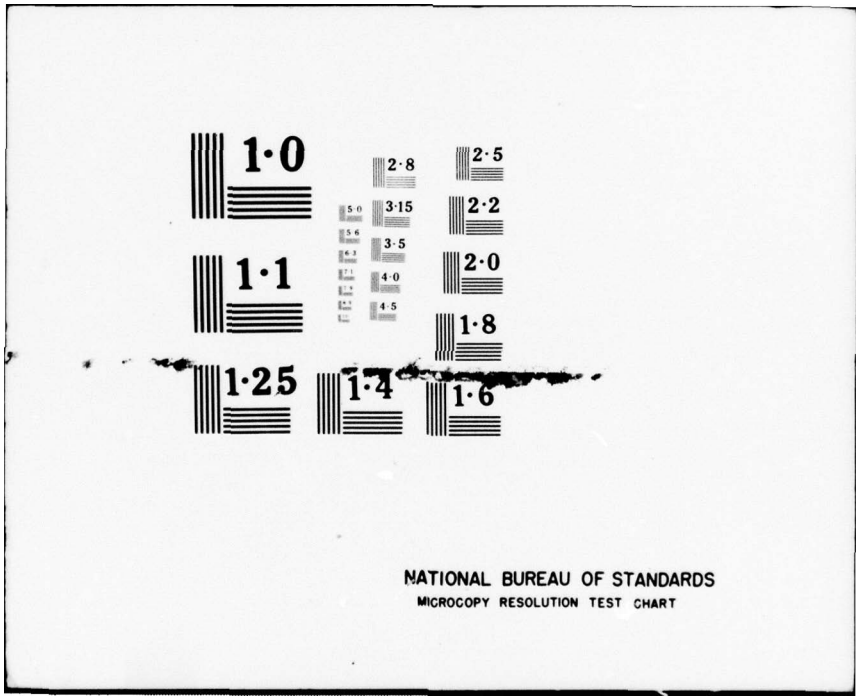
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NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

AD A040860

TECHNICAL REPORT TD-77-11

AN INVESTIGATION OF FLOW AND STABILITY CHARACTERISTICS FOR A BODY OF REVOLUTION WITH FINS AND FLARE IN PRESENCE OF PLUME INDUCED SEPARATION AT MACH NUMBERS 0.7 TO 1.4

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This report was prepared from data plotted by REMTECH, Inc., Huntsville, AL. All data presented are in a data base maintained by REMTECH and are available in tabular or magnetic tape form.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Thrust Effects
Longitudinal Stability
Plume Effects
Base Pressure
Plume
Boundary Layer Separation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The results of a wind tunnel test, simulating rocket motor exhaust jet effects on missile aerodynamics at Mach numbers of 0.7 to 1.4 are presented. A normal jet plume simulator was used to induce afterbody boundary layer separation. Flow visualization techniques including both shadowgraph and oil flow photographs were taken. The primary emphasis for this report is the force and moment measurements taken on twelve configurations including: five tail fin configurations; body alone; → next page

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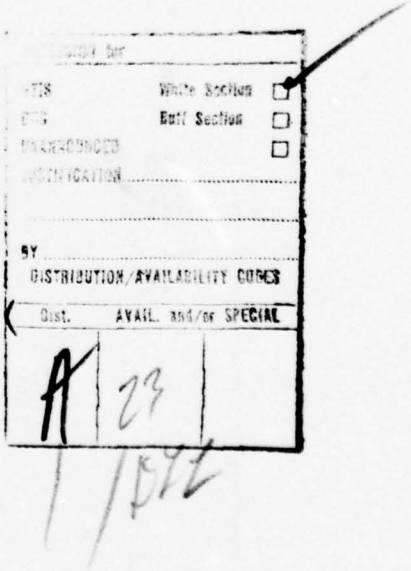
three forward fin configurations; body flare combination; and two combinations of forward fins/strakes with tail fins. All force and moment coefficients are presented in plotted form. One configuration is shown with ground plane interference simulation.

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I. INTRODUCTION

The objective of this test was to study several techniques for improving static aerodynamic stability for missiles with large rocket motor plumes. Flow phenomena were recorded through both oil flow and shadowgraph for seven of the thirteen configurations that were tested during the force phase. This report documents primarily the data from the aerodynamic force measurement phase. Subsequent reports will include more detail analysis with data from the visualization phase. All testing was conducted in the Aerodynamic Wind Tunnel (IT) of the Arnold Engineering Development Center (AEDC) Propulsion Wind Tunnel Facility (PWT).

It has been shown (reference 1) that longitudinal location of fin stabilizers may be adjusted to improve aerodynamic stability for particular plume-missile configurations that have afterbody boundary layer flow separation. Location of fins forward of the missile body base may not be feasible in some cases, and it could further complicate the structural considerations of hardware design. The model for this test was designed so that aerodynamic stability could be studied for configurations with geometric modification to aft mounted fin stabilizers. These were: extended fin exposed span, fin body gap, and extended fin chord. Two additional configurations were introduced: strakes/fin-strake combinations and a forward mounted flare. All of these were covered in the thirteen configurations tested. A normal jet plume simulator was used to induce the afterbody boundary layer separation. One series of test throughout the Mach number range of 0.7 to 1.4 was conducted with a solid bottom tunnel wall replacing the normal perforated wall. This was implemented to provide nose bow shock reflections and/or ground plane interference effects on aerodynamic stability with plume simulated boundary layer separation.

II. APPARATUS

A. Test Facility Description and Operation.

The AEDC-PWT Aerodynamic Wind Tunnel (IT) is a continuous flow, nonreturn facility, with Mach number capability from 0.2 to 1.5. The tunnel total pressure is essentially nonvariant at approximately 2850 psfa with ± 5 percent variation. The total temperature variation can be controlled from 80 to 120 degree F. The test section is one foot square and 37.5 inches long with 6 percent porosity with all four perforated walls installed. During the visualization phase the sidewalls were replaced with solid transparent walls, and during the force test simulating ground plane interference the bottom wall was replaced with a solid floor. A more detailed description of the IT facility may be found in the AEDC Test Facility Handbook (reference 2).

B. Model

The model was a sting mounted body of revolution having a diameter of 1.1 in. It had a 3-caliber tangent ogive nose with a 7.4 caliber cylindrical afterbody, making a total length of 10.4 calibers (11.44 in.), figure 1. Five tail fins were added to give six arrangements of: two exposed span variations (F2, F5); three fin root chord body gaps (F5, F6, F7); two chord variations (F2, F8); and F2 rolled 45° to the "X" position. Three fins were mounted forward of the base; S1, S2 and F2. Fins S1 and S2 are referred to as "strakes" and are mounted with their trailing edge 1.5 calibers from the base. Fin F2 was mounted with the trailing edge 1.65 calibers from the base. Combinations of the small strake S1 and tail fins F5 and F7 were also tested. A truncated cone "flare" one caliber long was added with the flare base one caliber from

the body base. The flare height and the exposed span of strake S1 were made to be the estimated boundary layer thickness for the model in the 1T test section. Strake S2 was made to be two boundary layer thicknesses. Fin F2 and the body were made to be geometrically similar to previous models tested at CALSPAN, and AEDC, PWT 16T, reference 1. These configurations are shown in figure 1 and table I. Installation photographs of each of these are shown in figure 2. Many other arrangements are available with this model. The plume simulator is identified on the first of the photographs of figure 2. Geometric similarity between this plume simulator and the larger model simulator, reference 1, was maintained where possible. Total radial flow from the plume simulator is from 12 holes 5/64 in. diameter equally spaced around the circumference of the simulator, located 0.73 in. aft of the model base. Both the larger plume simulator and this simulator had a total sonic jet orifice area of 6.0% of the model cross-sectional area with the centerline of the orifice 0.66 body diameters (calibers) aft of the body base. Due to structural considerations the simulator diameter to model diameter ratio could not be matched. The simulator was tested for both leaks and structural integrity up to approximately 2000 psi chamber pressure. The simulator used in this test was 0.815 in. in diameter for a simulator to model diameter ratio of 0.74 as compared to 0.60 for the larger model, reference 2. Detailed descriptions of the plume simulator and all model parts including sting and adapter are contained in MIRADCOM drawings RDK-13900 series.

C. Instrumentation

Force and moment measurements were made by an AEDC six-component internal 3/4 in. strain-gage balance, 6-.75-.040-.52 mf. Two model

base pressures and the plume simulator chamber pressure were measured with transducers and plumbing integal to the sting-simulator hardware. Plume simulator chamber temperature was measured with an internal iron-constantan thermocouple.

III. TEST PROCEDURES AND CONDITIONS

The test was conducted through a Mach number range of 0.7 to 1.4. Tunnel and atmospheric conditions prevented obtaining a tunnel section Mach number of 1.5. Tunnel total temperature was varied from 125 to 180° F as required to prevent moisture condensation in the test section. The nominal tunnel test conditions are summarized in table II.

Data for single run/part number were obtained by varying angle-of-attack with Mach number and plume simulator chamber pressure held constant. Angle-of-attack was nominally varied from -3 to 4 degrees at zero yaw and roll "+" attitudes. Angle-of-attack was varied up to +6 degrees for the runs with the ground plane simulation, and two configurations were run with a 45 degree "x" roll angle. The plume simulator air supply was adjusted to give the preselected chamber pressure that gave the desired radial thrust coefficient (CRT) for the tunnel test section conditions. The values for chamber pressure at specified values of CRT along with the expression for computation is contained in table III. The mass flow rate varied up to 1.5 - 2.0 pounds per second.

During the shadowgraph and oil flow phases pictures were taken primarily at angles of attack of 0, 1, and 2 degrees. Force and moments were not recorded during the visualization phase of testing. The composition of oil used was 1 part titanium dioxide, 2 parts oil (mobil DTE heavy-medium duty oil) and 1 - 2 drops oleic acid per quart of above mixture.

IV. DATA

A. Reduction

All balance force coefficients are referenced to the cross-sectional area of the body, 0.95033 sq. in. The moment reference center is located at model station 5.83 inches aft of the nose or at 5.1 calibers forward of the body base. The moment coefficients are referenced to the body cross-sectional area times the body diameter (1.1 in.). The sign convention is the standard body axis system, positive nose up and right (climbing right turn). The two base pressures were averaged and ratioed to the free stream ambient pressure. The computation method of the radial thrust coefficient, and values obtained during the test are listed in table III. Corrections to angle-of-attack were made for sting and balance deflections caused by aerodynamic loads and model weight.

B. Uncertainty

Data uncertainty was estimated by AEDC for a confidence level of 95 percent. The values shown in table IV are based on the uncertainty of both balance measurements and tunnel conditions.

C. Presentation of Results

This report presents the results of the force phase of this test. Table V contains a complete run log for both the oil flow and shadowgraph phases along with the force measurement runs. During the initial part of the testing strain gage balance drift caused by a lead length temperature compensation problem was excessive. Because of this part (run) numbers through 50 are not included in the presentation with the exception of Mach number 1.35 data. Most of these data were repeated, and are presented in Appendix A.

1. Visualization Results

Approximately 145 oil flow and 138 shadowgraph photographs were taken at discrete Mach number, angle of attack, and simulated thrust levels. A number of the 70 mm oil flow prints have been enlarged, then superimposed onto the full sized shadowgraph prints to provide visualization of the combined body surface and external flow patterns at matching flow and plume simulator conditions. Sample combined prints with jet-off and two simulator pressures for body without fins are shown for Mach number 1.25 at one degree angle-of-attack on figures 3 through 5. Figure 6 shows the large fin-body (BF5) and figure 7 the combination of strake and gap fin (BF7S1) for CRT = 7.2. Analysis of the visualization results and how they are related to and aid in interpretation of force data is incomplete.

2. Force and Moment Results

The stability coefficients, normal force, side force, pitching moment, and yawing moment are shown in Appendix A for all configurations. The base pressure ratio as a function of CRT at the various Mach numbers are shown in figure 8. It should be pointed out here that the base pressure and especially the point of flow separation - boundary layer separation - on the afterbody is significantly affected by the condition of the body approach boundary layer. In addition to boundary layer properties of temperature, Reynolds number and turbulence, the thickness must be considered when comparing these results to either similar tests or prototype versions. However, the trends that exist for increases in simulator (CRT) magnitude, Mach number, angle-of-attack and limited comparisons between configurations should represent qualities of all similar situations. Samples of the rolling moment coefficients are

shown in figures 9 and 10. The data shown in figure 9 are all at Mach 1.25 for cases where the variations in side force and yawing moment (Appendix A) are quite large. Body alone data - jet off - is shown in figure 10. All coefficients will be retained for future reference.

The stability derivatives over the linear portion of the normal force and pitching moment curves near zero angle-of-attack (generally $-1.5 \leq \alpha \leq 1.5$ degrees) are presented in Appendix B for all configurations tested. A list of all of these slopes are contained in table VI. Comparisons of the jet off stability and forebody axial force coefficients are shown in figures 11 and 12.

REFERENCES

1. Batiuk, G., Henderson, J. H., "A Summary of Jet Plume Effects on the Stability Characteristics of a Body of Revolution with Various Fin Configurations at Mach Numbers from 0.2 to 2.3 (Normal Jet Plume Simulator)," U. S. Army Missile Command, Redstone Arsenal, Alabama, 13 December 1976, Report No. RD-77-12.

2. "Test Facilities Handbook" (Tenth Edition), Propulsion Wind Tunnel Facility, Vol. 4, Arnold Engineering Development Center, May 1974.

NOMENCLATURE

SYMBOL	PLOT SYMBOL	DEFINITION
b/2		fin chord length, in.
c		fin exposed semi-span, in.
C_A		axial force coefficient
C_{D_o}	CDo	fore drag coefficient, total less base drag
C_ℓ	Cl	rolling moment coefficient
C_m	C_{LM}	pitching moment coefficient
C_n	C_{LN}	yawing moment coefficient
C_N	C_N	normal force coefficient
C_{m_α}	CMa, $C_{M_{ALPHA}}$	pitching moment slope at zero angle of attack
C_{N_α}	CNa, $C_{N_{ALPHA}}$	normal force slope at zero angle of attack
C_Y	C_Y	side force coefficient
CRT	CRT	radial thrust coefficient
ℓ_{ref}	LREF	reference length, in.
M_∞		tunnel test section Mach number
P_b/P_∞	Pb/Pi	base to tunnel static pressure ratio
P_t		tunnel stagnation pressure, psfa
q_∞		tunnel test section dynamic pressure, psf
R_N		Reynolds number, per foot

NOMENCLATURE (Continued)

SYMBOL	PLOT SYMBOL	DEFINITION
S_{ref}	SREF	reference area used to reduce data to coefficient form, in.
t		fin thickness, in.
X_{cp}	XCP	center of pressure in calibers from nose
X_{mrp}	XMRP	moment reference point on X axis
α	ALPHA	angle of attack, degrees
ϕ	PHI	angle of roll, degrees

TABLE I

MODEL GEOMETRY

Config.	c (in.)	b/2 (in.)	Gap (in.)	t (in.)	Profile	Remarks
B	---	---	---	---	---	Body alone
F2	0.66	0.55	0.0	0.033	1/4c Wedge Flat Plate	Fin
F5		1.32				
F6		1.045	0.275			
F7		0.77	0.55			
F8	2.31	0.55	0.0			
*S1	1.10	0.15			Flat with Round L.E.	Strake
S2		0.30				
**FL		0.15	---	---	Flare Angle 7.75°	---

* Trailing edge of strakes 1.50 calibers from base.

** Flare base 1.0 caliber from base.

TABLE II

NOMINAL TEST CONDITIONS

M_∞	P_t (psfa)	q_∞ (psf)	$R_N \times 10^{-6}$ (per ft.)
0.60	2850	563	4.001
0.70		705	4.426
0.90		955	5.013
1.00		1054	5.187
1.10		1130	5.287
1.25		1204	4.999
1.40		1229	4.916

TABLE III

NOMINAL PLUME SIMULATOR CHAMBER PRESSURE

MACH	CRT							
	2.5	3	4.2	6	7.2	9	12	18
0.7	172	204	281	397	474	590	783	1169
0.9	227	271	376	533	637	794	1056	1579
1.0	249	297	412	585	701	874	1163	1740
1.1	265	317	441	627	750	936	1246	
1.25	281	336	467	665	797	995		
1.4	285	341	476	678				

$$CRT = A_{nj} \; (0.5283 \times P_c \; (1.4 \times M_j^2 + 1) - P_s/144) \; / \; (A_{ref} \times q/144)$$

where

A_{nj} = Total exit area, 12 orifices

$A_{nj}/A_{ref} = 0.06$

M_j = Sonic jet (M=1.0)

q = Free stream dynamic pressure, psf

P_c = Chamber pressure in simulator, psi

P_s = Tunnel static pressure, psf

P_t = 2850 psi -- tunnel total pressure

TABLE IV

DATA UNCERTAINTY

M_∞	ΔM_∞	Δq (psf)	ΔC_N	ΔC_Y	ΔC_A	ΔC_m	ΔC_n	ΔC_ℓ
0.60	$\pm$.003	$\pm$4.75	$\pm$.059	$\pm$.036	$\pm$.029	$\pm$.031	$\pm$.046	$\pm$.012
0.70	$\pm$.003	$\pm$4.35	$\pm$.047	$\pm$.028	$\pm$.023	$\pm$.025	$\pm$.037	$\pm$.009
0.90	$\pm$.003	$\pm$3.79	$\pm$.035	$\pm$.021	$\pm$.017	$\pm$.018	$\pm$.027	$\pm$.007
1.00	$\pm$.004	$\pm$3.93	$\pm$.032	$\pm$.019	$\pm$.016	$\pm$.017	$\pm$.024	$\pm$.006
1.10	$\pm$.006	$\pm$4.30	$\pm$.030	$\pm$.018	$\pm$.015	$\pm$.016	$\pm$.023	$\pm$.006
1.25	$\pm$.012	$\pm$4.45	$\pm$.028	$\pm$.017	$\pm$.014	$\pm$.015	$\pm$.021	$\pm$.005
1.40	$\pm$.025	$\pm$1.96	$\pm$.027	$\pm$.016	$\pm$.013	$\pm$.014	$\pm$.021	$\pm$.005

TABLE V. DATA SET SUMMARY

FORCE AND MOMENT PHASE

TEST AEDC TM-350

Data Set	Config	Mach No.	α	ϕ	CRT										
					0	2.5	3	4.2	6	7.2	8.2	9	12	14	18
B60001	B	0.7	A	0	522				525			524			523
02	B	0.9	A	0	517				516			515			
03	B	1.0	A	0	513	512			511			526*			
04	B	1.1	A	0	504,508	510			509			506			
05	B	1.25	A	0	496	501		500		43,497					
06	B	1.35	A	0	48	47	46	45							
07	B	1.4	A	0	528	531	530	529							
08	BFL	0.7	A	0	595				598			597			596
09	BFL	1.0	A	0	589	592			591				590		
10	BFL	1.25	A	0	583	588		586		585		587			
11	BF2	0.7	A	0	562				567			564	563		
12	BF2	1.0	A	0	568	571			570				569		
13	BF2	1.25	A	0	573	576		575		574					
14	BF2	1.25	A	45	578			580	579						
15	BF2/A	1.25	A	0	712	717		716		715	714	713			
16	BF2/B	0.7	B	0	739				742				741		740
17	BF2/B	0.9	B	0	727	730			729				728		
18	BF2/B	1.0	B	0	731				733			732	738		
19	BF2/B	1.1	B	0	734				736			735			
20	BF2/B	1.25	B	0	720	724		723		721		722			
21	BF2/B	1.4	B	0	743	746		745	744						
22	BF5	0.7	A	0	544				547			546			545
23	BF5	0.9	A	0	548				550			549			
24	BF5	1.0	A	0	551	553			552				555		
25	BF5	1.1	A	0	559	558			557			556			
26	BF5	1.25	A	0	538	540		539		543					
27	BF5	1.4	A	0	534	537	536	535							
28	BF6	0.7	A	0	601				604			603			602

BF2/A = Forward Location

BF2/B = Aft Location, Solid Bottom Wall

α Schedules: A = +4, ±3, ±2, ±1.5, ±1.0, ±0.5, 0

B = +6, +4, ±3, ± 2, ±1.5, ±1.0, ±0.5, 0

* CRT=11

TEST RUN NUMBERS

TABLE V. DATA SET SUMMARY (continued)

FORCE AND MOMENT PHASE (concluded)

TEST AEDC TM-350

Data Set	Config	Mach No.	α	ϕ	CRT										
					0	2.5	3	4.2	6	7.2	8.2	9	12	14	18
B60029	BF6	1.0	A	0	605	607			606				609		
30	BF6	1.25	A	0	610	613		612		611					
31	BF7	0.7	A	0	627				626			625			624
32	BF7	1.0	A	0	628	630			629				623		
33	BF7	1.25	A	0	615	619		618	617	616					
34	BF8	0.7	A	0	642				641			640			635
35	BF8	1.0	A	0	639	638			637				636		
36	BF8	1.25	A	0	645	648		647		646					
37	BS1	0.7	A	0	669							670			664
38	BS1	1.0	A	0	668	667			666			665			
39	BS1	1.25	A	0	658	661		660		659	663	662			
40	BS1	1.25	A	45	651			655	654	653	652				
41	BS2	0.7	A	0	698							697			
42	BS2	1.0	A	0	693	696			695			694			
43	BS2	1.25	A	0	687	692		691		690	689	688			
44	BF7S1	0.7	A	0	673							678			674
45	BF7S1	1.0	A	0	677				676				675		
46	BF7S1	1.25	A	0	684	683		682		681	680	679			
47	BF5S1	0.7	A	0	702				706			705			
48	BF5S1	1.0	A	0	701				704				703		
49	BF5S1	1.25	A	0	707			709		708					
50	B	0.7	0	0	5 - Variable CRT - Base Pressure Data Only										
51	B	1.0	0	0	50 - Variable CRT - Base Pressure Data Only										
52	B	1.25	0	0	49 - Variable CRT - Base Pressure Data Only										

TABLE V. DATA SET SUMMARY (continued)

OIL VISUALIZATION PHASE

TEST AEDC TM-350

Data Set	Config	Mach No.	α	ϕ	CRT										
					0	2.5	3	4.2	6	7.2	8.2	9	12	14	18
	B	0.7	0	0								102		97,101	
	B	0.7	1	0								103		98,100	
	B	0.7	2	0								104		99	
	B	0.7	3	0								105			
	B	1.0	0	0	79	88			85				80		
	B	1.0	1	0		89			84				81		
	B	1.0	2	0		90			83				82		
	B	1.0	3	0		91									
	B	1.0	4	0		92									
	B	1.0	5	0		93									
	B	1.0	6	0		94									
	B	1.25	0	0	56			62,71	72	57					
	B	1.25	1	0	63,67			61,70	73	58					
	B	1.25	2	0	64,68			60,69	74	59					
	B	1.25	3	0					75						
	B	1.25	6	0					76			115,			
	BF5	0.7	0	0	109							116,126			114,121
	BF5	0.7	1	0	110							117,125			113,122
	BF5	0.7	2	0	111							118,124			112,123
	BF5	1.0	0	0	129				135				134		
	BF5	1.0	1	0	130				136				133		
	BF5	1.0	2	0	131				137				132		
	BF5	1.25	0	0				145		140					
	BF5	1.25	1	0	146			144		141					
	BF5	1.25	2	0	147,148			143		142					
	BF7	0.7	0	0	188				187			182			
	BF7	0.7	1	0	189				186			183			
	BF7	0.7	2	0	190				185			184			
	BF7	1.0	0	0		179			174						

TABLE V. DATA SET SUMMARY (continued)

OIL VISUALIZATION PHASE (continued)

TEST AEDC TM-350

Data Set	Config	Mach No.	α	ϕ	CRT										
					0	2.5	3	4.2	6	7.2	8.2	9	12	14	18
	BF7	1.0	1	0		178			175						
	BF7	1.0	2	0		177			176						
	BF7	1.25	0	0	158,169	168		157	163	151					
	BF7	1.25	1	0	159,170	167		156	164	152					
	BF7	1.25	2	0	160,171	166		155	165	153,154					
	BFL	0.7	0	0	193,194							207			200
	BFL	0.7	1	0	195							206			201
	BFL	0.7	2	0	196							205			202
	BFL	0.7	3	0								204			203
	BFL	1.0	-2	0	222										
	BFL	1.0	0	0	221	216			215				210		
	BFL	1.0	1	0	220	217			214				211		
	BFL	1.0	2	0	219	218			213				212		
	BFL	1.25	0	0	231					230		225			
	BFL	1.25	1	0	232					229		226			
	BFL	1.25	2	0	233					228		227			
	BS1	0.7	0	0	274							273			268
	BS1	0.7	1	0	275							272			269
	BS1	0.7	2	0	276							271			270
	BS1	1.0	0	0	265	262			261			256			
	BS1	1.0	1	0		263			260			257			
	BS1	1.0	2	0		264			259			258			
	BS1	1.25	-1	0		253									
	BS1	1.25	0	0	242	252		247		241		236			
	BS1	1.25	1	0	243	251		248		240		237			
	BS1	1.25	2	0	244	250		249		239		238			
	BF7S1	0.7	0	0								284			279
	BF7S1	0.7	1	0								283			280
	BF7S1	0.7	2	0								282			281

TABLE V. DATA SET SUMMARY (continued)

OIL VISUALIZATION PHASE (concluded)

TEST AEDC TM-350

Data Set	Config	Mach No.	α	ϕ	CRT										
					0	2.5	3	4.2	6	7.2	8.2	9	12	14	18
	BF7S1	1.0	0	0					293				288		
	BF7S1	1.0	1	0					292				289		
	BF7S1	1.0	2	0					291				290		
	BF7S1	1.25	0	0		310		305		301,302		296			
	BF7S1	1.25	1	0		309		306		300		297			
	BF7S1	1.25	2	0		308		307		299		298			
	BS1	1.25	0	45				319	318	313					
	BS1	1.25	1	45				320	317	314					
	BS1	1.25	2	45				321	316	315					
	BF2	1.25	0	45	330			329	324						
	BF2	1.25	1	45				328	325						
	BF2	1.25	2	45				327	326						

TABLE V. DATA SET SUMMARY (continued)

SHADOWGRAPH VISUALIZATION PHASE

TEST AEDC TM-350

Data Set	Config	Mach No.	α	ϕ	CRT										
					0	2.5	3	4.2	6	7.2	8.2	9	12	14	18
	B	0.7	0	0	363								369*		368
	B	0.7	1	0	364								370*		367
	B	0.7	2	0	365								371*		366
	B	1.0	0	0	351	362			357				356		
	B	1.0	1	0	352	361			358				355		
	B	1.0	2	0	353	360			359				354		
	B	1.25	0	0	333	345		344		339		338			
	B	1.25	1	0	334	346		343		340		337			
	B	1.25	2	0	335	347		342		341		336			
	BF5	0.7	0	0	374								380*		379
	BF5	0.7	1	0	375								381*		378
	BF5	0.7	2	0	376								382*		377
	BF5	1.0	0	0	383	389			388						
	BF5	1.0	1	0	384	390			387						
	BF5	1.0	2	0	385	391			386						
	BF5	1.25	0	0	392	404		403		398		397			
	BF5	1.25	1	0	393	405		402		399		396			
	BF5	1.25	2	0	394	406		401		400		395			
	BS1	1.25	0	0	409	420		415		414	428	423			
	BS1	1.25	1	0	410	419		416		413	427	424			
	BS1	1.25	2	0	411	418		417		412	426	425			
	BF7S1	1.25	0	0	431	448		443		442	437	436			
	BF7S1	1.25	1	0	432	447		444		441	438	435			
	BF7S1	1.25	2	0	433	446		445		440	439	434			
	BFL	1.25	0	0	451			464		462,463		458			
	BFL	1.25	1	0	452			465		461/1		455,459			
	BFL	1.25	2	0	453			466		461/2		454,456, 457,460			
	▼														
	BS1	1.25	0	45	469			481		476	475				

*CRT=11

TABLE V. DATA SET SUMMARY (concluded)

SHADOWGRAPH VISUALIZATION PHASE (concluded)

TEST AEDC TM-350

Data Set	Config	Mach No.	α	ϕ	CRT										
					0	2.5	3	4.2	6	7.2	8.2	9	12	14	18
	BS1	1.25	1	45	470			480		477	474				
	BS1	1.25	2	45	471			479		478	473				
	BF2	1.25	0	45	484			490	489						
	BF2	1.25	1	45	485			491	488						
	BF2	1.25	2	45	486			492	487						

TABLE VI. SUMMARY OF STABILITY DERIVATIVES - C_{N_α}

TEST AEDC TM-350

Data Set	Config	Mach No.	α	ϕ	CRT 0	2.5	3	4.2	6	7.2	8.2	9	12	14	18
B60001	B	0.7	A	0	.0445				.0030			-.0423			-.0777
02	B	0.9	A	0	.0484				-.0520			-.1046			
03	B	1.0	A	0	.0500	.0115			-.0678			-.1000*			
04	B	1.1	A	0	.0503	-.0064			-.0841			-.0793			
05	B	1.25	A	0	.0515	-.0052		-.0887		-.2107					
06	B	1.35	A	0	.0483	-.0115	-.0259	-.0799							
07	B	1.4	A	0	.0495	-.0041	-.0117	-.0611							
08	BFL	0.7	A	0	.0540				.0464			.0432			.0409
09	BFL	1.0	A	0	.0611	.0629			.0439				.0315		
10	BFL	1.25	A	0	.0646	.0645		.0507		.0063		-.0424			
11	BF2	0.7	A	0	.1158				.0393			-.0150	-.1338		
12	BF2	1.0	A	0	.1310	.0566			-.1035				-.0981		
13	BF2	1.25	A	0	.1405	-.0422		-.0526		-.1210					
14	BF2	1.25	A	45	.1237			-.0586	-.0977						
15	BF2/A	1.25	A	0	.1549	.1000		.0531		-.1177	-.2614	-.4636			
16	BF2/B	0.7	B	0	.1176				.0497				-.0852		.0238
17	BF2/B	0.9	B	0	.1263	.0696			-.0966				.0096		
18	BF2/B	1.0	B	0	.1291				-.1748			.0093	.0157		
19	BF2/B	1.1	B	0	.1323				-.0858			.0422			
20	BF2/B	1.25	B	0	.1403	-.0314		-.0476		-.0808		.0083			
21	BF2/B	1.4	B	0	.1268	-.0036		-.0787	-.0356						
22	BF5	0.7	A	0	.2502				.1275			.0356			-.1515
23	BF5	0.9	A	0	.4180				.0748			-.1756			
24	BF5	1.0	A	0	.2976	.2015			-.0761				-.0949		
25	BF5	1.1	A	0	.2982	.1279			-.0408			-.0476			
26	BF5	1.25	A	0	.2989	.0736		-.0194		-.1258					
27	BF5	1.4	A	0	.2623	.1233	.0123	-.0660							
28	BF6	0.7	A	0	.1508				.0683			.0285			-.0307

BF2/A = Forward Location

BF2/B = Aft Location, Solid Bottom Wall

α Schedules: A = +4, ±3, ±2, ±1.5, ±1.0, ±0.5, 0

B = +6, +4, ±3, ±2, ±1.5, ±1.0, ±0.5, 0

*CRT=11

TEST RUN NUMBERS

TABLE VI. SUMMARY OF STABILITY DERIVATIVES (continued)

C_{N_α} (concluded)

TEST AEDC TM-350

Data Set	Config	Mach No.	α	ϕ	CRT										
					0	2.5	3	4.2	6	7.2	8.2	9	12	14	18
B60029	BF6	1.0	A	0	.1747	.1094			-.0101				-.0341		
30	BF6	1.25	A	0	.1699	.0875		-.0082		-.1862					
31	BF7	0.7	A	0	.1106				.0624			.0448			-.0233
32	BF7	1.0	A	0	.1399	.0782			.0398				-.0135		
33	BF7	1.25	A	0	.1339	.0696		-.0108	-.0879	-.1706					
34	BF8	0.7	A	0	.1298				.0757			.0213			-.3171
35	BF8	1.0	A	0	.1418	.0724			-.3384				-.4439		
36	BF8	1.25	A	0	.1716	-.0729		-.3984		-.7039					
37	BS1	0.7	A	0	.0474							-.0163			-.0717
38	BS1	1.0	A	0	.0582	.0324			-.0511			-.0882			
39	BS1	1.25	A	0	.0647	.0012		-.0475		-.1759	-.1063	.0287			
40	BS1	1.25	A	45	.0603			-.0559	-.1561	-.1060	-.0684				
41	BS2	0.7	A	0	.0788							.0003			
42	BS2	1.0	A	0	.0847	.0525			-.0376			-.0786			
43	BS2	1.25	A	0	.0858	.0471		-.0264		-.1559	-.1796	-.0858			
44	BF7S1	0.7	A	0	.1192										-.0384
45	BF7S1	1.0	A	0	.1471				.0417				-.0542		
46	BF7S1	1.25	A	0	.1480	.0833		-.0315		-.1636	.0232	.0882			
47	BF5S1	0.7	A	0	.2640				.1598			.0642			
48	BF5S1	1.0	A	0	.2913				-.0037				-.0412		
49	BF5S1	1.25	A	0	.3008			.0007		-.0787					

TABLE VI. SUMMARY OF STABILITY DERIVATIVES (continued)

C_{m_α}

TEST AEDC TM-350

Data Set	Config	Mach No	α	φ	CRT 0	2.5	3	4.2	6	7.2	8.2	9	12	14	18
B60001	B	0.7	A	0	.1372				.2635			.4707			.5847
02	B	0.9	A	0	.1257				.4949			.7191			
03	B	1.0	A	0	.1012	.2393			.5652			.6382*			
04	B	1.1	A	0	.1194	.3749			.6054			.5254			
05	B	1.25	A	0	.1183	.3855		.7286		1.0412					
06	B	1.35	A	0	.1563	.4446	.4951	.6929							
07	B	1.4	A	0	.1647	.4127	.4799	.6390							
08	BFL	0.7	A	0	.1322				.1169			.1378			.1471
09	BFL	1.0	A	0	.0684	.0895			.1305				.1778		
10	BFL	1.25	A	0	.0702	.0891		.1472		.3063		.4755			
11	BF2	0.7	A	0	-.1740				.1003			.3320	.8741		
12	BF2	1.0	A	0	-.2697	.0561			.7669				.6249		
13	BF2	1.25	A	0	-.2839	.5605		.5425		.6644					
14	BF2	1.25	A	45	-.2699			.5549	.6448						
15	BF2/A	1.25	A	0	-.1703	.0598		.1803		.7466	1.2056	1.8334			
16	BF2/B	0.7	A	0	-.1926				.1129				.6616		.1486
17	BF2/B	0.9	A	0	-.2521	.0039			.7544				.1676		
18	BF2/B	1.0	A	0	-.2665				1.0588			.1936	.1596		
19	BF2/B	1.1	A	0	-.2730				.6252			.0564			
20	BF2/B	1.25	A	0	-.2708	.5078		.4895		.4882		.0388			
21	BF2/B	1.4	A	0	-.2037	.4146		.7219	.4614						
22	BF5	0.7	A	0	-.8485				-.2581			.1017			.9159
23	BF5	0.9	A	0	-1.6036				-.0295			1.0598			
24	BF5	1.0	A	0	-1.0477	-.5686			.5971				.5975		
25	BF5	1.1	A	0	-1.0373	-.2235			.4416			.3635			
26	BF5	1.25	A	0	-1.0186	.0629		.3920		.6983					
27	BF5	1.4	A	0	-.8598	-.1796	.3670	.6680							
28	BF6	0.7	A	0	-.3679				-.0237			.2045			.3761

* CRT=11

TABLE VI. SUMMARY OF STABILITY DERIVATIVES (concluded)

C_{m_α} (concluded)

TEST AEDC TM-350

Data Set	Config	Mach No.	α	ϕ	CRT 0	2.5	3	4.2	6	7.2	8.2	9	12	14	18
B60029	BF6	1.0	A	0	-.4908	-.1693			.3313				.3774		
30	BF6	1.25	A	0	-.4400	-.0446		.3663		.9932					
31	BF7	0.7	A	0	-.2005				-.0043			.1191			.3865
32	BF7	1.0	A	0	-.3276	-.0176			.1275				.2875		
33	BF7	1.25	A	0	-.2692	.0542		.3804	.6122	.9057					
34	BF8	0.7	A	0	-.1779				.0714			.2475			1.5798
35	BF8	1.0	A	0	-.2440	.1079			1.7718				1.8892		
36	BF8	1.25	A	0	-.2644	.8093		2.0457		2.9912					
37	BS1	0.7	A	0	.1074							.4120			.5206
38	BS1	1.0	A	0	.0787	.2147			.5133			.6305			
39	BS1	1.25	A	0	.1099	.3596		.5238		.9108	.6229	.1721			
40	BS1	1.25	A	45	.0999			.5577	.8757	.6149	.4629				
41	BS2	0.7	A	0	.0448							.3223			
42	BS2	1.0	A	0	.0223	.1484			.4732			.5985			
43	BS2	1.25	A	0	.0577	.2570		.5472		.8246	.9211	.6243			
44	BF7S1	0.7	A	0	-.2250										.4312
45	BF7S1	1.0	A	0	-.3192				.1569				.4025		
46	BF7S1	1.25	A	0	-.3015	-.0139		.4695		.8371	.1225	.0205			
47	BF5S1	0.7	A	0	-.8450				-.3966			.0214			
48	BF5S1	1.0	A	0	-.9831				.3190				.3991		
49	BF5S1	1.25	A	0	-.9864			.3284		.5497					

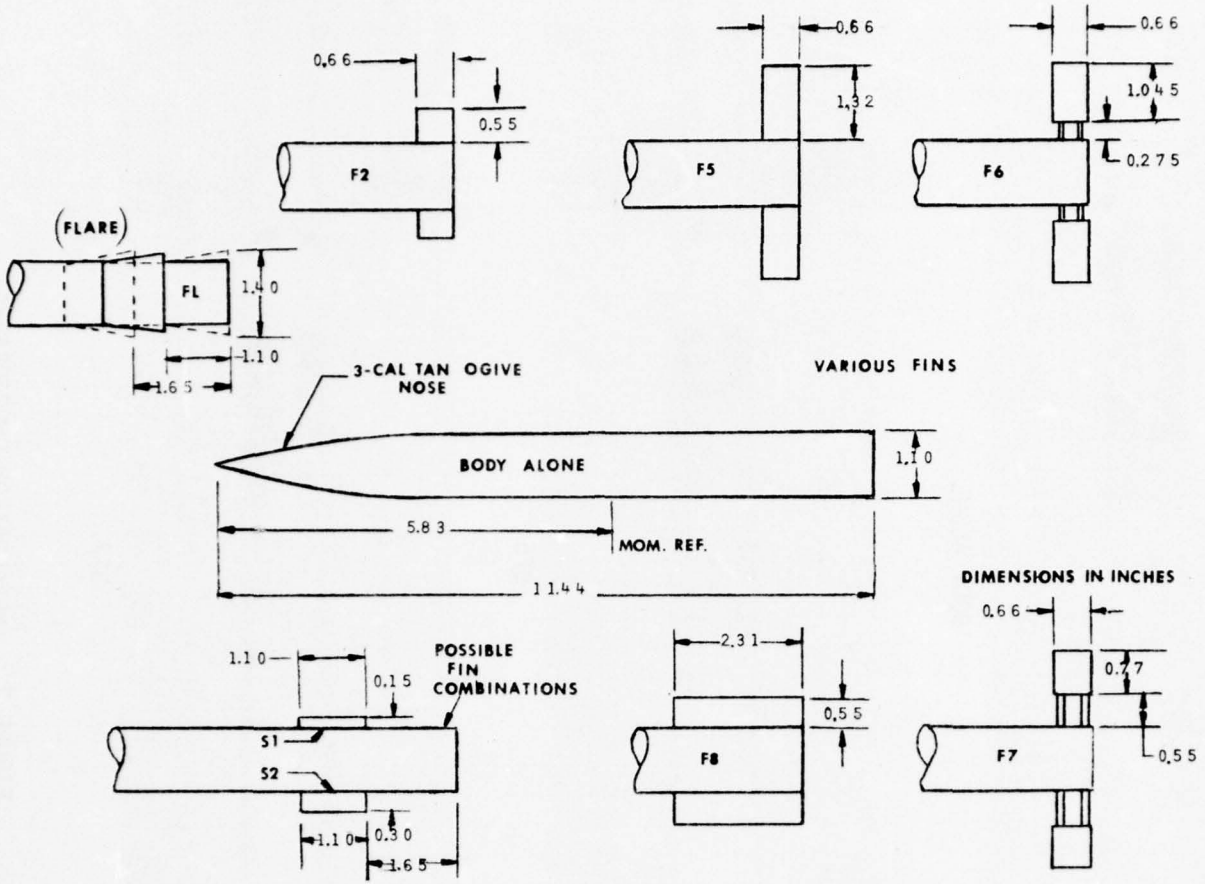
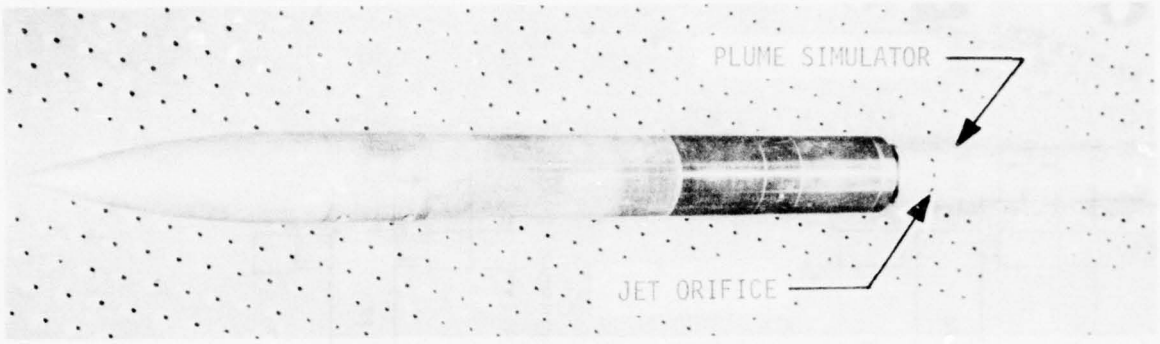
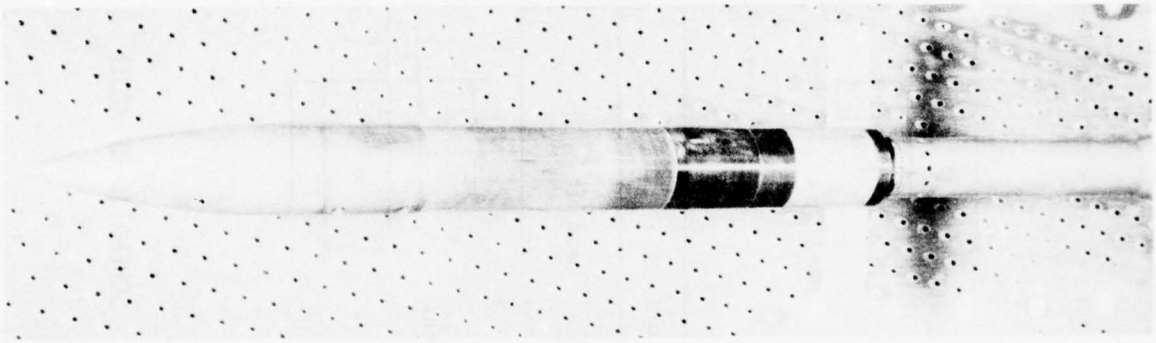


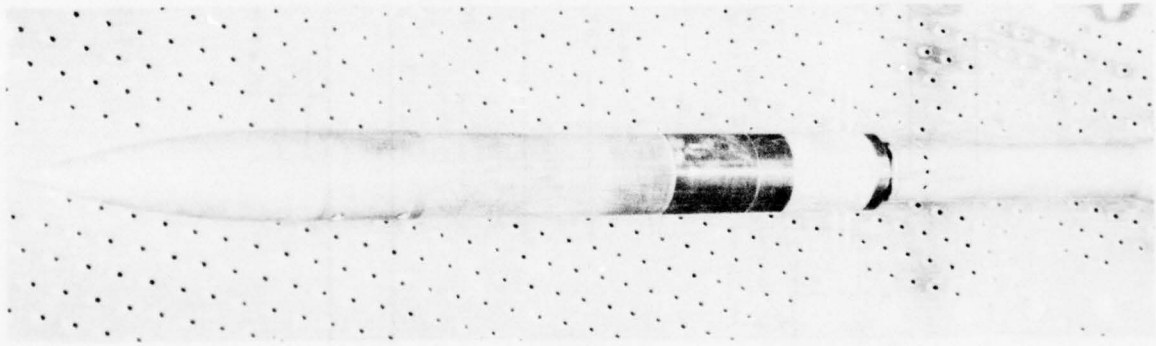
FIGURE 1. SCHEMATIC OF MODEL



BODY ALONE

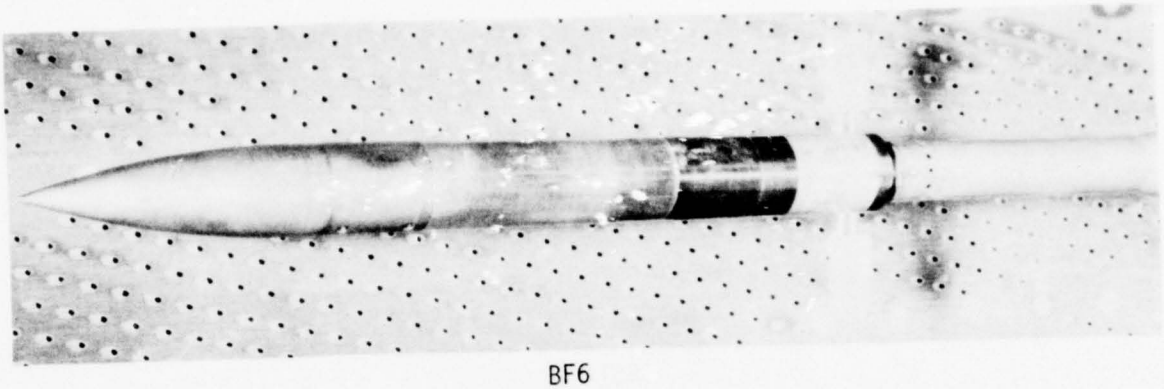


BF5

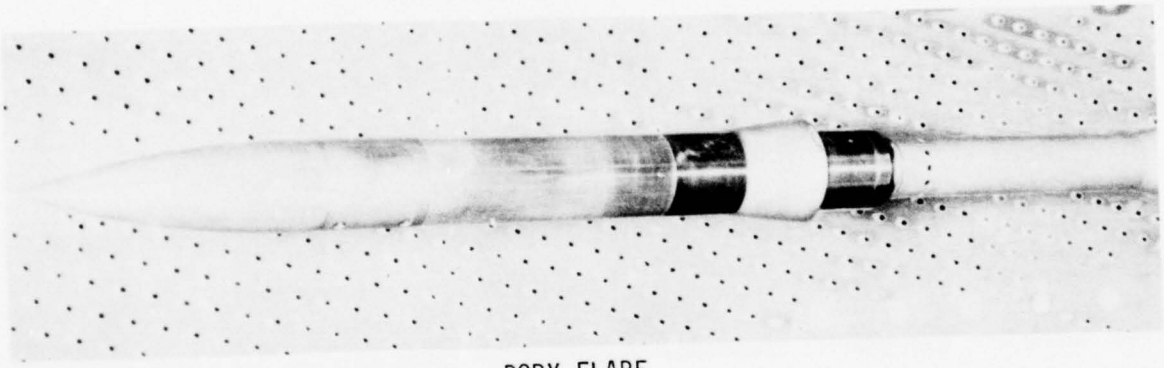


BF7

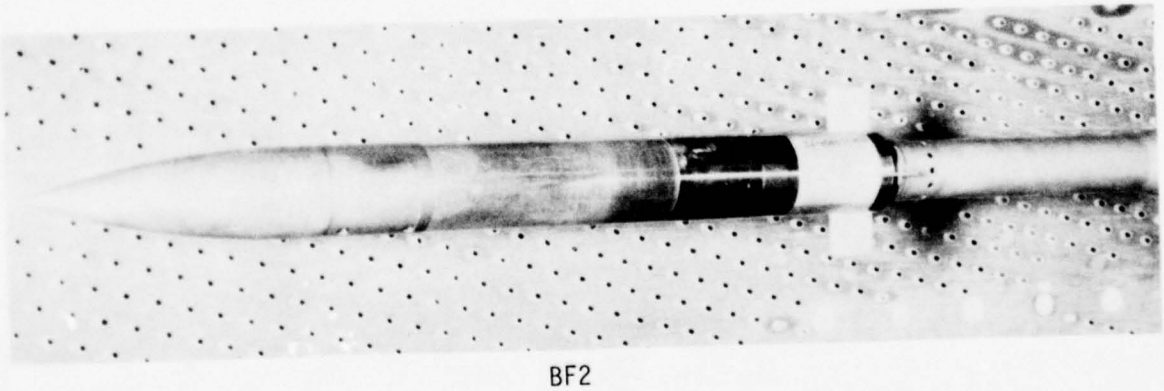
FIGURE 2. INSTALLATION PHOTOGRAPHS



BF6

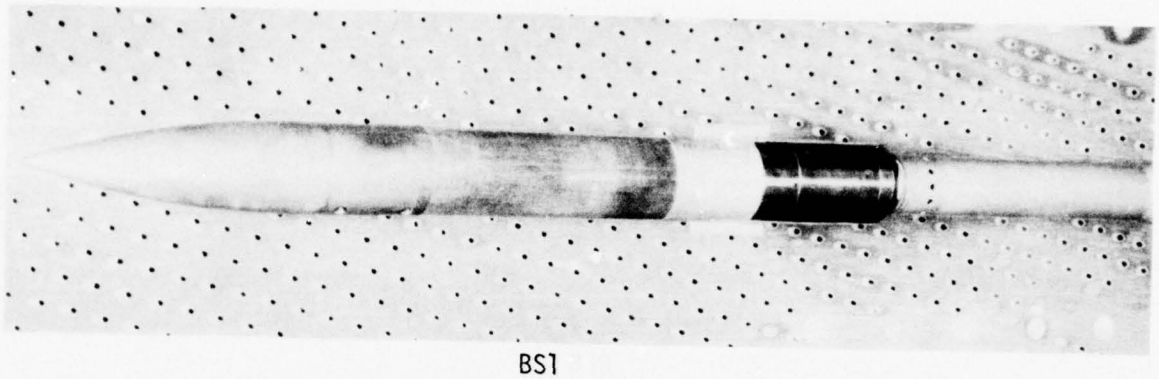


BODY FLARE

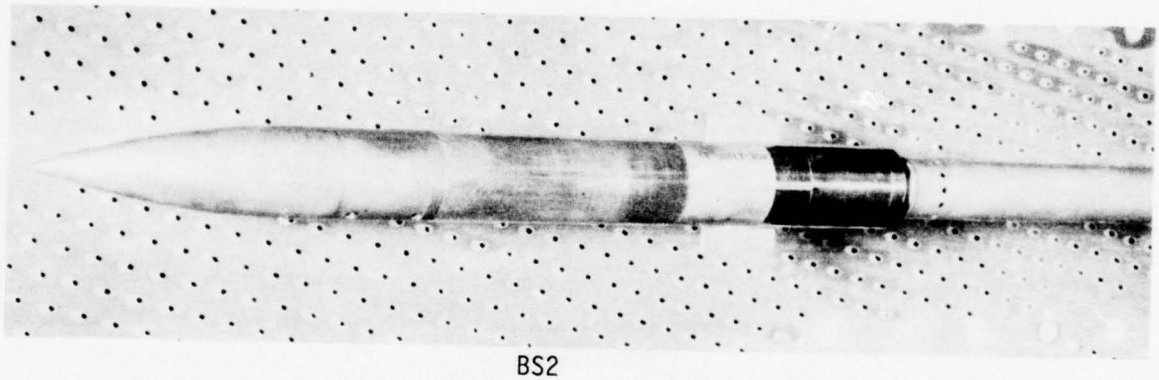


BF2

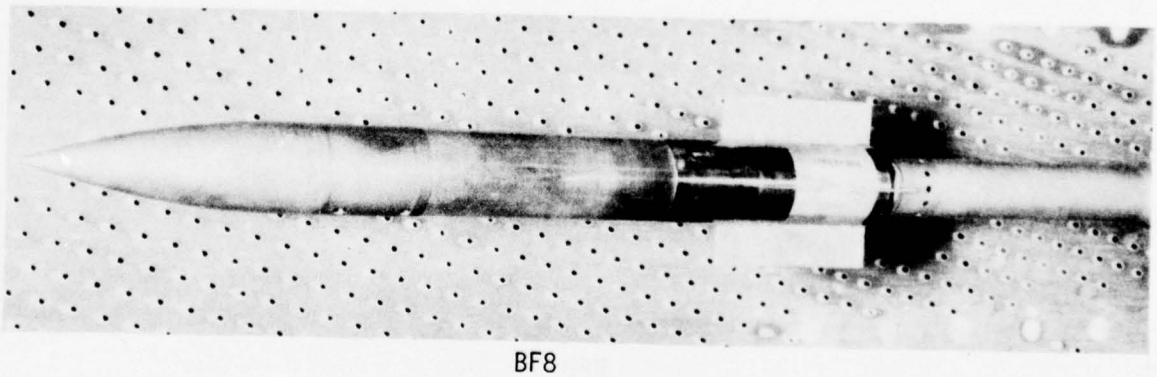
FIGURE 2. CONTINUED



BS1

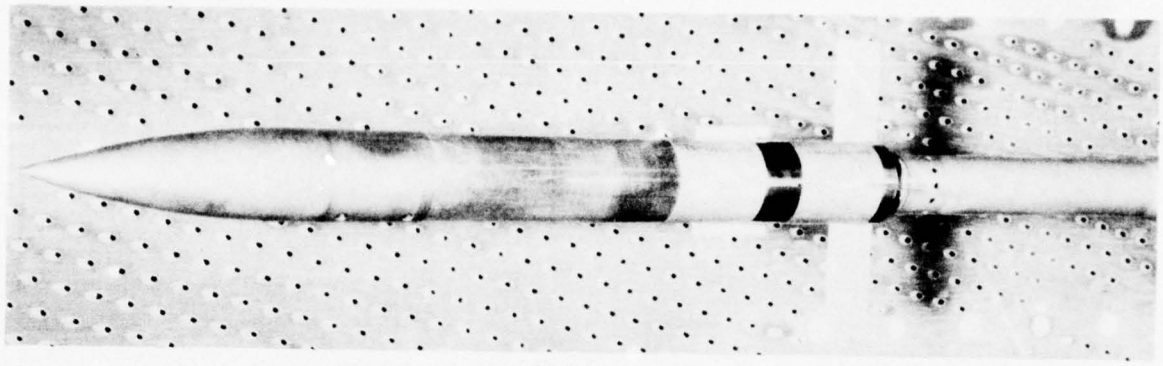


BS2

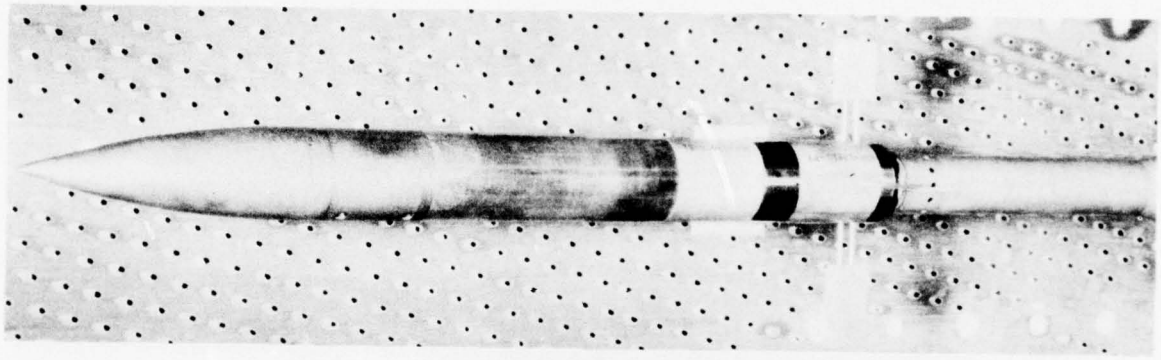


BF8

FIGURE 2. CONTINUED



BF5S1



BF7S1

FIGURE 2. CONCLUDED

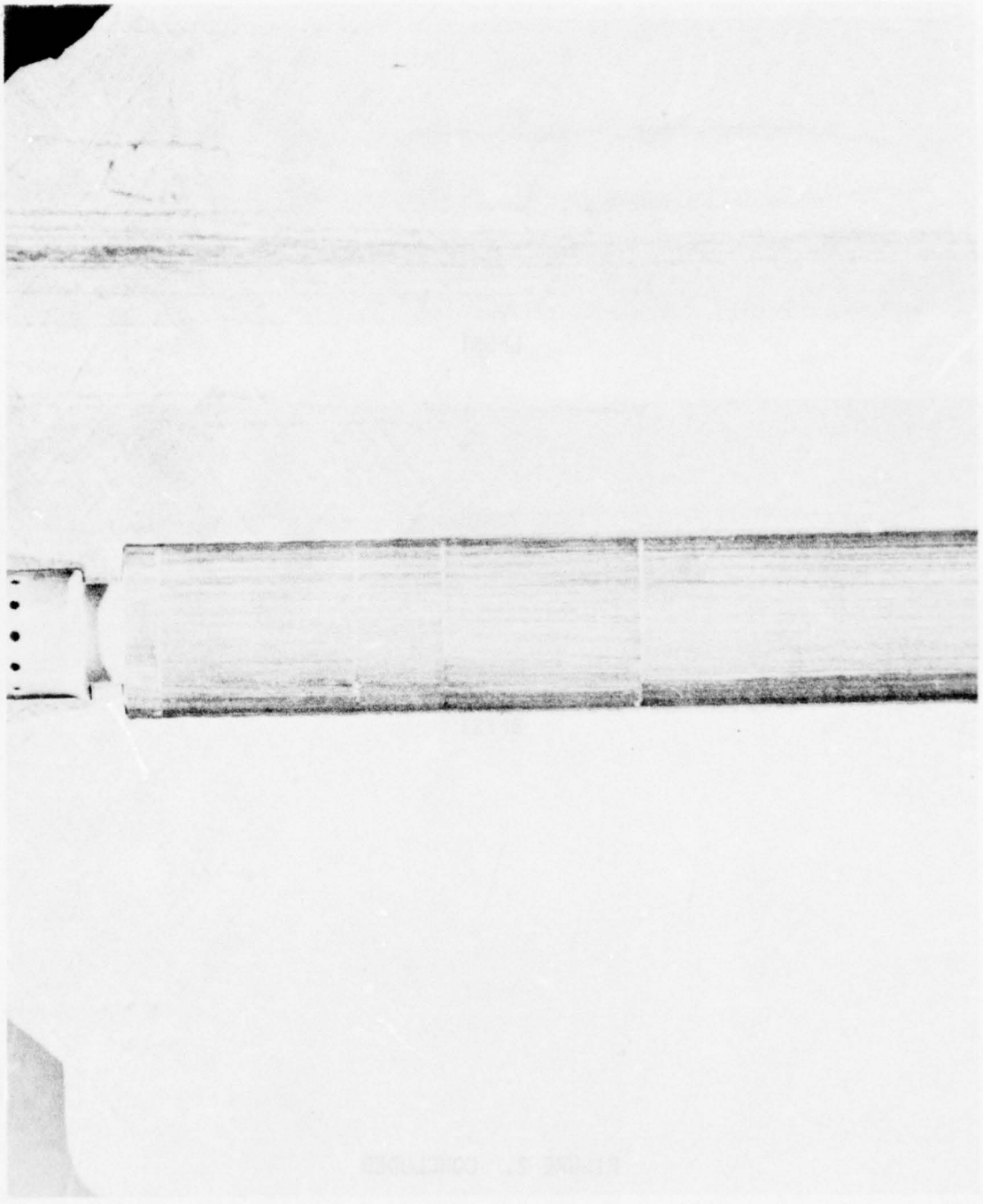


FIGURE 3. COMBINED OIL FLOW/SHADOWGRAPH
BODY ALONE, M_∞=1.25, CRT=0, α=1°

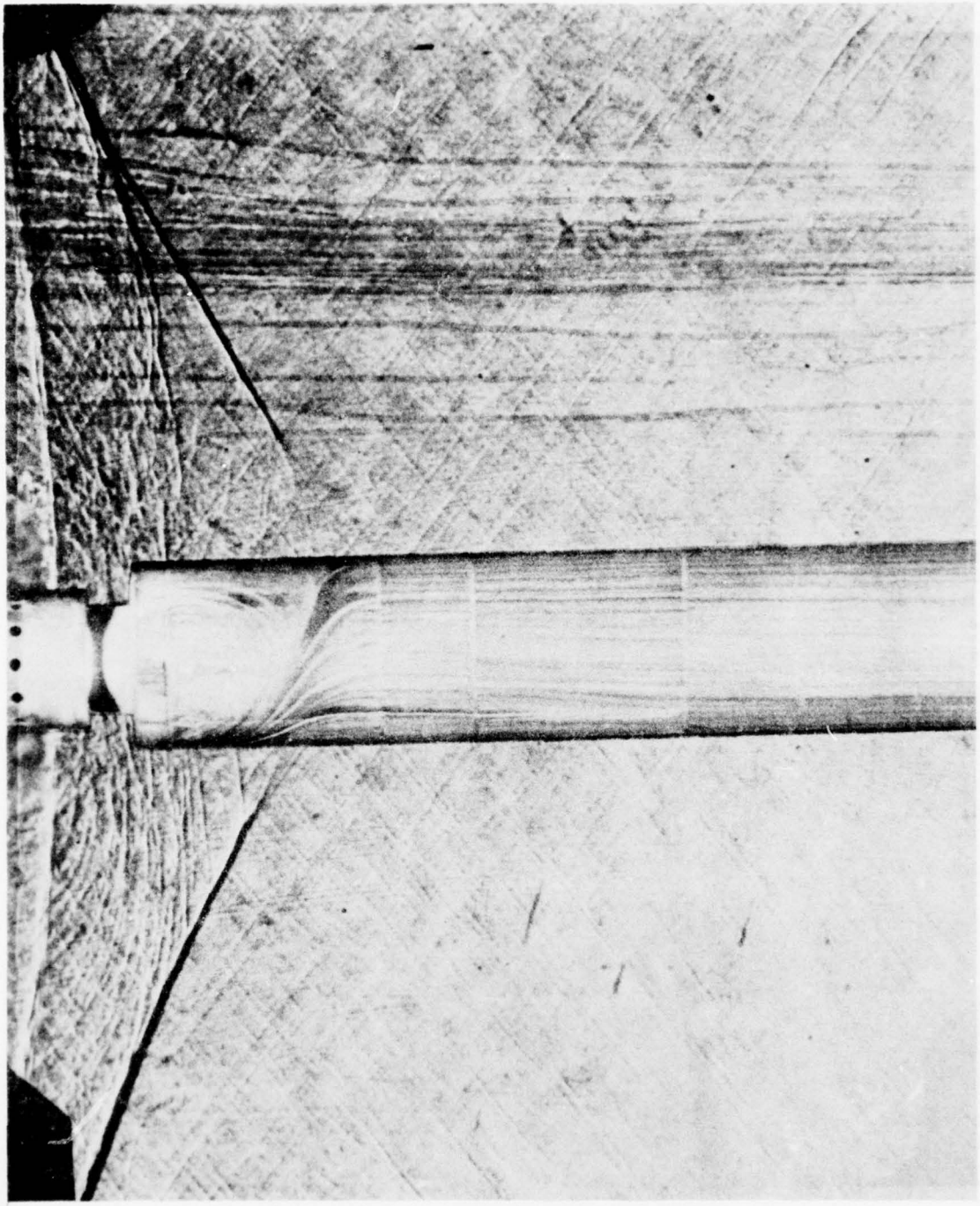


FIGURE 4. COMBINED OIL FLOW/SHADOWGRAPH
BODY ALONE, M_∞=1.25, CRT=4.2, α=1°

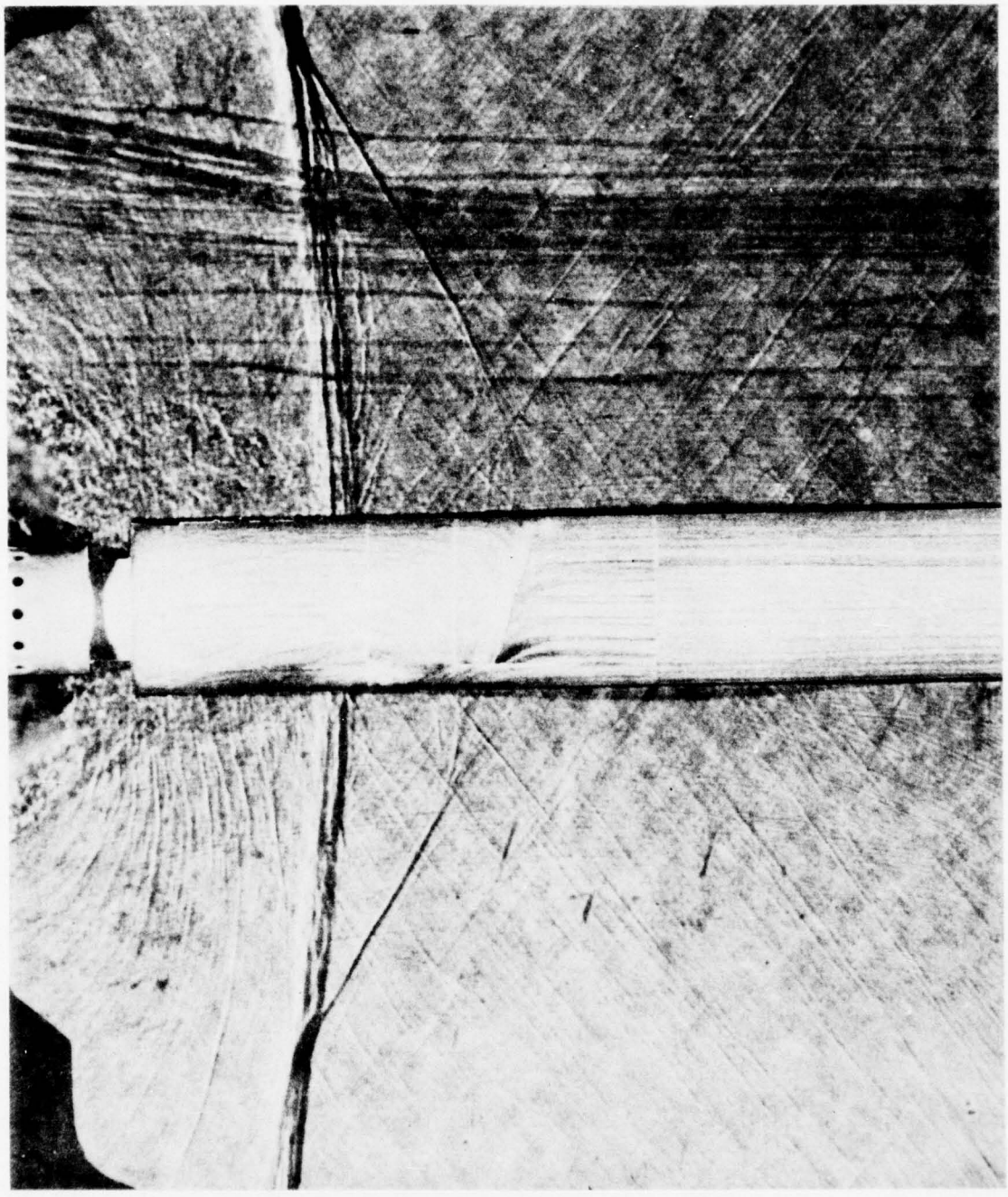


FIGURE 5. COMBINED OIL FLOW/SHADOWGRAPH
BODY ALONE, M_∞=1.25, CRT=7.2, α=1°

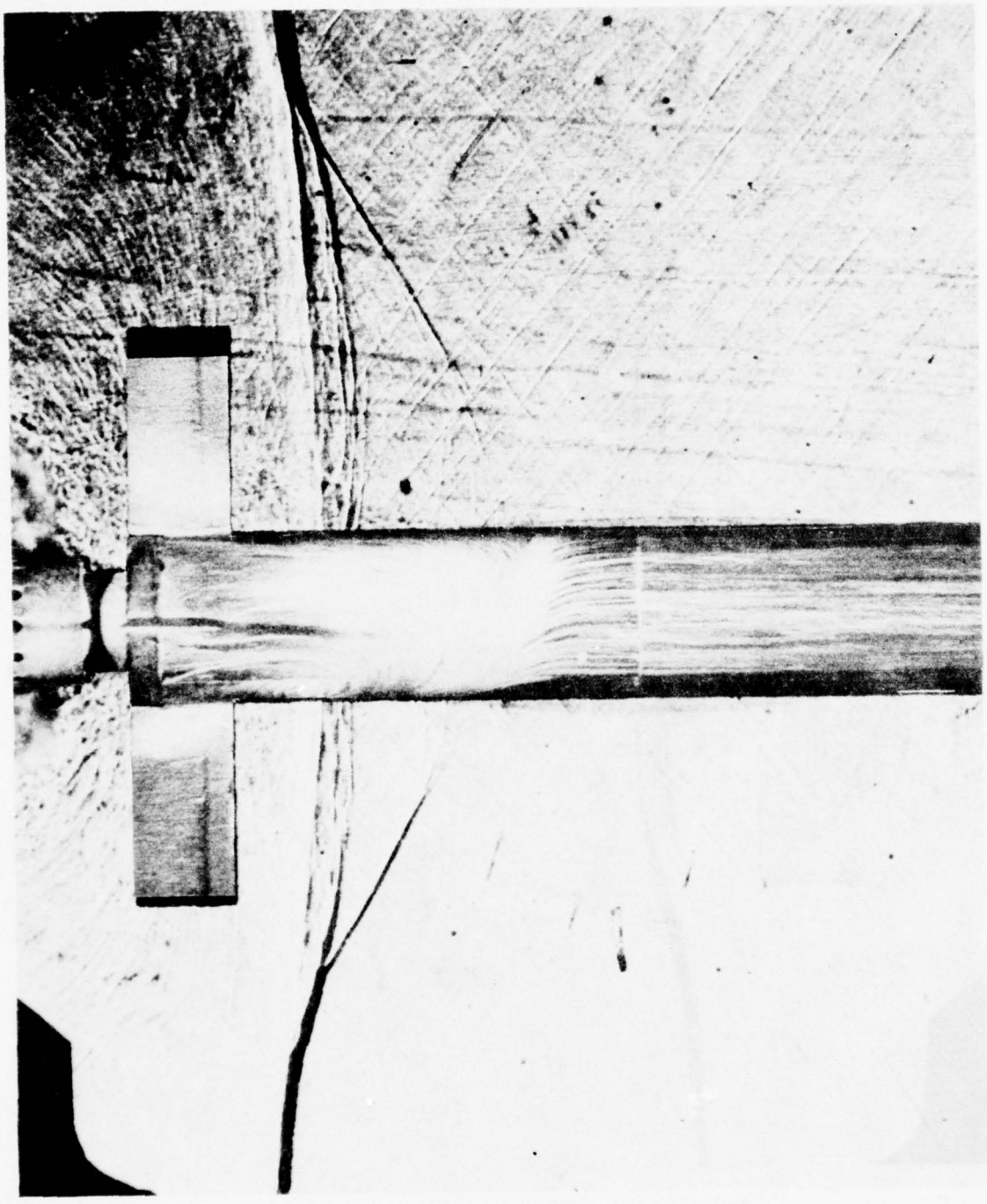


FIGURE 6. COMBINED OIL FLOW/SHADOWGRAPH

BF5, M_∞=1.25, CRT=7.2, α=1°

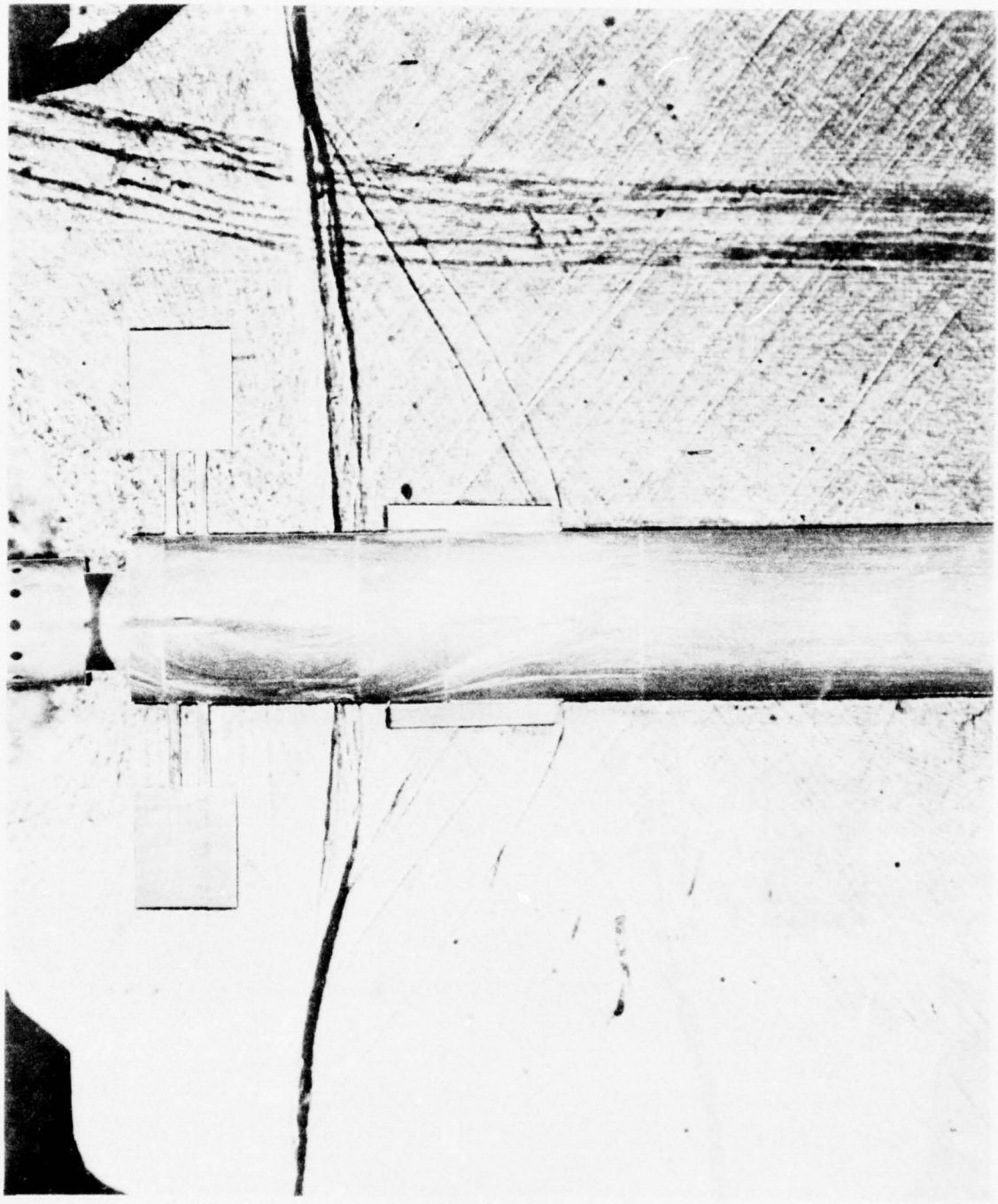


FIGURE 7. COMBINED OIL FLOW/SHADOWGRAPH
BF7S1, M_∞=1.25, CRT=7.2, α=1°

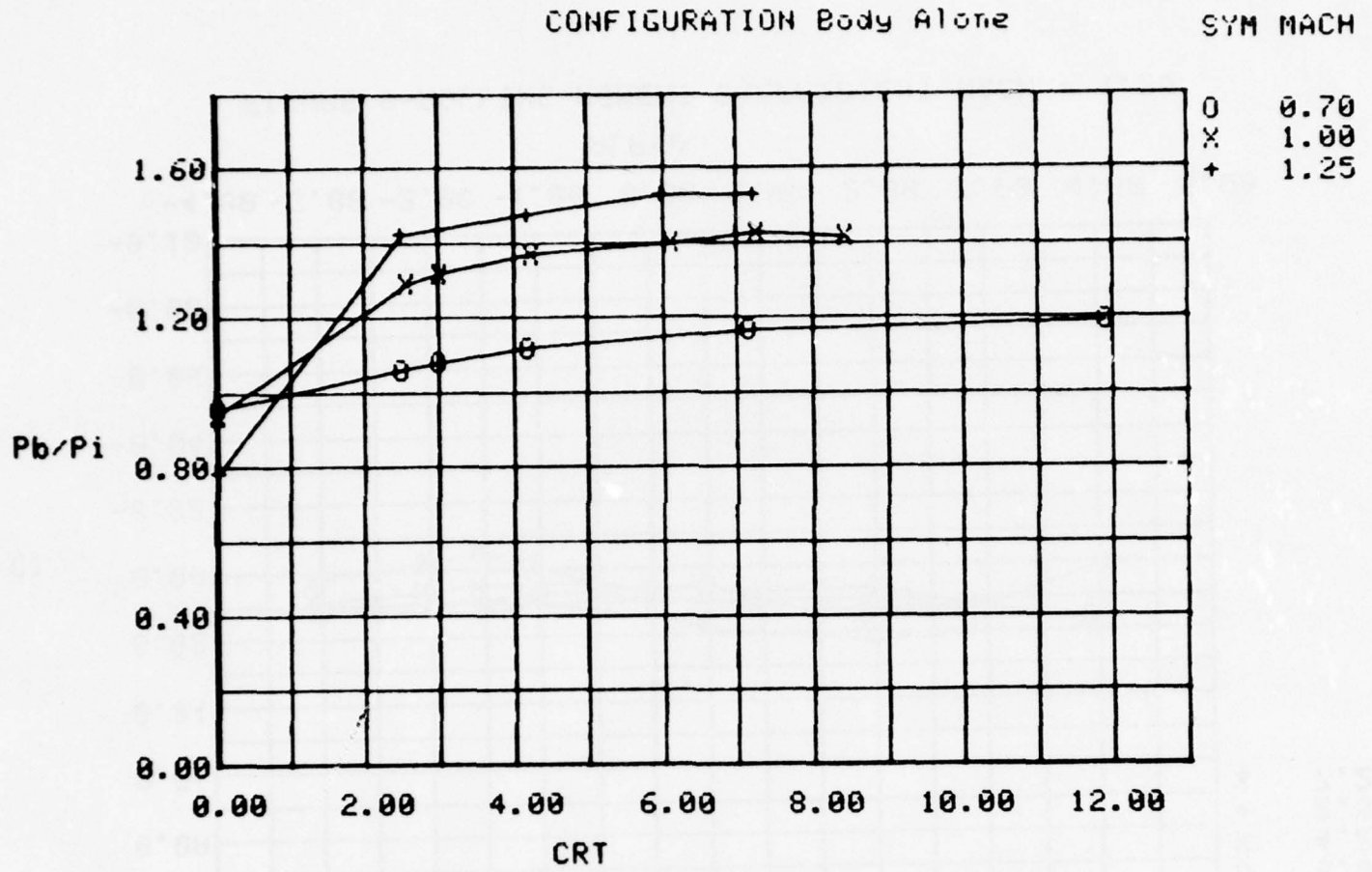


FIGURE 8 - BASE PRESSURE RATIO VERSUS CRT

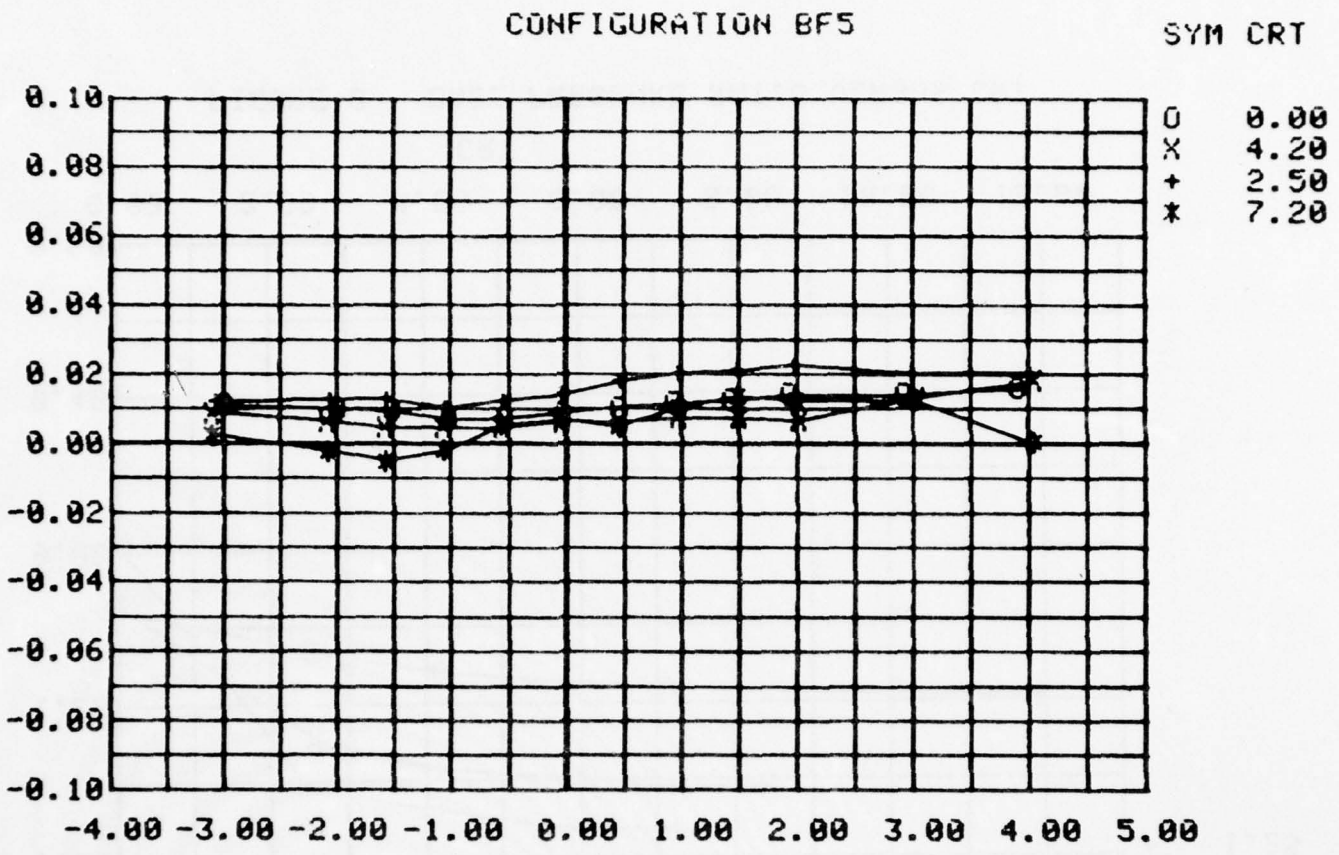


FIGURE 9-ROLLING MOMENT COEFFICIENT MACH = 1.25

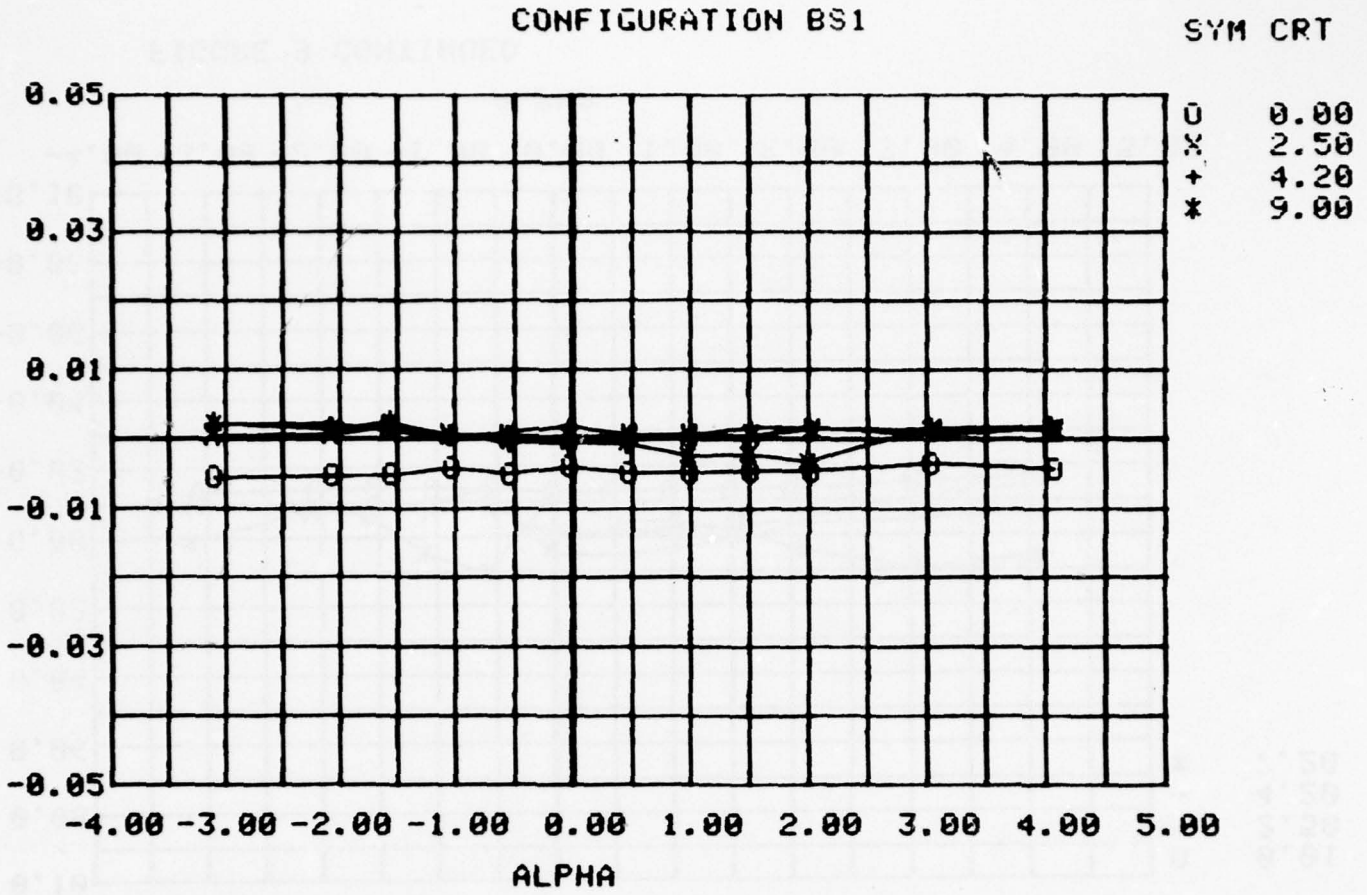


FIGURE 9-CONTINUED

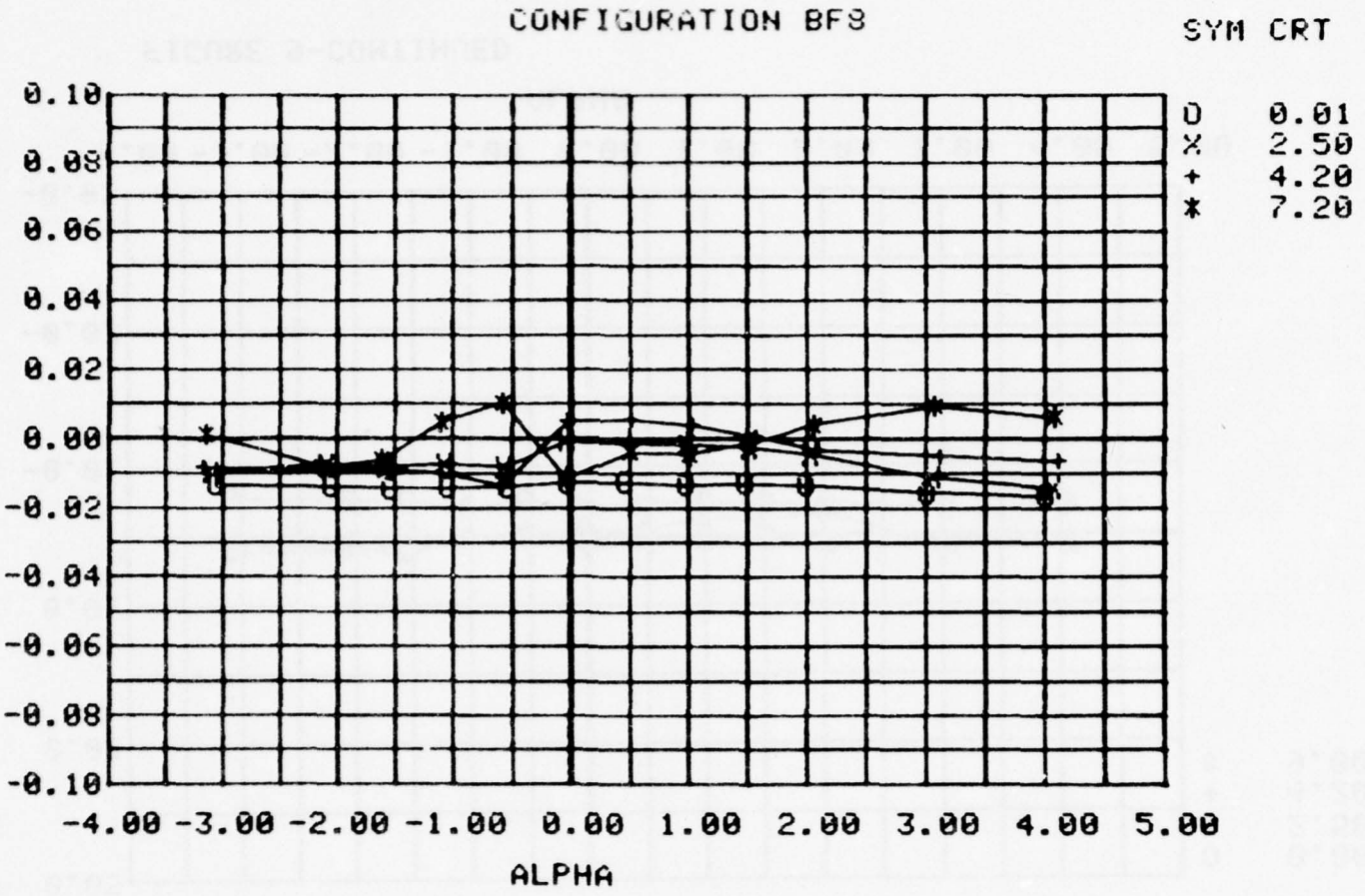


FIGURE 9 CONTINUED

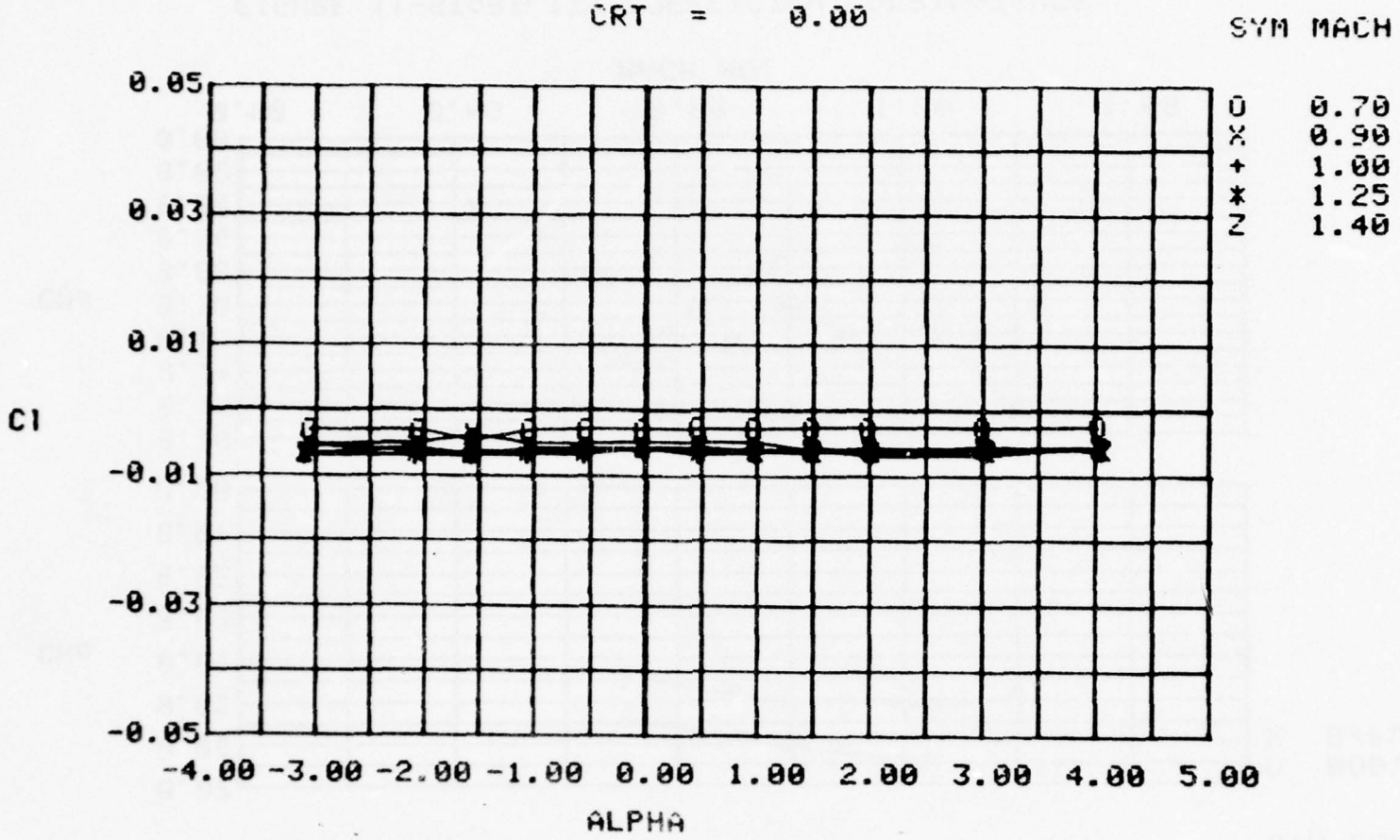


FIGURE 10-ROLLING MOMENT COEFFICIENT - BODY ALONE

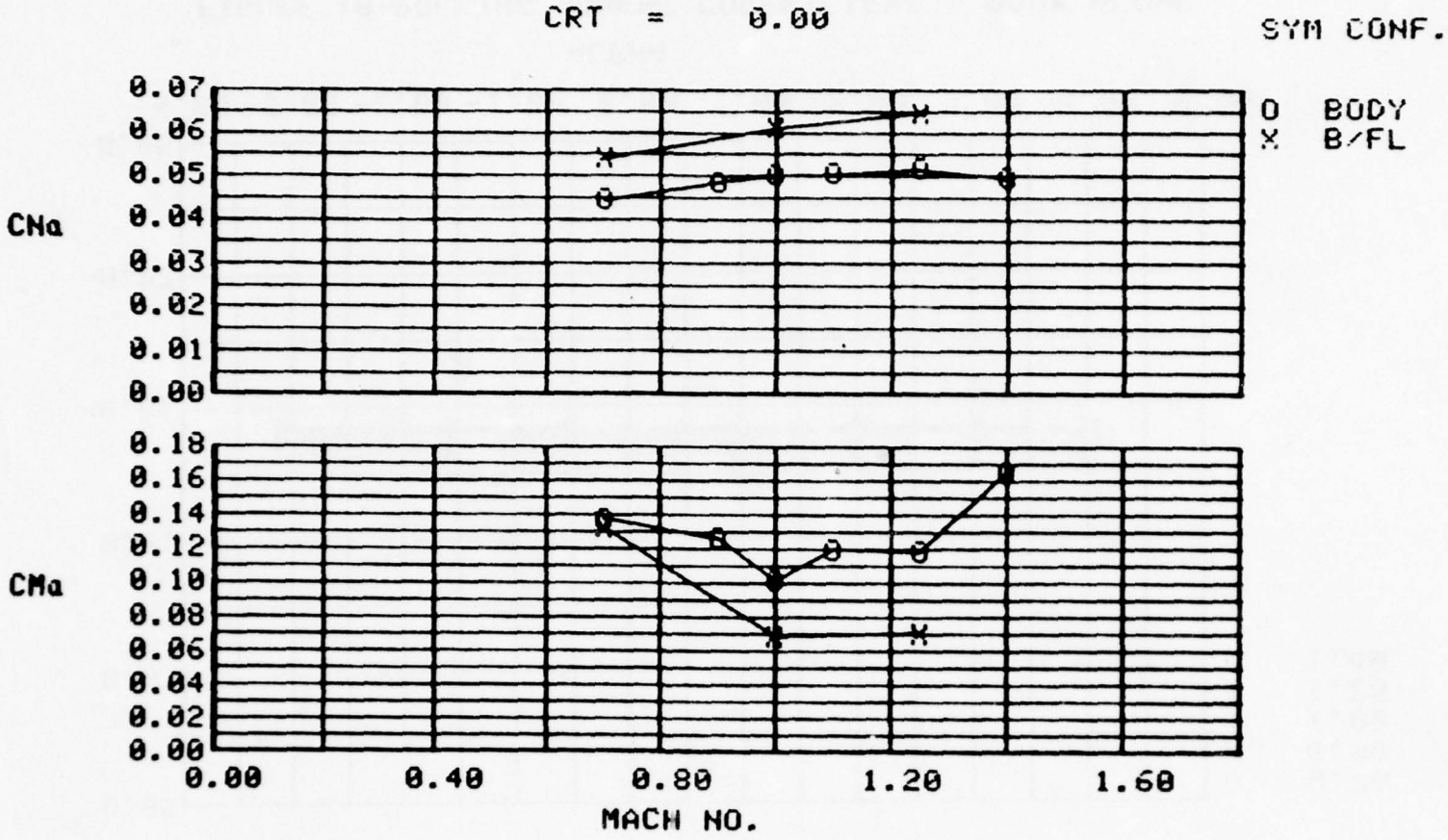


FIGURE 11-STABILITY COEFFICIENT DERIVATIVES

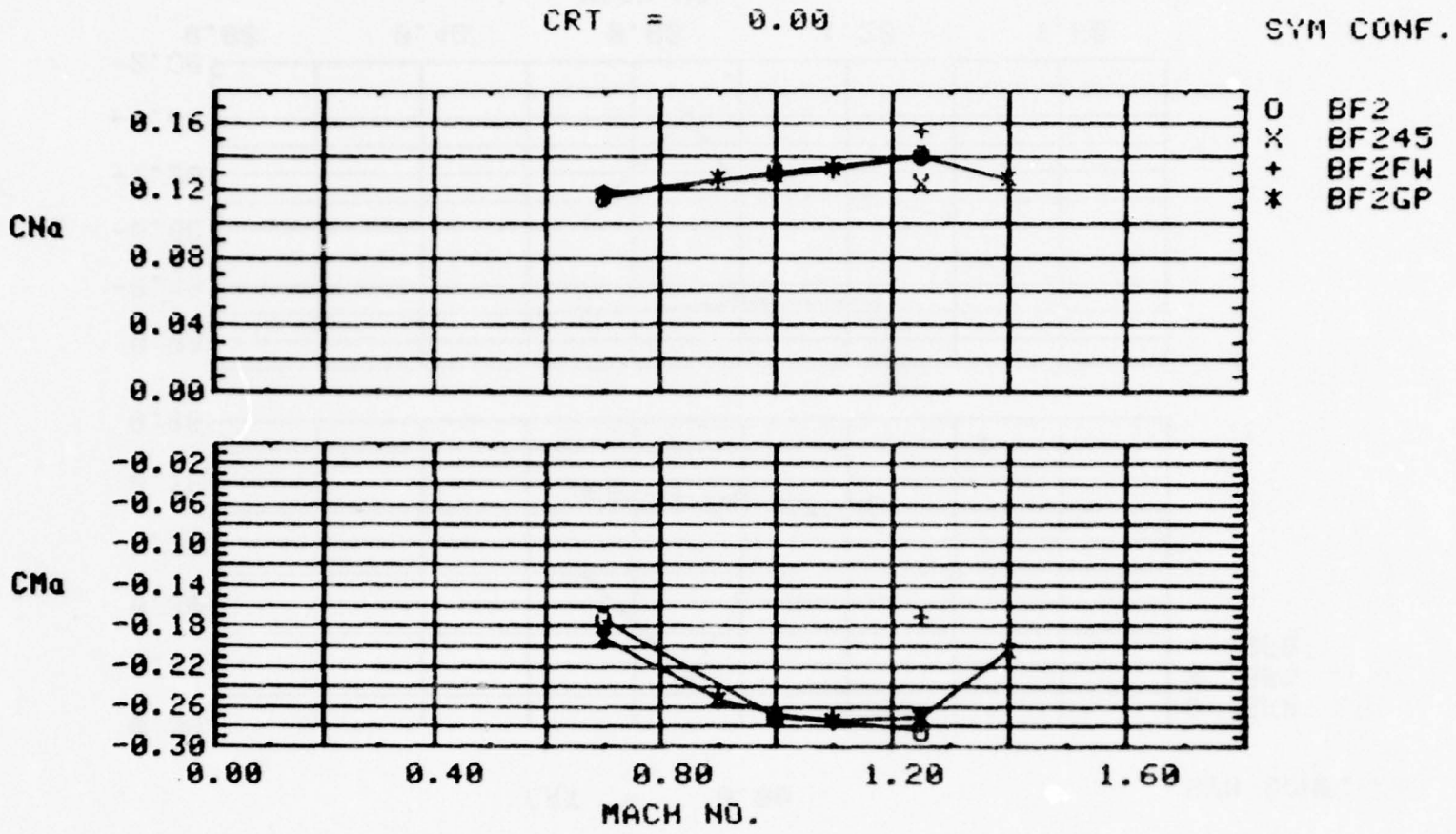


FIGURE 11-Continued

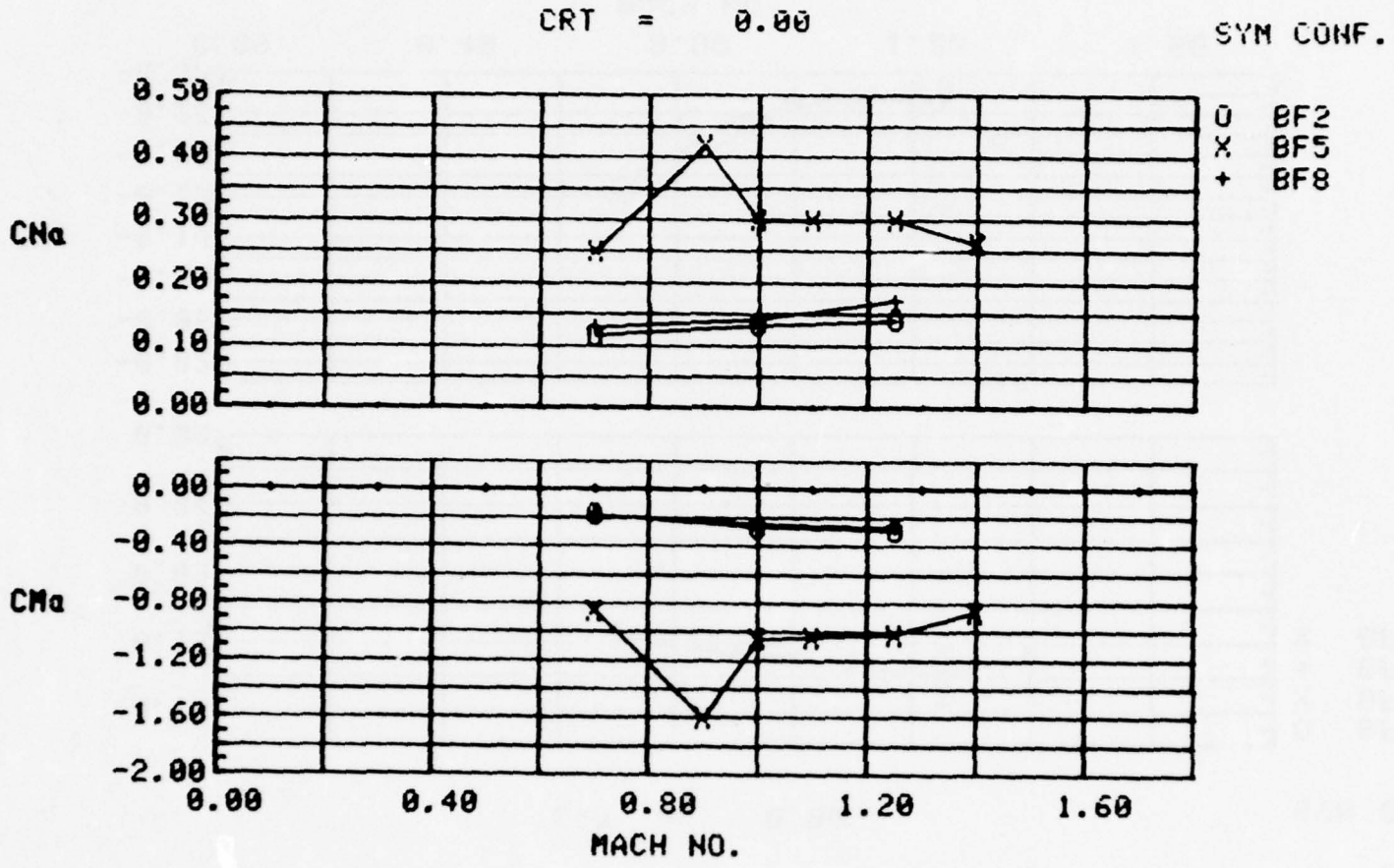


FIGURE 11-Continued

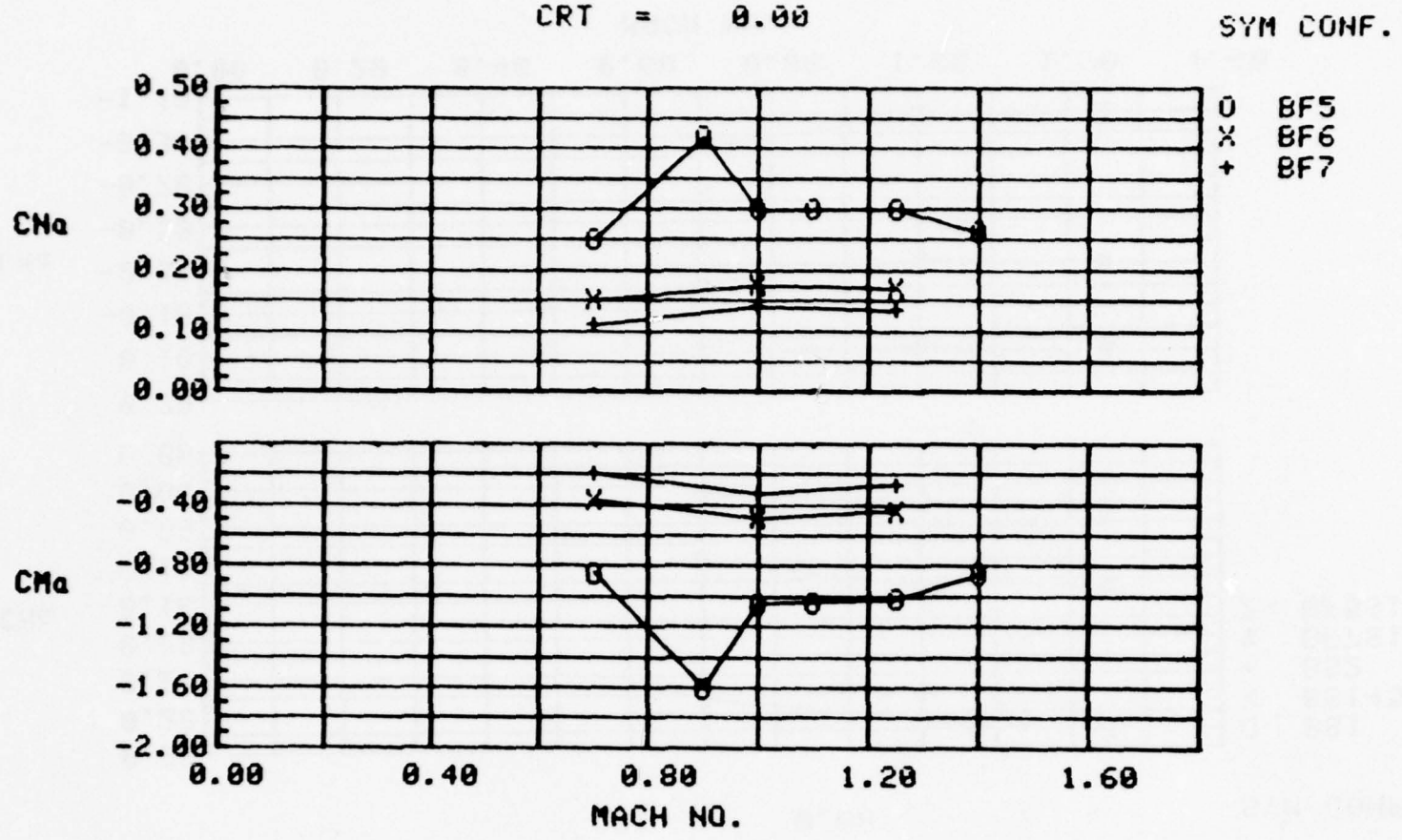


FIGURE 11-Continued

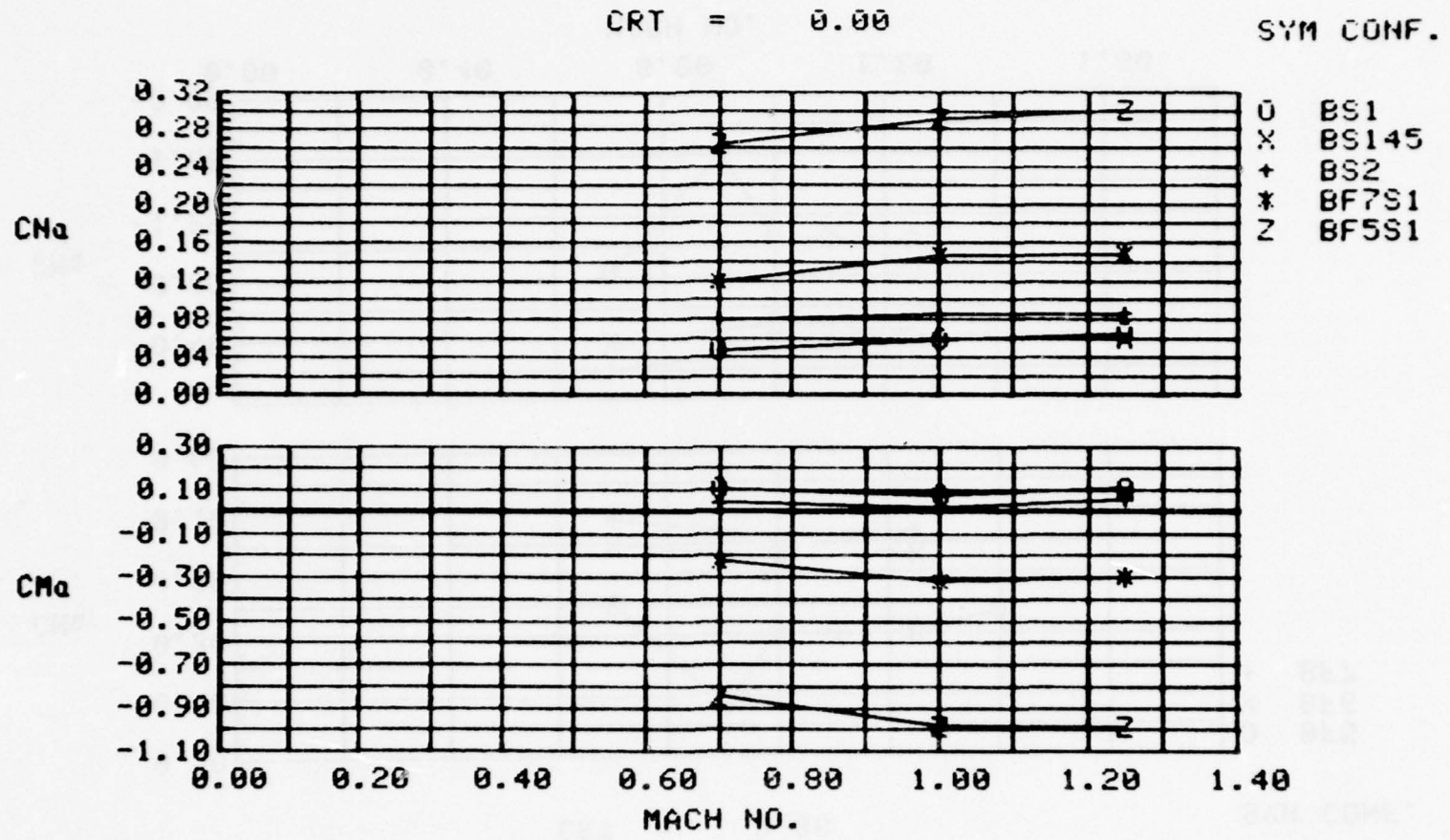


FIGURE 11-Continued

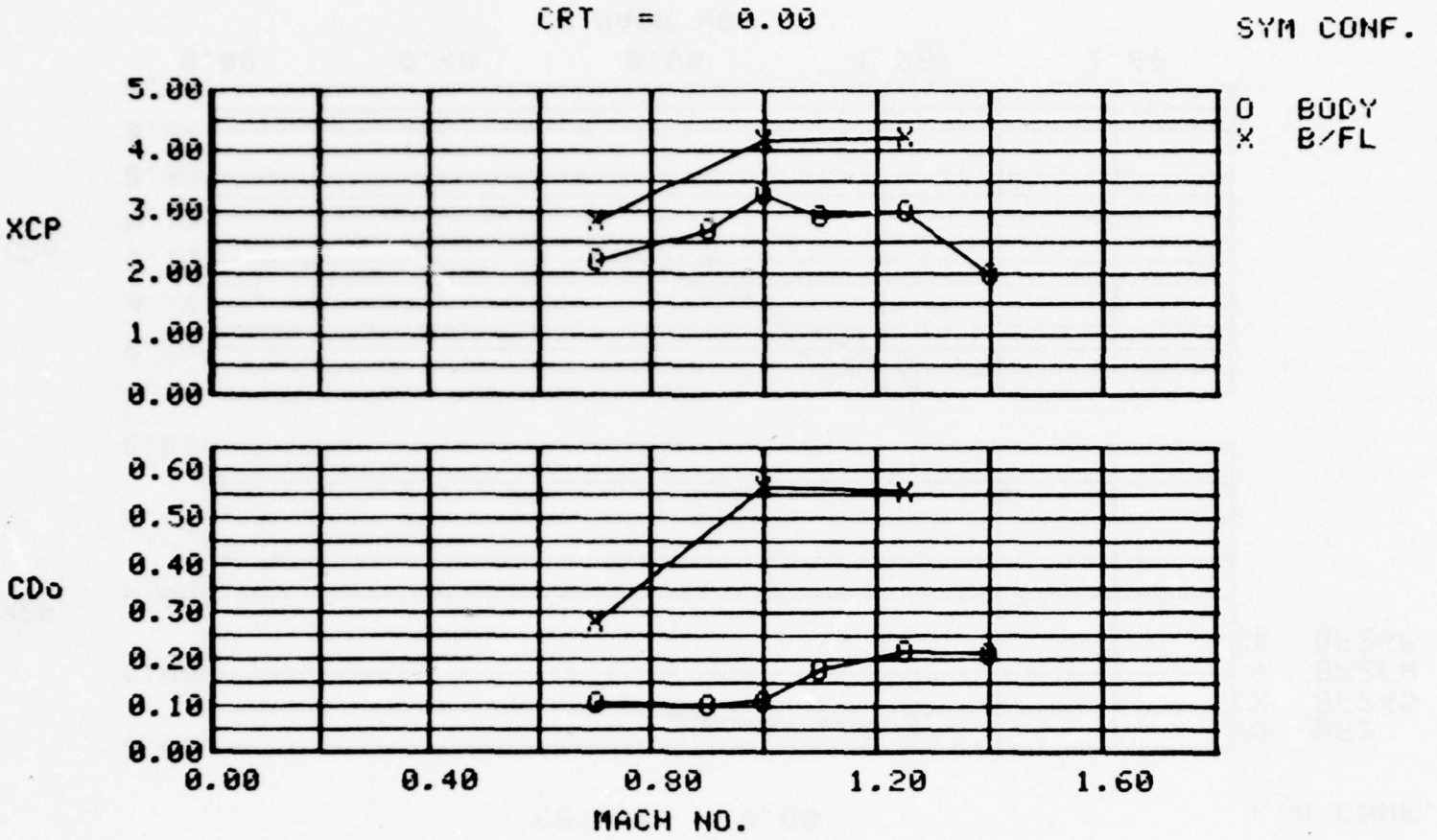


FIGURE 12-CENTER OF PRESSURE FROM NOSE AND ZERO LIFT FORE DRAG

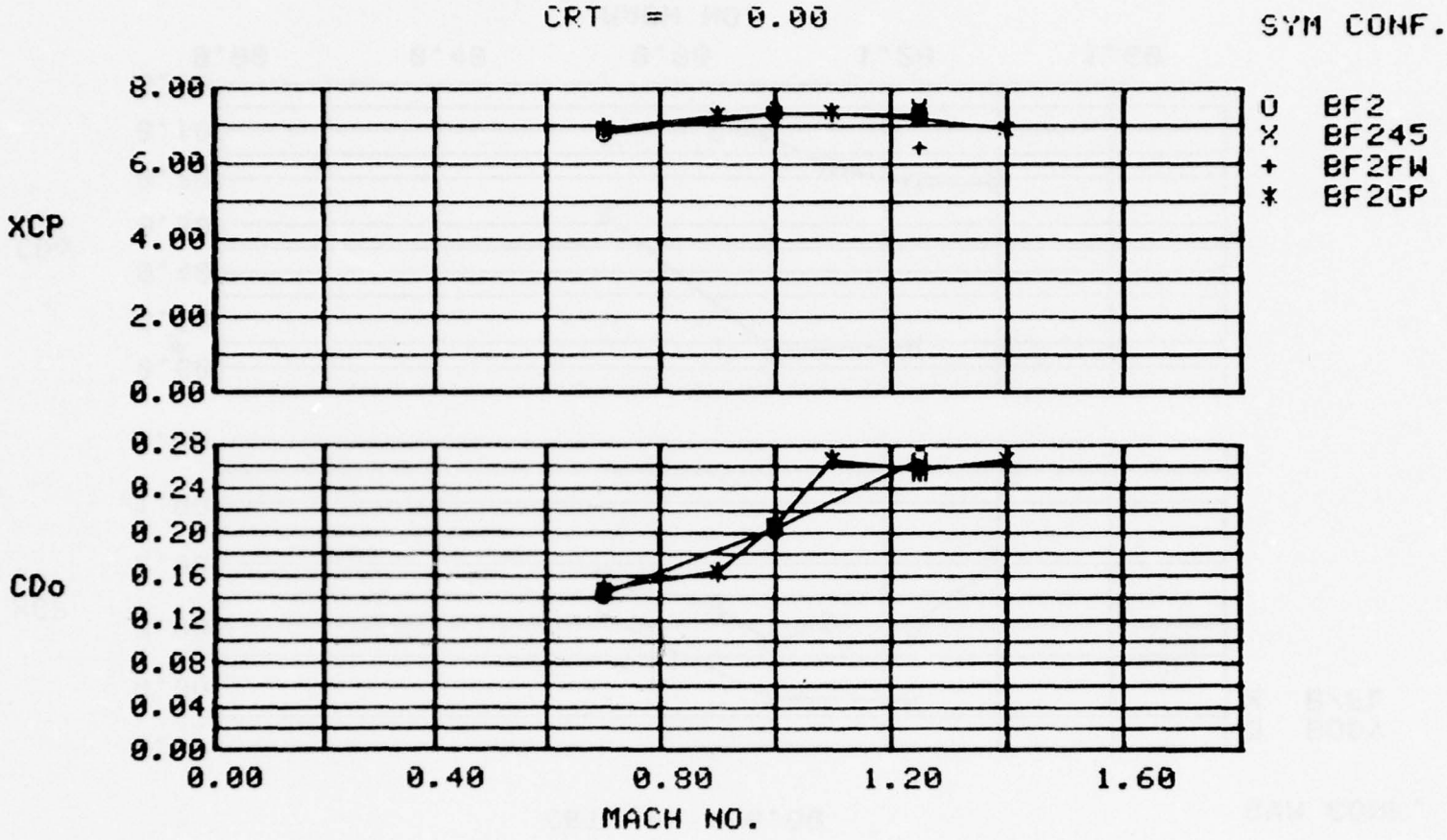


FIGURE 12-Continued

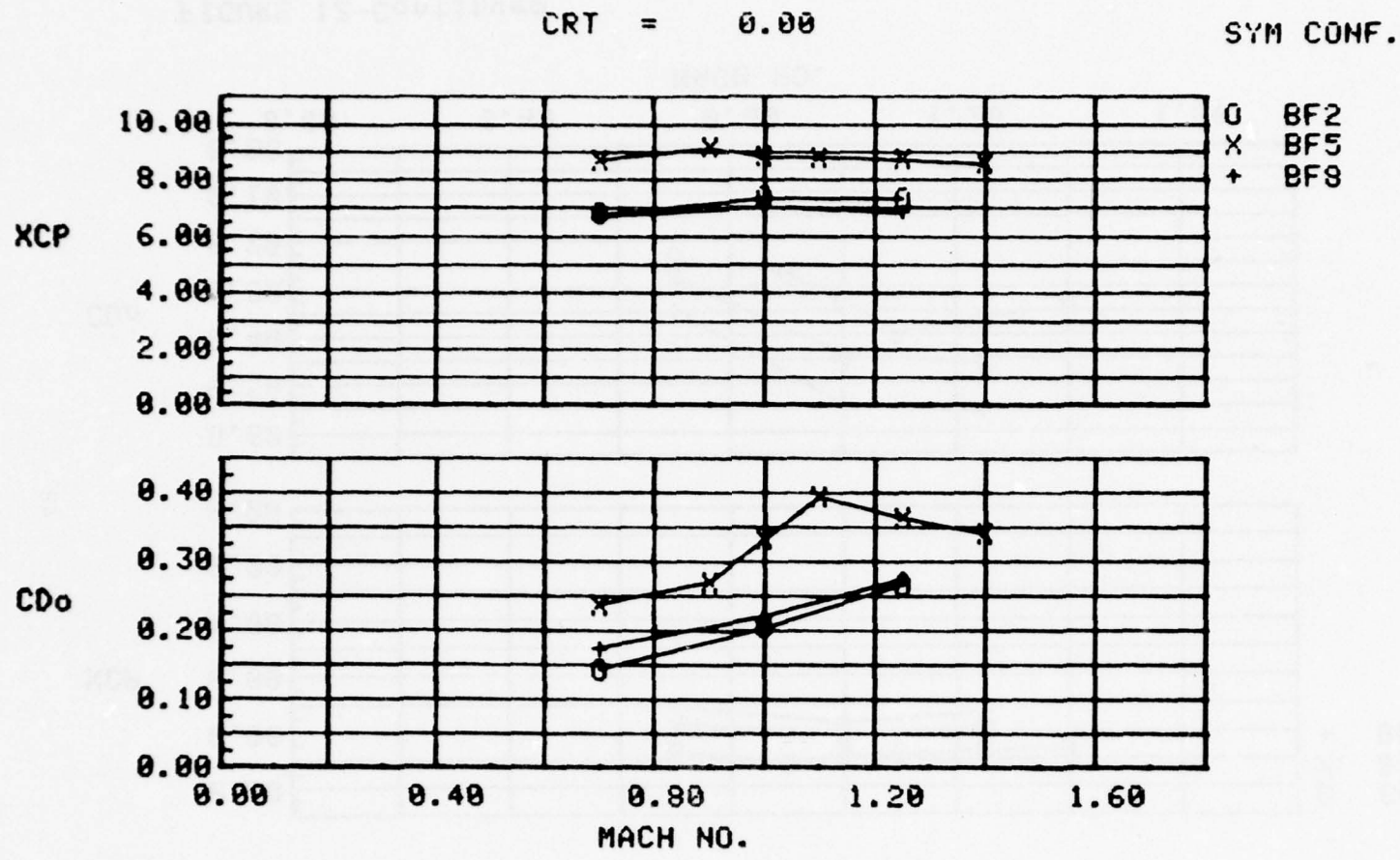


FIGURE 12-Continued

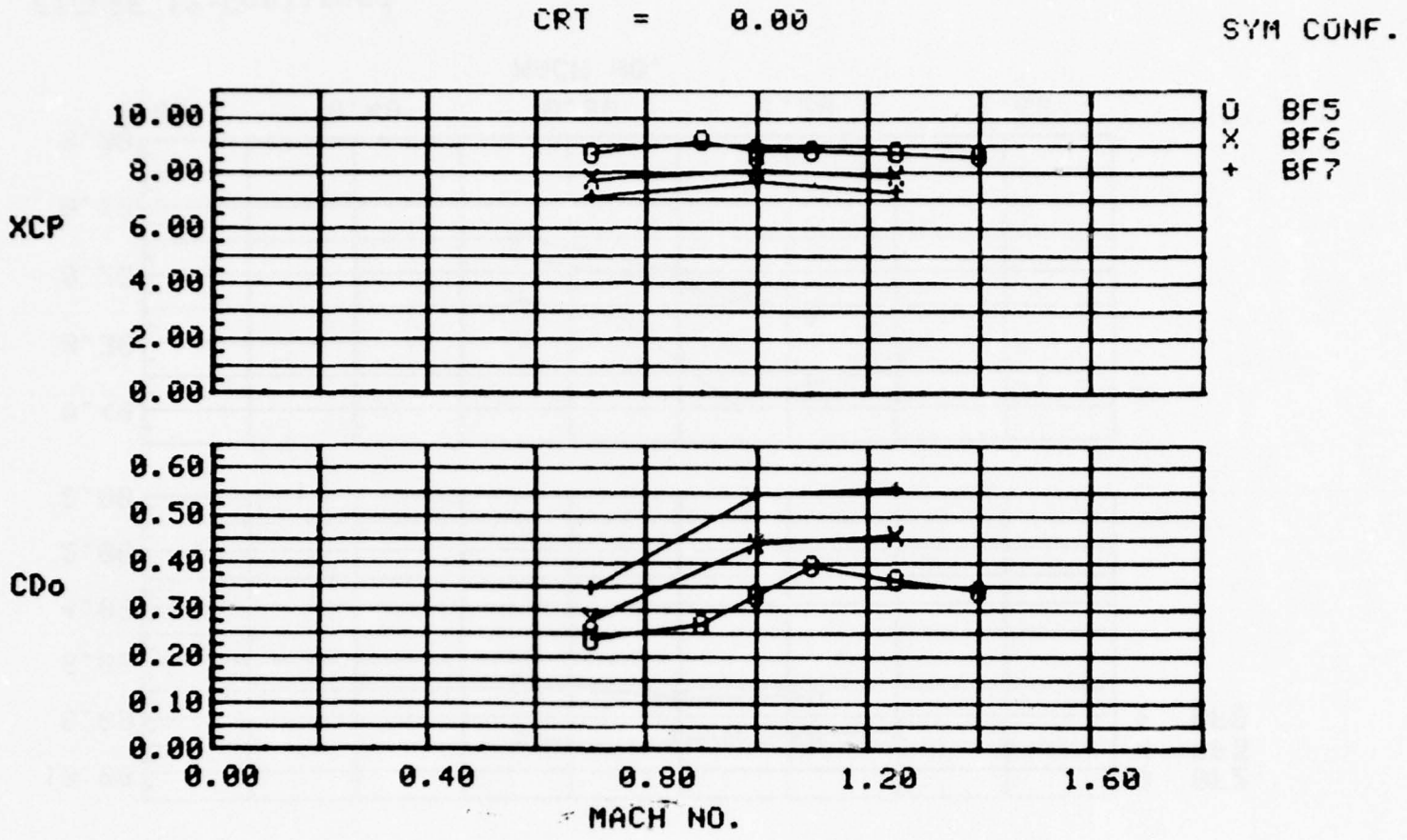


FIGURE 12-Continued

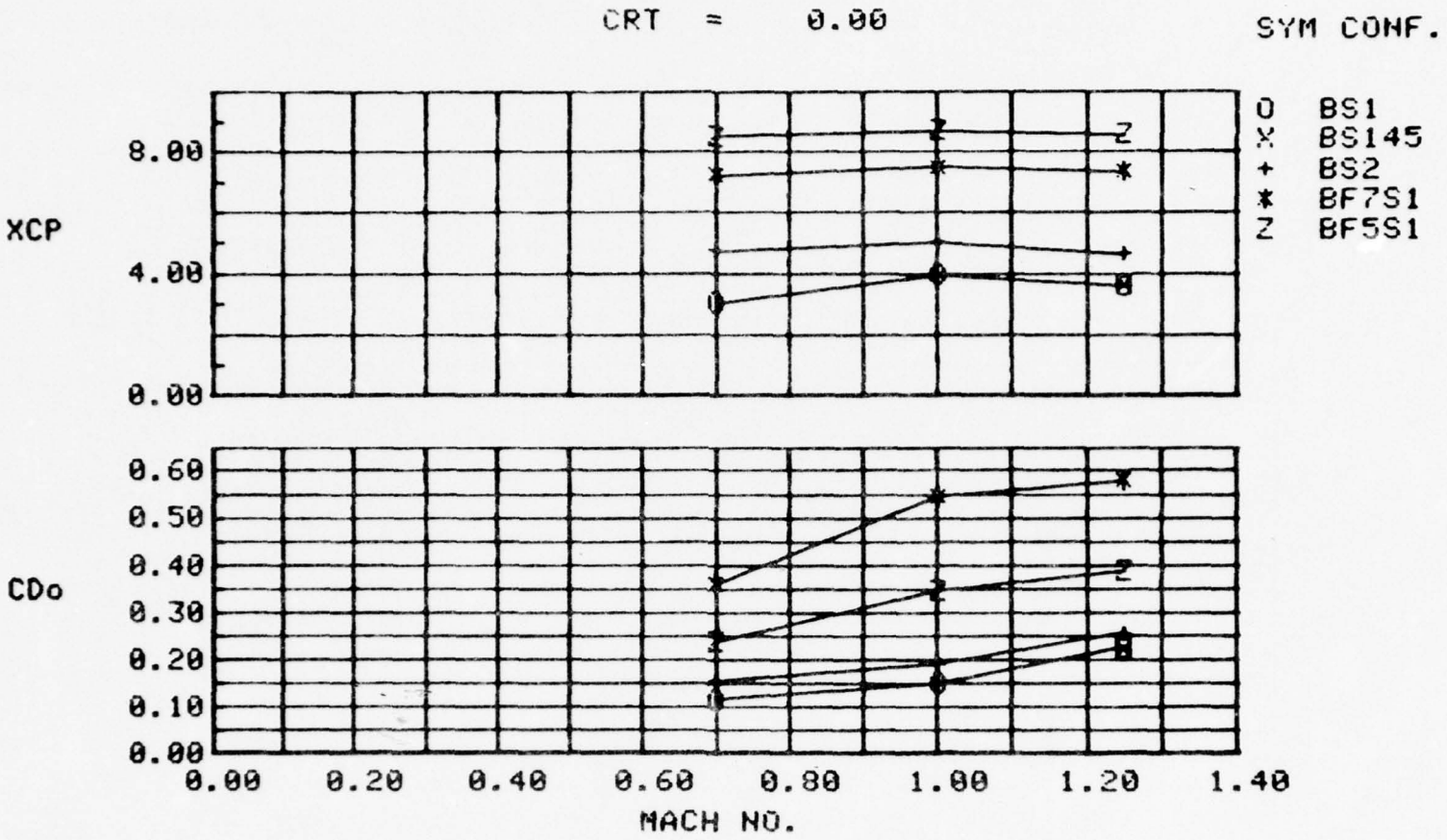


FIGURE 12-Continued

APPENDIX A

PLOTS OF BASIC DATA

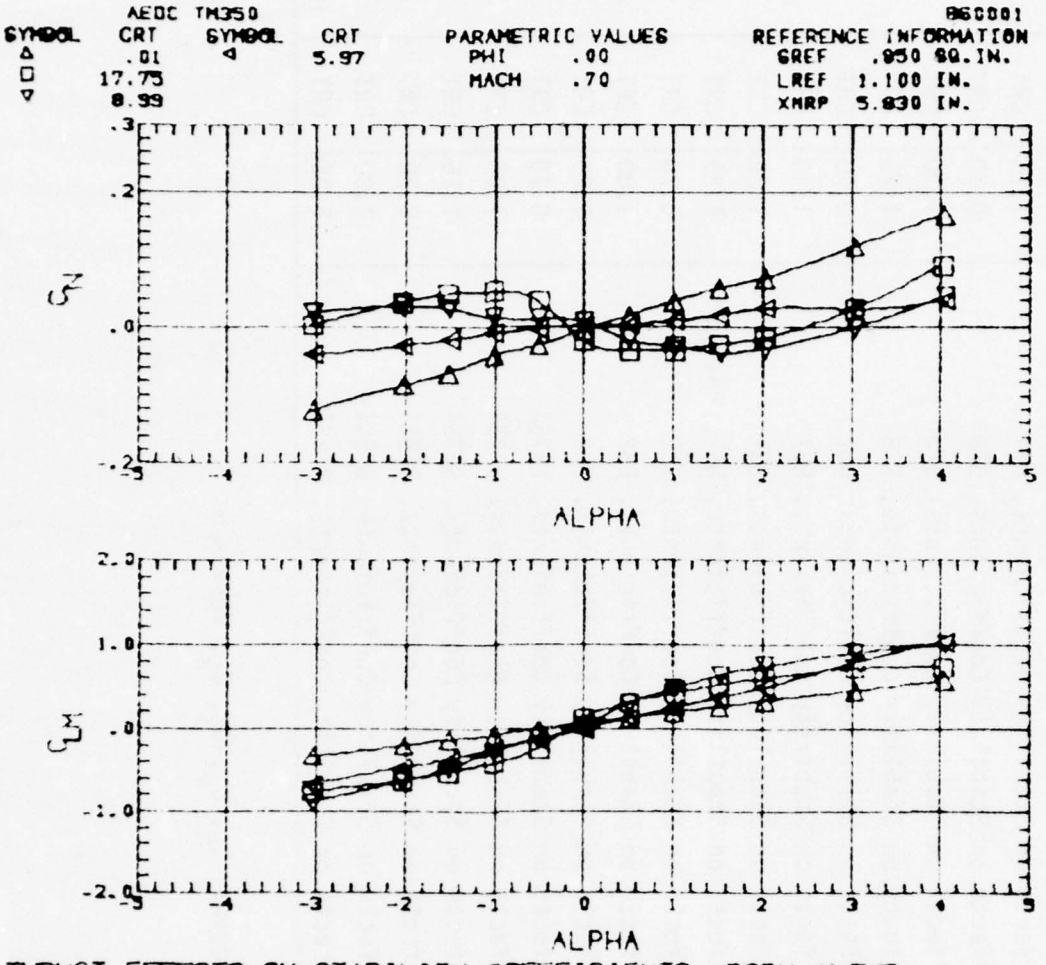
INDEX OF DATA FIGURES

TITLE	MACH	CONDITION VARYING	PAGE
Thrust Effects on Stability Coefficients, Body Alone	0.70	CRT	4
Thrust Effects on Stability Coefficients, Body Alone	0.90	CRT	6
Thrust Effects on Stability Coefficients, Body Alone	1.00	CRT	8
Thrust Effects on Stability Coefficients, Body Alone	1.10	CRT	10
Thrust Effects on Stability Coefficients, Body Alone	1.25	CRT	12
Thrust Effects on Stability Coefficients, Body Alone	1.35	CRT	14
Thrust Effects on Stability Coefficients, Body Alone	1.40	CRT	16
Thrust Effects on Stability Coefficients, Body Flare	0.70	CRT	18
Thrust Effects on Stability Coefficients, Body Flare	1.00	CRT	20
Thrust Effects on Stability Coefficients, Body Flare	1.25	CRT	22
Thrust Effects on Stability Coefficients, BF2	0.70	CRT	24
Thrust Effects on Stability Coefficients, BF2	1.00	CRT	26
Thrust Effects on Stability Coefficients, BF2	1.25	CRT	28
Thrust Effects on Stability Coefficients, BF2, Phi=45°	1.25	CRT	30
Thrust Effects on Stability Coefficients, BF2 (1.65 Fwd)	1.25	CRT	32
Thrust Effects on Stability Coefficients, BF2+Grnd Pl Refl	0.70	CRT	34
Thrust Effects on Stability Coefficients, BF2+Grnd Pl Refl	0.90	CRT	36
Thrust Effects on Stability Coefficients, BF2+Grnd Pl Refl	1.00	CRT	38
Thrust Effects on Stability Coefficients, BF2+Grnd Pl Refl	1.10	CRT	40
Thrust Effects on Stability Coefficients, BF2+Grnd Pl Refl	1.25	CRT	42
Thrust Effects on Stability Coefficients, BF2+Grnd Pl Refl	1.40	CRT	44
Thrust Effects on Stability Coefficients, BF5	0.70	CRT	46
Thrust Effects on Stability Coefficients, BF5	0.90	CRT	48
Thrust Effects on Stability Coefficients, BF5	1.00	CRT	50
Thrust Effects on Stability Coefficients, BF5	1.10	CRT	52
Thrust Effects on Stability Coefficients, BF5	1.25	CRT	54
Thrust Effects on Stability Coefficients, BF5	1.40	CRT	56
Thrust Effects on Stability Coefficients, BF6	0.70	CRT	58
Thrust Effects on Stability Coefficients, BF6	1.00	CRT	60
Thrust Effects on Stability Coefficients, BF6	1.25	CRT	62

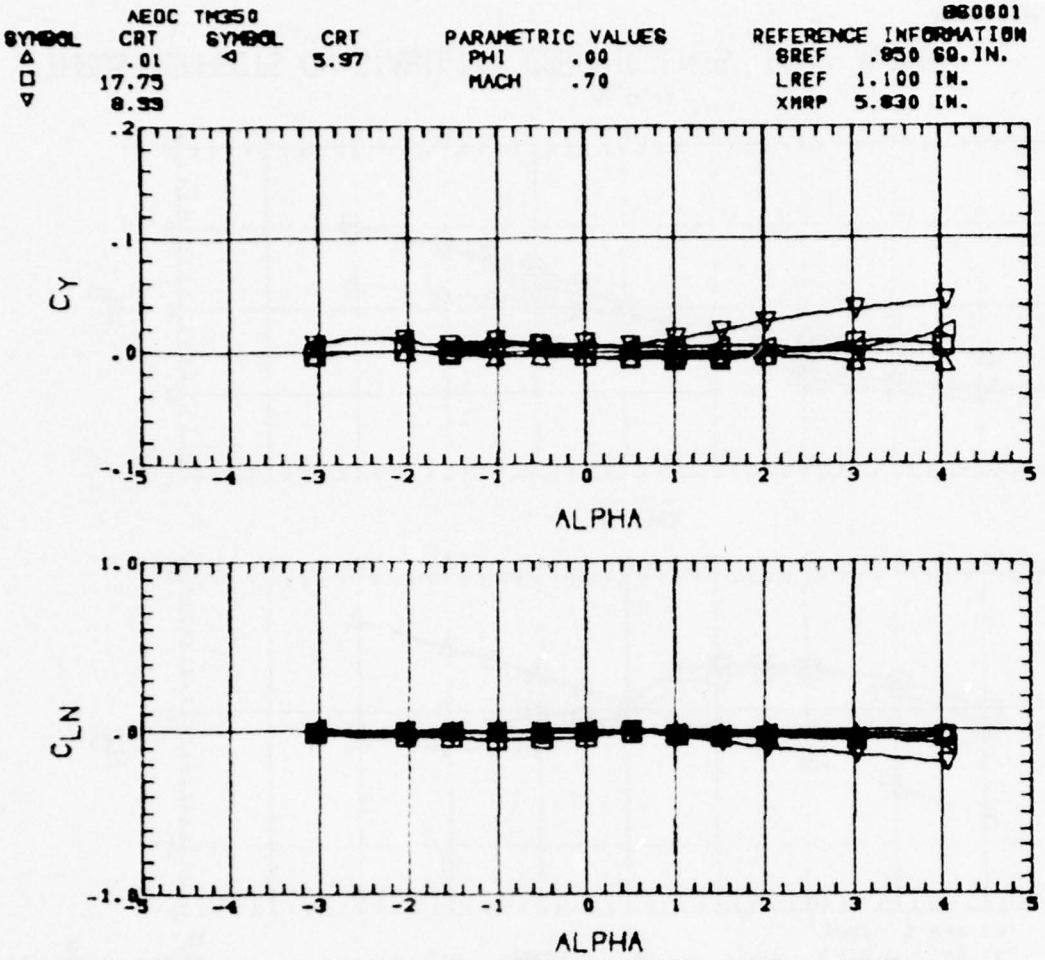
INDEX OF DATA FIGURES - CONCLUDED

TITLE	MACH	CONDITION VARYING	PAGE
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Thrust Effects on Stability Coefficients, BF7	1.00	CRT	66
Thrust Effects on Stability Coefficients, BF7	1.25	CRT	68
Thrust Effects on Stability Coefficients, BF8	0.70	CRT	70
Thrust Effects on Stability Coefficients, BF8	1.00	CRT	72
Thrust Effects on Stability Coefficients, BF8	1.25	CRT	74
Thrust Effects on Stability Coefficients, BS1	0.70	CRT	76
Thrust Effects on Stability Coefficients, BS1	1.00	CRT	78
Thrust Effects on Stability Coefficients, BS1	1.25	CRT	80
Thrust Effects on Stability Coefficients, BS1, Phi=45°	1.25	CRT	82
Thrust Effects on Stability Coefficients, BS2	0.70	CRT	84
Thrust Effects on Stability Coefficients, BS2	1.00	CRT	86
Thrust Effects on Stability Coefficients, BS2	1.25	CRT	88
Thrust Effects on Stability Coefficients, BF7S1	0.70	CRT	90
Thrust Effects on Stability Coefficients, BF7S1	1.00	CRT	92
Thrust Effects on Stability Coefficients, BF7S1	1.25	CRT	94
Thrust Effects on Stability Coefficients, BF5S1	0.70	CRT	96
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Thrust Effects on Stability Coefficients, BF5S1	1.25	CRT	100

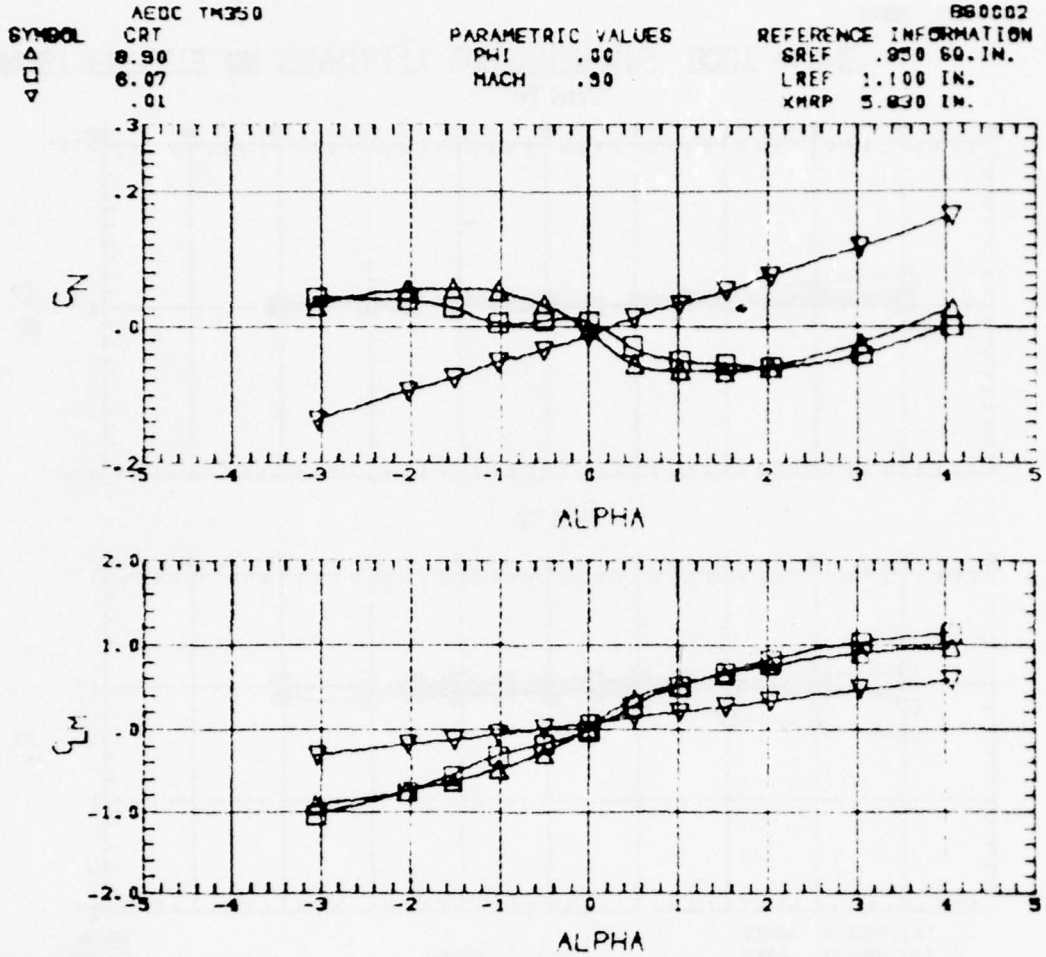
Plot Schedule: C_N, C_m, C_Y, C_n, versus α



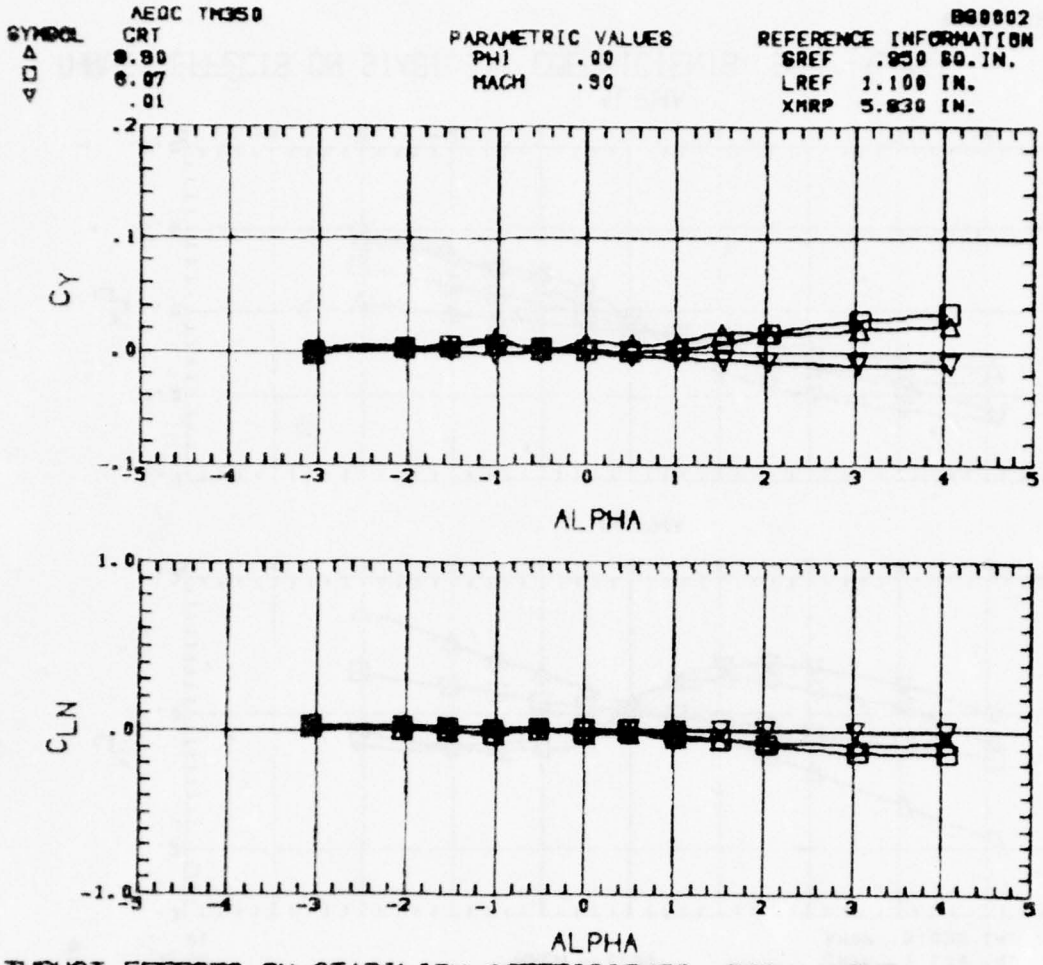
THRUST EFFECTS ON STABILITY COEFFICIENTS BODY ALONE



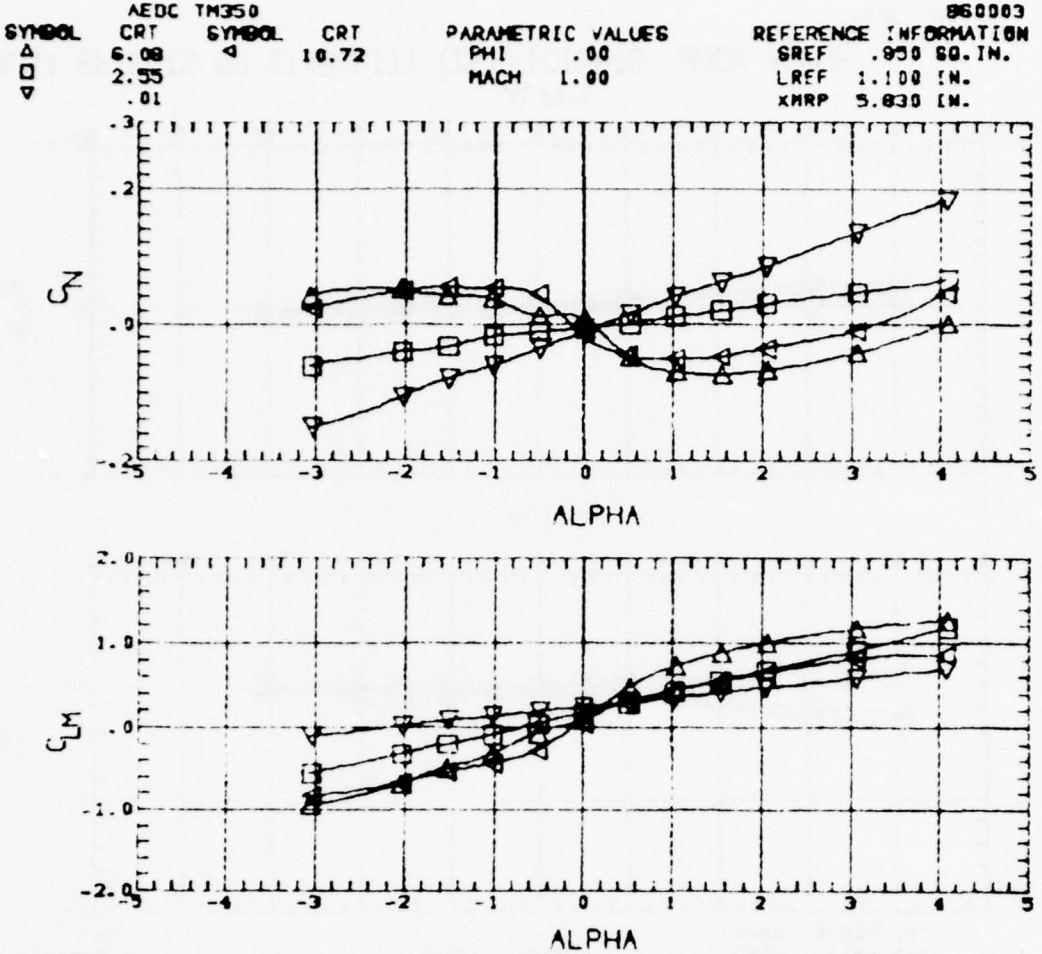
THRUST EFFECTS ON STABILITY COEFFICIENTS BODY ALONE



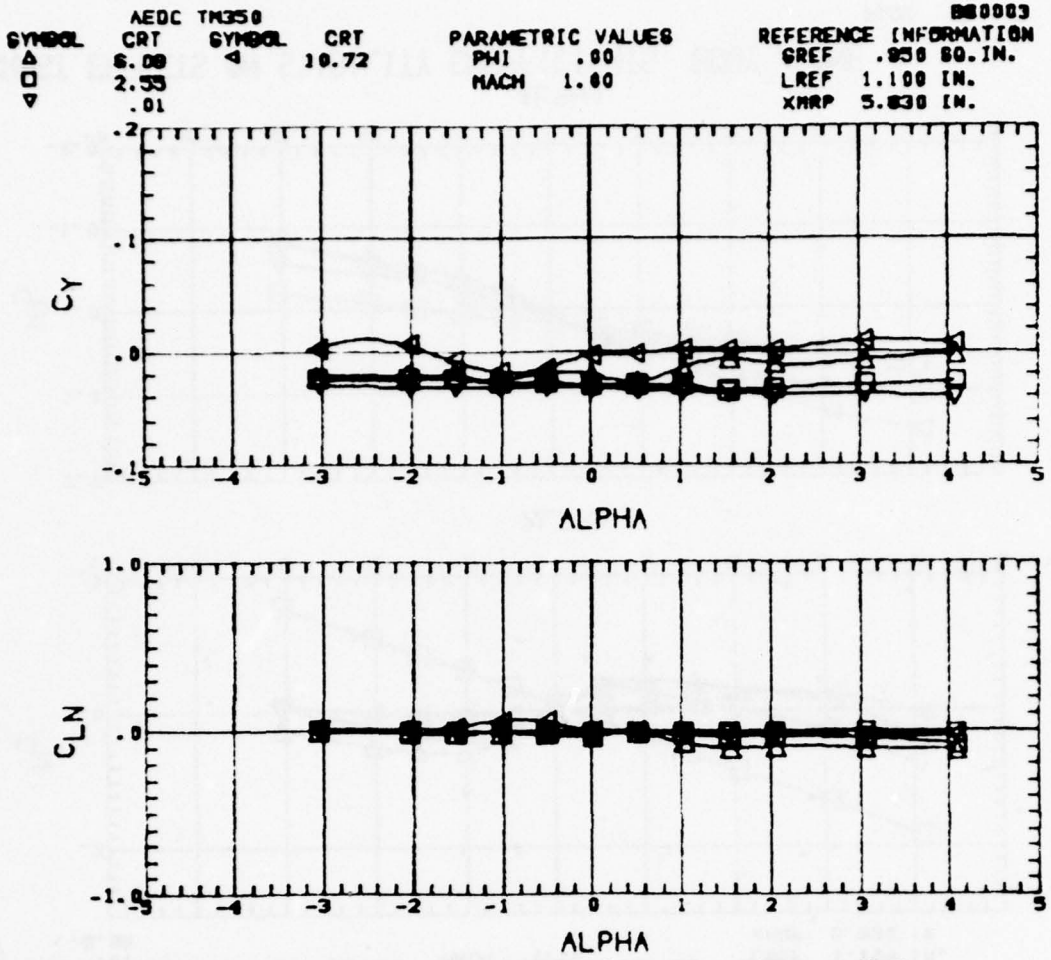
THRUST EFFECTS ON STABILITY COEFFICIENTS BODY ALONE



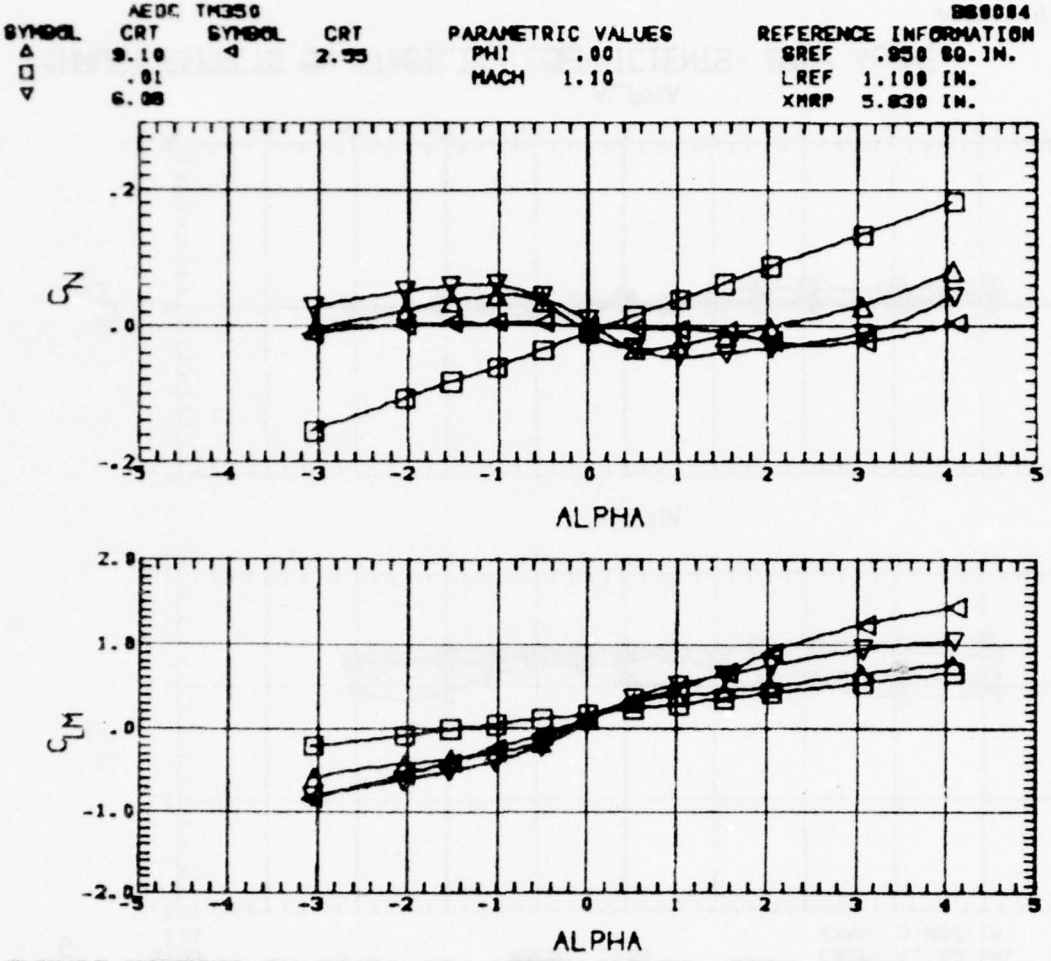
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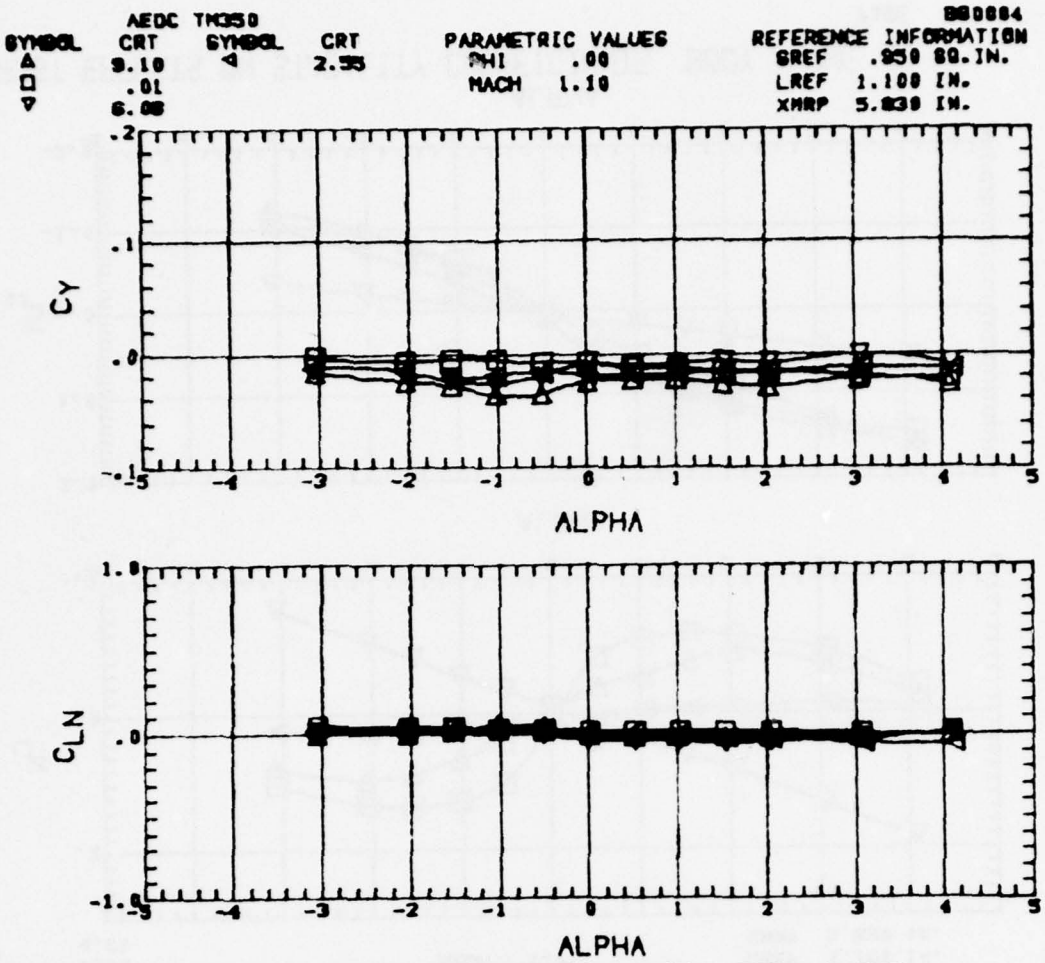
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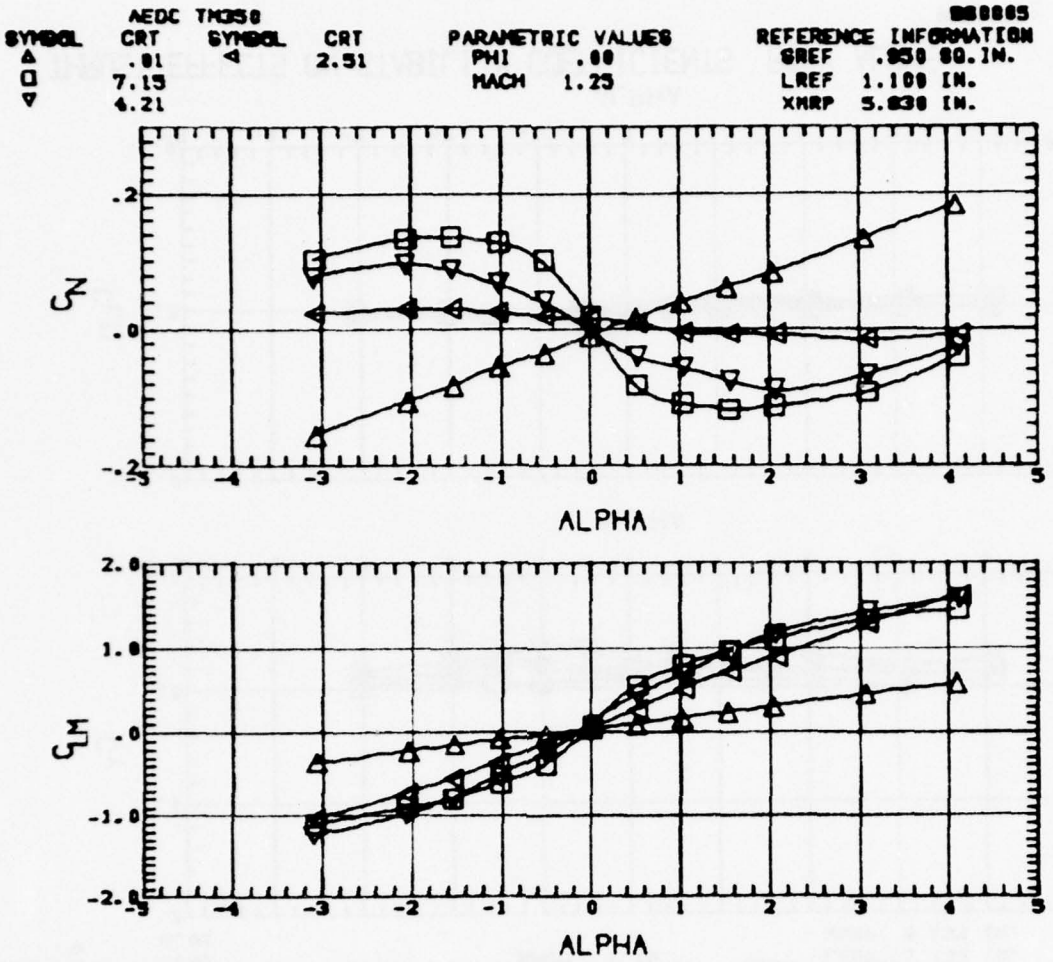
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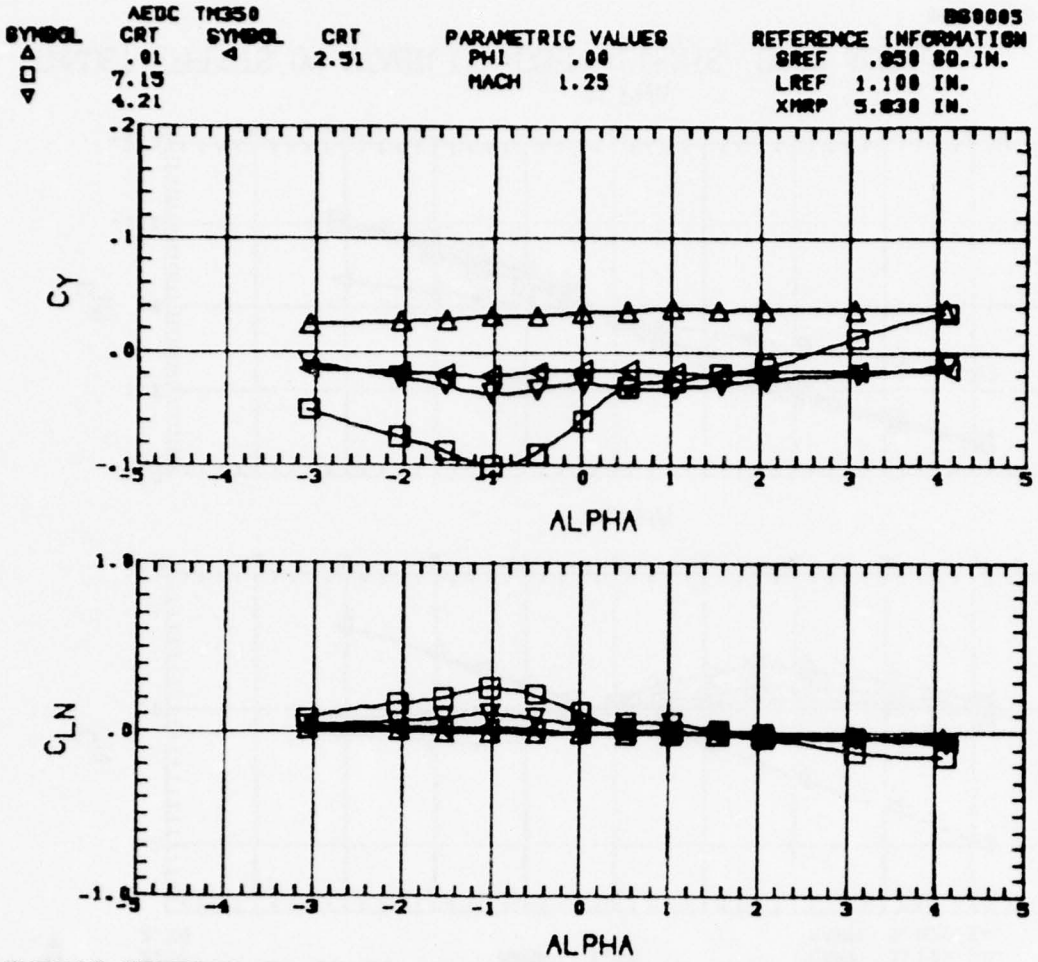
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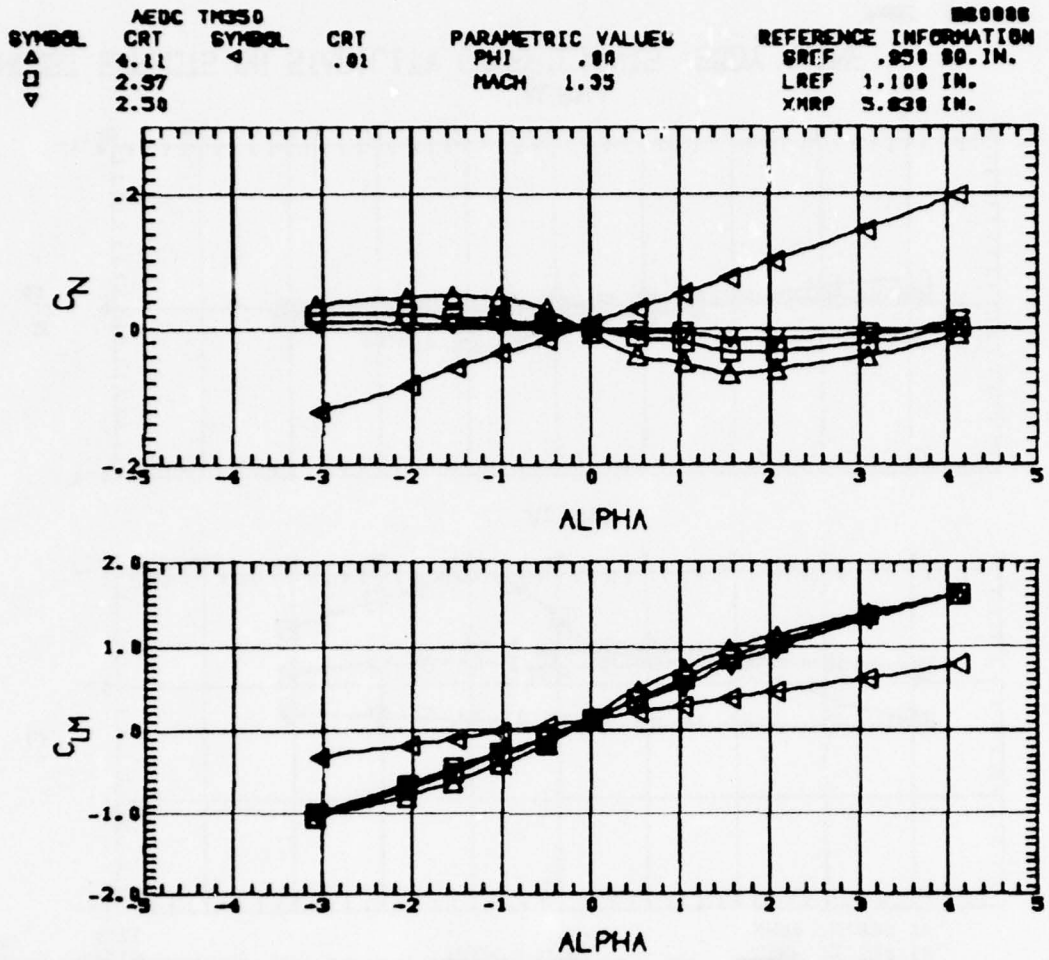
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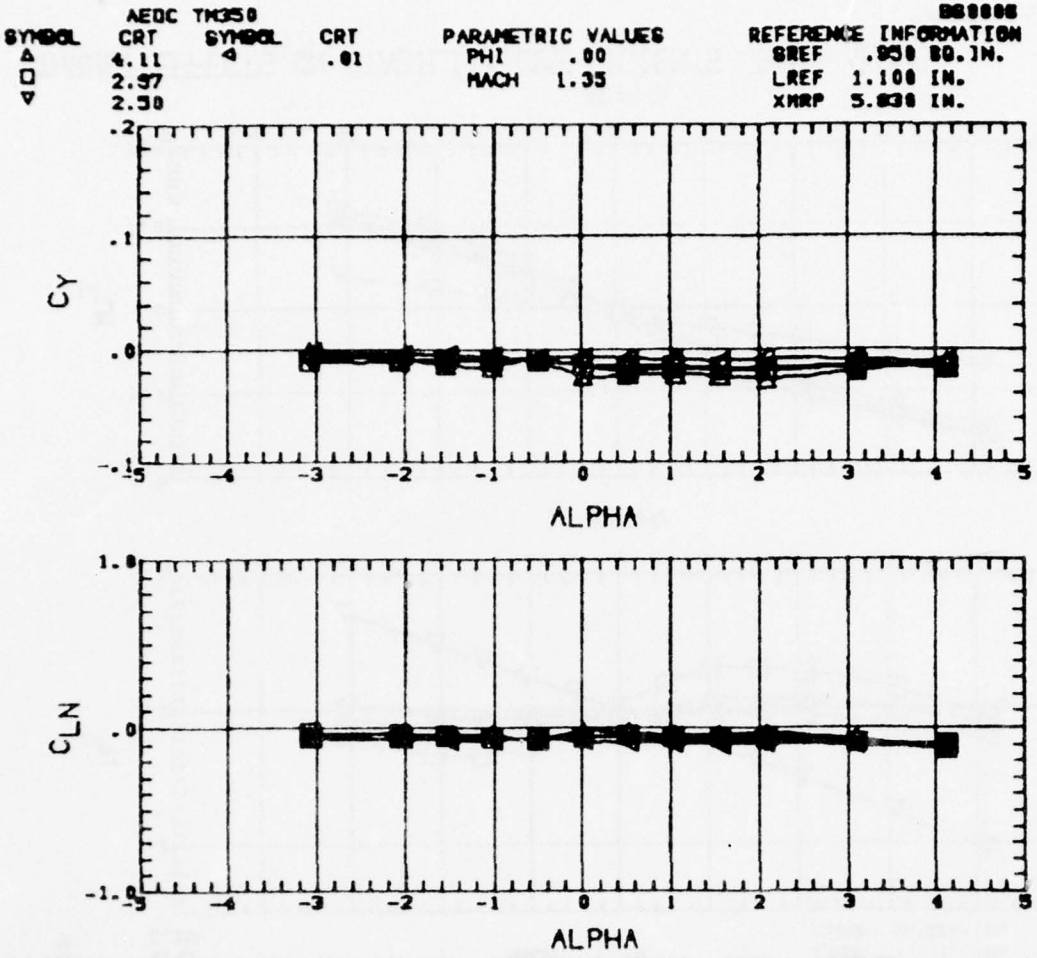
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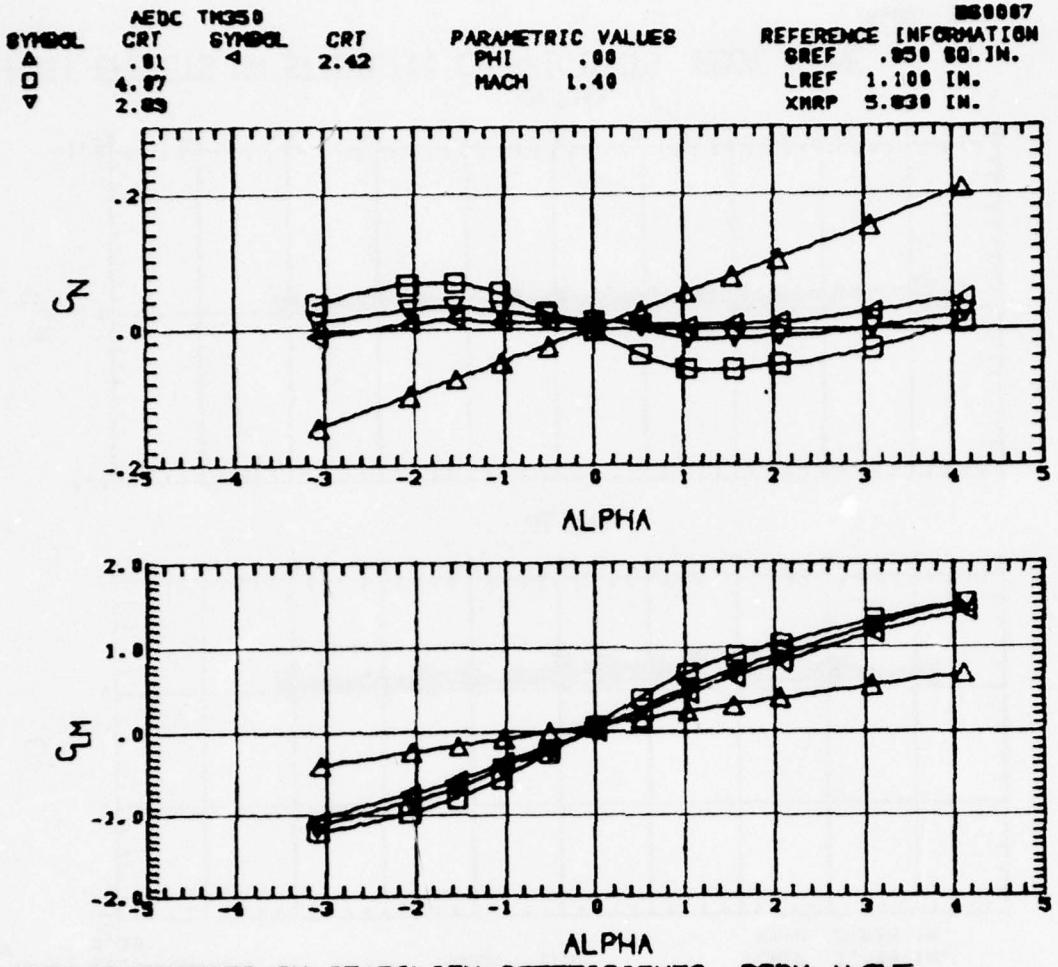
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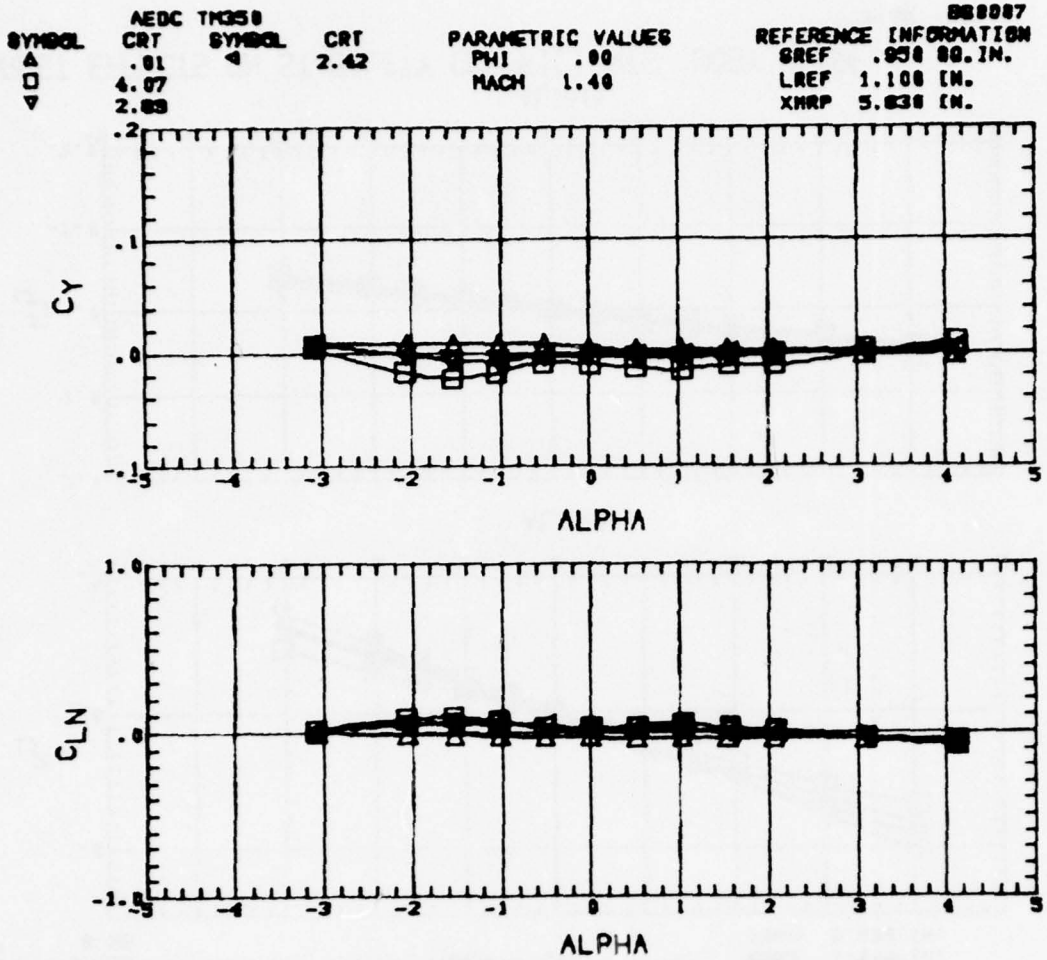
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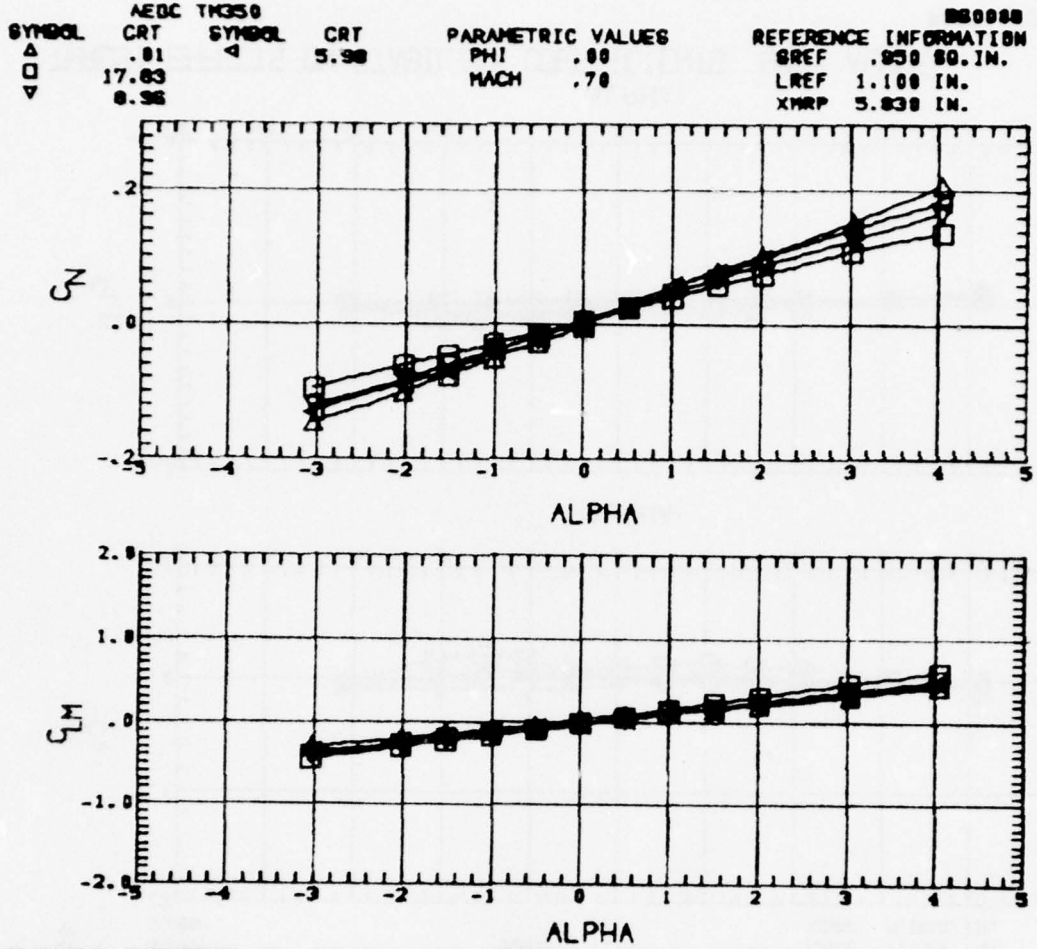
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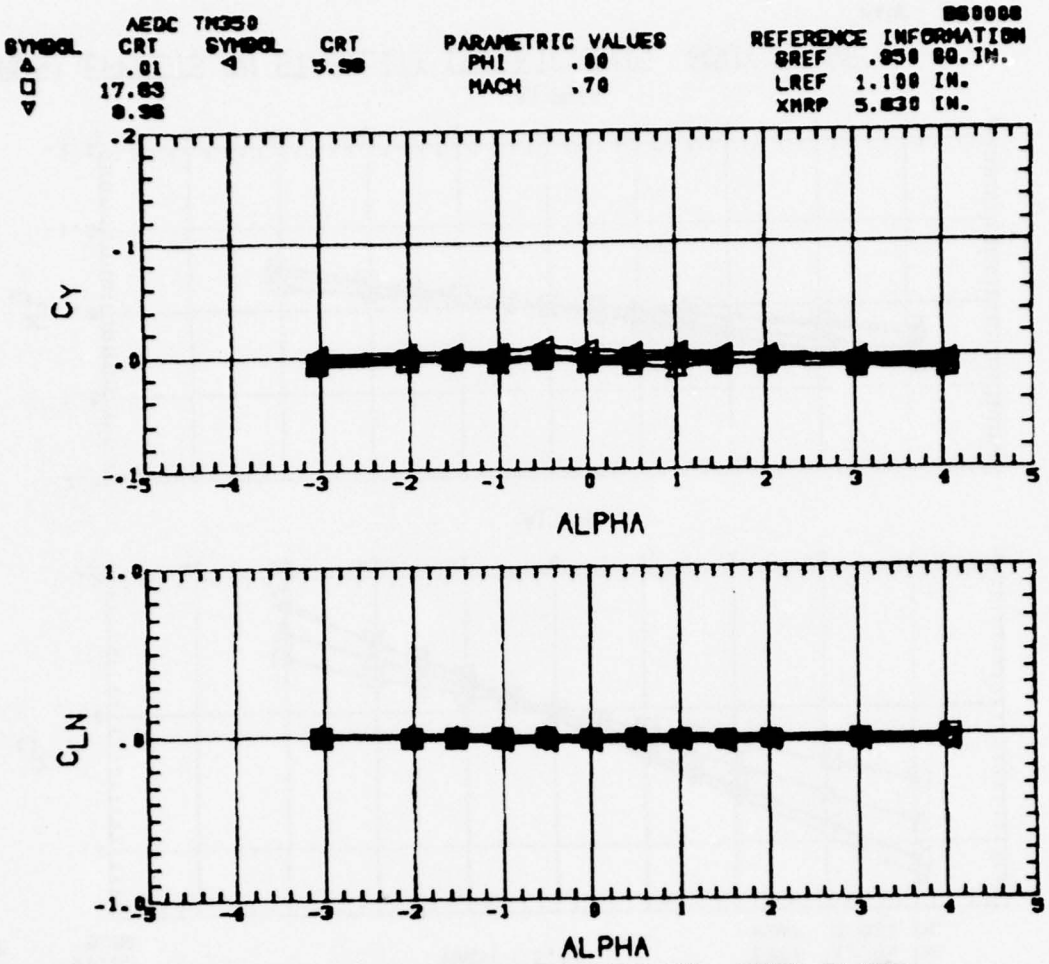
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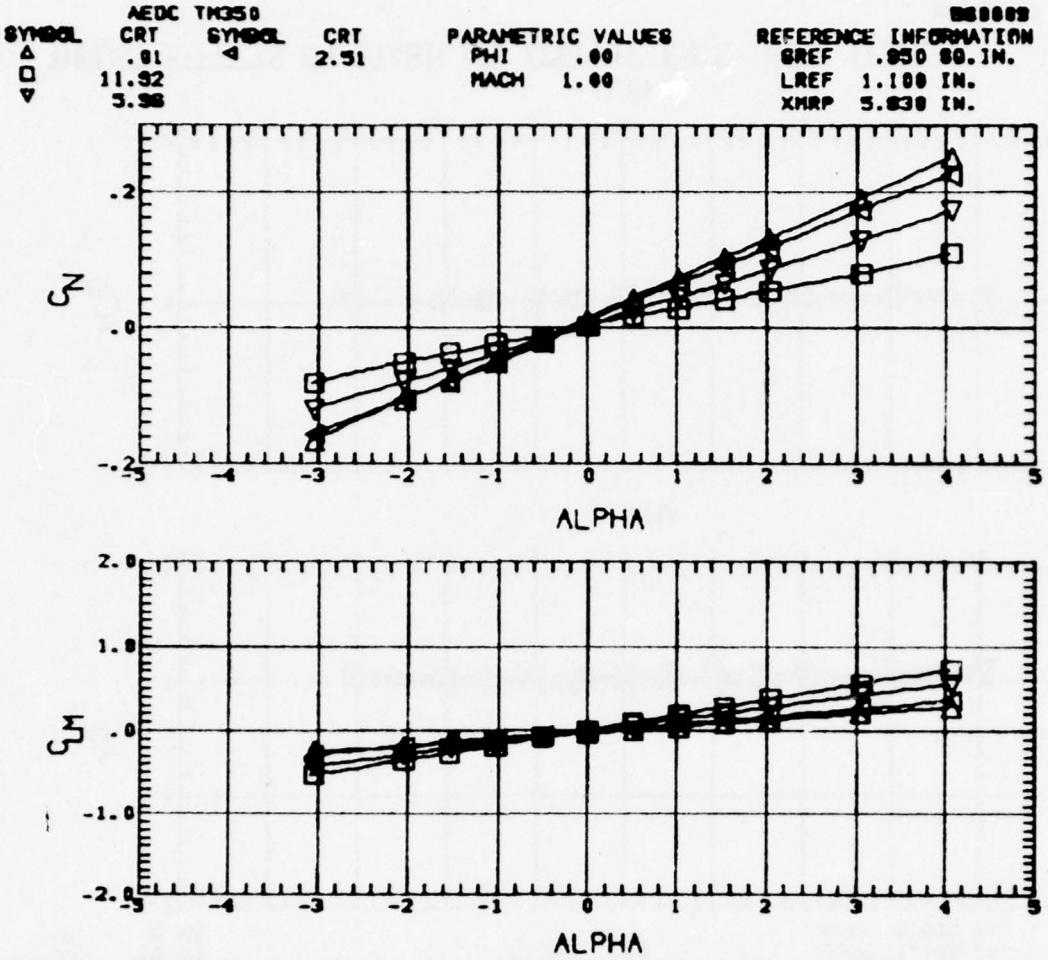
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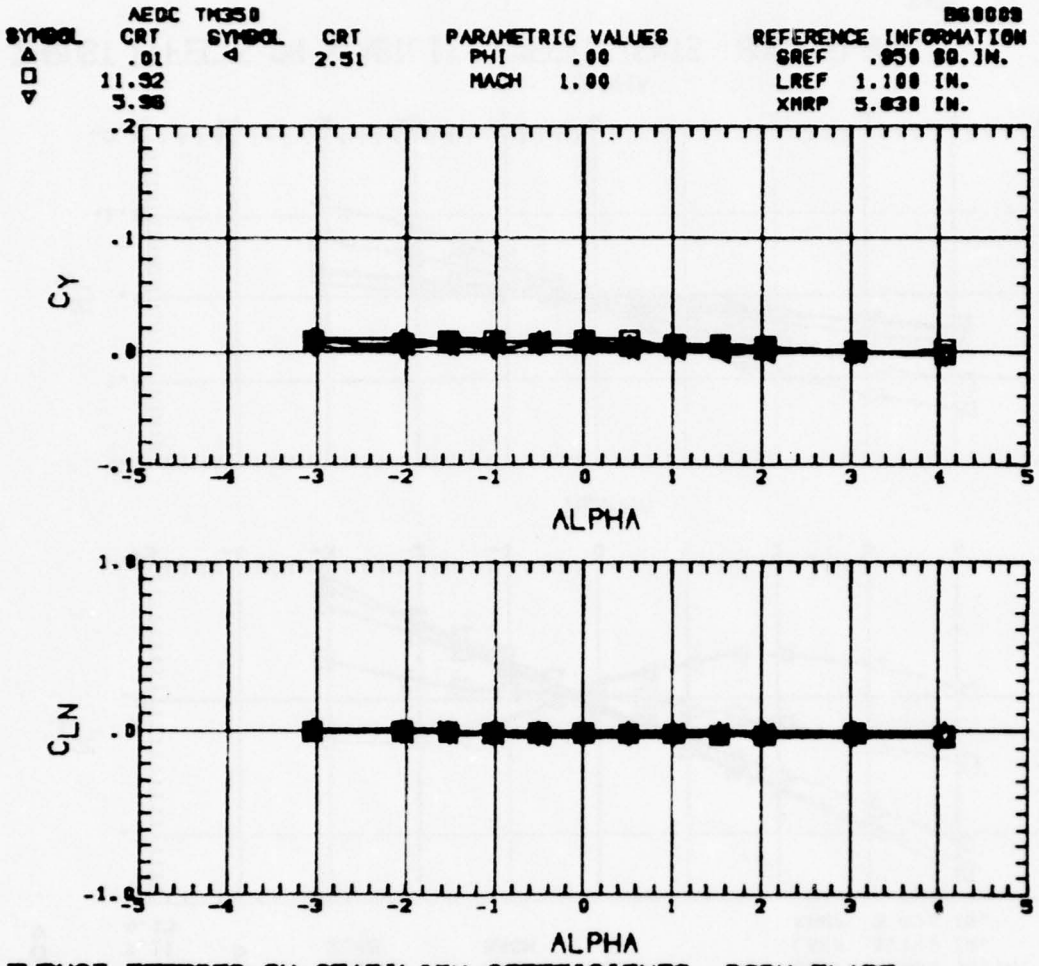
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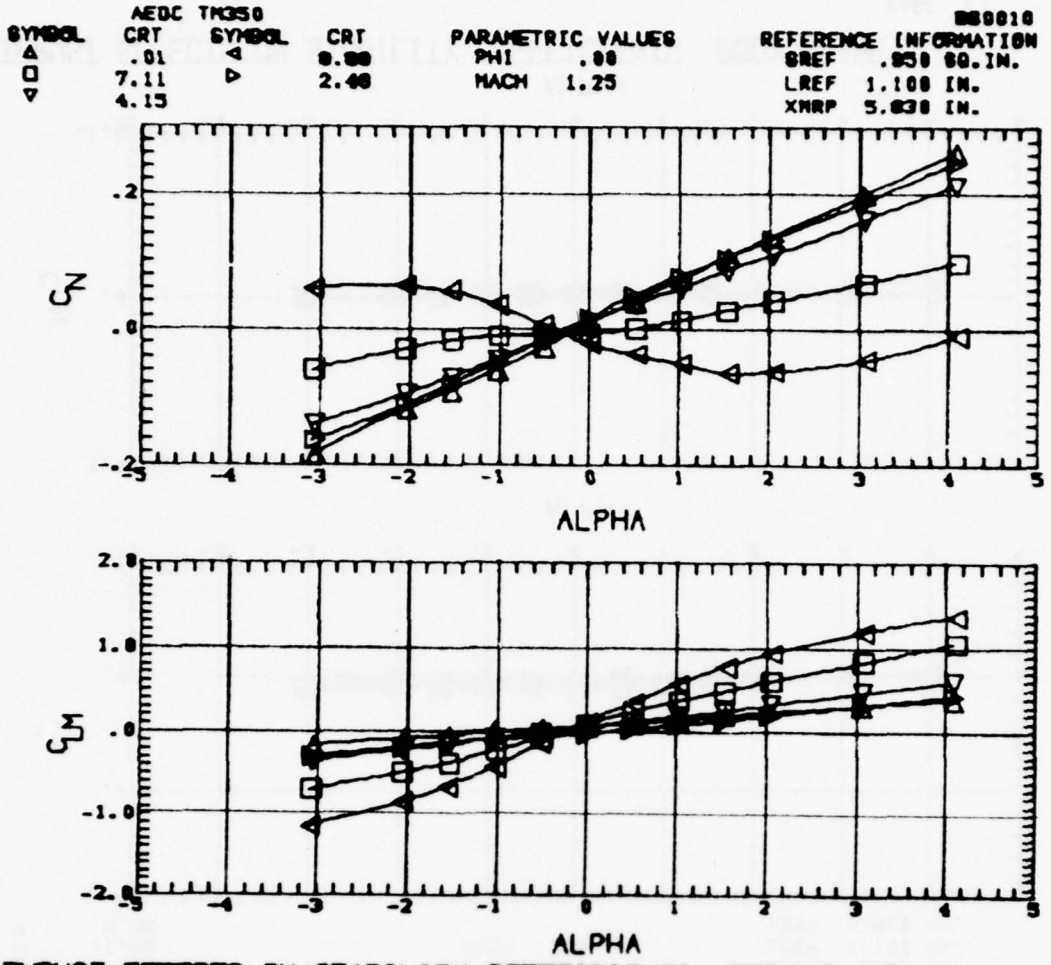
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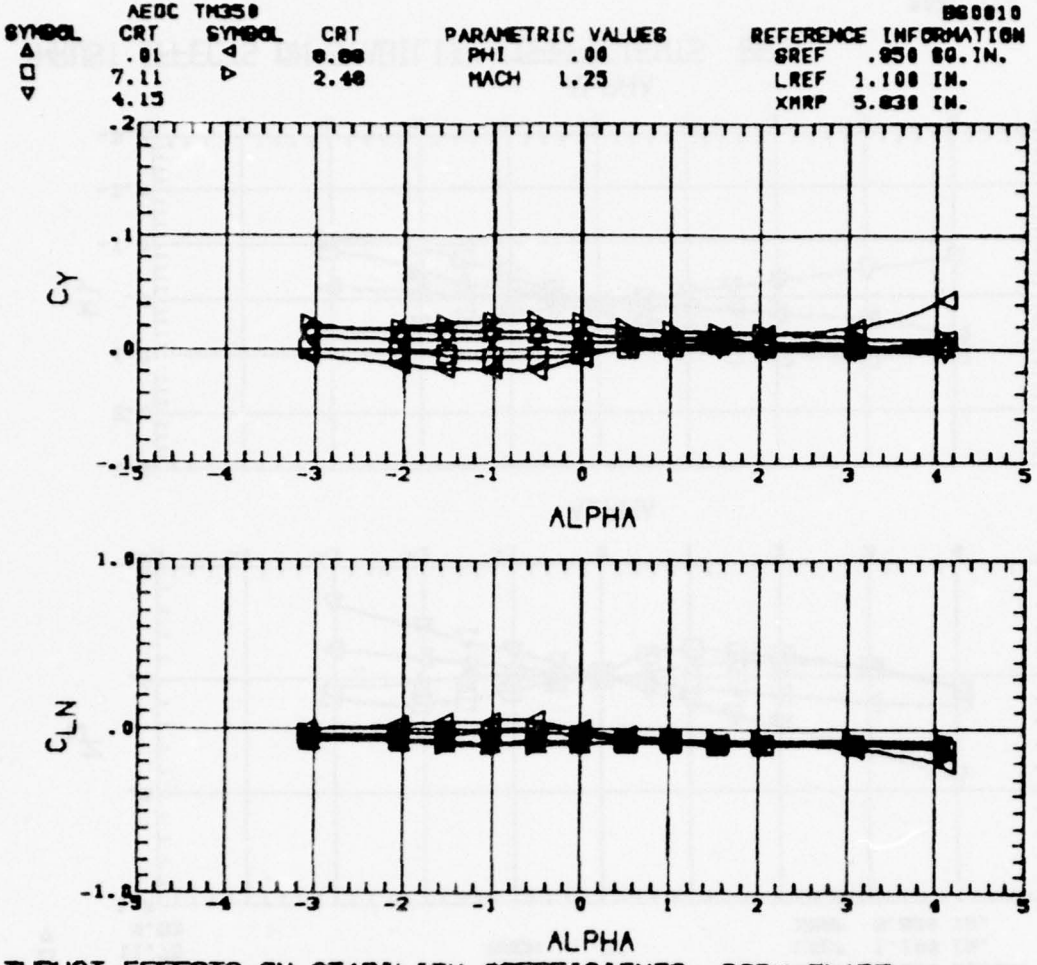
THRUST EFFECTS ON STABILITY COEFFICIENTS BODY FLARE



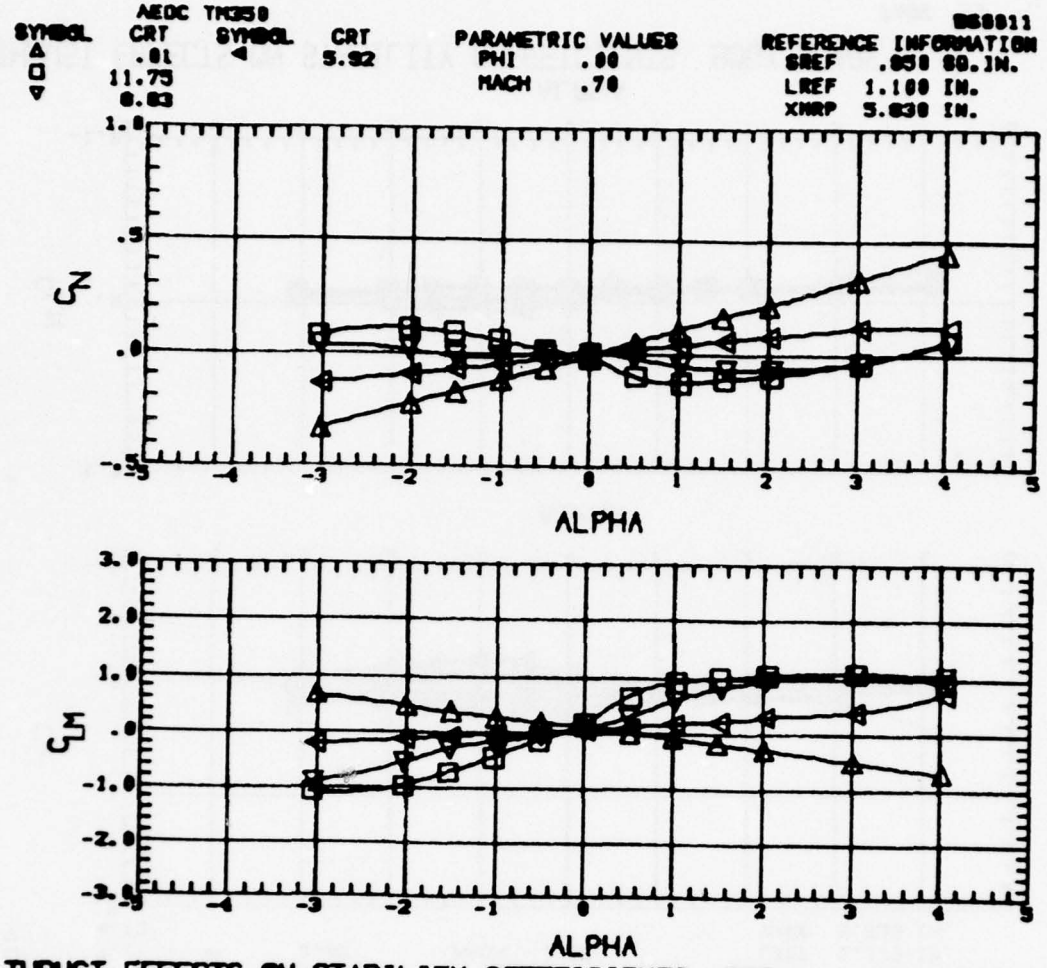
THRUST EFFECTS ON STABILITY COEFFICIENTS BODY FLARE



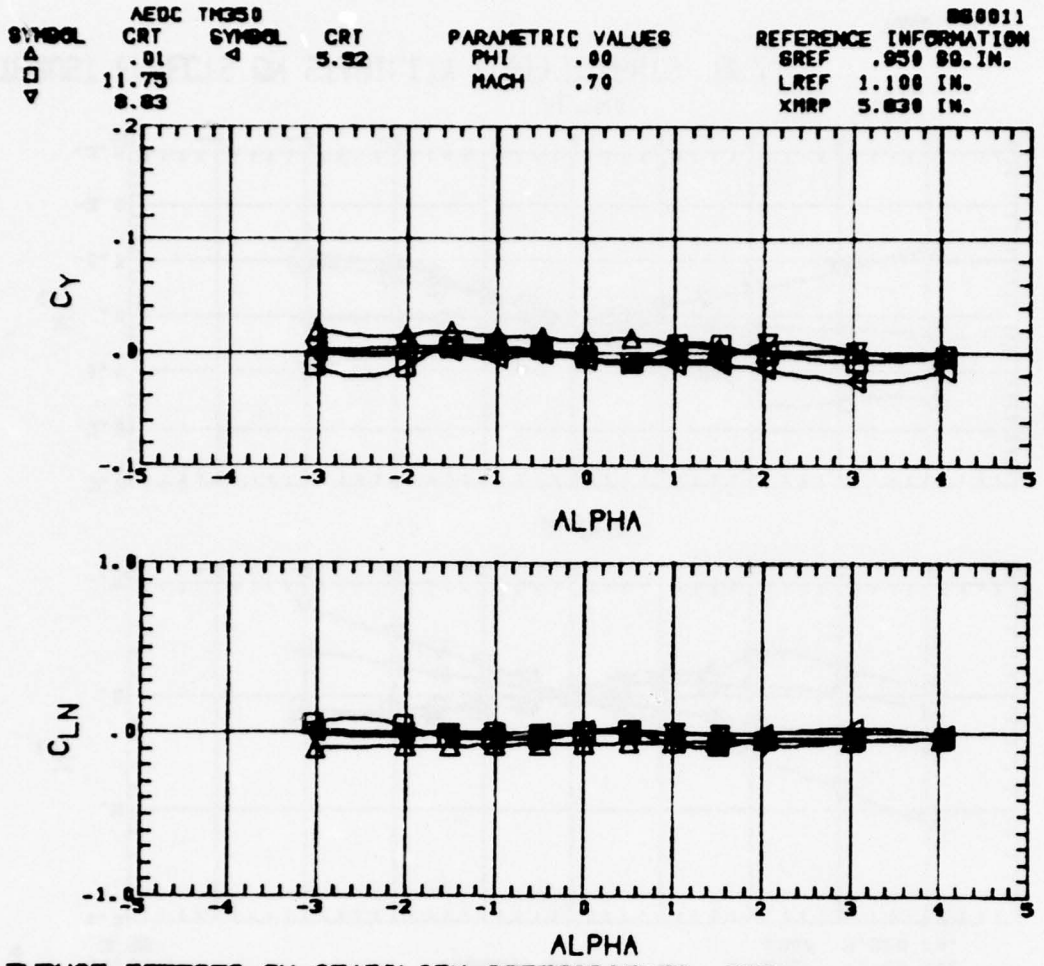
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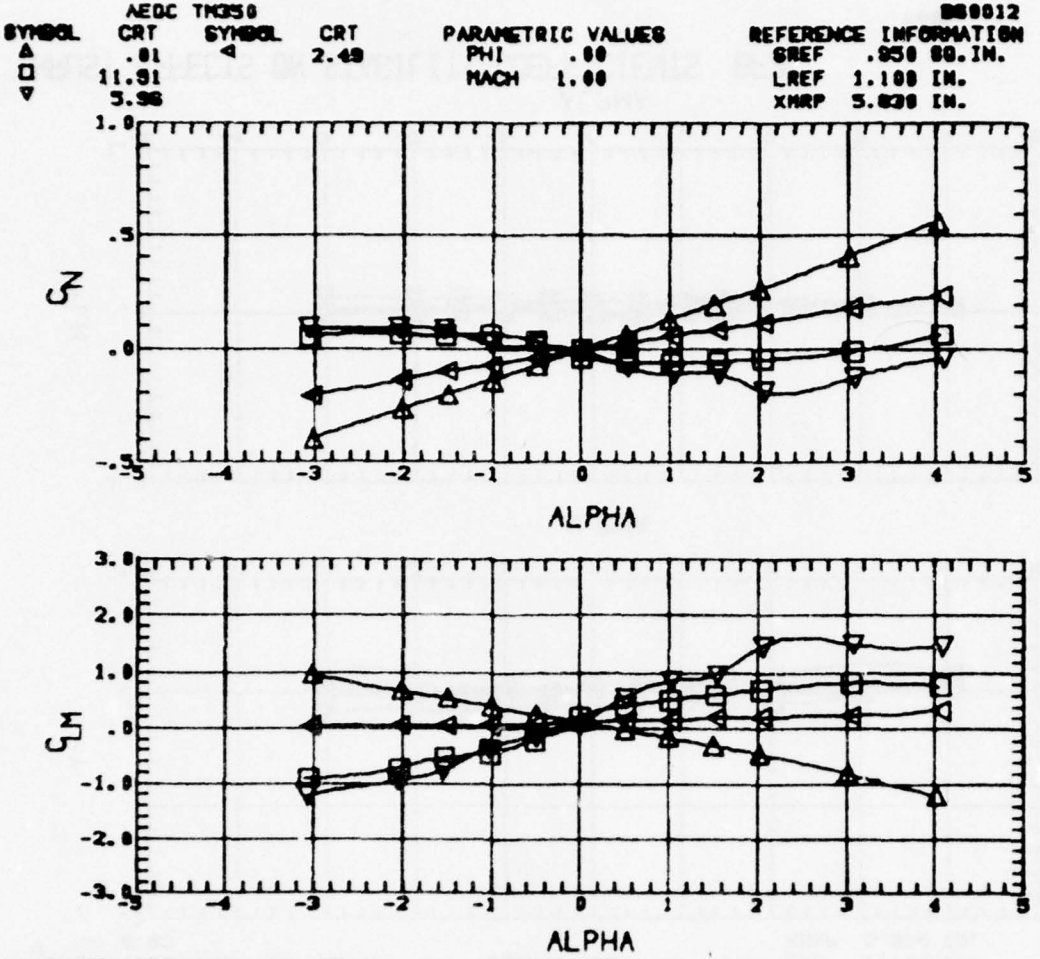
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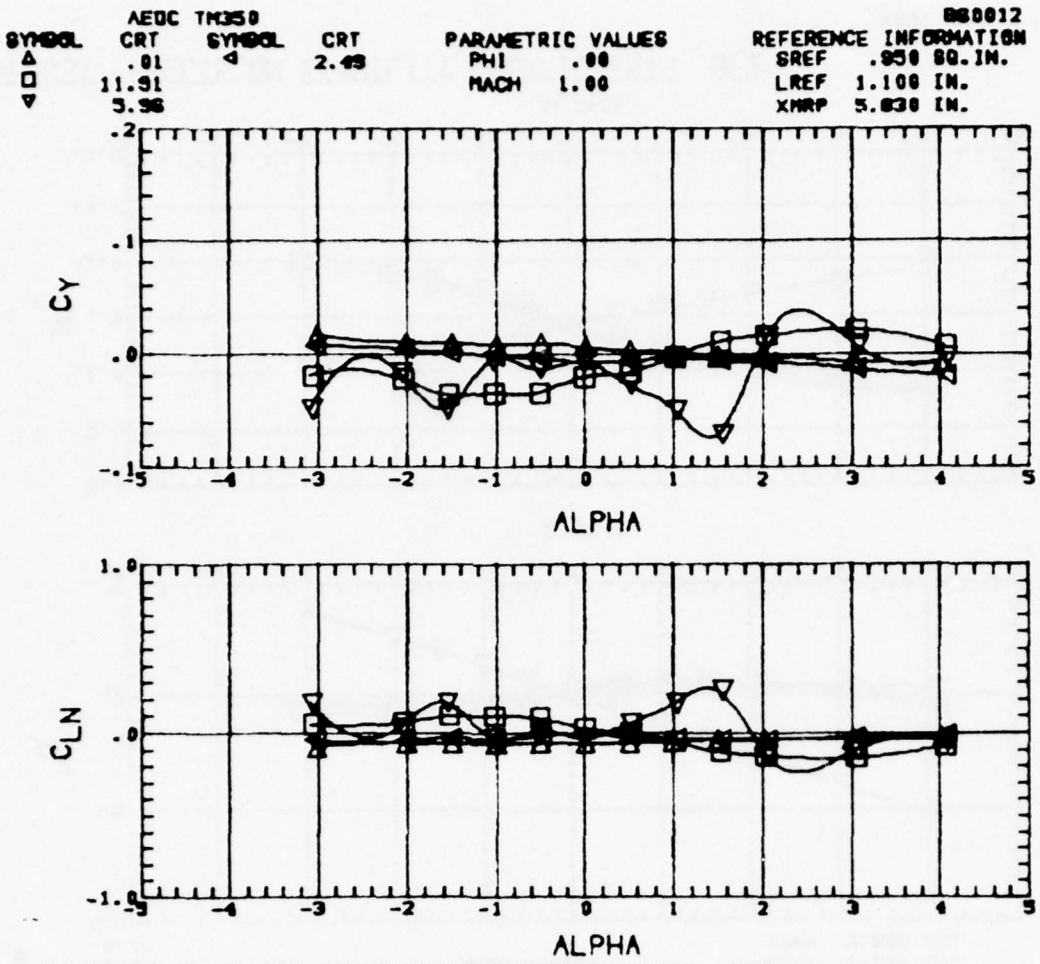
THRUST EFFECTS ON STABILITY COEFFICIENTS BF2



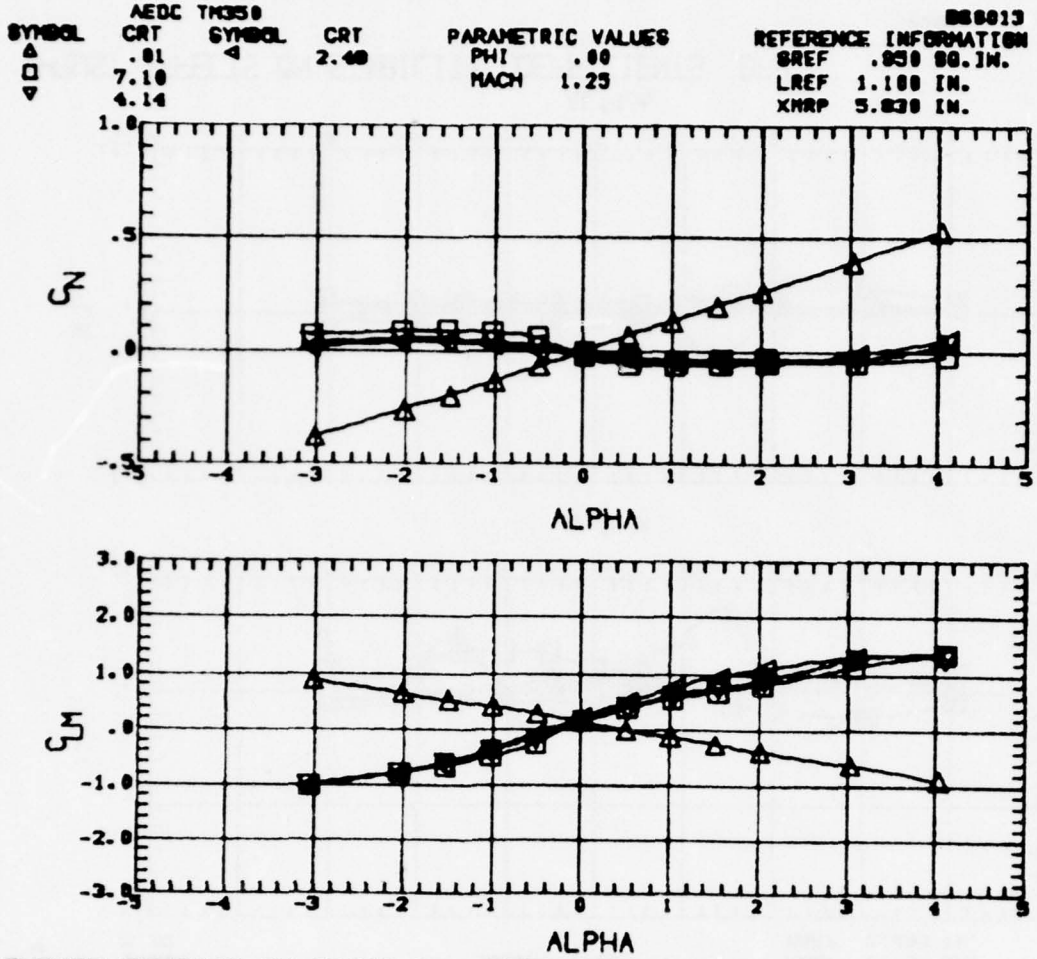
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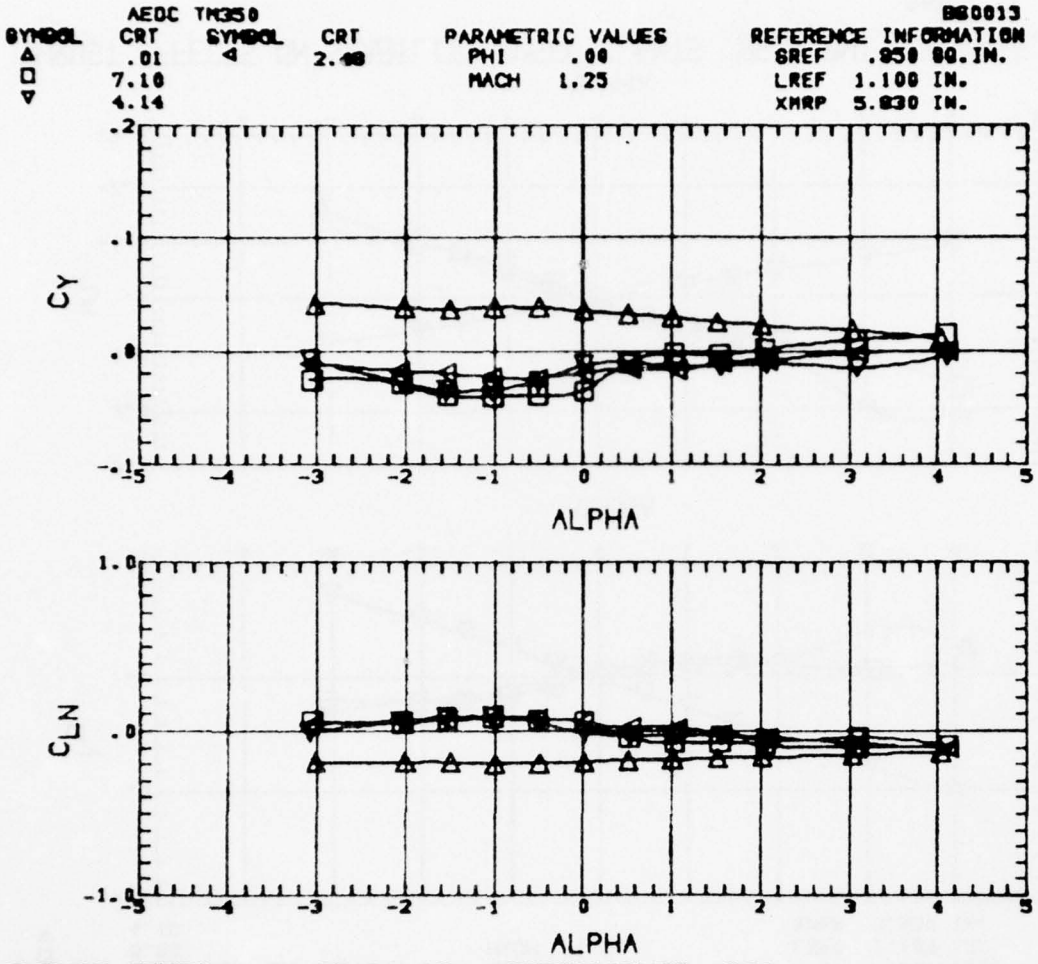
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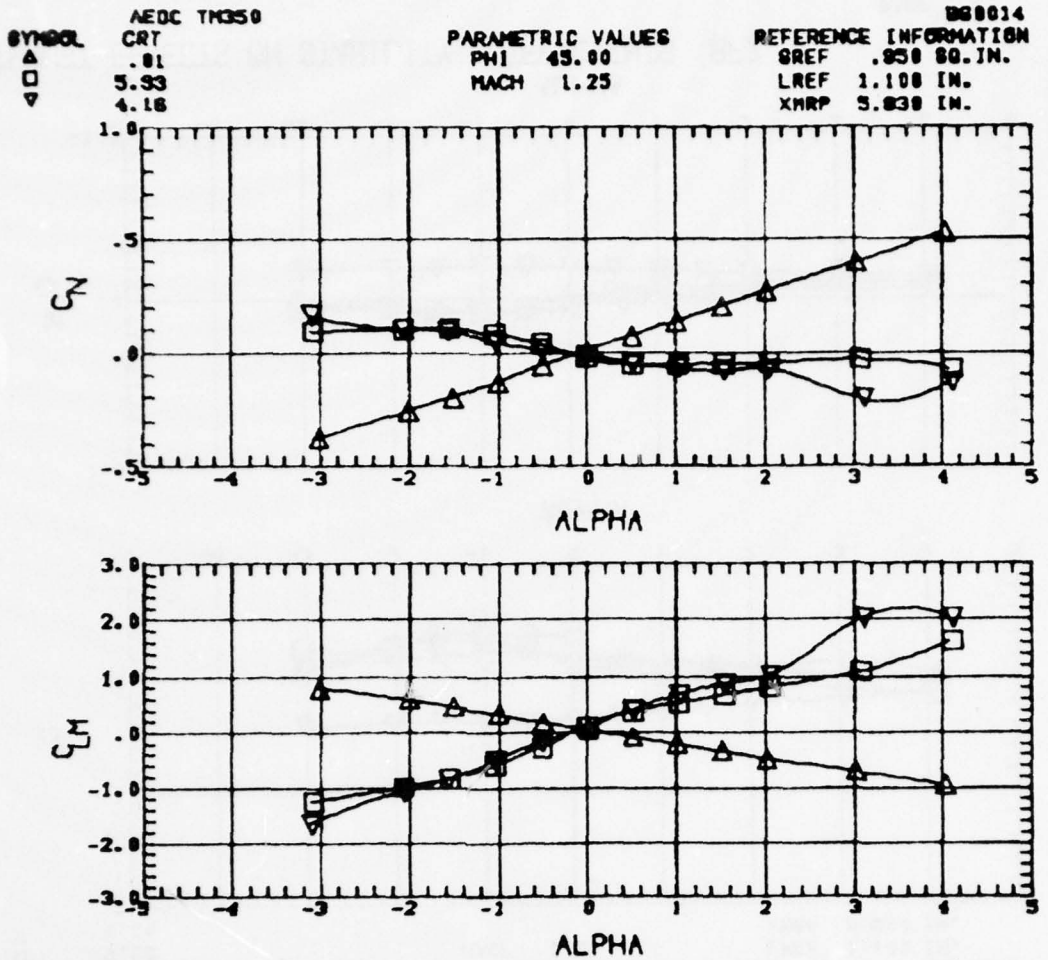
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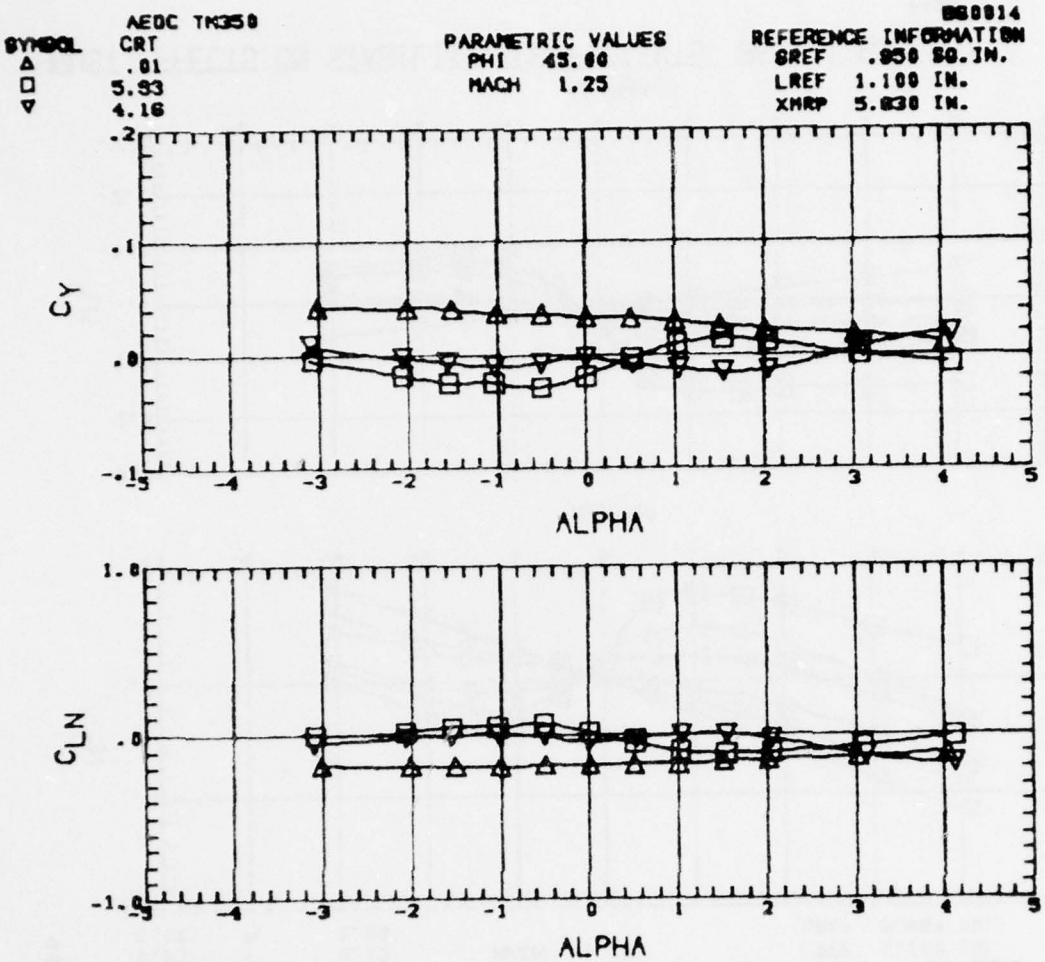
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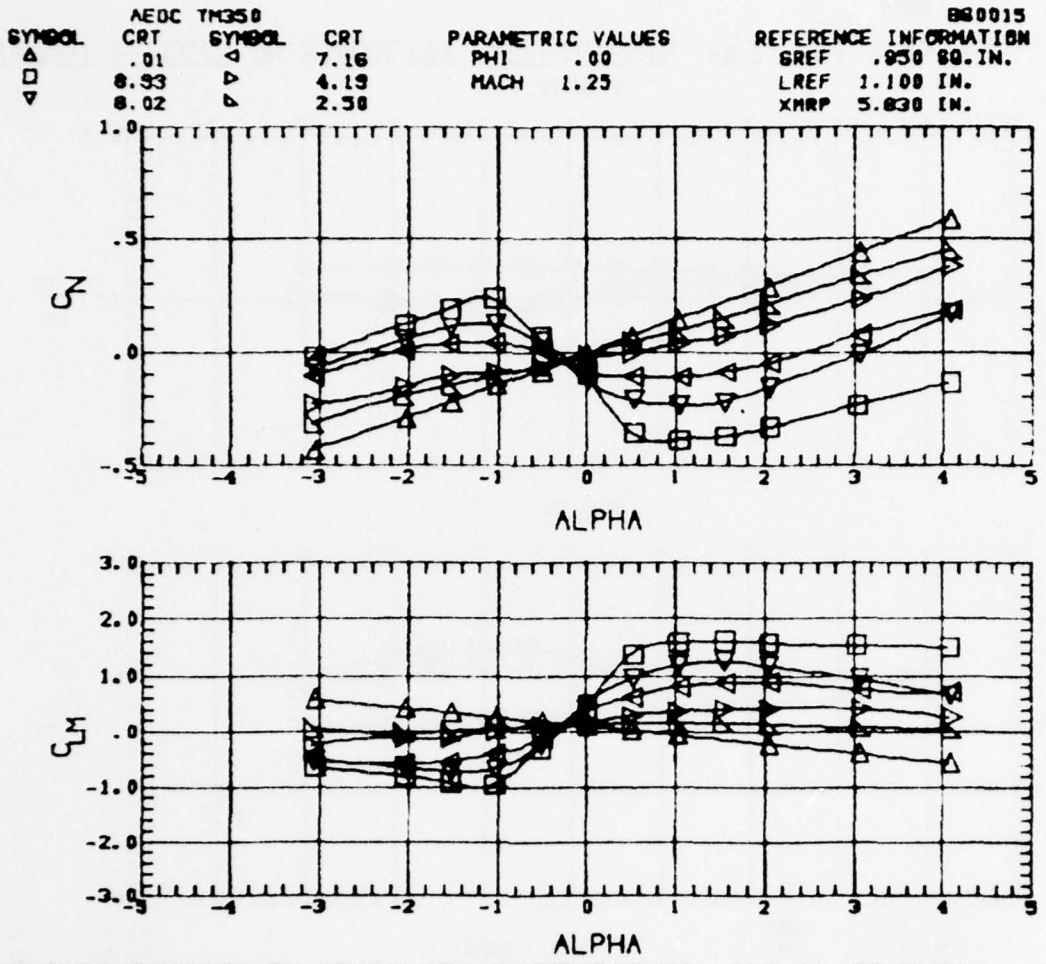
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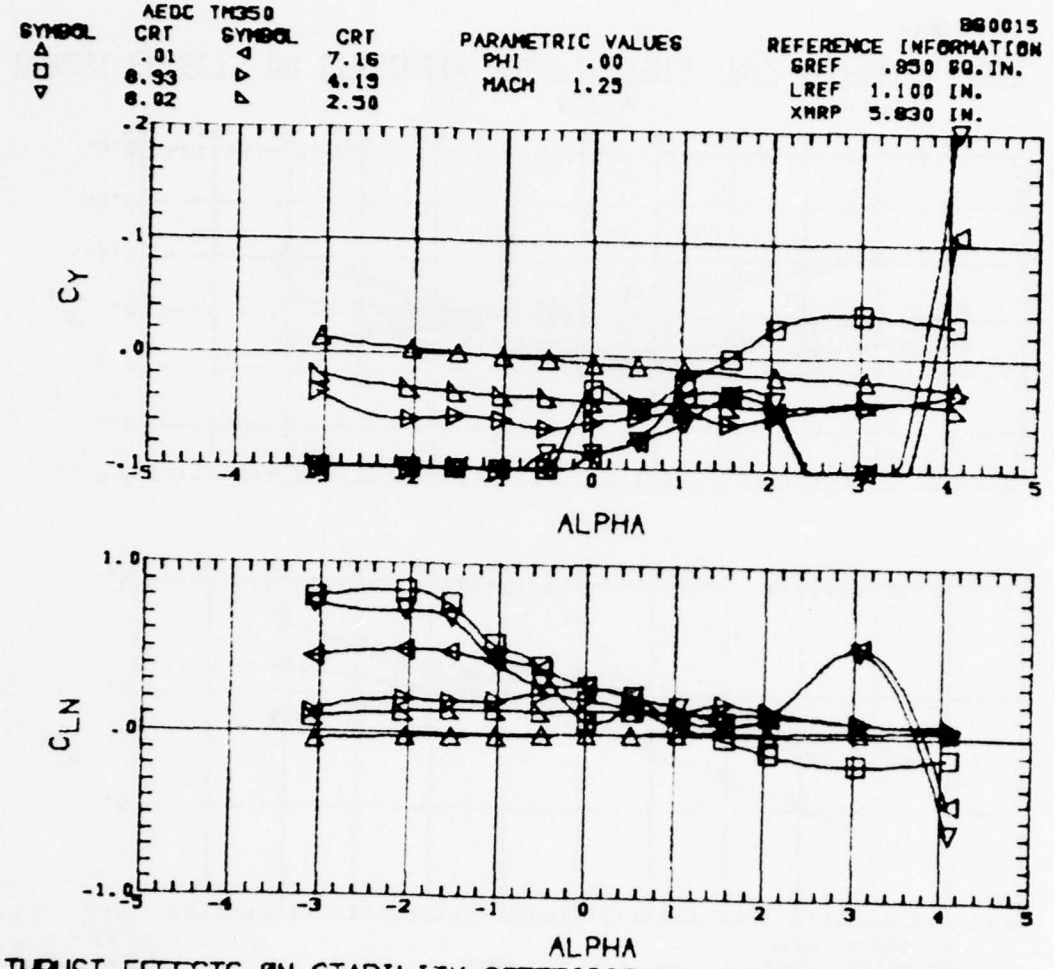
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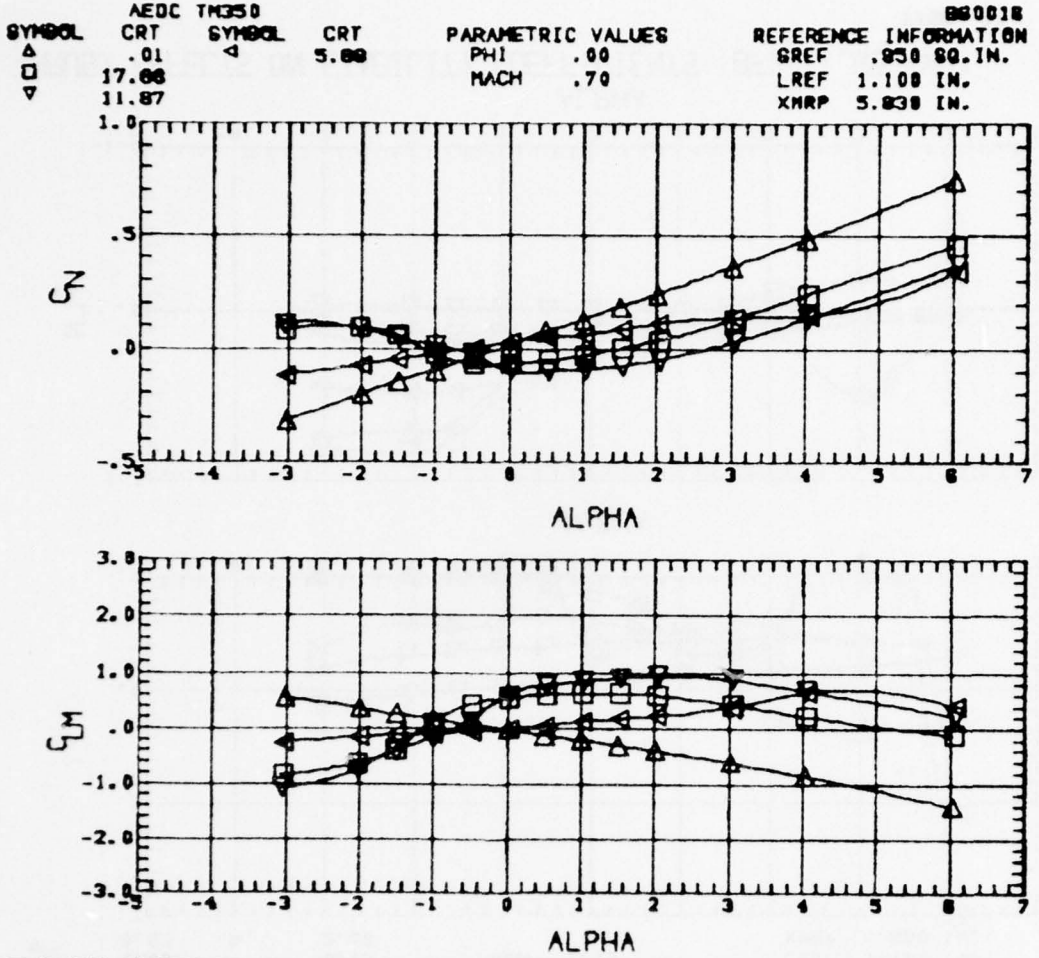
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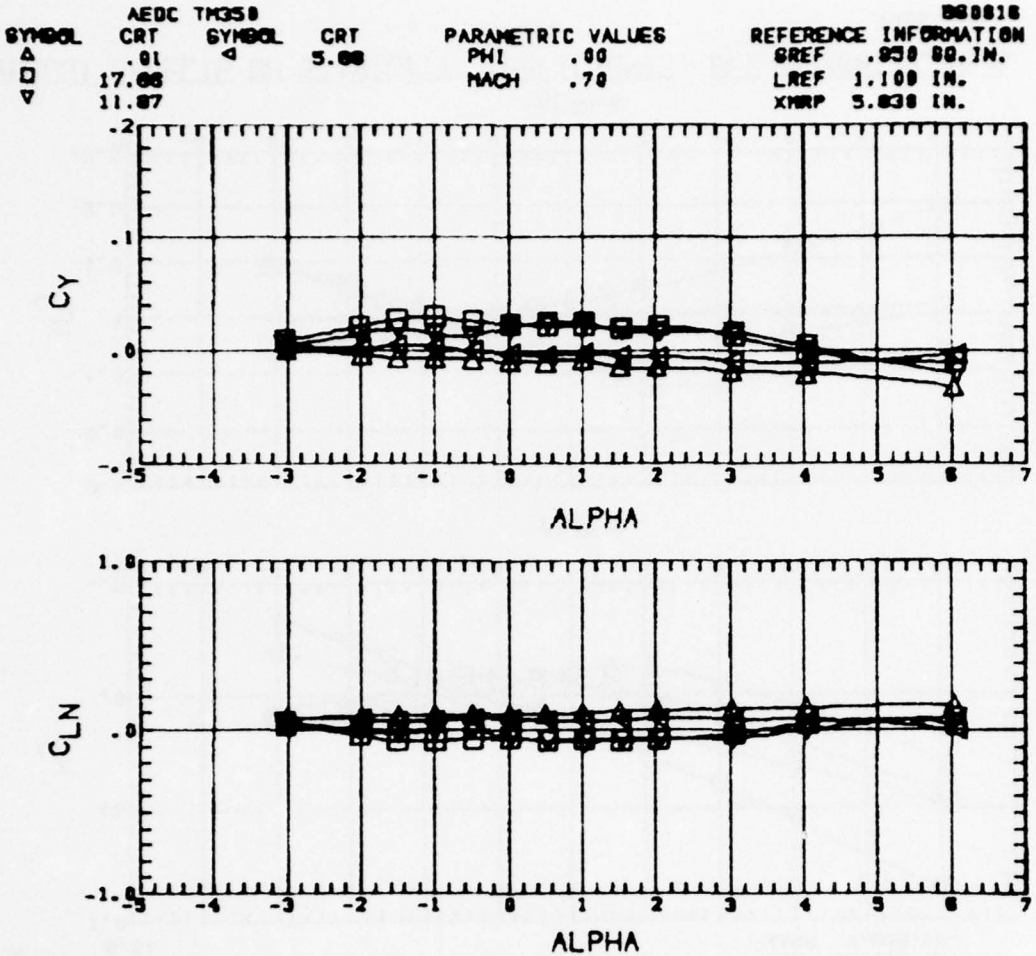
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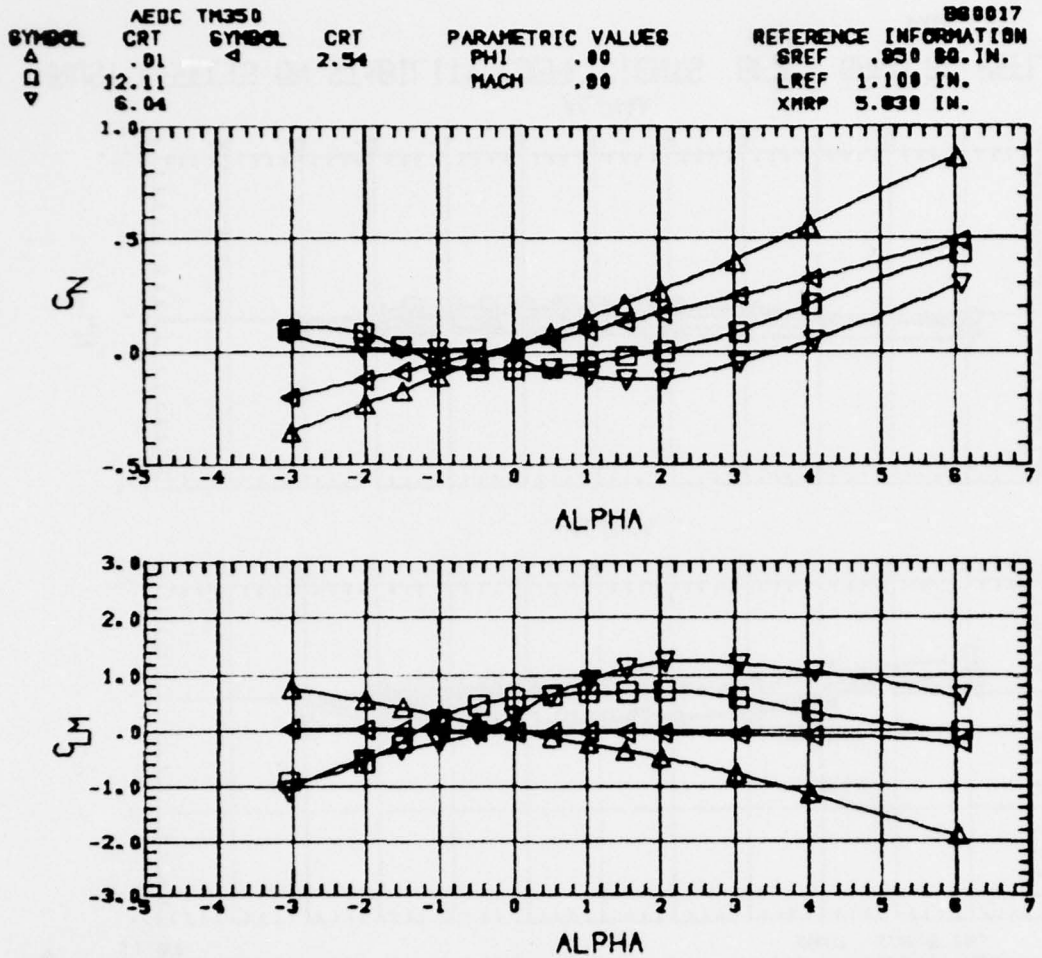
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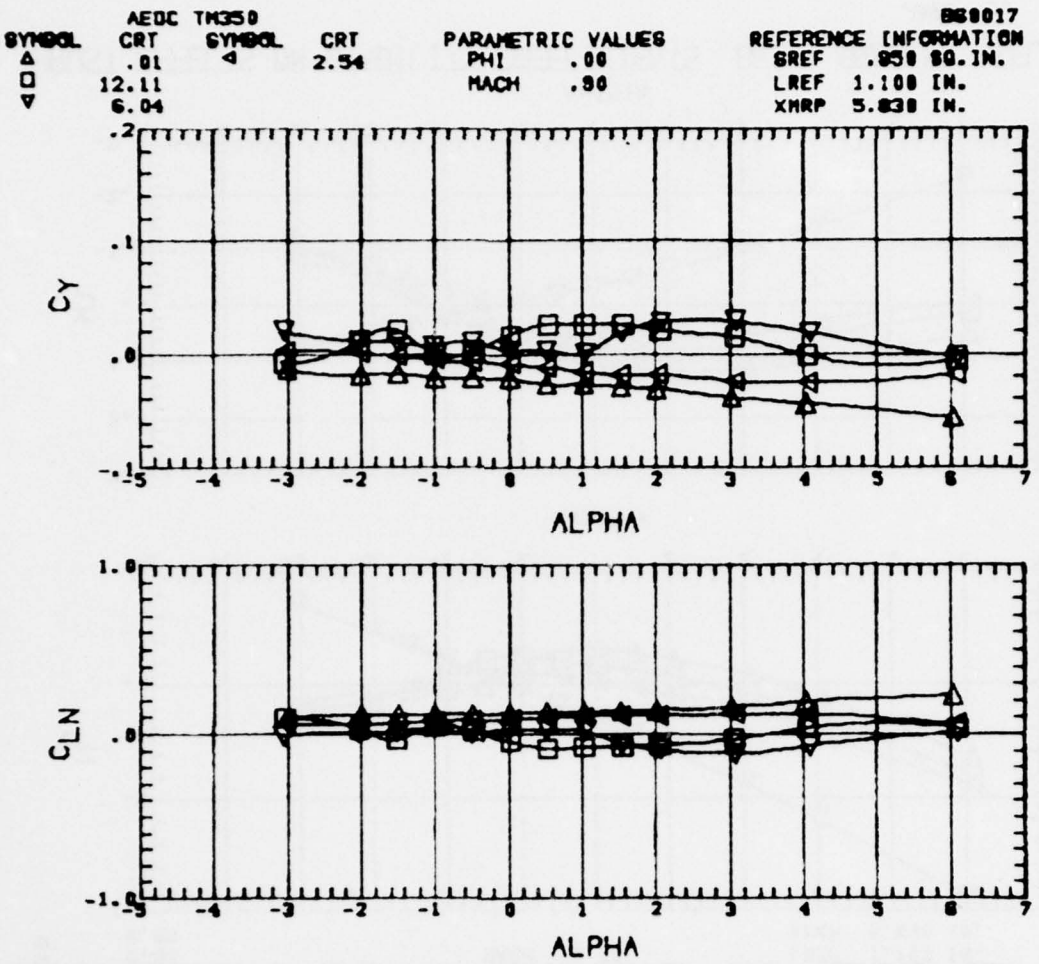
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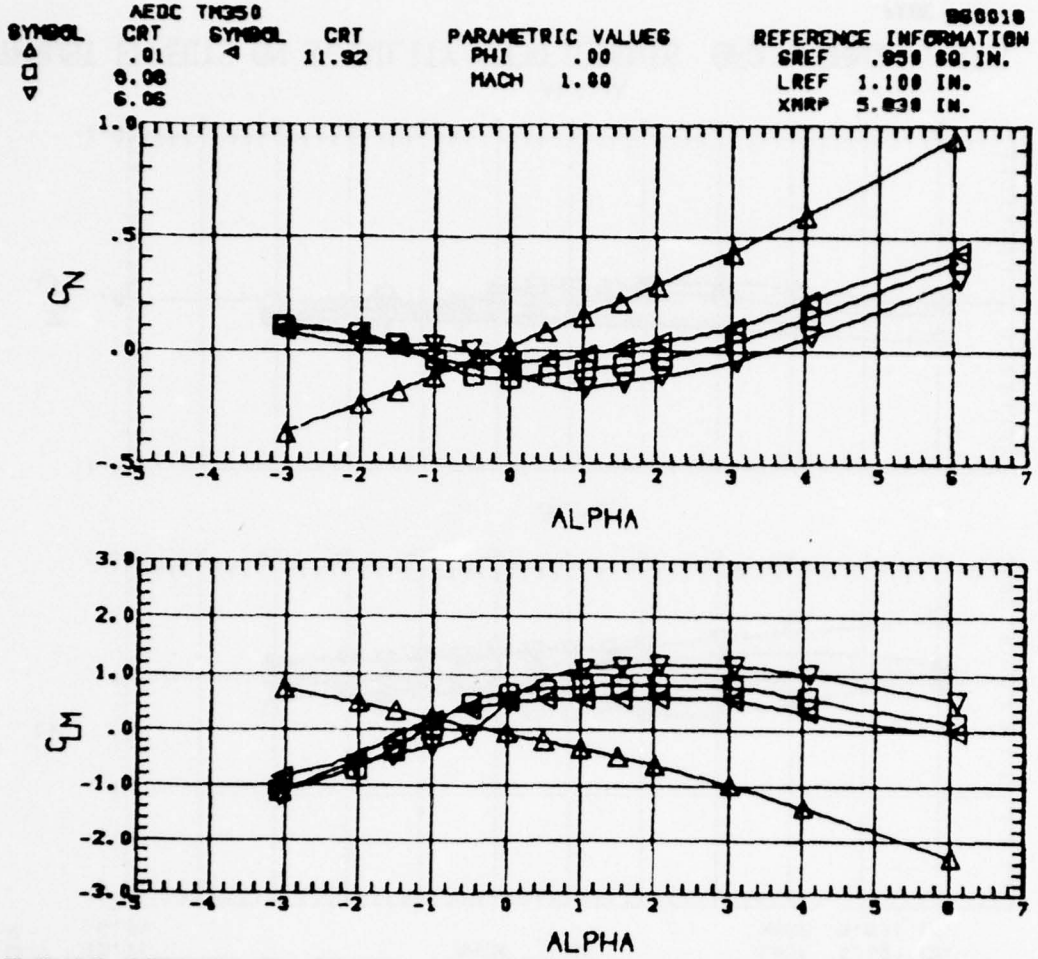
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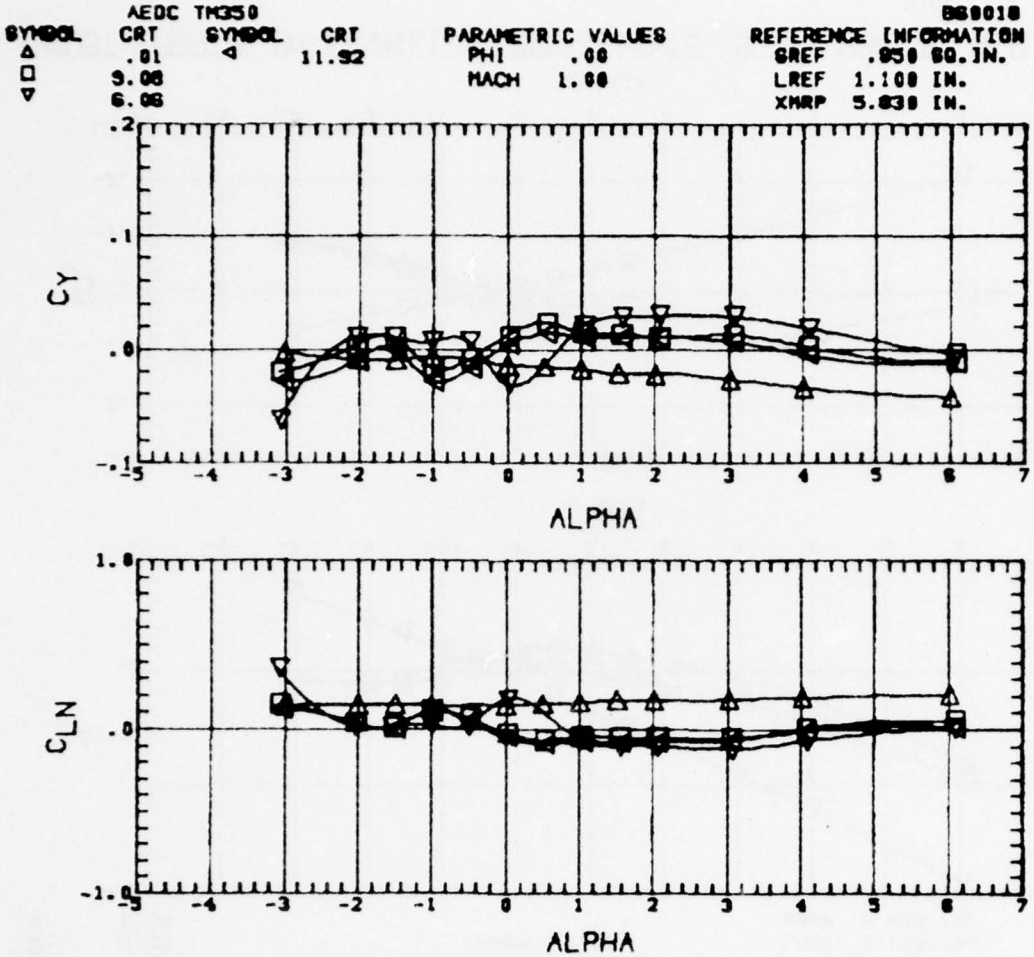
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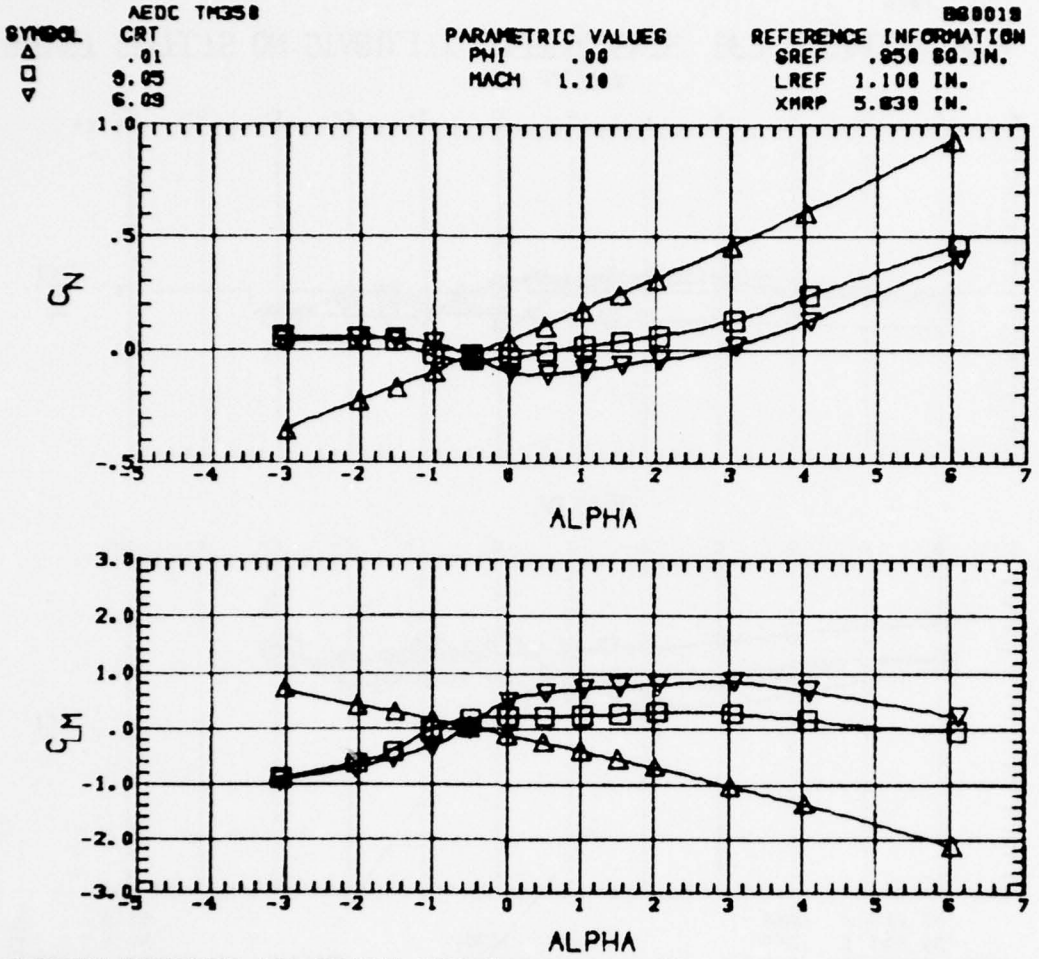
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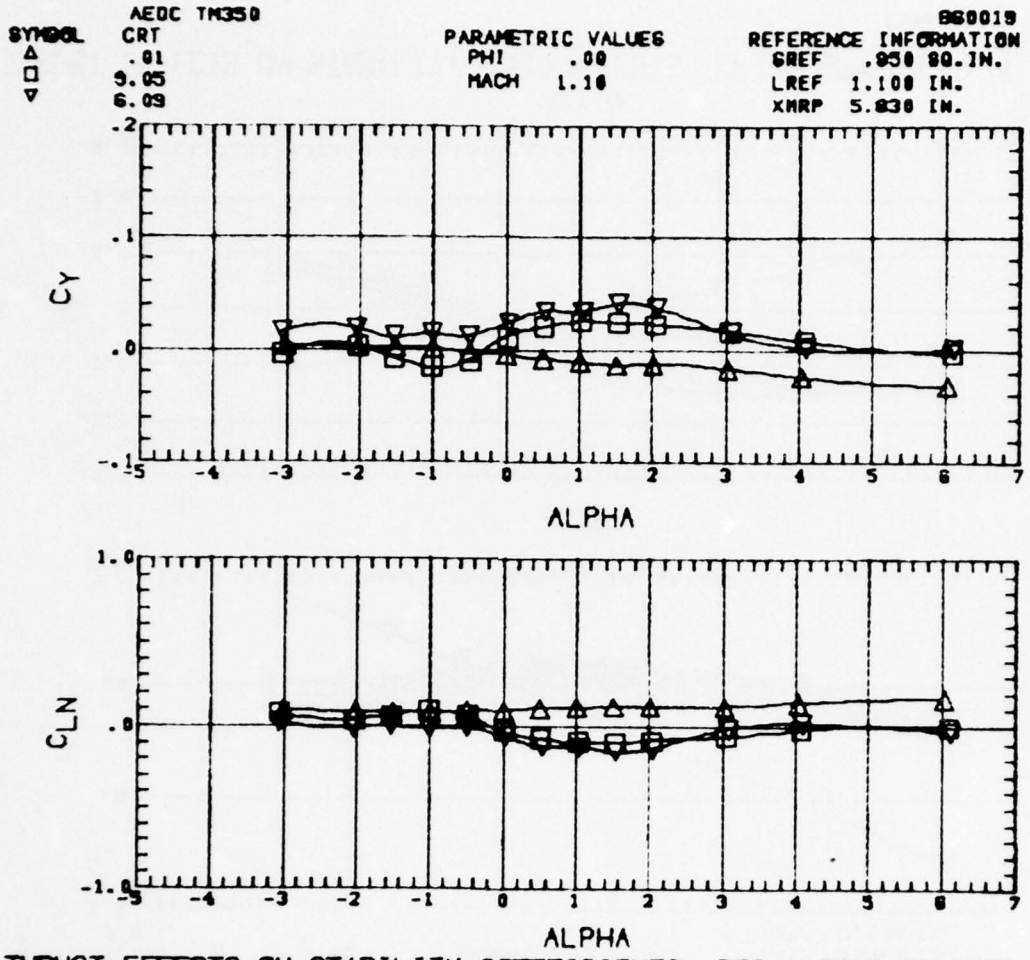
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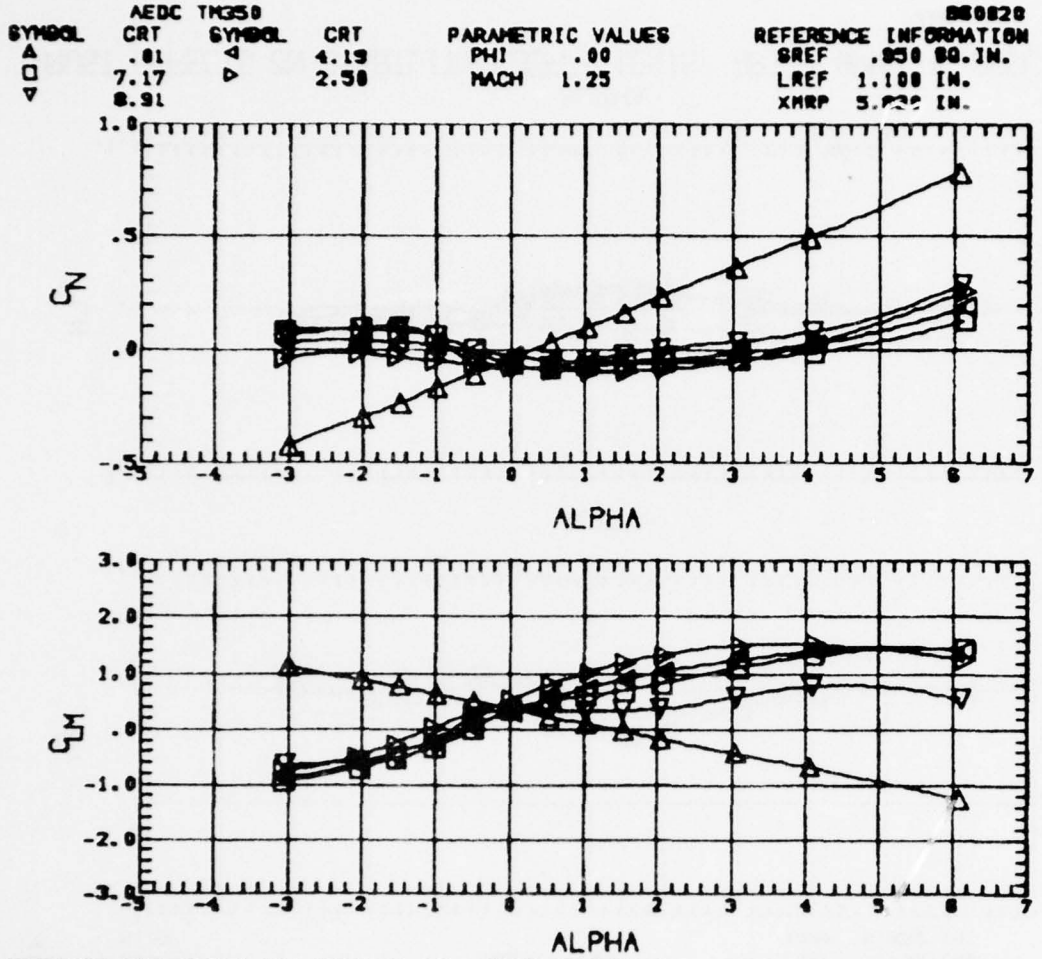
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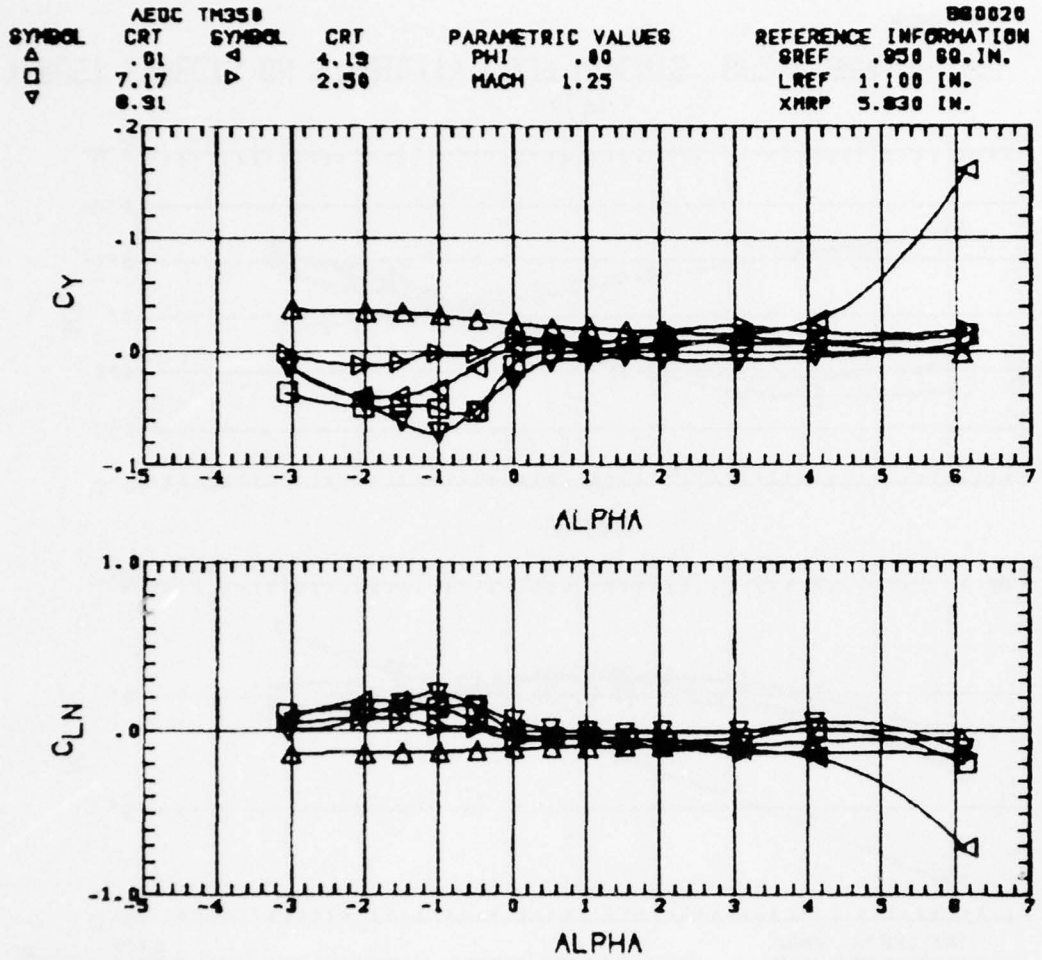
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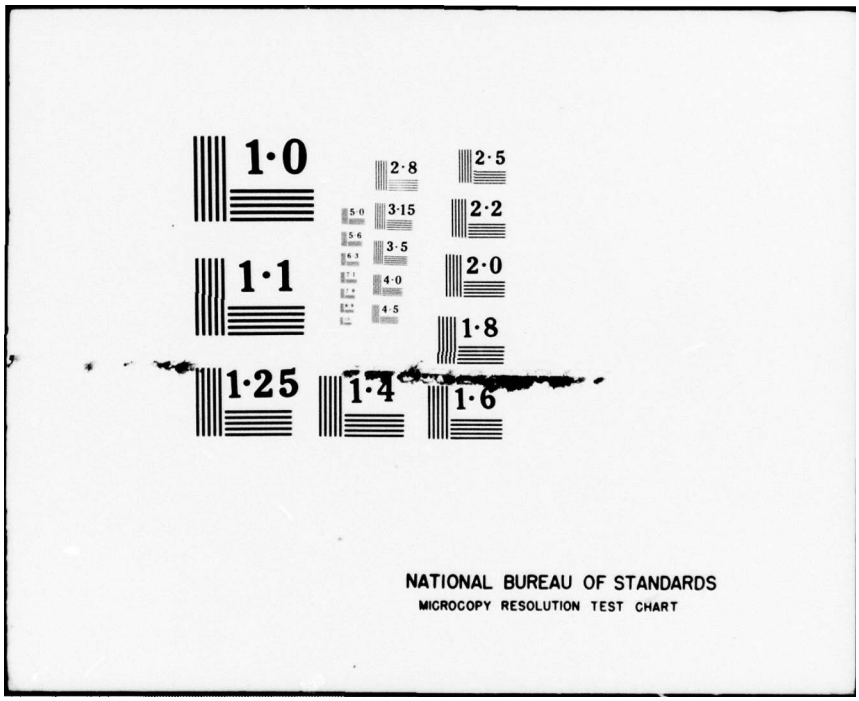


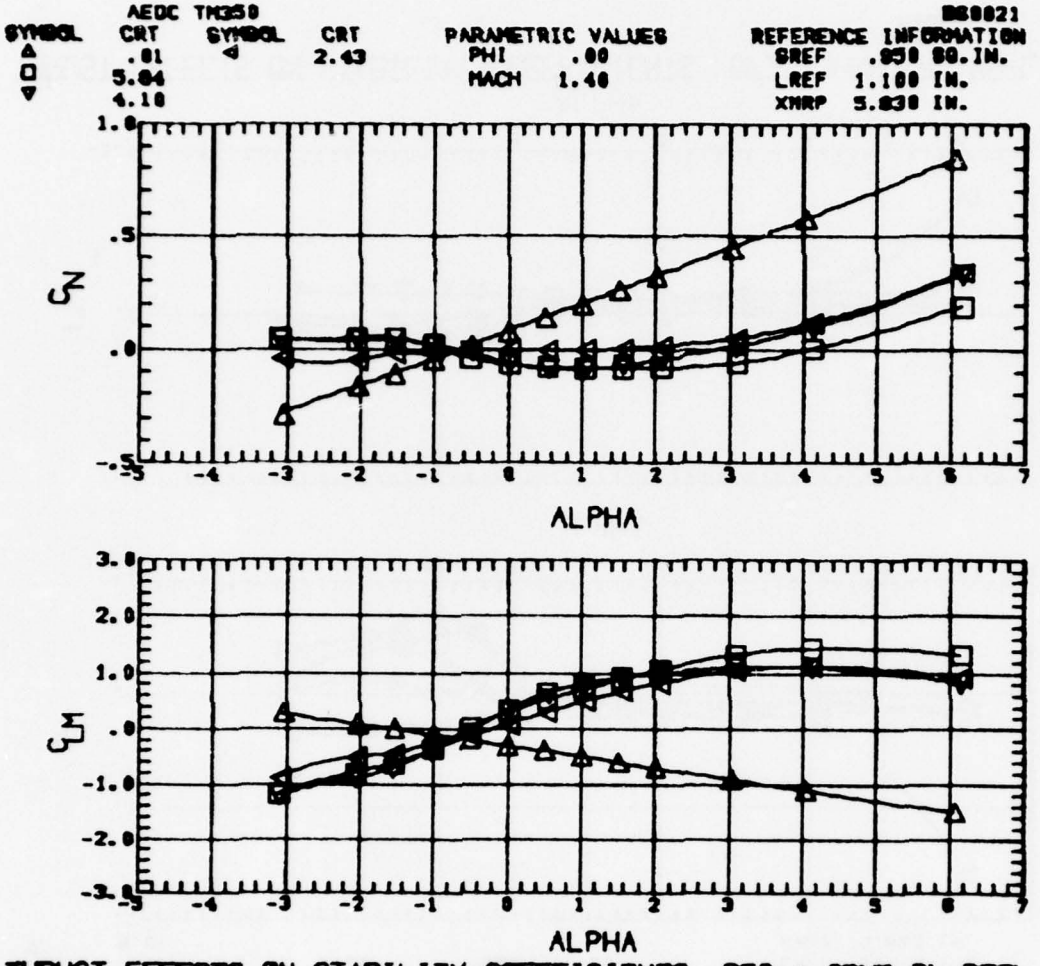
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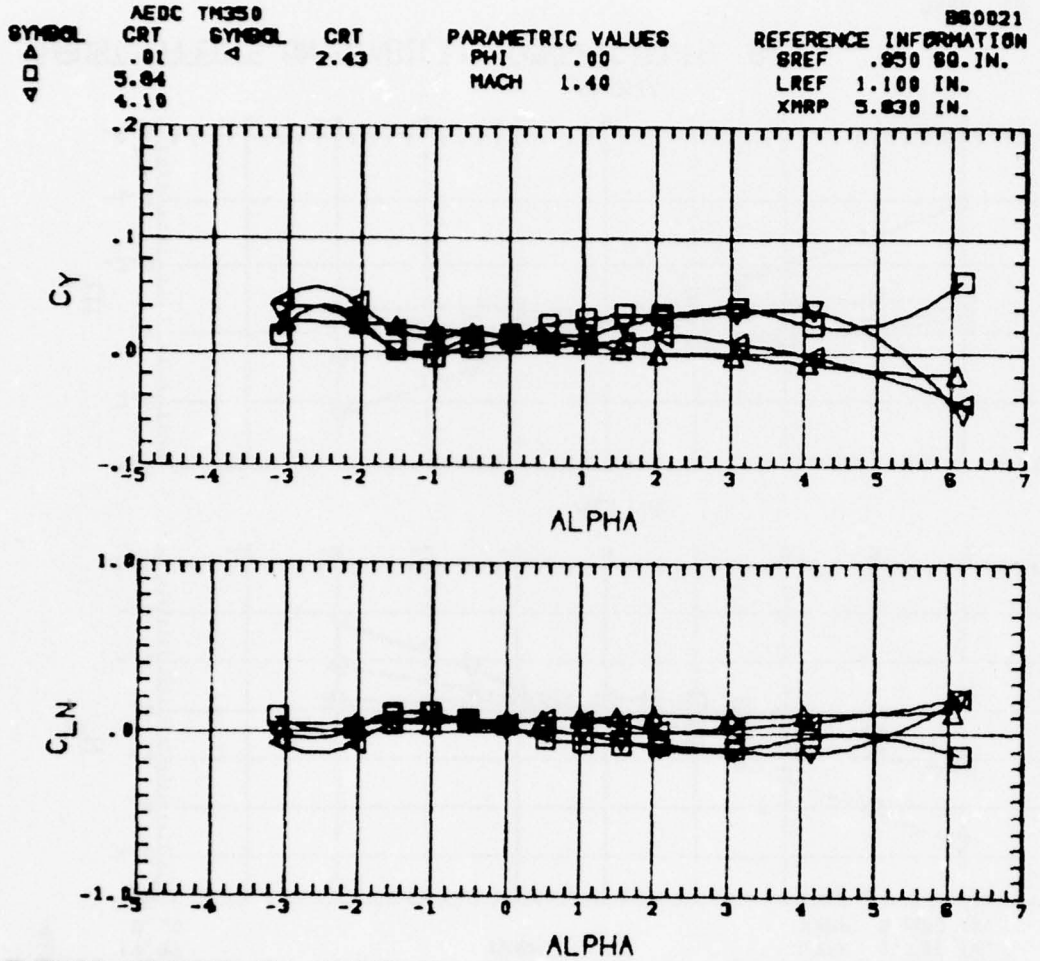
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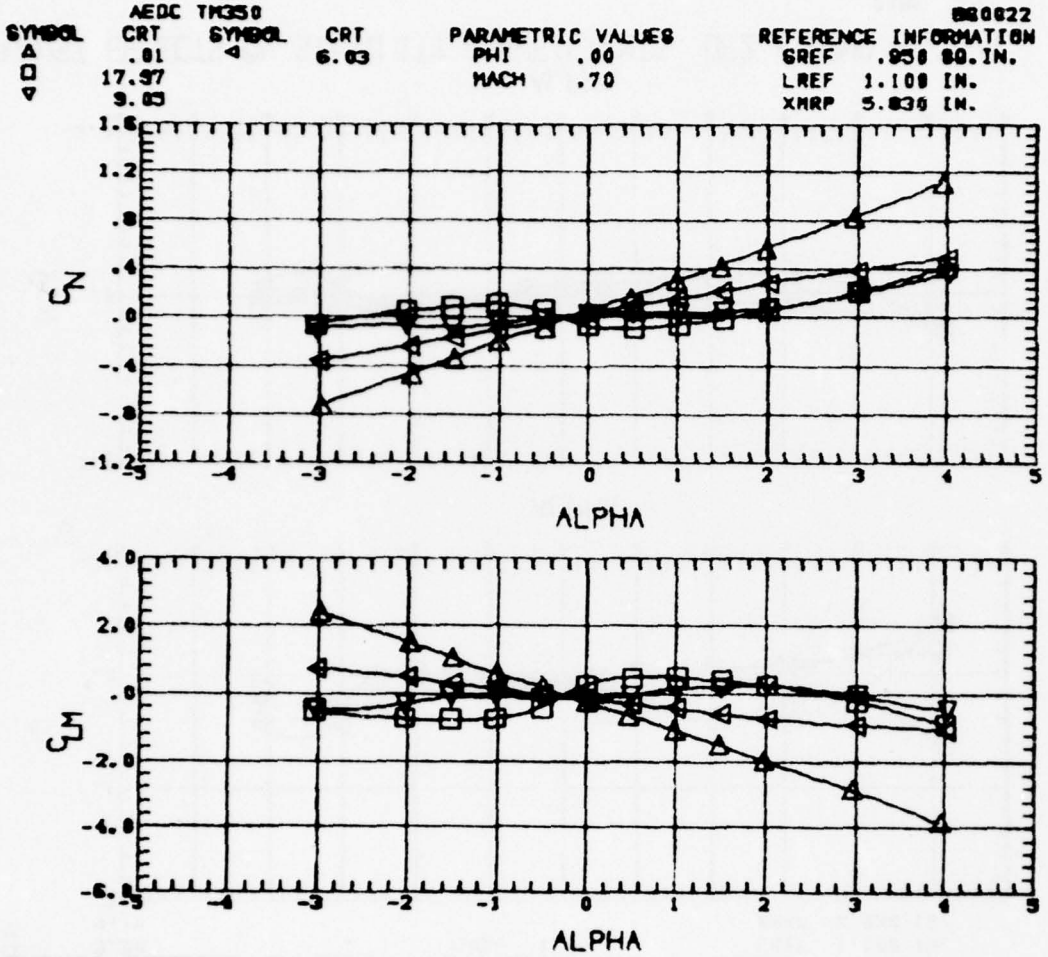

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NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART



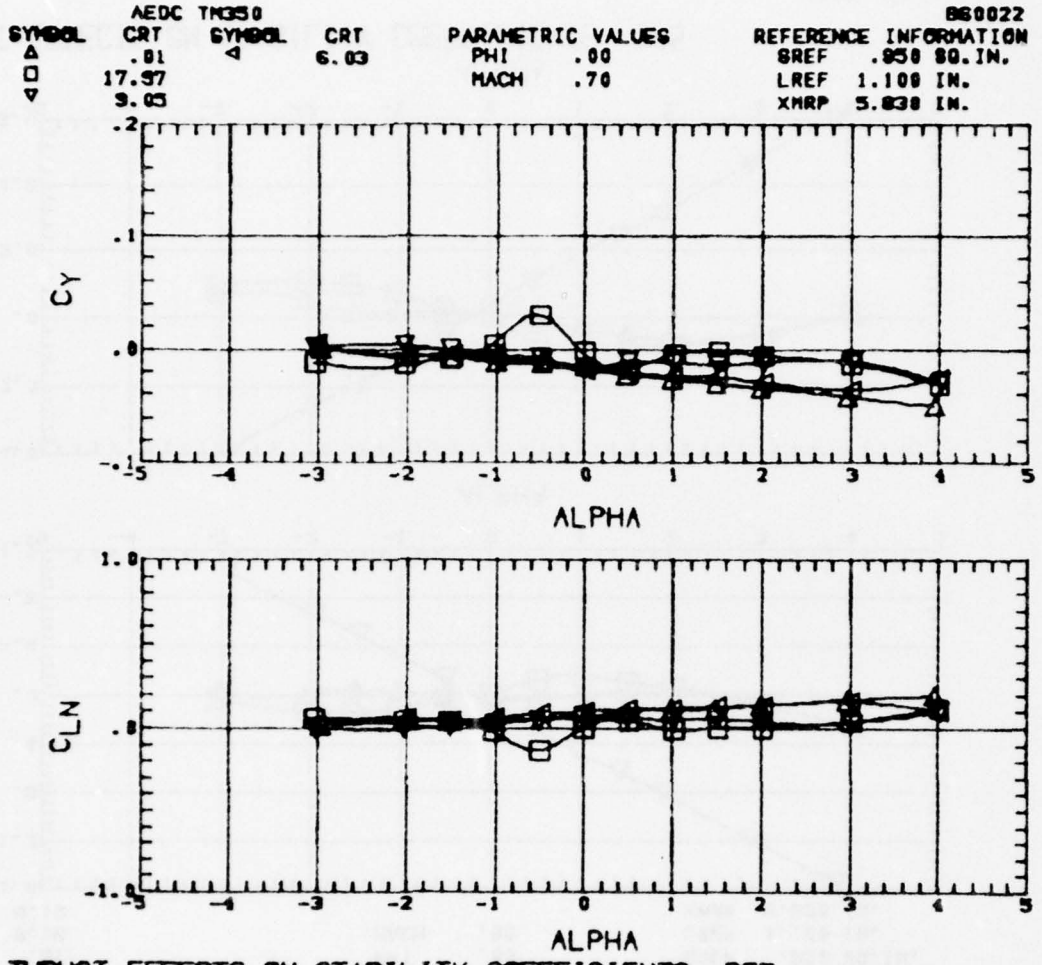
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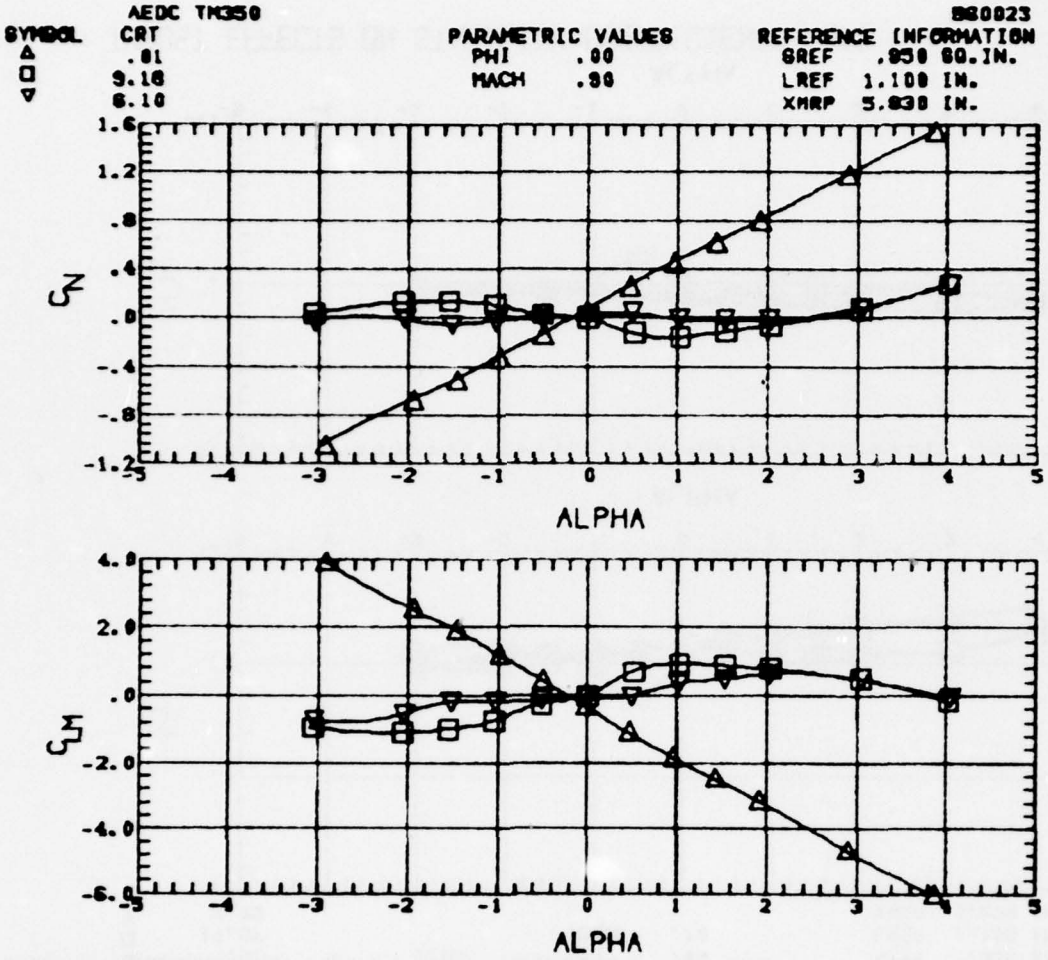
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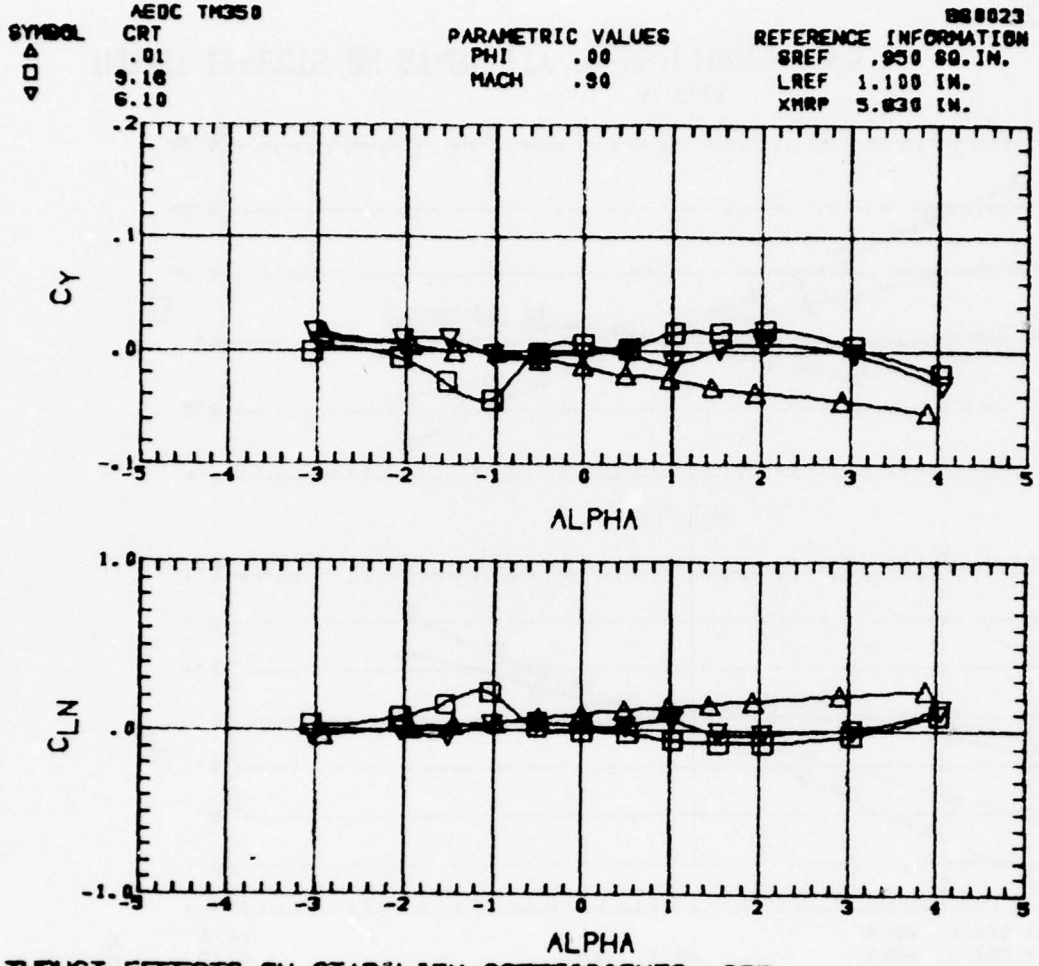
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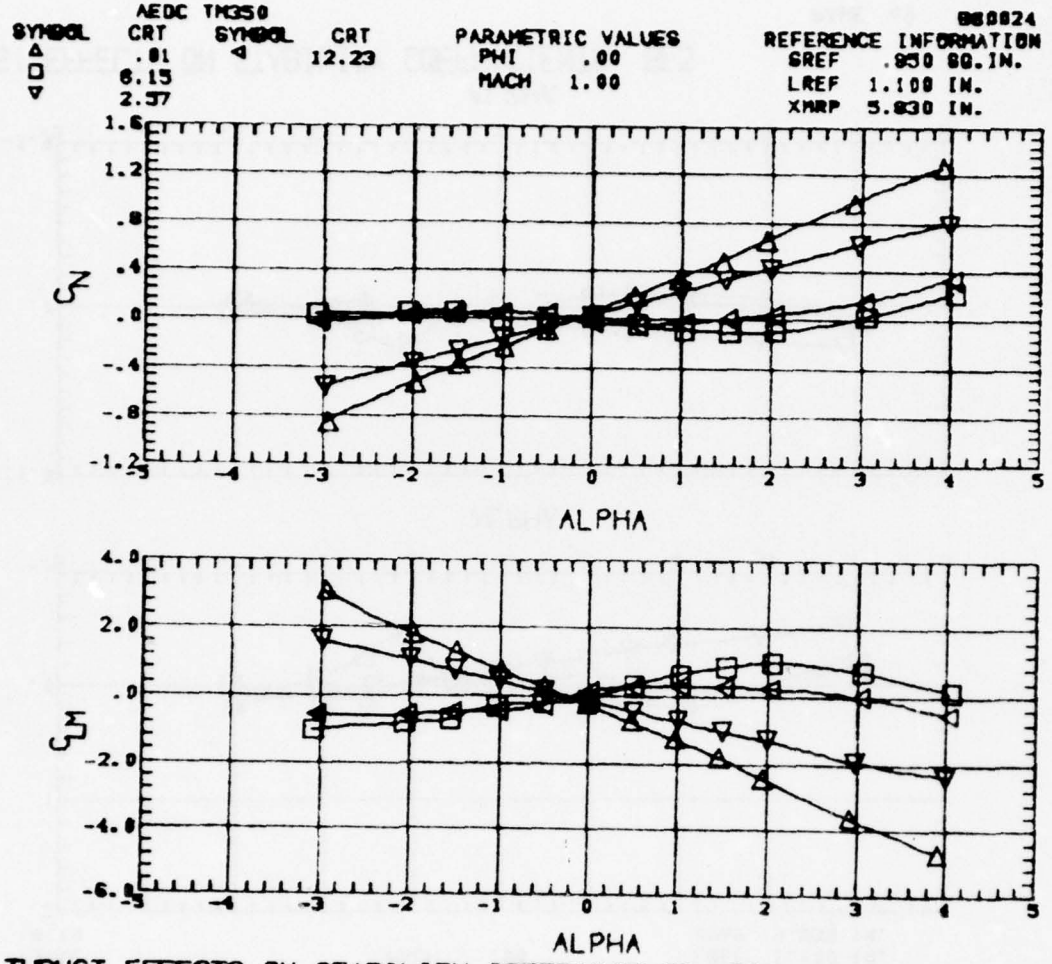
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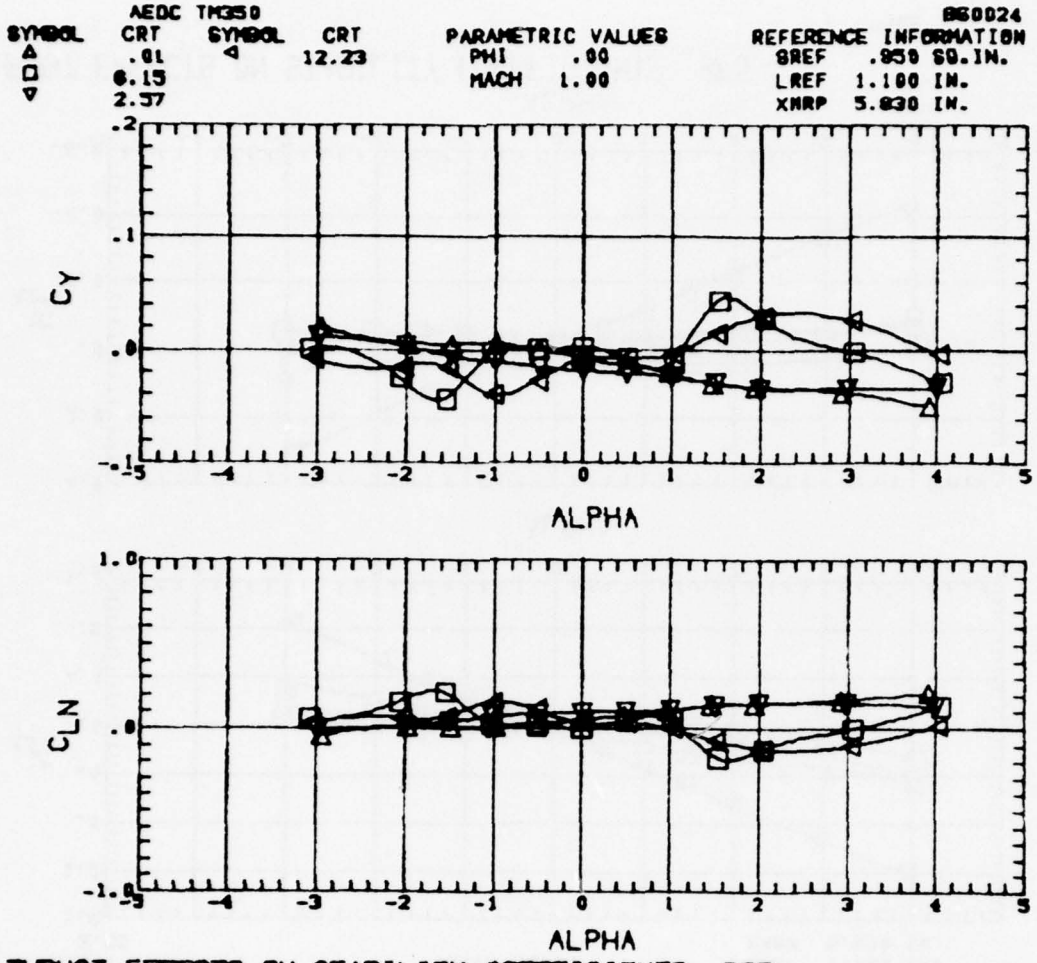
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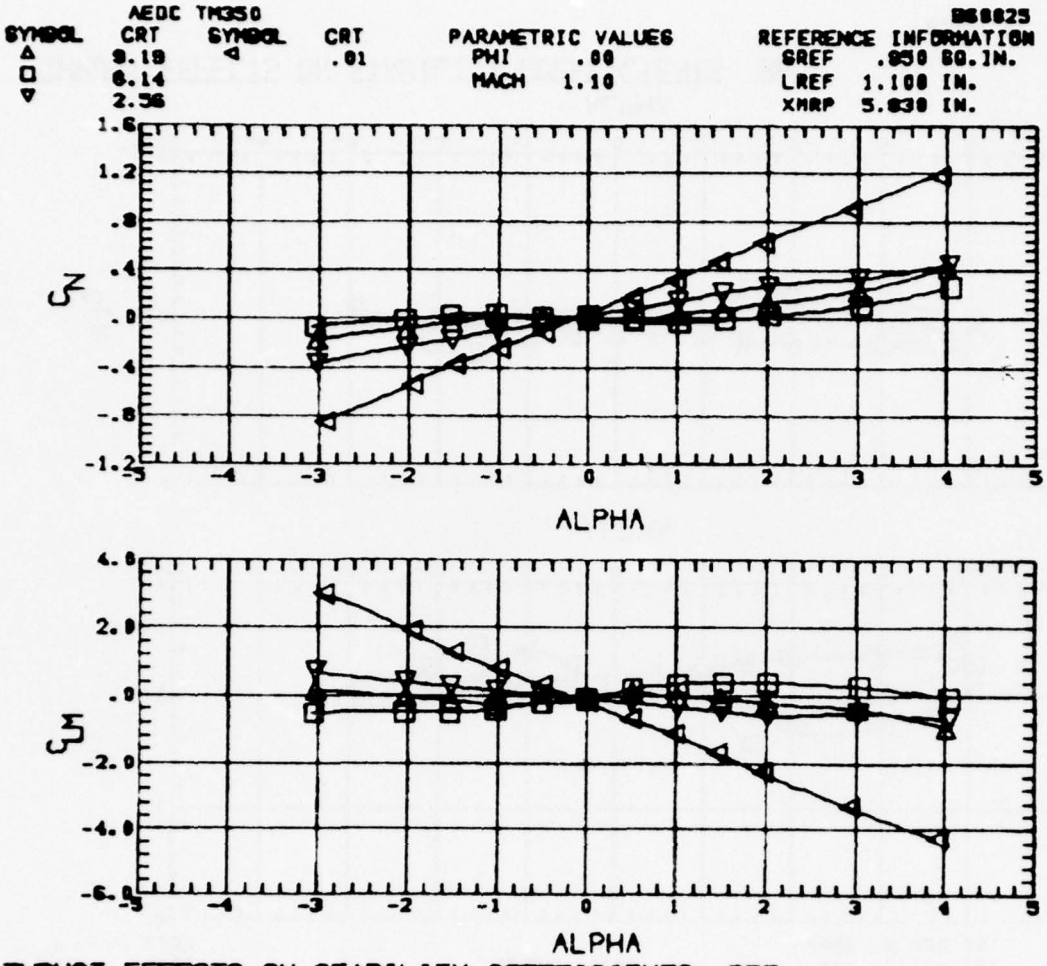
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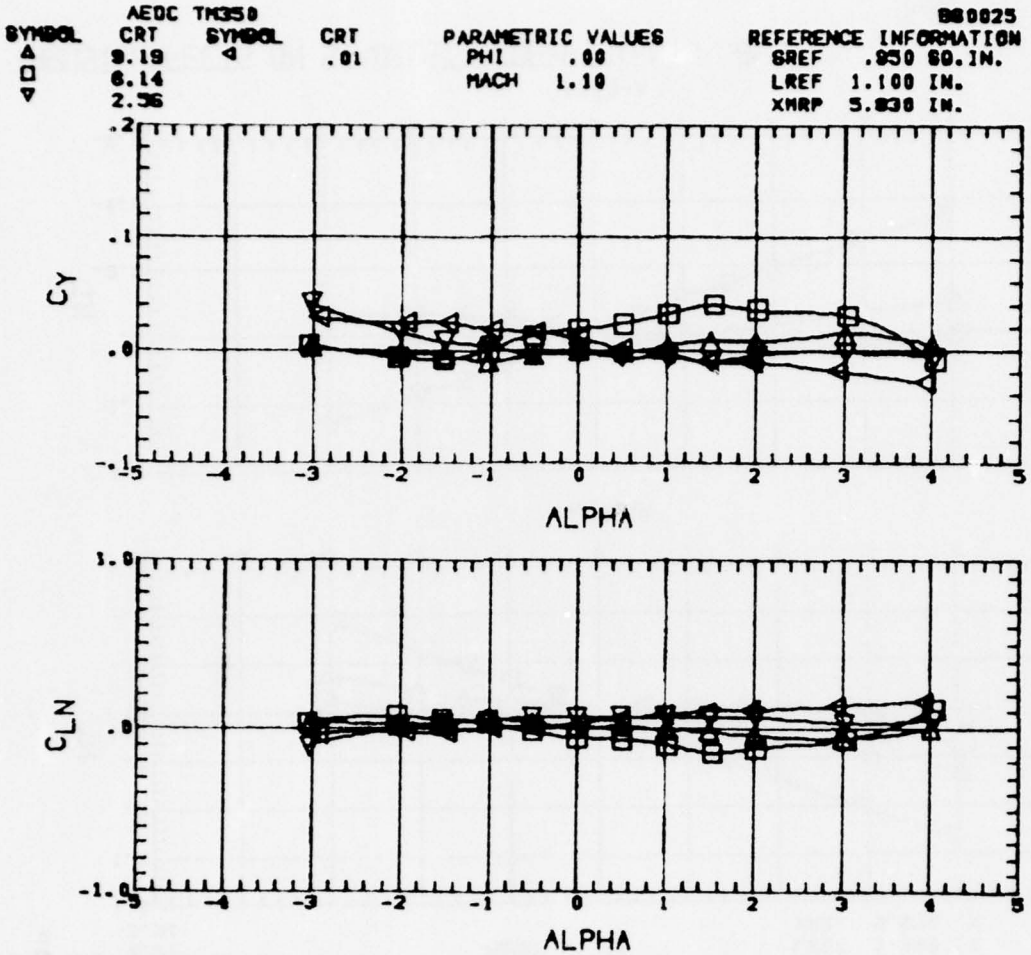
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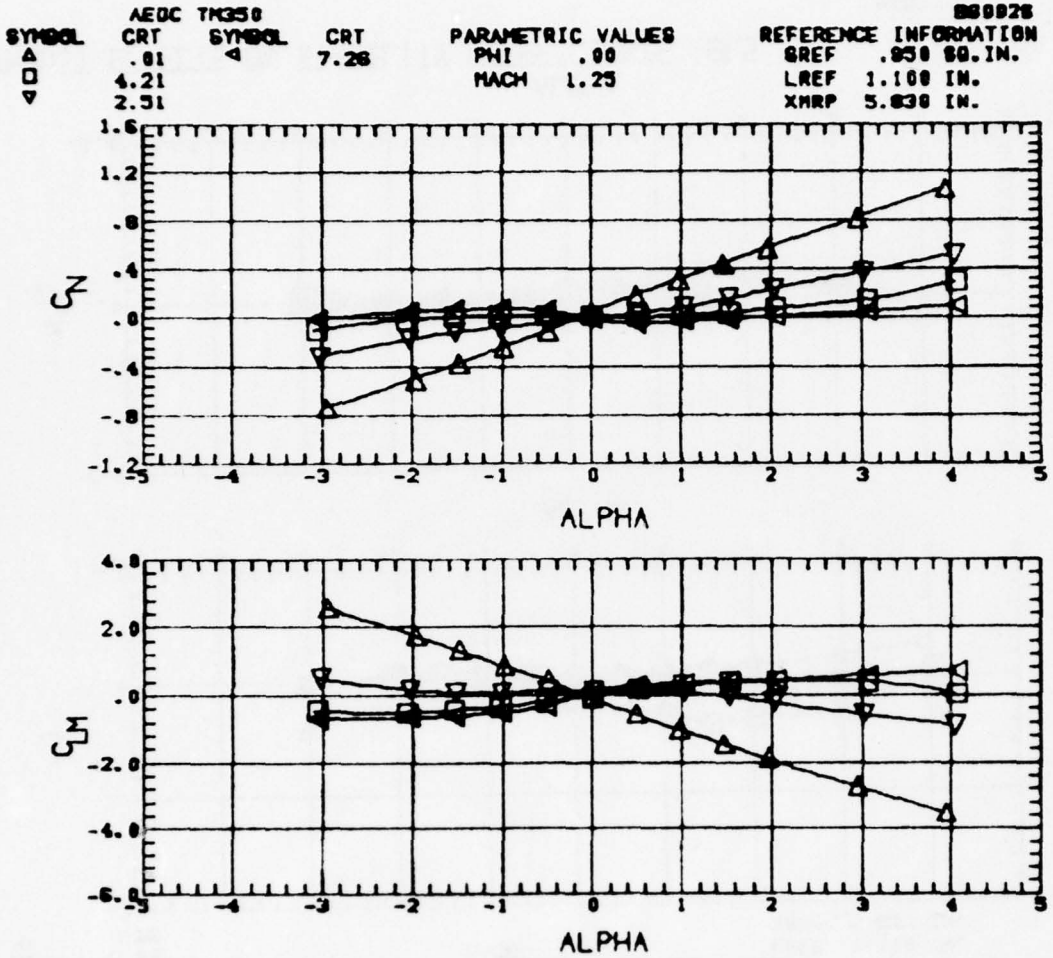
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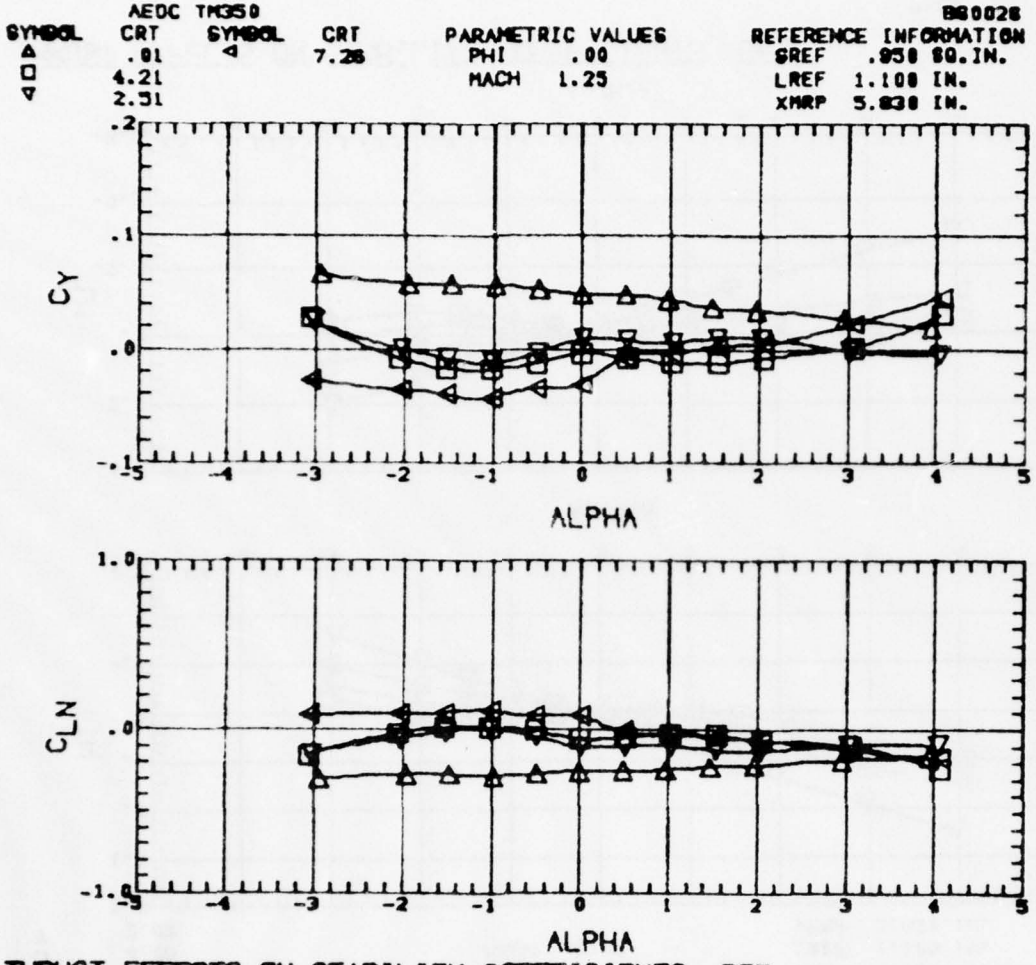
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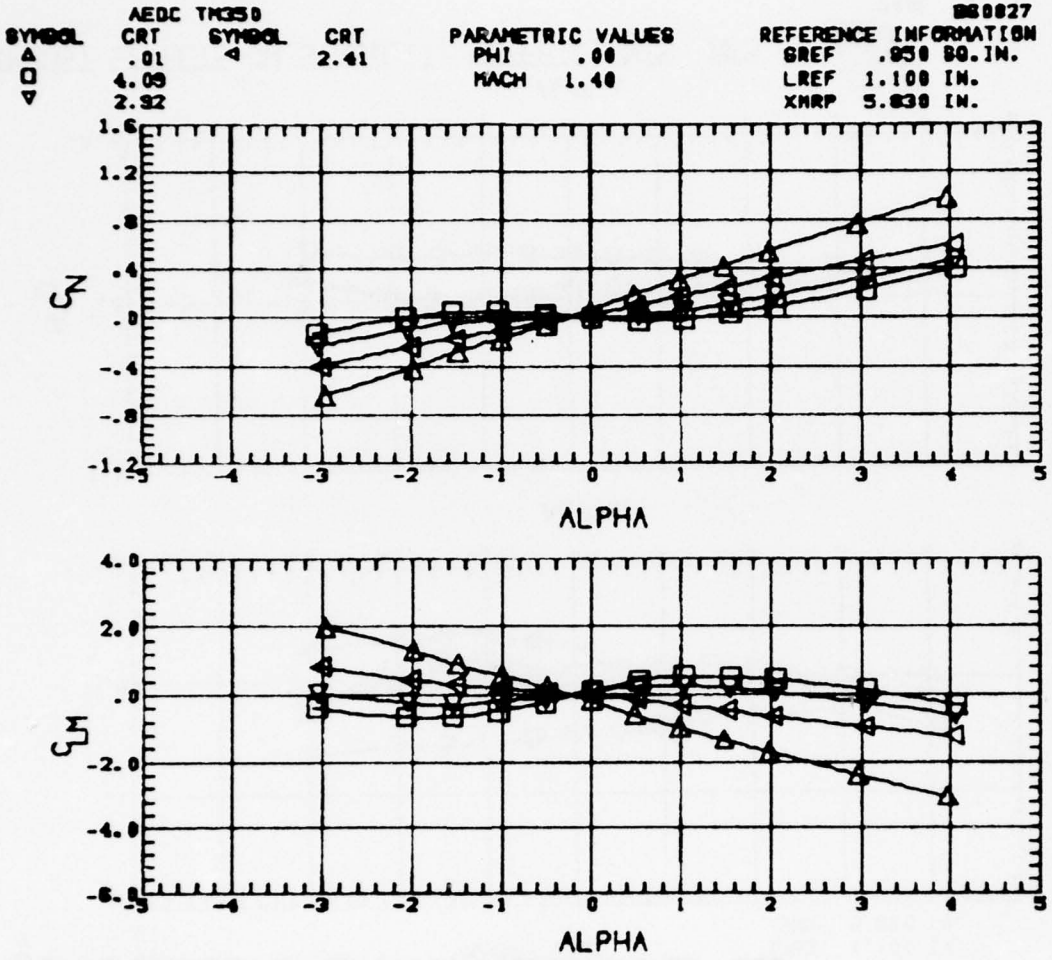
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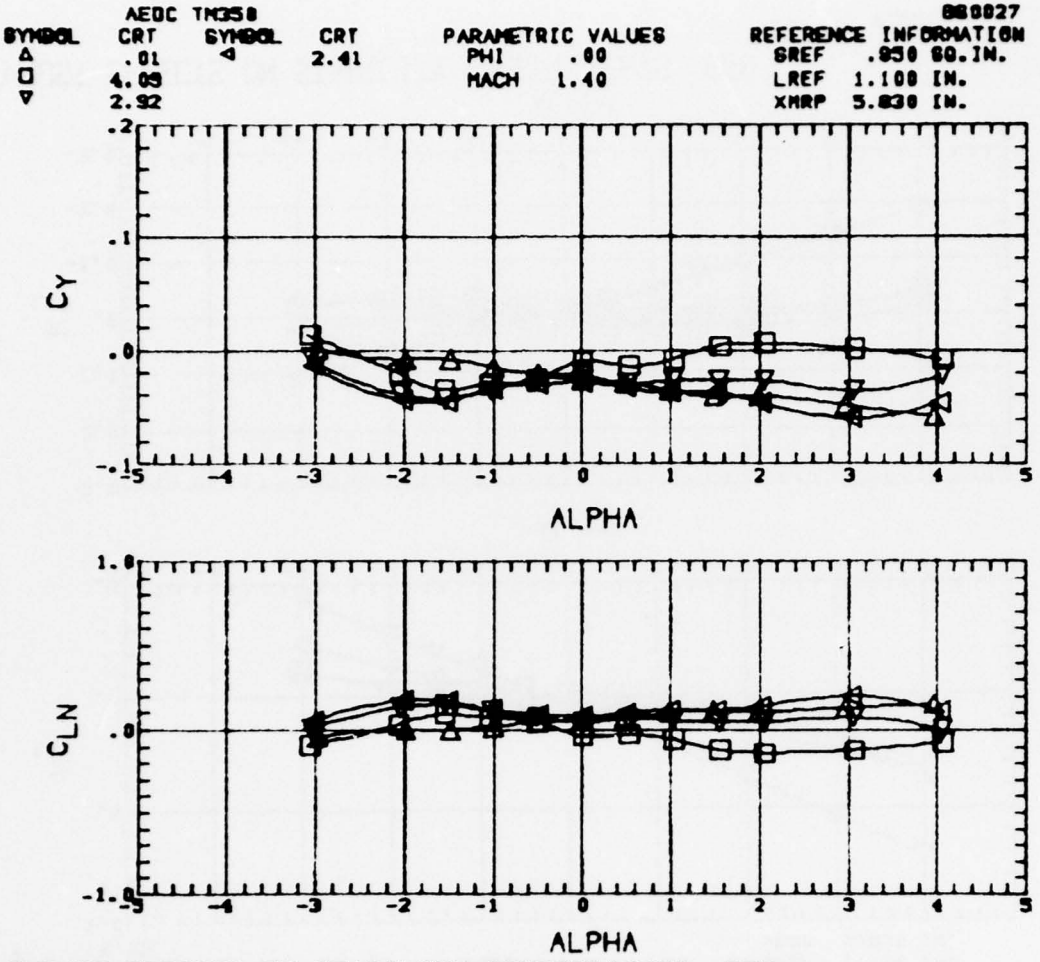
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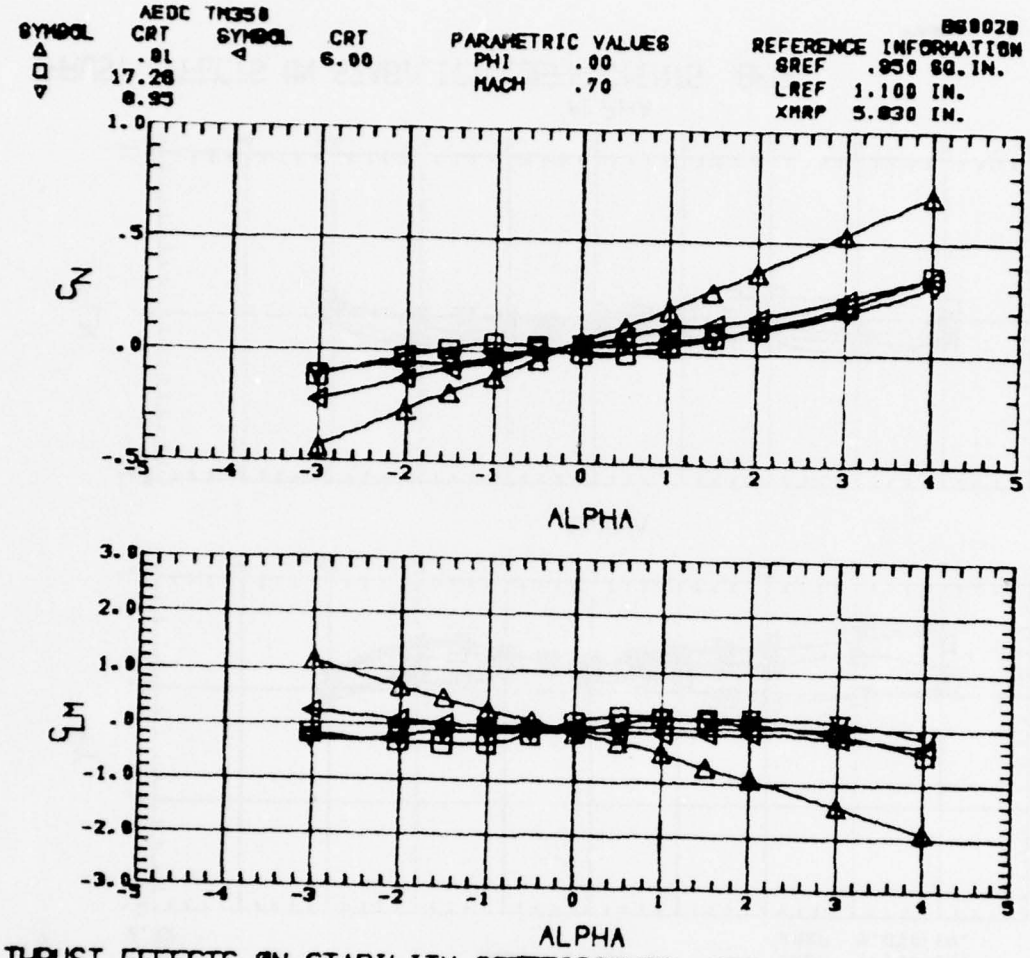
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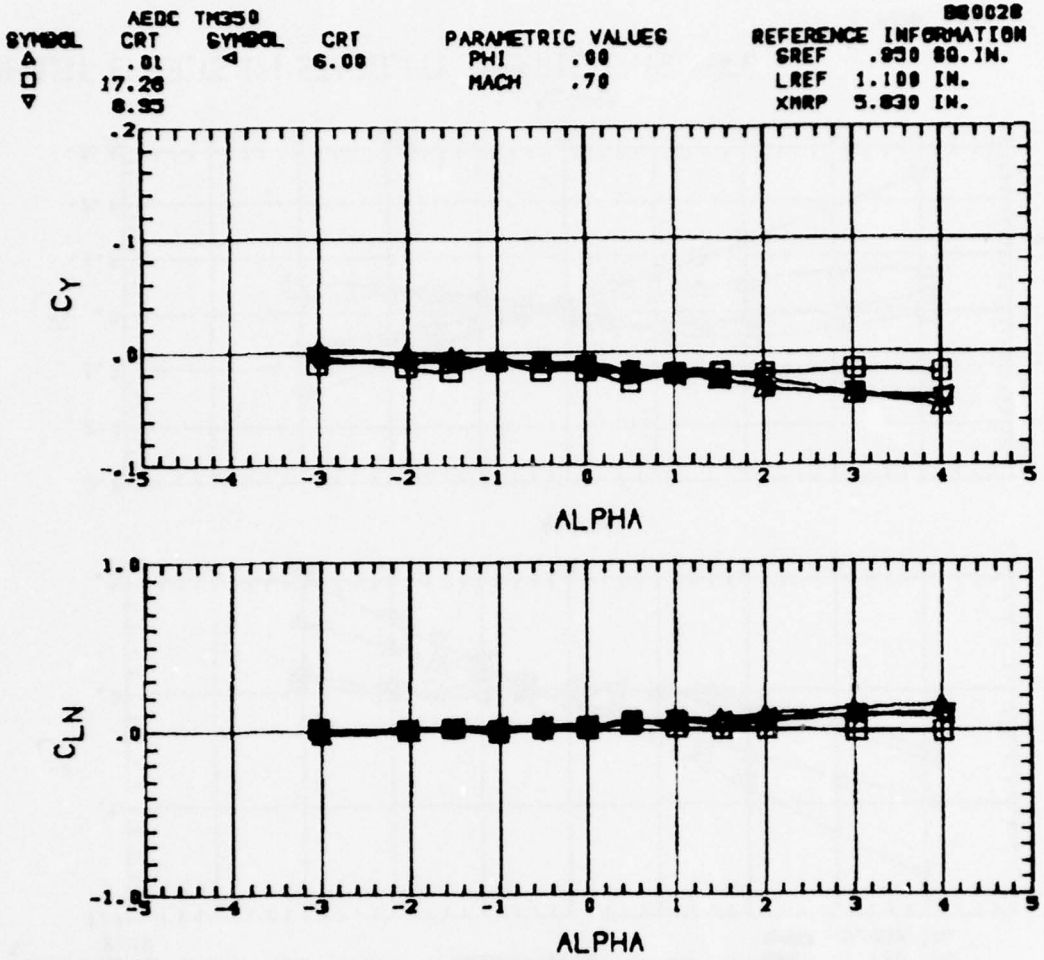
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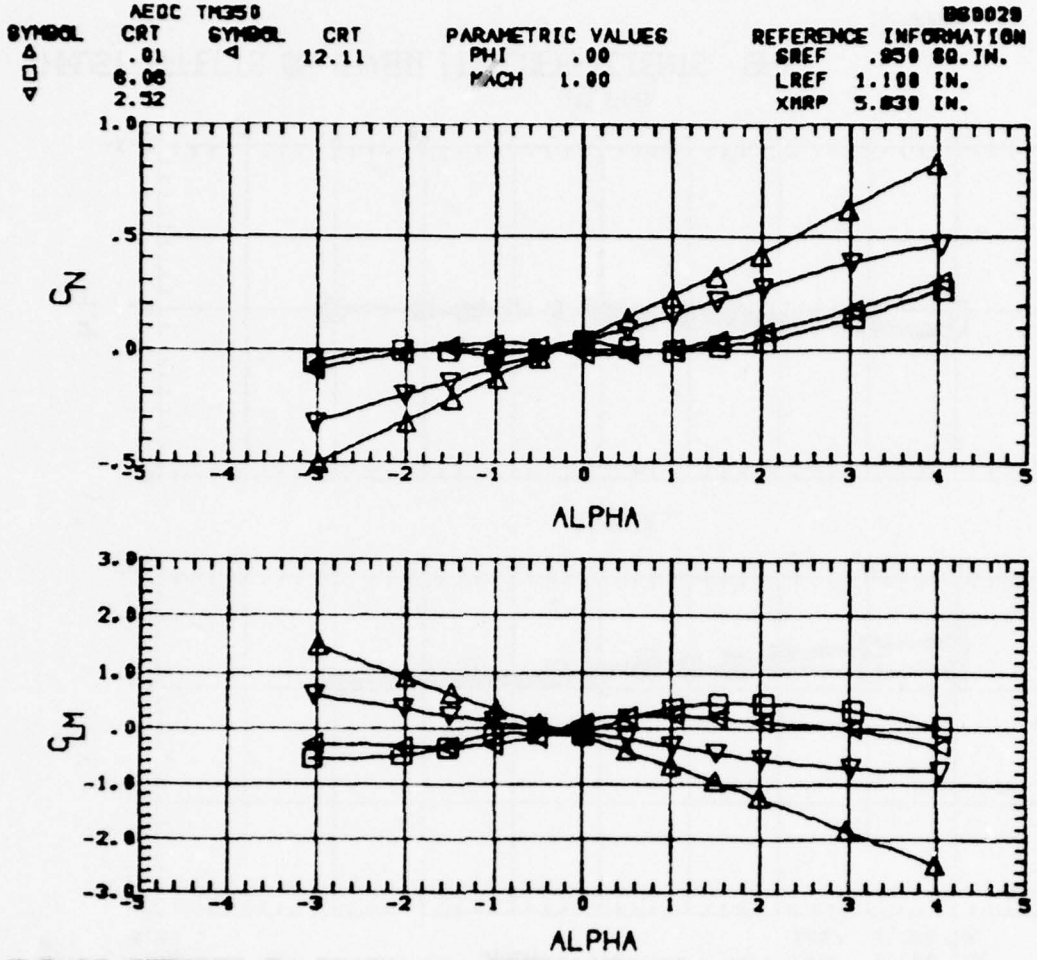
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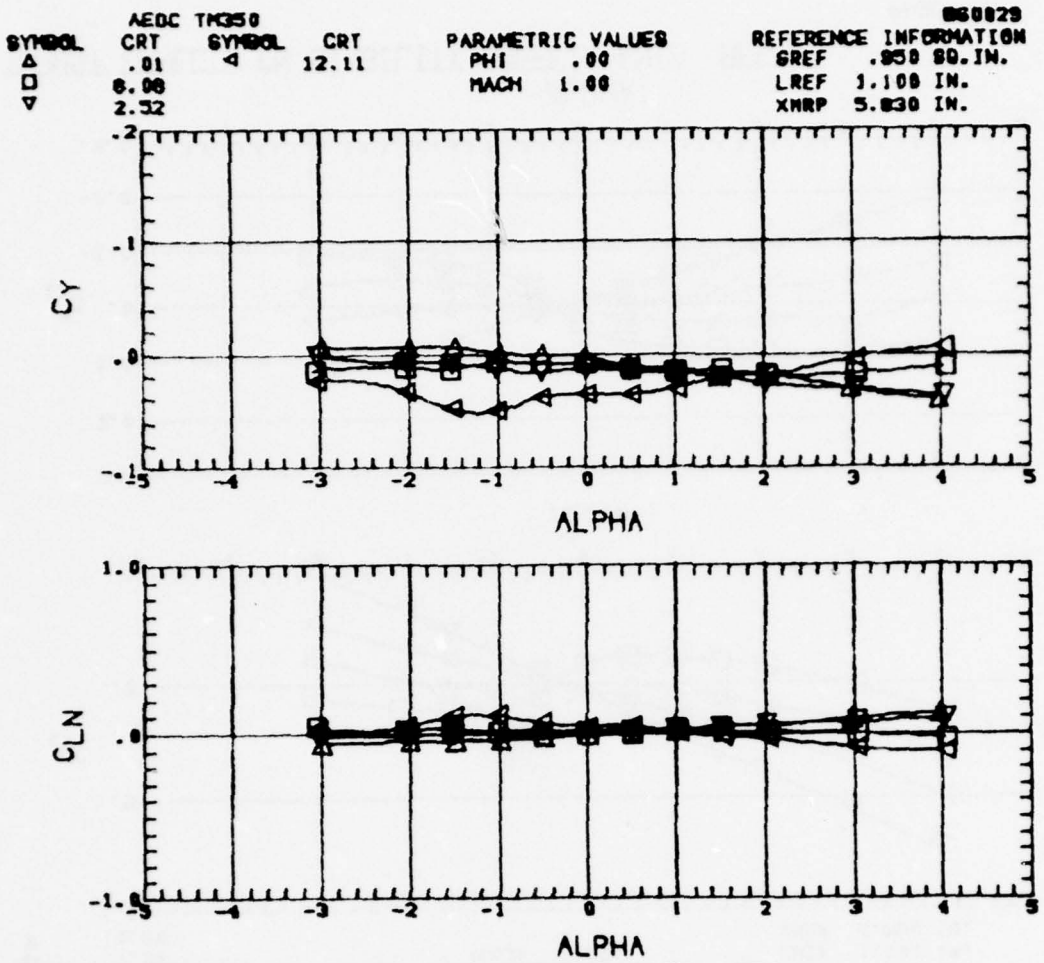
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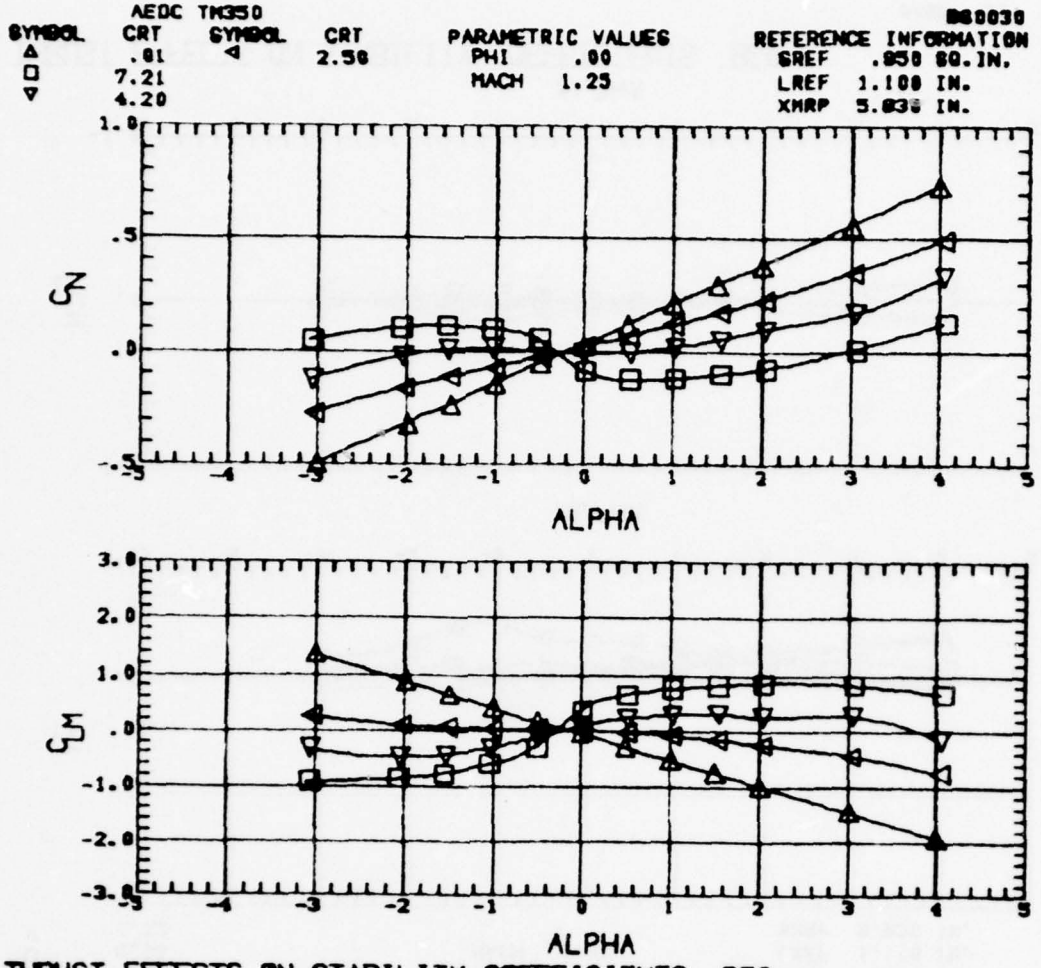
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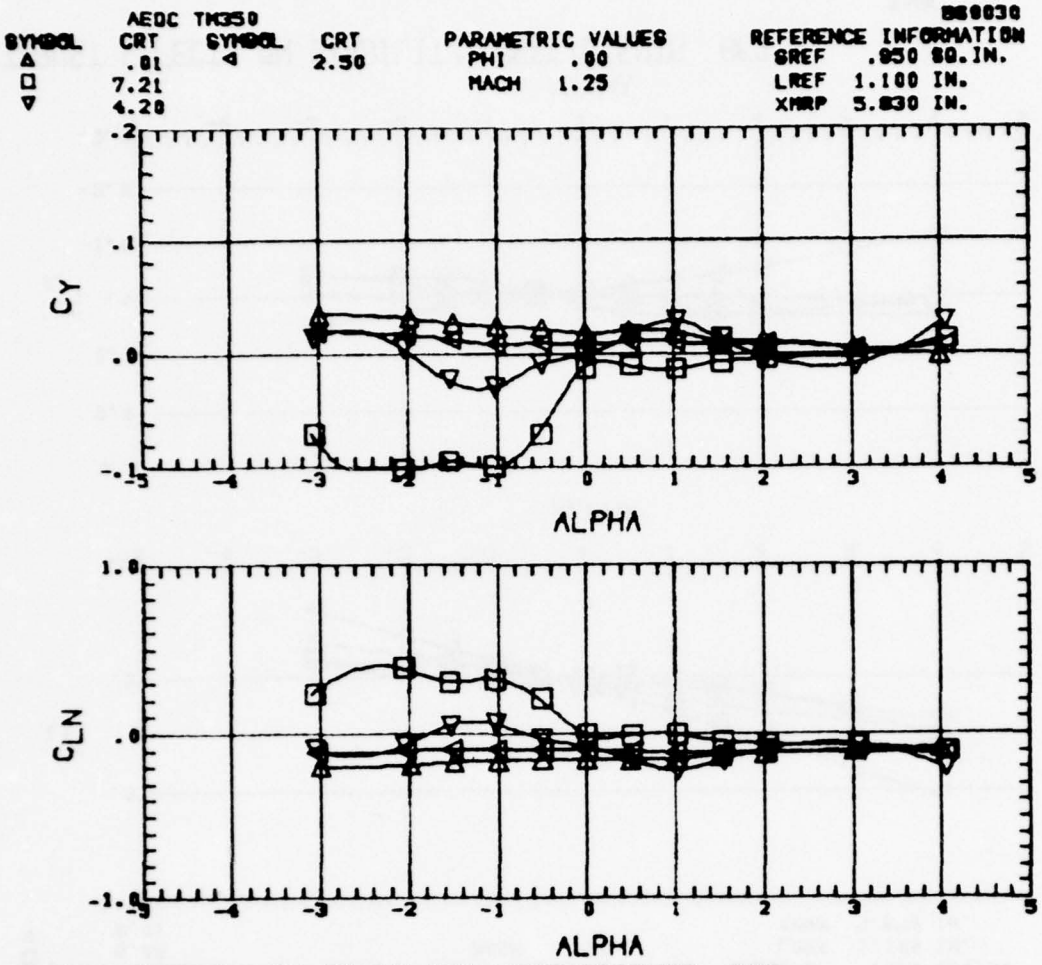
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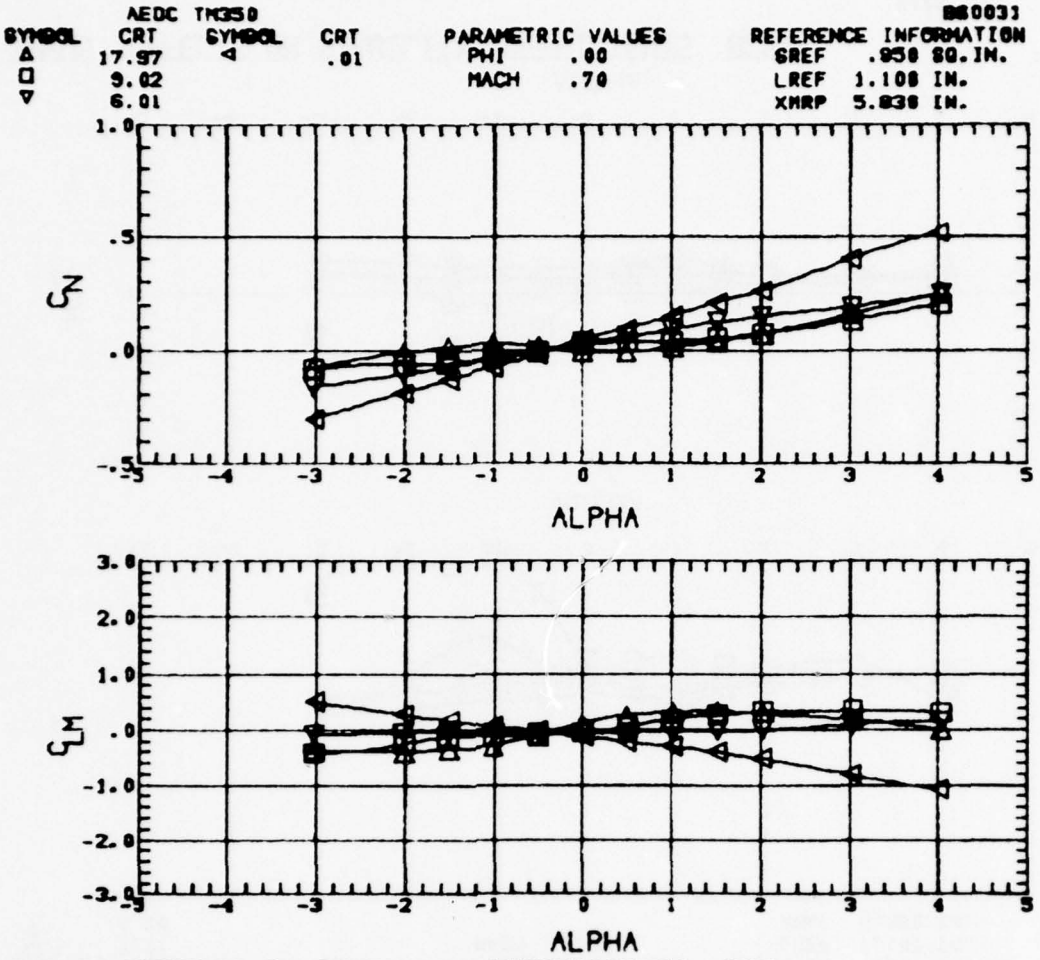
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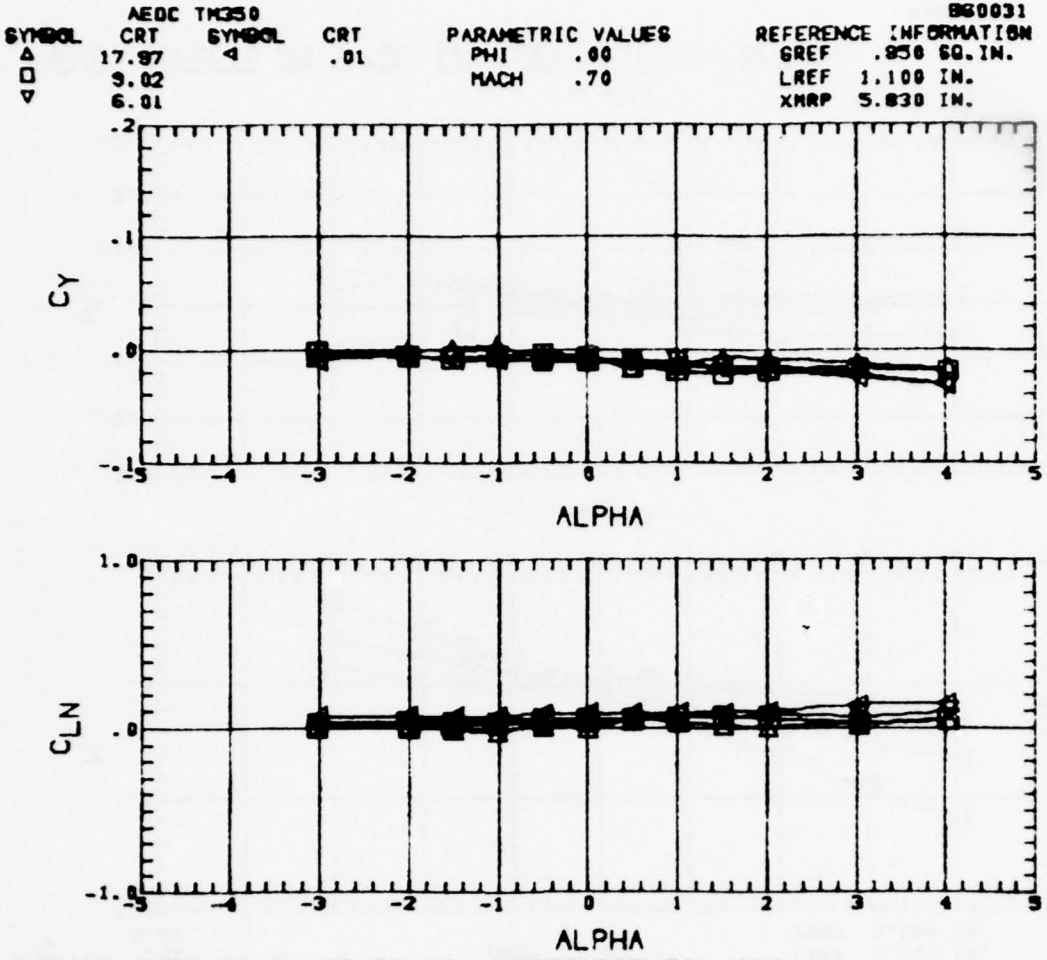
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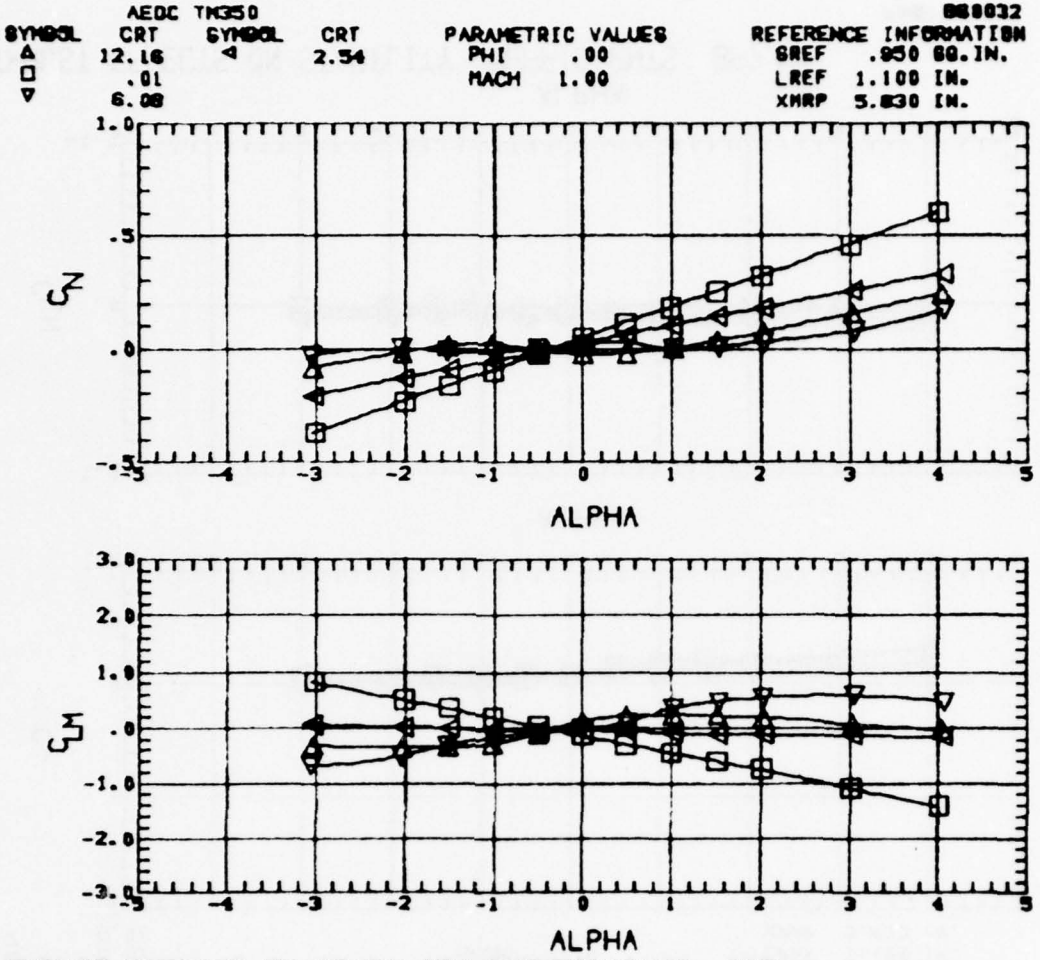
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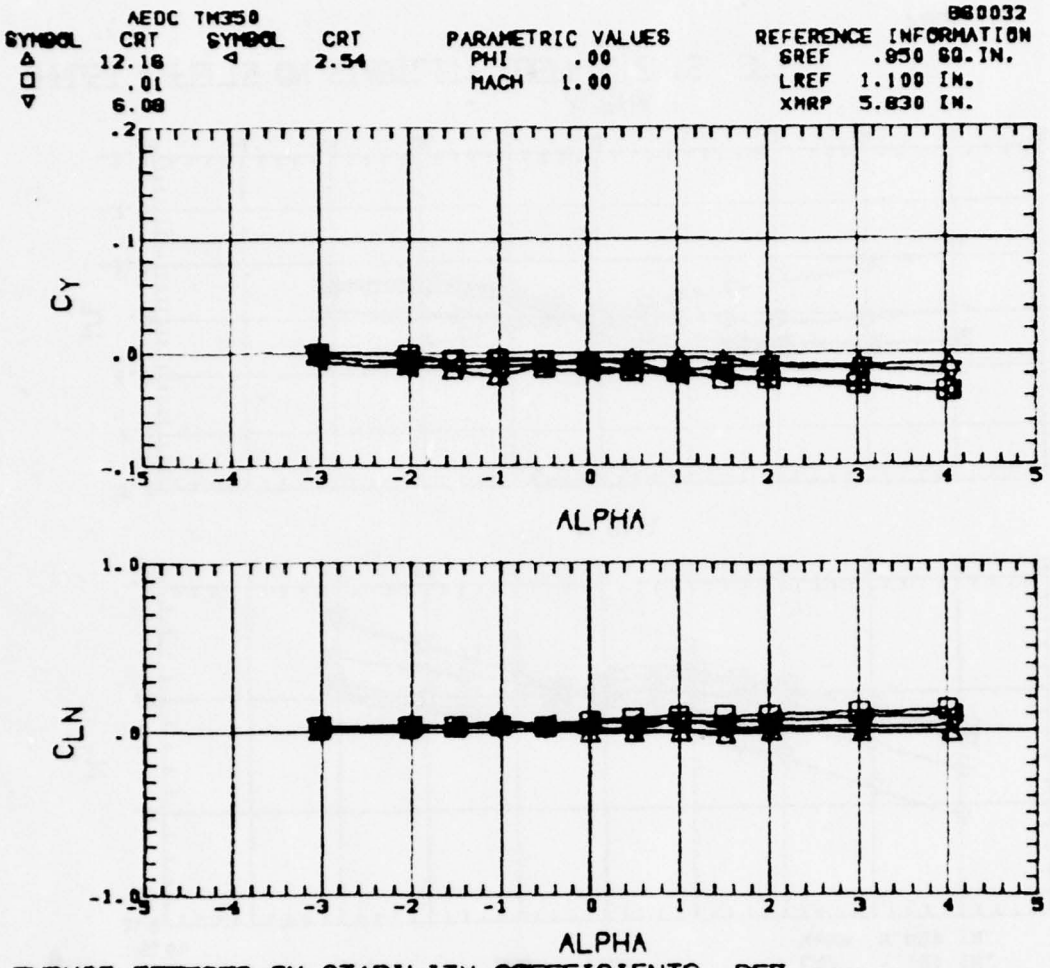
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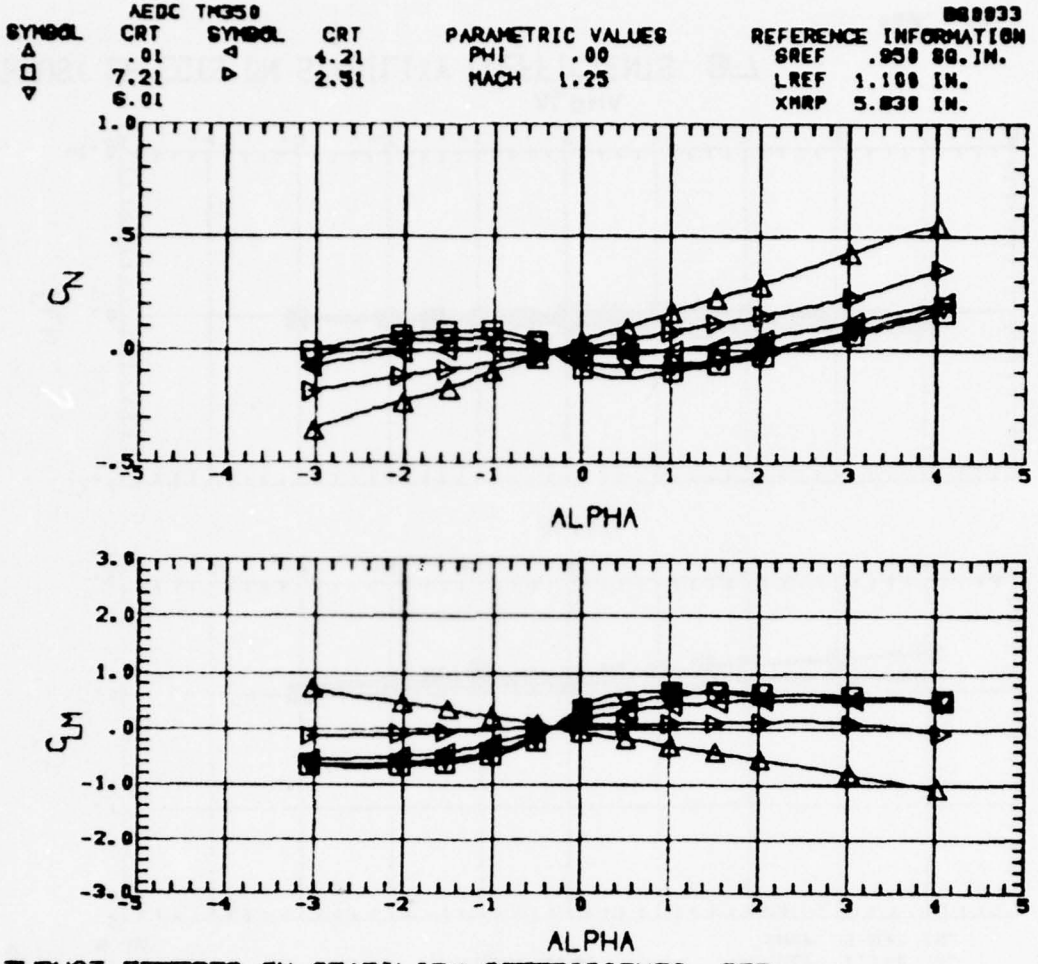
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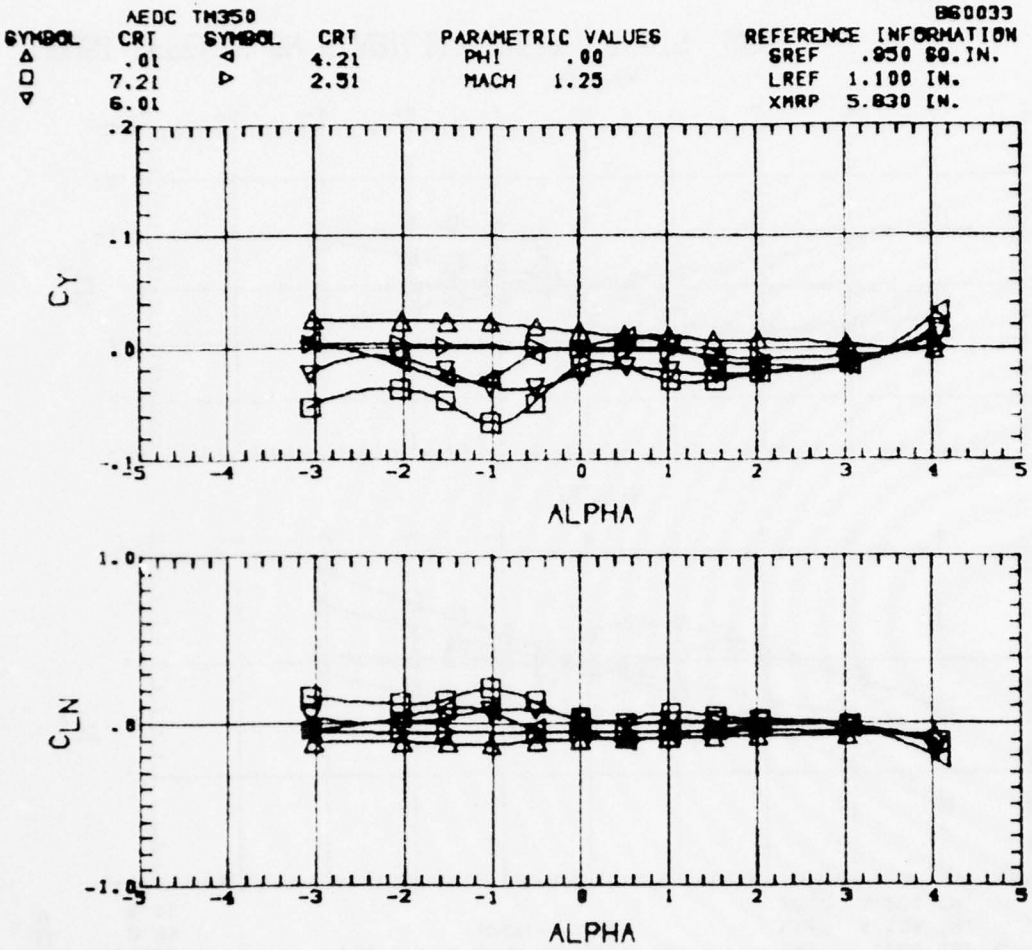
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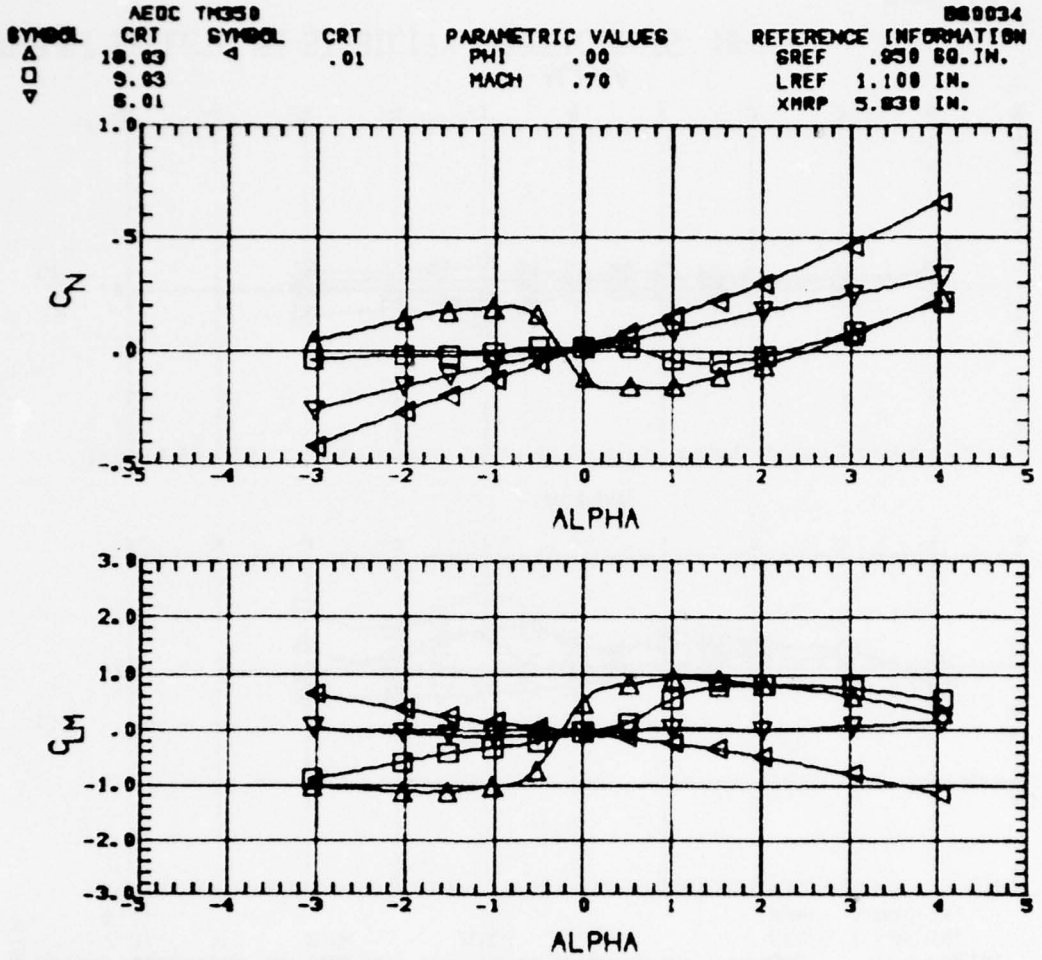
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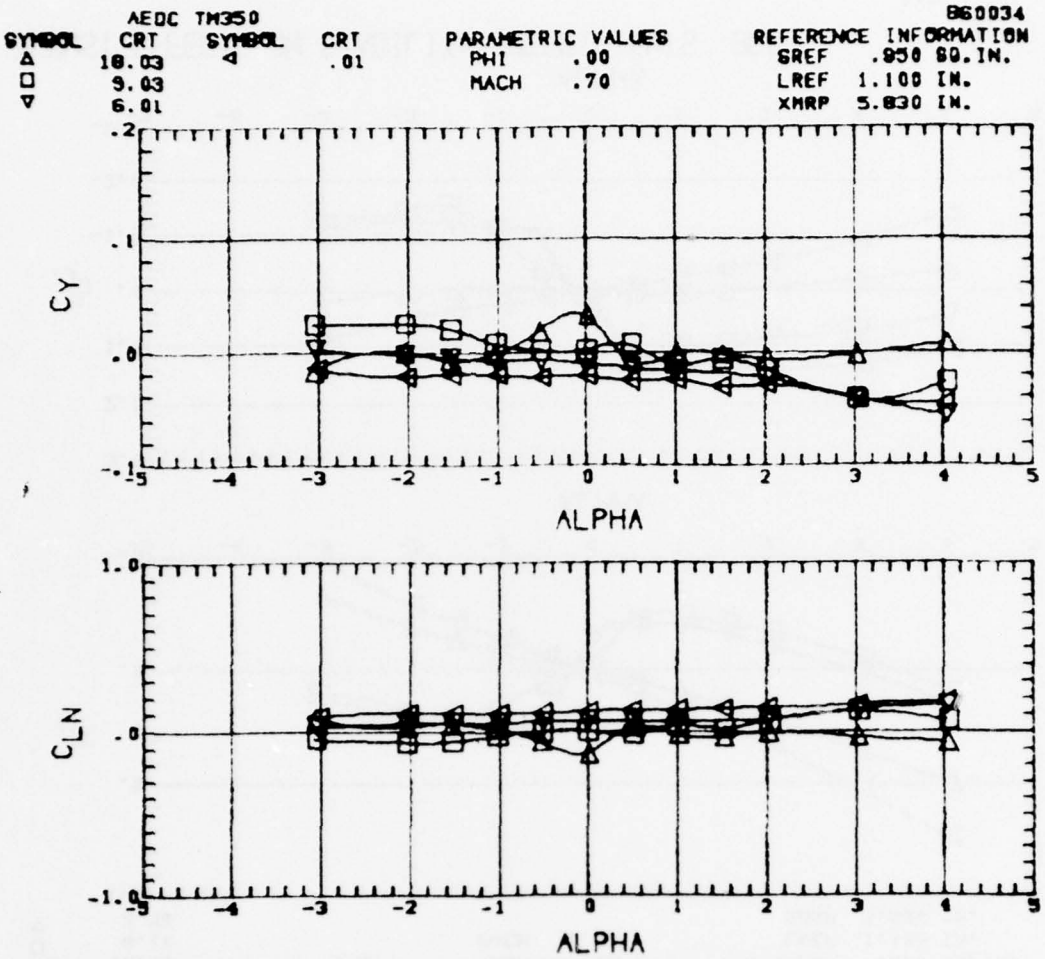
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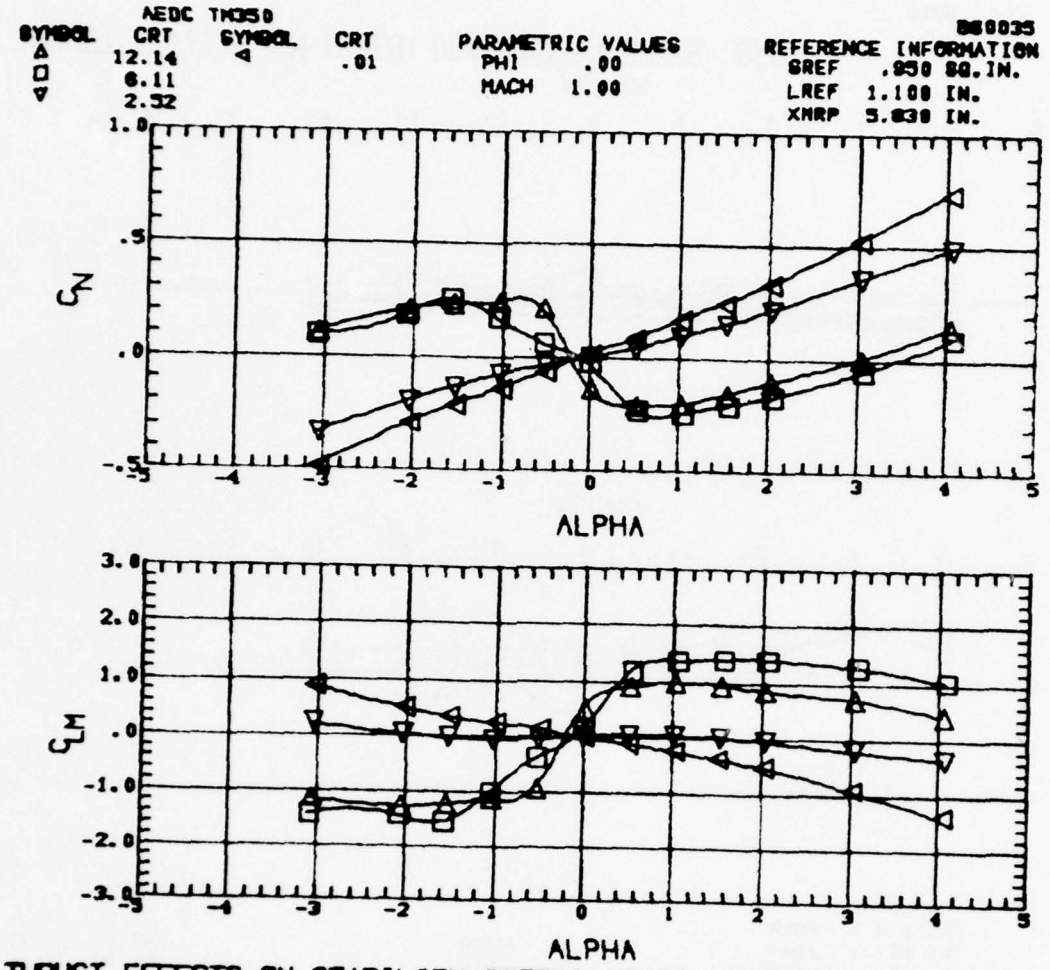
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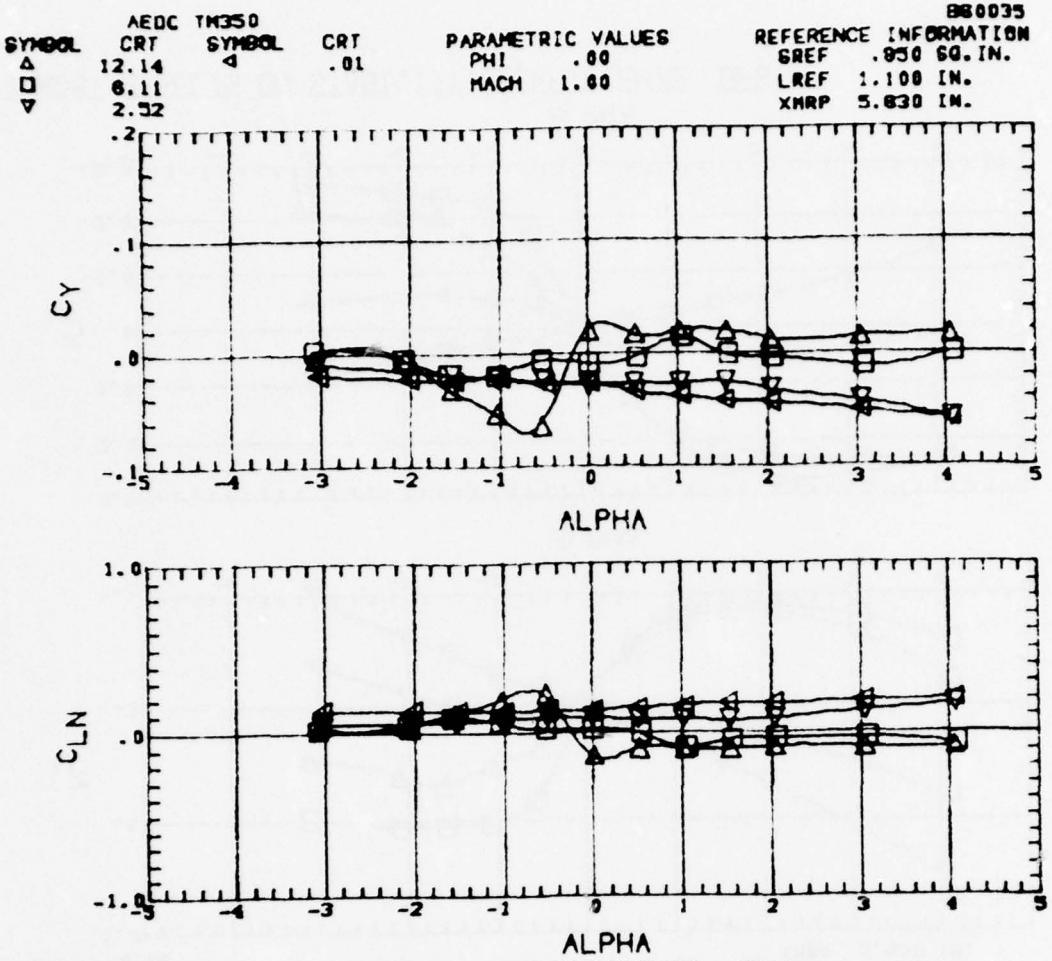
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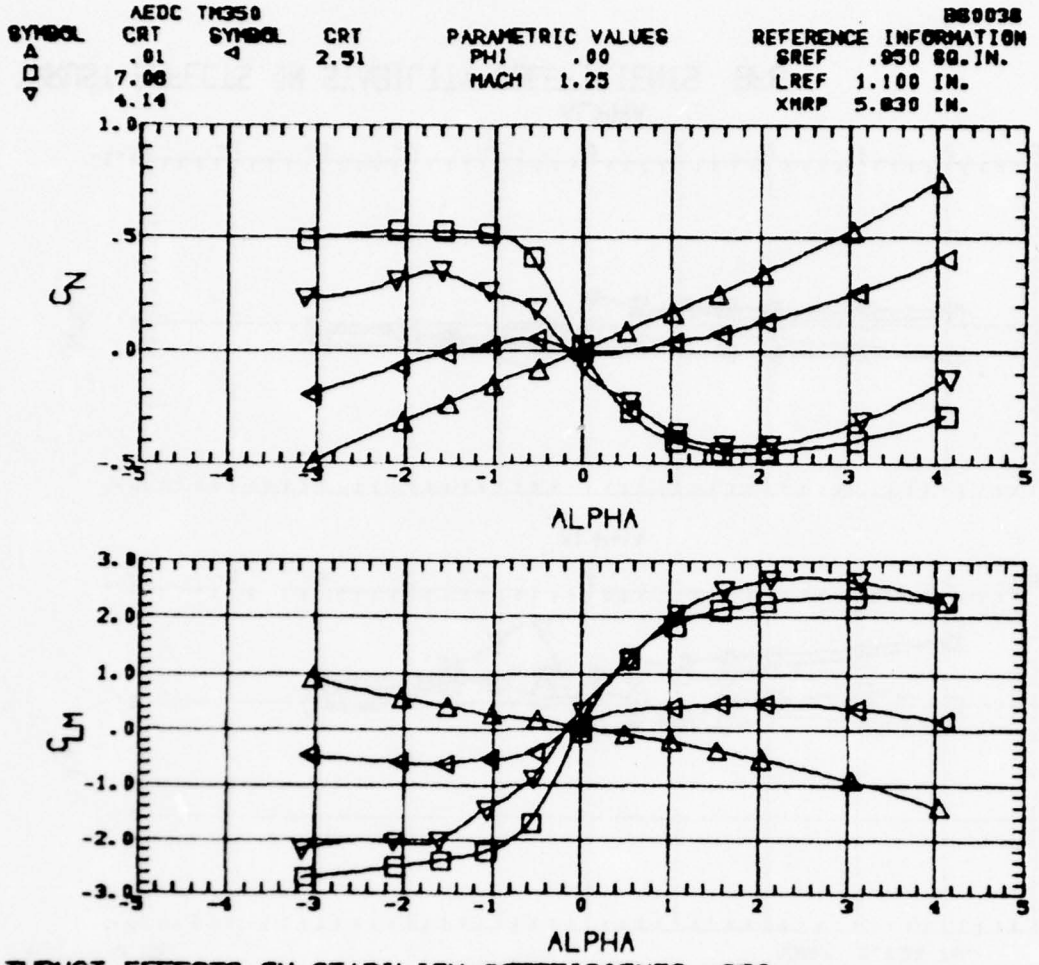
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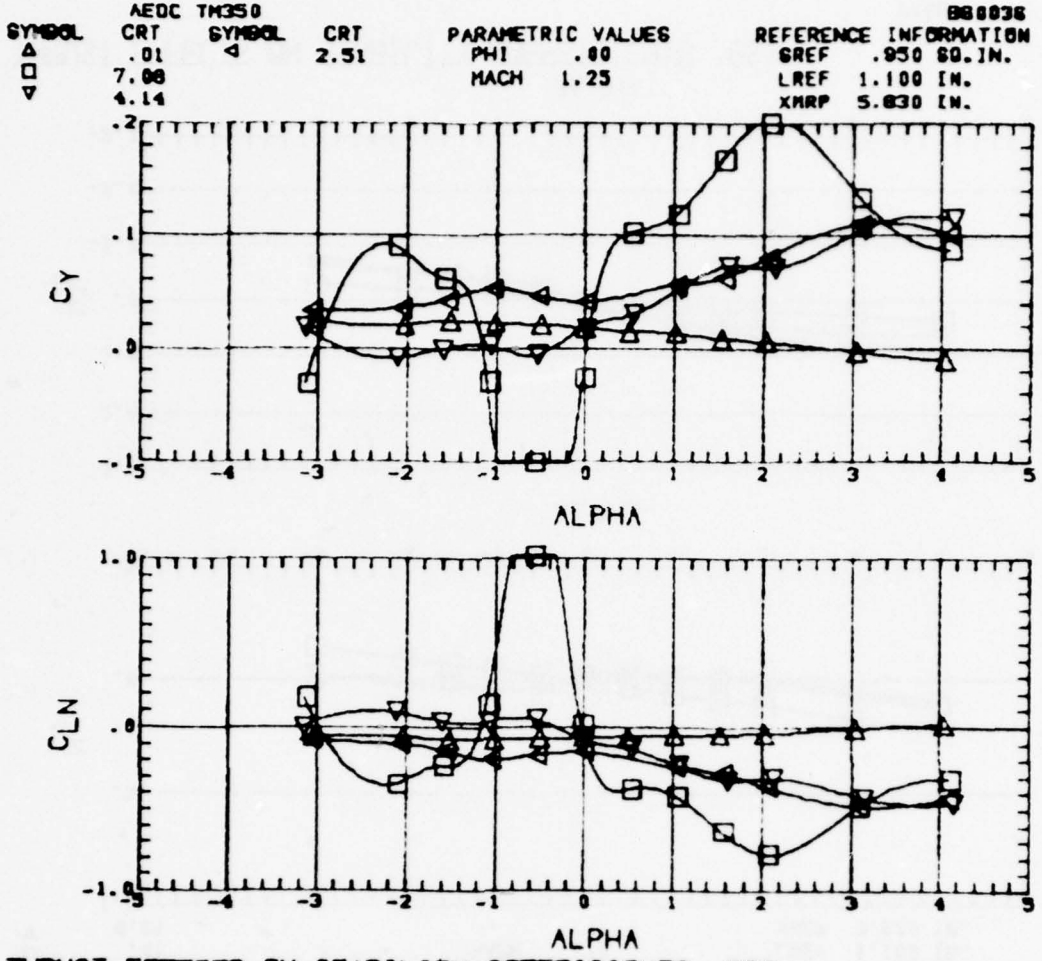
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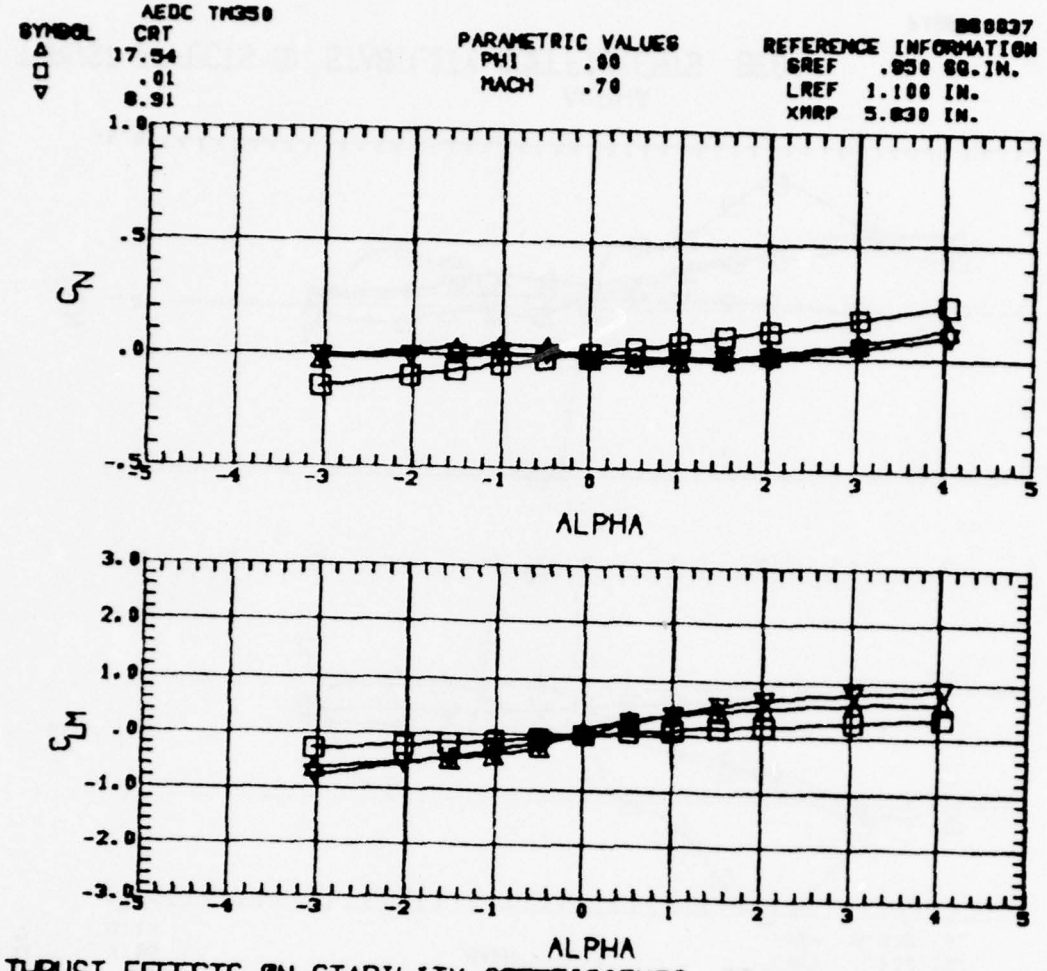
THRUST EFFECTS ON STABILITY COEFFICIENTS BF8



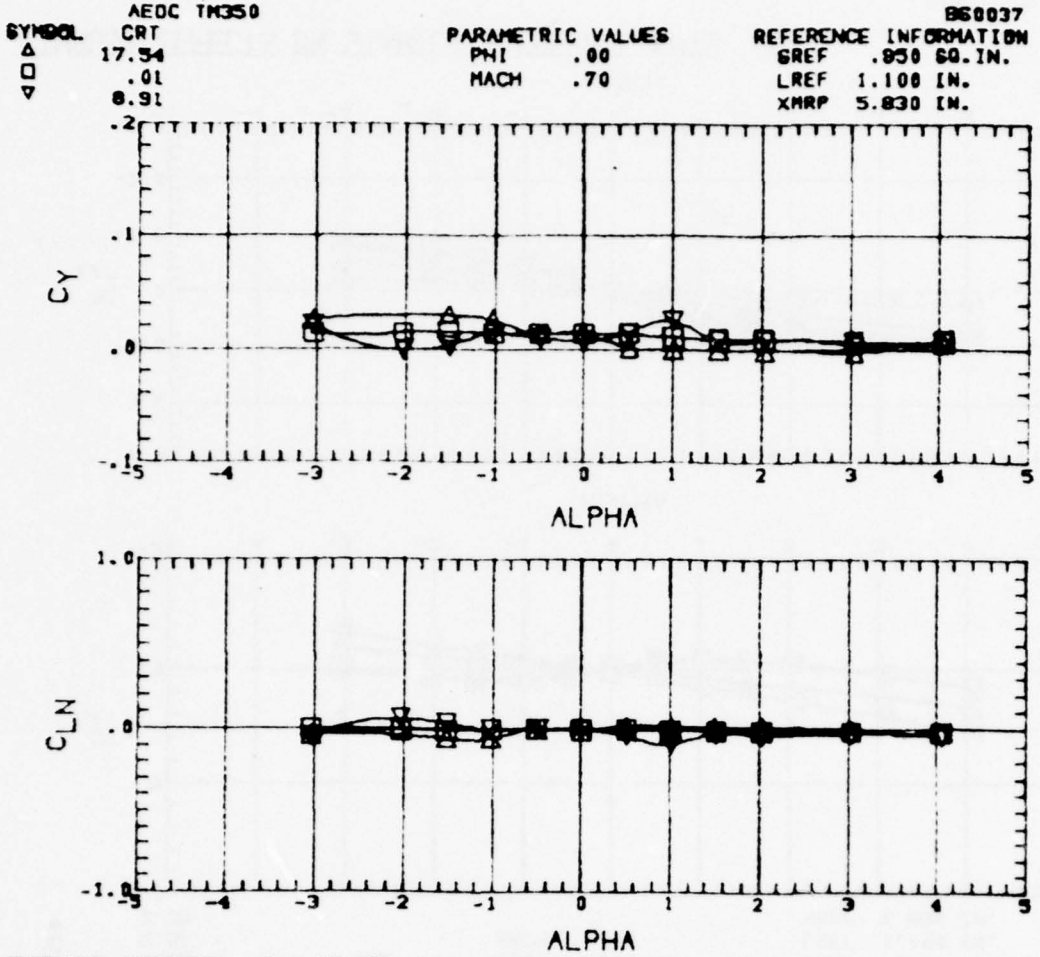
THRUST EFFECTS ON STABILITY COEFFICIENTS BF8



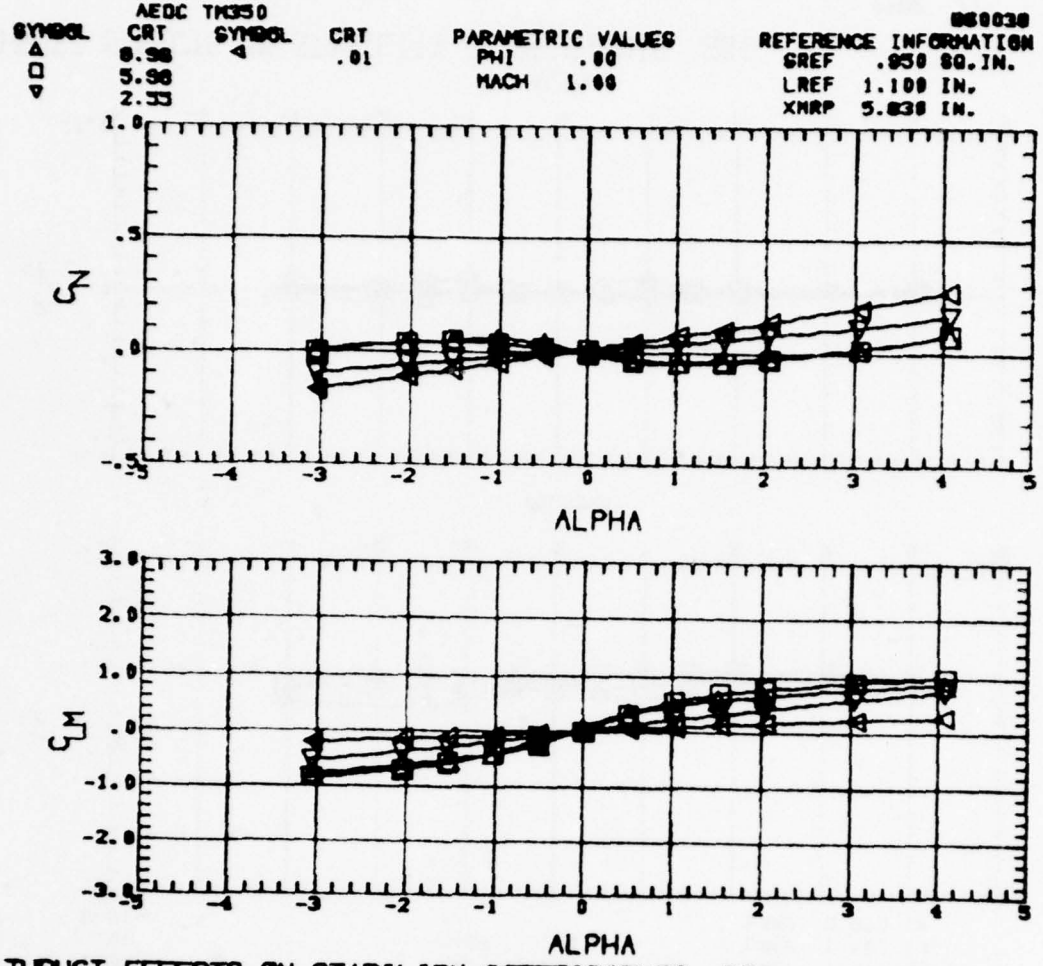
THRUST EFFECTS ON STABILITY COEFFICIENTS BF8



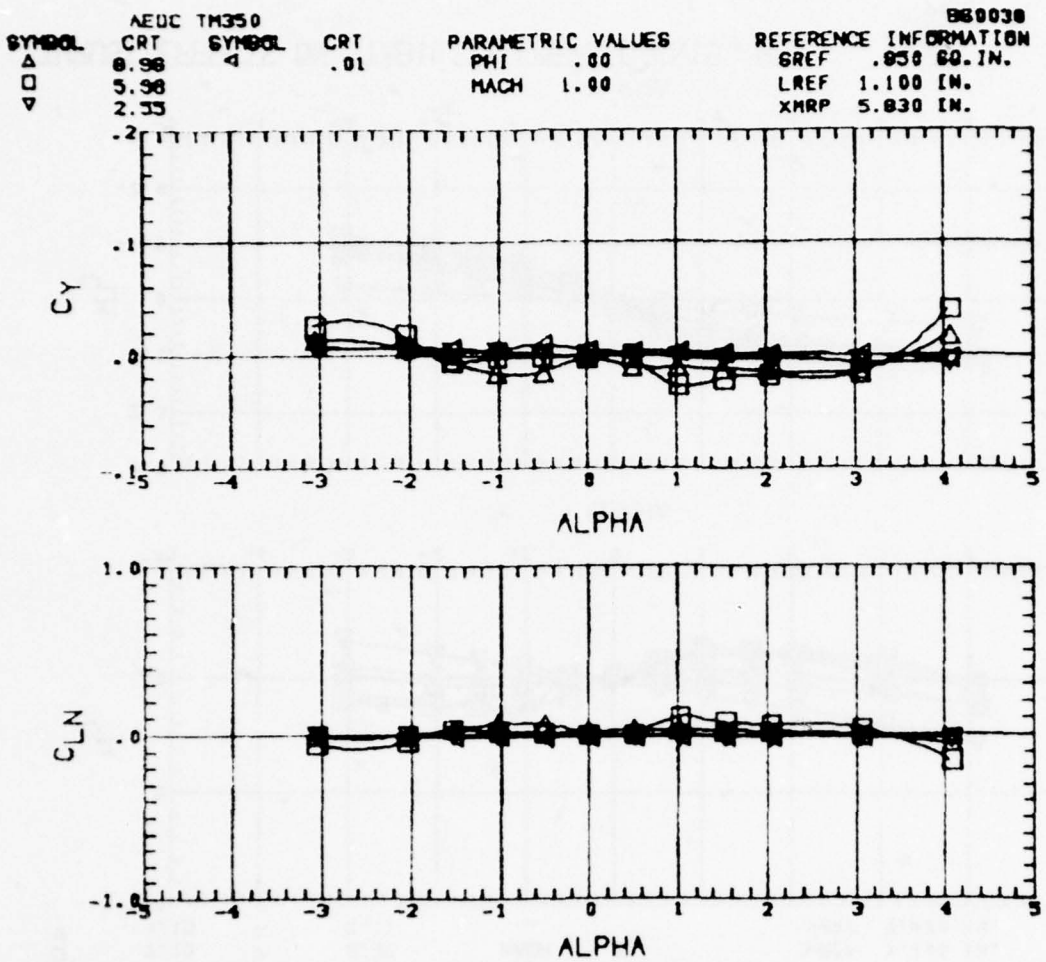
THRUST EFFECTS ON STABILITY COEFFICIENTS BS1



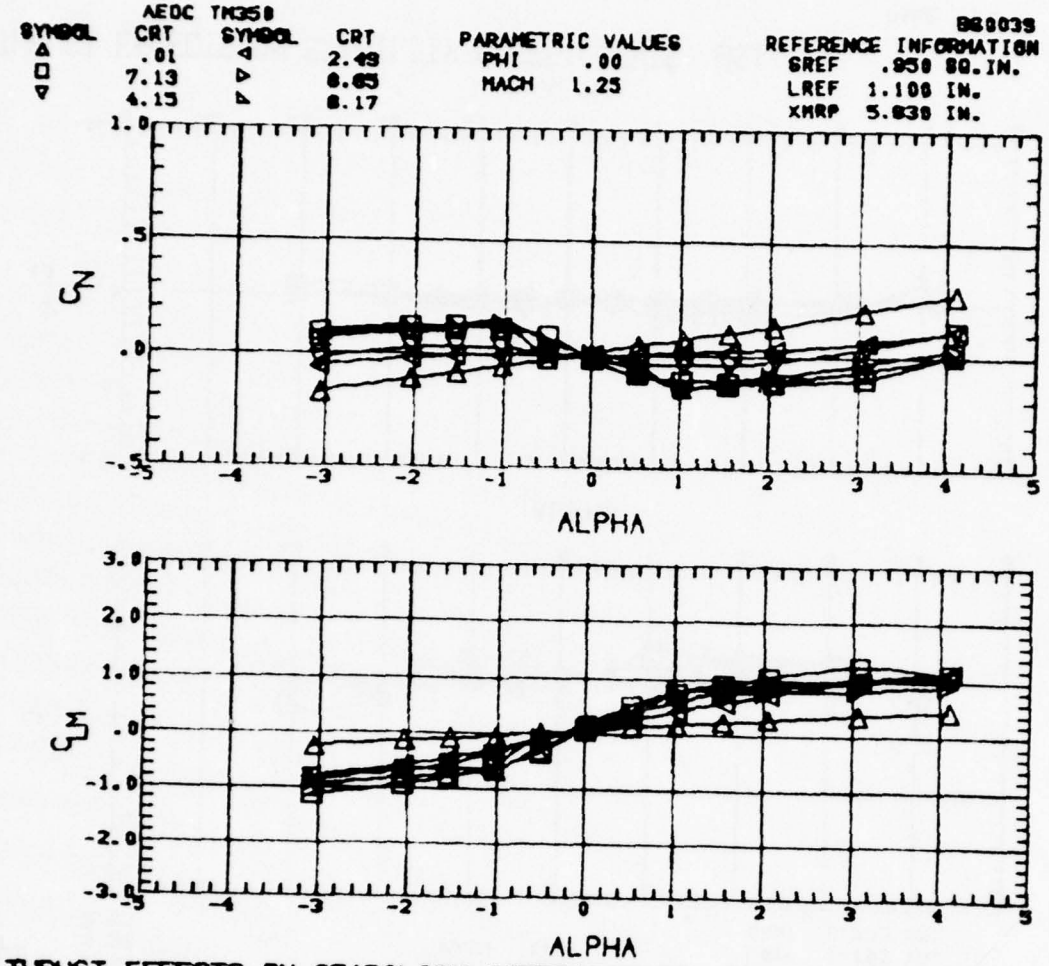
THRUST EFFECTS ON STABILITY COEFFICIENTS BS1



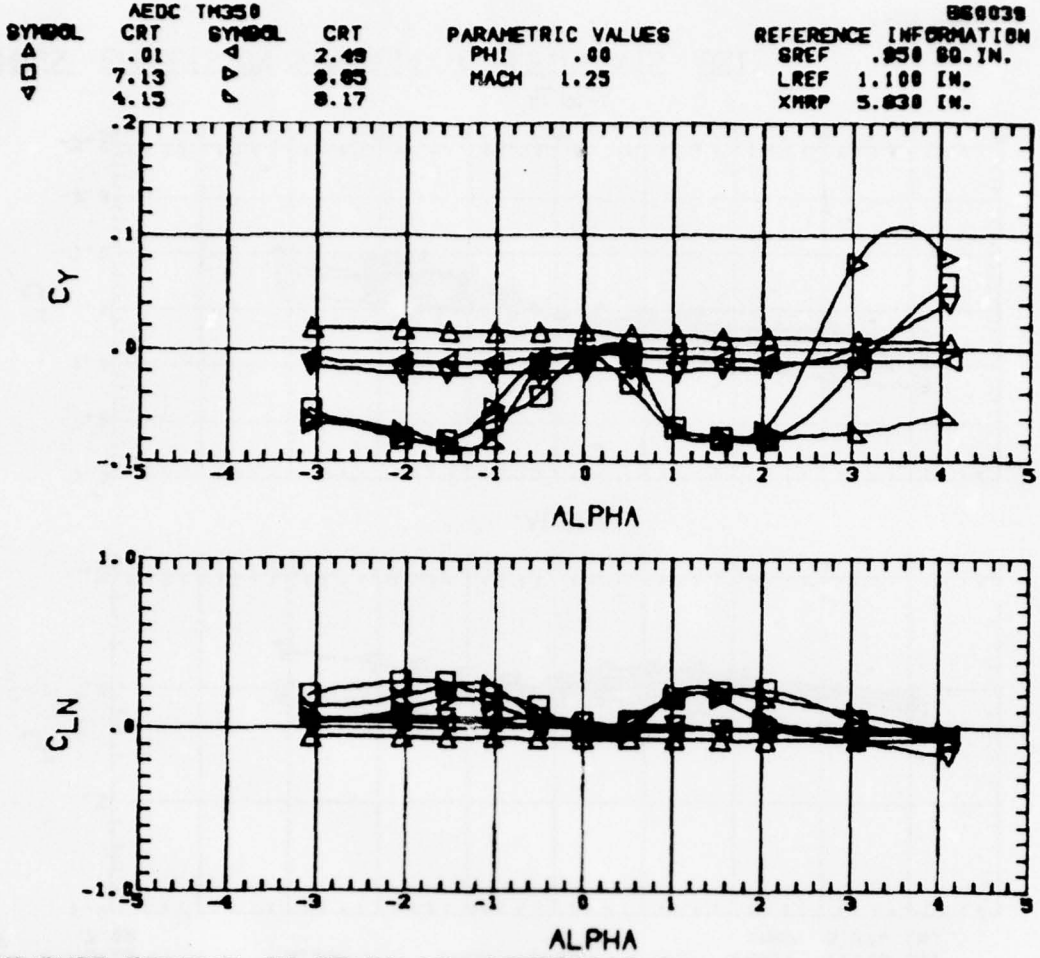
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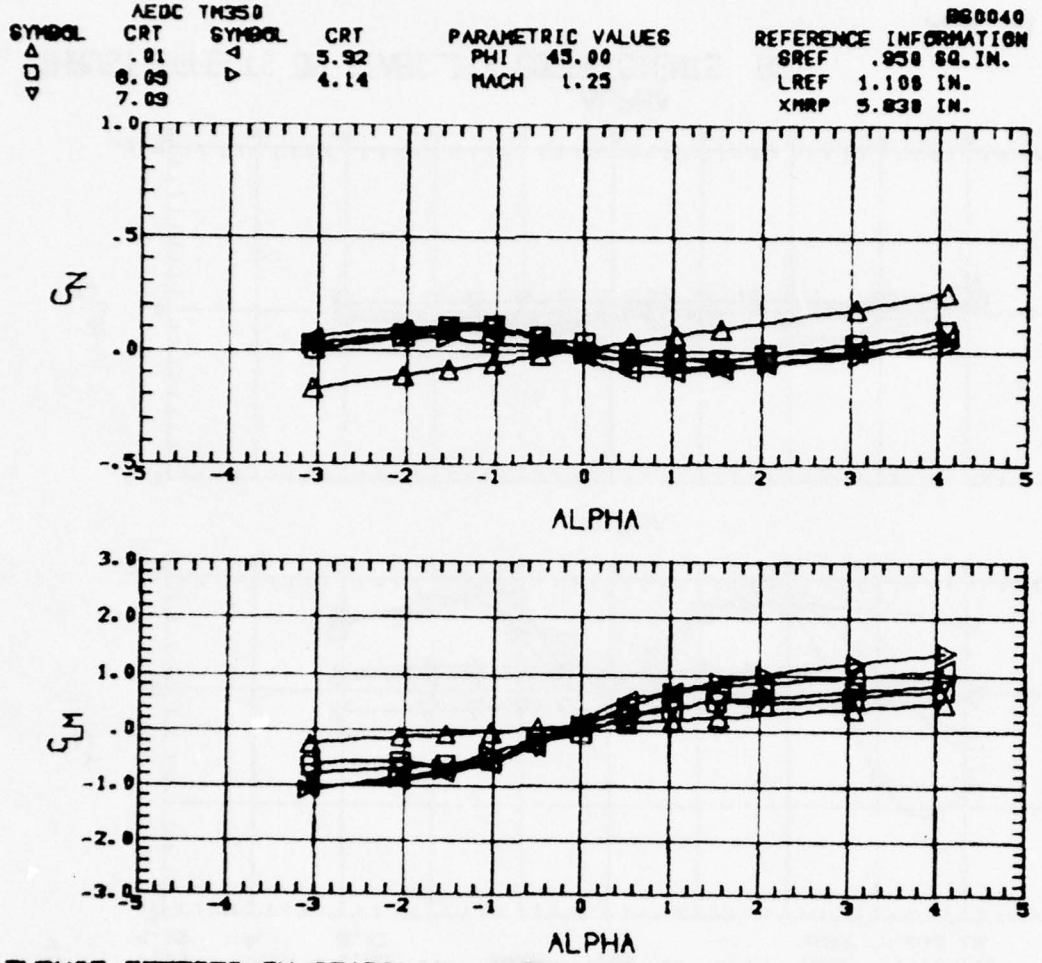
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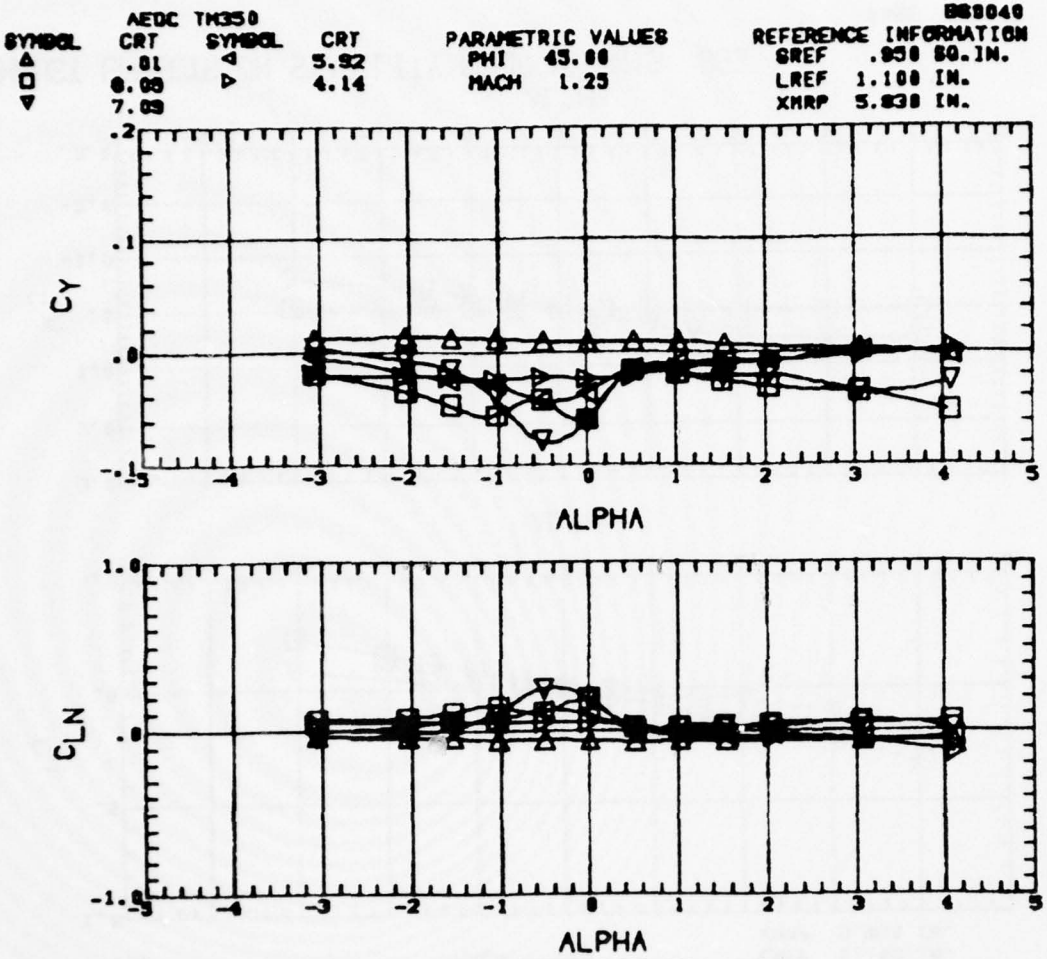
THRUST EFFECTS ON STABILITY COEFFICIENTS BS1



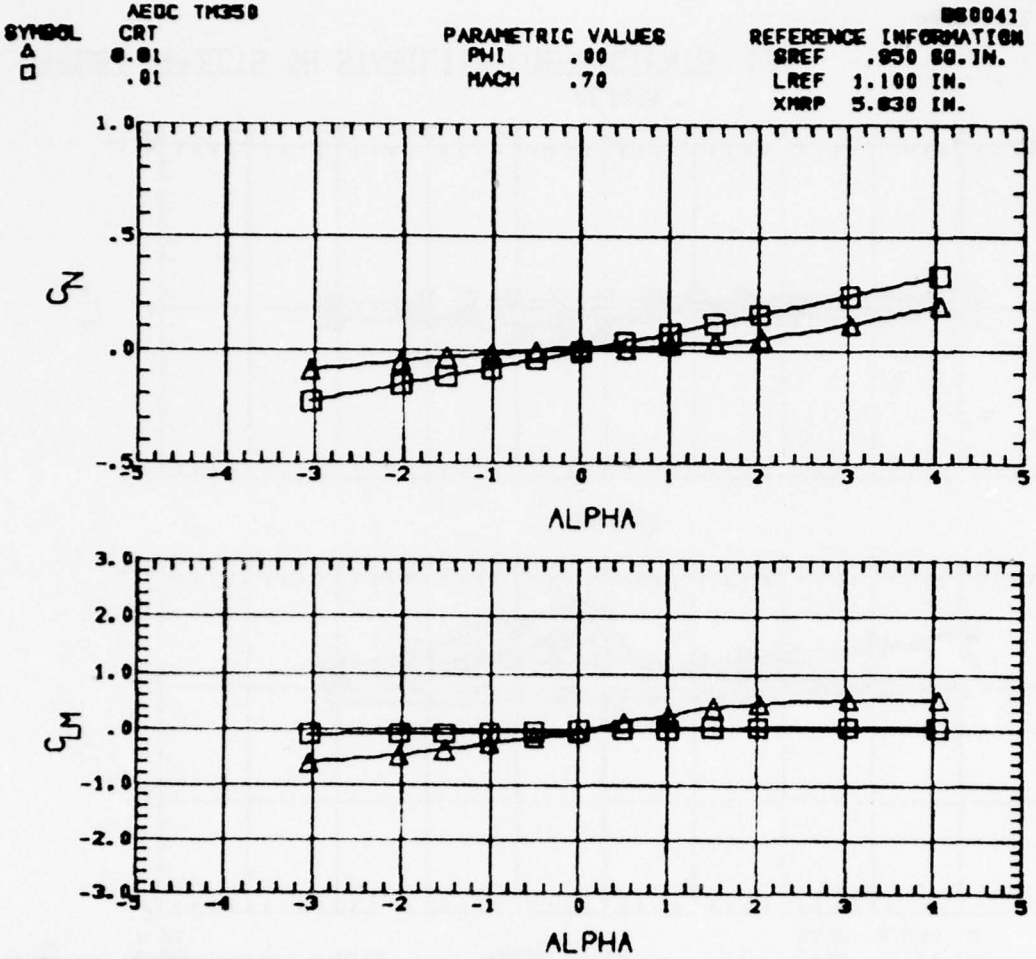
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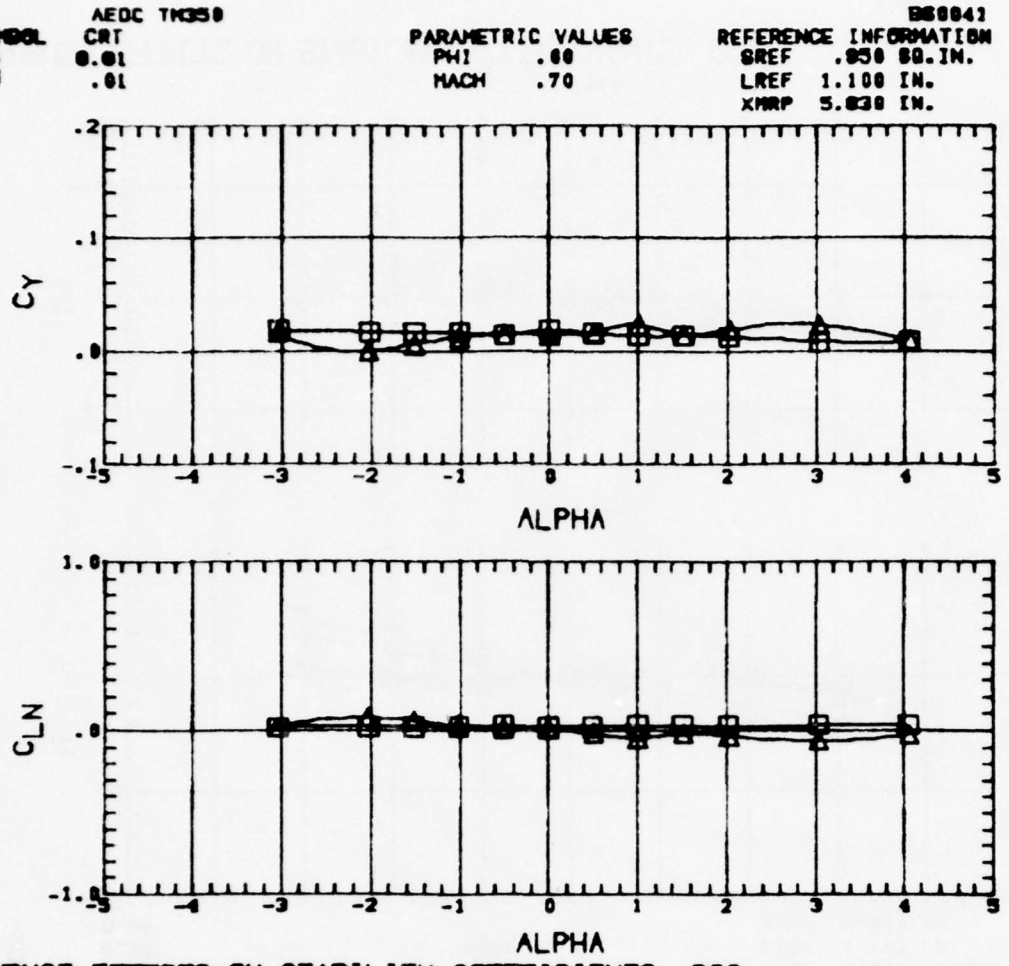
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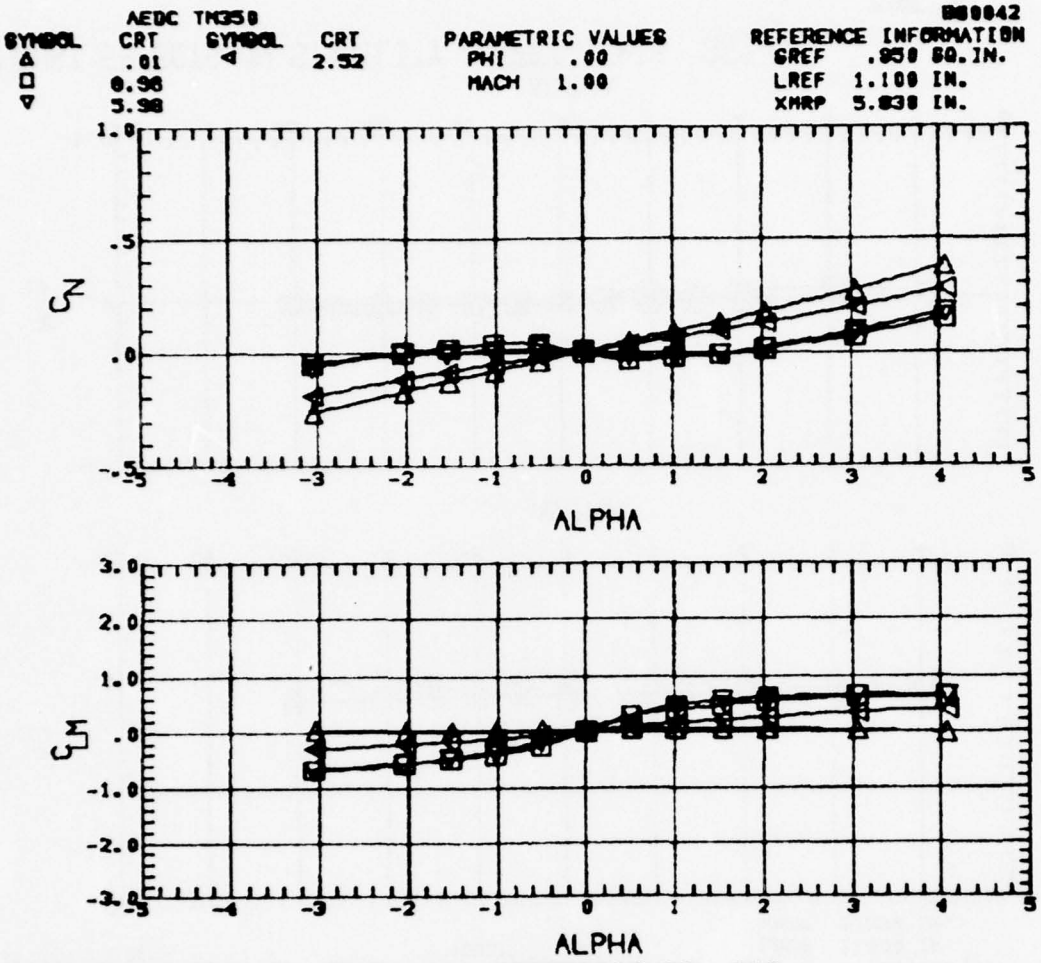
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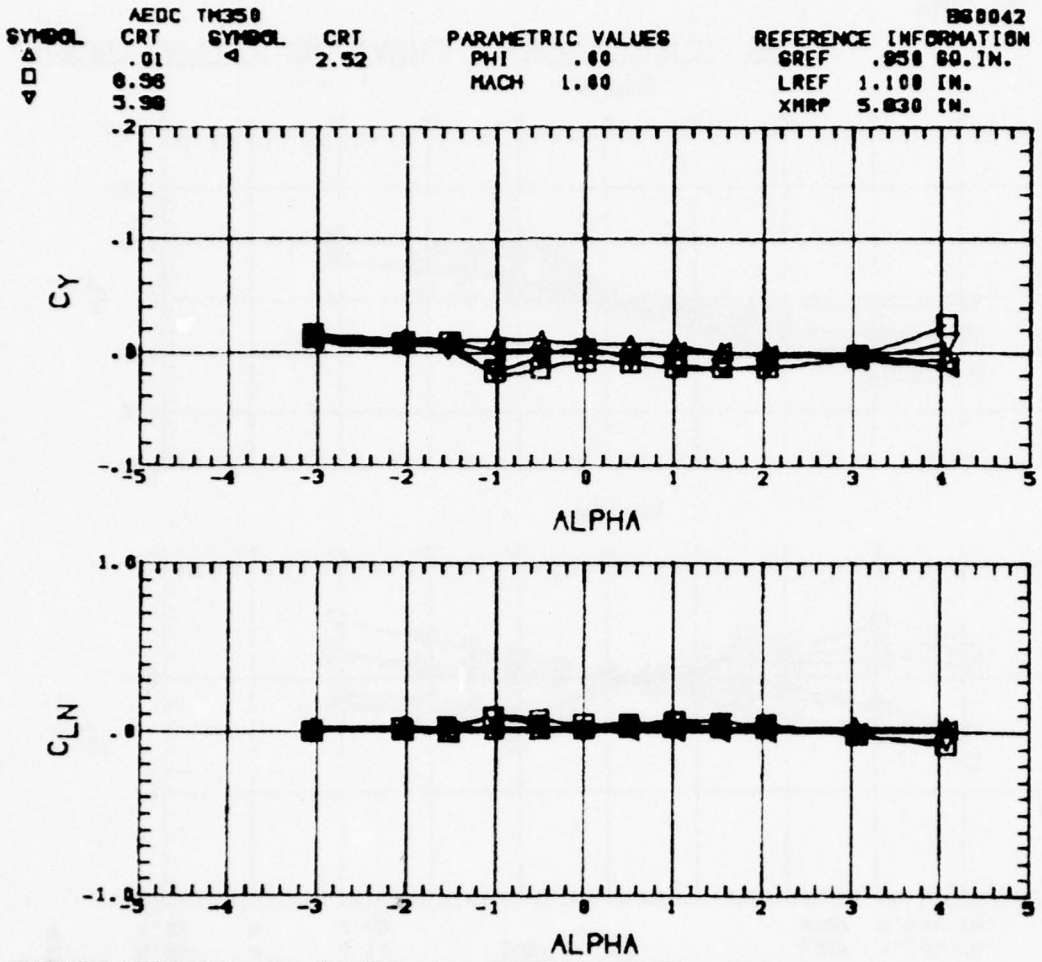
THRUST EFFECTS ON STABILITY COEFFICIENTS BS2



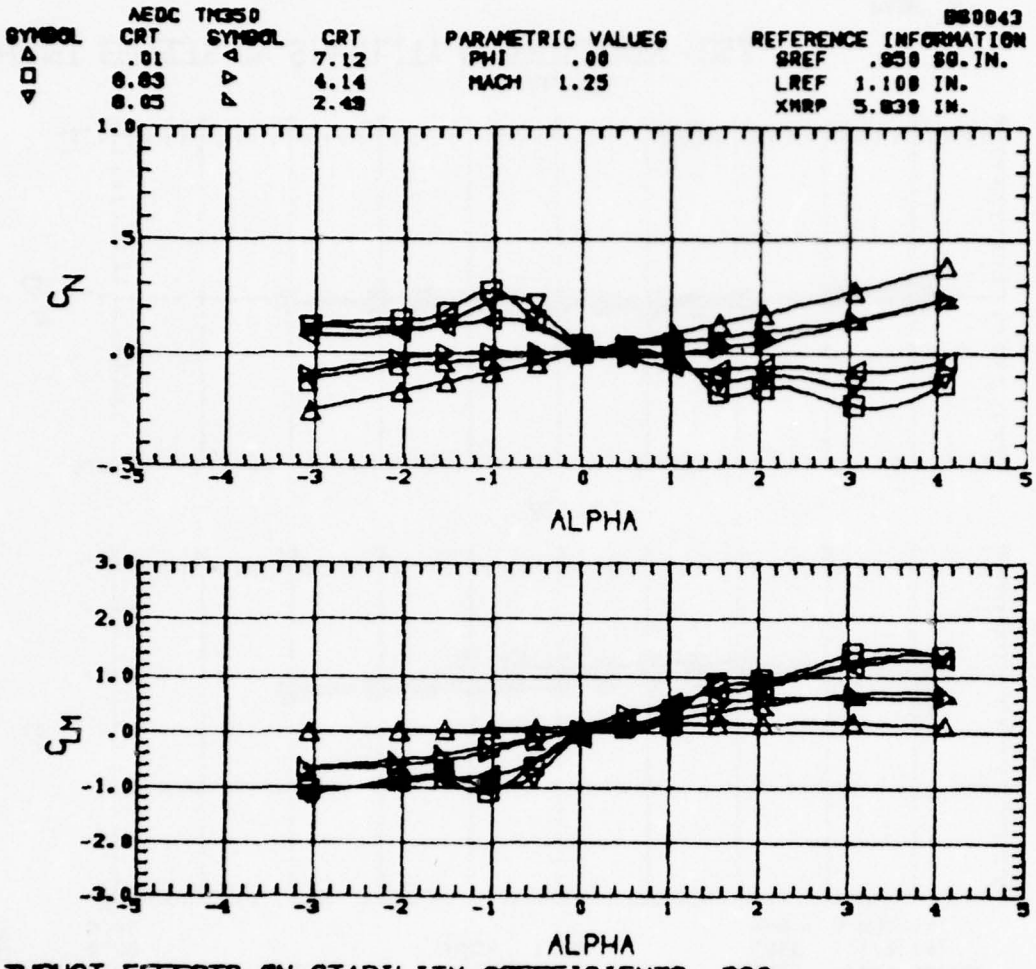
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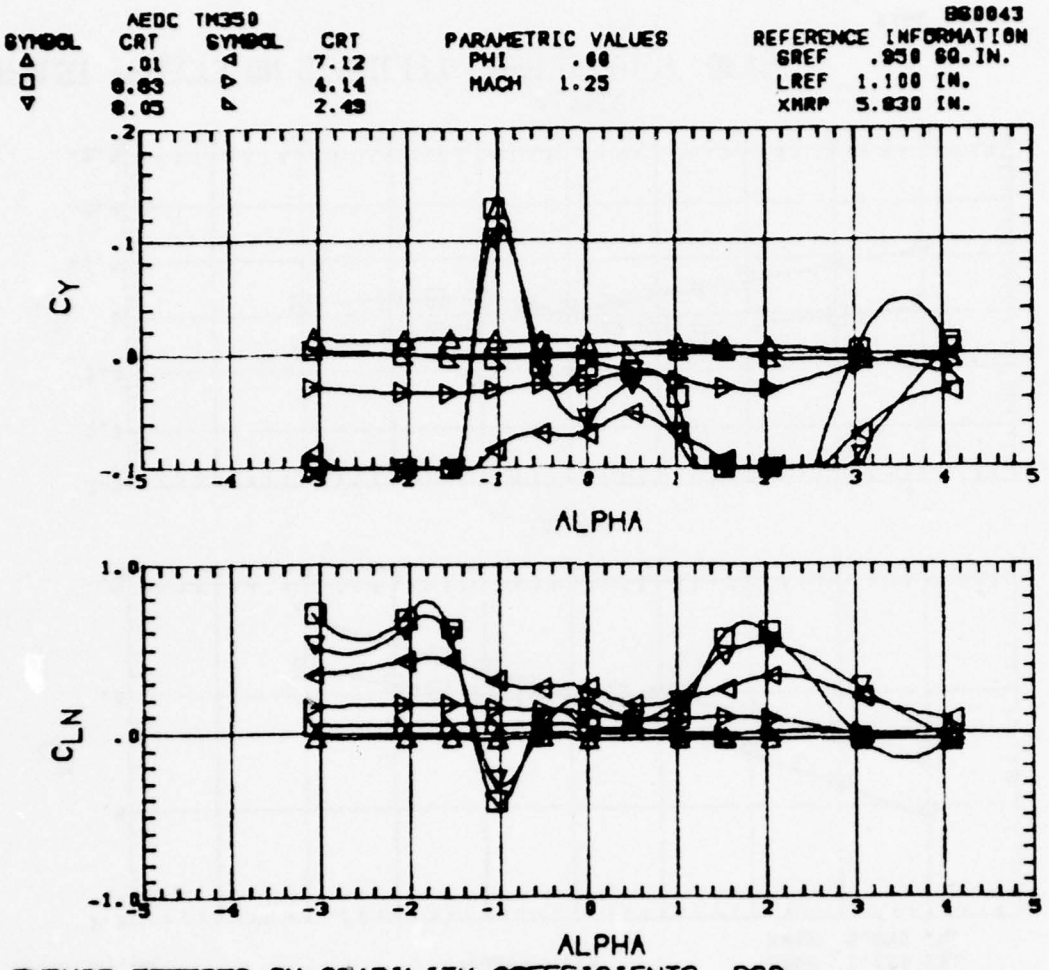
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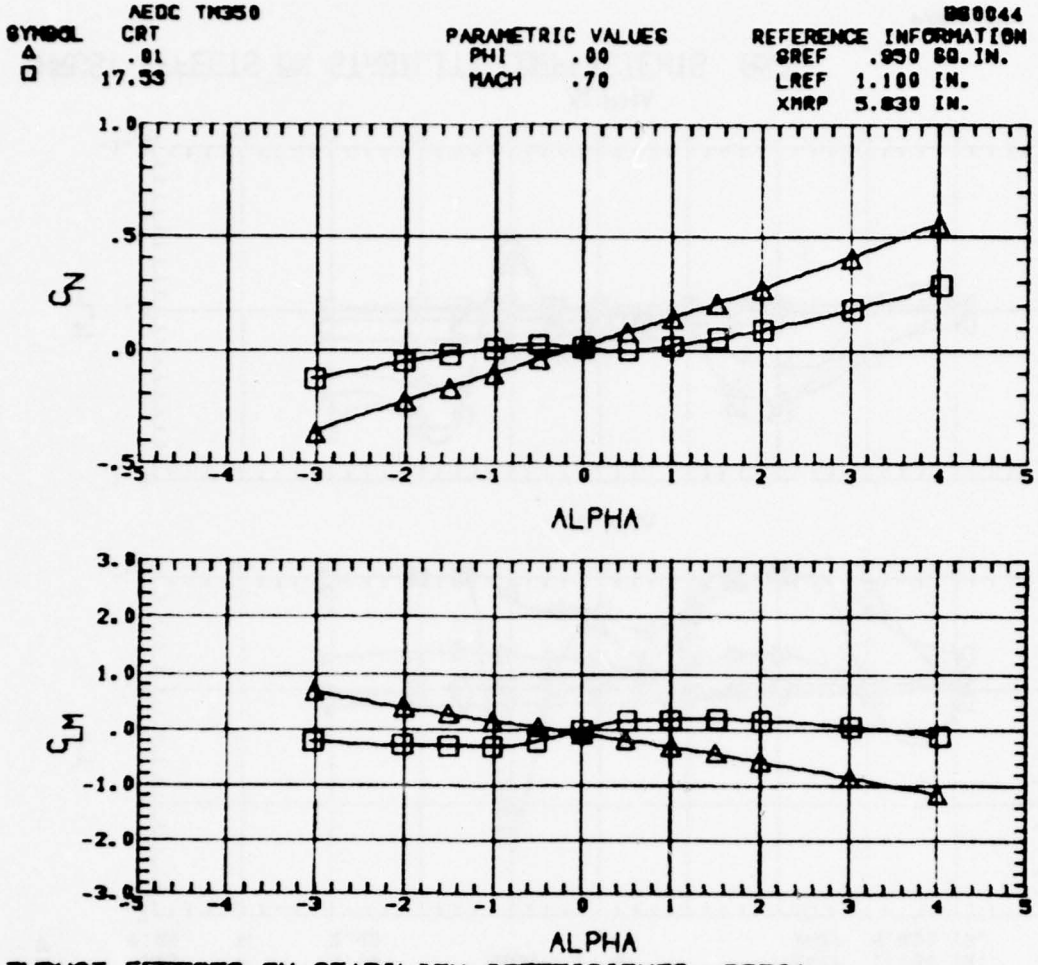
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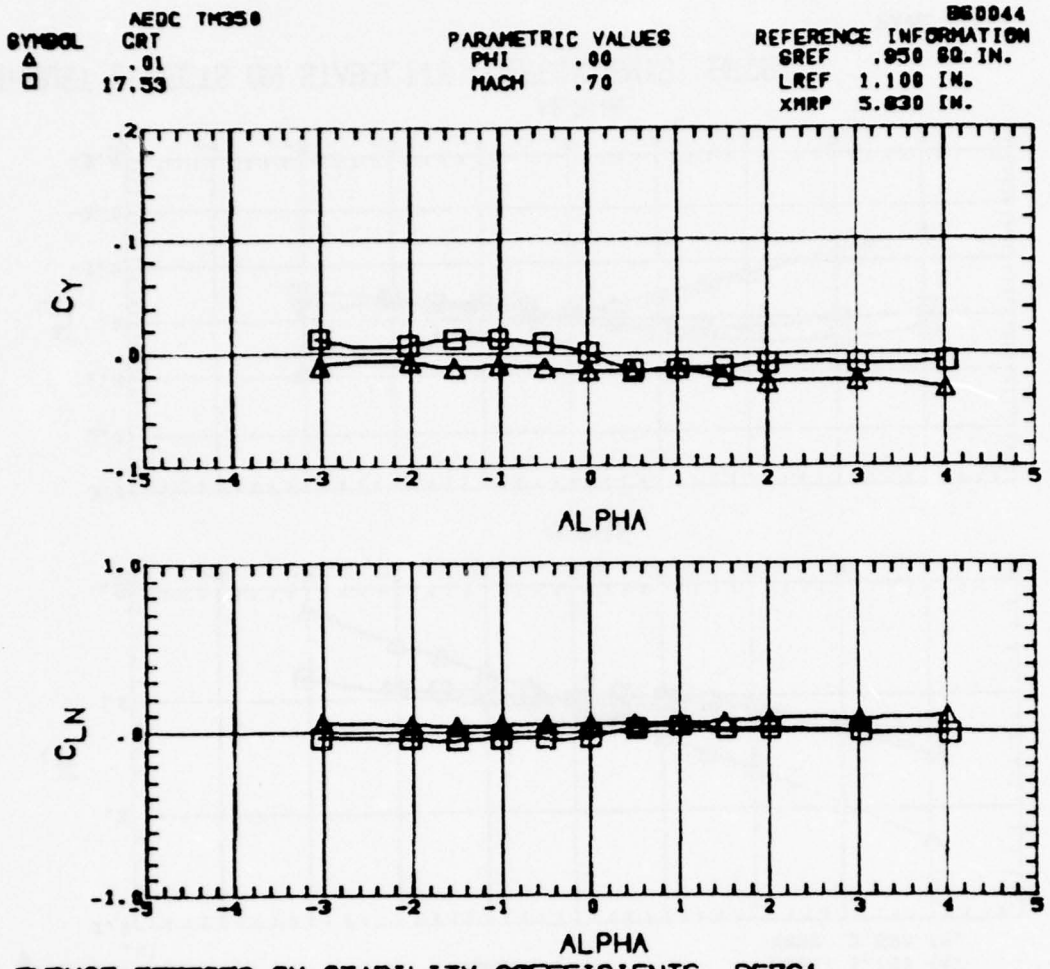
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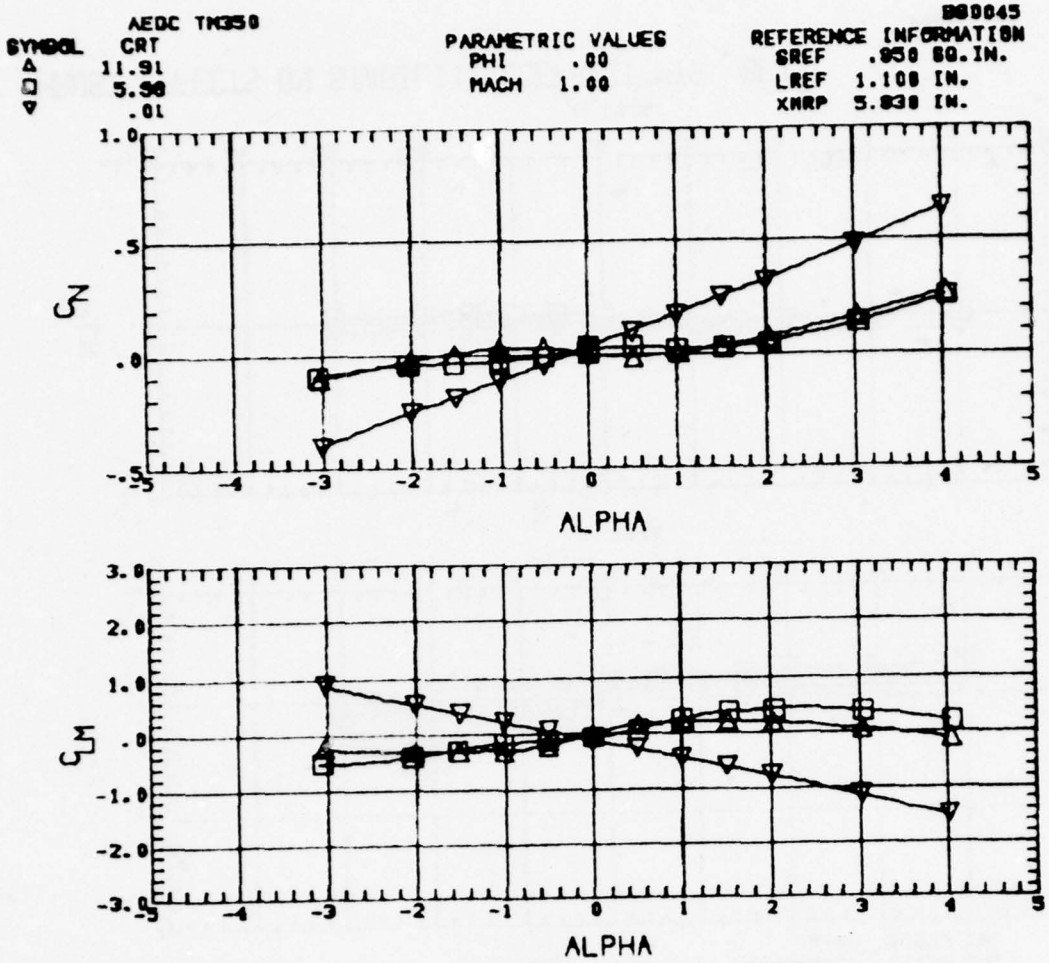
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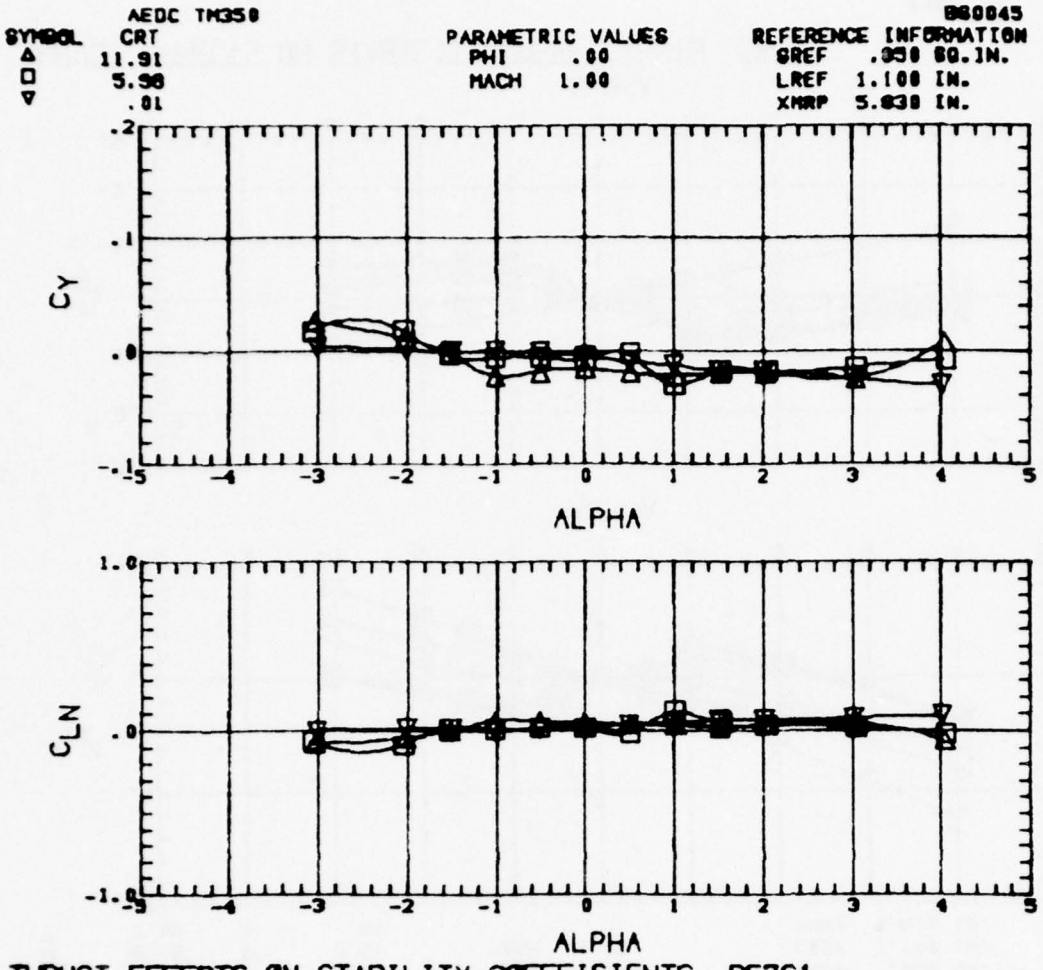
THRUST EFFECTS ON STABILITY COEFFICIENTS BF7S1



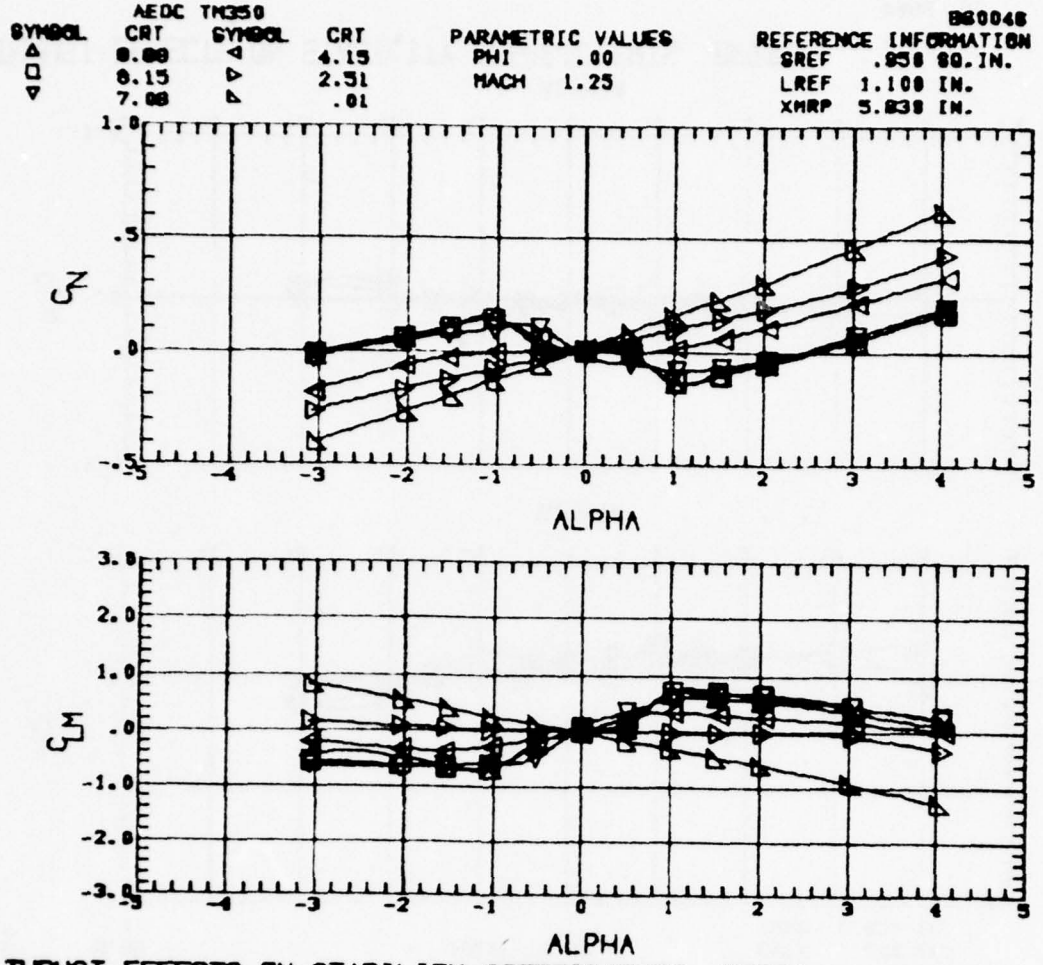
THRUST EFFECTS ON STABILITY COEFFICIENTS BF7S1



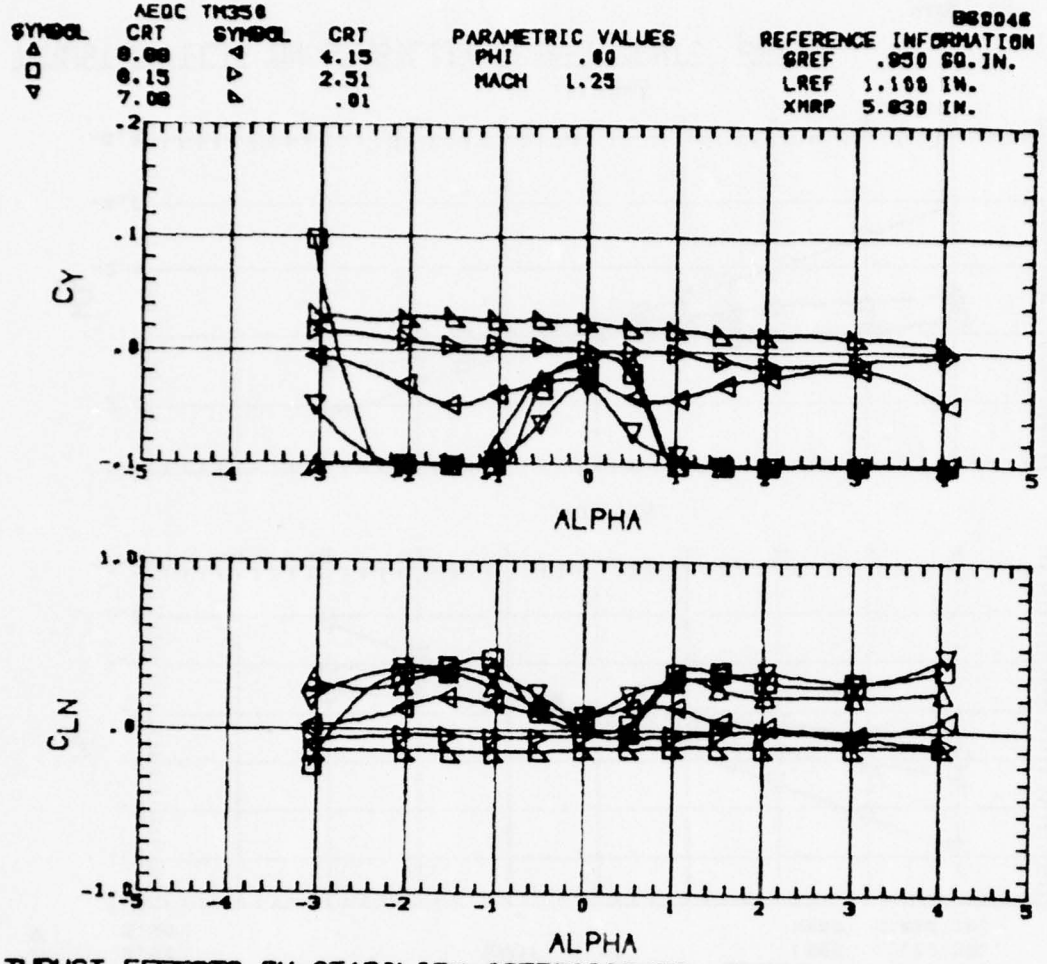
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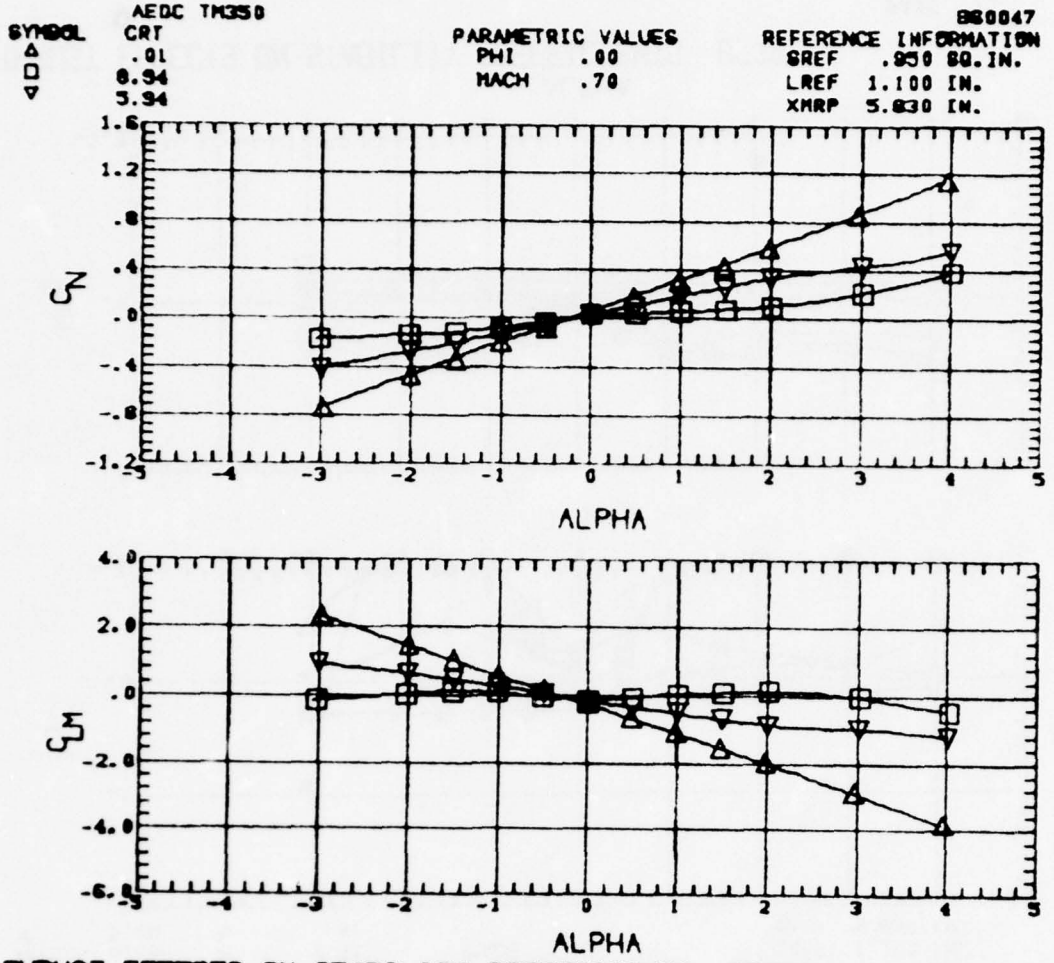
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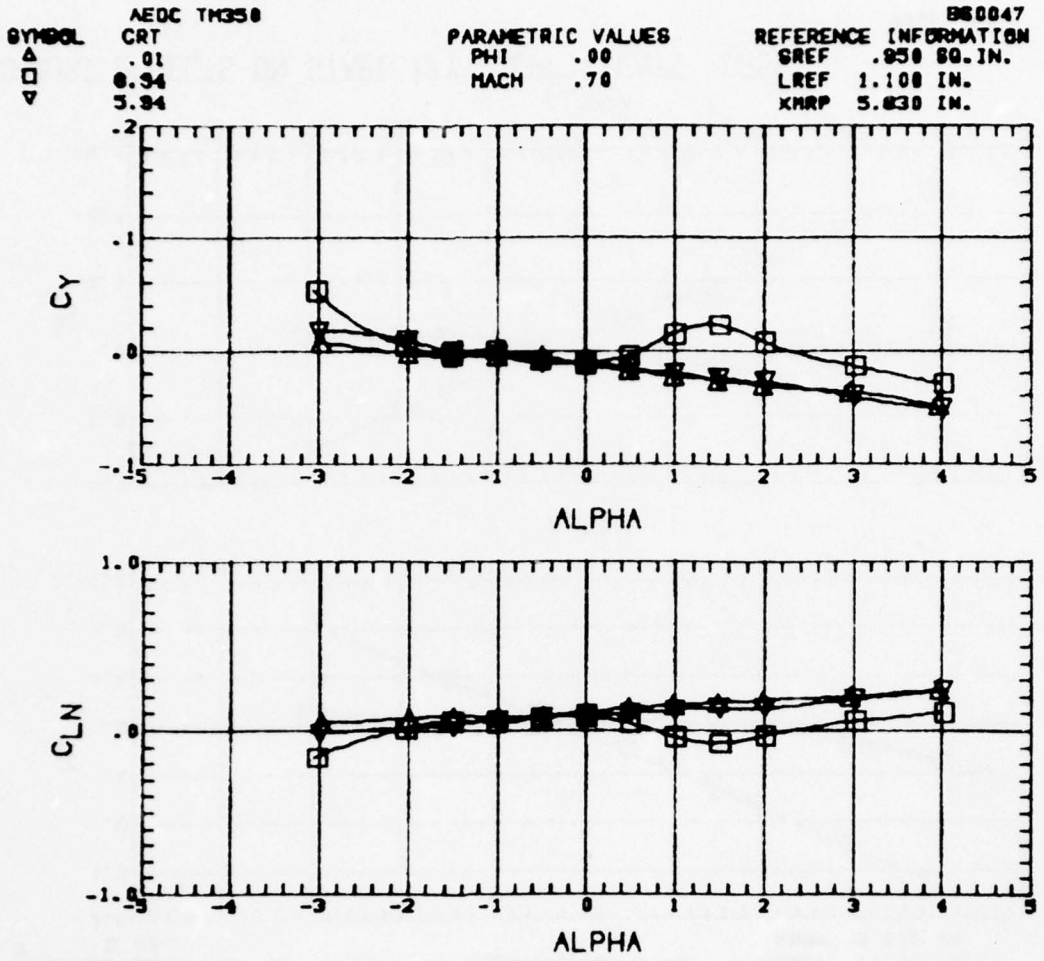
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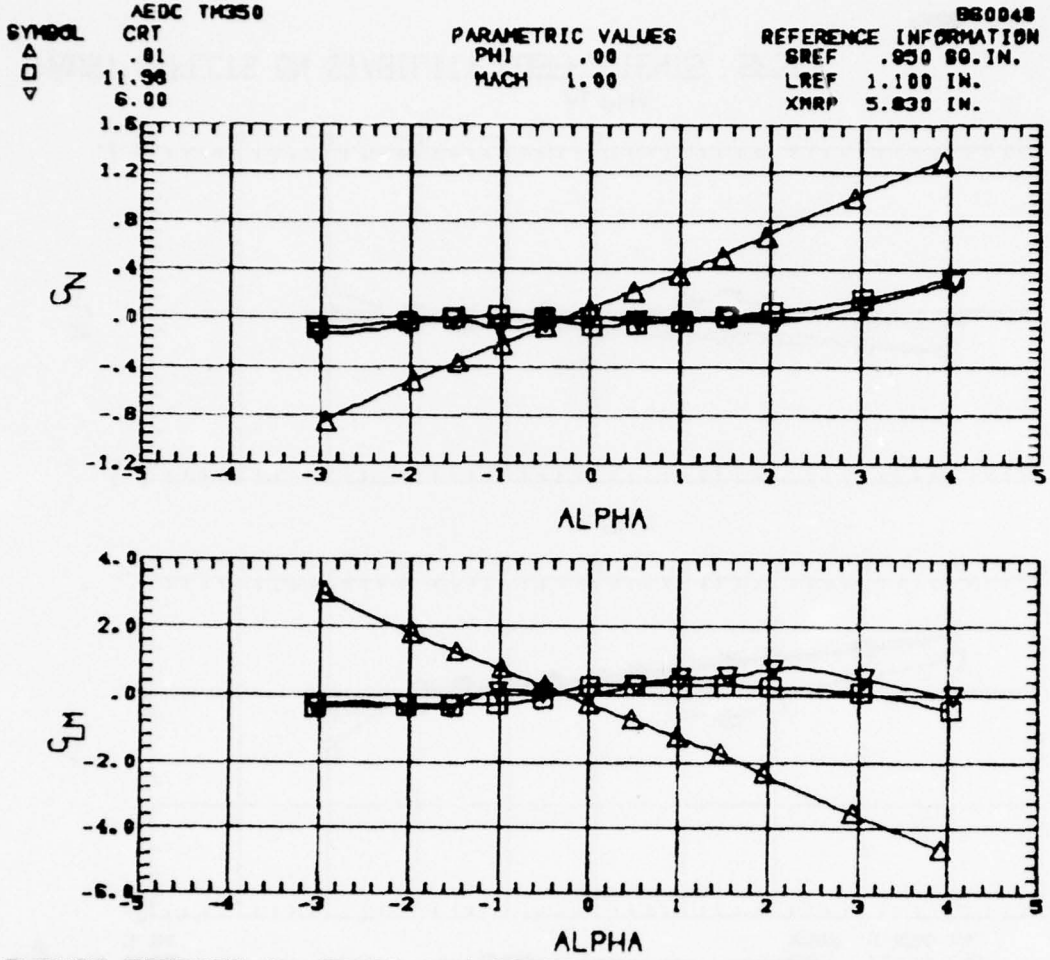
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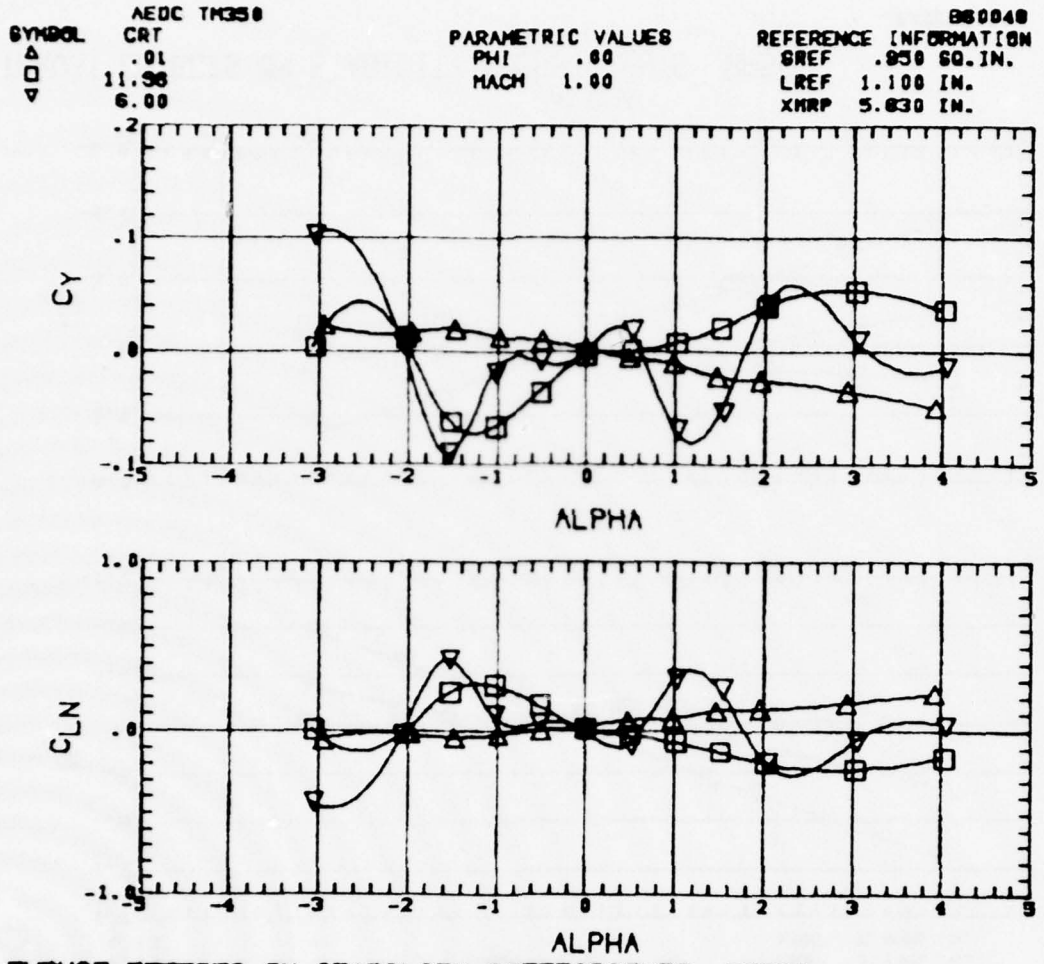
THRUST EFFECTS ON STABILITY COEFFICIENTS BF5S1



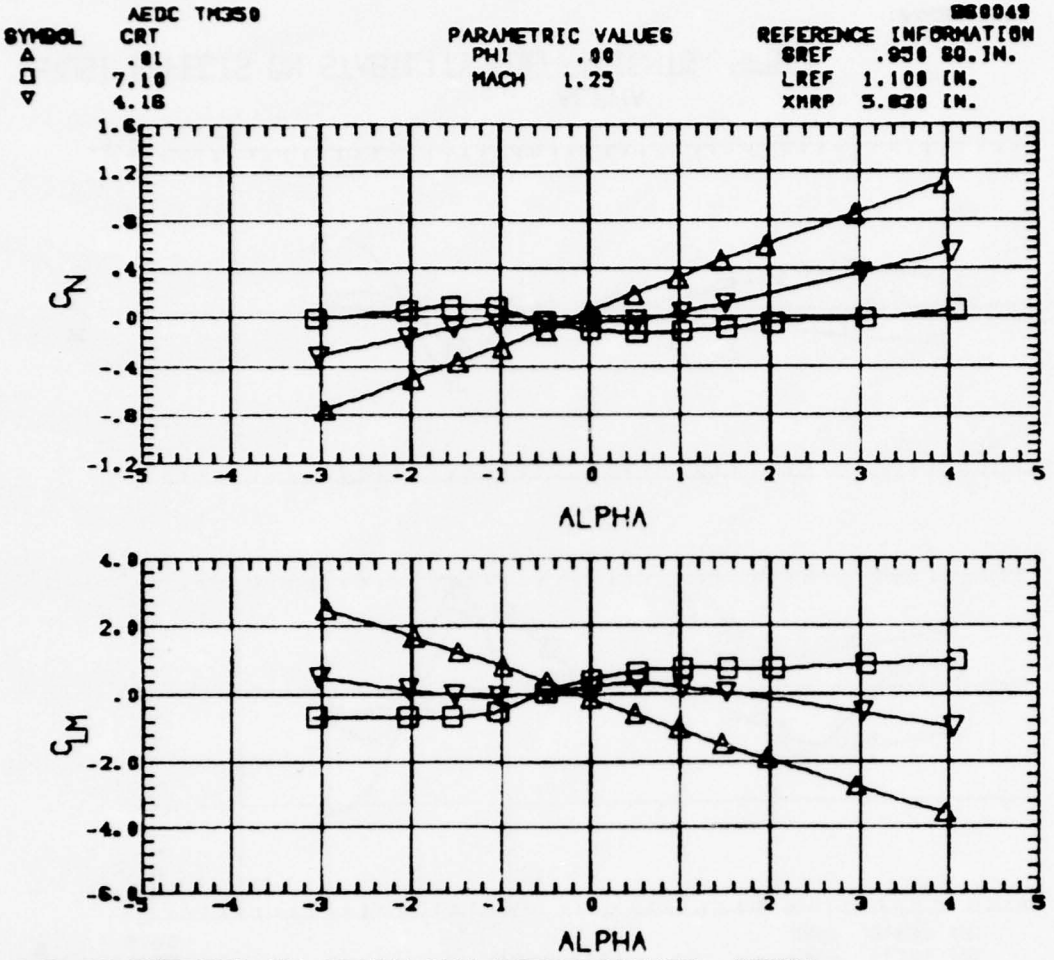
THRUST EFFECTS ON STABILITY COEFFICIENTS BF5S1



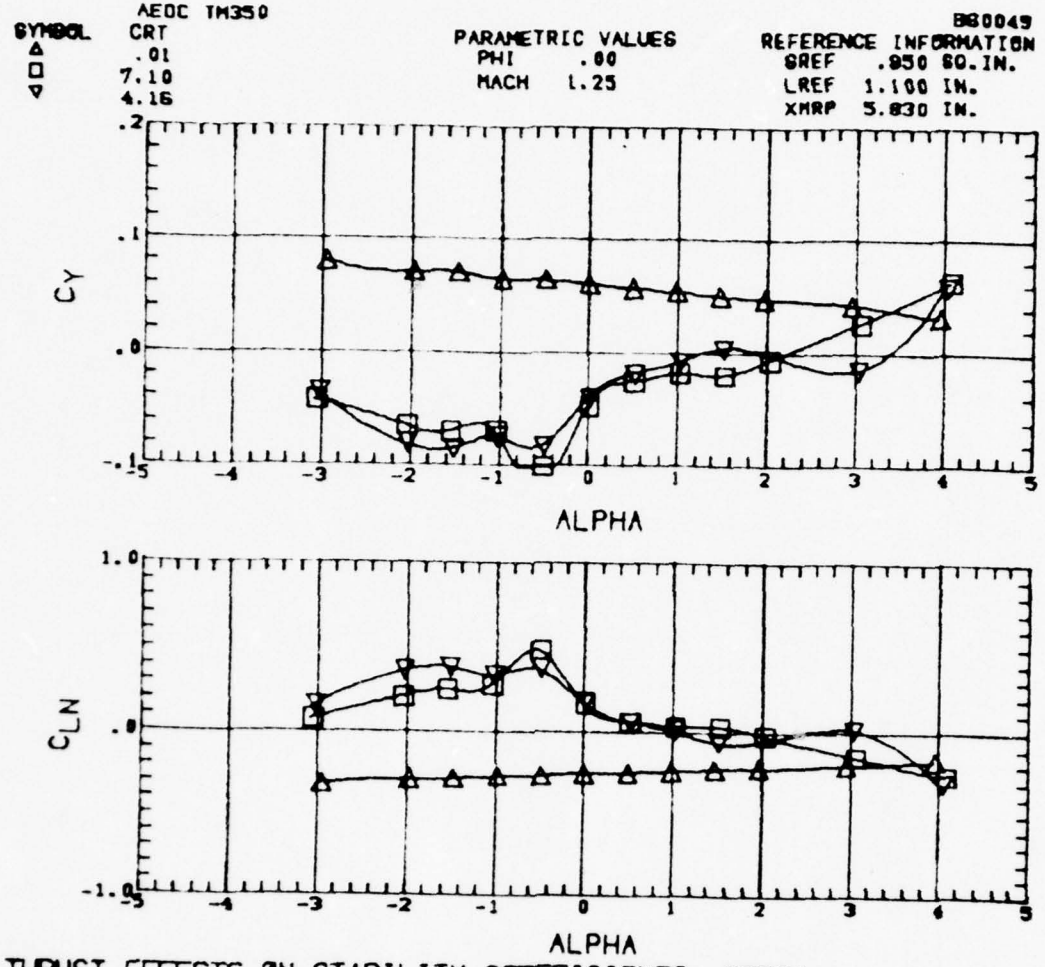
THRUST EFFECTS ON STABILITY COEFFICIENTS BF5S1



THRUST EFFECTS ON STABILITY COEFFICIENTS BF5S1



THRUST EFFECTS ON STABILITY COEFFICIENTS BF5S1



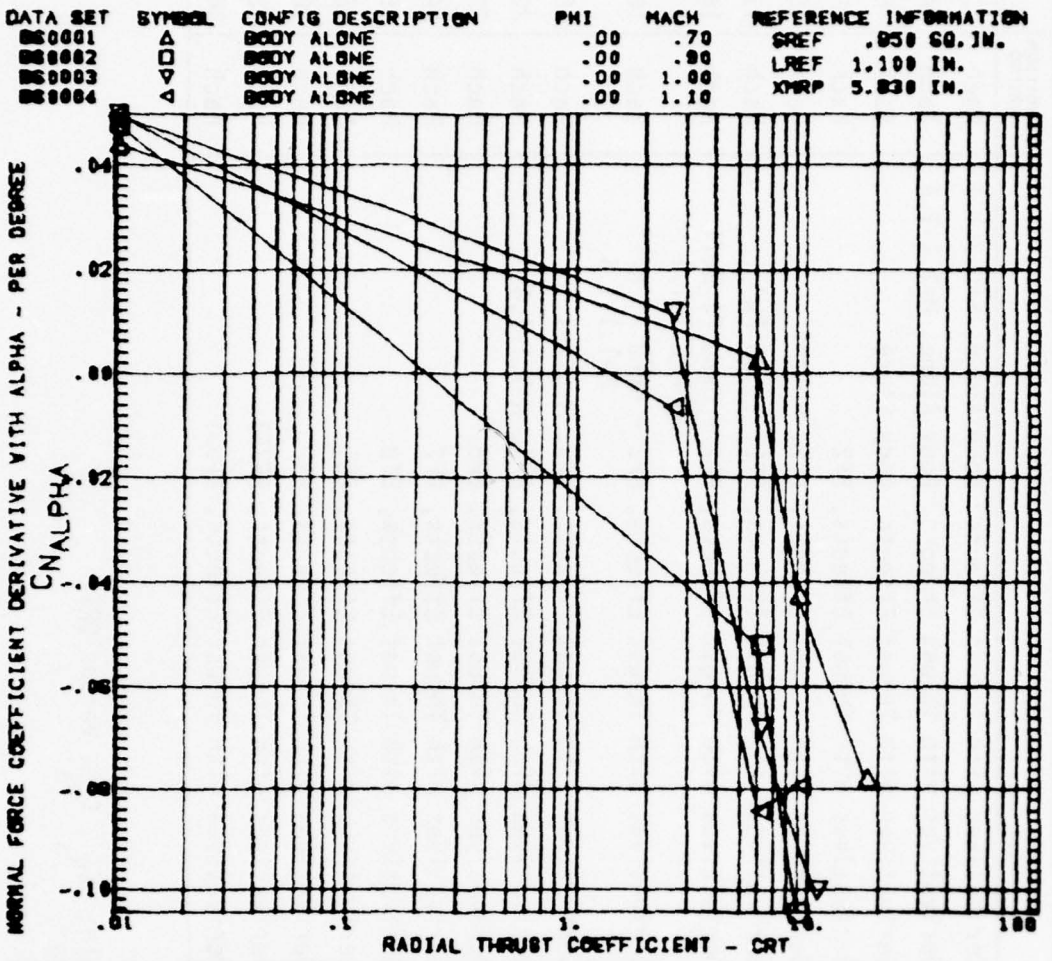
THRUST EFFECTS ON STABILITY COEFFICIENTS BF5S1

APPENDIX B
SLOPES AT ZERO ANGLE OF ATTACK

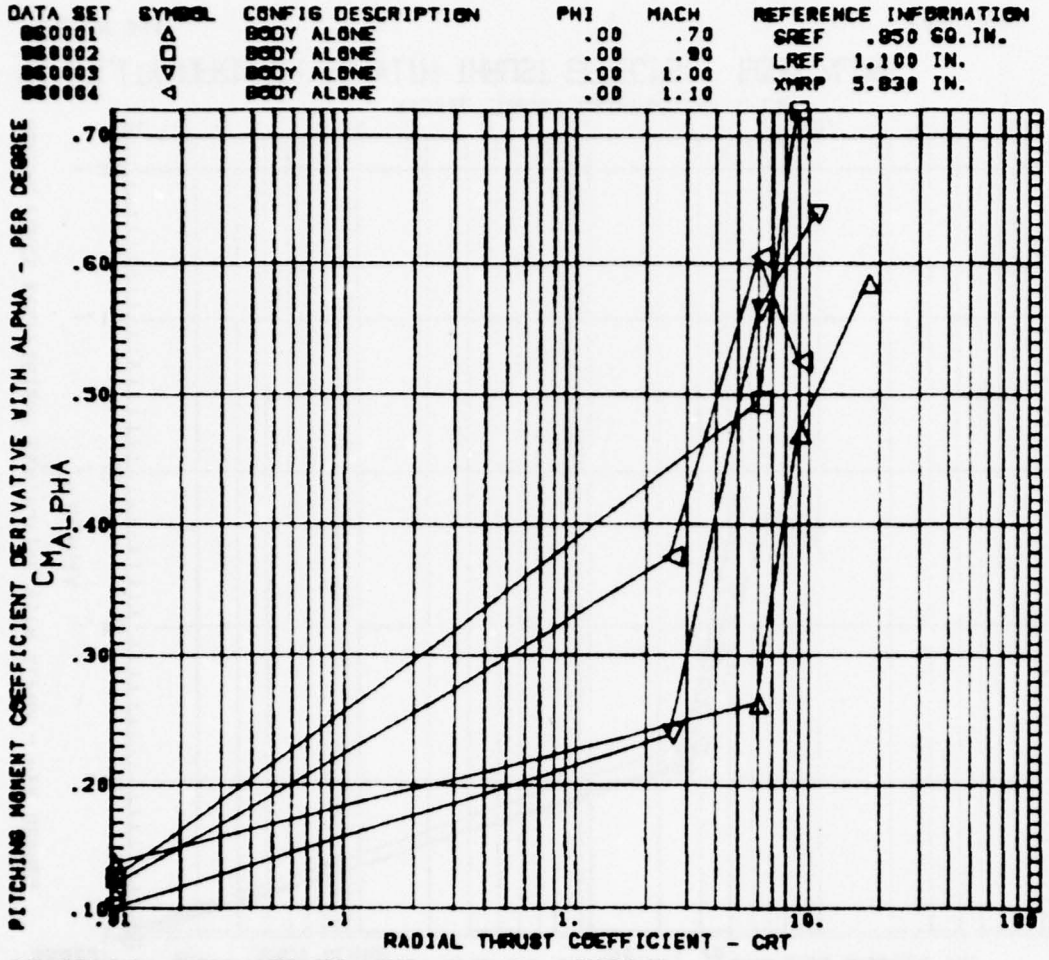
INDEX OF SLOPE FIGURES

TITLE	CONDITION VARYING	PAGE
Stability Derivatives with Thrust Effects, Body Alone, M=0.7-1.1	Mach	2
Stability Derivatives with Thrust Effects, Body Alone, M=1.1-1.4	Mach	4
Stability Derivatives with Thrust Effects, Body Flare	Mach	6
Stability Derivatives with Thrust Effects, BF2	Mach	8
Stability Derivatives with Thrust Effects, BF2, Phi=45°	Mach	10
Stability Derivatives with Thrust Effects, BF2, (1.65 Fwd)	Mach	12
Stability Derivatives with Thrust Effects, BF2 + Grnd Pl Refl M=0.7-1.1	Mach	14
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Stability Derivatives with Thrust Effects, BF5, M=0.7-1.1	Mach	18
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Stability Derivatives with Thrust Effects, BF6	Mach	22
Stability Derivatives with Thrust Effects, BF7	Mach	24
Stability Derivatives with Thrust Effects, BF8	Mach	26
Stability Derivatives with Thrust Effects, BS1	Mach	28
Stability Derivatives with Thrust Effects, BS2	Mach	30
Stability Derivatives with Thrust Effects, BF7S1	Mach	32
Stability Derivatives with Thrust Effects, BF5S1	Mach	34

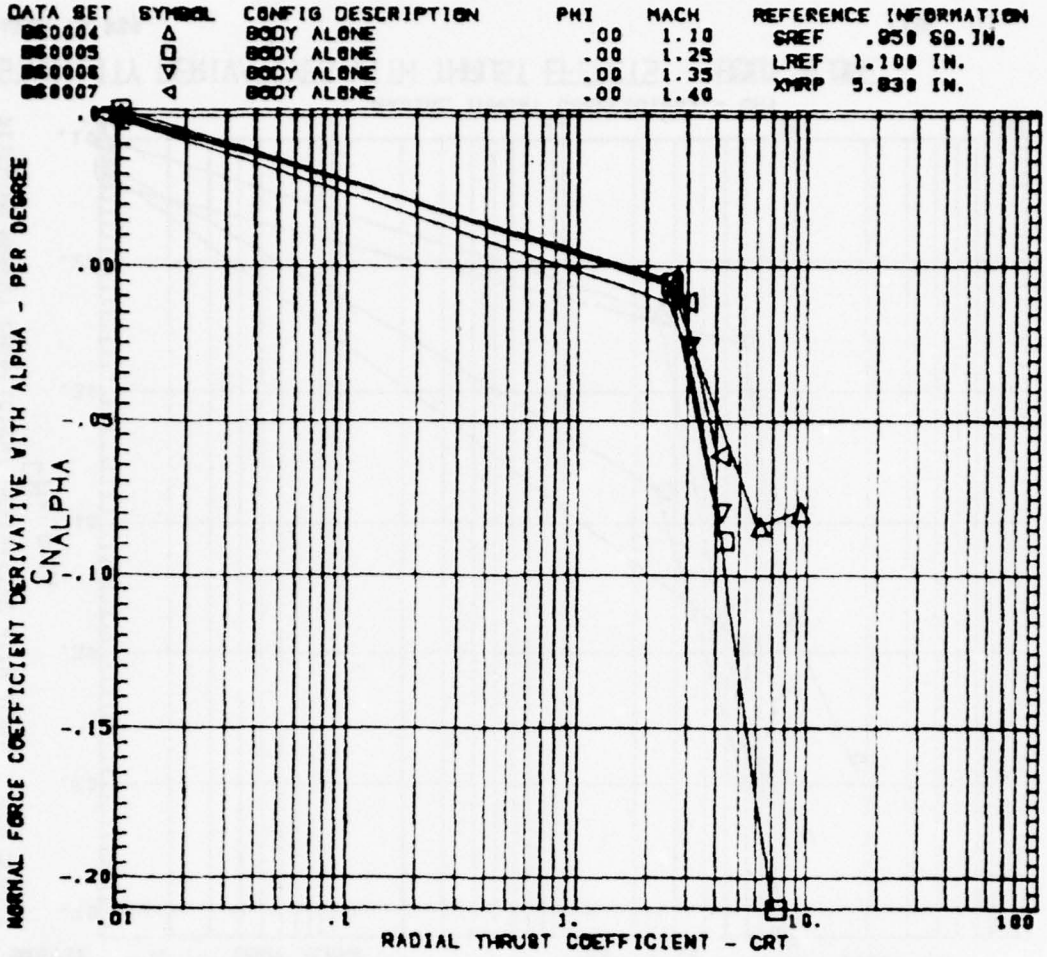
Plot Schedule: C_{N_α}, C_{m_α} versus CRT



STABILITY DERIVATIVES WITH THRUST EFFECTS BODY ALONE

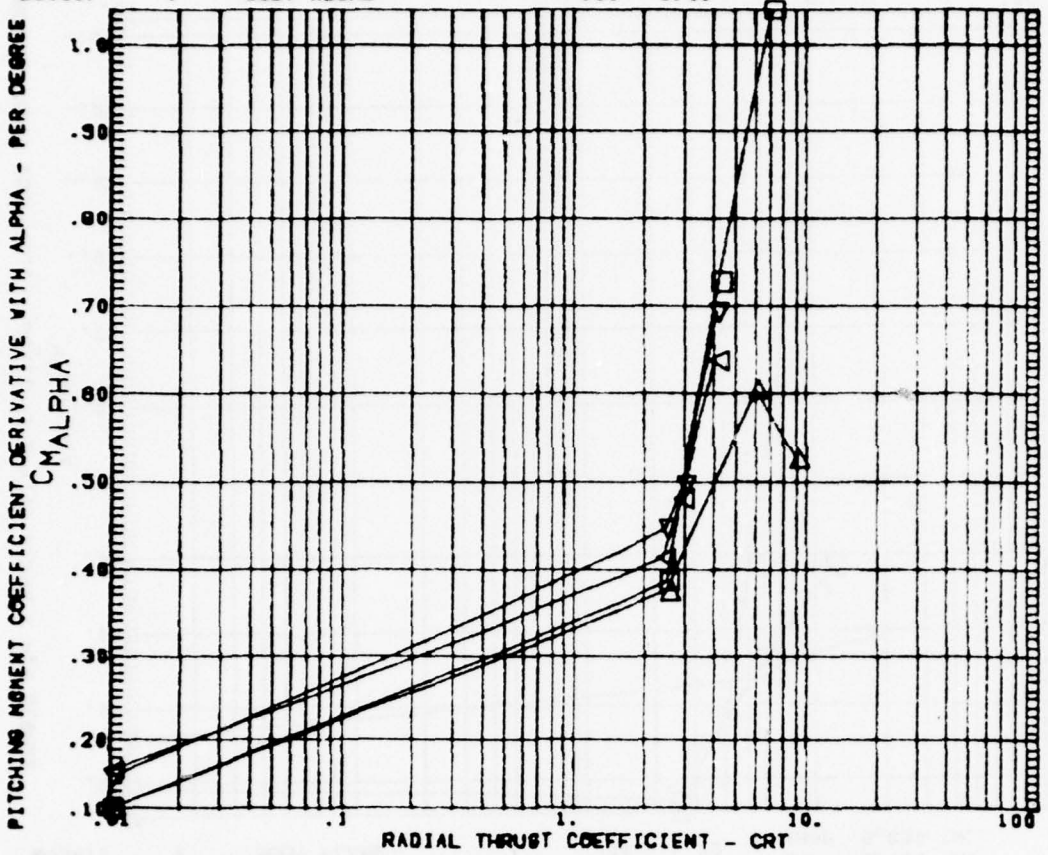


STABILITY DERIVATIVES WITH THRUST EFFECTS BODY ALONE



STABILITY DERIVATIVES WITH THRUST EFFECTS BODY ALONE

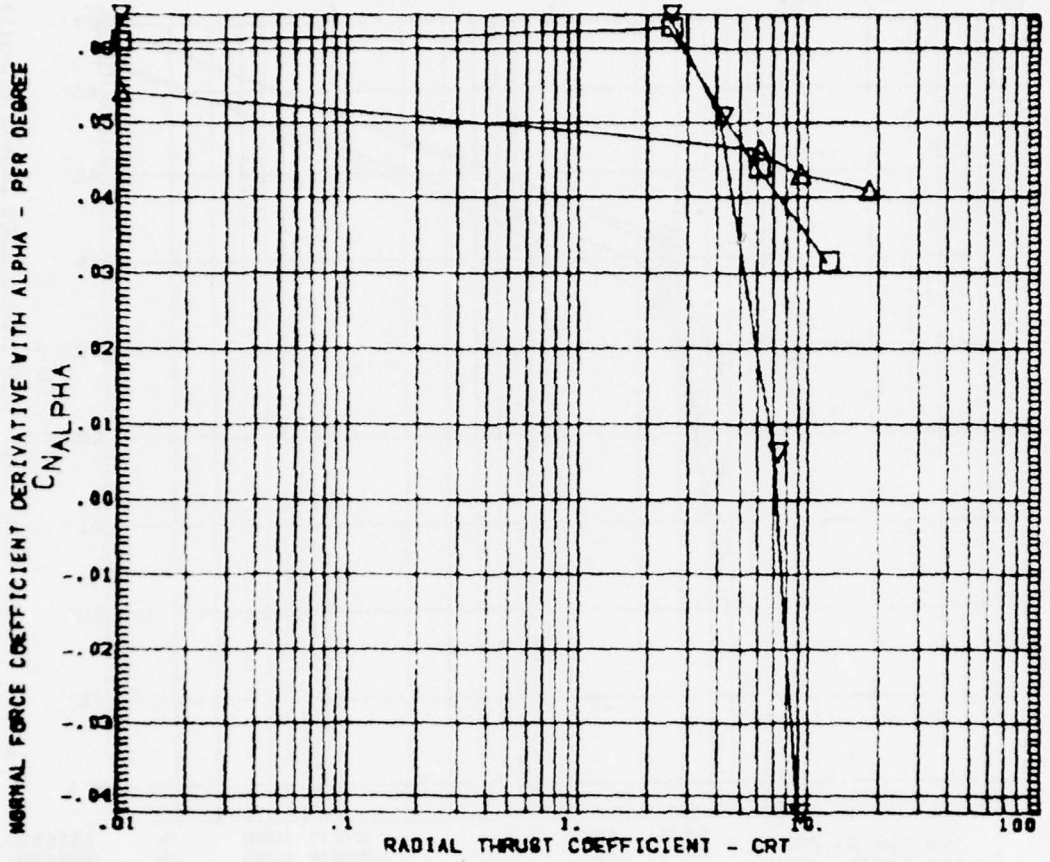
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BS0004	△	BODY ALONE	.00	1.10	SREF .850 SQ.IN.
BS0005	□	BODY ALONE	.00	1.25	LREF 1.100 IN.
BS0006	▽	BODY ALONE	.00	1.35	XMRP 5.830 IN.
BS0007	◁	BODY ALONE	.00	1.40	



STABILITY DERIVATIVES WITH THRUST EFFECTS BODY ALONE

DATA SET	SYMBOL	CONFIG DESCRIPTION	PHI	MACH
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B60009	□	BODY FLARE	.00	1.00
B60010	▽	BODY FLARE	.00	1.25

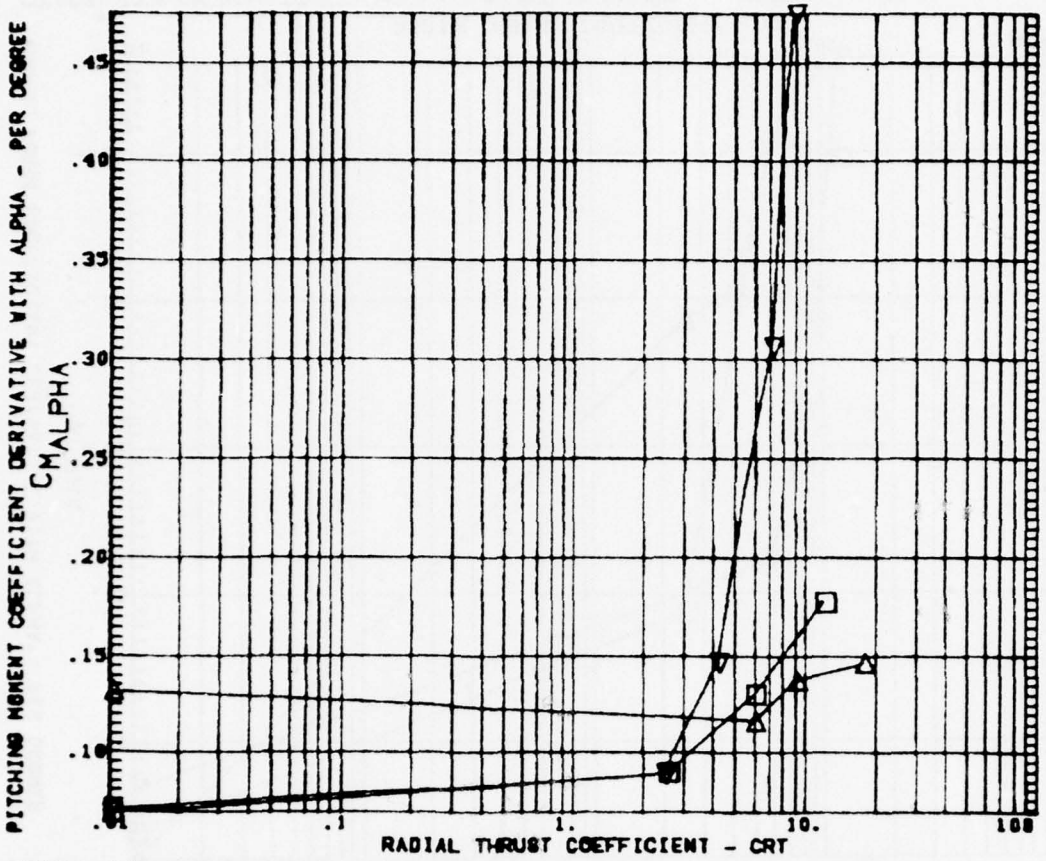
REFERENCE INFORMATION
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LREF 1.100 IN.
XMRP 5.830 IN.



STABILITY DERIVATIVES WITH THRUST EFFECTS BODY FLARE

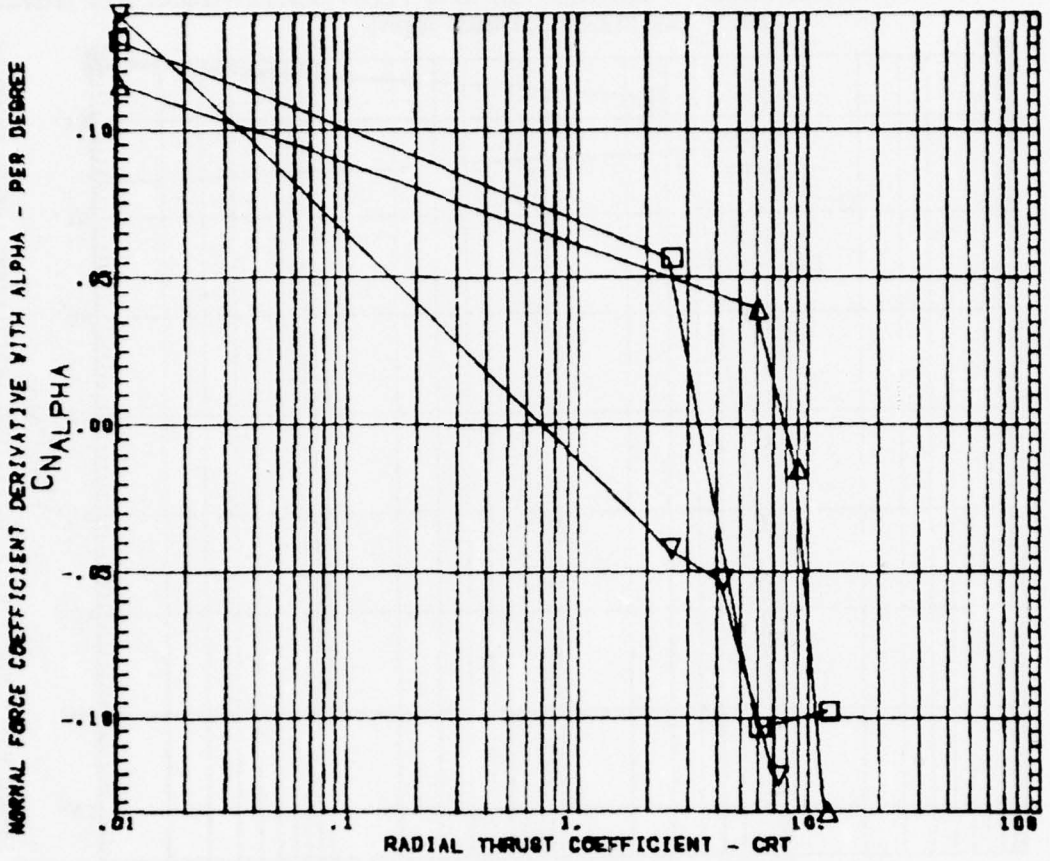
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BS0009	□	BODY FLARE	.00	1.00
BS0010	▽	BODY FLARE	.00	1.25

REFERENCE INFORMATION
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LREF 1.100 IN.
XMRP 5.830 IN.



STABILITY DERIVATIVES WITH THRUST EFFECTS BODY FLARE

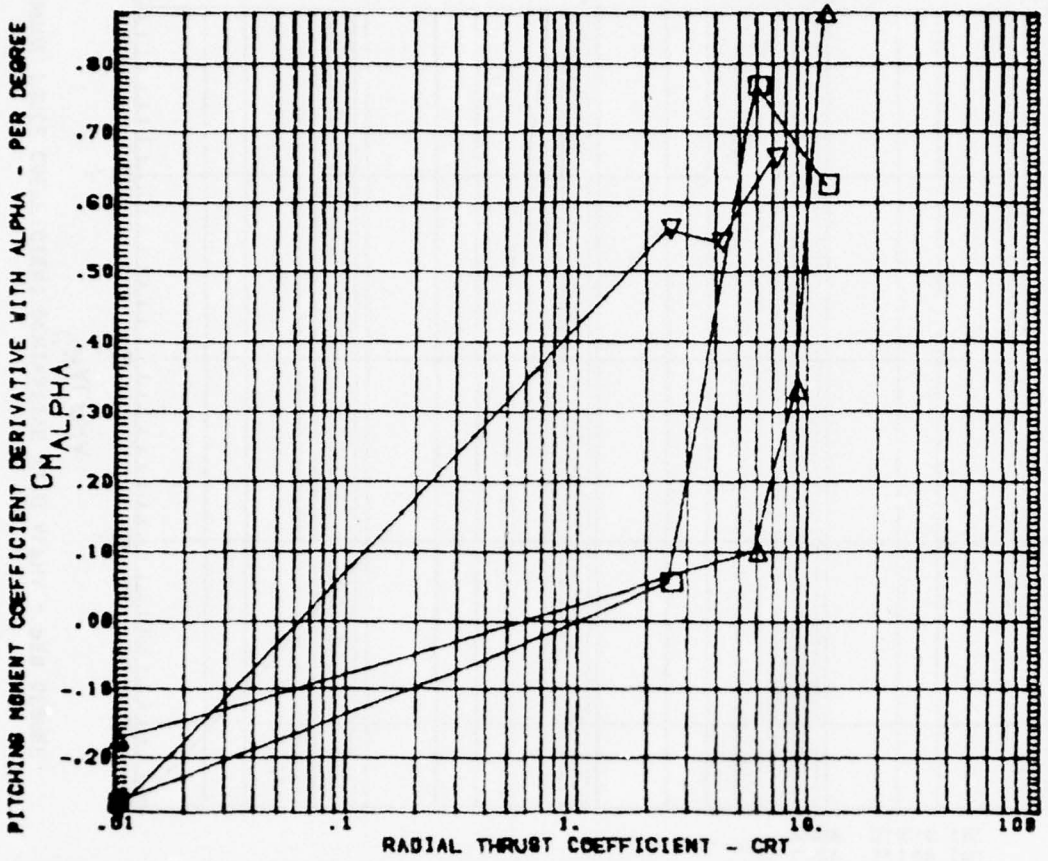
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0S0012	□	BF2	.00	1.00	LREF 1.100 IN.
0S0013	▽	BF2	.00	1.25	XMRP 5.830 IN.



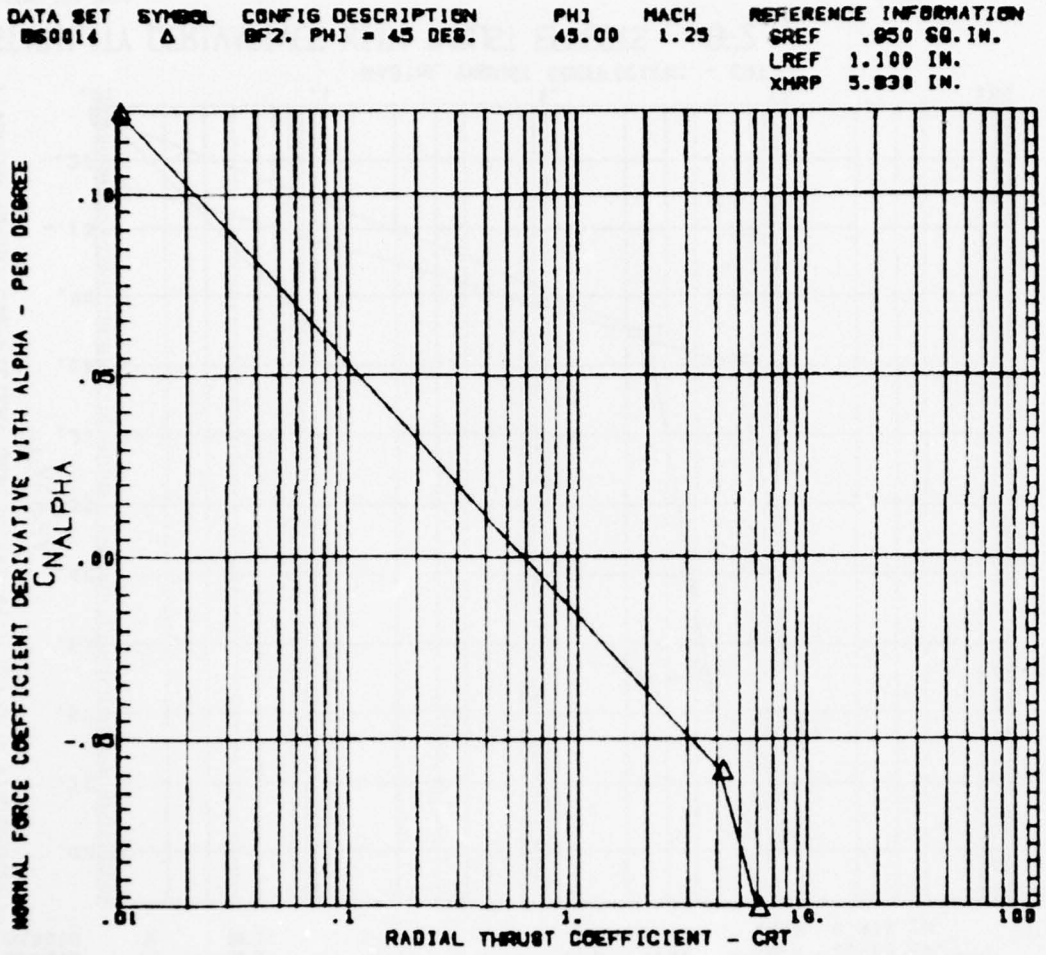
STABILITY DERIVATIVES WITH THRUST EFFECTS BF2

DATA SET	SYMBOL	CONFIG DESCRIPTION	PHI	MACH
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860012	□	BF2	.00	1.00
860013	▽	BF2	.00	1.25

REFERENCE INFORMATION
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LREF 1.100 IN.
XMRP 5.830 IN.

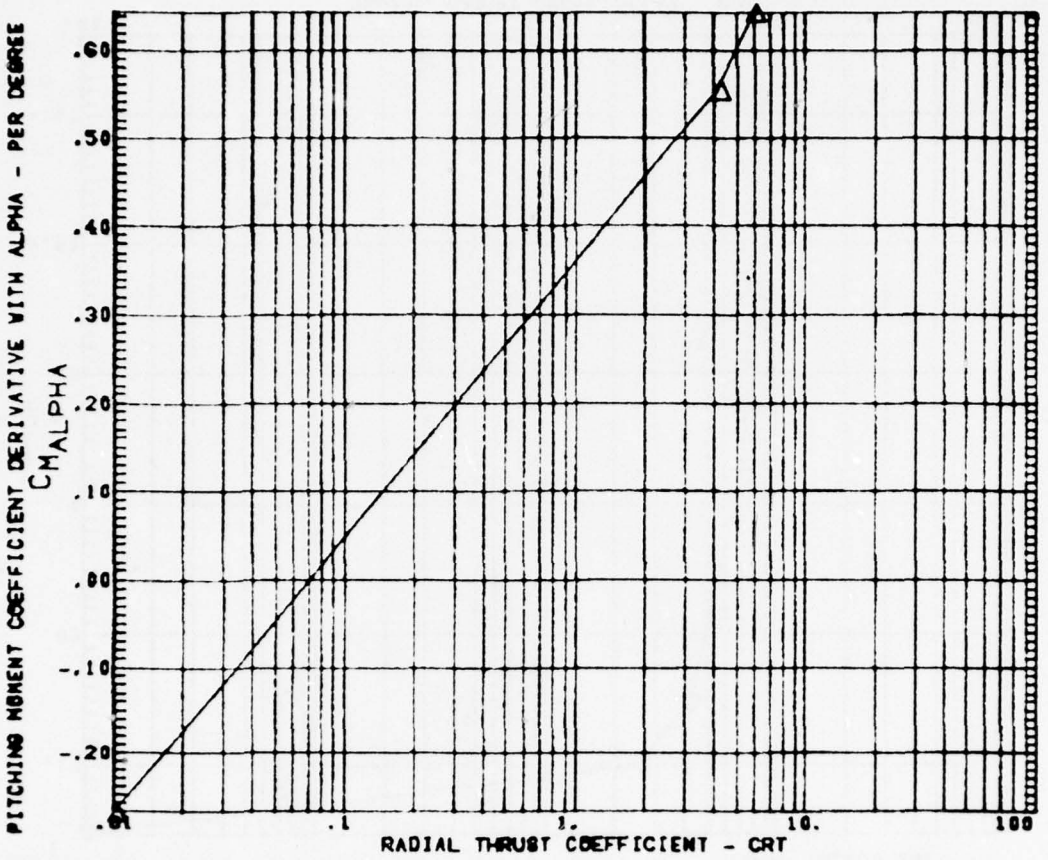


STABILITY DERIVATIVES WITH THRUST EFFECTS BF2

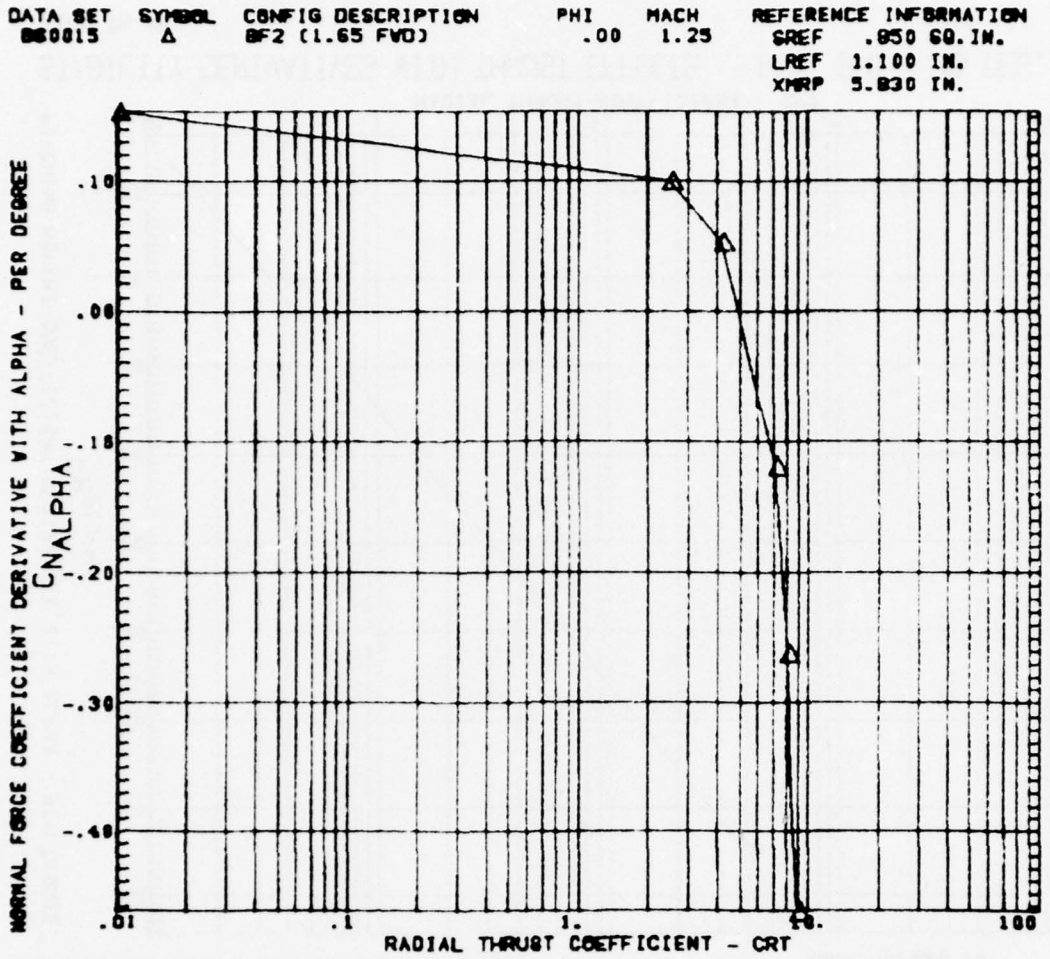


STABILITY DERIVATIVES WITH THRUST EFFECTS BF2. PHI = 45 DEG.

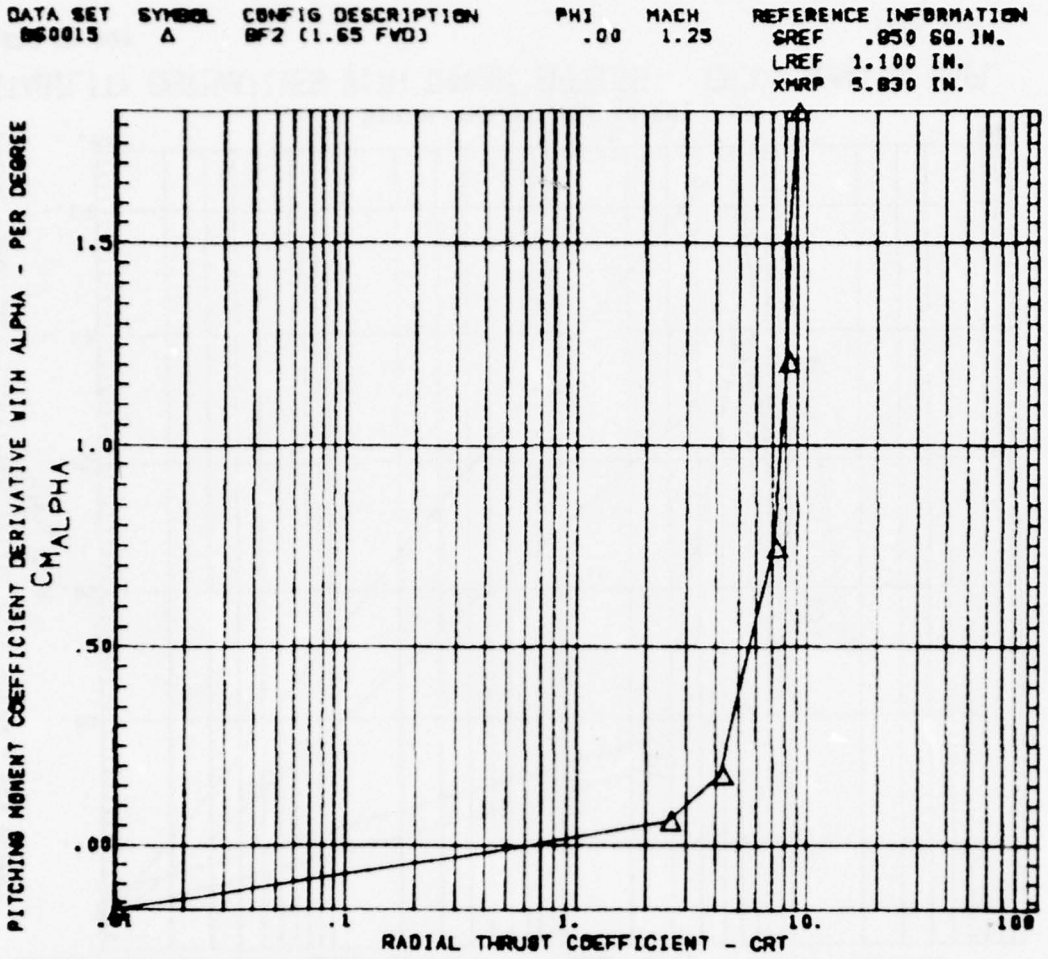
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					LREF 1.100 IN.
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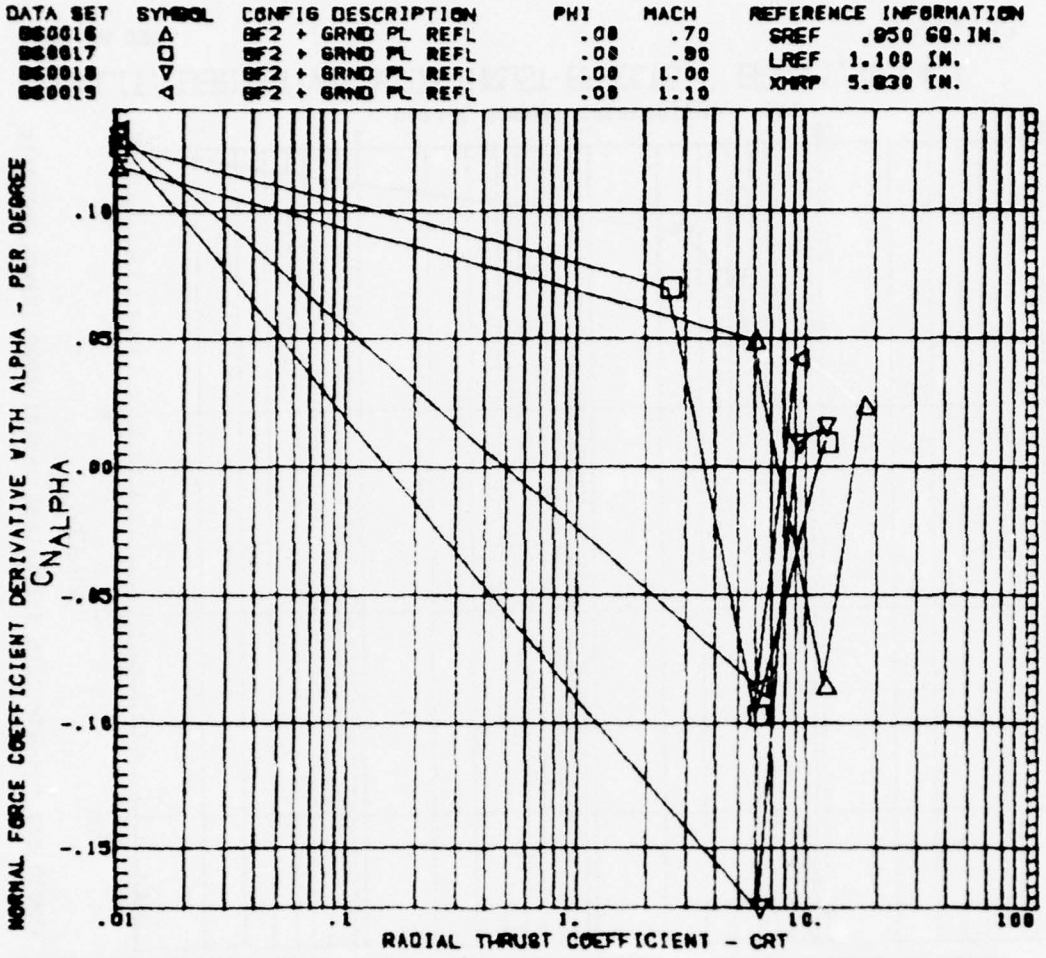
STABILITY DERIVATIVES WITH THRUST EFFECTS BF2. PHI = 45 DEG.



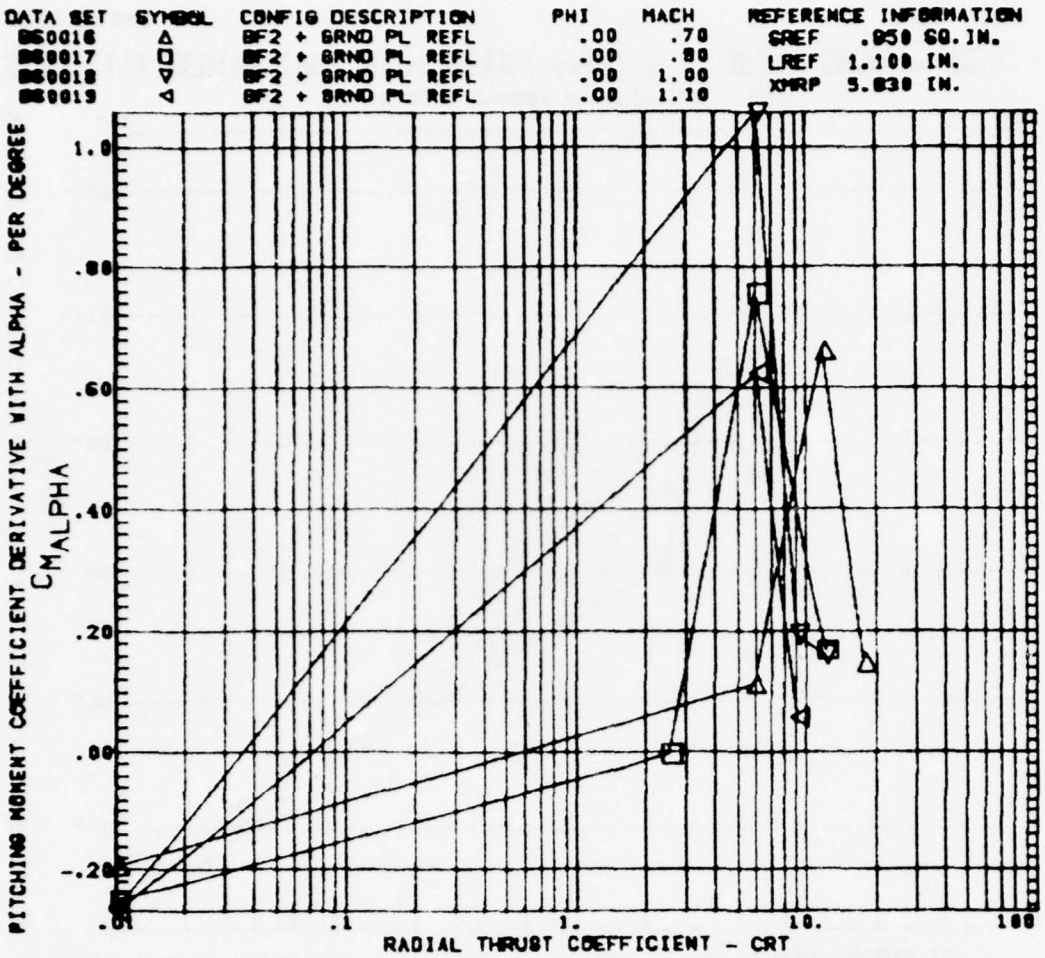
STABILITY DERIVATIVES WITH THRUST EFFECTS BF2 (1.65 FWD)



STABILITY DERIVATIVES WITH THRUST EFFECTS BF2 (1.65 FWD)



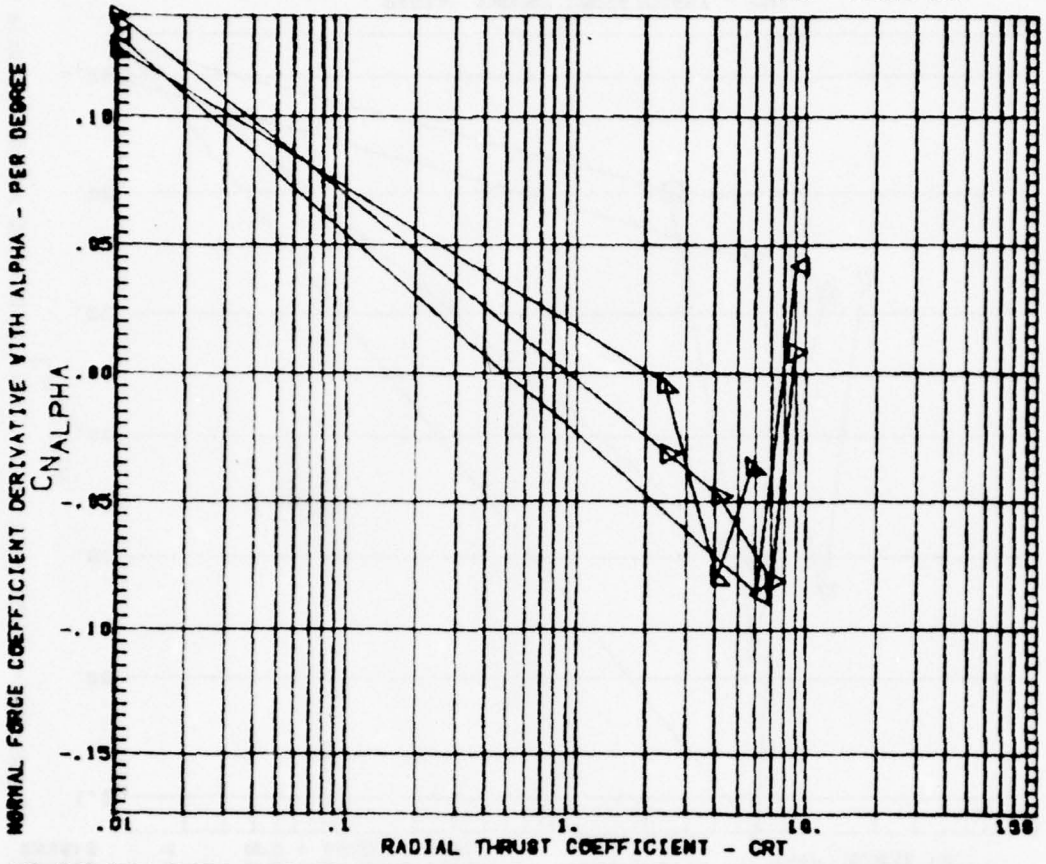
STABILITY DERIVATIVES WITH THRUST EFFECTS BF2 + GRND PL REFL



STABILITY DERIVATIVES WITH THRUST EFFECTS BF2 + GRND PL REFL

DATA SET	SYMBOL	CONFIG DESCRIPTION	PHI	MACH
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B60020	▷	BF2 + GRND PL REFL	.00	1.25
B60021	△	BF2 + GRND PL REFL	.00	1.40

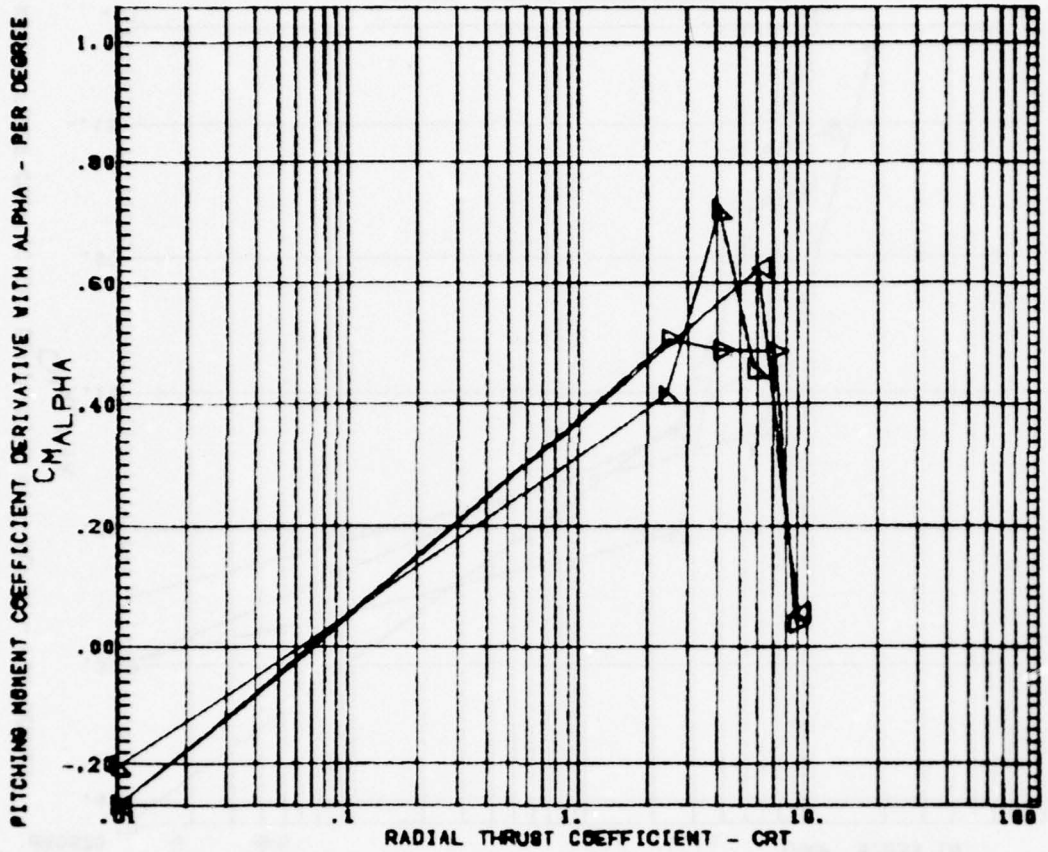
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LREF 1.100 IN.
XMRP 5.830 IN.



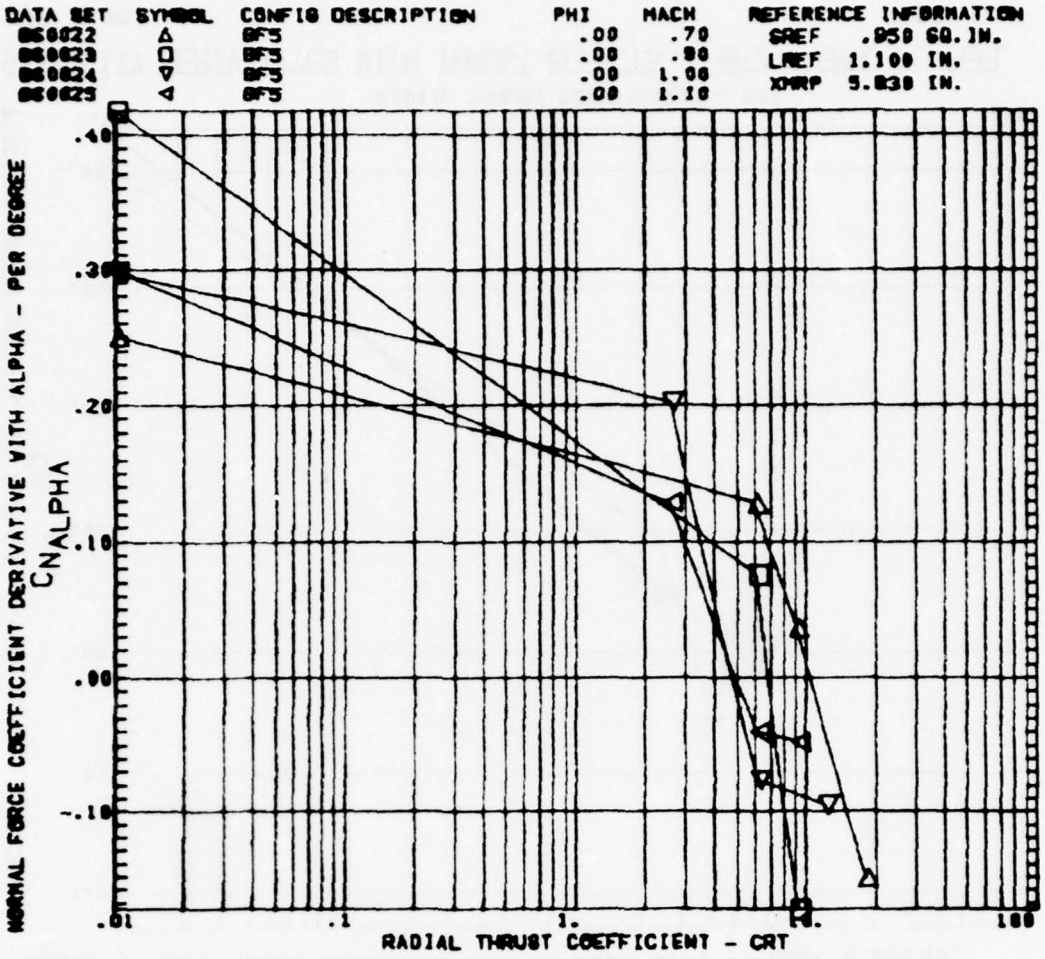
STABILITY DERIVATIVES WITH THRUST EFFECTS BF2 + GRND PL REFL

DATA SET	SYMBOL	CONFIG DESCRIPTION	PHI	MACH
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860020	▷	BF2 + GRND PL REFL	.00	1.25
860021	◁	BF2 + GRND PL REFL	.00	1.40

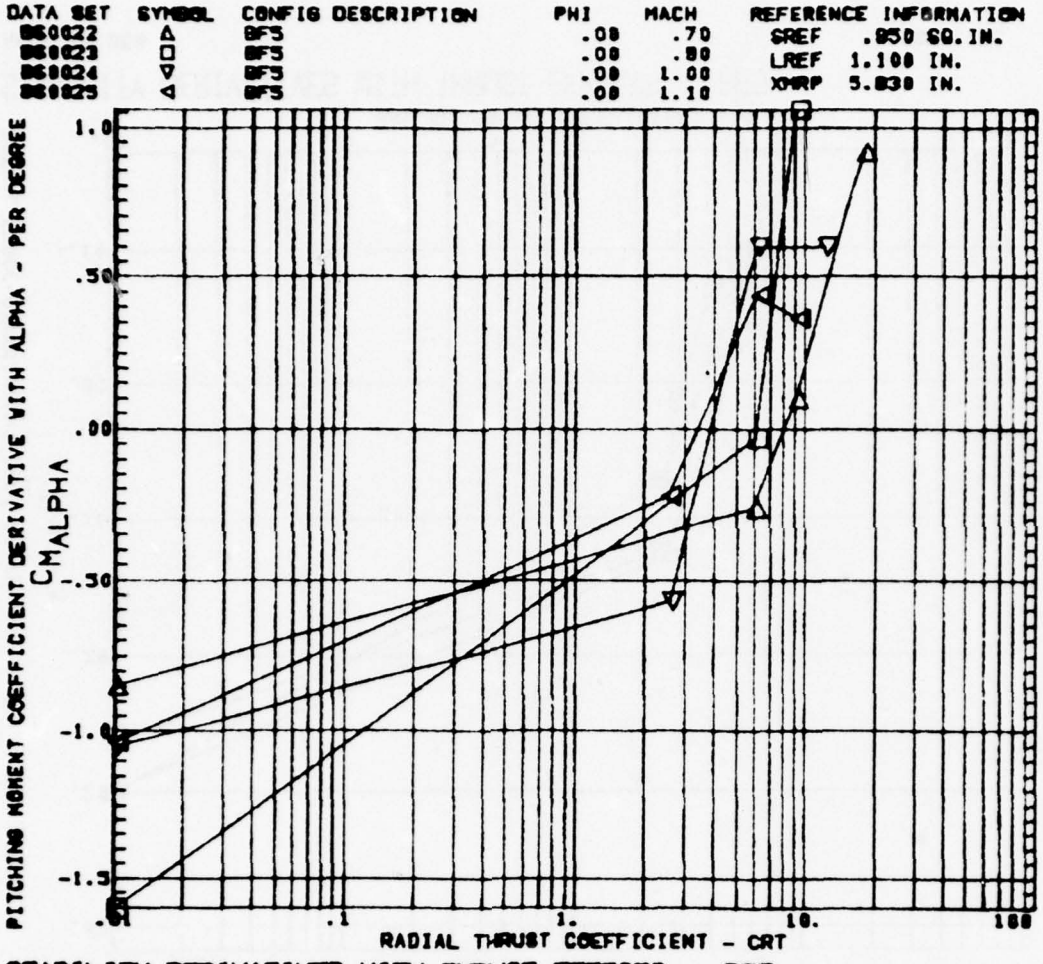
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LREF 1.100 IN.
XMRP 5.830 IN.



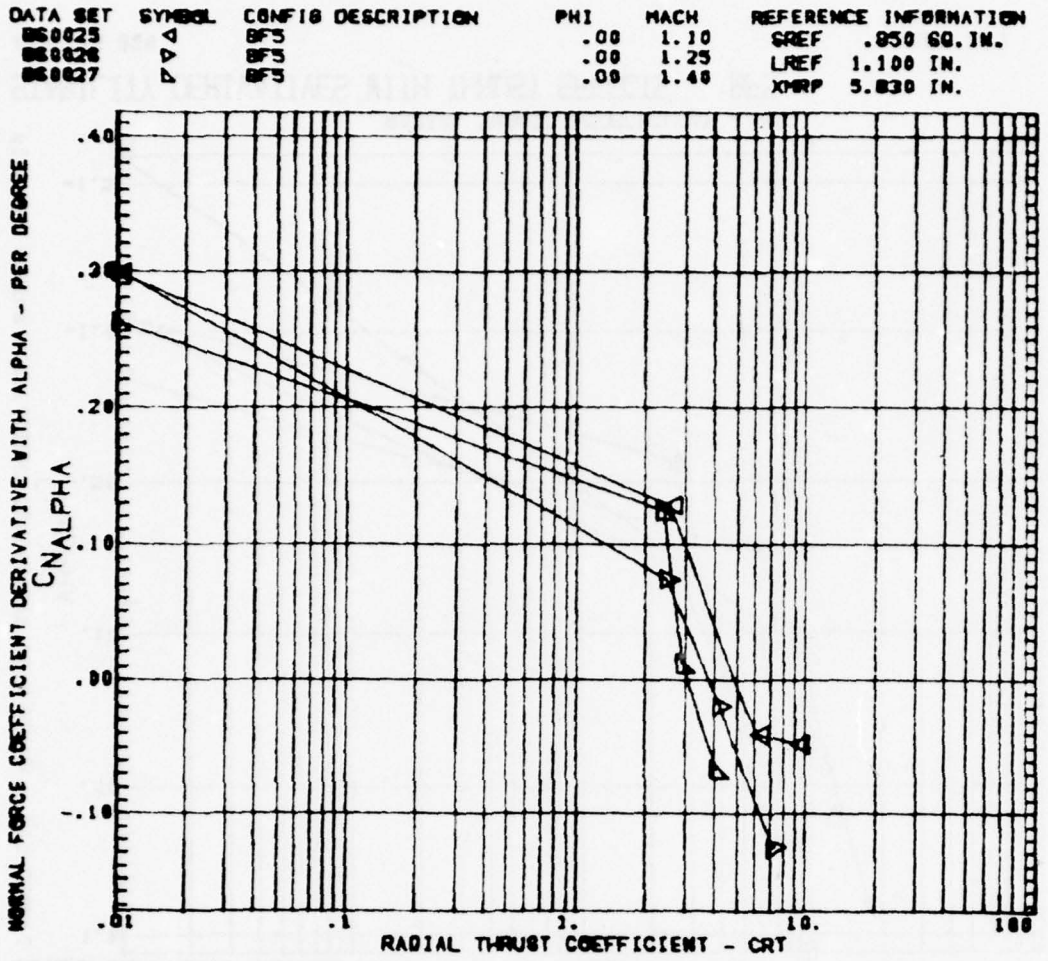
STABILITY DERIVATIVES WITH THRUST EFFECTS BF2 + GRND PL REFL



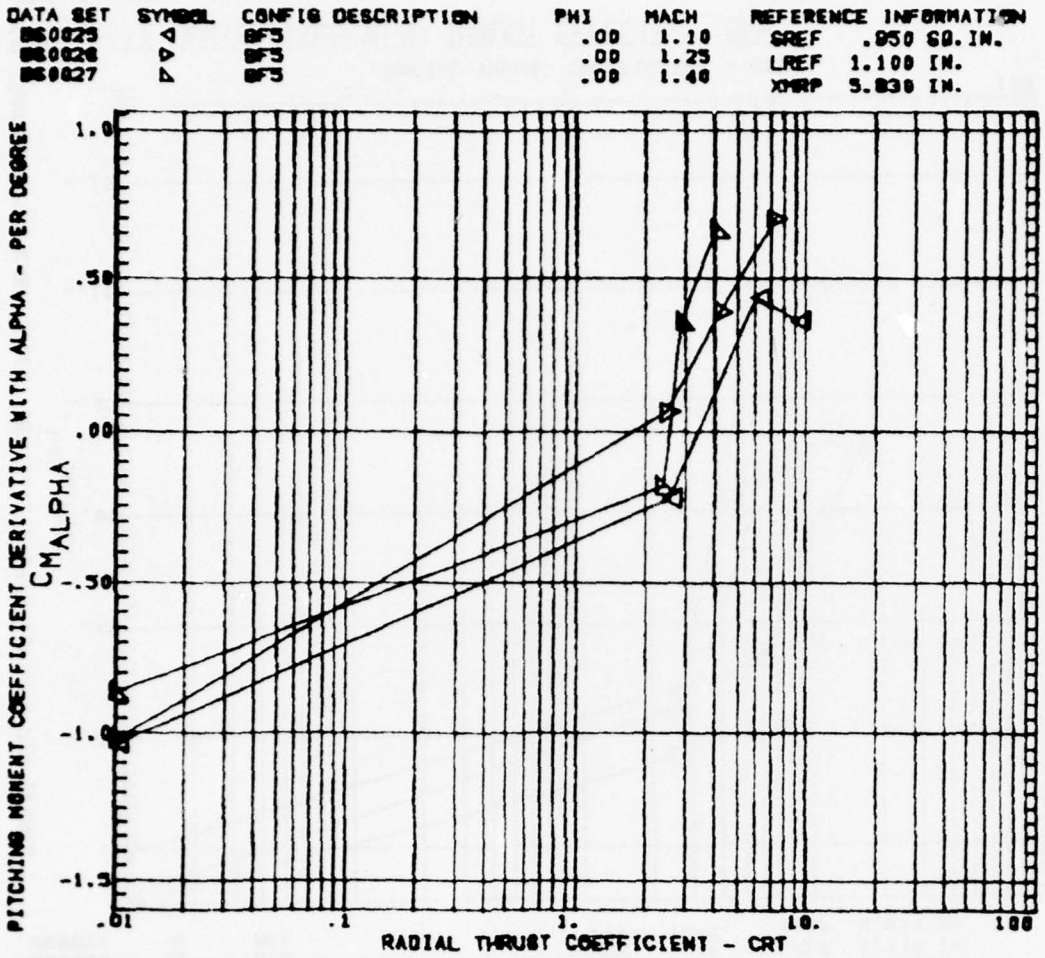
STABILITY DERIVATIVES WITH THRUST EFFECTS BF5



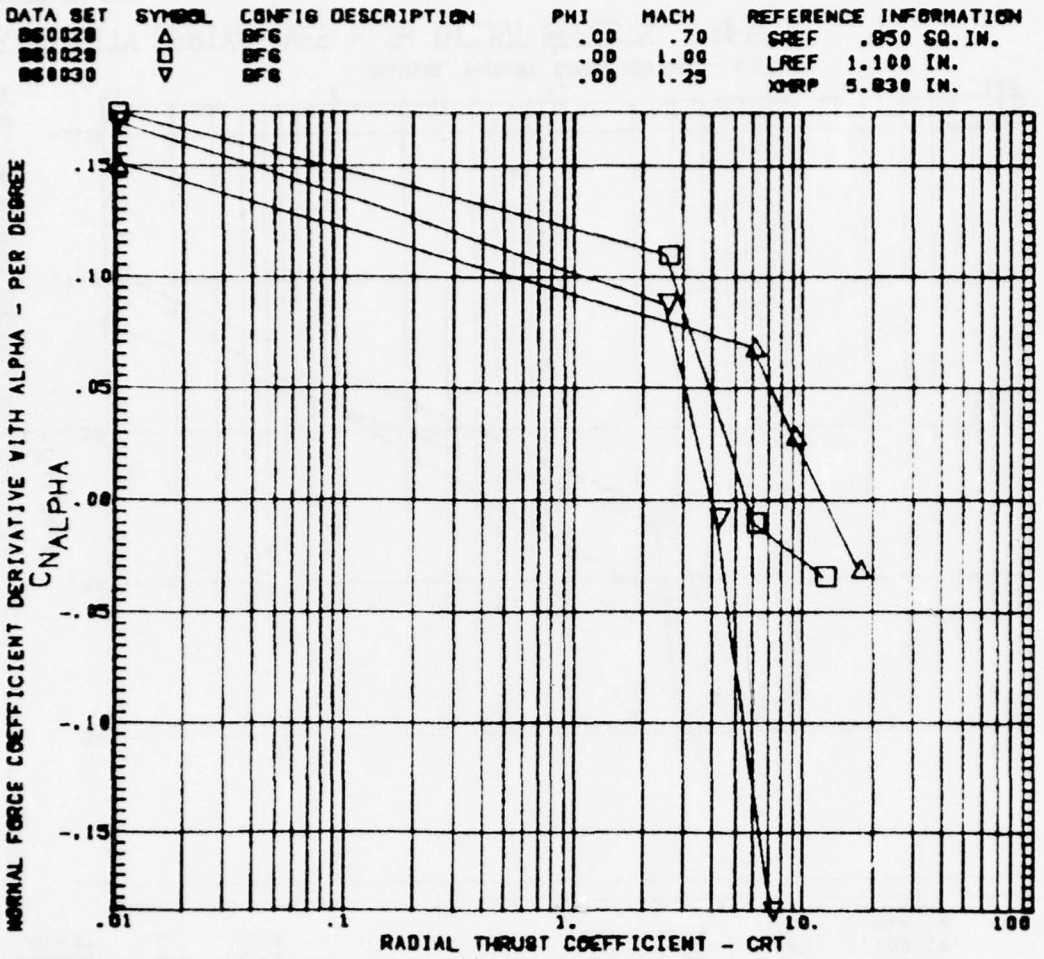
STABILITY DERIVATIVES WITH THRUST EFFECTS BF5



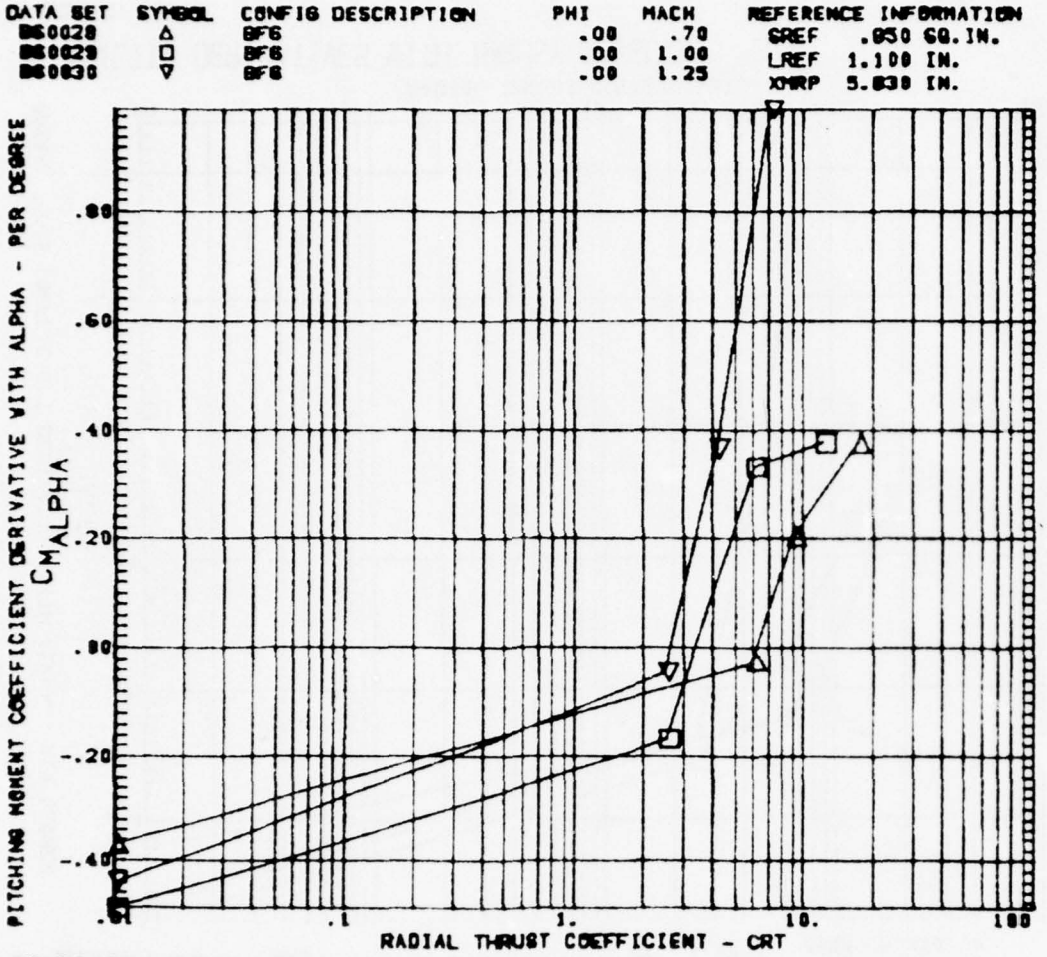
STABILITY DERIVATIVES WITH THRUST EFFECTS BF5



STABILITY DERIVATIVES WITH THRUST EFFECTS BF5

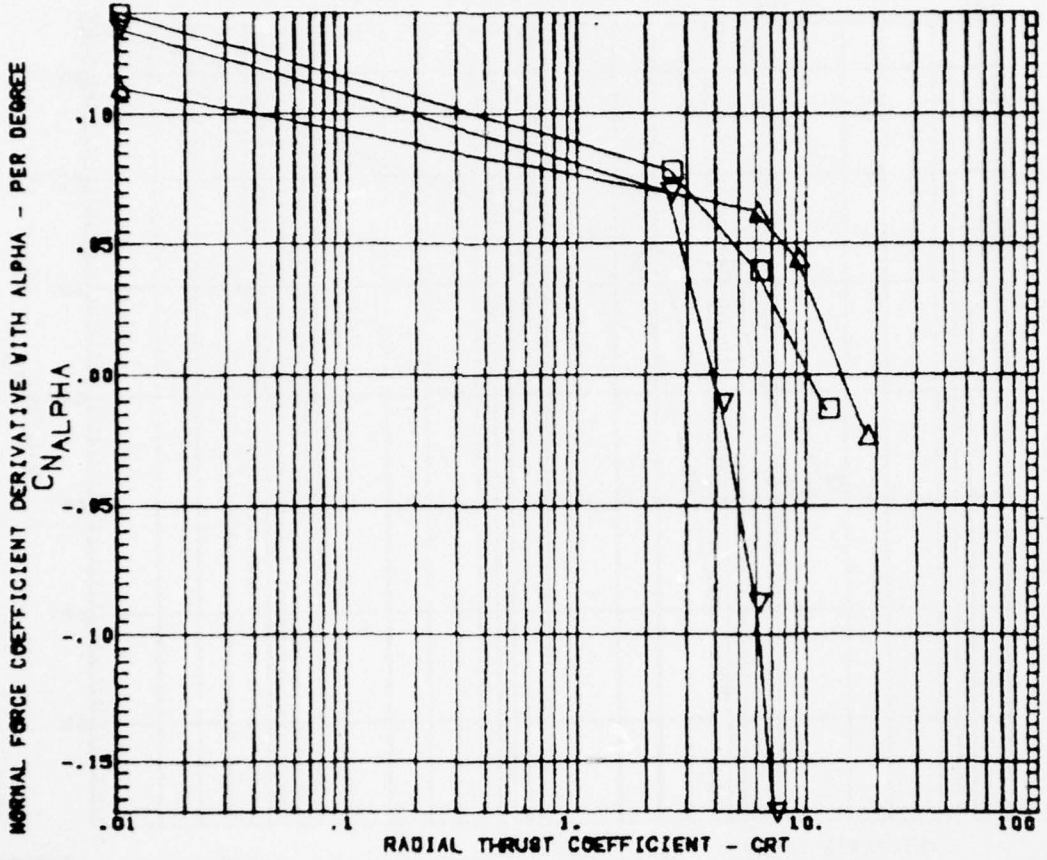


STABILITY DERIVATIVES WITH THRUST EFFECTS BF6



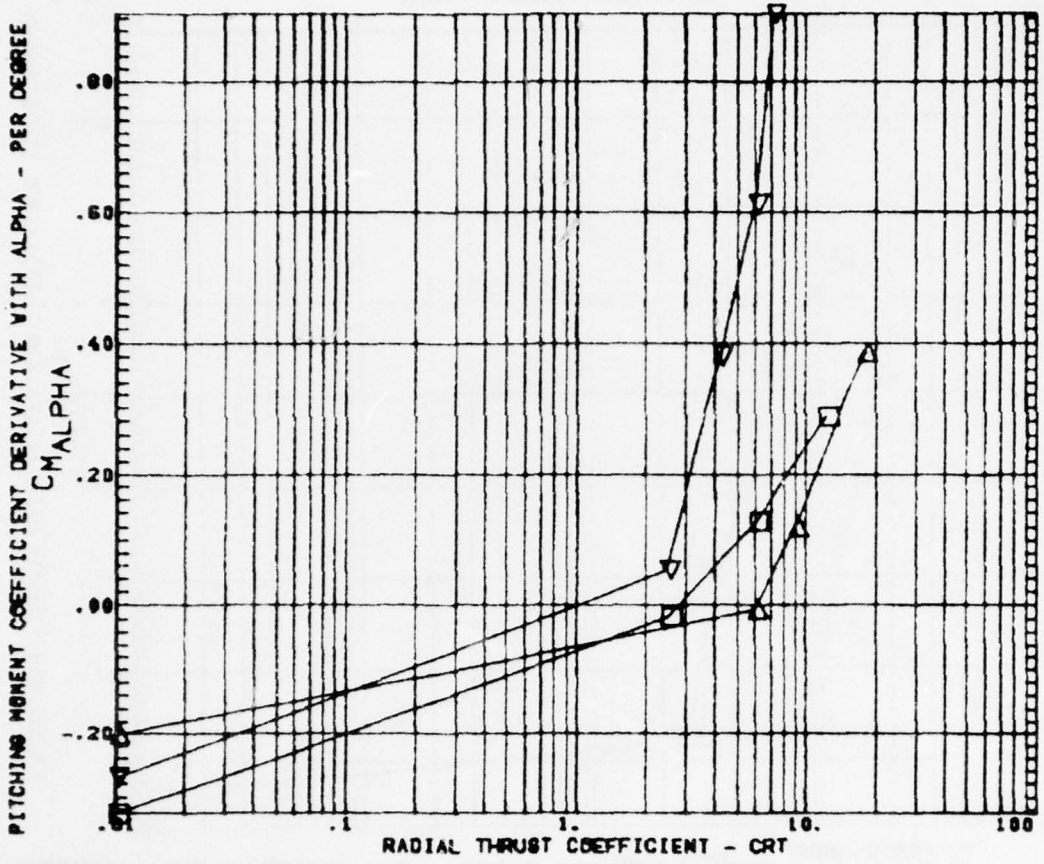
STABILITY DERIVATIVES WITH THRUST EFFECTS BF6

DATA SET	SYMBOL	CONFIG DESCRIPTION	PHI	MACH	REFERENCE INFORMATION
860031	△	BF7	.00	.70	SREF .950 SQ.IN.
860032	□	BF7	.00	1.00	LREF 1.100 IN.
860033	▽	BF7	.00	1.25	XMRP 5.830 IN.

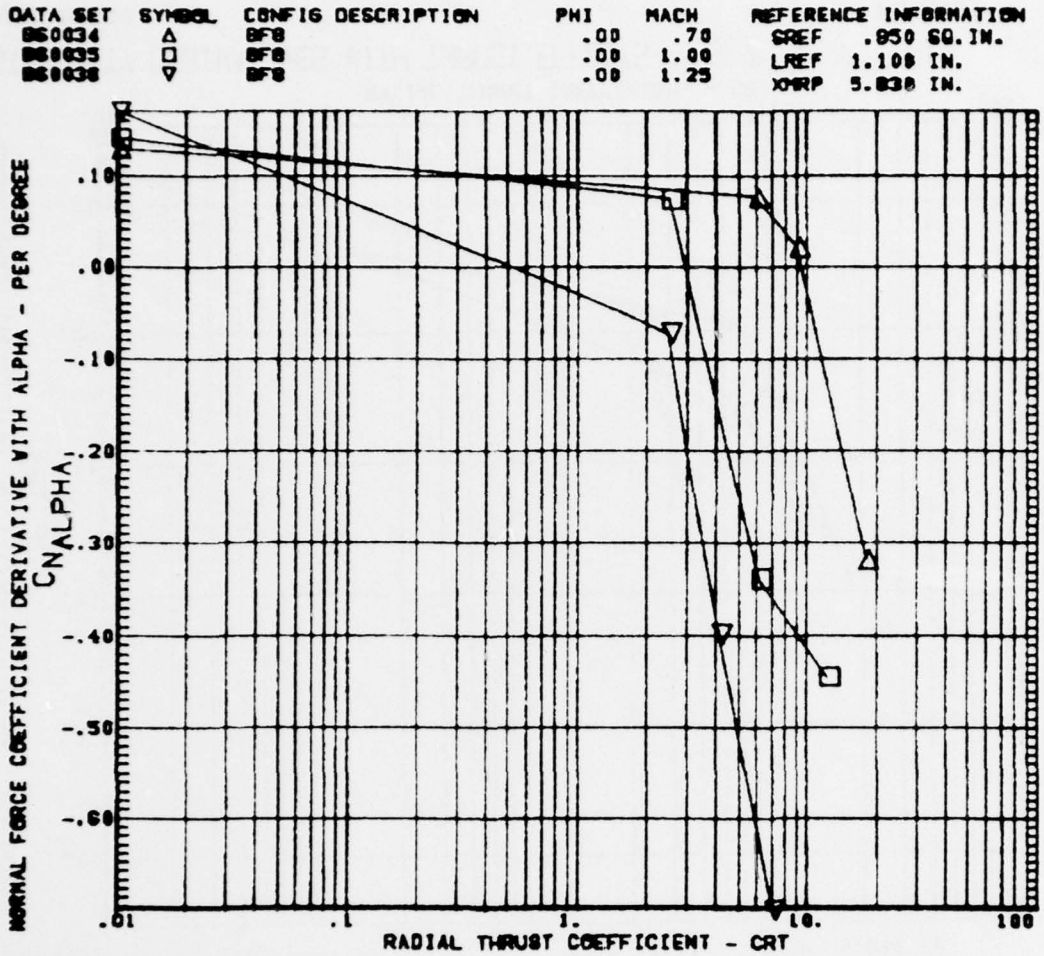


STABILITY DERIVATIVES WITH THRUST EFFECTS BF7

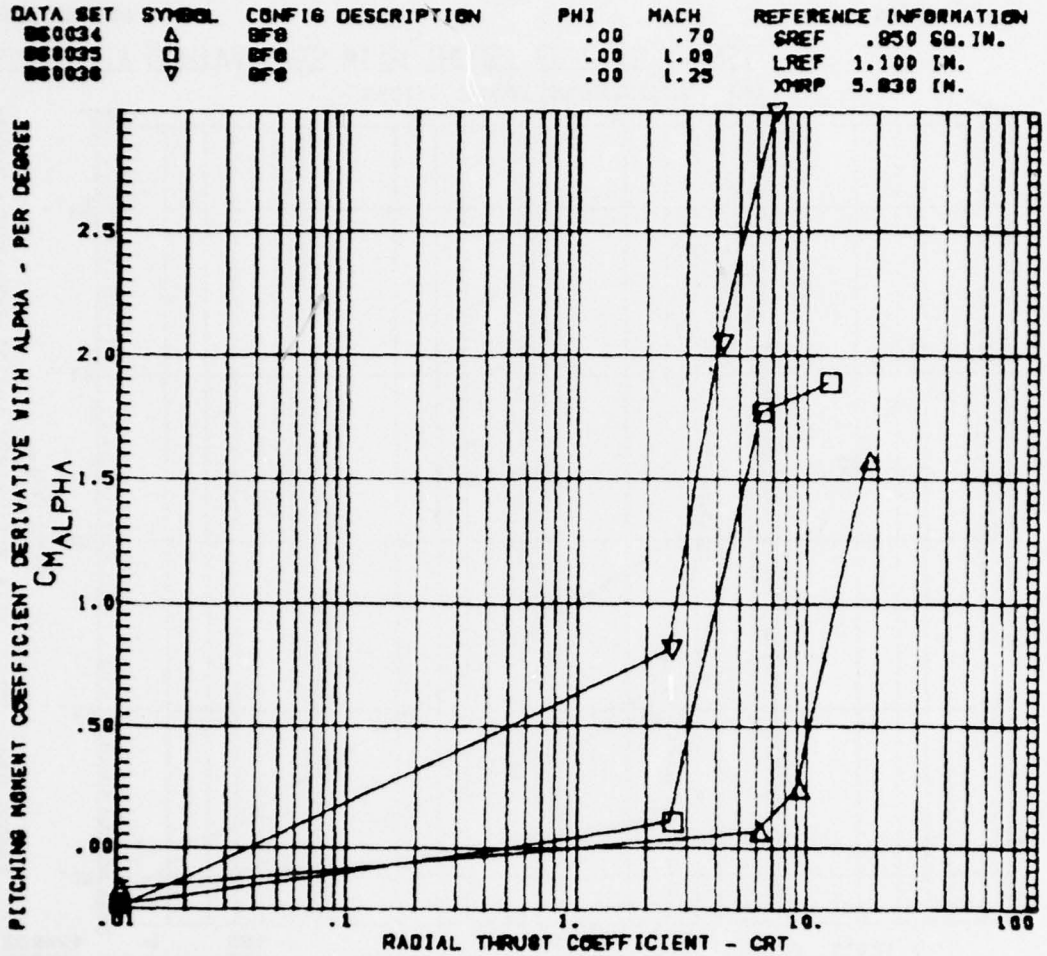
DATA SET	SYMBOL	CONFIG DESCRIPTION	PHI	MACH	REFERENCE INFORMATION
B60031	△	BF7	.00	.70	SREF .950 SQ.IN.
B60032	□	BF7	.00	1.00	LREF 1.100 IN.
B60033	▽	BF7	.00	1.25	XMRP 5.830 IN.



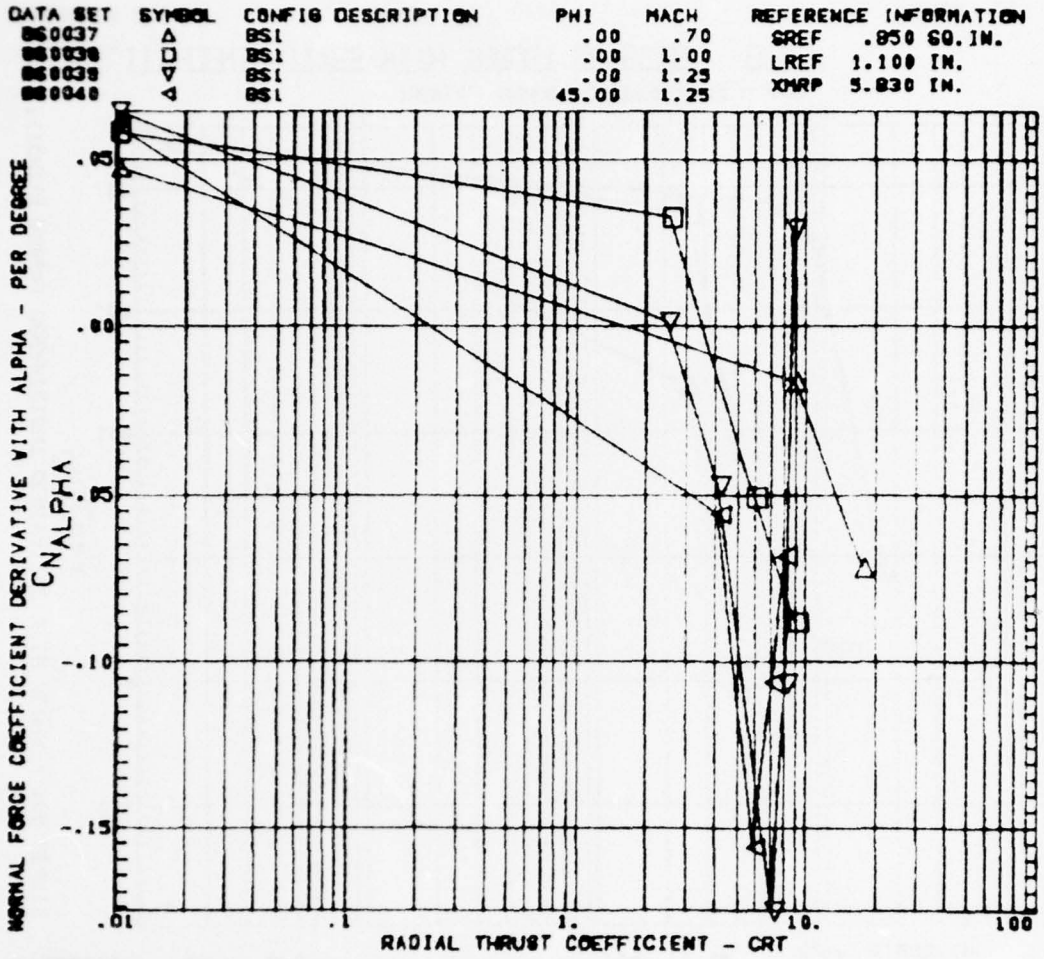
STABILITY DERIVATIVES WITH THRUST EFFECTS BF7



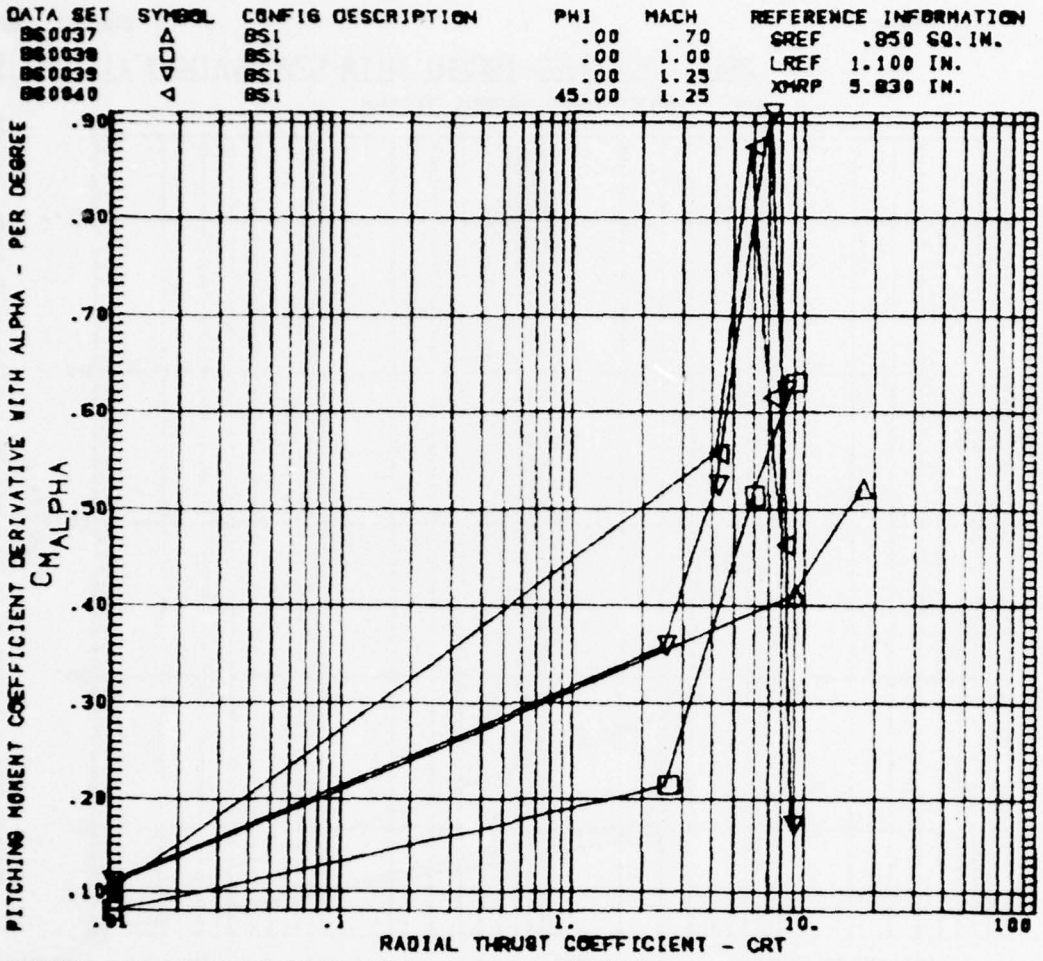
STABILITY DERIVATIVES WITH THRUST EFFECTS BF8



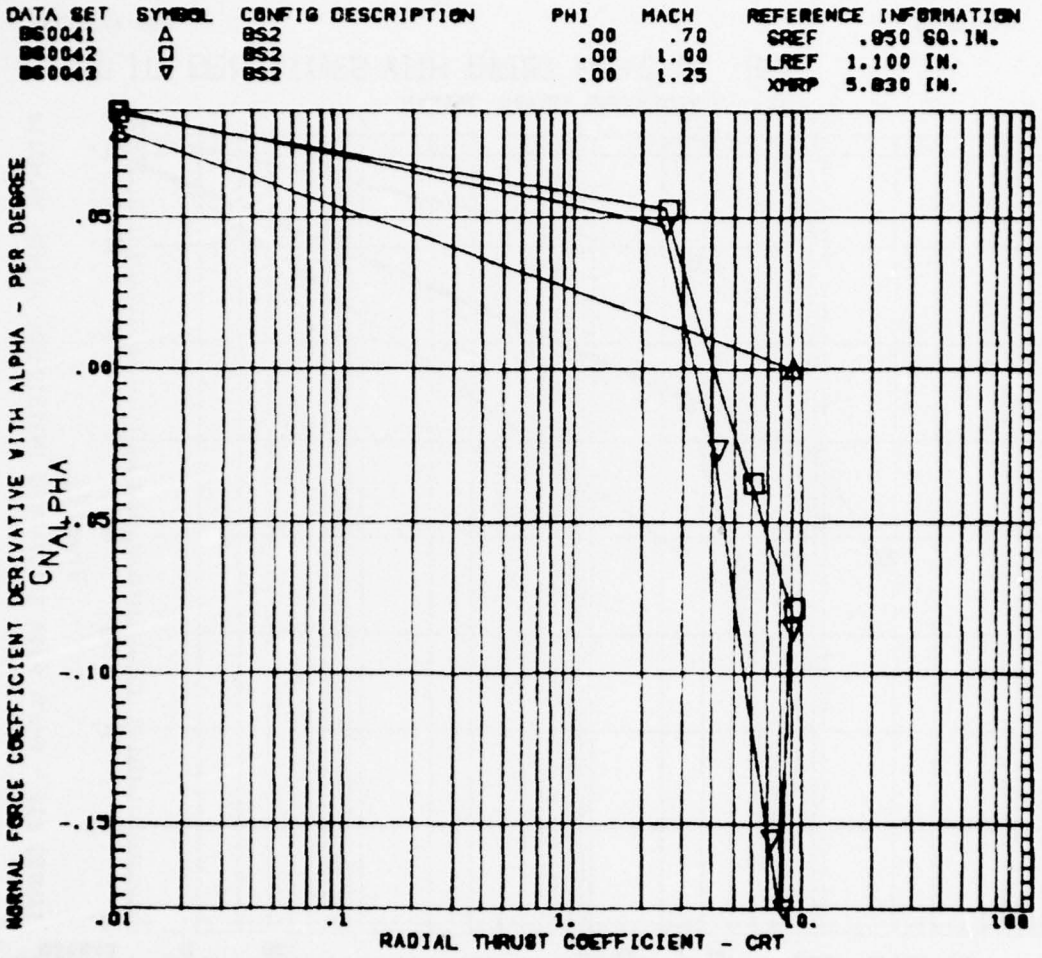
STABILITY DERIVATIVES WITH THRUST EFFECTS BF8



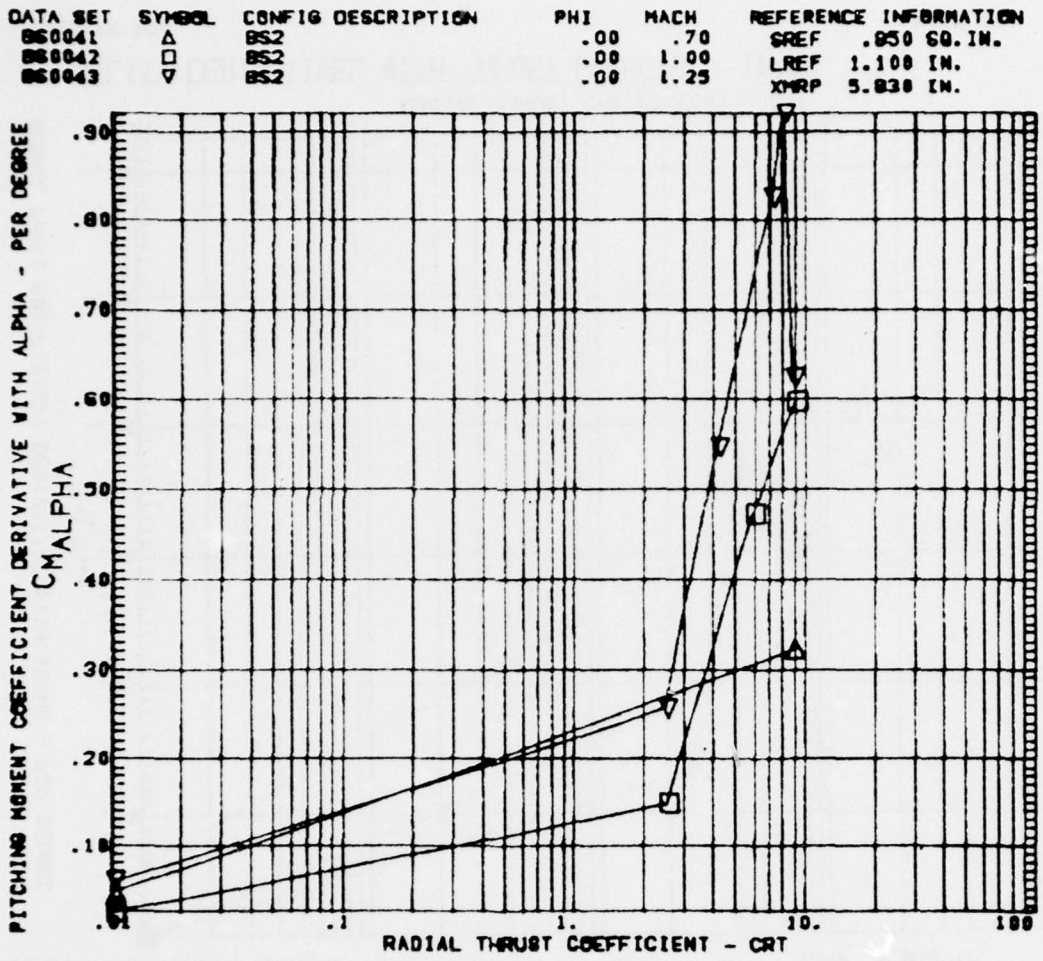
STABILITY DERIVATIVES WITH THRUST EFFECTS BS1



STABILITY DERIVATIVES WITH THRUST EFFECTS BS1



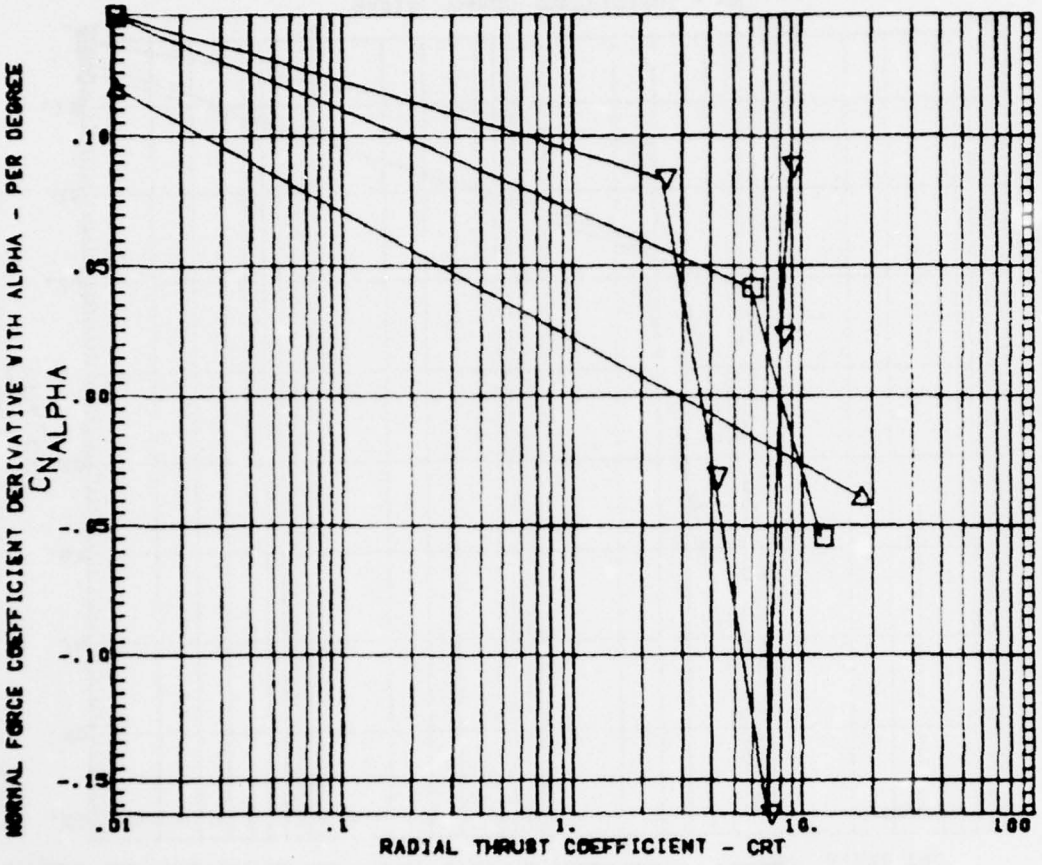
STABILITY DERIVATIVES WITH THRUST EFFECTS BS2



STABILITY DERIVATIVES WITH THRUST EFFECTS BS2

DATA SET	SYMBOL	CONFIG DESCRIPTION	PHI	MACH
BS0044	△	BF7S1	.00	.70
BS0045	□	BF7S1	.00	1.00
BS0046	▽	BF7S1	.00	1.25

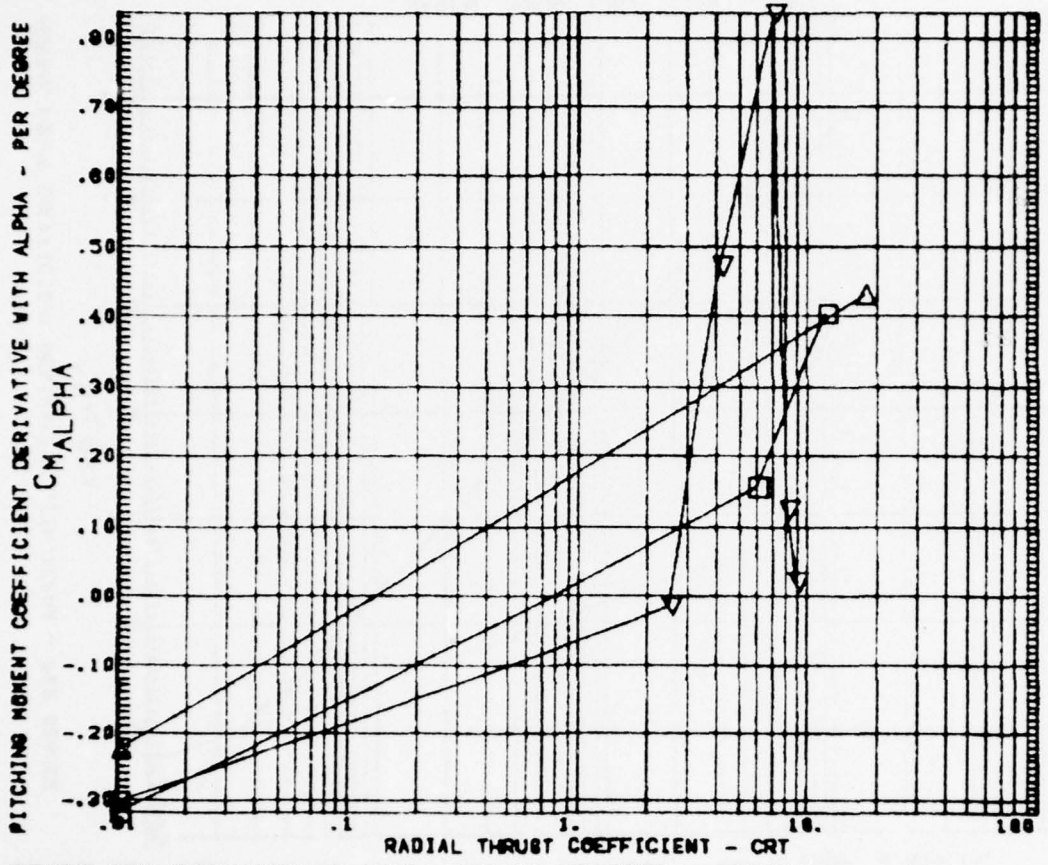
REFERENCE INFORMATION
SREF .950 SQ.IN.
LREF 1.100 IN.
XMRP 5.830 IN.



STABILITY DERIVATIVES WITH THRUST EFFECTS BF7S1

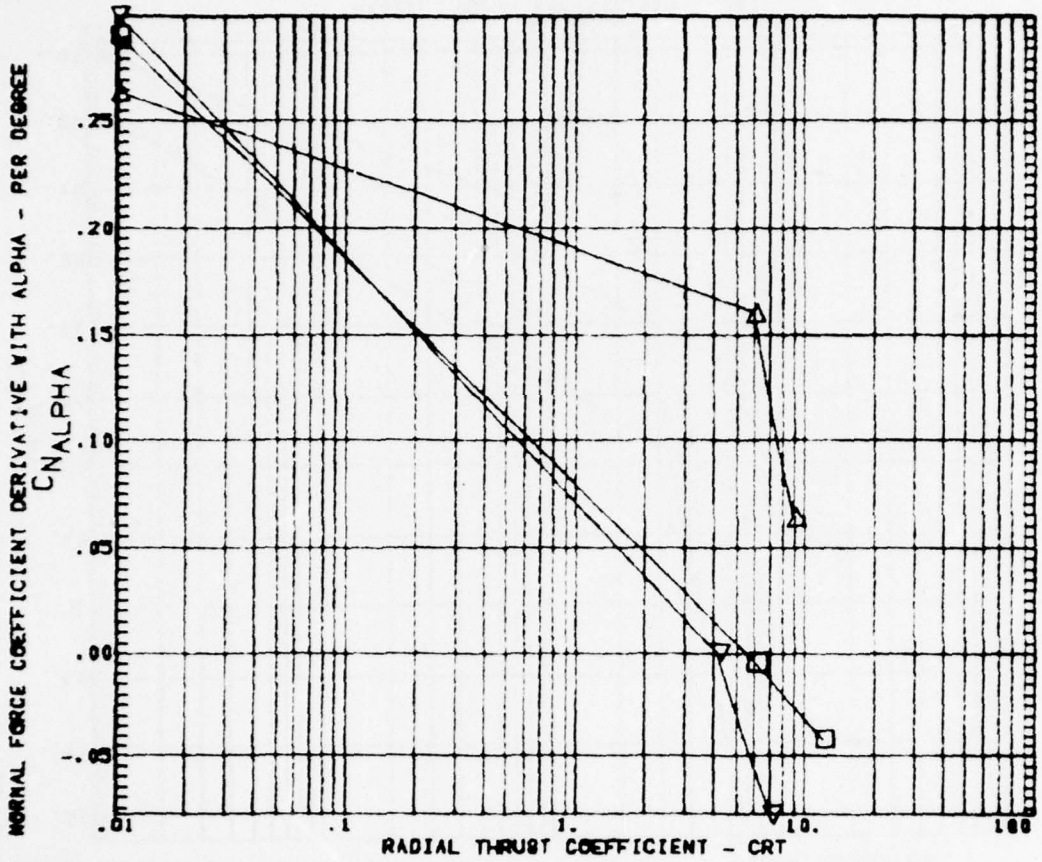
DATA SET	SYMBOL	CONFIG DESCRIPTION	PHI	MACH
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BS0045	□	BF7S1	.00	1.00
BS0046	▽	BF7S1	.00	1.25

REFERENCE INFORMATION
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LREF 1.100 IN.
XMRP 5.830 IN.

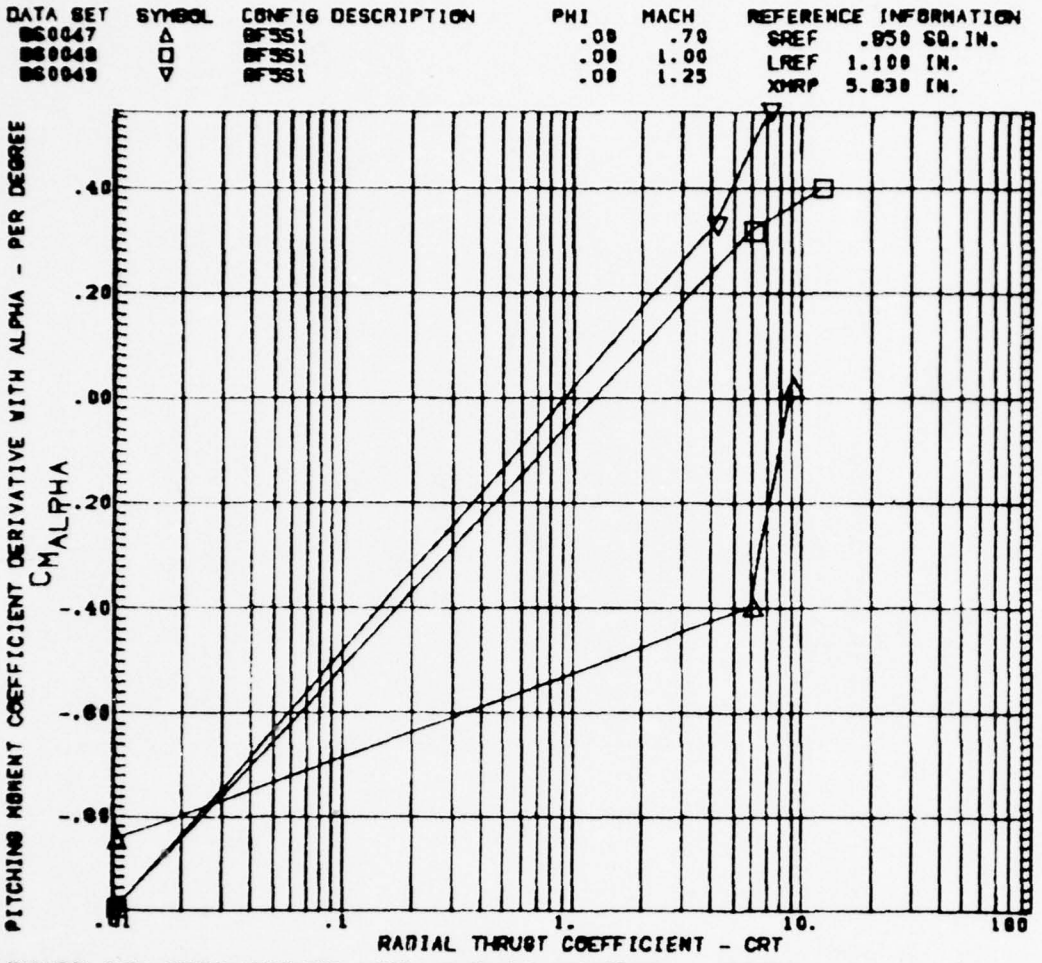


STABILITY DERIVATIVES WITH THRUST EFFECTS BF7S1

DATA SET	SYMBOL	CONFIG DESCRIPTION	PHI	MACH	REFERENCE INFORMATION
860047	△	BF5S1	.00	.70	SREF .850 SQ.IN.
860048	□	BF5S1	.00	1.00	LREF 1.100 IN.
860049	▽	BF5S1	.00	1.25	XMRP 5.838 IN.



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