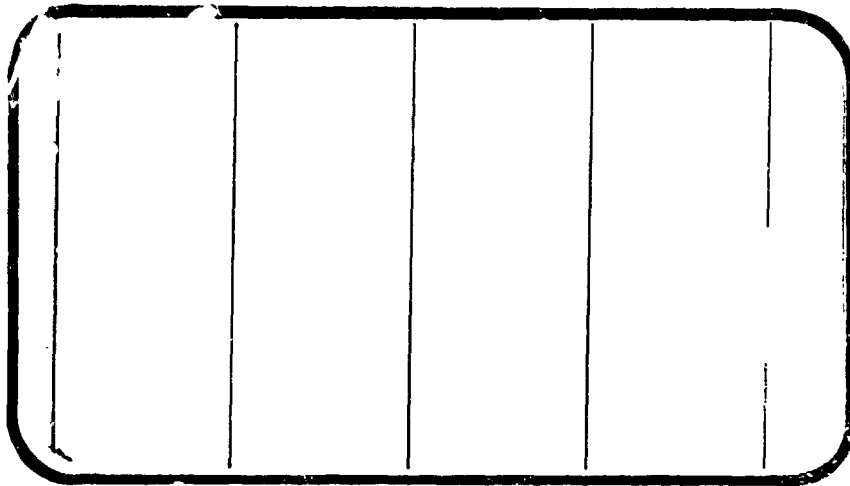




NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA CR-

141513
A



(NASA-CR-141513) RESULTS OF INVESTIGATION
ON AN 0.004-SCALE 140C MODIFIED
CONFIGURATION SPACE SHUTTLE VEHICLE ORBITER
MODEL (74-0) IN THE NASA/LANGLEY RESEARCH
CENTER HYPERSONIC NITROGEN TUNNEL (OA89)

N75-21344

Unclas
G3/18 19244



SPACE SHUTTLE

AEROTHERMODYNAMIC DATA REPORT

JOHNSON SPACE CENTER

HOUSTON, TEXAS

DATA Management services



March, 1975

DMS-DR-2214
NASA CR-141,513

RESULTS OF INVESTIGATIONS ON AN 0.004-SCALE
140C MODIFIED CONFIGURATION SPACE SHUTTLE VEHICLE
ORBITER MODEL (74-0)
IN THE NASA/LANGLEY RESEARCH CENTER
HYPERSONIC NITROGEN TUNNEL (UA89)

By

P. J. Hawthorne
Shuttle Aero Sciences
Rockwell International Space Division

Prepared under NASA Contract Number NAS9-13247

By

Data Management Services
Chrysler Corporation Space Division
New Orleans, La. 70189

for

Engineering Analysis Division
Johnson Space Center
National Aeronautics and Space Administration
Houston, Texas

WIND TUNNEL TEST SPECIFICS:

Test Number: HNT 30, 31
NASA Series Number: OA29
Model Number: 74-0
Test Dates: 12 July through 6 August 1974 and
30 August through 5 September 1974
Occupancy Hours: 136

FACILITY COORDINATOR:

Bernard Spencer, Jr.
Mail Stop 411
Langley Research Center
Hampton, Virginia 23665

Phone: (804) 827-3911

PROJECT ENGINEERS:

F. J. Hawthorne
Rockwell International
Space Division
Mail Code AC07
12214 Lakewood Blvd.
Downey, California 90241

Phone: (213) 922-2440

William C. Woods.
Langley Research Center
SSD, Hypersonic Analysis Section
Bldg. 1247-B, Room 120B
Mail Stop 163-A
Hampton, Virginia 23665

Phone: (804) 827-2483

DATA MANAGEMENT SERVICES:

Prepared by: Liaison--J. E. Vaughn
Operations--G. G. McDonald

Reviewed by: J. L. Glynn *JL*

Approved: *N. B. Kemp*
N. B. Kemp, Manager
Data Management Services

Concurrence: *J. G. Swider*
J. G. Swider, Manager
Flight Technology Branch

Chrysler Corporation Space Division assumes no responsibility for the data presented other than display characteristics.

RESULTS OF INVESTIGATIONS ON AN 0.004-SCALE
140C MODIFIED CONFIGURATION SPACE SHUTTLE VEHICLE
ORBITER MODEL (74-0)
IN THE NASA/LANGLEY RESEARCH CENTER
HYPERSONIC NITROGEN TUNNEL (0A89)

By

P. J. Hawthorne, Rockwell International Space Division

ABSTRACT

This report documents data obtained during a wind tunnel test of an 0.004-scale 140C modified configuration SSV Orbiter in the NASA/Langley Research Center 22-inch Hypersonic Nitrogen Tunnel. The test was conducted during July, August and September 1974 and 136 occupancy hours were charged. All presented runs were conducted at a nominal Mach number of 19.8 and at a Reynolds number of approximately 0.68×10^6 per foot.

The complete 140C modified model was tested with various elevon settings and additionally in wing off/bodyflap off configuration at angles of attack from -5 to 42.5 degrees at zero yaw.

Purpose of this test was to obtain high hypersonic longitudinal and lateral-directional stability and control characteristics of the updated SSV configuration in an initially diatomic medium.

TABLE OF CONTENTS

	Page
ABSTRACT	iii
INDEX OF MODEL FIGURES	2
INDEX OF DATA FIGURES	3
NOMENCLATURE	4
REMARKS	7
CONFIGURATIONS INVESTIGATED	9
TEST FACILITY DESCRIPTION	11
DATA REDUCTION	13
TABLES	
I. TEST CONDITIONS	14
II. DATASET/RUN NUMBER COLLATION SUMMARY	15
III. MODEL DIMENSIONAL DATA	16
FIGURES	
MODEL	24
DATA	27
APPENDIX	
TABULATED SOURCE DATA	

INDEX OF MODEL FIGURES

Figure	Title	Page
1.	Axis systems.	24
2.	140C modified Orbiter for test OA89.	25
3.	Model photographs.	
a.	Test Section With Model Injected, 45° Bent Sting	26
b.	74-0 Model on 45° Sting	26

INDEX OF DATA FIGURES

FIGURE	TITLE	PLOT* SCHEDULE	CONDITIONS VARIED	PAGES
4	Effect of Elevon and Body Flap Deflection on Long. Charact. (45 deg. Sting)	A	ELEVTR, BDFLAP	1-4
5	Effect of Elevon and Body Flap Deflection on Long. Charact. (25 deg. Sting)	A	ELEVTR, BDFLAP	5-8
6	Effect of Aileron and Body Flap Deflection on Lat.-Direct (45 deg. Sting)	B	AILRON, BDFLAP	9
7	Effect of Wing and Body Flap on Long. Charact. (45 deg. Sting)	A	CONFIG.	10-13
8	Effect of Sting Support on Long. Charact. (Controls Neutral)	A	STING	14-17
9	Effect of Sting Support on Long. Charact. (Elevator = 20, Body Flap = 16.3)	A	STING	18-21

* PLOT SCHEDULE:

A) CN vs. ALPHA, CN vs CLM, CL vs. ALPHA, CL vs. CLM, CA, CLM, L/D, and CD vs. ALPHA

B) CY and CYN vs. ALPHA

NOMENCLATURE
General

<u>SYMBOL</u>	<u>PLOT SYMBOL</u>	<u>DEFINITION</u>
a		speed of sound; m/sec, ft/sec
C_p	CP	pressure coefficient; $(p_1 - p_\infty)/q$
M	MACH	Mach number; V/a
p		pressure; N/m^2 , psf
q	Q(NSM) Q(PSF)	dynamic pressure; $1/2\rho V^2$, N/m^2 , psf
RN/L	RN/L,RN	Reynolds number; based on model length
V		velocity; m/sec, ft/sec
α	ALPHA	angle of attack, degrees
β	BETA	angle of sideslip, degrees
ψ	PSI	angle of yaw, degrees
ϕ	PHI	angle of roll, degrees
ρ		mass density; kg/m^3 , slugs/ft ³

Reference & C.G. Definitions

A_b		base area; m^2 , ft^2
b	BREF	wing span or reference span; m, ft
c.g.		center of gravity
$\frac{l}{c}$ _{REF}	LREF	reference length or wing mean aerodynamic chord; m, ft
S	SREF	wing area or reference area; m^2 , ft^2
	MRP	moment reference point
	XMRP	moment reference point on X axis
	YMRP	moment reference point on Y axis
	ZMRP	moment reference point on Z axis

SUBSCRIPTS

b	base
l	local
s	static conditions
t	total conditions
∞	free stream

NOMENCLATURE (Continued)

Body-Axis System

<u>SYMBOL</u>	<u>PLOT SYMBOL</u>	<u>DEFINITION</u>
C_N	CN	normal-force coefficient; $\frac{\text{normal force}}{qS}$
C_A	CA	axial-force coefficient; $\frac{\text{axial force}}{qS}$
C_Y	CY	side-force coefficient; $\frac{\text{side force}}{qS}$
C_{A_b}	CAB	base-force coefficient; $\frac{\text{base force}}{qS}$ $-A_b(P_b - P_\infty)/qS$
C_{A_f}	CAF	forebody axial force coefficient, $C_A - C_{A_b}$
C_m	CIM	pitching-moment coefficient; $\frac{\text{pitching moment}}{qS/REF}$
C_n	CYN	yawing-moment coefficient; $\frac{\text{yawing moment}}{qSb}$
C_l	CBL	rolling-moment coefficient; $\frac{\text{rolling moment}}{qSb}$

Stability-Axis System

C_L	CL	lift coefficient; $\frac{\text{lift}}{qS}$
C_D	CD	drag coefficient; $\frac{\text{drag}}{qS}$
C_{D_b}	CDB	base-drag coefficient; $\frac{\text{base drag}}{qS}$
C_{D_f}	CDF	forebody drag coefficient; $C_D - C_{D_b}$
C_Y	CY	side-force coefficient; $\frac{\text{side force}}{qS}$
C_m	CIM	pitching-moment coefficient; $\frac{\text{pitching moment}}{qS/REF}$
C_n	CLN	yawing-moment coefficient; $\frac{\text{yawing moment}}{qSb}$
C_l	CSL	rolling-moment coefficient; $\frac{\text{rolling moment}}{qSb}$
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)
Additional Nomenclature

<u>Symbol</u>	<u>Plot Symbol</u>	<u>Definition</u>
IML		inner mold line
MRC		moment reference center
OML		outer mold line
X_{CP}/L_B	XCP/L	longitudinal center of pressure location, fraction of body length
X_0		Orbiter longitudinal station, in.
Y_0		Orbiter lateral station, in
Z_0		Orbiter vertical station, in
α_i		wing incidence angle, degrees
δ_{BF}	BDFLAP	bodyflap deflection angle, degrees
δ_R	RUDDER	rudder deflection angle, degrees
δ_{SB}	SPDBRK	speedbrake deflection angle, degrees
δ_a	AILRON	aileron, total aileron deflection angle, degrees, (left aileron - right aileron)/2
δ_e	ELEVTR	elevator surface deflection angle, positive deflection trailing edge down, degrees
	BALANC	parameter name to document balance utilized in testing, BALANC = 1 (LaRC HN05), BALANC = 2 (LaRC HN06), see Remarks section
	STING	parameter name for sting, sting parameter values of 25 and 45 denote a 25° and 45° sting used for testing, respectively

REMARKS

OA89 was conducted in three distinct portions, from July 12 through July 29, July 30 to August 6 and from August 30 through September 5, 1974.

During the first time period, the model was installed in the tunnel on the Langley Research Center HNO 6 component water cooled balance on a 45° bent sting. On July 24 it was found that the model was running slightly yawed, and this along with certain balance problems prompted re-running of the basic configuration flows to determine incremental effects of these problems. On July 29, the thermocouple indicating balance water temperature indicated 32°F during the afternoon run, and subsequent investigation revealed a broken bellows in the water cooling line, and that ice had been forming in the balance due to evaporative cooling. A balance change was then made to the lower range HNO 5 component water cooled balance, still on the 45° bent sting.

From July 30 to August 6 selected runs were made with the HNO 5 instrument, and it was undertaken to rerun the test with an abbreviated run schedule due to time constraints on the 74-0 model utilization. The test article was then removed from the test section for use elsewhere; this entire entry is referred to by Langley Research Center as test HNT 30.

The second installation was made at the end of August to investigate suspected sting effects; this time the HNO 5 balance was used with a 25° bent sting. This is known as the HNT 31 test series. Base pressure data were taken with only one pressure tap during OA89, instead of the two shown in the pretest report. Data were collected at total pressures of 2200 and

REMARKS (Concluded)

5000 psi during both HNT 30 and HNT 31, but the $P_T = 2200$ psi data is considered to be of questionable quality and only the $P_T = 5000$ psi data utilizing the HNO 5 balance is presented here, and none of the HNO 6 balance data are presented.

CONFIGURATIONS INVESTIGATED

During test OA89, the 140C modified vehicle was tested in full up and wing off configurations. The basic aircraft is of blended wing body design with a double delta wing, full span elevons and a single centerline vertical tail with rudder and/or speedbrake capability. A bodyflap and short pod orbital maneuvering system (OMS) were mounted on the aft fuselage bottom edge and upper sidewalls, respectively.

The following letter designations are used to denote the components of the -140C modified configurations:

- B₆₂ Fuselage to the outer mold line contours of drawings VL70-000202B, -000200B & 000203 for the aft body contour (except OMS), the VL70-000202B drawing was used in lieu of the C revision specified on the VL70-000140C control drawing since the C revision was not available. The MPS nozzles are not simulated.
- C₁₂ Canopy to VL70-000202B lines; see B₆₂ above.
- E₄₃ Elevon used with VL70-000200B wing, with 6" gaps. The hinge-line is unswept and located at $X_0 = 1387$.
- F₁₀ Center pivot bodyflap hinge line at $X_0 = 1532$ and planform as denoted on VL70-000200B drawing.
- M₁₄ Baseline short nose Orbital Maneuvering System (OMS) pods mounted on the upper base of the fuselage. Shape is defined by drawing VL70-08457. Rocket engine nozzles are simulated.
- R₅ Rudder utilized with V₈ vertical tail and shown on VL70-000146A.
- V₈ 45° sweep leading edge single centerline mounted vertical tail of modified diamond section as per VL70-000146A.
- W₁₂₇ VL70-000200B wing. Wing is of 81°/45° sweep leading edge and is 6 inches F.S. thicker at the body than -140A. Airfoil is RIC modified NASA 0011.3 at $Y_0 = 199$, 0012-64 at theoretical tip. $\alpha_j = +0^\circ 30'$ dihedral = $3^\circ 30'$ at TE., tip is defined by VL70-006092.

CONFIGURATIONS INVESTIGATED (Concluded)

Component descriptor sheets are given in Table III.

The tested configurations were denoted as:

140C modified = B₆₂ C₁₂ E₄₃ F₁₀ M₁₄ R₅ V₈ W₁₂₇

140C modified wing and body flap off = B₆₂ C₁₂ M₁₄ R₅ V₈

TEST FACILITY DESCRIPTION

The NASA/Langley Research Center 18-inch Hypersonic Nitrogen Tunnel is a blow down facility with a normal operational time of up to two hours for force and moment testing. This long run time is possible because the nitrogen is obtained in liquid form, mechanically pumped to 17,000 psig P_T , and then vaporized and heated to 2900°F T_T prior to entry into the nozzle. The test section is of the open jet variety with a water cooled diffuser that exits into a 60-foot diameter vacuum sphere.

Models are sting mounted on an injectable blade strut with externally controllable pitch capability and manually settable yaw freedom. Force testing is done utilizing 5 component water cooled internal strain gauge balances, with injection time kept to a absolute minimum (less than 5 seconds) to alleviate balance drift problems due to aerodynamic heating. Air is also blown on the model to cool it while in the retracted position between injections.

Recent calibrations of the tunnel indicate that the most satisfactory conditions to obtain force data are:

Total pressure = 5000 psi

Total temp = 3360 °R

RN/foot = 0.68×10^6

Mach = 19.80

The most recent operational parameters of the contoured nozzle are best obtained from the LaRC Hypersonic Analysis Section (Phone (804) 827-2483).

TEST FACILITY DESCRIPTION (Concluded)

The tunnel is also equipped with an electron beam flow visualization device which allows color photographs with depth of field to be made of the flow system, allowing interpretation of shock interactions and flow separation phenomena.

DATA REDUCTION

Those data presented were obtained with the LaRC HNO 5 internal strain gauge balance at one set of tunnel conditions only (refer to the Remarks section). Data were converted to standard NASA force and moment coefficients and are presented about a nominal moment reference center in both stability and body axis systems.

Additionally, the normal force center of pressure is presented as:

$$X_{cp}/L_B = \frac{X_{CG}}{L_B} - \frac{C_m(\bar{c})}{C_N L_B}$$

where X_{cp} is the longitudinal distance from the inner mold line nose station ($X_0 = 238$ inches full scale) to the center of pressure. X_{CG} is the distance from inner mold line to the moment reference point ($X_{CG} = X_{MRP} - 238 = 838.7$ inches). The body length (L_B) is 1290.3 inches.

The following reference dimensions were used to reduce the data to coefficient form:

$$\begin{aligned} S_{ref} &= 2690.0 \text{ ft}^2 \\ L_{REF} = \bar{c} &= 474.81 \text{ in.} \\ B_{REF} = b &= 936.68 \text{ in.} \\ X_{MRP} &= 1076.7 \text{ in. } X_0 \\ Y_{MRP} &= 0.0 \text{ in. } Y_0 \\ Z_{MRP} &= 375.0 \text{ in. } Z_0 \end{aligned}$$

TABLE III MODEL DIMENSIONAL DATA

MODEL COMPONENT : BODY - B₄₂

GENERAL DESCRIPTION : Configuration 140C orbiter fuselage MCR 200-R₄.
Similar to 140A 'B fuselage except aft body revised and improved
midbody-wing-boot fairing. X₀ = 950 to X₀ = 1040.

MODEL SCALE: 0.004

DRAWING NUMBER : VL70-000140C -000202C -000205A
-000200B -000203

DIMENSIONS .	FULL SCALE	MODEL SCALE
Length (OML: Fwd Sta. X ₀ =235)	In. 1293.3	5.173
Length (IML: Fwd Sta. X ₀ =238)	In. 1290.3	5.161
Max. Width (@ X ₀ = 1528.3)	In. 264.0	1.056
Max Depth (@ X = 1464)	In. 250.0	1.000
Fineness Ratio (OML Length / Max. Width)	4.899	4.899
Area - Ft ²		
Max. Cross-Sectional	340.885	0.0055
Planform		
Wetted		
Base		

TABLE III (CONT'D)

MODEL COMPONENT : CANOPY - C12

GENERAL DESCRIPTION : Configuration 140C orbiter canopy vehicle
cabin No. 31 updated to MCR 200-R₄. Used with fuselage B₆₂.

MODEL SCALE: 0.004

DRAWING NUMBER: VL70-000140C -000202B -000204

DIMENSIONS :	FULL SCALE	MODEL SCALE
Length ($X_0 = 434.643$ to 578) In.	<u>143.357</u>	<u>0.573</u>
Max Width (@ $X_0 = 513.127$) In.	<u>152.412</u>	<u>0.610</u>
Max Depth ($Z_0 = 501$ to 449.30) In.	<u>51.61</u>	<u>0.206</u>
Fineness Ratio	<u> </u>	<u> </u>
Area	<u> </u>	<u> </u>
Max. Cross-Sectional	<u> </u>	<u> </u>
Planform	<u> </u>	<u> </u>
Wetted	<u> </u>	<u> </u>
Base	<u> </u>	<u> </u>

TABLE III (CONT'D)

MODEL COMPONENT: ELEVON - E₁₃

GENERAL DESCRIPTION: Configuration 140A 'B orbiter elevons.

DATA are for one side, used on 74-0 model with W₁₂₇. E₁₃ is 6" F.S. straight
slotted gap version of E₂₆. gaps are at elevon/body flare juncture and at
Y₀ = 311.0 MODEL SCALE: 0.004

DRAWING NUMBER: VL70- 000200 --006089. -006092
R80006 Lockheed Missile & Space Co., Huntsville, Ala.

<u>DIMENSIONS:</u>	<u>FULL-SCALE</u>	<u>MODEL SCALE</u>
Area - Ft ²	<u>210.0</u>	<u>0.003</u>
Span (equivalent), In.	<u>349.2</u>	<u>1.397</u>
Inb'd equivalent chord, In.	<u>118.004</u>	<u>0.472</u>
Outb'd equivalent chord, In.	<u>55.192</u>	<u>0.221</u>
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	<u>0.2096</u>	<u>0.2096</u>
At Outb'd equiv. chord	<u>0.4004</u>	<u>0.4004</u>
Sweep Back Angles, degrees		
Leading Edge	<u>0.00</u>	<u>0.00</u>
Tailing Edge	<u>- 10.056</u>	<u>-10.056</u>
Hingeline	<u>0.00</u>	<u>0.00</u>
Area Moment ($\frac{\text{Product of area} \times \bar{c}}{3}$) Ft ³	<u>1587.25</u>	<u>0.0001</u>
Mean Aerodynamic Chord, In.	90.7	0.363

TABLE III (CONT'D)

MODEL COMPONENT : BODY FLAP - F₁₀

GENERAL DESCRIPTION : Configuration 140C body flap. Hingeline located
at $X_0 = 1532$, $Z_0 = 287$.

MODEL SCALE: 0.004

DRAWING NUMBER : VL70-000140C, VL70-355114

DIMENSIONS :	FULL SCALE	MODEL SCALE
Length ($X_0=1525.5$ to 1613) In.	<u>27.50</u>	<u>0.350</u>
Max Width (@ L.E., $X_0 = 1525.5$) In.	<u>256.00</u>	<u>1.024</u>
Max Depth ($X_0 = 1532$) In.	<u>19.798</u>	<u>0.792</u>
Fineness Ratio	<u> </u>	<u> </u>
Area - Ft. ²	<u> </u>	<u> </u>
Max. Cross-Sectional (@ H.L.)	<u>35.196</u>	<u>0.00056</u>
Planform	<u>135.00</u>	<u>0.0022</u>
Wetted	<u> </u>	<u> </u>
Base (@ $X_0 = 1613$)	<u>4.89</u>	<u>0.000078</u>

TABLE III (CONT'D)

MODEL COMPONENT : OMS POD - M₁

GENERAL DESCRIPTION : Preliminary IML version of short OMS pod.

(First used on 0.015 scale Model 36-0 for test No. OA83).

MODEL SCALE: 00%

DRAWING NUMBER : VL70-008457

DIMENSIONS : (For 1 of 2 sides)	FULL SCALE	MODEL SCALE
Length (OMS Fwd Sta $X_o = 1311$), In.	<u>254.0</u>	<u>1.036</u>
Max Width (@ $X_o = 1511$) In.	<u>135.6</u>	<u>0.5424</u>
Max Depth (@ $X_o = 1511$) In.	<u>73.6</u>	<u>0.2944</u>
Fineness Ratio	<u>2.54080</u>	<u>2.54080</u>
Area - Ft ²	<u> </u>	<u> </u>
Max. Cross-Sectional	<u>54.507</u>	<u>0.00087</u>
Planform	<u> </u>	<u> </u>
Wetted	<u> </u>	<u> </u>
Base	<u> </u>	<u> </u>

TABLE III (CONT'D)

MODEL COMPONENT: VERTICAL - V₈

GENERAL DESCRIPTION: Configuration 140C orbiter vertical tail (identical to configuration 140A 'B vertical tail).

MODEL SCALE: 0.004

DRAWING NUMBER: VL70-000140C -000146R

DIMENSIONS:	FULL SCALE	MODEL SCALE
TOTAL DATA		
Area (Theo) - Ft ²		
Planform	<u>413.253</u>	<u>0.0068</u>
Span (Theo) - In.	<u>315.72</u>	<u>1.263</u>
Aspect Ratio	<u>1.675</u>	<u>1.675</u>
Rate of Taper	<u>0.507</u>	<u>0.507</u>
Taper Ratio	<u>0.404</u>	<u>0.404</u>
Sweep-Back Angles, Deg. ±		
Leading Edge	<u>45.000</u>	<u>45.000</u>
Trailing Edge	<u>26.2</u>	<u>26.2</u>
0.25 Element Line	<u>41.13</u>	<u>41.13</u>
Chords:		
Root (Theo) MP	<u>268.50</u>	<u>1.074</u>
Tip (Theo) MP	<u>108.47</u>	<u>0.434</u>
M.C	<u>199.81</u>	<u>0.799</u>
Fus. Sta. of .25 MAC	<u>1463.35</u>	<u>5.853</u>
W.P. of .25 MAC	<u>635.52</u>	<u>2.542</u>
B.L. of .25 MAC	<u>0.0</u>	<u>0.0</u>
Airfoil Section		
Leading Wedge Angle - Deg.	<u>10.000</u>	<u>10.000</u>
Trailing Wedge Angle - Deg.	<u>14.92</u>	<u>14.92</u>
Leading Edge Radius	<u>2.00</u>	<u>0.008</u>
Void Area	<u>13.17</u>	<u>0.00021</u>
Blanketed Area	<u>0.0</u>	<u>0.0</u>

TABLE III (CONT'D)

MODEL COMPONENT: RUDDER - R₅

GENERAL DESCRIPTION: Conf-uration 140C orbiter rudder (identical to
Configuration 140A 'B rudder).

MODEL SCALE: 0.004

DRAWING NUMBER: VL70-000146B -000095

<u>DIMENSIONS:</u>	<u>FULL-SCALE</u>	<u>MODEL SCALE</u>
Area - Ft ²	<u>100.15</u>	<u>0.0016</u>
Span (equivalent) . In.	<u>201.00</u>	<u>0.804</u>
Inb'd equivalent chord . In.	<u>91.585</u>	<u>0.366</u>
Outb'd equivalent chord In.	<u>50.833</u>	<u>0.203</u>
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	<u>0.400</u>	<u>0.400</u>
At Outb'd equiv. chord	<u>0.400</u>	<u>0.400</u>
Sweep Back Angles, degrees		
Leading Edge	<u>34.83</u>	<u>34.83</u>
Tailing Edge	<u>26.25</u>	<u>26.25</u>
Hingeline	<u>34.83</u>	<u>34.83</u>
(Product of Area & \bar{c})		
Area Moment (Normal to hingeline) . Ft. ³	<u>610.92</u>	<u>0.000039</u>
Mean Aerodynamic Chord In.	<u>73.2</u>	<u>0.293</u>

TABLE III. (Concluded)

MODEL COMPONENT: WING-W₁₂₇

GENERAL DESCRIPTION: Configuration 140C orbiter wing, MCR 200-R, similar to
140A 'B wing W₁₁₆ but with refinements: improved wing-boot-midbody fairing
(.X₀ = 940 to X₀ = 1040).

MODEL SCALE: 0.001

TEST NO.

DWG. NO. VL70-000141C, -000200B

DIMENSIONS:

FULL-SCALE

MODEL SCALE

TOTAL DATA

Area (Theo.) Ft²

Planform

Span (Theo) In.

Aspect Ratio

Rate of Taper

Taper Ratio

Dihedral Angle, degrees

Incidence Angle, degrees

Aerodynamic Twist, degrees

Sweep Back Angles, degrees

Leading Edge

Trailing Edge

0.25 Element Line

Chords:

Root (Theo) B.P.O.O.

Tip, (Theo) B.P.

MAC

Fus. Sta. of .25 MAC

W.P. of .25 MAC

B.L. of .25 MAC

EXPOSED DATA

Area (Theo) Ft²

Span, (Theo) In. BP108

Aspect Ratio

Taper Ratio

Chords

Root BP108

Tip $1.00 \frac{b}{2}$

MAC

Fus. Sta. of .25 MAC

W.P. of .25 MAC

B.L. of .25 MAC

Airfoil Section (Rockwell Mod NAS1)

XXXX-64

Root $\frac{b}{2} =$

Tip $\frac{b}{2} =$

Data for (1) of (2) Sides

Leading Edge Cuff

Planform Area Ft²

Leading Edge Intersects Fus M. L. @ Sta

Leading Edge Intersects Wing @ Sta

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

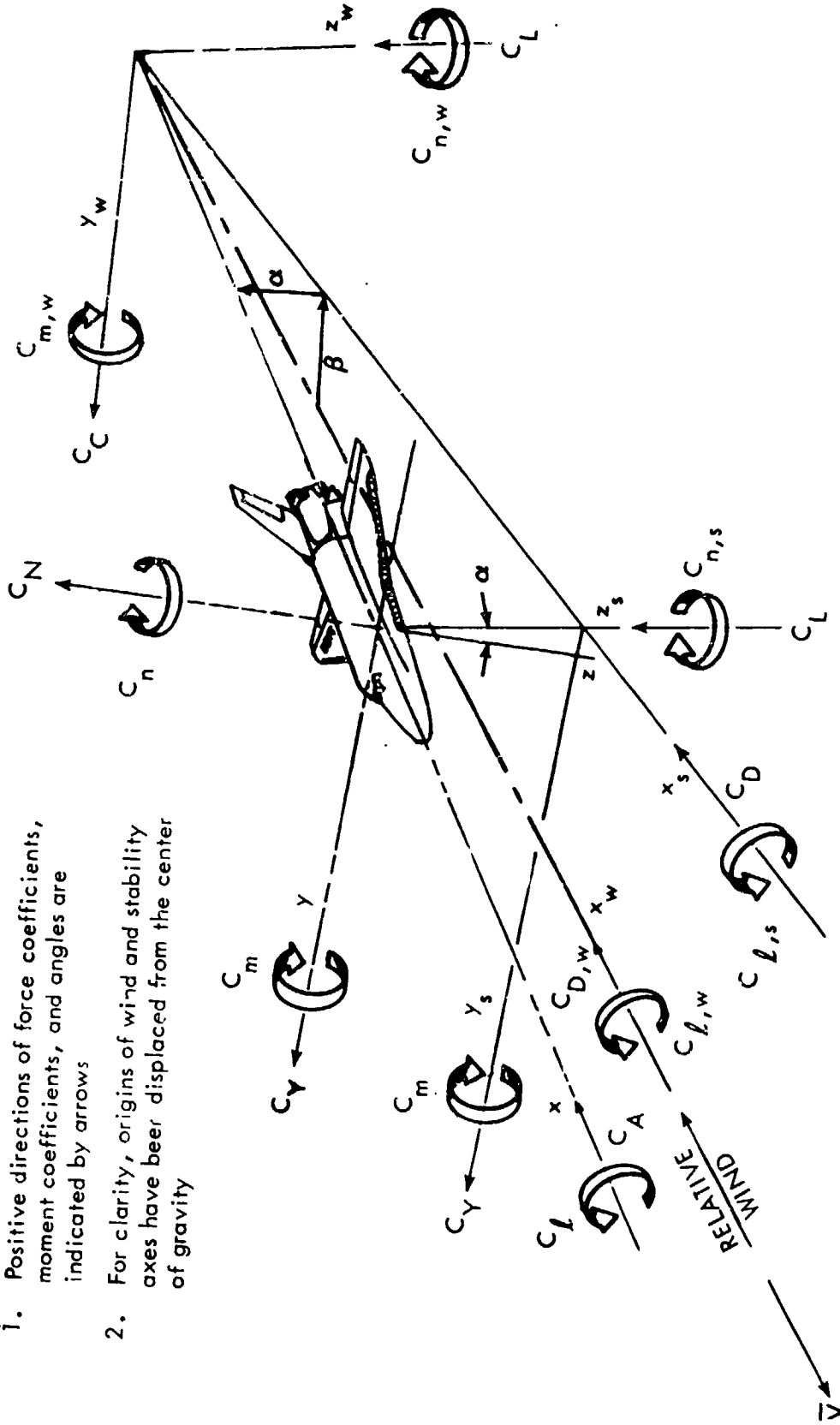


Figure 1. - Axis systems.

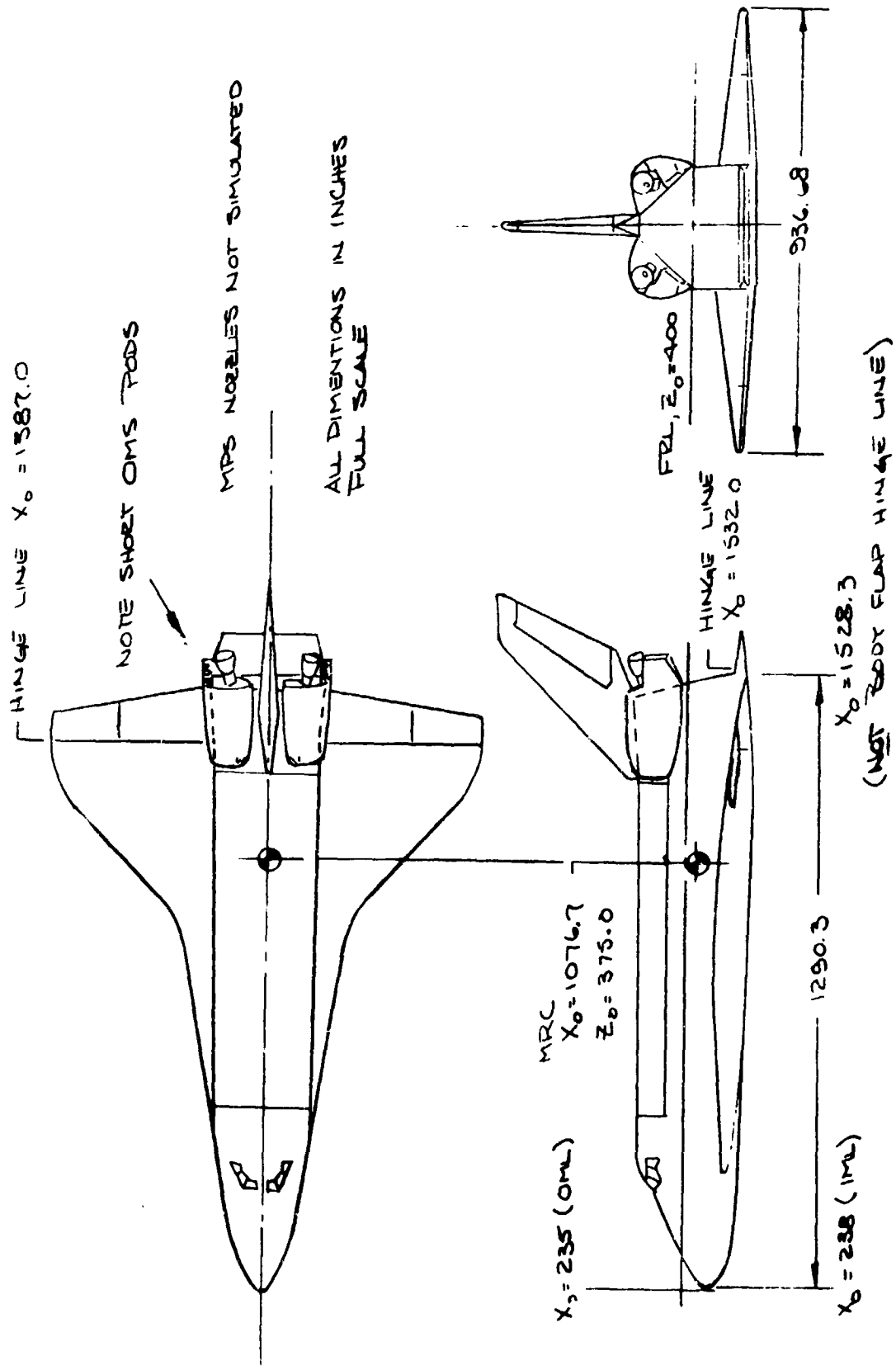
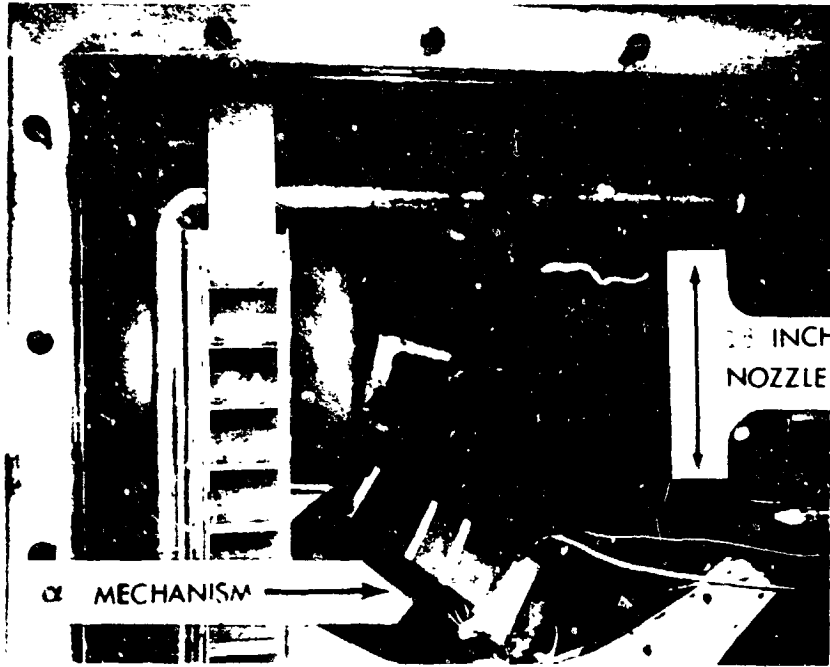


Figure 2. - 140C modified Orbiter for test 0A89



a. Test Section with Model Injected, 45° Bent Sting



b. 74-0 Model on 45° Sting

Figure 3. - Model photographs.

DATA FIGURES

DATA SET SYMBOL CONFIGURATION DESCRIPTION

(R00001) □ M19 N.T. - 30(0A-89) (862C)ZF 10H(43)(V1Z7E43)(V895)

(R00002) ◇ M19 N.T. - 30(0A-89) (862C)ZF 10H(43)(V1Z7E43)(V895)

(R00003) ◇ M19 N.T. - 30(0A-89) (862C)ZF 10H(43)(V1Z7E43)(V895)

ELEVTR 0.000

AILRON 0.000

BOFLAP 0.000

SPOBRK 55.000

SCALE 0.0040

REFERENCE INFORMATION

SC FT 2690.0000

INC-ES 474.8100

INC-ES 936.8600

IN. X0 1076.7000

IN. Y0 .0000

IN. Z0 375.0000

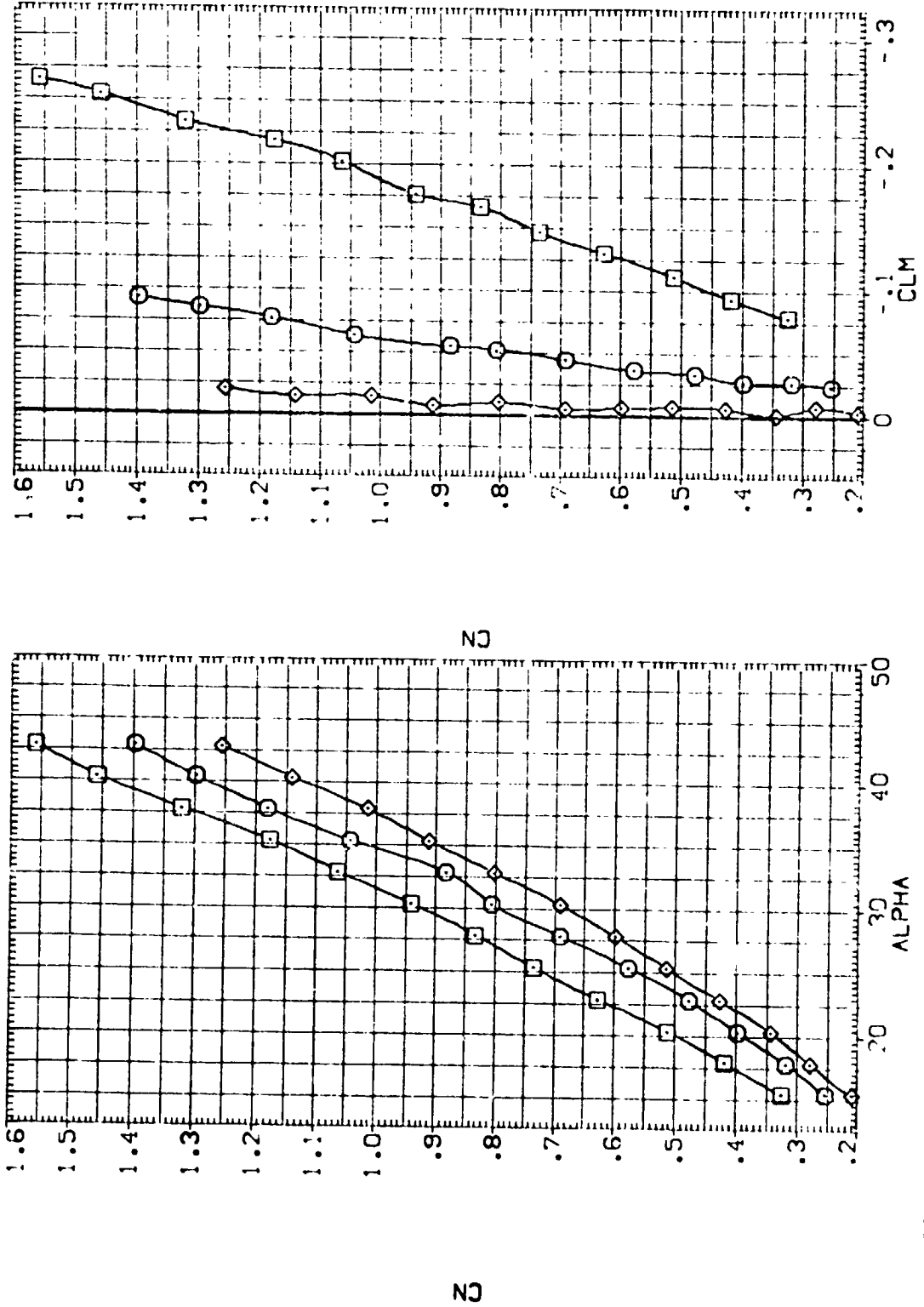


FIGURE 4 EFFECT OF ELEVON AND BODY FLAP DEFLECTION ON LONG CHARACTER(45DEG STING)

(A)MACH = 1.9.80

PAGE 1

DATA SET SYMBOL CONFIGURATION DESCRIPTION

{R00001} H19 N.T.-30(0A-88) (862C12F) (014) (V) (27E43) (V895)

{R00002} H19 N.T.-30(0A-88) (862C12F) (014) (V) (27E43) (V895)

{R00003} H19 N.T.-30(0A-88) (862C12F) (014) (V) (27E43) (V895)

ELEVTR .000

AILRON .000

BOFLAP .000

SPOBRK 55.000

REFERENCE INFORMATION

SREF 2650.0000 SQ. FT

LREF 474.8100 IN.-ES

BREF 936.3600 IN.-ES

XREF 1076.7000 IN. X0

YREF .0000 IN. Y0

ZREF 375.0000 IN. Z0

SCALE .0040

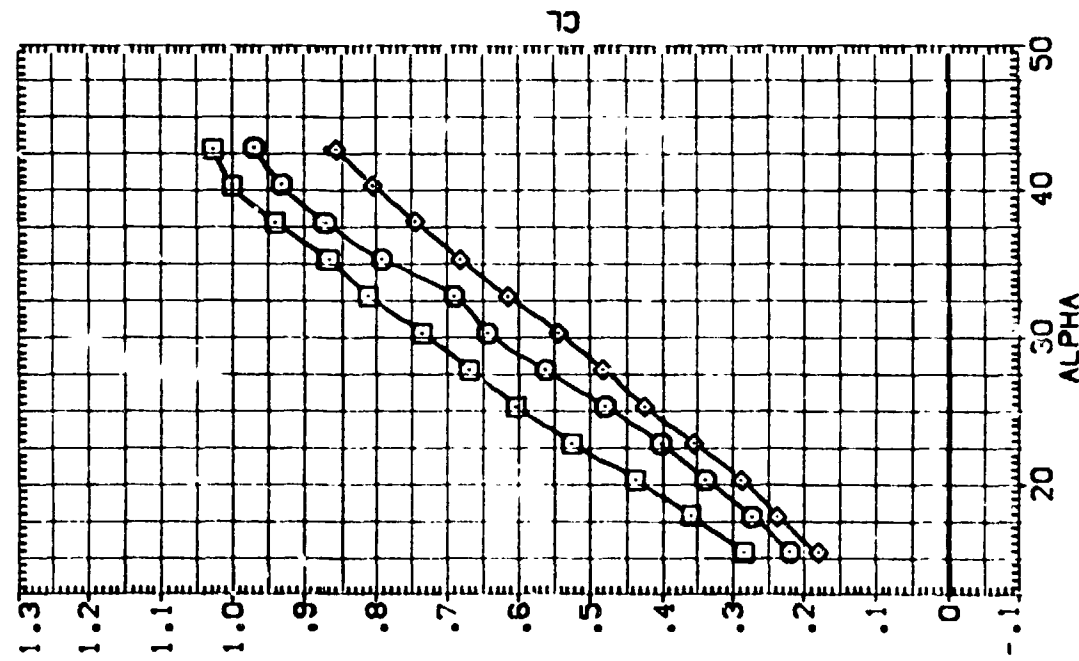
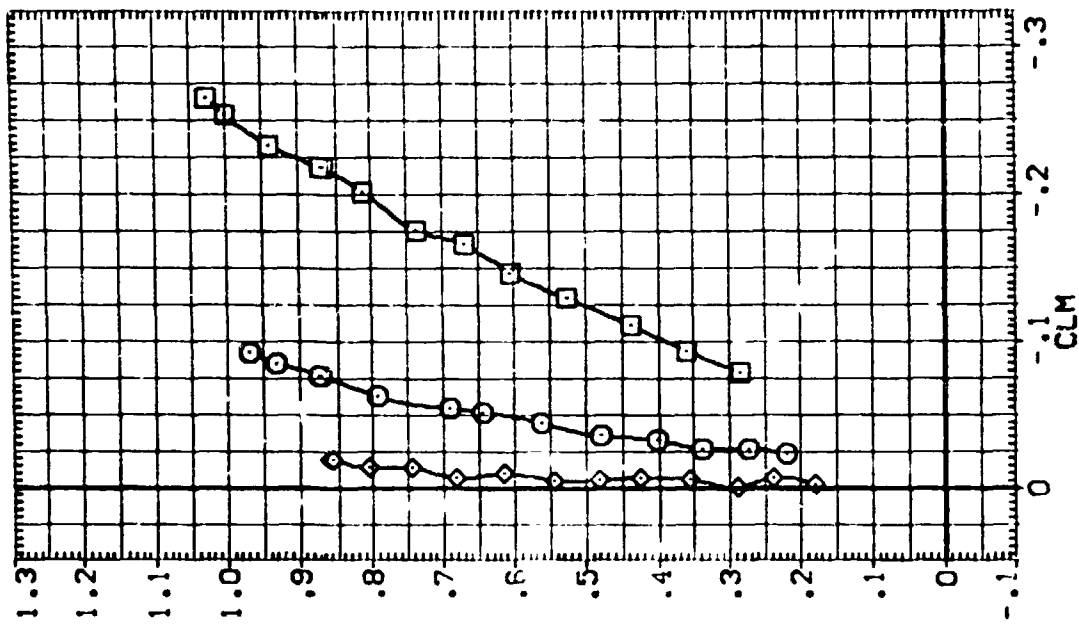


FIGURE 4 EFFECT OF ELEVON AND BODY FLAP DEFLECTION ON LONG CHARACT(45DEG STING)

(A)MACH = 19.80

PAGE 2



DATA SET SYMBL. CONFIGURATION DESCRIPTION

{R00001}	M19 N.T.-30(DA-89)	(B52C)Z	(D114)	(V1Z7E43)	(V876)
{R00002}	M19 N.T.-30(DA-89)	(B52C)Z	(D114)	(V1Z7E43)	(V876)
{R00003}	M19 N.T.-30(DA-89)	(B52C)Z	(D114)	(V1Z7E43)	(V876)

ELEVTR ALLIGN BOFLAP SPOBRK REFERENCE INFORMATION

ELEVTR	.000	.000	.000	SREF	2650.0000	SO	FT
ALLIGN	.000	.000	.000	LREF	474.8100	IN	IN
BOFLAP	.000	16.300	-11.700	BREF	936.6800	IN	ES
SPOBRK	55.000	55.000	55.000	XMRP	1076.7000	IN	XD
REFERENCE INFORMATION				YMRP	.0000	IN	YD
				ZMRP	375.0000	IN	ZD
				SCALE	.0040		

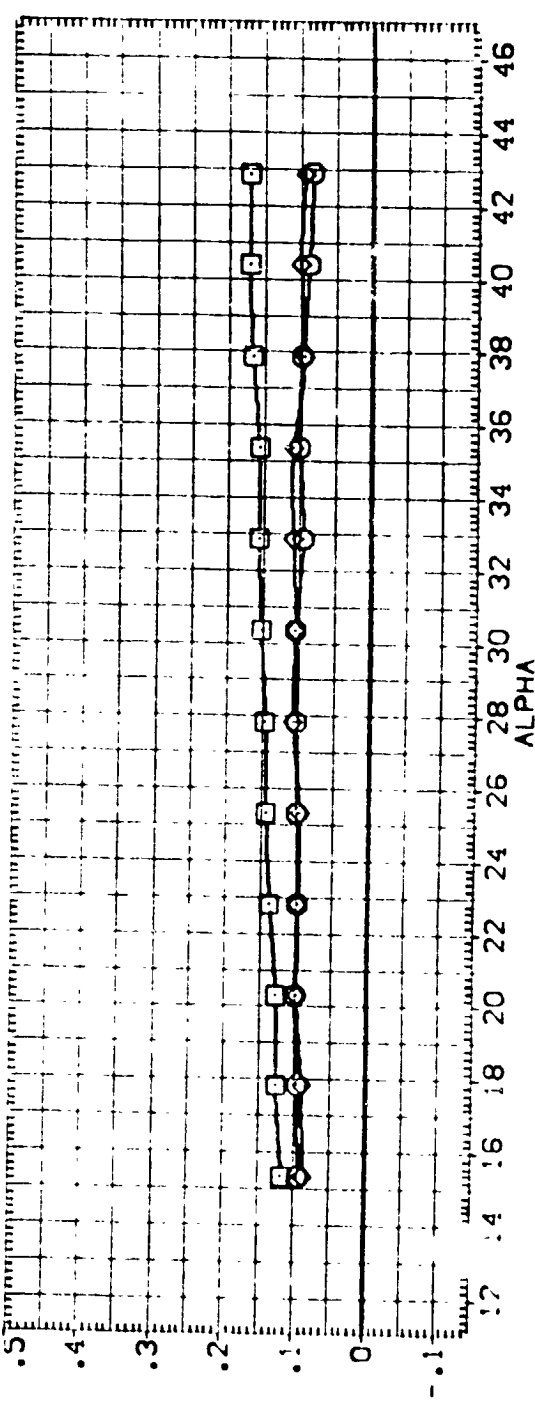
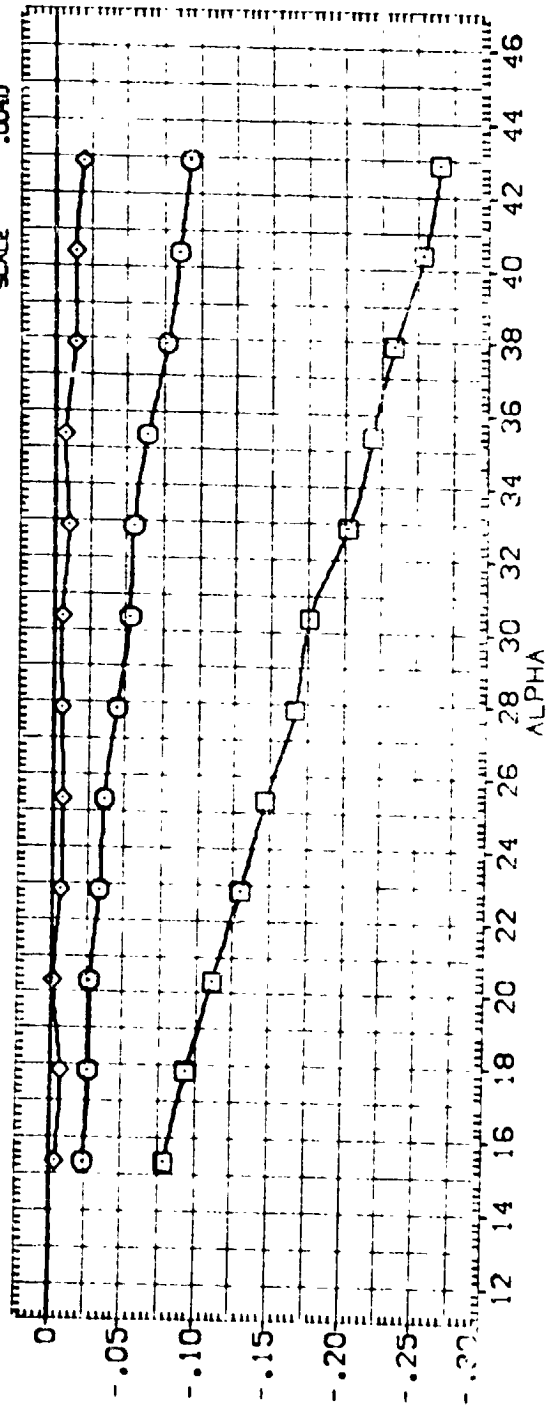


FIGURE 4 EFFECT OF ELEVON AND BODY FLAP DEFLECTION ON LONG CHARACTER (45DEG STING)
 (A) MACH = 19.80



DATA SET SYMBOL CONFIGURATION DESCRIPTION

{R00001}	M19 N.T.-30(0A-09)	(B52C12-10)(14)(V127E43)(V895)	ELEVTR	A1LUNO	B0FLAP	SFOBRK	REFERENCE INFORMATION
{R00002}	M19 N.T.-30(0A-09)	(B52C12-10)(14)(V127E43)(V895)	.000	.000	.000	95.000	SREF 2690.0000
{R00003}	M19 N.T.-30(0A-09)	(B52C12-10)(14)(V127E43)(V895)	20.000	.000	16.300	55.000	LREF 474.8100
			-35.000	.000	-11.700	55.000	BREF 928.6800
							XPRP 1076.7000
							YPRP .0000
							ZPRP 375.0000
							SCALE .0040

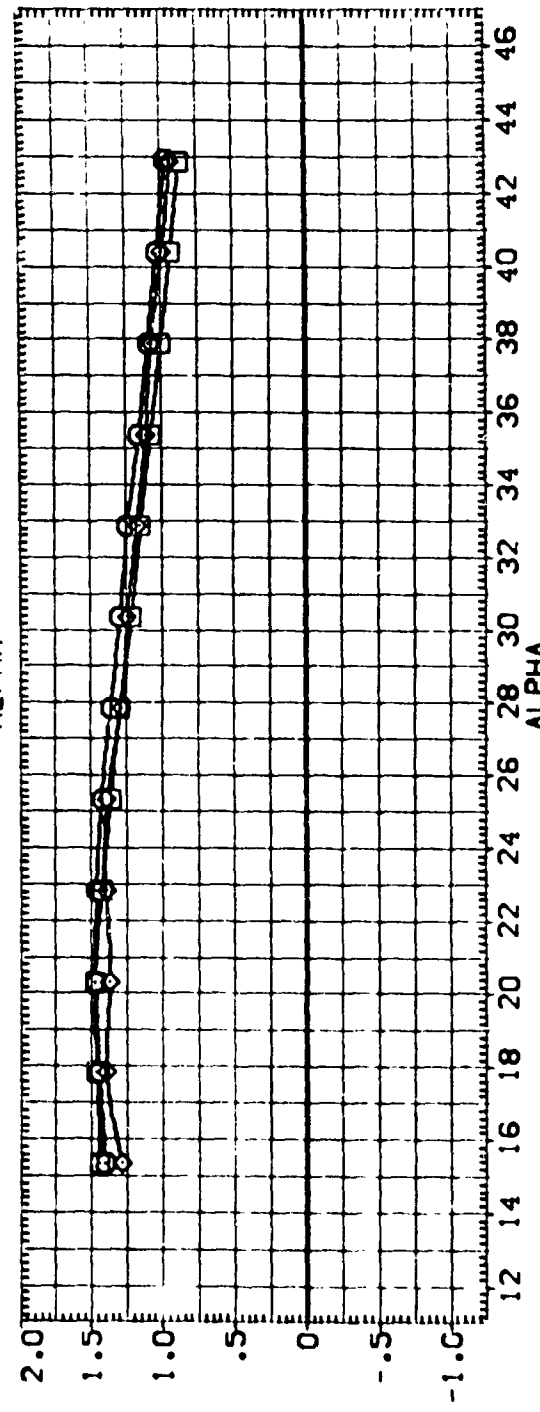
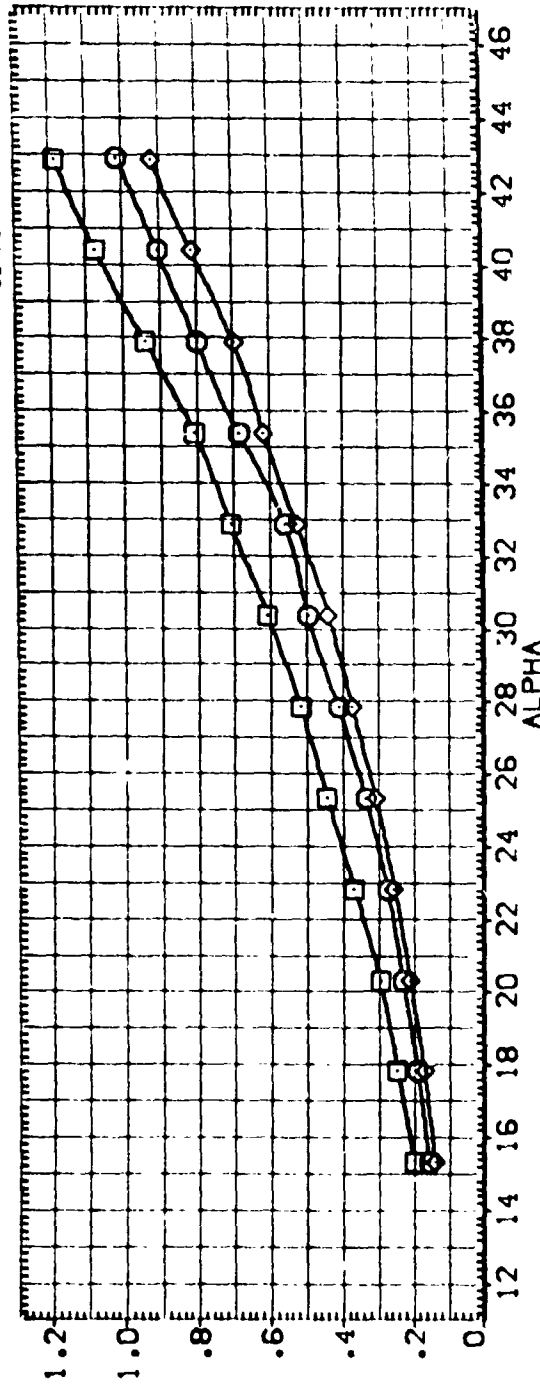


FIGURE 4 EFFECT OF ELEVON AND BODY FLAP DEFLECTION ON LONG CHARACTER(45DEG STING)



DATA SET SYMBOL	CONFIGURATION DESCRIPTION	ELE/TR	AIL/ON	BD/FLAP	SP/BRK	REFERENCE INFORMATION
{R00006}	M19 N1.-31(OA-89) (B52C) X (OH14) (V1Z7E43) (V8RS)	.000	.000	.000	55.000	SREF 2690.0000 SQ. FT
{R00007}	M19 N1.-31(OA-89) (B52C) X (OH14) (V1Z7E43) (V8RS)	10.000	.000	16.300	55.000	LREF 474.6100 IN.-ES
{R00008}	M19 N1.-31(OA-89) (B52C) X (OH14) (V1Z7E43) (V8RS)	20.000	.000	16.300	55.000	BREF 936.6800 IN.-ES
{R00009}	M19 N1.-31(OA-89) (B52C) X (OH14) (V1Z7E43) (V8RS)	-40.000	.000	-11.700	55.000	XMRP 1076.7000 IN. XG
						YMRP .0000 IN. YG
						ZMRP 375.0000 IN. ZG
						SCALE .0040

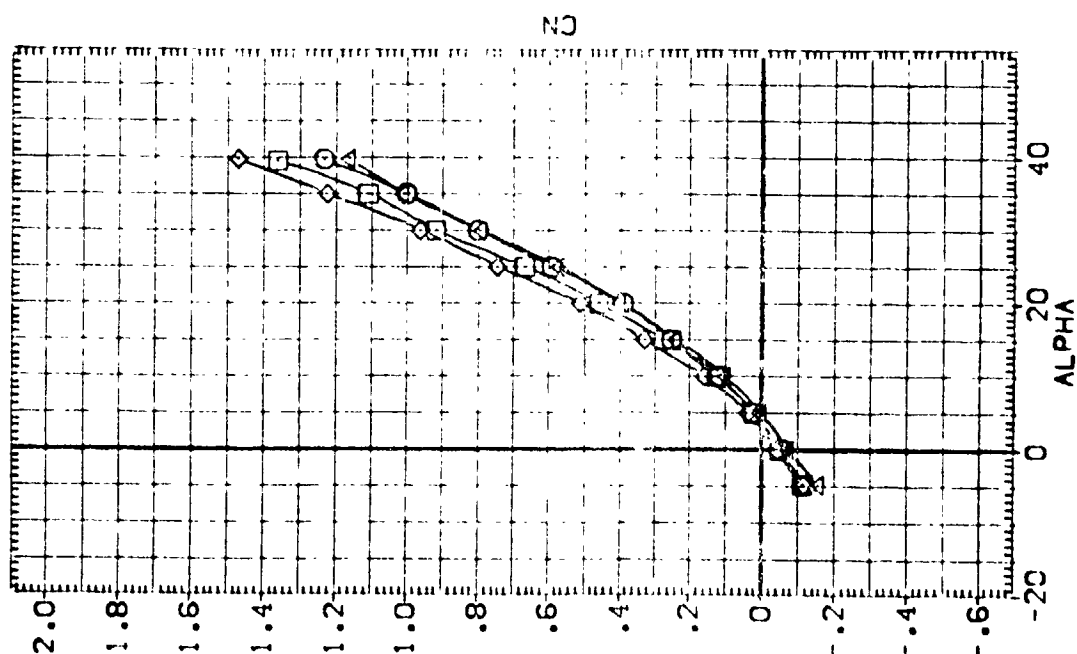
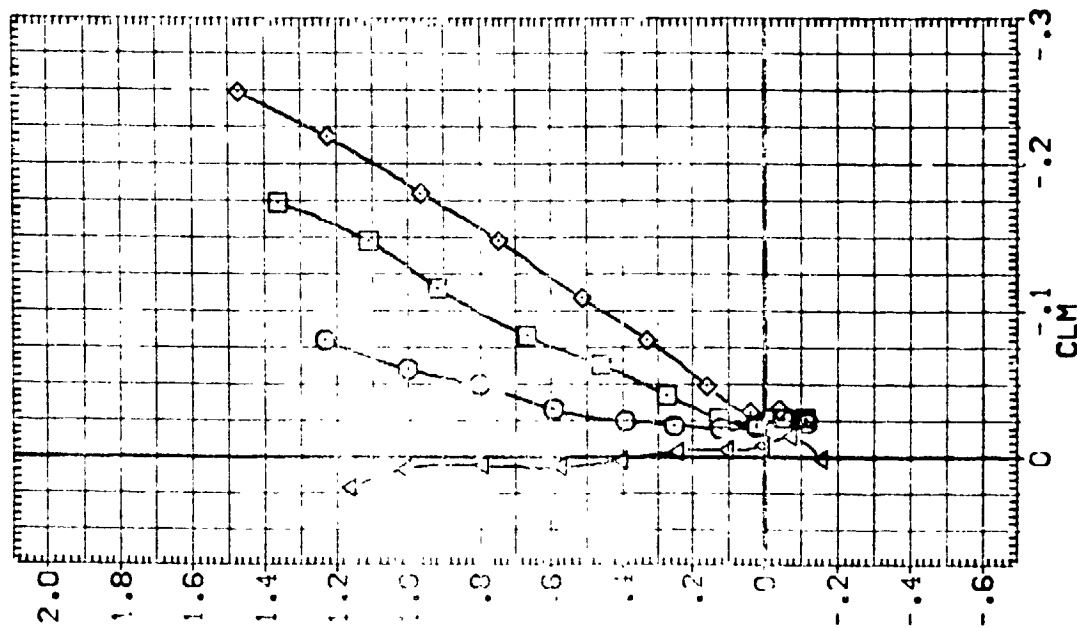


FIGURE 5 EFFECT OF ELEVON AND BODY FLAP DEFLECTION ON LONG CHARACTER (25DEG STING)

(A)MACH = 19.80

DATA SET SYMBOL: {R00005} {R00007} {R00008} {R00009}

CONFIGURATION DESCRIPTION: M19 N.T.-31(DA-88) (B62C) 2F(DH14) (V127E43) (V87S) M19 N.T.-31(DA-88) (B62C) 2F(DH14) (V127E43) (V87S) M19 N.T.-31(DA-88) (B62C) 2F(DH14) (V127E43) (V87S) M19 N.T.-31(DA-88) (B62C) 2F(DH14) (V127E43) (V87S)

LEVTR: .000 .000 .000 .000 .000 .000 .000 .000

AILERON: .000 .000 .000 .000 .000 .000 .000 .000

BDFLAP: .000 .000 .000 .000 .000 .000 .000 .000

SPOBRK: 55.000 55.000 55.000 55.000 55.000 55.000 55.000 55.000

REFERENCE INFORMATION: SREF 2690.0000 S0. FT. 50. INCHES LREF 474.8100 LREF 59. INCHES XREF 936.8600 XREF 1076.7000 XREF 1076.7000 XREF 1076.7000 ZREF 379.0000 ZREF 379.0000 ZREF 379.0000 SCALE .0010

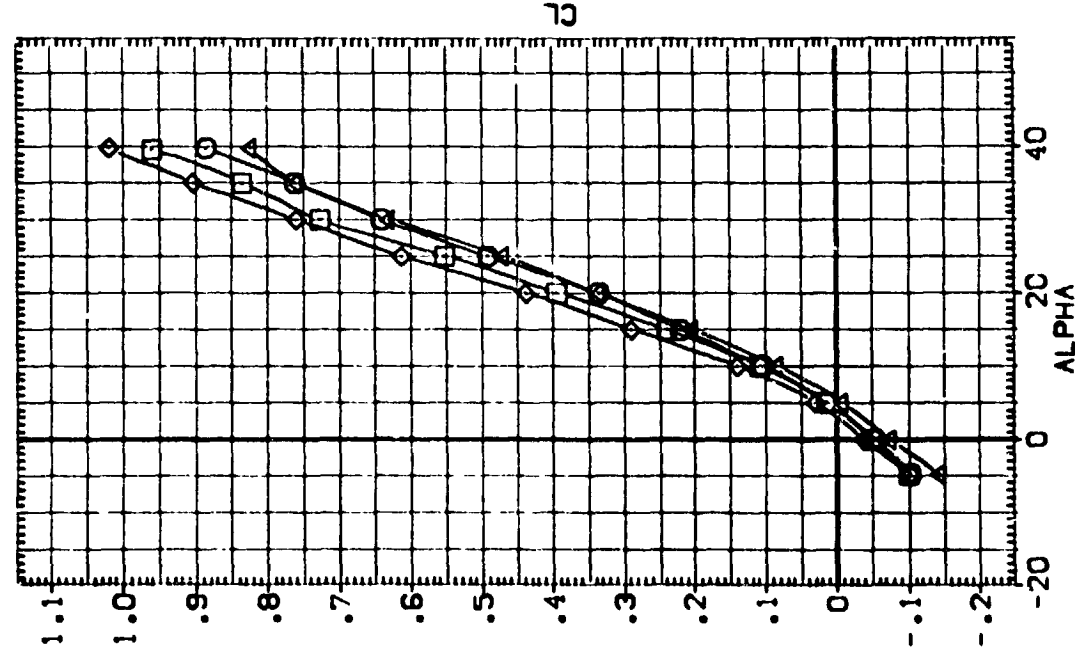
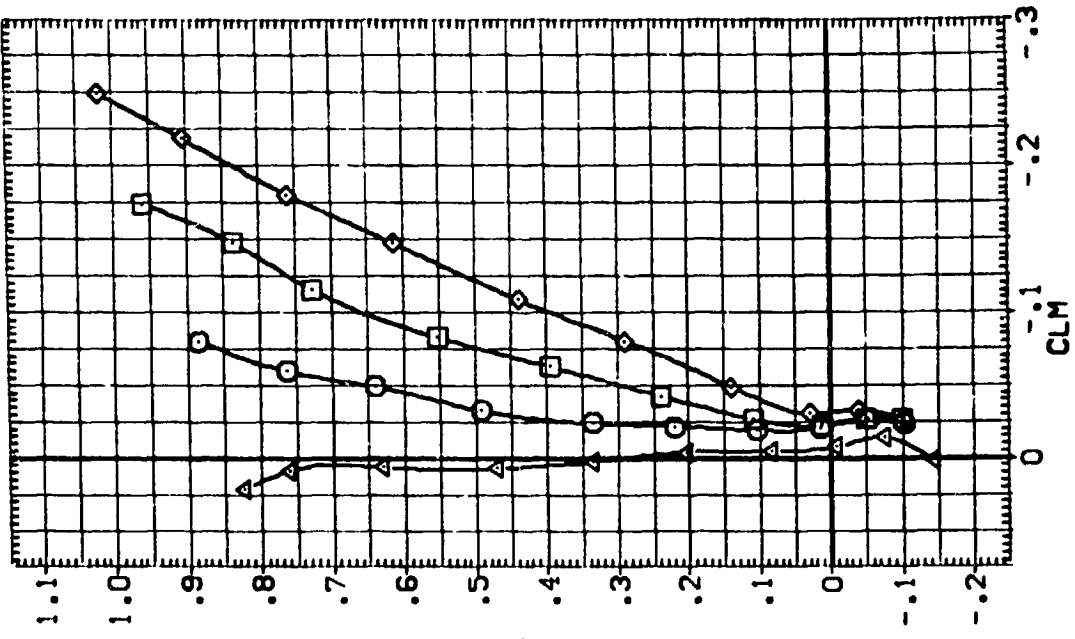
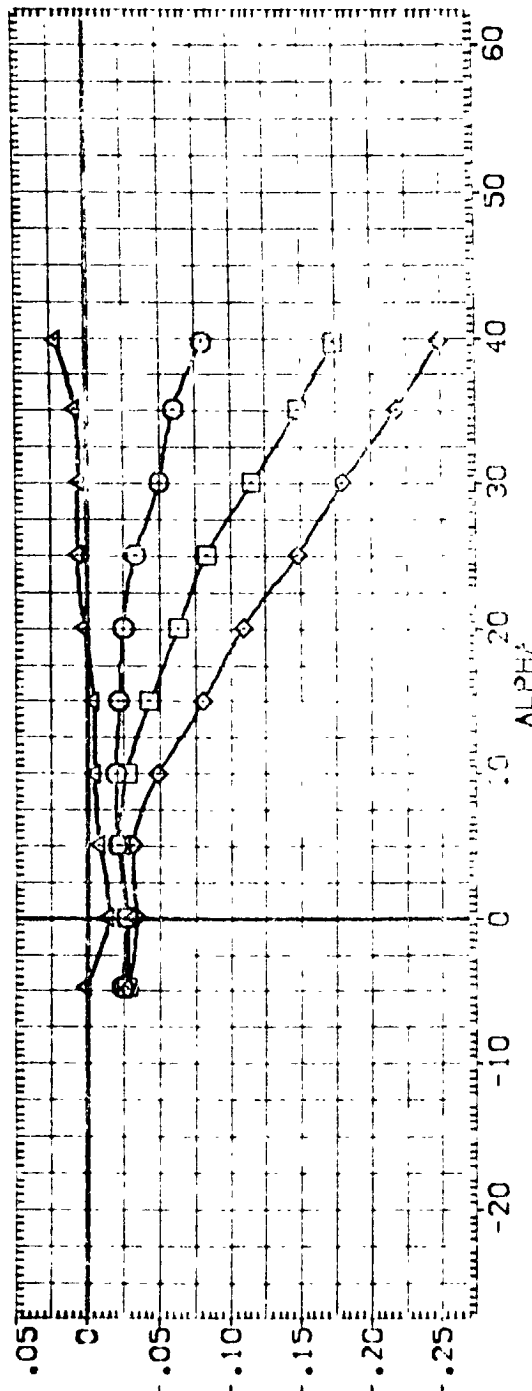


FIGURE 5 EFFECT OF ELEVON AND BODY FLAP DEFLECTION ON LONG CHARACTER (25DEG STING)
 (A)MACH = 19.80

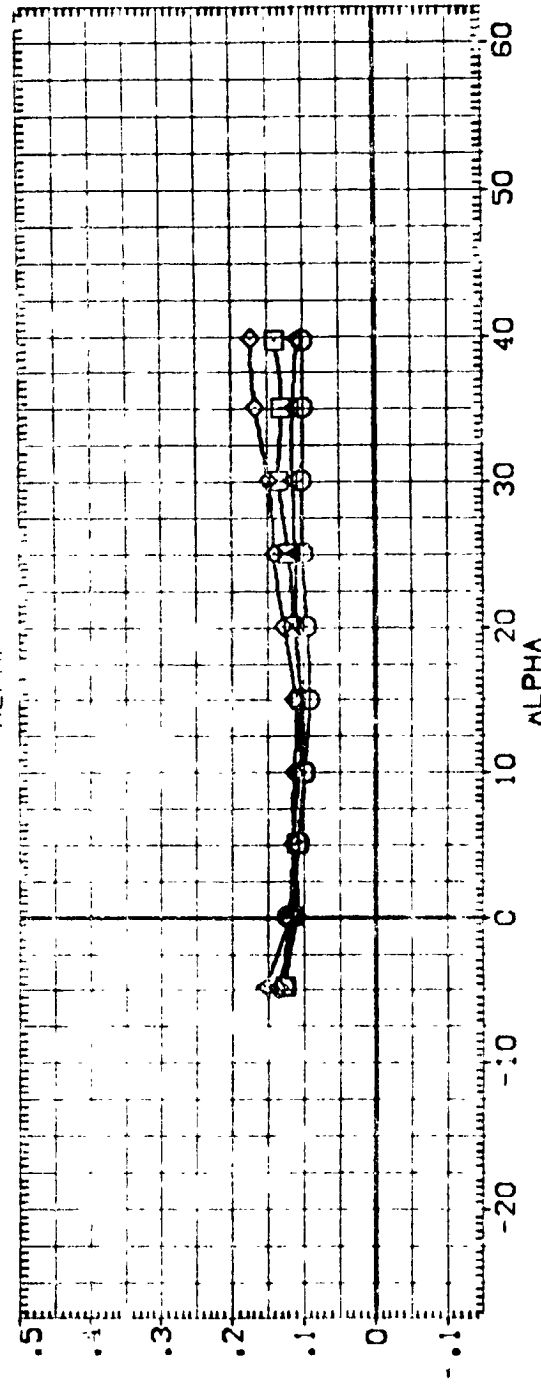


DATA SET SYMBOL CONFIGURATION DESCRIPTION

{R00006}	M19 N.T.-31(CA-88)	(B6ZC1Z 10H14)(V1Z7E43)(V8R5)	ELEVLR	A1LRON	BDFLAP	SPOBRK	REFERENCE INFORMATION
{R00007}	M19 N.T.-31(CA-88)	(B6ZC1Z 10H14)(V1Z7E43)(V8R5)	.000	.000	.000	55.000	SREF 2690.0000 SQ. FT
{R00008}	M19 N.T.-31(CA-88)	(B6ZC1Z 10H14)(V1Z7E43)(V8R5)	10.000	.000	16.300	55.000	LREF 474.8100 INCHES
{R00009}	M19 N.T.-31(CA-88)	(B6ZC1Z 10H14)(V1Z7E43)(V8R5)	20.000	.000	16.300	55.000	BREF 936.6300 INCHES
{R00010}	M19 N.T.-31(CA-88)	(B6ZC1Z 10H14)(V1Z7E43)(V8R5)	-40.000	.000	-11.700	55.000	XPRP 1076.7000 IN. X0
							YPRP .0000 IN. Y0
							ZPRP 375.0000 IN. Z0
							SCALE .0040



CLM



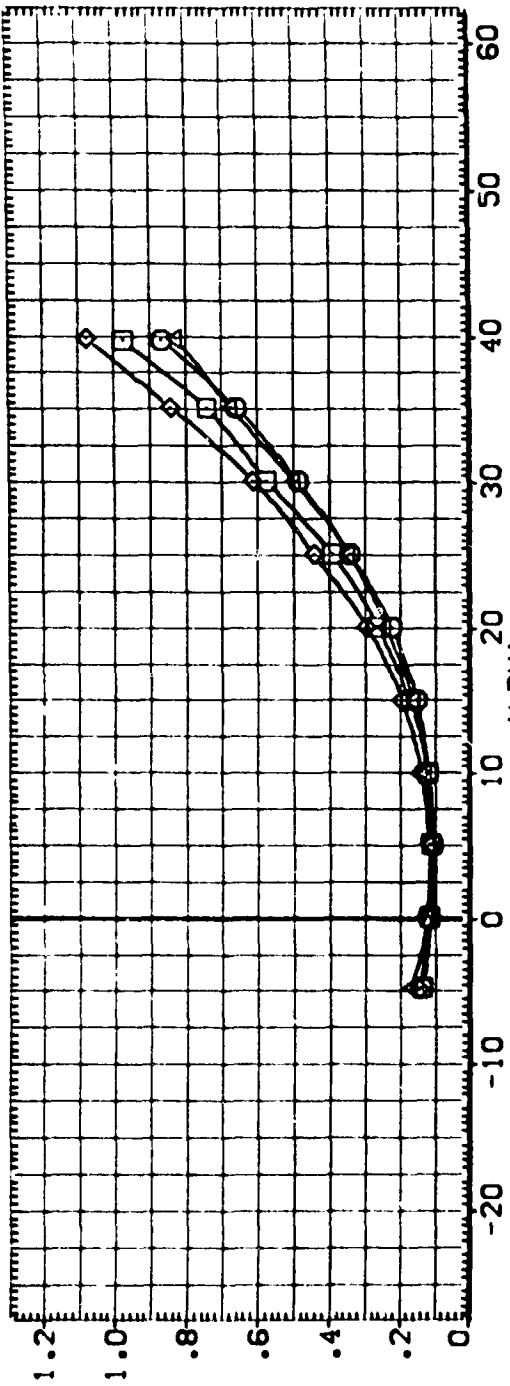
CA

FIGURE 5 EFFECT OF ELEVON AND BODY FLAP DEFLECTION ON LONG CHARACTER (25DEG STING)
 (A)MACH = 19.80 PAGE 7

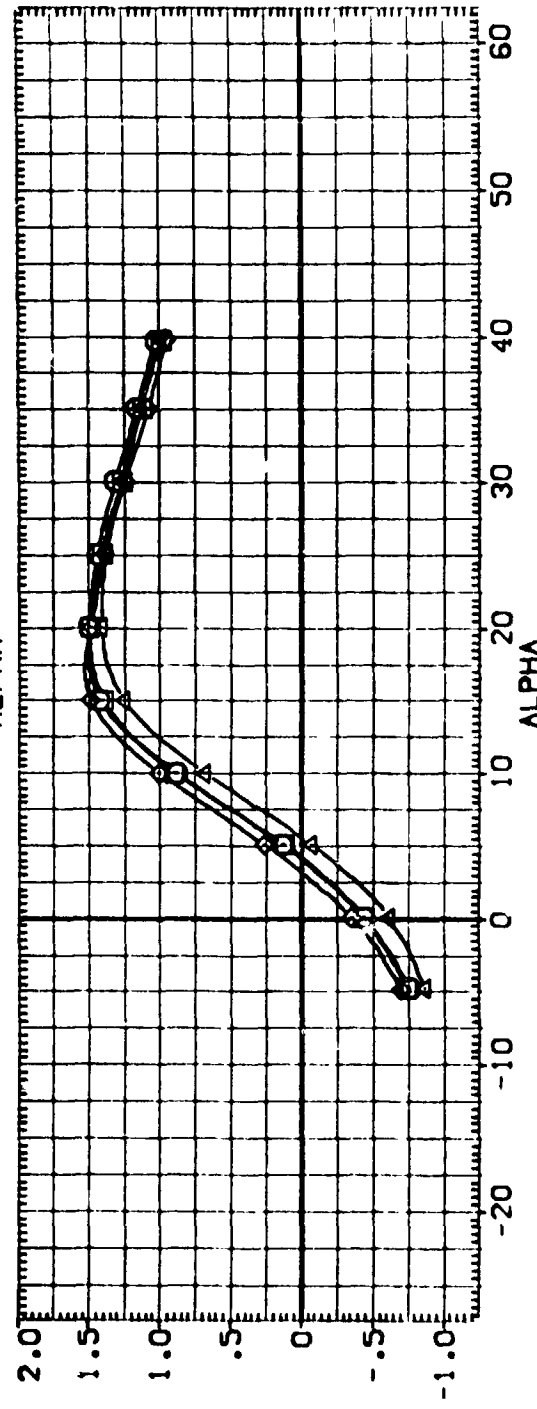
ORIGINAL PAGE IS OF POOR QUALITY



DATA SET SYMBOL	CONFIGURATION DESCRIPTION	ELEVTR	AILERON	BOFLAP	SPOBRK	REFERENCE INFORMATION
{R0008}	M19 N.T.-31(DA-88) (B52C) ZF10H143(V127E43)(V85)	.000	.000	.000	55.000	SREF 2650.0000 SO FV
{R0007}	M19 N.T.-31(DA-88) (B52C) ZF10H143(V127E43)(V85)	10.000	.000	16.300	55.000	LREF 474.8100 INO-ES
{R0108}	M19 N.T.-31(DA-88) (B52C) ZF10H143(V127E43)(V85)	20.000	.000	16.300	55.000	BREF 526.6800 INO-ES
{R0109}	M19 N.T.-31(DA-88) (B52C) ZF10H143(V127E43)(V85)	-10.000	.000	-11.700	55.000	XMPR 1076.7000 IN. YD
						ZMPR .0000 IN. ZD
						SCALE .0040



83



87

FIGURE 5 EFFECT OF ELEVON AND BODY FLAP DEFLECTION ON LONG CHARACT(25DEG STING)



DATA SET SYMBOL: [R00001] [R00004] MIS N.T.: -30(0A-88) (B52C1Z10H143)(V1Z7E43)(V885) MIS N.T.: -30(0A-88) (B52C1Z10H143)(V1Z7E43)(V885)

CONFIGURATION DESCRIPTION: ELEVTR AILERON BDFLAP SPOBRK REFERENCE INFORMATION

SREF	2690.0000	SO. F.
LREF	474.8100	IN. OES
BREF	936.6800	IN. OES
XREF	1076.7000	IN. X0
YREF	0.0000	IN. Y0
ZREF	375.0000	IN. Z0
SCALE	.004C	

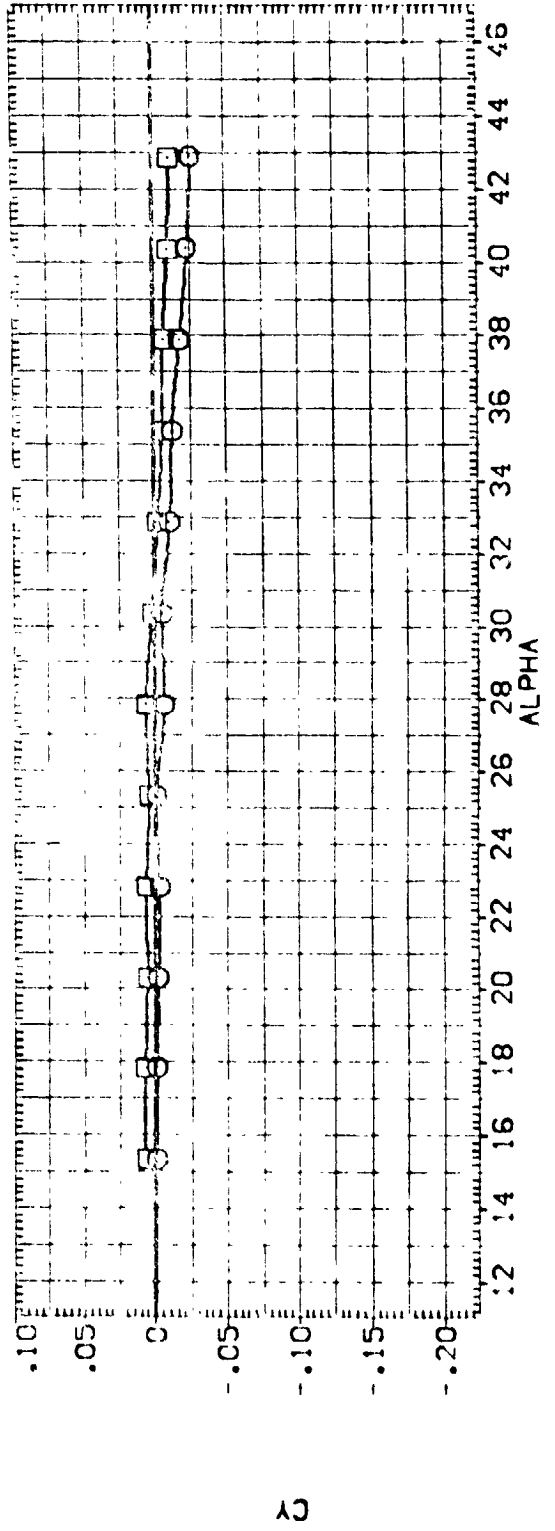
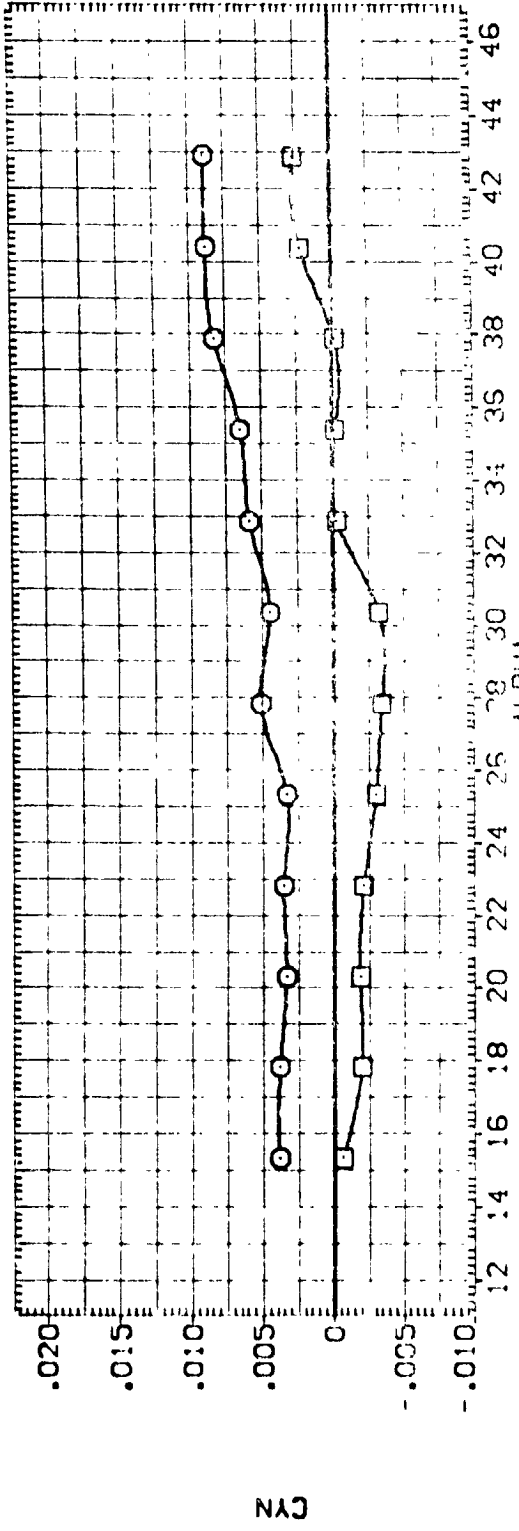


FIGURE 6 EFFECT OF AILERON AND BODY FLAP DEFLECTION ON LAT-DIRECT (45DEG STING)

ORIGINAL PAGE IS OF POOR QUALITY



DATA SET SYMBOL: M19 N.T.-30(DA-89) (852C12 M141) (V895)
 {R00001} M19 N.T.-30(DA-89) (852C12F10H141) (V127E43) (V895)

CONFIGURATION DESCRIPTION
 M19 N.T.-30(DA-89) (852C12 M141) (V895)
 M19 N.T.-30(DA-89) (852C12F10H141) (V127E43) (V895)

REFERENCE INFORMATION
 SREF 2690.0000 SQ. FT.
 LREF 474.8100 INCHES
 BREF 936.6900 IN. X0
 XMRP 1076.7000 IN. Y0
 YMRP .0000 IN. Z0
 ZMRP 375.0000 IN. Z0
 SCALE .0010

ELEVTR .000
 AIRLON .000
 BOFLAP .000
 SPOBRK 55.000
 55.000

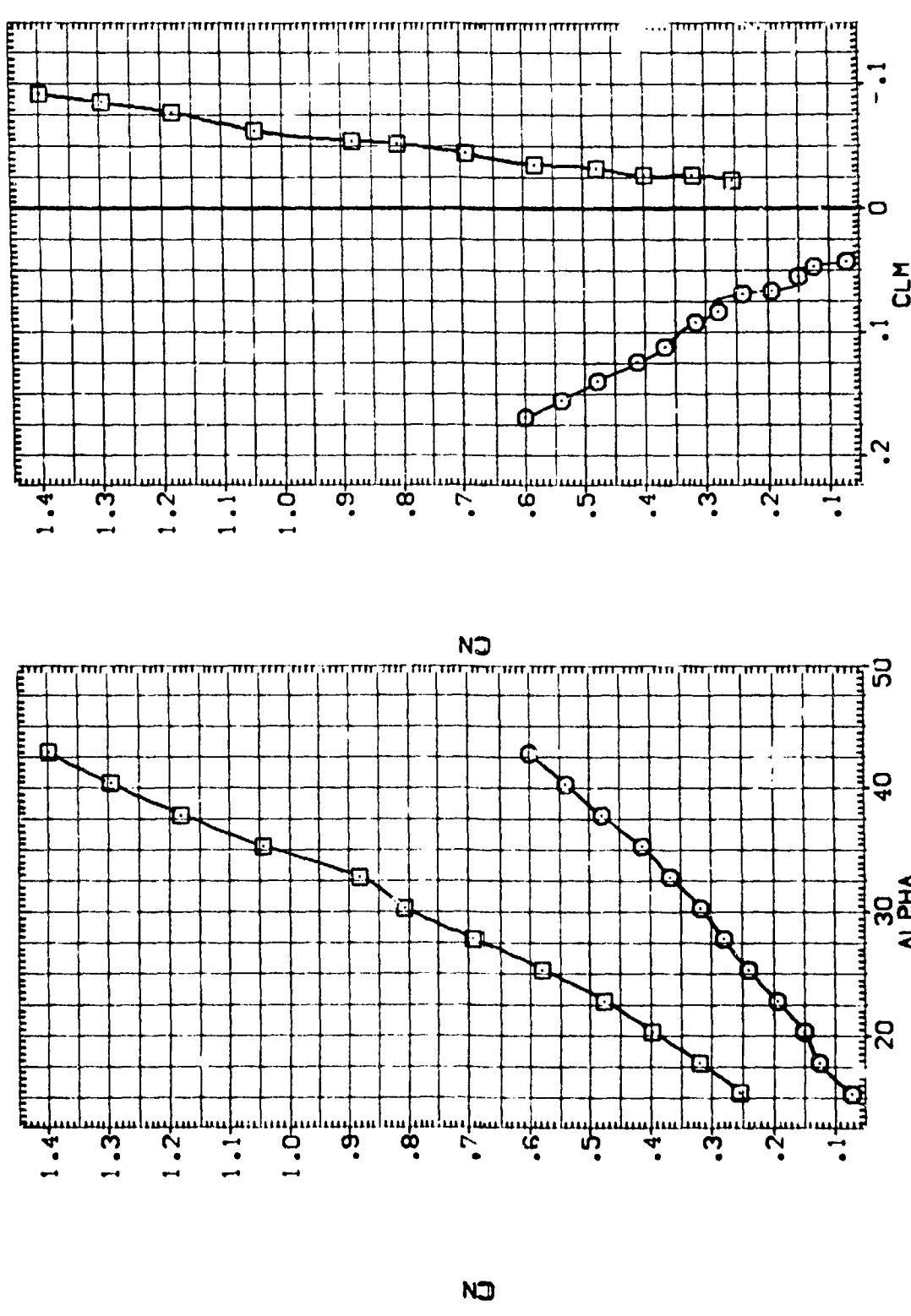


FIGURE 7 EFFECT OF WING AND BODY FLAP ON LONG. CHARACT. (45 DEG. STING)

(A)MACH = 19.80



DATA SET SYMBOL: {R00005} {R00001}

CONFIGURATION DESCRIPTION:
 H19 N.T.-30(0A-88) (862C12) M141(1V895)
 H19 N.T.-30(0A-88) (862C12F10H141) (1V127E43) (1V895)

ELEVTR AILRON BDFLAP SPOBRK
 .000 .000 .000 .000

REFERENCE INFORMATION:
 SREF 2690.0000 SO. FT
 LREF 474.8100 INCHES
 BREF 906.68 IN. X 90
 YTRP 1076.7000 IN. X 90
 ZTRP .0000 IN. X 90
 SCALE 375.0000 IN. X 90
 .0040

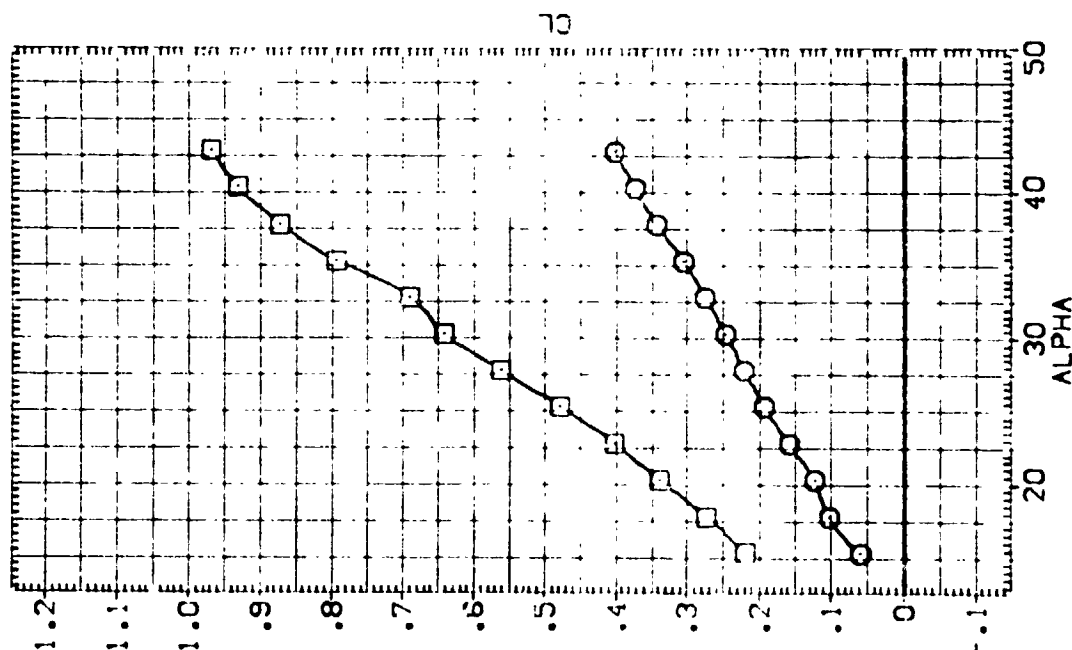
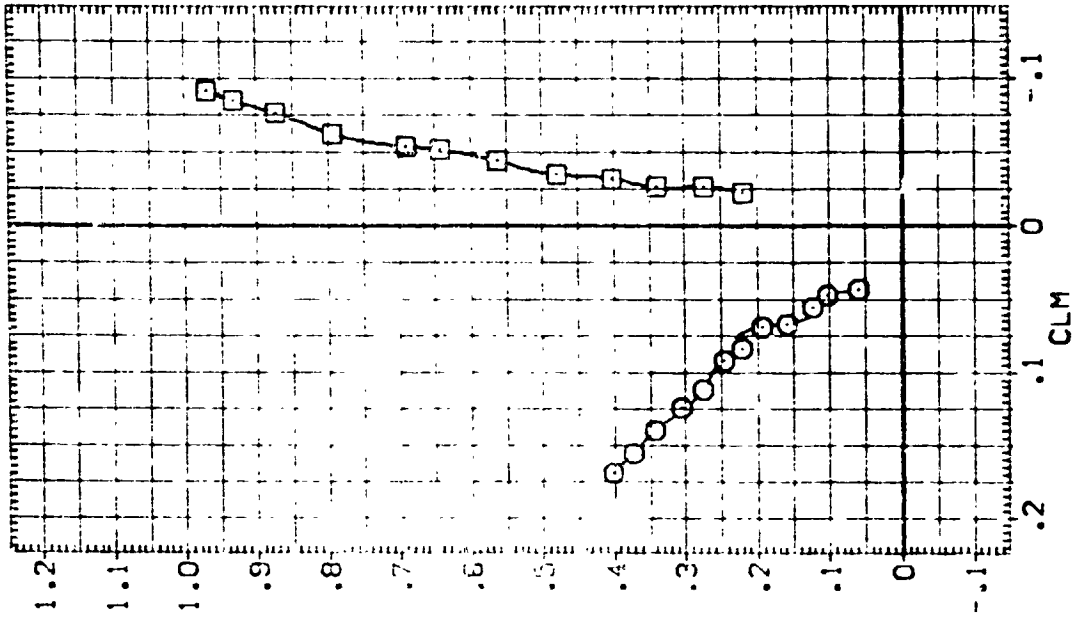


FIGURE 7 EFFECT OF WING AND BODY FLAP ON LONG. CHARACT. (45 DEG. STING)
 (A)MACH = 19.80

DATA SET SYMBOL: 000005
 CONFIGURATION DESCRIPTION: HIS N.T. 30(9A-00) (SECT 12) (M14) (V17E43) (VERS)
 REFERENCE INFORMATION:
 SREF 2850.0000 SO. F.
 LREF 474.8100 INCHES
 XREF 826.6800 IN. XG
 YREF 1076.7000 IN. YG
 ZREF .0000 IN. ZG
 SCALE 375.0000
 .004C

ELEVTR ALLRON BOFLAP SPOBRK
 .000 .000 .000 .000
 .000 .000 .000 .000

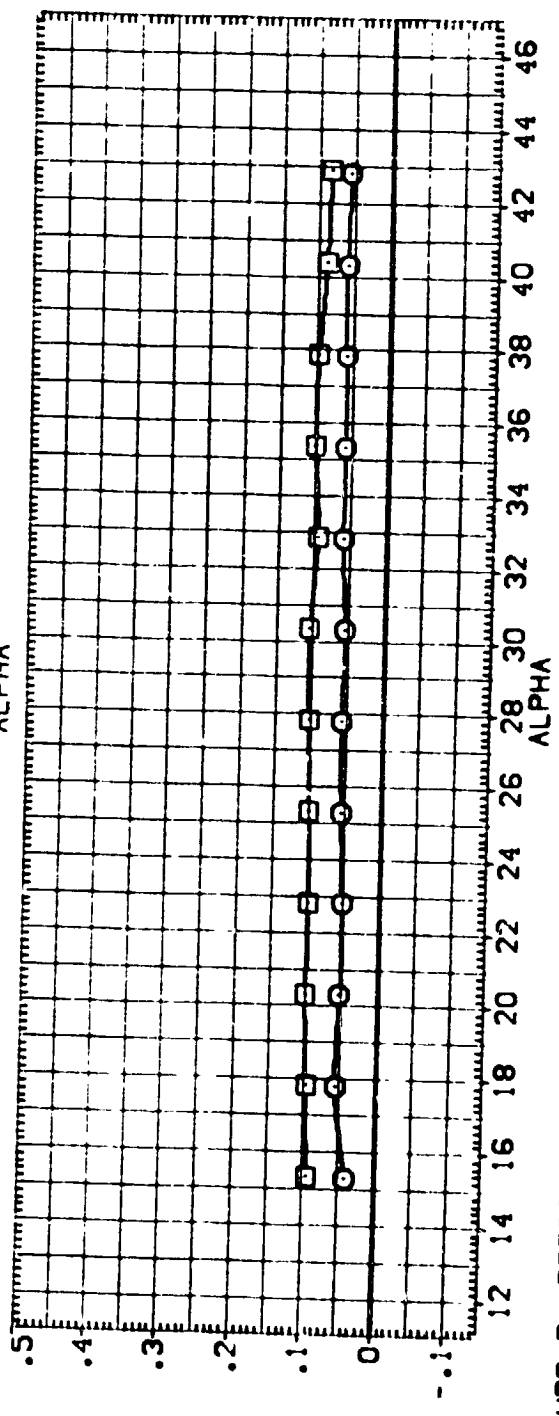
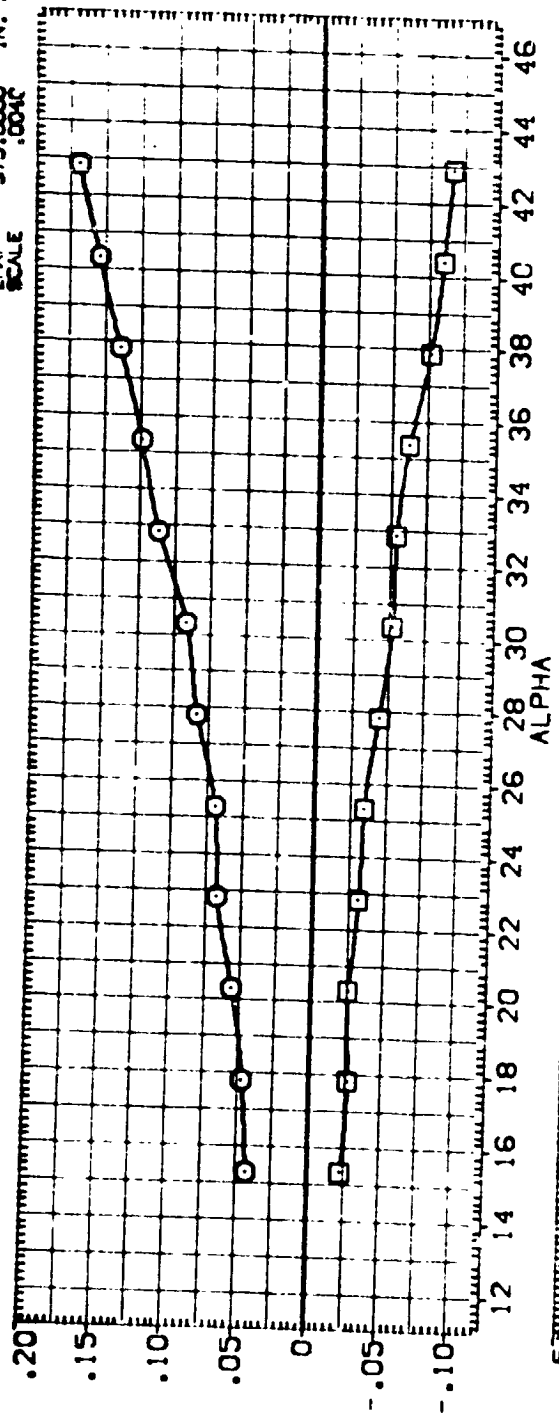


FIGURE 7 EFFECT OF WING AND BODY FLAP ON LONG. CHARACT. (45 DEG. STING)
 (A)MACH = 19.80

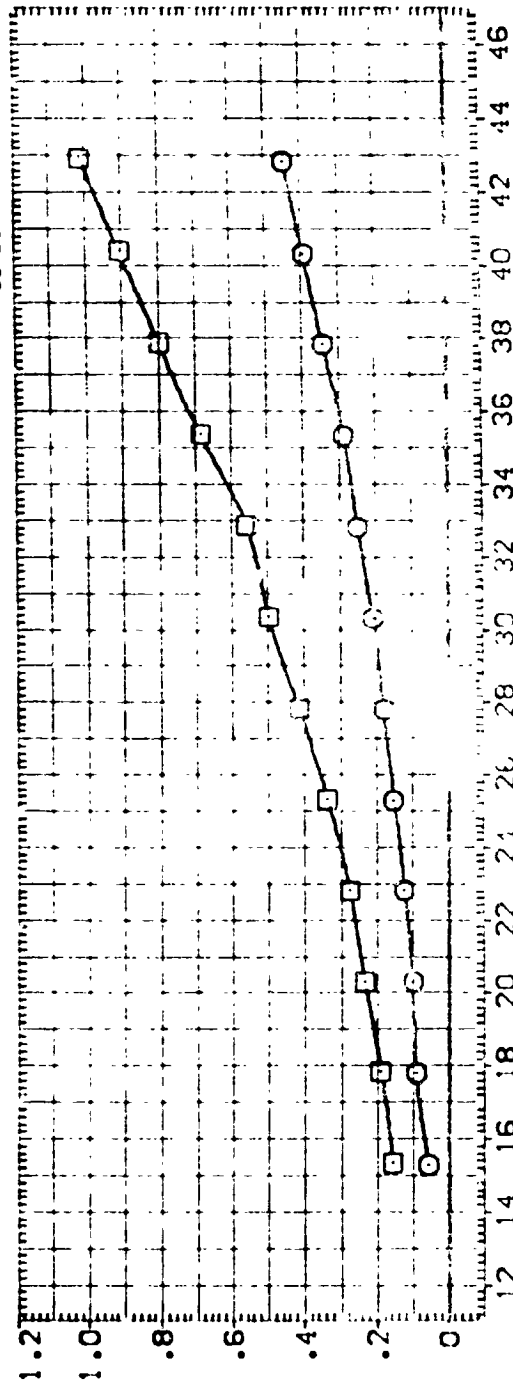


DATA SET SYMBOL: **8** CONFIGURATION DESCRIPTION: M19 N.T.-30(0A-08) {B62C12 M14} {VARS} M19 N.T.-30(0A-08) {B62C12-10M14} {V17E43} {VARS}

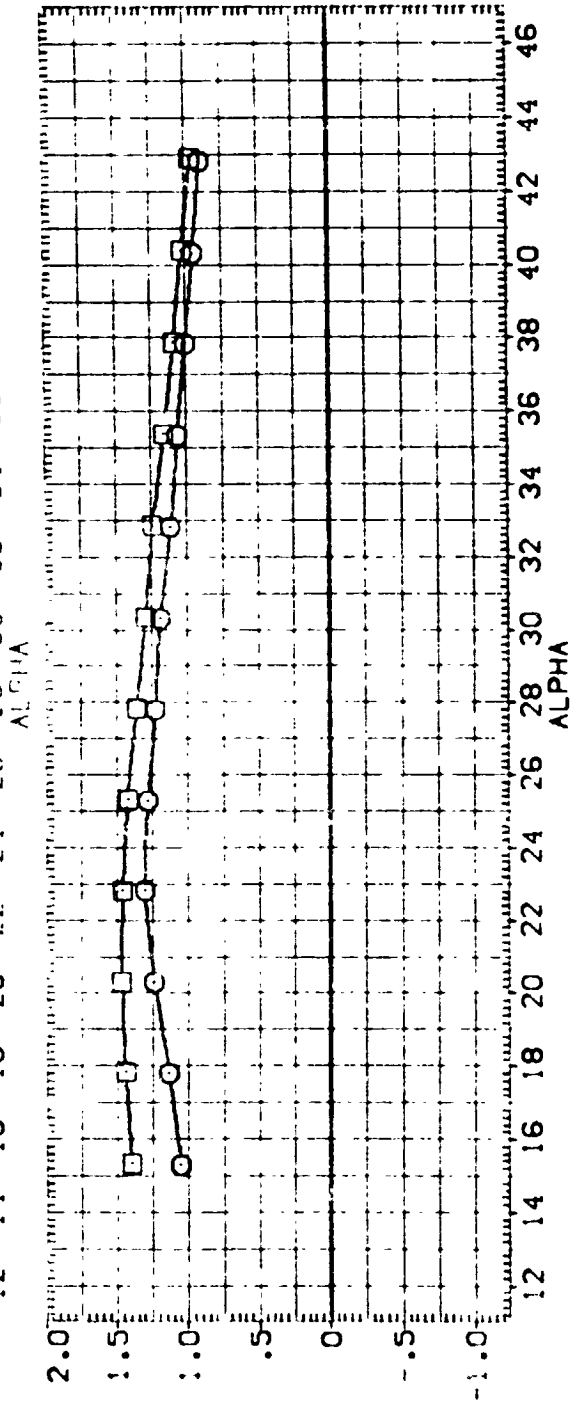
REFERENCE INFORMATION:

SREF	2690	.0000	SPORBK	55.000
LREF	474	8100		55.000
BREF	506	5800		
XPRP	1076	.7000		
YPRP		.0000		
ZPRP	375	.0000		
SCALE		.0040		

SO. FT. IN. OZ. IN. YD IN. YD



CL



L/D

FIGURE 7 EFFECT OF WING AND BODY FLAP ON LONG. CHARACT. (45 DEG. STING)
 (A) MACH = 19.80

DATA SET SYMB. CONFIGURATION DESCRIPTION
 {R0000} M19 N1.30(CA-00) (B52C12F10M14)(V1Z7E43)(V0RS)
 {R0000} M19 N1.31(CA-00) (B52C12F10M14)(V1Z7E43)(V0RS)

ELEVTR BOFLAP SPOBRK STING
 .000 .000 .000 45.000
 .000 .000 .000 25.000

REFERENCE INFORMATION
 SREF 2690.0000 20. FT
 LREF 474.8100 IN.-ES
 BREF 566.6800 IN.-ES
 XMRP 1076.7000 IN. X0
 YMRP .0000 IN. Y0
 ZMRP 375.0000 IN. Z0
 SCALE .0040

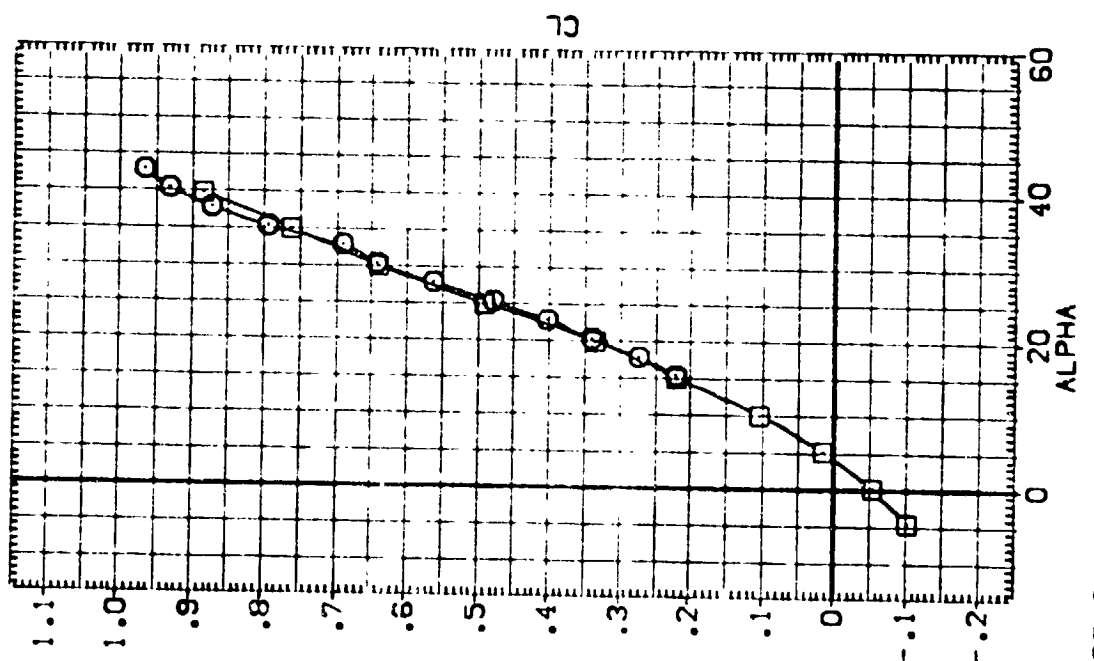
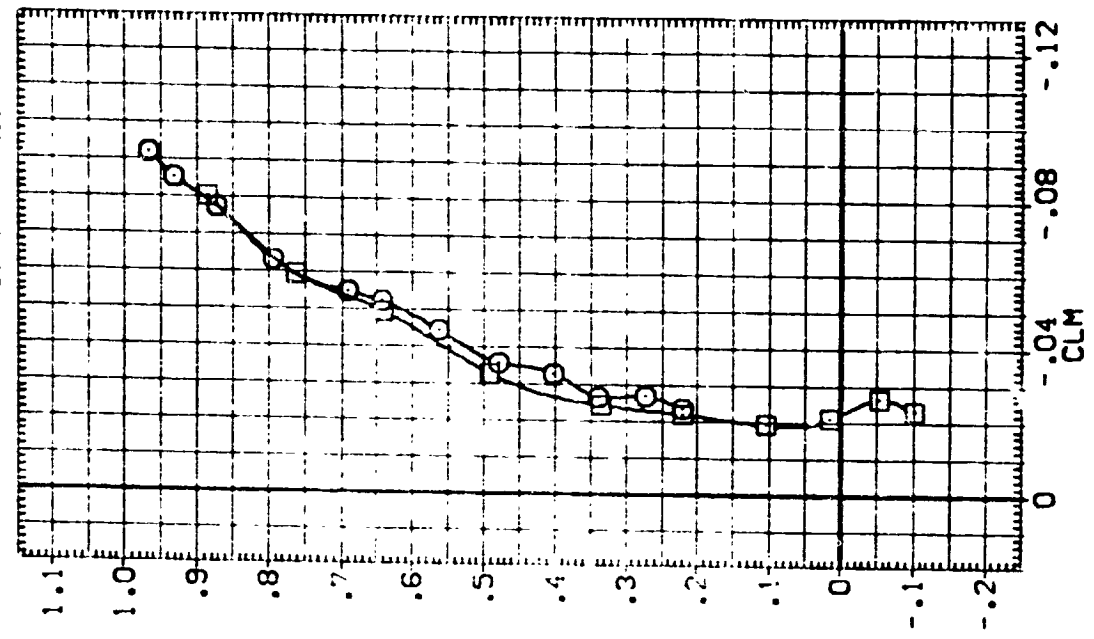
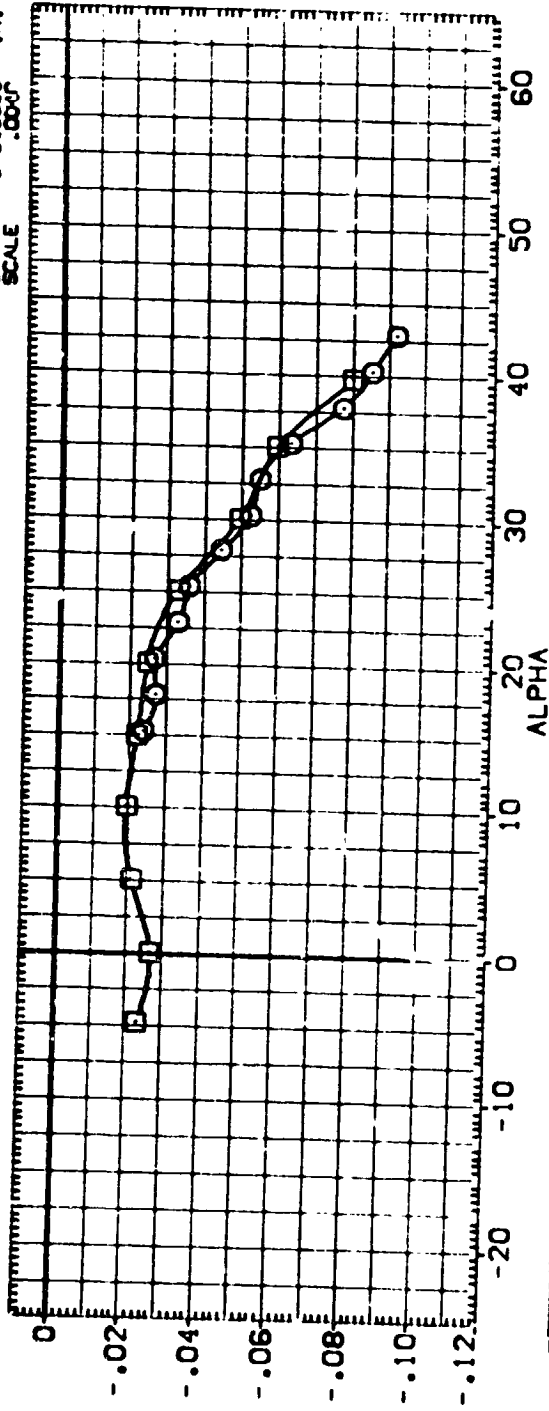


FIGURE 8 EFFECT OF STING SUPPORT ON LONG. CHARACT. (CONTROLS NEUTRAL)
 (A) MACH = 19.80

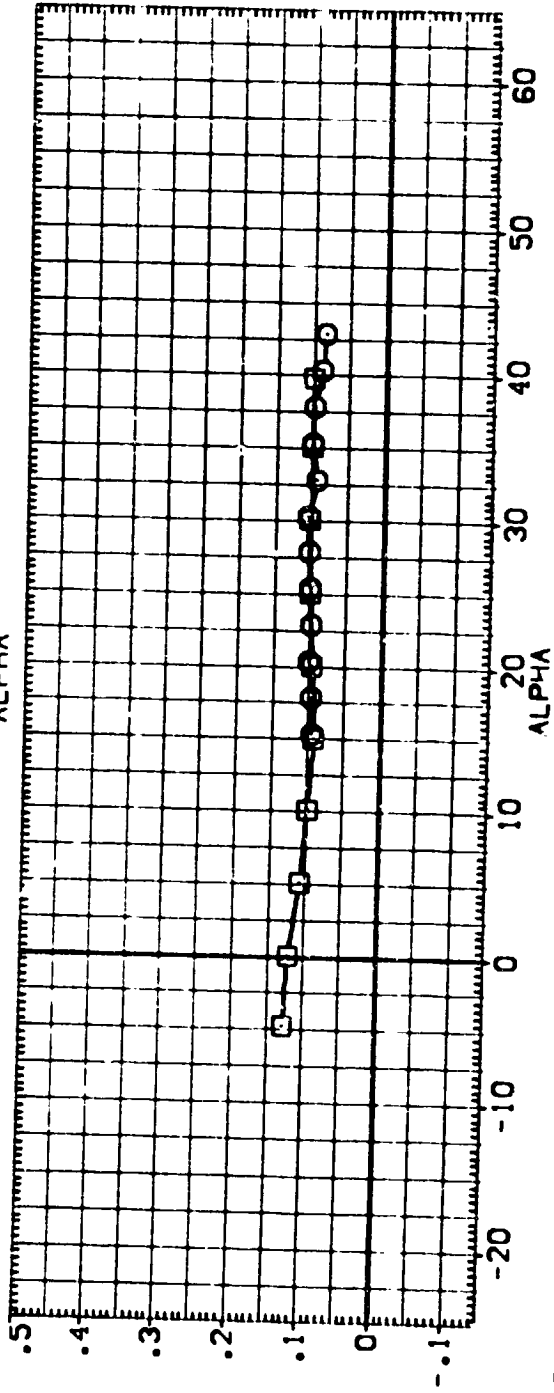
DATA SET SYMBOL CONFIDURATION DESCRIPTION
 {R00001} □ M19 N.Y.-30(CA-00) {662C12F 0141}{V127E43}{V085}
 {R00006} □ M19 N.Y.-31(CA-00) {662C12F 0141}{V127E43}{V085}

ELEVTR 807LAP 2FOBRK 8TING
 .000 .000 55.000 45.000
 .000 .000 55.000 25.000

REFERENCE INFORMATION
 SREF 2690.0000 50. F.
 LREF 474.8100 INCHES
 BREF 506.6300 INCHES
 XAPP 1076.7000 IN. X0
 YAPP .0000 IN. Y0
 ZAPP .0000 IN. Z0
 SCALE .0001



53



5

FIGURE 8 EFFECT OF STING SUPPORT ON LONG. CHARACT. (CONTROLS NEUTRAL)

(A) MACH = 19.80

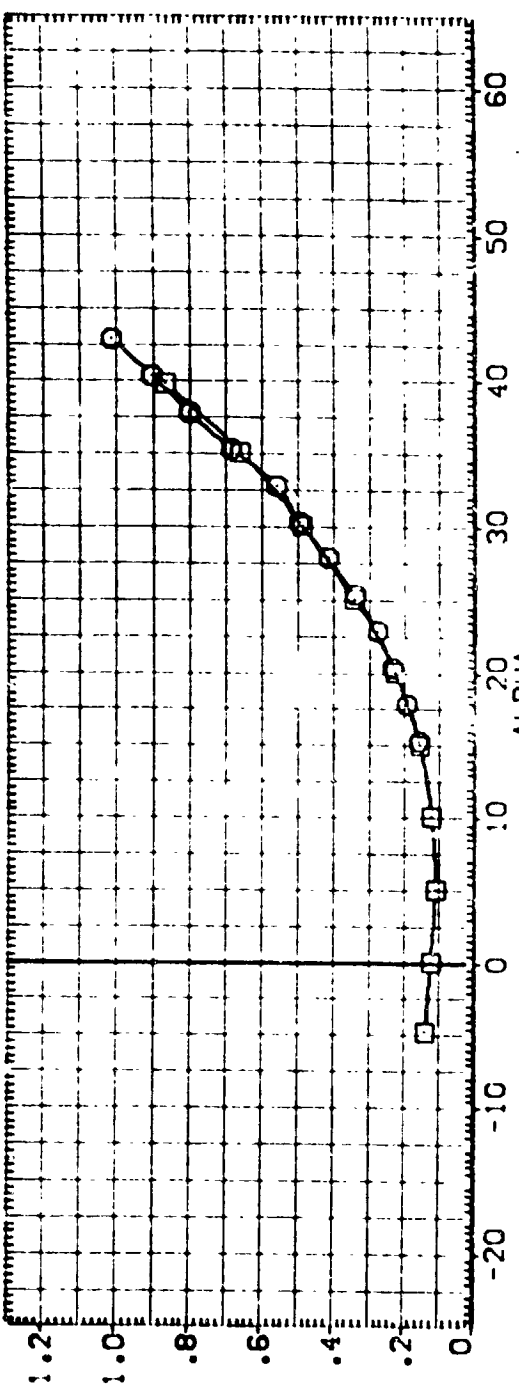


DATA SET SYMBOL: []
 CONFIGURATION DESCRIPTION:
 M19 N.T.-30(DA-88) (BACC12(DM14)(V127E43)(V875))
 M19 N.T.-31(DA-88) (BACC12(DM14)(V127E43)(V875))

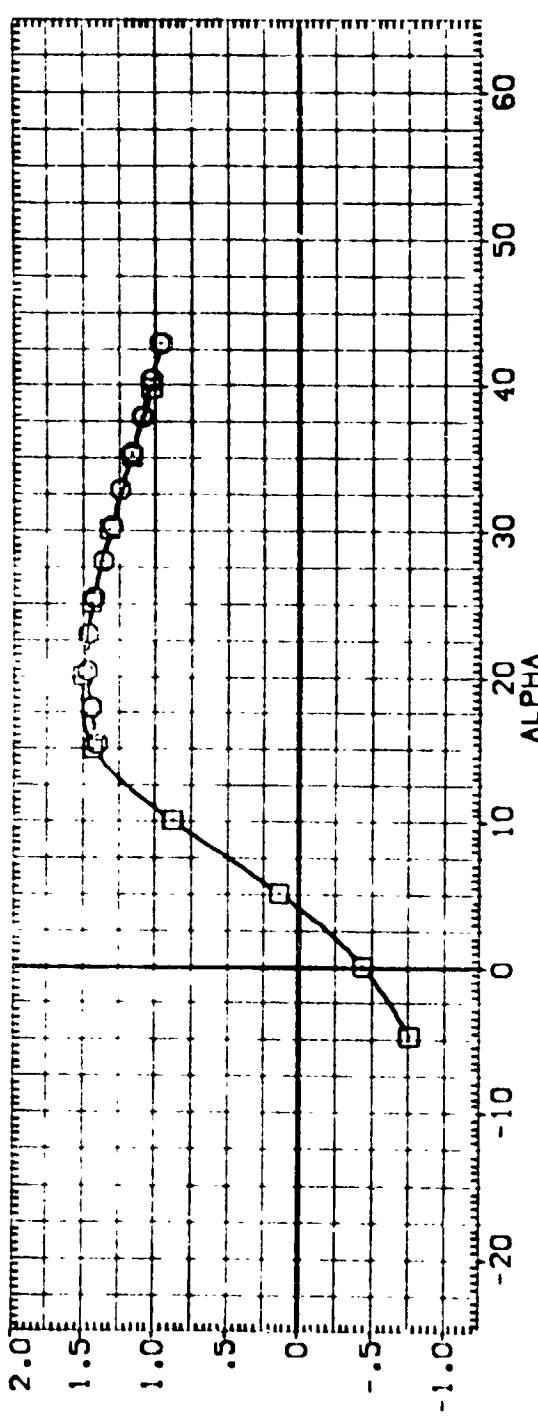
ELEVTR: .000
 BOFLAP: .000
 SPDRX: 55.000
 STING: 45.000

REFERENCE INFORMATION:
 SREF: 2650.0000
 LREF: 474.8100
 BREF: 506.5800
 XREF: 1076.7000
 YREF: .0000
 ZREF: 375.0000
 SCALE: .0040

INFORMATION:
 SO: INO-ES
 NO: INO-ES
 N: N: X0
 N: N: X0
 N: N: X0



93



97

FIGURE 8 EFFECT OF STING SUPPORT ON LONG. CHARACT. (CONTROLS NEUTRAL)

(A) MACH = 19.80

DATA SET SYMBOL: 8
 CONFIGURATION DESCRIPTION: M19 N.T.-31(0A-08) (852C12F10M14) (V127E43)(V085)
 {800002} M19 N.T.-31(0A-08) (852C12F10M14) (V127E43)(V085)
 {800008}

ELEVTR: 20.000
 BODYFLAP: 16.300
 SPOONK: 55.000
 STING: 45.000

REFERENCE INFORMATION:
 SHEET: 2850.0000
 LINE: 474.8100
 CASE: 508.5800
 XPROP: 1076.7000
 YPROP: .0000
 Z-LOC: 375.0000
 SCALE: IN. 20

NO. 80
 IN. 40
 IN. 10
 IN. 20

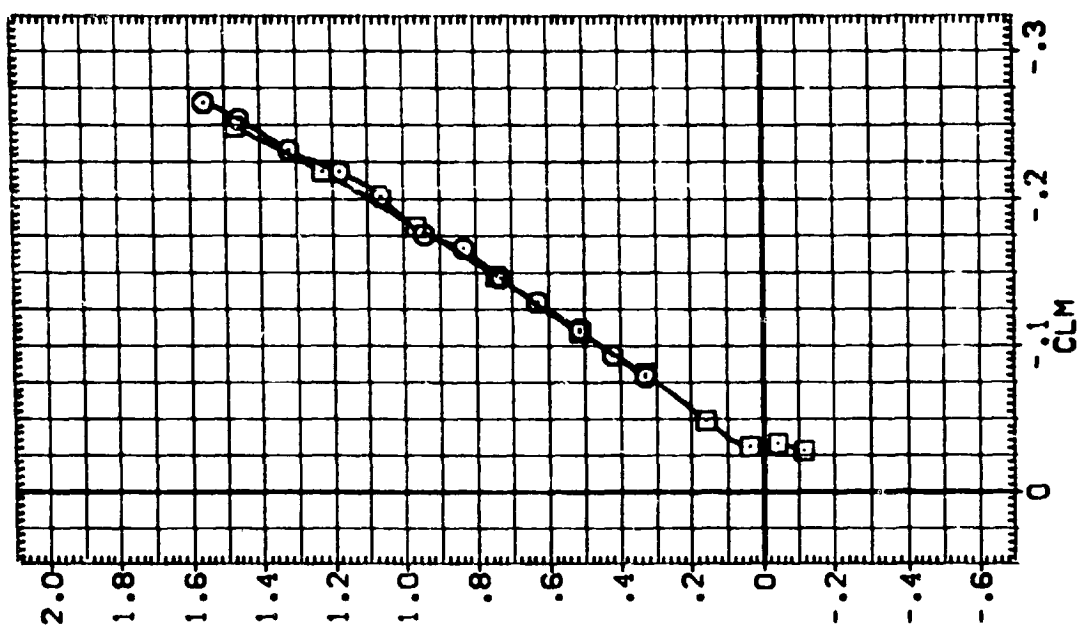
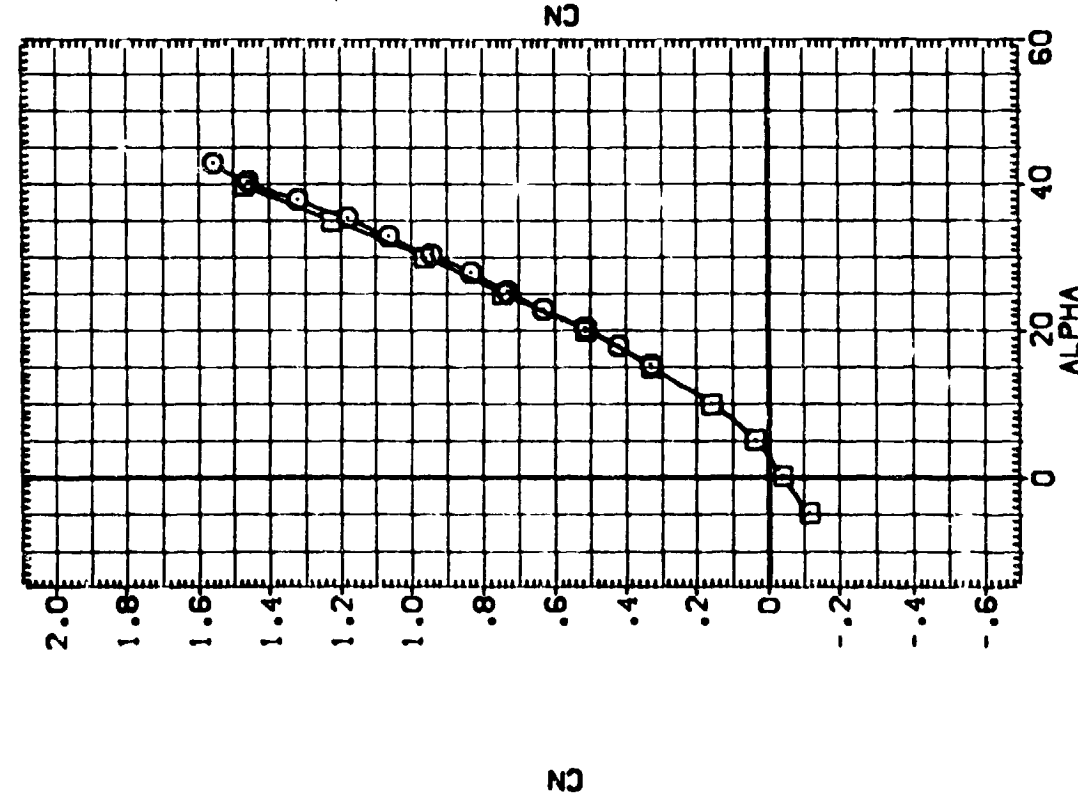


FIGURE 9 EFFECT OF STING SUPPORT ON LONG. CHARACT. (ELEVON= 20, BODY FLAP=16.3)
 (A)MACH = 19.80



DATA SET SYMBOL: 9
 CONFIGURATION DESCRIPTION: M19 N17-30(DA-68) (B52C12: (M14) (V127E43)) (V8F5)
 M19 N17-31(DA-68) (B52C12: (M14) (V127E43)) (V8F5)

ELEVTR: 20.000
 20.000

BOFLAP: 16.300
 16.300

SFOBRK: 55.000
 55.000

STING: 15.000
 25.000

REFERENCE INFORMATION:
 SREF: 2090.0000 SQ. FT.
 LREF: 174.8100 IN.-ES
 BREF: 936.8600 IN.-ES
 XMRP: 1076.7000 IN. X0
 YMRP: .0000 IN. Y0
 ZMRP: 375.0000 IN. Z0
 SCALE: .0040

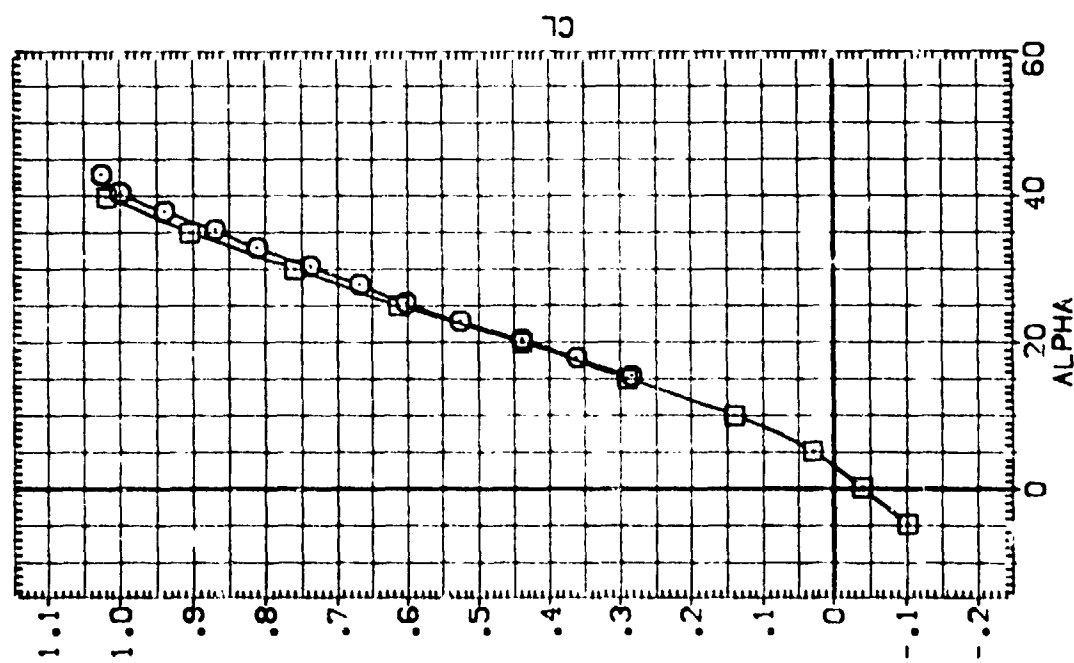
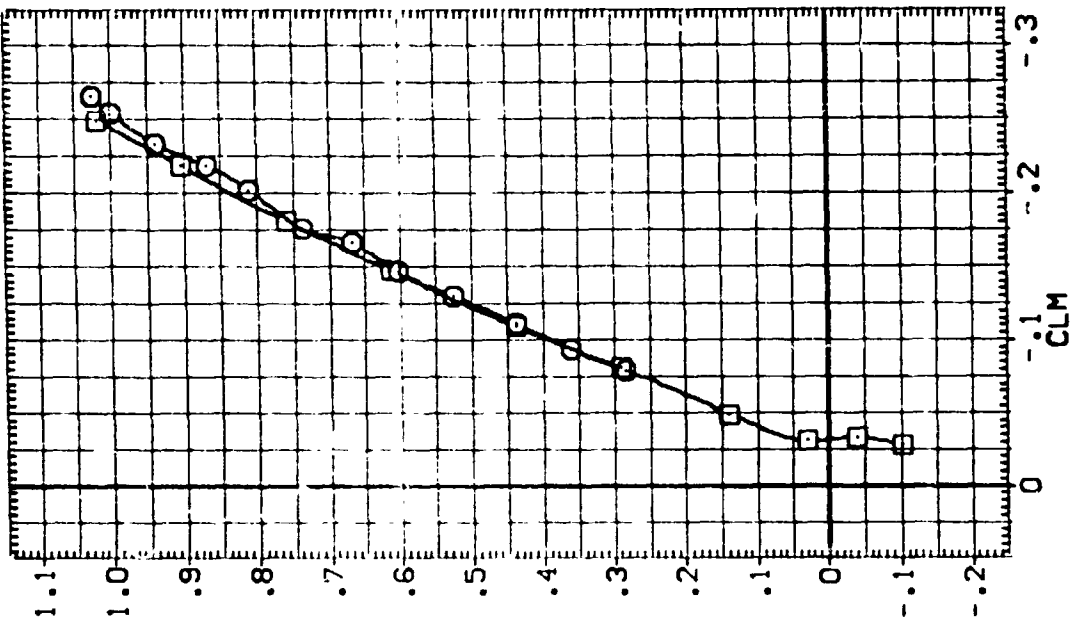
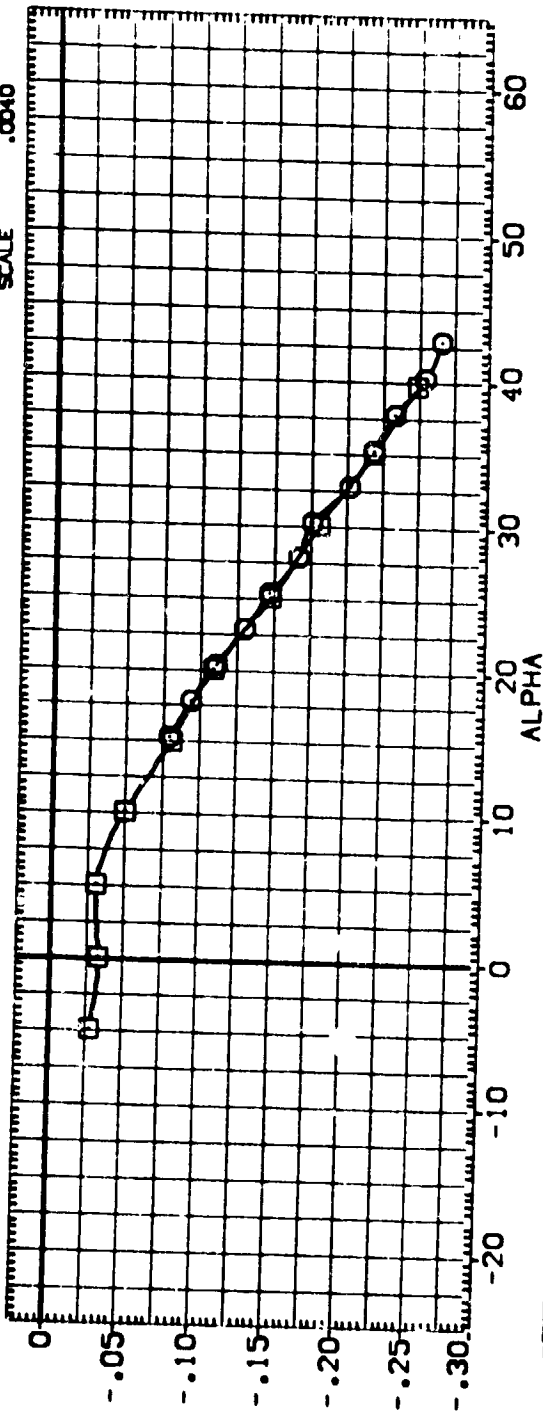


FIGURE 9 EFFECT OF STING SUPPORT ON LONG. CHARACT. (ELEVON= 20, BODY FLAP=16.3)
 (A)MACH = 19.80

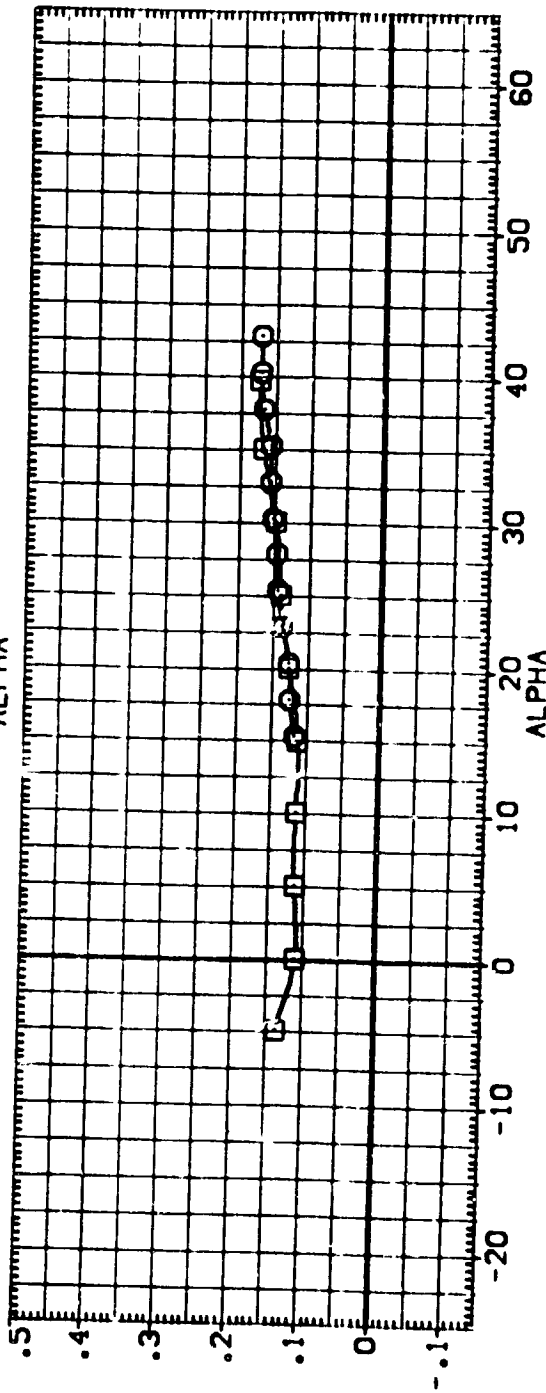
DATA SET SYMB. CONFIGURATION DESCRIPTION
 { 100007 } □ MIS N.T.-30(OA-08) (882C12F10H14)(V127E43)(V05)
 { 100008 } □ MIS N.T.-31(OA-08) (882C12F10H14)(V127E43)(V05)

ELEVTR 20.000
 BODYFLAP 16.300
 STING 45.000

REFERENCE INFORMATION
 SREF 2890.0000 SQ. FT.
 LREF 474.8100 INCHES
 BREF 508.8800 INCHES
 XMRP 1076.7000 IN. X05
 YMRP .0000 IN. Y05
 ZMRP 375.0000 IN. Z0
 SCALE .0040



CM



CS

FIGURE 9 EFFECT OF STING SUPPORT ON LONG. CHARACT. (ELEVON= 20, BODY FLAP=16.3)
 (A) MACH = 19.80



DATA SET SYMBOL: [REDACTED] [REDACTED]

CONFIGURATION DESCRIPTION: M19 N.1.-31(0A-88) (B62C12F10H14)(V17E43)(V8F5) ELEVTR 20.000 STING 45.000

M19 N.1.-31(0A-88) (B62C12F10H14)(V17E43)(V8F5) ELEVTR 20.000 STING 45.000

SPORBK 55.000

BDFLAP 16.300

SPORBK 55.000

SCALE 375.0000

REFERENCE INFORMATION: SO. FT 50.000

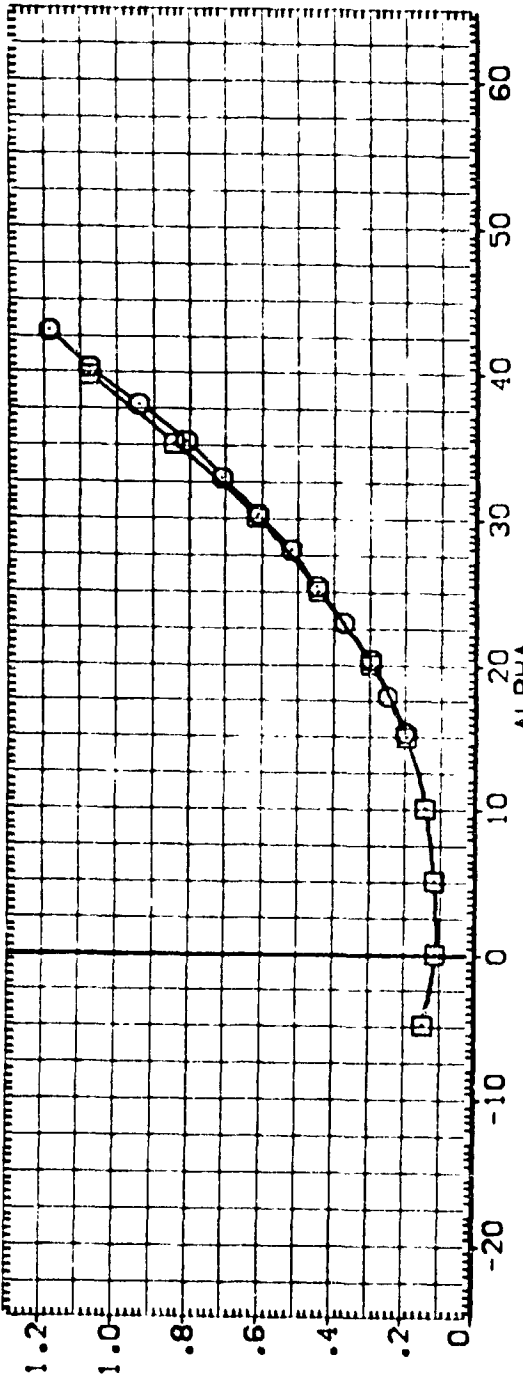
SREF 2650.0000 IN.-ES 100.000

LREF 474.8100 IN.-ES 100.000

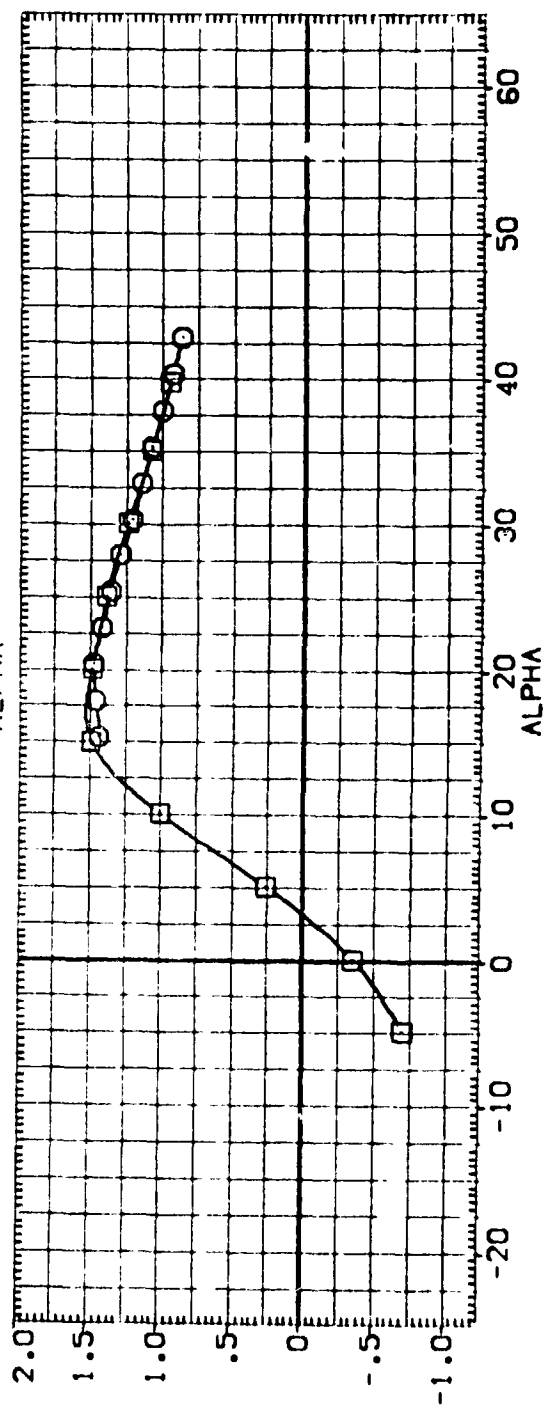
BREF 506.8800 IN.-ES 100.000

XMRP 1076.7000 IN. YD 100.000

YMRP 375.0000 IN. ZD 100.000



CL



L/D

FIGURE 9 EFFECT OF STING SUPPORT ON LONG. CHARACT. (ELEVON= 20, BODY FLAP=16.3)

(A)MACH = 19.80

APPENDIX
TABULATED SOURCE DATA

Tabulations of plotted data are available on request from Data Management Services.

M19 N.T.-30 (CA-89) (BSEC12F10M14) (M127E43) (VMS)

(R00704) (19 MAR 75)

REFERENCE DATA

BREF = 2490.0700 98. FT ZMRP = 1076.7000 IN. MO
 LINEF = 474.8100 INCHES YMRP = .0000 IN. YO
 BREF = 936.8000 INCHES ZMRP = 375.0000 IN. ZO
 SCALE = .07147

BETA = .0000 ELEVTR = .0000
 ALLRON = 10.0000 BOFLAP = -11.7000
 SPOBOK = 55.0000 BALANCE = 1.0000
 STING = 45.0000

RUN NO. 30/0 RINVL = .27 GRADIENT INTERVAL = -5.00/ 5.00

MAON	ALPHA	CN	CA	CLIN	CY	CYM	CL	CD	L/O	XCP/L
19.000	15.320	.28239	.09348	-.02802	.00686	-.00087	.22794	.18141	1.41193	.66930
19.000	17.825	.32886	.09974	-.03247	.00723	-.00196	.28256	.19963	1.44438	.66833
19.000	20.331	.41823	.10806	-.03753	.00590	-.00185	.33332	.24478	1.45173	.66353
19.000	22.835	.47946	.09937	-.03934	.00618	-.00211	.40332	.27785	1.45281	.66080
19.000	25.340	.56590	.10331	-.04769	.00461	-.00392	.46714	.33953	1.38824	.66099
19.000	27.847	.67102	.10745	-.05420	.00639	-.00347	.54312	.40845	1.32970	.67973
19.000	30.355	.79192	.10961	-.06155	.00198	-.00326	.62796	.49496	1.26832	.67880
19.000	32.861	.87872	.11090	-.07028	-.00237	-.00334	.67795	.56995	1.18948	.67944
19.000	35.369	1.07310	.11366	-.07998	-.00369	-.00325	.75217	.67333	1.11709	.67934
19.000	37.879	1.15922	.11264	-.09109	-.00669	-.00321	.84582	.60066	1.05640	.67892
19.000	40.384	1.21985	.10824	-.09199	-.01011	.00316	.86035	.67127	.98747	.67775
19.000	42.892	1.35674	.10244	-.10643	-.01116	.00264	.92428	.99847	.92599	.67887
	GRADIENT	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000



M19 N.T.-33 (CA-69) (862C12 M141) (VAR5) (R00235) (18 MAR 75)

REFERENCE DATA
 SREF = 2690.0777 90. FT WARP = 1076.7000 IN. XO
 LREF = 474.8173 INCHES YMRP = .0000 IN. YO
 BREF = 936.6873 INCHES ZMRP = 375.0000 IN. ZO
 SCALE = .0740

PARAMETRIC DATA

BETA = .000 SPOBRK = 55.000
 BALANCE = 1.000 STING = 43.000

GRADIENT INTERVAL = -5.00/ 3.00

MACH	ALPHA	CN	CA	CLM	CY	CYN	CL	CO	L/D	KCP/L
19.870	15.300	.07152	.03635	.04271	-.01236	.00574	.05007	.05306	1.03309	-.43023
19.870	17.804	.12327	.03432	.04642	-.00327	.00330	.10261	.09021	1.13739	.31367
19.870	20.306	.15324	.03768	.05498	-.00337	.00292	.12332	.09967	1.23731	-.31934
19.870	22.810	.19363	.03956	.06629	-.00328	.00250	.13888	.12166	1.30379	.32402
19.870	25.314	.23997	.03995	.06892	-.00300	.00215	.15306	.15136	1.28063	.34432
19.870	27.818	.27980	.03803	.06323	-.00180	.00139	.22114	.16004	1.22830	.34146
19.870	30.321	.31637	.03394	.09199	-.01376	.00529	.24604	.20168	1.19217	-.34377
19.870	32.828	.36804	.02888	.11171	-.01932	.00737	.27367	.24791	1.11230	.33781
19.870	35.330	.41349	.02707	.12458	-.02534	.00944	.30433	.28567	1.06532	-.35913
19.870	37.836	.46079	.02596	.13993	-.03386	.01467	.34391	.34106	1.00369	.36273
19.870	40.341	.53776	.02583	.15304	-.04362	.01923	.39295	.39295	.94619	-.34391
19.870	42.846	.59880	.02520	.16949	-.04799	.02400	.46134	.44754	.89677	.34381
	GRADIENT	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000

M19 N.T.-31 (CA-69) (862C12F10M14) (M12/E43) (VAR5) (R00236) (18 MAR 75)

REFERENCE DATA

SREF = 2690.0777 90. FT WARP = 1076.7000 IN. XO
 LREF = 474.8173 INCHES YMRP = .0000 IN. YO
 BREF = 936.6873 INCHES ZMRP = 375.0000 IN. ZO
 SCALE = .0740

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
 AIRCON = .000 DDFLAP = .000
 SPOBRK = 55.000 BALANCE = 1.000
 STING = 25.000

GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	CN	CA	CLM	CY	CYN	CL	CO	L/D	KCP/L
19.870	-4.756	-.11435	.12633	-.02327	.00613	.00033	-.10348	.13338	-.76436	.37512
19.870	.049	-.03337	.12060	-.02652	.00481	.00070	-.05367	.12056	-.44521	.46783
19.870	5.056	.02344	.10801	-.02193	.00306	.00066	.01401	.10726	.13011	.97893
19.870	10.064	.12330	.09835	-.01331	.00371	-.00006	.00421	.11636	.08032	.01763
19.870	15.074	.25131	.09122	-.02203	-.00332	.00230	-.21894	.13344	1.42666	.68226
19.870	20.084	.39227	.09492	-.02446	.00151	.00090	.33582	.22386	1.50013	.67293
19.870	25.098	.56943	.10066	-.03272	.00495	.00006	.49108	.34117	1.43938	.67043
19.870	30.112	.79882	.10115	-.04947	.00219	.00147	.64027	.48825	1.31135	.67279
19.870	35.125	1.00092	.09931	-.05975	.00079	.00021	.76152	.65711	1.13689	.67197
19.870	39.789	1.23361	.09921	-.08028	.00033	.00100	.88442	.66687	1.02163	.67335
	GRADIENT	.01265	-.00119	-.00068	-.00034	.00000	.00000	-.00000	.00000	-.00233

M19 N.T.-31 (CA-89) (BSEC12F10M1.4) (M12Z7E43) (VWR5)

(R002207) (17 MAR 75)

REFERENCE DATA

SREF = 2690.0000 96. FT XMRP = 1076.0000 IN. NO
LREF = 474.8100 INCHES YMRP = .0000 IN. YO
BREF = 936.6000 INCHES ZMRP = 375.0000 IN. ZO
SCALE = .0040

PARAMETRIC DATA

BETA = .000 ELEVTR = 10.000
AFLRON = .000 BDFLAP = 16.300
SPOBRK = 55.000 BALANCE = 1.000
STTING = 29.000

RUN NO. 3/ D RM/L = .21 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	CN	CA	CLM	CY	CYM	CL	CD	L/D	KCP/L
19.000	-4.755	-11106	.12540	-.02662	.00003	.00161	-.10028	.13418	-.74734	.56114
19.000	.050	-.03070	.11445	-.02730	.00446	-.00032	-.11440	-.44409	-.45106	
19.000	9.037	.02174	.10675	-.02243	.00097	.00106	.01211	.10955	.11075	1.02967
19.000	10.065	.12758	.09979	-.02676	.00161	-.00026	.10 96	.18032	.89593	.72737
19.000	13.075	.27506	.10322	-.04292	.00057	-.00022	.23075	.17121	1.39449	.70746
19.000	20.068	.49927	.11252	-.06295	.00186	-.00046	.39269	.26341	1.49082	.70044
19.000	23.100	.86593	.11965	-.06291	.00339	-.00093	.52229	.39083	1.41312	.69502
19.000	30.095	.91596	.13237	-.11596	.00310	-.00040	.72611	.57582	1.26942	.69680
19.000	35.126	1.11023	.12920	-.14766	.00439	-.00027	.83426	.74365	1.12188	.69895
19.000	39.741	1.36296	.13665	-.17384	.00625	-.00061	.96034	.97680	.96356	.69694
	GRADIENT	.01256	-.00228	-.00010	.00093	-.00044	.01030	-.00412	.06311	-.02274

M19 N.T.-31 (CA-89) (BSEC12F10M1.4) (M12Z7E43) (VWR5)

(R002208) (18 MAR 75)

REFERENCE DATA

SREF = 2690.0000 96. FT XMRP = 1076.0000 IN. NO
LREF = 474.8100 INCHES YMRP = .0000 IN. YO
BREF = 936.6000 INCHES ZMRP = 375.0000 IN. ZO
SCALE = .0040

PARAMETRIC DATA

BETA = .000 ELEVTR = 20.000
AFLRON = .000 BDFLAP = 16.300
SPOBRK = 55.000 BALANCE = 1.000
STTING = 25.000

RUN NO. 8/ D RM/L = .20 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	CN	CA	CLM	CY	CYM	CL	CD	L/D	KCP/L
19.000	-4.874	-11425	.13621	-.02755	-.00206	.00184	-.10226	.14549	-.70321	.56191
19.000	.052	-.03936	.11072	-.03310	-.00365	.00156	-.03946	.10959	-.33699	.34070
19.000	9.059	.03964	.11266	-.03092	.00104	.00023	.02975	.11575	.23703	.93560
19.000	10.067	.16186	.11243	-.04921	-.00224	.00133	.13974	.13907	1.00332	.76187
19.000	15.077	.32897	.11152	-.06061	.00092	.00006	.28664	.19325	1.49363	.74017
19.000	20.067	.51217	.12610	-.10686	.00218	-.00019	.43771	.29434	1.46709	.72822
19.000	25.101	.74399	.14023	-.14795	.00363	-.00010	.61424	.44280	1.36781	.72318
19.000	30.113	.96308	.14722	-.18090	.00326	.00025	.75924	.61033	1.24357	.71912
19.000	35.127	1.22299	.16702	-.21865	.00302	.00054	.90414	.64031	1.07597	.71379
19.000	39.642	1.47180	.17274	-.24907	.00479	.00063	1.01925	1.07544	.94775	.71229
	GRADIENT	.01320	-.00332	-.00117	-.00032	-.00006	.01274	-.00719	.06988	-.04491



(R80379) (10 MAR 75)

M19 N.T.-31 (CA-89) (862C12F10M14) (W127E43) (V8R5)

REFERENCE DATA

MACH = 2690.0000 90. FT
 LREF = 474.8100 INCHES
 BREF = 936.6800 INCHES
 SCALE = .07140

XMRP = 1076.0000 IN. XO
 YMRP = .0000 IN. YO
 ZMRP = 375.0000 IN. ZO

RUN NO. 23/ 0 RNV/L = .21 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	CN	CA	CLM	CY	CYN	CL	CD	L/D	KCP/L
19.800	-4.738	-1.1707	.15322	.00131	.00386	.00046	-1.14382	-.16572	-.86787	.85307
19.800	.048	-.07419	.12053	-.01393	.00644	-.00269	-.07429	.12047	-.81666	.58081
19.800	5.055	.00109	.11471	-.00804	.00284	-.00032	-.00902	.11436	-.07891	3.36431
19.800	10.063	.10344	.10127	-.00324	.00152	.00021	.08328	.12271	-.67864	.66965
19.800	15.074	.23872	.10373	-.00420	.00249	.00007	.20353	.16224	1.25453	-.64648
19.800	20.086	.39732	.10863	.00210	.00361	-.00049	.33363	.23847	1.40832	.64806
19.800	25.100	.57130	.11076	.00680	.00490	-.00025	.47037	.34264	1.37277	.84556
19.800	30.116	.79397	.11376	.00973	.00454	.00054	.62972	.49678	1.26758	.64721
19.800	35.132	1.00857	.11280	.00831	.00204	.00115	.75993	.67264	1.12976	.64697
19.800	39.793	1.15933	.12803	.02120	-.00496	.00433	.92179	.82513	.99393	.64328
	GRADIENT	.01725	-.00680	-.00318	.00054	-.00024	.01447	-.000942	.03227	-.01574

PARAMETRIC DATA

BETA = .000
 AILRON = .000
 SPOBRK = 55.000
 STING = 25.000

ELEVTR = -40.000
 BDFLAP = -11.000
 BALANCE = 1.000

(A80371) (10 MAR 75)

M19 N.T.-30 (CA-89) (862C12F10M14) (W127E43) (V8R5)

REFERENCE DATA

MACH = 2690.0000 90. FT
 LREF = 474.8100 INCHES
 BREF = 936.6800 INCHES
 SCALE = .07140

XMRP = 1076.0000 IN. XO
 YMRP = .0000 IN. YO
 ZMRP = 375.0000 IN. ZO

RUN NO. 23/ 0 RNV/L = .26 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	RN	Q (PSF)
19.800	15.322	-.00086	.27990	40.66197
19.800	17.827	-.00087	.27890	40.50217
19.800	20.333	-.00059	.27820	40.41900
19.800	22.838	-.00059	.28267	40.61838
19.800	25.345	-.00069	.28135	40.41900
19.800	27.852	-.00059	.28179	40.32784
19.800	30.357	-.00059	.28060	40.29878
19.800	32.865	-.00039	.28304	40.67649
19.800	35.375	-.00033	.28116	40.38595
19.800	37.883	-.00023	.28525	39.93503
19.800	40.391	.00009	.28818	39.92107
19.800	42.898	.00032	.28089	40.31331
	GRADIENT	.00000	.00000	.00000

PARAMETRIC DATA

BETA = .000
 AILRON = .000
 SPOBRK = 55.000
 STING = 45.000

ELEVTR = .000
 BDFLAP = .000
 BALANCE = 1.000

DATE 19 MAR /5

CASE SOURCE DATA

PAGE 4

M19 N.T.-35 (04-89) (B02C12F10M14) (M127E03) (V04S)

(A00712) (18 MAR /8)

REFERENCE DATA

SREF = 2993.0777 96. FT
 LREF = 474.8173 INCHES
 BREF = 938.6873 INCHES
 SCALE = .0047

WARP = 1076.7033 IN. X0
 YWAP = .0000 IN. Y0
 ZWAP = 379.0000 IN. Z0

PARAMETRIC DATA

BETA = .000 ELEVTR = 20.000
 ALLCON = .000 BDFLAP = 16.000
 SPOORR = 99.000 BALANCE = 1.000
 STING = 45.000

RUN NO. 26/ 0 RWL = .27 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	RN	Q (PSF)
19.873	15.323	-.00116	.26009	40.31331
19.873	17.828	-.00098	.26040	40.24087
19.873	20.334	-.00091	.26032	40.18258
19.873	22.840	-.00097	.26792	40.18004
19.873	25.346	-.00082	.26724	40.06634
19.873	27.852	-.00076	.27015	40.07217
19.873	30.358	-.00062	.26986	40.45656
19.873	32.865	-.00051	.26879	40.29878
19.873	35.371	-.00044	.26782	40.15351
19.873	37.880	-.00035	.26 1	40.22815
19.873	40.388	-.00026	.26069	40.28428
19.873	42.894	-.00022	.26879	40.29878
	GRADIENT	.00000	.00000	.00000



REFERENCE DATA PARAMETRIC DATA

BREF = 2697.0000 SQ. FT XMRP = 1076.7000 IN. NO BETA = .000 ELEVTR = -35.000
LREF = 474.8100 INCHES YMRP = .0700 IN. YO AILRON = .000 BOFLAP = -11.000
BREF = 936.6800 INCHES ZMRP = 375.5000 IN. ZO SPOBRK = 55.000 BALNCE = 1.000
SCALE = .0700 STING = 45.000

RUN NO. 2870 RM/L = .27 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	RN	Q (PSF)
19.800	15.321	-.00063	.26792	40.16804
19.800	17.626	-.00055	.26792	40.16804
19.800	20.331	-.00055	.26821	40.21162
19.800	22.037	-.00062	.26847	40.24067
19.800	23.543	-.00034	.26995	40.47311
19.800	27.849	-.00033	.27015	40.50217
19.800	30.356	-.00048	.27005	40.48764
19.800	32.864	-.00027	.27005	40.48764
19.800	35.372	-.00040	.26986	40.45950
19.800	37.880	-.00028	.26986	40.42953
19.800	40.387	-.00033	.26995	40.47311
19.800	42.894	-.00036	.26995	40.47311
	GRADIENT	.00000	.00000	.00000

M19 N.T.-37 (04-89) (B62C12F10M14) (M127E43) (V085)

(A800004) (18 MAR 75)

REFERENCE DATA

XREF = 2691.0000 90. FT ZMRP = 1076.7000 IN. NO
 LINEF = 474.8100 INCHES YMRP = .0000 IN. YO
 BREF = 936.6800 INCHES ZMRP = 375.0000 IN. ZO
 SCALE = .0140

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
 ATLRON = 10.000 BDFLAP = -11.000
 SPOBKK = 55.000 BALANCE = 1.000
 STING = 45.000

RUN NO. 30/ 0 RML = .27 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	RN	G (PSF)
19.800	15.380	-.00032	.26942	40.70355
19.800	17.825	-.00023	.26924	40.61836
19.800	20.331	-.00012	.26936	40.51669
19.800	22.835	-.00009	.26928	40.47311
19.800	25.340	.00028	.26731	40.32784
19.800	27.847	.00021	.26806	40.13898
19.800	30.355	.00055	.26491	39.96465
19.800	32.861	.00028	.26885	40.56028
19.800	35.369	.00054	.26618	40.45858
19.800	37.879	.00059	.26693	40.26973
19.800	40.384	.00037	.27155	40.96704
19.800	42.892	.00035	.27030	40.77819
	GRADIENT	.00000	.00000	.00000



M19 N.T.-31 (0A-89) (862C12 M141) (VOR5) (A40006) (18 MAR 75)

REFERENCE DATA

SREF = 2690.0000 SQ. FT XMRP = 1076.7000 IN. MO
LREF = 474.8100 INCHES YMRP = .0000 IN. YO
BREF = 936.6800 INCHES ZMRP = 375.0000 IN. ZO
SCALE = .07147

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
BALANCE = 1.000 STING = 45.000

RUN NO. 32/ 0 RM/L = .28 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	RN	Q (PSF)
19.000	15.300	-.00020	.27870	40.48764
19.000	17.804	-.00035	.27840	40.44406
19.000	20.306	-.00037	.28190	40.95251
19.000	22.810	-.00029	.28180	40.93799
19.000	25.314	-.00020	.28180	40.93799
19.000	27.818	-.00022	.28190	40.95251
19.000	30.321	-.00005	.27930	40.57480
19.000	32.826	-.00010	.27890	40.51669
19.000	35.330	.00015	.27860	40.47311
19.000	37.836	-.00024	.27860	40.47311
19.000	40.341	-.00036	.27830	40.42953
19.000	42.846	-.00052	.27880	40.47311
	GRADIENT	.00000	.00000	.00000

M19 N.T.-31 (0A-89) (862C12F10M14) (M127E43) (VOR5)

REFERENCE DATA

SREF = 2690.0000 SQ. FT XMRP = 1076.7000 IN. MO
LREF = 474.8100 INCHES YMRP = .0000 IN. YO
BREF = 936.6800 INCHES ZMRP = 375.0000 IN. ZO
SCALE = .07147

PARAMETRIC DATA

BETA = .000 ELEVTR = .000
AILRON = .000 BOFLAP = .000
SPDRK = 55.000 BALANCE = 1.000
STING = 25.000

RUN NO. 07/ 0 RM/L = .21 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	RN	Q (PSF)
19.000	-4.756	-.00079	.20851	40.63155
19.000	.049	-.00066	.21020	40.92147
19.000	5.056	-.00054	.20688	40.51265
19.000	10.064	-.00037	.20673	40.28366
19.000	15.074	-.00023	.20899	40.70403
19.000	20.084	-.00037	.20888	40.70403
19.000	25.098	-.00049	.20896	40.71853
19.000	30.112	-.00055	.20844	40.61706
19.000	35.125	-.00054	.20835	40.60256
19.000	39.789	-.00047	.20821	40.57357
	GRADIENT	.00000	.00000	.00000

(AG0007) (18 MAR 75)

M19 N.T.-31 (CA-89) (862C12F10M14) (M127E43) (VER3)

REFERENCE DATA

SREF = 2690.0000 56. FT XMRP = 1076.7000 IN. NO
 LREF = 474.8100 INCHES YMRP = .0000 IN. YO
 BREF = 936.6600 INCHES ZMRP = 375.0000 IN. ZO
 SCALE = .0040

RUN NO. 3/0 RM/L = .21 GRADIENT INTERVAL = -5.00/ 9.00

MACH	ALPHA	BETA	RN	Q (PSF)
19.800	-4.755	-.00042	.20336	40.80256
19.800	.000	-.00033	.20807	40.54436
19.800	5.057	-.00036	.20777	40.48660
19.800	10.065	-.00010	.20762	40.45761
19.800	15.075	.00000	.20747	40.42861
19.800	20.086	-.00007	.20732	40.34164
19.800	25.100	-.00029	.20702	40.34164
19.800	30.095	-.00037	.20717	40.37063
19.800	35.126	-.00032	.20926	40.77651
19.800	39.741	-.00050	.20911	40.74752
	GRADIENT	.00002	-.00006	-.01207

PARAMETRIC DATA

BETA = .000 ELEVTR = 10.000
 ATLRON = .000 BOFLAP = 19.300
 SPOBRK = 55.000 BALNCE = 1.000
 STING = 25.000

REFERENCE DATA

SREF = 2690.0000 56. FT XMRP = 1076.7000 IN. NO
 LREF = 474.8100 INCHES YMRP = .0000 IN. YO
 BREF = 936.6600 INCHES ZMRP = 375.0000 IN. ZO
 SCALE = .0040

RUN NO. 6/0 RM/L = .20 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	RN	Q (PSF)
19.800	-4.874	-.00026	.20312	40.19668
19.800	.032	-.00003	.20366	40.34164
19.800	5.059	-.00017	.20490	40.15319
19.800	10.087	-.00011	.20430	40.03723
19.800	15.077	-.00011	.20408	39.99374
19.800	20.037	-.00017	.20393	39.96475
19.800	25.101	-.00034	.20366	39.95025
19.800	30.113	-.00035	.20364	39.90677
19.800	35.127	-.00037	.20371	39.92126
19.800	39.842	-.00050	.20364	39.90677
	GRADIENT	.00005	.00015	.02943

(AG0008) (18 MAR 75)

M19 N.T.-31 (CA-89) (862C12F10M14) (M127E43) (VER3)

PARAMETRIC DATA

BETA = .000 ELEVTR = 20.000
 ATLRON = .000 BOFLAP = 16.300
 SPOBRK = 55.000 BALNCE = 1.000
 STING = 25.000

M19 N.T.-31 (CA-88) (B62C12F1DMLC) (R127E43) (VOR5) (A80000) (18 MAR /5)

REFERENCE DATA

SREF = 2090.0000 90. FT
 LREF = 474.8100 INCHES
 BREF = 936.6600 INCHES
 SCALE = .0040

BETA = .000
 AILRON = .000
 SPOBRK = 55.000
 STING = 25.000

PARAMETRIC DATA

ELEVTR = -40.000
 BDPLAP = -11.700
 BALANCE = 1.000

RUN NO. 2/ 0 RM/L = .21 GRADIENT INTERVAL = -5.00/ 5.00

MACH	ALPHA	BETA	RN	Q (PSF)
19.800	-4.756	-0.0052	.20747	40.42661
19.800	.048	-0.0049	.20695	40.32714
19.800	5.055	-0.0021	.20695	40.32714
19.800	10.063	-0.0021	.20680	40.29815
19.800	15.074	-0.0027	.20710	40.35613
19.800	20.086	-0.0024	.20777	40.48680
19.800	25.100	-0.0041	.20851	40.63155
19.800	30.116	-0.0054	.20926	40.77651
19.800	35.132	-0.0045	.21007	40.93597
19.800	39.793	-0.0047	.20918	40.76202
	GRADIENT	.00001	-.00011	-.02111