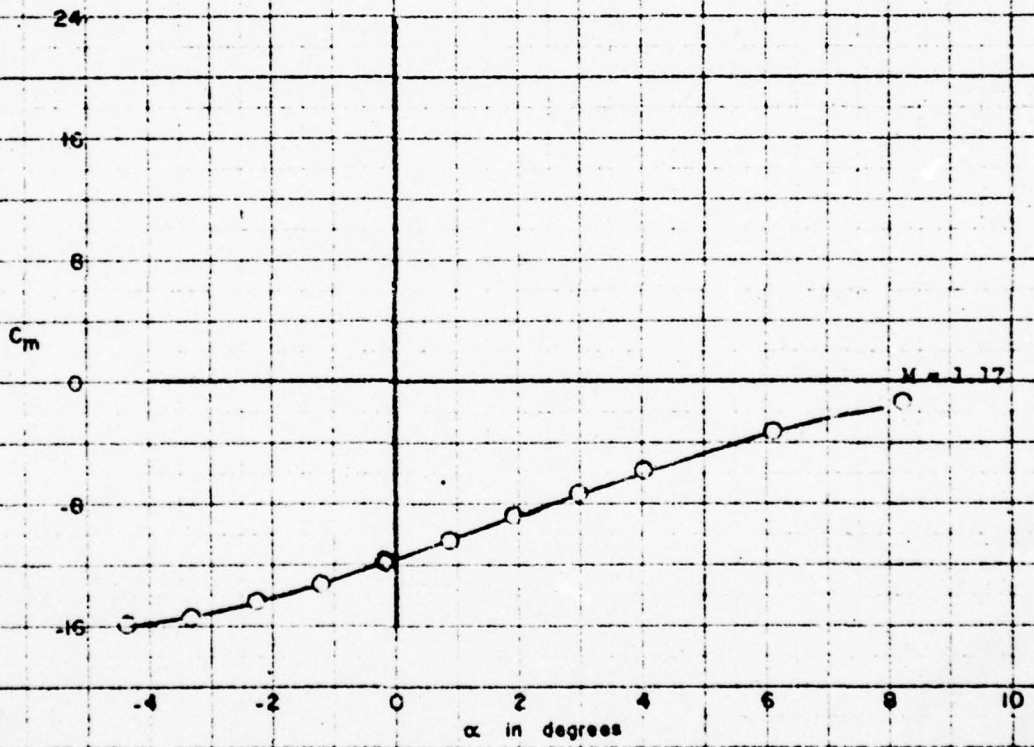


Figure 16 (Concluded)
(b) Concluded

FIGURE 16b (concl)

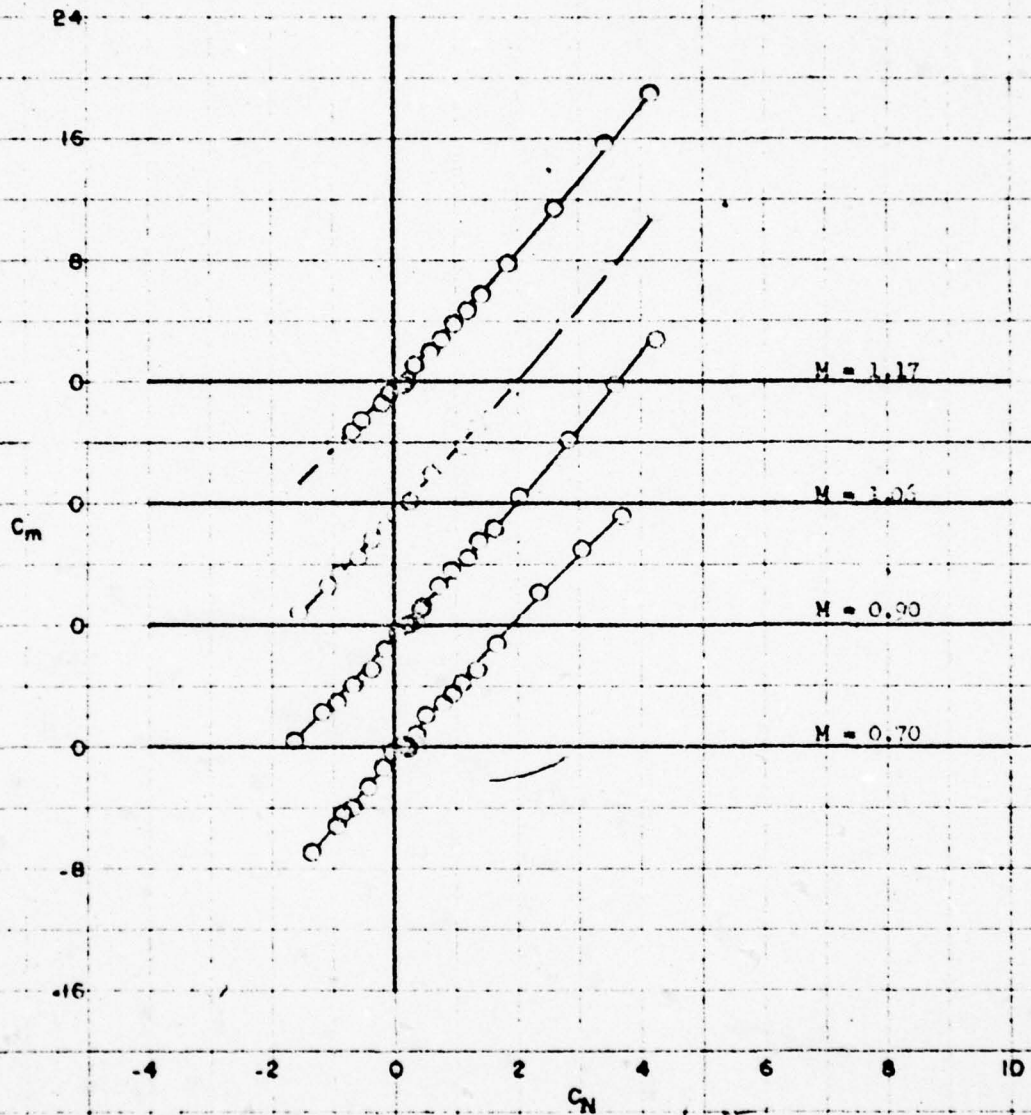


Figure 17 - Variation of Pitching-Moment Coefficient With Normal-Force Coefficient for Configuration

B₂₂R₅H₁₀W

(a) $\phi = -45^\circ$; $i = i' = 0^\circ$; $\delta = \delta' = 0^\circ$

FIGURE 17a

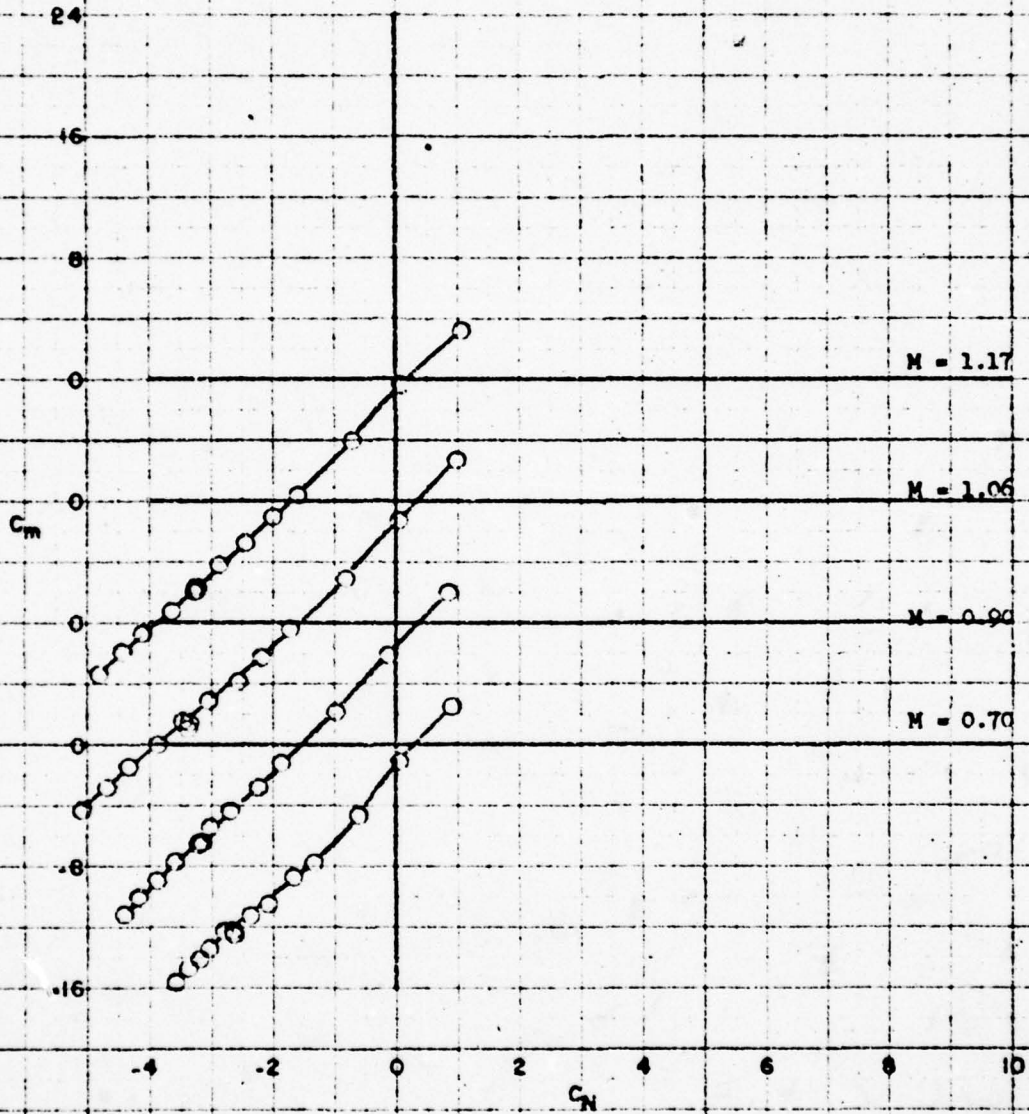


Figure 17 (Continued)
(b) $\phi = -45^\circ$; $i = i' = -10^\circ$; $\delta = \delta' = 0^\circ$

FIGURE 17b

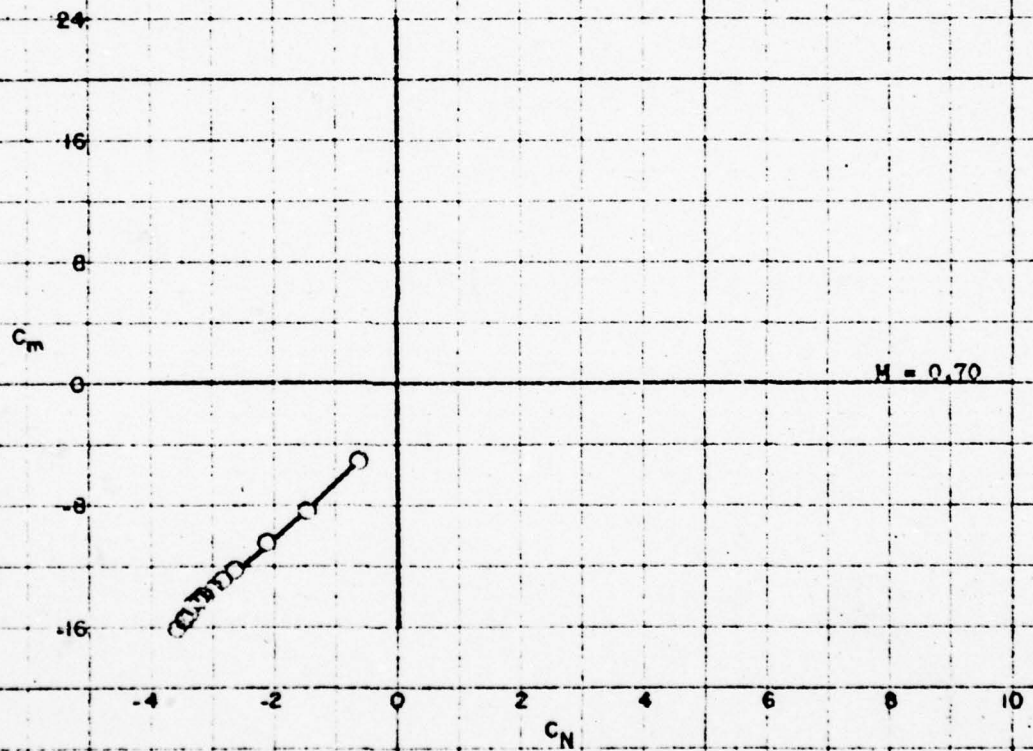


Figure 17 (Continued)

(c) $\phi = -45^\circ$; $i = i' = -15^\circ$; $\delta = \delta' = 0^\circ$

FIGURE 17c

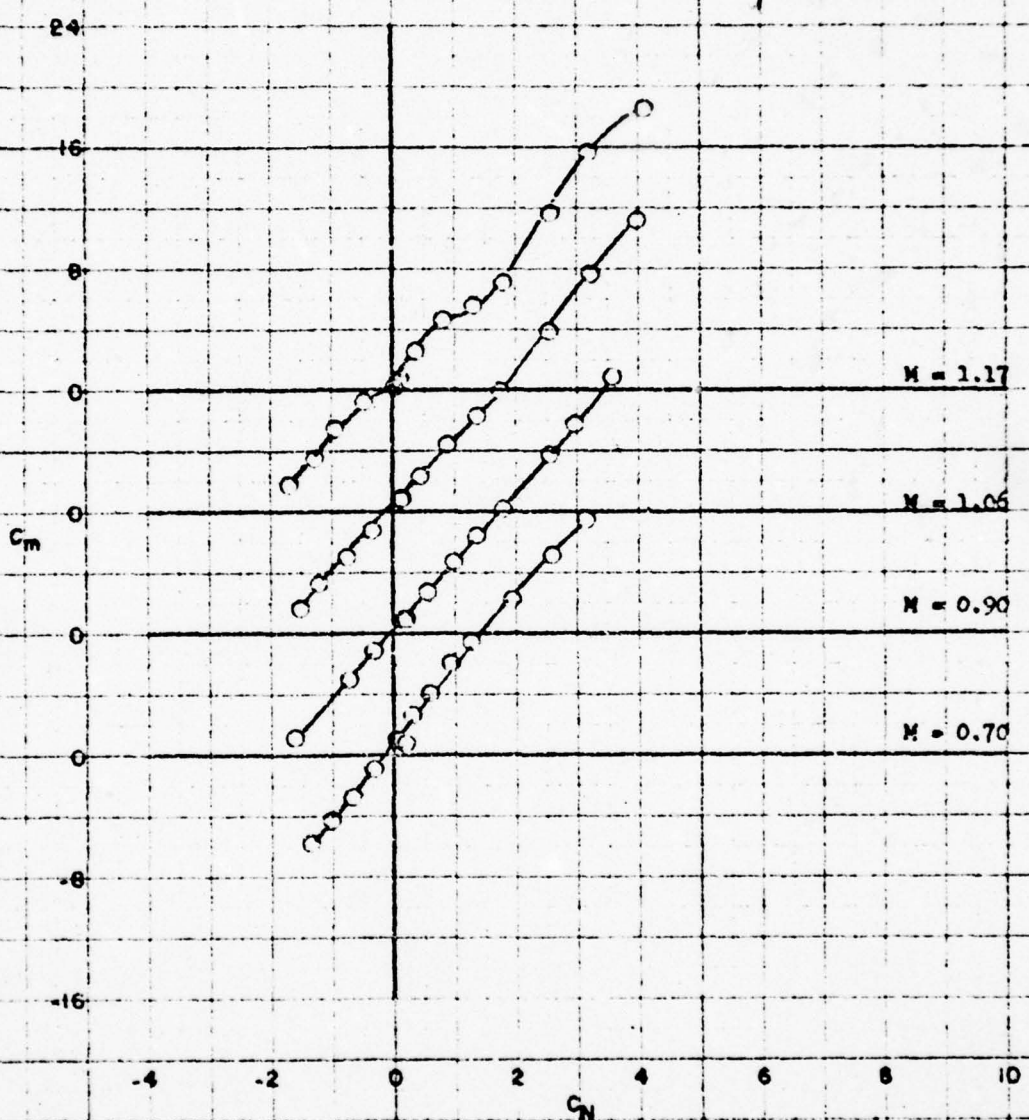


Figure 17 (Continued)

(d) $\phi = -45^\circ$; $i = i' = 0^\circ$; $\delta = \delta' = 5^\circ$

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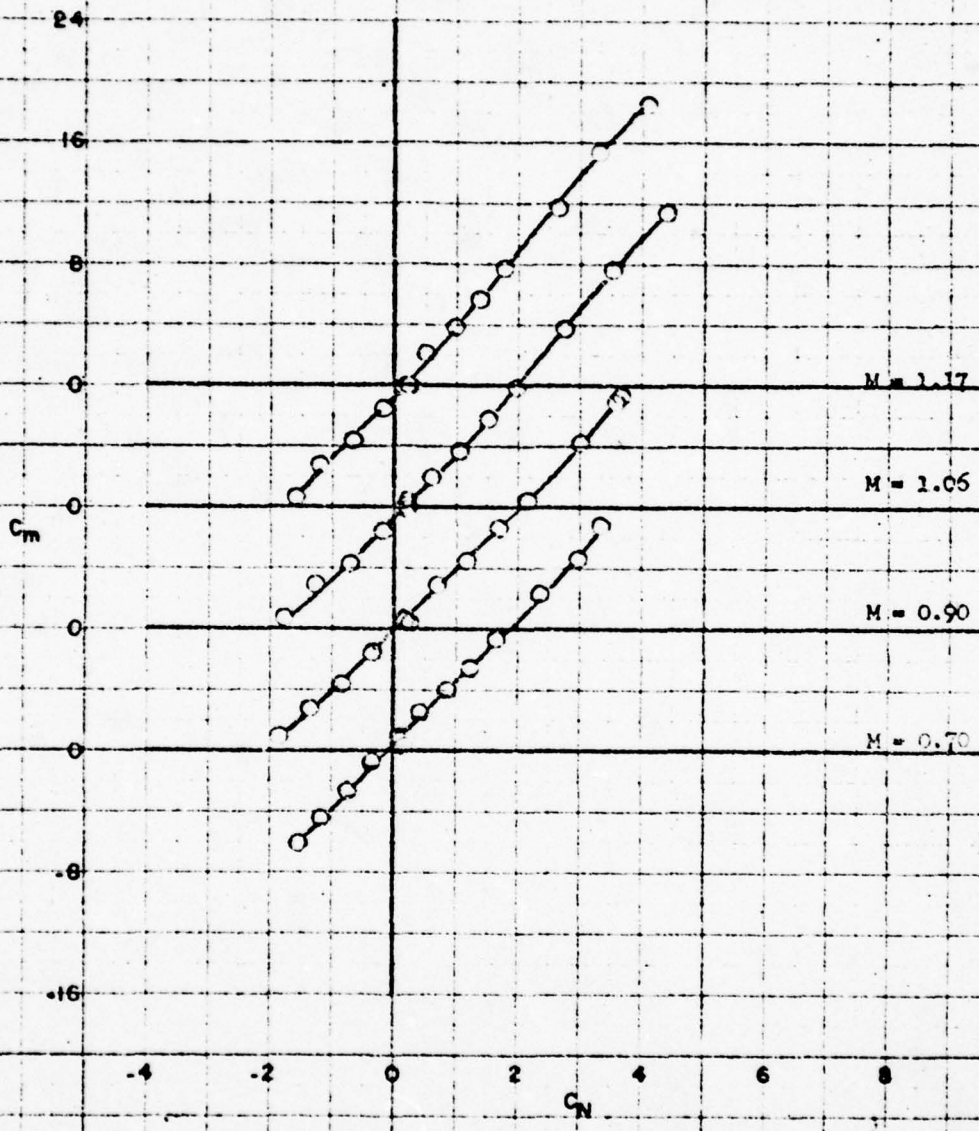


Figure 17 (Continued)
(e) $\phi=0^\circ$; $i=i'=0^\circ$; $\delta=\delta'=0^\circ$

~~CONFIDENTIAL~~

FIGURE 17e

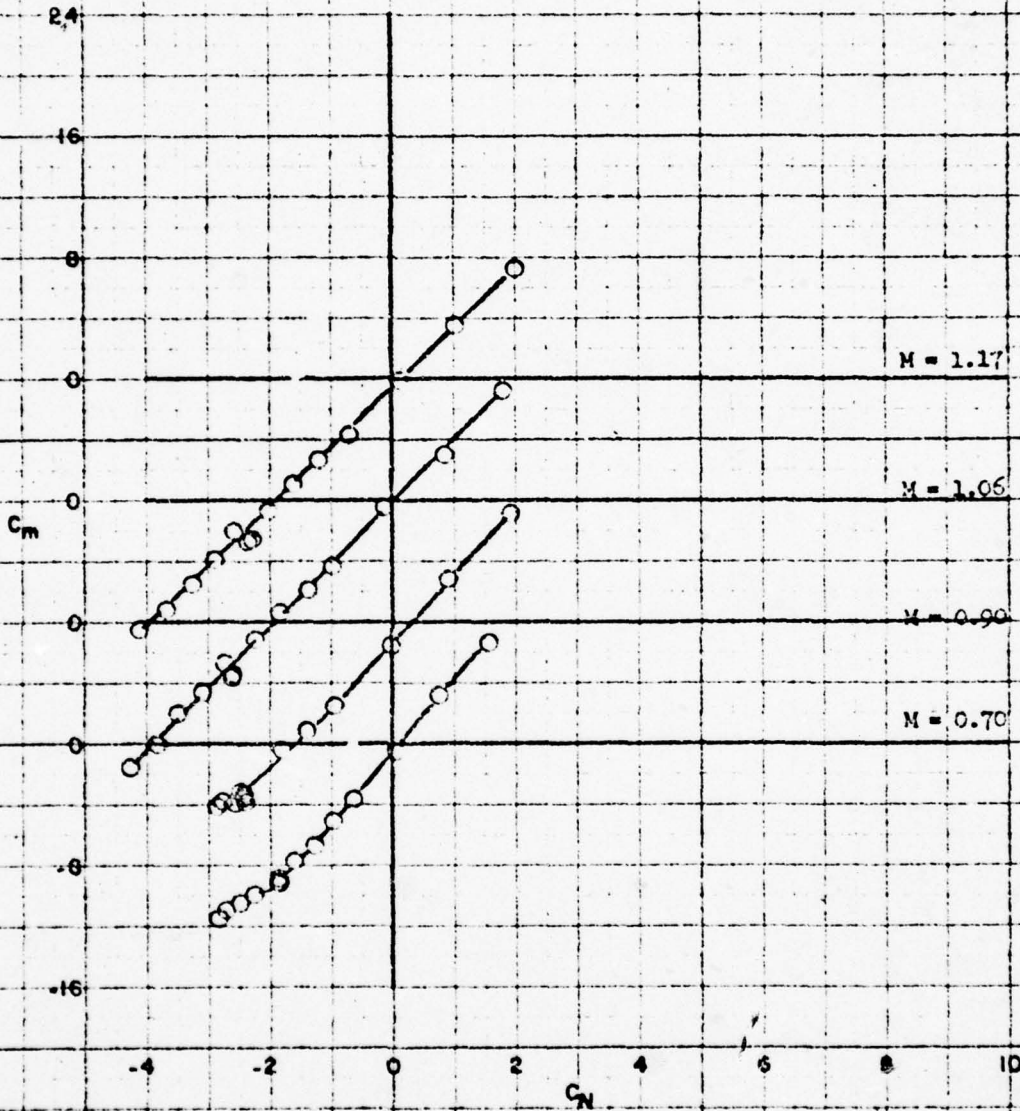


Figure 17 (Concluded)

(f) $\phi=0^\circ$; $i=-10^\circ$, $i'=0^\circ$; $\delta=\delta'=0^\circ$

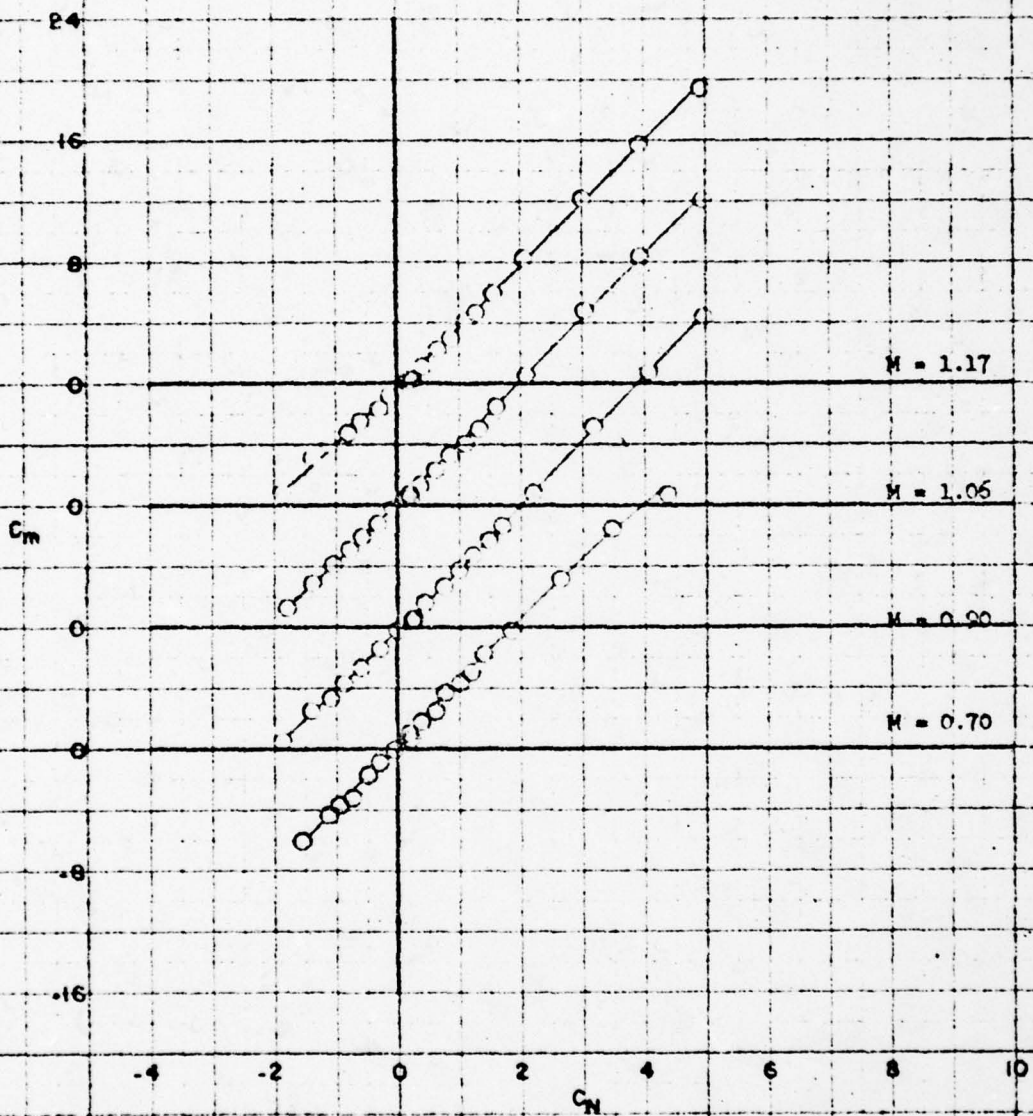


Figure 18 - Variation of Pitching-Moment Coefficient With Normal-Force Coefficient for Configuration B₂₂R₅H₁₀WT₁₀

(a) $\phi = -45^\circ$; $i = i' = 0^\circ$; $\delta = \delta' = 0^\circ$

FIGURE 18a

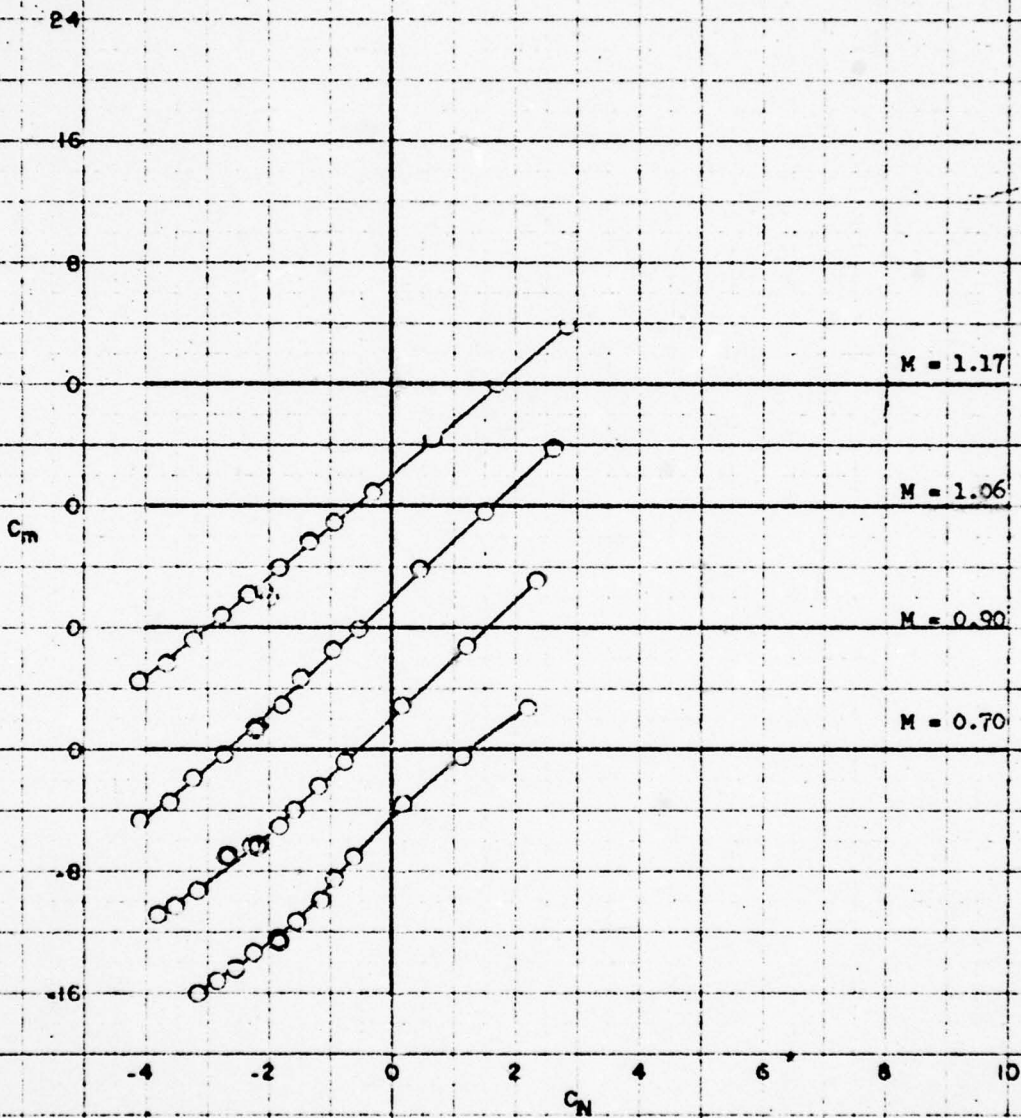
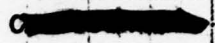


Figure 18 (Continued)
(b) $\phi = -45^\circ$; $i = i' = -10^\circ$; $\delta = \delta' = 0^\circ$

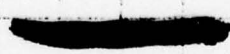
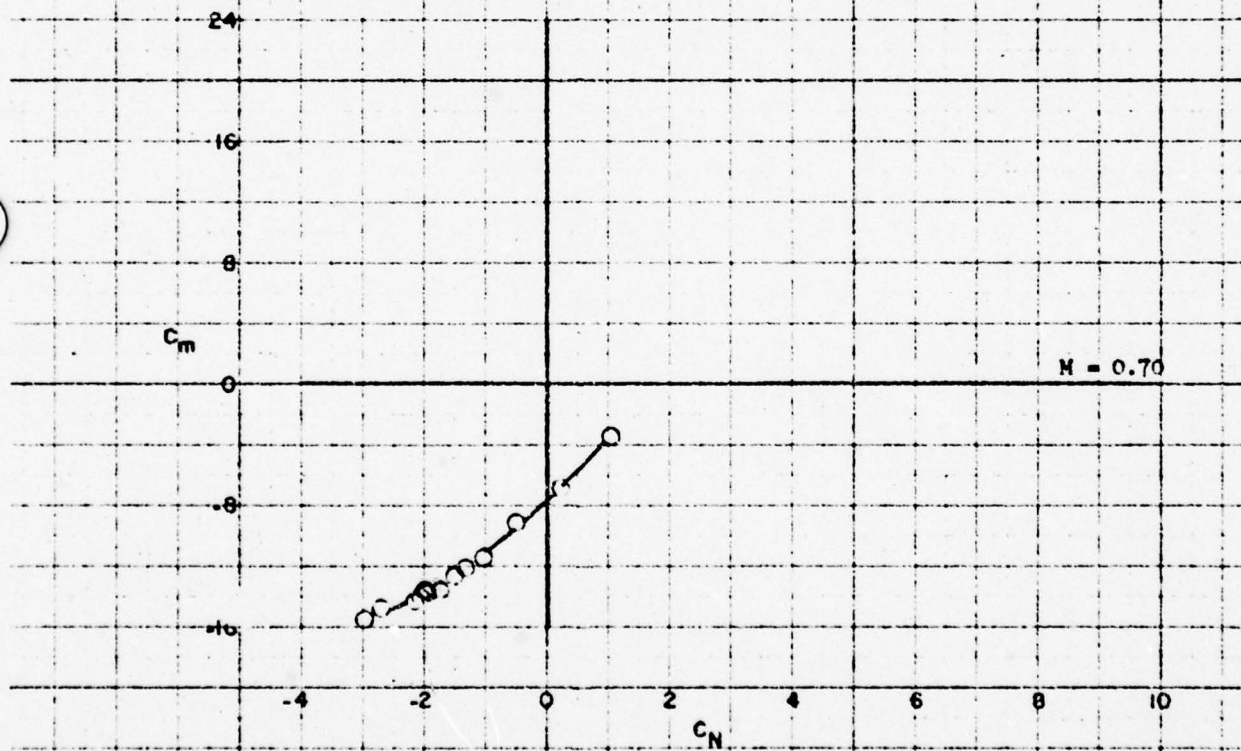
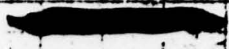


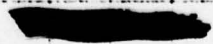
FIGURE 18b



M = 0.70

Figure 13 (Continued)

(c) $\phi = -45^\circ$; $i = i' = -15^\circ$; $\delta = \delta' = 0^\circ$



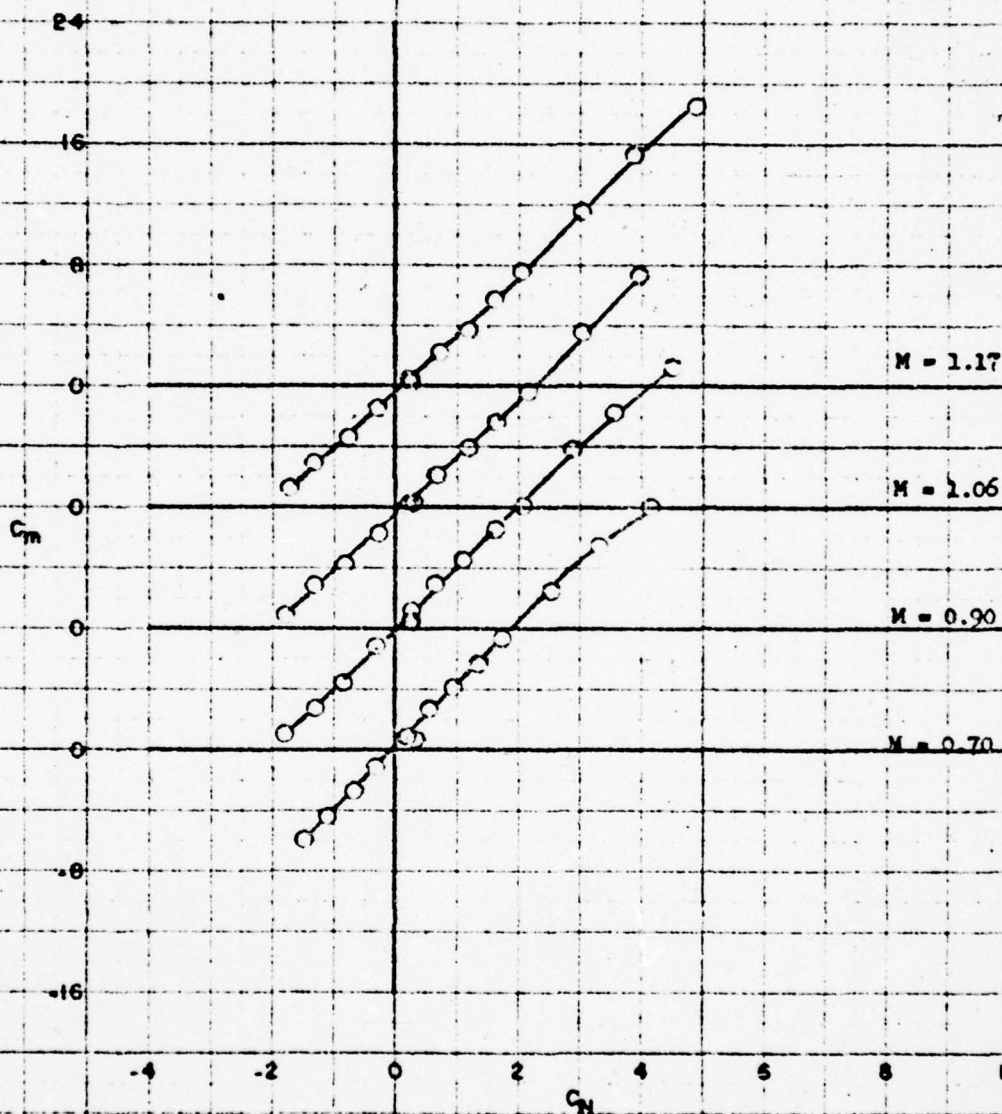


Figure 18 (Continued)

(d) $\phi = -45^\circ$; $i = i' = 0^\circ$; $\delta = \delta' = 5^\circ$

FIGURE 18d

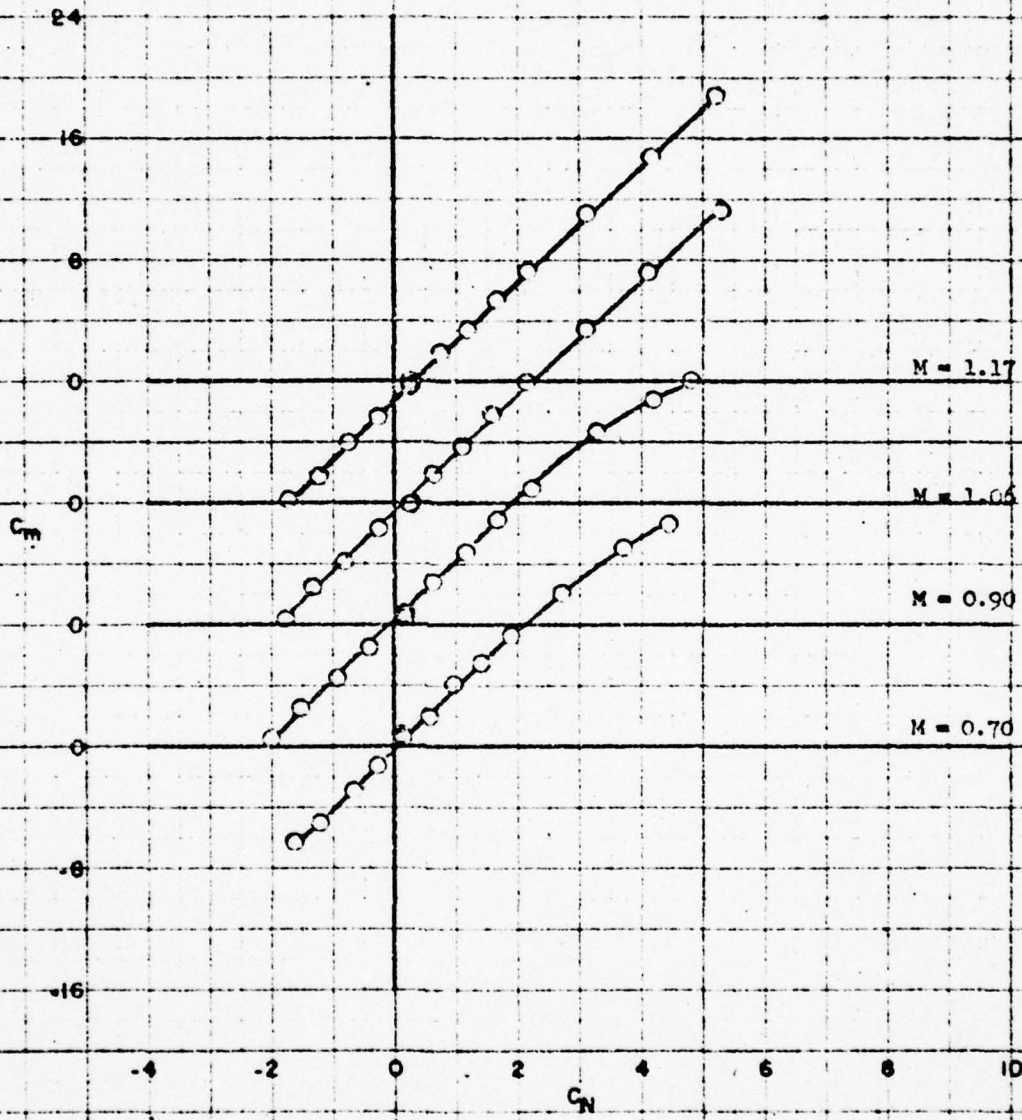


Figure 18 (Continued)

(e) $\alpha=0^\circ$; $i=i'=0^\circ$; $\delta=\delta'=0^\circ$

~~CONFIDENTIAL~~

FIGURE 18e

~~CONFIDENTIAL~~

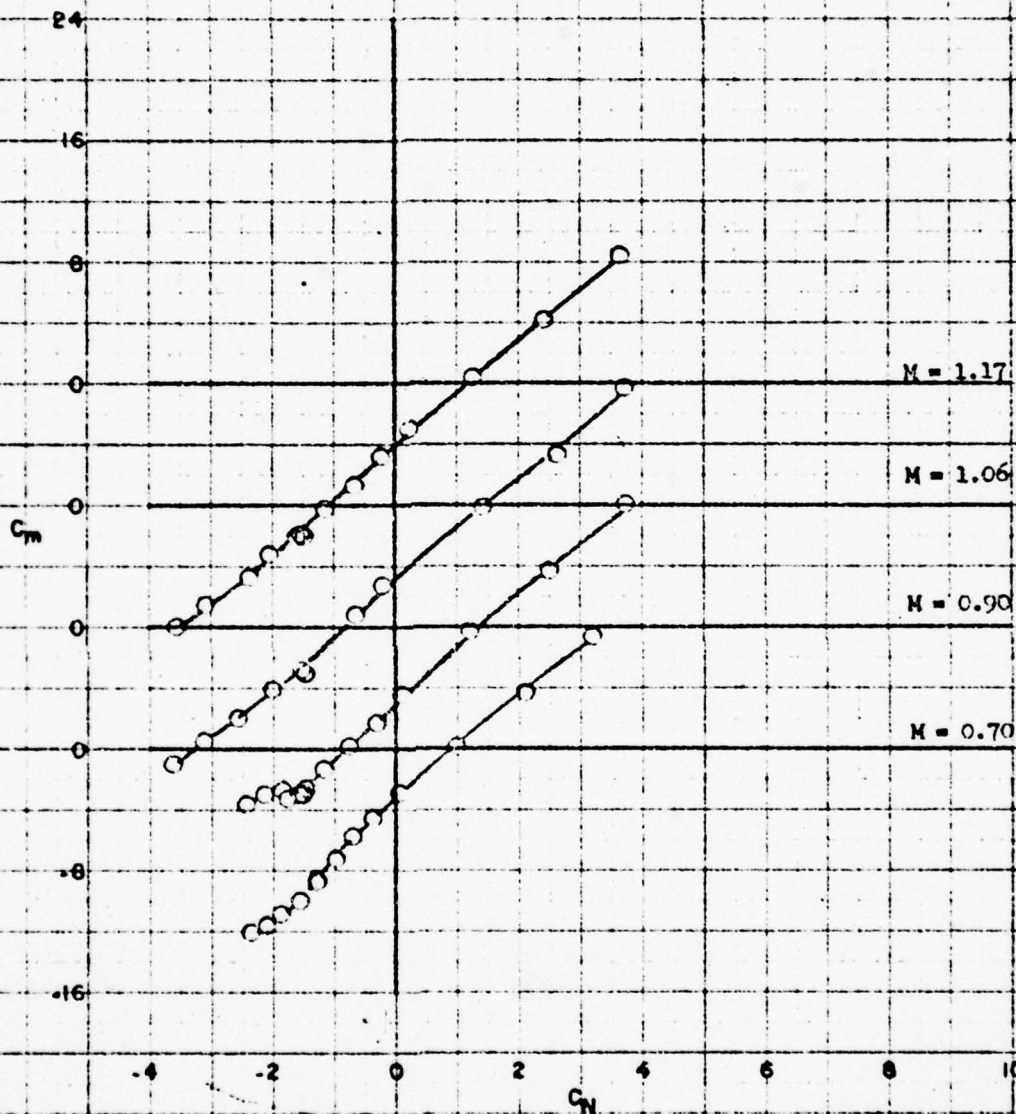


Figure 18 (Concluded)
(f) $\phi=0^\circ$; $i=-10^\circ$, $i'=0^\circ$; $\delta=\delta'=0^\circ$

~~CONFIDENTIAL~~

FIGURE 18f

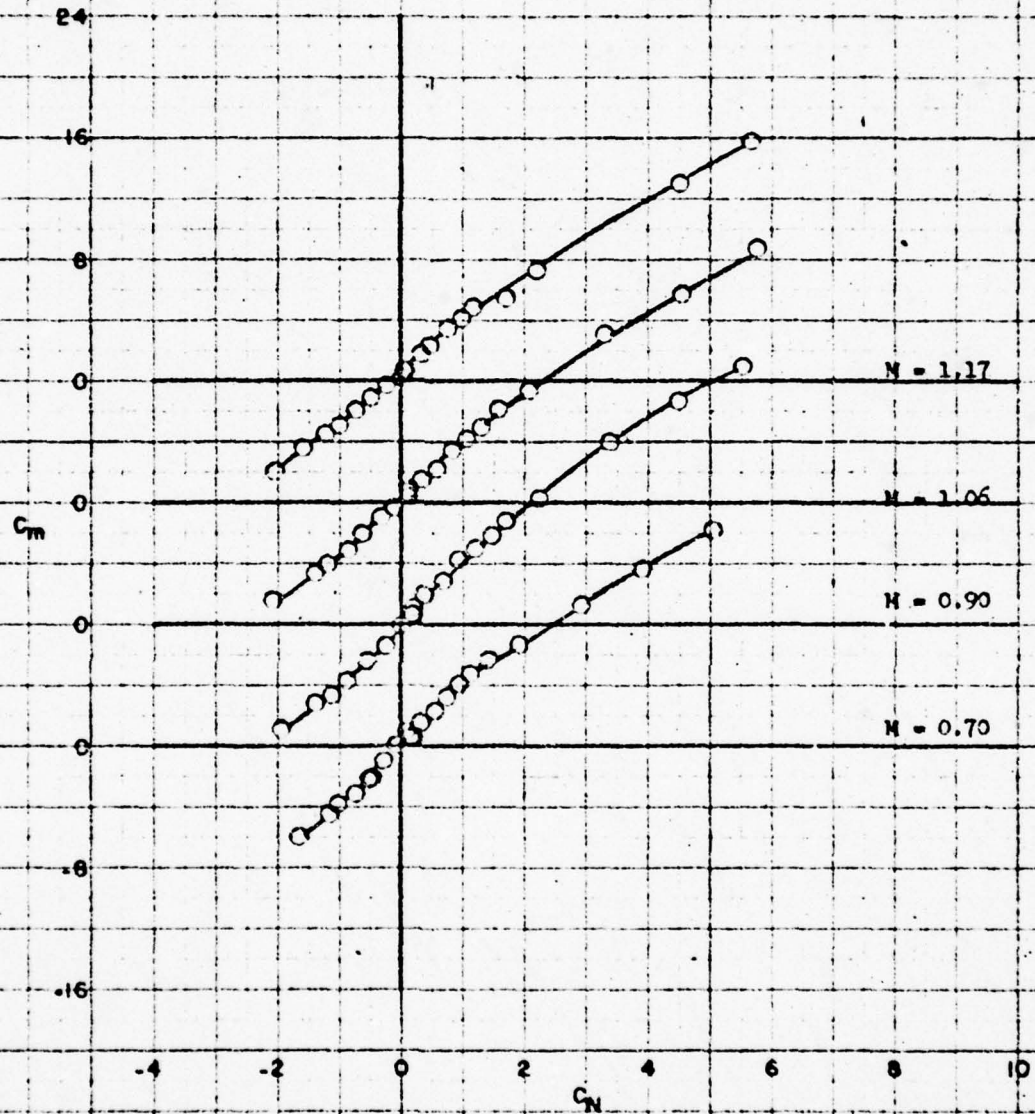


Figure 19 - Variation of Pitching-Moment Coefficient With Normal-Force Coefficient for Configuration B₂₂R₅H₁₀WT₁₀F₁₈

(a) $\phi = -45^\circ$; $i = i' = 0^\circ$; $\delta = \delta' = 0^\circ$

FIGURE 19a

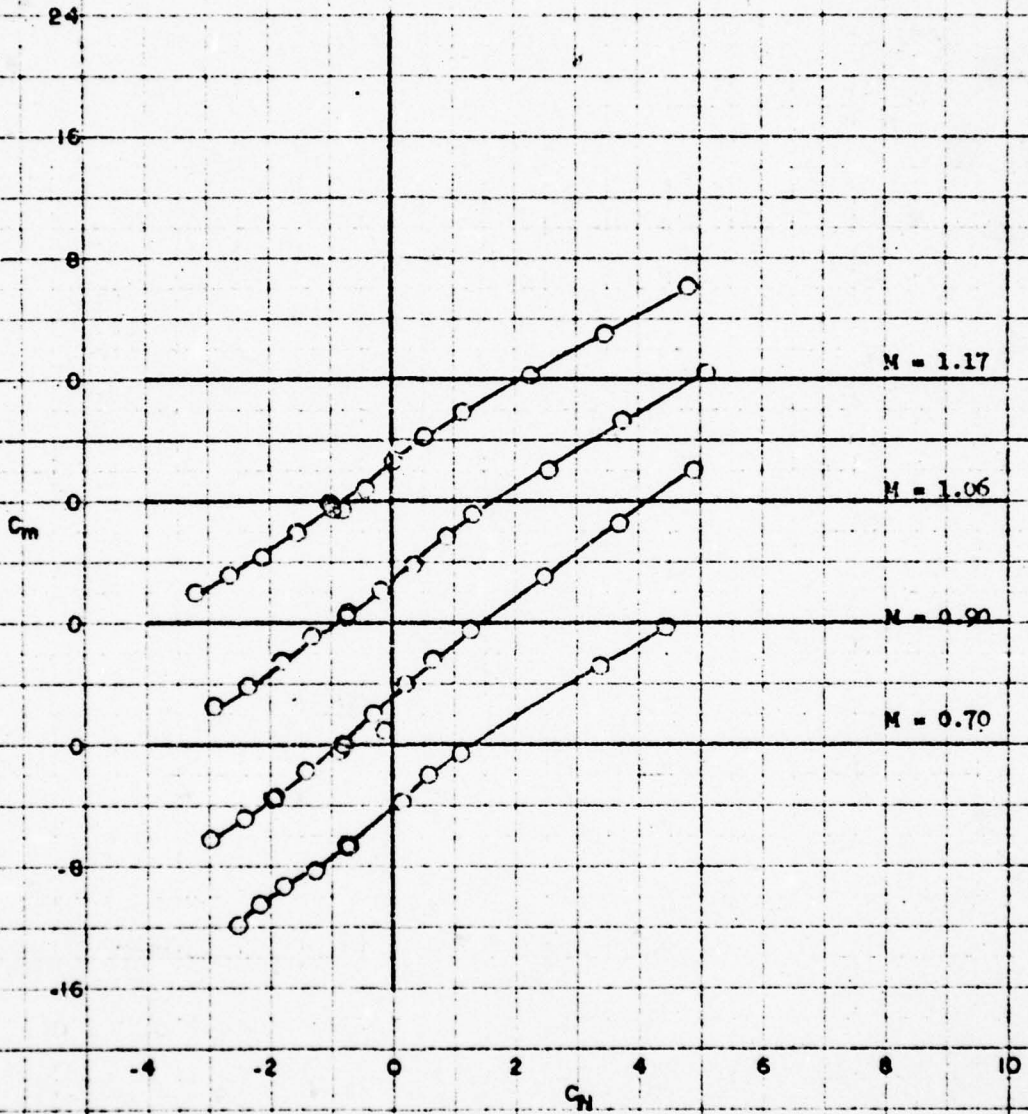


Figure 19 (Continued)

(b) $\phi = -25^\circ$; $l = l' = -5^\circ$; $\delta = \delta' = 0^\circ$

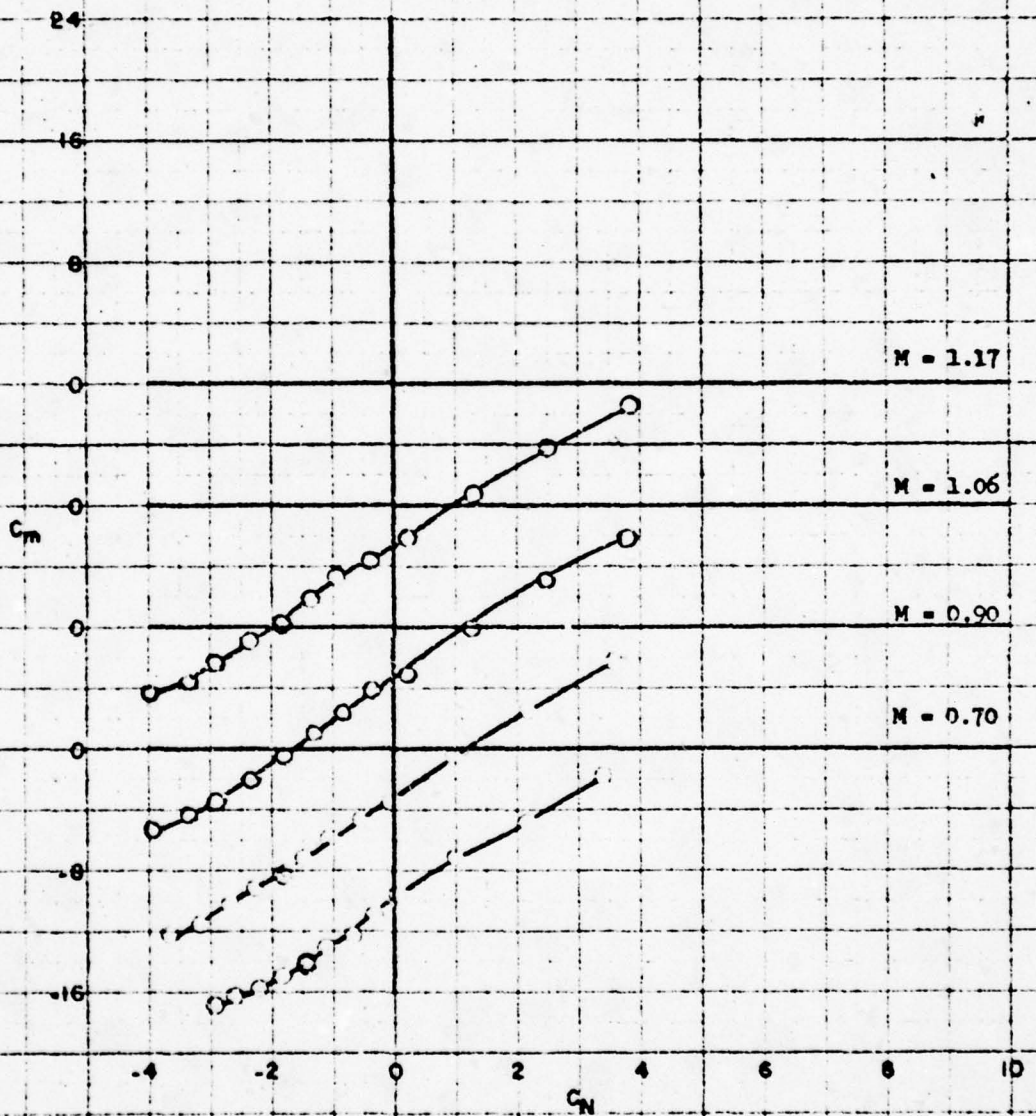


Figure 19 (Continued)
 (c) $\phi = -45^\circ$; $i = i' = -10^\circ$; $\delta = \delta' = 0^\circ$

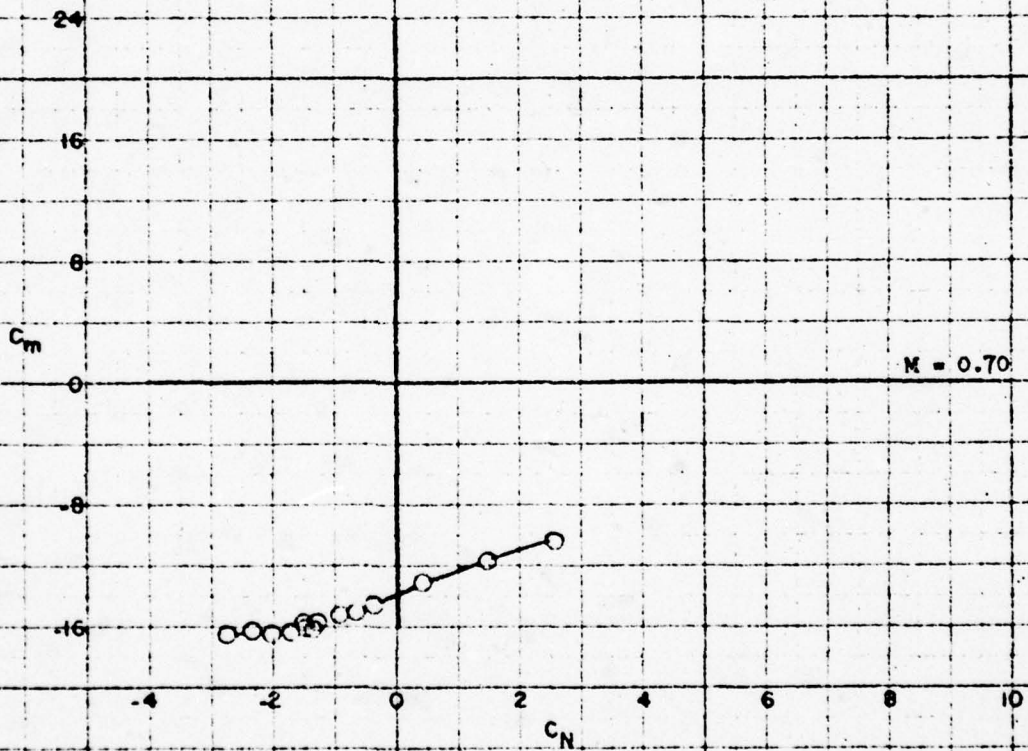


Figure 19 (Continued)

(d) $\phi = -45^\circ$; $i = i' = -15^\circ$; $\delta = \delta' = 0^\circ$

FIGURE 19d

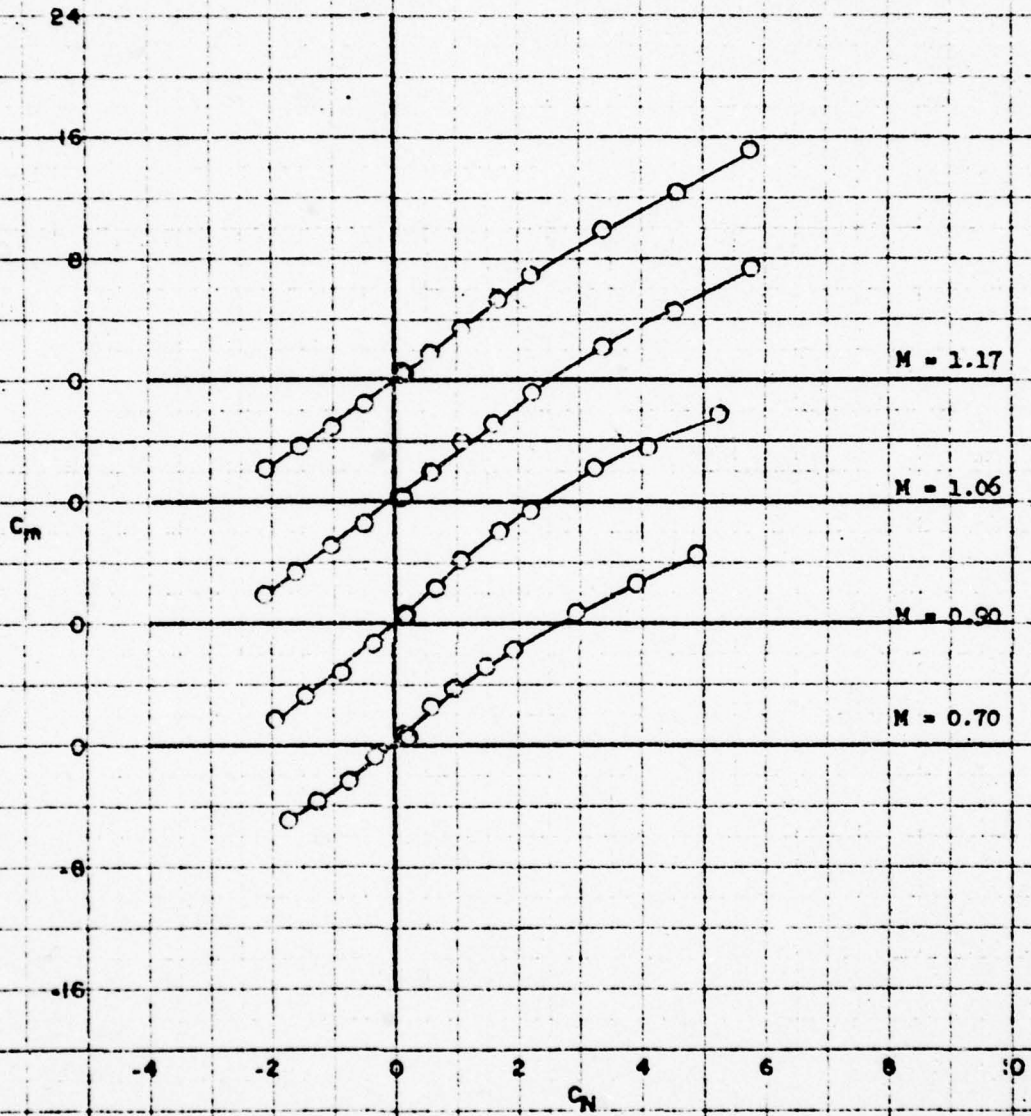


Figure 19 (Continued)

(e) $\phi = -45^\circ$; $i = i' = 0^\circ$; $\delta = \delta' = 5^\circ$

FIGURE 19e

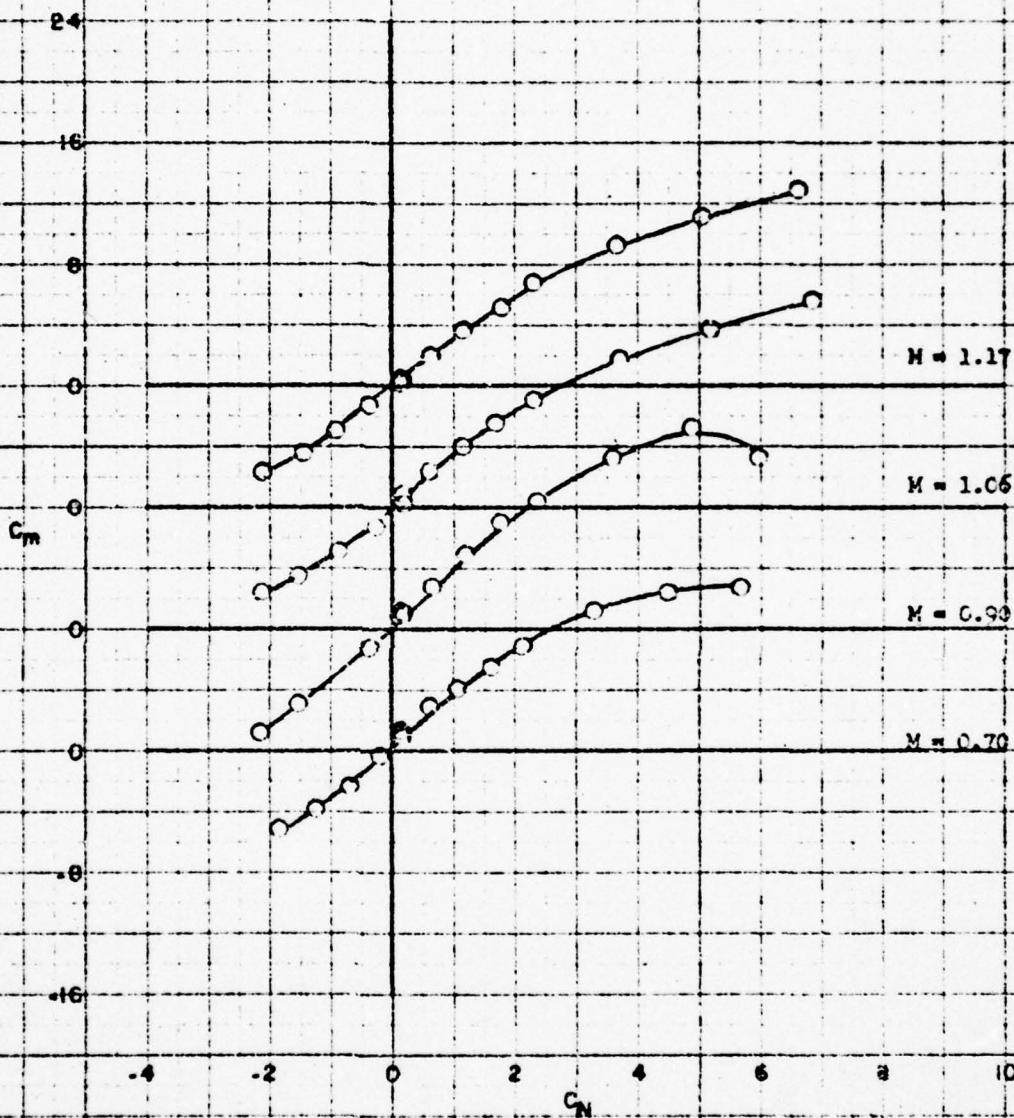


Figure 19 (Continued)

(F) $\alpha=0^\circ$; $i=1^\circ=0^\circ$; $\delta=\delta'=0^\circ$

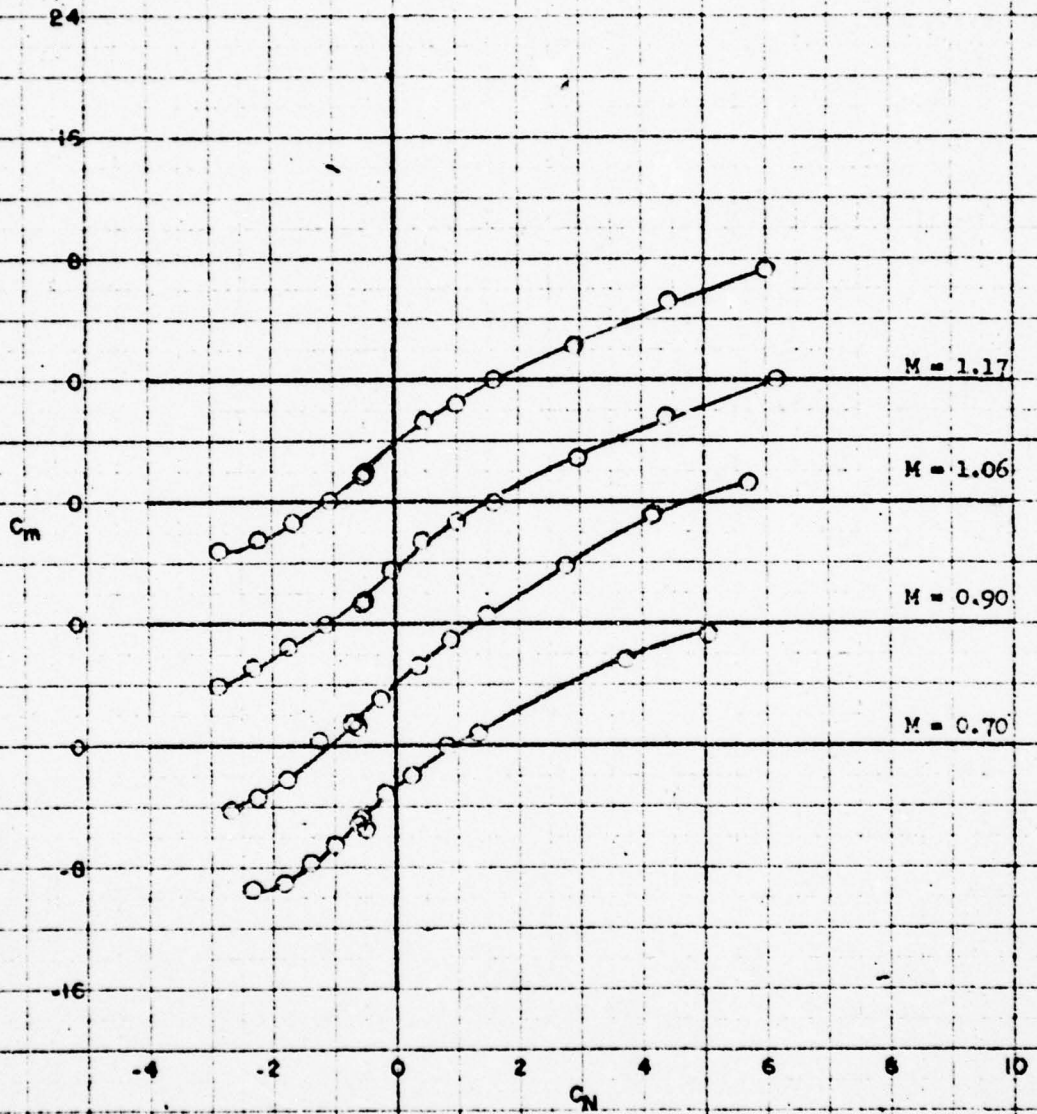


Figure 19 (Continued)
(g) $\phi = 0^\circ$; $i = -5^\circ$; $i' = 0^\circ$; $\delta = \delta' = 0^\circ$

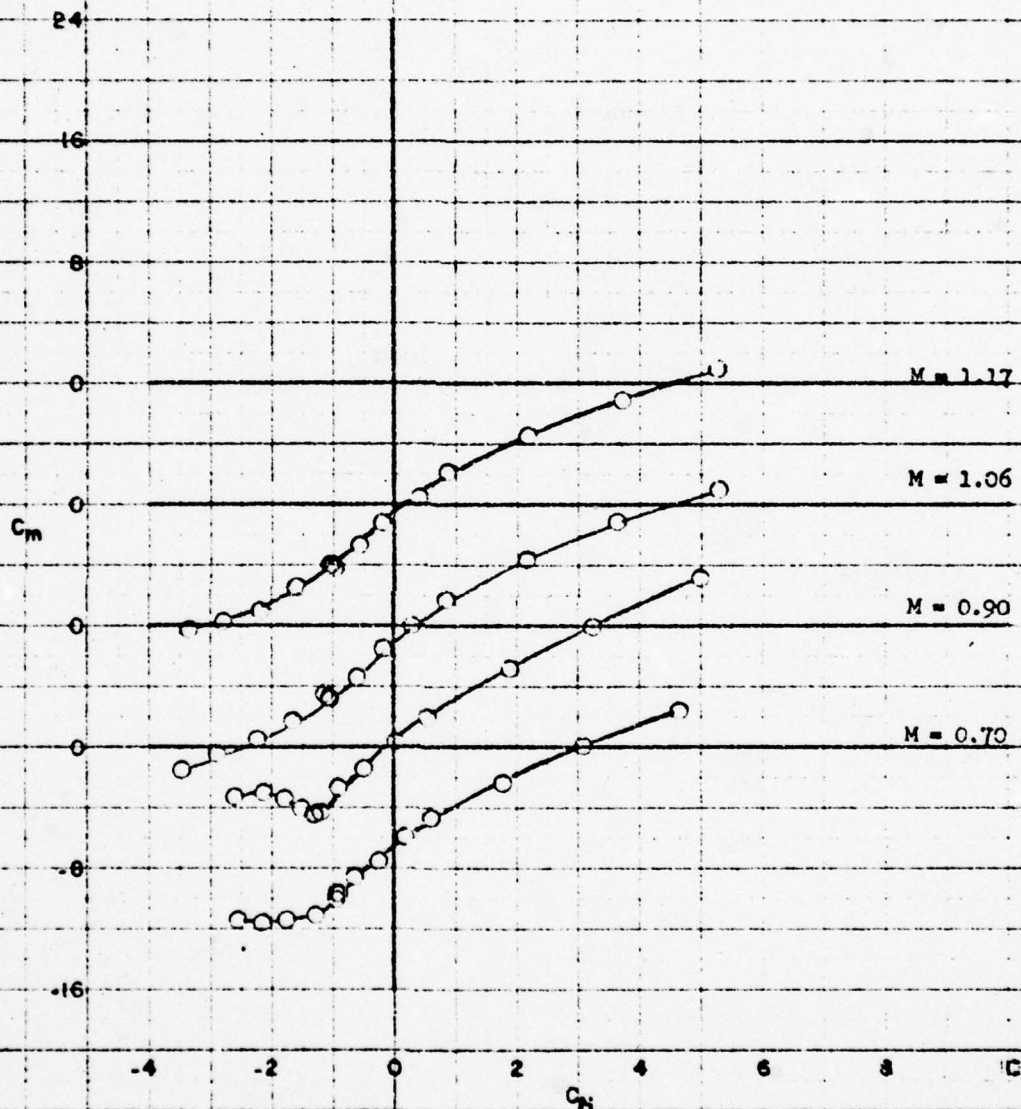


Figure 19 (Concluded)
(h) $\phi=0^\circ$; $i=-10^\circ$; $i'=0^\circ$; $\delta=\delta'=0^\circ$

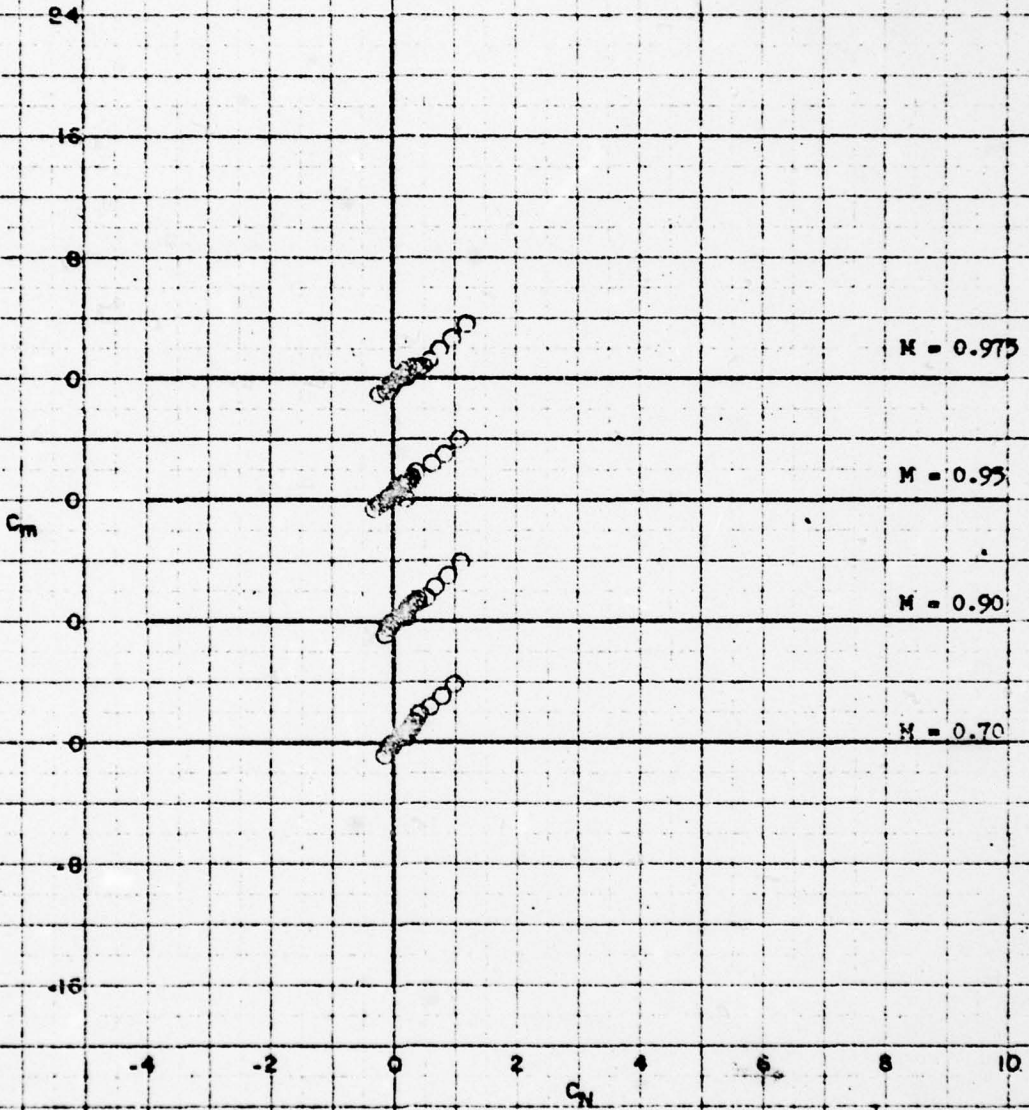


Figure 20 - Variation of Pitching-Moment Coefficient With Normal-Force Coefficient for Configuration B₂₂R₅H₁₀

$\phi = -15^\circ$

FIGURE 20

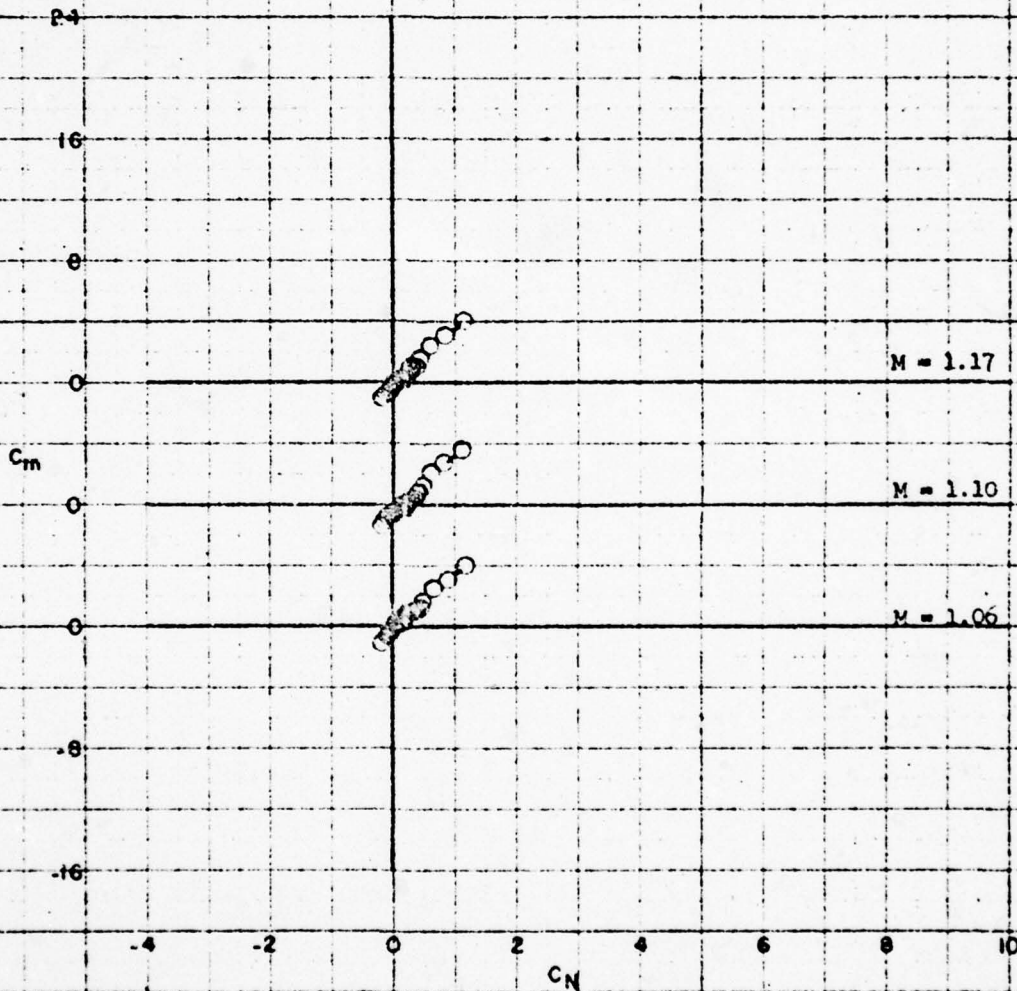


Figure 20. (Concluded)

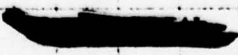


FIGURE 20 (concl)

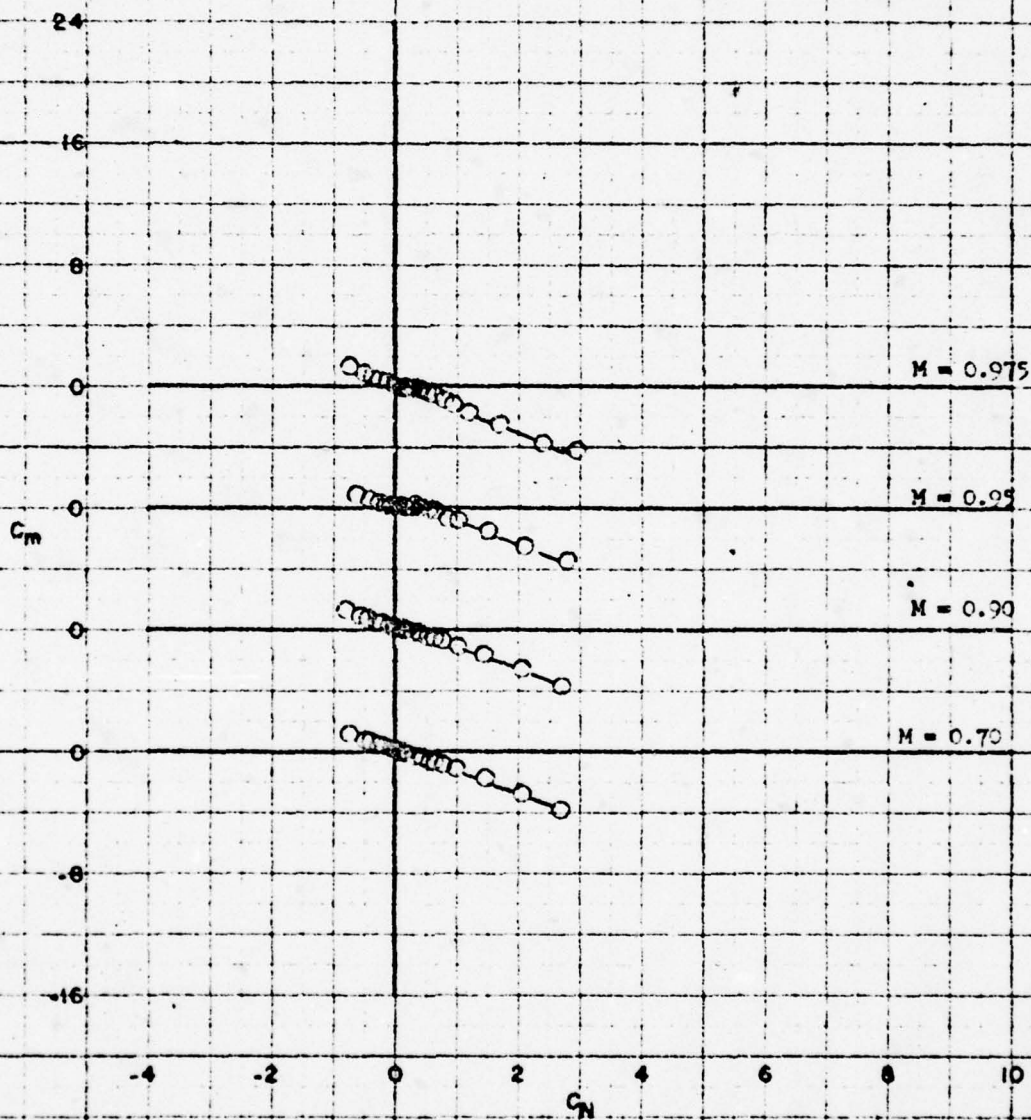


Figure 21 - Variation of Pitching-Moment Coefficient With Normal-Force Coefficient for Configuration B₂₂R₅H₁₀F₁₈

$\alpha = 45^\circ$

FIGURE 21

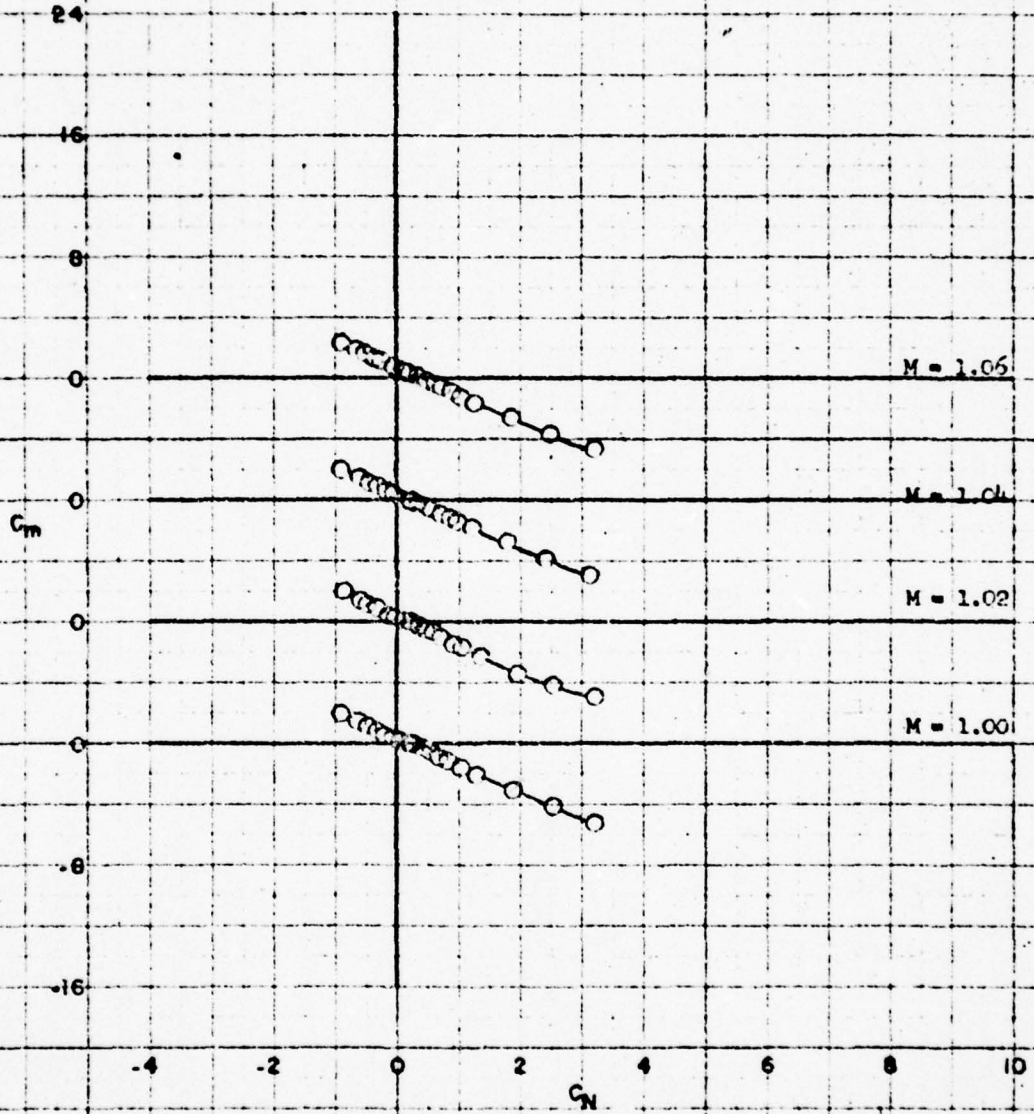


Figure 21 (Continued)

~~CONFIDENTIAL~~

FIGURE 21 (cont)

~~CONFIDENTIAL~~

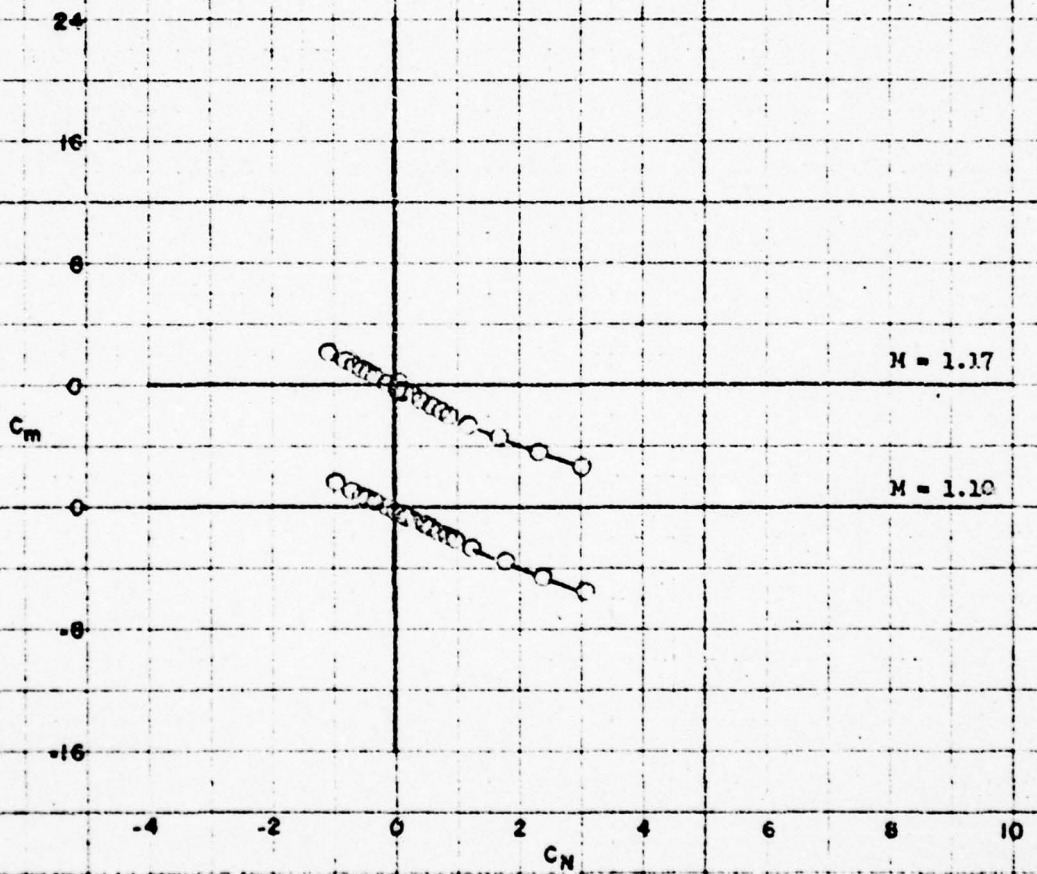


Figure 21 (Concluded)

~~CONFIDENTIAL~~

FIGURE 21 (concl)

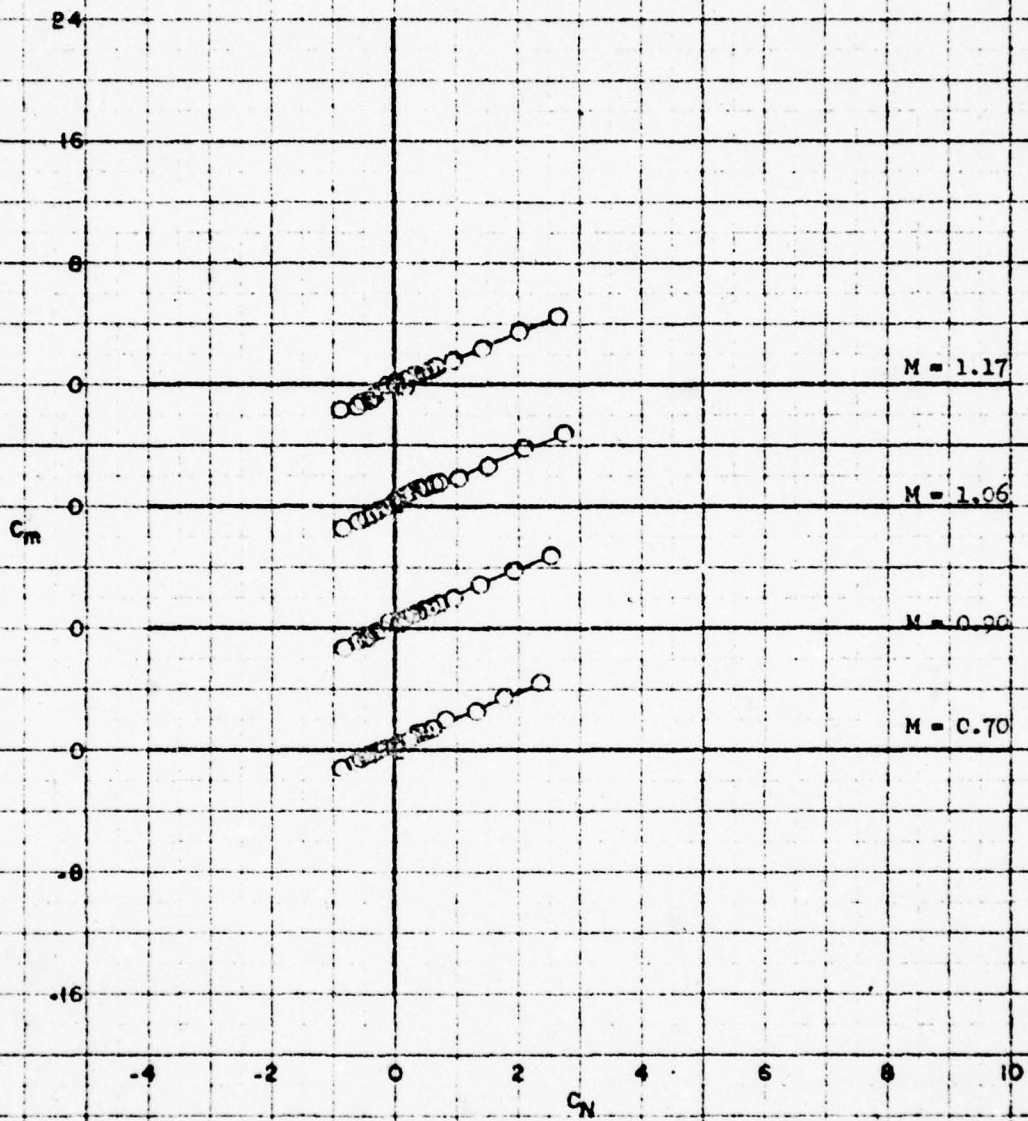


Figure 22 - Variation of Pitching-Moment Coefficient With Normal-Force Coefficient for Configuration B₂₂R₅H₁₀T₁₀

$\alpha = -45^\circ$

FIGURE 22

~~CONFIDENTIAL~~

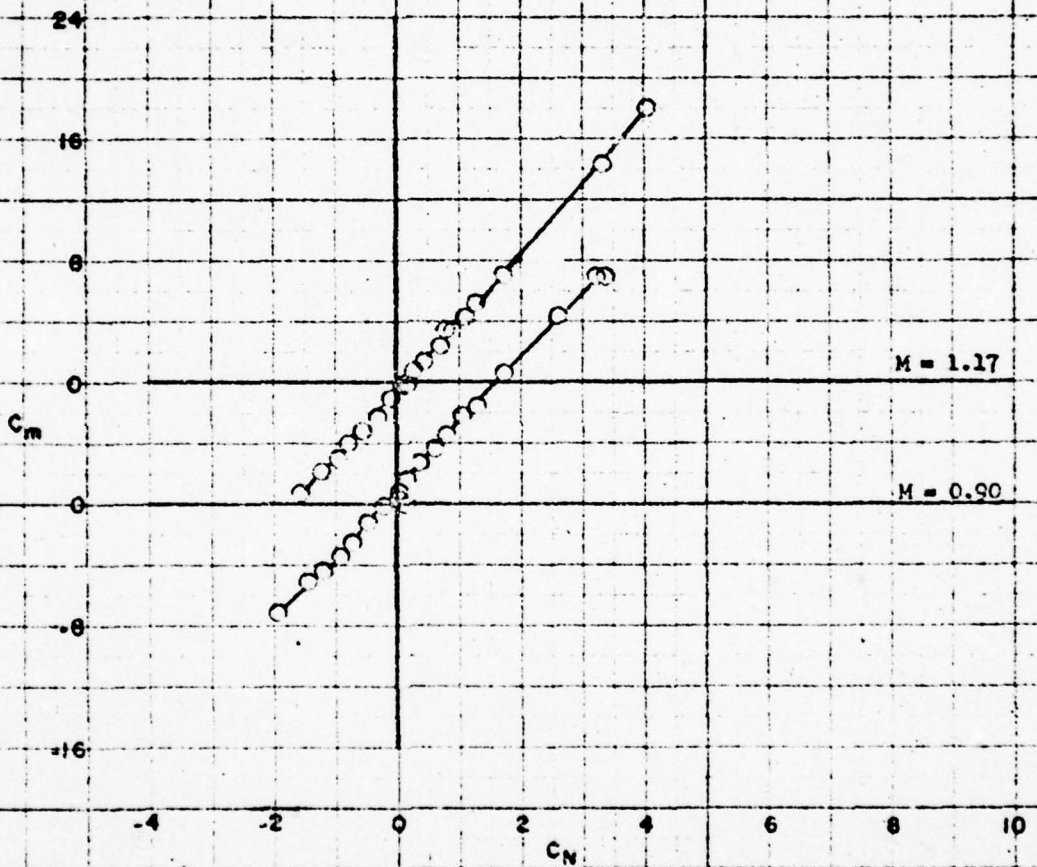


Figure 23 - Variation of Pitching-Moment Coefficient With Normal-Force Coefficient for Configuration B₂₂R₅H₁₀WC

(a) $\phi=0^\circ$; $i=1^\circ=0^\circ$; $\delta=5^\circ=0^\circ$

~~CONFIDENTIAL~~
FIGURE 23a

~~CONFIDENTIAL~~

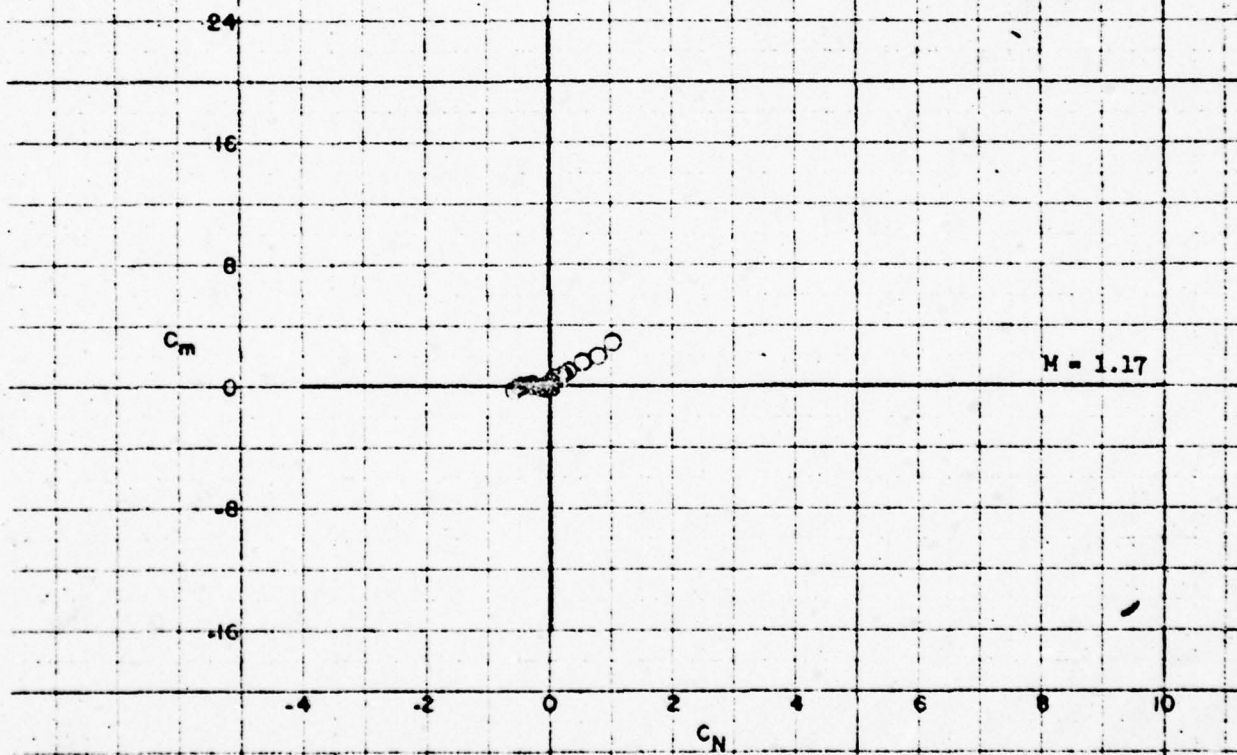


Figure 23 (Continued).

(b) $\phi=0^\circ$; $1=-5^\circ$, $1'=0^\circ$; $\delta=6' = 0^\circ$

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FIGURE 23b

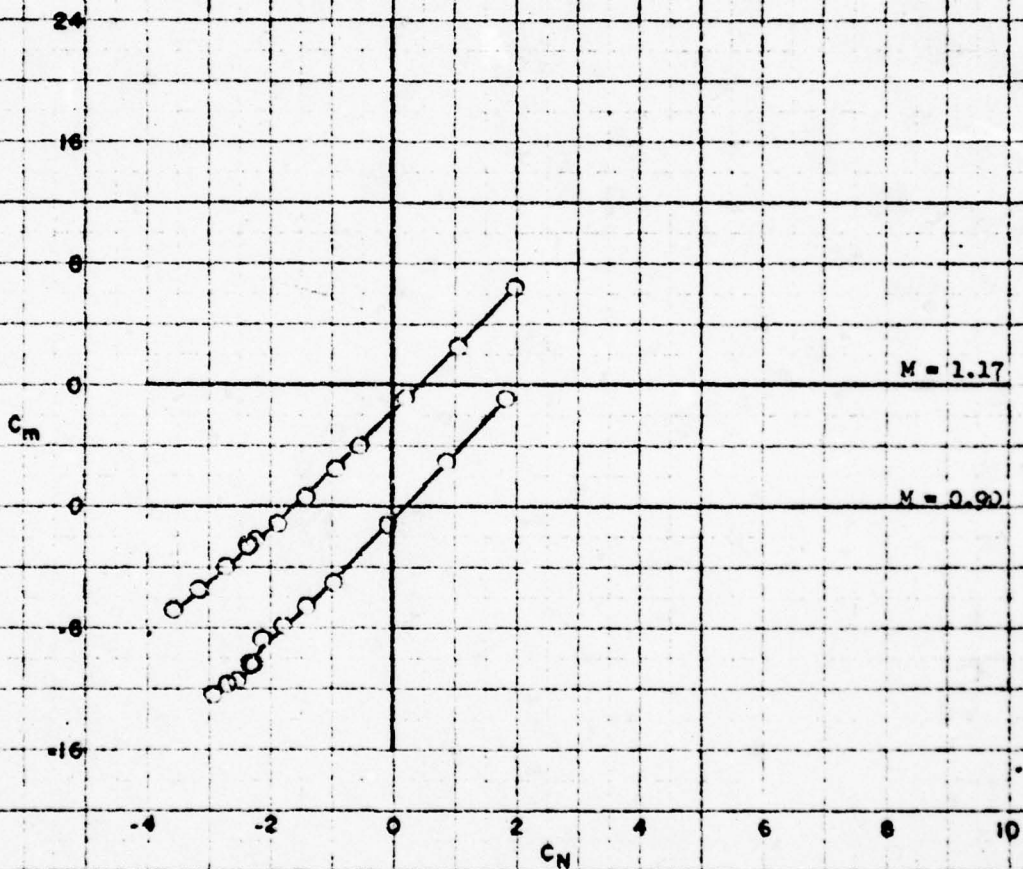


Figure 23 (Concluded)

(c) $\phi = 0^\circ$; $i = -10^\circ$, $i' = 0^\circ$; $\delta = \delta' = 0^\circ$

FIGURE 23c

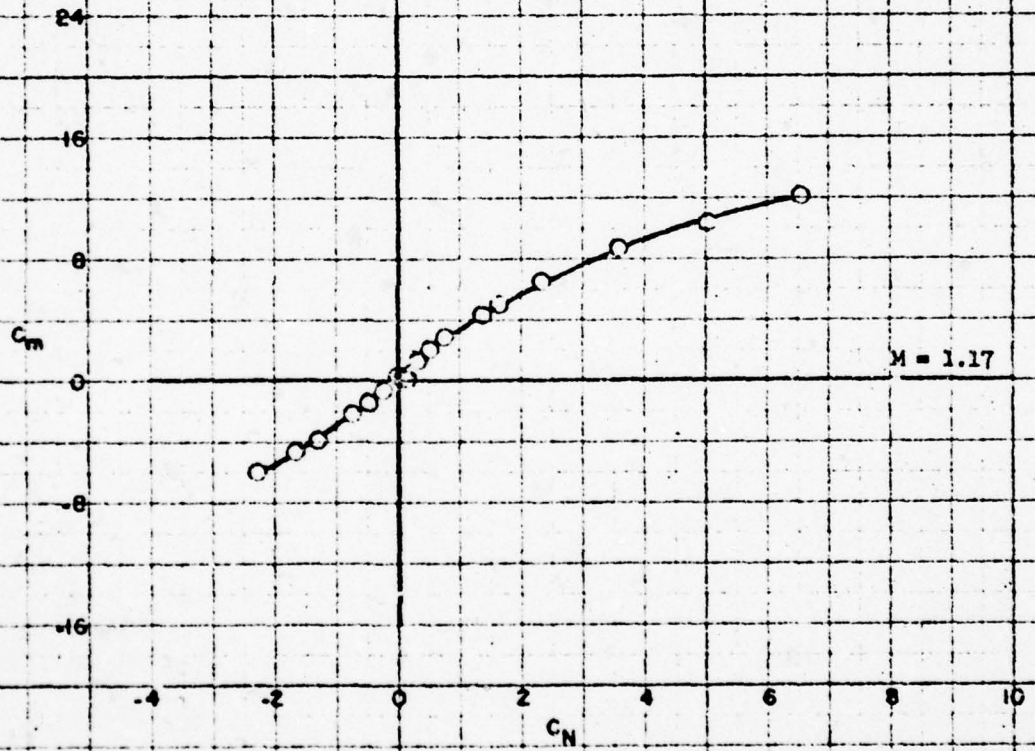


Figure 24 - Variation of Pitching-Moment Coefficient With Normal-Force Coefficient for Configuration B₂₂R₅10^{WT}10^F18^C

(a) $\alpha=0^\circ$; $\delta=0^\circ$; $\delta'=0^\circ$

FIGURE 24a

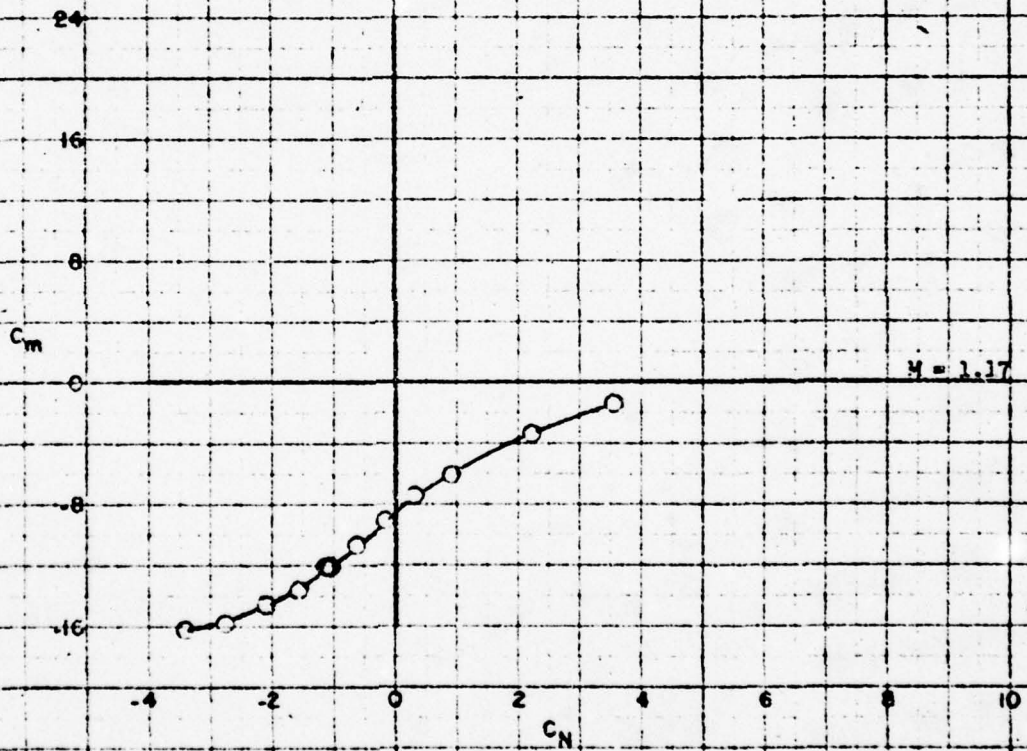


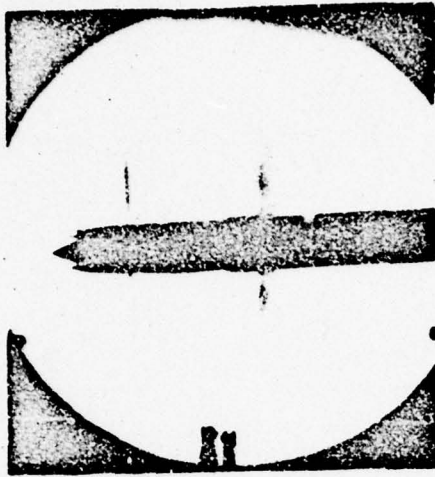
Figure 24 (Concluded)

(b) $\phi=0^\circ$; $i=-10^\circ$; $i'=0^\circ$; $\delta=\delta'=0^\circ$

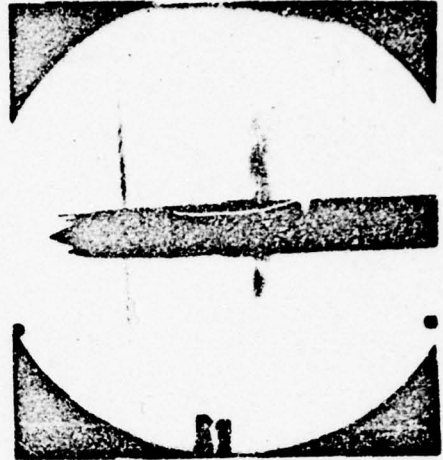
FIGURE 24b

AERO 1002

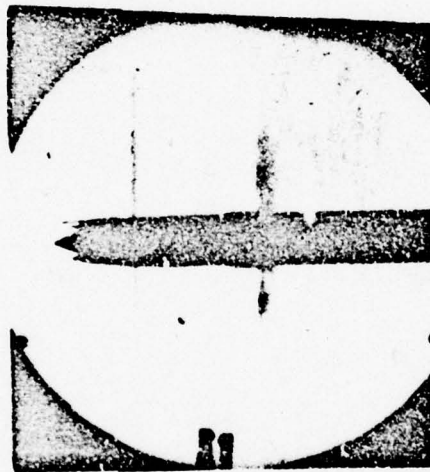
-160-



$\alpha = -2^\circ$



$\alpha = -1^\circ$



$\alpha = -0.5^\circ$

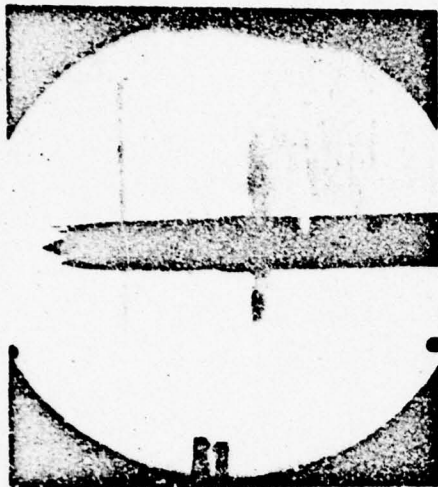
Figure 25 - Schlieren Photographs of the Missile.

Configuration B₂₂R₅H₁₀

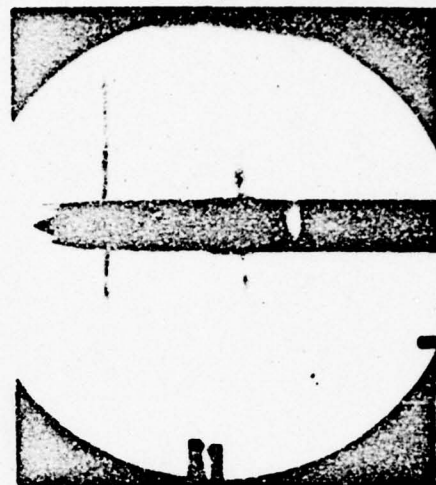
(a) M = 0.95

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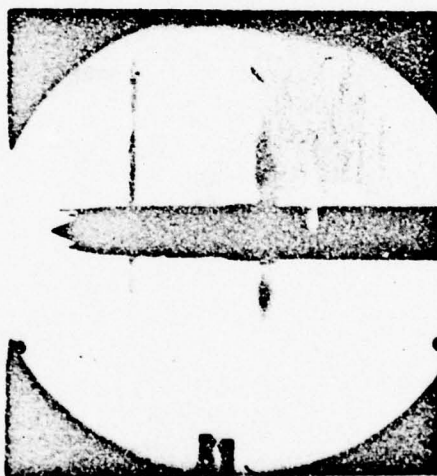
CONFIDENTIAL



$\alpha = 0^\circ$



$\alpha = 0.5^\circ$



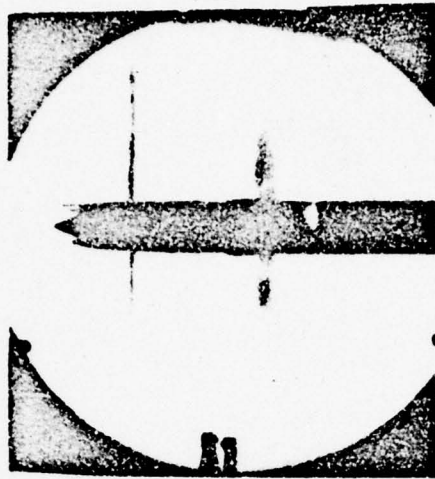
$\alpha = 1^\circ$

Figure 25 (Continued)

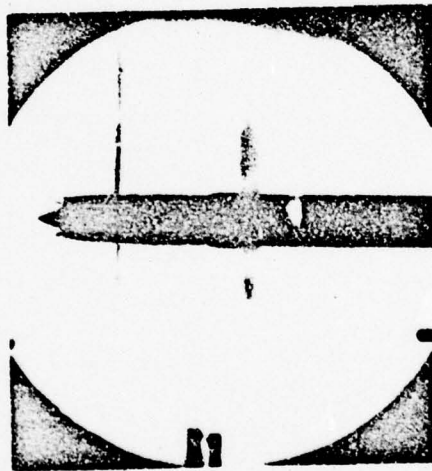
(a) Continued

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$\alpha = 1.5^\circ$



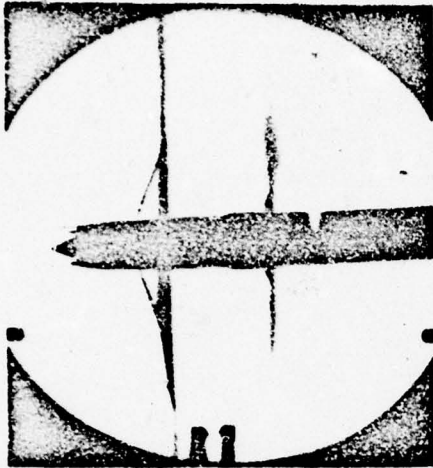
$\alpha = 2^\circ$

Figure 25 (Continued)

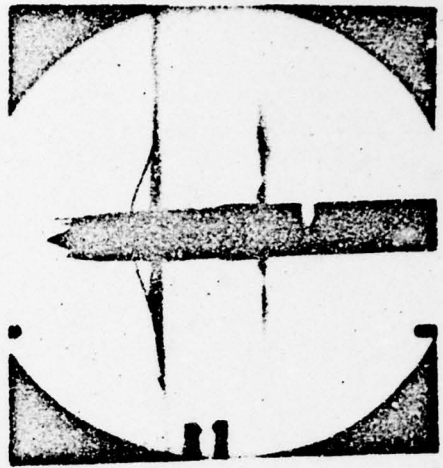
(a) Concluded

AERO 1002

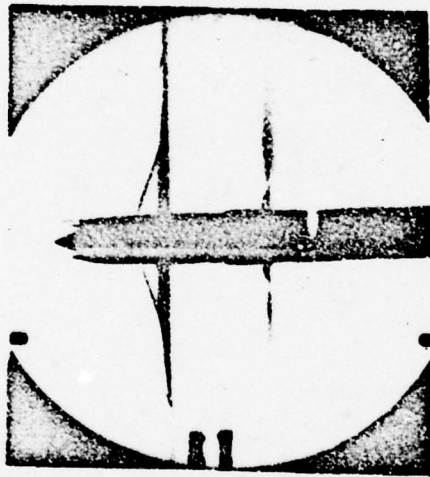
-163-



$\alpha = -2^\circ$



$\alpha = -1.5^\circ$

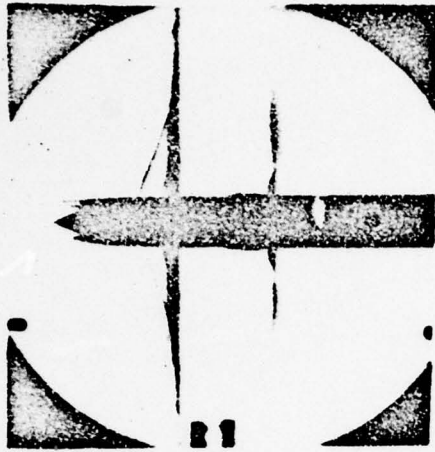


$\alpha = -1^\circ$

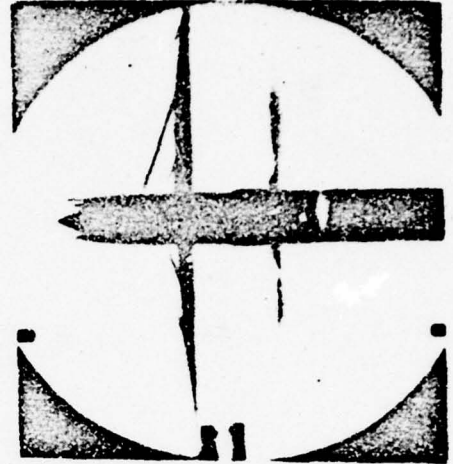
Figure 25 (Continued)

(b) $M = 0.975$

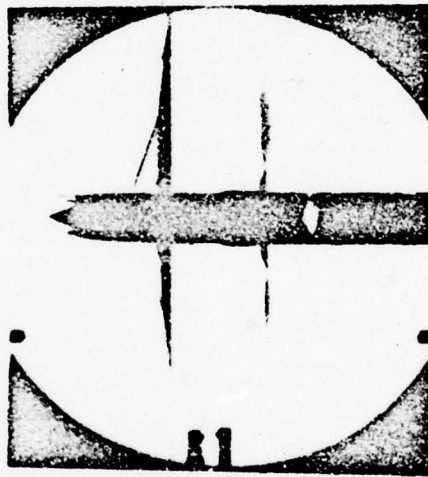
PSD - 302, 766



$\alpha = -0.5^\circ$

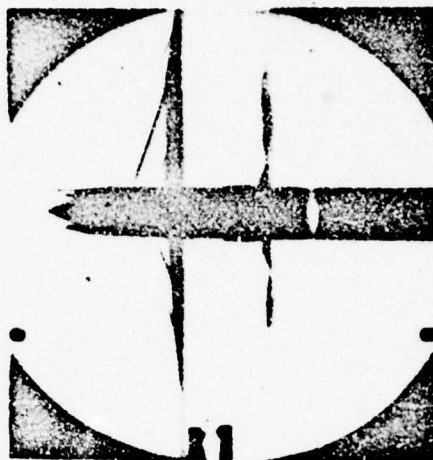


$\alpha = 0.5^\circ$

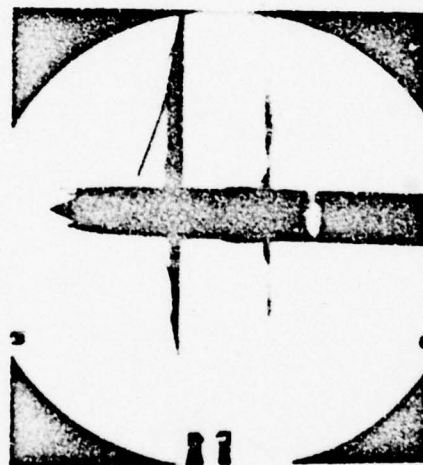


$\alpha = 1^\circ$

Figure 25 (Continued)
(b) Continued



$\alpha = 1.5^\circ$



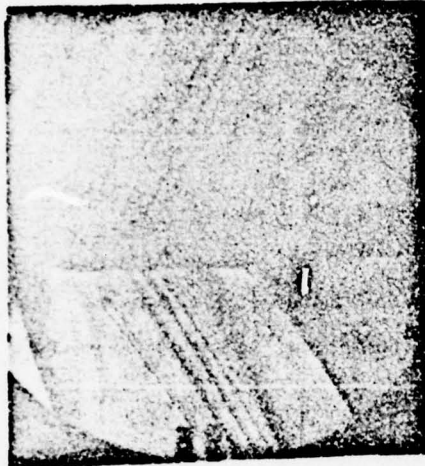
$\alpha = 2^\circ$

Figure 25 (Continued)

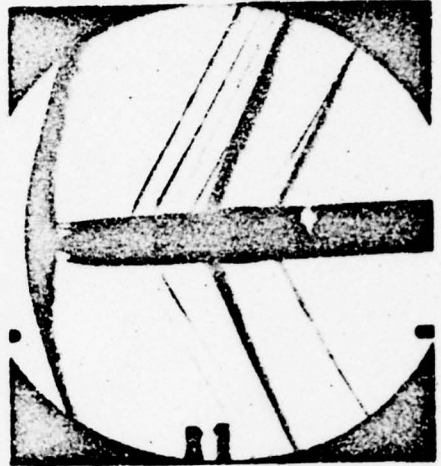
(b) Concluded

AERO 1002

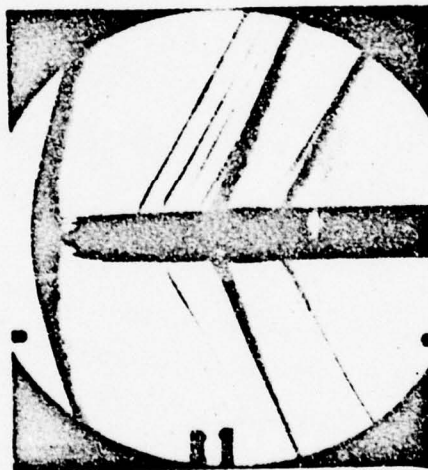
-166-



$\alpha = -2^\circ$



$\alpha = -1.5^\circ$



$\alpha = -1^\circ$

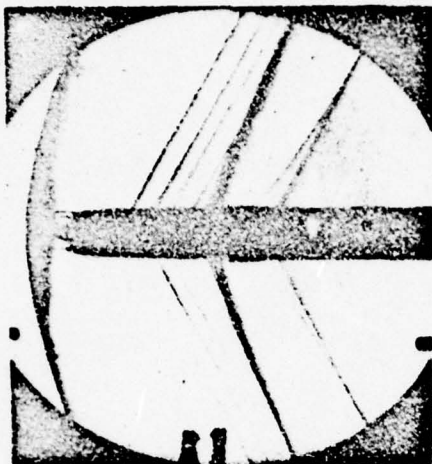
Figure 25 (Continued)

(c) $M = 1.10$

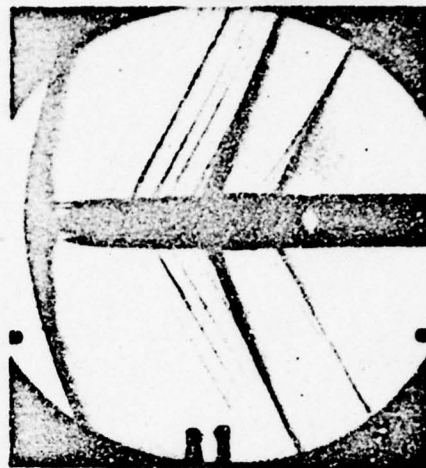
PSD - 302, 769

AERO 1002

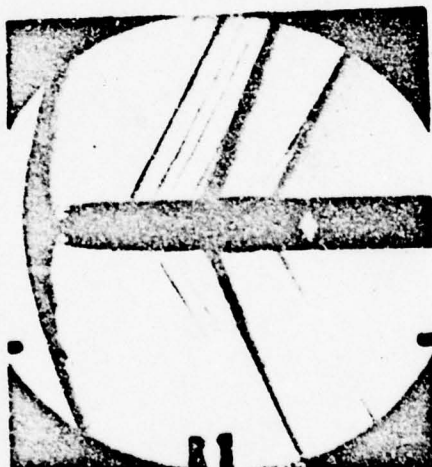
-167-



$\alpha = -0.5^\circ$



$\alpha = 0.5^\circ$

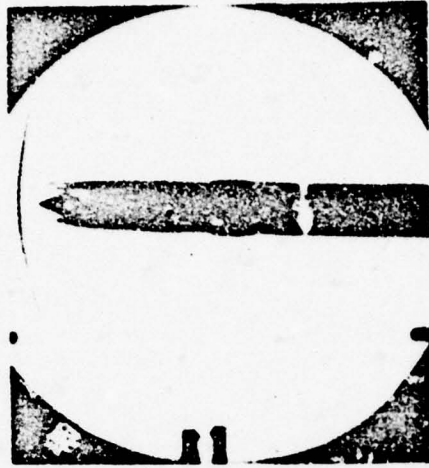


$\alpha = 1^\circ$

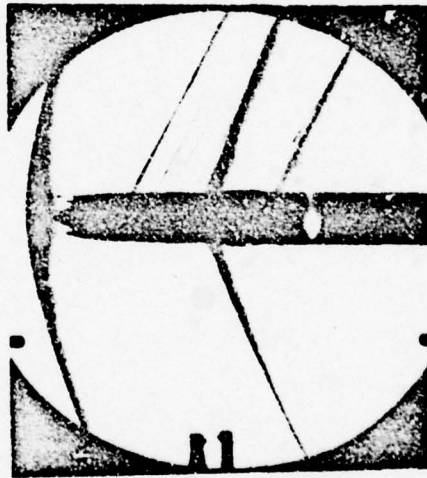
Figure 25 (Continued)

(c) Continued

PSD - 302, 770



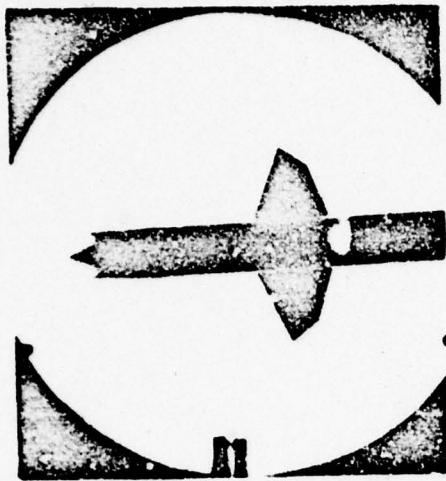
$\alpha = 1.5^\circ$



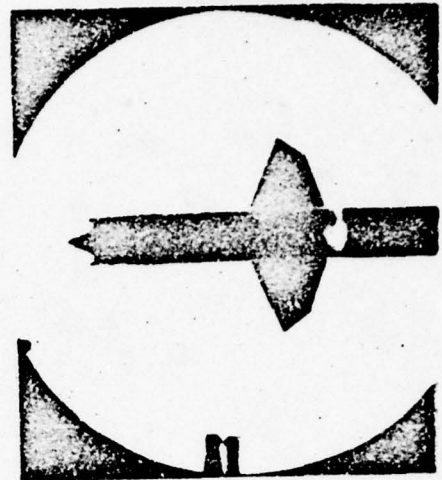
$\alpha = 2^\circ$

Figure 25 (Concluded)

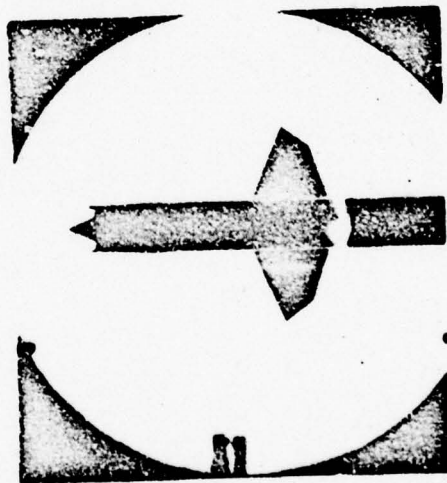
(c) Concluded



$\alpha = -2^\circ$



$\alpha = -1^\circ$

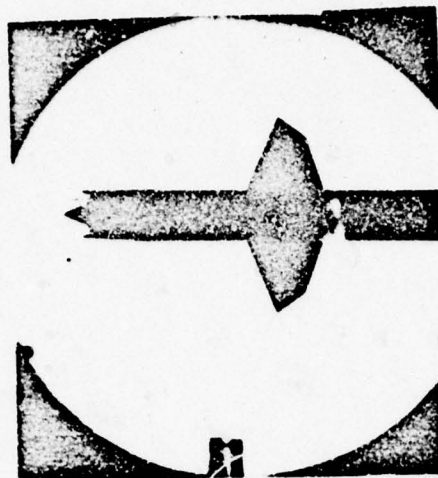


$\alpha = 0^\circ$

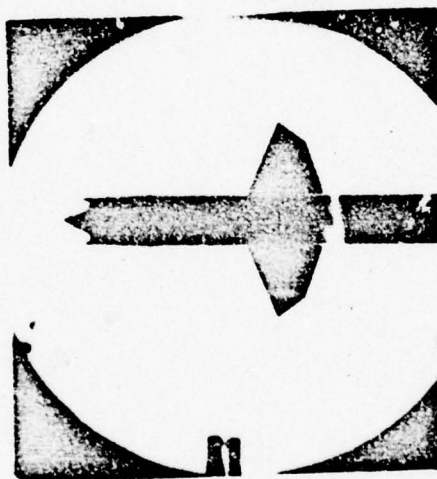
Figure 26 - Schlieren Photographs of the Missile.

Configuration B₂₂R₅H₁₀W

(a) M = 0.90



$\alpha = 1^\circ$

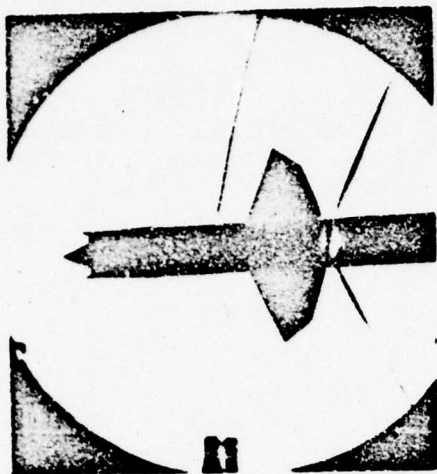


$\alpha = 2^\circ$

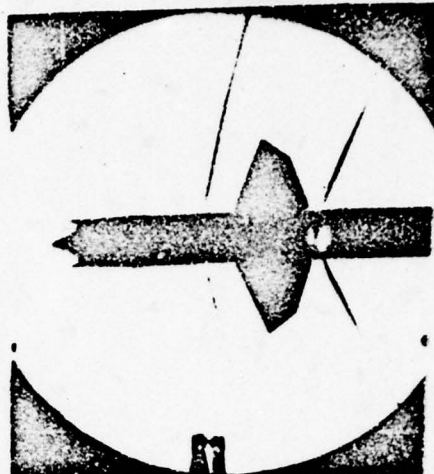
Figure 26 (Continued)
(a) Concluded

AERO 1002

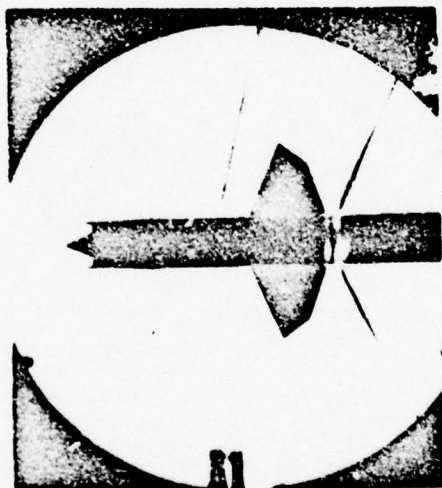
-171-



$\alpha = -2^\circ$



$\alpha = -1^\circ$

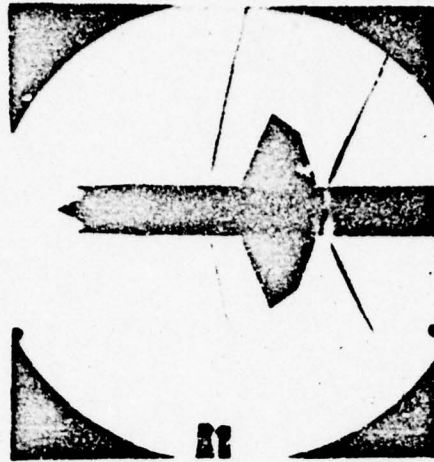


$\alpha = 0^\circ$

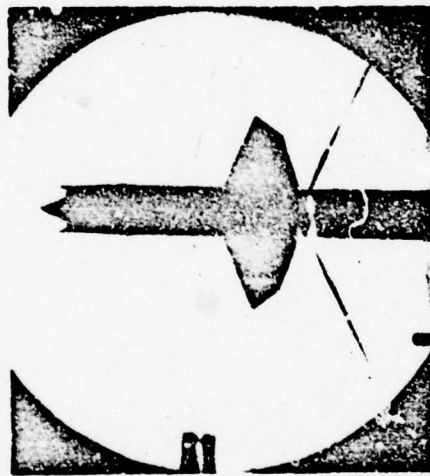
Figure 26 (Continued)

(b) $M = 1.06$

PSD - 302, 774



$\alpha = 1^\circ$



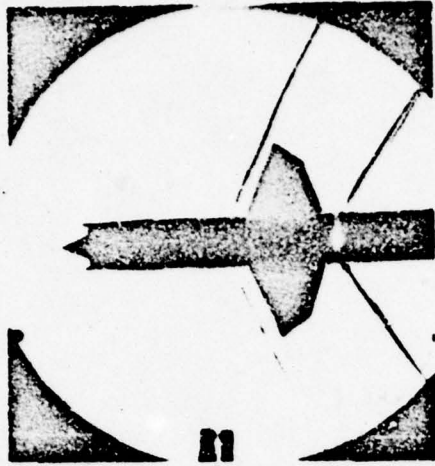
$\alpha = 2^\circ$

Figure 26 (Continued)

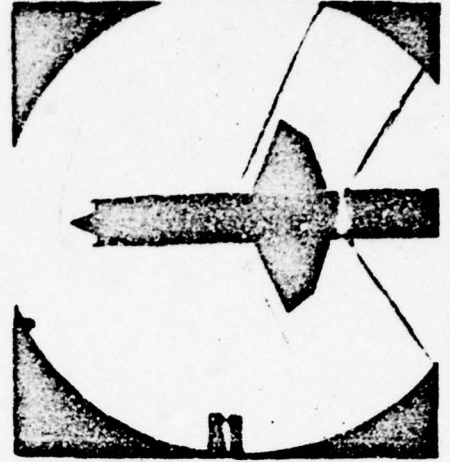
(b) Concluded

AERO 1002

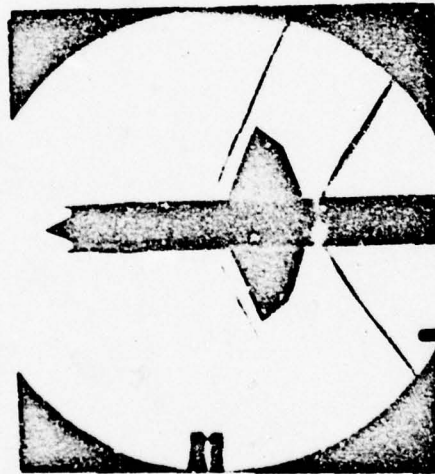
-173-



$\alpha = -2^\circ$



$\alpha = -1^\circ$

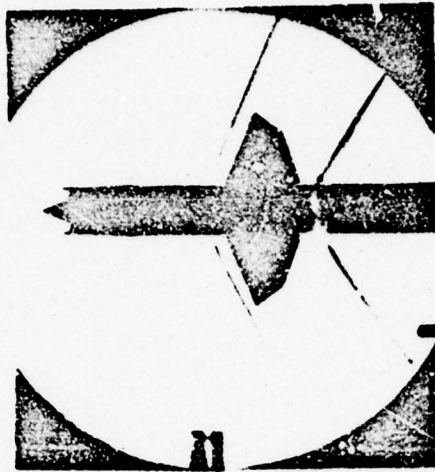


$\alpha = 0^\circ$

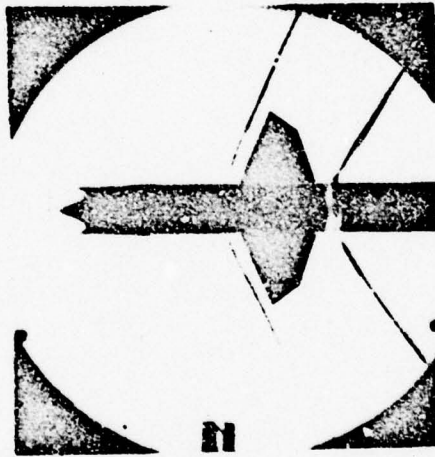
Figure 26 (Continued)

(c) $M = 1.17$

PSD - 302, 776



$\alpha = 1^\circ$



$\alpha = 2^\circ$

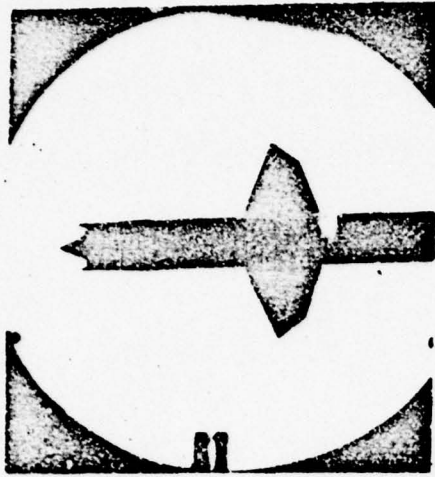
Figure 26 (Concluded)

(c) Concluded

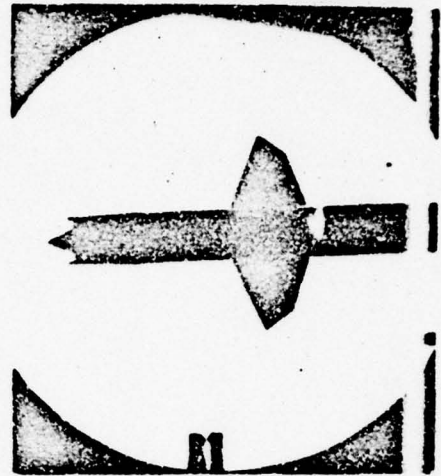
PSD - 302, 777

AERO 1002

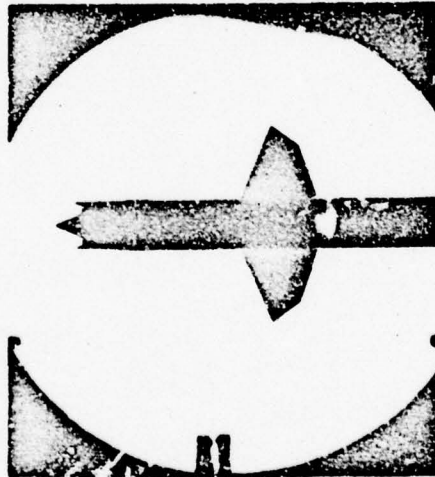
-175-



$\alpha = -2^\circ$



$\alpha = -1^\circ$



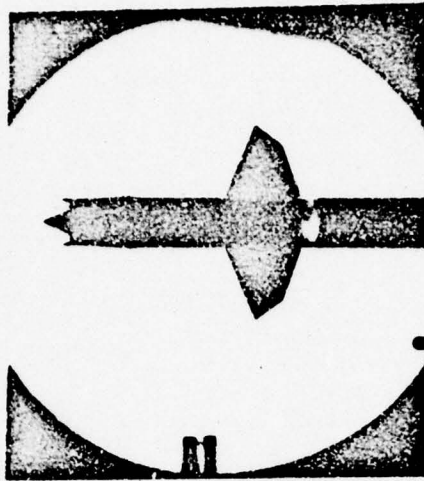
$\alpha = 0^\circ$

Figure 27 - Schlieren Photographs of the Missile.

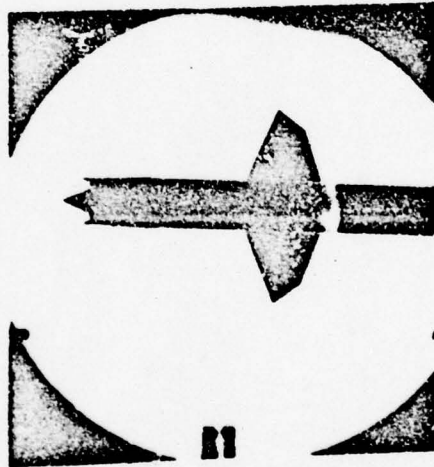
Configuration "22^R5^H10^T10^W"

PSD - 302, 778

(a) M = 0.90

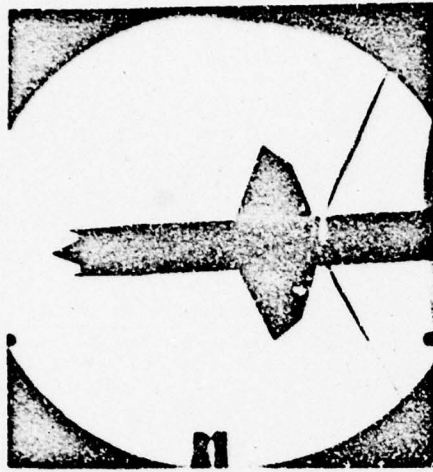


$\alpha = 1^\circ$

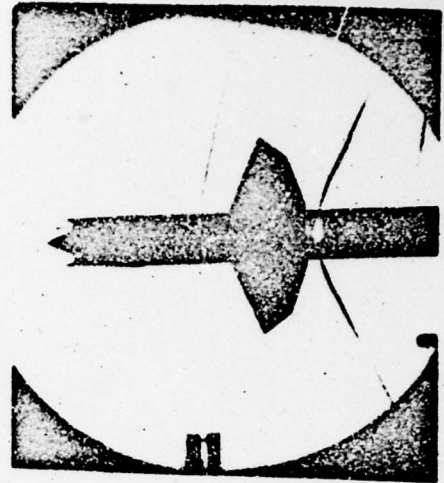


$\alpha = 2^\circ$

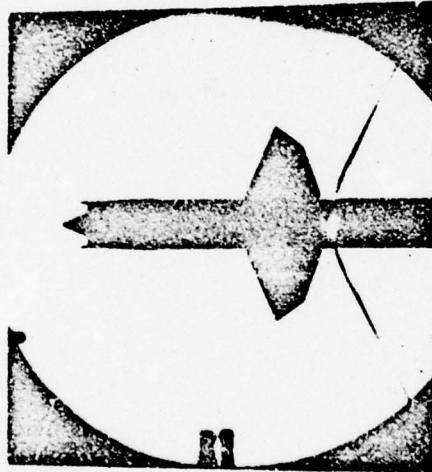
Figure 27 (Continued)
(a) Concluded



$\alpha = -2^\circ$



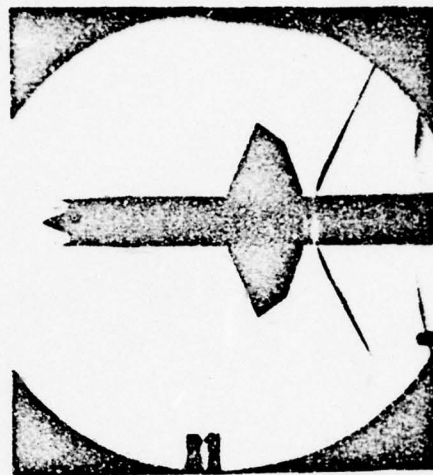
$\alpha = -1^\circ$



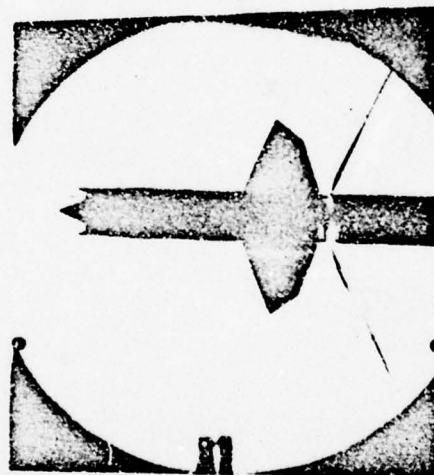
$\alpha = 0^\circ$

Figure 27 (Continued)

(b) $M = 1.06$



$\alpha = 1^\circ$



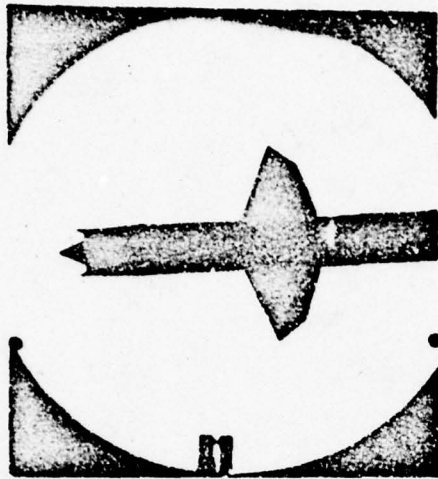
$\alpha = 2^\circ$

Figure 27 (Concluded)

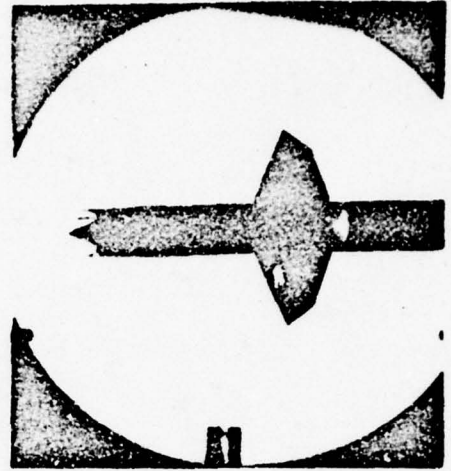
(b) Concluded

AERO 1002

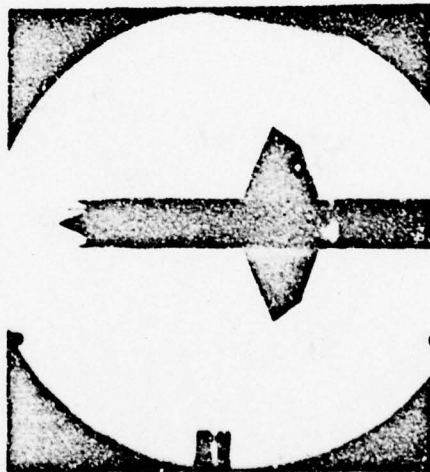
-179-



$\alpha = -2^\circ$



$\alpha = -1^\circ$



$\alpha = 0^\circ$

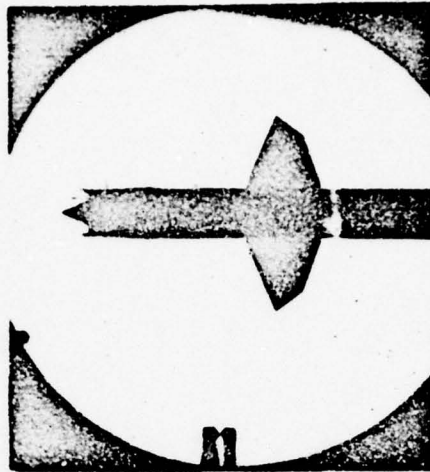
Figure 28 - Schlieren Photographs of the Missile.

Configuration B₂₂R₅H₁₀WT₁₀F₁₈

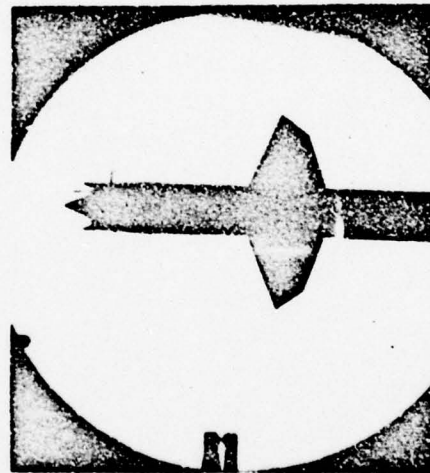
(a) M = 0.90

PSD - 302, 782

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$\alpha = 1^\circ$

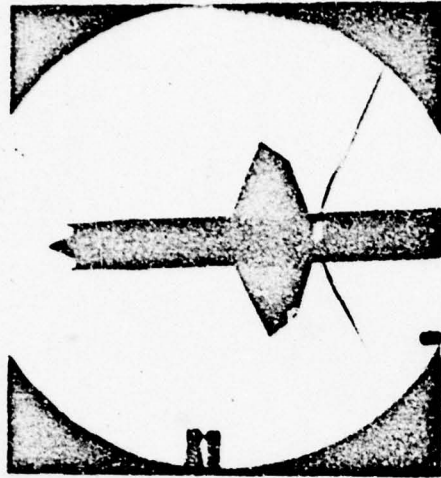


$\alpha = 2^\circ$

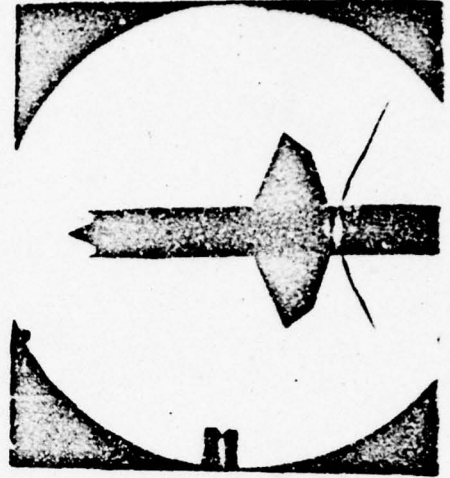
Figure 28 (Continued)

(a) Concluded

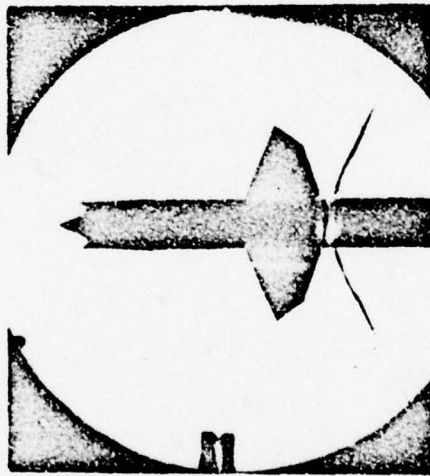
~~CONFIDENTIAL~~



$\alpha = -2^\circ$



$\alpha = -1^\circ$

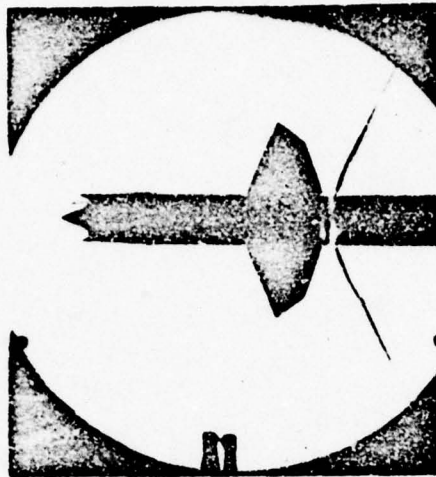


$\alpha = 0^\circ$

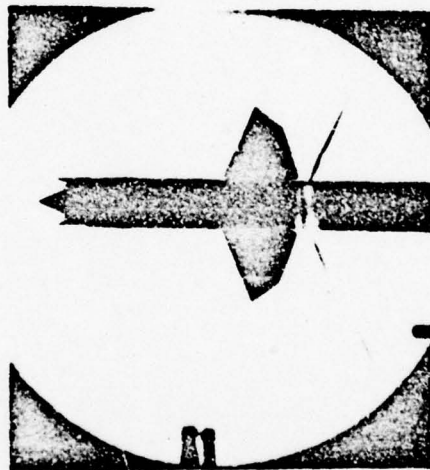
Figure 28 (Continued)

(b) $M = 1.06$

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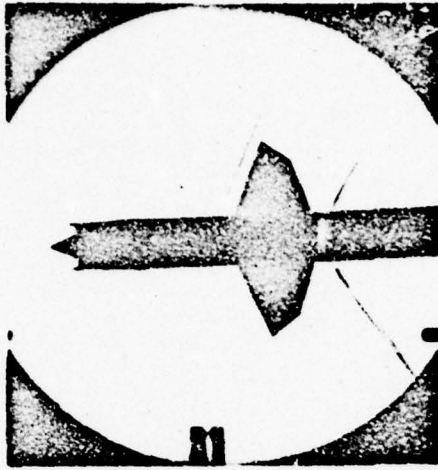
$\alpha = 1^\circ$



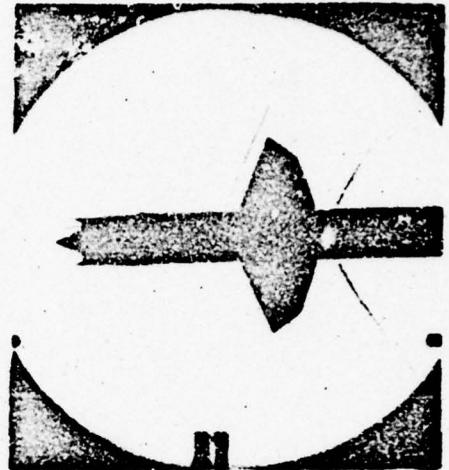
$\alpha = 2^\circ$

Figure 28 (Continued)
(b) Concluded

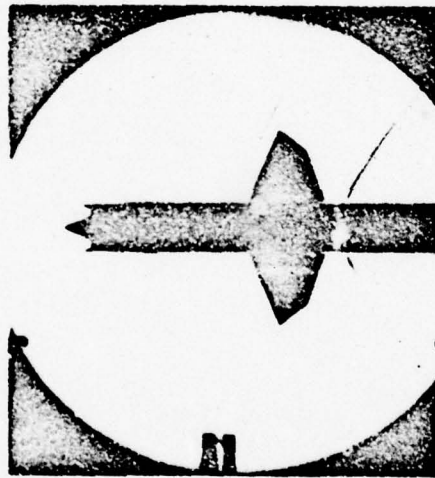
~~CONFIDENTIAL~~



$\alpha = -2^\circ$



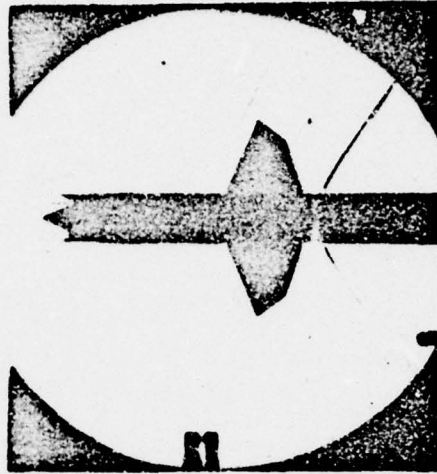
$\alpha = -1^\circ$



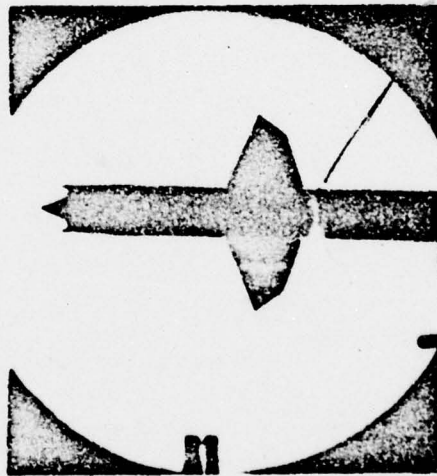
$\alpha = 0^\circ$

Figure 28 (Continued)

(c) $M = 1.17$



$\alpha = 1^\circ$

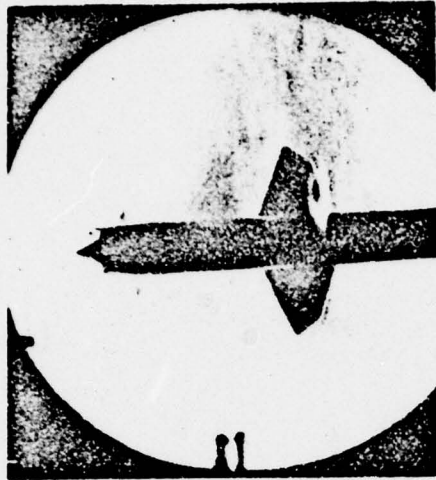


$\alpha = 2^\circ$

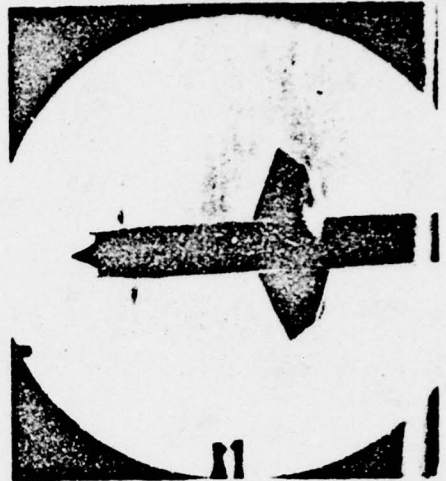
Figure 28 (Concluded)
(c) Concluded

AERO 1002

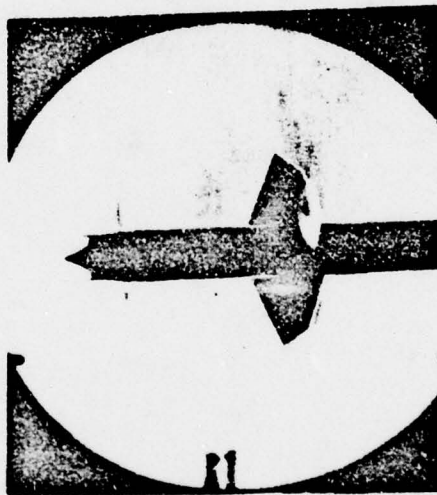
-185-



$\alpha = -2^\circ$



$\alpha = -1.5^\circ$



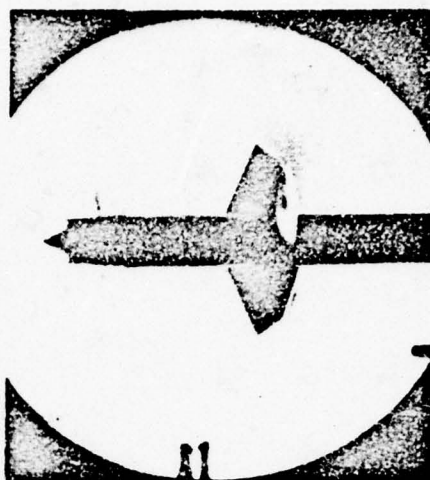
$\alpha = -1^\circ$

Figure 29 - Schlieren Photographs of the Missile.

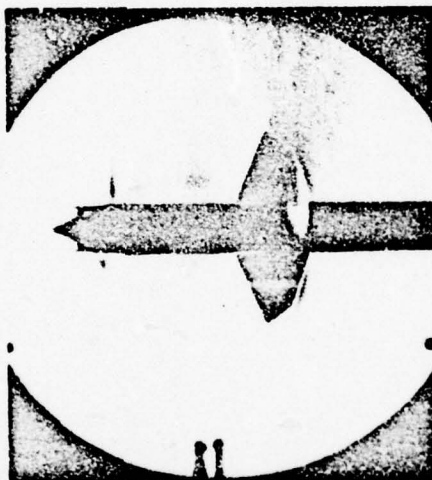
Configuration $B_{22}R_5H_{10}WC$

PSD - 302, 788

(a) $M = 0.90$



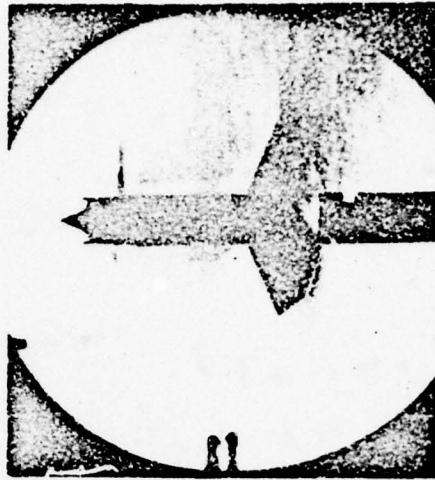
$\alpha = -0.5^\circ$



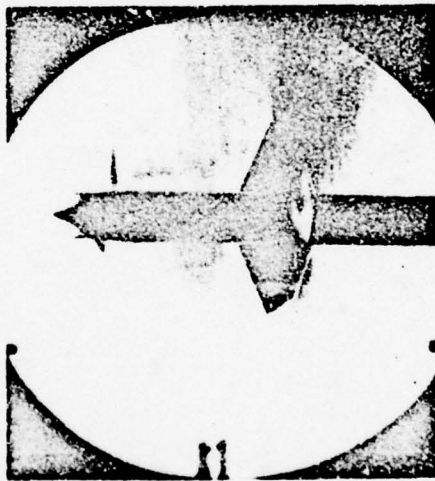
$\alpha = 0.5^\circ$

Figure 29 (Continued)

(a) Continued



$\alpha = 1^\circ$



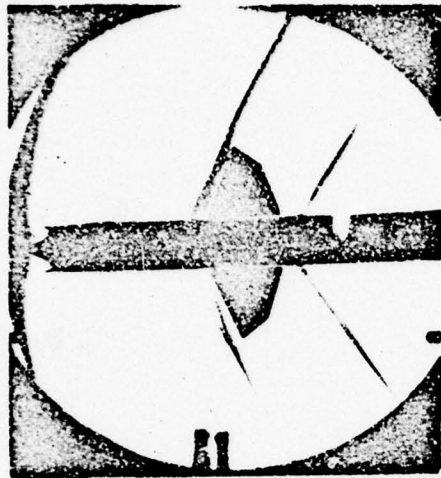
$\alpha = 1.5^\circ$

Figure 29 (Continued)

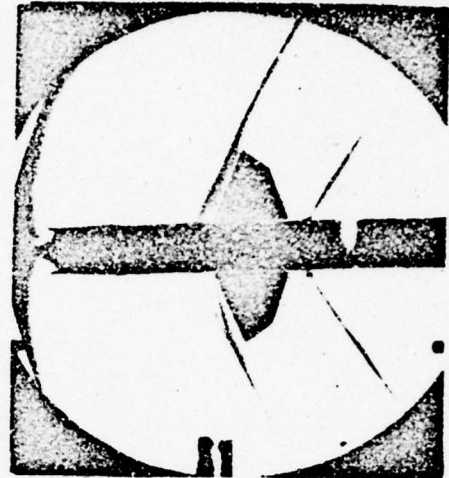
(a) Concluded

AERO 1002

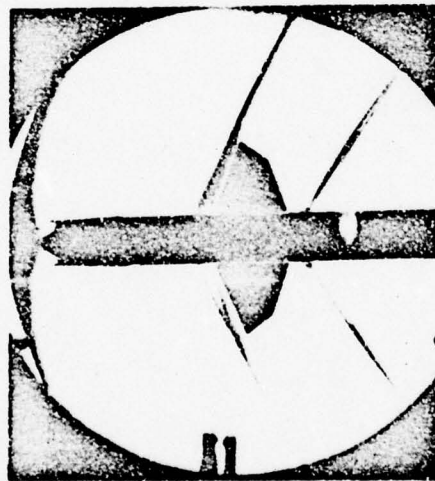
-188-



$\alpha = -2^\circ$



$\alpha = -1.5^\circ$



$\alpha = -1^\circ$

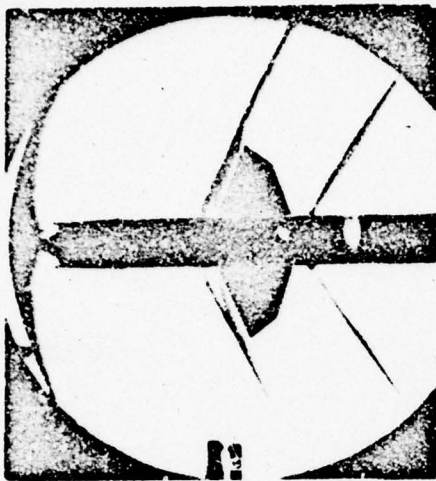
Figure 29 (Continued)

(b) $M = 1.17$

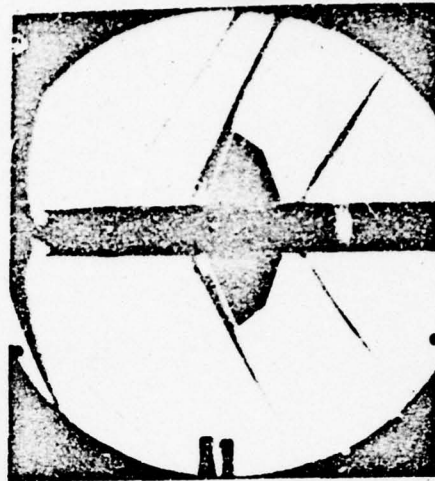
PSD - 302, 791

AERO 1002

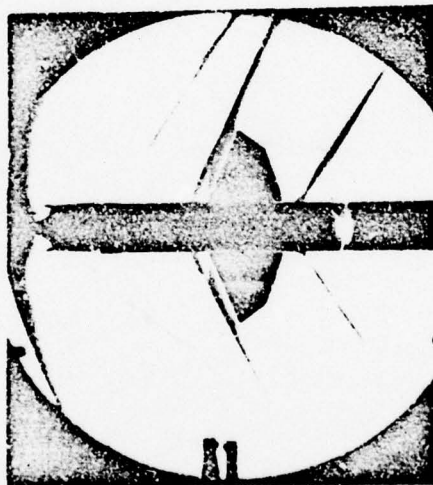
-189-



$\alpha = -0.5^\circ$



$\alpha = 0.5^\circ$

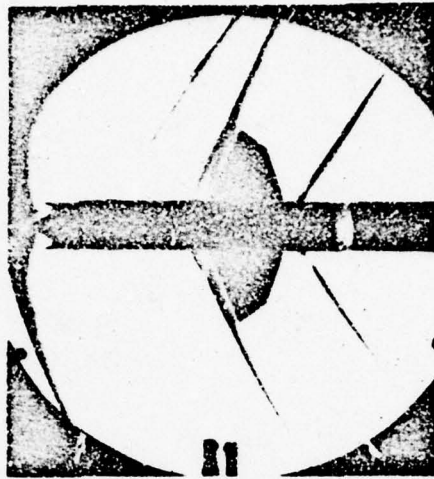


$\alpha = 1^\circ$

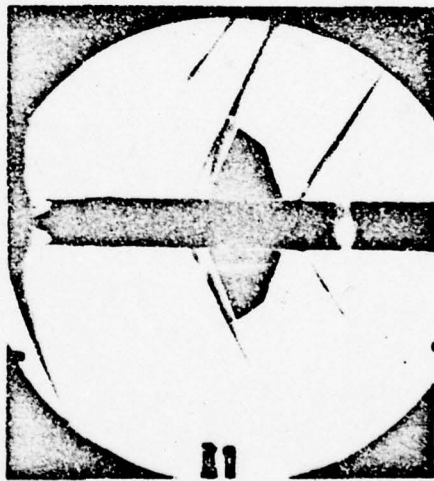
Figure 29 (Continued)

(b) Continued

PSD - 302, 792



$\alpha = 1.5^\circ$



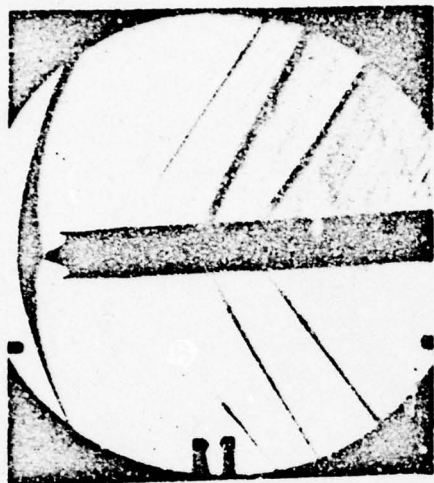
$\alpha = 2^\circ$

Figure 29 (Concluded)

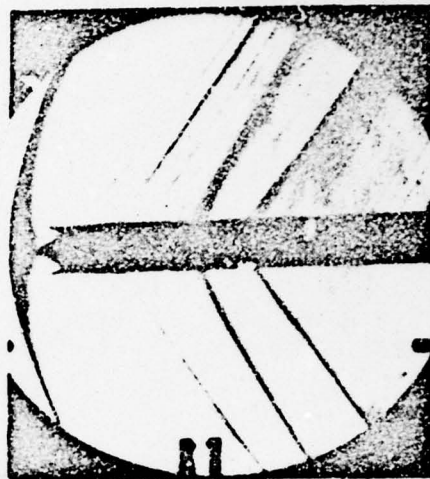
(b) Concluded

AERO 1002

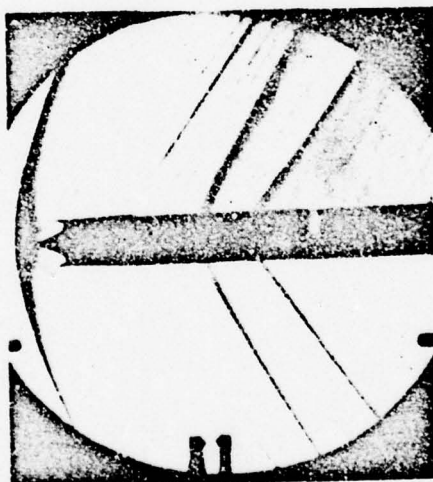
-191-



$\alpha = -2^\circ$



$\alpha = -1.5^\circ$



$\alpha = -1^\circ$

Figure 30 - Schlieren Photographs of the Missile.

Configuration B₂₂R₅H₁₀C

PSD - 302, 794

M = 1.17

AD-A062 289

DAVID TAYLOR MODEL BASIN WASHINGTON D C AERODYNAMICS LAB F/G 16/4.2
TRANSONIC WIND-TUNNEL TESTS OF A 1/15-SCALE MODEL OF THE TALOS --ETC(U)
MAR 61 M E MCDONALD

UNCLASSIFIED

AERO-1002

NL

3 OF 3
ADA
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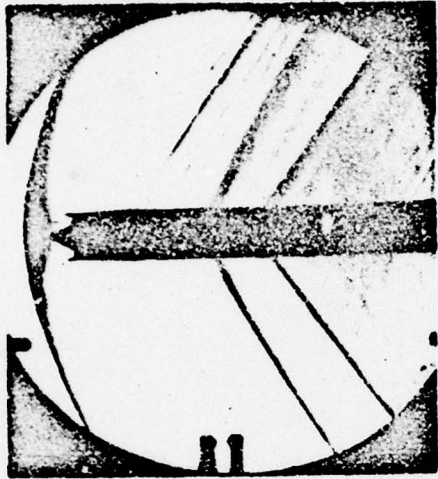


END
DATE
FILMED

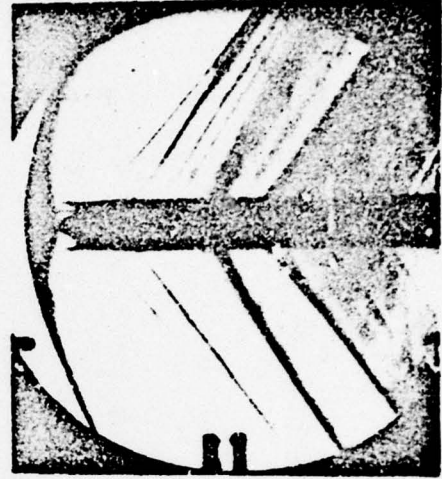
3 -79
DDC

AERO 1002

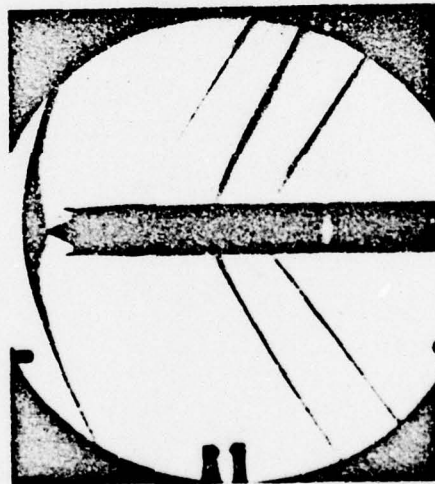
-192-



$\alpha = -0.5^\circ$



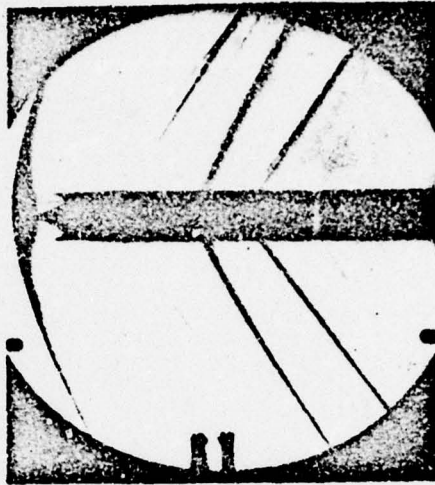
$\alpha = 0.5^\circ$



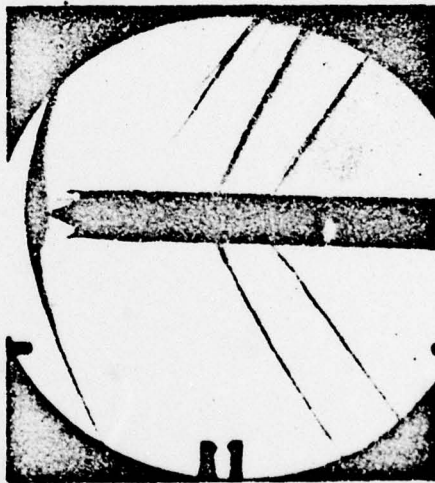
$\alpha = 1^\circ$

Figure 30 (Continued)

PSD - 302, 795



$\alpha = 1.5^\circ$



$\alpha = 2^\circ$

Figure 30 (Concluded)

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David Taylor Model Basin

TRANSONIC WIND-TUNNEL TESTS OF A 1/15-SCALE MODEL OF THE TALOS 6c1 MISSILE (Title Unclassified), by Michael E. McDonald. Wash., Mar 1961. 195 l. Incl. illus. 2 refs. (Aerodynamics Lab. Aero Problem 640-116)

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On cover: [BUWaps] Problem Assignment 3-34-11. Surface-to-air, supersonic guided missile tested at Mach 0.7 to 1.17, angles of attack of -4° to 10° , and roll angles of 0° and -45° . Effects of ram-air bleed at base of 2nd stage and longitudinal stability and control effectiveness of missile and components evaluated. Small scale of model affected positioning of six-component balances. Bendix Products Div. is prime contractor for Teleg. Data-type report.

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1. GUIDED MISSILES (SAM-N-6c1)--STABILITY
2. JET ENGINES, RAM-BLEED-OFF
3. EXHAUST LOUVERS
4. STRAIN GAGE BALANCES, SIX-COMPONENT
5. MODELS--SIZE
6. PHOTOGRAPHY, SCHLIEREN
1. McDonald, Michael E.
11. Aero Test C-116
111. BUWaps Prob Assigt 3-34-11