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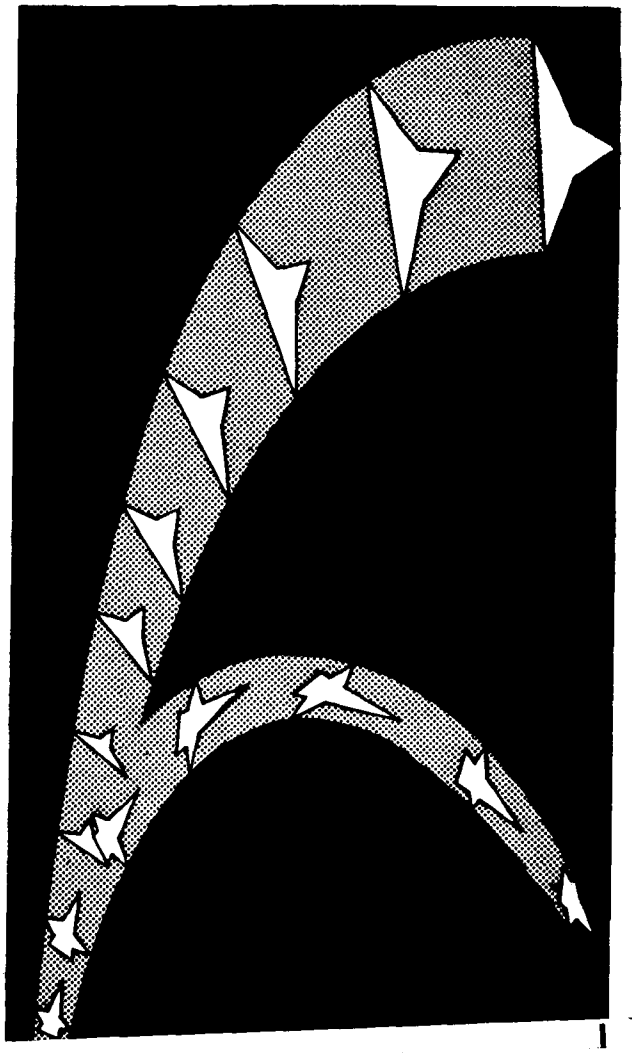

—SPACE SHUTTLE—

EXPERIMENTAL INVESTIGATIONS FOR BASE DRAG REDUCTION ON A 0.015 SCALE MODEL MSFC PROPOSED SPACE SHUTTLE BOOSTER AT MACH NUMBERS FROM 0.40 TO 1.10

by

Dale Bradley, LMSC

FOOT TUNNEL

Lockheed
Missile and Space Corp.

SADSAC SPACE SHUTTLE
AEROTHERMODYNAMIC
DATA MANAGEMENT SYSTEM

CONTRACT NAS8-4016
MARSHALL SPACE FLIGHT CENTER

SPACE DIVISION CHRYSLER CORPORATION

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SADSAC/SPACE SHUTTLE

WIND TUNNEL TEST DATA REPORT

CONFIGURATION: MSFC Parametric Booster (.015 Scale Model)

TEST PURPOSE: Base Drag Reduction Investigation

TEST FACILITY: Cornell Aero. Lab 8 x 8 Foot Transonic Wind Tunnel

TESTING AGENCY: LMSC - Huntsville

TEST NO. & DATE: CAL 18-063, 1-2 Nov., 1971 (OCC. HRS. 28)

FACILITY COORDINATOR: Robert J. Dennis

PROJECT ENGINEER(S): Dale Bradley, LMSC

DATA MANAGEMENT SERVICES

LIAISON: John E. Vaughn — DATA OPERATIONS: Albert D. Martin
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CONTRACT NAS 8-4016 AMENDMENT 153 DRL 184-58

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EXPERIMENTAL INVESTIGATIONS FOR BASE DRAG REDUCTION ON A .015 SCALE MODEL MSFC PROPOSED SPACE SHUTTLE BOOSTER AT MACH NUMBERS FROM 0.40 TO 1.10

By Dale Bradley

SUMMARY

A 0.015-scale model of a modified version of the MDAC Space Shuttle Booster was tested in the Cornell Aeronautical Laboratory 8 x 8 Foot Transonic Wind Tunnel during November 1971 to obtain force, static stability, and control effectiveness data. The objective of this test was the reduction of cruise (M = 0.4) base drag by the use of base flaps, base vents, elevon deflection and base flow from a plenum mounted forward of the base heat shield. Transonic data were also obtained to determine the aerodynamic characteristics of the new base shape. Six component aerodynamic force and moment data were recorded over an angle of attack range from -4° to 20° at 0° sideslip and over a sideslip range from -6° to 6° at 0°, 6° and 15° angle of attack. Mach number varied from 0.4 to 1.10 at a constant R of 2.0×10^{6} per unit length.

NOMENCLATURE

(General)

SYMBOL	SADSAC SYMBOL	DEFINITION
α	ALPHA	angle of attack, angle between the projection of the wind X_w-axis on the body X, Z-plane and the body X-axis; degrees
β	BETA	sideslip angle, angle between the wind X_w-axis and the projection of this axis on the body X-Z-plane; degrees
ψ	PSI	yaw angle, angle of rotation about the body Z-axis, positive when the positive X-axis is rotated toward the positive Y-axis; degrees
ϕ	PHI	roll angle, angle of rotation about the body X-axis, positive when the positive Y-axis is rotated toward the positive Z-axis; degrees
ρ		air density; K_g/m^3, slugs/ft^3
a		speed of sound; m/sec, ft/sec
V		speed of vehicle relative to surrounding atmosphere; m/sec, ft/sec
q	Q(PSI) Q(PSF)	dynamic pressure; $1/2\rho V^2$, psi, psf
M	MACH	Mach number; V/a
RN/L	RN/L	Reynolds number per unit length; million/ft
p		static pressure; psi
P		total pressure; psi
C_p	CP	pressure coefficient; $(p-p_\infty)/q$

NOMENCLATURE (Continued)

Reference & C. G. Definitions

SYMBOL	SADSAC SYMBOL	DEFINITION
S		wing area; m^2, ft^2
S	SREF	reference area; m^2, ft^2
$\bar{c}$		wing mean aerodynamic chord or reference chord; m, ft, in (see ℓ_{ref} or LREF)
ℓ_{ref}	LREF	reference length; m, ft, in.; (see $\bar{c}$)
b_{ref}	BREF	wing span or reference span; m, ft, in
A_b		base area; m^2, ft^2, in^2
c. g.		center of gravity
MRP	MRP	abbreviation for moment reference point
	XMRP	abbreviation for moment reference point on X-axis
	YMRP	abbreviation for moment reference point on Y-axis
	ZMRP	abbreviation for moment reference point on Z-axis

NOMENCLATURE (Continued)

Axis System General

SYMBOL	DEFINITION
F	force; F, lbs
M	moment; M, in-lb

Subscript	Definition
N	normal force
A	axial force
L	lift force
D	drag force
Y	force or moment about the Y axis
Z	moment about the Z axis
X	moment about the X axis
s	stability axis system
w	wind axis system
ref	reference conditions
∞	free stream conditions
t	total conditions
b	base

NOMENCLATURE (Continued)

Body & Stability Axis System

SYMBOL	SADSAC SYMBOL	DEFINITION
		Body Axis System
C_N	CN	normal force coefficient; F_N/qS
C_A	CA	axial force coefficient; F_A/qS
C_{A_b}	CAB	base axial force coefficient; $\left[-1\right] \left[(p_b - p_\infty)/q\right] (A_b/S)$
C_{A_f}	CAF	forebody axial force coefficient; $C_A - C_{A_b}$
C_n	CYN	yawing moment coefficient; $M_Z/qS\ b_{ref}$
C_ℓ	CBL	rolling moment coefficient; $M_X/qS\ b_{ref}$
		Common to Both Axis Systems
C_m	CLM	pitching moment coefficient; $M_Y/qS\ \ell_{ref}$
C_y	CY	side force coefficient; F_Y/qS
		Stability Axis System
C_L	CL	lift force coefficient; F_L/qS
C_D	CD	drag force coefficient; F_D/qS
C_{D_b}	CDB	base drag coefficient
C_{D_f}	CDF	forebody drag coefficient; $C_D - C_{D_b}$
C_n	CLN	yawing moment coefficient; $M_{Z,s}/qS\ b_{ref}$
C_ℓ	CSL	rolling moment coefficient; $M_{X,s}/qS\ b_{ref}$
L/D	L/D	lift-to-drag ratio; C_L/C_D
L/D_f	L/DF	lift to forebody drag ratio; C_L/C_{D_f}

NOMENCLATURE (Continued)

Surface Definitions

SYMBOL	SADSAC SYMBOL	DEFINITION
i_t	HORIZT	horizontal tail incidence; positive when trailing edge down; degrees
δ		symmetrical surface deflection angle; degrees; positive deflections are:
	AILRON	aileron - total aileron deflection; (left aileron - right aileron)/2
	CANARD	canard - trailing edge down
	ELEVON	elevon - trailing edge down
	ELEVTR	elevator - trailing edge down
	FLAP	flap - trailing edge down
	RUDDER	rudder - trailing edge to the left
	SPOILR	spoiler - trailing edge down
	TAB	tab - trailing edge down with respect to control surface
δ		antisymmetrical surface deflection angle, degrees; positive trailing edge down:
	AIL-L	left aileron - trailing edge down
	AIL-R	right aileron - trailing edge down
	ELVN-L	left elevon - trailing edge down
	ELVN-R	right elevon - trailing edge down
	SPLR-L	left spoiler - trailing edge down
	SPLR-R	right spoiler - trailing edge down

SURFACE SUBSCRIPTS	DEFINITION
a	aileron
b	base
c	canard
e	elevator or elevon
f	flap
r	rudder or ruddervator
s	spoiler
t	tail

CONFIGURATIONS INVESTIGATED

The 0.015 scale model MSFC Space Shuttle Booster is a modified version of the MDAC (256-14) booster configuration and consists of the following components:

B_4	Modified MDAC 256-15 fuselage
B_5	Same as B_4 except has body flaps
B_6	Same as B_4 except has slots in body
B_7	Same as B_4 except has rocket nozzles removed
W_3	Wings
V_1	Wing tip mounted vertical fin
C_2	Small canard
F_2	Trailing edge flap on canard

The configurations tested are shown in Table I. Table III gives pertinent dimensional information on each of the above components.

Grit was used on the model to insure boundry layer transition. Figure 12 depicts the manner in which it was applied and the grit size used as determined by the method of Braslow and Knox.

TEST FACILITY DESCRIPTION

The 8-Foot Transonic Wind Tunnel was placed in operation in December of 1956 as the result of modernizing the 12-Foot Variable Density Wind Tunnel to extend its operation through the transonic range. The tunnel has a perforated throat and an auxiliary pumping system for plenum pumping. The continuous circuit tunnel is capable of operating from 1/6 to 2-1/2 atmospheres total pressure, thereby providing a wide range of test Reynolds numbers as well as Mach numbers. The range of operating pressures is necessarily limited by the total power available at the higher Mach numbers. Pumping the tunnel to these conditions is done by four centrifugal compressors for above one atmosphere testing and by seven compressors for below one atmosphere. Evacuation of the tunnel to 800 psf total pressure can be accomplished by use of the auxiliary compressor from atmospheric pressure. This procedure takes approximately 8 minutes. Consequently, at least an initial expenditure of time is necessary to bring the tunnel to the desired operating conditions. During model changes, two gate valves isolate the test section from the tunnel proper making it necessary to bring only the test sphere to atmospheric conditions. By careful planning of the test program it is then possible to reduce pumping time to a minimum.

The test section of the tunnel is a removable cart. In many instances this feature permits the installation of a model prior to testing resulting in a saving of tunnel time. Three carts are in active use: a sting cart for the testing of sting-mounted, full-span models, a reflection plane cart for use with semi-span reflection plane models and the fairing cart for full-span models mounted from a plate.

Low speed airflow calibrations have been performed for free-stream velocities from 5 to 90 feet per second. Velocities in this range are steady and can be set accurately using a fixed main drive blade angle and varying the rpm. Low speed tests may be run within the operating tunnel densities of 1/6 of an atmosphere to 2.5 atmospheres.

More explicit details of the tunnel and its operational characteristics can be found in the 8-Foot Transonic Wind Tunnel Report WTO-300 at Cornell Aeronautical Laboratory.

DATA REDUCTION

The six component force and moment data recorded by the balance were corrected for weight tares, tunnel flow angularity, sting and balance deflection and reduced to coefficient form using the following reference values.

S_{REF} = wing planform area = 1.355 ft^2

ℓ_{REF} = unmodified body length = 3.453 ft

$b_{REF} = \ell_{REF}$

Moments are referenced to a center of gravity location 2.594 ft aft of the nose and 0.01875 ft above fuselage centerline (see Figure 2).

Corrections to axial force measurement for the effects of base pressure were made utilizing the following equations:

$$C_{A_B} = (C_{P_1} + C_{P_2} + C_{P_3} + C_{P_4}/4)\ A_1/S_{REF} + (C_{P_5} + C_{P_6} + C_{P_7} + C_{P_8}/4)A_2/S_{REF}$$

where

C_{P_1}, C_{P_2}, C_{P_3}, C_{P_4} are pressure coefficients of pressures measured on the heat shield

C_{P_5}, C_{P_6}, C_{P_7}, C_{P_8} are pressure coefficients of pressures measured at the nozzle exit

A_1 = heat shield area = 0.1629 ft^2

A_2 = nozzle exit area = 0.0792 ft^2

TABULATED DATA LISTING

A tabulated data listing, consisting of all aero data sets, both original and those created in arriving at the plotted material to be presented subsequently, is available as an addendum to this report. The tabular listing is made up in two sections:

(a) a brief summary list of all data sets containing the identifier, the descriptor, and the resident dependent variables.

(b) a full list of all data sets containing all resident or selected aerodynamic coefficients of the data sets as well as the above mentioned information.

The listing is currently sent on limited distribution to the following organizations:

NASA AMES	Mr. V. Stevens
CAL	Mr. R. J. Dennis
LMSC	Mr. C. Donald Andrews

If copies of this listing are desired, please contact the above or the cognizant SADSAC personnel who, for this data, is:

Mr. Albert D. Martin
Department 2780
Chrysler Corporation Space Division
New Orleans, La. 70129

(504) 255-2304

TABLE I

TEST CAL 8x8' DATA SET COLLATION SHEET

☐ PRETEST
☑ POSTTEST

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	SCHD. β	PARAMETERS/VALUES				NO. of RUNS	MACH NUMBERS (OR ALTERNATE INDEPENDENT VARIABLE)													
									0.6	0.7	0.8	0.9	1.0	1.1								
RU9001	B4C2F2W3V1	A	0		0	0	0	1	72	74	78	90	85	86								
002	↓	0	A		↓	↓	↓	1	73	75	79	91	83	87								
003		6	↓						73	76	80	92	84	88								
004	↓	15	↓					1	72	77	81	93	85	89								
005	B5C2F2W3V1	A	0					1	14													
006	↓	0	A					1	16													
007		6	↓					1	17													
008	↓	15	↓					1	15													
009	B6C2F2W3V1	A	0					1	20													
010	↓	0	A					1	21													
011	↓	6	↓					1	22													
012	↓	15	↓		↓	↓		1	23													
013	B4C2F2W3V1	A	0		10	0		1	24													
014	↓	0	A		↓	↓		1	25													
015	↓	6	↓					1	26													
016	↓	15	↓					1	27													
017	↓	A	0		-10	↓		1	14													
018	↓	0	A		↓	↓		1	15													
019	↓	6	↓					1	16													
020	↓	15	↓		↓	↓		1	17													

1	7	13	19	25	31	37	43	49	55	61	67	75 76
CN CP	CA CP2	CLM CP3	CBL CP4	CYN CP5	CY CP6	CL CP7	CD CP8	L/D CPC1	CAS CPC2			

COEFFICIENTS: → IDPVAR(1) | IDPVAR(2) | NDV

α or β SCHEDULES

αA = 0 ± 4 2 6 8 10 15 20

βA = 0 ± 3 ± 6 @ α = 0, 6, 15

NASA-MSFC-MAF

TEST CAL 8×8' DATA SET COLLATION SHEET

☐ PRETEST
☒ POSTTEST

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	SCHD. β	PARAMETERS/VALUES	δ_e	δ_c	m_b	NO. of RUNS	MACH NUMBERS (OR ALTERNATE INDEPENDENT VARIABLE) 0.40
RU9021	B4C2F2W3V1	A	0		20	0	—	1	48
022		0	B					1	49
023		6	|					1	50
024		15	↓		↓			1	51
025		A	0		30			1	52
026		0	B		|			1	53
027		6	|		|			1	54
028		15	↓		↓	↓		1	55
029		A	0		0	10		1	56
030		0	B		|	|		1	57
031		6	|		|	|		1	58
032		15	↓		|	↓		1	59
033		A	0		|	20		1	60
034		0	B		|	|		1	61
035		6	|		|	|		1	62
036		15	↓		↓	|		1	63
037		A	0		10	|		1	32
038		0	A		|	|		1	33
039		6	|		|	|		1	34
040		15	↓		↓	↓		1	35

1	7	13	19	25	31	37	43	49	55	61	67	75 76
CN CD	CA CPR	CLM CPB	CLL CPA	CYN CPS	CY CPC	CL CPZ	CD CPD	L/D CPC1	CAR CPC2			

COEFFICIENTS: → IDPVAR(1) | IDPVAR(2) | NDV

α or β SCHEDULES

αA = 0 4 2 6 8 10 15 20

βA = 0 3 4 6 δ_e = 0, 6, 15

NASA-MSFC-MAF

TEST CAL 8×6' DATA SET COLLATION SHEET

☐ PRETEST
☐ POSTTEST

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	SCHD. β	PARAMETERS/VALUES	δe	δc	im	NO. of RUNS	MACH NUMBERS (OR ALTERNATE INDEPENDENT VARIABLE)	0.40											
RU9 011	B4C2F2 W3V1	A	0		-10	20	–	1		36											
012		0	A					1		37											
013		6						1		38											
014		15						1		39											
015		A	0		+10	10		1		28											
016		0	A					1		29											
017		6						1		30											
018		15						1		31											
019		A	0		-10			1		40											
050		0	A					1		41											
051		6						1		42											
052		15						1		43											
053		A	0		-20	0		1		94											
054		0	A					1		95											
055		6						1		96											
056		15						1		97											
057		A	0		0	0	.353	1		68											
058		0	A					1		69											
059		6						1		70											
060		15						1		71											

1	7	13	19	25	31	37	43	49	55	61	67	75 76
CN	CA	CLM	CLI	CYN	CY	CL	CD	L/D	CAB			

COEFFICIENTS: → IDPVAR(1) | IDPVAR(2) | NDV

α or β SCHEDULES

NASA-MSFC-MAF

TEST CAL 8x8 DATA SET COLLATION SHEET

☐ PRETEST
☑ POSTTEST

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	SCHD. β	PARAMETERS/VALUES			NO. of RUNS	MACH NUMBERS (OR ALTERNATE INDEPENDENT VARIABLE)	
					δ_a	Δ_c		2.0	0.40
RUS061	B4C2F2W3V1	0	0		0	0	VAR.		5
062	↓	↓	↓		↓	↓	↓	67	
063									13
064	↓								72
065	B7C2F2W3V1								10
066	B5C2F2W3V1	↓	↓		↓	↓	↓		15

1	7	13	19	25	31	37	43	49	55	61	67	75 76
CN	CA	CLM	KPL	KYN	CY	CL	CD	L/D	CAB		BS FLOW	
CP...	CPZ...	CP3...	CP4...	CP5...	CPL...	CP7...	CP8...	CPC1...	CPC2...			

COEFFICIENTS: → IDPVAR(1) | IDPVAR(2) | NDV

α or β SCHEDULES: M_b VAR - VARIABLE FLOWRATE (0 - .815 in uneven increments)

NASA-MSFC-MAF

TABLE II.

TEST CONDITIONS

TEST CAL 8 x 8' - 063

MACH NUMBER	REYNOLDS NUMBER per unit length	DYNAMIC PRESSURE (pounds/sq. inch)	STAGNATION TEMPERATURE (degrees Fahrenheit)
0.40	2×10^6	1.146	63
0.70		1.931	77
0.80		2.181	87
0.90		2.389	89
1.00		2.590	97
1.10		2.736	99

BALANCE UTILIZED: CAL-TASK-MK XIX

	CAPACITY:	ACCURACY:	COEFFICIENT TOLERANCE:
NF	2400 lb	±12.0 lb	±.0230
SF	1200 lb	± 6.0 lb	±.0115
AF	200 lb	± 1.0 lb	±.0019
PM	5900 in. lb.	±29.5 in.lb	±.0014
YM	2500 in. lb.	±12.5 in.lb	±.0006
RM	1600 in. lb.	± 8.0 in.lb	±.0004

COMMENTS:

Coefficient tolerance is for M = 1.0, q = 385 psf.

TABLE III. MODEL COMPONENT DESCRIPTION

MODEL COMPONENT: BODY - B_4 (Base Flow)

GENERAL DESCRIPTION: Modified MDAC 256-14 Body (ℓ = 3.638') with Large Base Area to Shield Engines. There is a Non-Metric Base Flow Plenum Installed.

DRAWING NUMBER: CAL W14-0047B

DIMENSIONS:	FULL SCALE	MODEL SCALE
Length	242 ft	3.638 ft
Max. Width	37.7 ft	0.566 ft
Max. Depth	34.0 ft	0.510 ft
Fineness Ratio	--	--
Area		
Max. Cross-Sectional	1076 ft^2	0.242 ft^2
Planform	--	--
Wetted	--	--
Base	1076 ft^2	0.242 ft^2

TABLE III. MODEL COMPONENT DESCRIPTION (Continued)

MODEL COMPONENT: W_3

GENERAL DESCRIPTION: This wing is basically the same as W_1 except it was modified near the root chord. This modification results in a slight decrease in wing exposed area due to the flare of the body at the base (B_4)

DRAWING NUMBER: NSRDC A152024-1

DIMENSIONS:	FULL-SCALE	MODEL SCALE
TOTAL DATA		
Area		
Planform	6020 ft^2	1.355 ft^2
Wetted	--	--
Span (equivalent)	120.67 ft	1.81 ft
Aspect Ratio	2.42	2.42
Rate of Taper	--	--
Taper Ratio	.547	.547
Diehedral Angle, degrees	7°40', 15°	7°40', 15°
Incidence Angle, degrees	0°, 3°	0°, 3°
Aerodynamic Twist, degrees	--	--
Toe-In Angle	0°	0°
Cant Angle	--	--
Sweep Back Angles, degrees		
Leading Edge	40°	40°
Trailing Edge	19°31'	19°31'
0.25 Element Line	--	--
Chords:		
Root (Wing Sta. 0.0)	64.55 ft	.969 ft
Tip, (equivalent)	35.4 ft	.53 ft
MAC	--	--
Fus. Sta. of .25 MAC	--	--
W.P. of .25 MAC	--	--
B.L. of .25 MAC	--	--
Airfoil Section		
Root	64A010	64A010
Tip	64A010	64A010
EXPOSED DATA		
Area	3960 ft^2	.891 ft^2
Span, (equivalent)	86.8 ft	1.30 ft
Aspect Ratio	1.89	1.89
Taper Ratio	.627	.627
Chords		
Root	56.4 ft	.845 ft
Tip	35.4	.53 ft
MAC	--	--
Fus. Sta. of .25 MAC	--	--
W.P. of .25 MAC	--	--
B.L. of .25 MAC	--	--

TABLE III. MODEL COMPONENT DESCRIPTION (Continued)

MODEL COMPONENT: BODY - B5 (Base Flaps)

GENERAL DESCRIPTION: Same as B4 except flaps on the top and bottom (60" x 318" full scale) and in the sides (60" x 212" full scale). Flaps are deflected in toward the booster main engine nozzles.

DRAWING NUMBER: CAL W14-0046B

DIMENSIONS:	FULL SCALE	MODEL SCALE
Length	242 ft	3.638 ft
Max. Width	37.7 ft	0.566 ft
Max. Depth	34.0 ft	0.510 ft
Fineness Ratio	--	--
Area		
Max. Cross-Sectional	1076 ft^2	0.242 ft^2
Planform	--	--
Wetted	--	--
Base	1076 ft^2	-.242 ft^2

TABLE III. MODEL COMPONENT DESCRIPTION (Continued)

MODEL COMPONENT: BODY - B6 (Base Venting)

GENERAL DESCRIPTION: Same as B4 except slots have been cut in top and bottom (60" x 318" full scale) and in the sides (60" x 212" full scale) just aft of the heat shield (STA. 3861 Rel. to Nose at STA. 1025)

DRAWING NUMBER: CAL W14-0045B

DIMENSIONS:	FULL SCALE	MODEL SCALE
Length	242 ft	3.638 ft
Max. Width	37.7 ft	0.566 ft
Max. Depth	34.0 ft	0.510 ft
Fineness Ratio	--	--
Area		
Max. Cross-Sectional	1076 ft^2	0.242 ft^2
Planform	--	--
Wetted	--	--
Base	1076 ft^2	0.242 ft^2

TABLE III. MODEL COMPONENT DESCRIPTION (Continued)

MODEL COMPONENT: BODY - B7

GENERAL DESCRIPTION: Same as B4 except the booster main rocket nozzles (except four partial nozzles around the sting) were removed.

DRAWING NUMBER:

DIMENSIONS:	FULL SCALE	MODEL SCALE
Length	242 ft	3.638 ft
Max. Width	37.7 ft	0.566 ft
Max. Depth	34.0 ft	0.510 ft
Fineness Ratio	--	--
Area		
Max. Cross-Sectional	1076 ft^2	0.242 ft^2
Planform	--	--
Wetted	--	--
Base	1076 ft^2	0.242 ft^2

TABLE III. MODEL COMPONENT DESCRIPTION (Continued)

MODEL COMPONENT: V1

GENERAL DESCRIPTION: Booster Wing Tip Vertical Fin

(Dimensions given are for each tip)

DRAWING NUMBER: NRDC A152027-1,4

DIMENSIONS:	FULL-SCALE	MODEL SCALE
TOTAL DATA		
Area		
Planform	1010 ft^2	.226 ft^2
Wetted	[3] --	--
Span (equivalent)	38.80 ft	.582 ft
Aspect Ratio	1.5	1.5
Rate of Taper	--	--
Taper Ratio	.467	.467
Diehedral Angle, degrees	65°	65°
Incidence Angle, degrees	3°	3°
Aerodynamic Twist, degrees	0	0
Toe-In Angle	0	0
Cant Angle	0	0
Sweep Back Angles, degrees		
Leading Edge	40°	40°
Trailing Edge	19°31'	19°31'
0.25 Element Line	--	--
Chords:		
Root (Wing Sta. 0.0)	35.35 ft	.530 ft
Tip, (equivalent)	16.50 ft	.247 ft
MAC	--	--
Fus. Sta. of .25 MAC	--	--
W.P. of .25 MAC	--	--
B.L. of .25 MAC	--	--
Airfoil Section		
Root	64A010	64A010
Tip	64A009	64A009
EXPOSED DATA		
Area	--	--
Span, (equivalent)	--	--
Aspect Ratio	--	--
Taper Ratio	--	--
Chords		
Root	--	--
Tip	--	--
MAC	--	--
Fus. Sta. of .25 MAC	--	--
W.P. of .25 MAC	--	--
B.L. of .25 MAC	--	--

TABLE III. MODEL COMPONENT DESCRIPTION (Continued)

MODEL COMPONENT: C2

GENERAL DESCRIPTION: Booster Small Canard

DRAWING NUMBER: NSRDC A152018-5

DIMENSIONS:	FULL-SCALE	MODEL SCALE
TOTAL DATA		
Area		
Planform	2235 ft^2	0.503 ft^2
Wetted	--	--
Span (equivalent)	72.6 ft	1.09 ft
Aspect Ratio	2.36	2.36
Rate of Taper	--	--
Taper Ratio	.118	.118
Diehedral Angle, degrees	0	0
Incidence Angle, degrees	3^o, 15^o	3^o, 15^o
Aerodynamic Twist, degrees	0	0
Toe-In Angle	--	--
Cant Angle	--	--
Sweep Back Angles, degrees		
Leading Edge	53^o	53^o
Trailing Edge	0	0
0.25 Element Line	--	--
Chords:		
Root (Wing Sta. 0.0)	55 ft	.825 ft
Tip, (equivalent)	6.47 ft	.097 ft
MAC	--	--
Fus. Sta. of .25 MAC	--	--
W.P. of .25 MAC	--	--
B.L. of .25 MAC	--	--
Airfoil Section		
Root	64A010	64A010
Tip	64A010	64A010
EXPOSED DATA		
Area	750 ft^2	0.169 ft^2
Span, (equivalent)	38.8 ft	0.581 ft
Aspect Ratio	2	2
Taper Ratio	0.2	0.2
Chords		
Root	32.2 ft	0.484 ft
Tip	6.46 ft	0.097 ft
MAC	--	--
Fus. Sta. of .25 MAC	--	--
W.P. of .25 MAC	--	--
B.L. of .25 MAC	--	--

TABLE III. MODEL COMPONENT DESCRIPTION (Concluded)

MODEL COMPONENT: F2 with Canard C2

GENERAL DESCRIPTION: Booster Canard Trailing Edge Flap (40% Chord - Exposed Area)

DRAWING NUMBER: NSRDC A152018-5

DIMENSIONS:	FULL-SCALE	MODEL SCALE
Area	300 ft^2	0.0676 ft^2
Span (equivalent)	38.8 ft	0.581 ft
Inb'd equivalent chord	12.9 ft	0.1936 ft
Outb'd equivalent chord	2.59 ft	0.0388 ft
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	0.4	0.4
At Outb'd equiv. chord	0.4	0.4
Sweep Back Angles, degrees		
Leading Edge	28°	28°
Tailing Edge	0	0
Hingeline	--	--
Area Moment (Normal to hinge line)	--	--

TABLE IV. INDEX OF MODEL FIGURES

TABLE V. INDEX TO DATA FIGURES

TITLE	PLOTTED COEFFICIENTS SCHEDULE	CONDITIONS VARYING	PAGES
Comparison of New Base Shape With Old Base Shape-Longitudinal Characteristics	A,C	Configuration	1-20
Comparison of New Base Shape With Old Base Shape-Lateral-Directional Characteristics	B,D	Configuration	21-22
Effect of Base Weight Flow Rate on Longitudinal Characteristics	A,B	Base Flow	23-26
Effect of Booster Base Shape on Longitudinal Characteristics	A	Configuration	27-29
Effect of Booster Base Shape on Lateral-Directional Characteristics	B	Configuration	30
Elevon Control Effectiveness - Longitudinal Characteristics	A	Elevator Deflections	31-33 35-37 39-41
Elevon Control Effectiveness - Lateral-Directional Characteristics	B	Elevator Deflections	34, 38, 42
Canard Control Effectiveness - Longitudinal Characteristics	A	Canard Deflections	43-45
Canard Control Effectiveness - Lateral-Directional Characteristics	B	Canard Deflections	46
Effect of Varying Engine Weight Flow Rate on Longitudinal Characteristics	E	Configuration	47-48

TABLE V. INDEX TO DATA FIGURES
(Continued)

TITLE	PLOTTED COEFFICIENTS SCHEDULE	CONDITIONS VARYING	PAGES
Aerodynamic Characteristics as a Function of Elevator Deflection	F	ALPHA	49-52
Aerodynamic Characteristics as a Function of Canard Deflection	F	ALPHA	53-56

PLOTTED COEFFICIENTS SCHEDULE:

A) CL vs. ALPHA, CLM; CA, CAB, CN vs. ALPHA

L/D, CD vs. ALPHA; CL vs. CD

B) CY, CYN, CBL vs. BETA

C) DCLMDA, CLALFA vs. MACH

CDAFO, CABAFO, CAAFO vs. MACH

D) CYBETA, DCYNDB, DCBLDB vs. MACH

E) CLM, CL, CD, L/D, CN, CA, CAB vs. BSFLOW

F) CLM, CL, CD, CAB vs. ANGLE

MODEL FIGURES

Notes:

1. Positive directions of force coefficients moment coefficients, and angles are indicated by arrows.

2. For clarity, origins of wind and stability axes have been displaced from the center of gravity.

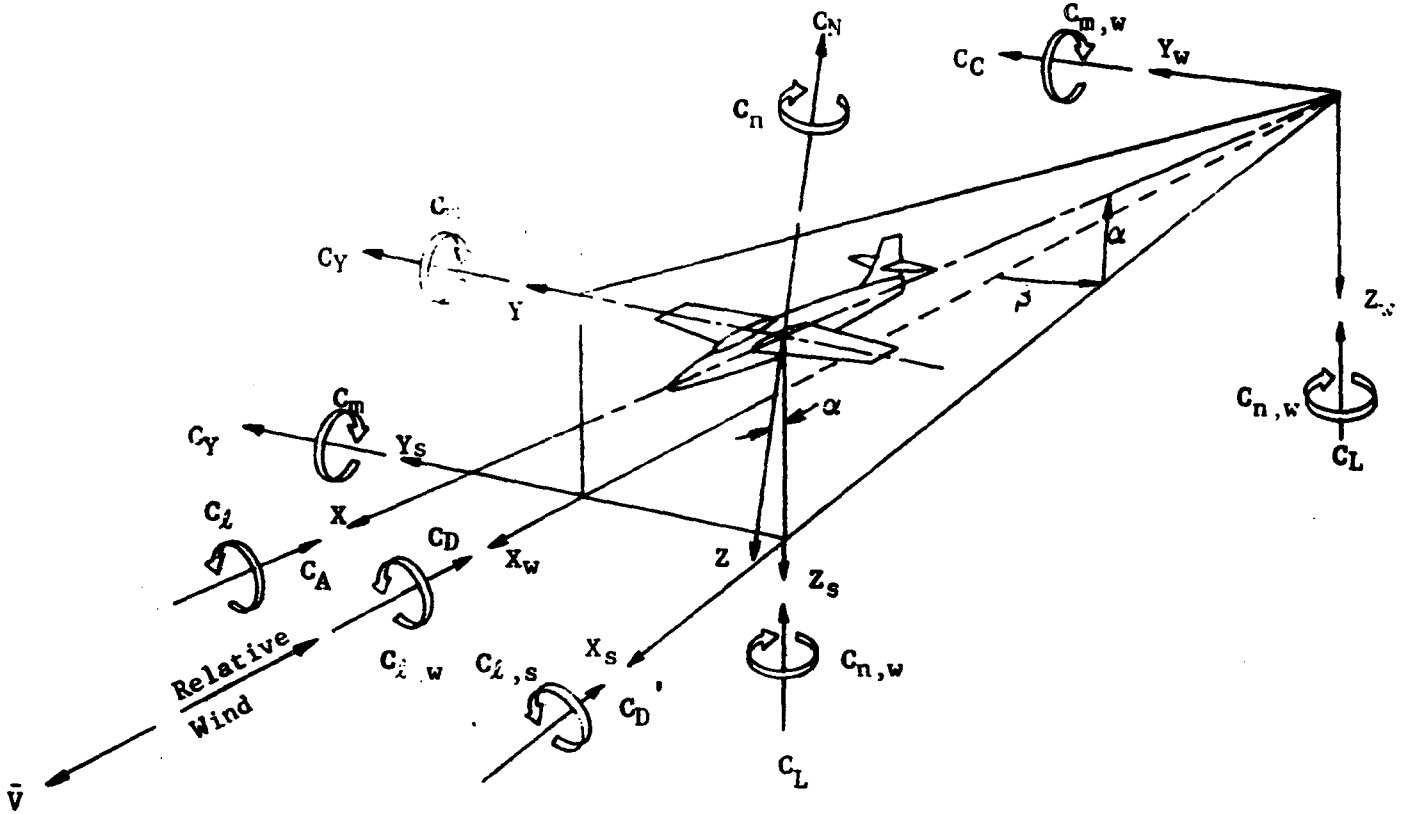


Figure 1. Axis systems, showing direction and sense of force and moment coefficients, angle of attack, and sideslip angle

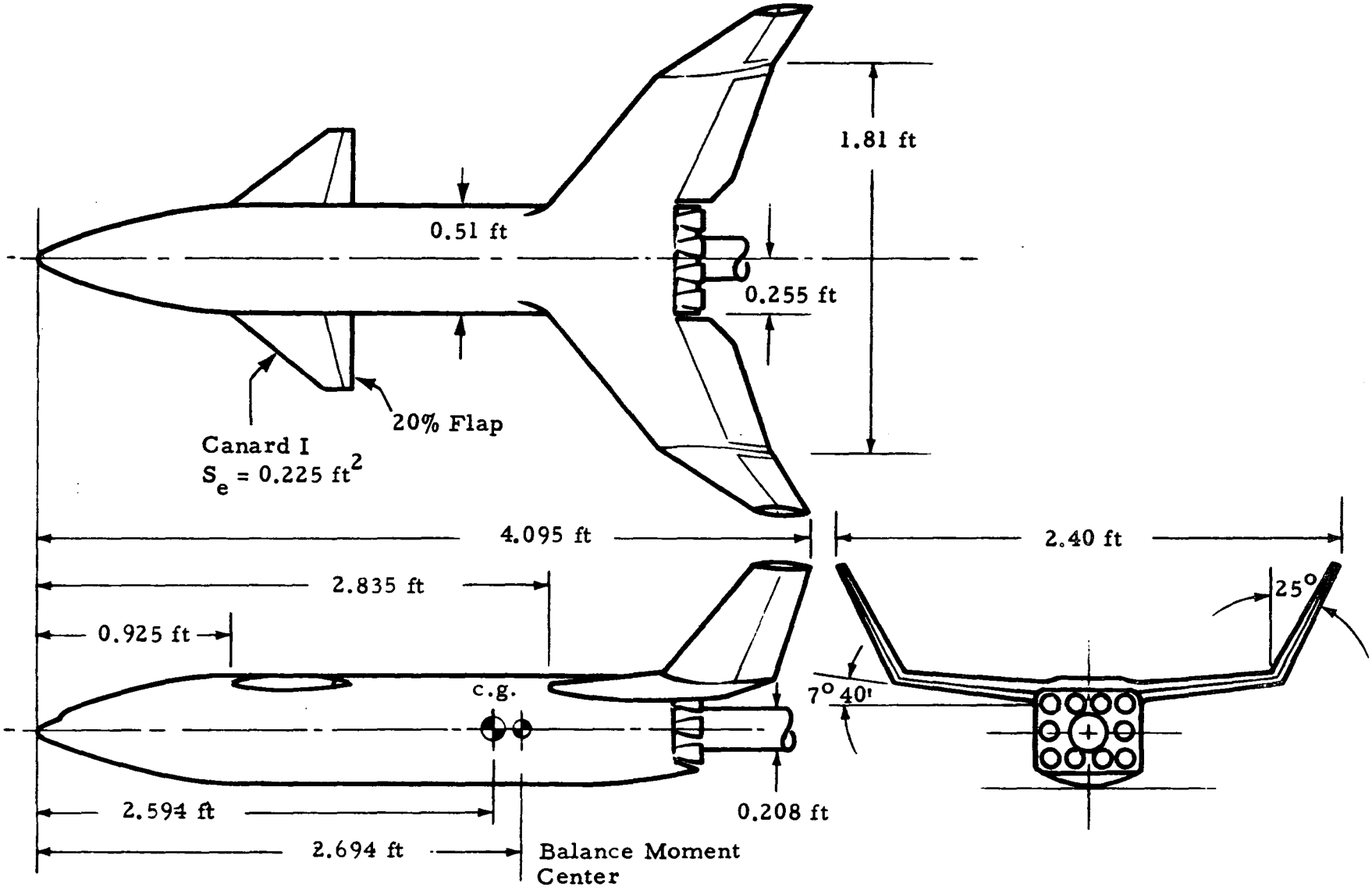


Fig. 2 - General Arrangement of the Baseline Model

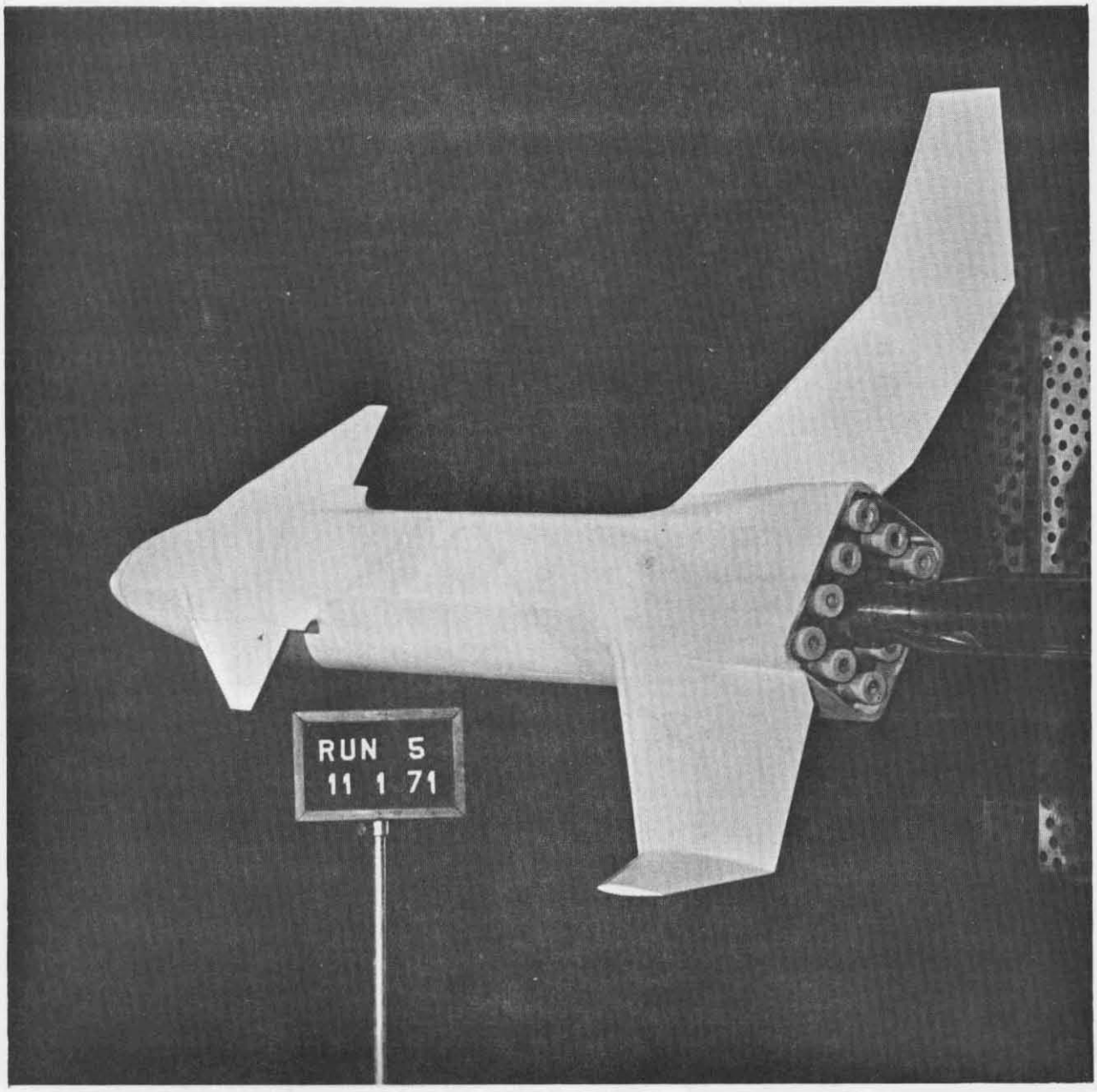


FIGURE 3. PHOTOGRAPH OF $B_4C_2F_2W_3V_1$ INSTALLED IN CAL 8 x 8 FOOT TUNNEL

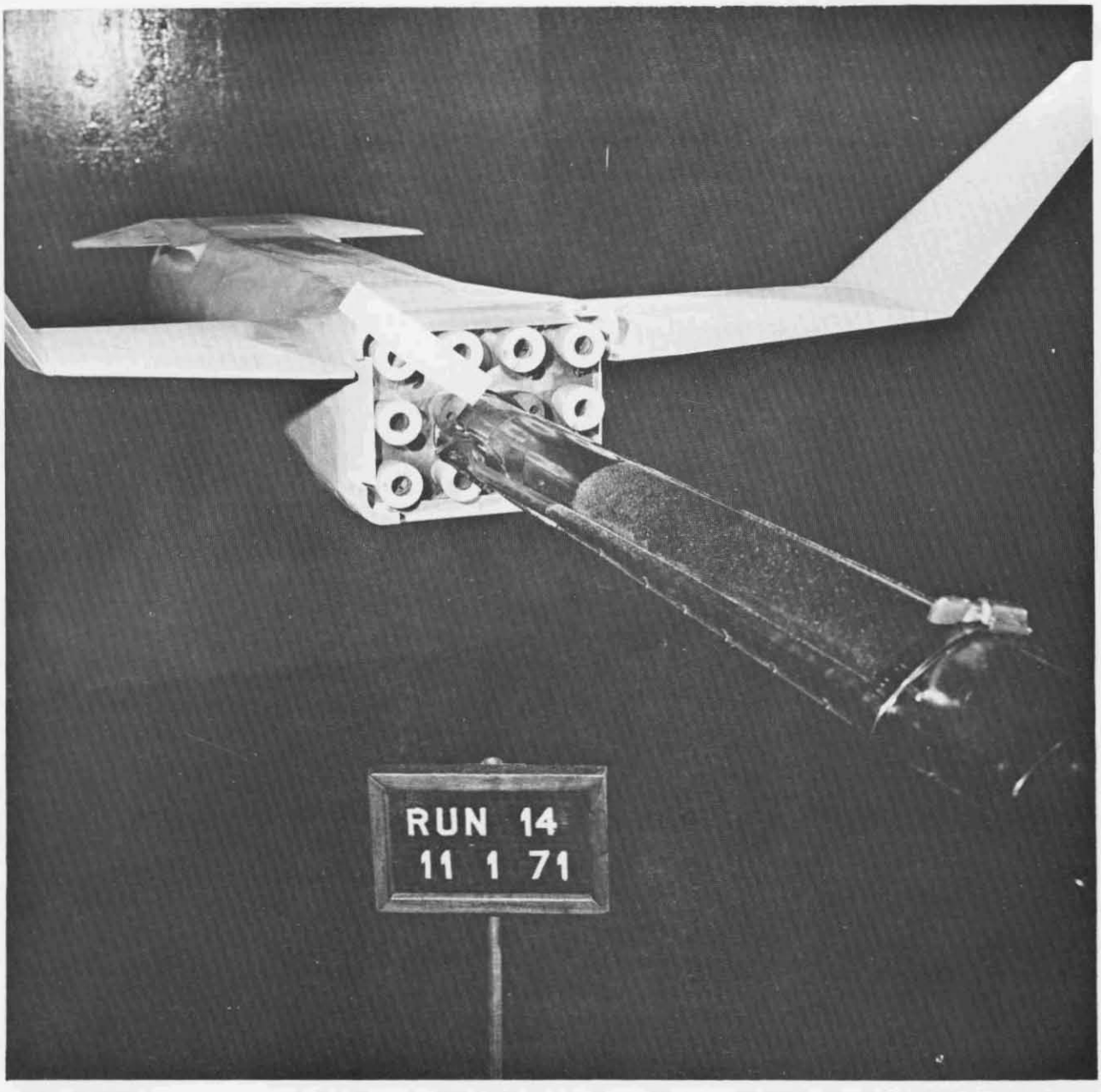


FIGURE 4. PHOTOGRAPH OF $B_5C_2F_2W_3V_1$ INSTALLED IN CAL 8 x 8 FOOT TUNNEL

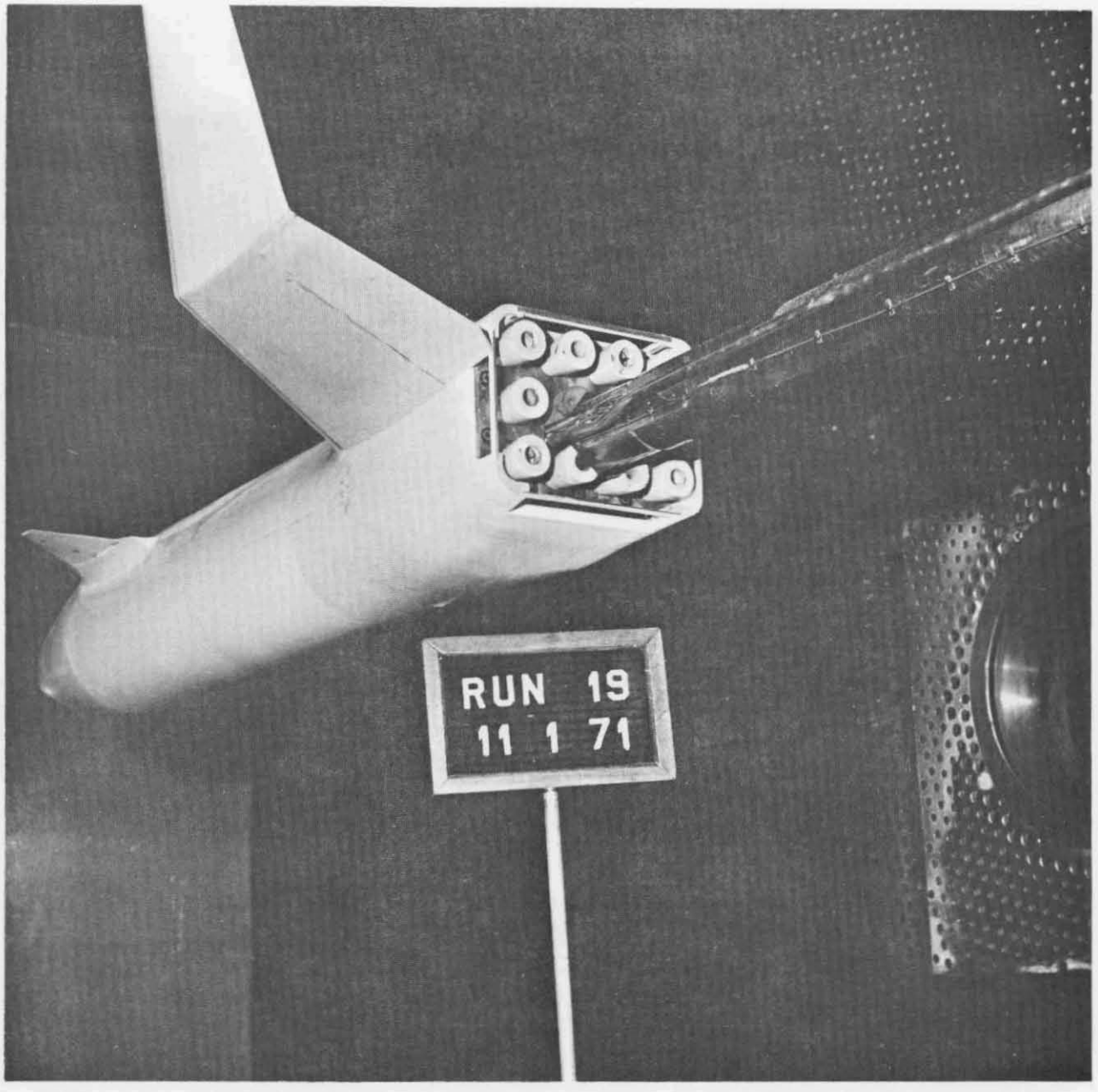
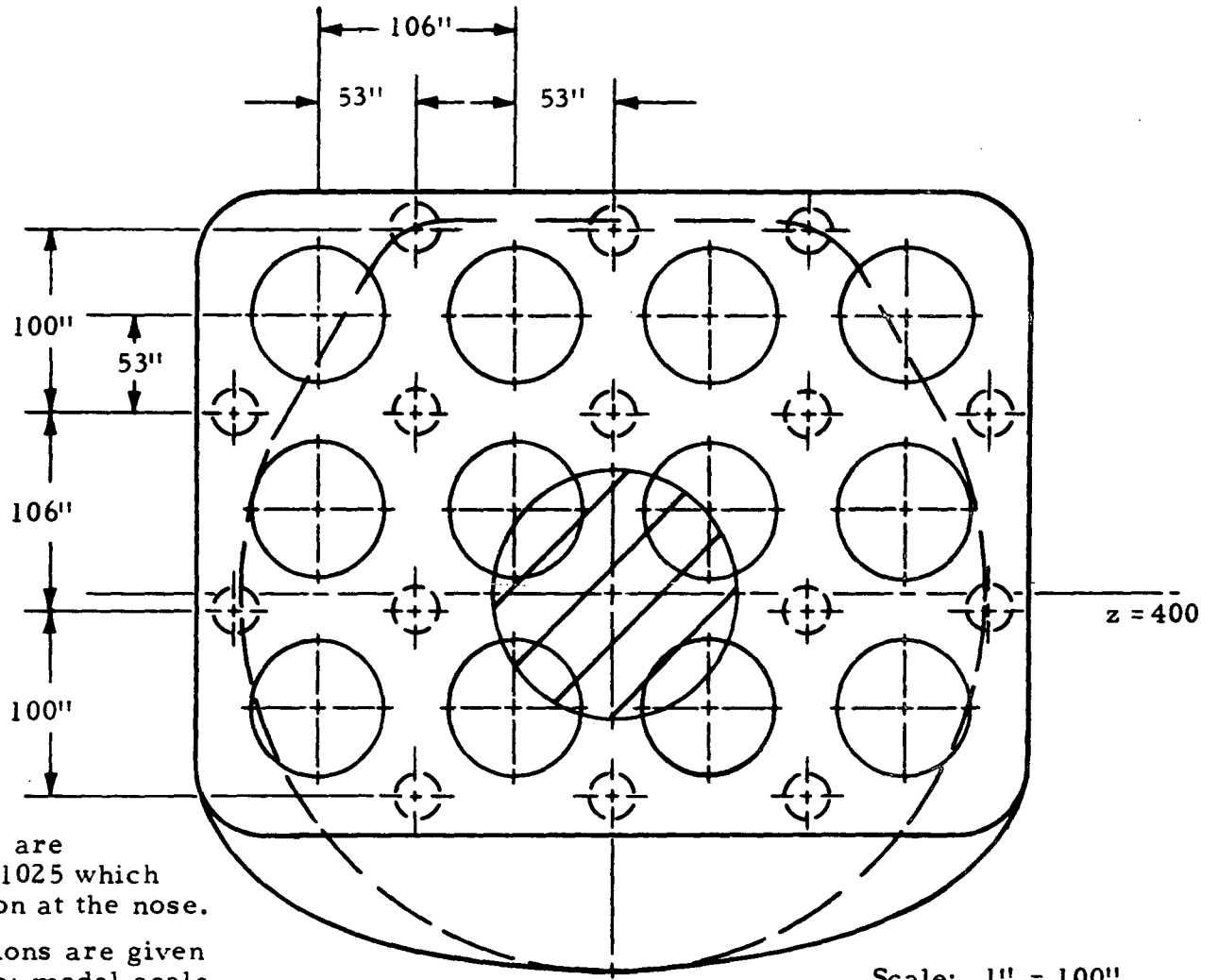


FIGURE 5. PHOTOGRAPH OF $B_6C_2F_2W_3V_1$ INSTALLED IN CAL 8 x 8 FOOT TUNNEL



Note: (1) All stations are relative to 1025 which is the station at the nose.

(2) All dimensions are given in full scale; model scale is 0.015.

Fig. 6 - Base Plenum Orifice Location (End View)

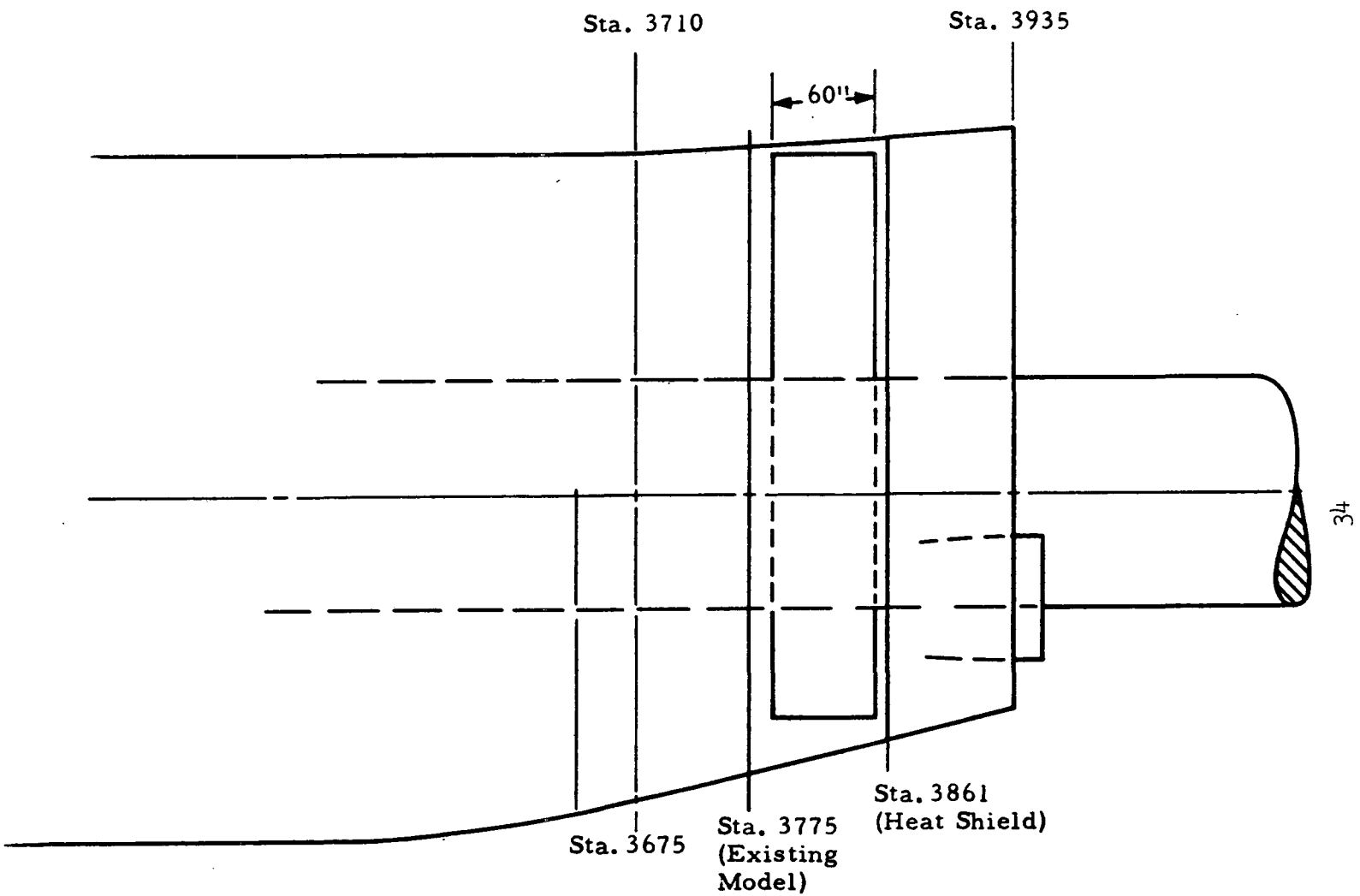


Fig. 7 - Base Plenum Orifice Location (Side View)

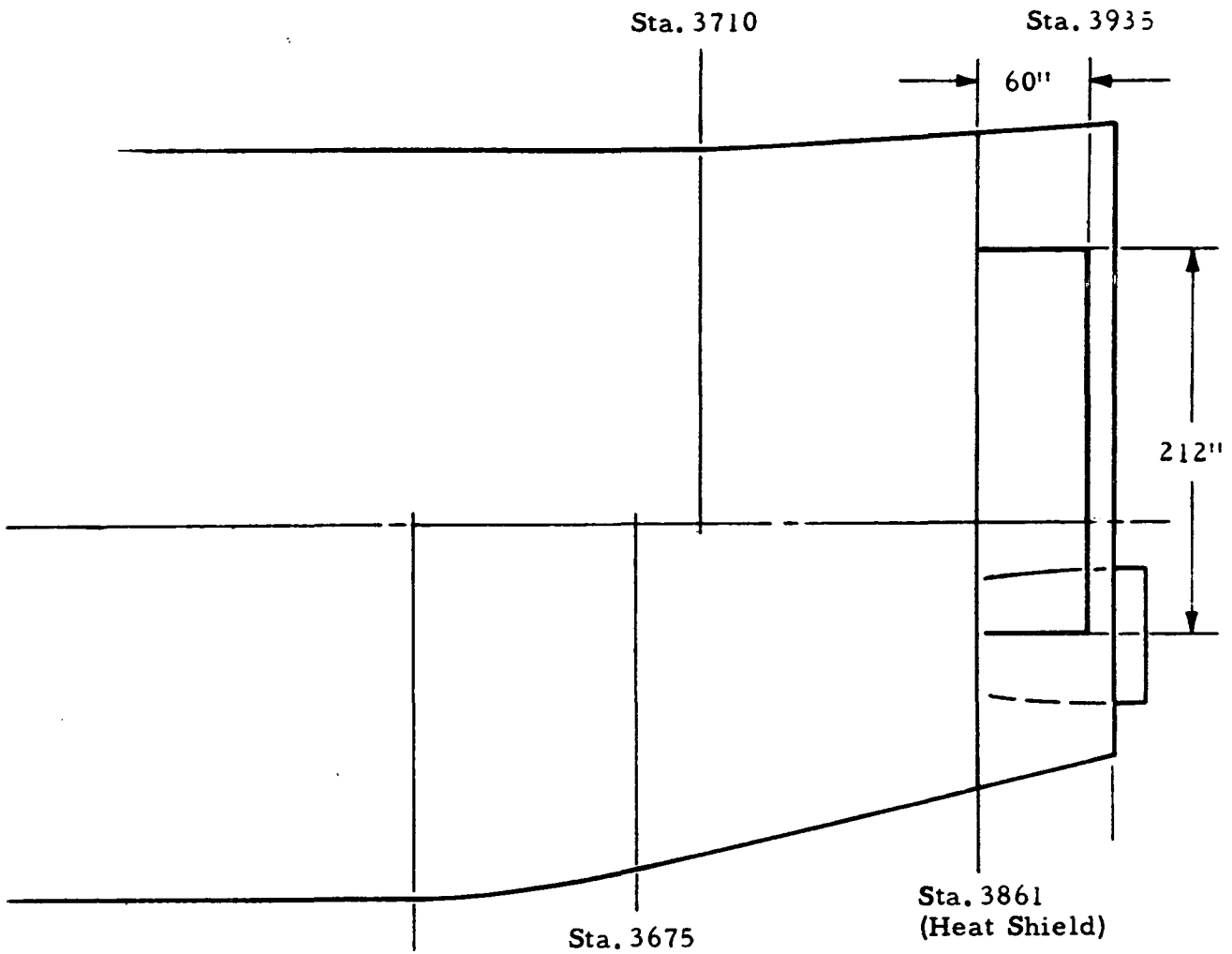


Fig. 8 - Base Venting (Side View)

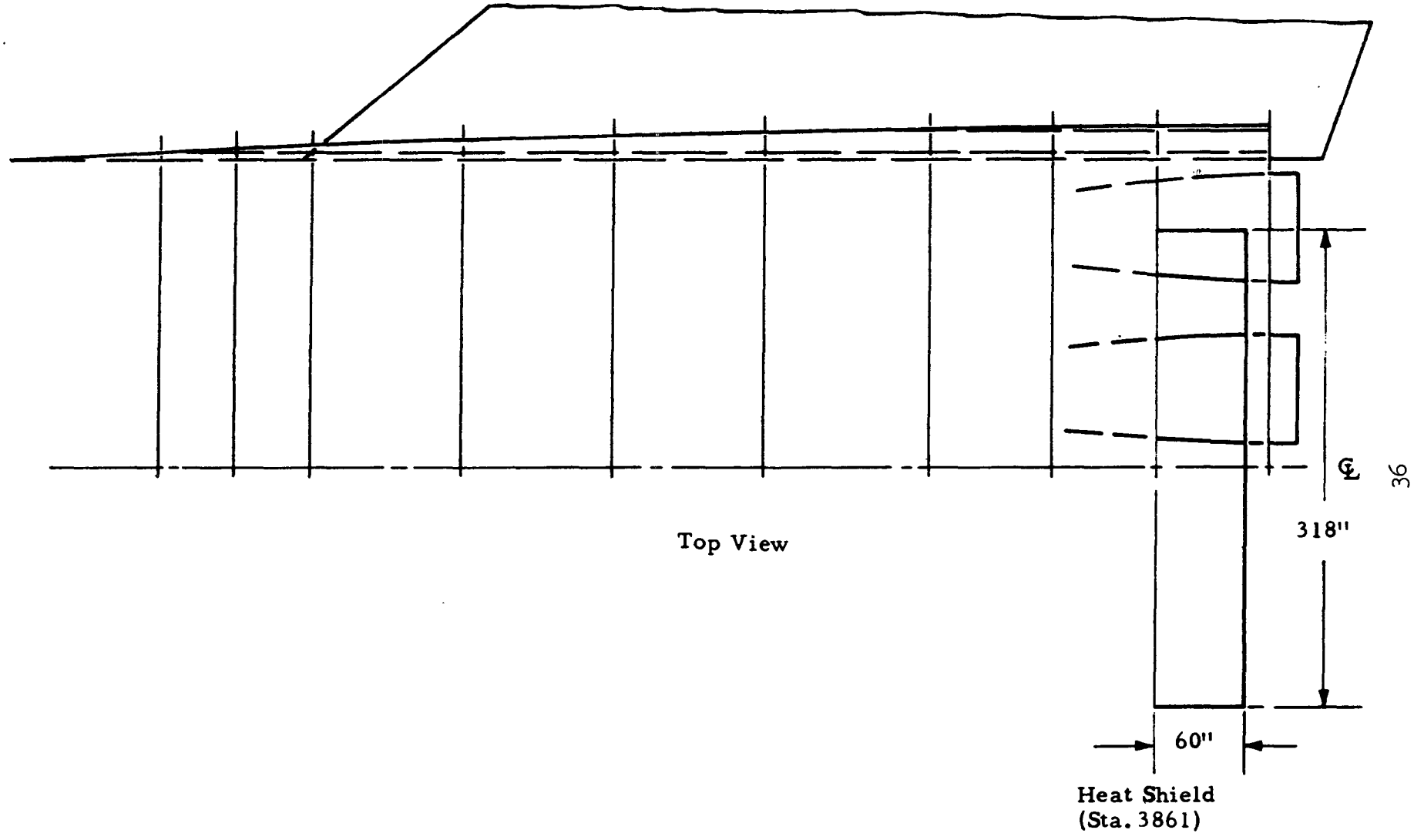
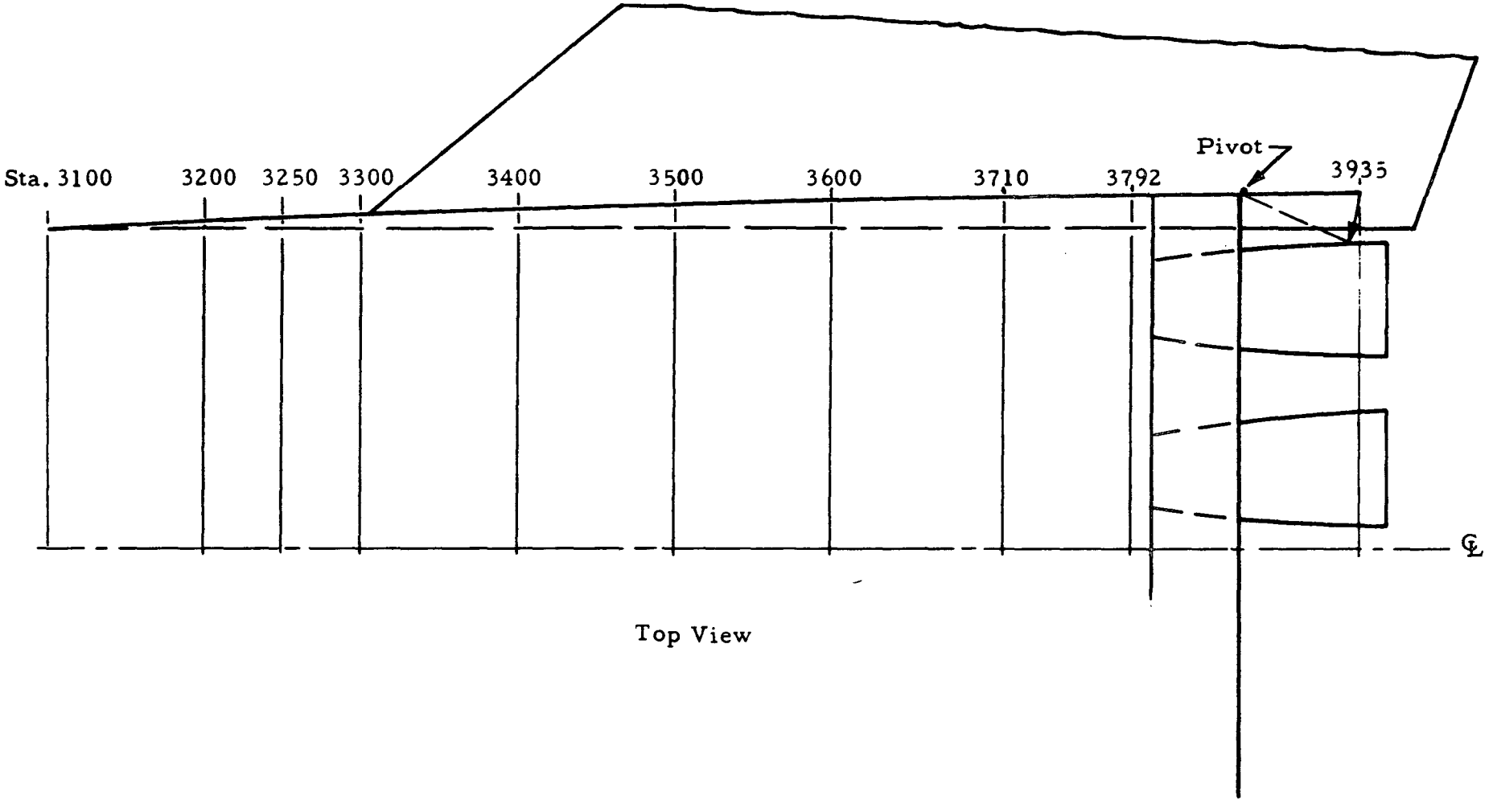


Fig. 9 - Base Venting (Top View)



Top View

Fig. 10 - Body Flaps (Top View)

Heat Shield 3861

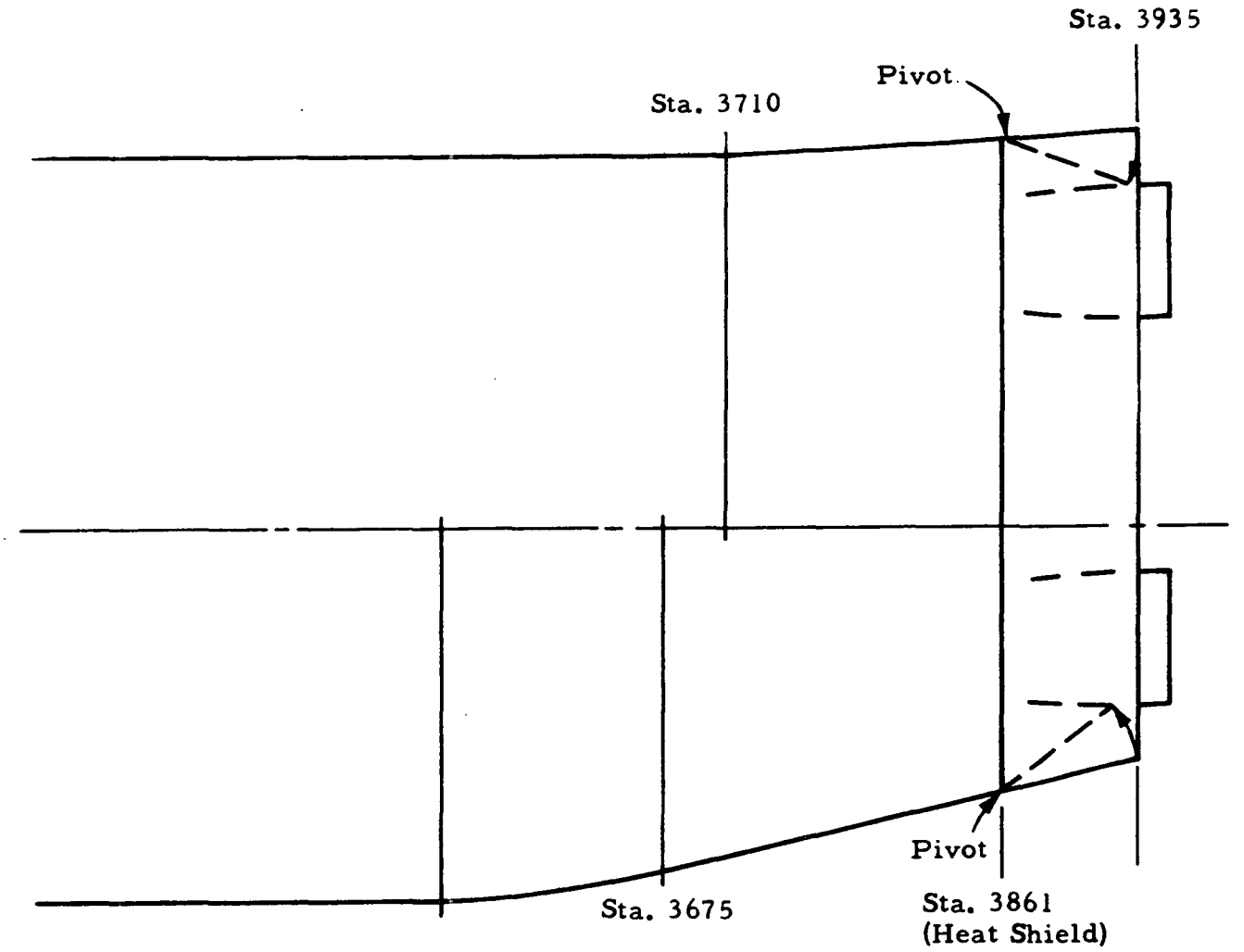


Fig. 11 - Body Flaps (Side View)

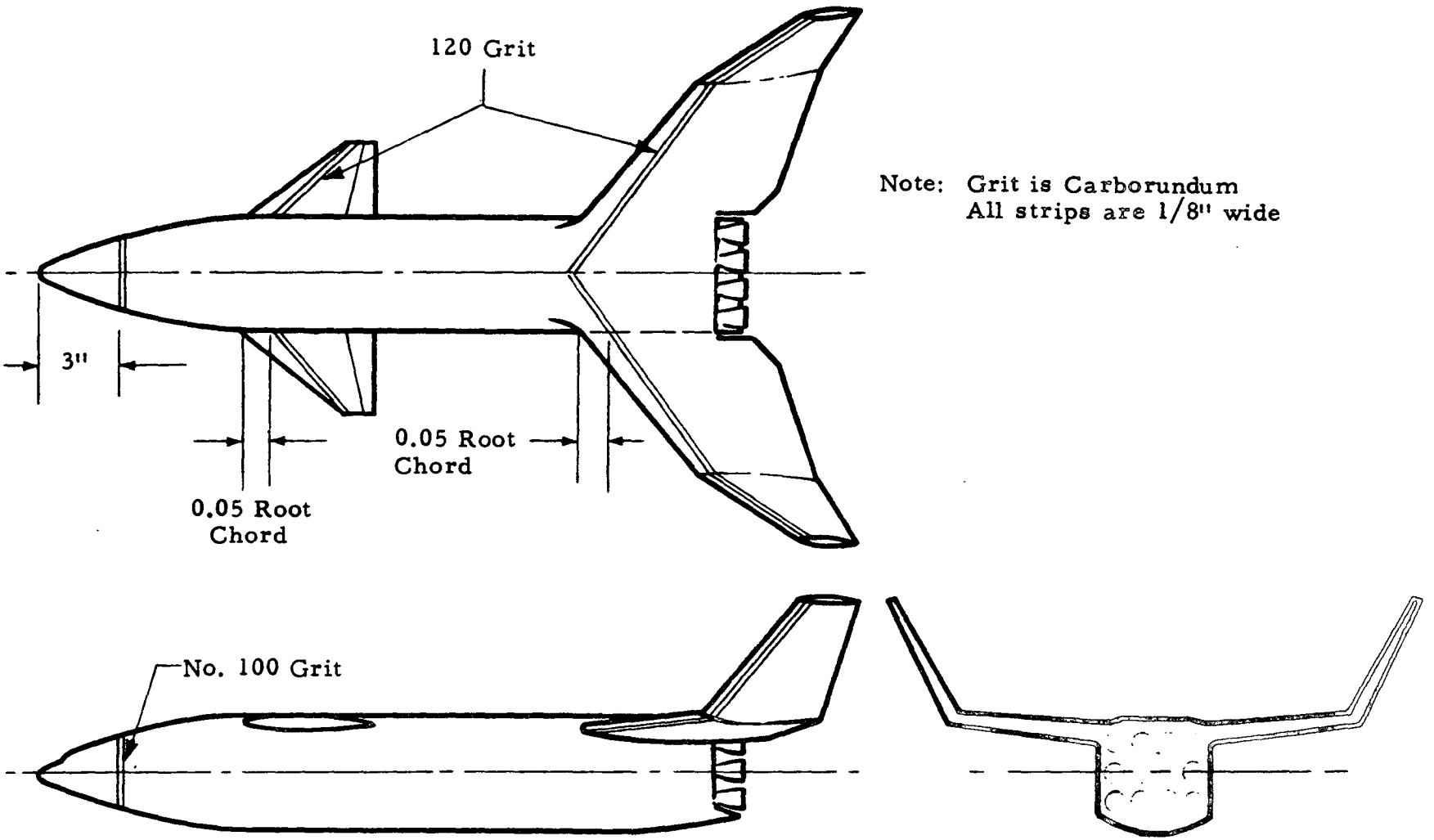
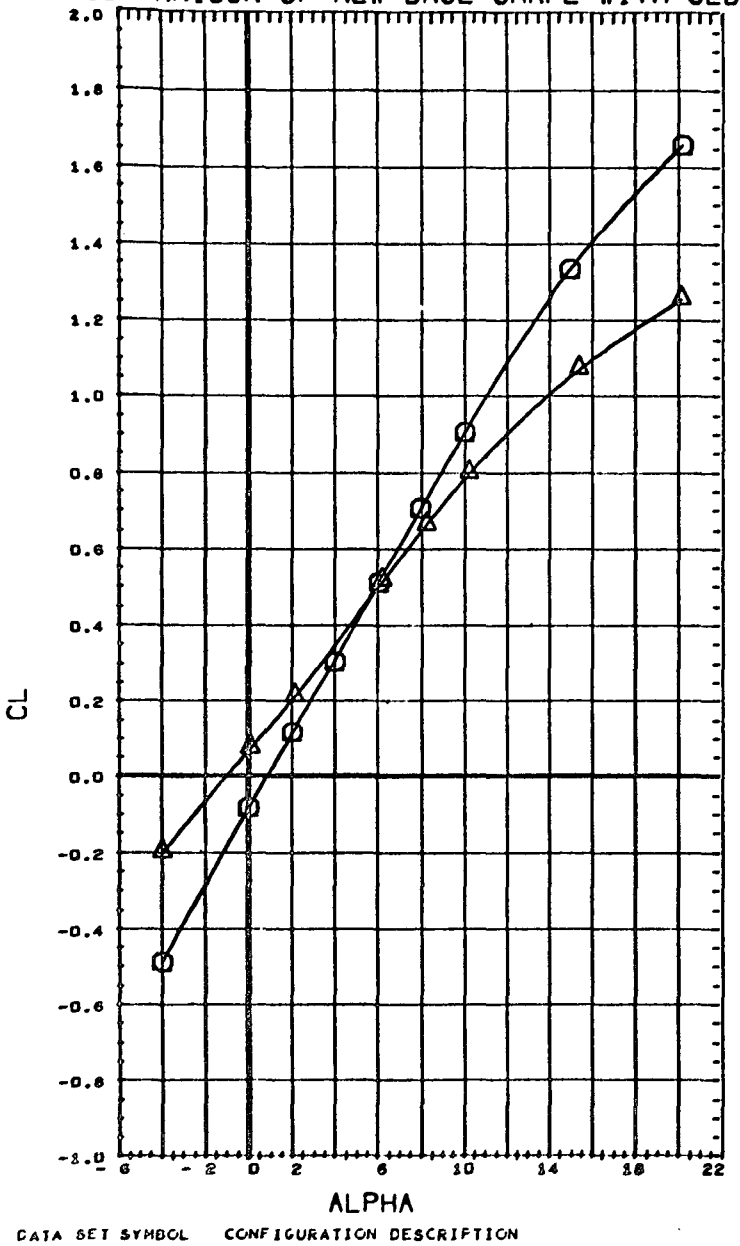
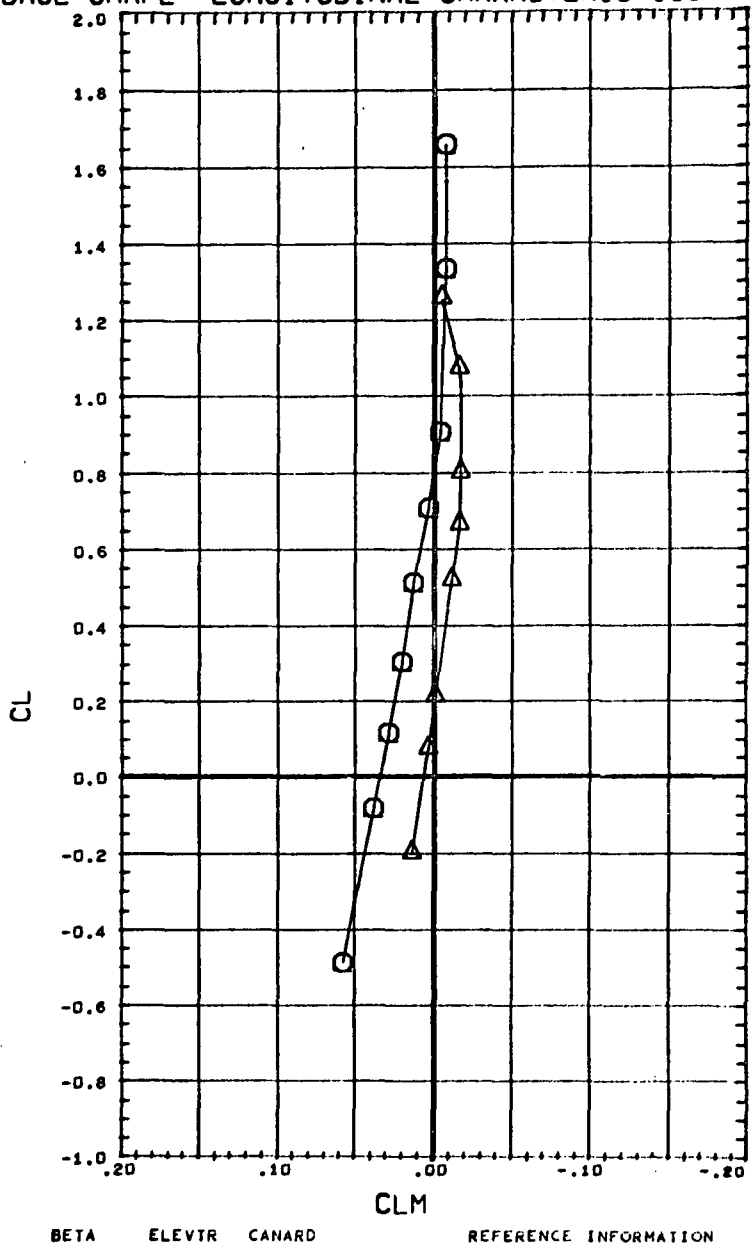


Fig. 12- Typical Transition Grit Installation on Body, Wing and Canard

DATA FIGURES

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS





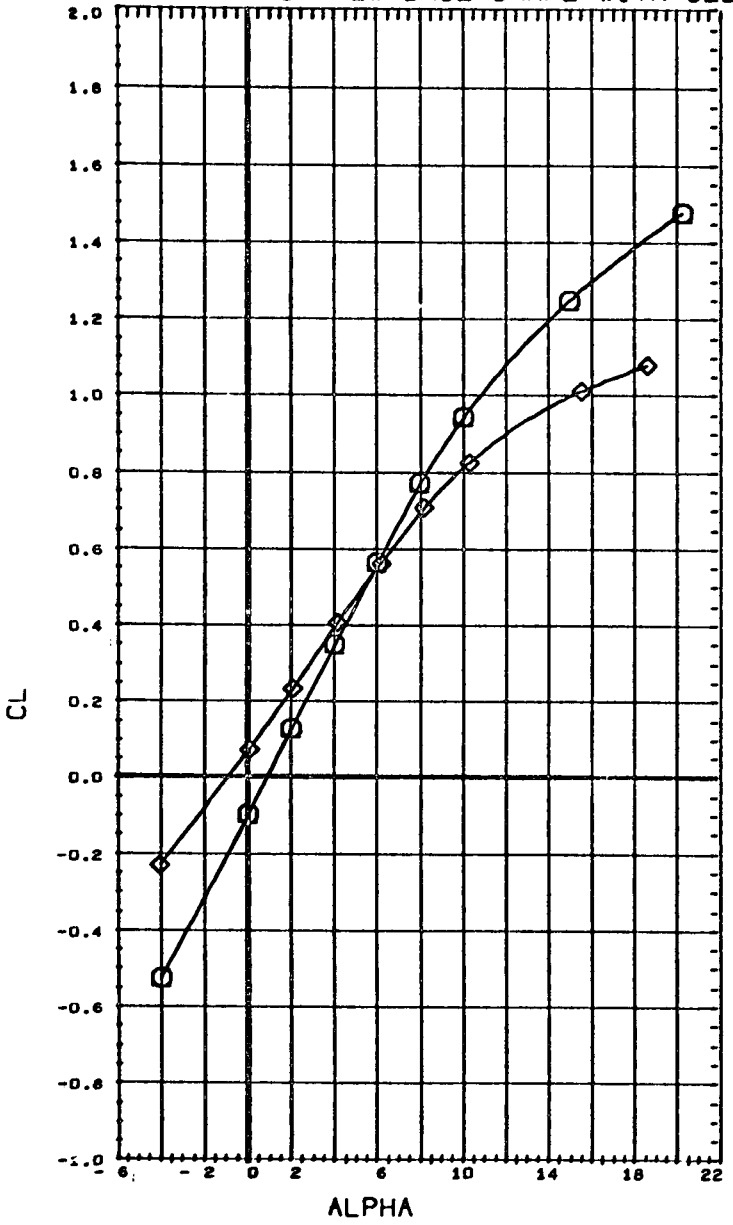
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RV9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(AN2001)	△	NSRDC-3110,MSFC/LMSC BOOSTER B1C2F1W1V1
(AN3001)	◇	DATA NOT AVAILABLE FOR ALL CONDITIONS

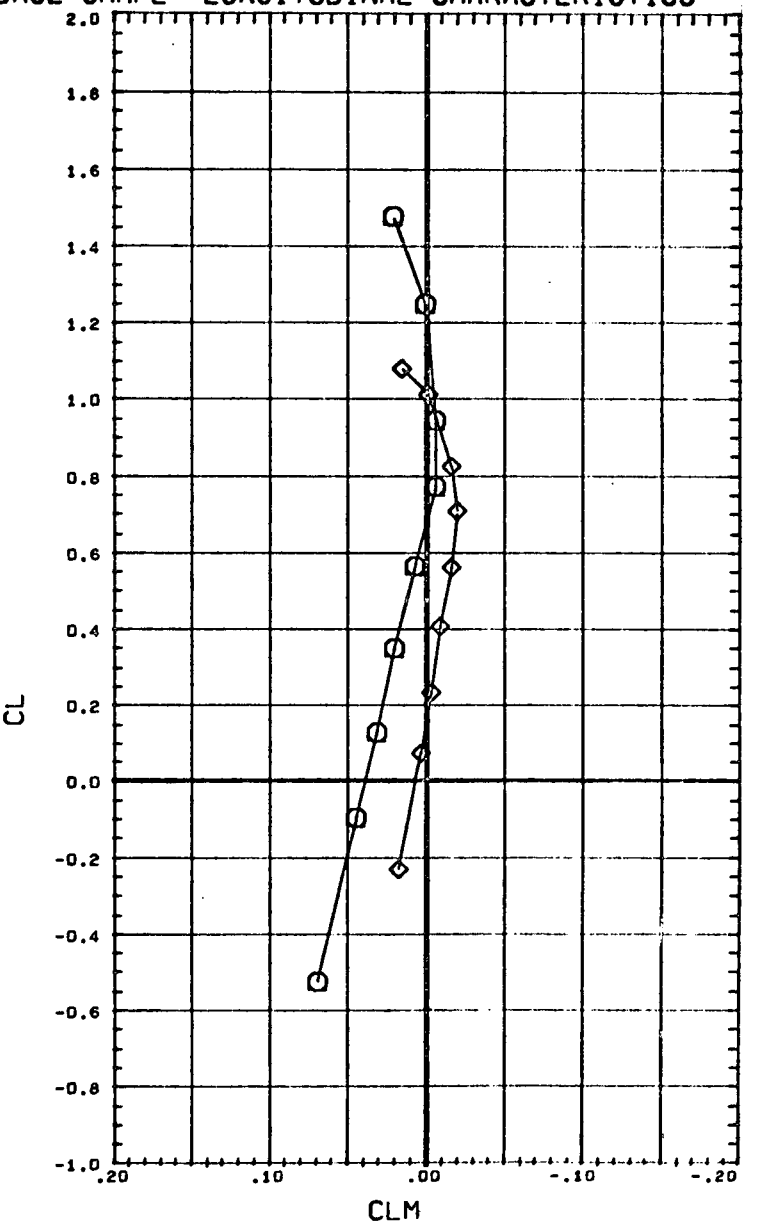
MACH 0.400

BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS





DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
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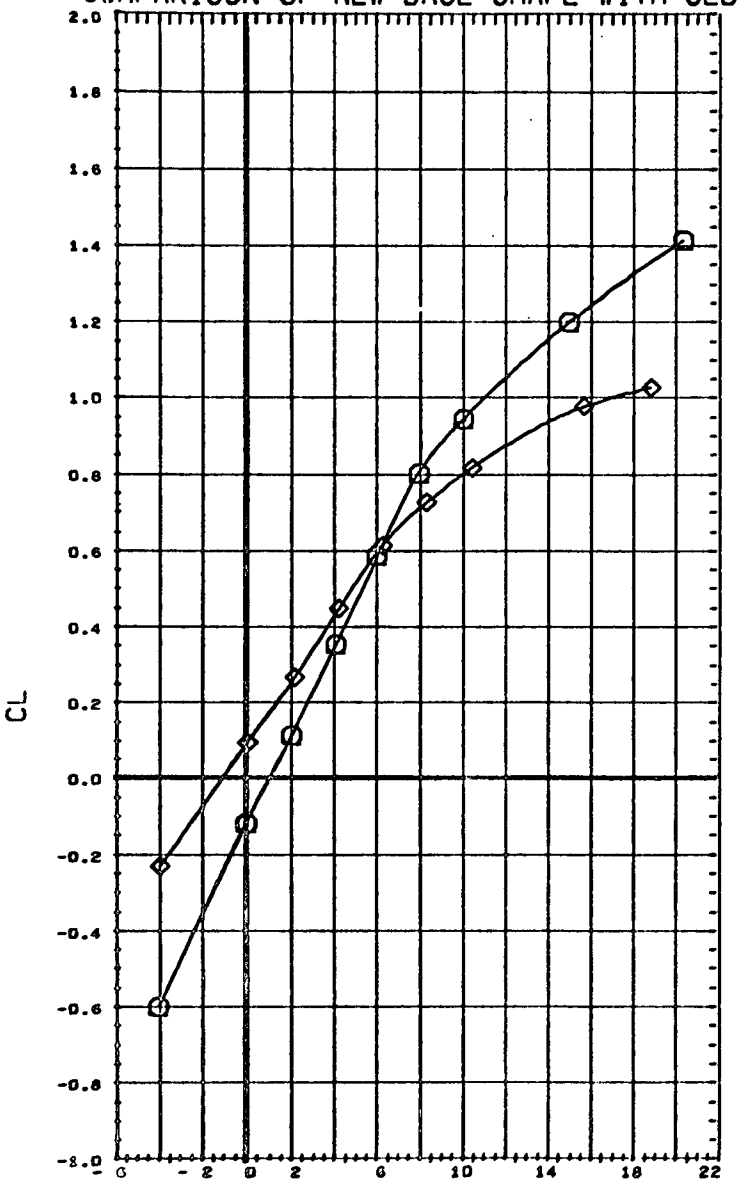
(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

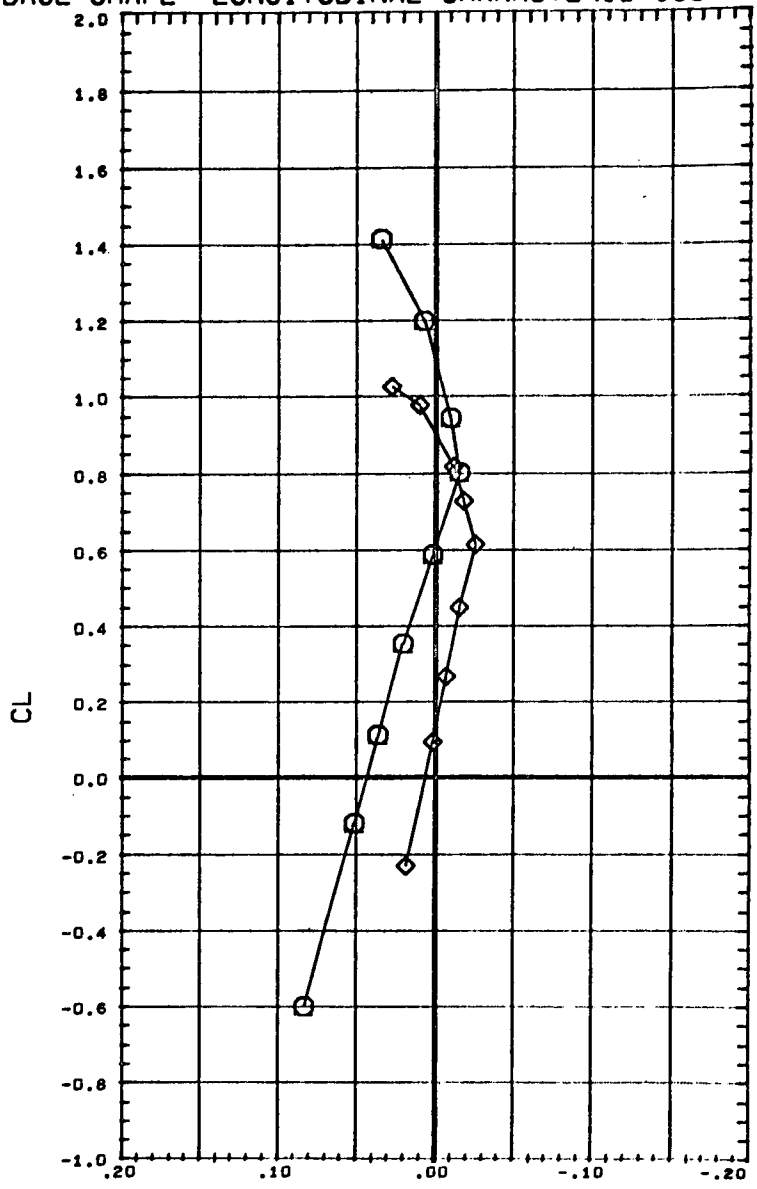
MACH 0.698

BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS





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(AN2501)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3501)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

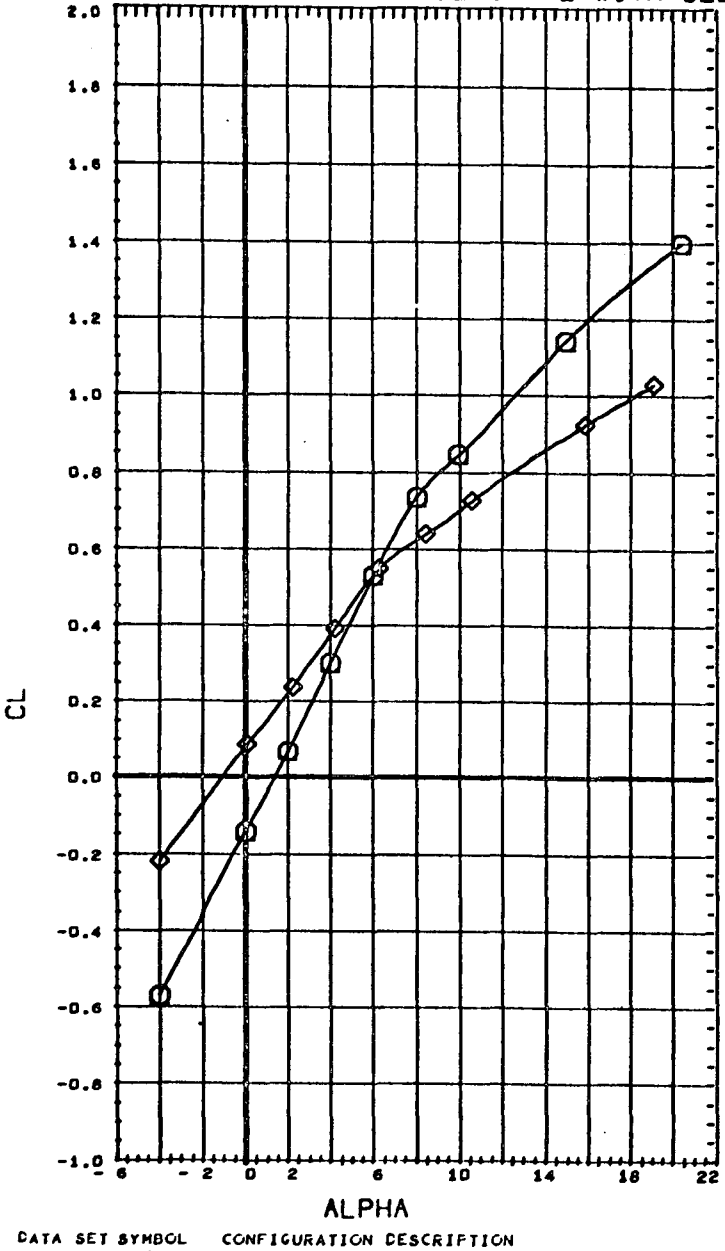
MACH 0.798

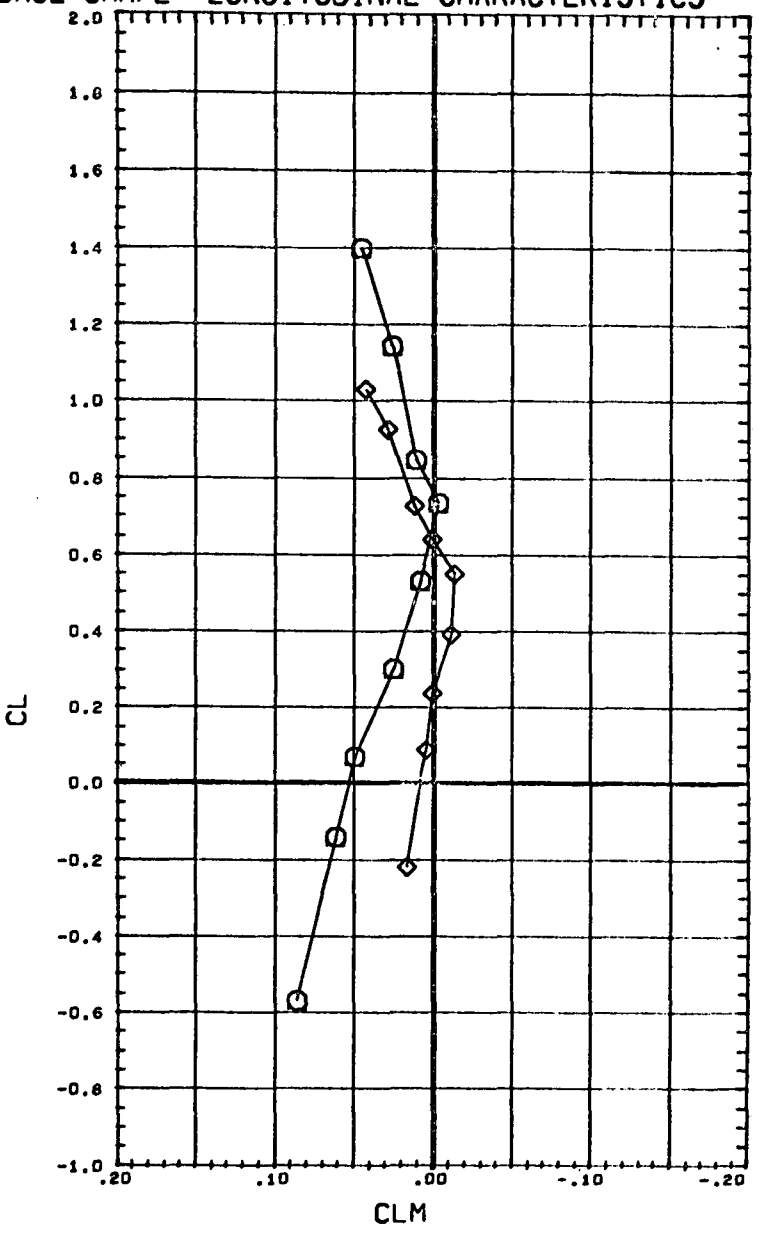
BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS





DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
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(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	N&RDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

MACH 0.897

BETA	ELEVTR	CANARD
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-0.019	0.000	0.000
0.031	0.000	0.000

REFERENCE INFORMATION		
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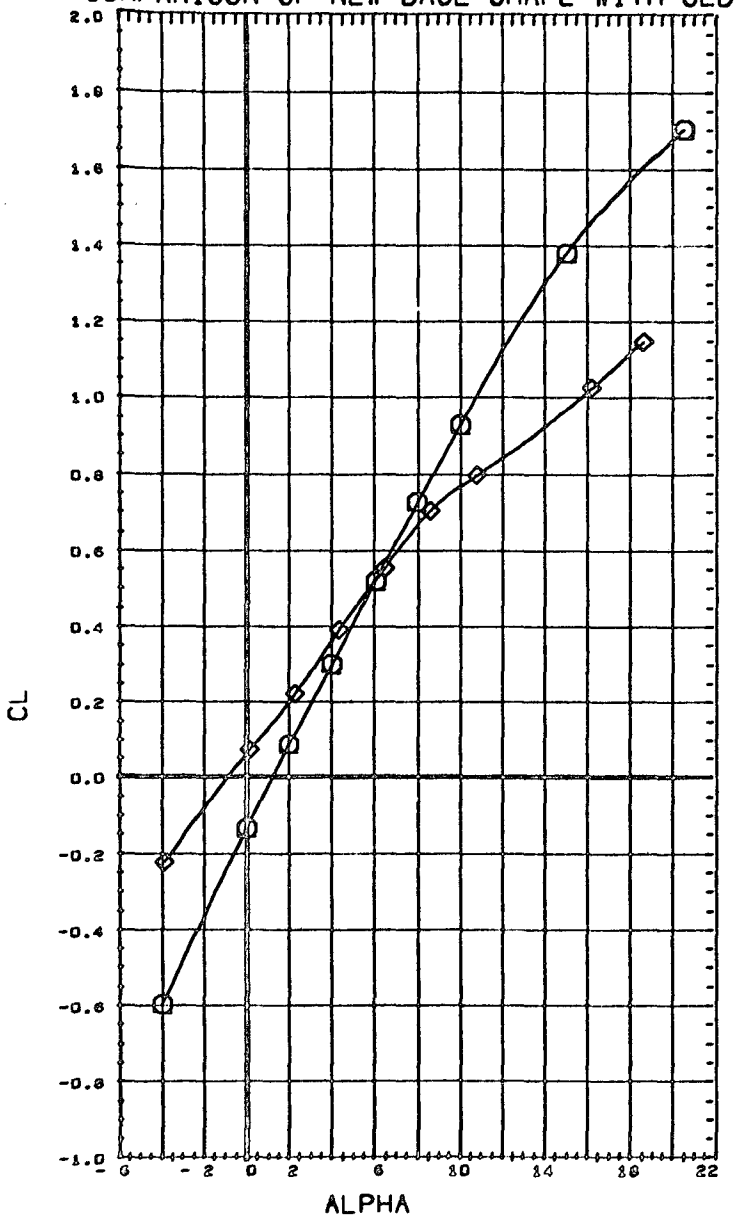
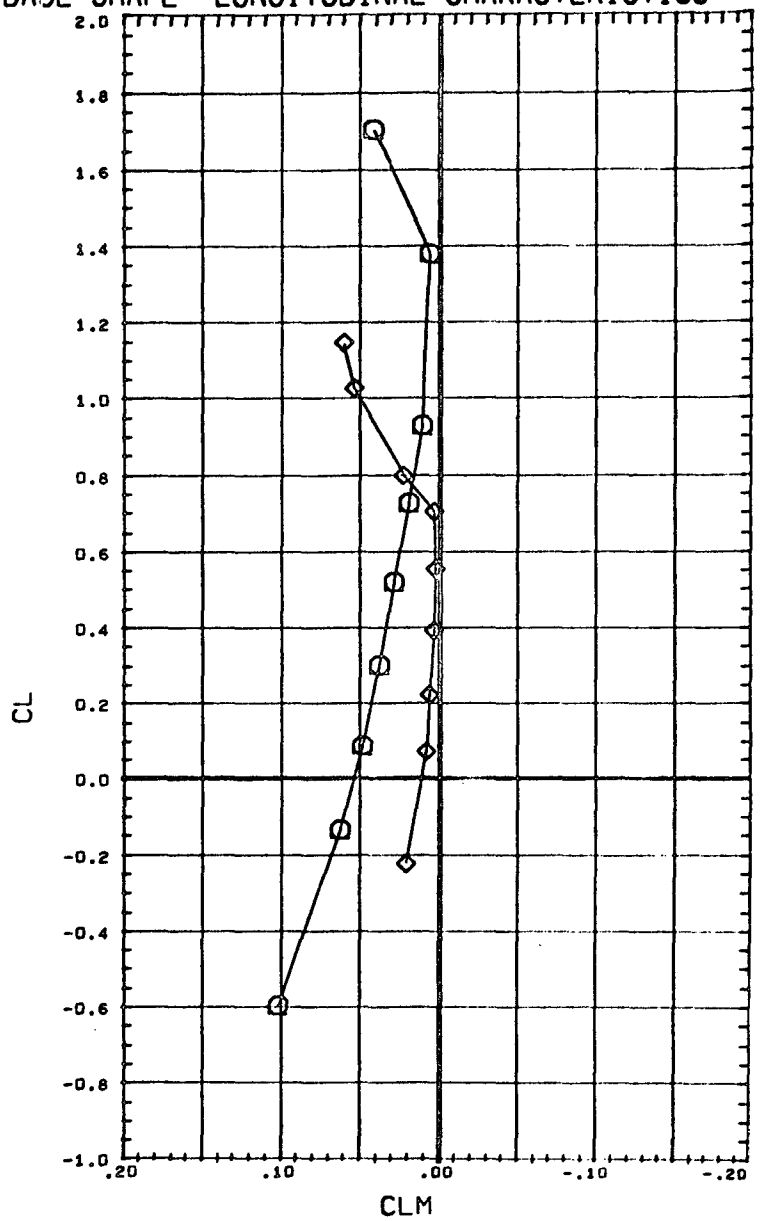
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS





DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
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(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

MACH 0.999

BETA	ELEVTR	CANARD
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-0.019	0.000	0.000
0.031	0.000	0.000

REFERENCE INFORMATION

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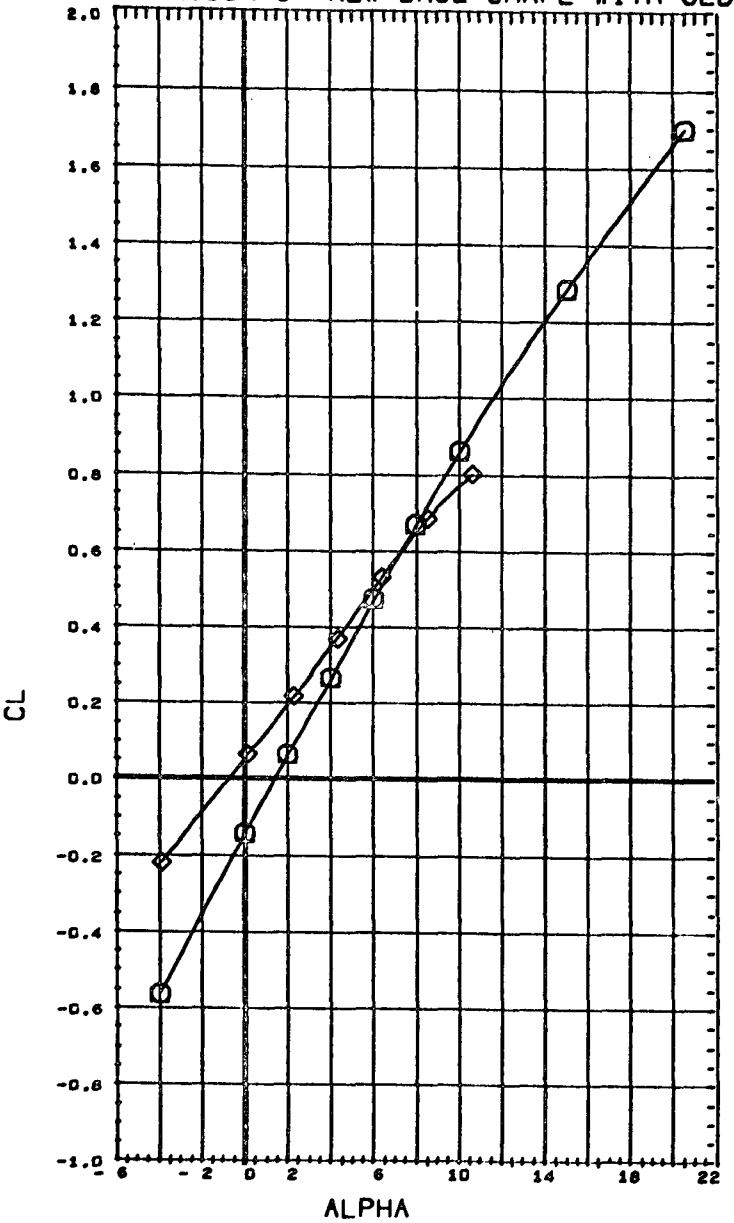
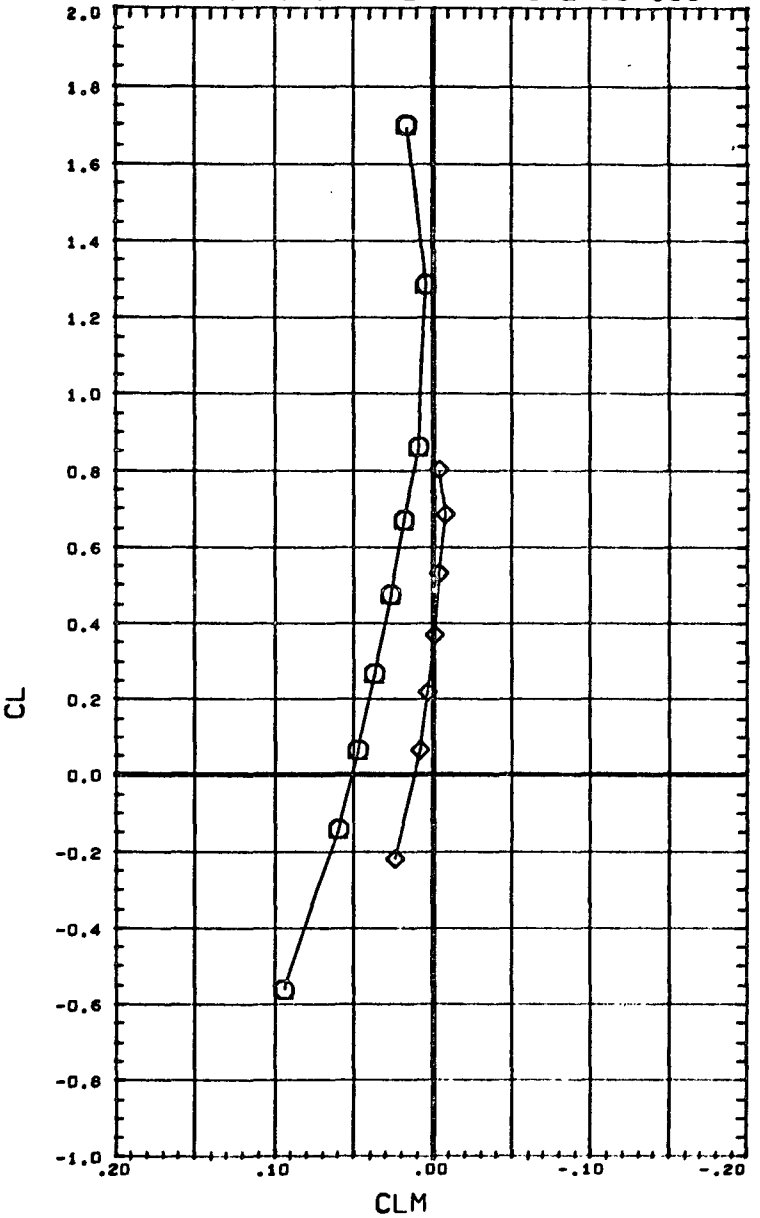
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS





DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
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(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

MACH 1.099

BETA	ELEVTR	CANARD
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-0.019	0.000	0.000
0.031	0.000	0.000

REFERENCE INFORMATION		
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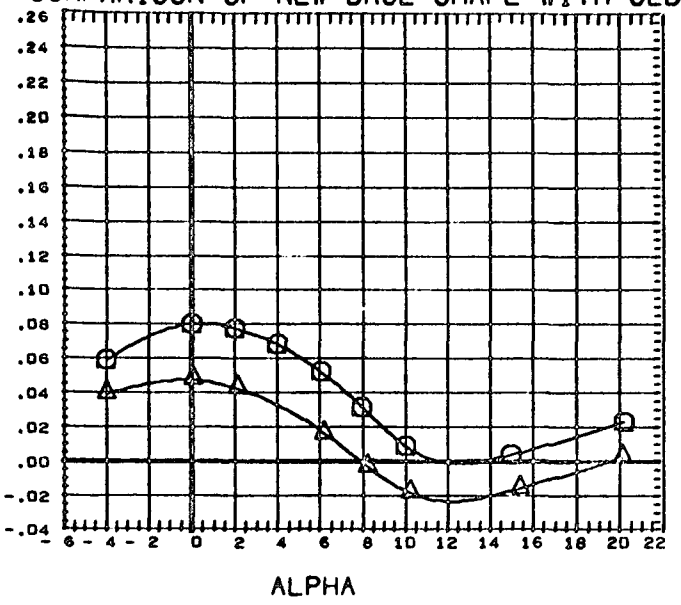
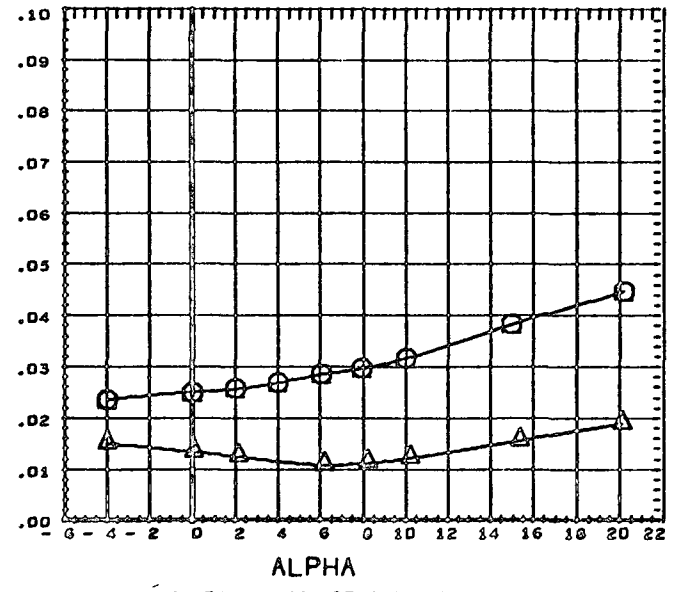
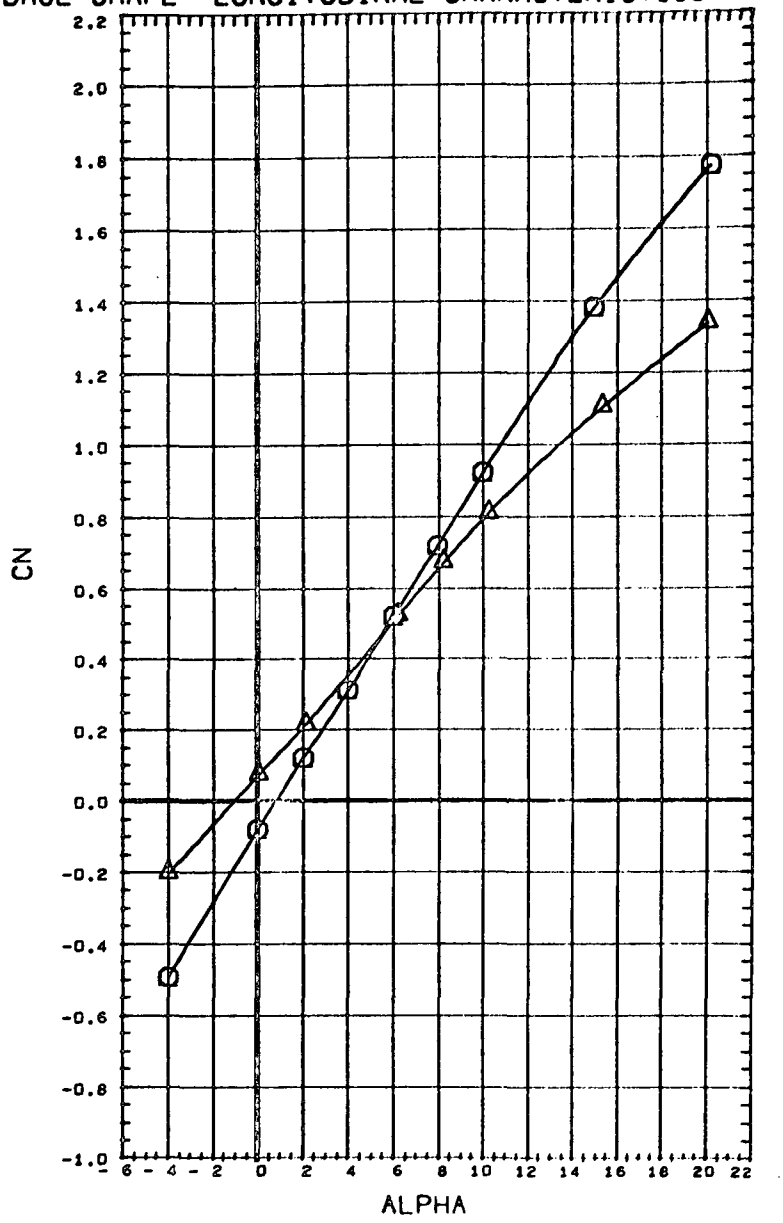
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
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(AN3001)	◇	DATA NOT AVAILABLE FOR ALL CONDITIONS

MACH 0.400

BETA	ELEVTR	CANARD
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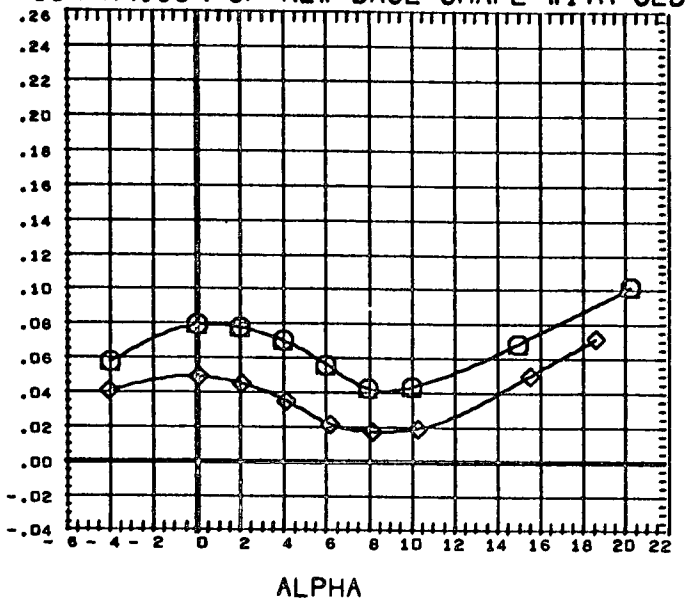
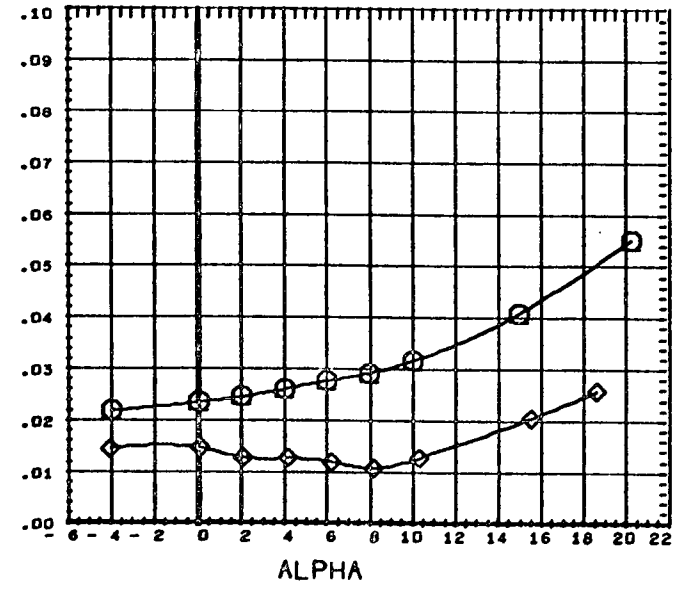
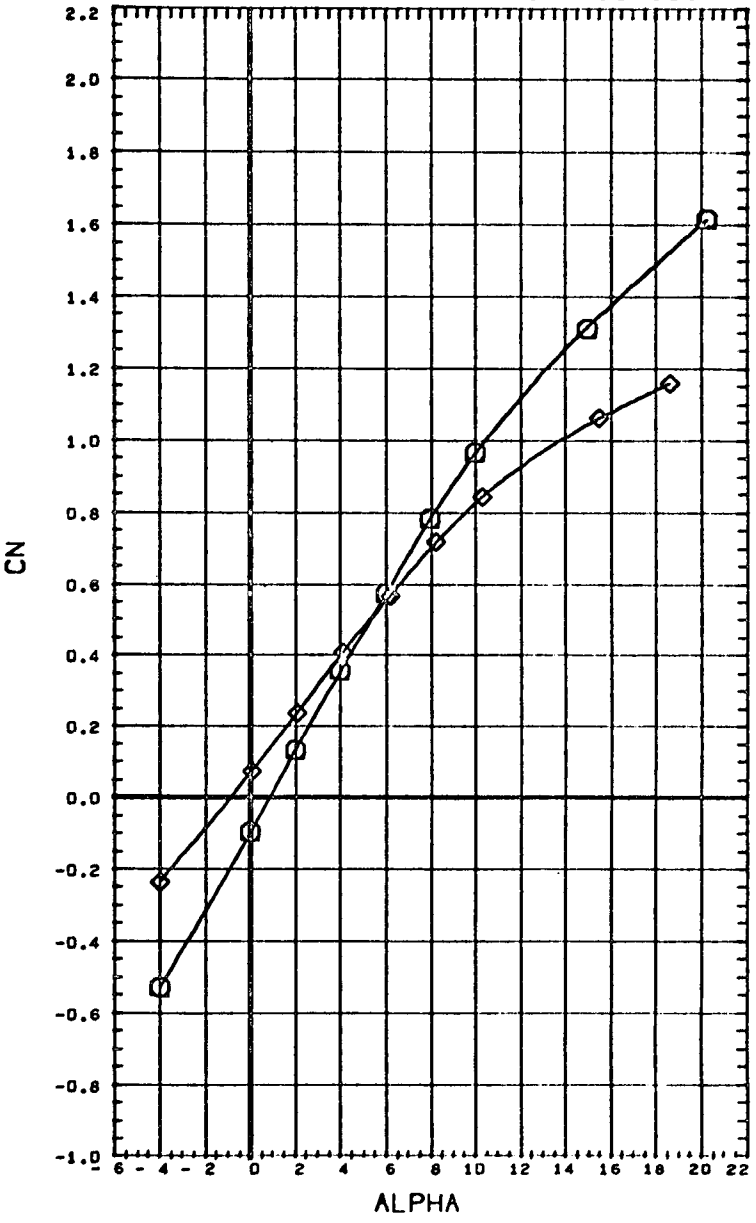
-0.019	0.000	0.000
0.031	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
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(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

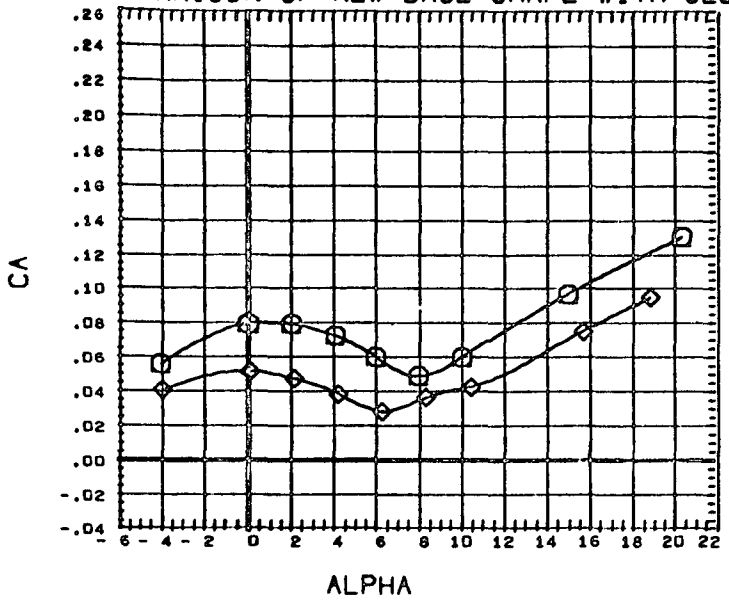
MACH 0.698

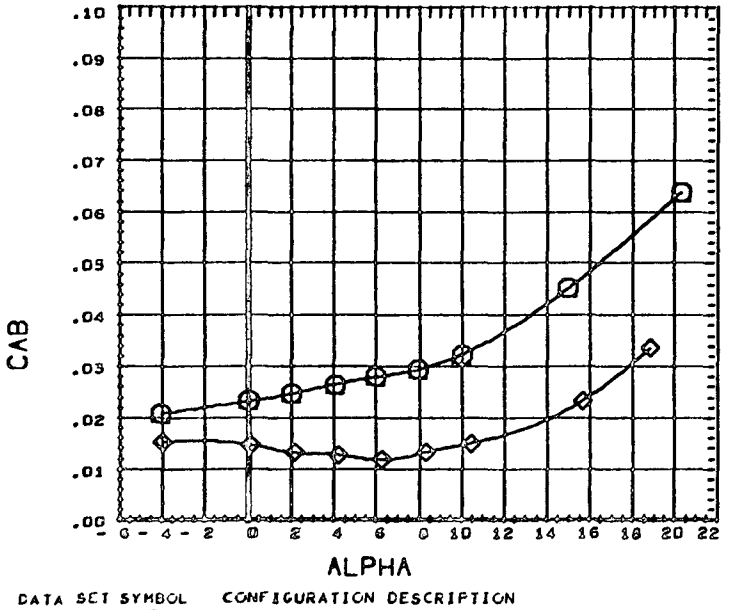
BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

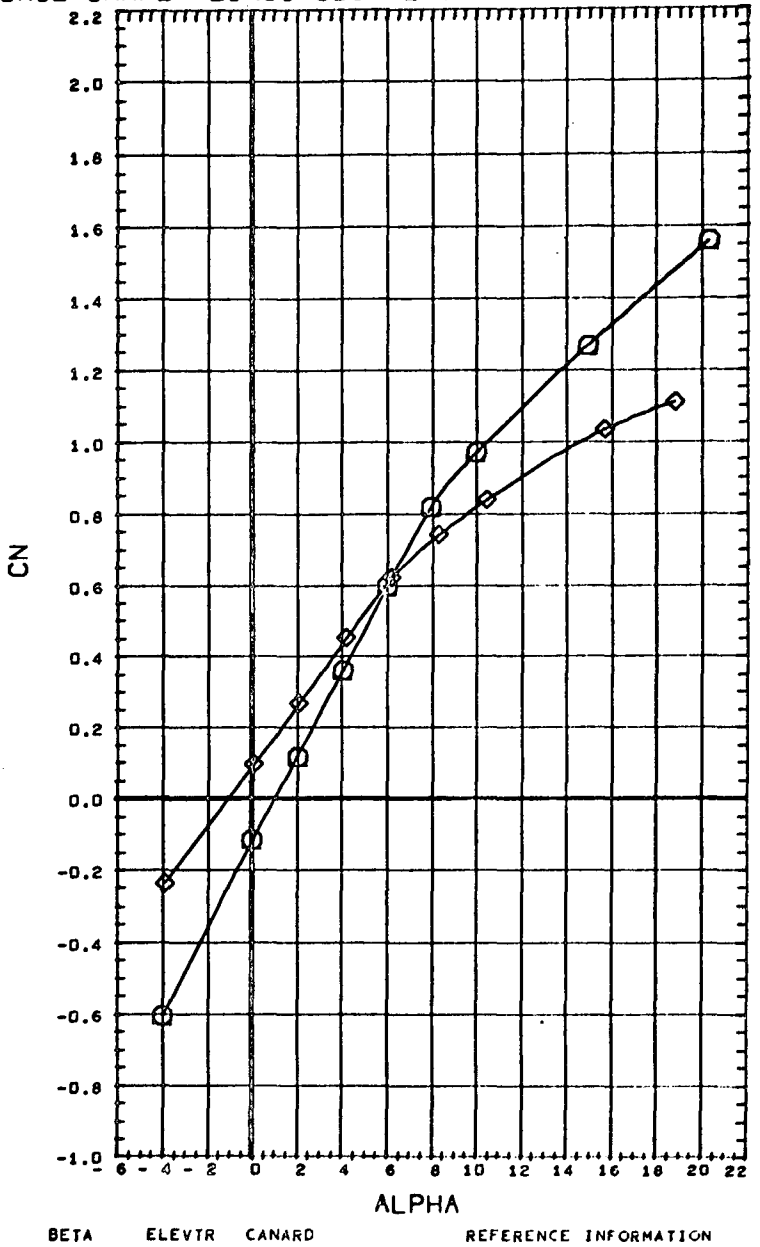
REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	&SRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

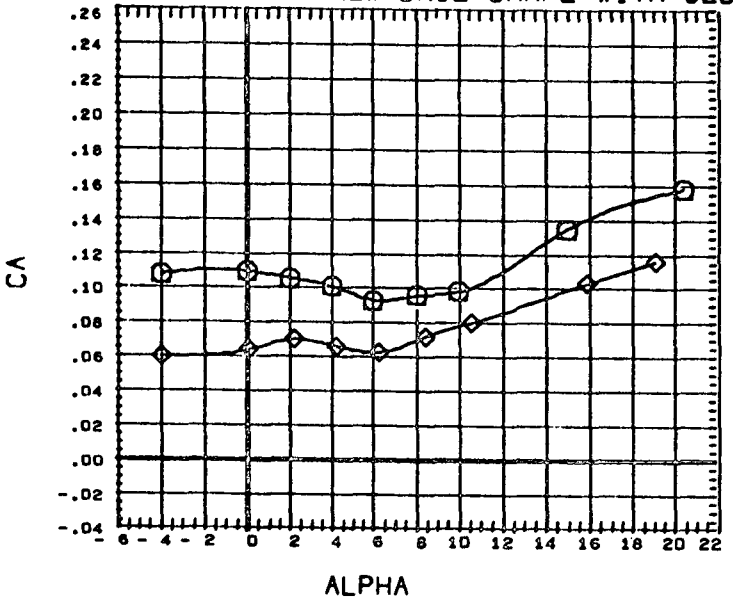
MACH 0.798

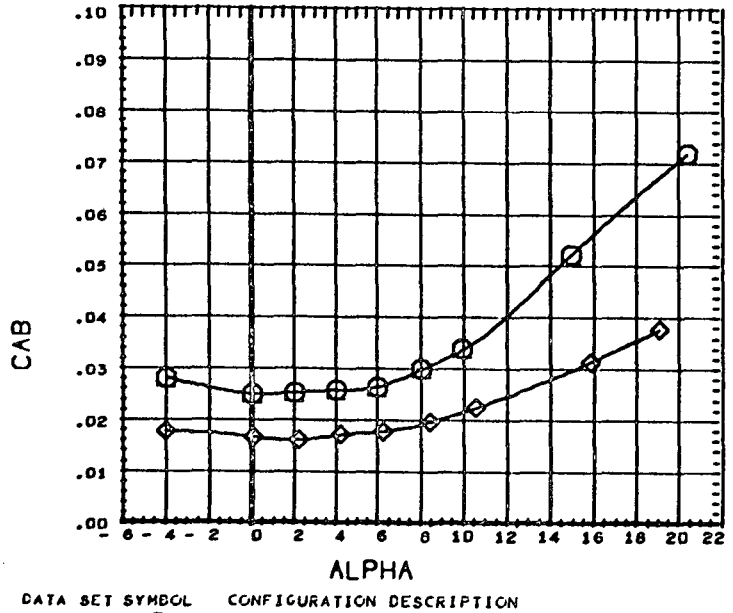
BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

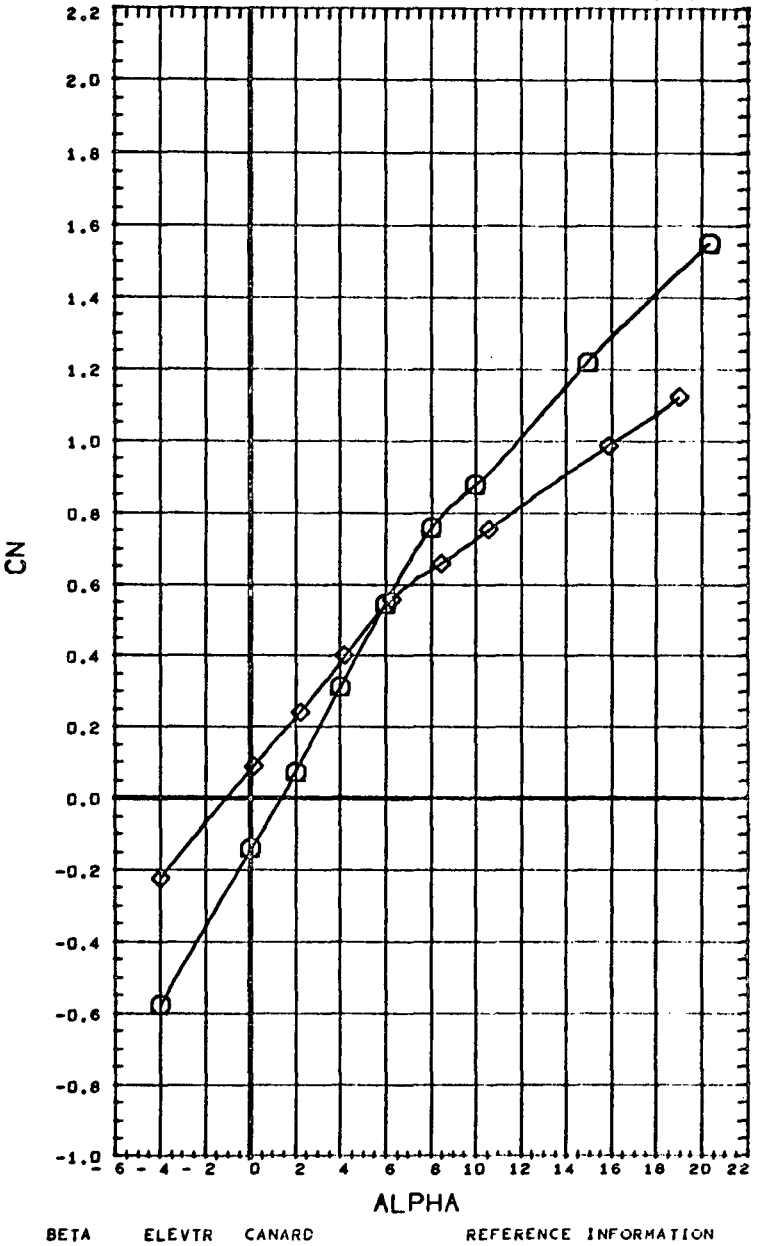
REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







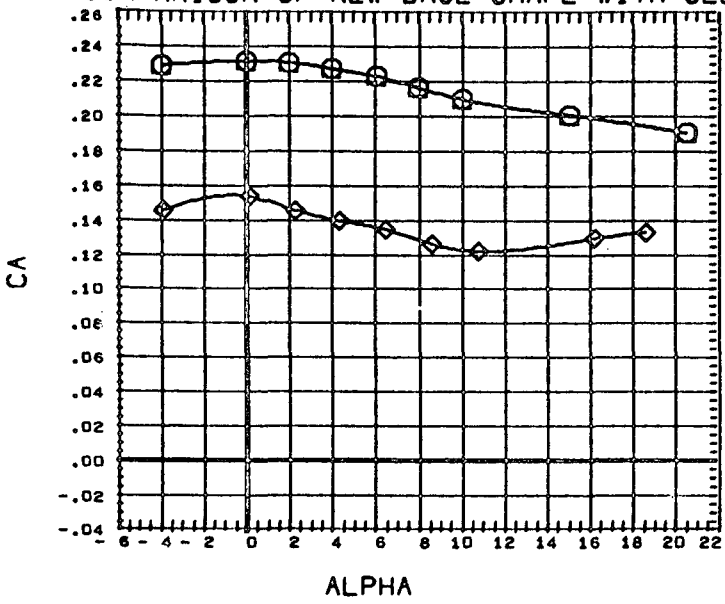
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

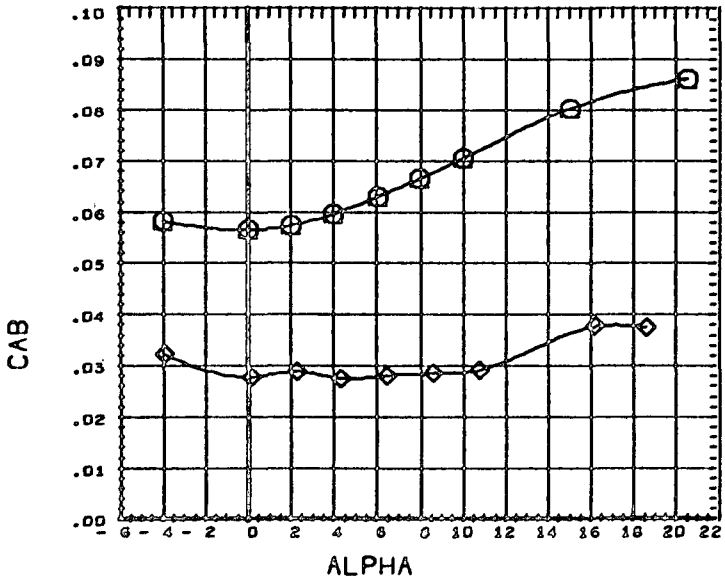
MACH 0.897

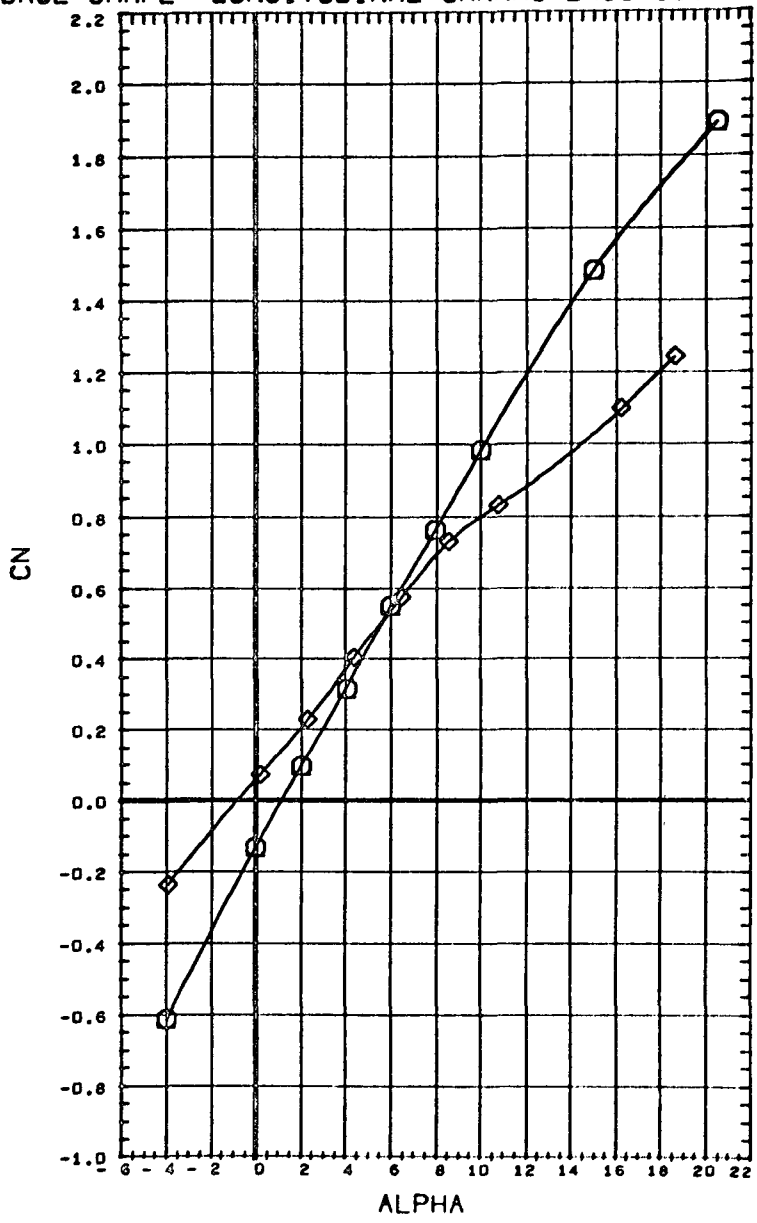
BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

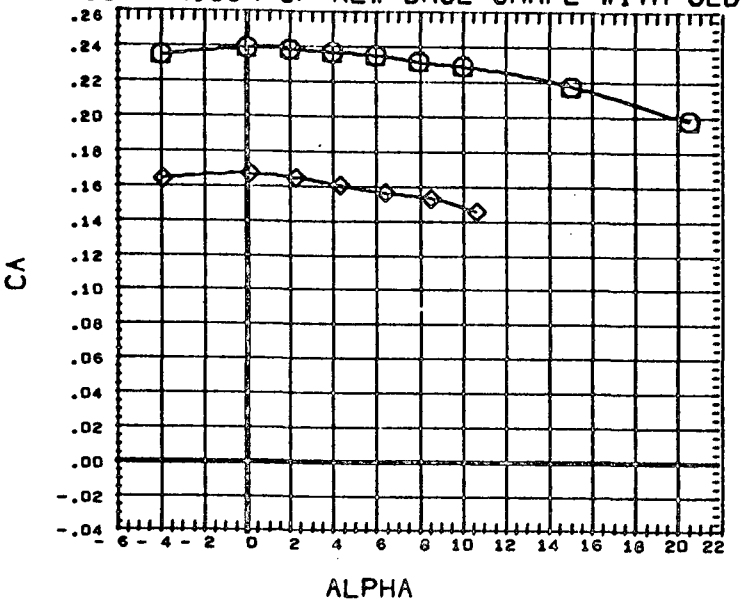
MACH 0.999

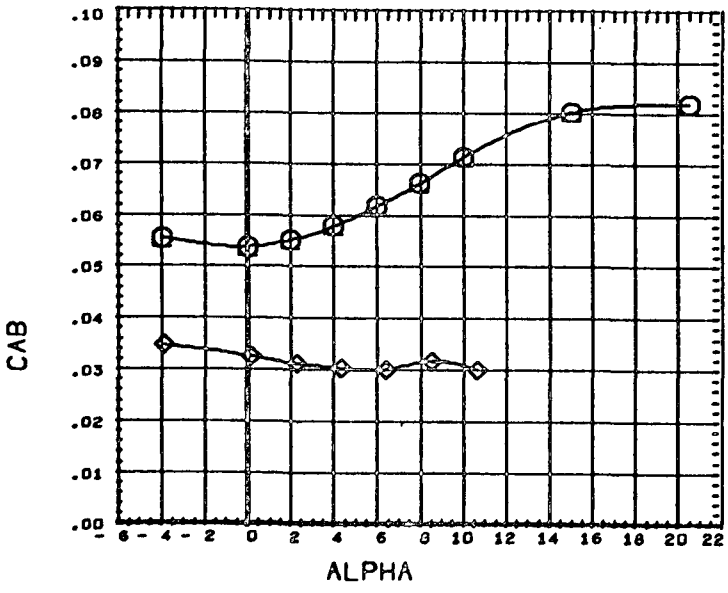
BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

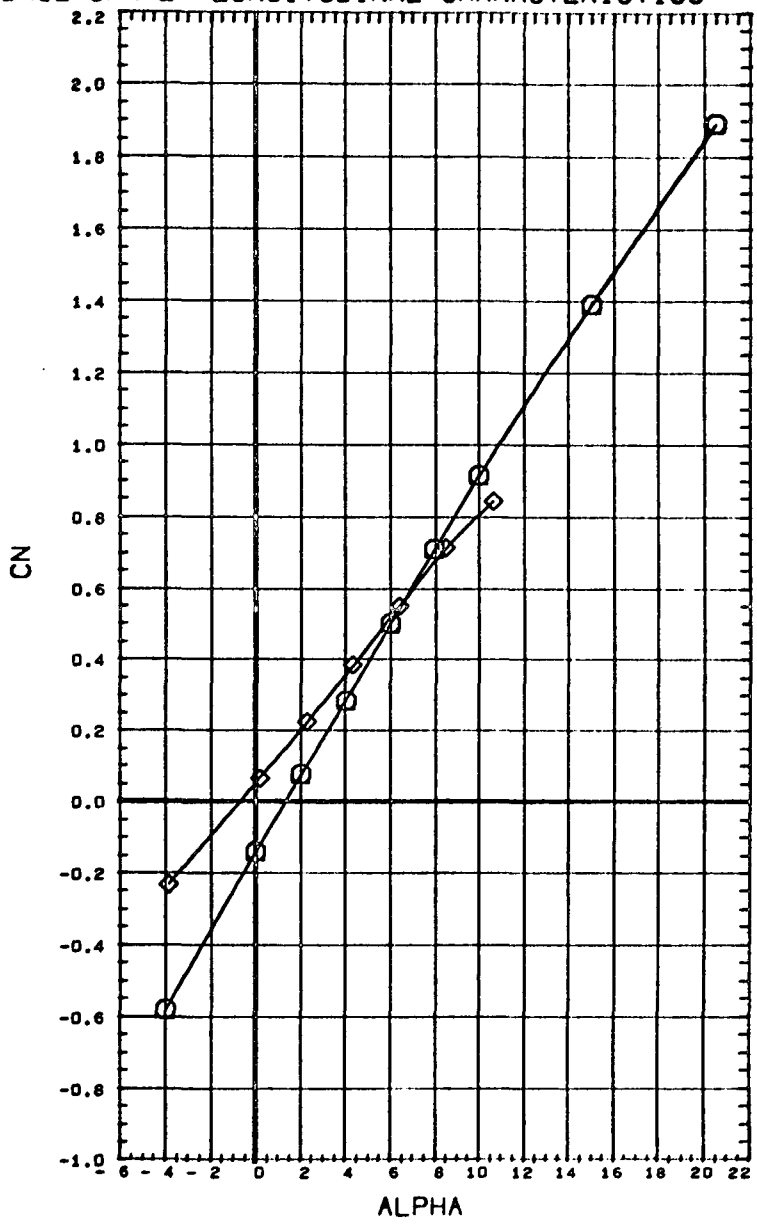
REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

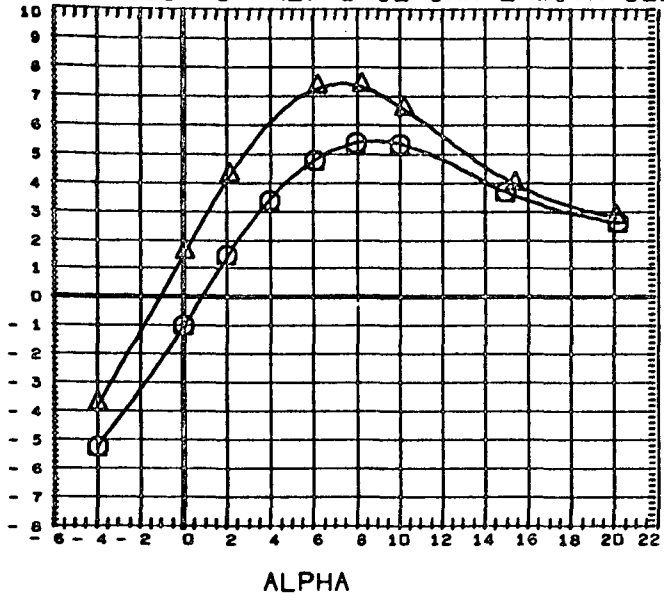
MACH 1.099

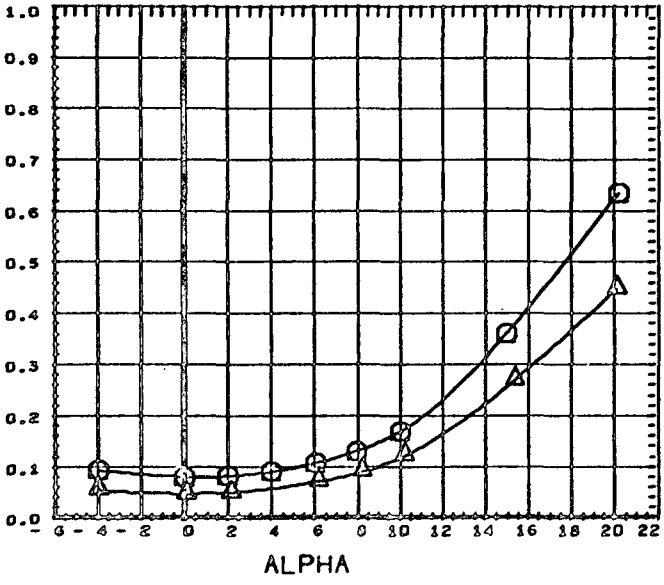
BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

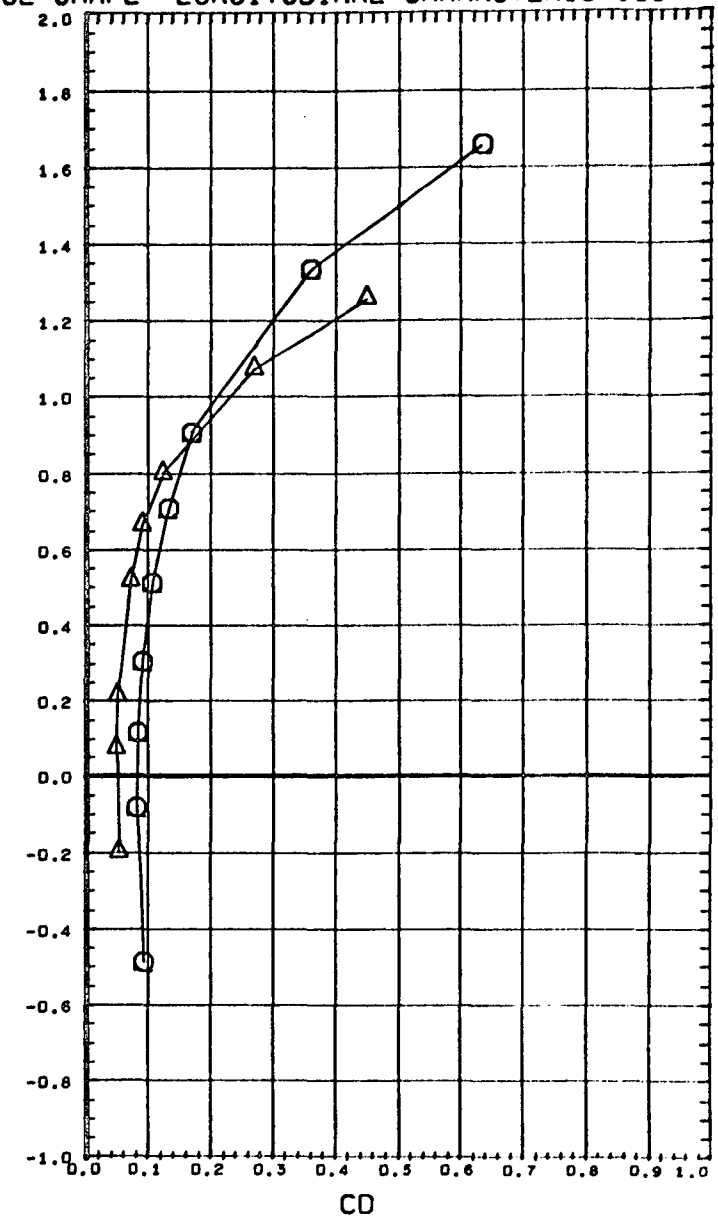
REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(AN2001)	△	NSRDC-3110,MSFC/LMSC BOOSTER B1C2F1W1V1
(AN3001)	◇	DATA NOT AVAILABLE FOR ALL CONDITIONS

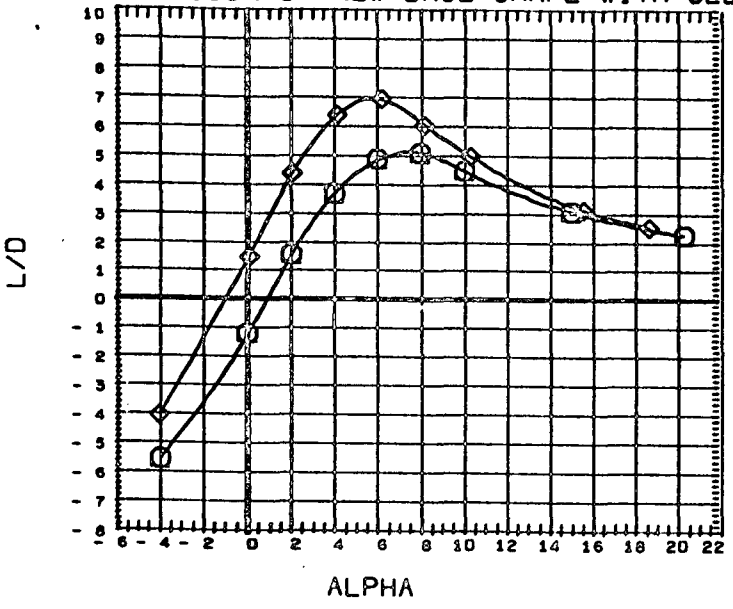
BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

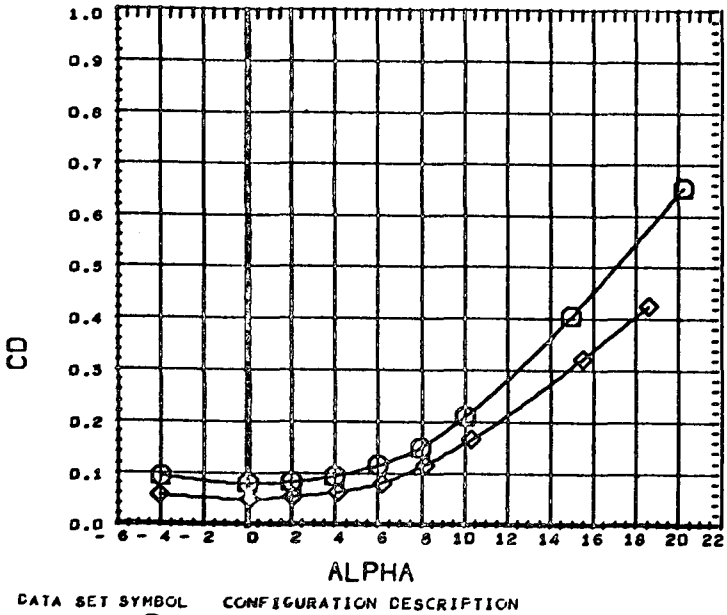
MACH 0.400

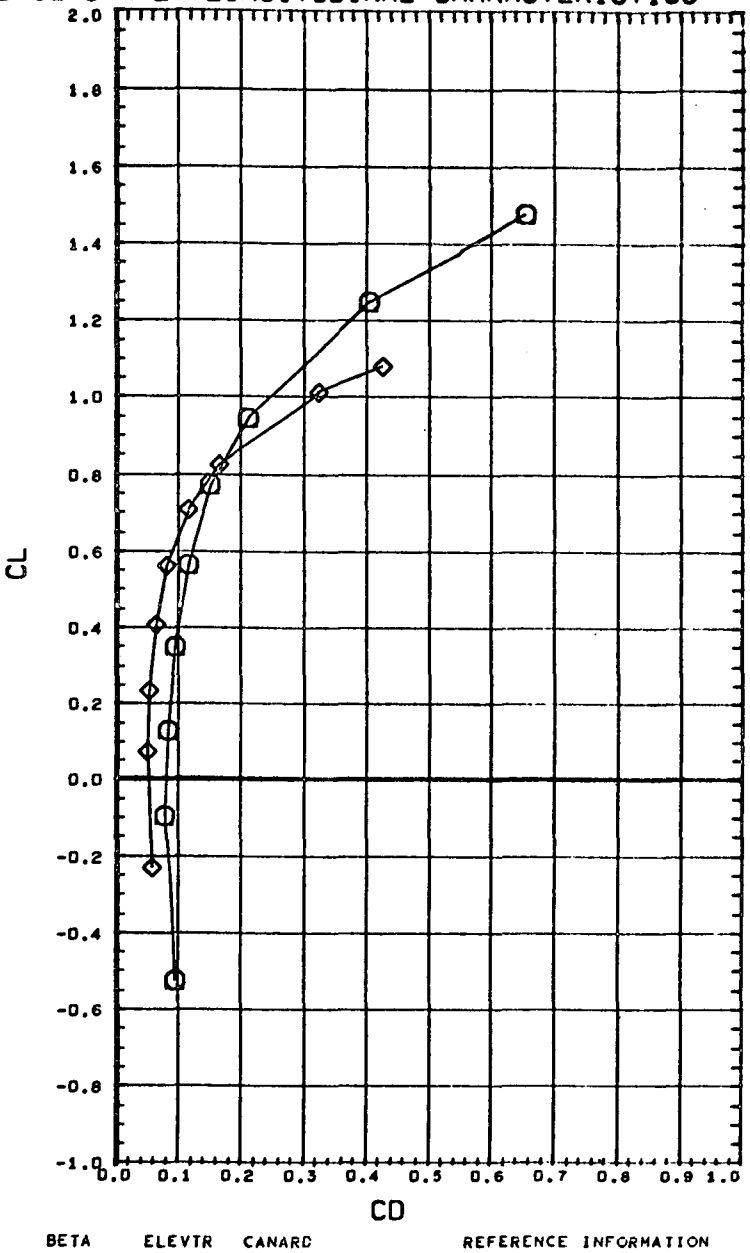
REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

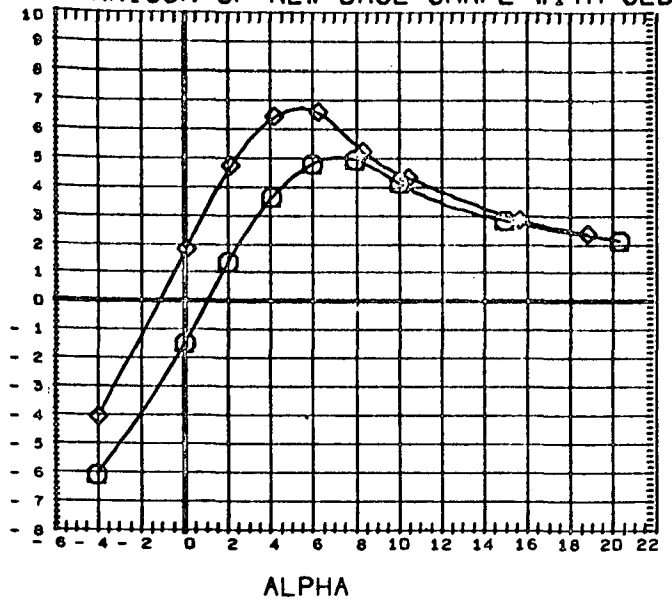
MACH 0.698

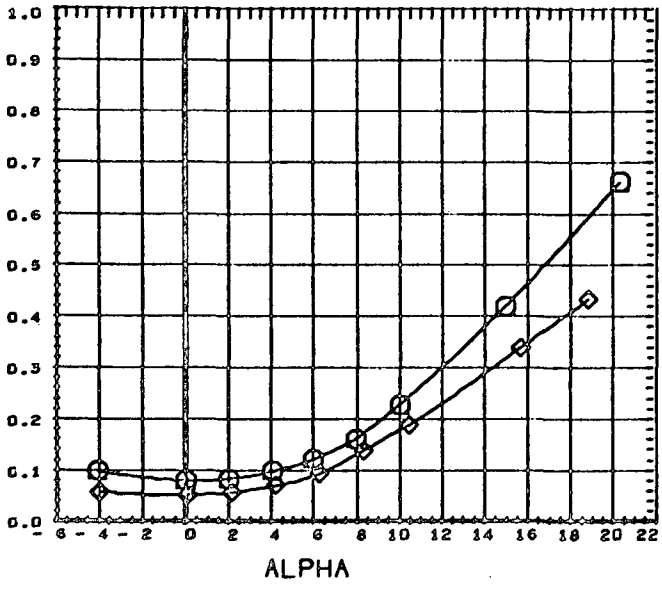
BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

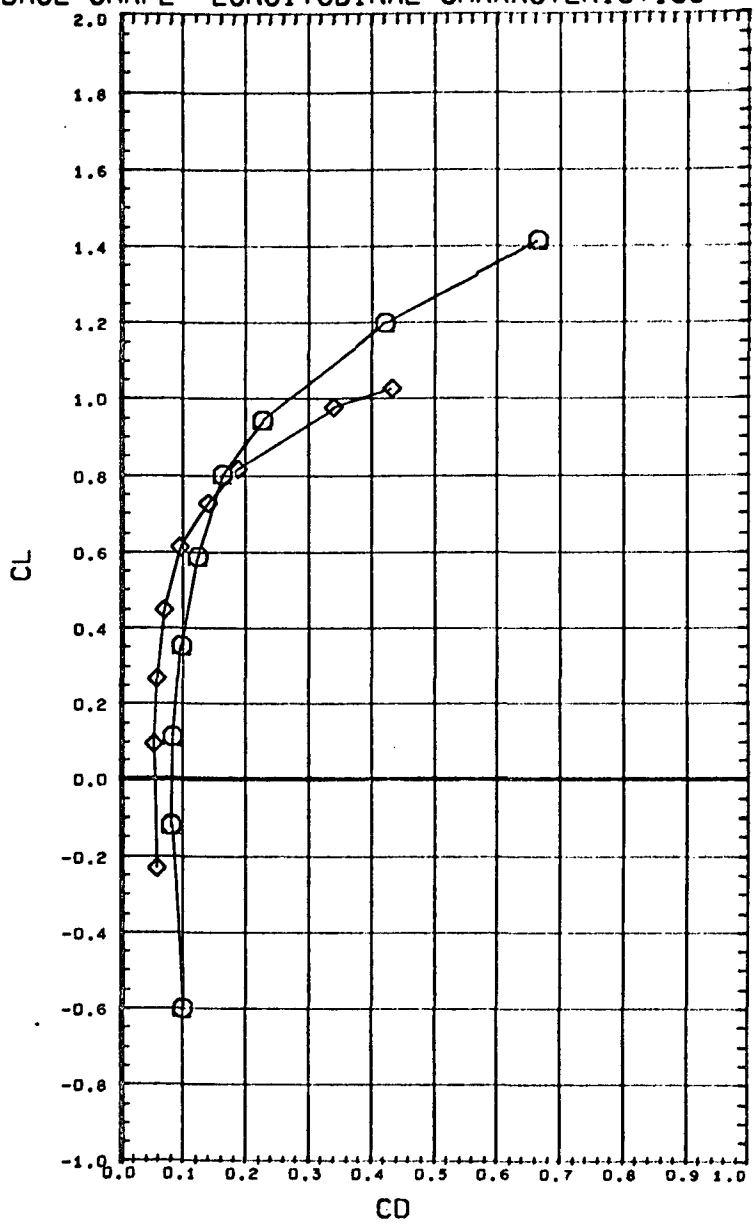
REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

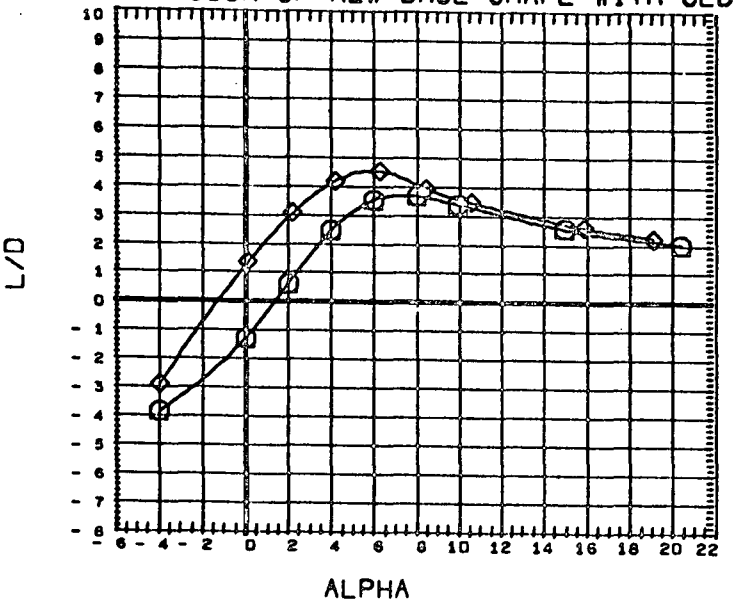
MACH 0.798

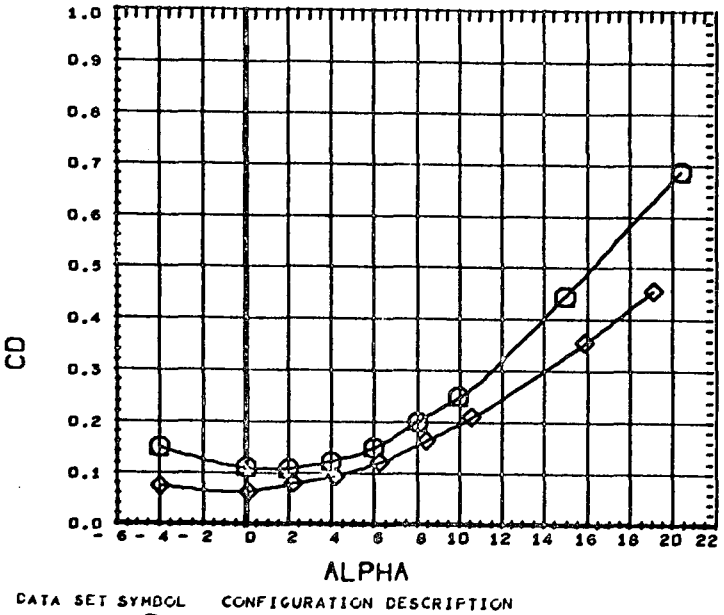
BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

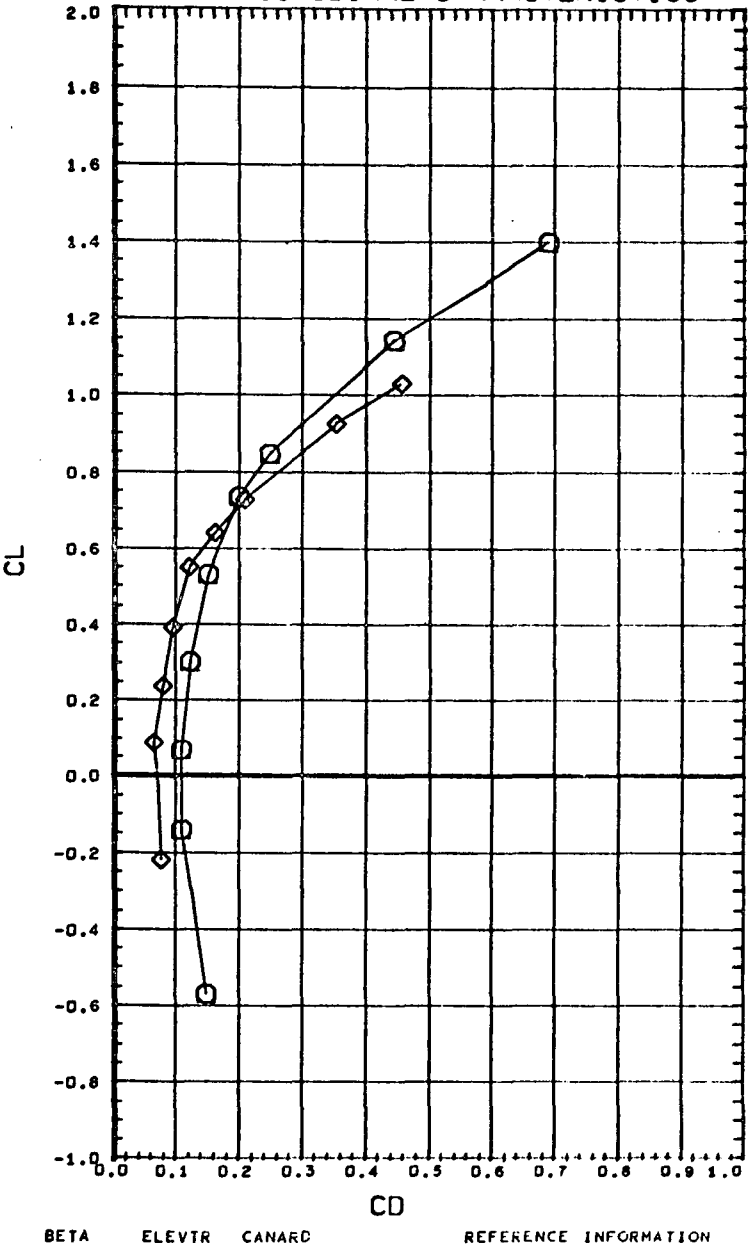
REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







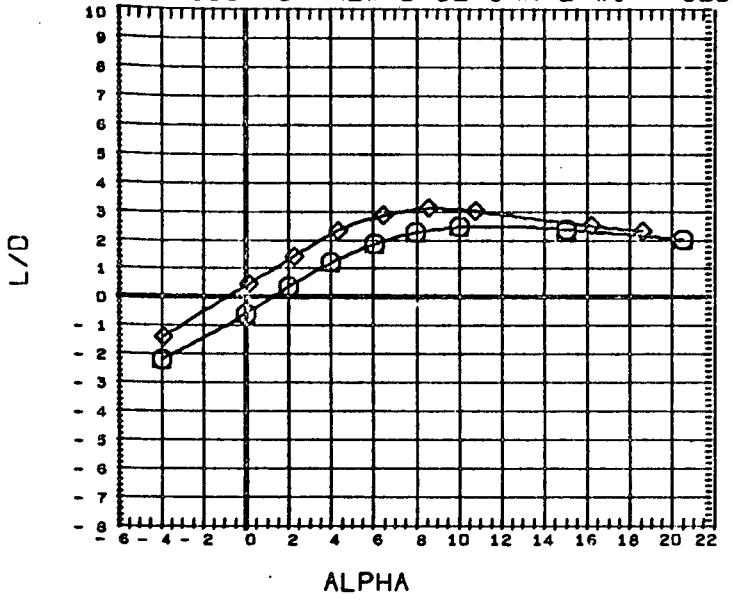
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

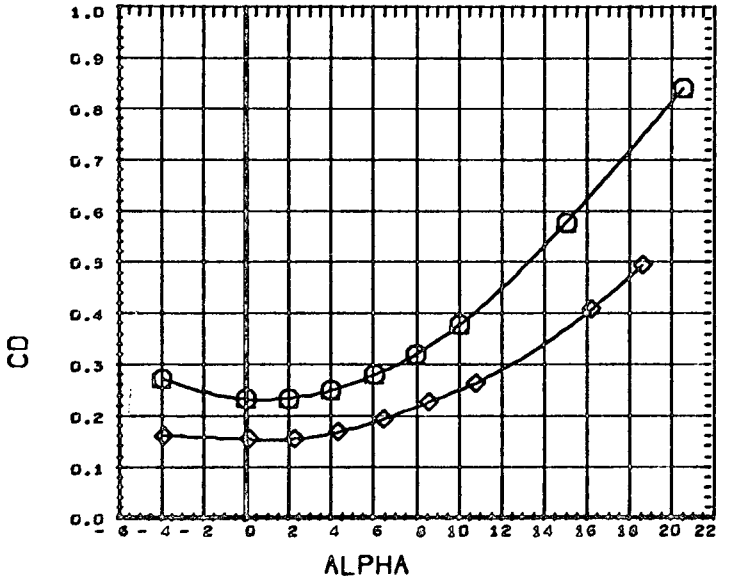
MACH 0.897

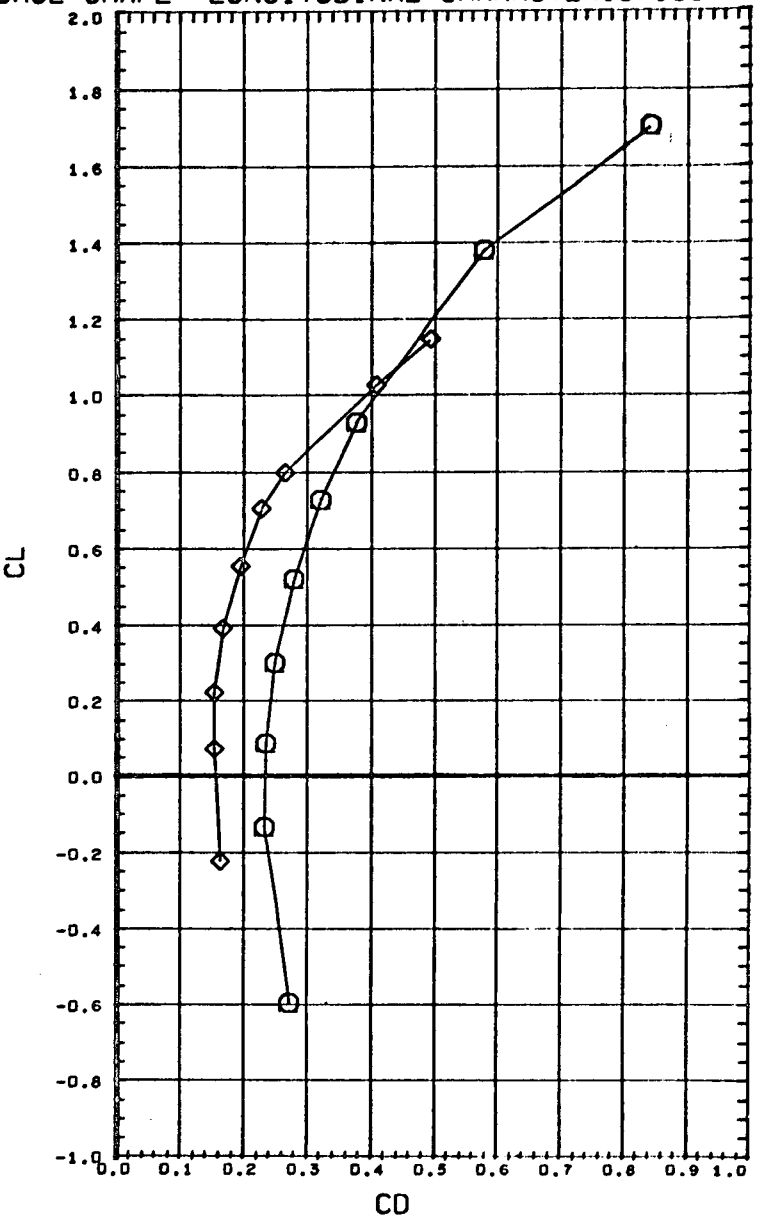
BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







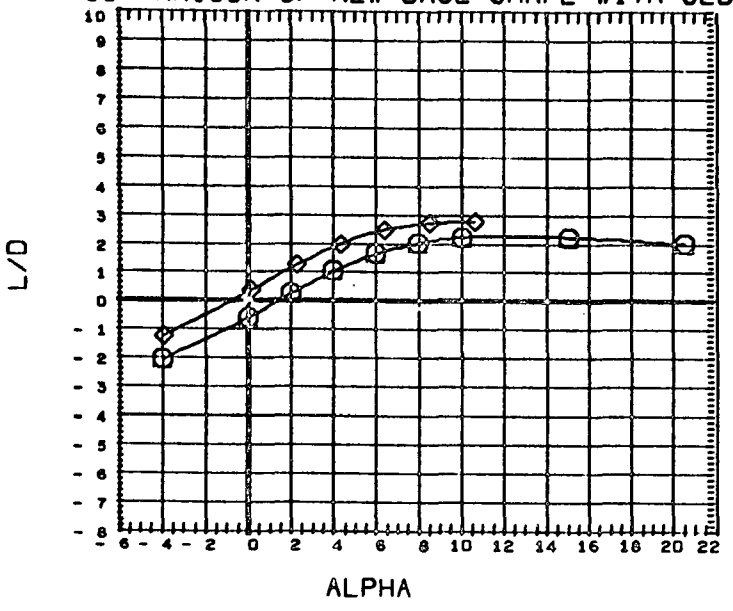
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

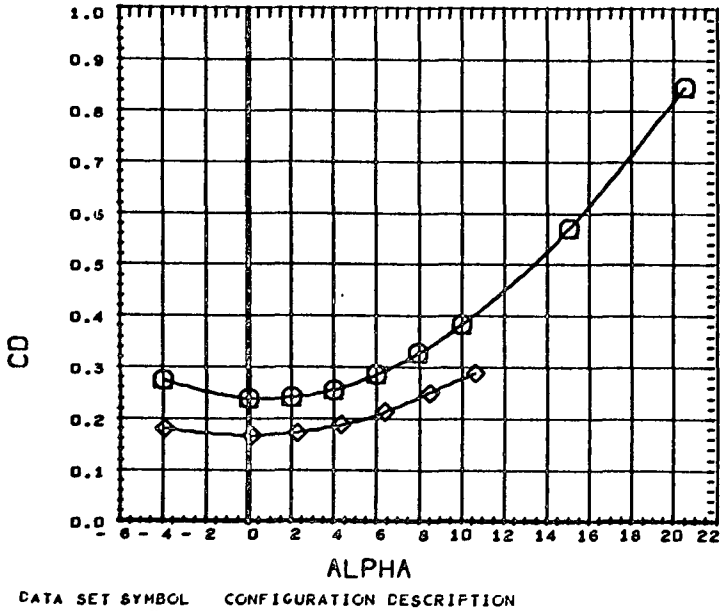
MACH 0.999

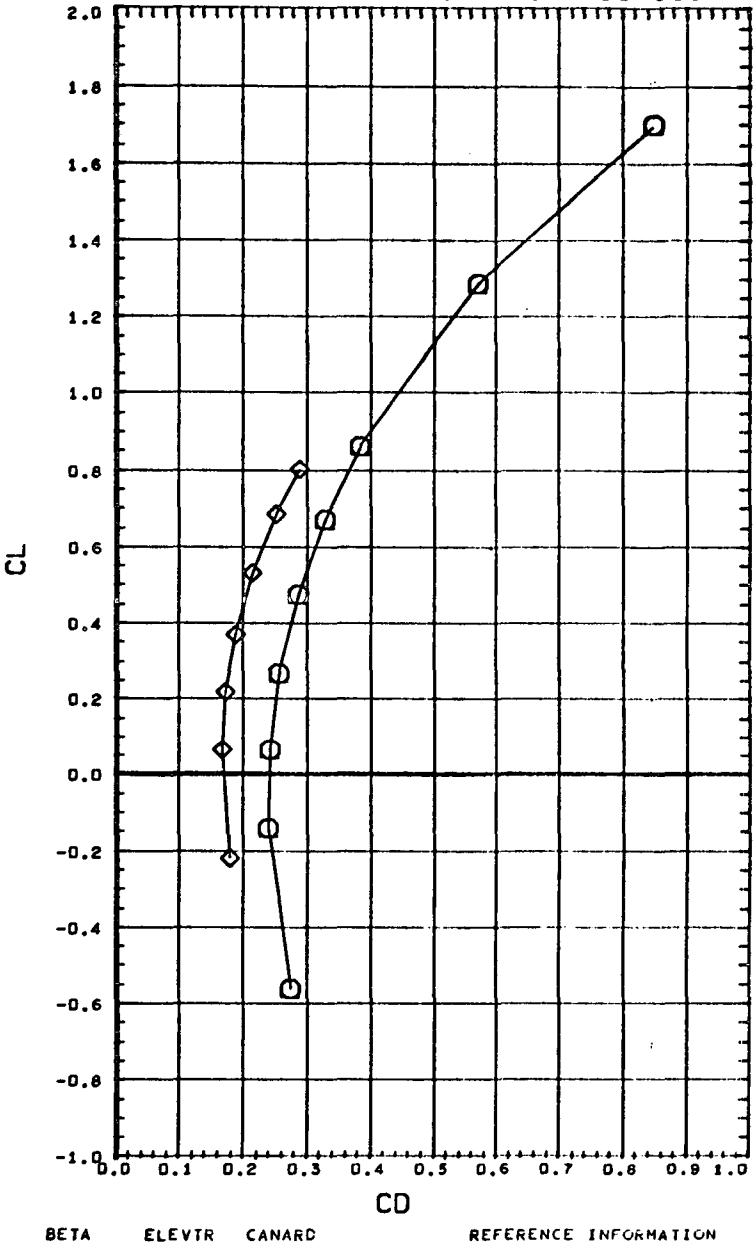
BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS







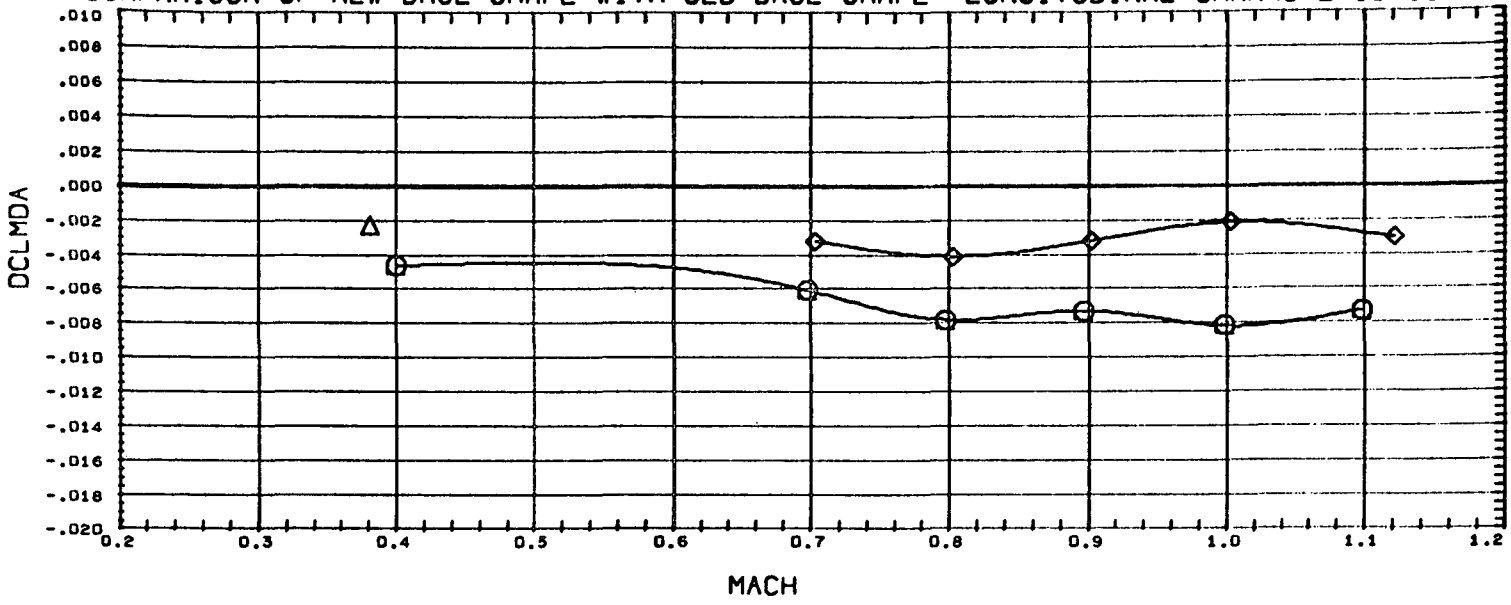
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(AN2001)	△	DATA NOT AVAILABLE FOR ALL CONDITIONS
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1

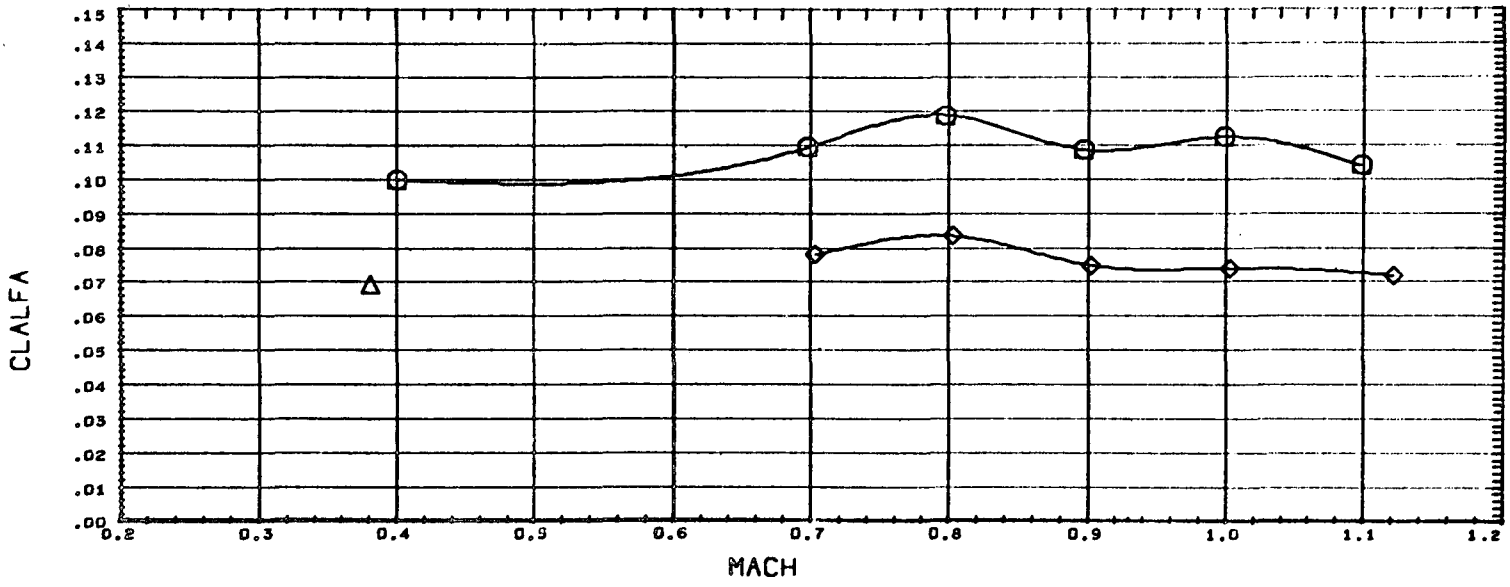
MACH 1.099

BETA	ELEVTR	CANARD
0.000	0.000	0.000
-0.019	0.000	0.000
0.031	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS



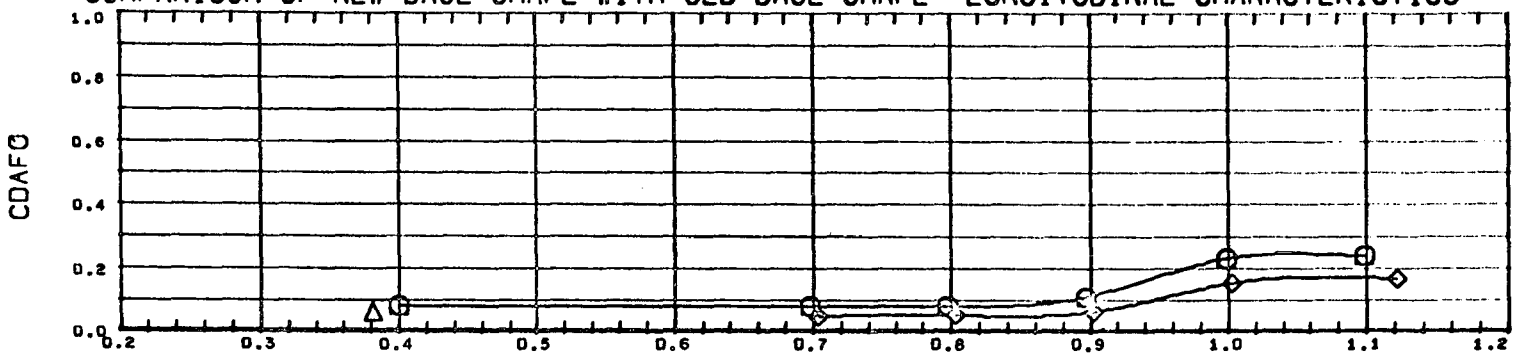


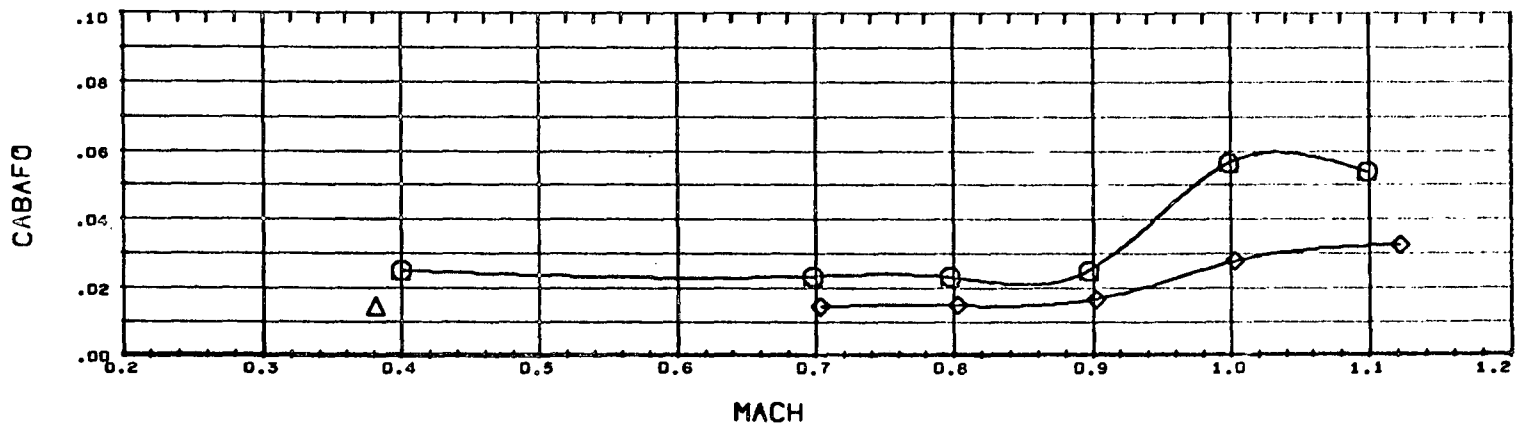
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	BETA	ELEVTR	CANARD
(RU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	0.000
(AN2001)	△	NSRDC-3110,MSFC/LMSC BOOSTER B1C2F1W1V1	-0.019	0.000	0.000
(AN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1	0.031	0.000	0.000

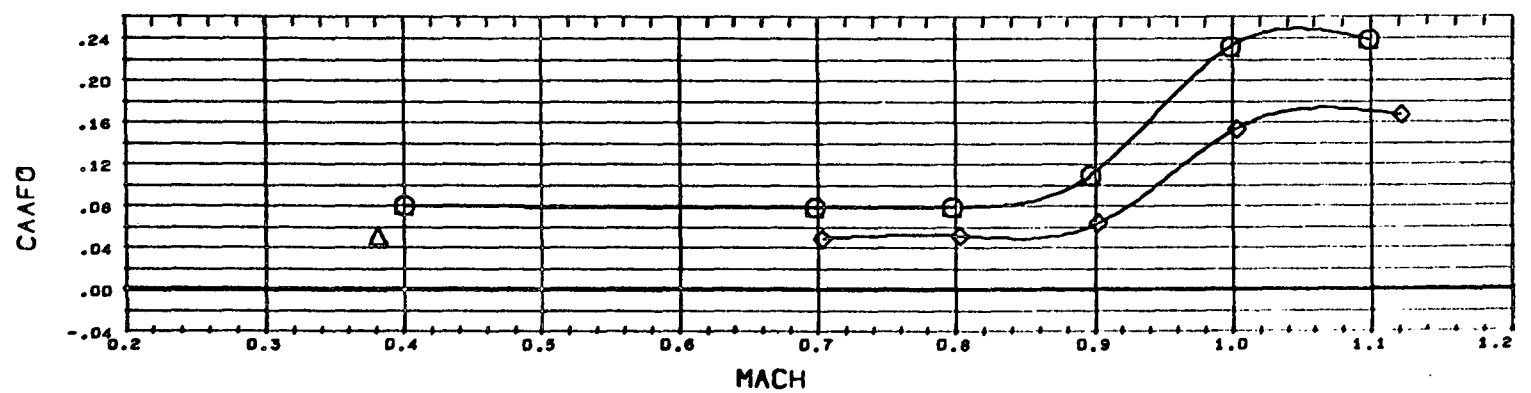
REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LONGITUDINAL CHARACTERISTICS



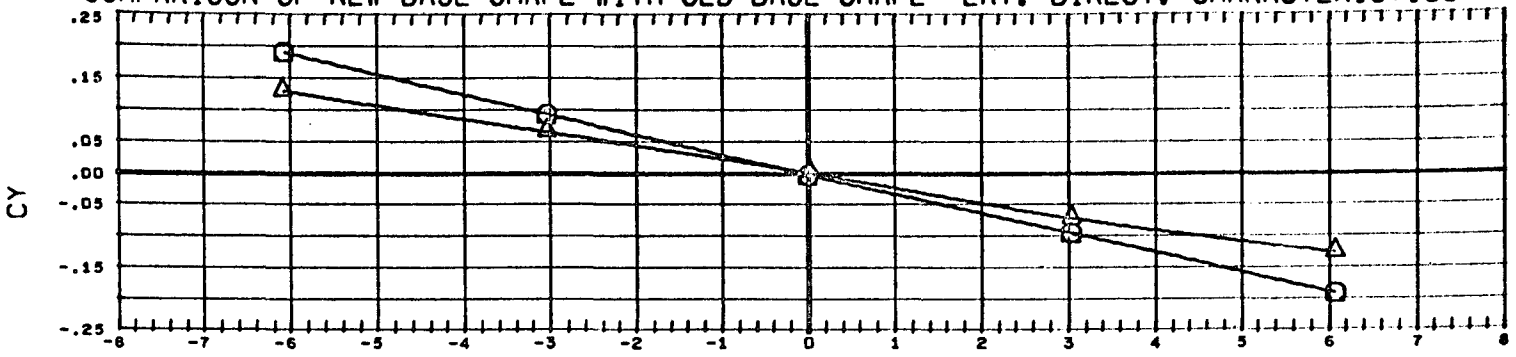


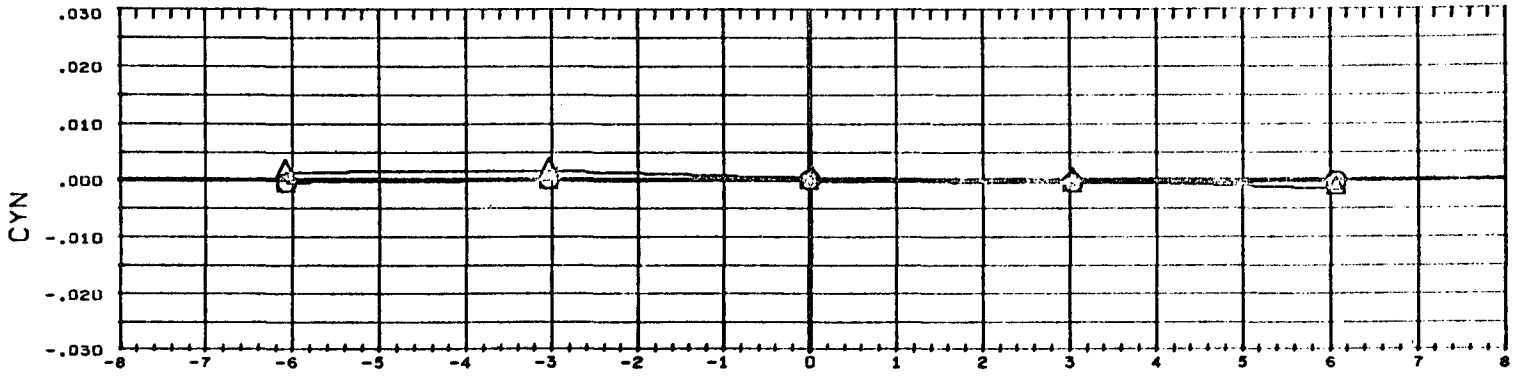


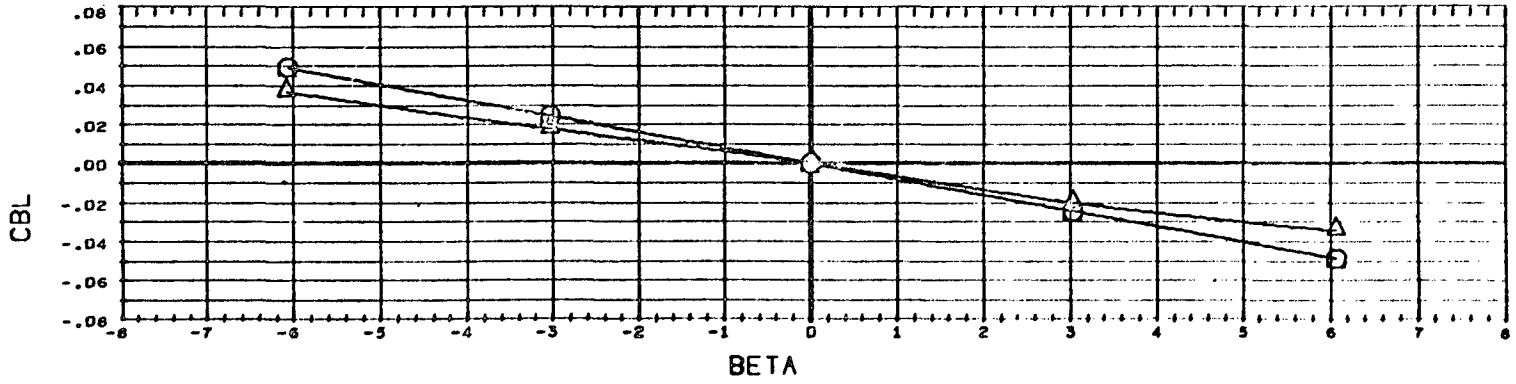
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	BETA	ELEVTR	CANARD
(BU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	0.000
(BN2001)	△	NSRDC-3110,MSFC/LMSC BOOSTER B1C2F1W1V1	-0.019	0.000	0.000
(BN3001)	◇	NSRDC-3210,MSFC/LMSC BOOSTER B1C2F2W1V1	0.031	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LAT.-DIRECT. CHARACTERISTICS





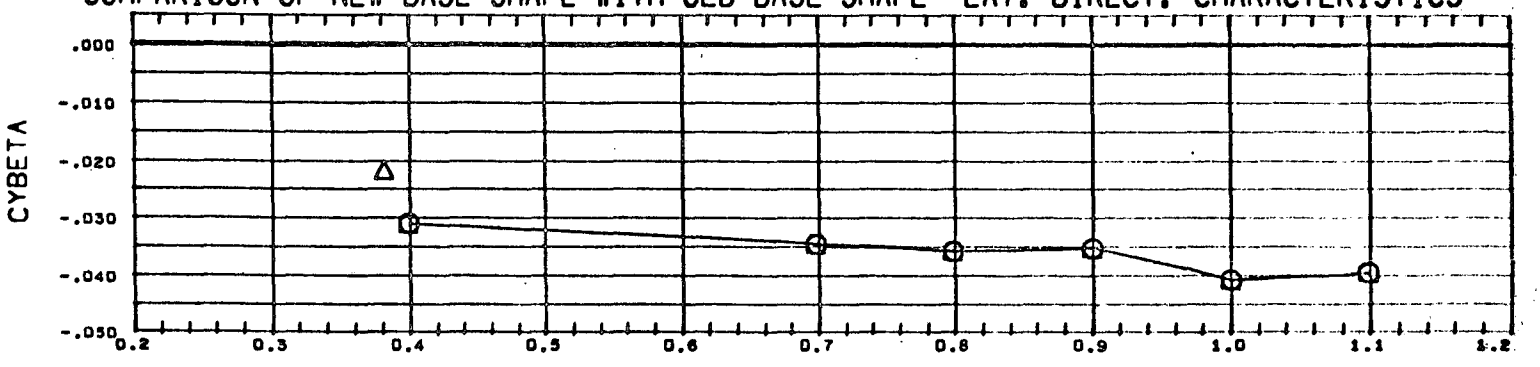


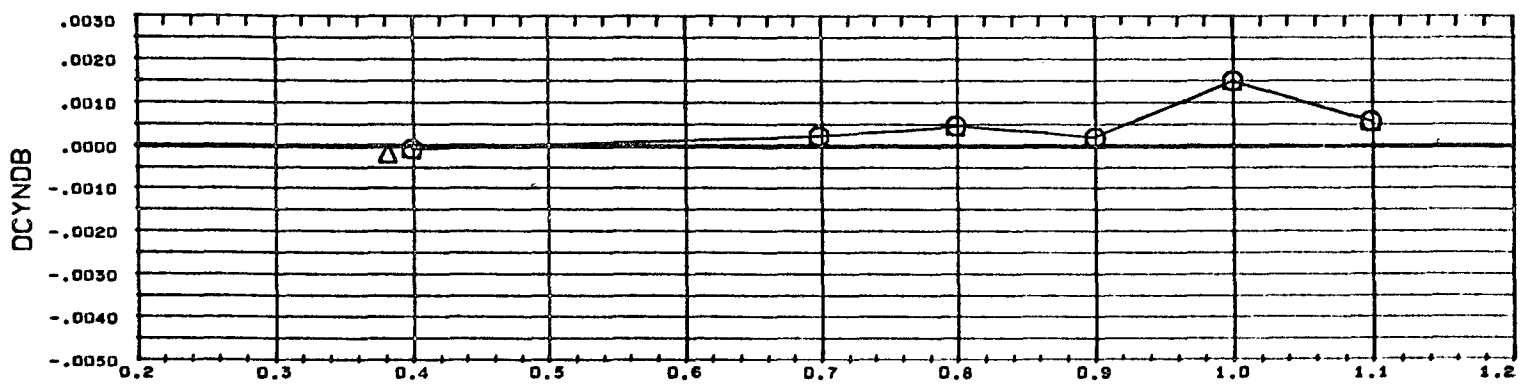
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ALPHA	ELEVTR	CANARD
(CU9002)	Q	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	0.000
(AN2002)	A	NSRDC-3110,MSFC/LMSC BOOSTER B1C2F1W1V1	0.033	0.000	0.000

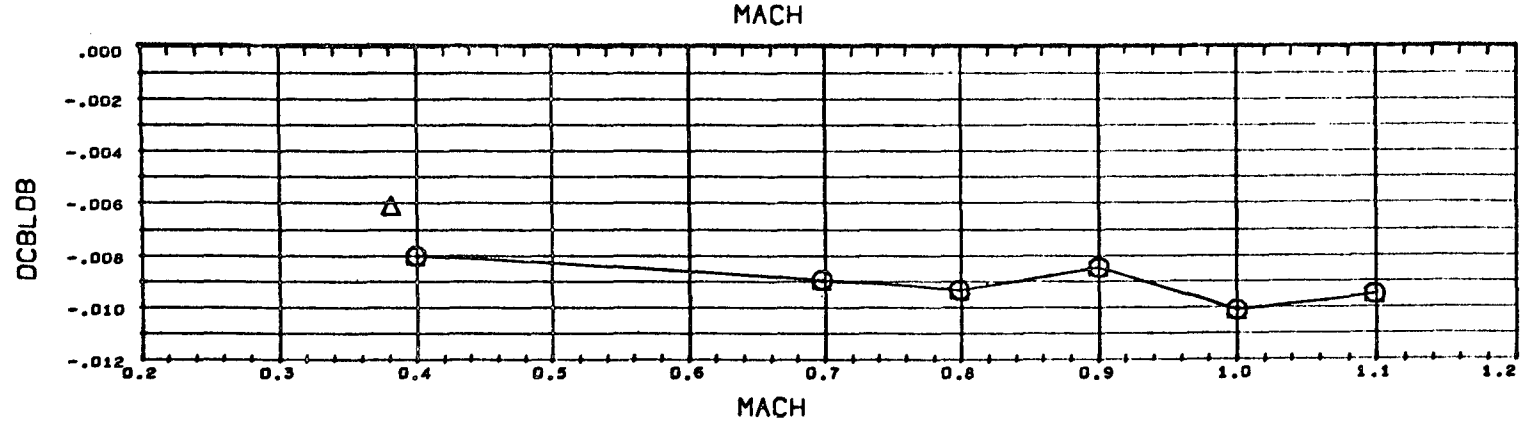
MACH 0.399

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

COMPARISON OF NEW BASE SHAPE WITH OLD BASE SHAPE -LAT.-DIRECT. CHARACTERISTICS



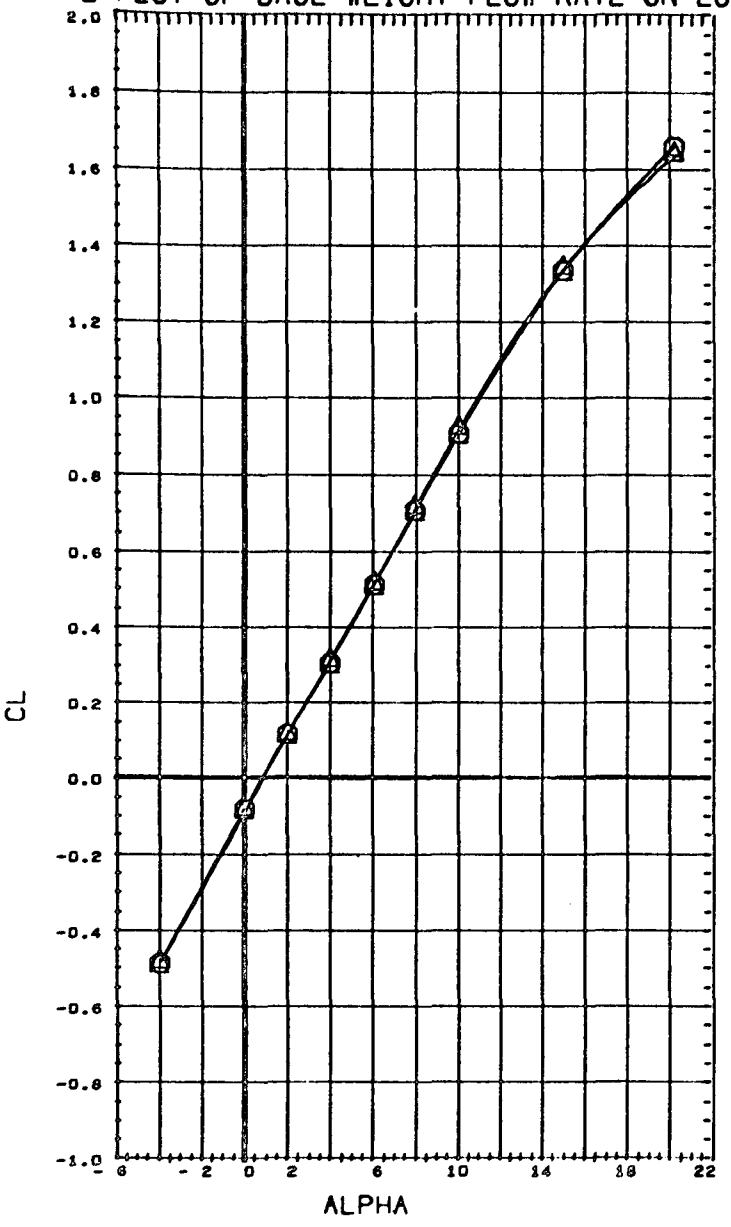


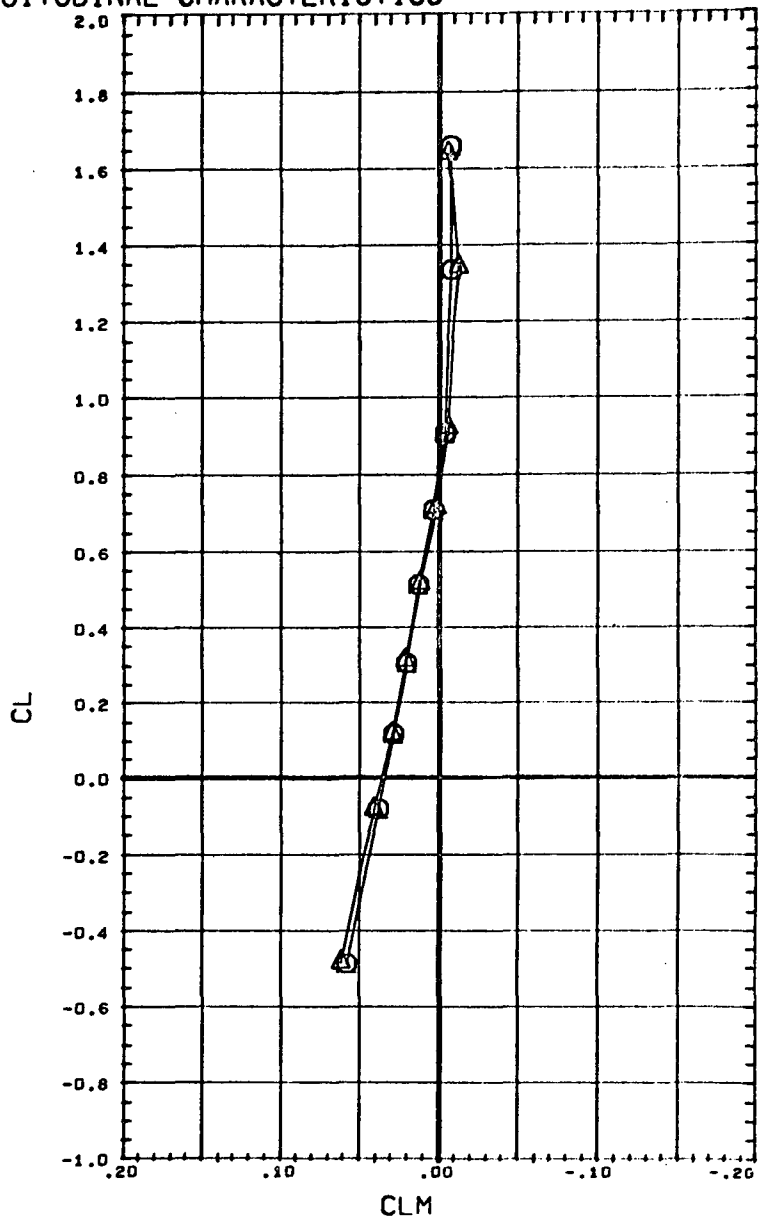


DATA SET SYMBOL		CONFIGURATION DESCRIPTION	ALPHA	ELEVTR	CANARD
(RU9002)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	0.000
(AN2002)	△	NSRDC-3110,MSFC/LMSC BOOSTER B1C2F1W1V1	0.033	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

EFFECT OF BASE WEIGHT FLOW RATE ON LONGITUDINAL CHARACTERISTICS





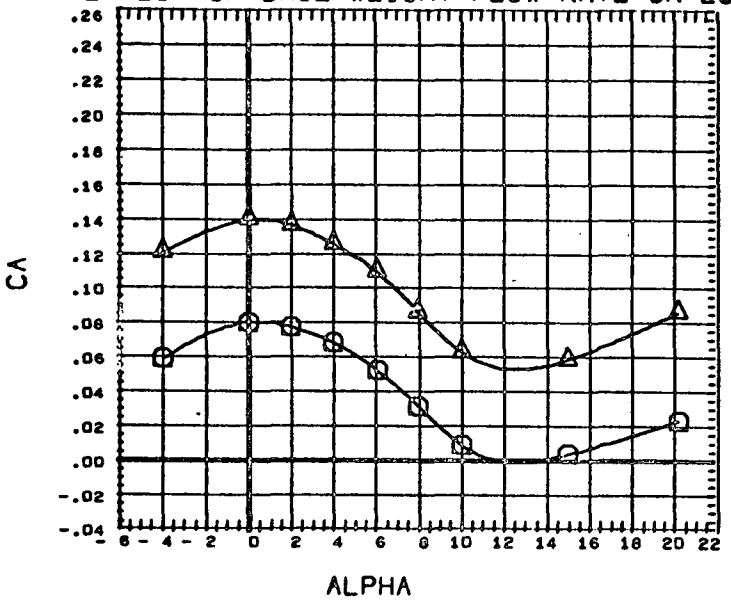
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(CU9001)		CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(CU9057)		CAL MSFC/LMSC BOOSTER B4C2F2W3V1

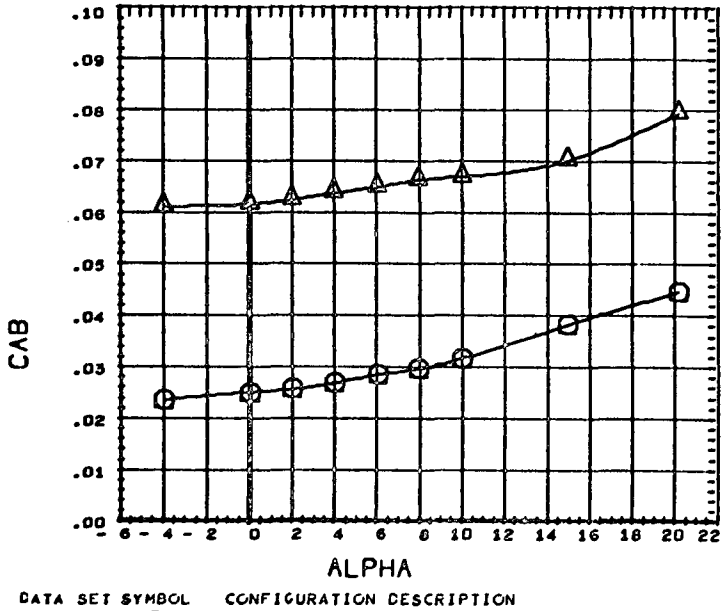
BETA	ELEVTR	CANARD	BSFLOW
0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.353

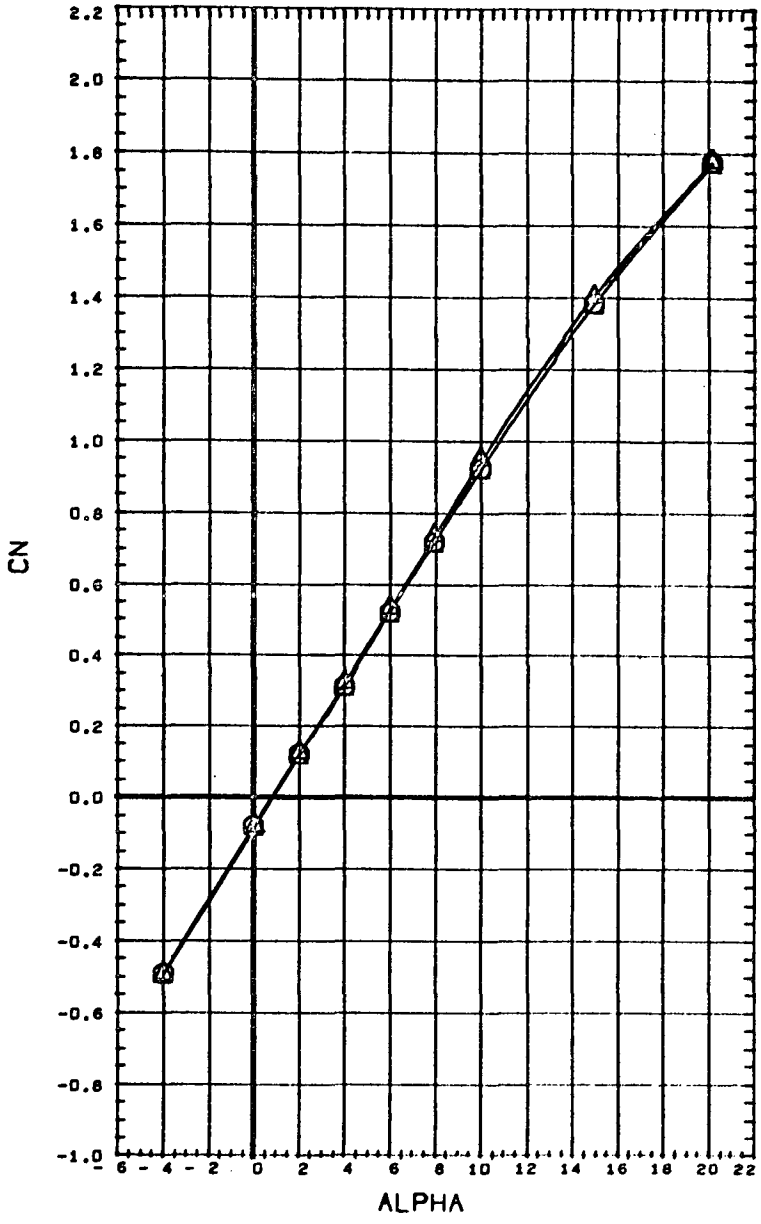
REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

MACH 0.400

EFFECT OF BASE WEIGHT FLOW RATE ON LONGITUDINAL CHARACTERISTICS







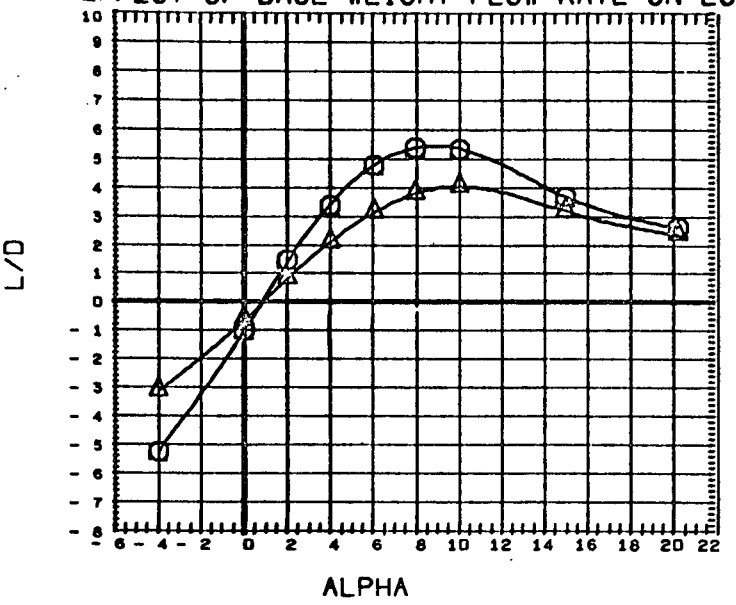
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(CU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(CU9057)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

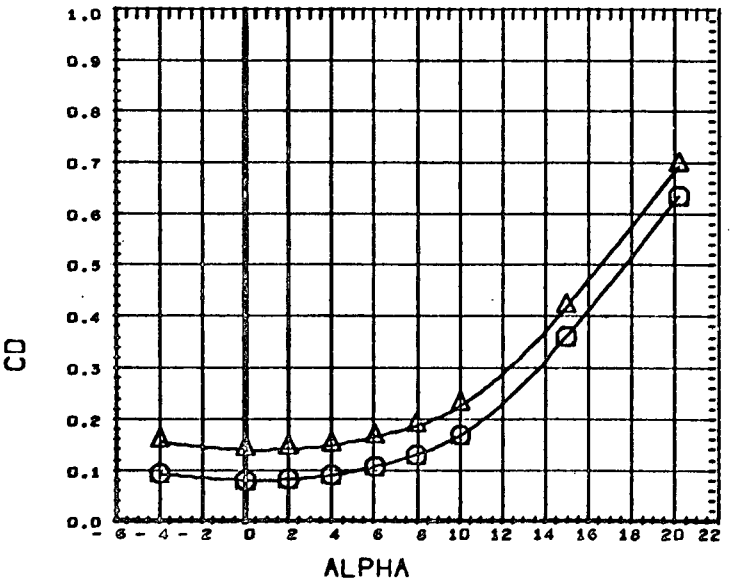
MACH 0.400

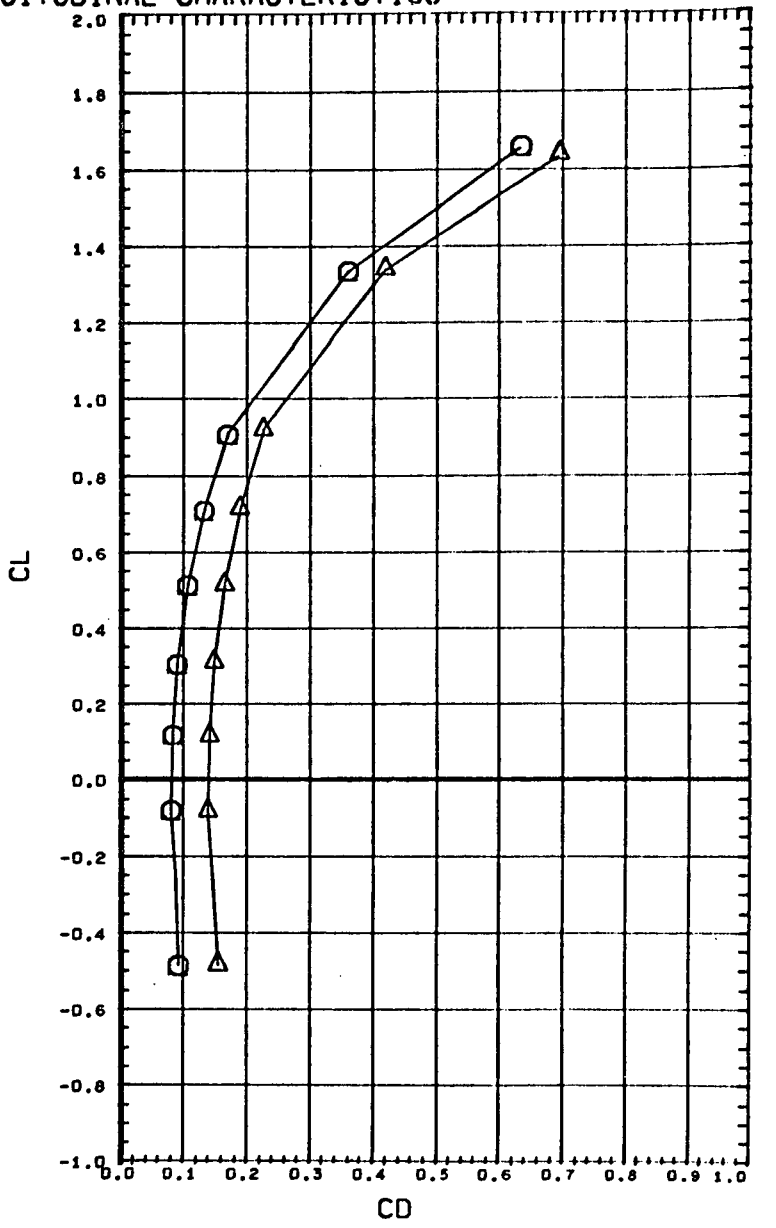
BETA	ELEVTR	CANARD	BSFLOW
0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.353

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

EFFECT OF BASE WEIGHT FLOW RATE ON LONGITUDINAL CHARACTERISTICS







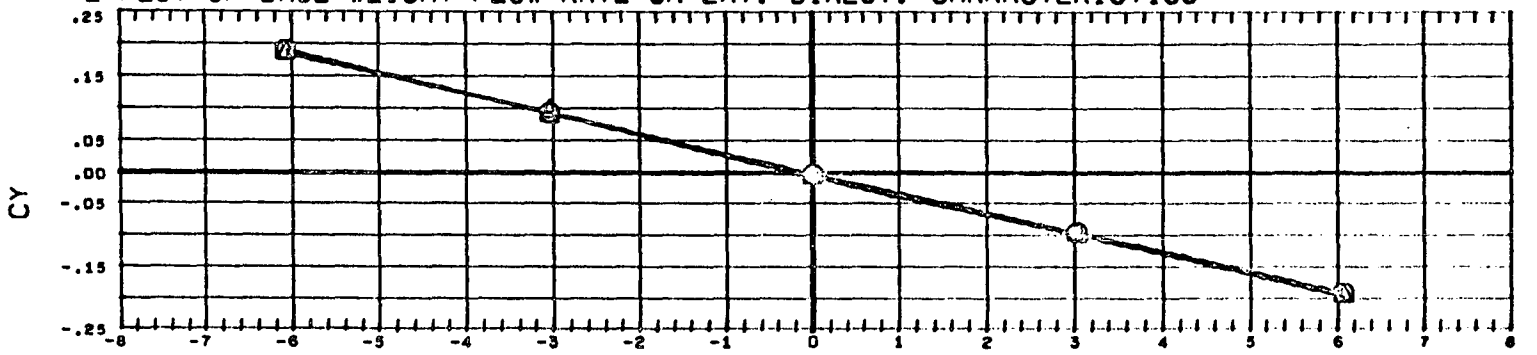
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(CU9001)		CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(CU9057)		CAL MSFC/LMSC BOOSTER B4C2F2W3V1

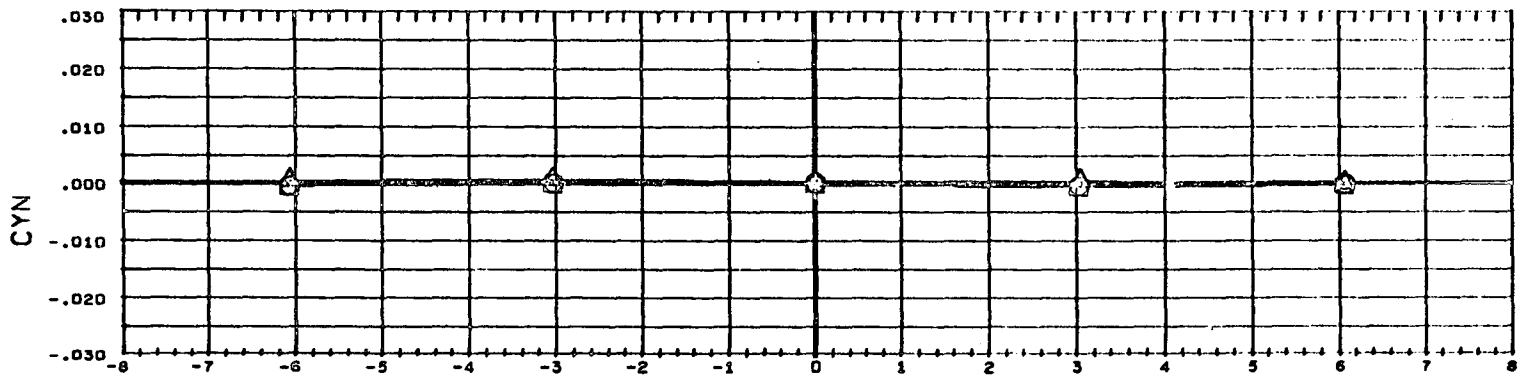
BETA	ELEVTR	CANARD	BSFLOW
0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.353

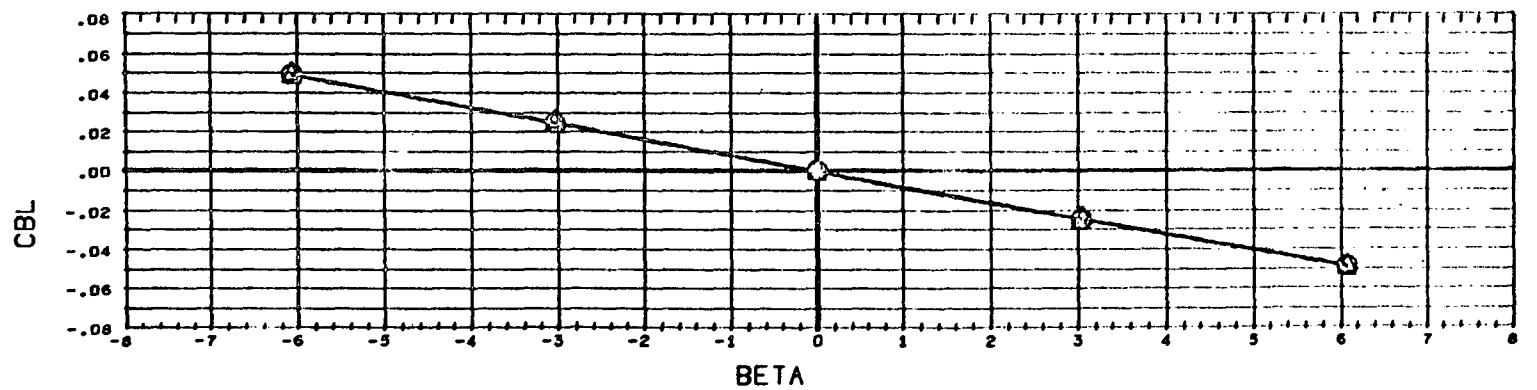
REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

MACH 0.400

EFFECT OF BASE WEIGHT FLOW RATE ON LAT.-DIRECT. CHARACTERISTICS





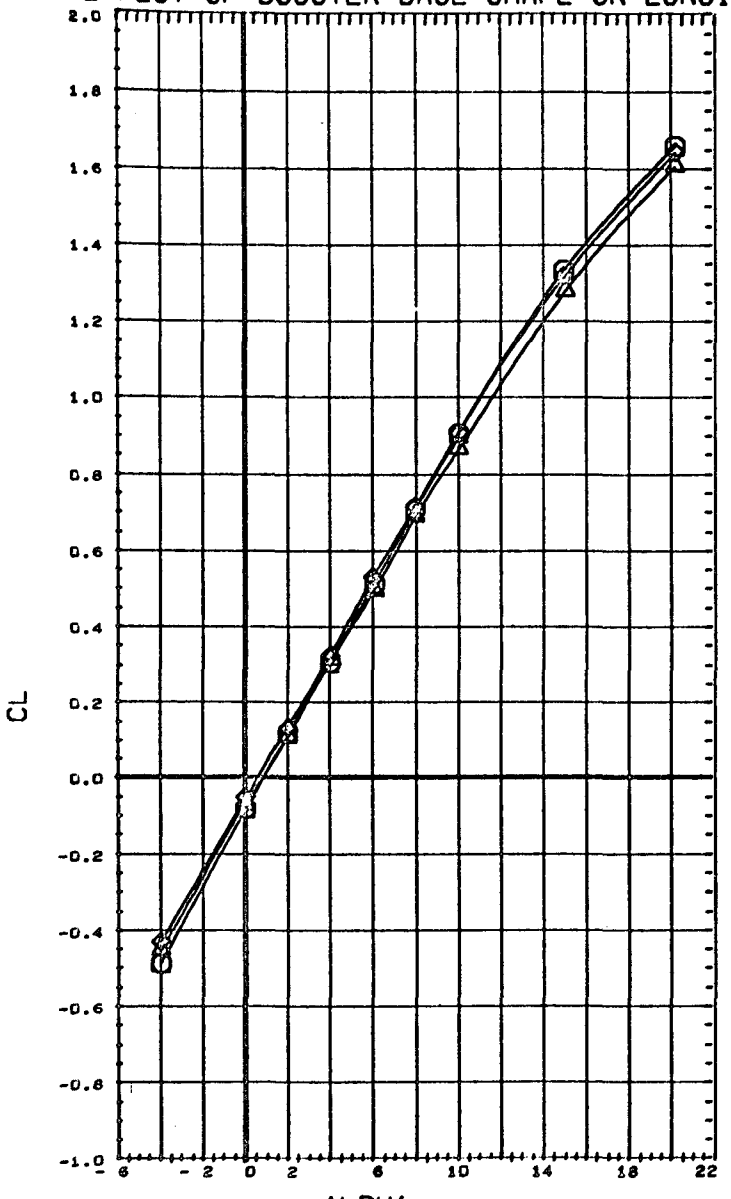


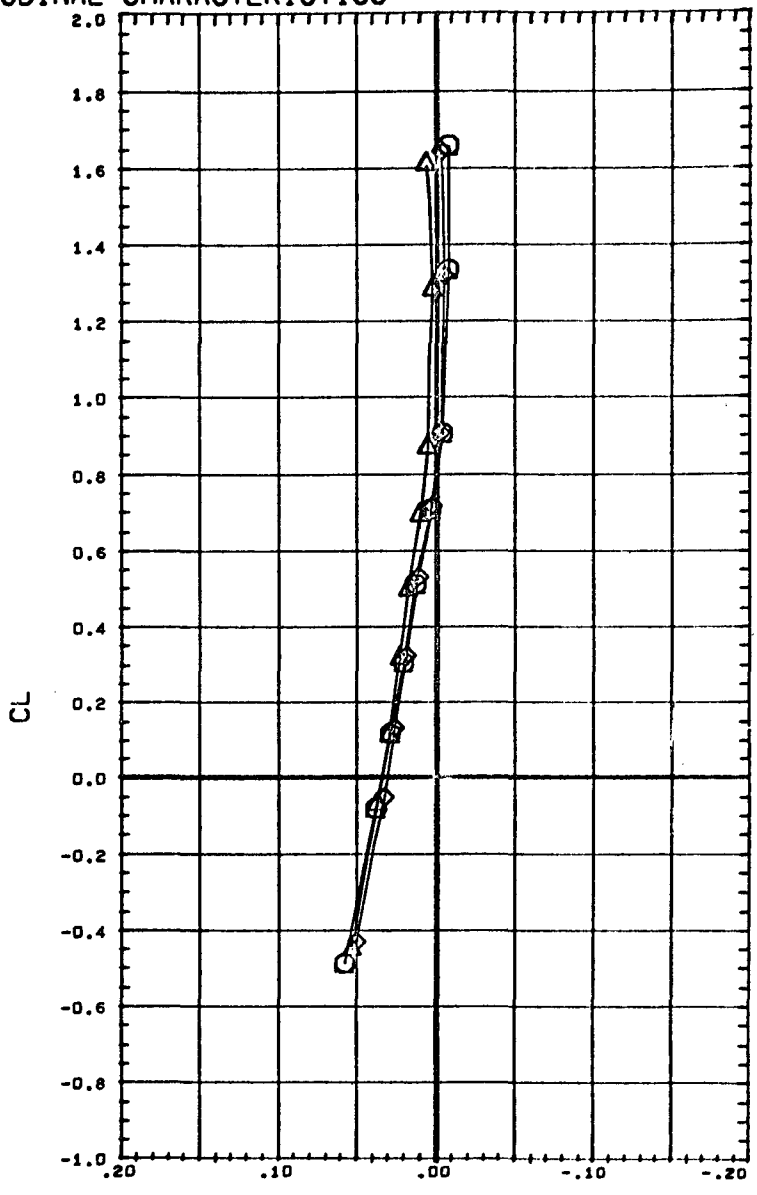
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ALPHA	ELEVTR	CANARD	BSFLOW
(CU9002)	Q	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	0.000	0.000
(RU9058)	A	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	0.000	0.353

MACH 0.399

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

EFFECT OF BOOSTER BASE SHAPE ON LONGITUDINAL CHARACTERISTICS





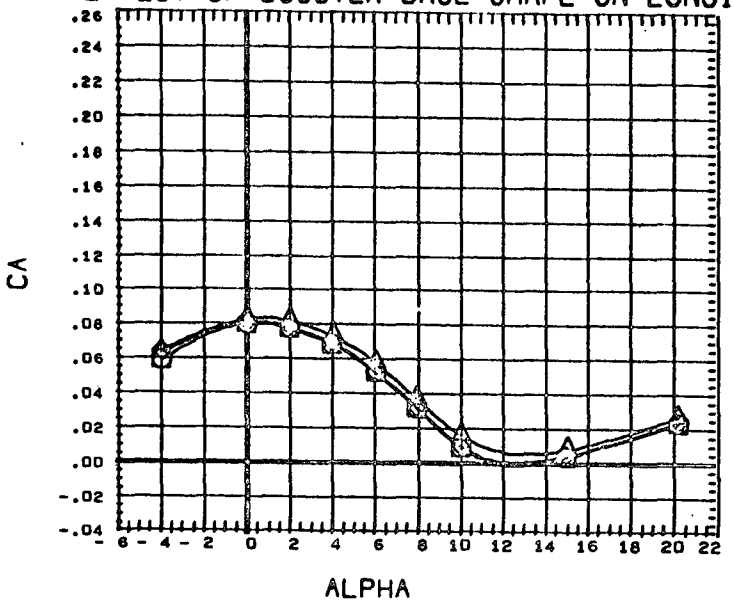
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	
(CU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	
(RU9005)	△	CAL MSFC/LMSC BOOSTER B5C2F2W3V1	BASE FLAP
(RU9009)	◇	CAL MSFC/LMSC BOOSTER B6C2F2W3V1	BASE VENT

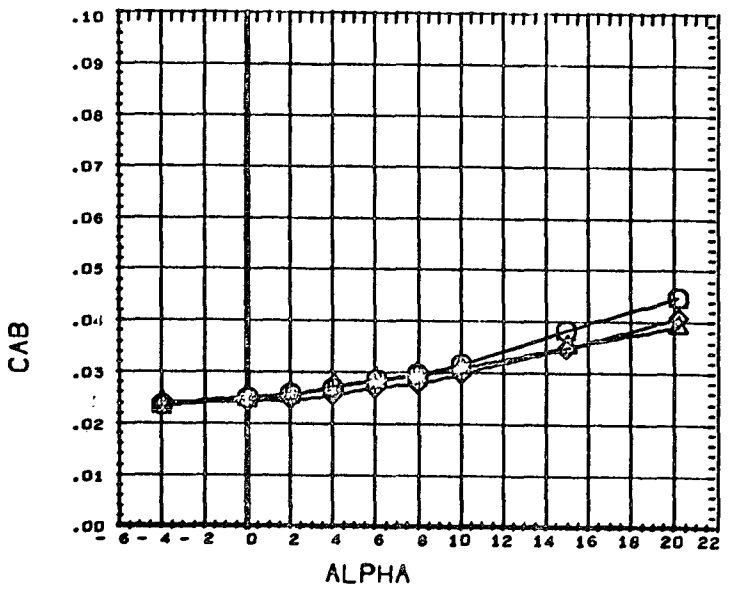
MACH 0.400

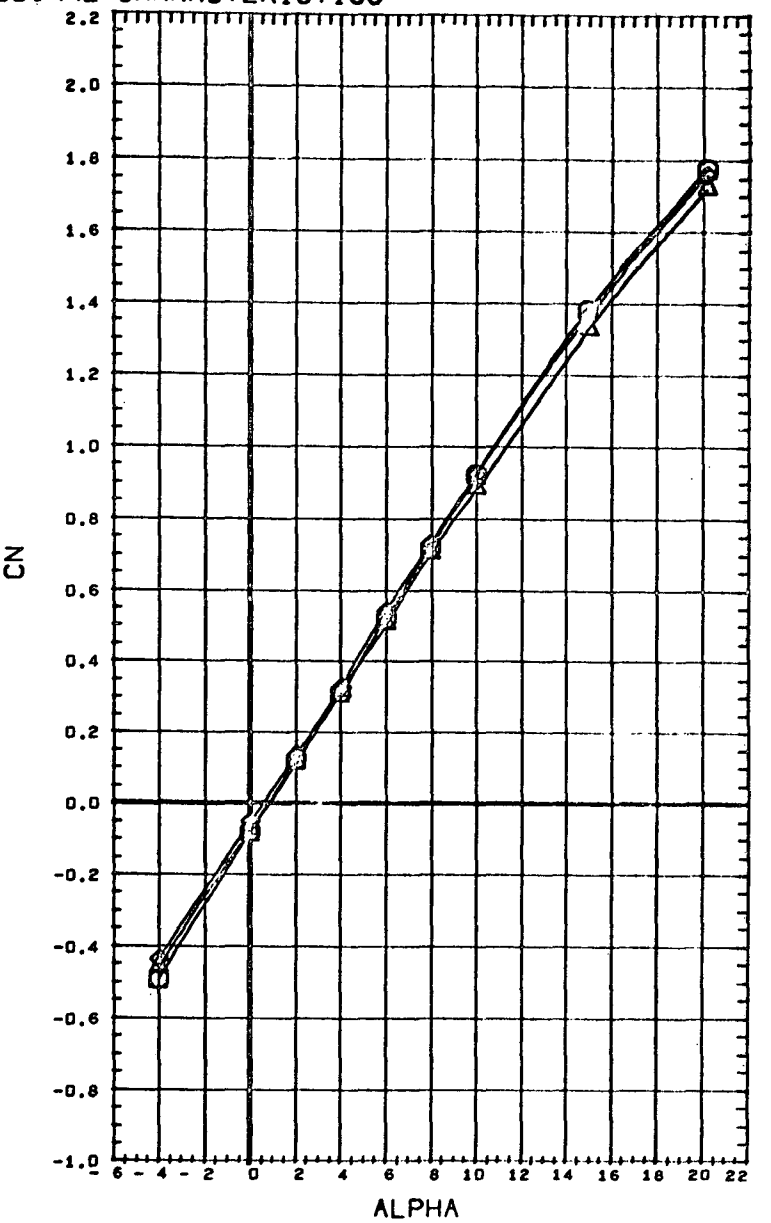
BETA	ELEVTR	CANARD	BSFLOW
0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

EFFECT OF BOOSTER BASE SHAPE ON LONGITUDINAL CHARACTERISTICS







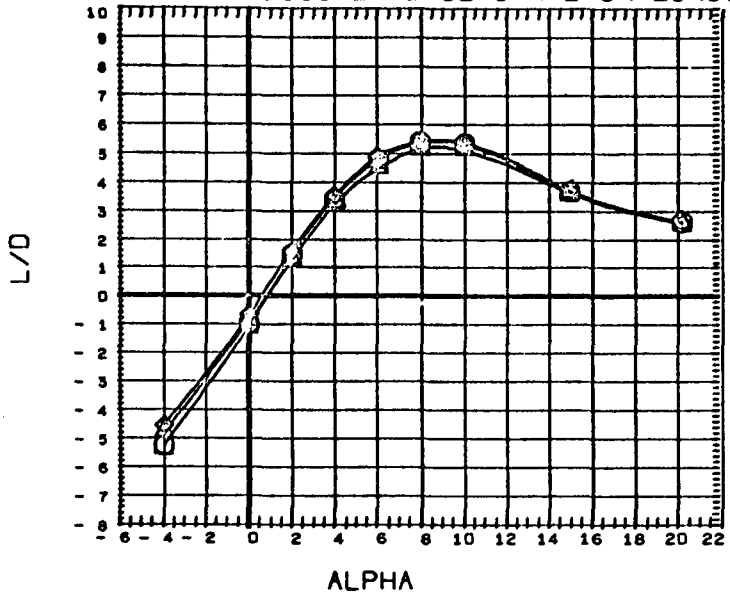
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	
(CU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	
(RU9005)	△	CAL MSFC/LMSC BOOSTER B5C2F2W3V1	BASE FLAP
(RU9009)	◇	CAL MSFC/LMSC BOOSTER B6C2F2W3V1	BASE VENT

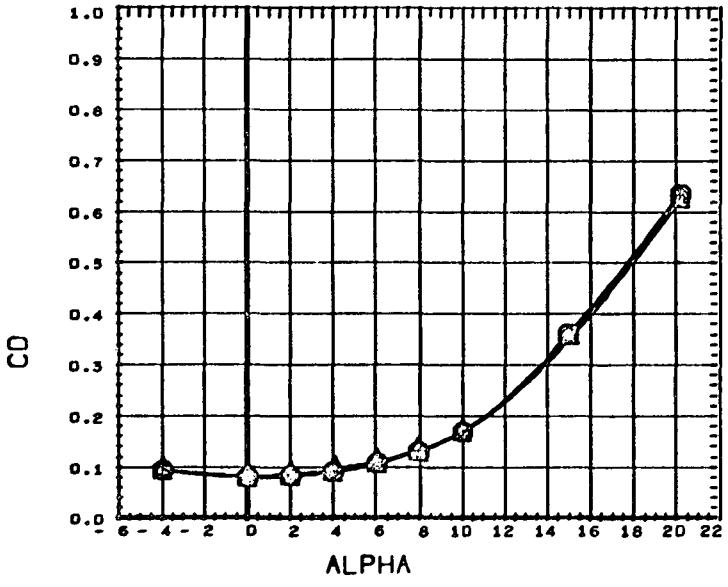
MACH 0.400

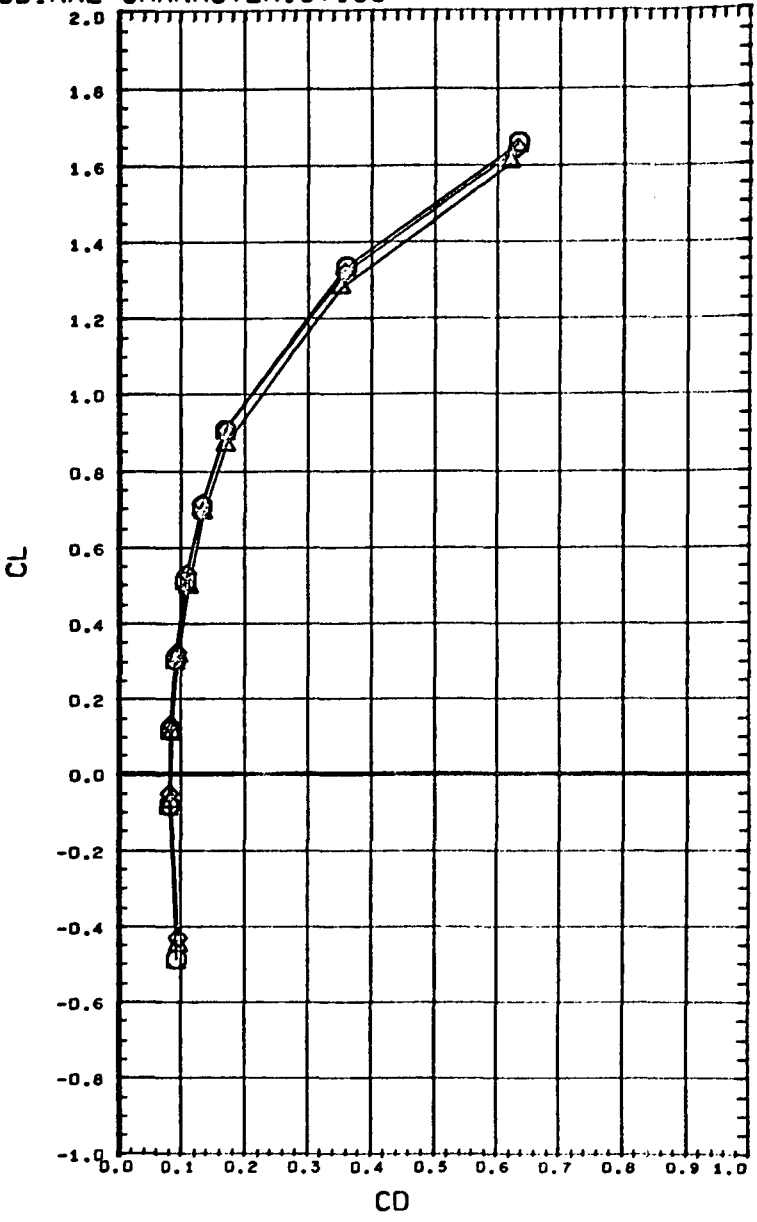
BETA	ELEVTR	CANARD	BSFLOW
0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

EFFECT OF BOOSTER BASE SHAPE ON LONGITUDINAL CHARACTERISTICS







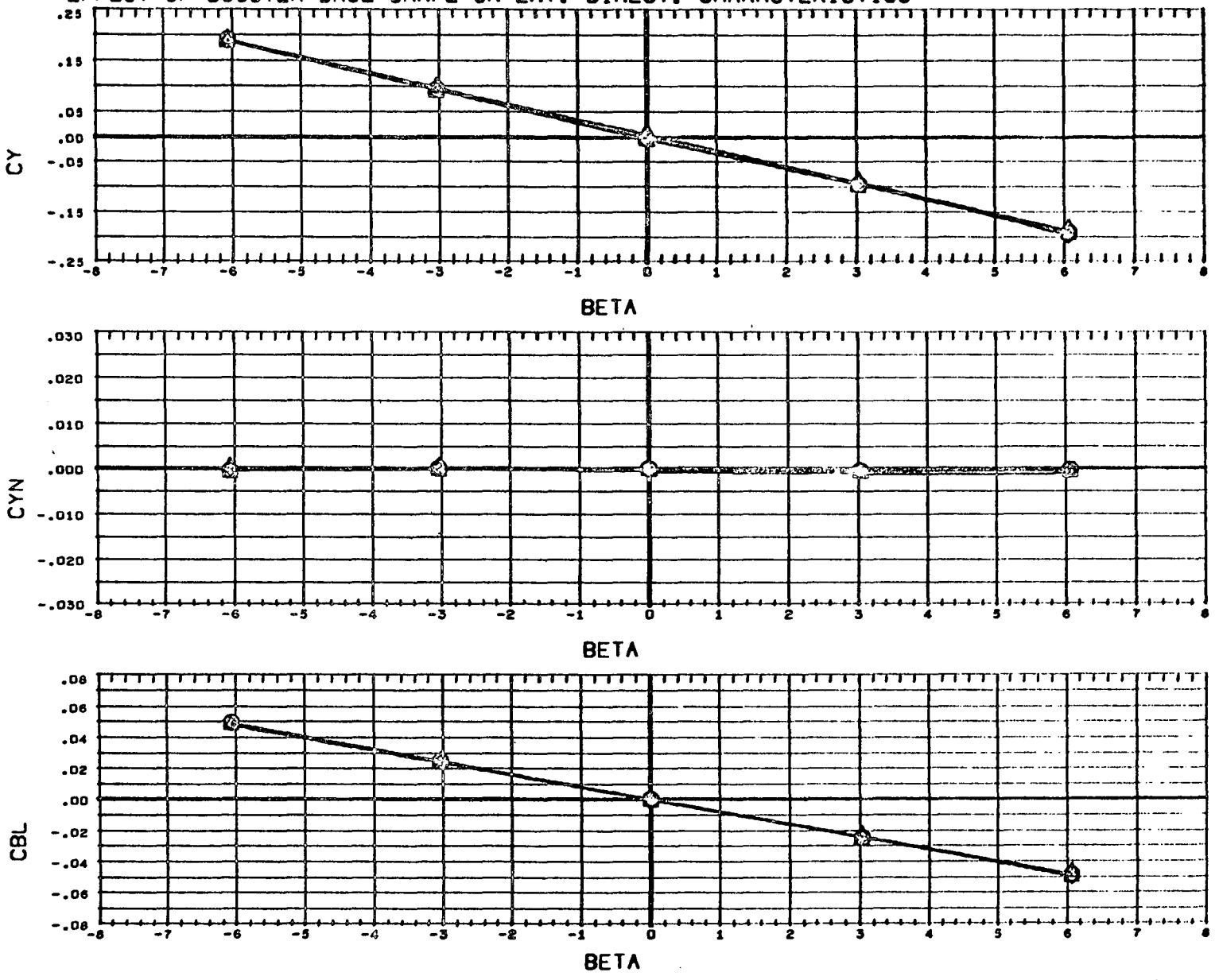
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	
(CU5051)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	
(RU9005)	△	CAL MSFC/LMSC BOOSTER B5C2F2W3V1	BASE FLAP
(RU9009)	◇	CAL MSFC/LMSC BOOSTER B6C2F2W3V1	BASE VENT

MACH 0.400

BETA	ELEVTR	CANARD	BSFLOW
0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

EFFECT OF BOOSTER BASE SHAPE ON LAT.-DIRECT. CHARACTERISTICS

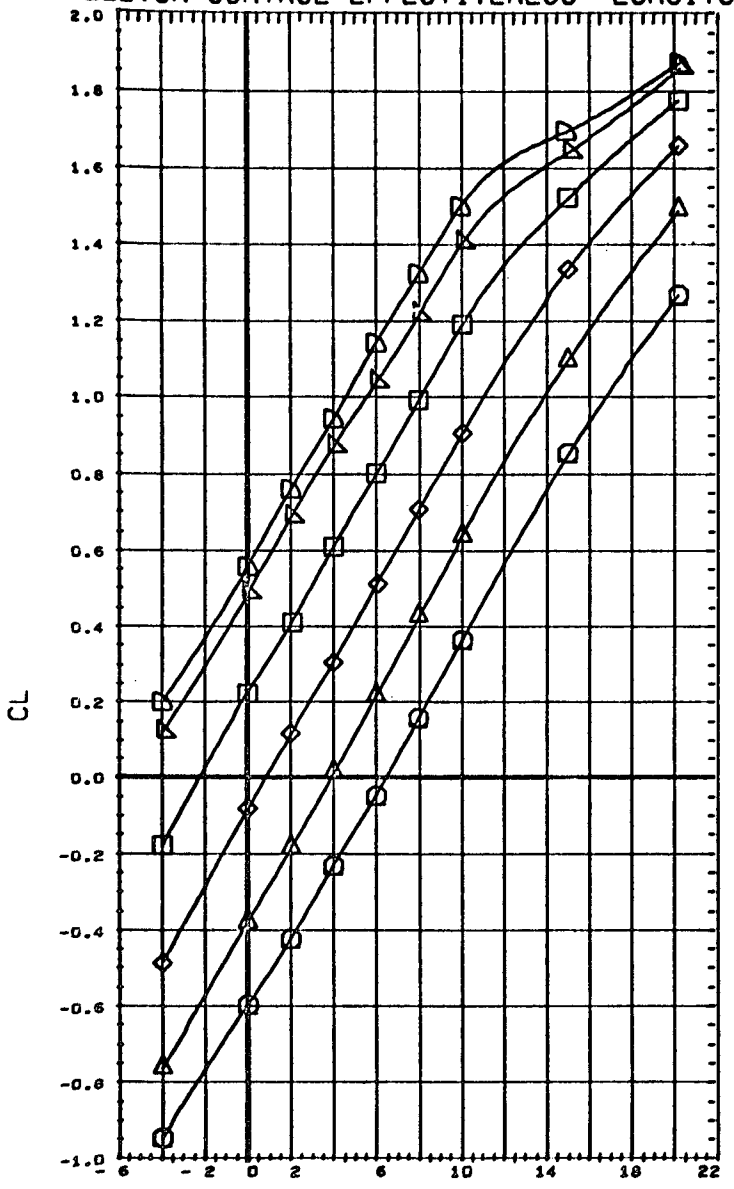


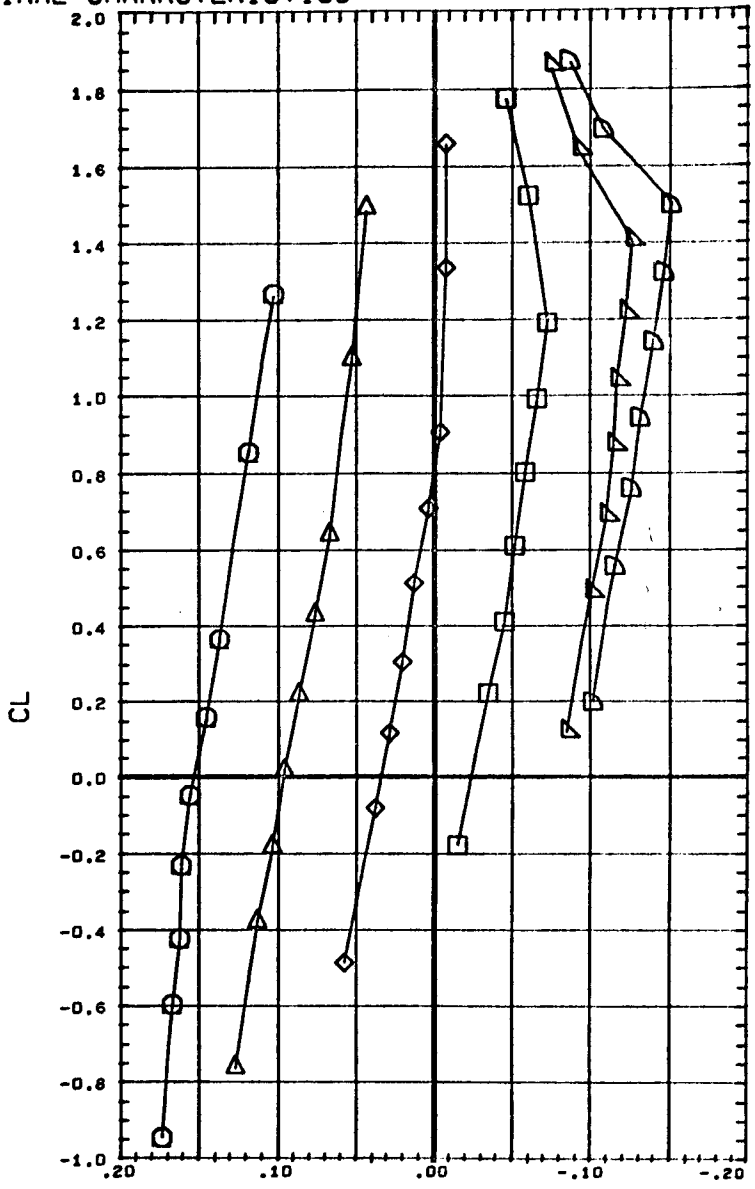
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION		ALPHA	ELEVTR	CANARD	BSFLOW
(CU9002)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1		0.000	0.000	0.000	0.000
(RU9006)	△	CAL MSFC/LMSC BOOSTER B5C2F2W3V1	BASE FLAP	0.000	0.000	0.000	0.000
(RU9010)	◇	CAL MSFC/LMSC BOOSTER B6C2F2W3V1	BASE VENT	0.000	0.000	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

MACH 0.399

ELEVON CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS





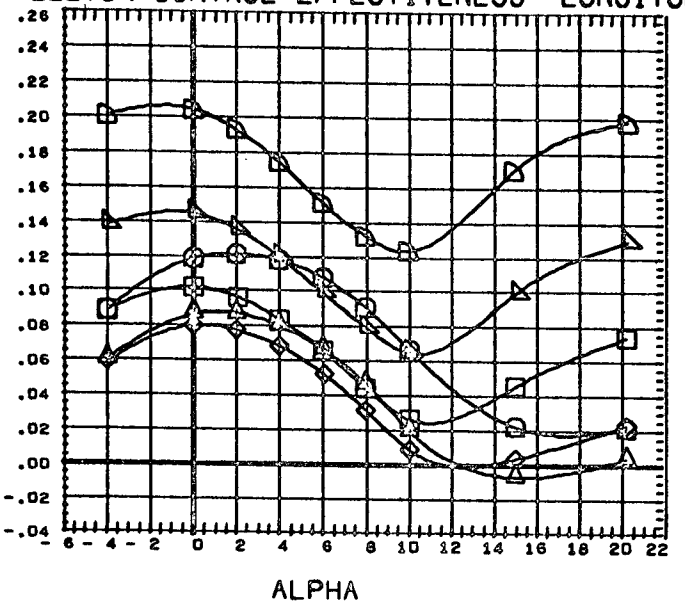
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9033)		CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(TU9017)		CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(CU9001)		CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9013)		CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9021)		CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9025)		CAL MSFC/LMSC BOOSTER B4C2F2W3V1

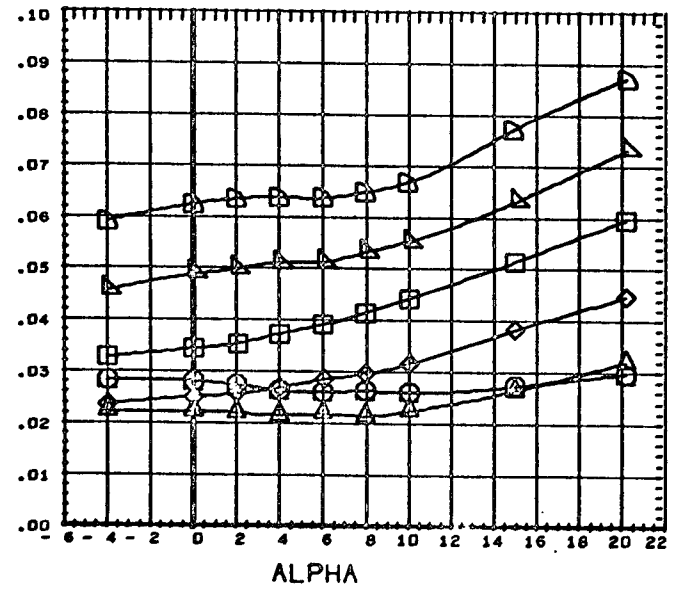
MACH 0.398

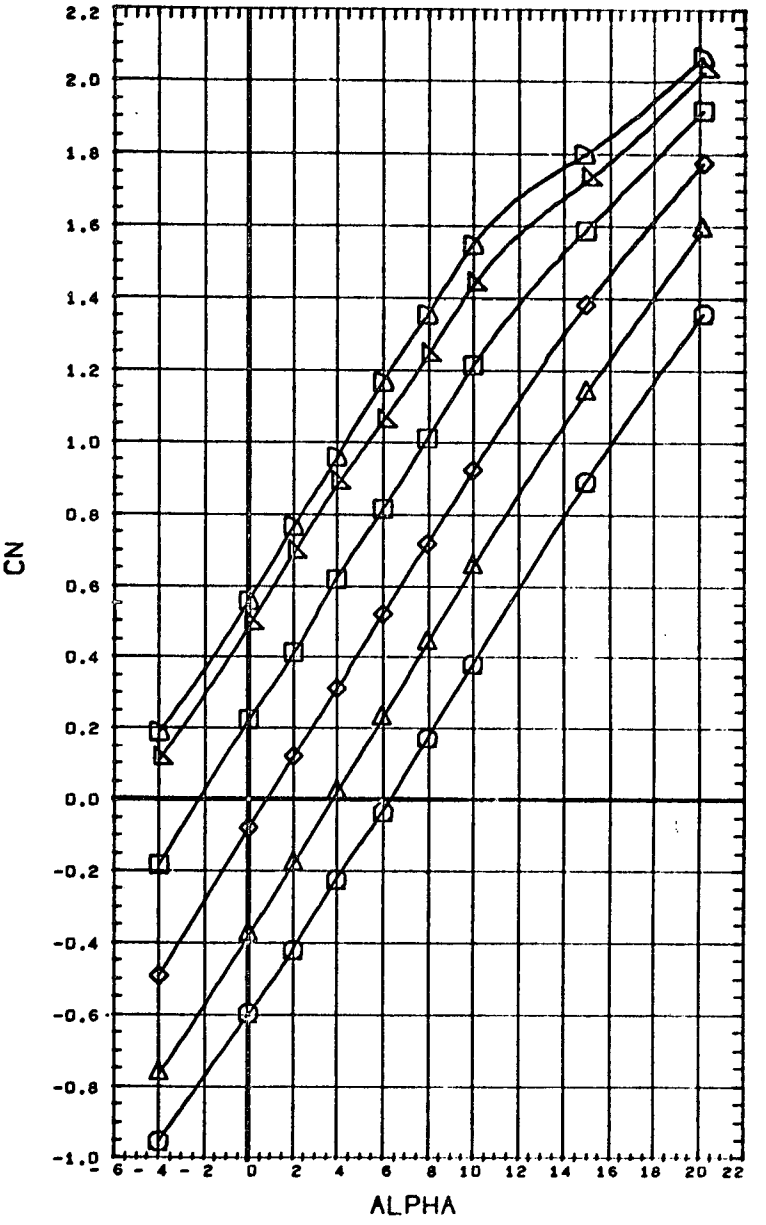
BETA	ELEVTR	CANARD	BSFLOW
0.000	-20.000	0.000	0.000
0.000	-10.000	0.000	0.000
0.000	0.000	0.000	0.000
0.000	10.000	0.000	0.000
0.000	20.000	0.000	0.000
0.000	30.000	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

ELEVON CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS







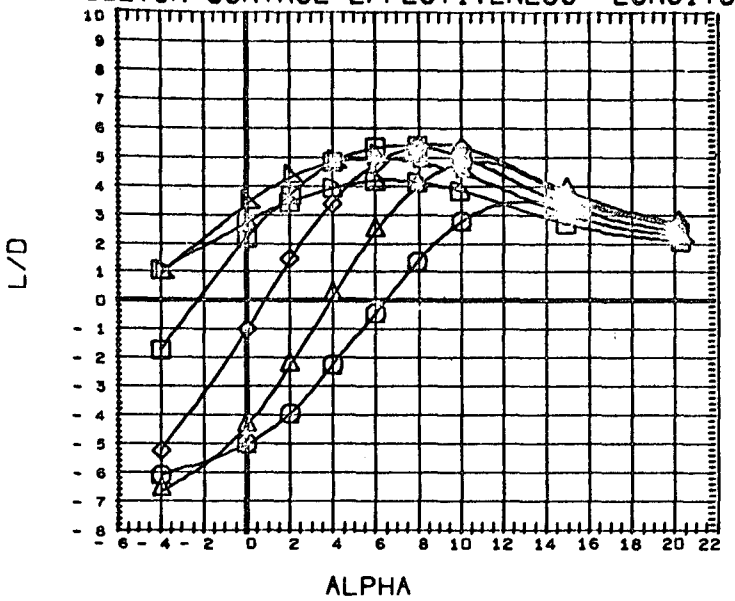
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9053)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(TU9017)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(CU9501)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9013)	□	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9021)	▷	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9025)	D	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

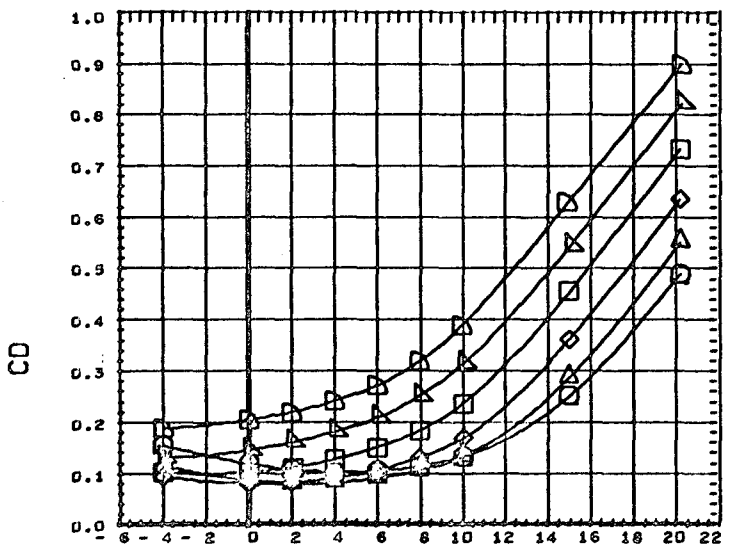
MACH 0.398

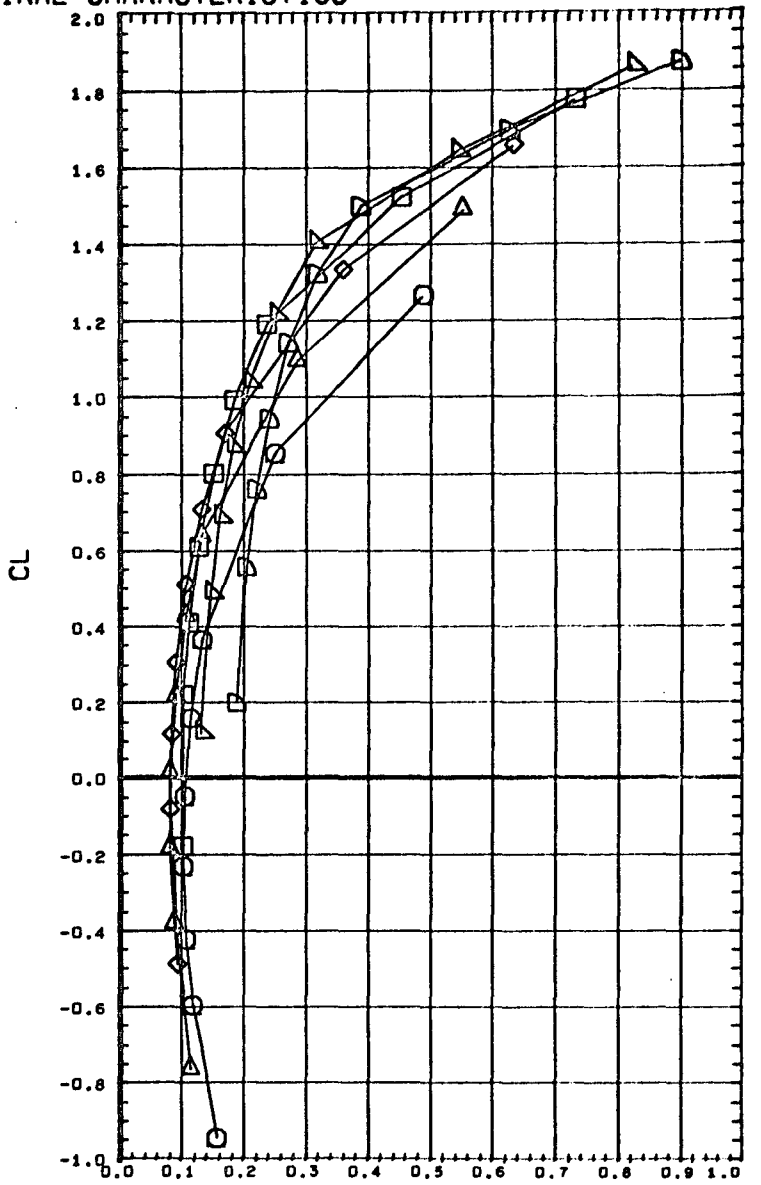
BETA	ELEVTR	CANARD	BSFLOW
0.000	-20.000	0.000	0.000
0.000	-10.000	0.000	0.000
0.000	0.000	0.000	0.000
0.000	10.000	0.000	0.000
0.000	20.000	0.000	0.000
0.000	30.000	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

ELEVON CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS







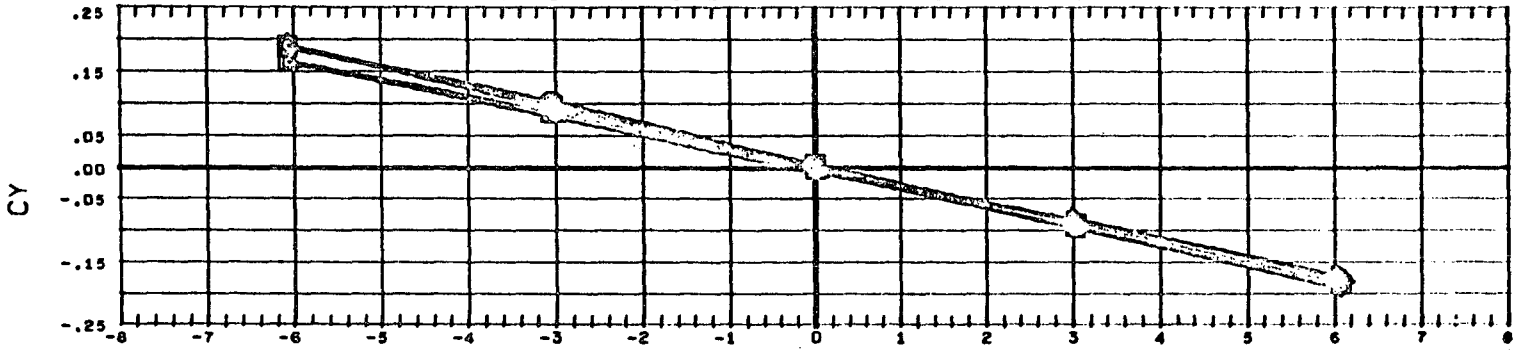
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9053)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(TU9017)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(CU9001)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9013)	□	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9021)	▷	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9025)	▷	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

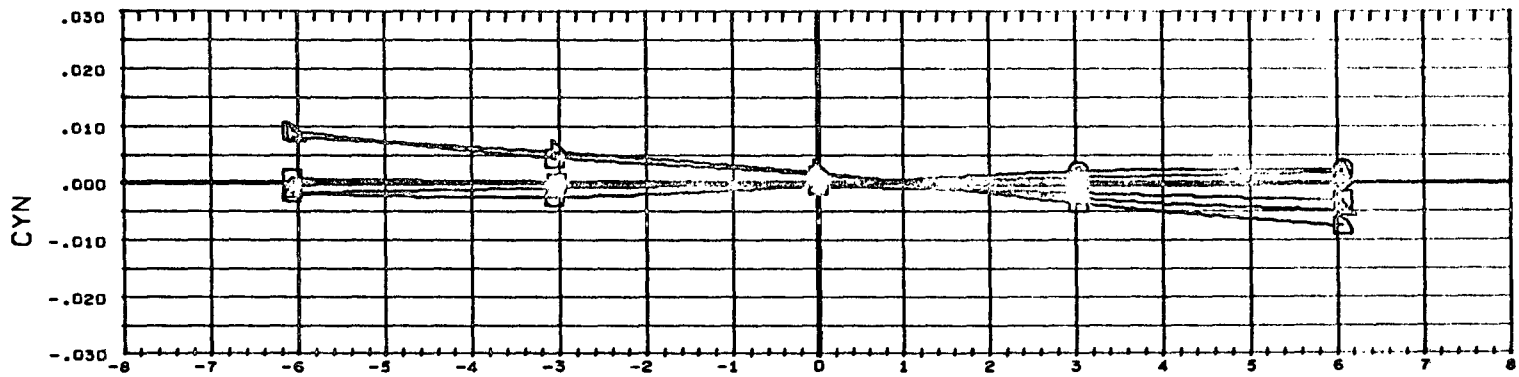
MACH 0.398

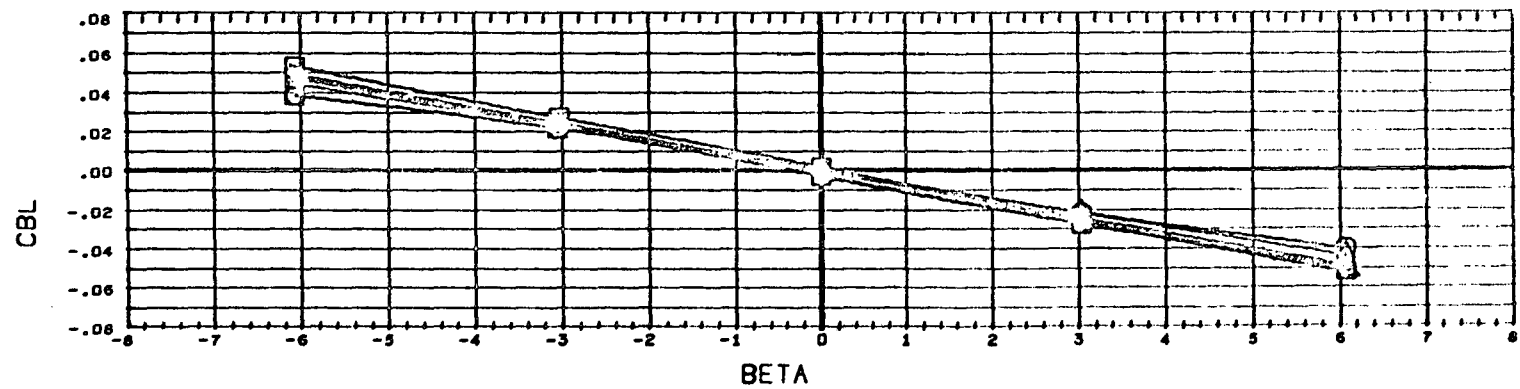
BETA	ELEVTR	CANARD	BSFLOW
0.000	-20.000	0.000	0.000
0.000	-10.000	0.000	0.000
0.000	0.000	0.000	0.000
0.000	10.000	0.000	0.000
0.000	20.000	0.000	0.000
0.000	30.000	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

ELEVON CONTROL EFFECTIVENESS- LAT.-DIRECT. CHARACTERISTICS





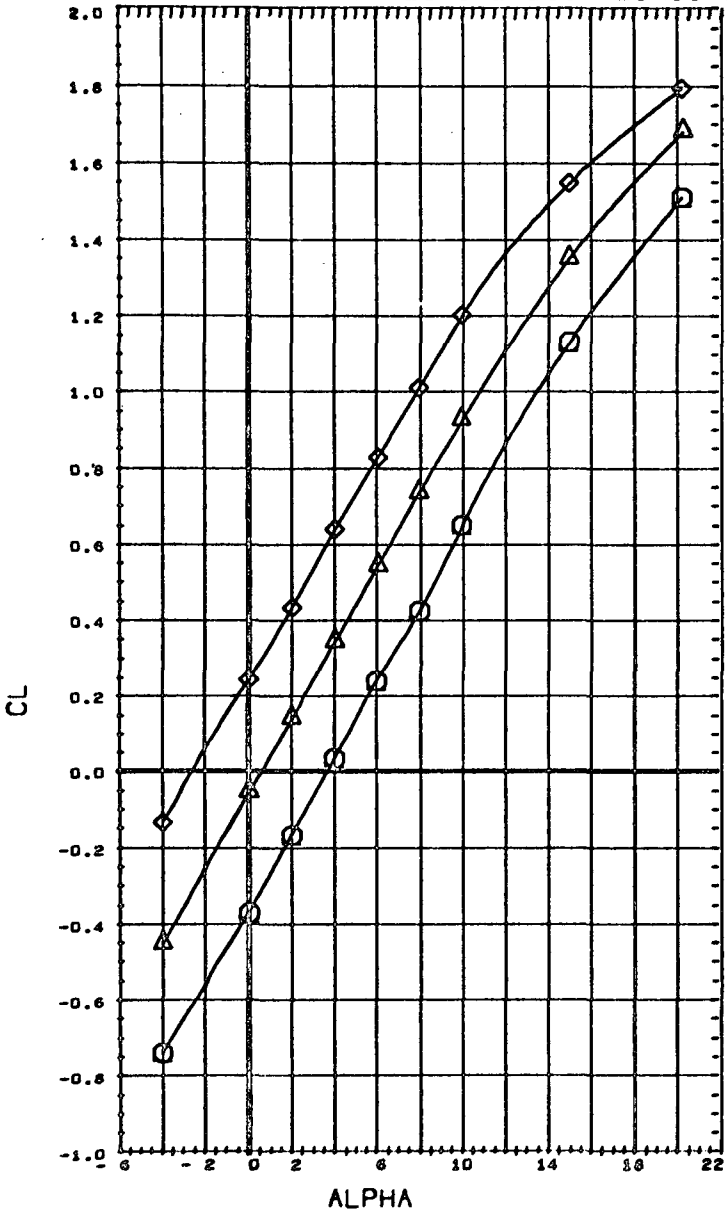


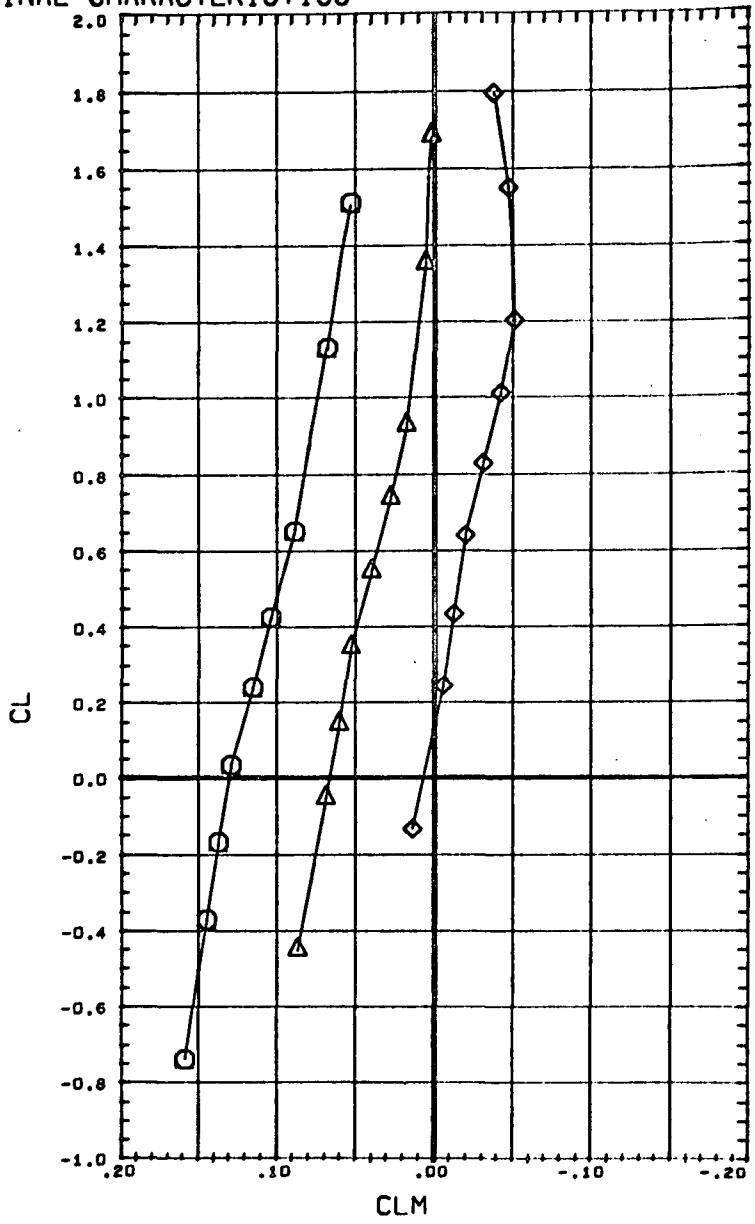
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ALPHA	ELEVTR	CANARD	BSFLOW
(RU9054)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	-20.000	0.000	0.000
(TU9018)	□	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	-10.000	0.000	0.000
(CU9002)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	0.000	0.000
(RU9014)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	10.000	0.000	0.000
(RU9022)	▽	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	20.000	0.000	0.000
(RU9026)	⊲	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	30.000	0.000	0.000

MACH 0.399

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

ELEVON CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS





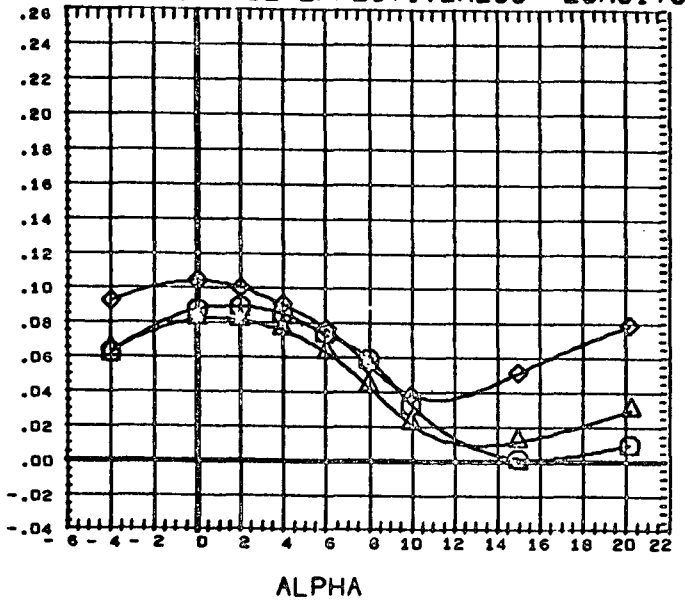
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9049)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9029)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9045)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

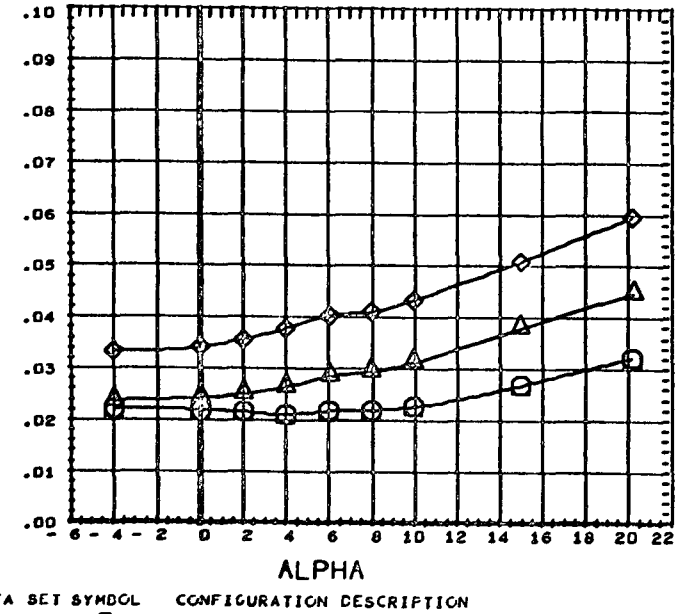
BETA	ELEVTR	CANARD	BSFLOW
0.000	-10.000	10.000	0.000
0.000	0.000	10.000	0.000
0.000	10.000	10.000	0.000

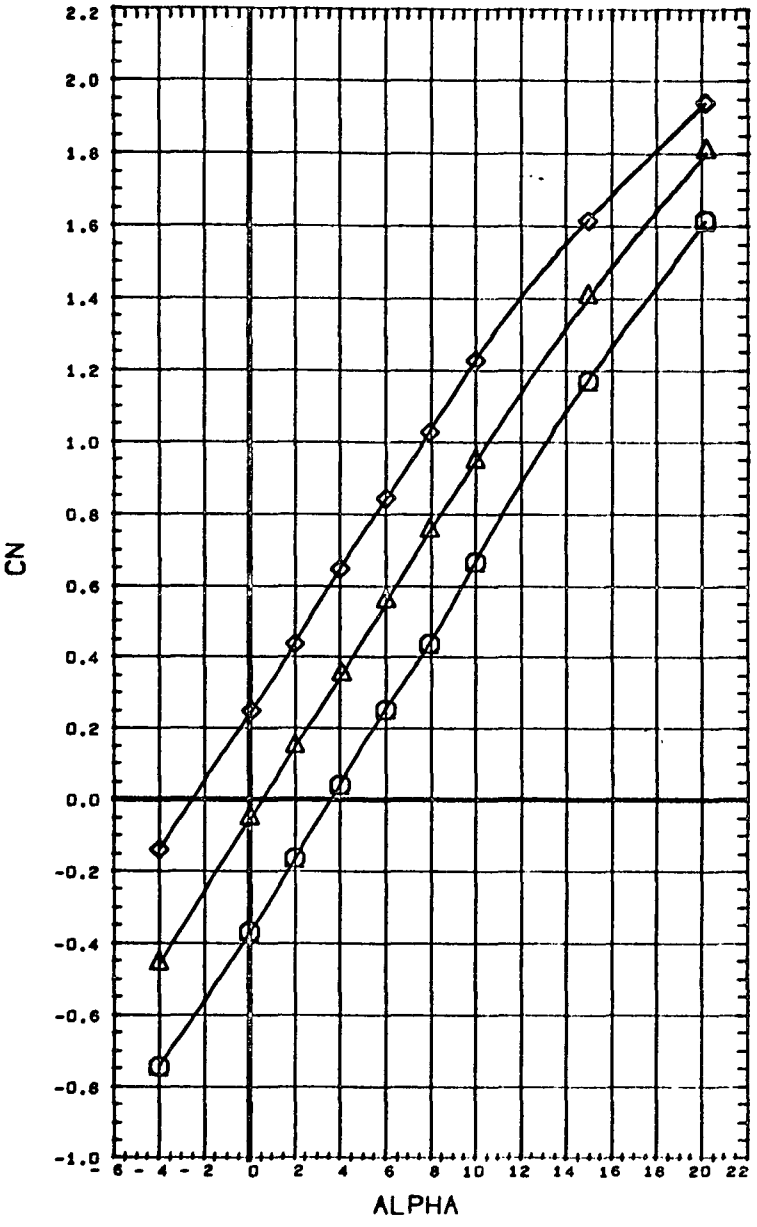
REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

MACH 0.399

ELEVON CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS







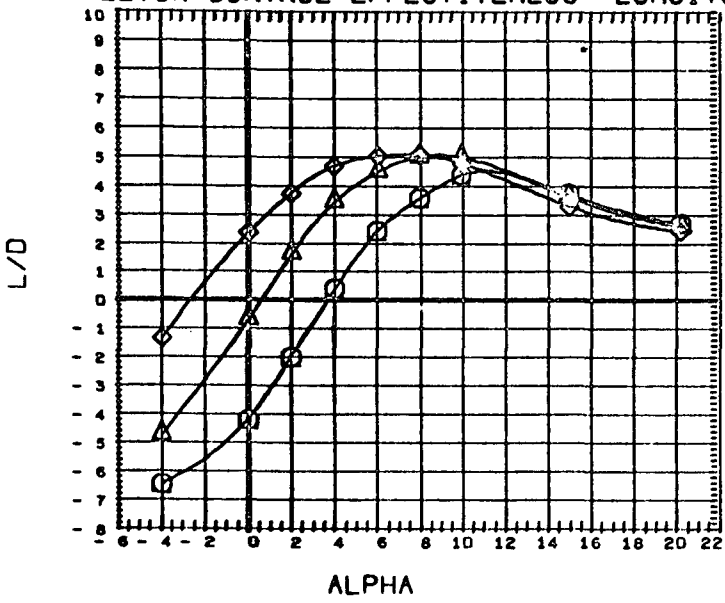
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9049)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9029)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9045)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

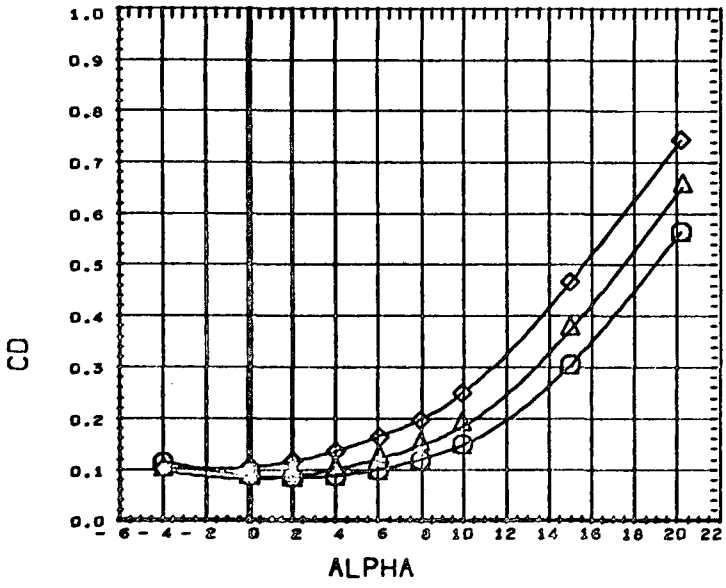
MACH 0.399

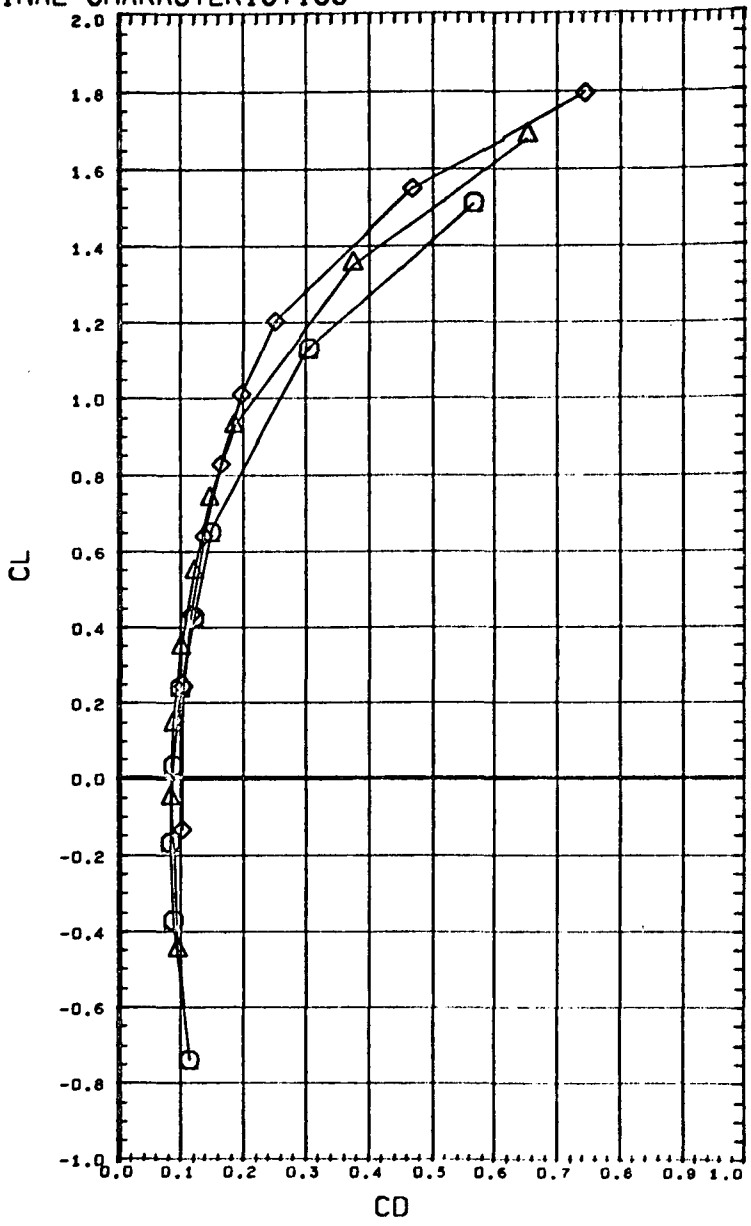
BETA	ELEVTR	CANARD	BSFLOW
0.000	-10.000	10.000	0.000
0.000	0.000	10.000	0.000
0.000	10.000	10.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

ELEVON CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS







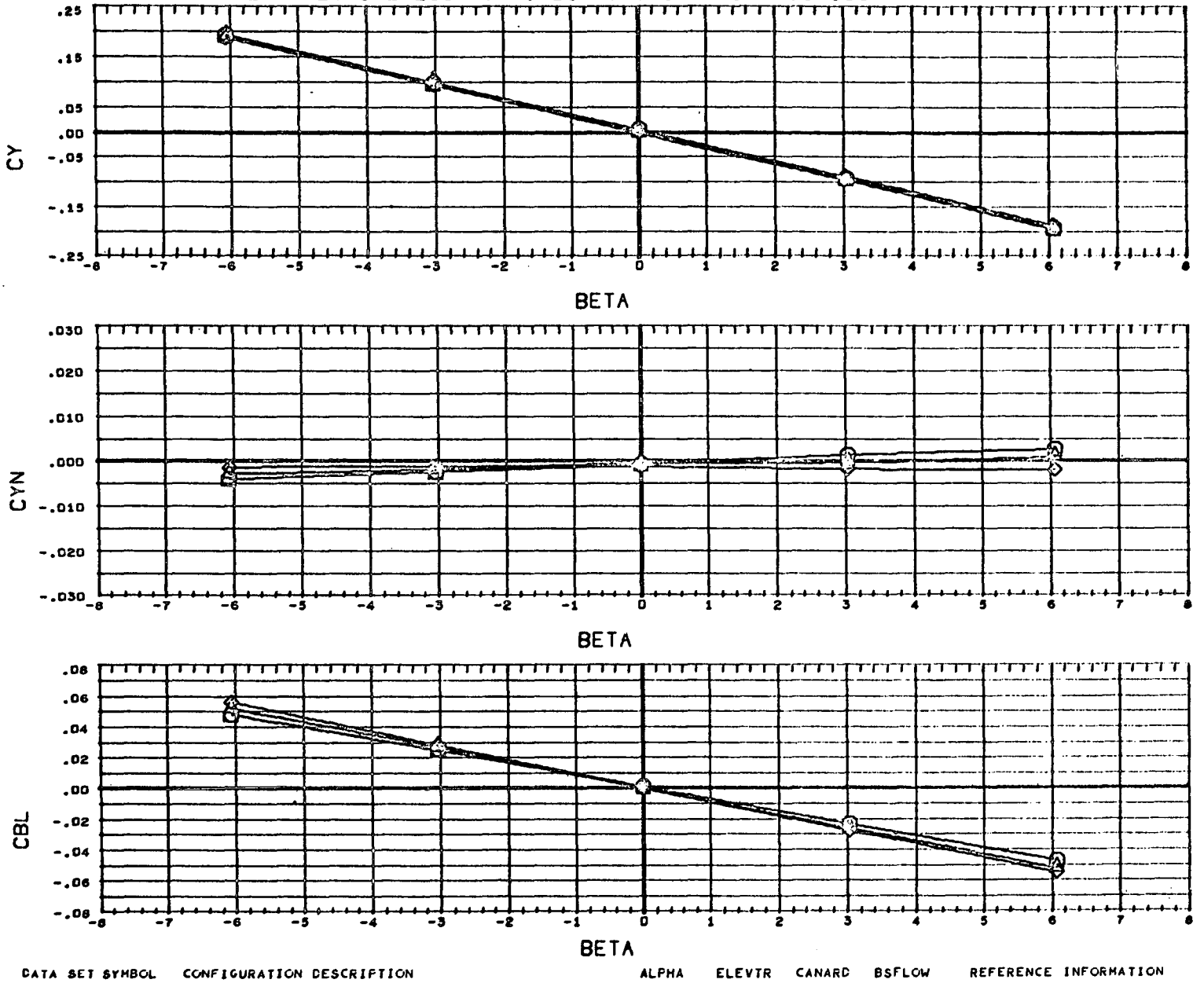
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9049)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9029)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9045)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

MACH 0.399

BETA	ELEVTR	CANARD	BSFLOW
0.000	-10.000	10.000	0.000
0.000	0.000	10.000	0.000
0.000	10.000	10.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

ELEVON CONTROL EFFECTIVENESS- LAT.-DIRECT. CHARACTERISTICS

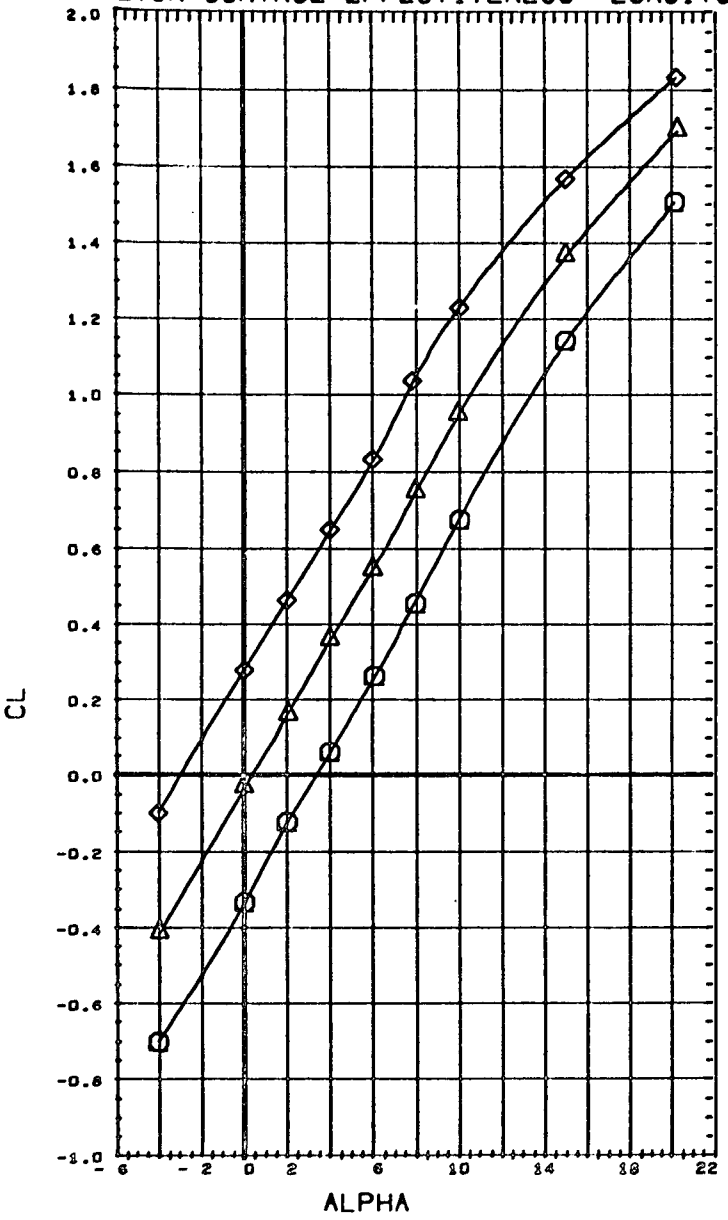


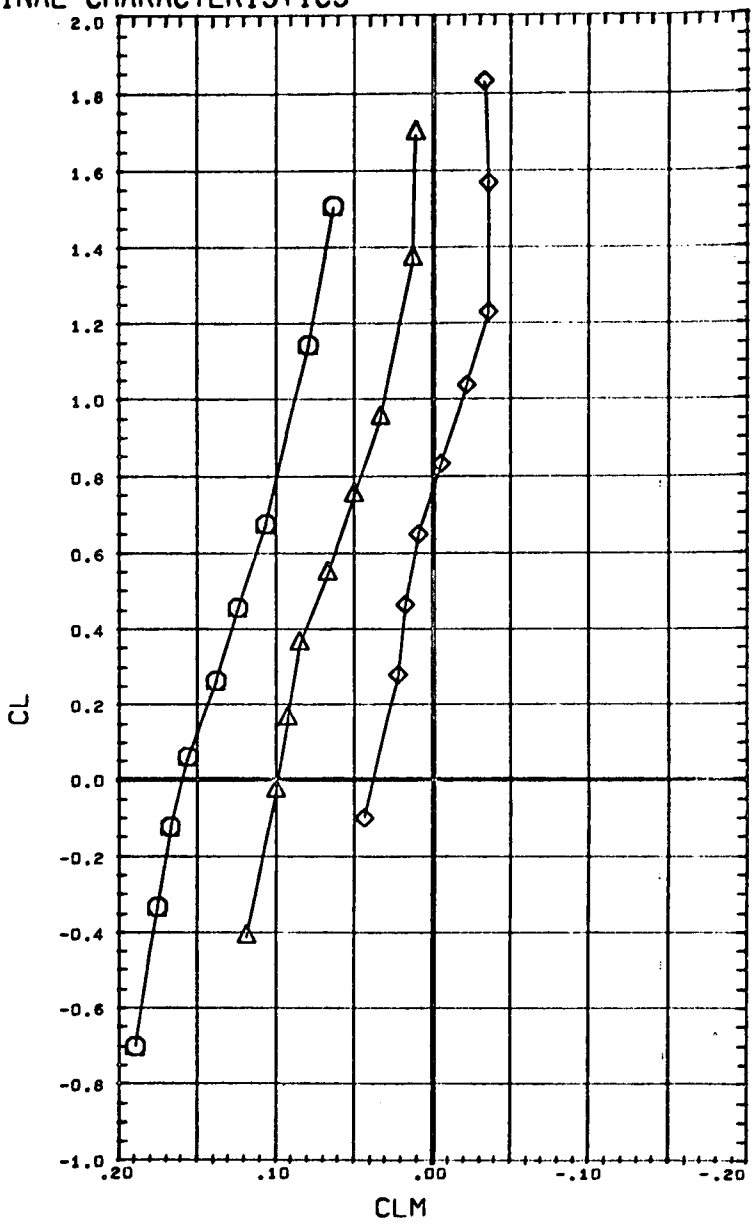
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ALPHA	ELEVTR	CANARD	BSFLOW
(RU9059)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	-10.000	10.000	0.000
(RU9039)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	10.000	0.000
(RU9046)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	10.000	10.000	0.000

MACH 0.398

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

ELEVON CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS





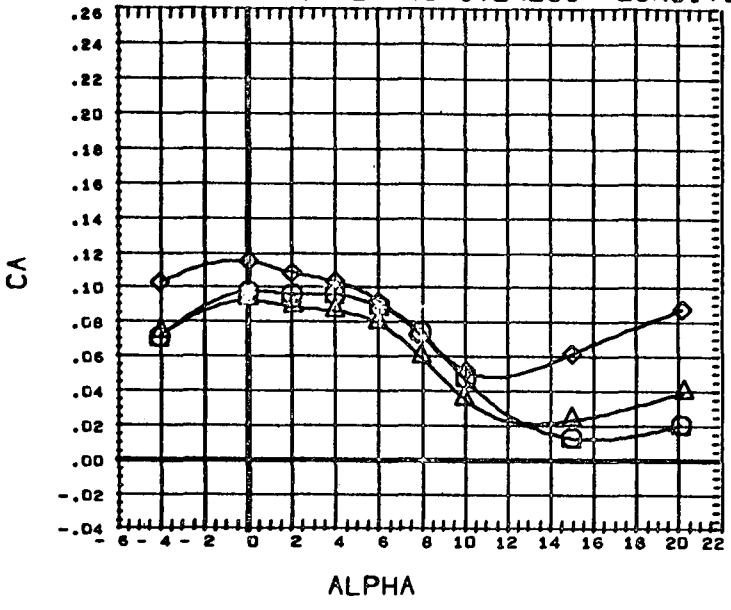
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9041)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9033)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9037)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

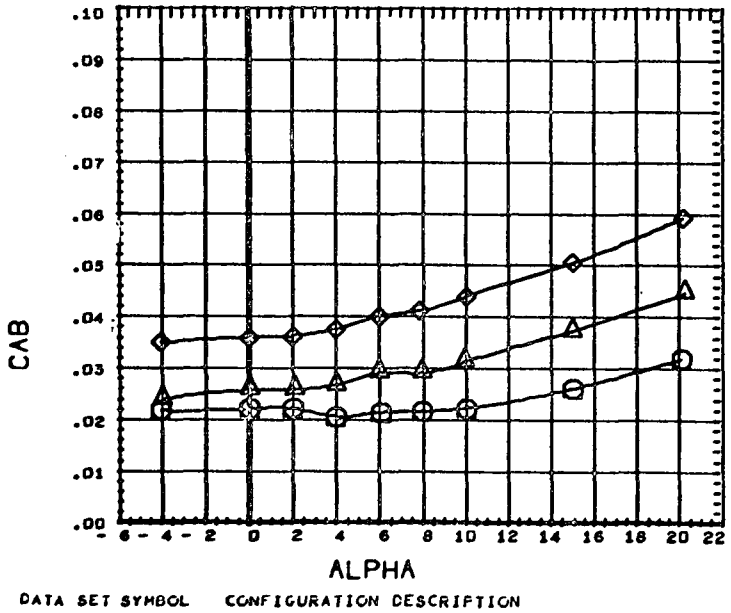
MACH 0.398

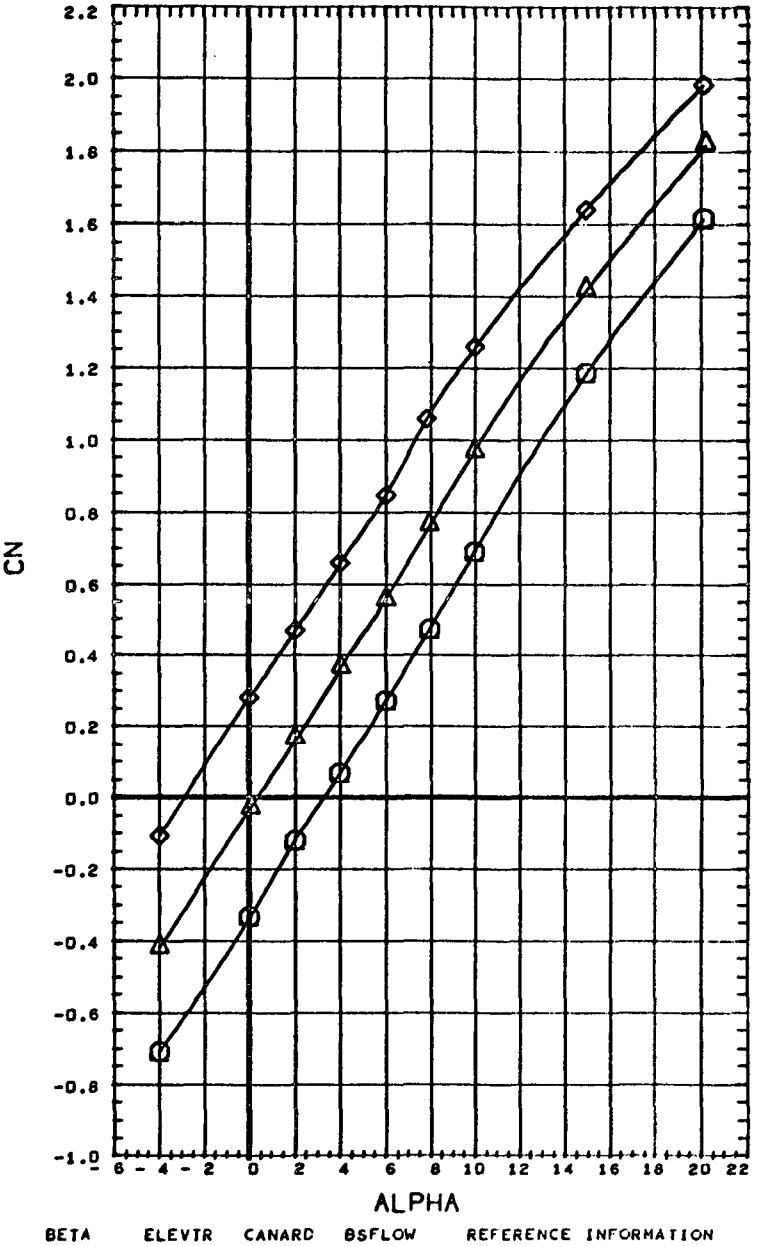
BETA	ELEVTR	CANARD	BSFLOW
0.000	-10.000	20.000	0.000
0.000	0.000	20.000	0.000
0.000	10.000	20.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

ELEVON CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS







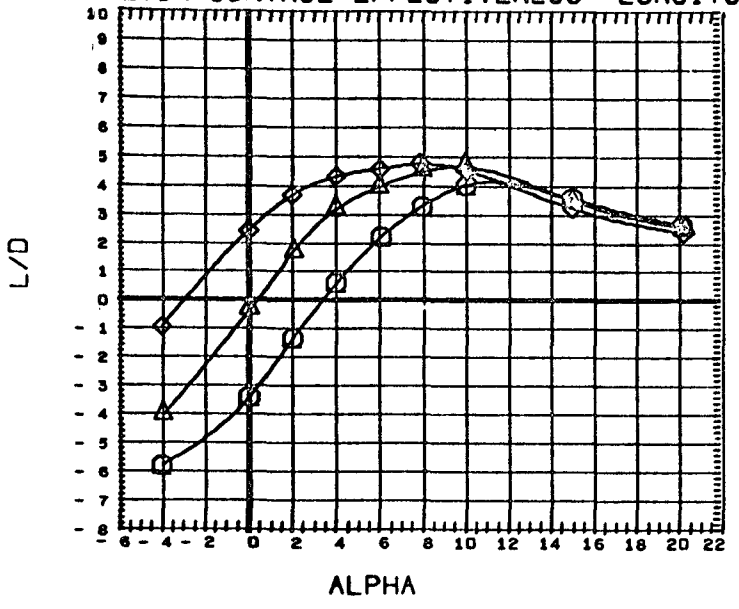
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9041)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9033)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9037)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

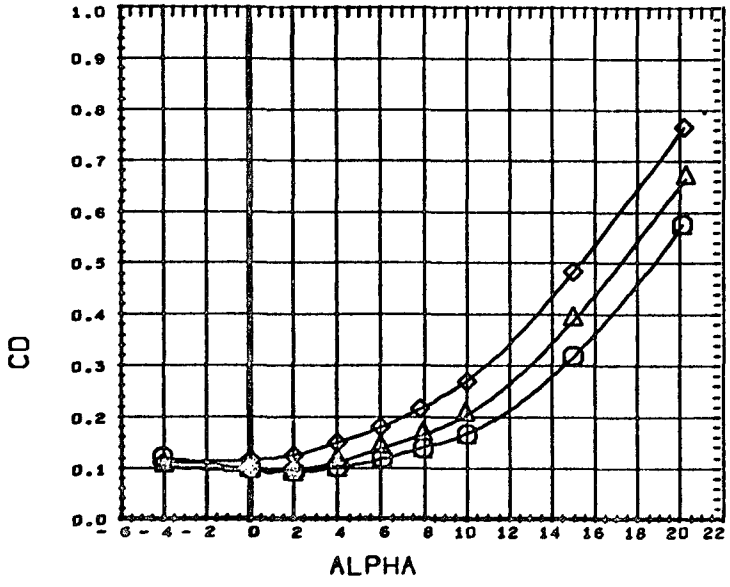
MACH 0.398

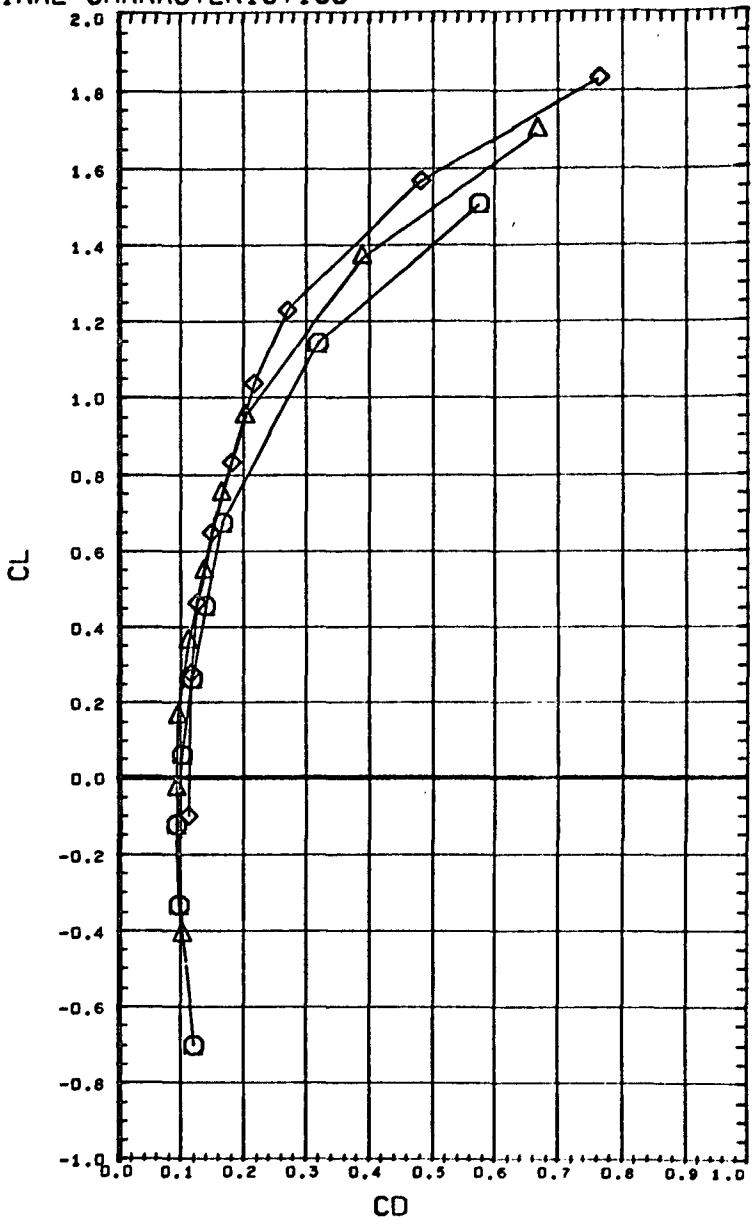
BETA	ELEVTR	CANARD	BSFLOW
0.000	-10.000	20.000	0.000
0.000	0.000	20.000	0.000
0.000	10.000	20.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

ELEVON CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS







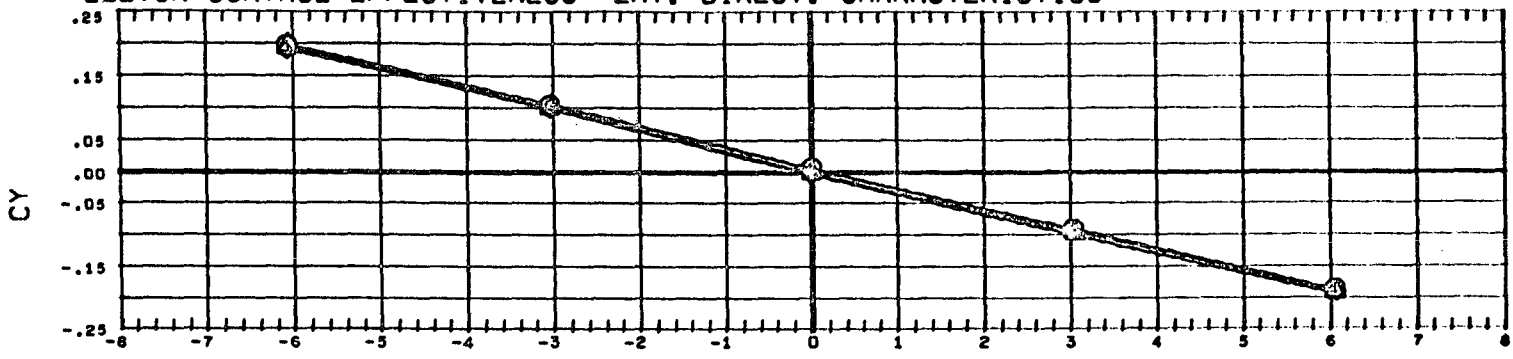
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(RU9041)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9033)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9037)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

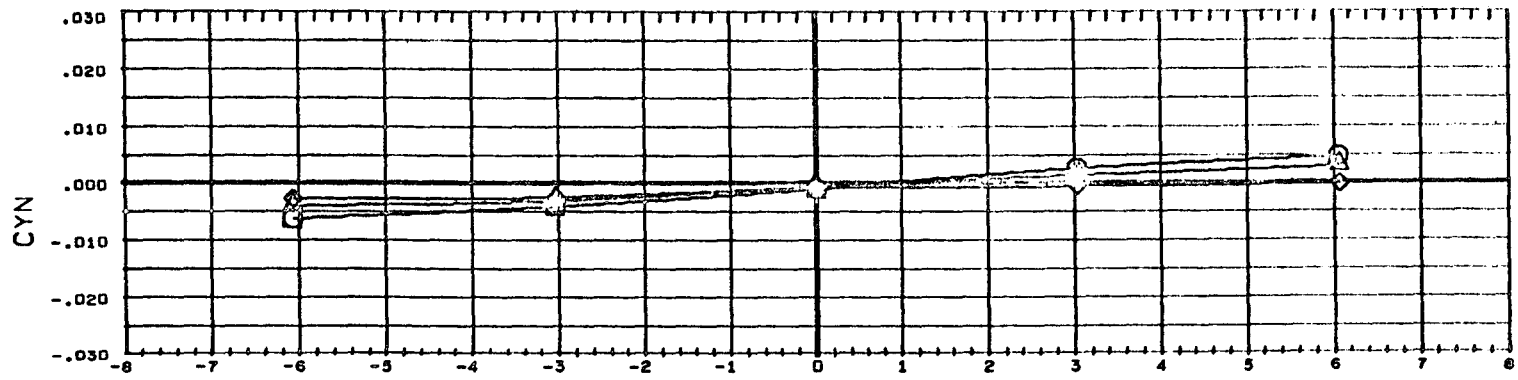
MACH 0.398

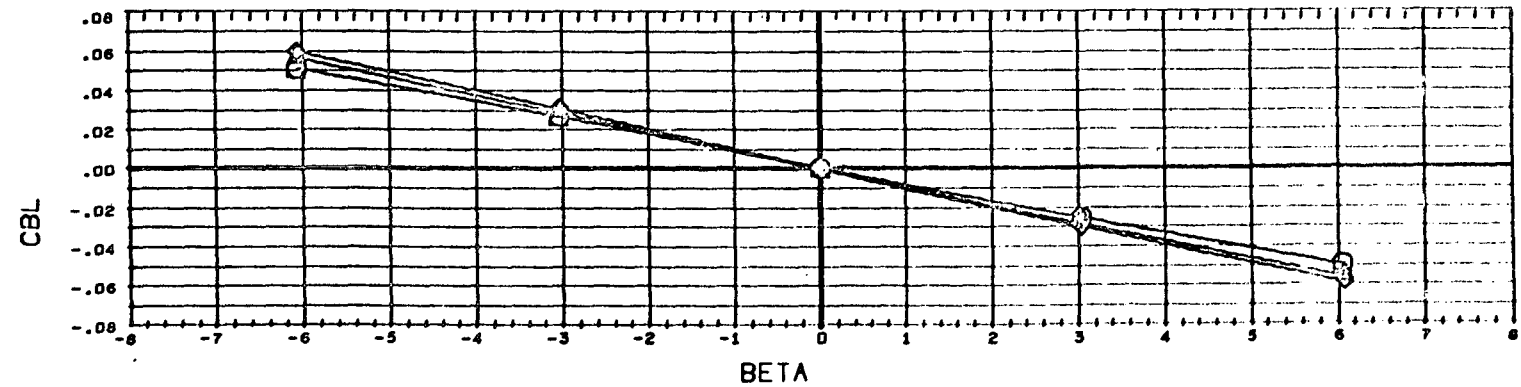
BETA	ELEVTR	CANARD	BSFLOW
0.000	-10.000	20.000	0.000
0.000	0.000	20.000	0.000
0.000	10.000	20.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

ELEVON CONTROL EFFECTIVENESS- LAT.-DIRECT. CHARACTERISTICS





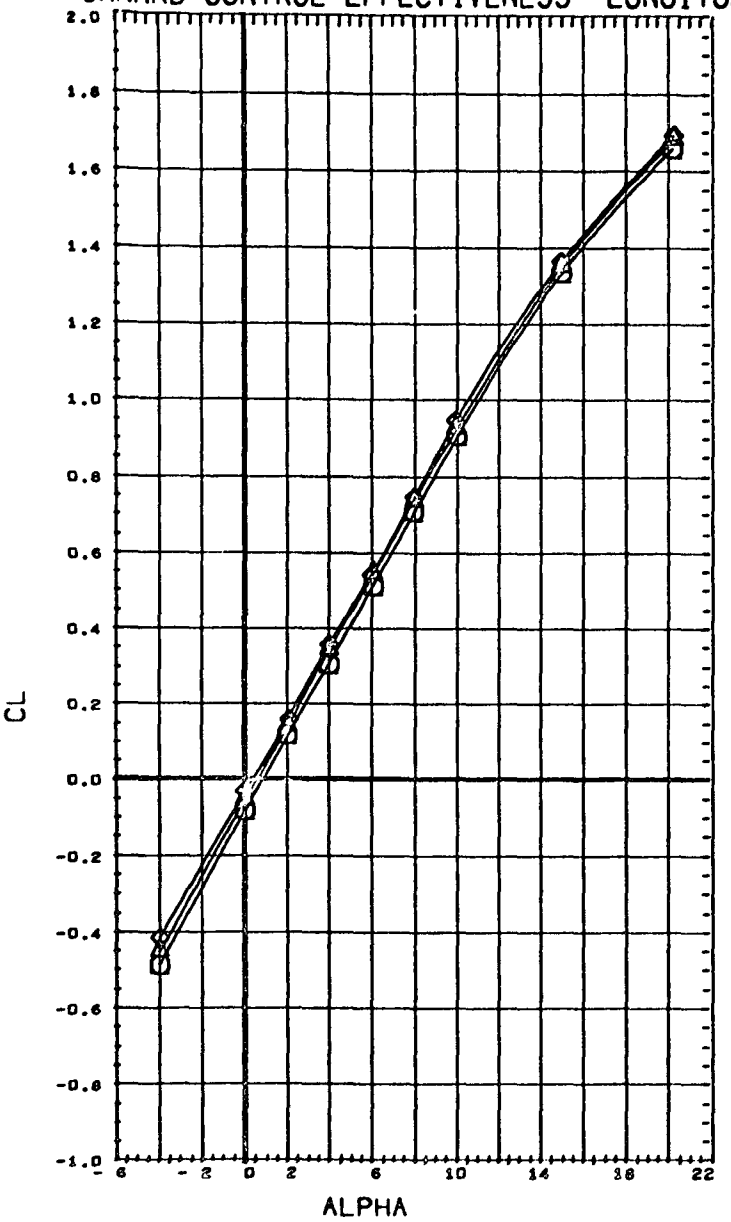


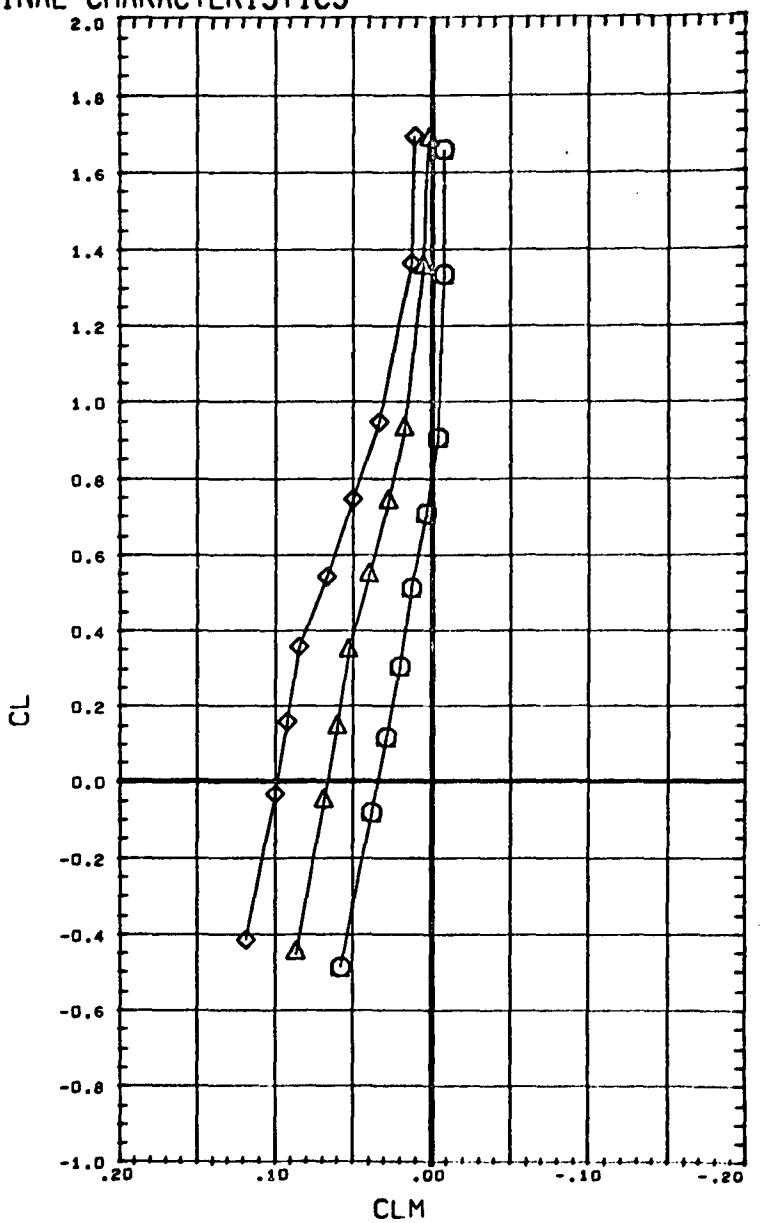
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ALPHA	ELEVTR	CANARD	BSFLOW
(RU9042)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	-10.000	20.000	0.000
(RU9034)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	20.000	0.000
(RU9038)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	10.000	20.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.0000	PER CT

MACH 0.399

CANARD CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS





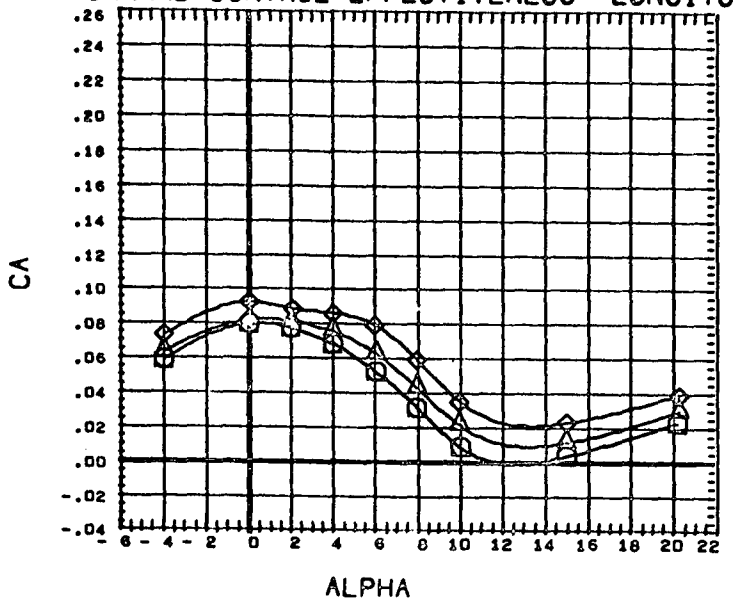
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(CU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9029)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9033)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

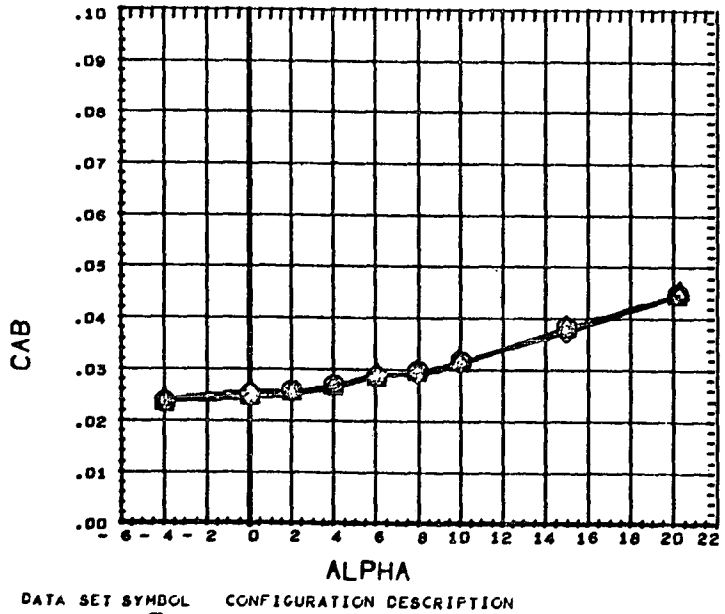
MACH 0.400

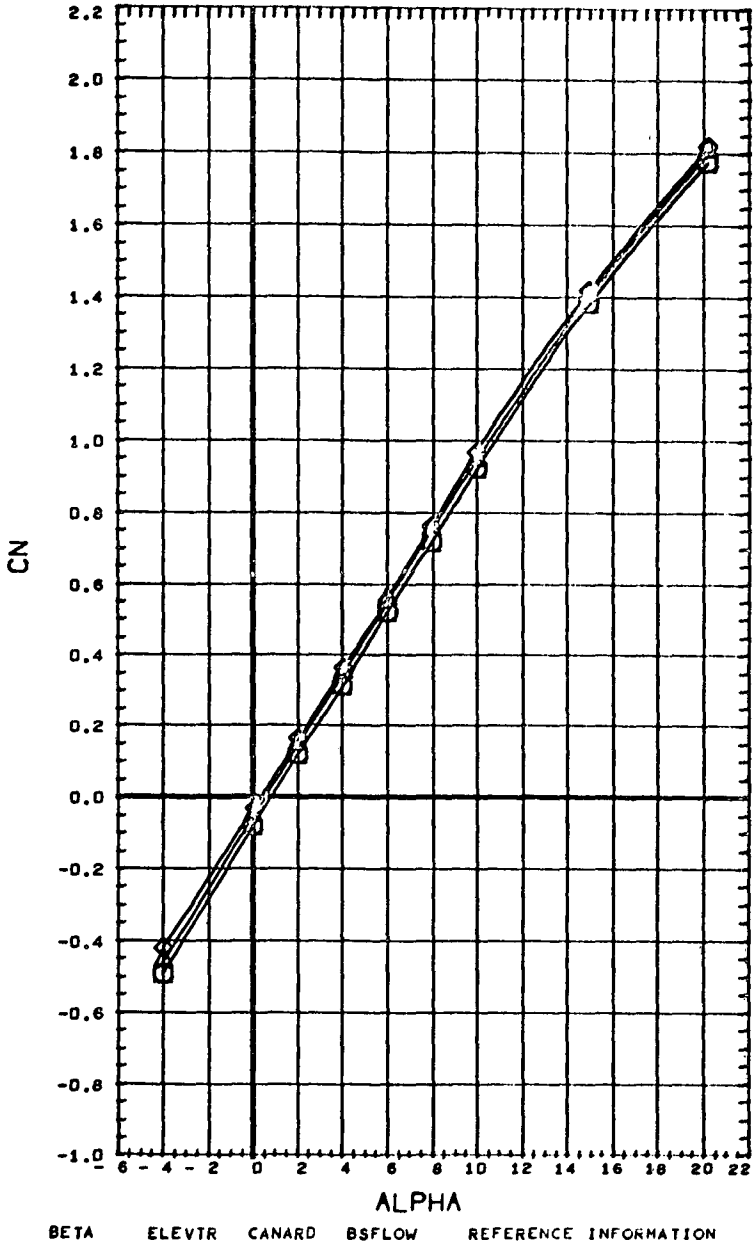
BETA	ELEVTR	CANARD	BSFLOW
0.000	0.000	0.000	0.000
0.000	0.000	10.000	0.000
0.000	0.000	20.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

CANARD CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS







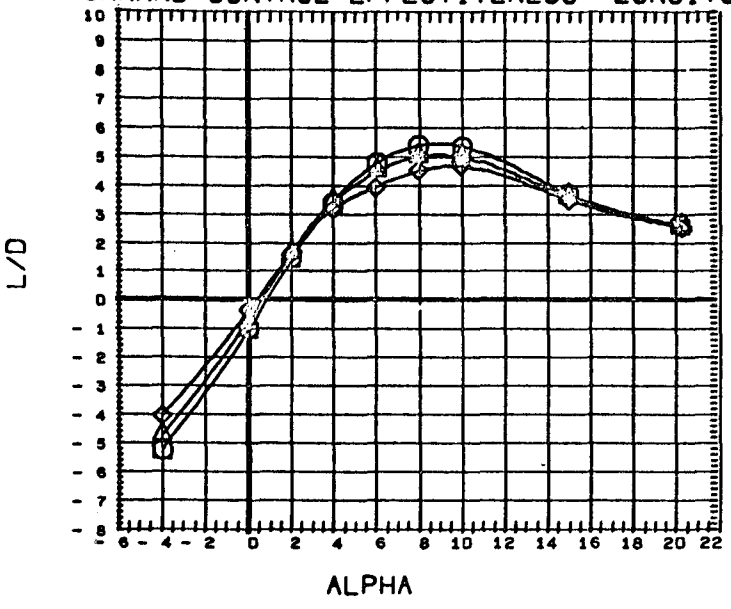
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(CU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9029)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9033)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

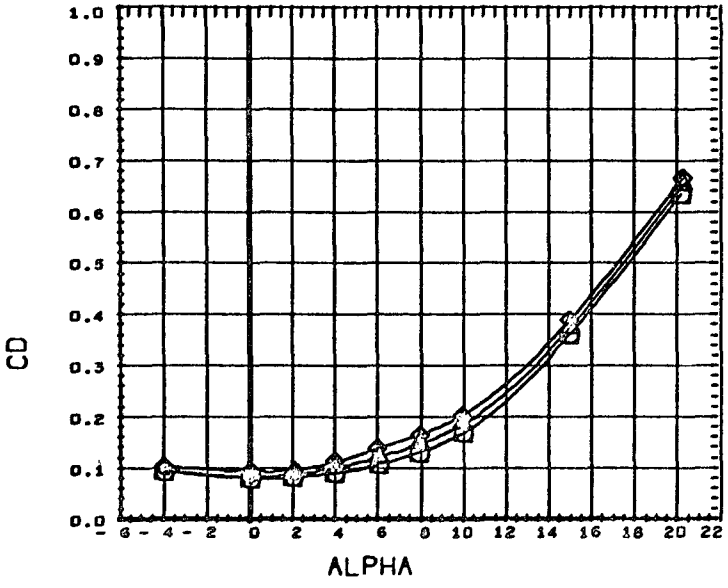
MACH 0.400

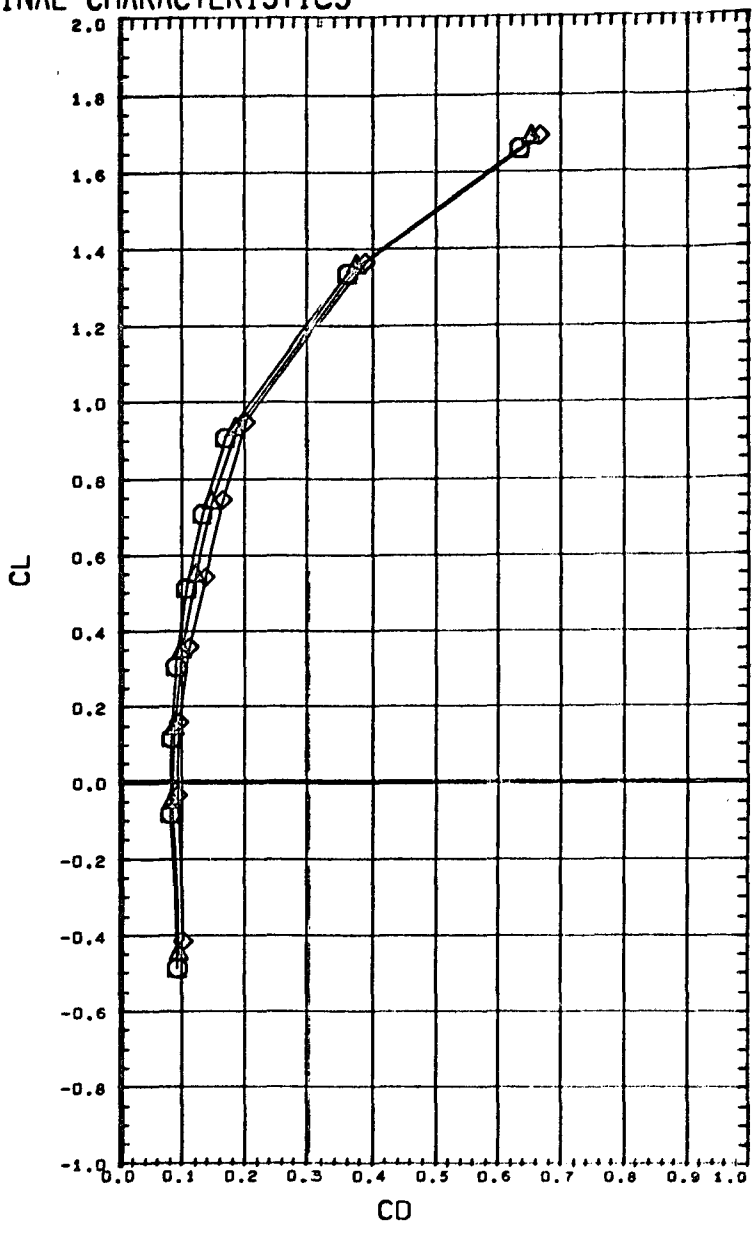
BETA	ELEVTR	CANARD	BSFLOW
0.000	0.000	0.000	0.000
0.000	0.000	10.000	0.000
0.000	0.000	20.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

CANARD CONTROL EFFECTIVENESS- LONGITUDINAL CHARACTERISTICS







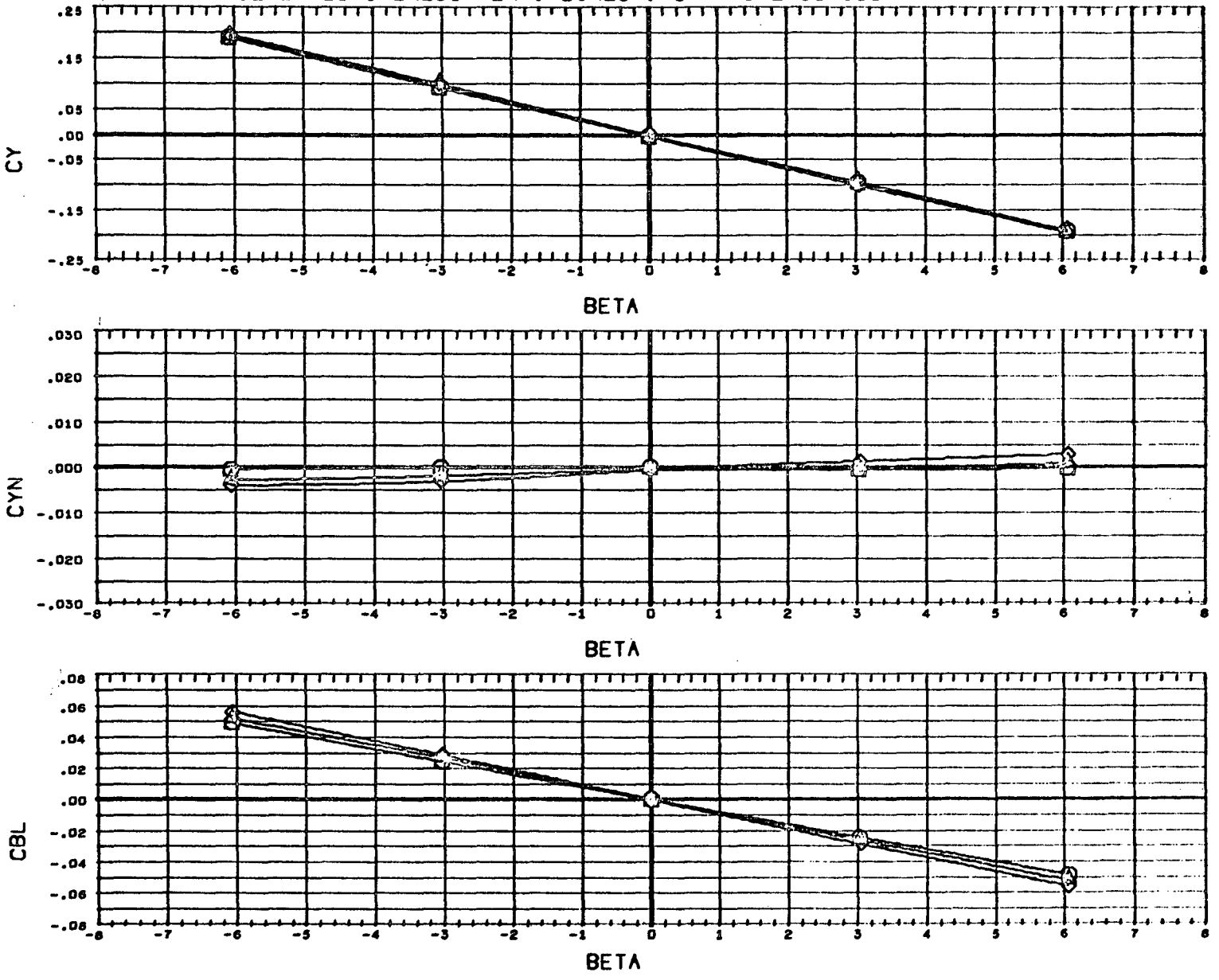
DATA SET	SYMBOL	CONFIGURATION DESCRIPTION
(CU9001)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9029)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1
(RU9033)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1

MACH 0.400

BETA	ELEVTR	CANARD	BSFLOW
0.000	0.000	0.000	0.000
0.000	0.000	10.000	0.000
0.000	0.000	20.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

CANARD CONTROL EFFECTIVENESS- LAT.-DIRECT. CHARACTERISTICS

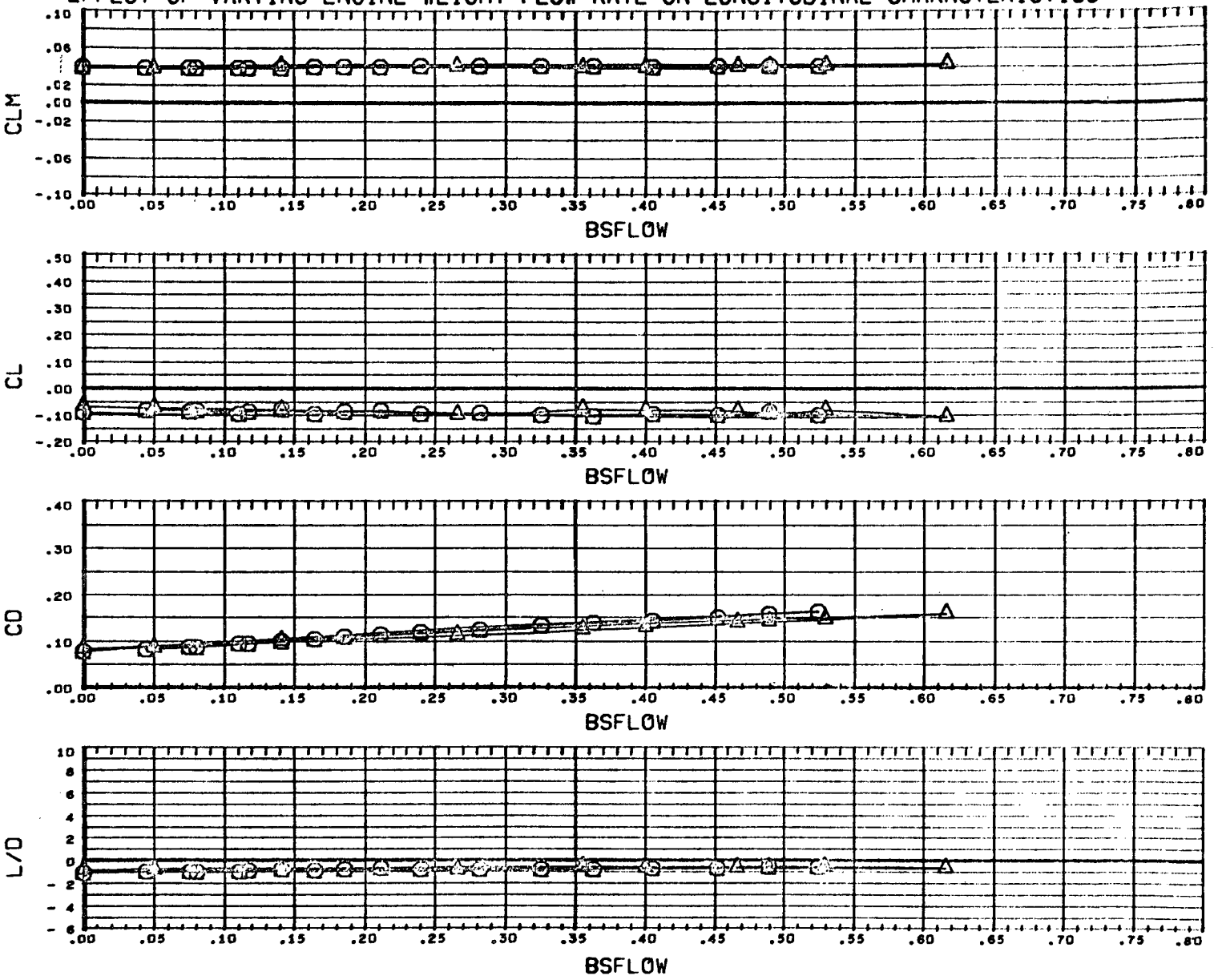


DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ALPHA	ELEVTR	CANARD	BSFLOW
(CU9002)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	0.000	0.000
(RU9030)	△	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	10.000	0.000
(RU9034)	◇	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	20.000	0.000

MACH 0.399

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRF	2.5950	FT.
YMRF	0.0000	FT.
ZMRF	0.0187	FT.
SCALE	1.5000	PER CT

EFFECT OF VARYING ENGINE WEIGHT FLOW RATE ON LONGITUDINAL CHARACTERISTICS

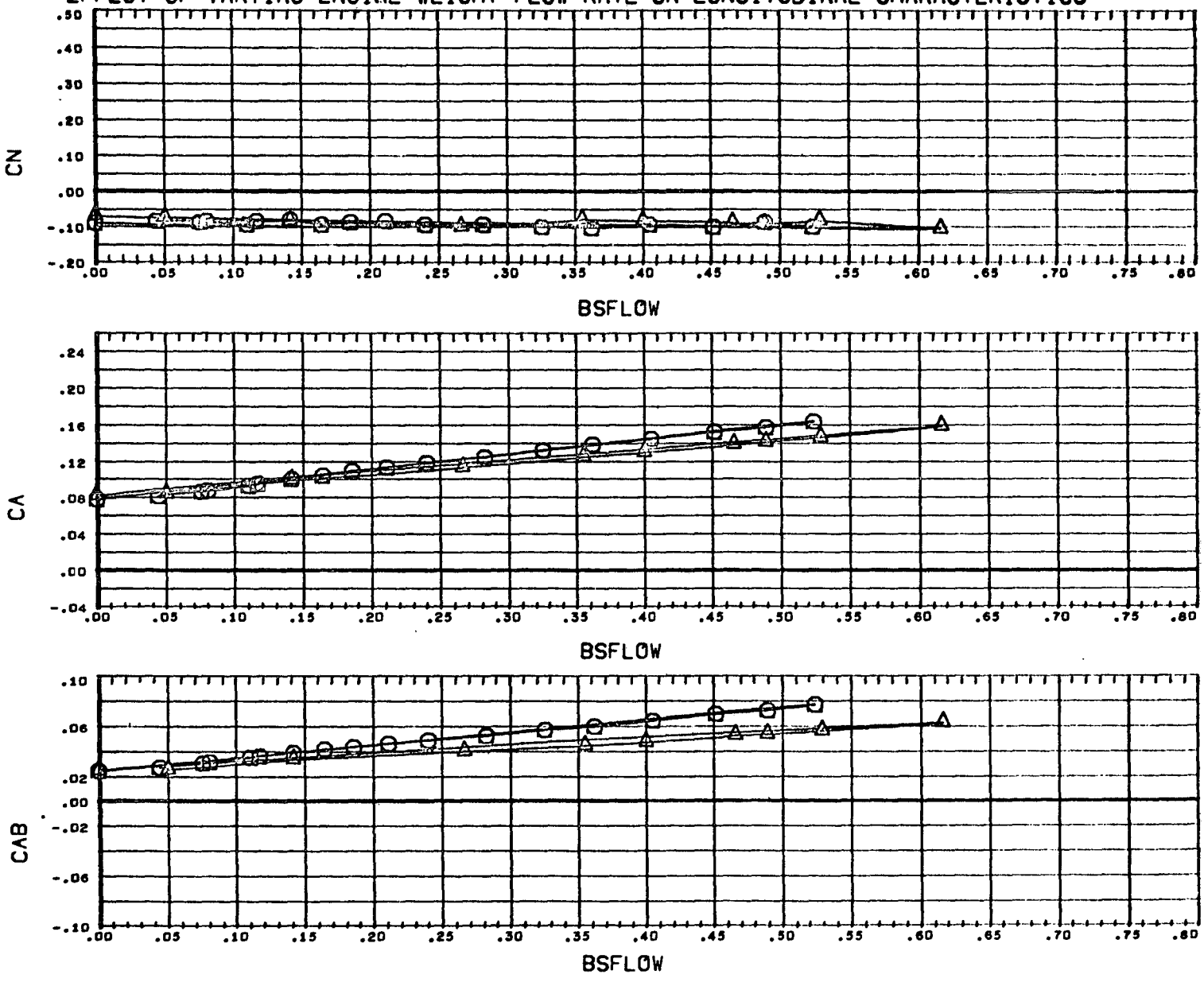


DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ALPHA	BETA	ELEVTR	CANARD
(RU9061)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	0.000	0.000
(RU9066)	△	CAL MSFC/LMSC BOOSTER B5C2F2W3V1	0.000	0.000	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0137	FT.
SCALE	1.5000	PER CT

MACH 0.400

EFFECT OF VARYING ENGINE WEIGHT FLOW RATE ON LONGITUDINAL CHARACTERISTICS

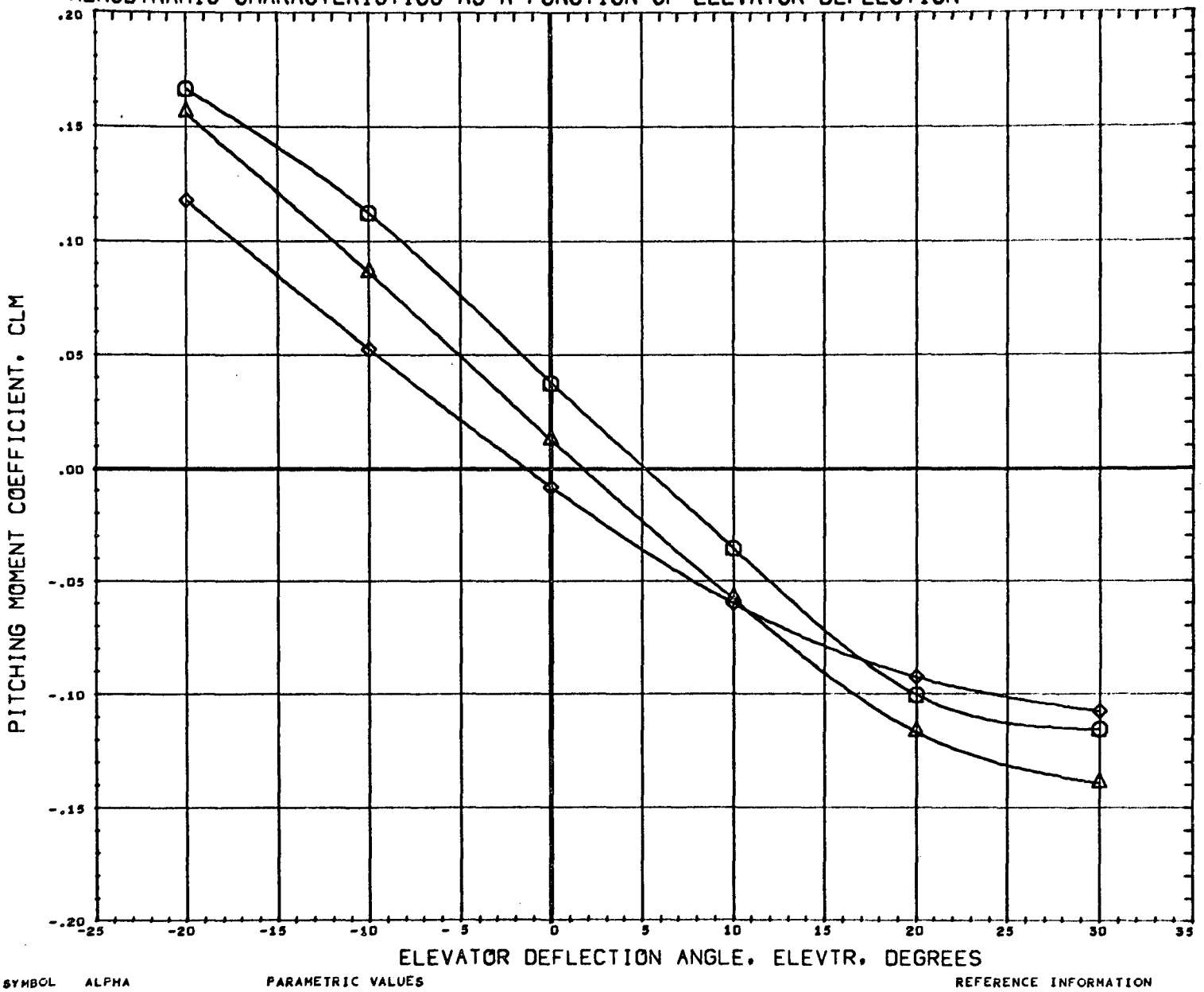


DATA SET	SYMBOL	CONFIGURATION DESCRIPTION	ALPHA	BETA	ELEVTR	CANARD
(RU9061)	○	CAL MSFC/LMSC BOOSTER B4C2F2W3V1	0.000	0.000	0.000	0.000
(RU9066)	△	CAL MSFC/LMSC BOOSTER B5C2F2W3V1	0.000	0.000	0.000	0.000

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

MACH 0.400

AERODYNAMIC CHARACTERISTICS AS A FUNCTION OF ELEVATOR DEFLECTION



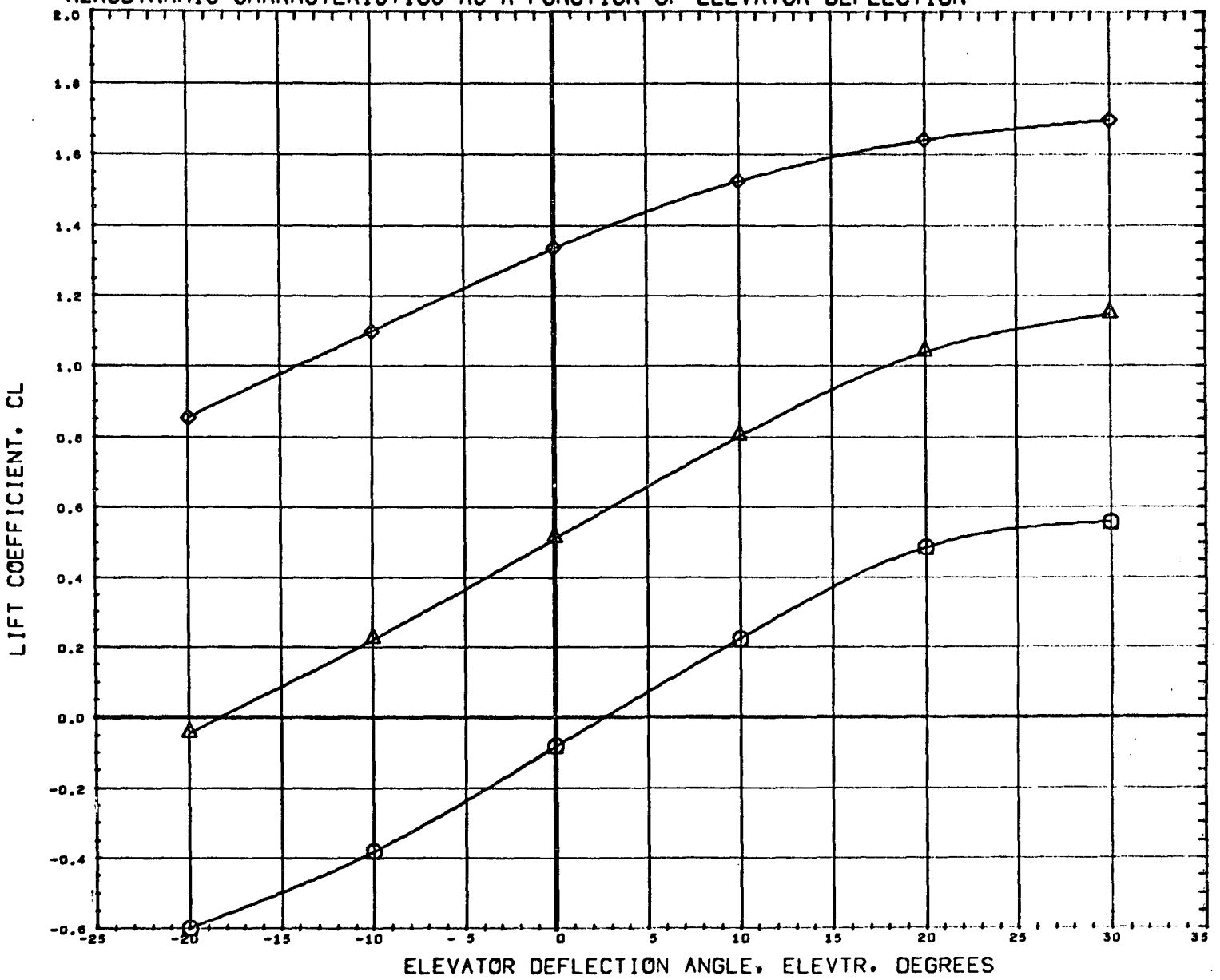
SYMBOL	ALPHA		PARAMETRIC VALUES		
○	0.000	MACH	0.400	BETA	0.000
△	6.000	CANARD	0.000	BSFLOW	0.000
◇	15.000				

DATA HIST. CODE MMI

REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.9000	PER CI

AERODYNAMIC CHARACTERISTICS AS A FUNCTION OF ELEVATOR DEFLECTION



SYMBOL	ALPHA
○	0.000
△	6.000
◇	15.000

PARAMETRIC VALUES

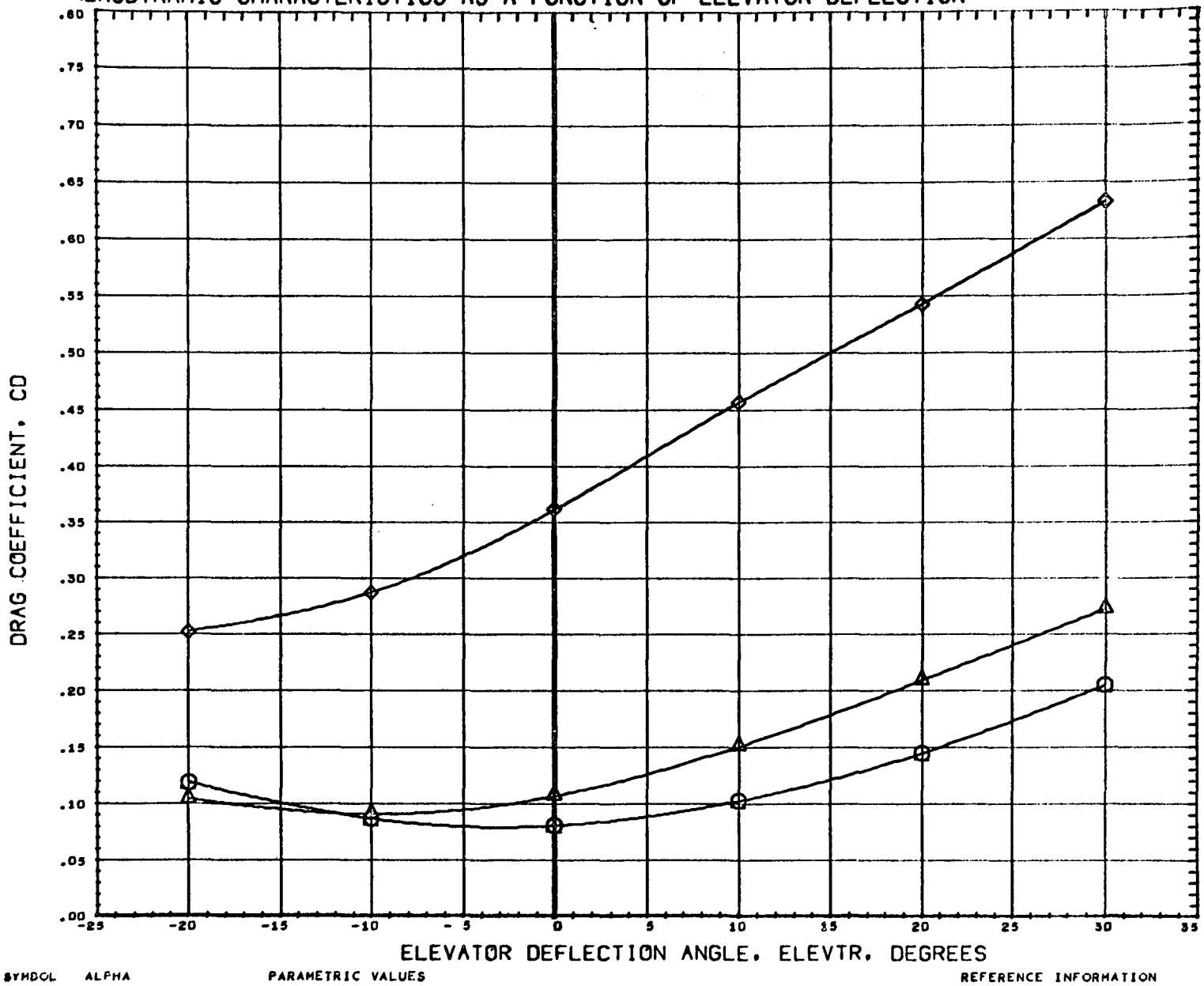
MACH	0.400	BETA	0.000
CANARD	0.000	BSFLOW	0.000

REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

DATA HIST. CODE MMI

AERODYNAMIC CHARACTERISTICS AS A FUNCTION OF ELEVATOR DEFLECTION



SYMBOL	ALPHA
○	0.000
△	6.000
◇	15.000

PARAMETRIC VALUES

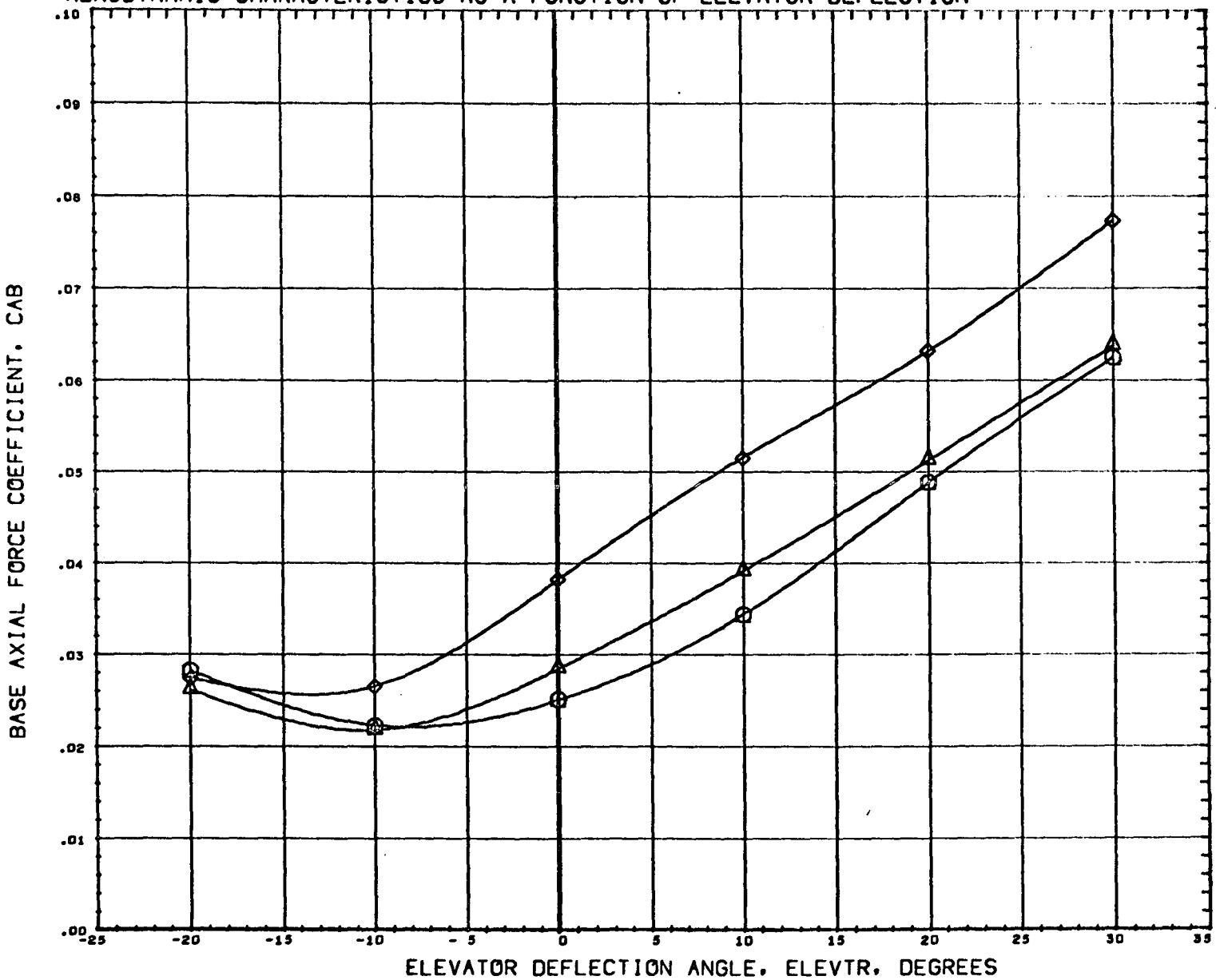
MACH	0.400	BETA	0.000
CANARD	0.000	BSFLOW	0.000

REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.9000	PER CT

DATA HIST. CODE MMI

AERODYNAMIC CHARACTERISTICS AS A FUNCTION OF ELEVATOR DEFLECTION

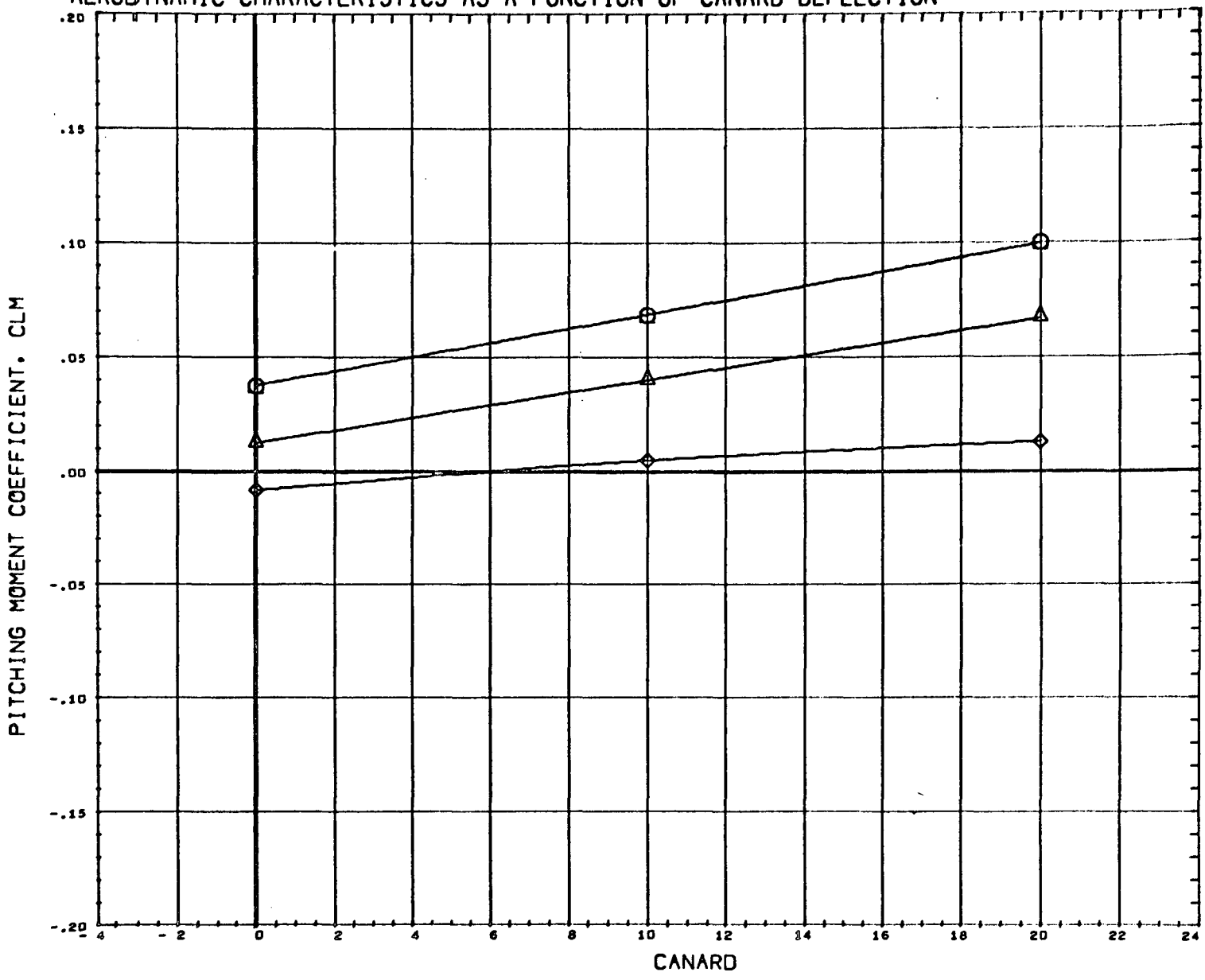


SYMBOL	ALPHA		PARAMETRIC VALUES		
○	0.000	MACH	0.400	BETA	0.000
△	6.000	CANARD	0.000	BSFLOW	0.000
◇	15.000				

DATA HIST. CODE MMI

REFERENCE INFORMATION		
SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0167	FT.
SCALE	1.5000	PER CT

AERODYNAMIC CHARACTERISTICS AS A FUNCTION OF CANARD DEFLECTION



SYMBOL	ALPHA
○	0.000
△	6.000
◇	15.000

PARAMETRIC VALUES

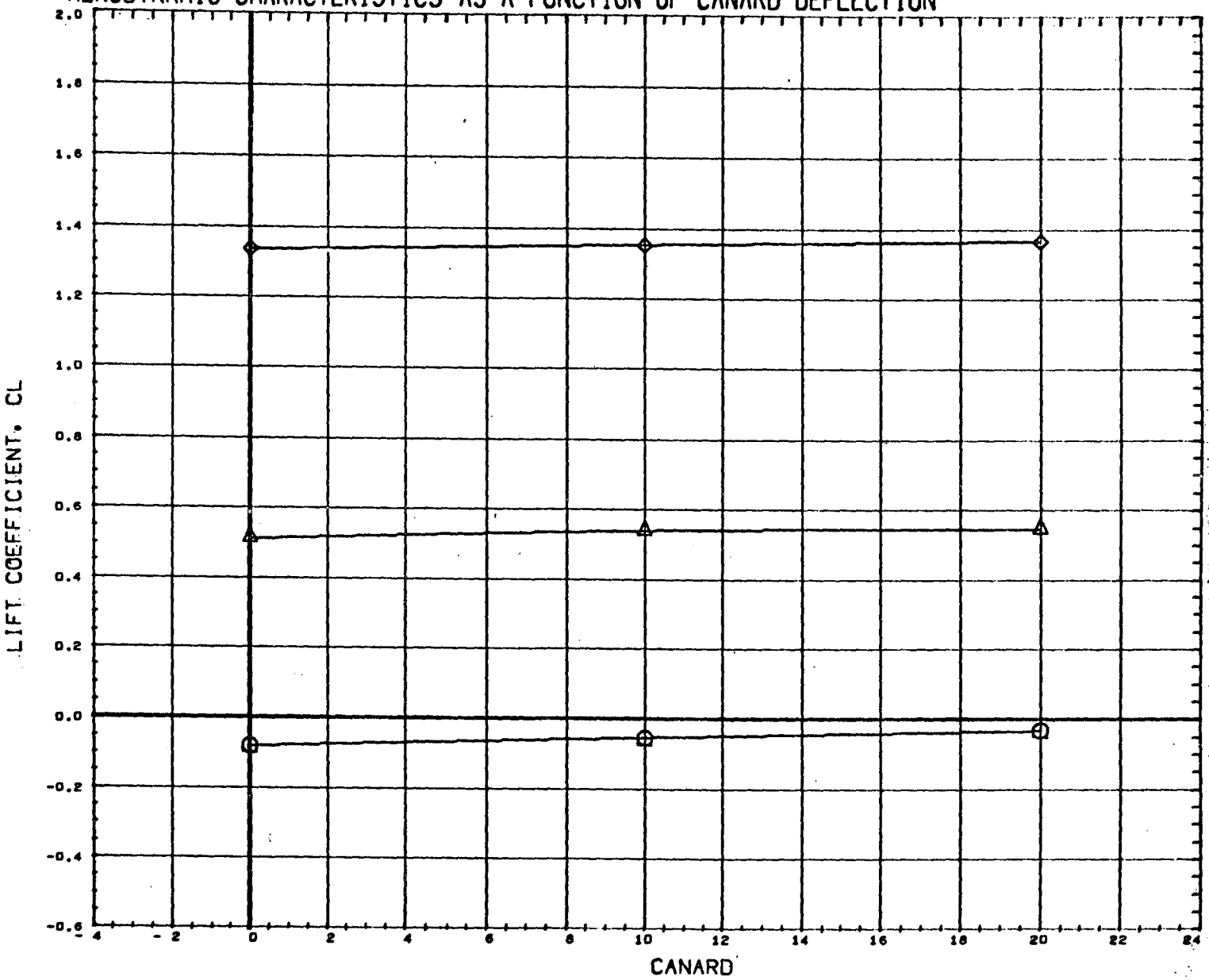
MACH	0.400	BETA	0.000
ELEVTR	0.000	BSFLOW	0.000

REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

DATA HIST. CODE MMI

AERODYNAMIC CHARACTERISTICS AS A FUNCTION OF CANARD DEFLECTION



SYMBOL	ALPHA
○	0.000
△	6.000
◇	15.000

PARAMETRIC VALUES

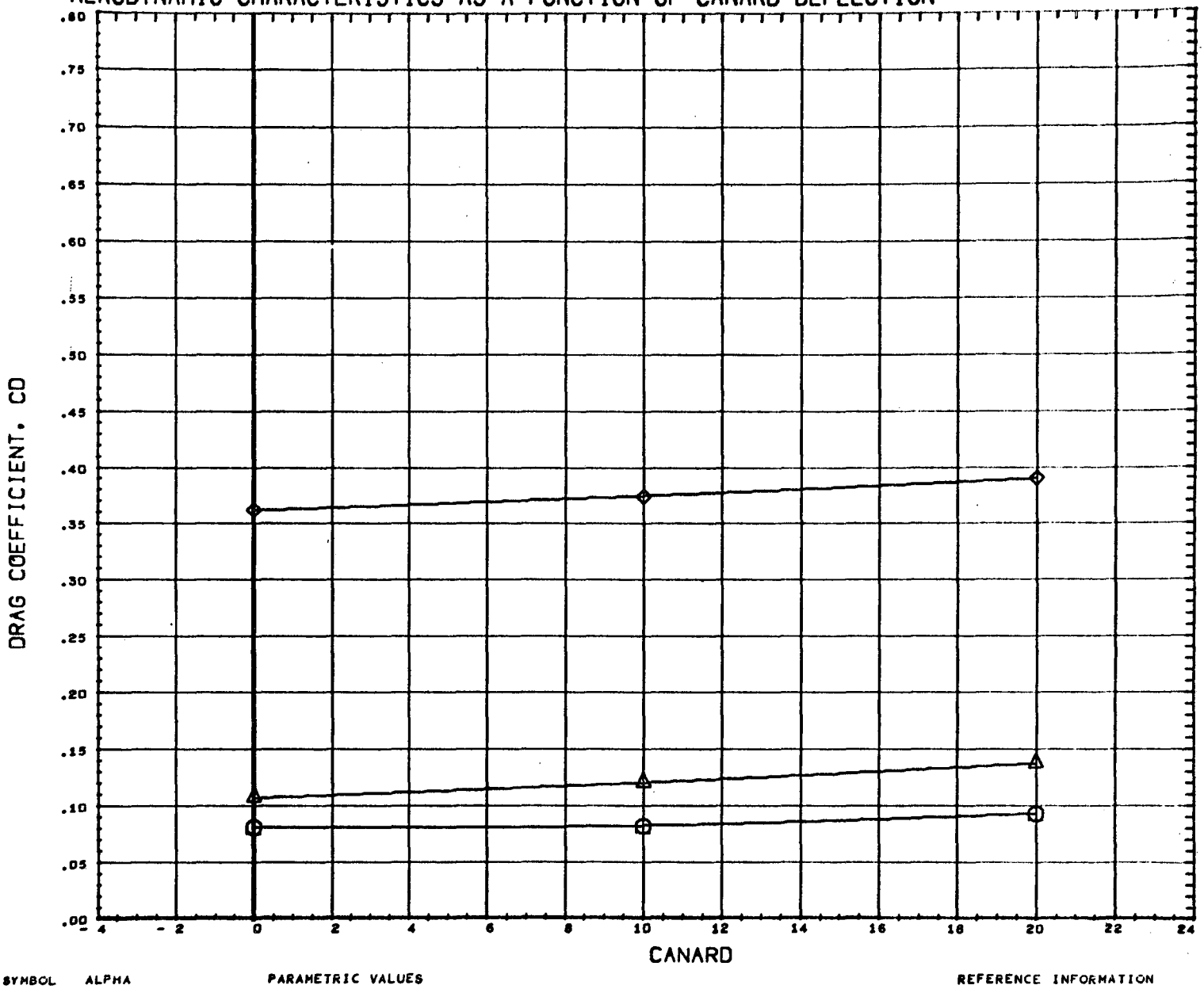
MACH	0.400	BETA	0.000
ELEVTR	0.000	BSFLOW	0.000

REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4530	FT.
BREF	3.4530	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0187	FT.
SCALE	1.5000	PER CT

DATA HIST. CODE MMI

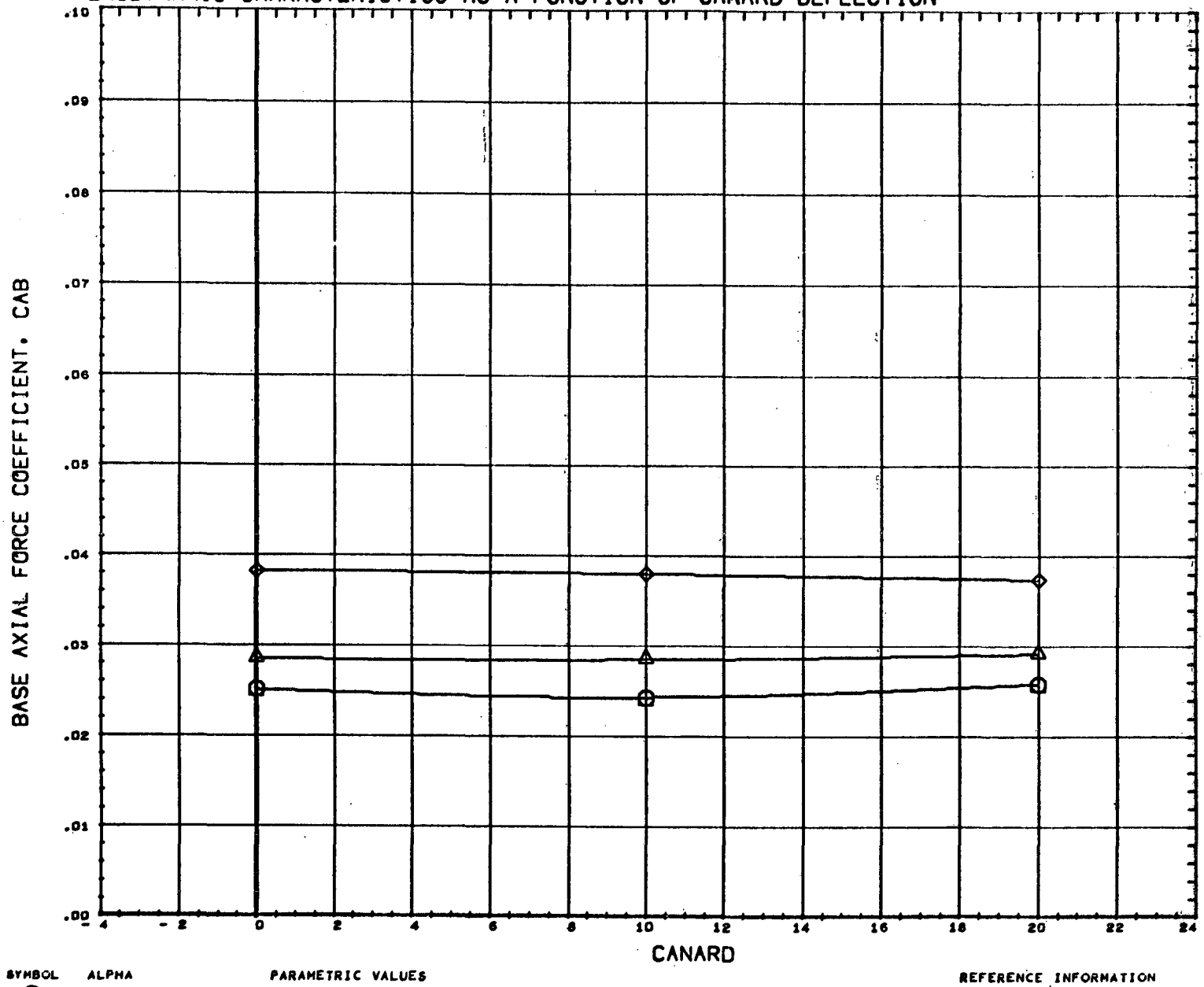
AERODYNAMIC CHARACTERISTICS AS A FUNCTION OF CANARD DEFLECTION



SYMBOL	ALPHA		PARAMETRIC VALUES			REFERENCE INFORMATION		
○	0.000	MACH	0.400	BETA	0.000	SREF	1.3550	SQ.FT.
△	6.000	ELEVTR	0.000	BSFLOW	0.000	LREF	3.4530	FT.
◇	15.000					BREF	3.4530	FT.
						XMRP	2.5950	FT.
						YMRP	0.0000	FT.
						ZMRP	0.0187	FT.
						SCALE	1.5000	PER CT

DATA HIST. CODE MMI

AERODYNAMIC CHARACTERISTICS AS A FUNCTION OF CANARD DEFLECTION



SYMBOL	ALPHA		PARAMETRIC VALUES		
○	0.000	MACH	0.400	BETA	0.000
△	6.000	ELEVTR	0.000	BSFLOW	0.000
◇	15.000				

DATA HIST. CODE MMI

REFERENCE INFORMATION

SREF	1.3550	SQ.FT.
LREF	3.4550	FT.
BREF	3.4550	FT.
XMRP	2.5950	FT.
YMRP	0.0000	FT.
ZMRP	0.0167	FT.
SCALE	1.5000	PER CT