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DRAG AND STABILITY DATA FOR SEVERAL SAMOS CONFIGURATIONS OBTAINED FROM FREE-FLIGHT MODEL FIRINGS (C)

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Ballistics Research Report 39

DRAG AND STABILITY DATA FOR SEVERAL SAMOS CONFIGURATIONS
OBTAINED FROM FREE-FLIGHT MODEL FIRINGS

Prepared by:

Leonard E. Crogan

ABSTRACT: Firings of several SAMOS configurations were conducted in the Naval Ordnance Laboratory Pressurized Ballistics Range No. 3. The configurations differed in nose corner radius only. It was observed that with a decrease in the nose corner radius, the drag coefficient increased, the slope of the normal force coefficient decreased, and the slope of the pitching moment coefficient increased. From these experimental data, it was concluded that a decrease in the nose corner radius resulted in a rearward movement of the center of pressure.

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3 April 1961

This report presents the results of firings made with models of the SAMOS configuration in the Naval Ordnance Laboratory's Pressurized Ballistics Range No. 3 to determine their free-flight characteristics.

This work was done at the request of the Research and Advanced Development Division of AVCO Corporation under task number AFO4-(647)347. Appreciation is extended to Miss Amy A. Chamberlin for reducing the data and to Mr. John E. Fontenot for his assistance in the firing of many models.

W. D. COLEMAN
Captain, USN
Commander

A. E. SEIGEL
By direction

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SYMBOLS

$C_D = \frac{D_t}{qS}$ = total drag coefficient based on the maximum cross-sectional area(S) of the model

C_{M_α} = (slope of the pitching moment)/qSD = slope of the pitching moment coefficient referred to the CG

$C_{M_q} + C_{M_{\dot{\alpha}}}$ = (slope of yaw damping moment due to q)/(D/2V) qSD +
(slope of yaw damping moment due to $\dot{\alpha}$)/($-\frac{D}{2V}$) qSD =
slope of damping moment coefficient referred to the CG

C_{N_α} = (slope of normal force)/qS = slope of normal force coefficient

CG_N = center of gravity, subscript N denotes measured from nose of model

CP = center of pressure

D = maximum diameter of model

D_t = component of the aerodynamic force directed along the trajectory

I = moment of inertia about CG, I_A denotes axial and I_B, transverse

k_D, k_M, k_N = parameters used to correct to zero yaw the drag, pitching moment, and normal force coefficients, respectively (see paragraph 9 of the text)

M = Mach number (based on midrange value of V)

P.E. = probable error based on accuracy of data fitting
(P.E.s, swerve equation; P.E.y, yaw equation)

$q = \frac{\rho V^2}{2}$ = dynamic pressure or q = lateral component of angular velocity of model

Re_D = $\frac{\rho VD}{\mu}$ = Reynolds number based on maximum diameter (D) of model

S = $\frac{\pi D^2}{4}$ = maximum cross-sectional area of model

SYMBOLS

V = velocity (usually a midrange value)
 α = angle of attack
 $\dot{\alpha}$ = rate of change of angle of attack with time
 δ^2 = mean squared yaw
 μ = coefficient of viscosity
 ρ = density of air
 λ_1, λ_2 = damping rates of nutational arm (1) and precessional arm (2)

Subscript

o coefficient corrected to zero yaw

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DRAG AND STABILITY DATA FOR SEVERAL SAMOS CONFIGURATIONS
OBTAINED FROM FREE-FLIGHT MODEL FIRINGS

INTRODUCTION

1. Models of several SAMOS configurations were fired in the Naval Ordnance Laboratory Pressurized Ballistics Range No. 3 (reference (a)) to determine their drag and stability characteristics. The configurations differed only in nose corner radius.

Model Details

2. Sketches are presented in Figure 1 of all of the SAMOS model configurations tested. Table I lists the average weights and moments of inertia of these configurations. Rounds 3846 and 3849 are listed separately from the rest of the rounds of their respective drawing numbers because they were manufactured of different materials from the rest of the rounds. This difference in material caused these rounds to differ from the rest of the rounds in weight and moment of inertia only.

3. Models of three different sizes were used. Their maximum diameters were 0.750, 0.600, and 0.500 inches. The configurations differed in nose corner radius only. Four different radii were investigated. The full-scale nose corner radii were one, two, five, and eight inches. Models of the configurations having either one-inch or eight-inch nose corner radius were tested with only one center of gravity location for each configuration. Models of the configurations having either two-inch or five-inch nose corner radius were tested with two center of gravity locations for each configuration.

4. Sabots to cradle the models at initial angles of 0, 10, 15, 20, and 25 degrees were used in launching the models. Figure 2 is a photograph of a model and sabot designed for launching the model at 25° from a powder gun and a model and sabot designed for launching the model at 0° from a light-gas gun.

5. Figure 3 is a shadowgraph of a model from drawing number 1831-5 in flight at a Mach number of 4.94.

Discussion and Results

6. The models were fired at the different initial launch angles to determine if the dynamic stability of the configurations is affected by angle of attack. The results of this program indicate that neither angle of attack nor any of the center of gravity locations investigated affected the dynamic stability of the configurations. This is graphically shown in Figure 4 where angle of yaw is plotted against pitching angle. The axes are in multiples of degrees as shown on each graph. The motion of the model starts where the two oversized dots are plotted. As can be seen, the maximum amplitude of the yawing motion remains constant.

7. The drag and stability coefficients were obtained using data reduction techniques described in reference (b).

8. Tables II through VIII list the drag coefficients, slope of the normal force coefficients, and slope of the pitching moment coefficients both uncorrected and corrected to zero yaw for all of the SAMOS configurations tested. The slope of the damping moment coefficient uncorrected to zero yaw is also included. This coefficient was not corrected to zero yaw because of the high probable error and resultant scatter in the coefficient. However, the uncorrected data were plotted and a rough curve drawn through the points (Figure 5). The existence of any effect upon the dynamic stability coefficient with a variation of either the center of gravity location or the nose corner radius could not be inferred from the data obtained in this program.

9. The coefficients were corrected to zero yaw by using one of the following equations:

$$C_{D_0} = C_D - k_D \delta^2,$$

$$C_{M_{\alpha_0}} = C_{M_{\alpha}} - k_M \delta^2,$$

and

$$C_{N_{\alpha_0}} = C_{N_{\alpha}} - k_N \delta^2$$

where the factors k_D , k_M , and k_N were determined from a number of rounds within a given Mach number region.

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Because of the limited number of models with a full-scale nose corner radius of one inch, the data obtained from these models were corrected to zero yaw by means of correction factors obtained from models with a full-scale nose corner radius of two inches. This was deemed justifiable since the scatter in the data from these configurations was larger than any systematic difference caused by the different nose corner radii.

10. Figure 6 is a plot of the drag coefficient against Mach number. It shows an increase in the drag coefficient with a decrease of the nose corner radius.

11. The plot of the slope of the normal force coefficient (Figure 7) indicates an increase in the coefficient with an increase in the nose corner radius. However, there is an overlapping of points for the two-inch and five-inch full-scale corner radius models caused by the scatter of the data.

12. Figure 8 is a plot of the slope of the pitching moment coefficient against Mach number. It is broken into two center of gravity groups. The group with a center of gravity location of approximately 35 percent of the length from the nose of the model illustrates an increase in the slope of the pitching moment coefficient with a decrease in the nose corner radius. This, along with the trend of the slope of the normal force coefficient, indicates a forward movement of the center of pressure with an increase in nose corner radius. Notice that as for the slope of the normal force coefficient, the data for the two-inch and five-inch corner radius models overlap. The other group of points seems to indicate just the opposite trend - an increase in the slope of the pitching moment coefficient with an increase in the nose corner radius. However, one explanation might be that the scatter in the data for the two-inch and for the five-inch full-scale corner radius models together with the 2.4 percent difference in the center of gravity location of the two types of models causes this apparent anomaly.

Conclusions

13. An increase in the drag coefficient with a decrease of the nose corner radius was observed on models of the SAMOS configuration.

14. The slope of the normal force coefficient decreased with a decrease in the nose corner radius. The slope of the

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pitching moment coefficient increased with a decrease in the nose corner radius for a center of gravity location from the nose of approximately 35 percent of the length. Therefore, from the experimental data, it is observed that the center of pressure moves rearward as the nose corner radius is decreased.

15. No measurable effect of center of gravity location, nose corner radius, or angle of attack could be observed upon the dynamic stability of the SAMOS models investigated.

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References

- (a) May, A., and Williams, F.J., "Free-Flight Ranges at the Naval Ordnance Laboratory," NavOrd Report 4063 (1955)
- (b) Murphy, C. H., "Data Reduction for the Free-Flight Spark Ranges," BRL Report No. 900 (1954)

TABLE I
AVERAGE WEIGHTS AND MOMENTS OF INERTIA OF SAMOS MODELS

DRAWING NO.	1831		1831-5	1844		2304-11	2304-7	2205-5	2304-9
	RD. 3846	Rest of RD's.		RD. 3849	Rest of RD's.				
Weight (Grams)	22.288	37.974	37.996	10.871	19.242	14.144	14.045	21.156	14.166
I_A (Gram-In. ²)	1.538	2.622	2.631	0.480	0.849	0.387	0.383	0.692	0.383
I_B (Gram-In. ²)	1.847	3.124	3.122	0.584	1.01	0.475	0.470	0.786	0.473

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DRAG AND STABILITY DATA FOR
SAMOS MODELS (DRAWING NO. 1831)

TABLE II

ROUND	3803	3802	3796	3846
Max. Full-Scale Nose Corner Rad. (In.)	1	1	1	1
M	5.121	5.418	5.664	6.247
δ^2 (Deg.) ²	4000	136	4170	25
$Re_D \times 10^{-6}$	2.211	2.348	1.278	1.429
C_D	1.273	1.443	1.366	1.526
P.E. ($\pm$)	.001	.003	.001	.001
C_{D_0}	*	1.493	*	1.535
P.E.y (Rad.) (+)				.004
P.E.s (In.) (+)				.02
C_{M_α} /Deg.	-.0006	-.0013	-.0008	-.00119
P.E. (+)				.00001
$C_{M_{\alpha_0}}$ /Deg.	*	-.0015	*	-.00123
C_{N_α} /Deg.				-.010
P.E. (+)				.001
$C_{N_{\alpha_0}}$ /Deg.				-.010
$C_{M_q} + C_{M_{\dot{\alpha}}}$				-.7
P.E. ($\pm$)				.2
CP-CG (Cal.)				.118
CG _N (In.)	.395	.394	.394	.399
Length (In.)	.880	.880	.879	.880
Diameter (In.)	.749	.749	.749	.750
$\lambda_1 \times 10^3$ (1/Ft.)				+.798
$\lambda_2 \times 10^3$ (1/Ft.)				+1.973

* These rounds were not corrected to zero yaw because of the high δ^2 . In this region, C_D and C_{M_α} cannot be assumed linear with δ^2 .

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 DRAG AND STABILITY DATA
 SAMOS MODELS (DRAWING N

TABLE IV

ROUND	3814	3814	3817	3814	3817	3823	38
Full-Scale Nose Corner Rad. (In.)	2	2	2	2	2	2	
M	4.686	4.997	5.202	5.226	5.496	5.843	5.8
δ^2 (Deg.) ²	106	100	22	93	20	205	
$Re_D \times 10^{-6}$	1.599	1.705	1.455	1.783	1.537	1.468	1.6
C_D	1.425		1.520	1.465		1.446	1.5
P.E. ($\pm$)	.004		.003	.002		.004	.00
C_{D_0}	1.464		1.528	1.499		1.522	1.5
P.E.y (Rad.)(+)		.009			.006		
P.E.s (In.)($\pm$)		.02			.009		
$C_{M\alpha}$ /Deg.		-.00117			-.00150		
P.E. ($\pm$)		.00001			.00001		
$C_{M\alpha_0}$ /Deg.		-.00135			-.00154		
$C_{N\alpha}$ /Deg.		-.0138			-.0118		
P.E. ($\pm$)		.0009			.0007		
$C_{N\alpha_0}$ /Deg.		-.0130			-.0116		
$C_{M_q} + C_{M_{\dot{\alpha}}}$		-.2			-.1		
P.E. ($\pm$)		.2			.2		
CP - CG (Cal.)		.085			.125		
CG _N (In.)	.316	.316	.314	.316	.314	.315	.31
Length (In.)	.703	.703	.701	.703	.701	.702	.70
Diameter (In.)	.600	.600	.600	.600	.600	.600	.60
$\lambda_1 \times 10^3$ (1/Ft.)		+1.285			+2.913		
$\lambda_2 \times 10^3$ (1/Ft.)		+1.121			+2.034		

* This round was not corrected to zero yaw because of the high δ^2 . In this region, C_D and $C_{M\alpha}$ cannot be determined.
 ** Not corrected to zero yaw because of high P.E., as compared to other $C_{N\alpha}$ data, and subsequent inaccuracies.

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 AG AND STABILITY DATA FOR
 S MODELS (DRAWING NO. 1844)

TABLE IV

3823	3817	3821	3823	3826	3819	3823	3849	3816
2	2	2	2	2	2	2	2	2
5.843	5.872	6.010	6.182	6.296	6.302	6.484	6.524	6.559
205	17	180	191	309	119	176	15	2990
1.468	1.642	1.635	1.553	1.591	1.662	1.632	1.217	1.783
1.446	1.519	1.429		1.349	1.481	1.454	1.511	1.073
.004	.001	.002		.004	.001	.003	.001	.002
1.522	1.525	1.496		1.463	1.525	1.519	1.517	*
		.01	.01		.02		.01	
		.03	.02		.07		.06	
		-.00108	-.00118	-.0006	-.00128		-.00103	-.0007
		.00002	.00001		.00002		.00009	
		-.00140	-.00152	-.0012	-.00149		-.00106	*
		-.0111	-.0115		-.005		-.006	
		.0006	.0003		.006		.004	
		-.0097	-.0100		**		**	
		-.5	0		+.3		-.5	
		.4	.2		.4		1.7	
		.099	.103		.243		.168	
.315	.314	.314	.315	.313	.314	.315	.320	.316
.702	.701	.701	.702	.701	.701	.702	.695	.703
.600	.600	.600	.600	.600	.600	.600	.603	.600
		-.467	+1.452		+1.833		-.852	
		+.964	+1.210		+3.189		+2.306	

ion, C_D and $C_{M\alpha}$ cannot be assumed linear with δ^2 .
 , and subsequent inaccuracy.

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3821	3823	3826	3819	3823	3849	3816	3834
2	2	2	2	2	2	2	2
6.010	6.182	6.296	6.302	6.484	6.524	6.559	7.136
180	191	309	119	176	15	2990	61
1.635	1.553	1.591	1.662	1.632	1.217	1.783	1.285
1.429		1.349	1.481	1.454	1.511	1.073	1.478
.002		.004	.001	.003	.001	.002	.001
1.496		1.463	1.525	1.519	1.517	*	1.501
.01	.01		.02		.01		.005
.03	.02		.07		.06		.02
-.00108	-.00118	-.0006	-.00128		-.00103	-.0007	-.00113
.00002	.00001		.00002		.00009		.00001
-.00140	-.00152	-.0012	-.00149		-.00106	*	-.00124
-.0111	-.0115		-.005		-.006		-.0099
.0006	.0003		.006		.004		.0009
-.0097	-.0100		**		**		-.0094
-.5	0		+.3		-.5		+.3
.4	.2		.4		1.7		.2
.099	.103		.243		.168		.114
.314	.315	.313	.314	.315	.320	.316	.315
.701	.702	.701	.701	.702	.695	.703	.702
.600	.600	.600	.600	.600	.603	.600	.600
-.467	+1.452		+1.833		-.852		+1.660
+.964	+1.210		+3.189		+2.306		+1.355

assumed linear with δ^2 .

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DRAG AND STABILITY DATA FOR
SAMOS MODELS (DRAWING NO. 1831 - 5)

TABLE III

ROUND	3820	3824	3820	3820	3812	3808	3811	3808	3808
Full-Scale Nose Corner Rad. (In.)	2	2	2	2	2	2	2	2	2
M	4.356	4.461	4.586	4.908	5.285	5.464	5.518	5.637	5.792
δ^2 (Deg.) ²	69	310	66	63	77	220	179	211	204
$Re_D \times 10^{-6}$	1.851	1.859	1.949	2.086	2.260	1.255	2.343	1.294	1.330
C_{D_0}	1.475	1.348	1.479	1.479	1.481	1.403	1.412	1.404	1.404
P.E. (+)	.007	.002	.006	.006	.002	.001	.003	.001	.006
C_{D_0}	1.501	1.463	1.502	1.502	1.509	1.484	1.478	1.478	1.478
P.E.y (Rad.) (+)		.02	.006			.01		.007	
P.E.s (In.) (+)		.06	.01			.02		.02	
$C_{M_{\alpha}} / \text{Deg.}$		-.00087	-.00126			-.00126		-.00094	
P.E. (+)		.00002	.00001			.00002		.00005	
$C_{M_{\alpha}} / \text{Deg.}$		-.00143	-.00138			-.00141		-.00132	
$C_{N_{\alpha}} / \text{Deg.}$		-.013	-.0126			-.0115		-.0134	
P.E. (+)		.001	.0004			.0009		.0007	
$C_{N_{\alpha_0}} / \text{Deg.}$		-.011	-.0121			-.0109		-.0117	
$C_{M_q} + C_{M_{\dot{\alpha}}}$		-.4	-.3			+.2		-.5	
P.E. (+)		.5	.2			.3		.3	
CP-OG (Cal.)		.066	.099			.109		.070	
CG_N (In.)	.395	.396	.395	.395	.395	.395	.394	.395	.395
Length (In.)	.879	.879	.879	.879	.879	.880	.879	.880	.880
Diameter (In.)	.749	.749	.749	.749	.750	.750	.750	.750	.750
$\lambda_1 \times 10^3$ (1/Ft.)		-.416	+1.261			+2.528		+324	
$\lambda_2 \times 10^3$ (1/Ft.)		+933	+528			+1.693		+004	

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DRAG AND STABILITY DATA FOR
SAMOS MODELS (DRAWING NO. 2304-11)

TABLE V

ROUND	3968	3970	3926	3924	3935	3928	4006	4065	4067
Full Scale Nose Corner Rad. (In.)	2	2	2	2	2	2	2	2	2
M_{δ}^2 (Deg.) ²	4.706 44	4.777 147	5.131 174	5.158 1330	5.186 1370	5.271 634	5.897 77	7.240 162	7.343 245
$Re_D \times 10^{-6}$	1.339	1.359	0.750	0.739	0.770	0.780	1.640	0.601	0.741
C_D	1.471	1.458	1.429	1.272	1.269	1.307	1.453	1.407	1.400
P.E. (+)	.001	.001	.001	.001	.001	.003	.001	.001	.002
C_{D_0}	1.487	1.512	1.493	*	*	1.542	1.481	1.467	1.491
P.E.y (Rad.) (+)	.01	.006	.01	.03	.05	.01	.007	.01	.008
P.E.s (In.) (+)	.01	.02	.01	.03	.03	.02	.02	.02	.01
$C_{M_{\alpha}}/\text{Deg.}$	-.00247	-.002625	-.00243	-.00284	-.00283	-.00275	-.00244	-.00246	-.00256
P.E. (+)	.00002	.000006	.00002	.00001	.00002	.00001	.00001	.00002	.00001
$C_{M_{\alpha_0}}/\text{Deg.}$	-.00248	-.002665	-.00248	*	*	-.00292	-.00246	-.00250	-.00263
$C_{N_{\alpha}}/\text{Deg.}$	-.011	-.012	-.0119	-.0258	-.0248	-.0167	-.012	-.012	-.012
P.E. (+)	.001	.001	.0007	.0009	.0006	.0007	.002	.001	.007
$C_{N_{\alpha_0}}/\text{Deg.}$	-.011	-.011	-.0105	*	*	-.0116	-.011	-.011	-.010
$C_{M_{\alpha}} + C_{M_{\alpha_0}}$	-1.0	-.46	+.9	-.5	-.6	-.1	-.3	+.3	+.4
P.E. (+)	.3	.08	.3	.2	.3	.2	.2	.4	.3
CP-CG (Cal.)	.217	.219	.204	.110	.114	.164	.208	.201	.216
CGN (In.)	.205	.205	.205	.205	.206	.206	.207	.207	.206
Length (In.)	.583	.583	.584	.584	.584	.584	.583	.584	.583
Diameter (In.)	.500	.500	.500	.500	.500	.500	.500	.500	.500
$\lambda_1 \times 10^3$ (1/Ft.)	-2.236	+.455	+2.062	+.142	-.597	-.123	+.932	+1.518	+1.461
$\lambda_2 \times 10^3$ (1/Ft.)	-.197	+.412	+2.685	-.898	+.216	+1.055	+.859	+.028	+.518

* These rounds were not corrected to zero yaw because of the high δ^2 . In this region, C_D , $C_{M_{\alpha}}$, and $C_{N_{\alpha}}$ cannot be assumed linear with δ^2 .

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DRAG AND STABILITY DATA FOR
SAMOS MODELS (DRAWING NO. 2205-5)

TABLE VI

ROUND	4074	4013	4071	4005
Full Scale Nose Corner Rad. (In.)	5	5	5	5
M_{δ}^2 (Deg. ²)	5.336	5.512	5.624	6.119
$Re_D \times 10^{-6}$	31 1.499	51 1.544	9 1.573	192 1.700
C_D	1.409	1.423	1.424	1.385
P.E. ($\pm$)	.001	.001	.001	.001
C_{D_0}	1.418	1.438	1.427	1.443
P.E.y(Rad.)($\pm$)	.01	.004	.006	
P.E.s(In.)($\pm$)	.02	.02	.01	
$C_{M\alpha}$ /Deg.	-.00156	-.00144	-.00163	-.00151
P.E. ($\pm$)	.00003	.00001	.00002	.00004
$C_{M\alpha_0}$ /Deg.	-.00157	-.00146	-.00163	-.00158
$C_{N\alpha}$ /Deg.	-.013	-.0114	-.010	
P.E. ($\pm$)	.001	.0009	.002	
$C_{N\alpha_0}$ /Deg.	-.013	-.0110	-.010	
$C_M + C_{M_{\alpha}}$	+.4	-.1	+.1	
P.E. ($\pm$)	.8	.2	.5	
CP-CG (Cal.)	.121	.126	.171	
CG_N (In.)	.249	.248	.249	.247
Length (In.)	.585	.583	.585	.583
Diameter (In.)	.501	.500	.500	.500
$\lambda_1 \times 10^3$ (1/Ft.)	+2.434	+.351	+.216	
$\lambda_2 \times 10^3$ (1/Ft.)	+1.192	+1.784	+2.708	

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TABLE VII

ROUND	3967	3964	3969	3966	3954
Full-Scale Nose Corner Rad. (In.)	5	5	5	5	5
M_{δ}^2 (Deg. ²)	4.793	5.199	5.206	5.246	5.955
$Re_D \times 10^{-6}$	75 1.346	114 1.460	3 1.481	14 1.469	372 0.890
C_D	1.4243	1.398	1.445	1.432	1.321
P.E. ($\pm$)	.0004	.001	.001	.001	.001
C_{D_0}	1.4468	1.432	1.446	1.436	1.433
P.E.y(Rad.)($\pm$)	.01	.01	.006	.008	.008
P.E.s(In.)($\pm$)	.01	.01	.01	.01	.01
$C_{M_{\alpha}}$ /Deg.	-.00250	-.00233	-.00250	-.00255	-.002406
P.E. ($\pm$)	.00002	.00004	.00005	.00003	.000006
$C_{M_{\alpha_0}}$ /Deg.	-.00252	-.00237	-.00250	-.00255	-.002525
$C_{N_{\alpha}}$ /Deg.	-.0136	-.011	-.013	-.012	-.0147
P.E. ($\pm$)	.0006	.004	.009	.004	.0006
$C_{N_{\alpha_0}}$ /Deg.	-.0130	-.010	-.013	-.012	-.0120
$C_{M_q} + C_{M_{\dot{\alpha}}}$	-.1	+.3	-2.1	-.4	+.1
P.E. ($\pm$)	.2	.6	.7	.4	.1
CP-CG (Cal.)	.184	.209	.198	.204	.164
CG _N (In.)	.205	.206	.206	.206	.206
Length (In.)	.583	.584	.583	.584	.583
Diameter (In.)	.500	.500	.500	.500	.500
$\lambda_1 \times 10^3$ (1/Ft.)	+1.223	+.835	-1.683	+.420	+.465
$\lambda_2 \times 10^3$ (1/Ft.)	+1.570	+4.386	-7.575	+.738	+1.343

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DRAG AND STABILITY DATA FOR
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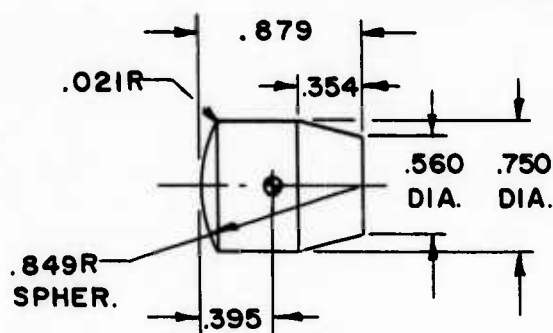
TABLE VIII

ROUND	3961	3955	4007	4064	4010	4066	4068
Full Scale Nose Corner Rad. (In.)	8	8	8	8	8	8	8
M ² (Deg. ²)	5.372	6.200	6.224	6.392	6.932	7.285	7.389
$\delta \times 10^{-6}$	197	332	149	305	230	372	358
Re _D	1.514	0.939	1.738	1.782	0.764	0.678	0.665
C _D	1.315	1.287	1.337	1.324	1.34	1.298	1.279
P.E. (±)	.001	.001	.001	.001	.07	.001	.003
C _{D0}	1.358	1.360	1.370	1.391	1.39	1.380	1.358
P.E.y (Rad.) (±)	.02	.01	.01				.03
P.E.s (In.) (±)	.01	.01	.02				.04
C _{Mα} /Deg.	-.00235	-.002244	-.00227	-.0023	-.00238	-.0023	-.00233
P.E. (±)	.00001	.000009	.00001				.00004
C _{Mα0} /Deg.	-.00237	-.002279	-.00229	-.0023	-.00240	-.0023	-.00237
C _{Nα} /Deg.	-.0139	-.0149	-.0137				-.013
P.E. (±)	.0006	.0006	.0008				.003
C _{Nα0} /Deg.	-.0139	-.0148	-.0137				-.013
C _M + C _{Mα}	+.3	-.2	-.3				0
P.E. (±)	.2	.2	.2				1
CP-CG (Cal.)	.169	.150	.166				.176
CGN (In.)	.206	.207	.207	.207	.208	.208	.207
Length (In.)	.582	.583	.583	.583	.584	.583	.583
Diameter (In.)	.500	.500	.500	.500	.500	.500	.500
$\lambda_1 \times 10^3$ (1/ft.)	+2.818	+2.52	+1.122				+594
$\lambda_2 \times 10^3$ (1/ft.)	+2.124	+686	+242				+652

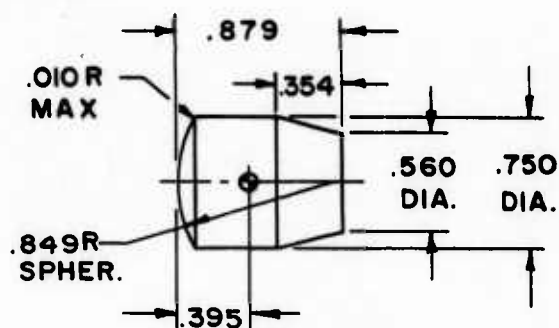
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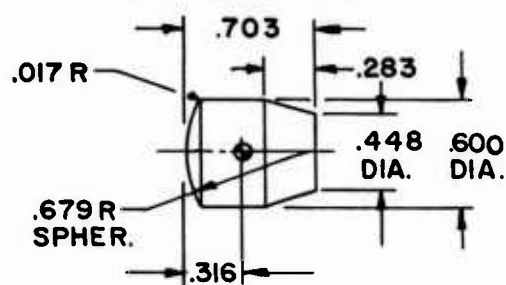
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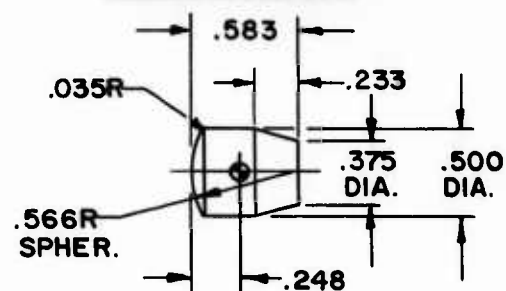
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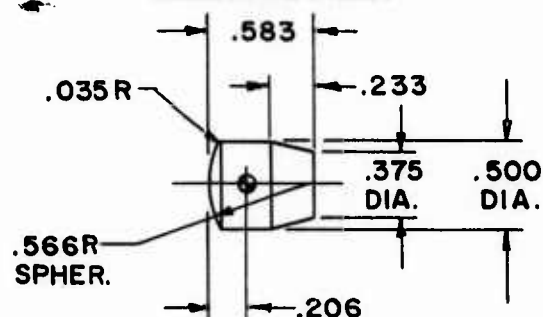
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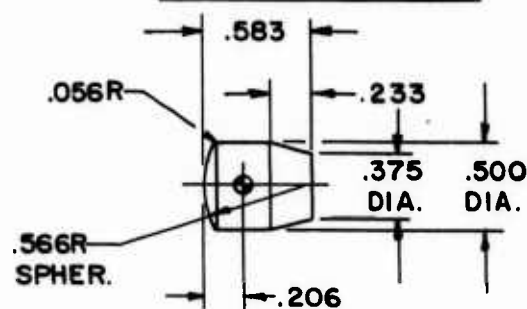
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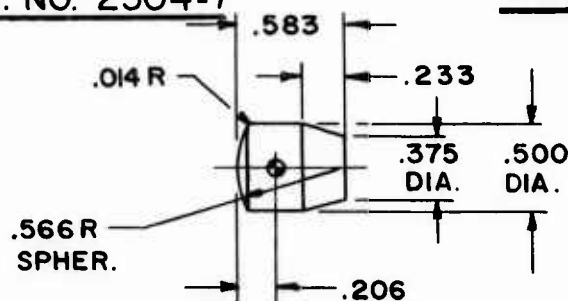
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DWG. NO. 2304-7



DWG. NO. 2304-9

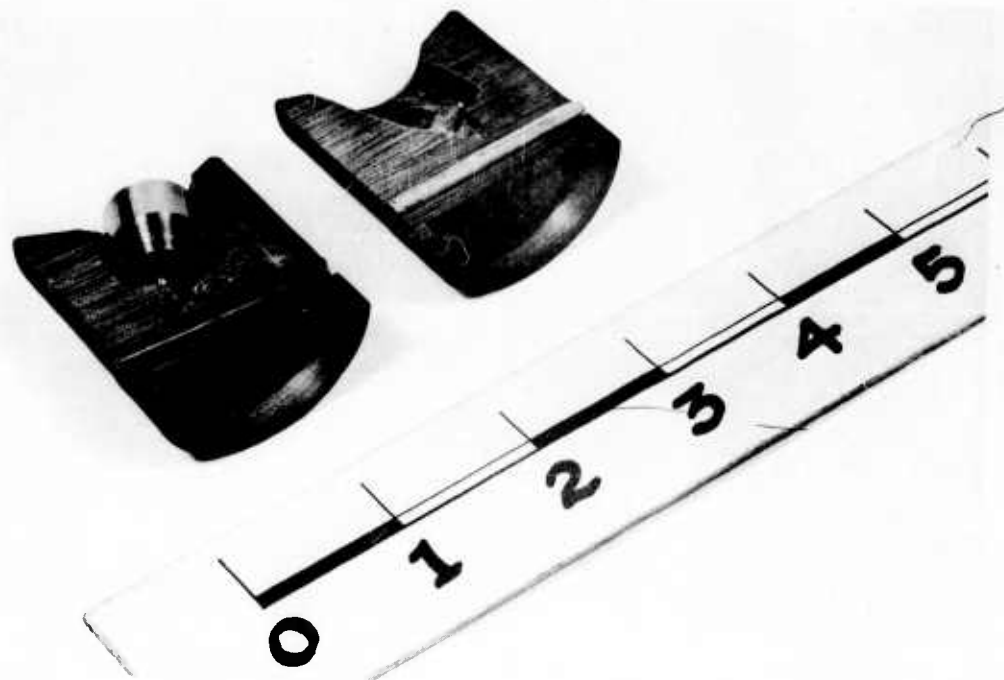


DWG. NO. 2304-11

NOTE:
DIMENSIONS ARE IN
INCHES.

FIG. I SAMOS MODELS

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25° POWDER GUN SABOT AND MODEL



0° GAS GUN SABOT AND MODEL

FIG.2 - SAMOS MODELS AND SABOTS

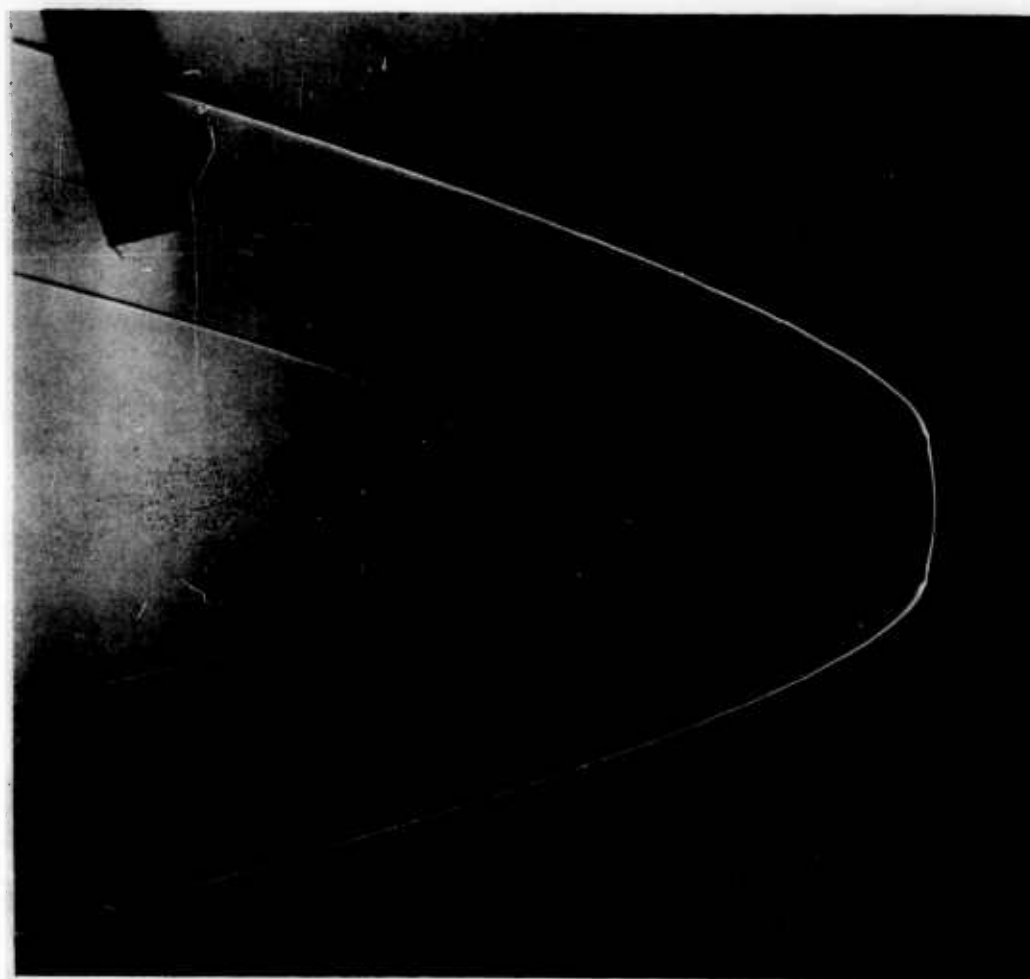


FIG.3 SHADOWGRAPH PRINT OF SAMOS MODEL
WITH A FULL-SCALE NOSE CORNER
RADIUS OF TWO INCHES (1831-5),
ROUND 3812, $M=4.94$

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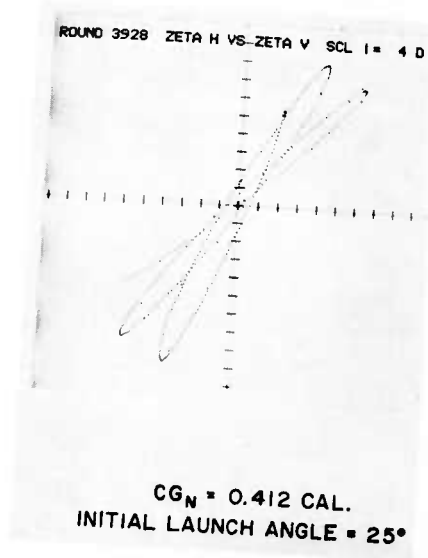
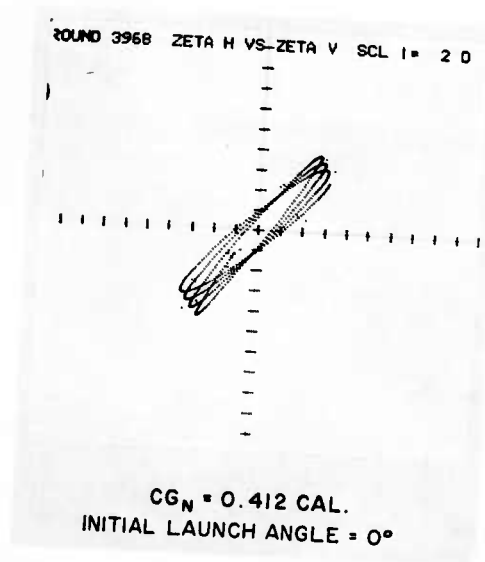
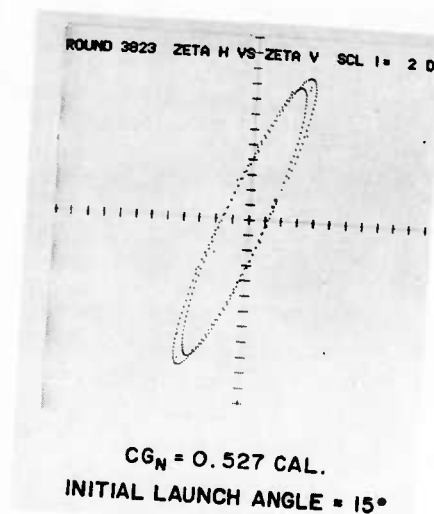
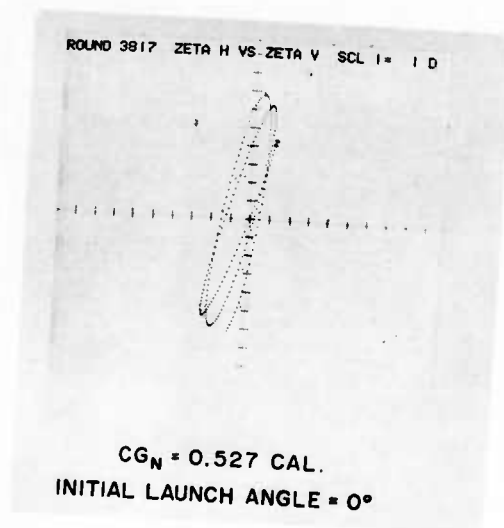


FIG.4 - COMPLEX ANGLE OF ATTACK PLOTS FOR SAMOS MODELS

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FIG.5 SLOPE OF DAMPING MOMENT
COEFFICIENT FOR SAMOS MODELS
AS A FUNCTION OF MACH NUMBER

FULL SCALE NOSE CORNER RAD. (IN)	CG _N (%)	DRAWING NO.
1	44.9	1831
2	44.9	1831-5, 1844
2	35.2	2304-11
5	35.2	2304-7
5	42.5	2205-5
8	35.5	2304-9

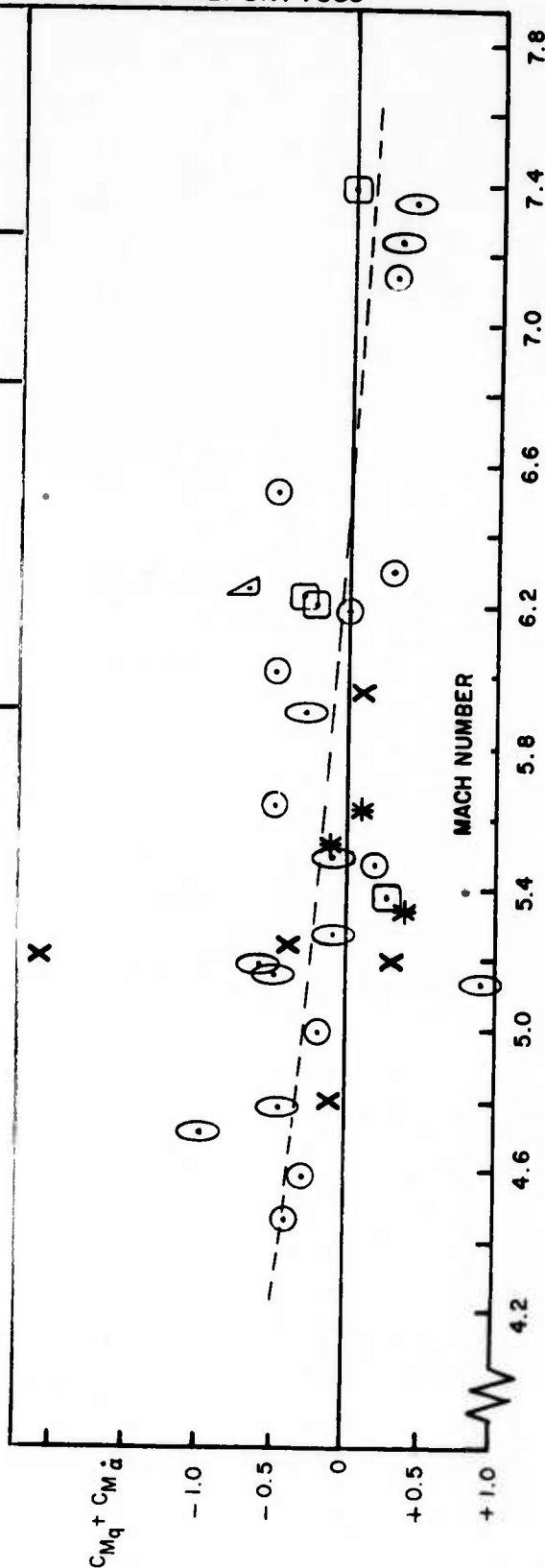


FIG. 6 ZERO YAW DRAG COEFFICIENT FOR SAMOS
MODELS AS A FUNCTION OF MACH NUMBER.

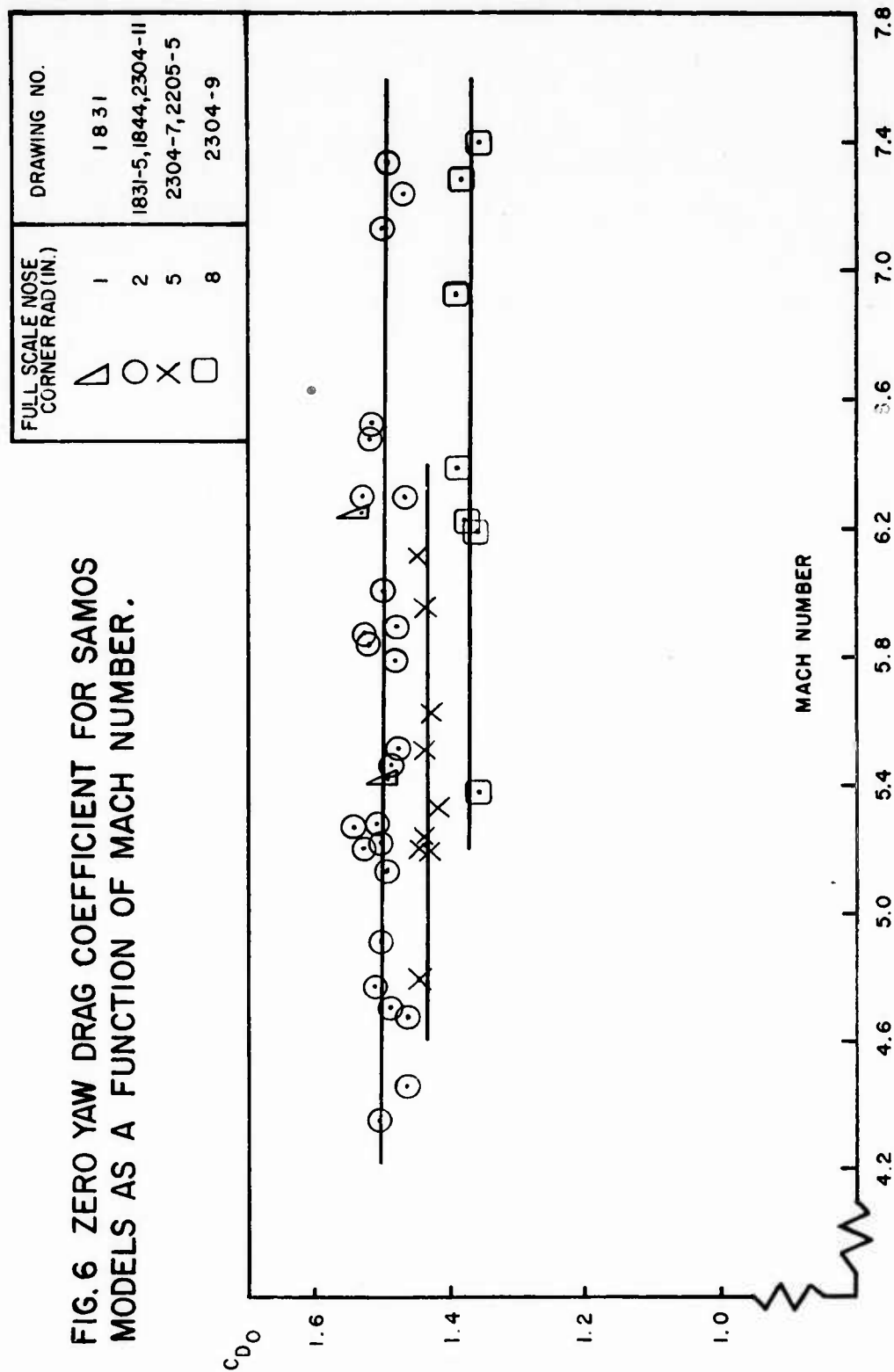
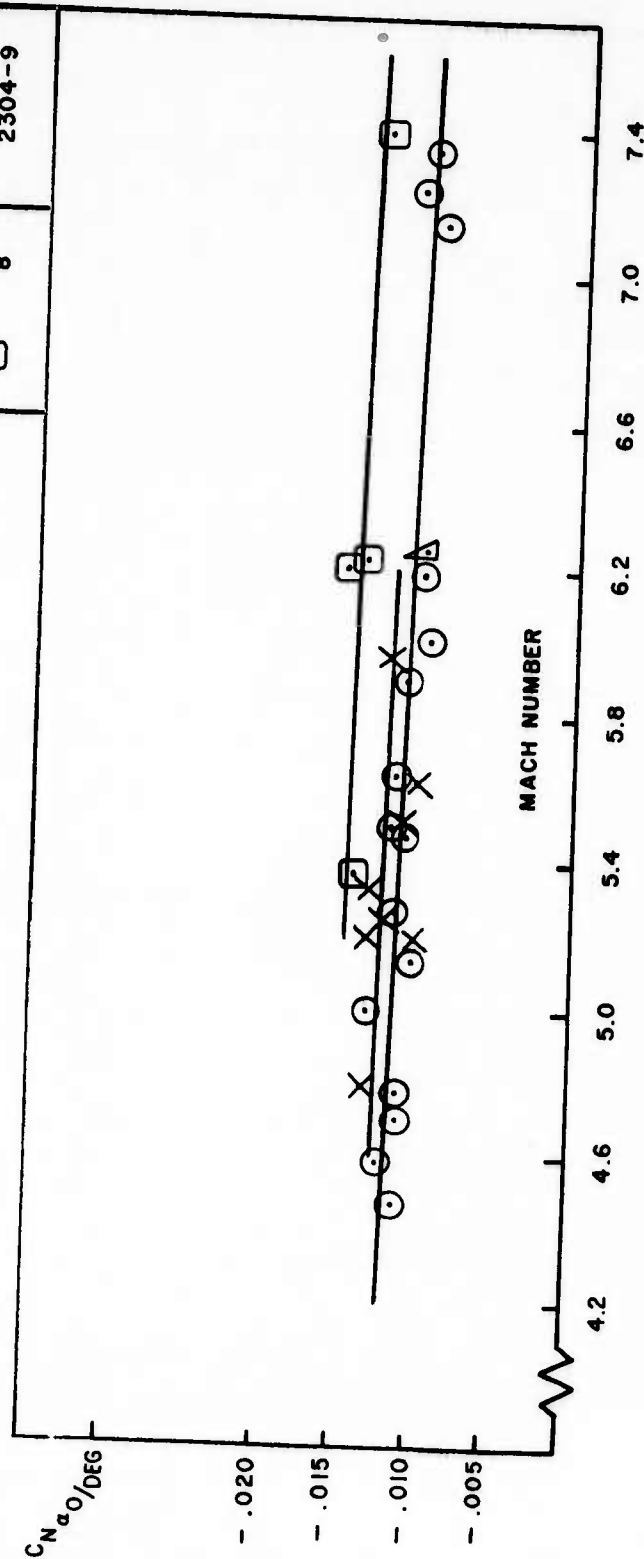


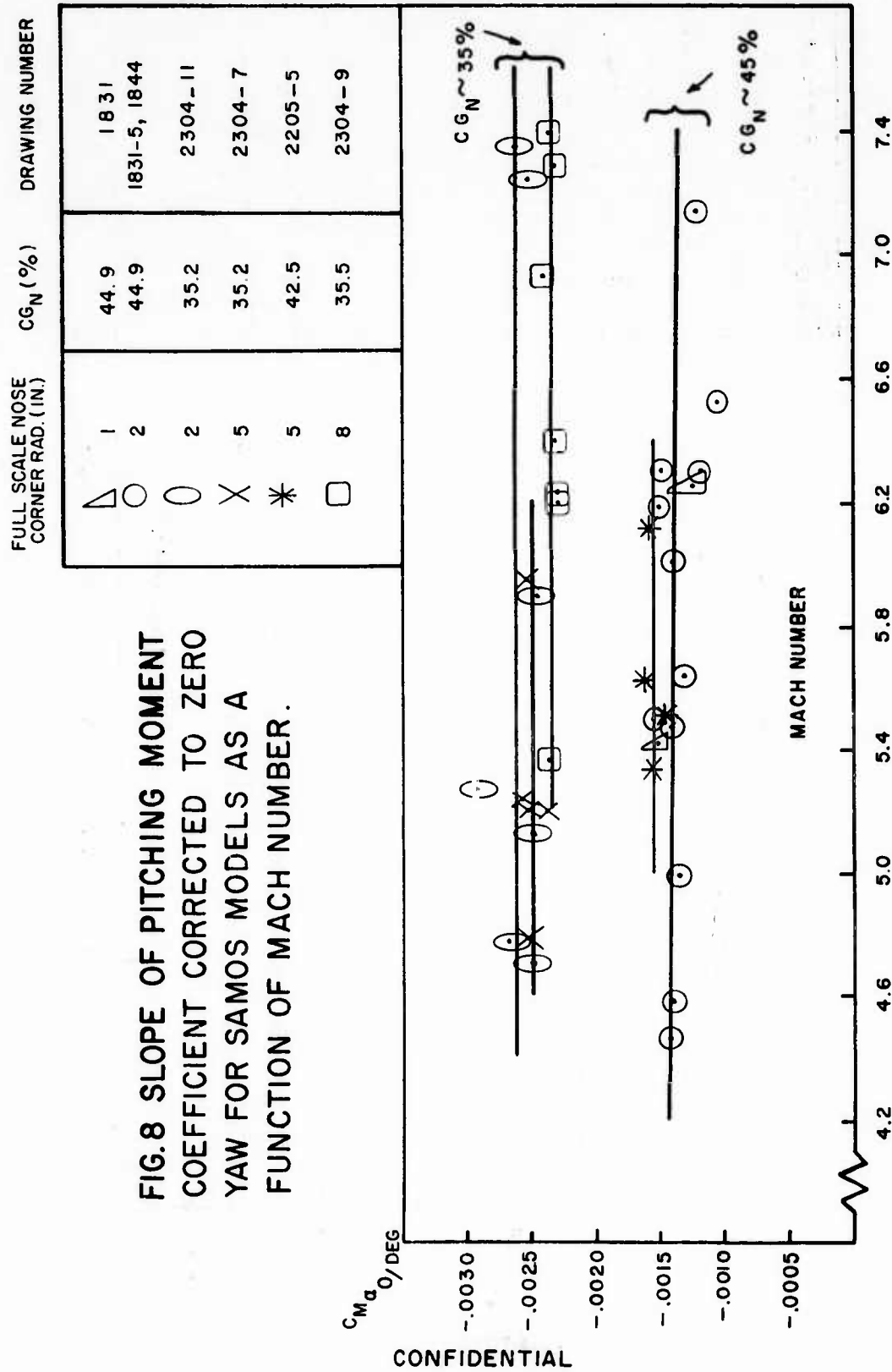
FIG. 7 SLOPE OF NORMAL FORCE COEFFICIENT
CORRECTED TO ZERO YAW FOR SAMOS MODELS
AS A FUNCTION OF MACH NUMBER

FULL SCALE NOSE CORNER RAD. (IN.)	DRAWING NUMBER
1	1831
2	1831-5, 1844, 2304-II
5	2304-7, 2205-5
8	2304-9



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FIG.8 SLOPE OF PITCHING MOMENT
COEFFICIENT CORRECTED TO ZERO
YAW FOR SAMOS MODELS AS A
FUNCTION OF MACH NUMBER.



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