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SD72-SH-0060
VOLUME IL-6

PRE-OPERATIONAL

AERODYNAMIC DESIGN DATA BOOK

VOLUME 1

ORBITER VEHICLE

PART 1

OCTOBER 1978
(Revised April 1982)

SDM BASELINE

CONTRACT No. NAS9-14000
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Space Transportation System
Integration & Operations Division
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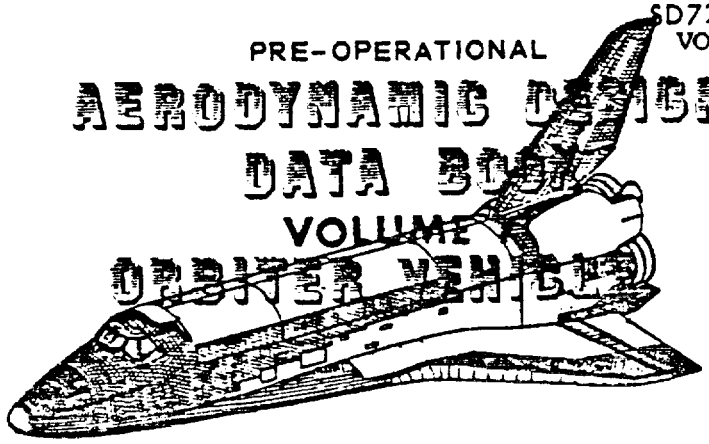
ORBITER VEHICLE



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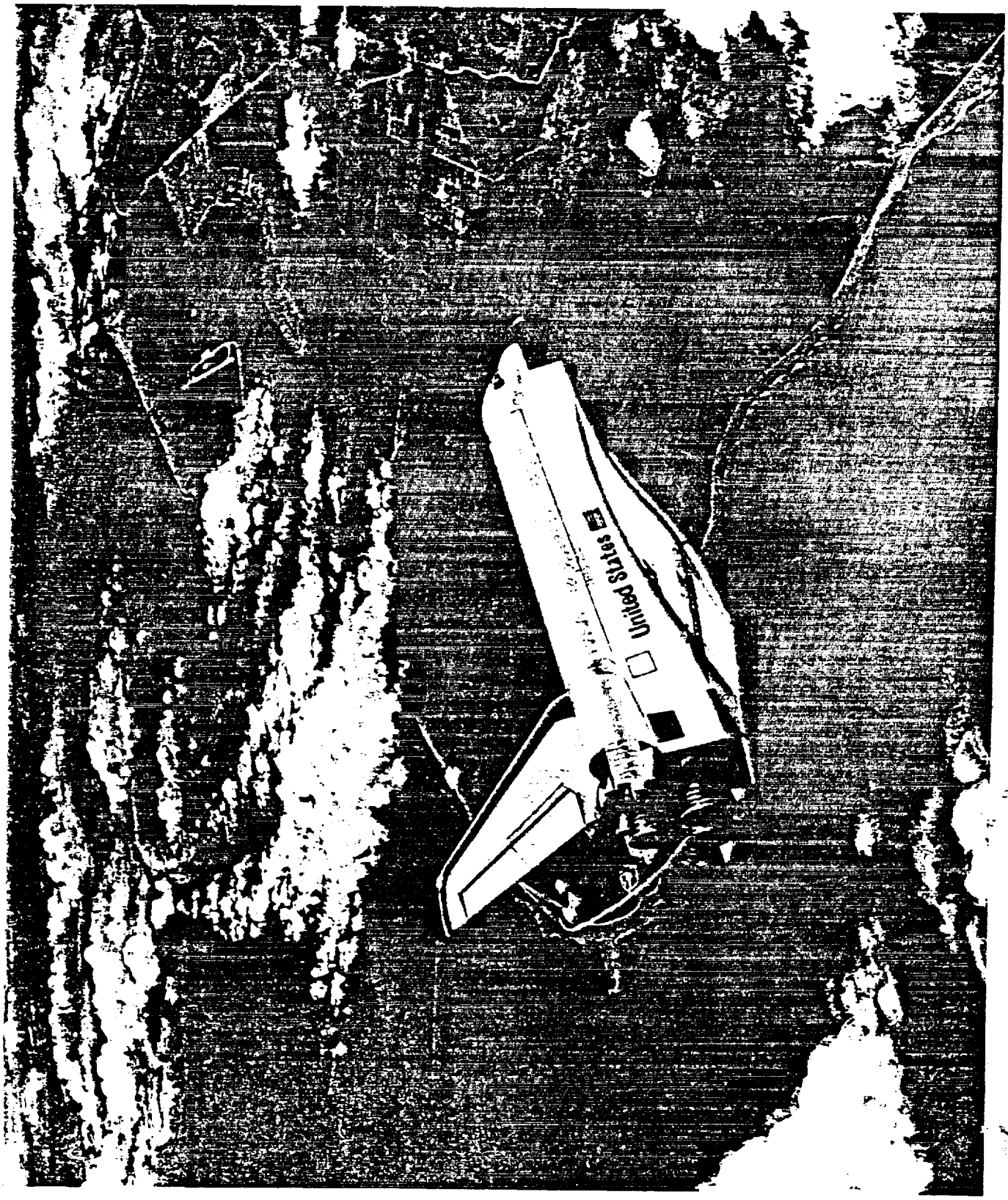

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REVISION RECORD

REV	DATA RELEASE DESCRIPTION	APPROVAL	DATE
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FOREWORD

The Rockwell Space Shuttle is a combination aircraft-spacecraft designed to launch a variety of payloads into earth orbit and/or retrieve payloads from orbit, return to earth, and land in the manner of conventional aircraft. The Space Shuttle Vehicle is comprised of three major elements: the Orbiter, External Tank, and Solid Rocket Boosters. Since the flight vehicle is a combination aircraft-spacecraft, its external features are designed to provide the protection and versatility for both space and atmospheric flight regimes.

The purpose of this document is to define the aerodynamic performance characteristics of the Orbiter Vehicle. The aerodynamic configuration is designed to ensure acceptable performance over hypersonic, supersonic, transonic, and subsonic speed ranges. The Aerodynamic Design Data Book consists of four volumes:

I ORBITER VEHICLE

II MATED VEHICLE

III AIRLOADS DESIGN DATA

IV ORBITER VEHICLE 101

The Design Data Book has been prepared to meet the needs of systems design and analysis engineering, loads and structural engineering, performance analyses, and manned simulation studies.

PREFACE

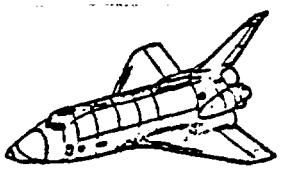
This document provides a single-source reference for all Orbiter Vehicle data appropriate to full-scale flight performance and stability and control analyses. The data include configuration descriptions, aerodynamic force and moment coefficients (both static and dynamic), and control effectiveness. Data are provided throughout the flight speed regimes from subsonic to hypersonic and high altitude; rarefied atmospheric effects are provided as well as the effects of aeroelastic deformation and reaction control flow field interactions.

Data are predicated on the results of wind tunnel tests of various scale models of the Orbiter Vehicle. Model support system tare effects have been determined for corrections to provide essentially support-free aerodynamic characteristics. Corrections have also been made (where appropriate) for scale effects (Reynolds number) and for non-representation of actual full-scale geometric features such as small excrescence items, Thermal Protection Subsystem tile steps and gaps, surface roughness, etc. All data are provided in a format which will allow a build-up from a basic configuration to any desired configuration by means of contributing elements to each force or moment component such as control surface effectiveness, landing gear effects, etc. Data are presented in a manner which treats each force and moment separately and equations are provided to facilitate the build-up procedure, transfer of data to moment reference centers other than the basic reference center (most forward center of gravity location), and account for the effects of aeroelastic deformation, rarefied atmosphere, and combined reaction control/aerodyanmic control in the low dynamic pressure regions.

This report grew out of earlier reports which were, and are, in a constant state of revision due to wind tunnel testing, revised data analyses, and NASA reviews. In preparing this edition, the Aero Sciences Department is indebted to the NASA for support in the data preparation. The basic aerodynamic data were reviewed by JSC, ARC, LaRC, and ARO/AEDC prior to release. Particular attention was given to the transonic and supersonic flight regimes. Viscous interaction data were supplied by LaRC and JSC provided the bridging between the viscous data and the orbital aerodyanmic characteristics. JSC and Rockwell coordinated the approach and landing flight test results for incorporation into the low speed data. The formation of an Aero Technical Panel, whose members (JSC, LaRC, ARC, AEDC, and DFRC) all contributed to this report, was of particular significance.

Rockwell engineers under D. C. Schlosser (supervisor) and D. C. Olsen (lead engineer) prepared and analyzed the data with primary responsibilities going to F. F. Fitzgerald, K. T. Cahill, D. G. Duhnke (longitudinal), F. F. Fitzgerald, W. M. Zeman, R. Beman (lateral/directional), H. Parrell, F. C. Chinn (hinge moments), D. F. Dominik, J. F. Kerswell, (aeroelasticity), and H. S. Dresser, J. S. Stone, and Y. H. Yoo (RCS). Digitized data tapes, and figures were the responsibilities of D. F. Dominik, T. A. Petrick, M. E. Kollanse, and D. E. Legan.

Downey, California W. R. Russell: Editor



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AERODYNAMIC DESIGN DATA BOOK

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NOMENCLATURE

A. ACRONYMS

ADS	Air Data System
ADTA	Air Data Transducer Assembly
AFCS	Automatic Flight Control System
AMI	Alpha-Mach Indicator
A/S	Airspeed
BFCS	Backup Flight Control System
CCB	Configuration Control Board
CDR	Critical Design Review
CEI	Contractor End Item
CSS	Control Stick Steering
DFI	Development Flight Instrumentation
DOF	Degree(s)-of-Freedom
EAFB	Edwards Air Force Base
ET	External Tank
ETR	Eastern Test Range
F	Ferry
FAA	Federal Aviation Agency
FCF	Functional Checkout Flight
FCS	Flight Control System
FF	Free-Flight
FMOF	First Manned Orbital Flight
FOF	First Operational Flight
FRC	Flight Research Center
FRF	Flight Readiness Firing
FRR	Flight Readiness Review
FSSR	Functional Subsystem Software Requirement
FTR	Flight Test Requirement
GN&C	Guidance, Navigation, and Control
HAC	Heading Alignment Circle
HQ	Handling Qualities
HSI	Horizontal Situation Indicator
HW	Head Wind
I	Inert
ILS	Instrument Landing System
JSC	Johnson Space Center

A. ACRONYMS (Continued)

KEAS	Knots-Equivalent Airspeed
KSC	Kennedy Space Center
LV	Launch Vehicle
M	Manned
MDM	Modulate-Demodulate
MML	Master Measurement List
MMLE	Modified Maximum Liklihood Estimate
MRC	Moment Reference Center
NAV	Navigation (System)
OFI	Operational Flight Instrumentation
OFT	Orbital Flight Test
OMS	Orbital Maneuvering System
OV	Orbiter Vehicle
PDR	Preliminary Design Review
PTI	Programmed Test Input
RCS	Reaction Control System
RID	Review Item Disposition
RSS	Root-Sum-Square
SILTS	Shuttle Infrared Leeside Temperature Sensor
SPI	Surface Position Indicator
SPS	Samples per Second
SRB	Solid Rocket Booster
S/C	Spacecraft or Stability and Control
STC	Supplemental Type Certificate
TAEM	Terminal Area Energy Management
TO	Take-Off
TOGW	Take-Off Gross Weight
TPS	Thermal Protection System
TBD	To Be Determined
T/W	Thrust-to-Weight Ratio
UHF	Ultra-High Frequency
VFT	Vertical Flight Test
VHF	Very-High Frequency
VDR/LOC	Visual Omni-Range/Localizer
WTR	Western Test Range

B. GENERAL

A	Acceleration Subscripts: X axial Y lateral Z normal	ft/sec^2 (also g's)
BL	Buttock Line	
BP	Buttock Plane	
℄	Centerline	
F	Force Subscripts: (see Acceleration, above)	lb
FRL	Fuselage Reference Line	
FRP	Fuselage Reference Plane	
FS	Fuselage Station	
H or HL	Hingeline	
M	Mach Number Subscripts: D dive MO maximum operating	
P	Pressure Subscripts: ∞ ambient (or freestream) s static T total o, SL } sea level	lbs/ft^2 (psf)
R	Universal Gas Constant	
ReN	Reynolds Number	
T	Temperature	°F, °R, or °K
T	Thrust	lbs
T	Thrustline	
V	Velocity u linear perturbed velocity along x-axis (positive forward) v linear perturbed velocity along y-axis (positive out right wing) w linear perturbed velocity along z-axis (positive downward)	fps or knots

B. GENERAL (Continued)

V (Continued)

Subscripts:
- c calibrated
- e equivalent
- I indicated
- D dive
- MCA minimum control in air
- MCG minimum control on ground
- MO maximum operating
- ∞ freestream

$\overline{V}'_\infty$	Viscous Parameter	
W	Weight	lbs
WL	Waterline	
WP	Water Plane	
WDP	Wing Datum Plane	
a	Speed of Sound in Air	ft/sec or knots
a.c.	Aerodynamic Center	
b	Span	ft
c	Chord	inches
$\overline{c}$	or MAC - mean aerodynamic chord	

Subscripts:
- bf body flap
- e elevon
- r rudder
- sb speed brake
- w wing

cg	Center of gravity	
cp	Center of pressure	
g	Acceleration due to gravity	ft/sec^2
h	Altitude (or height)	ft or nautical miles
m	Mass	slugs
n	Load Factor	g's
$\overline{q}$	dynamic pressure = $1/2\rho V^2$	lb/ft^2 (psf)
t	time	secs, mins, hrs
Δ	Increment	
ζ	Nondimensional change in MRC with regard to WP; $(Z_{MRC} - Z_{MRC_{REF}})/\overline{c}$	

B. GENERAL (Continued)

η	(1)	Semi-Span Parameter - y/b/2	
	(2)	Flexible-to-Rigid Ratio	
i, ι		Incidence	degrees
Λ		Sweep Angle	degrees
λ		Taper Ratio	
λ_∞		Mean Free Path	inches
ξ		Nondimensional change to MRC with regard to Fuselage Station $= (X_{MRC} - X_{MRC_{REF}})/\bar{c}$	
ρ	(1)	Mass density of air	slug/ft^3
	(2)	Correlation Coefficient	---
σ	(1)	Ratio of freestream density at a given altitude to standard sea level air density	
	(2)	Standard Deviation	
ω		Frequency	H_z (cycles/sec)
$\measuredangle$		Angle	
>		Greater than	
<		Less than	

C. CONFIGURATION

L_B	Body Length	inches
LE	Leading Edge	
S	Reference Area	

Subscripts:

a	aileron
bf	body flap
e	elevon (elevator)
r	rudder
sb	speed brake
w	wing
v	vertical tail

TE	Trailing Edge

C. CONFIGURATION (Continued)

X		Longitudinal axis	
Y		Lateral axis	
Z		Vertical axis	
δ	(1)	Control Surface Deflection	degrees

Subscripts:
- a aileron (positive for positive rolling moment)
- bf body flap (positive for nosedown pitching moment)
- e elevon (positive for nosedown pitching moment)
- r rudder (positive for nose-left yawing moment)
- sb speed brake

(2) Dihedral Angle — degrees

D. MOMENT & PRODUCTS OF INERTIA

1. Moment of Inertia — slug-ft^2
   - I_X rolling
   - I_Y pitching
   - I_Z yawing
2. Product of Inertia — slug-ft^2
   - I_{XY}, I_{XZ}, I_{YZ}

E. FORCES

A	Axial; aerodynamic force along the X-body axis (positive aft)	pounds
C_A	Axial force coefficient = $A/\bar{q}S$	
D	Drag; aerodynamic force along the total velocity vector in plane of symmetry (positive aft)	pounds
C_D	Drag coefficient = $D/\bar{q}S$	

E. FORCES (Continued)

L	Lift; aerodynamic force perpendicular to total velocity vector in plane of symmetry (positive upward)	pounds
C_L	Lift coefficient = $L/\bar{q}S$	
N	Normal; aerodynamic force along the Z-body axis (positive upward)	pounds
C_N	Normal force coefficient = $N/\bar{q}S$	
Y	Side; aerodynamic force along the Y-body axis (positive out right wing)	pounds
C_Y	Side force coefficient = $Y/\bar{q}S$	

F. MOMENTS

HM	Hinge; moment about hinge line	ft-pounds
C_h	Hinge moment coefficient = $HM/\bar{q}S\bar{c}$	
	Subscripts: bf body flap e elevon r rudder sb speed brake	
$\mathscr{L}$	Rolling; moment about the X-axis due to aerodynamic torques (positive right-wing down)	ft-pounds
C_ℓ	Rolling moment coefficient = $\mathscr{L}/\bar{q}Sb$	
M	Pitching; moment about the Y-axis due to aerodynamic torques (positive nose-up)	ft-pounds
C_m	Pitching moment coefficient = $M/\bar{q}S\bar{c}$	
$\mathscr{N}$	Yawing; moment about the Z-axis due to aerodynamic torques (positive nose-right)	ft-pounds
C_n	Yawing moment coefficient = $\mathscr{N}/\bar{q}Sb$	

G. ANGLES

α	Angle of attack; angle between the projection of the resultant velocity vector on the X-Z plane and the X-body (reference) axis	degrees
β	Sideslip; angle between the resultant velocity vector and the plane of symmetry (positive nose-left) $= -\psi$	degrees
γ	Flight path; inclination of flight path to the horizontal	degrees
ϵ	Downwash	degrees
σ	Sidewash	degrees
θ	Pitch; displacement of reference axis from the horizontal (positive nose-up)	degrees
ϕ	Roll or Bank (positive right-wing down)	degrees
ψ	Yaw; angle between the resultant velocity vector and the plane of symmetry (positive nose-right) $= -\beta$	degrees

H. TIME-RELATED PARAMETERS

a	Acceleration $= \dot{v}$	ft/sec^2
g	Acceleration due to gravity	ft/sec^2
$\dot{h}$	Altitude rate	ft/sec
p	Roll rate; angular velocity about the X-axis (positive right-wing down)	radians/sec
q	Pitch rate; angular velocity about the Y-axis (positive nose-up)	radians/sec
r	Yaw rate; angular velocity about the Z-axis (positive nose-right)	radians/sec
$\dot{\alpha}$	Rate of change of angle of attack	radians/sec
$\dot{\beta}$	Sideslip rate	radians/sec

INTRODUCTION

This document, Volume 1 of the AERODYNAMIC DESIGN DATA BOOK, contains information pertinent to the prediction of operating speeds, performance, and performance limited flight capabilities of the Space Transportation System Orbiter Vehicle. The data Book was prepared under the terms of contract number NAS9-14000 and is called for in the Information Requirements Document (IRD No. SE-640T).

All data presented in this volume represent the best available estimates of the full-scale flight characteristics for the Orbiter Vehicle. Each aerodynamic coefficient has been examined separately and presented in individual subsections where the various contributing elements to each total coefficient are examined in detail. Where additional information has been considered useful, Appendices are provided for additional discussion and/or elaboration of a subject such as RCS Flow Field Interactions or High Altitude Aerodynamics.

In November of 1980, a dedicated STS-1 (-1M edition) was published for use in the Orbital Flight Test Program. This -1M edition was not to be updated and was intended for pre-flight assessment of the STS-1 mission. Assessment data tapes have been provided for missions STS-2 through STS-7.

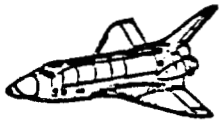
This current edition (-1L-6) updates the pre-operational (-1L-5) ADDB and includes recent wind tunnel test data. This edition is intended to be used with STS-4 and -5 flight derived delta data (assessment tapes) to conduct FCS verification for STS-8 and subsequent flights.

The differences between this revision (SD72-SH-0060-IL-6) to the pre-operational ADDB and both previous editions, (SD72-SH-0060-IL-5) and dedicated STS-1 (SD72-SH-0060-IM), of the ADDB are summarized in the following table:

STS-1(-IM) and Revisions IL-5 and IL-6 Data Differences
(STS-1 to IL-5 Noted by Asterisk)

Item	Section Affected	Change
Basic longitudinal aero C_L, C_D, L/D, C_N, C_A, C_m, Trim and Stability	2.2, 4.1	Revised from Mach 1.5 to 10.0 based on weighting certain high fidelity wind tunnel tests and, for C_m, to obtain better agreement with STS-1 flight test data. Figure 4.1-3 and table 4.1-1 revised to reflect change in TPS drag based on results of profilometer measurements.
Basic lateral/directional aero C_Y, C_n, C_ℓ	4.2	Data presentation changed to 4 argument. Data changed from Mach 2.5 to 8 to incorporate and weight results from LA-131, LA-144, and OA-258.
Longitudinal speed brake effectiveness $\Delta C_{N_{sb}}$, $\Delta C_{A_{sb}}$, $\Delta C_{m_{sb}}$	4.1	Format changed to present as basic longitudinal data at the respective speed brake settings. For Mach 1.5 to 10.0 small changes resulted from use of computer curve fit program to fair the data. Also, new data at high angles of attack at Mach 6 and fairing from nose shock used.
Lateral/directional speed brake effectiveness $\Delta C_{Y_{sb}}$, $\Delta C_{n_{sb}}$, $\Delta C_{\ell_{sb}}$	4.2	Incorporate as part of the basic lateral/directional sections for speed brake setting of 0, 25, 55 and 87.2 degrees. Speed brake effectiveness has been changed from Mach 2.5 to 8 based on a detailed analysis of high fidelity model wind tunnel test data.
Yawing moment coefficient due to roll rate C_{n_p}	4.2.1.2	Theoretical values changed to agree with results from wind tunnel test.
RCS	4.1,4.2 (6 comp)	Add elevon/body flap deflection effects on impingement.
	4.1,4.2 (6 comp)	Add side firing jet impingement during entry.
	4.1 (Longit.)	Eliminate carryover term.

Item	Section Affected	Changes
Equations	All basic aero sections plus App. D	Equations revised to reflect change in data format.
High altitude aerodynamics	App. C	Added doors open case for Orbiter at 600,000 ft. and Orbiter with doors closed at 300,000 feet.
Abort mission aero	App. F	Data and instructions added to obtain Aerodynamic Characteristics for RTLS and contingency abort missions.
Editing	All	Minor editing changes made where appropriate.
*Basic longitudinal data	App. F	Added data to support RTLS and contingency abort studies.
*Basic lateral/directional data	4.2	Modified basic lateral/directional data $-10^{\circ} \leq \alpha \leq 5^{\circ}$ over Mach range from 20 to 3 to eliminate inconsistencies with L.V. ADDB separation data.
*Ground effects data	4.1.1	Added body flap effectiveness in presence of ground.
*Speed brake hinge moments	5.3	Added speed brake hinge moment increments due to body flap deflection.
*Body flap hinge moments	5.2	Added body flap hinge moment increments due to speed brake deflection.
*Aileron derivative uncertainty	6.2	Added viscous aileron uncertainties.
*Basic aero uncertainties	6.0	Added high altitude (600K to 300K) uncertainties for basic aero characteristics.

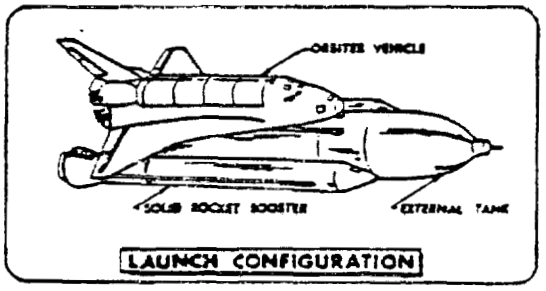


1.0 ORBITER MISSION

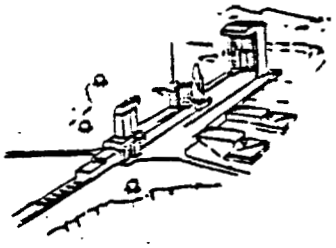
The Rockwell Space Shuttle Orbiter is designed to launch a variety of payloads into (and/or retrieve from) earth orbit. The Orbiter Vehicle will be launched in a vertical attitude and landing will be accomplished in a horizontal manner similar to conventional aircraft.

1.1 MISSION DESCRIPTION.

The Space Shuttle mission is summarized in Figure 1.1-1. Following flight readiness and checkout, the Space Shuttle will be launched by means of solid rocket boosters (SRB) and an external tank (ET) as shown in the sketch.



Maximum payload capability is 65,000 pounds for an easterly launch from the Eastern Test Range (ETR) at Kennedy Space Center (KSC) and 32,000 pounds for a polar orbit launch from the Western Test Range (WTR) at Vandenburg Air Force Base.



Subsequent to separation from the ET, the Orbiter Vehicle will be inserted into earth orbit where a payload may be deployed and/or retrieved. The Orbiter Vehicle can also function as a space laboratory for a moderate duration and will provide accommodations for up to five mission specialists in addition to the normal crew of commander and co-pilot. An on-orbit stay period of seven days is required and could be extended for up to 30 days during the operational phase of the program.

After completion of the orbital operations phase, deorbit is accomplished by retro-fire of the Orbital Maneuvering System (OMS) and the Orbiter descends to the atmospheric entry interface (nominally, an altitude of 400,000 feet). The initial entry phase extends to a dynamic pressure level of 20 psf (approximately 250,000 feet) during which RCS attitude control from two aft OMS pods is blended with aerodynamic surface controls, the latter gaining in effectiveness as dynamic pressure increases.

The entry flight phase, from a dynamic pressure level of 20 psf to a Mach number of less than five, is accomplished at a high angle of attack during which the blanketing effect of the wing essentially precludes any rudder control. Coordinated lateral-directional control is provided by combined yaw RCS and aileron control. The terminal phase occurs as angle of attack is reduced below 18 degrees. As the Orbiter descends to altitudes where winds, in conjunction with vehicle speed, can result in relatively large errors in inertially derived air data, probes are extended ($M \approx 3.5$) to provide air data relative to the vehicle. During a typical normal entry, range control is achieved by bank angle while angle of attack follows a

predetermined schedule to achieve (at approximately M = 1.5) an angle somewhat smaller than that corresponding to maximum L/D. A downrange capability of up to 4300 nautical miles with a cross range capability of 980 nautical miles may be realized.

Equilibrium subsonic gliding flight is achieved at an altitude of approximately 40,000 feet. Range control during the gliding descent is obtained by angle of attack modulation with velocity control maintained by the speed brake. The approach and landing interface occurs at 10,000 feet above ground level and a preflare is initiated at an appropriate altitude, followed by a deceleration float and touchdown. The initial approach target and flare altitude will be scheduled to provide a minimum of 25 seconds between flare initiation and touchdown.

Representative time histories of five trajectory parameters — altitude, relative velocity, flight path angle, total load factor, and dynamic pressure — are shown in Figure 1.1-2. These time histories represent a high cross range return from a 100-nautical mile orbit with a 25,000-pound payload and an aft center of gravity. The trajectory (TPS design number 14414) is presented for the purpose of illustration only.

More complete and detailed mission data are available in the Mission Data Book, Reference 1-1. Detailed descriptions of launch trajectories are given in References 1-2 and 1-3 and additional entry trajectory data may be obtained from Reference 1-4. References 1-5 and 1-6 contain detailed information relative to separation and abort.

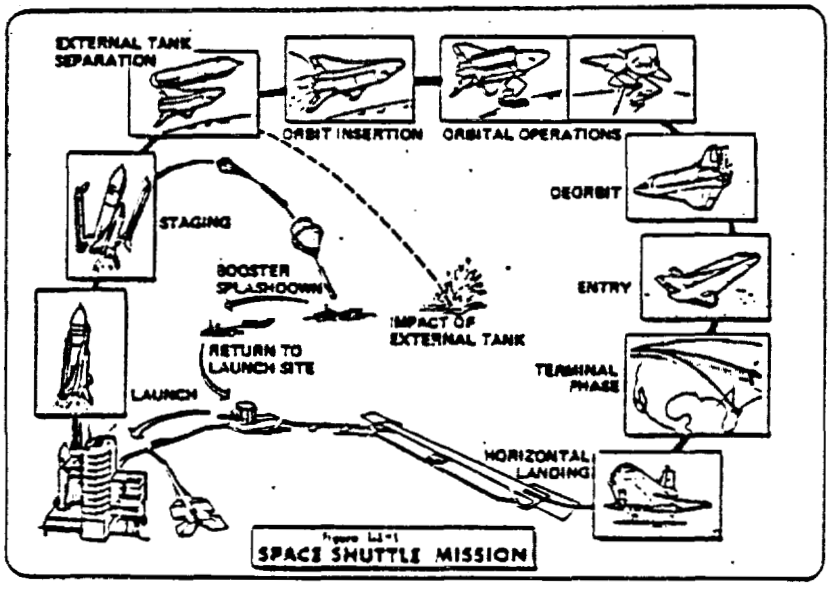


Figure 1.1-1
SPACE SHUTTLE MISSION

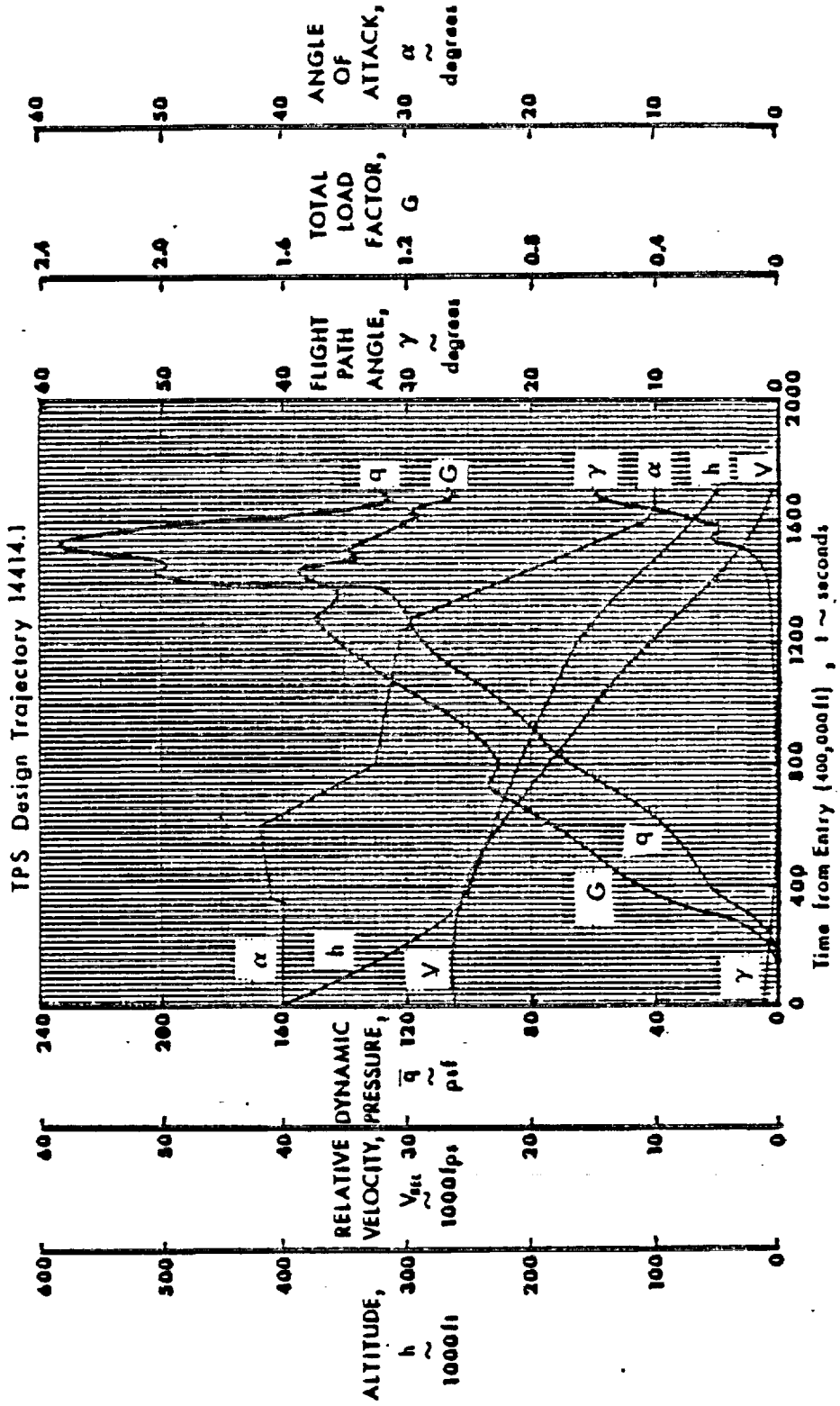


Figure 1.1-2
ORBITER ENTRY TRAJECTORY

1.2 MISSION CAPABILITY. The Orbiter Vehicle "mission capability envelope" is defined by four baseline reference missions. Table 1.2-1 summarizes these baseline missions. From the standpoint of entry, these become essentially two types of missions — a ramped angle of attack, characterized by long range and high cross range and a high angle of attack characterized by short range and small cross range. Typical trajectories representing these two missions are presented in Figure 1.2-1 for the former (typical of mission 1) and Figure 1.2-2 for the latter (typical of mission 3B). Orbital Flight Test (OFT) requirements should fall within the baseline reference mission envelope of capability.

Table 1.2-1
BASELINE REFERENCE MISSIONS

ITEM	OBJECTIVE	ORBIT		DURATION	PAYLOAD	
		[illegible]			ASCENT	DESCENT
		degrees	[illegible]		[illegible]	
1	PAYLOAD DELIVERY	28.5	150	7 Days	65.0	32.0
2	COMBINED REVISIT TO ORBITING ELEMENT & STACKLAB	56.0	270	7 Days	—	—
3	A PAYLOAD DELIVERY	104.0	100	1 Day	32.0	2.5
	B PAYLOAD RETRIEVAL				2.5	25.0

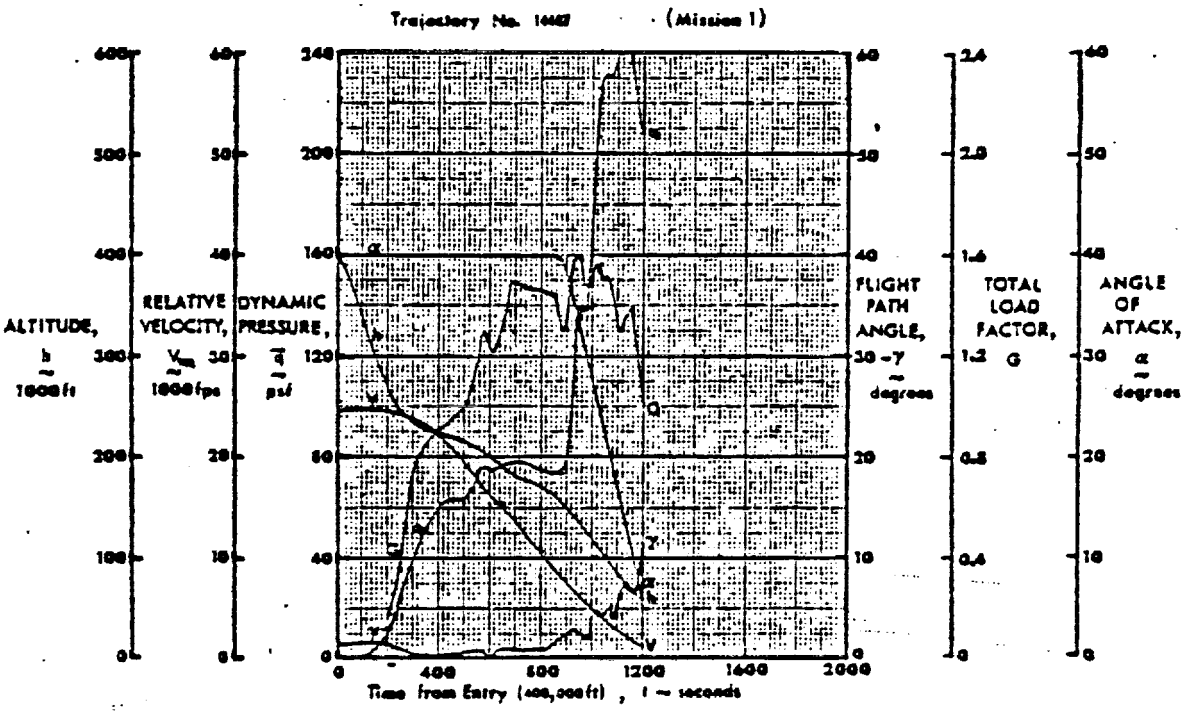


Figure 1.2-1
ORBITER ENTRY TRAJECTORY

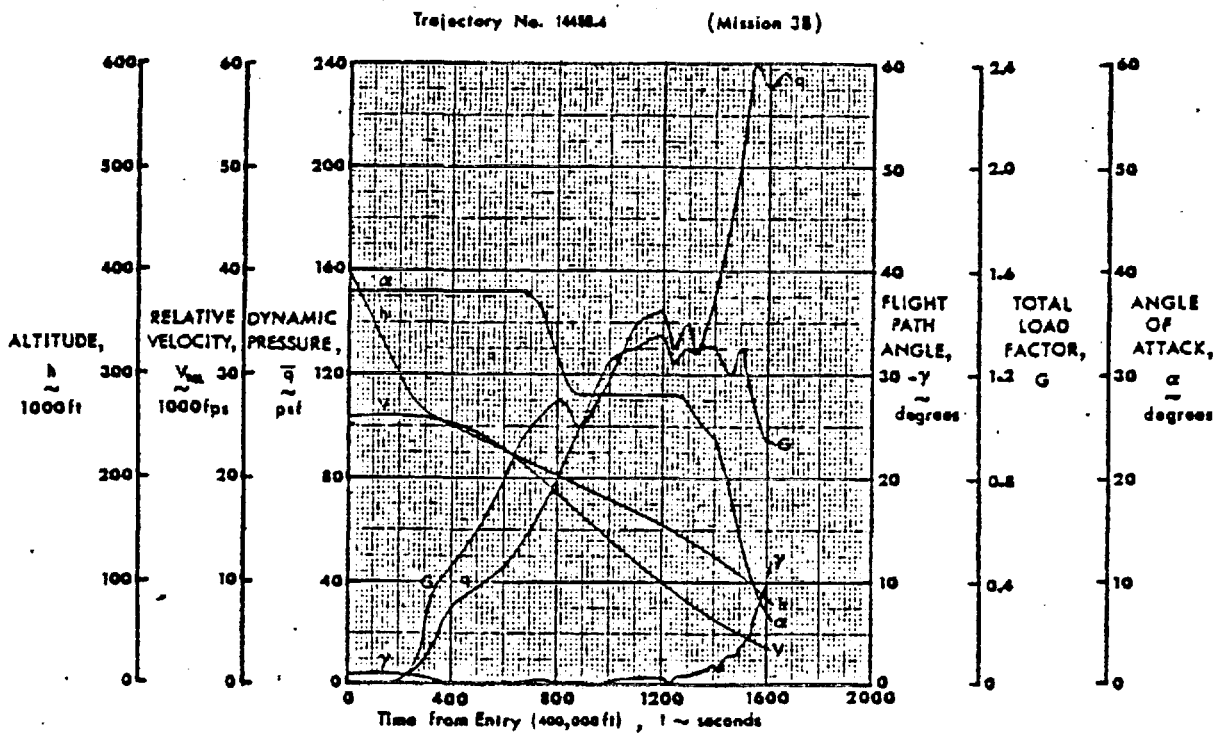


Figure 1.2-2
ORBITER ENTRY TRAJECTORY

1.3 FLIGHT TEST. The Orbital Flight Test (OFT) program is designed to substantiate the aerodynamic design of the Orbiter Vehicle throughout the expected flight regime. Flight test plans will be developed to satisfy multiple test objectives and to obtain a maximum data return: Testing will be consistent with the planned missions so that, insofar as possible, direct comparisons can be made. Verification of the aerodynamic design data will be accomplished by comparing the flight test derived aerodynamic data with results predicated on wind tunnel testing as presented in this report. The aerodynamic design data book will then be updated to reflect the flight results.

2.0 GROUND RULES

Major program requirements influencing the aerodynamic design of the delta wing Orbiter are defined in the Space Shuttle Program Request for Proposal as modified by SD MCR No. 0200 and Revisions (References 2-1 and 2-2). On March 3, 1975, MCR 1750 was initiated to replace MCR 0200. The former MCR, "Shuttle Baseline Control Drawings," assumed the function of the latter and will be revised (as required) to authorize release of baseline drawing changes.

2.1 DESIGN GROUND RULES. Aerodynamic design ground rules are summarized in Table 2.1-1.

Table 2.1-1 AERODYNAMIC DESIGN GROUND RULES

PARAMETER	VALUE
ANGLE OF ATTACK	
Hypersonic	25° to 50°
Supersonic	0° to 25°
Transonic	0° to 15°
Subsonic	-5° to 20°
LONGITUDINAL STABILITY	
STATIC MARGIN	
Hypersonic (Minimum)	Positive
Subsonic (Minimum)	-2% L_e
(Aft Center of Gravity)	(-5.45% MAC)
CENTER OF GRAVITY RANGE	
Design Range	0.650L_e to 0.675L_e
Minimum Travel	2%L_e
LIFT/DRAG MODULATION	
Subsonic Value - Peak	
(Gear-Up, δ_{se} = 0°)	Not less than 4.4
(Gear-Up, δ_{se} = 85°)	Not less than 2.5
LANDING PERFORMANCE	
MINIMUM DESIGN TOUCHDOWN SPEED (V_D)	171 knots
LANDING WEIGHT (WITH PAYLOAD)	187,900 pounds
PAYLOAD	32,000 pounds

2.2 FLIGHT ENVELOPES/CONDITIONS. Figure 2.2-1 presents the design center of gravity limits and static margin limits. A summary of the trim limits of Section 4.1.1.4 is also shown on the figure. The summary trim limits are based on the TPS design trajectory 14414.1 angle of attack schedule (also given in Section 4.1.1.4).

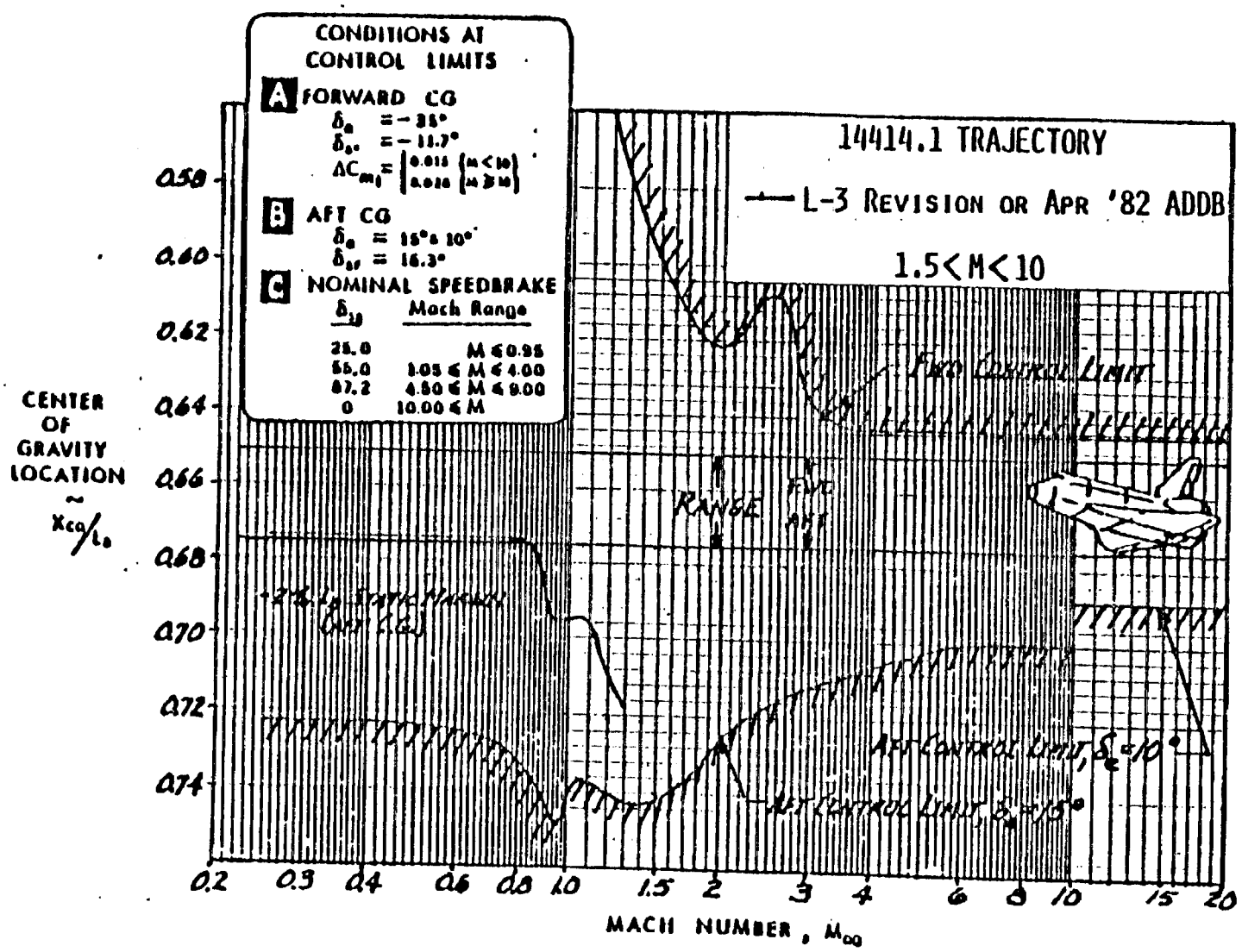


Figure 2.2-1
TRIM AND STABILITY BOUNDARIES CENTER OF GRAVITY RANGE

3.0 CONFIGURATION DESCRIPTION

The Orbiter Vehicle is configured to perform as both a spacecraft and an aircraft. To this end, the vehicle must provide the protection and versatility necessary for both orbital and atmospheric flight operations. Design of the vehicle is such that it will meet all requirements as set forth in the Orbiter Vehicle End Item Specification (Reference 3-1). Figure 3.0-1 presents a general arrangement, three-view drawing of the Orbiter Vehicle with reference dimensions and areas tabulated on the figure.

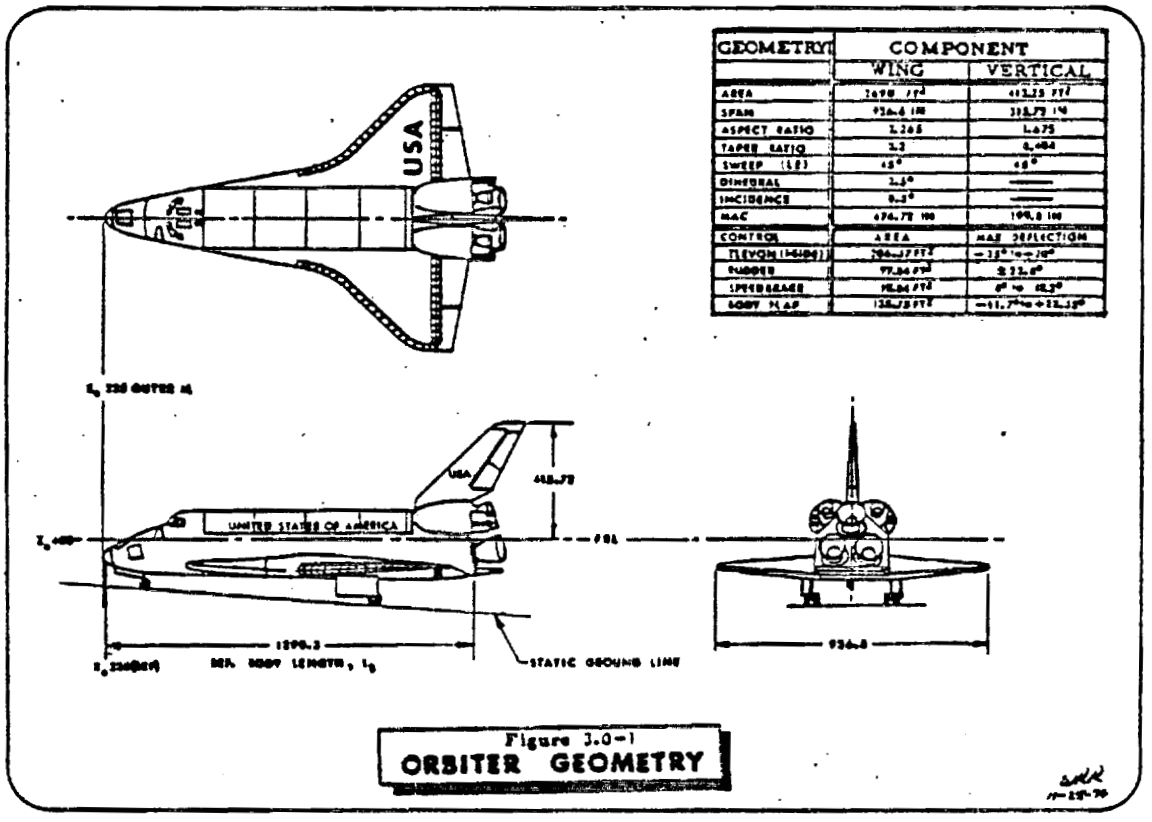


Figure 3.0-1
ORBITER GEOMETRY

Atmospheric (or aerodynamic) requirements are predicated, for the most part, on the entry phase of the Orbiter mission(s). The aerodynamic lines ensure acceptable performance over hypersonic, supersonic, transonic, and subsonic speed regimes while providing the specified downrange and cross range capabilities and meeting the specified landing requirements depicted in Figure 3.0-2.

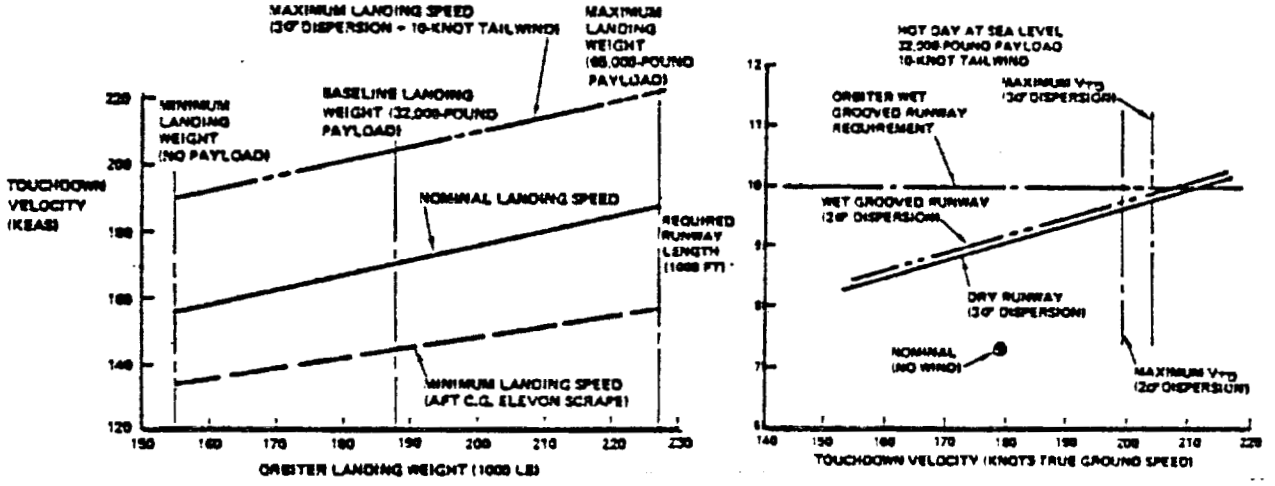


Figure 3.0-2 LANDING REQUIREMENTS

Evolution of the Orbiter Vehicle configuration from Authority to Proceed (ATP) to the present time is summarized in Figure 3.0-3. Major parameters influencing the design are noted on the figure.

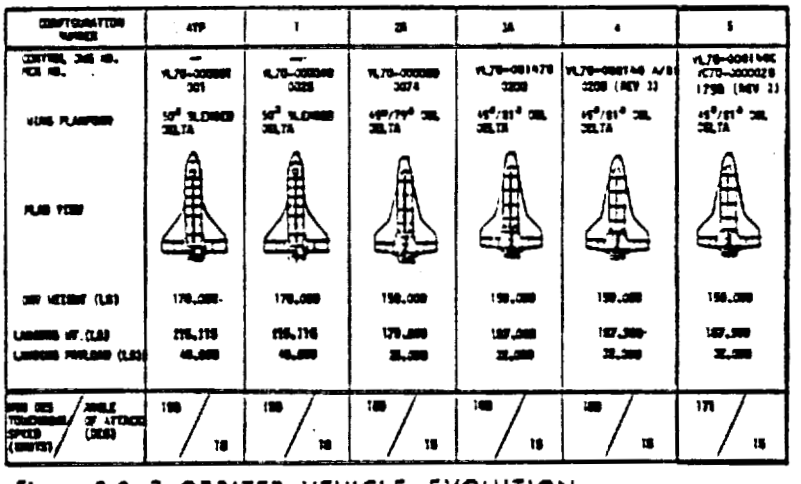


Figure 3.0-3 ORBITER VEHICLE EVOLUTION

3.1 CONFIGURATION AND DIMENSIONS. The configuration was selected to achieve high cross range aerodynamically and to be capable of trimmed flight over a wide range of angles of attack. The double-delta wing planform combined with a moderately low fineness ratio (approximately 5) body minimizes

interference heating effects, provides the required L/D ratio to meet cross range requirements, and possesses an acceptable trim range over the flight Mach number regime.

Aerodynamic design geometry of the Orbiter Vehicle is presented in Figure 3.1-1. The Master Dimensions Specification Manual, Reference 3-2, should be consulted for detailed lines drawings and dimensions. A summary breakdown of pertinent components is given in the ensuing paragraphs.

CAUTION. Reference areas and lengths used to normalize aerodynamic forces and moments are presented in the table below. In some cases (notably control surface hinge moments) the reference dimensions differ from the existing geometry. REFERENCE VALUES ARE BASED ON THEORETICAL AND NOT TRUE DIMENSIONS.

AERODYNAMIC FORCE AND MOMENT REFERENCE DIMENSIONS

PARAMETER	REFERENCE VALUE
LONGITUDINAL AND LATERAL/DIRECTIONAL COEFFICIENTS	
Wing Area, S_{REF}	2690.000 ft^2
Wing Span b_w	78.057 ft
Mean Aerodynamic chord (M.A.C.), $\bar{c}_w$	39.568 ft
HINGE MOMENT COEFFICIENTS	
ELEVON	
Area, S_e	210.000 ft^2
Chord c_e	90.700 in
Area Moment	19,047.000 ft^2-in
BODY FLAP	
Area, S_{BF}	135.000 ft^2
Chord, c_{BF}	81.000 in
Area Moment	10,935.000 ft^2-in
RUDDER/SPEEDBRAKE	
Area, S_r	100.150 ft^2
Chord, c_r	73.200 in
Area Moment	7331.000 ft^2-in

DESIGN DATA

INERT CONTROL WEIGHT
DESIGN LANDING WEIGHT
PAYLOAD DOWN WEIGHT
DESIGN LANDING SPEED

} REFER TO CONTRACT END ITEM SPECIFICATION MJ070-0001-1A

PROPULSION	MAIN	OMS	RCS
THRUST-VACUUM-LBS	470K	6K	0.9K
PROPELLANT TYPE	N_2/O_2	N_2O_4/MMH	N_2O_4/MMH
NUMBER	3'	2	40 +6 VERNIERS 25 LBF

LINES AND CONTOURS

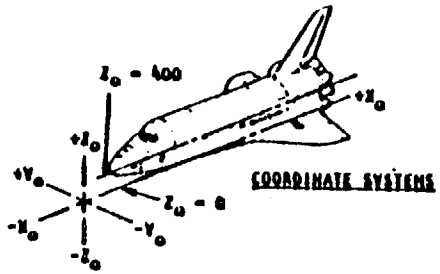
THIS DRAWING DEPICTS OUTER MOLD LINE (OML) ONLY. REFER TO MASTER DIMENSION SPECIFICATION MDV70 FOR DETAIL DATA

GEOMETRY

	WING	VERTICAL	FLAP
S_W FT^2	2,690	413.25	635.75
AR or ASPECT RATIO	2.265	1.675	
λ	0.20	0.404	
Λ L.E.	45°	45°	
DIHEDRAL (CHORD PLANE & TRAILING EDGE)	3°30'		
α BASIC WING	+0° 30'		
t/c Y_o = 0 (℄ BODY)	0.1137		
t/c Y_o = 199	0.113		
t/c Y_o = 468.34	0.12		
b IN.	936.68	315.72	
C_R IN.	689.24	268.50	
C_T IN.	137.85	108.47	
$\bar{C}$ IN.	474.81	199.81	
MAC	Y_o = 182.13	Z_o = 635.52	
AIRFOIL	TIP, 0012-64 MOD	10° SYM	
	Y_o = 199, .0010 MOD	60-40 WEDGE	
V_V (TAIL VOLUME)		.0537	
S_W EXPOSED, FT^2 (TOTAL)	2012.4 (INC. GL)	369.1	
S_{GLOVE} EXPOSED FT^2	290.8		
S_W TOTAL WETTED FT^2	4001.2	738.82	
S_{ELEVON} FT^2 (ONE SIDE)	206.57		
S_{RUD} FT^2		97.74	

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
8C	A	1. CARGO DOOR AFT TRIM X_o 1306.9 WAS 1307	9-13-74	
5G		2. REVISED GEO. NOTES		
7B		3. MPS VERT. ENG. SPACING 108 CORRECTED TO READ 103.		
9F		4. Z 446 NOTE WAS Z 448 ℄ MANIP		
8F		5. C/4 DIM 1136.83 WAS 1136.84		
7B		6. ET ATTACH LOC. AFT 95.5 CORR'D. TO READ 96.5		
9G		7. ADDED X_o 238 AS FWD LOC OF REF BODY LENGTH 1290.3		
13E		8. REMOVED 142° 45' DIM FROM SEC X_o 630.5		
13E		9. ADDED 37° 50' FOR RAD DEPLOY ANGLE AT SEC X_o 630.5		
13G & 13F		10. REMOVED NOT TO EXCEED < FROM SEC VIEW X_o 630.5 AND X_o 1072		
	B	SEE E.O. B01 FOR DIRECT DRAWING CHANGES INCORPORATED AND RELEASED AT B REVISION	1-16-76	
	C	SEE E.O. C01 FOR DIRECT DRAWING CHANGES INCORPORATED AND RELEASED AT "C" REVISION	3-18-77	J.T. GREEN
	D	SEE E.O. D01 FOR DIRECT DRAWING CHANGES INCORPORATED AND RELEASED AT "D" REVISION	9-14-77	J.T. GREEN
	E	SEE E.O. E01 FOR DIRECT DWG CHANGES INCORPORATED AND RELEASED AT "E" REVISION	3-30-78	J.K. COX J.T. GREEN



COORDINATE SYSTEMS

⚠ MPS GIMBAL ANGLES SHOWN INCLUDE 0° 30' DYNAMICS OVERTRAVEL AND 0° 30' THRUST MISALIGNMENT

2 TRACEABILITY NOT REQD

NOTES: UNLESS OTHERWISE SPECIFIED

FIGURE 3.1-1a
ORBITER DESIGN GEOMETRY

Space Systems Group
Rockwell International

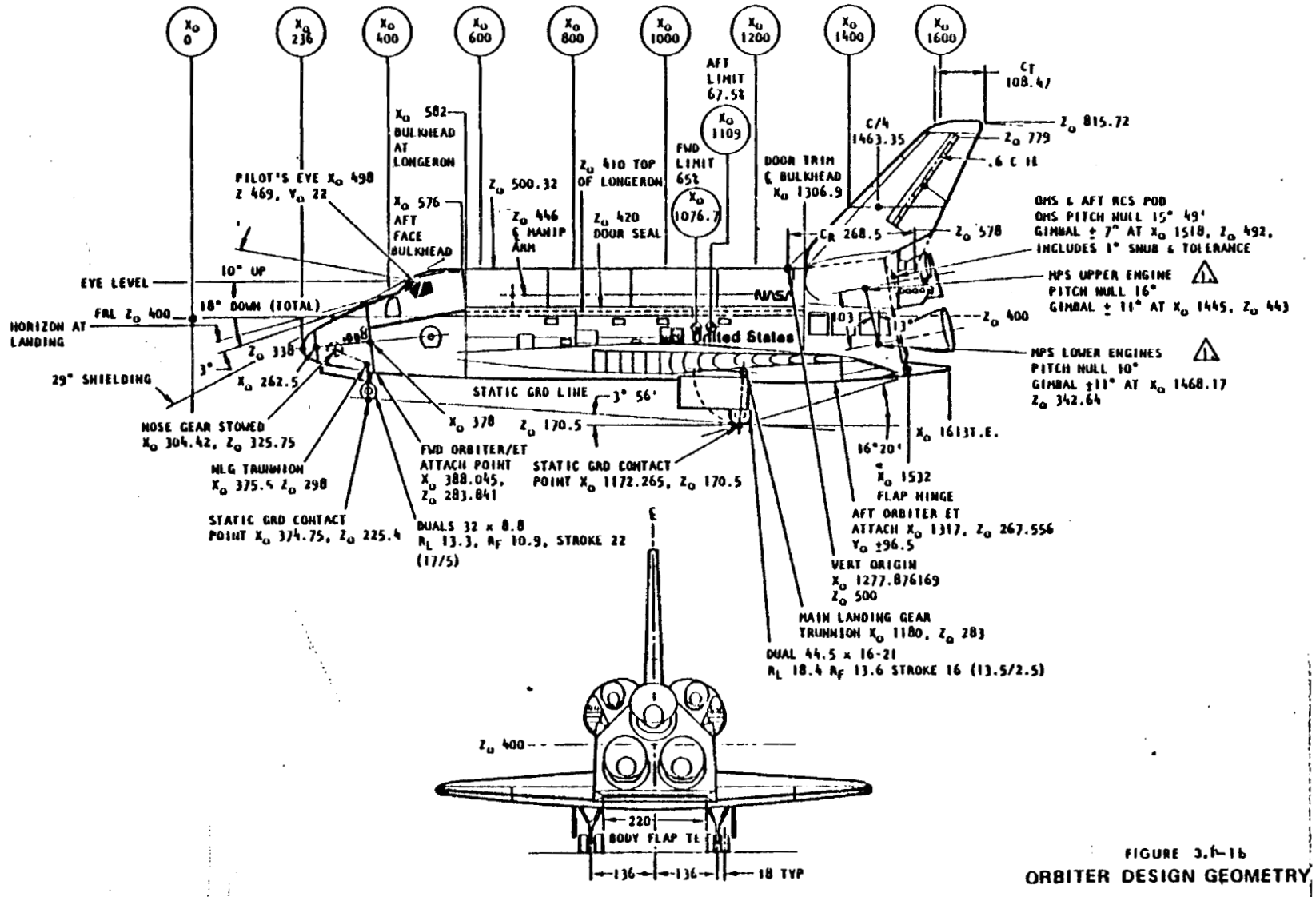


FIGURE 3.1-16
ORBITER DESIGN GEOMETRY

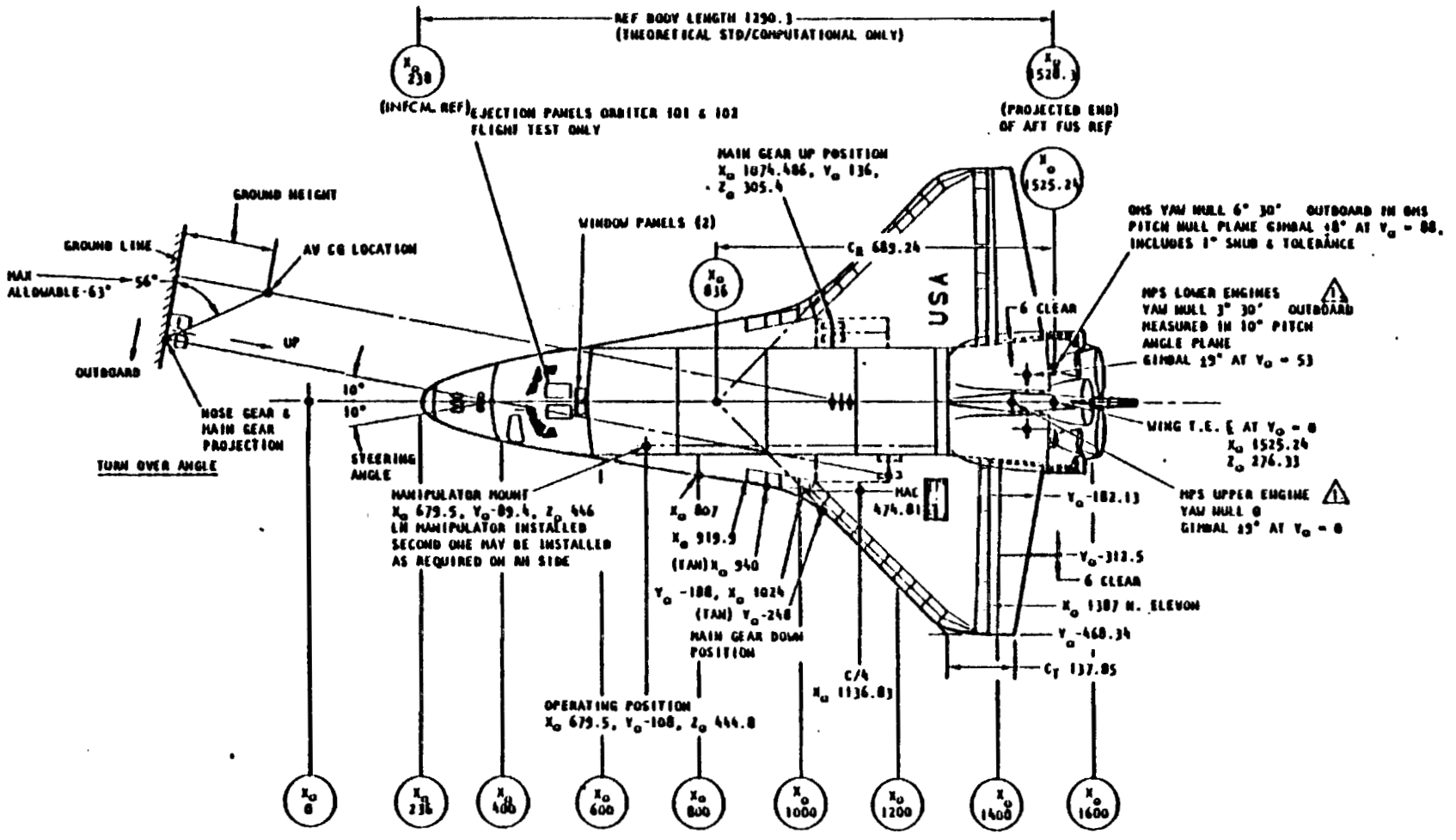


FIGURE 3.1-1c
ORBITER DESIGN GEOMETRY

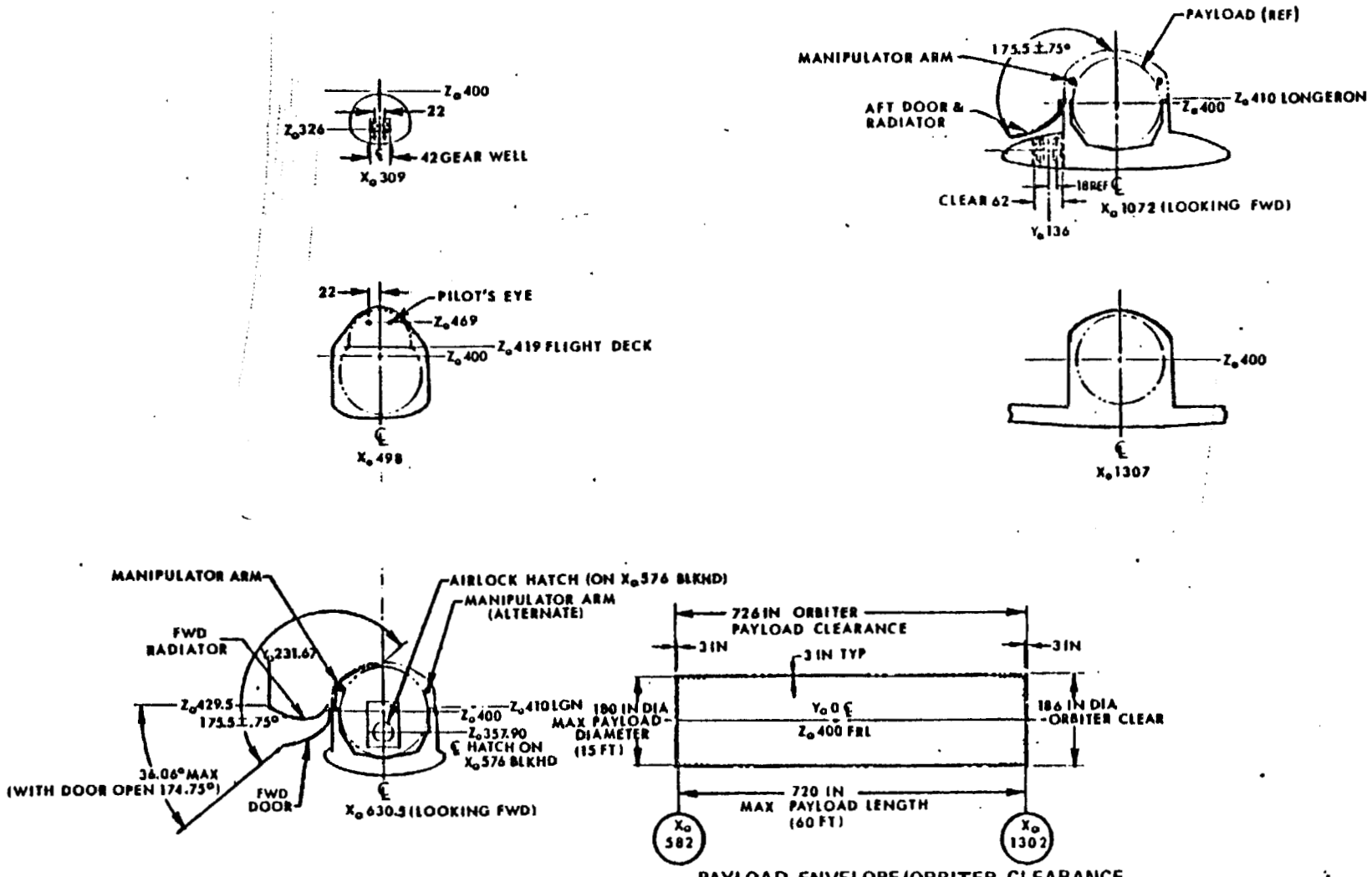


FIGURE 3.1-1d
ORBITER DESIGN GEOMETRY

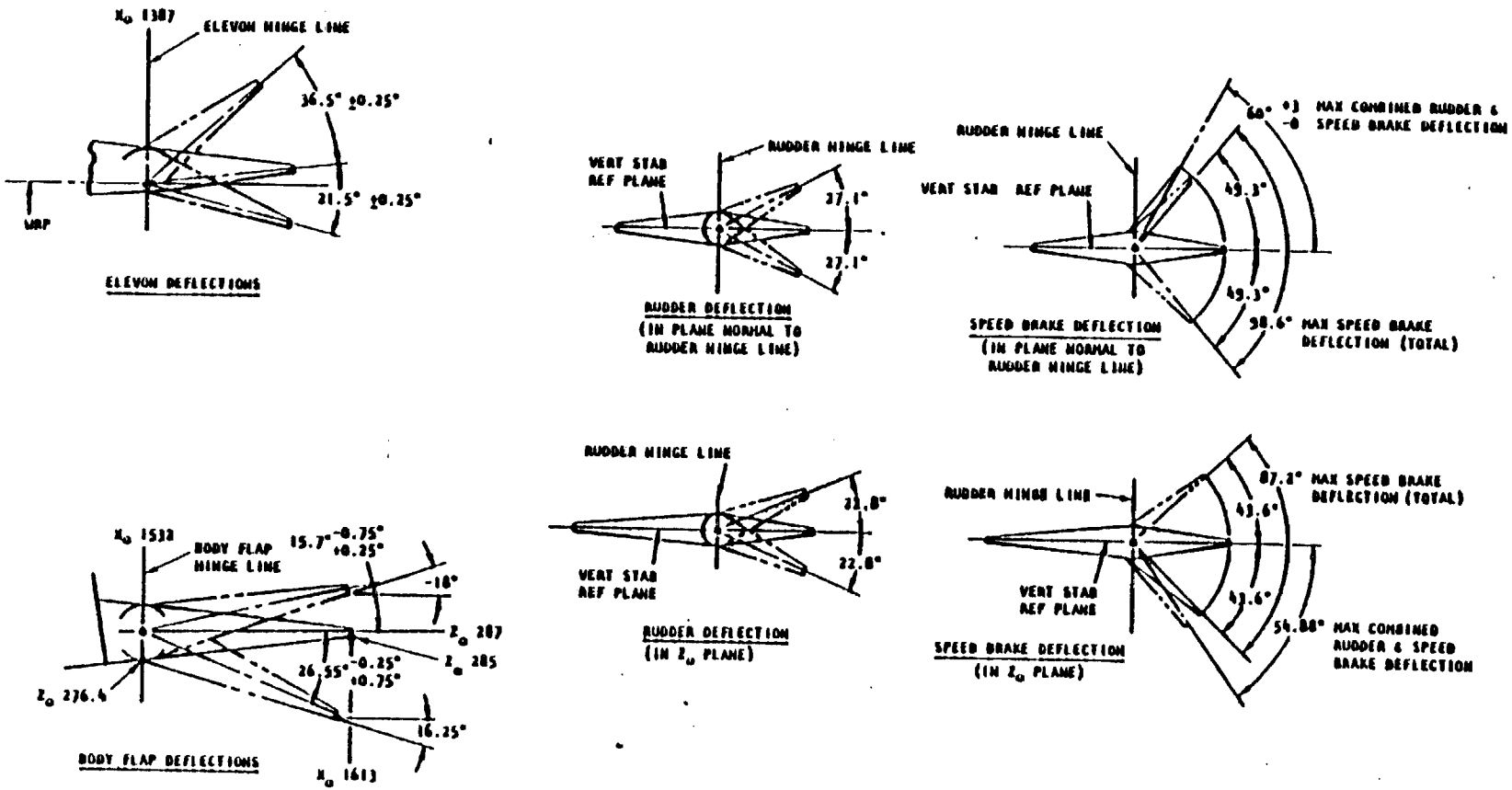


FIGURE 3.1-1.
ORBITER DESIGN GEOMETRY

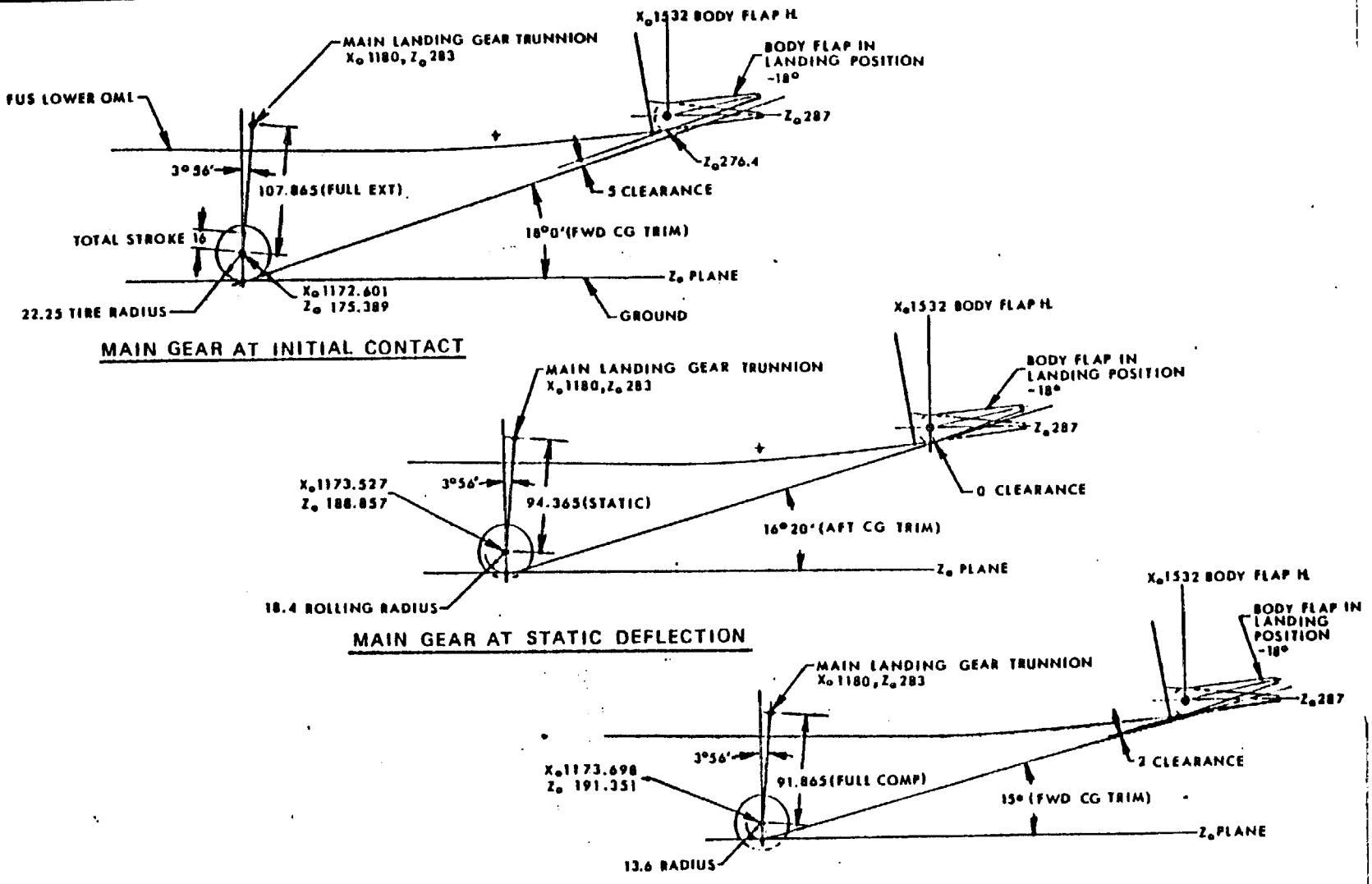


FIGURE 3.1-16
ORBITER DESIGN GEOMETRY

3.1.1 WING. The Orbiter wing was sized to provide a 171-knot touchdown speed (V_D) at a 15-degree angle of attack (tail scrape attitude for main gear strut compressed, tire flat) with body flap retracted and the center of gravity at the forward limit. The leading edge sweep (45 degrees) and aspect ratio (2.265) were selected on the basis of aero-thermodynamic trade studies to provide the design touchdown speed for a center of gravity at the forward limit with minimum wing size and to optimize the wing leading edge thermal protection system (TPS) for a reuse cycle of 100 flights prior to major rework. Spanwise twist distribution and chordwise camber are shown on Figure 3.1.1-1.

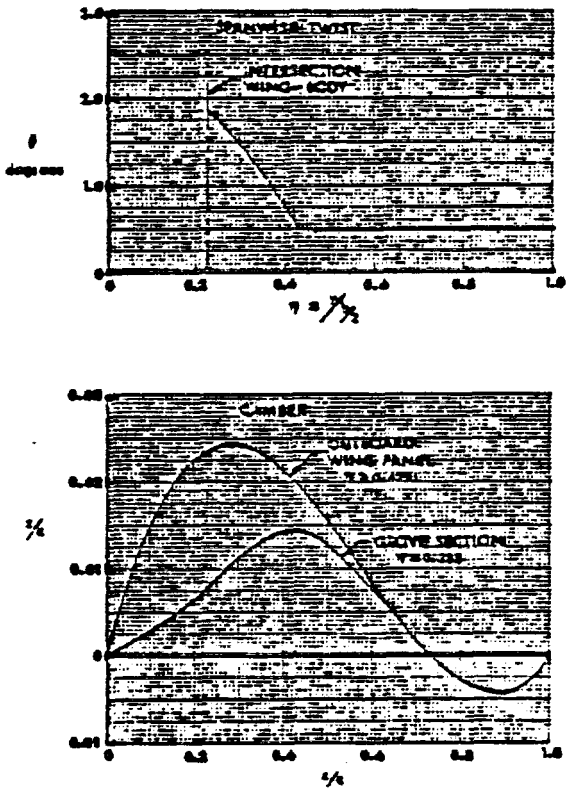
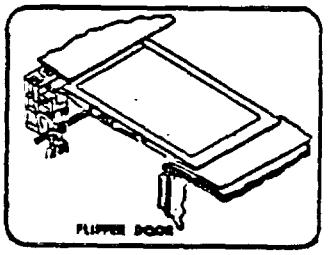


Figure 3.1.1-1
WING TWIST AND CAMBER

Control surfaces located in the wing consist of the elevons (elevator-ailerons) weith elevon seal (or "flipper") doors which effectively seal the resultant gaps when the elevons are deflected by *following* the control surface leading edge.



The wing planform reference area (2690 ft) includes that portion of the basic planform covered by the fuselage. It does NOT include the areas formed by wing-body fairings or areas clipped from the equivalent "delta" by the faired wing tips. Pertinent dimensional parameters are summarized in Table 3.1.1-1 (see also, Figures 3.1.4-1 through 3.1.4-4 for areas and perimeters.

Table 3.1.1-1 WING DIMENSIONAL PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS
AIRFOIL SECTION			
(Y_o 199.045)	—	0.0010 (mod)	---
(Y_o 468.340)	—	0012 - 64 (mod)	—
DIHEDRAL (at trailing edge)	δ_{TE}	3.5	degrees
AREA			
Planform (total)	S_{TOT}	2690	ft^2
Planform (exposed)	S_{TOT}	2012.4	ft^2
Wetted Surface (exposed)	S_{WET}	4001.2	ft^2
SPAN	b_w	78.056 (936.68)	ft (inch)
ASPECT RATIO	AR_w	2.265	---
TAPER RATIO	$\lambda = c_t/c_r$	0.20	---
SWEEP			
Leading Edge	Λ_{LE}	45	degrees
Trailing Edge	Λ_{TE}	-10	degrees
CHORD			
Root (theoretical)			
Fuselage Station (0.25c) (F.S.)	X_o	1008.31	Inches
Buttock Line (B.L.)	Y_o	0	Inches
Length	$c_{r_{theo}}$	57.44 (689.24)	ft (inch)
Root (exposed)			
Fuselage Station (0.25c) (F.S.)	X_o	778.5	Inches
Buttock Line (B.L.)	Y_o	108.0	Inches
Length	c_r	30.83 (370)	ft (inch)
Tip			
Fuselage Station (0.25C) (F.S.)	X_o	1338.30	Inches
Buttock Line (B.L.)	Y_o	468.34	Inches
Length	c_t	11.48 (137.35)	ft (inch)
Mean Aerodynamic	MAC		
Fuselage Station (0.25c) (F.S.)	X_o	1136.33	Inches
Buttock Line (B.L.)	Y_o	182.13	Inches
Length	$\bar{c}_w$	39.56 (474.31)	ft (inch)
GLOVE			
Sweep	Λ_{GLOVE}	81	degrees
Theoretical Intersection			
Fuselage Station (F.S.)	X_o	1024.0	Inches
Buttock Line (B.L.)	Y_o	158.0	Inches
ELEVON (one side)			
Inboard/Outboard Split (BL)	Y_o	311	Inches
Area	S_e	206.57	ft^2
Span	b_e	28.37	ft
Aspect Ratio	AR_e	4.03	---
Chord	MAC, $\bar{c}_e$	7.46 (89.5)	ft (inch)
Fuselage Station (0.25c) (F.S.)	X_o	1409.375	Inches
Distance (centroid to hingeline)	—	44.75	Inches

3.1.2 FUSELAGE (OR BODY). The Orbiter fuselage was designed to accommodate a variety of payloads and house the crew and maneuvering control systems. Nose camber, cross section, and upward sloping forebody sides were selected to improve hypersonic pitch trim and directional stability and in conjunction with wing-body blending, to reduce entry heating on the body sides. Attitude Control Propulsion System (ACPS) pods have been incorporated with the OMS and are located in the aft body fairings. Hinged surfaces attached to the fuselage include the cargo bay doors and the body flap. The cargo bay doors have 13 hinges on each side of the fuselage. The six forward hinges on each side are covered with TPS and faired fore and aft. The aft seven hinges have no TPS and no fairings. The body flap is used to protect the Shuttle main engines (SME) during entry and to provide trim capability to relieve elevon loads. Pertinent dimensional parameters are summarized in Table 3.1.2-1.

Table 3.1.2-1 FUSELAGE DIMENSIONAL PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS
LENGTH			
Reference	L_B	1290.3	Inches
Nose Fuselage Station (F.S.)	X_0	238	Inches
DEPTH	h_B	19.92 (239)	ft (inch)
Maximum at F.S.	X_B	1280	Inches
WIDTH	w_B	22.0 (264)	ft (inch)
Maximum at F.S.	X_B	1528.3	Inches
AREA			
Planform	S_B	1914.4	ft^2
Wetted Surface	S_{wetted}	5634	ft^2
Base	S_{base}	365.7	ft^2
OMS Pods	S_{OMS}	71.0	ft^2
CARGO BAY			
Diameter	d_{CB}	15	ft
Length	L_{CB}	60	ft
GLOVE			
Fuselage Intersection (F.S.)	X_G	500	Inches
(B.L.)	Y_G	102	Inches
(Based on OML - TPS Included)			
BODY FLAP			
Area (planform)	S_{bf}	135.75	ft^2
Span (equivalent)	b_{bf}	241.33	Inches
Chord	c_{bf}	81	Inches
Hinge Line (F.S.)	X_0	1532	Inches

3.1.3 VERTICAL TAIL. The vertical tail has been sized to provide a low-speed C_{n_β} of 0.0013 at an angle of attack of 13 degrees about a center of gravity located at the aft limit and has a reference area of 413.25 ft^2, including the rudder/speed brake. The rudder is split along the Orbiter buttock plane to provide directional stability augmentation in the hypersonic/supersonic flight regimes and to apply drag modulation for the subsonic flight phases, approach and landing. The section profile is a five-degree half-angle, 60 to 40 percent double wedge airfoil. Dimensional parameters are summarized in Table 3.1.3-1.

Table 3.1.3-1 VERTICAL TAIL DIMENSIONAL PARAMETERS
(Including rudder/speed brake)

PARAMETER	SYMBOL	VALUE	UNITS
AIRFOIL SECTION (root-tip)	---	10° Symmetrical 60% - 40% double wedge	---
AREA	S_v	413.25	ft^2
SPAN	b_v	26.31 (315.72)	ft (inch)
ASPECT RATIO	AR	1.675	---
TAPER RATIO	$\lambda_v = c_t/c_r$	0.404	---
SWEEP			
Leading Edge	$\Lambda_{v_{LE}}$	45	degrees
Trailing Edge	$\Lambda_{v_{TE}}$	26.2	degrees
CHORD			
Root	c_r	22.37 (268.5)	ft (inch)
Tip	c_t	9.04 (108.47)	ft (inch)
Mean Aerodynamic	$\bar{c}_v$	16.65 (199.31)	ft (inch)
Fuselage Station (0.25C) F.S.	X_o	1463.35	inch
Waterline W.L.	Z_o	635.5	inch
RUDDER/SPEED BRAKE			
AREA	S	97.24	ft^2
SPAN	b	16.55 (198.61)	ft (inch)
CHORD			
Mean Aerodynamic	$\bar{c}$	6.07 (72.34)	ft (inch)
Fuselage Station (0.25c) F.S.	X_o	1575.77	inch
Waterline W.L.	Z_o	670.41	inch

3.1.4 TOTAL VEHICLE. Cross sectional data defining the total Orbiter Vehicle geometry are presented in Figures 3.1.4-1 through 3.1.4-4. These figures provide the cross sectional area variation for components and total vehicle and the perimeter distribution for components and total vehicle. Total vehicle dimensional parameters are summarized in Table 3.1.4-1.

Table 3.1.4-1 TOTAL VEHICLE DIMENSIONAL PARAMETERS
(fuselage plus exposed wing)

PARAMETER	SYMBOL	VALUE	UNITS
AREA			
Planform	S_{TOTAL}	3952	ft^2
Wetted Surface	$S_{WET_{TOTAL}}$	11,136	ft^2
LENGTH			
Overall	L	122.0 (1464)	ft (inch)
Reference	L_o	107.5 (1290.3)	ft (inch)
SPAN	b_w	78.056 (936.68)	ft (inch)
HEIGHT			
Gear-Up	$h_{GEAR\ UP}$	46.14 (553.68)	ft (inch)
Gear-Down (static position)	$h_{GEAR\ DOWN}$	53.76 (645.12)	ft (inch)

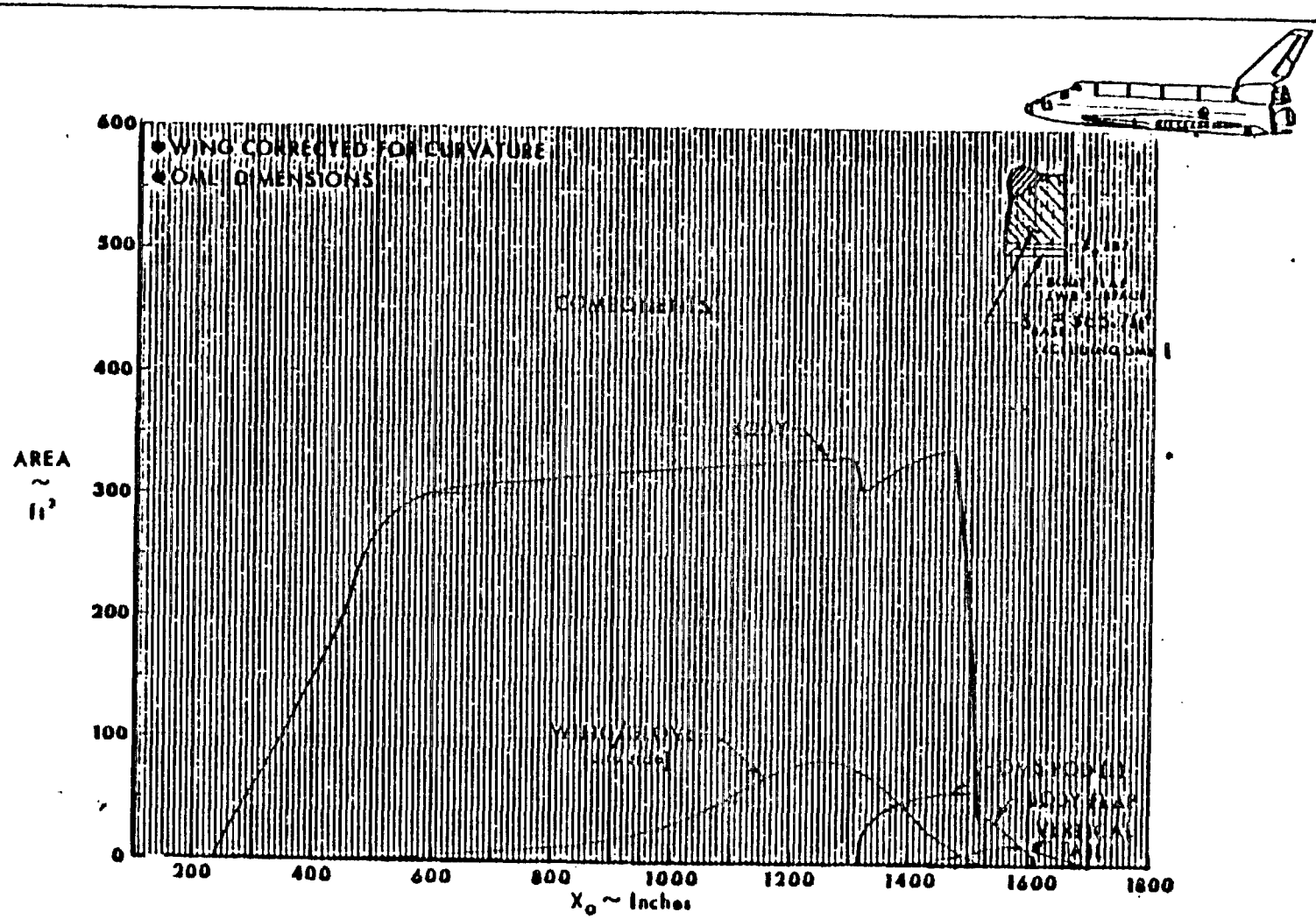


Figure 3.1.4-1
CROSS-SECTIONAL AREA VARIATION

Space Division
Rockwell International

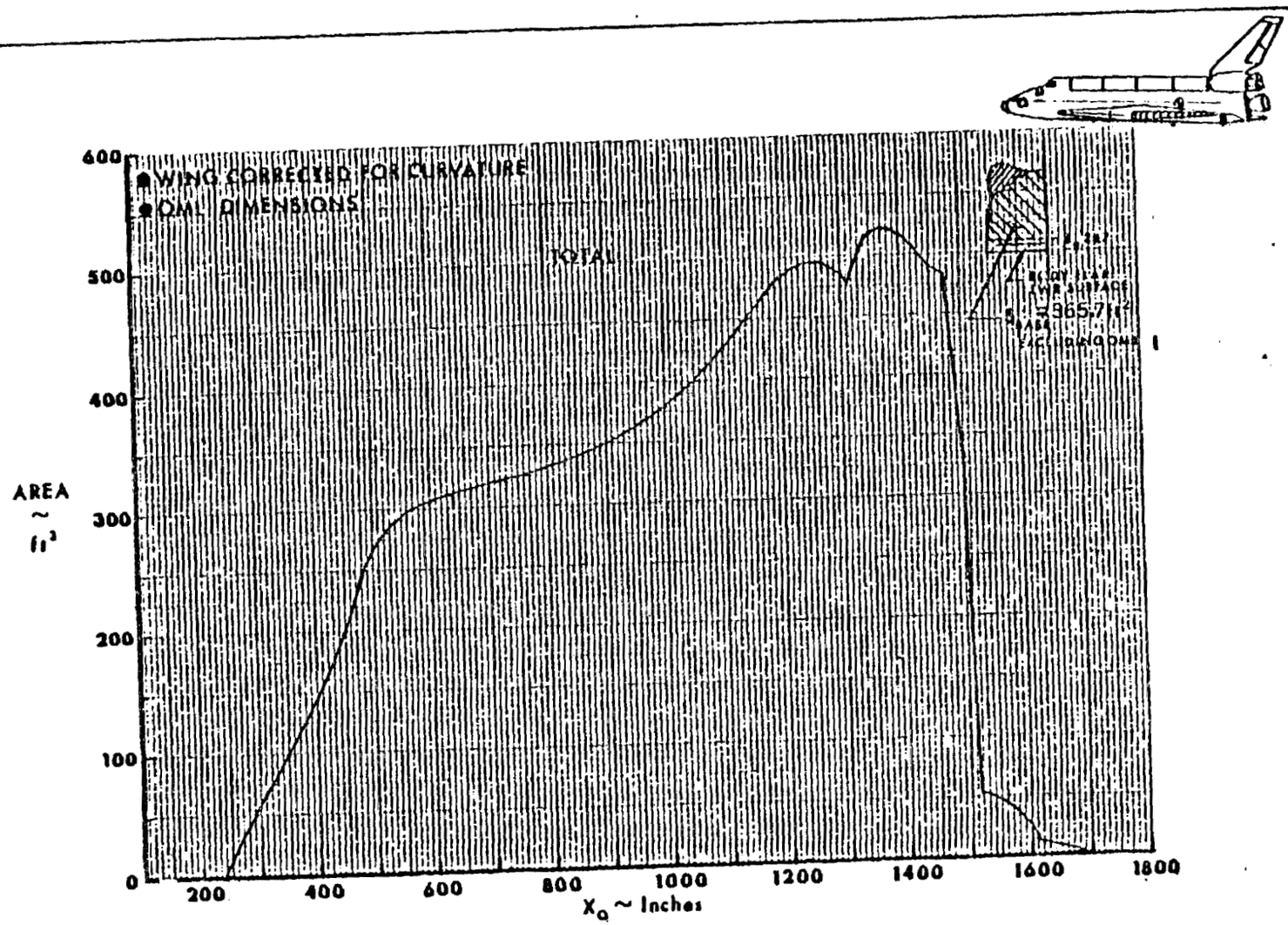


Figure 3.1.4-2
CROSS-SECTIONAL AREA VARIATION

Rockwell International
Space Division

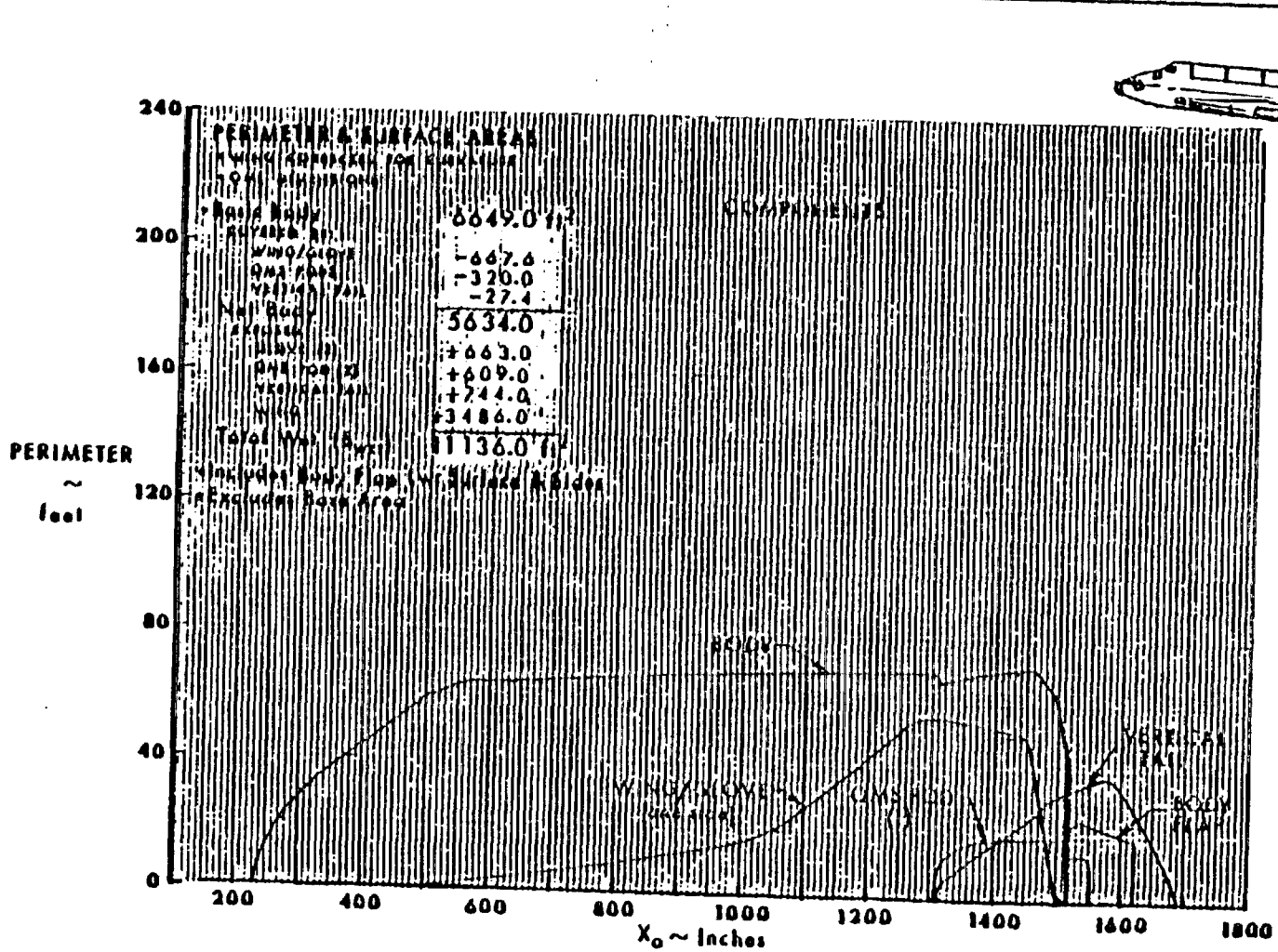


Figure 3.1.4-3
PERIMETER DISTRIBUTION

Rockwell International
Space Division

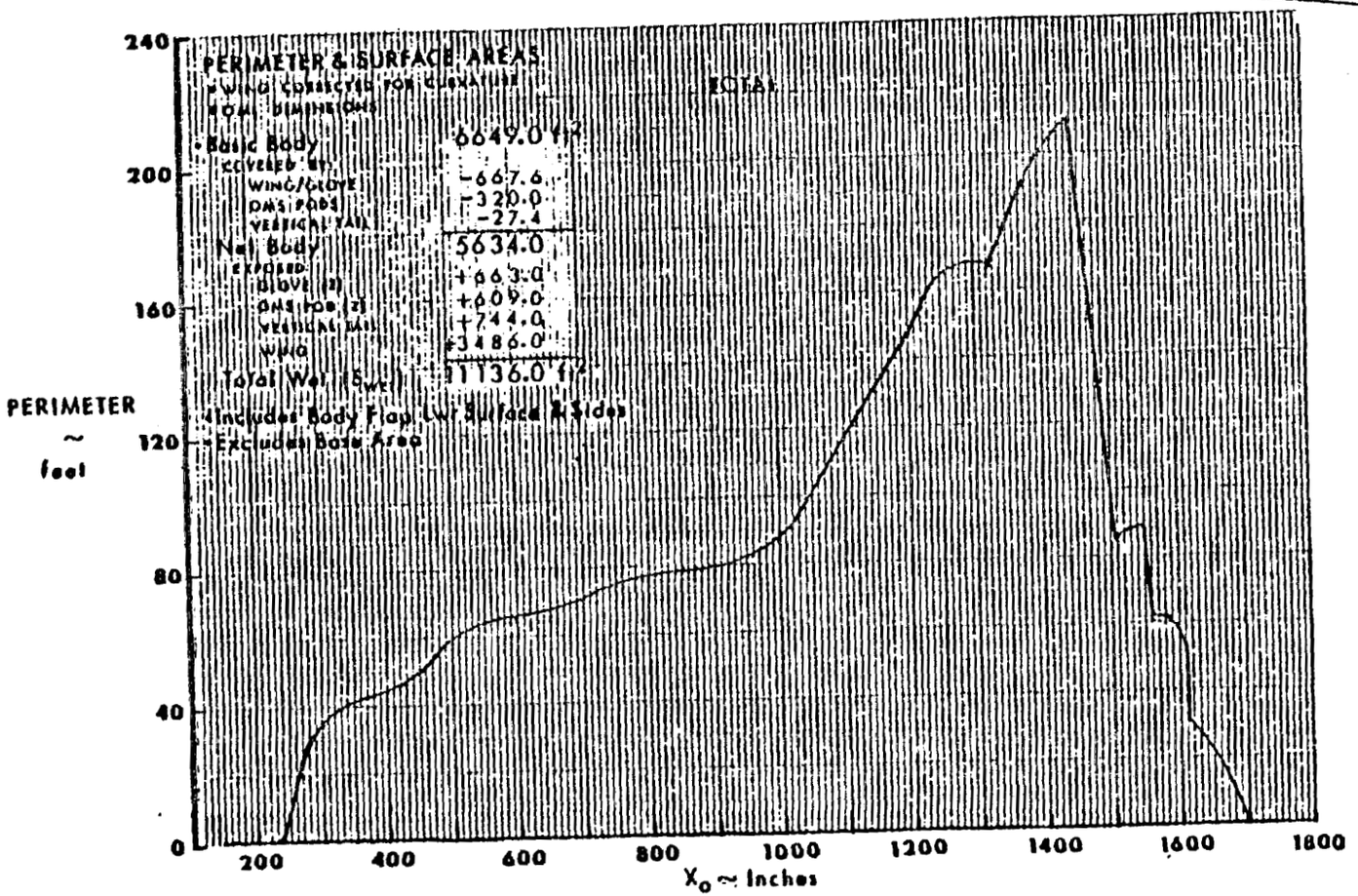
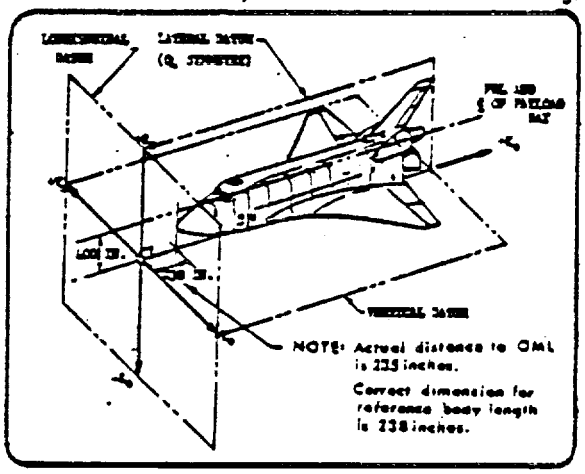


Figure 3.1.4-4
PERIMETER DISTRIBUTION

Space Division
Rockwell International

3.2 REFERENCE AXES AND SIGN CONVENTION

Reference axes and sign conventions are consistent with those for conventional aircraft. The Orbiter Vehicle axis system for vehicle design drawings and mass properties statements is illustrated in the sketch. This axis system is defined in the Space Shuttle Master Dimensions Specification, Reference 3-2, and on Figure 3.1-1. All vehicle design drawing axes systems are in accordance with NASA Phase B Technical Directives 2519 and 2519A.



3.2.1 AERODYNAMIC REFERENCE AXIS SYSTEMS. Definitions of the Orbiter Vehicle aerodynamic reference axis systems are illustrated in Figure 3.2.1-1. The positive X-axis for the Orbiter body axis system is shown parallel to the Fuselage Reference Line (FRL). Sign conventions for forces, moments, velocities, and accelerations are also shown on the figure. The aerodynamic reference axis systems are sets of conventional, right-hand, orthogonal axes with the X- and Z-axes in the plane of symmetry and with the positive X-axis directed out the nose (in the body axis system) or pointing into the component of the wind (in the stability axis system) which lies in the plane of symmetry.

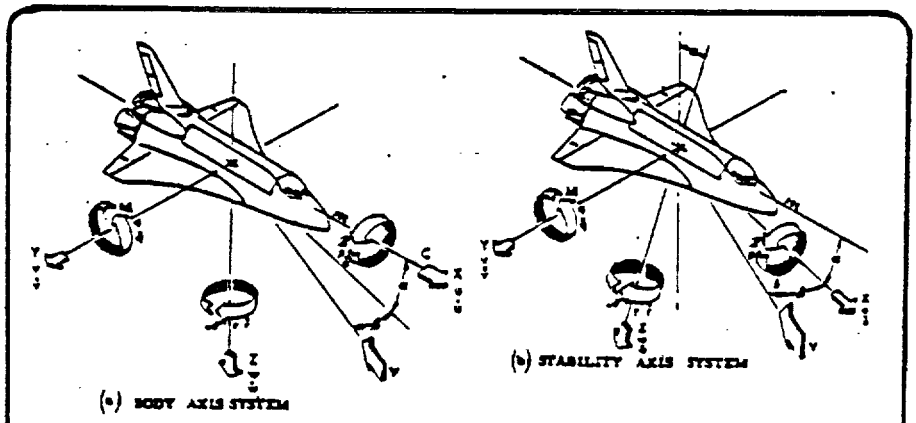


Figure 3.2.1-1
ORBITER REFERENCE AXIS SYSTEMS

3.2.2 AERODYNAMIC SIGN CONVENTION. Sign conventions for the aerodynamic force and moment coefficients used in this report are illustrated in Figure 3.2.2-1 for the stability axis system. Directions on the figure are positive as shown.

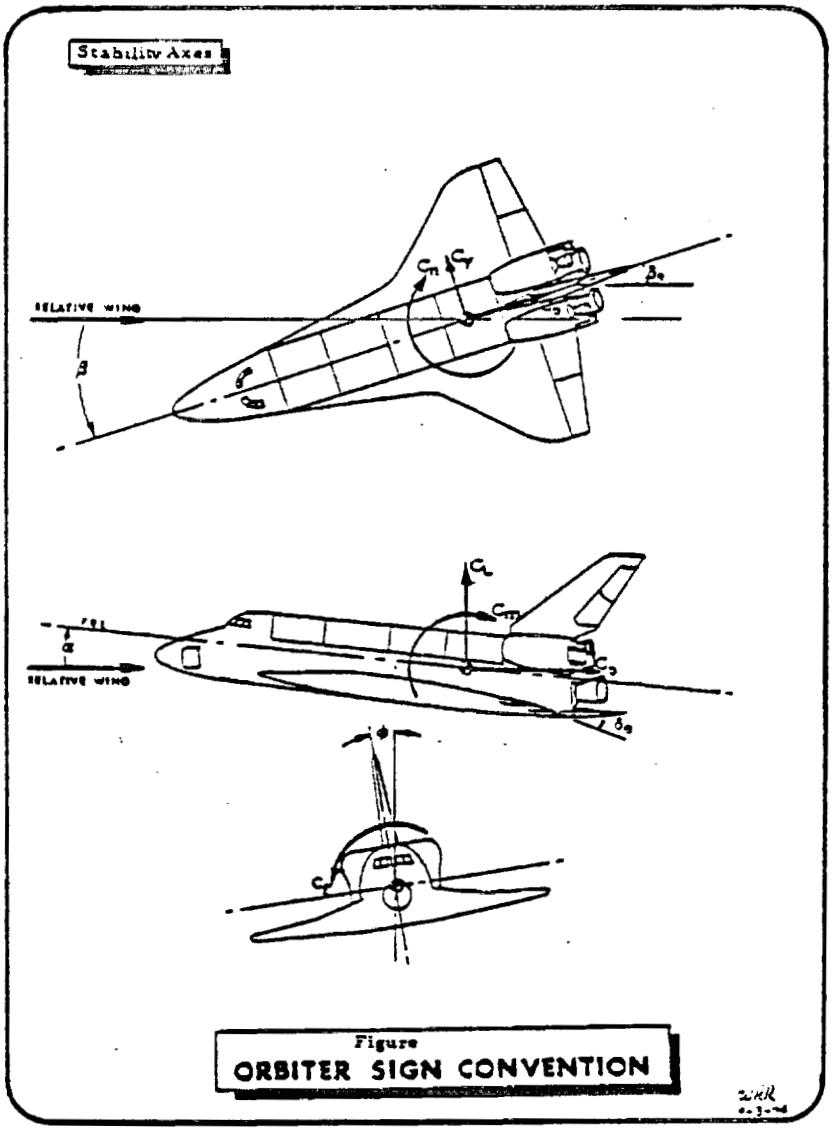
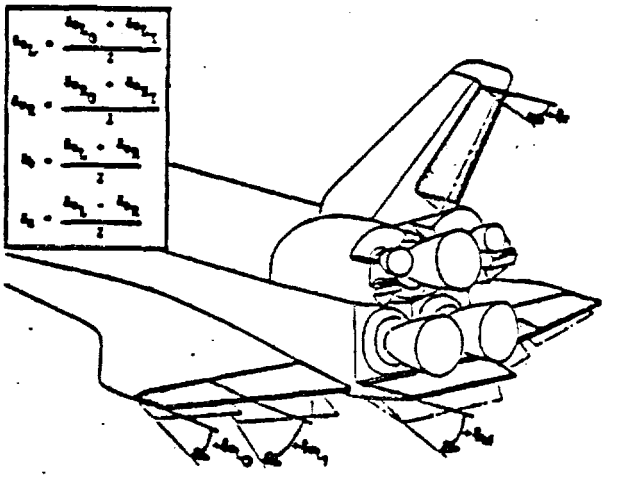


Figure
ORBITER SIGN CONVENTION

3.3 AERODYNAMIC CONTROL

Orbiter Vehicle aerodynamic control surface deflections, forces, and hinge moments are summarized and illustrated in the sketch. In general, control surface deflection angles are measured in a plane perpendicular to the control surface hinge axis. An exception is the rudder/speed brake control surface (s) deflections which are measured in a plane parallel to the fuselage reference plane (FRP). Each aerodynamic control surface and deflection is discussed separately in the ensuing paragraphs of this section.

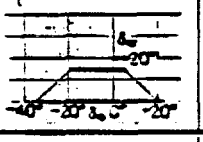


3.3.1 ELEVONS.

The elevons are divided into four segments, right- and left-inboard and right- and left-outboard. Gaps between the fuselage and elevon and between the inboard segments to which the data herein are applicable are those baselined in MCR 0315. A typical elevon control installation is shown in Figure 3.3.1-1.

Positive Deflection of	Angle	Aero Forces and Moments	Hinge Moment
Rudder, δ_r	$-\beta$, $-\phi$	$-C_Y$, $-C_n$	$-C_{h_r}$
Elevon, δ_e	$-\alpha$, $-\phi$	$-C_m$	$-C_{h_e}$
Right, δ_{e_R}	$-\phi$	$-C_f$	$-C_{h_{e_R}}$
Left, δ_{e_L}	$-\phi$	$-C_f$	$-C_{h_{e_L}}$
Aileron, δ_a	$-\phi$	$-C_f$	
Body Flap, δ_{bf}	$-\alpha$, $-\phi$	$-C_m$	$-C_{h_{bf}}$

Table 3.3-1 MAXIMUM CONTROL SURFACE DEFLECTIONS AND RATES

CONTROL SURFACE	DEFLECTION SYMBOL	DISPLACEMENT (MAXIMUM) degrees	RATE (NORMAL OPERATION) deg/sec
ELEVONS			
Elevator	δ_e	-35 TE UP +20 TE DOWN	20
Aileron	$\delta_a = \frac{1}{2}(\delta_{e_L} - \delta_{e_R})$		20
RUDDER	δ_r	± 22.8	10
SPEEDBRAKE	δ_{TE}	0 to 37.2	5
BODY FLAP	δ_{bf}	-11.7 TE UP +22.55 TE DOWN	1.3

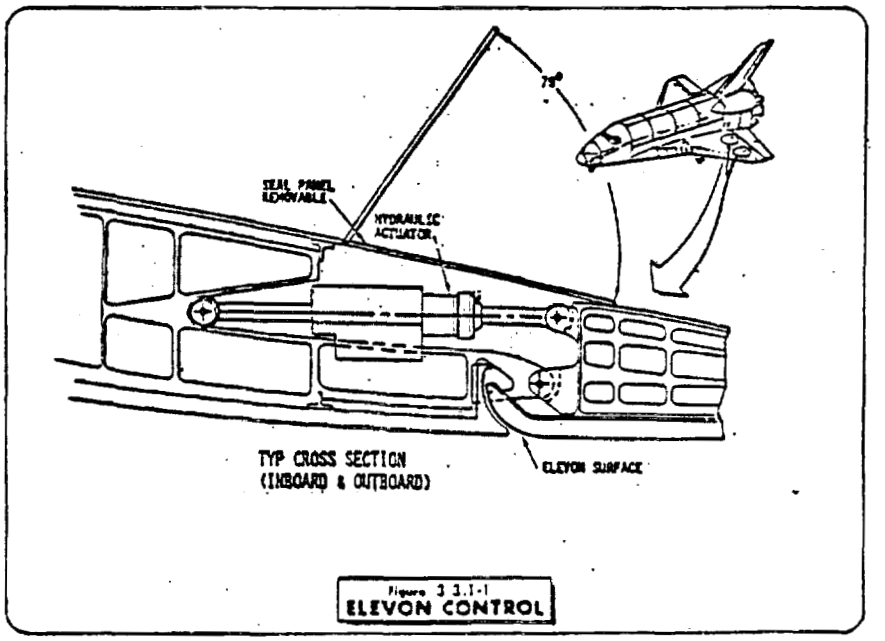


Figure 3.3.1-1
ELEVON CONTROL

The surfaces are servo-actuated with four actuators to control the four segments. These surfaces are employed for pitch and roll control and pitch and roll trim. Maximum control surface deflections and rates are given in Table 3.3-1. The elevon deflection range is -35 degrees (trailing edge up) to +20 degrees (trailing edge down) except during entry where it is limited to +10 degrees to prevent excessive heating. The aileron function deflections are shown on the table.

3.3.2 RUDDER/SPEED BRAKE. Directional control of the Orbiter is achieved aerodynamically by means of the rudder. During entry, at high angles of attack, the rudder is augmented by RCS (see section 3.6). The rudder is split into four panels, two per side (upper and lower), which are deflected together for yaw control and deployed symmetrically, in opposition, for drag modulation (speed brake function). Each pair (upper and lower) of panels is actuated by power hinges driven by a common torque shaft as illustrated in Figure 3.3.2-1.

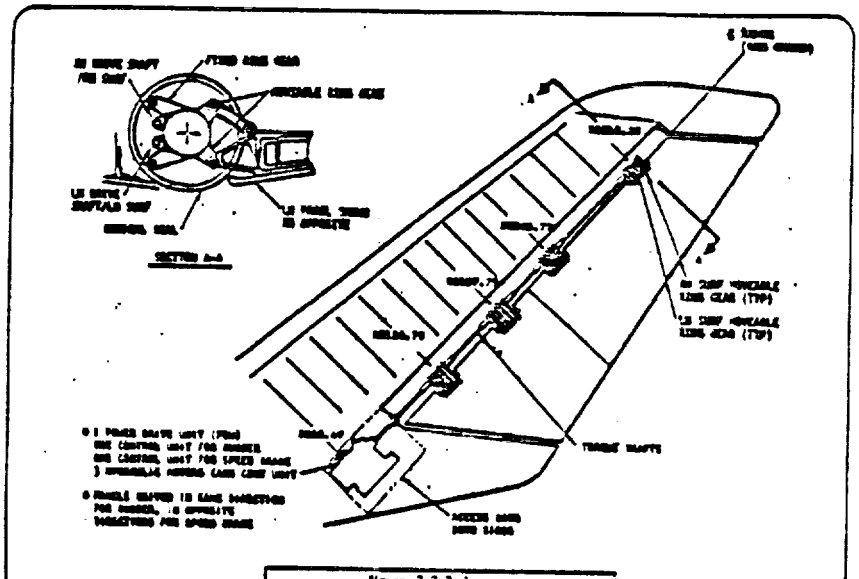


Figure 3.3.2-1
RUDDER SPEEDBRAKE CONTROL

Rudder/speed brake deflections are given in Figure 3.3.2-2 and in Table 3.3-1.

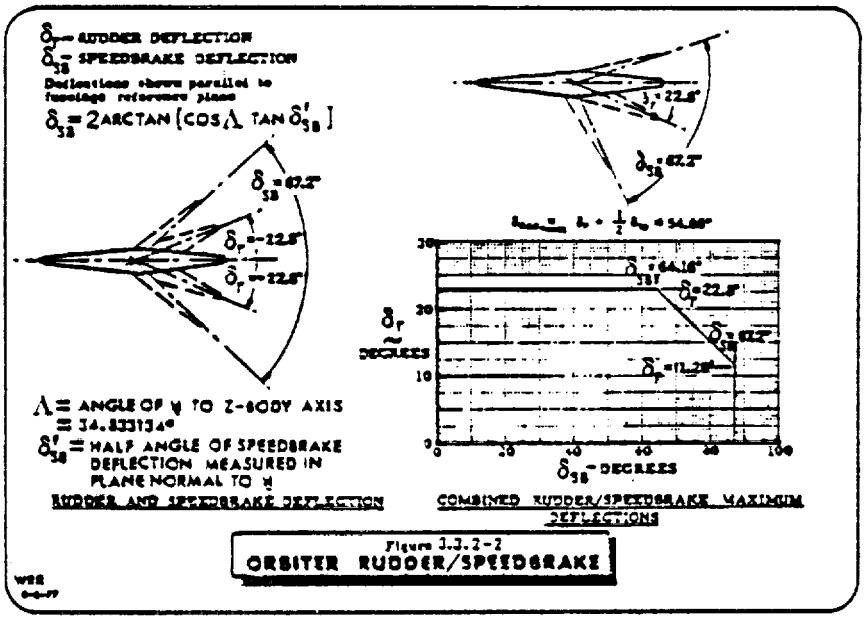


Figure 3.3.2-2
ORBITER RUDDER/SPEEDBRAKE

3.3.3 BODY FLAP. Trim capability to relieve elevon loads is obtained by body flap deflection actuated by power hinges as shown in Figure 3.3.3-1.

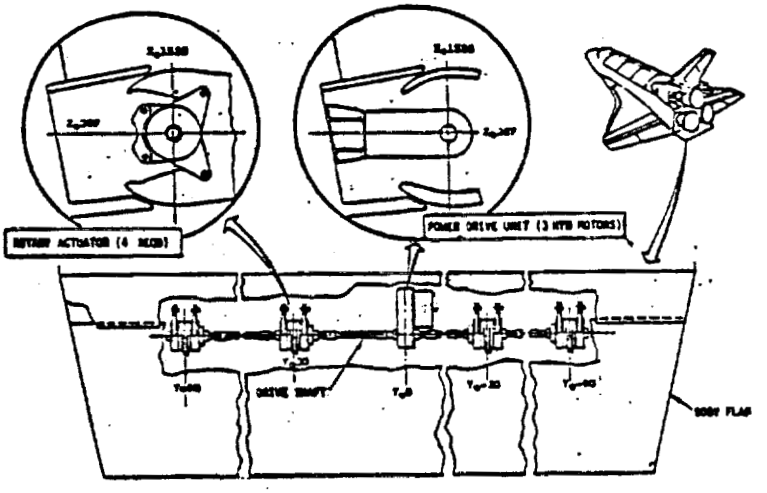


Figure 3.3.3-1
BODY FLAP CONTROL

Body flap deflection is from -11.7 degrees (trailing edge up) for entry with a forward center of gravity to +16.3 degrees (trailing edge down) for entry with an aft center of gravity. Maximum positive body flap deflection is +22.55 degrees as shown in Figure 3.3.3-2.

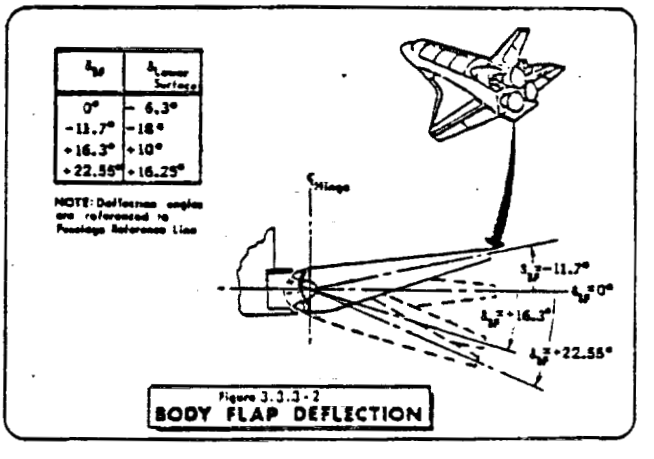


Figure 3.3.3-2
BODY FLAP DEFLECTION

3.4 LANDING GEAR AND GROUND CLEARANCE. The Orbiter Vehicle landing gear consists of a double-wheel steerable nose gear and two, double-wheel, wing-mounted, main gear. The gear is designed for a maximum landing weight of 227,000 pounds and a maximum-landing velocity of 221 knots. Maximum allowable sink rate for the Orbiter Vehicle with a 65,000-pound payload is 6.0 fps. Gear deployment velocity is 300 knots maximum. Steering capability is ±10 degrees and the crosswind constraint is 20 knots maximum. The landing gear installation is illustrated in Figure 3.4-1.

Ground effect, as shown in the data sections of this report, is given as a function of the ratio of height-above-ground to wing span. The height-above-ground is measured to a point on the vehicle just aft of the trailing edge of the inboard section of the elevon (FS 1506.84, WL 282.71). Height-above-ground as a function of angle of attack is given in Figure 3.4-2 for various values of the ratio h/b.

The touchdown attitude is restricted by the ground scrape angle (α_s) as illustrated on Figure 3.4-2. Scrape angle(s) is given for three landing gear strut conditions: fully extended; static; and fully compressed-tires flat when the body flap is in the landing position (-11.7 degrees). The effect of elevon deflection (trailing edge down) is to further restrict the touchdown attitude as shown on the figure.

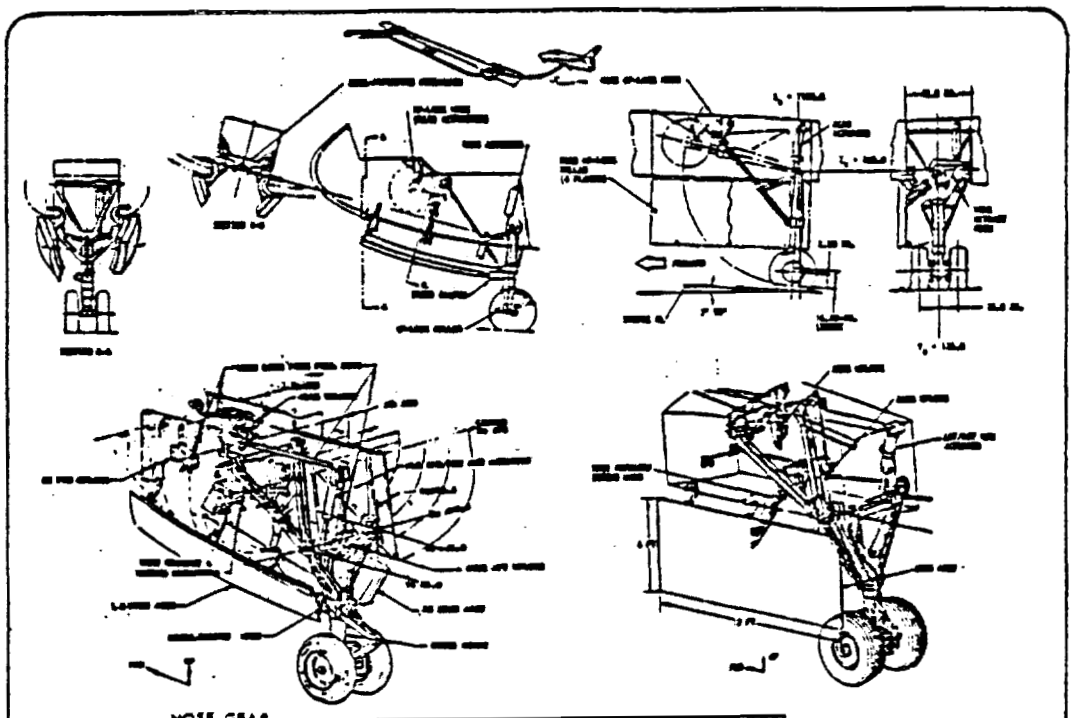


Figure 3.4-1
LANDING GEAR INSTALLATION

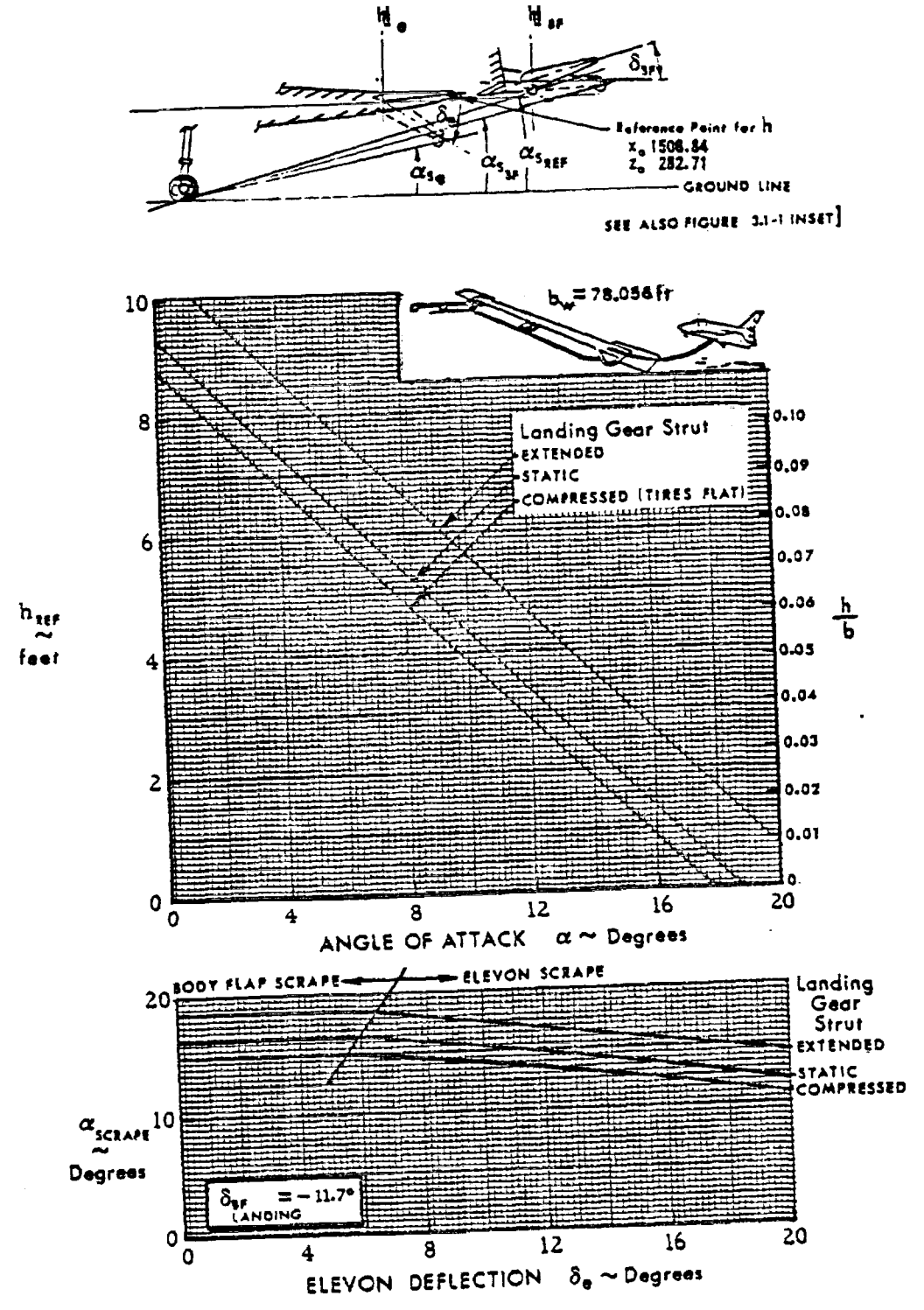


Figure 3.4-2
GROUND CLEARANCE

3.5 THERMAL PROTECTION SYSTEM. The Thermal Protection Subsystem (TPS) is designed to protect the primary airframe structure from the effects of aerodynamic heating during ascent and entry. In general, the TPS consists of reusable surface insulation (RSI) 'tiles' of three types having a 100-mission capability. The three types of insulation used are:

FRSI (flexible RSI) to 700°F (entry) and 750°F (ascent)

LRSI (low temperature RSI) 700°F to 1200°F (nominal)

HRSI (high temperature RSI) 1200°F to 2300°F (nominal)

The TPS is required to provide adequate capability for assuring safe earth return and intact landing of the Orbiter Vehicle following abort-once-around(AOA) and return-to-launch-site (RTLS) abort. General area TPS installation is shown in Figure 3.5-1.

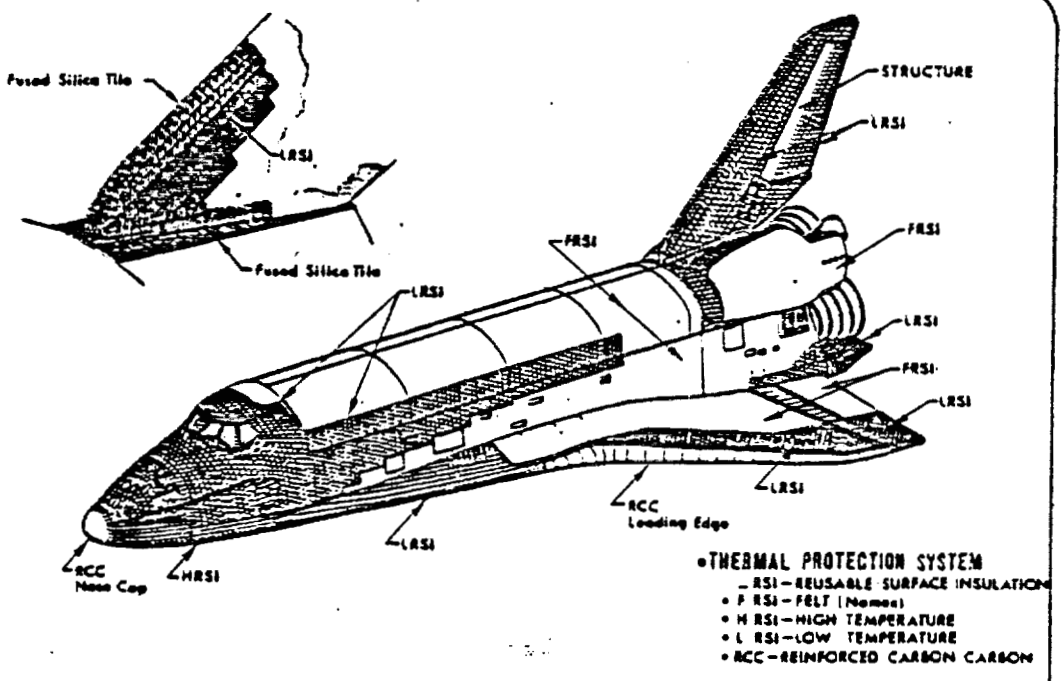


Figure 3.5-1
ORBITER VEHICLE 102

Tile gaps and steps influence the aerodynamic characteristics (particularly drag) as shown in Section 4.0 (where applicable). Orbiter moldline criteria are shown in Figure 3.5-2. A more detailed description of the TPS can be found in Reference 3-3.

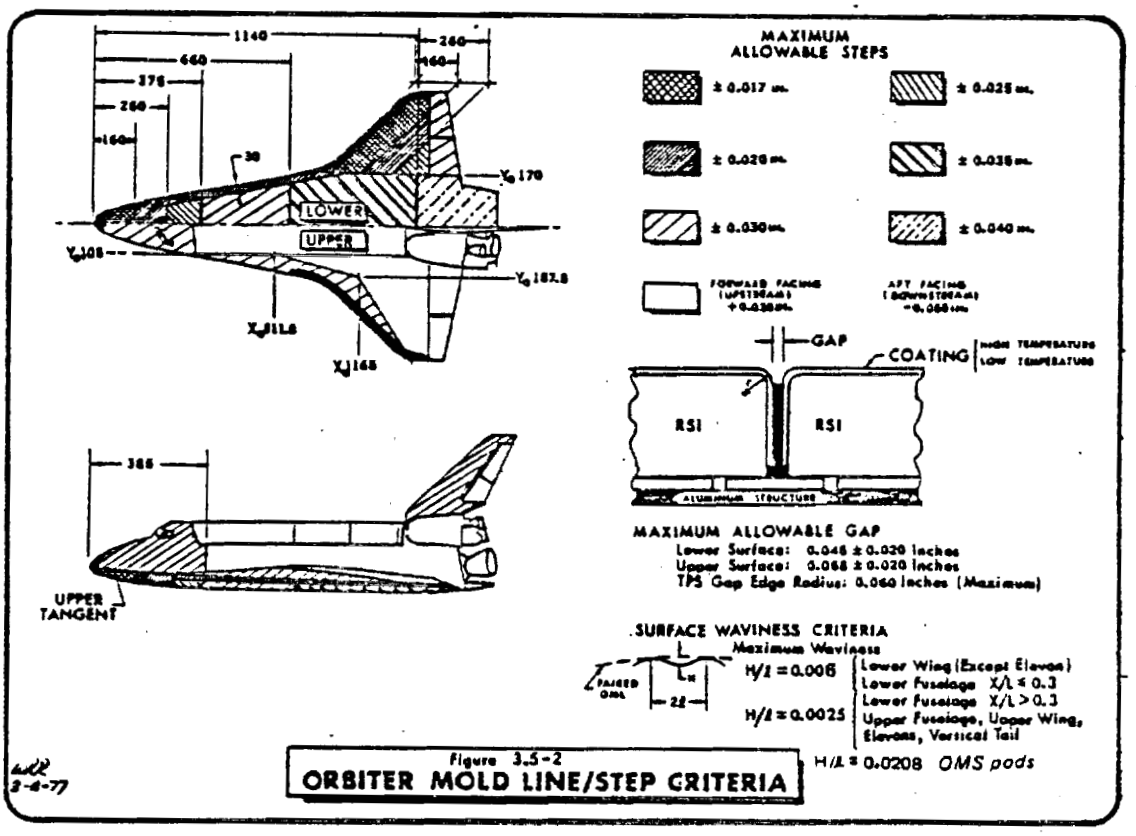
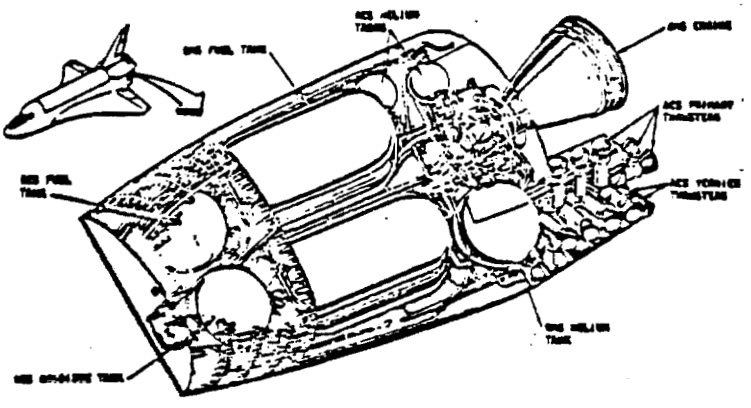
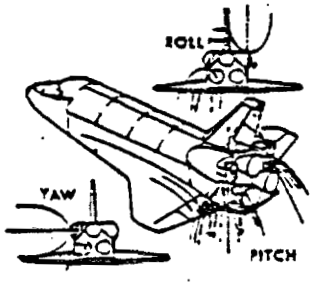


Figure 3.5-2
ORBITER MOLD LINE/STEP CRITERIA

3.6 REACTION CONTROL SYSTEM. Attitude control of the Orbiter during entry is provided by the aft reaction control system (RCS) in roll and pitch up to dynamic pressure levels of 10 and 20 psf, respectively. The RCS thrusters are located in the OMS pods as shown in the sketch. For dynamic pressure levels exceeding 20 psf, sufficient elevon (elevator-aileron) control authority is available and the roll and pitch thrusters are deactivated. The blanketing effect of the wing at high angles of attack necessitates the use of yaw thrusters to augment the rudder control until the angle of attack is reduced to approximately ten degrees. Aft RCS jet/aerodynamic interaction, illustrated in the sketch at left, is discussed in Appendix B and data are presented in Section 4.0 (where applicable).





3.7 AIR DATA SYSTEM. The air data system (ADS) is designed to provide air data relative to the vehicle at altitudes where winds, in conjunction with vehicle speeds, can produce relatively large errors in inertially derived air data. At approximately 100,000 feet of altitude (M = 3.5) two air data probes are extended from the Orbiter forebody (FS 299, WP 324) to sense vehicle flight conditions. One probe is located on each side of the orbiter forebody canted 10 degrees, nosedown, relative to the FRL. The ADS probe is illustrated in Figure 3.7-1. The air data probe is instrumented to measure total temperature (T_T), local static pressure (P_S), and angle of attack from three pressure ports (P_1, P_2, and P_T).

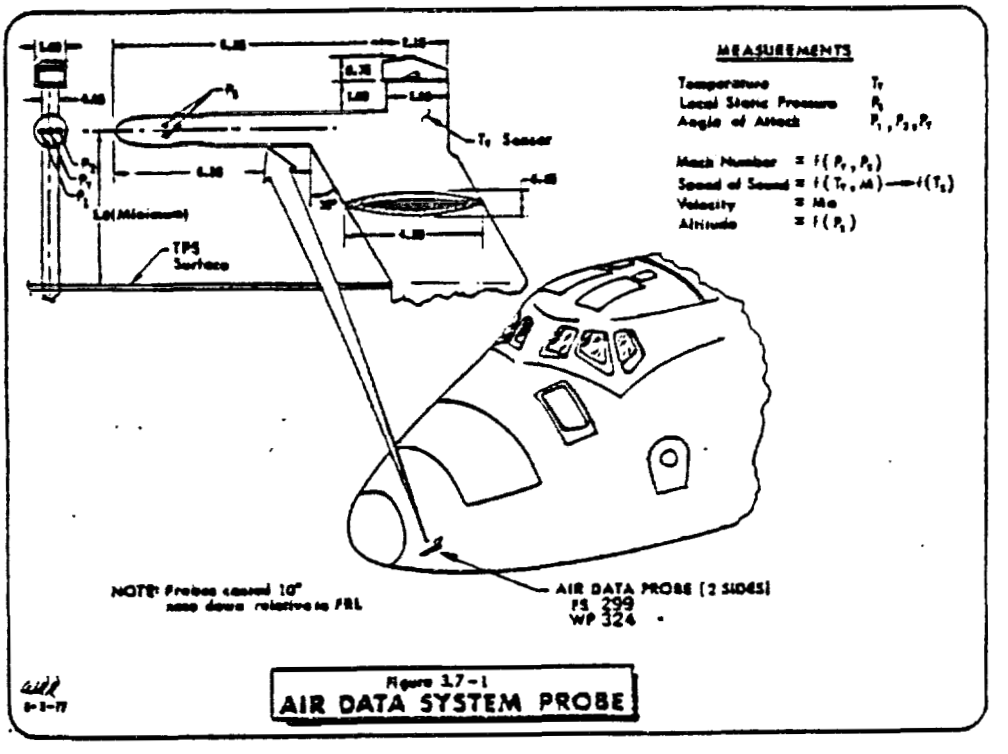


Figure 3.7-1
AIR DATA SYSTEM PROBE

3.8 CREW ESCAPE SYSTEM. The Crew Escape System (CES) is designed to provide safe egress and recovery for two crewmen to a maximum altitude of 75,000 feet. A sketch of the CES is given in Figure 3.8-1 which also provides the aerodynamic sign convention for the man/seat configuration. Free-air and proximity aerodynamic data for use in simulation studies of man/seat motion following ejection are provided in Section 4.3.

Components integral to the CES are two rocket-powered ejection seats mounted side-by-side and two ejection panels integral with the overhead structure. The ejection seats have powered, integrated, torso restraint harness systems utilizing single release controls with stabilization drogue parachute systems. The overhead ejection panels are equipped with a pyrotechnic train for severing the inner and outer crew module structure and the outer structure of the forward fuselage to provide an unobstructed path for the man/seat. The hatches are also equipped with thrusters and hinges necessary to propel the hatches clear of the man/seat trajectory. OV102 also includes a ballistic guillotine for severing overhead displays and controls electrical cable.

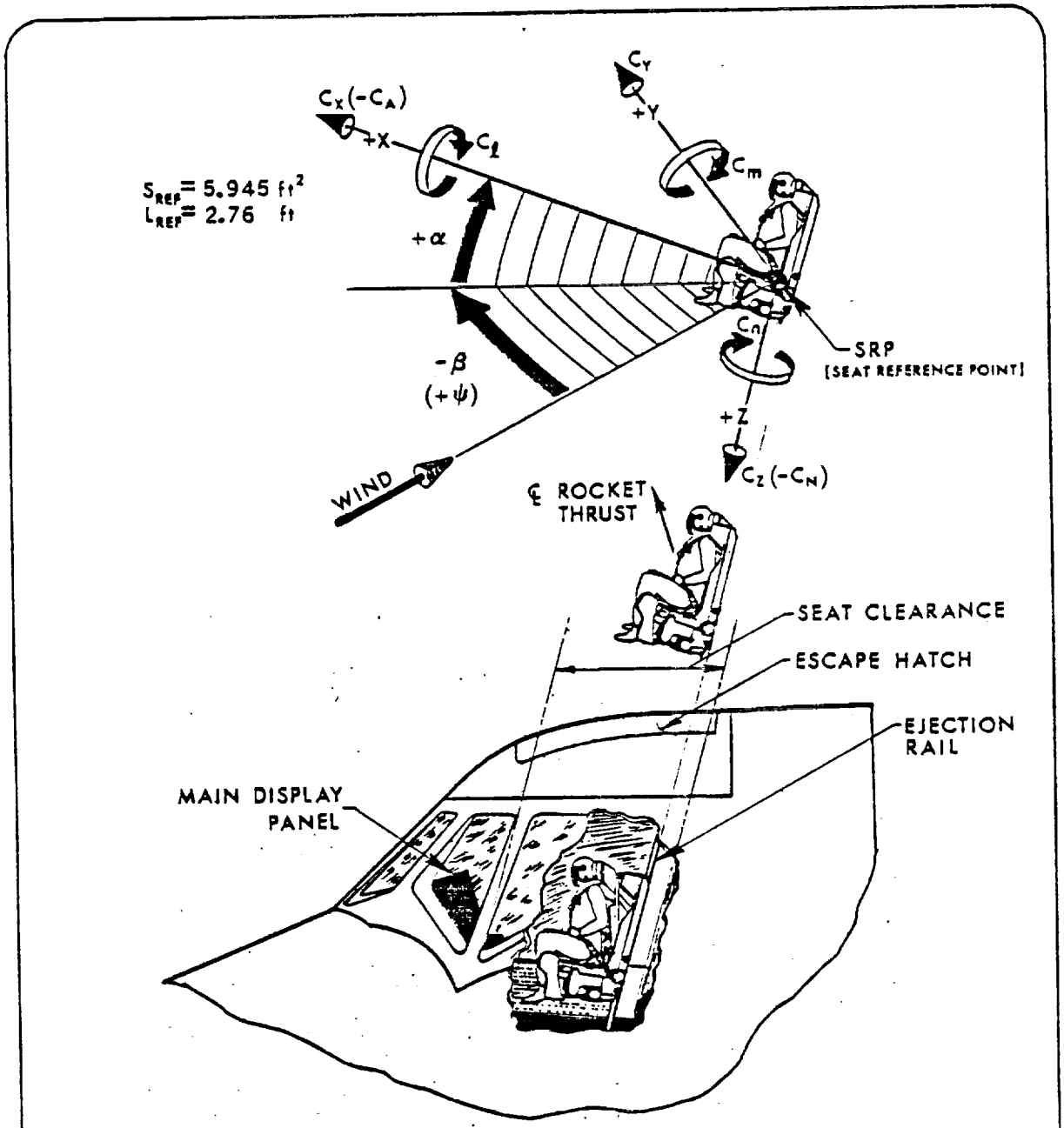


Figure 3.8-1
CREW ESCAPE SYSTEM

WRR
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3.9 SHUTTLE INFRARED LEESIDE TEMPERATURE SENSING. The Shuttle Infrared Leeside Temperature Sensing (SILTS) experiment is designed to obtain detailed temperature maps of the Orbiter Vehicle wing and fuselage upper surface for the entire entry heating period. The experiment is located in the SILTS fin tip assembly which replaces the baseline Orbiter fin tip. The forward portion is a hemispherical dome containing two double-pane windows for viewing forward and to the lift-side of the Orbiter. The dome contains window covers and a window cooling system. The exterior surface of the SILTS fin tip is covered with high-temperature reusable surface insulation (HRSI) tiles. During entry the IR camera is positioned alternately at the two windows at seven-second intervals. The objective of the experiment is to identify areas where reductions in TPS weight might be realized. Figure 3.9-1 presents a sketch of the experiment.

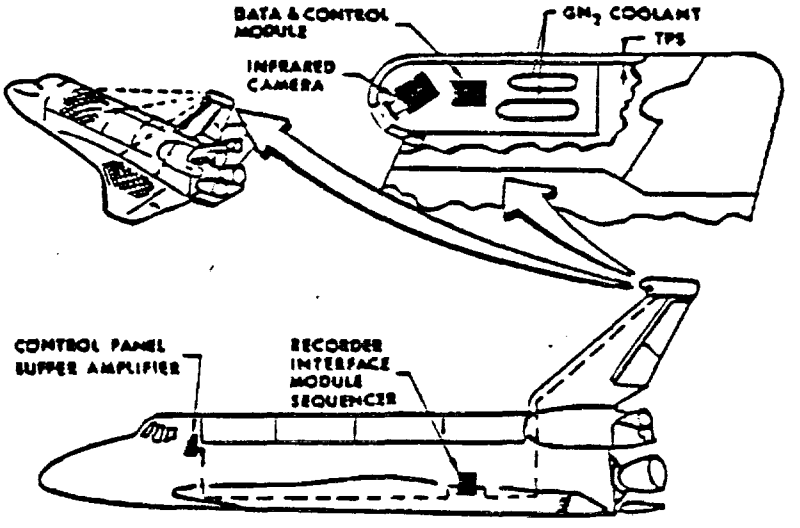


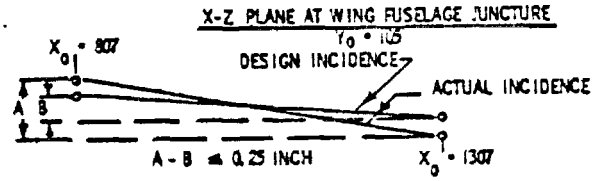
Figure 3.9-1
SILTS EXPERIMENT

3.10 MASS PROPERTIES. Mass properties data for the Orbiter Vehicle should be obtained from current Space Shuttle Mass Properties Status Reports for the Orbiter Vehicle. These status reports are Rockwell International, Space Division reports and are published monthly (e.g., see Reference 3-4).

3.11 SURFACE DESIGN REQUIREMENTS. The aerodynamic integrity of the Orbiter Vehicle is dependent on the efficiency of all surfaces exposed to the air flow such that surface design requirements are critical to the definition of the vehicle aerodynamic characteristics. The allowable aerodynamic surface alignments, Outer Mold Line (OML) fairing and smoothness requirements, and the sealing requirements which established deviations affecting both aerodynamic and aerothermodynamic characteristics of the Orbiter Vehicle are discussed in this subsection.

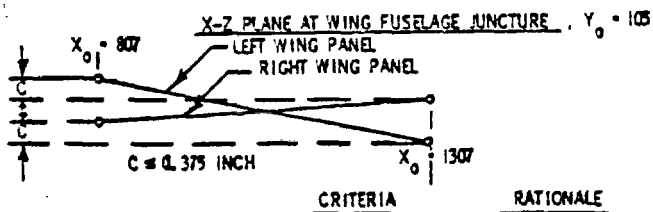
Aerodynamic surface alignments are outlined below.

WING INCIDENCE TOLERANCE



	CRITERIA	RATIONALE
● MAXIMUM ALLOWABLE WING INCIDENCE TOLERANCE AT WING-FUSELAGE JUNCTURE FOR THE LEADING EDGE ELEMENT RELATIVE TO THE TRAILING EDGE ELEMENT (FUSELAGE AND WING SUPPORTED IN MATING TOOLING)	≤ 0.25 INCH	MAINTAIN ACCEPTABLE IMPACT ON ELEVON REQUIREMENTS DUE TO STRUCT. MISALIGNMENTS

WING DIFFERENTIAL INCIDENCE TOLERANCE

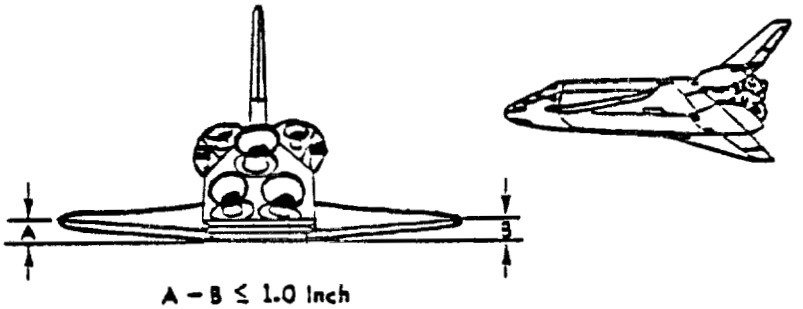


	CRITERIA	RATIONALE
● MAX ALLOWABLE DIFFERENTIAL INCIDENCE BETWEEN THE LEFT AND RIGHT WING PANELS AT THE WING-FUSELAGE JUNCTURE (VEHICLE SUPPORTED IN TOOLING JIG)	≤ 0.375 INCH FOR THE LEADING EDGE ELEMENT OF ONE PANEL RELATIVE TO THE TRAILING EDGE ELEMENT FOR THE OTHER PANEL	MINIMIZE DEGRADATION OF AILERON EFFECTIVENESS DUE TO STRUCTURAL MISALIGNMENT

WING'S DIFFERENTIAL INCIDENCE TOLERANCE EQUALS LEFT WING'S INCIDENCE TOLERANCE MINUS RIGHT WING'S INCIDENCE TOLERANCE OR,

$$C = (A - B)_{\text{LEFT WING}} - (A - B)_{\text{RIGHT WING}}$$

DIFFERENTIAL DEFLECTION OF WING TIPS

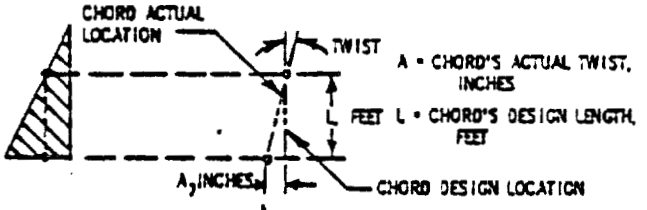


A − B ≤ 1.0 Inch

MAXIMUM DIFFERENTIAL DEFLECTION OF WING TIPS (FUSELAGE AND WING SUPPORTED IN MATING TOOLING)

RATIONALE: MINIMIZE ASYMMETRIC LIFT & ROLL

MAXIMUM ALLOWABLE TWIST TOLERANCE



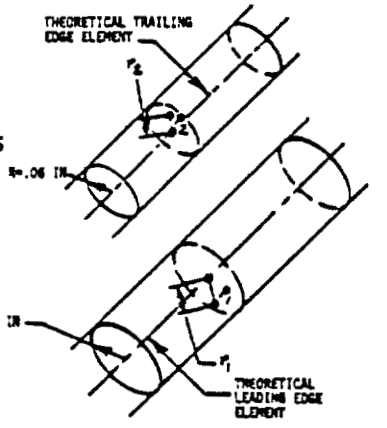
LIFTING SURFACE TWIST TOLERANCE = $\frac{A}{L}$, INCHES/FOOT

	CRITERIA	RATIONALE
● MAXIMUM ALLOWABLE TWIST TOLERANCE FOR ANY LIFTING SURFACE (WING OR TAIL) (VEHICLE IN TOOLING JIG)	≤ 0.005 INCH PER FOOT	MAINTAIN SURFACE AERO EFFICIENCY AND REDUCE CONTROL REQUIREMENTS
● THE MAXIMUM ALLOWABLE DIFFERENTIAL TWIST TOLERANCE PER 12 INCH SPANWISE DISTANCE (VEHICLE IN TOOLING JIG)	≤ 0.005 INCH PER FOOT	↓

ERROR IN LOCATION OF LEADING AND TRAILING EDGES

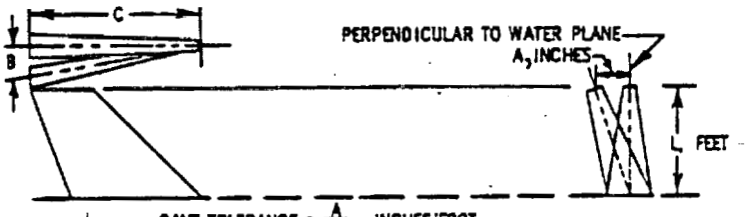
ERROR IN LOCATION OF LEADING AND TRAILING EDGES

CRITERIA	RATIONALE
● ACTUAL L.E. ELEMENT SHOULD LIE WITHIN AN 0.06 INCH-RADIUS CYLINDER FROM THE DESIGN LEADING EDGE ELEMENT ● ACTUAL T.E. SHOULD LIE WITHIN 0.06 INCH-RADIUS CYLINDER FROM THE THEORETICAL TRAILING EDGE ● REQUIREMENTS CHECKED AFTER LEADING AND TRAILING EDGE ASSEMBLIES HAVE BEEN FULLY FASTENED TO CENTER SECTION OF THE SURFACE.	PROVIDE ACCEPTABLE AERO CHARACTERISTICS WITHOUT IMPACTING WEIGHT AND COST



p_1 = LOCATION OF A POINT ON ACTUAL LEADING EDGE ELEMENT
p_2 = LOCATION OF A POINT ON ACTUAL TRAILING EDGE ELEMENT
r_1 = DEVIATION ERROR OF p_1 IN INCHES
r_2 = DEVIATION ERROR OF p_2 IN INCHES
R = MAXIMUM ALLOWABLE DEVIATION ERROR

VERTICAL TAIL CANT AND INCIDENCE TOLERANCE



CANT TOLERANCE = $\frac{A}{L}$, INCHES/FOOT

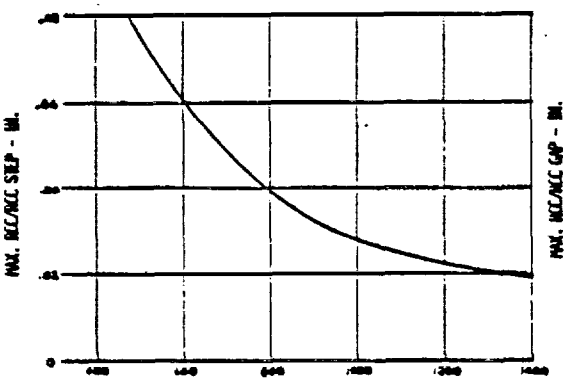
INCIDENCE TOLERANCE = $\frac{B}{C}$, INCHES/FOOT

	CRITERIA	RATIONALE
● MAXIMUM ALLOWABLE VERTICAL TAIL CANT (VEHICLE IN TOOLING JIG)	≤ 0.025 INCH PER FOOT	MAINTAIN VERTICAL TAIL AERO EFFICIENCY AND REDUCE CONTROL REQUIREMENTS
● MAXIMUM ALLOWABLE INCIDENCE TOLERANCE OF THE VERTICAL TAIL (VEHICLE IN TOOLING JIG)	≤ 0.0125 INCH PER FOOT	

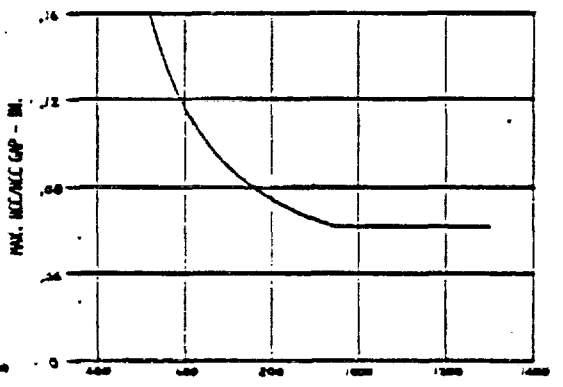
The aerothermodynamic criteria pertaining to surface discontinuities and waviness are based on aerodynamic efficiency requirements of lifting surfaces and the prevention of premature transition from laminar to turbulent boundary layers during the high heating portion of entry. The prevention of premature separation of the boundary layer on all fixed and movable lifting surfaces is also important. Aerodynamic efficiency is affected to a much greater extent by surface conditions over forward regions of components rather than aft regions. Tolerance criteria are, therefore, generally more severe for forward sections of the vehicle surfaces and are somewhat relaxed for aft portions.

Surface discontinuities consist of steps and gaps. A step is an abrupt deviation from the faired contour; e.g., a lap joint ( ). The tolerance for a forward facing step is generally the same as for a rearward facing step unless specifically noted otherwise. The step requirements (cf. Figure 3.5-2) apply to all surface irregularities which have a dimension normal to the OML except RCC areas. RCC step and gap criteria are shown below based on trajectory 2689.

BASED ON TRAJECTORY 2689



RCC/RCC STEP CRITERIA



RCC/RCC GAP CRITERIA

A gap is defined as an abrupt negative deviation from a faired contour followed by an abrupt positive deviation such as is caused by a poorly matched butt joint ( ) or spaces between TPS tiles. TPS gap criteria are outlined below and apply to all surface gaps with the exception of RCC areas (given above) and control surface gaps. Gaps shall not allow any increase in air leakage.

TPS GAP CRITERIA (PRE-FLIGHT)

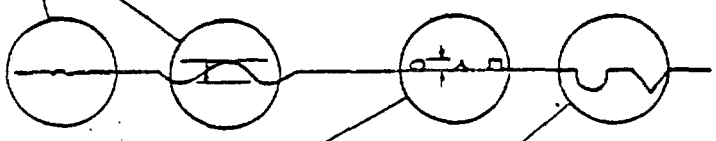
- BASIC REQUIREMENT: MINIMIZE GAP WIDTH AT THE AERODYNAMIC SURFACE
  - LOWER SURFACE: 0.045 ± 0.020 INCHES
    BELOW A LINE: X_{S_1} = 238, Z_S = 336 TO X_S = 582, Z_S = 320
    AND X_S > 582, Z_S = 320; LOWER SURFACE OF WING; GLOVE L.E. TO USI; UPPER AND LOWER BODY FLAP; BASE HEAT SHIELD
  - UPPER SURFACES: 0.055 ± 0.020 INCHES (ALL SURFACES NOT DEFINED ABOVE)
- TILE PATTERNED SO THAT NO GAPS ARE ALIGNED WITH LOCAL SURFACE STREAMLINES DURING ENTRY
- TPS GAP EDGE RADIUS: 0.05 INCHES (MAXIMUM)

A wave is defined as a smooth variation from a faired contour. The wave height (H) is the distance measured normal to the surface between a low point on the surface and an adjacent high point. The wavelength (2ℓ) is twice the distance from a low point on the surface to an adjacent high point. (Refer to Figure 3.5-2 for maximum allowable gaps and surface waviness criteria.) The waviness requirement applies to all external surfaces.

The master lines OML fairing requirements permit no reflex fairing on lower surfaces. Reflex fairing is permitted on upper surfaces. Continuous second derivatives of equations defining the surface of the lower forward fuselage are required. The maximum manufacturing fairing deviation from the theoretical fairing is ±0.06 inch consistent with the OML smoothness requirements, TPS thickness requirements, and aerodynamic surface alignment requirements. Maximum surface irregularities, including RMS surface finish, are defined below.

MICRO SURFACE FINISH CRITERIA DURING ENTRY

- APPLIES TO ALL EXTERNAL SURFACES (GRSI, LSI, FRSI, RCC, AND METALLIC TPS)
- DEFINITION OF MAXIMUM ALLOWABLE SMALL SCALE IRREGULARITIES
  - 300 μ IN. RMS SURFACE FINISH
  - 0.002 IN. AMPLITUDE SMALL SCALE WAVINESS (IN ANY DIRECTION)



- PROTUBERANCES 0.001 IN.
- HOLES, SCRATCHES, CRACKS 0.005 IN. WIDTH
  0.005 IN. DEPTH

Penetration criteria during entry are outlined below.

- NOSE LANDING GEAR DOOR OML
  - STEPS - ± 0.007 IN. MAXIMUM ANY DIRECTION
  - LONGITUDINAL GAPS - 0.054 IN. WIDE X 0.054 IN. DEEP OR EQUIVALENT AREA, ONE GAP PER DOOR INTERFACE
  - TRANSVERSE GAPS - 0.045 ± 0.020 IN. (FILLED WITH HIGH PRESSURE GRADIENT THERMAL BARRIER)
- FORWARD EXTERNAL TANK ATTACHMENT OML
  - STEPS - ± 0.007 IN. MAXIMUM
  - GAPS - 0.030 IN. MAXIMUM (BASED ON 3.0 IN. MAXIMUM CIRCLE DIAMETER)

Surface irregularities due to protuberances such as air data probes, umbilical attachment, vents, and nozzle ports must be assessed on an individual basis. Such items are shown on Figure 3.11-1 and are assessed in Section 4.1 (Table 4.1-1).

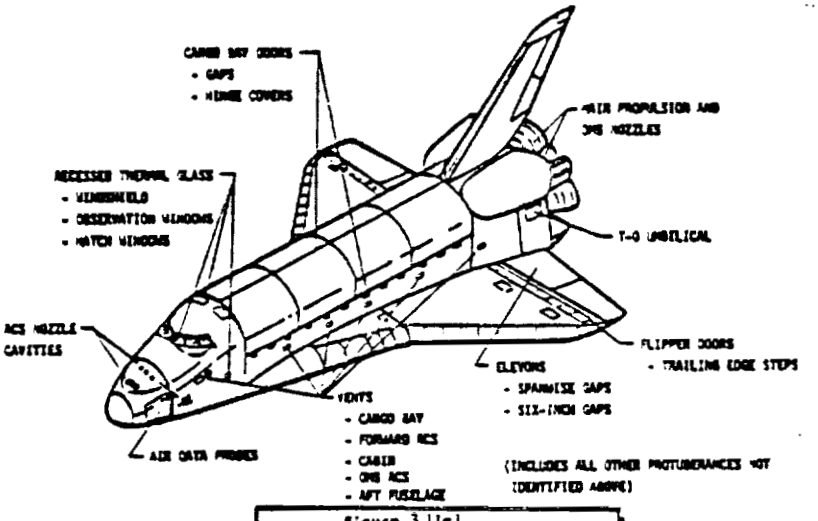


Figure 3.11-1
PROTUBERANCE ITEMS REQUIRING SPECIAL TREATMENT

The prevention of unprogrammed air leakage from inside the Orbiter or through lifting surfaces is important in maintaining lift effectiveness and minimum total drag. An unsealed surface has more profile drag and drag-due-to-lift than a sealed surface.

OUTER MOLD LINE SEALING REQUIREMENTS DURING ENTRY

- TPS ACREAGE
  - SEALED (SEALING BENEATH RSI IS ACCEPTABLE FOR LOW PRESSURE GRADIENT REGIONS, HIGH SURFACE PRESSURE GRADIENT REGIONS REQUIRE OML THERMAL BARRIERS)
- TPS ACREAGE PENETRATION INTERFACES (ACCESS PANELS, DOORS, HATCHES, VENTS, WINDOWS, MODULES, THRUSTERS, DUMPS, AND DRAINS)
  - 0.005 IN^2/IN OF INTERFACE MAXIMUM INTO COMPARTMENTS (NO CONCENTRATED HOLES ALLOWED)
- RCC/HRSI INTERFACES - WING LEADING EDGE AND ORBITER NOSE
  - LOWER SURFACE SEALED WITH THERMAL BARRIER (EQUIVALENT LEAK AREA 0.010 IN^2/IN SPAN, REQUIREMENT FOR RCC ATTACHMENT AREAS TBD)
  - UPPER SURFACE AREA TO BE LESS THAN 0.065 IN^2/IN AND GREATER THAN 0.035 IN^2/IN.
- RCC/RCC INTERFACES
  - LOWER SURFACE - NO INTENTIONAL LEAKS (OVERLAPPING EXPANSION JOINTS ALLOWED)
  - UPPER SURFACE - 0.005 IN^2/IN MAXIMUM, 0.003 IN^2/IN MINIMUM VENT GAPS
- RSI TPS GAPS MUST BE FILLED IN ALL HIGH SURFACE PRESSURE GRADIENT REGIONS
  - FUSELAGE CHINE, WING GLOVE, VERTICAL STABILIZER LEADING EDGE, WINDOW FRAMES, ALL TRAILING EDGES, ELEVON COVE, VERTICAL TAIL/RUDDER COVE, BODY FLAP COVE, ETC.

CONTROL SURFACE SEALING REQUIREMENTS DURING ASCENT AND ENTRY (ORBITER 102 AND SUBS)

SEAL LOCATION	DESIGN REQUIREMENT	
	IN^2/IN SPAN MAX.	IN^2/IN SPAN MIN.
· WING/ELEVON		
· LOWER SURFACE AND END SEALS	0.003 (TOTAL COVE LEAK)	0
· UPPER SURFACE		
· FLIPPER DOOR FORWARD SEAL	0.003	0
· FLIPPER DOOR TOTAL EQUIVALENT LEAKAGE AREA (INCLUDES TRAILING EDGE, PANEL TO PANEL, ETC.	0.003	0
· BODY FLAP		
· LOWER SURFACE AND END SEALS	0.003	
· UPPER SURFACE	0.5 AND 3.0 INCH MINIMUM COVE OVERLAP	0.038
· VERTICAL STABILIZER/RUDDER/SPEED BRAKE		
· VERTICAL STAB./RUDDER	0.003	0
· SPEED BRAKE/SPEED BRAKE (CLOSED POSITION)		
· TRAILING EDGE - THERMAL BARRIER	0.003	0
· STREAMWISE EDGES	REQUIRE PRESSURE SEAL	REQUIRE PRESSURE SEAL

4.0 AERODYNAMIC DATA

This section contains the Orbiter Vehicle Aerodynamic data to be used for entry trajectory analyses, subsystem design and analyses, flight control analyses, and manned simulation studies. The data presented herein represent the best available predictions of the full-scale flight characteristics of the Orbiter Vehicle.

The aerodynamic characteristics are presented in a form which will allow a *build-up* to any desired configuration and/or flight condition by incremental addition to the basic coefficient. Longitudinal characteristics are presented for both body-axis and stability-axis systems. Lateral-directional characteristics are presented in the body-axis system only. Aeroelastic data, assuming a quasi-static vehicle, and the effects of hypersonic and high altitude are also provided. Prescribed use of the data is to begin with the altitude table (or convert to the viscous parameter, $\bar{V}_\infty^1$) down to 300,000 feet ($\bar{V}_\infty^1 = 0.08$), use viscous parameter tables to a value of 0.005, and transition to the Mach number tables. Altitude may be converted to viscous parameter by use of Figure 4.0-1 (see also Appendix C). Where additional information is considered desirable, explanatory material has been provided in Appendices.

These data are given in the following subsections:

4.1 LONGITUDINAL AERODYNAMIC CHARACTERISTICS

4.2 LATERAL-DIRECTIONAL AERODYNAMIC CHARACTERISTICS

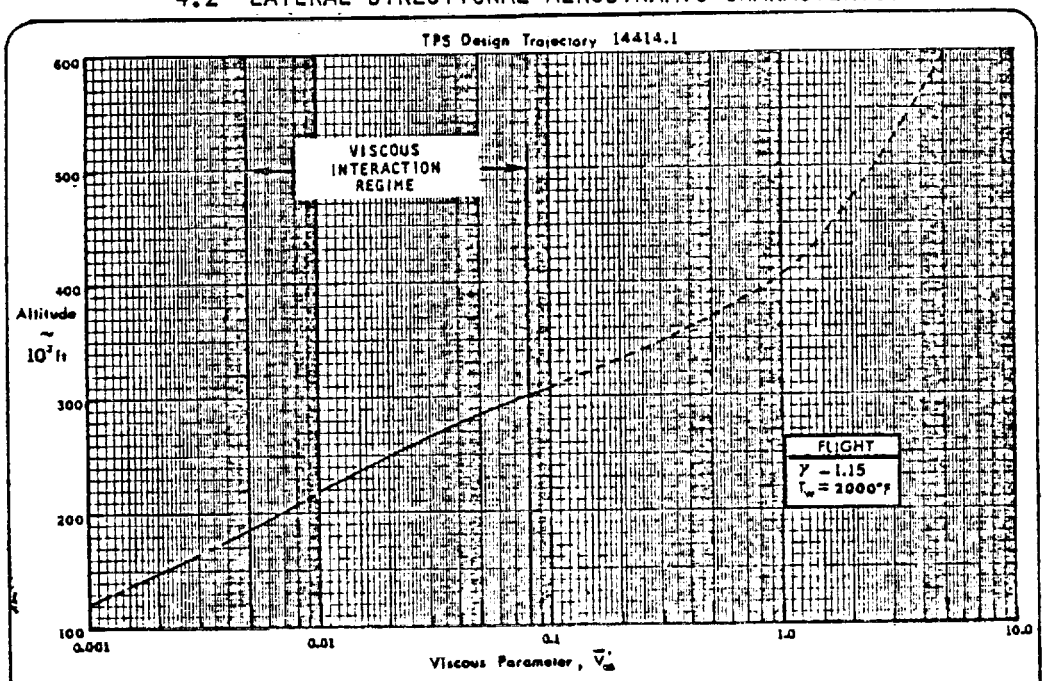


Figure 4.0-1
VISCOUS INTERACTION PARAMETER

The angle of attack and sideslip limits for these data are shown in Figures 4.0-2 and 4.0-3.

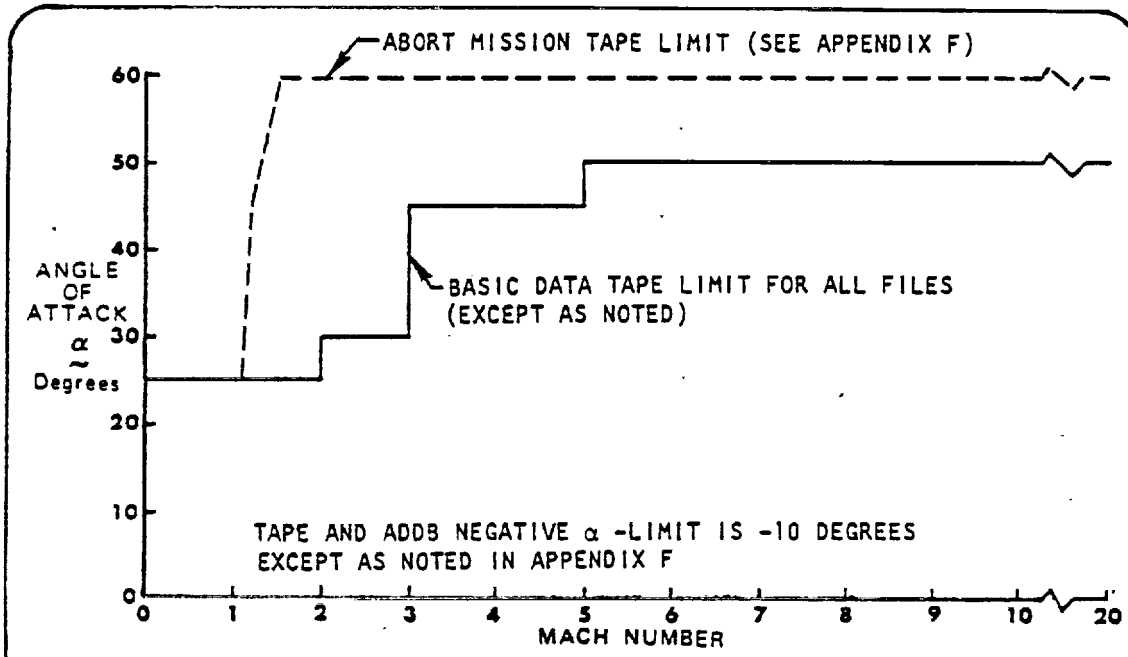


Figure 4.0-2
ANGLE OF ATTACK LIMITS

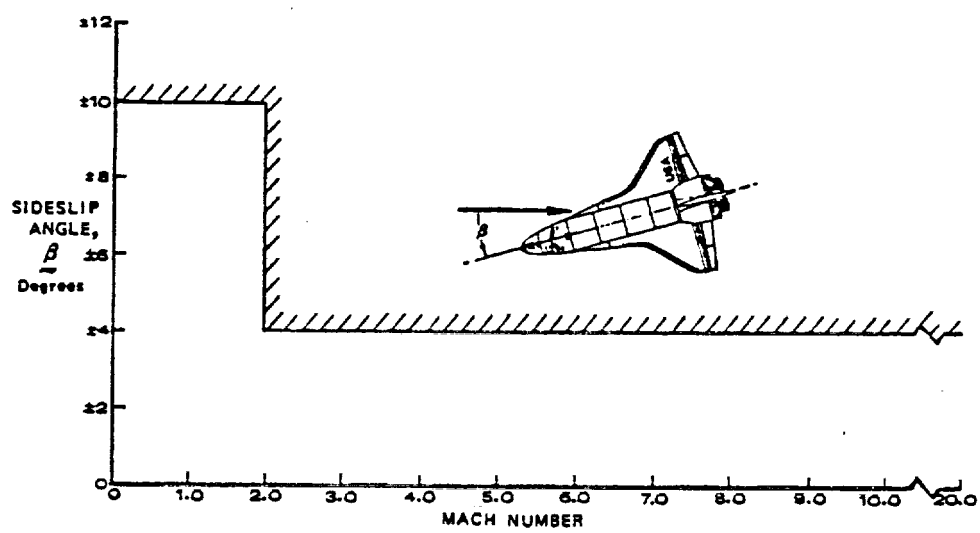


Figure 4.0-3
SIDESLIP ANGLE LIMITS

4.1 LONGITUDINAL AERODYNAMIC CHARACTERISTICS. Aerodynamic characteristics pertaining to the longitudinal degrees-of-freedom are presented as full-scale, rigid and elastic, force and moment coefficients. The longitudinal aerodynamic coefficients are presented in the following subsections:

4.1.1 BODY AXIS DATA

4.1.2 STABILITY AXIS DATA

Each subsection has been divided into individual coefficients and prefaced by the appropriate equation for obtaining a total coefficient for any selected flight condition. Each element of the equation is defined and referenced to its associated figure (or table) for obtaining the corresponding numerical values, which comprise the remainder of the sub-divisions. The limiting conditions for these data are presented in Figure 4.1-1.

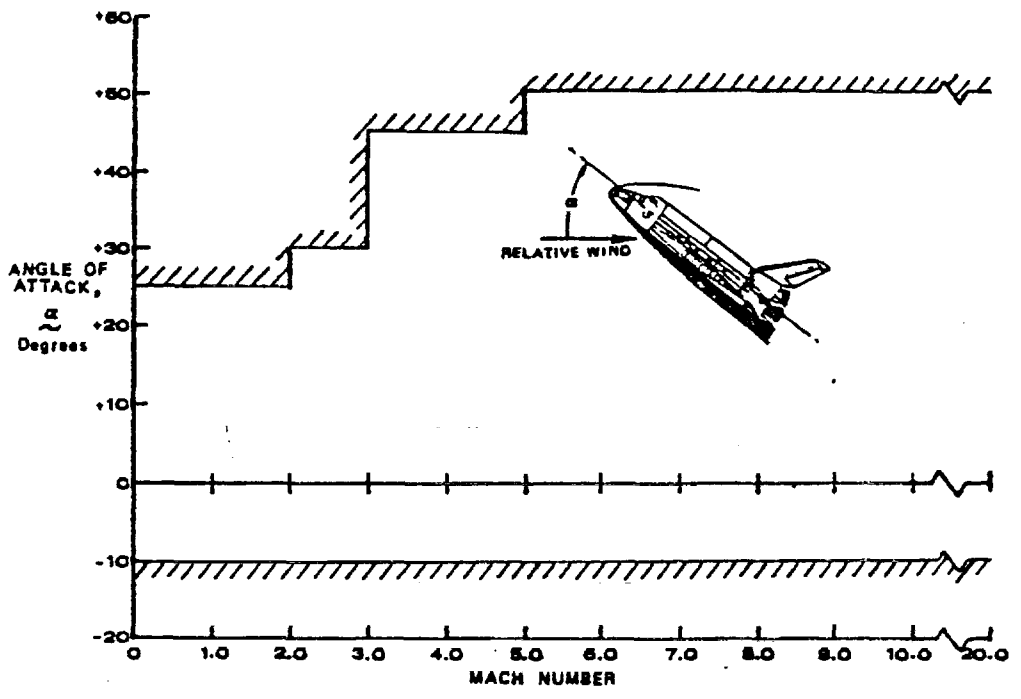


Figure 4.1-1
ANGLE OF ATTACK LIMITS

The aerodynamic data are based on wind tunnel test data involving scale models at various attitudes, Reynolds numbers, and Mach numbers. The data have been corrected for Reynolds number (skin friction) along the TPS design trajectory (cf. Section 1.1) as shown in Figure 4.1-2. Skin friction drag and forebody axial force coefficients are shown on Figure 4.1-3. Corrections for Outer-Mold-Line (OML) surface conditions (TPS tiles and protuberances) have been included as shown in Table 4.1-1 and Figure 4.1-4. Base drag characteristics were computed using wind tunnel test measurements of fuselage base pressure as given in Figures 4.1-5,-6, and -7.

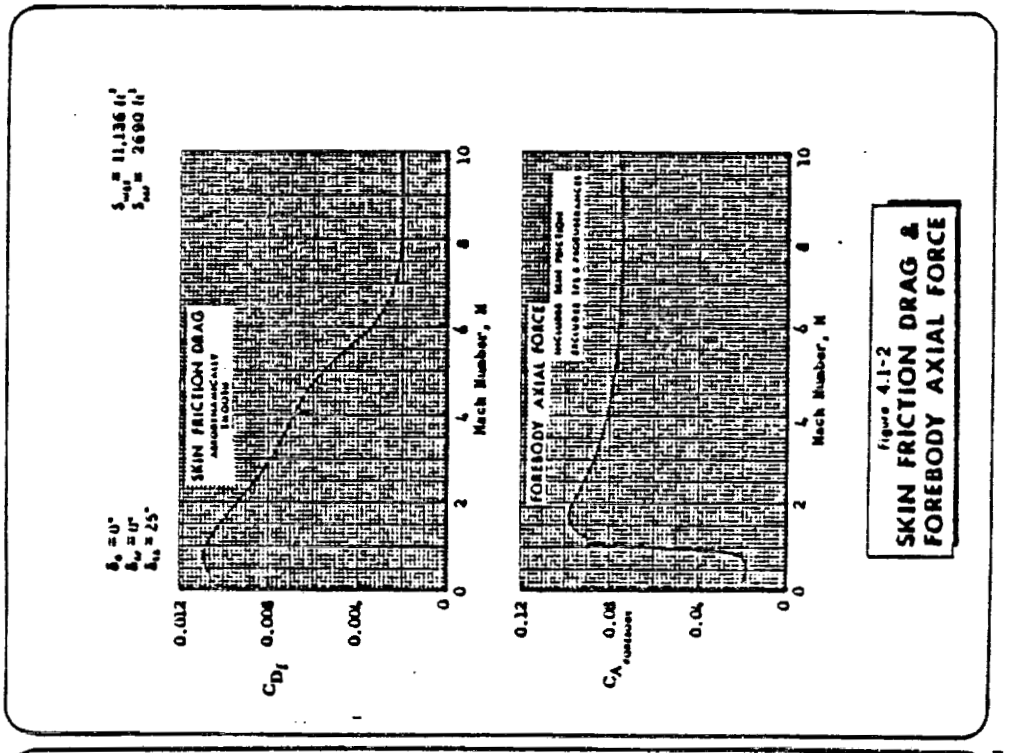


Figure 4.1-2
SKIN FRICTION DRAG & FOREBODY AXIAL FORCE

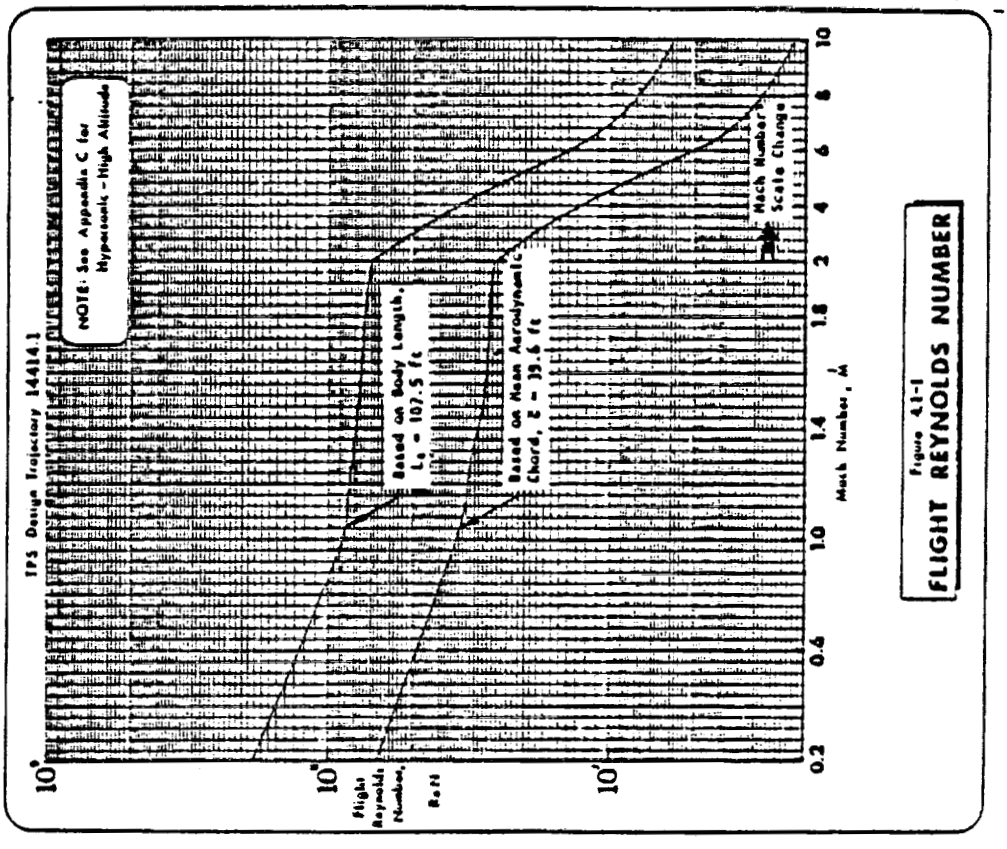


Figure 4.1-1
FLIGHT REYNOLDS NUMBER

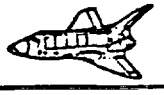


Table 4.1-1

PROTUBERANCE AND TPS ROUGHNESS DRAG

ITEM	MACH NUMBER															
	0.25	0.60	0.80	0.90	0.95	1.05	1.10	1.20	1.30	1.50	2.0	3.0	4.0	5.0	8.0	10.0
	DRAG COUNTS (1 count = 0.0001)															
PROTUBERANCES*																
AIR DATA PROBES	0.54	0.69	0.89	1.08	1.40	2.04	2.36	2.97	2.95	2.91	2.80	2.43	(For M>3.5, Probes Retracted)			
CREW ESCAPE DOOR HINGE	0.63	0.63	0.63	0.63	0.63	0.64	0.63	0.63	0.62	0.62	0.37	0.45	0.34	0.25	0.13	0.13
RCS NOZZLE PORTS	9.70	10.36	11.87	13.14	13.64	13.64	13.34	12.14	12.88	12.38	11.37	10.36	9.35	8.84	8.08	7.83
RECESSED THERMAL GLASS																
(a) Windshield	20.00	21.25	24.48	27.00	28.13	28.13	27.60	27.08	26.56	25.52	22.44	21.25	19.27	18.25	16.67	16.75
(b) Observation Windows	5.00	5.34	6.12	6.77	7.03	7.03	6.90	6.77	6.64	6.38	5.86	5.34	4.83	4.56	4.17	4.04
(c) Side Hatch Window	1.00	1.07	1.22	1.35	1.41	1.41	1.38	1.35	1.33	1.28	1.17	1.07	0.96	0.91	0.83	0.81
SPANWISE GAPS																
(a) Vertical Tail & Rudder	15.00	16.44	16.41	16.39	16.51	16.08	15.99	15.79	15.76	15.73	16.45	11.25	8.46	6.29	3.18	3.18
(b) Eleven Seal Doors	3.37	3.69	3.68	3.68	3.71	3.61	3.59	3.54	3.54	3.53	3.24	2.53	1.98	1.41	0.71	0.71
(c) Body to Body Flap	1.67	1.68	1.67	1.67	1.64	1.64	1.63	1.61	1.61	1.60	1.47	1.15	0.86	0.64	0.32	0.32
T-0 UMBILICAL	2.70	2.88	3.30	3.66	3.80	3.68	3.73	3.66	3.59	3.45	3.16	2.88	2.68	2.46	2.25	2.18
VENTS																
(a) Cargo Bay	0.35	0.36	0.36	0.36	0.36	0.36	0.35	0.35	0.35	0.35	All Vents closed for M> 1.52					
(b) Forward RCS	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01						
(c) Cabin	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02						
(d) OMS RCS	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01						
(e) Aft Fuselage	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12						
SUBTOTAL (ROUNDED)	61	64	71	76	78	79	78	77	76	74	68	59	49	44	36	35
TPS DRAG	32	33	38	40	41	43	44	44	43	40	35	27	20	14	3	3
TOTAL	93	97	109	116	119	122	122	121	119	114	103	86	69	58	39	38

*Reference Drawings: VL70-009028 Rev. "B" - TPS Penetration Diagram - Double Delta, Lightweight Orbiter, MCR 02OOR6 Baseline 6/11/74
VC70-004002 - Mid-Fuselage Active Vent System, Structural Skin Cutout Interface
VC70-000007 - Requirements - Orbiter Vent System - Non-Pressured Compartments

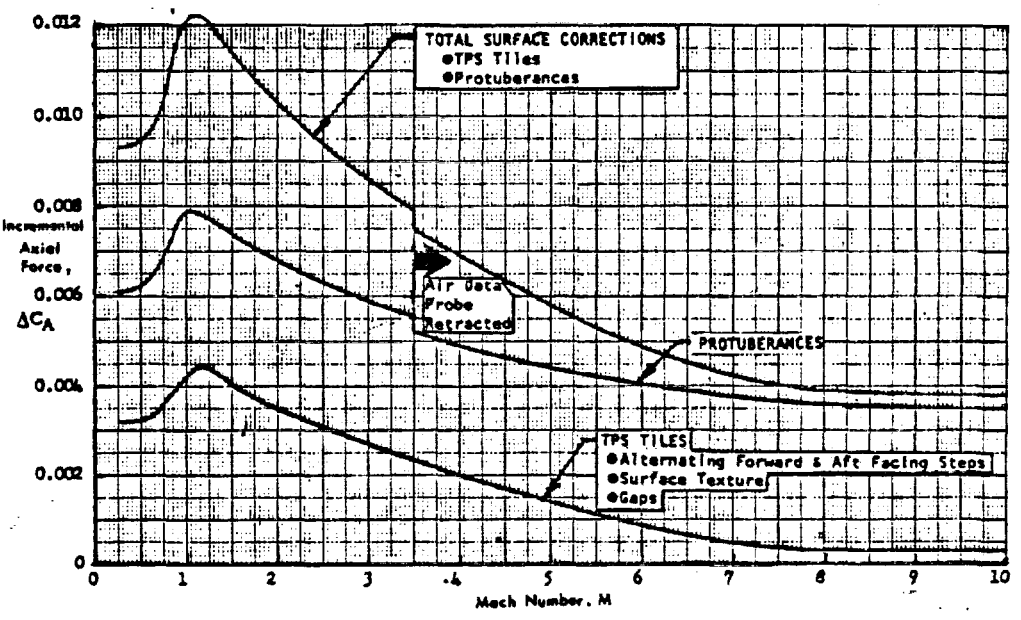


Figure 4.1-3
SURFACE IRREGULARITIES

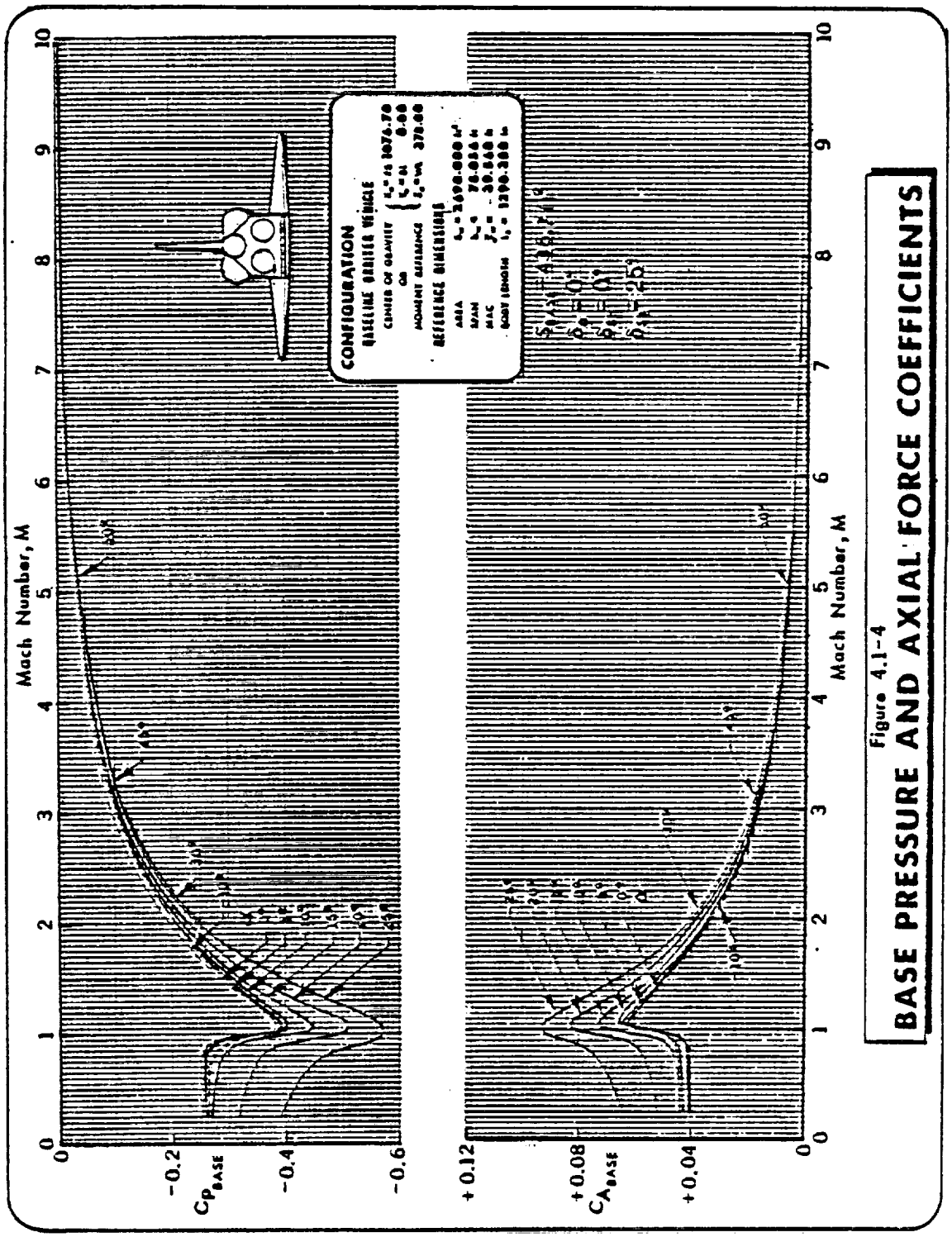


Figure 4.1-4
BASE PRESSURE AND AXIAL FORCE COEFFICIENTS

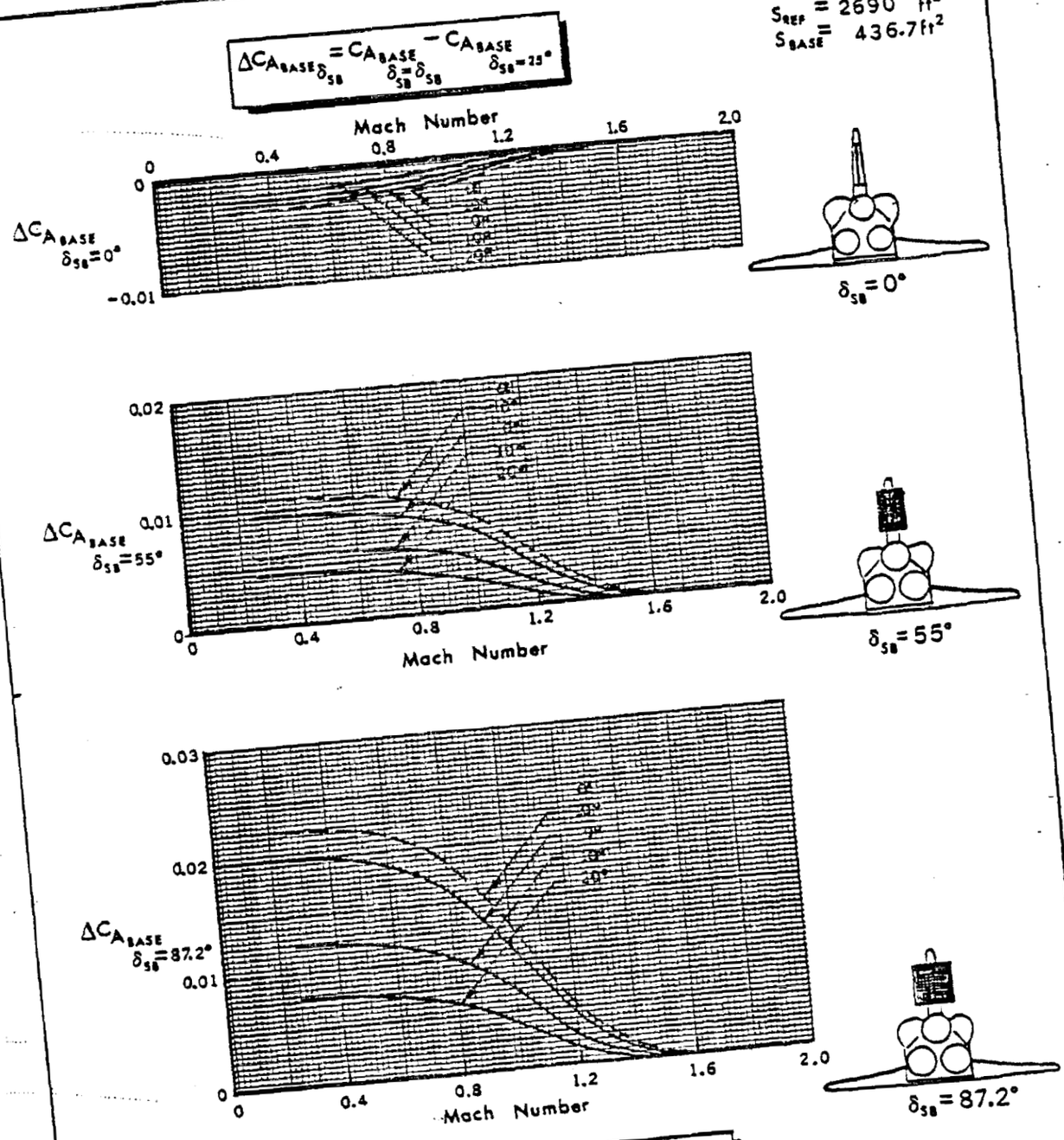


Figure 4.1-5
EFFECT OF SPEEDBRAKE

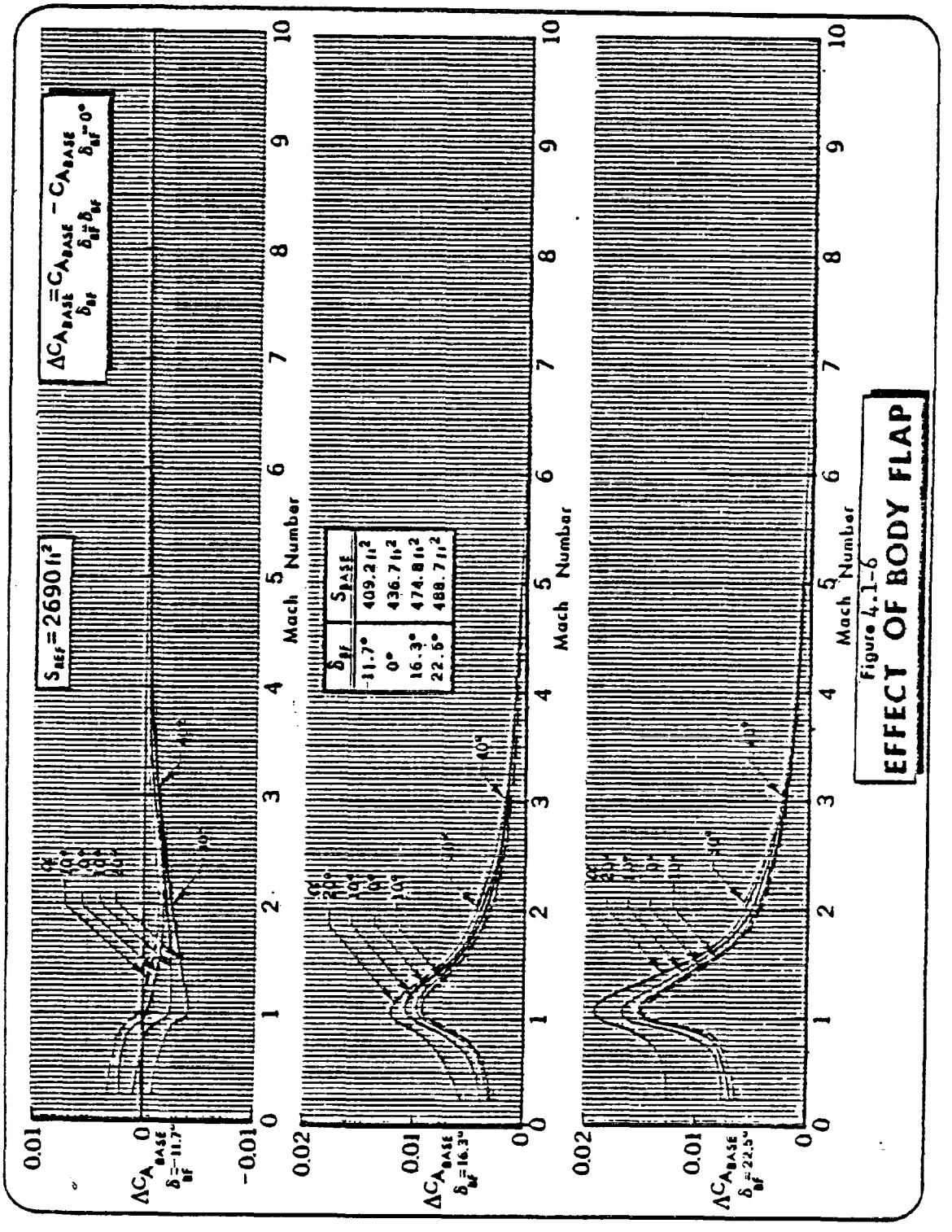


Figure 4.1-6
EFFECT OF BODY FLAP

4.1.1 BODY AXIS DATA. The longitudinal aerodynamic characteristics in the body axis system are:

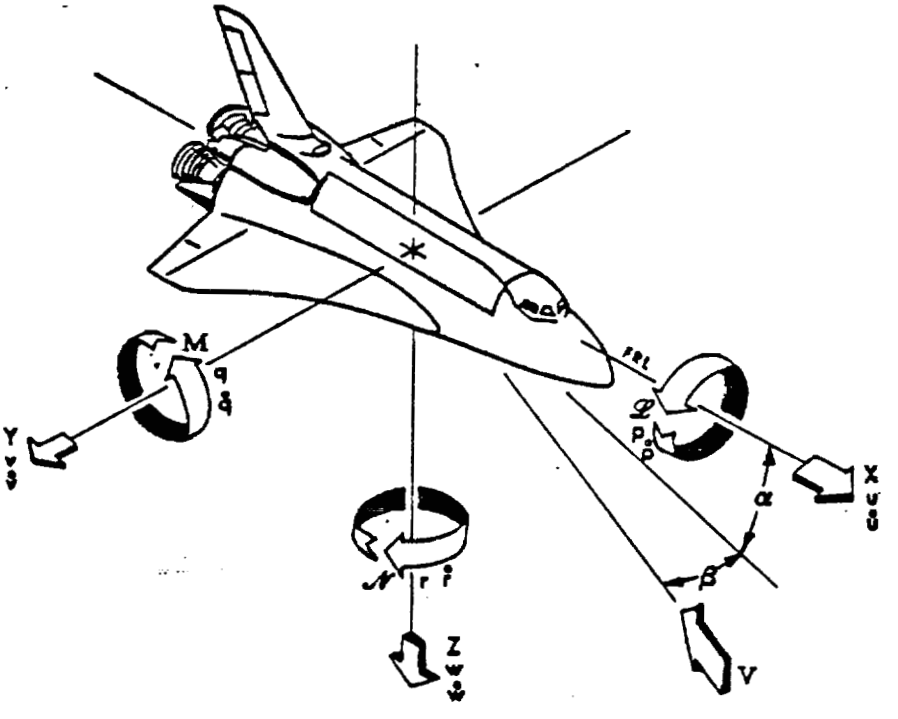
4.1.1.1 NORMAL FORCE COEFFICIENT

4.1.1.2 AXIAL FORCE COEFFICIENT

4.1.1.3 PITCHING MOMENT COEFFICIENT

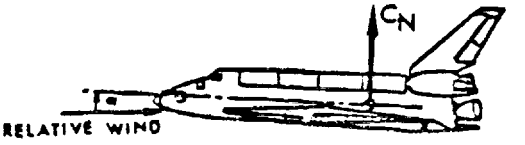
4.1.1.4 TRIM AND STABILITY

The pertinent equation for obtaining the total coefficient for any given flight condition precedes the presentation of data. Each element of the equation is defined and referenced to the appropriate figures and/or tables for obtaining the corresponding numerical values. Where additional information is considered beneficial (e.g., aeroelastic deformation, hypersonic viscous interaction, and RCS impingement), Appendices have been included for reference.



BODY AXIS SYSTEM

4.1.1.1 NORMAL FORCE COEFFICIENT. The Orbiter Vehicle aerodynamic normal force coefficient is defined in this section. The basic aerodynamic normal force coefficient data are presented in three forms: 1) as a function of speed brake angle, angle of attack and Mach number from M = 0.25 through M = 20; 2) as a function of angle of attack and the viscous interaction parameter ($\bar{V}_\infty^2$) from 0.005 (equivalent to M = 13.6) through 0.08 (equivalent to 300,000 feet of altitude); and 3) as a function of angle of attack and altitude from 300,000 feet through 600,000 feet. Orbital aerodynamic characteristics are included in Appendix C. RCS jet thrust, thrust impingment, and flow field changes due to jet plumes are also included in this section [4.1.1.1]. Uncertainties associated with the normal force characteristics are available in Section 6.0



The RCS flow field interaction data are presented as a contribution to the normal force (N) rather than the coefficient (C_N) since the terms due to jet thrust and impingement are independent of dynamic pressure and cannot, therefore, be normalized in the conventional manner. CAUTION should be observed when applying these terms in the flight regime where the RCS is used in conjunction with the aerodynamic force (cf Section 3.6); i.e., the aerodynamic coefficient must be converted to a dimensional force *before* adding the RCS flow field interaction effect (see also Appendix B).

The total normal force is:

$$N_{TOTAL} = \bar{q}\, S\, C_{N_{\substack{TOTAL\\AERO}}} + N_{RCS}$$

The total normal force coefficient is obtained by summing up the basic data (all surfaces zero except speed brake) with auxiliary data control surface deflections, ground effect, flexibility, etc.). All of the total data (basic plus auxiliary) are given at specified conditions. Linear interpolations are to be used at intermediate positions. *The total aerodynamic normal force is obtained by the following equation:

$$C_{N_{\substack{TOTAL\\AERO}}} = C_{N_{BASIC}} + [\Delta C_{N_{ELEVATOR}} + \Delta C_{N_{AILERON}}]_{ELEVON} + \Delta C_{N_{\substack{BODY\\FLAP}}} + \Delta C_{N_{RUDDER}} + \Delta C_{N_{\substack{SPEED\\BRAKE}}}$$

$$+ C_{N_{\dot{\alpha}}} \frac{\dot{\alpha}\bar{c}}{2V} + C_{N_{\hat{q}}} \frac{q\bar{c}}{2V} + \Delta C_{N_{FLEX}} + \Delta C_{N_{\substack{LANDING\\GEAR}}} + \Delta C_{N_{\substack{GROUND\\EFFECT}}} + \Delta C_{N_{\substack{SILTS\\POD}}}$$

where,

$C_{N_{BASIC}}$ = Basic, full-scale, freestream, rigid body normal force coefficient. (Figures 4.1.1.1-1 through-67)

NOTE: 1) All control surfaces neutral *except* δ_{SB} = 25°.

*Refer to Appendix D when using digitized data.

NOTE: The increment presented in Appendix E should be added to the total from above calculations to account for OV102 manufacturing misalignments.

$\Delta C_{N_{ELEVATOR}}$ = Change in normal force coefficient due to elevon (elevator) deflection, δ_e, when inboard and outboard angles are equal. (Figures 4.1.1.1-68 through -97)

NOTE: 1. Partial span factor, K_N, to be used for elevon-body flap interconnect flight system where δ_e is limited to ±5° and inboard and outboard angles are not equal. (Figure 4.1.1.1-98)

$$\Delta C_{N_{e_{\delta_{e_i} \neq \delta_{e_o}}}} = K_N \; \Delta C_{N_{e_{\delta_e = \delta_{e_i}}}} + (1 - K_N) \; \Delta C_{N_{e_{\delta_e = \delta_{e_o}}}}$$

$\Delta C_{N_{AILERON}}$ = Change in normal force coefficient due to aileron deflection, δ_a.

$$= \frac{1}{2}\left[K_{N_{(\delta_{e_L})}} \Delta C_{N_{e_{L_I}}} + (1 - K_{N_{(\delta_{e_L})}}) \Delta C_{N_{e_{L_O}}} + K_{N_{(\delta_{e_R})}} \Delta C_{N_{e_{R_I}}} + (1 - K_{N_{(\delta_{e_R})}}) \Delta C_{N_{e_{R_O}}}\right] - \Delta C_{N_{ELEVATOR}}$$

$\Delta C_{N_{BODY\ FLAP}}$ = Change in normal force coefficient due to body flap deflection, δ_{bf}. (Figures 4.1.1.1-99 through-127)

$\Delta C_{N_{RUDDER}}$ = Change in normal force coefficient due to rudder deflection, δ_r. (Assume zero)

$\Delta C_{N_{SPEED\ BRAKE}}$ = Change in normal force coefficient due to speed brake deflection, δ_{sb}. (Figures 4.1.1.1-1 through -65)

$= C_{N_{\delta_{SB}=\delta_{SB}}} - C_{N_{\delta_{SB}=25}}$

$C_{N_{\dot{\alpha}}}$ = Change in normal force coefficient due to rate of change of angle of attack, $\dot{\alpha}$, (per radian).* (Assume zero)

$C_{N_{\bar{q}}}$ = Change in normal force coefficient due to pitch rate, q, (per radian).* (Assume zero)

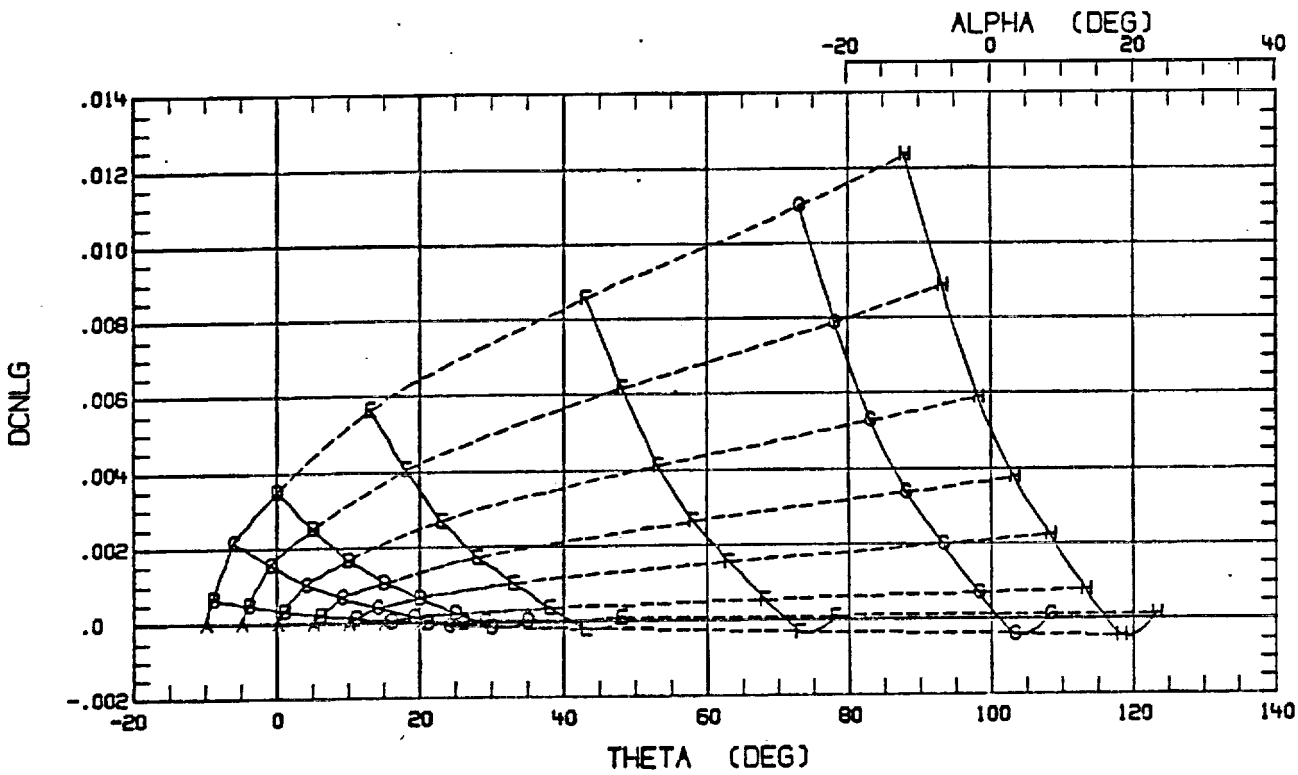
$\Delta C_{N_{FLEX}}$ = Change in normal force coefficient due to aeroelastic deformation.

$= \Delta C_{L_{FLEX}} \cos \alpha + \Delta C_{D_{FLEX}} \sin \alpha$

$\Delta C_{L_{FLEX}}$ = flexible lift increment (cf. Section 4.1.2.1)

$\Delta C_{D_{FLEX}}$ = flexible drag increment (cf. Section 4.1.2.2)

*For rotary derivative transfer equations see NASA SP-3070, "Summary of Transformation Equations and Equations of Motion Used in Free Flight and Wind Tunnel Data Reduction and Analysis," Gainer, T. G., and S. Hoffman, Langley Research Center, Hampton, Virginia (1972).



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	THETA (DEG)							
	0.0 A	1.000 B	4.000 C	10.000 D	23.000 E	53.000 F	83.000 G	98.000 H
ALPHA (DEG)	LANDING GEAR NORMAL FORCE COEFFI							
-10.000	0.0	0.00064	0.00214	0.00348	0.00563	0.00857	0.01098	0.01232
-5.000	0.0	0.00046	0.00154	0.00250	0.00404	0.00615	0.00788	0.00884
0.0	0.0	0.00031	0.00102	0.00166	0.00269	0.00410	0.00525	0.00589
5.000	0.0	0.00020	0.00066	0.00106	0.00171	0.00261	0.00335	0.00375
10.000	0.0	0.00011	0.00039	0.00063	0.00101	0.00154	0.00197	0.00221
15.000	0.0	0.00004	0.00014	0.00022	0.00034	0.00053	0.00068	0.00076
20.000	0.0	-0.00003	-0.00008	-0.00013	-0.00021	-0.00032	-0.00041	-0.00046
25.000	0.0	0.00001	0.00002	0.00003	0.00006	0.00009	0.00011	0.00012

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FIGURE 4.1.1.1-128
LANDING GEAR NORMAL FORCE COEFFICIENT INCREMENT

Landing Gear Down

$$\Delta C_{N_{\substack{GROUND\\EFFECT}}} = C_{N_{\substack{GROUND\\EFFECT}}} - C_{N_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = [illegible] 1076.70; Y_o = [illegible] 0.00; Z_o = [illegible] 375.38

REFERENCE DIMENSIONS

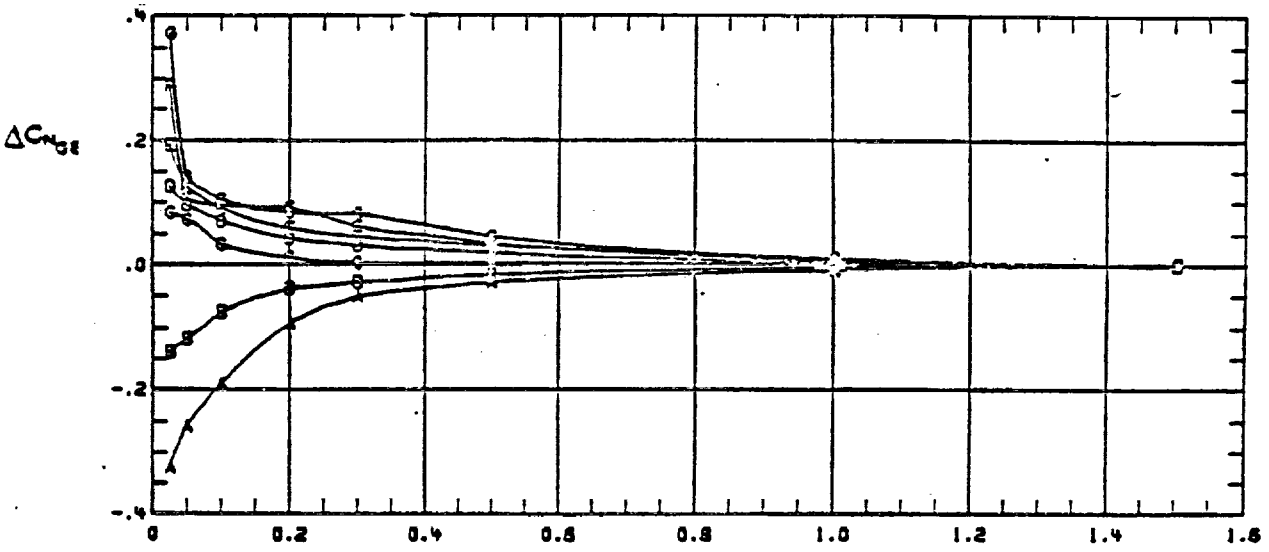
AREA S_w = 2690.000 ft²

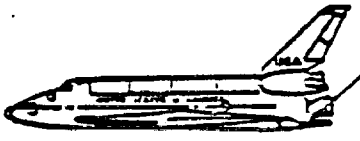
SPAN b_w = 78.058 ft

MAC c_w = 39.560 ft

BODY LENGTH l_B = 1290.300 in

$\delta_e = -40.000$ $\delta_{BF} = -11.7°$ δ_{SB} = ALL





Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.32480	-0.14000	0.08343	0.12607	0.19062	0.28655	0.37164
0.050	-0.25924	-0.11810	0.07243	0.09493	0.12470	0.10494	0.13964
0.100	-0.19079	-0.07600	0.03247	0.06978	0.09086	0.09409	0.10369
0.200	-0.09188	-0.03880	0.00947	0.04010	0.05632	0.08984	0.08217
0.300	-0.05063	-0.02960	0.00082	0.02933	0.04265	0.06071	0.08059
0.500	-0.02889	-0.01720	0.00044	0.01717	0.02978	0.03250	0.04332
1.000	-0.01001	-0.00500	0.0	0.00198	0.00412	0.00618	0.00820
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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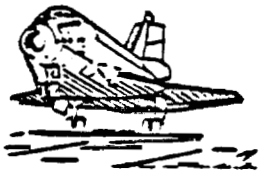
Figure 4.1.1.1-129
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$

CONFIGURATION

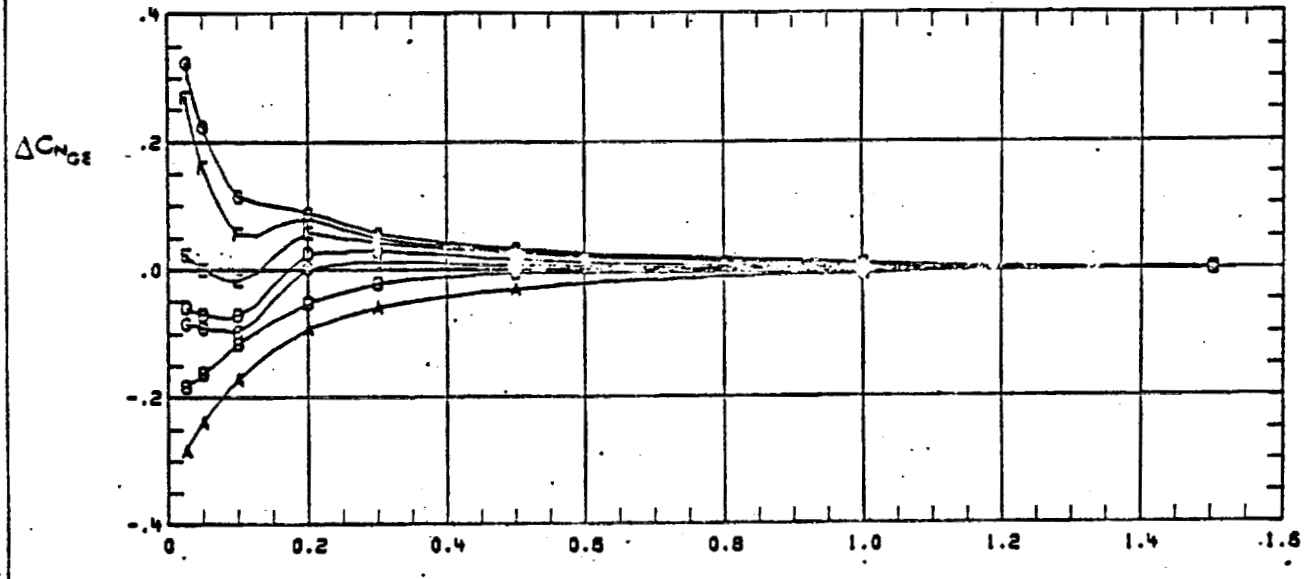
BASELINE ORBITER VEHICLE

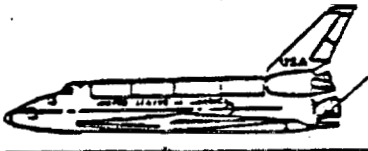
CENTER OF GRAVITY OR MOMENT REFERENCE	X_o = FS 1076.70, Y_o = BL 0.00, Z_o = WL 375.30

REFERENCE DIMENSIONS

AREA	S_w = 2690.000 ft²
SPAN	b_w = 78.056 in
MAC	c_w = 39.560 in
BODY LENGTH	L_b = 1296.300 in

$\delta_e = -30.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$





Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GROUND\ EFFECT}}$						
0.025	-0.28434	-0.18500	-0.08546	-0.06069	0.02267	0.26788	0.32295
0.050	-0.23952	-0.16380	-0.09166	-0.07108	-0.00047	0.15903	0.22115
0.100	-0.17154	-0.11730	-0.09671	-0.07258	-0.01859	0.05422	0.11294
0.200	-0.09381	-0.05340	0.00088	0.02400	0.05700	0.07782	0.08865
0.300	-0.06001	-0.02240	0.01118	0.02952	0.04119	0.04775	0.05582
0.500	-0.03051	-0.00620	0.00541	0.01423	0.02501	0.02731	0.03205
1.000	-0.00705	-0.00500	0.0	0.00198	0.00391	0.00632	0.00820
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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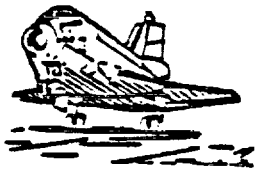
Figure 4.1.1.1-130
GROUND EFFECT



Landing Gear Down

$$\Delta C_{N_{\substack{GROUND\\EFFECT}}} = C_{N_{\substack{GROUND\\EFFECT}}} - C_{N_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1078.73; Y_o = BL 0.00; Z_o = WL 375.08

REFERENCE DIMENSIONS

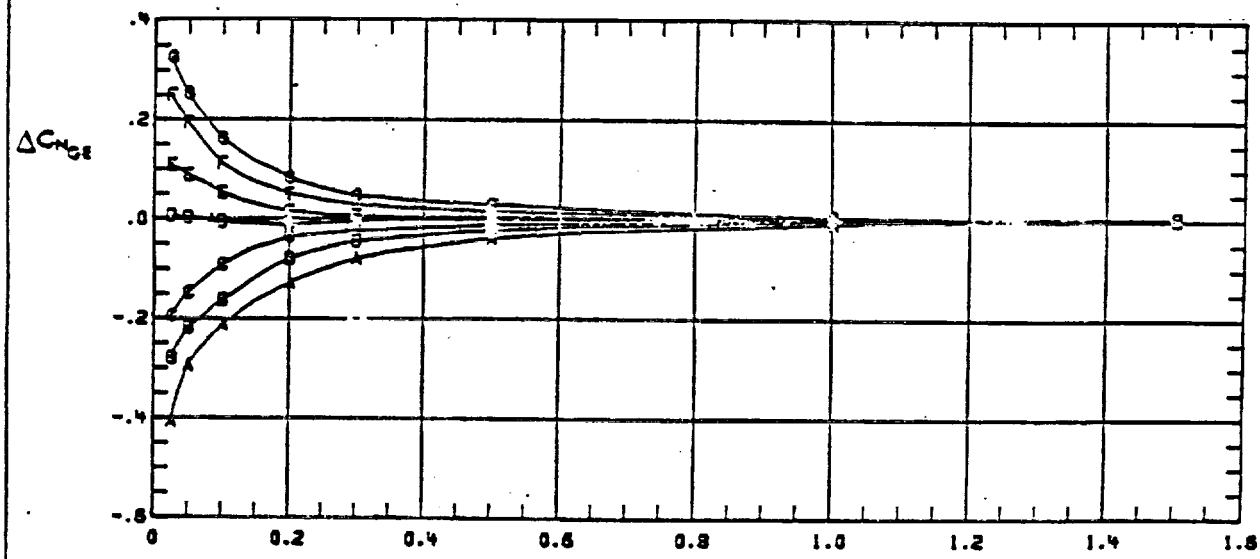
AREA S_w = 2690.000 ft²

SPAN b_w = 78.056 ft

MAC c_w = 35.560 ft

BODY LENGTH L_b = 1290.300 in

δ_e = -20.000 δ_{BF} = -11.7° δ_{SB} = ALL



Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.40532	-0.28000	-0.19674	0.00420	0.10698	0.24834	0.32302
0.050	-0.29492	-0.22000	-0.14722	0.00034	0.08669	0.19229	0.24961
0.100	-0.21372	-0.16320	-0.09238	-0.00838	0.05038	0.10873	0.16087
0.200	-0.12707	-0.08060	-0.03819	-0.01208	0.01221	0.04937	0.08169
0.300	-0.08111	-0.04600	-0.02427	-0.00619	0.00297	0.02550	0.04381
0.500	-0.04037	-0.02500	-0.01472	-0.00060	0.00073	0.01337	0.02702
1.000	-0.00998	-0.00500	-0.00399	-0.00198	0.0	0.00192	0.00470
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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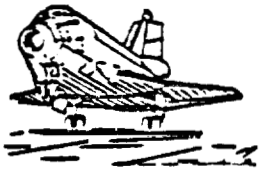
Figure 4.1.1.1-131
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{\substack{GROUND\\EFFECT}}} = C_{N_{\substack{GROUND\\EFFECT}}} - C_{N_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

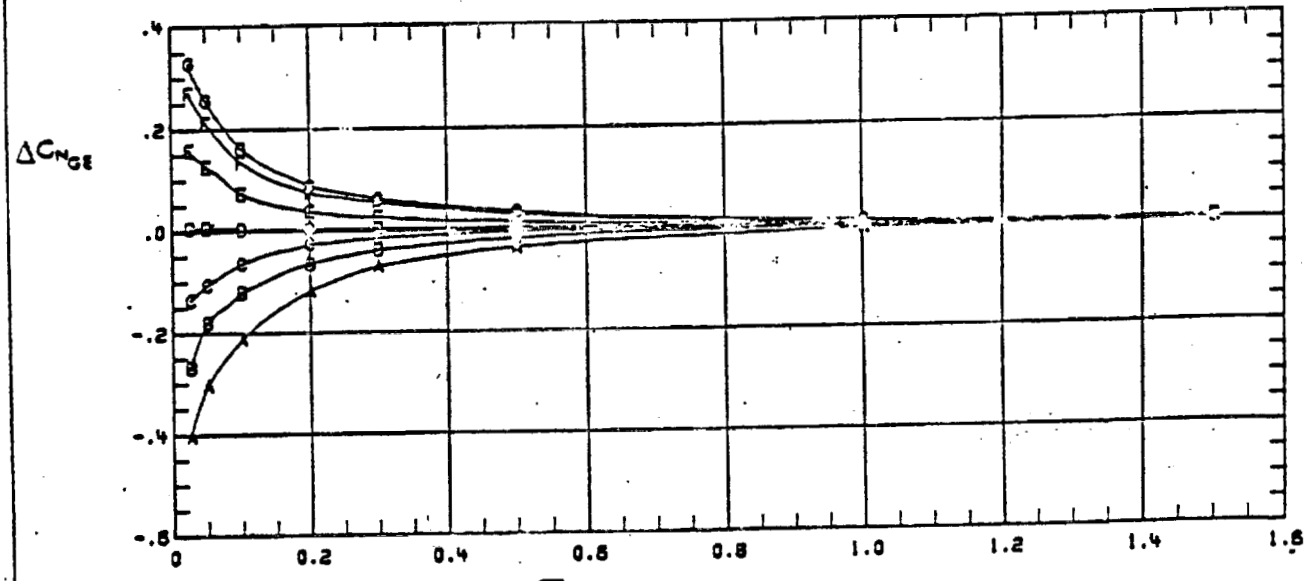
BASELINE ORBITER VEHICLE

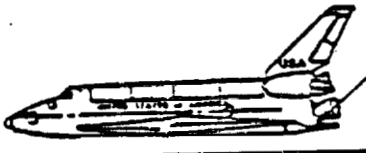
CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1076.73, Y_o = BL 0.00, Z_o = WL 375.00

REFERENCE DIMENSIONS

AREA S_w = 2896.000 ft²
SPAN b_w = 78.058 ft
MAC c_w = 39.560 ft
BODY LENGTH L_B = 1296.200 in

$\delta_e = -15.000$ $\delta_{BF} = -11.7°$ δ_{SB} = ALL





Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.40414	-0.27000	-0.13727	0.00381	0.15552	0.26762	0.32642
0.050	-0.30312	-0.18050	-0.10773	0.00331	0.12567	0.21037	0.25358
0.100	-0.21279	-0.12330	-0.06527	0.00262	0.07104	0.13238	0.15932
0.200	-0.11782	-0.06520	-0.02981	0.00166	0.03527	0.07251	0.08688
0.300	-0.07240	-0.04130	-0.01724	0.00100	0.02351	0.05252	0.06091
0.500	-0.03699	-0.01900	-0.00528	0.00045	0.01250	0.02966	0.03318
1.000	-0.00798	-0.00200	-0.00100	0.0	0.00196	0.00385	0.00564
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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DATE: 10-19-77
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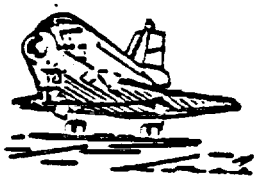
Figure 4.1.1.1-132
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{\substack{GROUND\\EFFECT}}} = C_{N_{\substack{GROUND\\EFFECT}}} - C_{N_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = 1076.73, Y_o = 0.00, Z_o = 375.38

REFERENCE DIMENSIONS

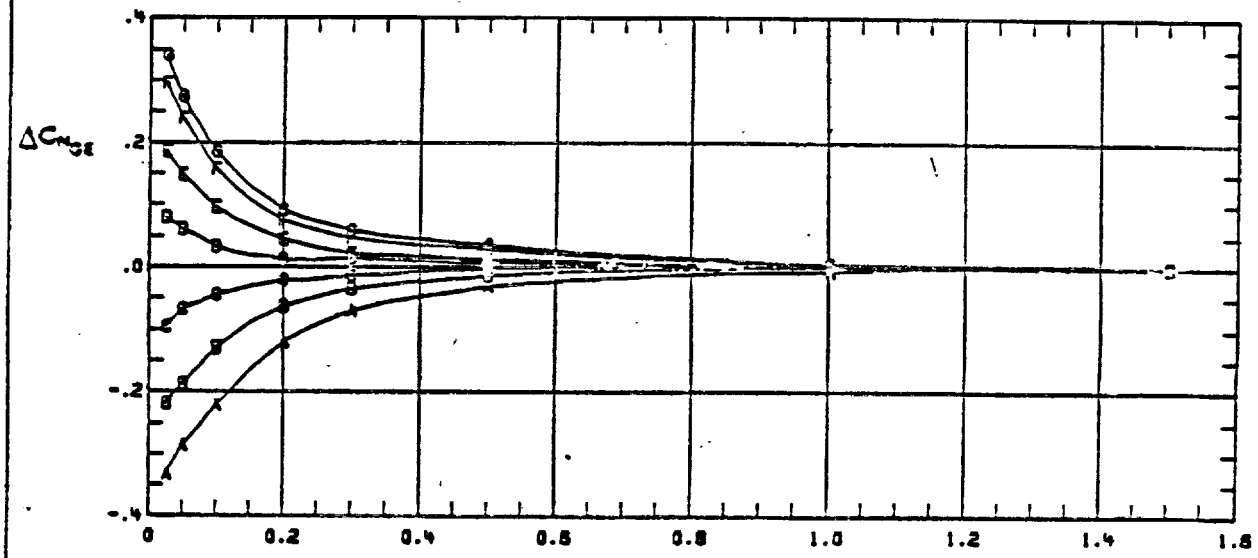
AREA S_w = 2690.300 ft²

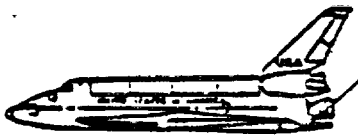
SPAN b_w = 78.056 ft

MAC c_w = 39.560 ft

BODY LENGTH L_B = 1296.300 in

$\delta_e = -10.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$





Reference Point for h/b
X_o 1506.44
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.33366	-0.22000	-0.09764	0.07747	0.18372	0.29495	0.33958
0.050	-0.26825	-0.18780	-0.06976	0.06026	0.14701	0.23816	0.27258
0.100	-0.22275	-0.13060	-0.04628	0.03188	0.09535	0.15655	0.18468
0.200	-0.12009	-0.06380	-0.02341	0.01127	0.04277	0.07365	0.09089
0.300	-0.07104	-0.03630	-0.01585	0.01181	0.02108	0.04571	0.05662
0.500	-0.03260	-0.01530	-0.00398	0.00518	0.01101	0.02641	0.03384
1.000	-0.00709	-0.00200	0.00007	0.00014	0.00119	0.00234	0.00350
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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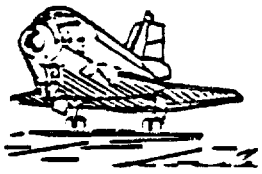
DATE: 10-19-77
REVISED:

Figure 4.1.1.1-133
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{\substack{GROUND\\EFFECT}}} = C_{N_{\substack{GROUND\\EFFECT}}} - C_{N_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1078.70; Y_o = BL 0.00; Z_o = WL 375.00

REFERENCE DIMENSIONS

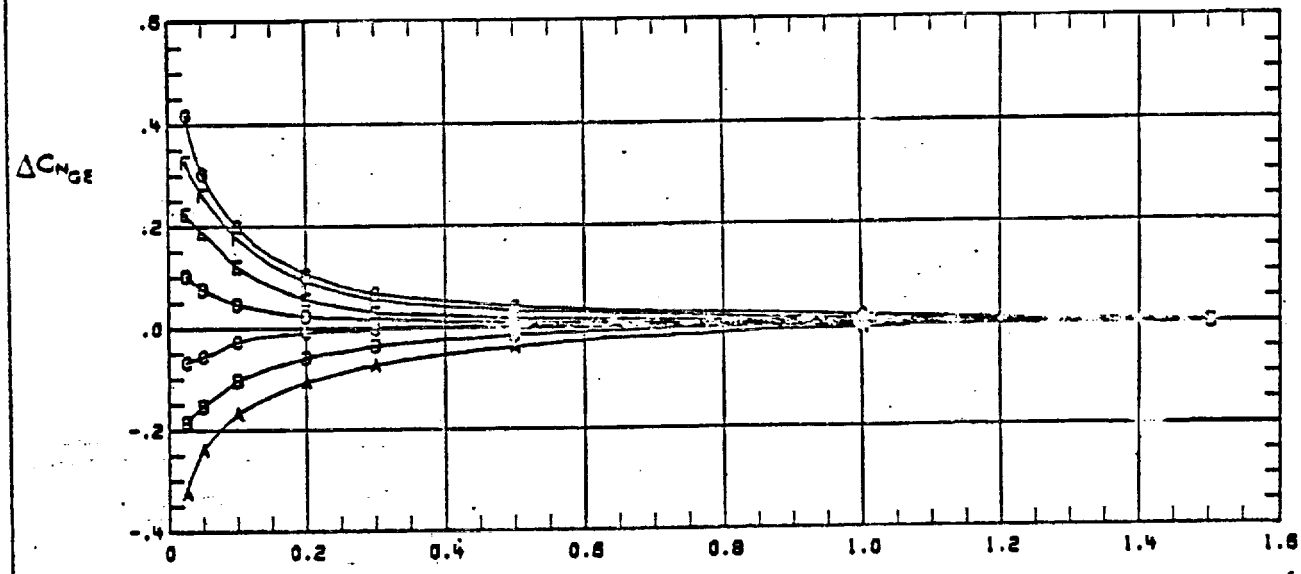
AREA S_w = 2690.000 ft²

SPAN b_w = 78.056 ft

MAC c_w = 39.560 ft

BODY LENGTH L_B = 1298.300 in

$\delta_e = -5.000$ $\delta_{BF} = -11.7°$ δ_{SB} = ALL



Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.32278	-0.18500	-0.06805	0.10213	0.22182	0.32458	0.41439
0.050	-0.23765	-0.15240	-0.05726	0.07396	0.18575	0.25966	0.30012
0.100	-0.16838	-0.10430	-0.02647	0.04603	0.11940	0.17373	0.19680
0.200	-0.10714	-0.05860	-0.00996	0.02205	0.05401	0.08949	0.10464
0.300	-0.07378	-0.03760	-0.00440	0.01592	0.02867	0.05397	0.06556
0.500	-0.03872	-0.01610	0.00190	0.00862	0.01590	0.03133	0.03950
1.000	-0.00608	0.0	0.00003	0.00304	0.00705	0.01085	0.01666
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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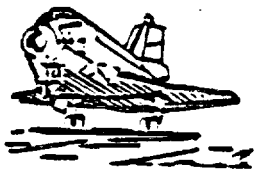
Figure 4.1.1.1-134
GROUND EFFECT

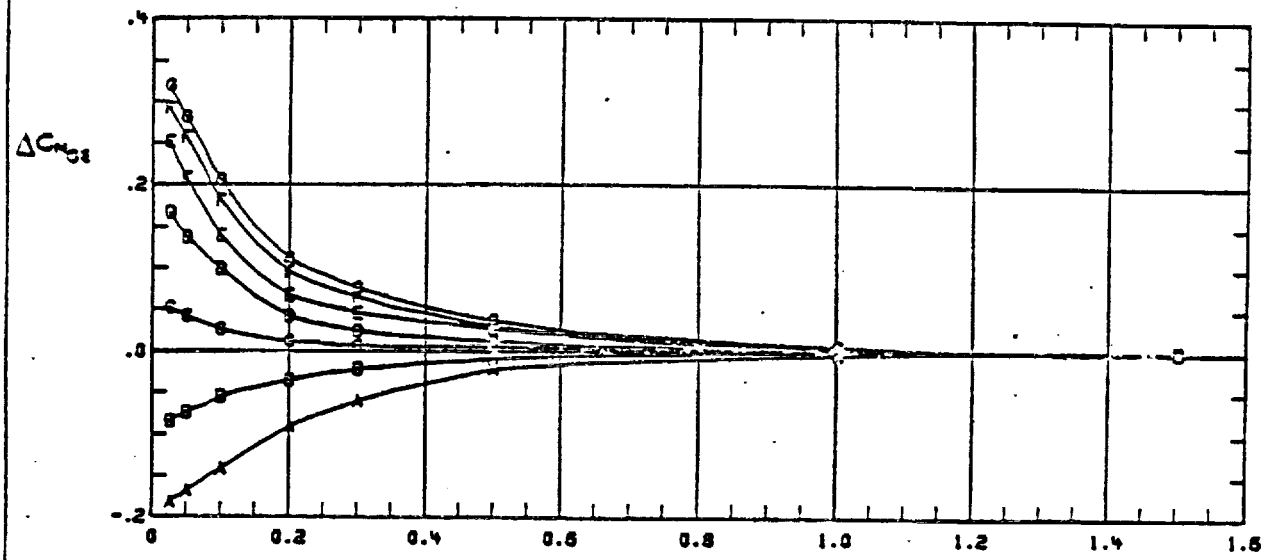
Landing Gear Down

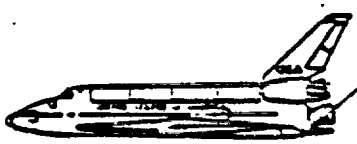


$$\Delta C_{N_{\substack{GROUND\\EFFECT}}} = C_{N_{\substack{GROUND\\EFFECT}}} - C_{N_{\substack{FREE\\STREAM}}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY ON MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = 0.0$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$





Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.18293	-0.08500	0.05136	0.16836	0.25129	0.29008	0.31932
0.050	-0.16753	-0.07520	0.04055	0.13627	0.20690	0.25509	0.27979
0.100	-0.14121	-0.05580	0.02583	0.09666	0.13848	0.17991	0.20400
0.200	-0.09073	-0.03590	0.01075	0.04134	0.06514	0.09354	0.10974
0.300	-0.06121	-0.02230	0.00548	0.02296	0.04502	0.06332	0.07383
0.500	-0.02259	-0.01080	0.00351	0.01084	0.02563	0.02912	0.03504
1.000	-0.00496	-0.00200	-0.00014	-0.00029	0.00164	0.00371	0.00564
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 10-19-77
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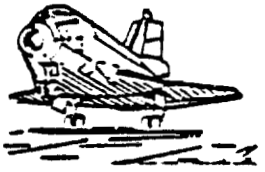
Figure 4.1.1.1-135
GROUND EFFECT

Landing Gear Down



$$\Delta C_{N_{GROUND\ EFFECT}} = C_{N_{GROUND\ EFFECT}} - C_{N_{FREE\ STREAM}}$$

CONFIGURATION

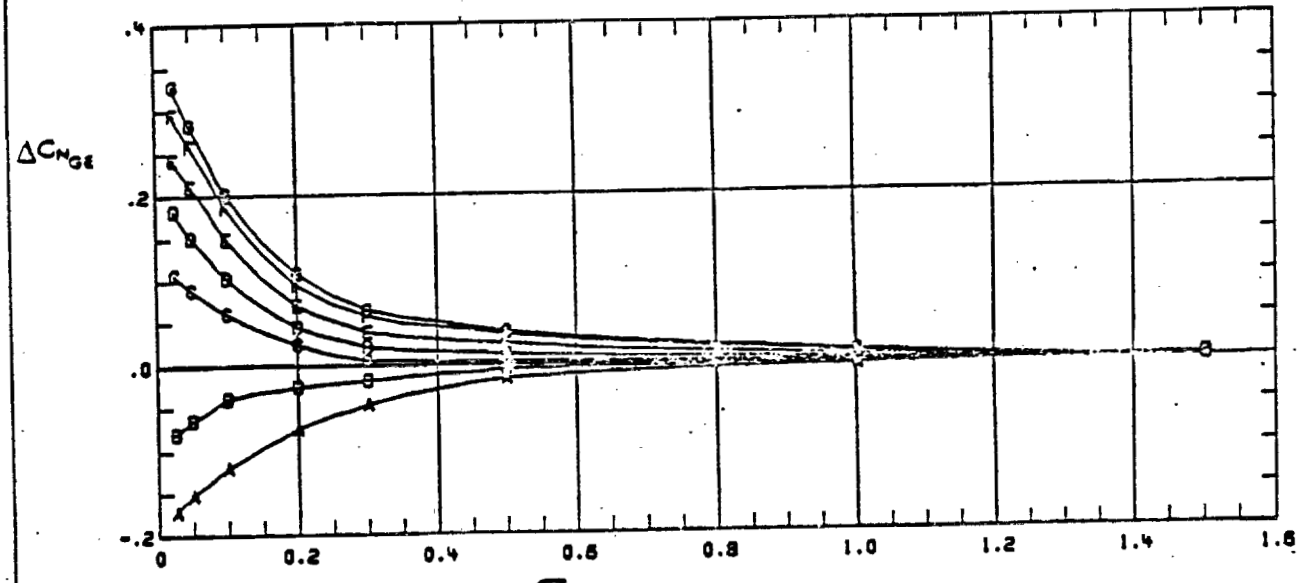
BASELINE ORBITER VEHICLE

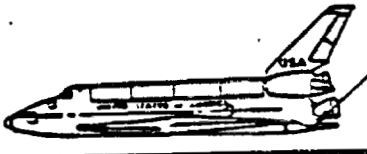
CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = 1078.70, Y_o = 0.00, Z_o = 375.00

REFERENCE DIMENSIONS

AREA	S_w = 2690.000 ft²
SPAN	b_w = 78.056 ft
MAC	c_w = 35.560 ft
BODY LENGTH	L_B = 1290.300 in

δ_e = 5.000 δ_{BF} = −11.7° δ_{SB} = ALL





Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A −4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.17233	-0.08000	0.10615	0.18108	0.24106	0.29371	0.32798
0.050	-0.15216	-0.06530	0.08815	0.15056	0.21077	0.25687	0.28245
0.100	-0.12166	-0.04020	0.05973	0.10256	0.14811	0.18471	0.20177
0.200	-0.07540	-0.02620	0.02329	0.04438	0.06966	0.09399	0.10791
0.300	-0.04720	-0.01830	0.00358	0.02019	0.03793	0.05623	0.06357
0.500	-0.01697	-0.00710	0.00242	0.01064	0.02271	0.03460	0.03834
1.000	-0.00399	-0.00200	0.0	0.00198	0.00587	0.00961	0.01128
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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DATE: 10-19-77
REVISED:

Figure 4.1.1.1-136
GROUND EFFECT

Landing Gear Down

$$\Delta C_{N_{\substack{GROUND\\EFFECT}}} = C_{N_{\substack{GROUND\\EFFECT}}} - C_{N_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1878.70, Y_o = BL 0.00, Z_o = WL 375.00

REFERENCE DIMENSIONS

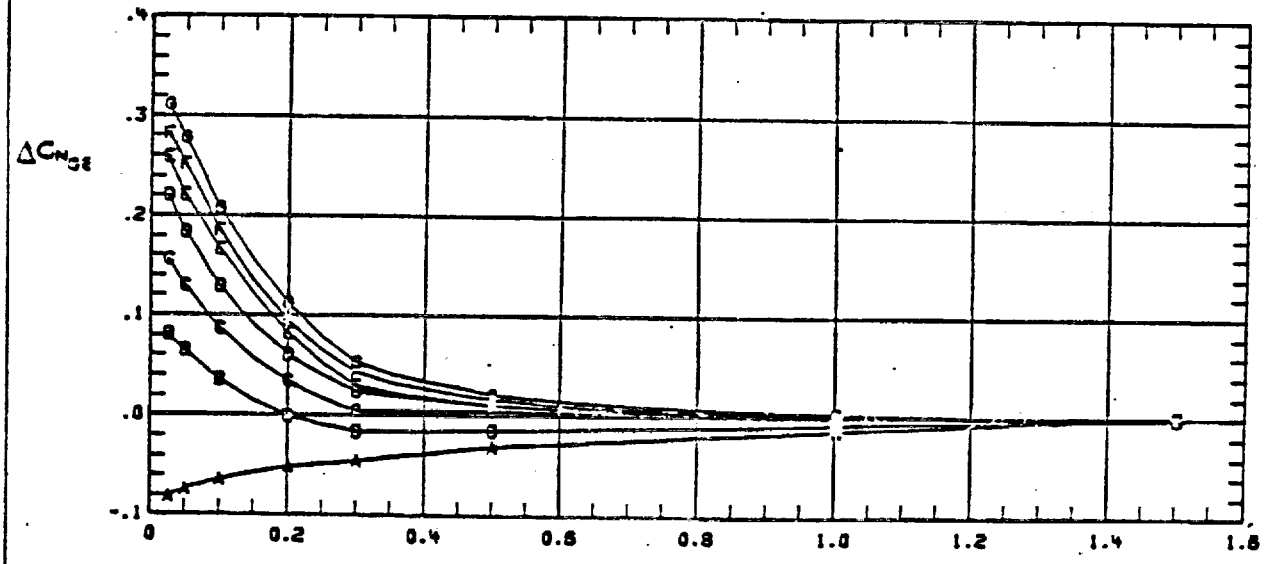
AREA S_w = 2690.000 ft²

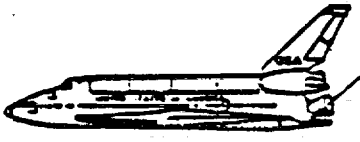
SPAN b_w = 78.056 ft

MAC c_w = 39.560 ft

BODY LENGTH L_B = 1290.300 in

$\delta_e = 10.000$ $\delta_{SF} = -11.7°$ δ_{SB} = ALL





Reference Point for h/b
X_o 1506.34
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	-0.08264	0.08000	0.15582	0.22024	0.25781	0.28150	0.31129
0.050	-0.07442	0.06360	0.12947	0.18348	0.22031	0.25070	0.27634
0.100	-0.06412	0.03460	0.08593	0.12972	0.16570	0.18388	0.20714
0.200	-0.05183	-0.00130	0.03306	0.06009	0.08120	0.09402	0.11084
0.300	-0.04526	-0.01670	0.00350	0.02329	0.02883	0.04167	0.05190
0.500	-0.03130	-0.01520	0.00387	0.00986	0.00952	0.01548	0.02083
1.000	-0.01397	-0.00800	0.0	0.0	0.00098	0.00192	0.00282
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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DATE: 10-10-77
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Figure 4.1.1.1-137
GROUND EFFECT

$\Delta C_{N_{LANDING\ GEAR}}$ = Change in normal force coefficient due to fully extended landing gear. (Figure 4.1.1.1-128

$\Delta C_{N_{GROUND\ EFFECT}}$ = Change in normal force coefficient due to proximity of ground, f(h/b)

NOTE: 1. See Section 3.4 for ground clearance and scrape attitude.

$$= \Delta C_{N_{GE_{\delta_{BF}=-11.7°}}} + \Delta C_{N_{BF_{GE}}}$$

$\Delta C_{N_{GE_{\delta_{BF}=-11.7°}}}$ = Incremental normal force coefficient in ground effect with $\delta_{BF} = -11.7^0$ (Figures 4.1.1.1-129 through -138)

$\Delta C_{N_{BF_{GE}}}$ = Incremental normal force coefficient in ground effect for various δ_{BF} deflections (Figures 4.1.1.1-139 through -145)

$\Delta C_{N_{SILTS\ POD}}$ = Change in normal force coefficient due to addition of SILTS pod.

$$= \Delta C_{L_{SILTS\ POD}} \cos \alpha + \Delta C_{D_{SILTS\ POD}} \sin \alpha$$

$\Delta C_{L_{SILTS\ POD}}$ = SILTS pod lift increment (cf. Section 4.1.2.1)

$\Delta C_{D_{SILTS\ POD}}$ = SILTS pod drag increment (cf. Section 4.1.2.2)

RCS flow field interactions have been subdivided into three components:

1. RCS JET THRUST (subscript JT)
2. RCS JET PLUME IMPINGEMENT (subscript IMP)
3. RCS JET PLUME EFFECT ON FLOW FIELD (subscript JI)

*The effect of the RCS may be described as a dimensional normal force (pounds) in terms of the significant contributing elements by:

$$N_{RCS} = N_{JT} + [N_{SURF} + \Delta N_{ELEVON} + \Delta N_{BODY\ FLAP}]_{IMP} + \bar{q}\ S[\Delta C_N + \Delta C_{N_{ELEVON}} + \Delta C_{N_{BODY\ FLAP}}]_{JI}$$

where,

N_{JT} = Normal force resulting from number (n) of jets being fired (cf. Appendix B)

$$= \sum_{OJG} [N_{JET} \cdot n] \sim lb$$

NOTE: 1. OJG = operating jet group #
2. Values given in Figure B-1 are for reference only

*Refer to Appendix D when using digitized data.

$N_{SURF_{IMP}}$ = Normal force resulting from jet impingement on OV surface(s). (Figure 4.1.1.1-146 and-147)

$$= \sum_{OJG} [N_{SURF_{IMP}} \cdot n] \sim lb$$

$\Delta N_{ELEVON_{IMP}}$ = Change in normal force due to effect of impingement on elevon effectiveness. (Figure 4.1.1.1-148)

$$= \sum_{OJG} [\frac{\partial N}{\partial \delta_e} \delta_e \cdot n] \sim lb$$

$\Delta N_{BODY\ FLAP_{IMP}}$ = Change in normal force due to effect of impingement on body flap effectiveness. (Figure 4.1.1.1-149)

$$= \sum_{OJG} [\frac{\partial N}{\partial \delta_{BF}} \delta_{BF} \cdot n] \sim lb$$

$\Delta C_{N_{JI}}$ = Change in normal force coefficient due to jet interaction. (Figures 4.1.1.1-150 through -152)

$$= \sum_{OJG} [\Delta C_{N_{JI}}]$$

$\Delta C_{N_{ELEVON_{JI}}}$ = Change in normal force coefficient due to jet interaction on elevon effectiveness.

$$= \sum_{OJG} \left[(\Delta C_N)_{\delta_{e_{REF}}} \left(\frac{\delta_e}{\delta_{e_{REF}}} \right)^{0.75} \right]$$

NOTE: 1. Down-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.1-153)

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.1.1.1-154)

2. Side-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.1-155)

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.1.1.1-156)

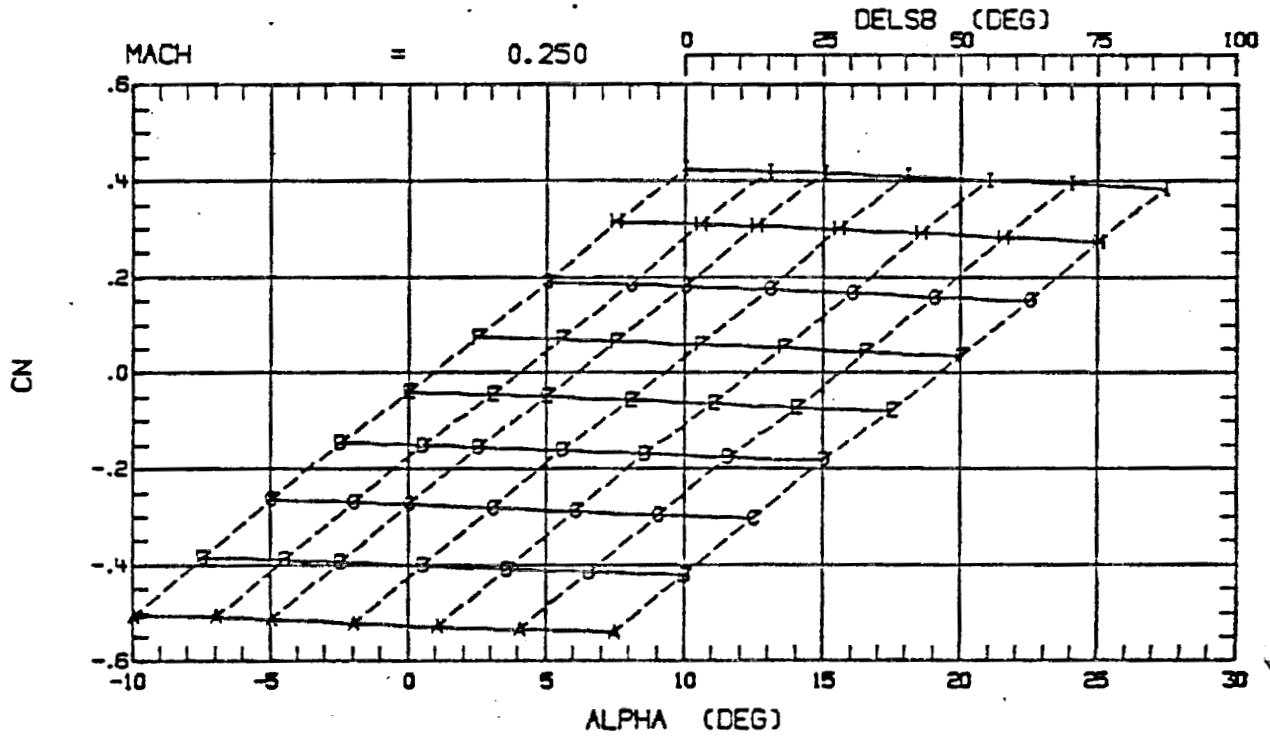
3. Up-firing jets (No effect)

$\Delta C_{N_{\substack{BODY \\ FLAP \\ JI}}}$ = Change in normal force coefficient due to jet interaction on body flap effectiveness.

$$= \sum_{OJG} \left[(\Delta C_N)_{\delta_{BF}} \left(\frac{\delta_{BF}}{\delta_{BF_{REF}}} \right)^{0.75} \right]$$

NOTE: 1. Down-firing jets (Figure 4.1.1.1-15)
$\delta_{BF} < 0°$, $\delta_{BF_{REF}} = -14.25°$
$\delta_{BF} > 0°$ (No effect)
2. Side-firing jets (No effect)
3. Up-firing jets (No effect)

The total RCS effect, N_{RCS}, during thrust build-up and decay is obtained by reducing the full thrust value by the ratio of momentary thrust (see Ref. 4-3) to full thrust.



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.50713	-0.38671	-0.26564	-0.14549	-0.04030	0.07391	0.18818	0.31250	0.42184
15.000	-0.50985	-0.39049	-0.27050	-0.15077	-0.04600	0.06879	0.18359	0.30843	0.41825
25.000	-0.51500	-0.39530	-0.27500	-0.15500	-0.05000	0.06500	0.18000	0.30502	0.41500
40.000	-0.52296	-0.40304	-0.28294	-0.16256	-0.05750	0.05751	0.17248	0.29741	0.40725
55.000	-0.53053	-0.41065	-0.29022	-0.17003	-0.06490	0.05026	0.16533	0.29031	0.40016
70.000	-0.53601	-0.41708	-0.29762	-0.17802	-0.07350	0.04165	0.15669	0.28164	0.39143
87.200	-0.54119	-0.42348	-0.30325	-0.18418	-0.08020	0.03384	0.14775	0.27175	0.38059

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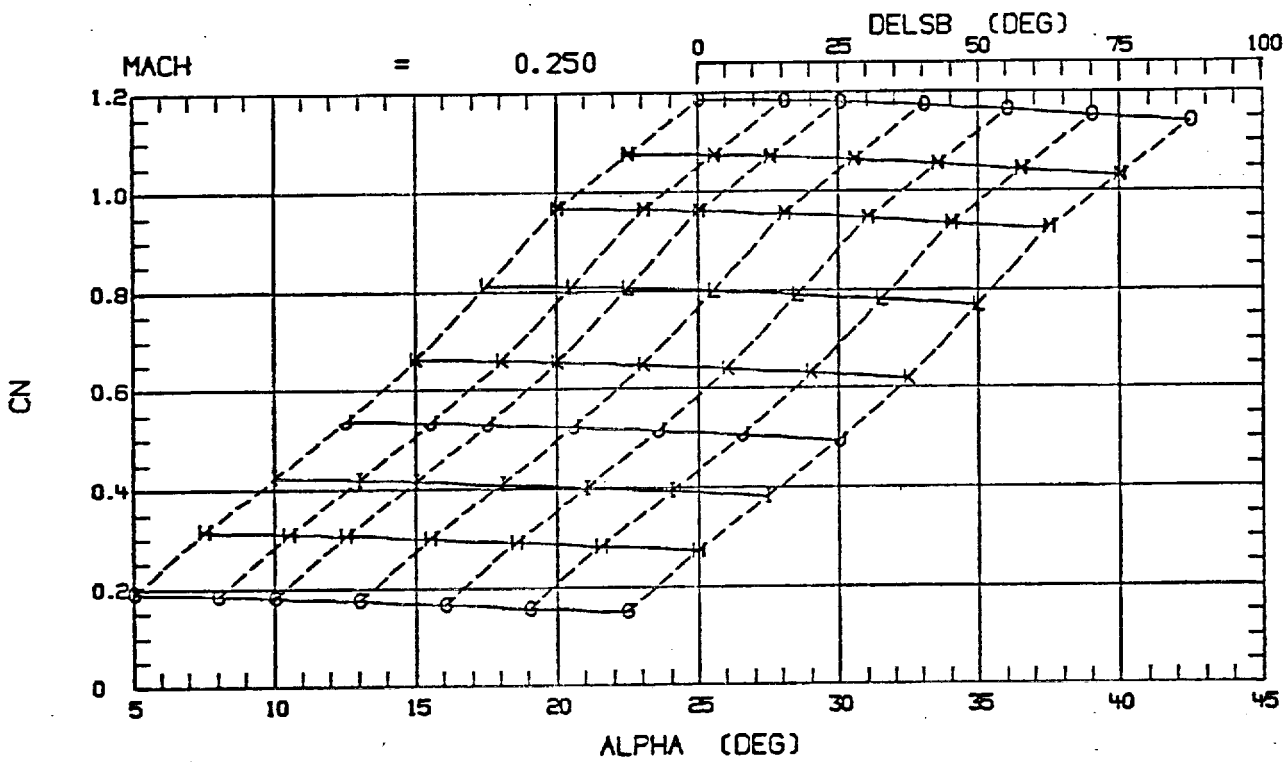
FIGURE 4.1.1.1-1
BASIC NORMAL FORCE COEFFICIENT



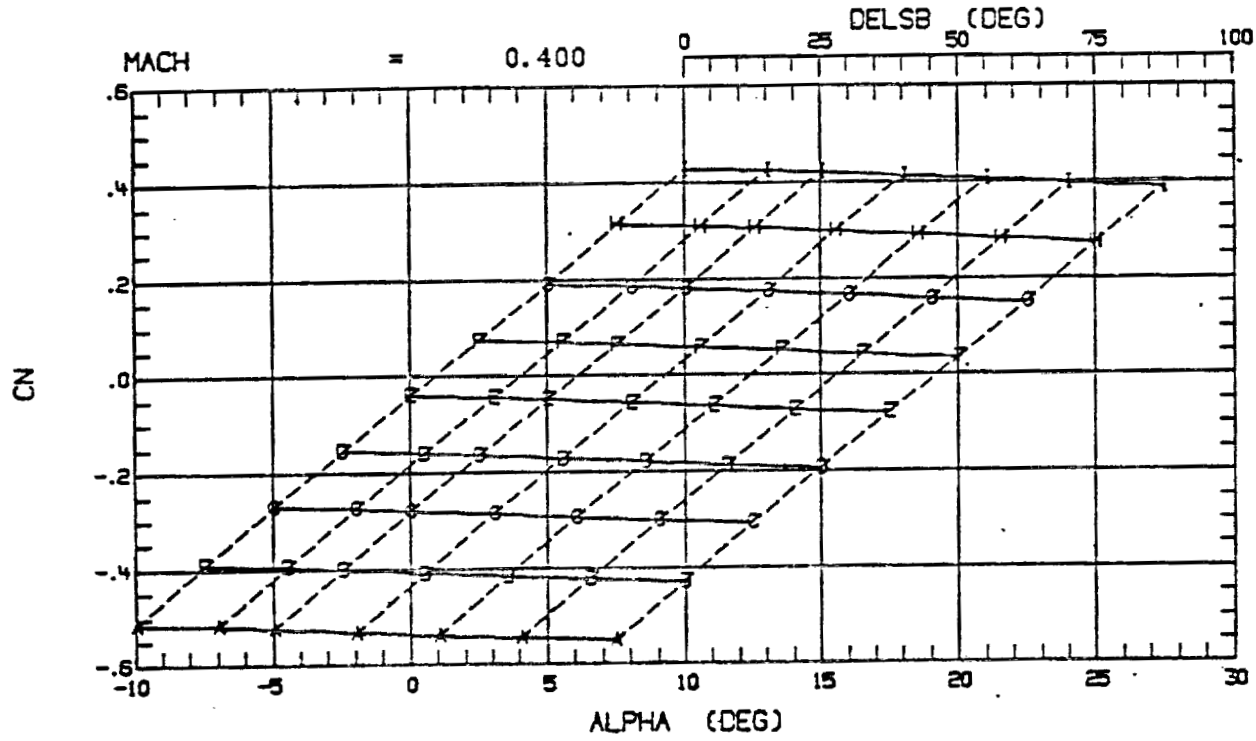
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.18818	0.31250	0.42184	0.53666	0.66151	0.81141	0.96635	1.07583	1.18532
15.000	0.18359	0.30843	0.41825	0.53310	0.65796	0.80784	0.96273	1.07285	1.18303
25.000	0.18000	0.30502	0.41500	0.53000	0.65500	0.80500	0.95000	1.06999	1.18000
40.000	0.17248	0.29741	0.40725	0.52241	0.64755	0.79769	0.95281	1.06257	1.17230
55.000	0.16533	0.29031	0.40016	0.51500	0.63979	0.78957	0.94433	1.05373	1.16314
70.000	0.15669	0.28164	0.39143	0.50568	0.62983	0.77888	0.93295	1.04197	1.15108
87.200	0.14775	0.27175	0.38059	0.49464	0.61860	0.76757	0.92146	1.03012	1.13870

ENGINEER D
DATE 3-82

FIGURE 4.1.1.1-2
BASIC NORMAL FORCE COEFFICIENT

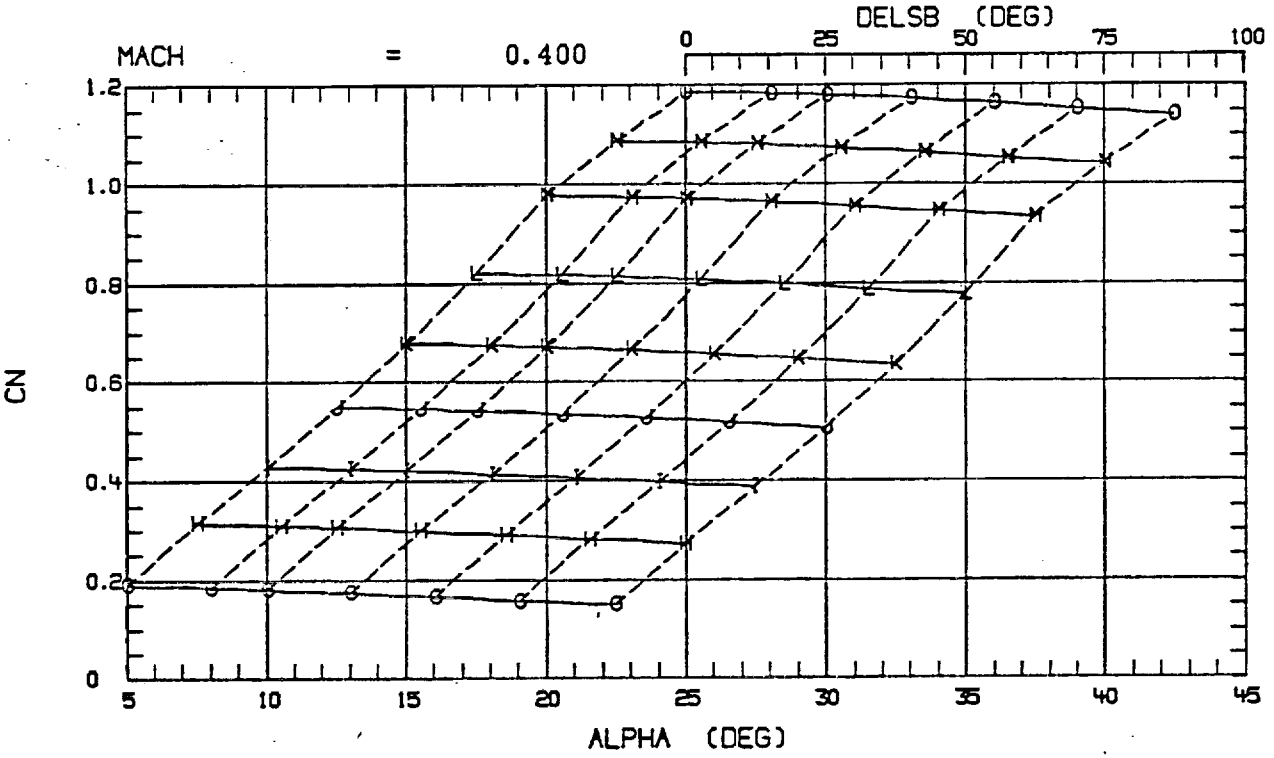


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.51613	-0.39364	-0.27084	-0.15549	-0.04030	0.07392	0.18818	0.31248	0.42583
15.000	-0.51885	-0.39742	-0.27551	-0.16077	-0.04600	0.06879	0.18359	0.30841	0.42324
25.000	-0.52400	-0.40223	-0.28000	-0.16500	-0.05000	0.06500	0.18000	0.30500	0.42000
40.000	-0.53186	-0.40997	-0.28765	-0.17255	-0.05750	0.05752	0.17248	0.29739	0.41224
55.000	-0.53953	-0.41758	-0.29522	-0.18003	-0.06490	0.05027	0.16533	0.29029	0.40515
70.000	-0.54501	-0.42401	-0.30253	-0.18802	-0.07350	0.04164	0.15688	0.28162	0.39843
87.200	-0.55020	-0.42941	-0.30825	-0.19418	-0.08020	0.03385	0.14775	0.27172	0.38558

ENGINEER DL
DATE 3-82

FIGURE 4.1.1.1-3
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.18818	0.31248	0.42583	0.54865	0.67652	0.81941	0.97636	1.08583	1.18531
15.000	0.18359	0.30841	0.42324	0.54509	0.67296	0.81584	0.97274	1.08285	1.18303
25.000	0.18000	0.30500	0.42000	0.54200	0.67000	0.81300	0.97000	1.07999	1.18000
40.000	0.17248	0.29739	0.41224	0.53440	0.66255	0.80569	0.96282	1.07255	1.17230
55.000	0.16533	0.29029	0.40515	0.52700	0.65479	0.79757	0.95433	1.06373	1.16314
70.000	0.15668	0.28162	0.39643	0.51768	0.64484	0.78688	0.94296	1.05196	1.15108
87.200	0.14775	0.27172	0.38558	0.50684	0.63360	0.77557	0.93147	1.04012	1.13870

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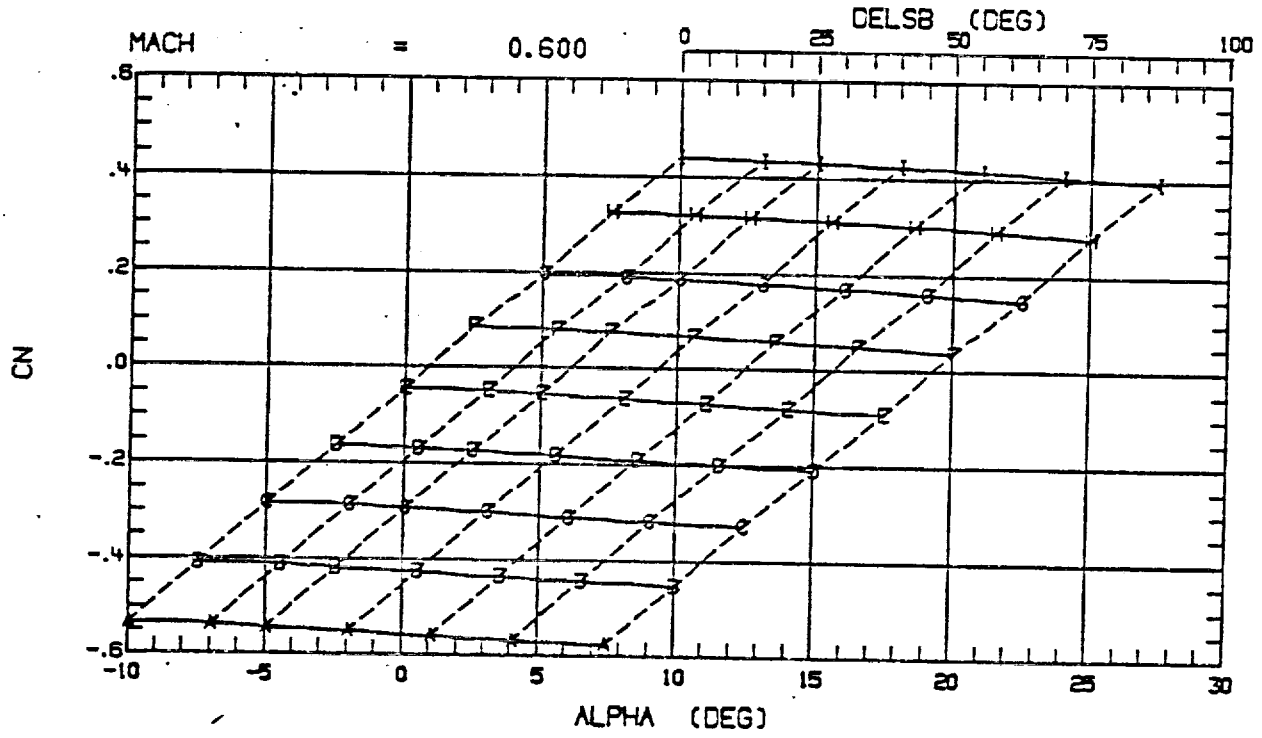
DATE 3-82

FIGURE 4.1.1.1-4
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.53521	-0.41013	-0.28508	-0.16502	-0.04500	0.08465	0.19432	0.32384	0.43845
15.000	-0.53839	-0.41379	-0.28920	-0.16960	-0.05000	0.07958	0.18917	0.31903	0.43394
25.000	-0.54500	-0.41999	-0.29500	-0.17500	-0.05500	0.07500	0.18500	0.31499	0.43000
40.000	-0.55219	-0.42714	-0.30207	-0.18331	-0.06454	0.06640	0.17733	0.30761	0.42298
55.000	-0.56159	-0.43705	-0.31258	-0.19317	-0.07362	0.05760	0.16896	0.29961	0.41522
70.000	-0.56905	-0.44476	-0.32058	-0.20147	-0.08246	0.04809	0.15858	0.28964	0.40567
87.200	-0.57696	-0.45299	-0.32921	-0.21059	-0.09211	0.03777	0.14759	0.27789	0.39320

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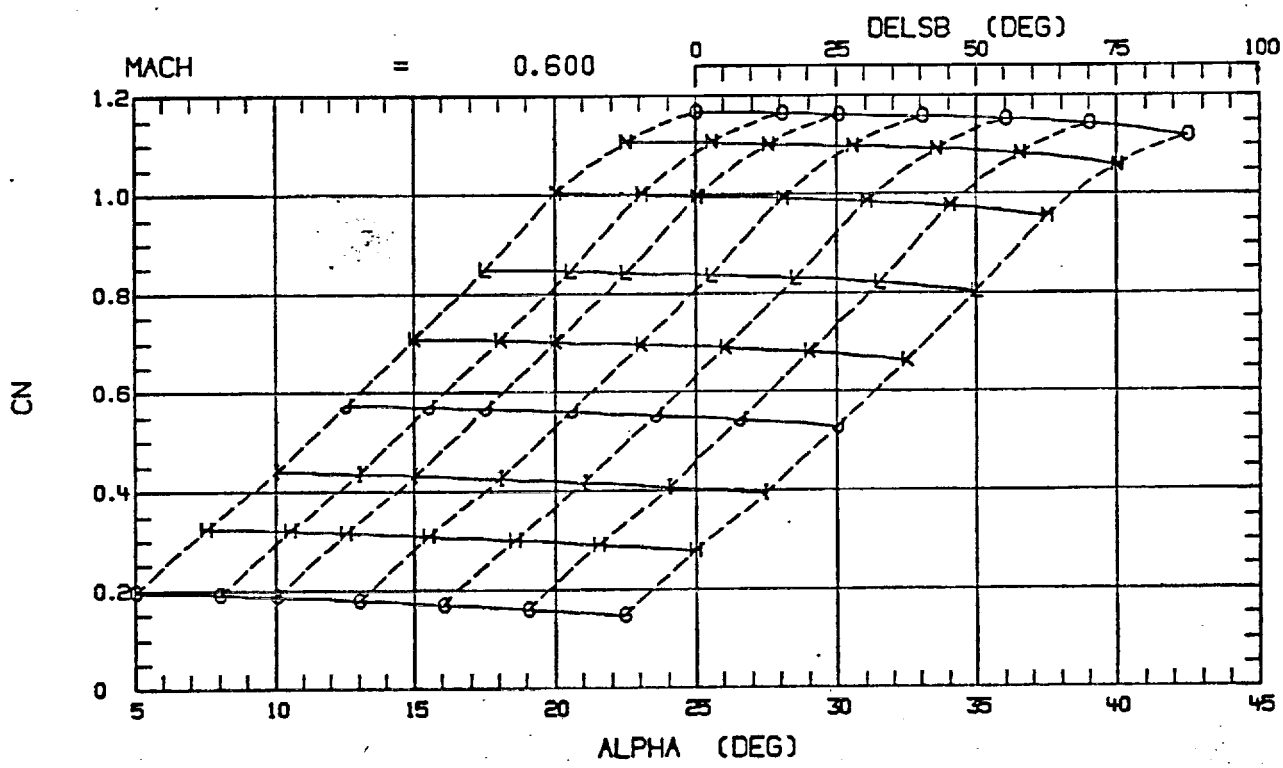
FIGURE 4.1.1.1-5
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000	7.500	10.000	12.500	15.000	17.500	20.000	22.500	25.000
	G	H	I	J	K	L	M	N	O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.19432	0.32384	0.43845	0.57303	0.70766	0.84732	1.00103	1.10679	1.16859
15.000	0.18917	0.31903	0.43394	0.56906	0.70418	0.84430	0.99843	1.10455	1.16466
25.000	0.18500	0.31499	0.43000	0.56500	0.70000	0.84000	0.99400	1.10000	1.16000
40.000	0.17733	0.30761	0.42288	0.55927	0.69553	0.83559	0.99034	1.09687	1.15737
55.000	0.16896	0.29961	0.41522	0.55153	0.68778	0.82894	0.98402	1.09104	1.15195
70.000	0.15858	0.28984	0.40567	0.54225	0.67869	0.81998	0.97512	1.08211	1.14295
87.200	0.14759	0.27789	0.39320	0.52740	0.66146	0.80036	0.95315	1.05782	1.11640

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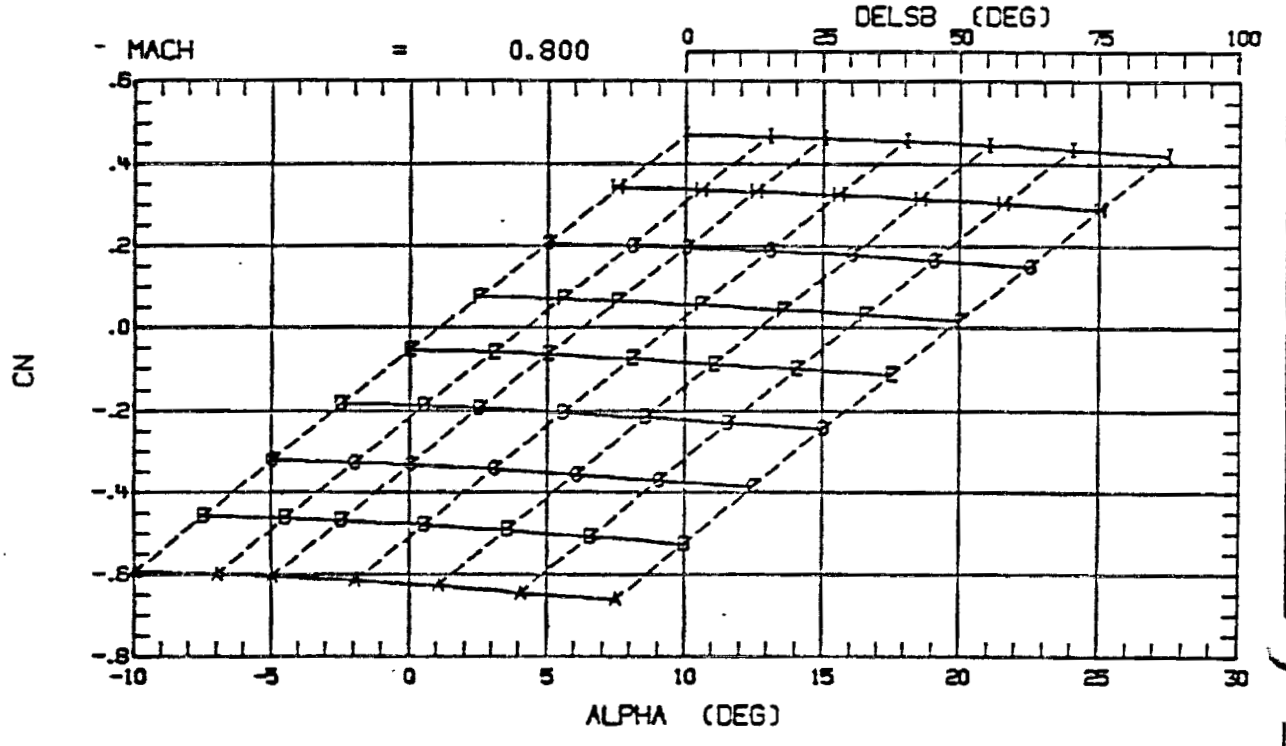
FIGURE 4.1.1.1-6
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.59400	-0.45891	-0.32450	-0.18472	-0.05500	0.07472	0.20446	0.33981	0.47022
15.000	-0.59930	-0.46419	-0.32971	-0.18994	-0.06000	0.06961	0.19924	0.33464	0.46507
25.000	-0.60500	-0.46970	-0.33504	-0.19500	-0.06500	0.06500	0.19500	0.33000	0.46000
40.000	-0.61589	-0.48063	-0.34619	-0.20632	-0.07645	0.05497	0.18643	0.32246	0.45339
55.000	-0.62746	-0.49261	-0.35845	-0.21894	-0.08950	0.04355	0.17657	0.31306	0.44445
70.000	-0.64547	-0.50669	-0.37306	-0.23194	-0.10099	0.03099	0.16295	0.30093	0.43385
87.200	-0.66252	-0.52518	-0.38860	-0.24686	-0.11539	0.01667	0.14660	0.28622	0.41870

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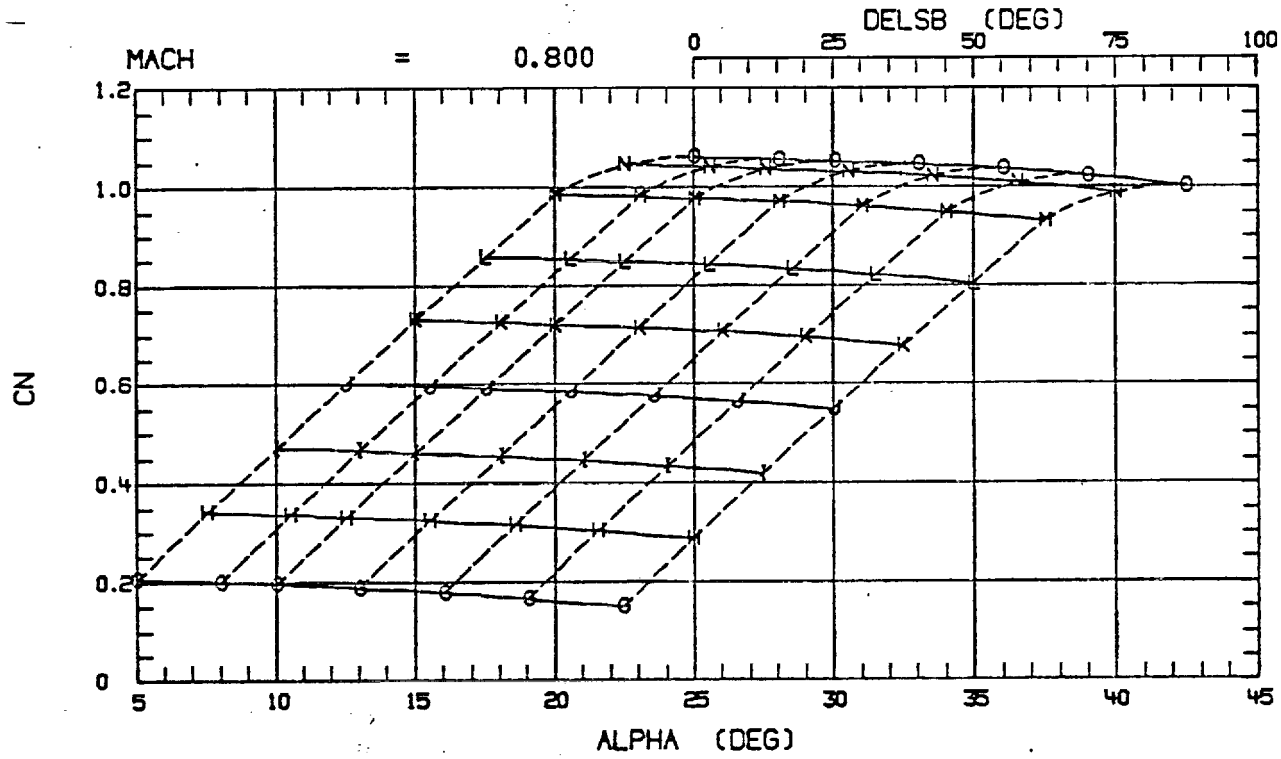
FIGURE 4.1.1.1-7
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.20446	0.33981	0.47022	0.60003	0.72984	0.85664	0.98445	1.04426	1.05907
15.000	0.19924	0.33464	0.46507	0.59493	0.72480	0.85164	0.97948	1.03932	1.05414
25.000	0.19500	0.33000	0.46000	0.59000	0.72000	0.84700	0.97500	1.03500	1.05000
40.000	0.18643	0.32246	0.45339	0.58372	0.71397	0.84114	0.96923	1.02925	1.04419
55.000	0.17857	0.31306	0.44445	0.57490	0.70525	0.83249	0.96062	1.02065	1.03559
70.000	0.16295	0.30093	0.43385	0.56391	0.69379	0.82048	0.94801	1.00737	1.02158
87.200	0.14860	0.28622	0.41870	0.54776	0.67655	0.80219	0.92960	0.98682	0.99988

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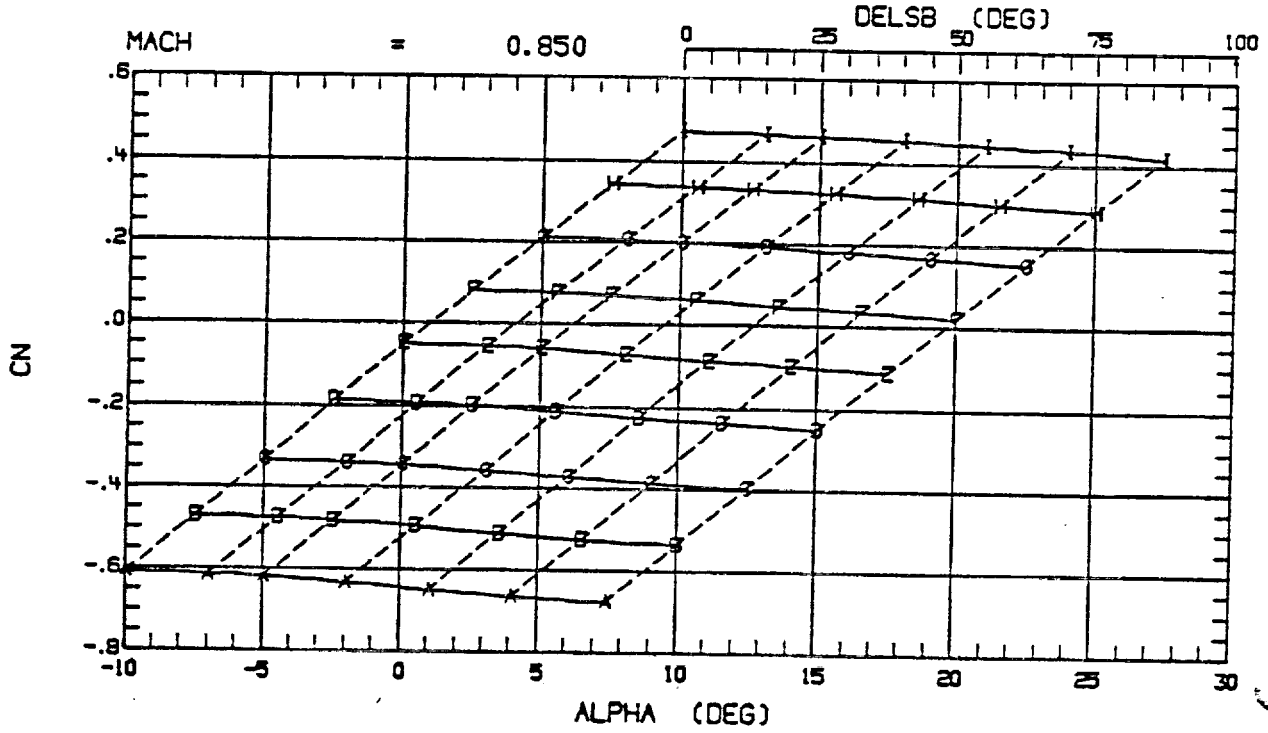
FIGURE 4.1.1.1-8
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.60921	-0.47198	-0.33554	-0.18976	-0.05200	0.07988	0.20980	0.34038	0.47098
15.000	-0.61419	-0.47694	-0.34045	-0.19461	-0.05675	0.07497	0.20471	0.33501	0.46536
25.000	-0.62000	-0.48252	-0.34600	-0.20000	-0.06200	0.07000	0.20000	0.33000	0.46000
40.000	-0.63368	-0.49607	-0.35918	-0.21297	-0.07451	0.05886	0.19024	0.32151	0.45270
55.000	-0.64961	-0.51132	-0.37394	-0.22703	-0.08825	0.04656	0.17936	0.31140	0.44339
70.000	-0.66467	-0.52651	-0.38721	-0.23967	-0.10024	0.03413	0.16646	0.29925	0.43192
87.200	-0.67636	-0.53774	-0.40010	-0.25330	-0.11469	0.01935	0.15125	0.28373	0.41608

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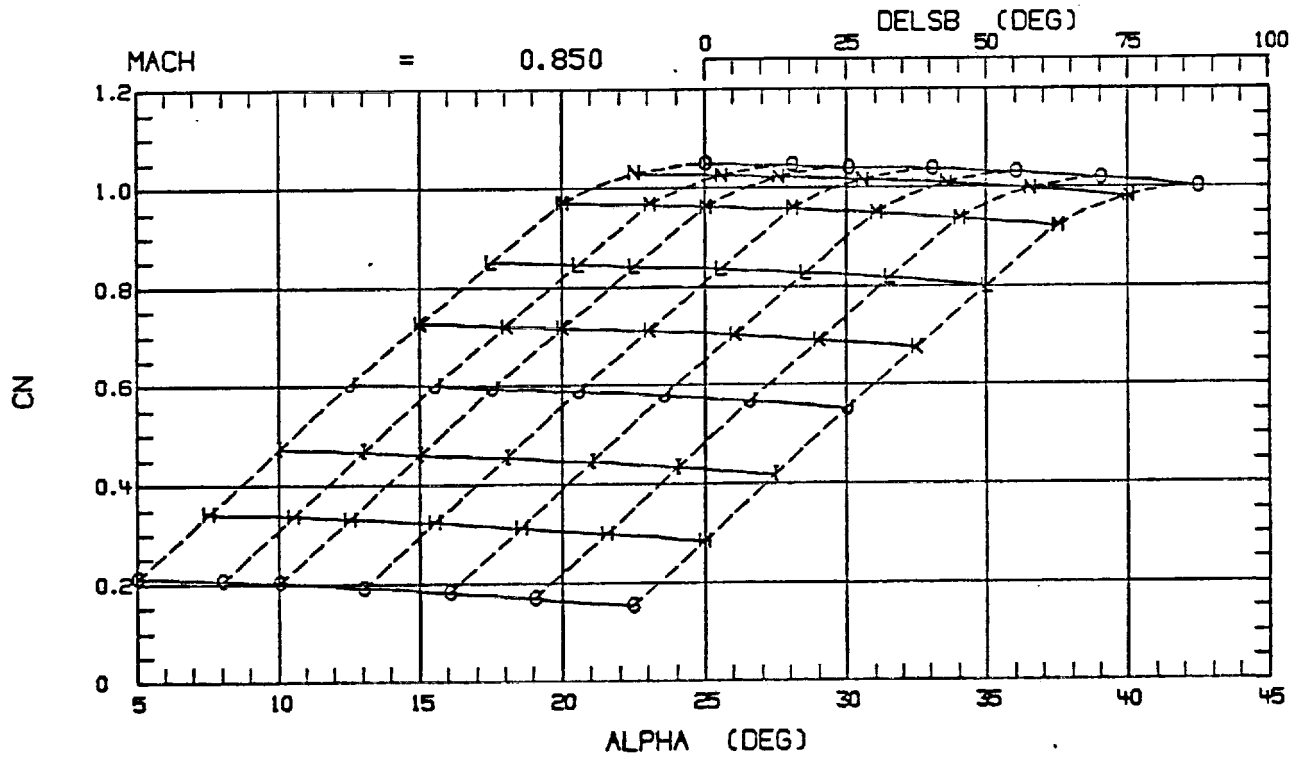
FIGURE 4.1.1.1-9
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.20980	0.34038	0.47098	0.60442	0.72488	0.84933	0.96881	1.02830	1.04782
15.000	0.20471	0.33501	0.46536	0.59912	0.71988	0.84462	0.96437	1.02411	1.04385
25.000	0.20000	0.33000	0.46000	0.59400	0.71500	0.84000	0.96000	1.02000	1.04000
40.000	0.19024	0.32151	0.45270	0.58745	0.70910	0.83468	0.95519	1.01562	1.03597
55.000	0.17936	0.31140	0.44339	0.57849	0.70048	0.82633	0.94705	1.00764	1.02811
70.000	0.16646	0.29925	0.43192	0.56728	0.68950	0.81557	0.93649	0.99727	1.01790
87.200	0.15126	0.29373	0.41608	0.55133	0.67335	0.79914	0.91976	0.98015	1.00033

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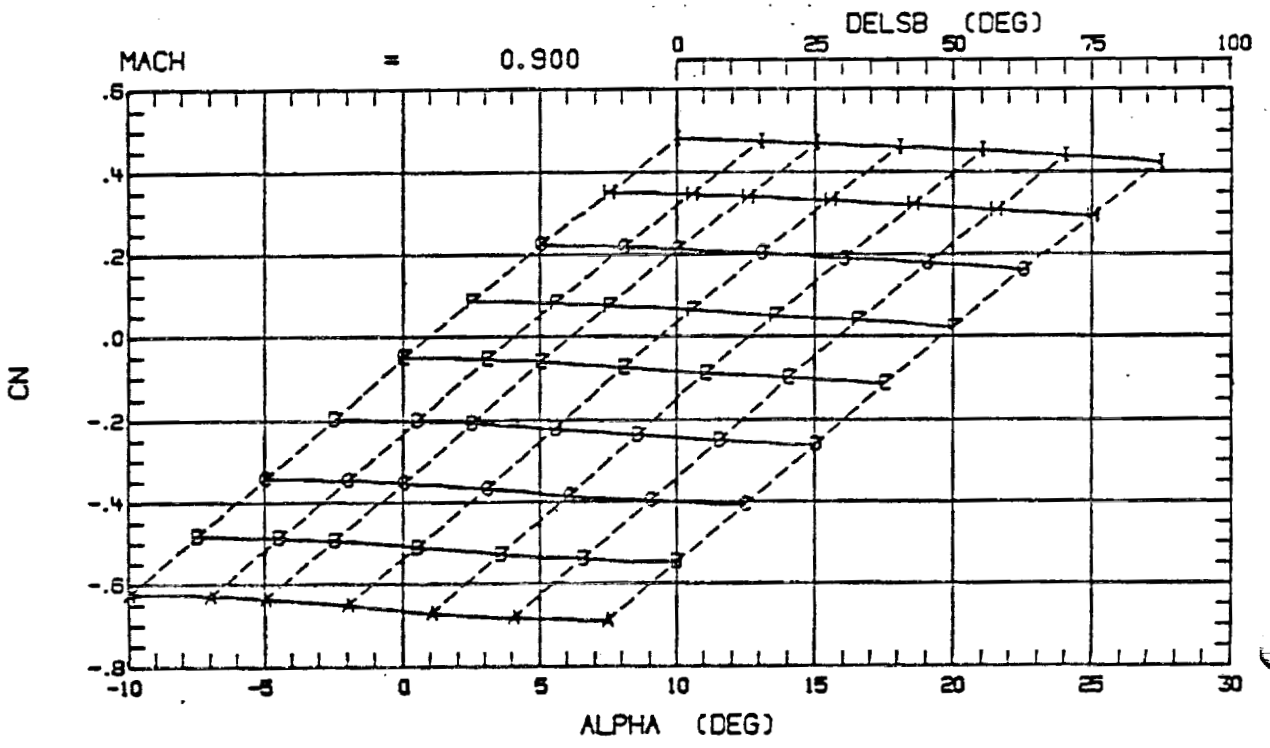
FIGURE 4.1.1.1-10
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.62442	-0.48403	-0.34463	-0.19979	-0.05000	0.08505	0.22214	0.34694	0.47874
15.000	-0.62907	-0.48886	-0.34924	-0.20434	-0.05450	0.08035	0.21719	0.34339	0.47257
25.000	-0.63500	-0.49452	-0.35500	-0.21000	-0.06000	0.07500	0.21200	0.33800	0.46700
40.000	-0.65166	-0.51049	-0.37022	-0.22439	-0.07357	0.06275	0.20106	0.32855	0.45901
55.000	-0.67176	-0.52902	-0.38728	-0.24010	-0.08800	0.04958	0.18916	0.31774	0.44933
70.000	-0.68398	-0.54110	-0.39941	-0.25237	-0.10050	0.03728	0.17699	0.30535	0.43699
87.200	-0.69010	-0.54929	-0.40964	-0.26472	-0.11500	0.02205	0.16093	0.29925	0.42047

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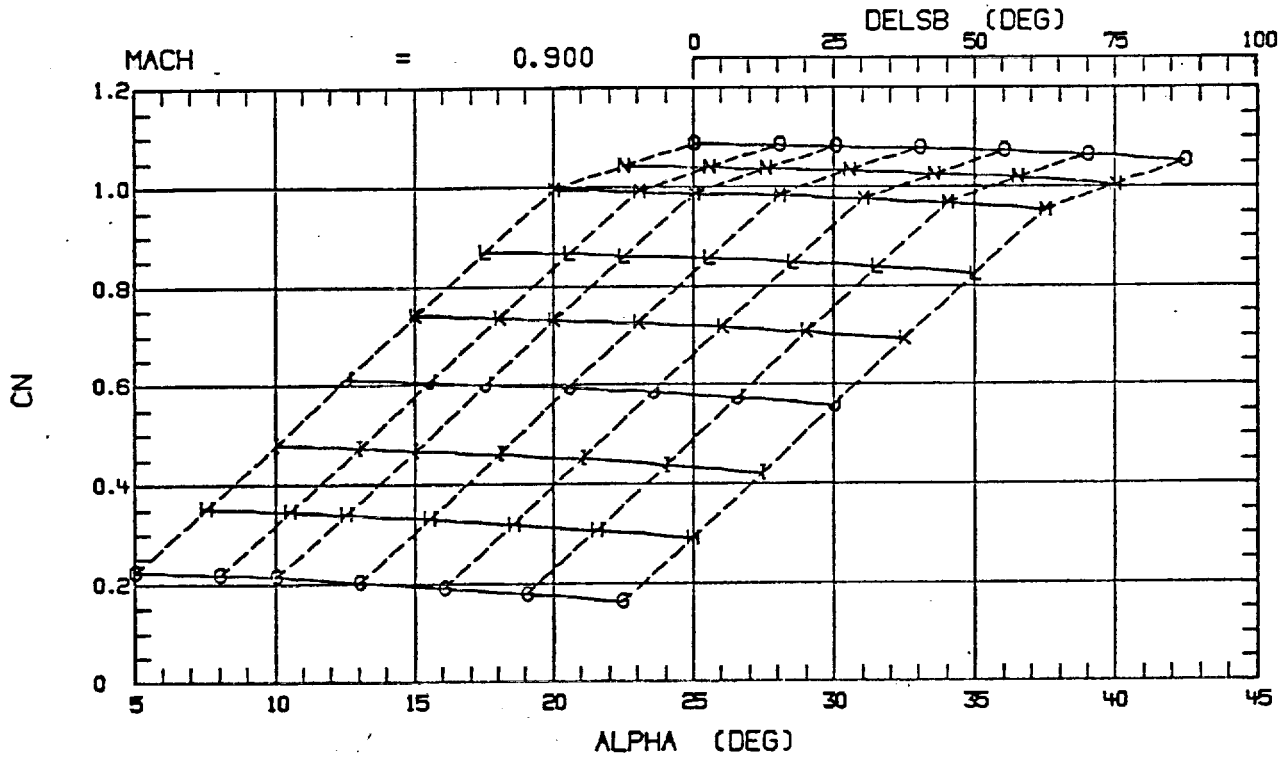
FIGURE 4.1.1.1-11
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.22214	0.34894	0.47874	0.61081	0.73992	0.86904	0.99318	1.04236	1.08657
15.000	0.21719	0.34339	0.47267	0.60531	0.73497	0.86462	0.98926	1.03891	1.08356
25.000	0.21200	0.33800	0.46700	0.60000	0.73000	0.86001	0.98500	1.03500	1.08000
40.000	0.20106	0.32855	0.45901	0.59316	0.72425	0.85524	0.98117	1.03199	1.07773
55.000	0.18916	0.31774	0.44933	0.58408	0.71570	0.84717	0.97348	1.02464	1.07084
70.000	0.17699	0.30555	0.43699	0.57265	0.70521	0.83766	0.96498	1.01717	1.06423
87.200	0.16093	0.29925	0.42047	0.55689	0.69012	0.82313	0.95091	1.00347	1.05079

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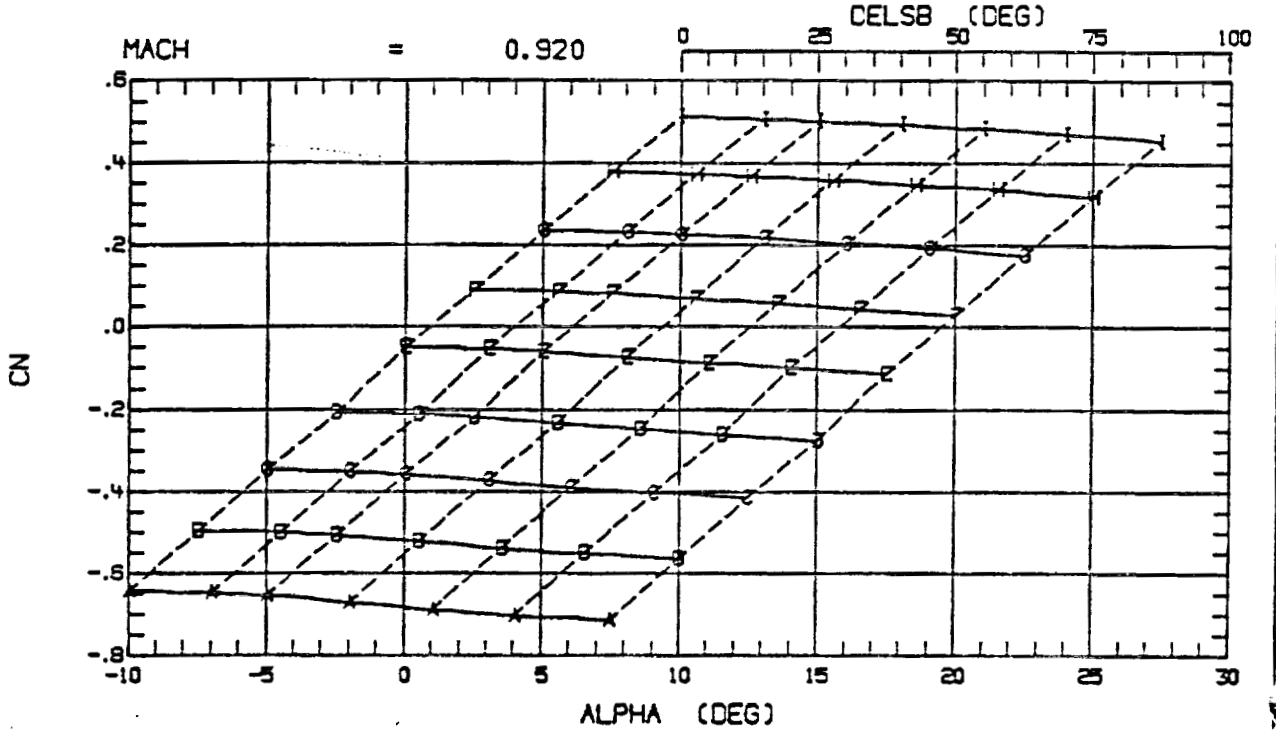
FIGURE 4.1.1.1-12
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.84425	-0.49639	-0.34958	-0.20978	-0.05000	0.08993	0.23490	0.37578	0.51166
15.000	-0.84861	-0.50070	-0.35386	-0.21402	-0.05418	0.08540	0.23001	0.37027	0.50558
25.000	-0.85500	-0.50697	-0.36000	-0.22000	-0.06000	0.08000	0.22500	0.36500	0.50000
40.000	-0.87127	-0.52261	-0.37497	-0.23427	-0.07385	0.06844	0.21542	0.35610	0.49177
55.000	-0.88990	-0.53999	-0.39119	-0.24945	-0.08780	0.05540	0.20350	0.34515	0.48175
70.000	-0.70258	-0.55253	-0.40386	-0.26200	-0.10030	0.04251	0.19047	0.33234	0.46916
87.200	-0.71458	-0.55524	-0.41715	-0.27627	-0.11560	0.02540	0.17329	0.31532	0.45222

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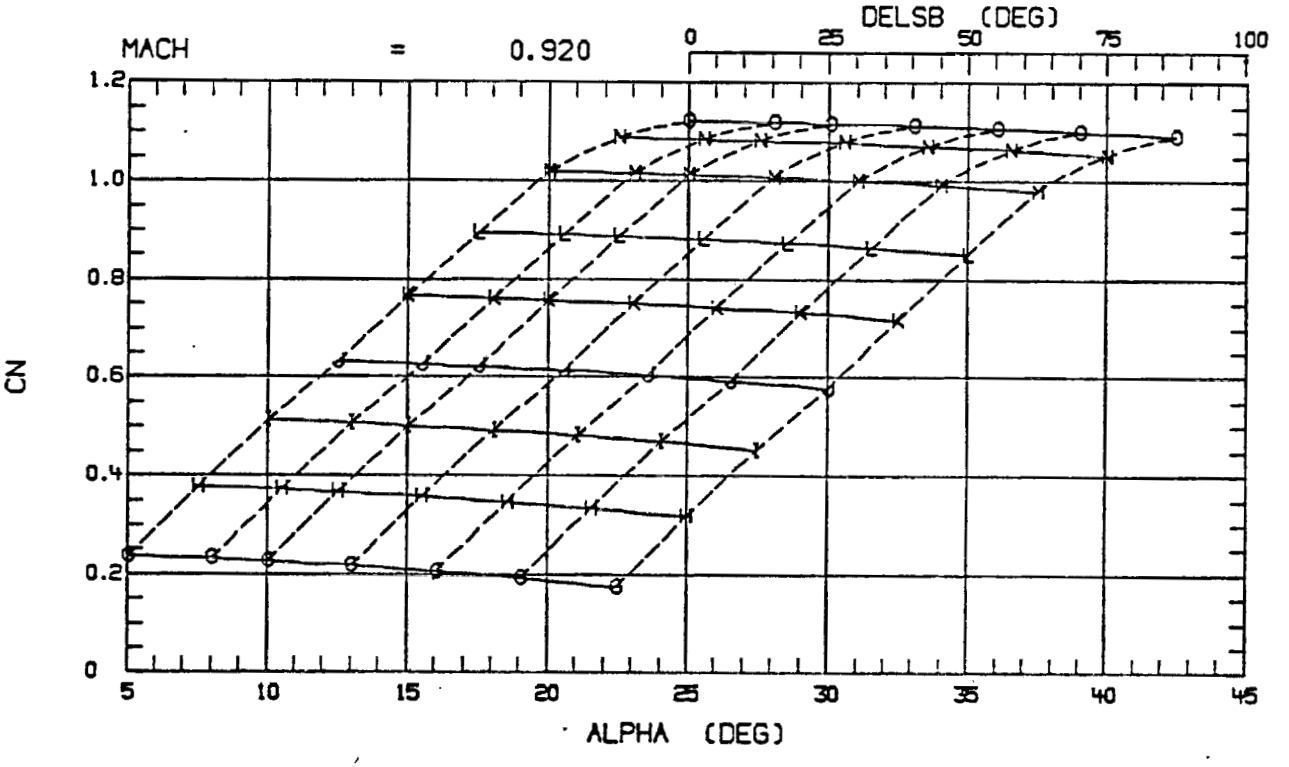
FIGURE 4.1.1.1-13
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.23490	0.37578	0.51166	0.63070	0.76475	0.89383	1.01793	1.08707	1.12125
15.000	0.23001	0.37027	0.50558	0.62511	0.75964	0.88917	1.01372	1.08329	1.11789
25.000	0.22500	0.36500	0.50000	0.62000	0.75500	0.88500	1.01000	1.08000	1.11500
40.000	0.21542	0.35610	0.49177	0.61295	0.74903	0.88004	1.00595	1.07676	1.11247
55.000	0.20360	0.34515	0.48175	0.60371	0.74050	0.87211	0.99858	1.06984	1.10592
70.000	0.19047	0.33234	0.46916	0.59228	0.73023	0.86300	0.99060	1.06297	1.10017
87.200	0.17329	0.31532	0.45222	0.57668	0.71589	0.84982	0.97848	1.05182	1.08985

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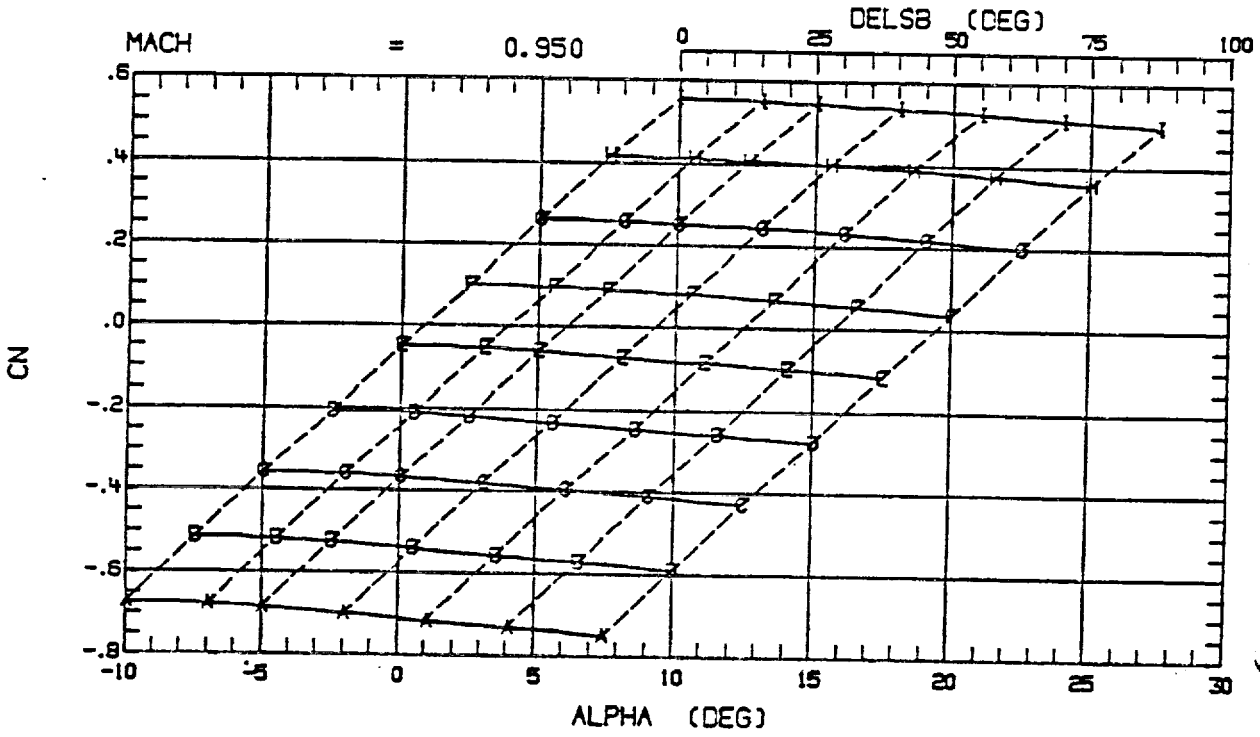
FIGURE 4.1.1.1-14
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.67402	-0.51623	-0.35952	-0.20976	-0.05000	0.09977	0.25954	0.41554	0.55653
15.000	-0.67792	-0.52006	-0.36329	-0.21351	-0.05370	0.09650	0.25474	0.41010	0.55044
25.000	-0.68500	-0.52696	-0.37000	-0.22000	-0.06000	0.09000	0.25000	0.40500	0.54500
40.000	-0.70066	-0.54209	-0.38460	-0.23406	-0.07353	0.07948	0.24244	0.39691	0.53639
55.000	-0.71711	-0.55774	-0.39957	-0.24847	-0.08750	0.06665	0.23075	0.38576	0.52587
70.000	-0.73162	-0.57173	-0.41305	-0.26145	-0.10000	0.05312	0.21617	0.37203	0.51291
87.200	-0.75129	-0.59046	-0.43094	-0.27860	-0.11650	0.03545	0.19733	0.35394	0.49535

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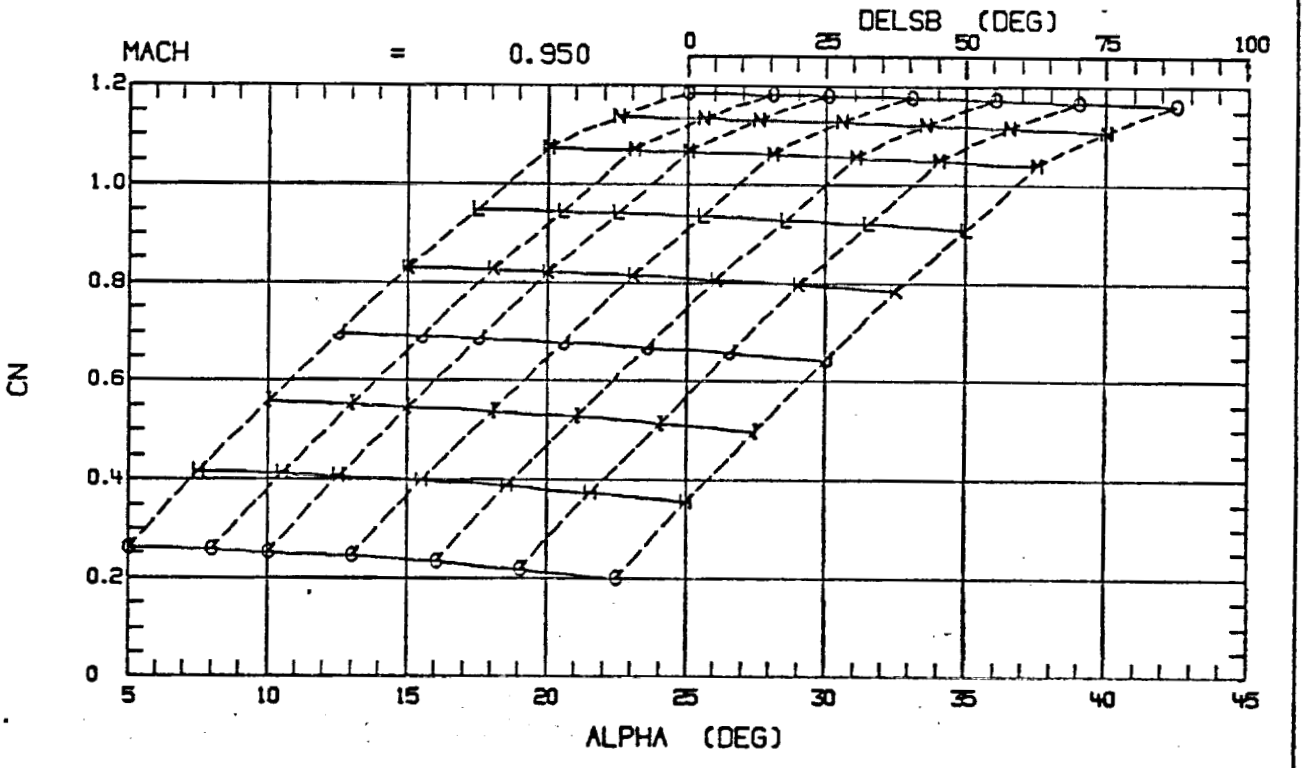
FIGURE 4.1.1.1-15
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.25954	0.41554	0.55653	0.69552	0.82951	0.94853	1.07256	1.13663	1.18577
15.000	0.25474	0.41010	0.55044	0.68979	0.82414	0.94351	1.06791	1.13237	1.18187
25.000	0.25000	0.40500	0.54500	0.68500	0.82000	0.94000	1.06500	1.13000	1.18000
40.000	0.24244	0.39691	0.53639	0.67761	0.81372	0.93474	1.06063	1.12641	1.17708
55.000	0.23075	0.38576	0.52587	0.66814	0.80521	0.92707	1.05372	1.12014	1.17135
70.000	0.21617	0.37203	0.51291	0.65670	0.79525	0.91853	1.04652	1.11421	1.16660
87.200	0.19733	0.35394	0.49535	0.64136	0.78205	0.90738	1.03732	1.10684	1.16095

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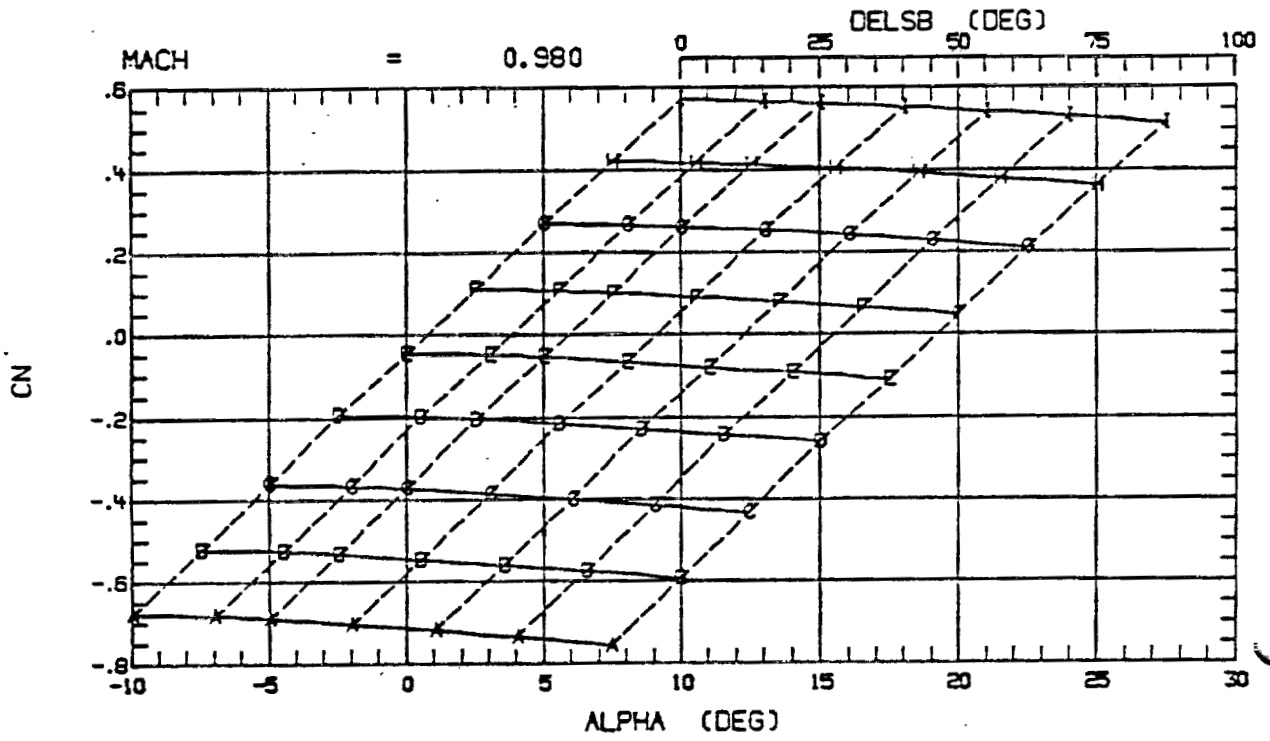
FIGURE 4.1.1.1-16
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.568 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.67900	-0.52130	-0.38453	-0.19478	-0.04500	0.10979	0.25966	0.42053	0.57148
15.000	-0.68295	-0.52517	-0.38835	-0.19858	-0.04877	0.10540	0.25463	0.41499	0.56533
25.000	-0.69000	-0.53203	-0.37500	-0.20500	-0.05500	0.10000	0.25000	0.41000	0.56000
40.000	-0.70478	-0.54634	-0.38885	-0.21638	-0.06794	0.08989	0.25267	0.40208	0.55151
55.000	-0.71966	-0.56074	-0.40299	-0.23206	-0.08137	0.07749	0.24130	0.39119	0.54118
70.000	-0.73508	-0.57536	-0.41671	-0.24519	-0.09382	0.06408	0.22691	0.37777	0.52965
87.200	-0.75601	-0.59493	-0.43504	-0.26241	-0.11003	0.04667	0.20829	0.35987	0.51125

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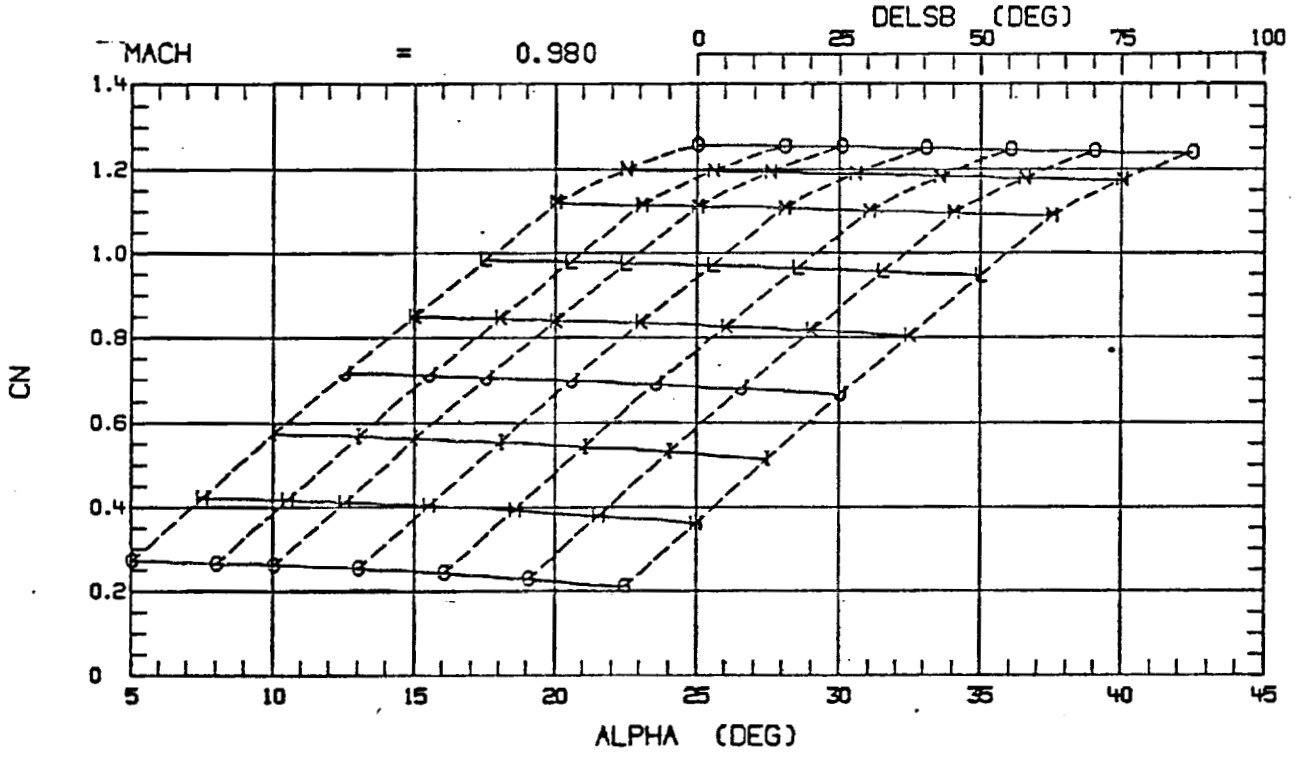
FIGURE 4.1.1.1-17
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.26966	0.42053	0.57148	0.71551	0.84953	0.98359	1.11767	1.19680	1.25595
15.000	0.26463	0.41499	0.56533	0.70963	0.84395	0.97835	1.11278	1.19232	1.25187
25.000	0.26000	0.41000	0.56000	0.70500	0.83999	0.97500	1.11000	1.19000	1.25000
40.000	0.25267	0.40208	0.55151	0.69774	0.83386	0.96990	1.10582	1.18663	1.24731
55.000	0.24130	0.39119	0.54118	0.68854	0.82572	0.96268	1.09943	1.18099	1.24232
70.000	0.22691	0.37777	0.52965	0.67754	0.81616	0.95486	1.09326	1.17624	1.23889
87.200	0.20829	0.35987	0.51126	0.66274	0.80389	0.94502	1.08575	1.17097	1.23574

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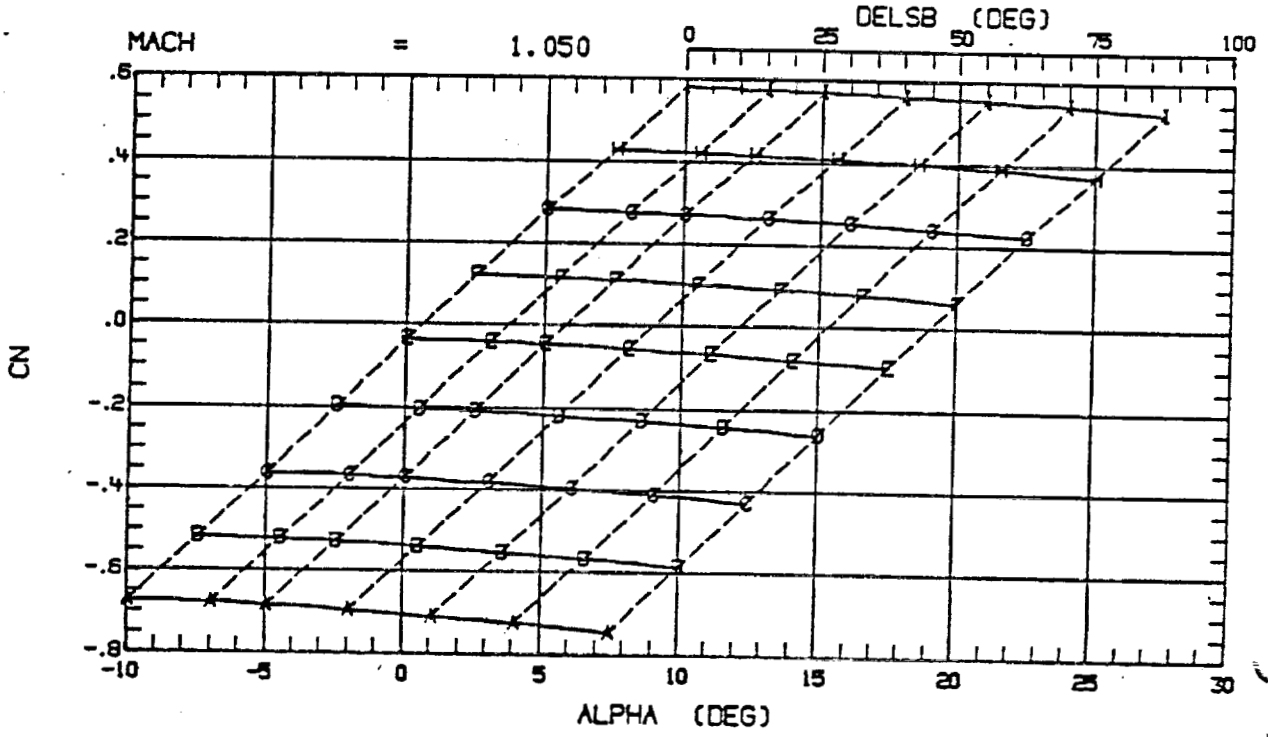
FIGURE 4.1.1.1-18
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.057 FT.
M.A.C. CW = 39.568 FT.
BODY LENGTH LB = 1290.3 IN.

DELSB (DEG)	ALPHA (DEG) -10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
	NORMAL FORCE COEFFICIENT								
0.0	-0.67432	-0.51904	-0.36474	-0.19989	-0.03700	0.11991	0.27980	0.42571	0.58155
15.000	-0.67950	-0.52412	-0.36974	-0.20485	-0.04193	0.11481	0.27458	0.41977	0.57493
25.000	-0.68500	-0.52950	-0.37500	-0.21000	-0.04700	0.11000	0.27000	0.41500	0.57000
40.000	-0.69681	-0.54082	-0.38687	-0.22051	-0.05719	0.10072	0.26159	0.40715	0.56267
55.000	-0.70968	-0.55350	-0.39945	-0.23256	-0.06879	0.08962	0.25097	0.39740	0.55378
70.000	-0.72522	-0.55794	-0.41184	-0.24543	-0.08120	0.07722	0.23954	0.38534	0.54208
87.200	-0.74597	-0.58748	-0.43029	-0.26298	-0.09777	0.05069	0.22199	0.36882	0.52550

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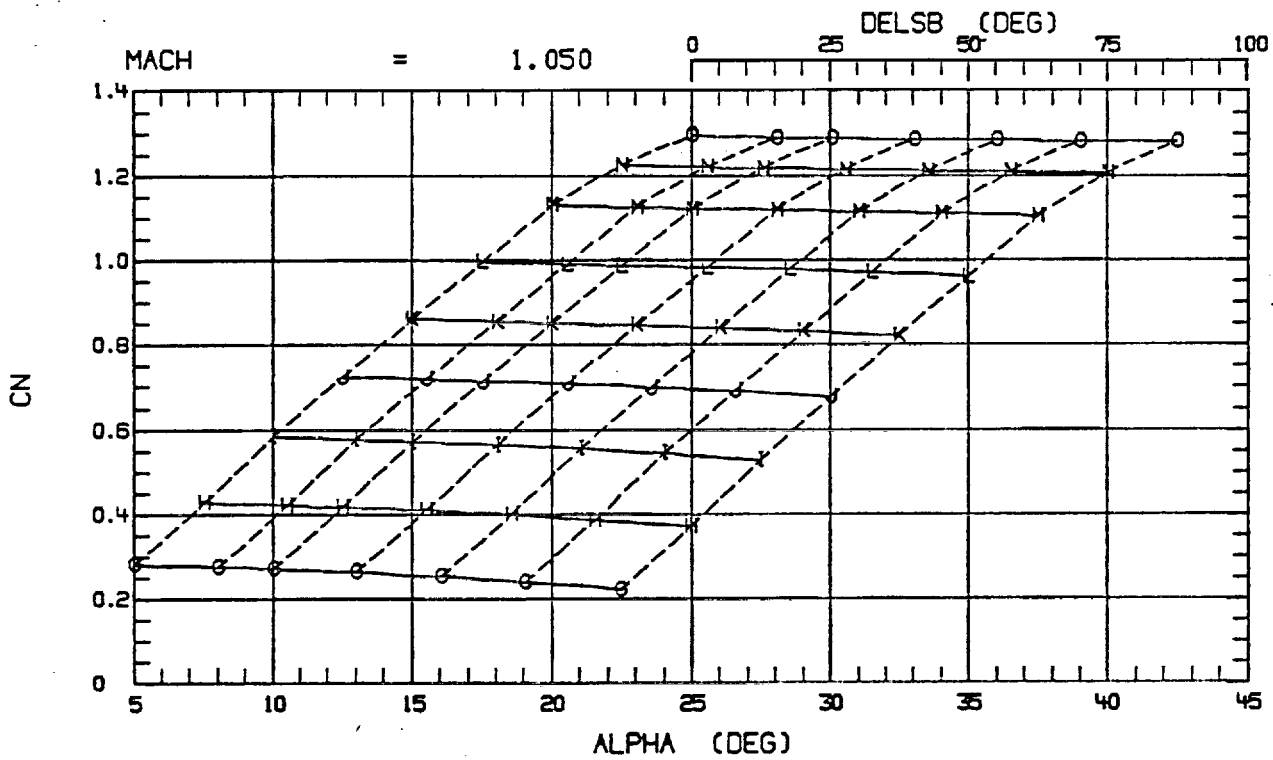
FIGURE 4.1.1.1-19
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.27980	0.42571	0.58155	0.72282	0.86009	0.99435	1.12862	1.22291	1.29219
15.000	0.27458	0.41977	0.57493	0.71640	0.85388	0.98842	1.12297	1.21754	1.28711
25.000	0.27000	0.41500	0.57000	0.71200	0.85000	0.98500	1.12000	1.21500	1.28500
40.000	0.26159	0.40715	0.56267	0.70577	0.84483	0.98082	1.11674	1.21261	1.28338
55.000	0.25097	0.39740	0.55378	0.69815	0.83844	0.97553	1.11270	1.20984	1.28145
70.000	0.23854	0.38534	0.54208	0.68823	0.83024	0.96942	1.10841	1.20706	1.28048
87.200	0.22199	0.36882	0.52560	0.67456	0.81930	0.96098	1.10235	1.20333	1.27895

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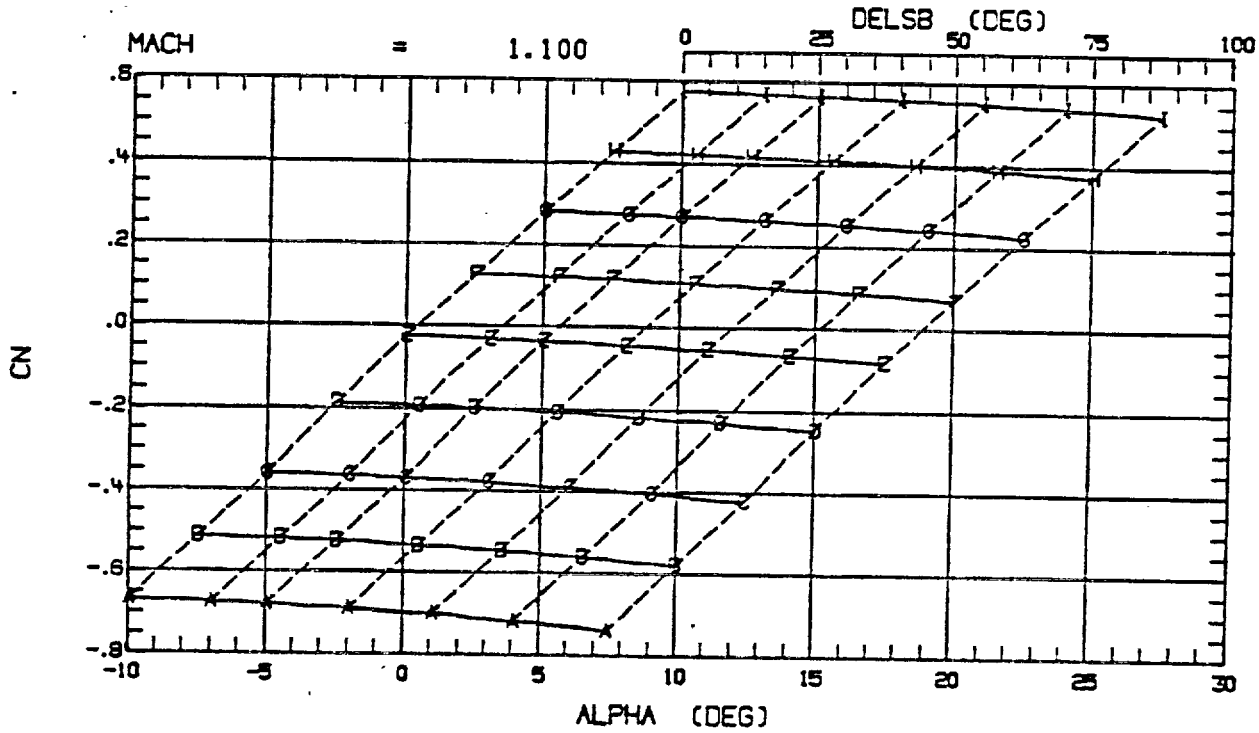
FIGURE 4.1.1.1-20
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.66938	-0.51512	-0.36181	-0.18953	-0.02600	0.12495	0.27968	0.42574	0.57863
15.000	-0.57469	-0.52054	-0.36715	-0.19525	-0.03132	0.11953	0.27457	0.41966	0.58973
25.000	-0.68000	-0.52549	-0.37200	-0.20000	-0.03600	0.11500	0.27000	0.41500	0.58500
40.000	-0.69022	-0.53531	-0.38147	-0.20917	-0.04493	0.10625	0.26138	0.40728	0.55812
55.000	-0.70227	-0.54692	-0.39269	-0.22004	-0.05550	0.09595	0.25133	0.39814	0.54985
70.000	-0.71766	-0.56141	-0.40637	-0.23299	-0.06780	0.08406	0.23979	0.38687	0.53887
87.200	-0.73981	-0.58114	-0.42479	-0.25023	-0.08400	0.06847	0.22474	0.37162	0.52349

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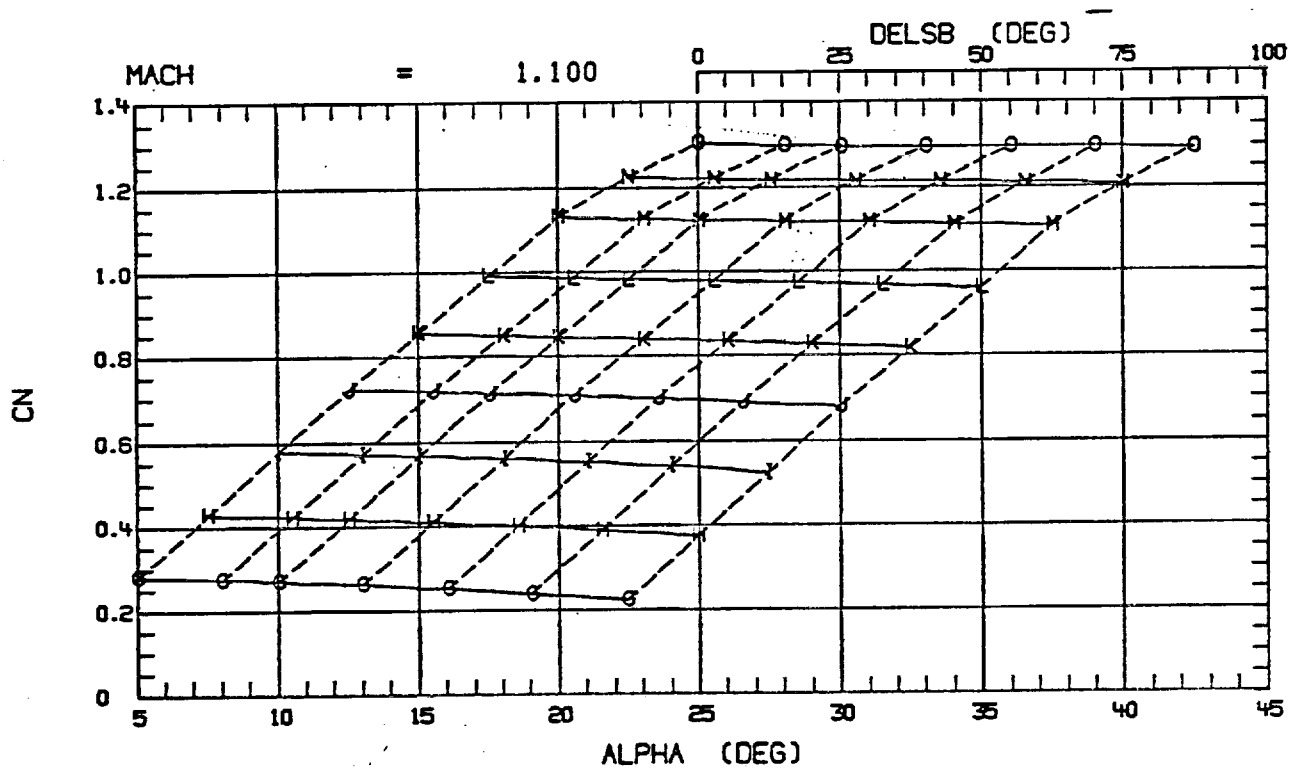
FIGURE 4.1.1.1-21
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.27988	0.42574	0.57653	0.72290	0.86526	0.98963	1.12900	1.22338	1.30277
15.000	0.27457	0.41966	0.56973	0.71633	0.84892	0.98353	1.12314	1.21776	1.29740
25.000	0.27000	0.41500	0.56500	0.71200	0.84500	0.98000	1.11999	1.21500	1.29500
40.000	0.26138	0.40728	0.55812	0.70620	0.84025	0.97625	1.11724	1.21316	1.29408
55.000	0.25133	0.39814	0.54985	0.69931	0.83471	0.97203	1.11428	1.21144	1.29351
70.000	0.23979	0.38687	0.53887	0.69009	0.82720	0.96618	1.11000	1.20866	1.29214
87.200	0.22474	0.37162	0.52349	0.67718	0.81666	0.95791	1.10391	1.20464	1.29005

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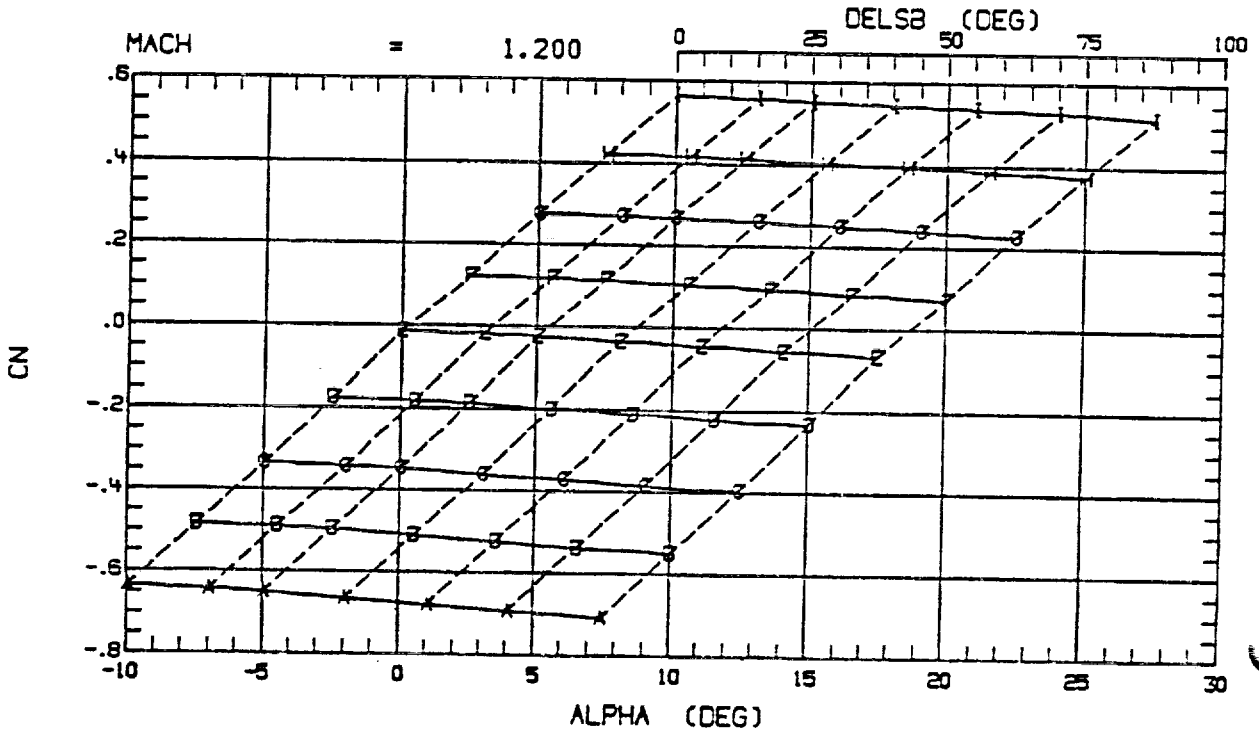
FIGURE 4.1.1.1-22
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.63704	-0.48730	-0.33855	-0.17929	-0.01500	0.12149	0.27456	0.42033	0.56310
15.000	-0.64251	-0.49256	-0.34359	-0.18406	-0.01950	0.11677	0.26959	0.41469	0.55685
25.000	-0.65000	-0.49949	-0.35000	-0.19000	-0.02500	0.11170	0.26500	0.41000	0.55200
40.000	-0.66576	-0.51377	-0.36293	-0.20138	-0.03500	0.10297	0.25731	0.40241	0.54450
55.000	-0.67880	-0.52506	-0.37436	-0.21216	-0.04500	0.09352	0.24850	0.39391	0.53627
70.000	-0.69250	-0.53898	-0.38656	-0.22372	-0.05600	0.08276	0.23791	0.38422	0.52742
87.200	-0.70677	-0.55254	-0.39951	-0.23615	-0.06800	0.07062	0.22558	0.37210	0.51544

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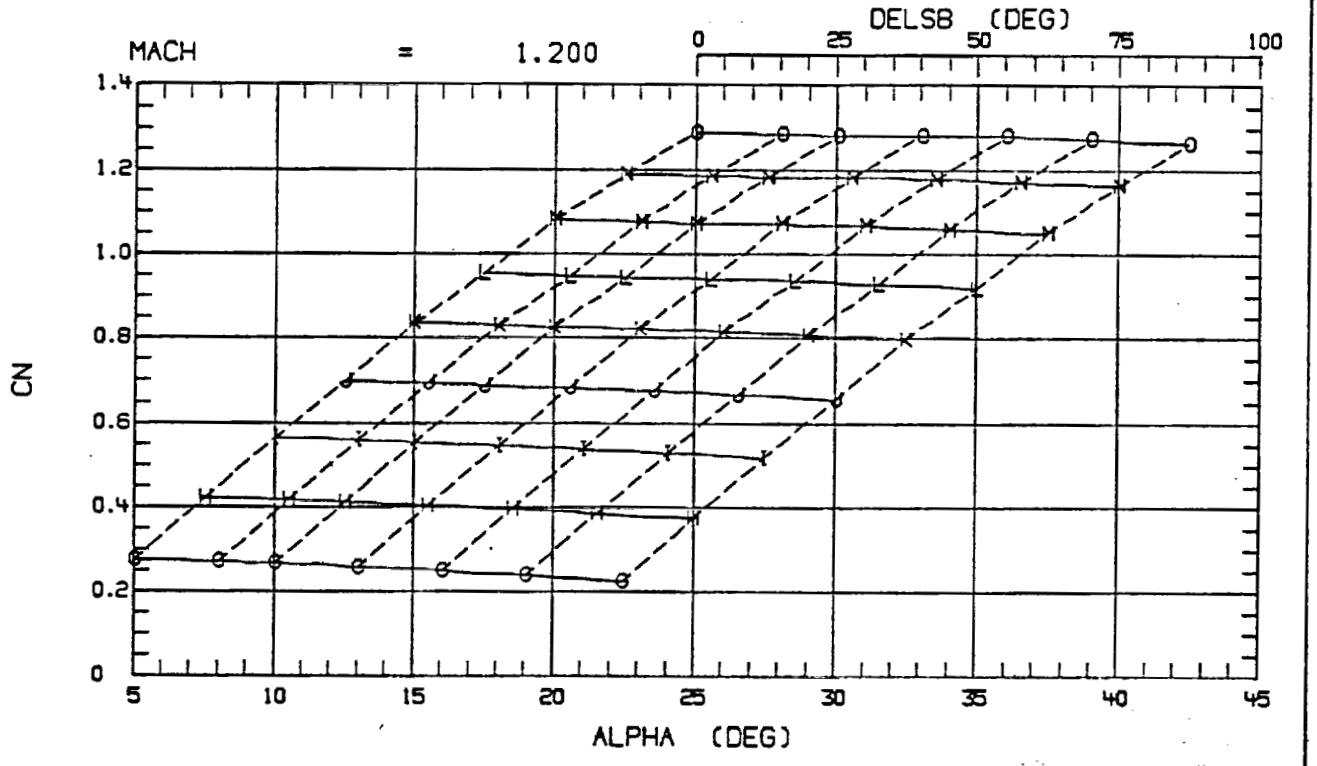
FIGURE 4.1.1.1-23
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.27456	0.42033	0.56310	0.69746	0.83485	0.95227	1.07875	1.18825	1.28781
15.000	0.26959	0.41469	0.55685	0.69150	0.82919	0.94689	1.07384	1.18339	1.28322
25.000	0.26500	0.41000	0.55200	0.68700	0.82502	0.94300	1.07000	1.17999	1.28000
40.000	0.25731	0.40241	0.54450	0.66082	0.82016	0.93952	1.06790	1.17929	1.28067
55.000	0.24850	0.39391	0.53627	0.67397	0.81459	0.93506	1.06444	1.17665	1.27874
70.000	0.23791	0.38422	0.52742	0.66555	0.80846	0.92712	1.05656	1.16874	1.27067
87.200	0.22558	0.37210	0.51544	0.65443	0.79613	0.91751	1.04759	1.16033	1.26275

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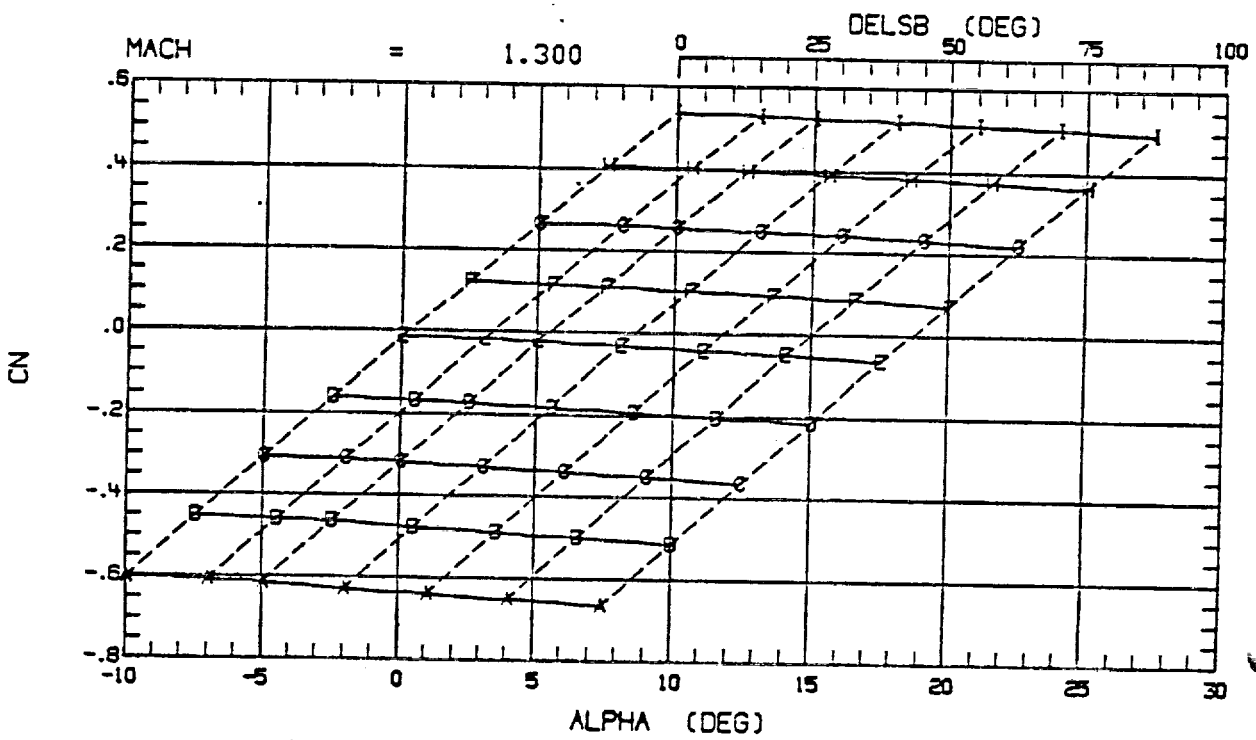
FIGURE 4.1.1.1-24
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.60317	-0.45558	-0.30901	-0.16449	-0.01300	0.11950	0.26401	0.40457	0.53515
15.000	-0.60892	-0.46133	-0.31469	-0.16989	-0.01825	0.11471	0.25984	0.39963	0.52968
25.000	-0.61500	-0.46700	-0.32000	-0.17500	-0.02300	0.11000	0.25500	0.39500	0.52500
40.000	-0.62885	-0.47961	-0.33139	-0.18521	-0.03208	0.10202	0.24607	0.38824	0.51837
55.000	-0.64086	-0.49105	-0.34226	-0.19548	-0.04175	0.09324	0.24010	0.38059	0.51095
70.000	-0.65250	-0.50219	-0.35291	-0.20567	-0.05149	0.08355	0.23042	0.37182	0.50307
87.200	-0.66613	-0.51521	-0.36540	-0.21750	-0.06273	0.07196	0.21846	0.36029	0.49185

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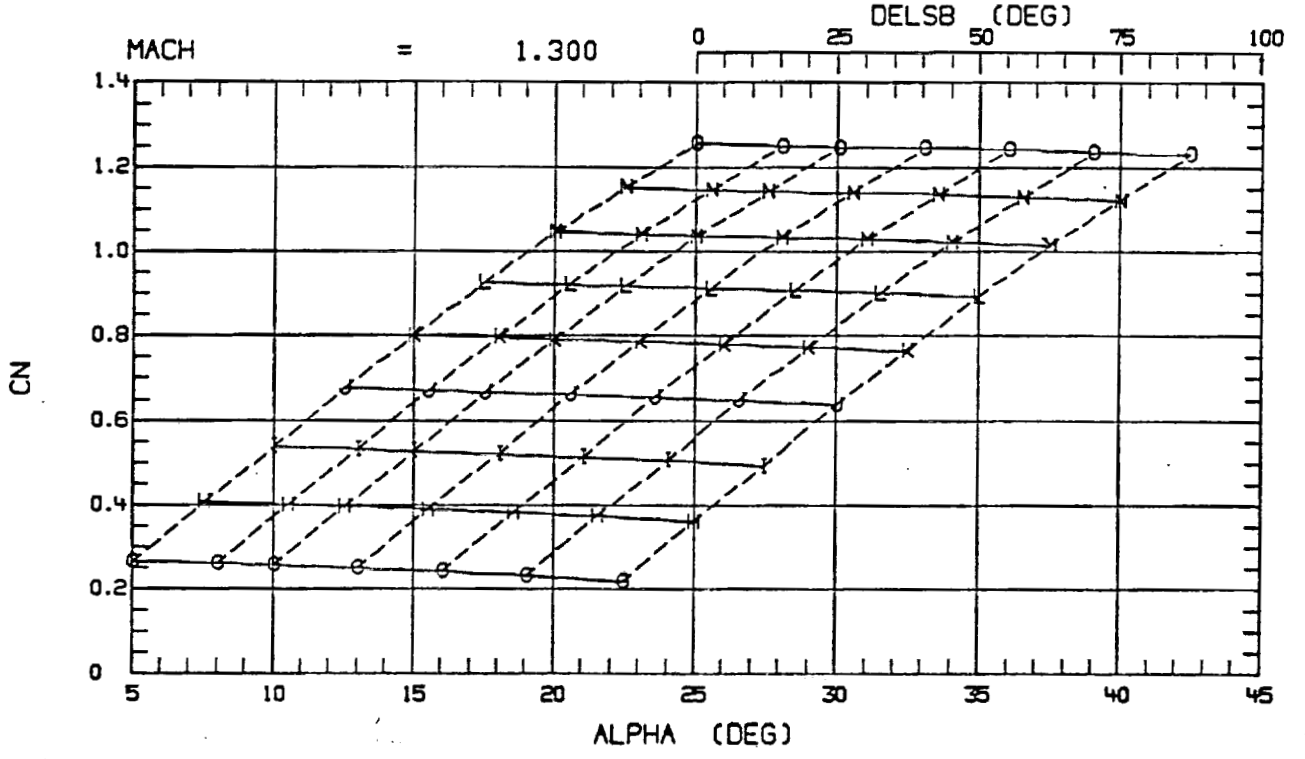
FIGURE 4.1.1.1-25
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.26401	0.40457	0.53515	0.67502	0.79992	0.92483	1.04478	1.14975	1.25475
15.000	0.25984	0.39963	0.52968	0.66948	0.79431	0.91914	1.03901	1.14388	1.24878
25.000	0.25500	0.39500	0.52500	0.66500	0.79000	0.91500	1.03500	1.14000	1.24498
40.000	0.24807	0.38824	0.51837	0.65914	0.78493	0.91073	1.03154	1.13738	1.24322
55.000	0.24010	0.38059	0.51095	0.65281	0.77962	0.90634	1.02801	1.13460	1.24111
70.000	0.23042	0.37182	0.50307	0.64531	0.77241	0.89933	1.02109	1.12771	1.23413
87.200	0.21846	0.36029	0.49185	0.63512	0.76316	0.89097	1.01355	1.12084	1.22786

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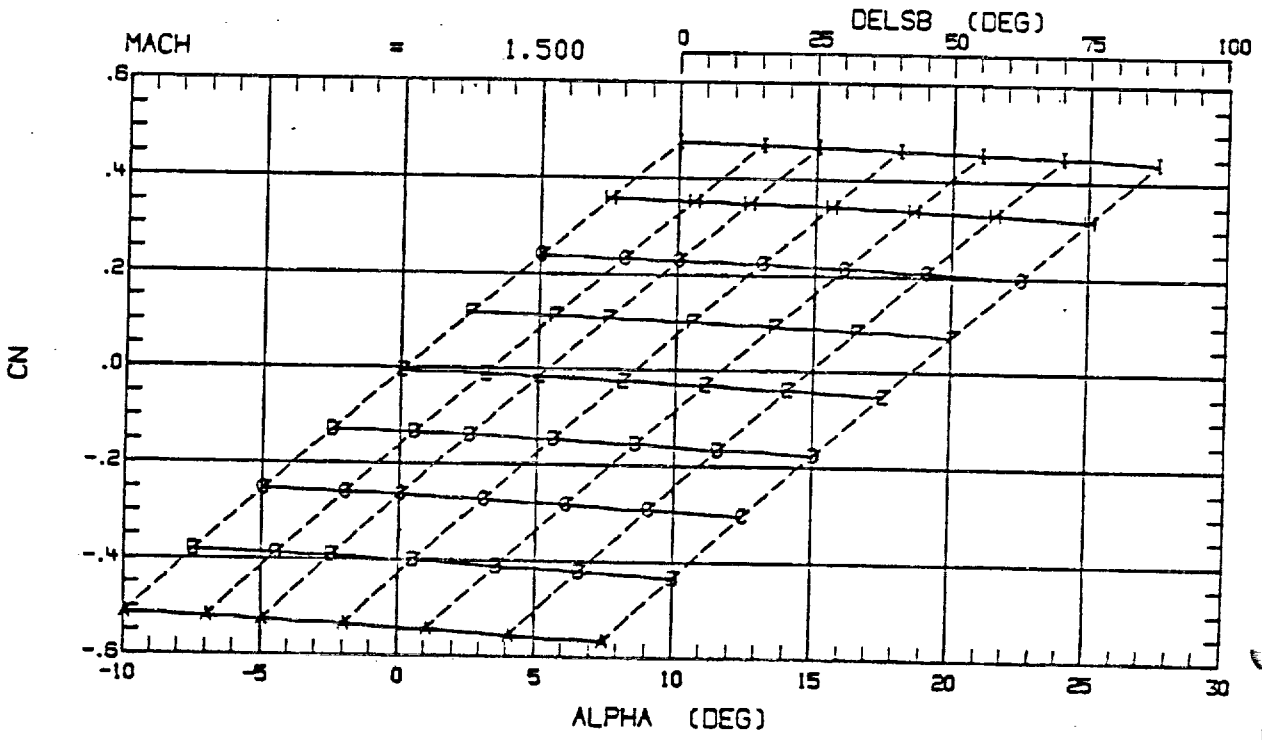
FIGURE 4.1.1.1-26
BASIC NORMAL FORCE COEFFICIENT



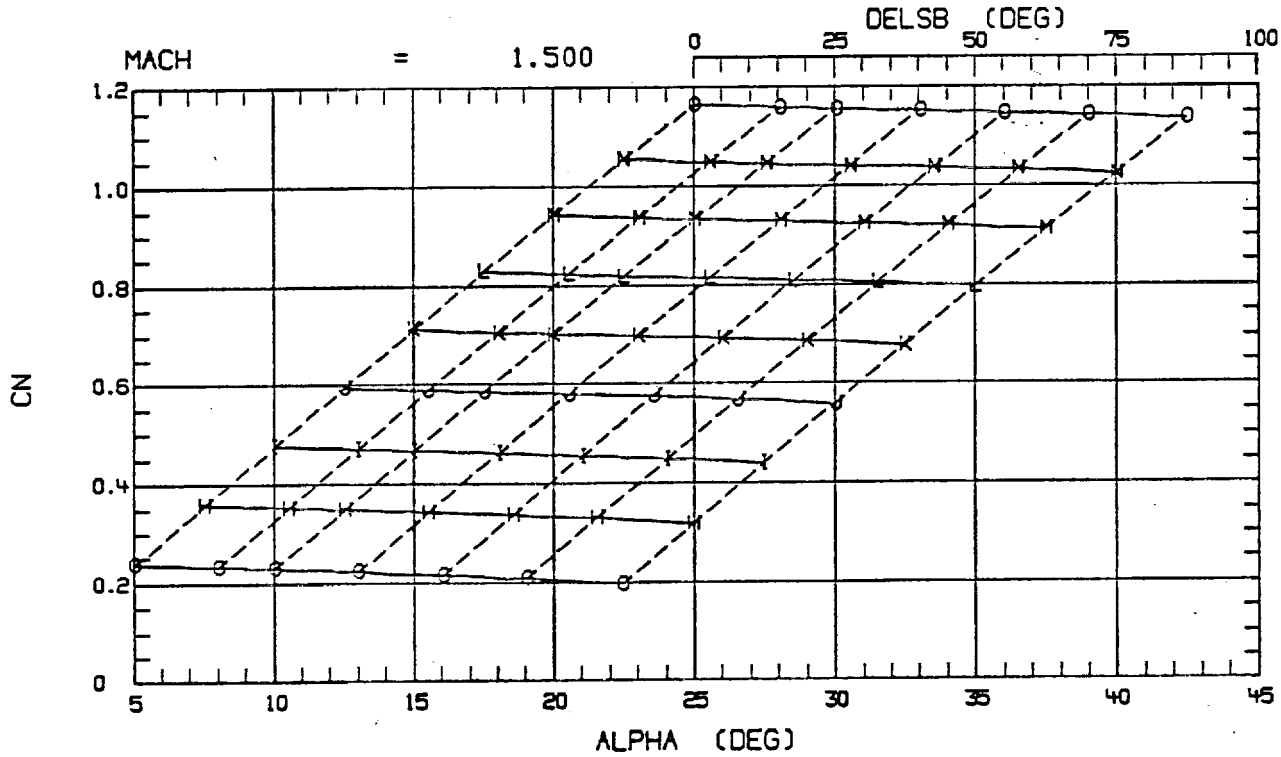
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.51573	-0.38380	-0.25557	-0.13010	-0.00684	0.11535	0.23625	0.35629	0.47551
15.000	-0.52194	-0.38937	-0.25075	-0.13507	-0.01154	0.11039	0.23111	0.35089	0.46982
25.000	-0.52710	-0.39441	-0.25553	-0.13956	-0.01577	0.10637	0.22730	0.34723	0.46626
40.000	-0.53626	-0.40337	-0.27410	-0.14761	-0.02324	0.09951	0.22099	0.34143	0.46091
55.000	-0.54628	-0.41330	-0.28368	-0.15667	-0.03167	0.09176	0.21394	0.33503	0.45512
70.000	-0.55645	-0.42342	-0.29353	-0.16611	-0.04061	0.08338	0.20612	0.32778	0.44840
87.200	-0.56735	-0.43421	-0.30419	-0.17661	-0.05093	0.07324	0.19618	0.31805	0.43891

ENGINEER
DATE 3-82

FIGURE 4.1.1.1-27
BASIC NORMAL FORCE COEFFICIENT



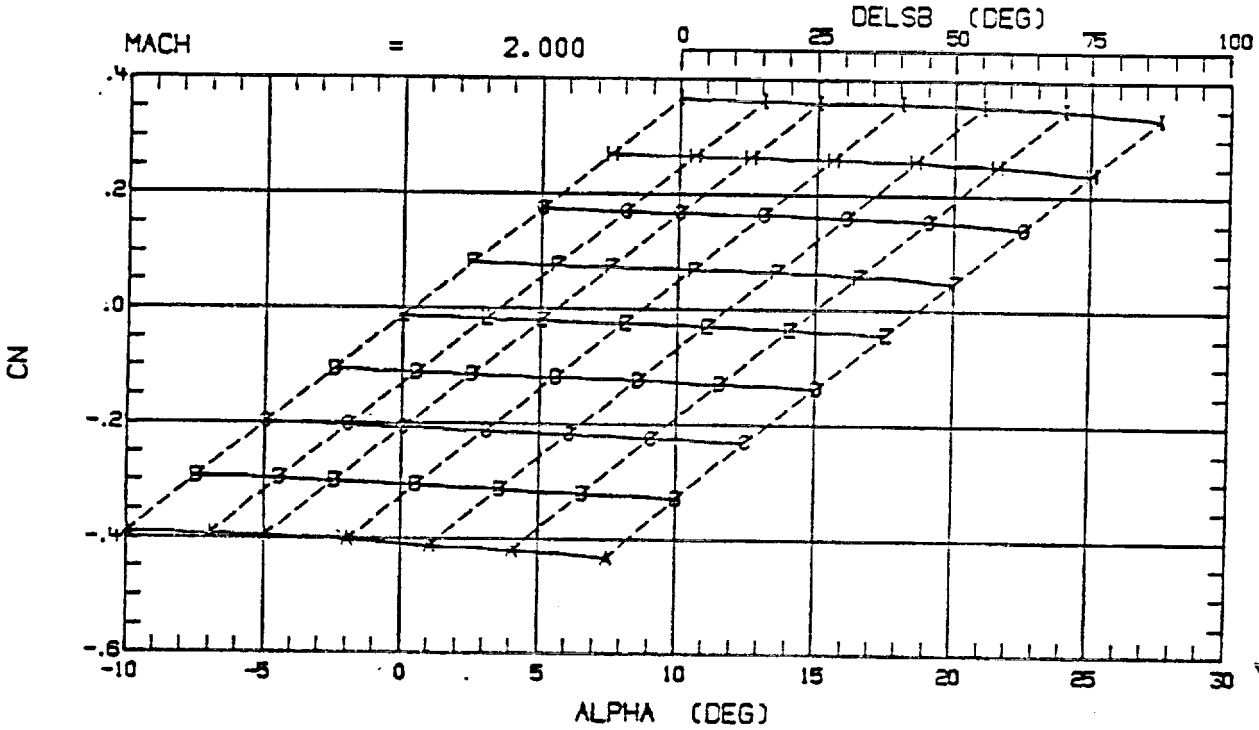
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.23625	0.35628	0.47551	0.59391	0.71129	0.82741	0.94193	1.05444	1.16450
15.000	0.23111	0.35089	0.46982	0.58789	0.70496	0.82082	0.93515	1.04760	1.15772
25.000	0.22730	0.34723	0.46626	0.58439	0.70150	0.81738	0.93172	1.04418	1.15435
40.000	0.22099	0.34143	0.46091	0.57942	0.69683	0.81293	0.92744	1.04002	1.15027
55.000	0.21394	0.33503	0.45512	0.57416	0.69202	0.80850	0.92331	1.03612	1.14655
70.000	0.20612	0.32778	0.44840	0.56793	0.68624	0.80312	0.91830	1.03144	1.14217
87.200	0.19618	0.31805	0.43991	0.55870	0.67733	0.79457	0.91017	1.02381	1.13512

ENGINEER D²
DATE 3-82

FIGURE 4.1.1.1-29
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH LB = 1290.3 IN.	

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.39179	-0.29431	-0.19960	-0.10846	-0.01383	0.07913	0.17314	0.25874	0.38633
15.000	-0.39453	-0.29908	-0.20524	-0.11221	-0.01929	0.07410	0.16848	0.25427	0.35177
25.000	-0.39799	-0.30298	-0.20896	-0.11559	-0.02223	0.07164	0.16842	0.25250	0.35016
40.000	-0.40506	-0.30924	-0.21453	-0.12036	-0.02623	0.06833	0.16571	0.25027	0.35829
55.000	-0.41368	-0.31609	-0.22018	-0.12521	-0.03055	0.06437	0.16002	0.25583	0.35511
70.000	-0.42307	-0.32309	-0.22598	-0.13063	-0.03608	0.05848	0.15374	0.25026	0.34846
87.200	-0.43377	-0.33083	-0.23292	-0.13819	-0.04508	0.04773	0.14129	0.23842	0.33575

ENGINEER D²
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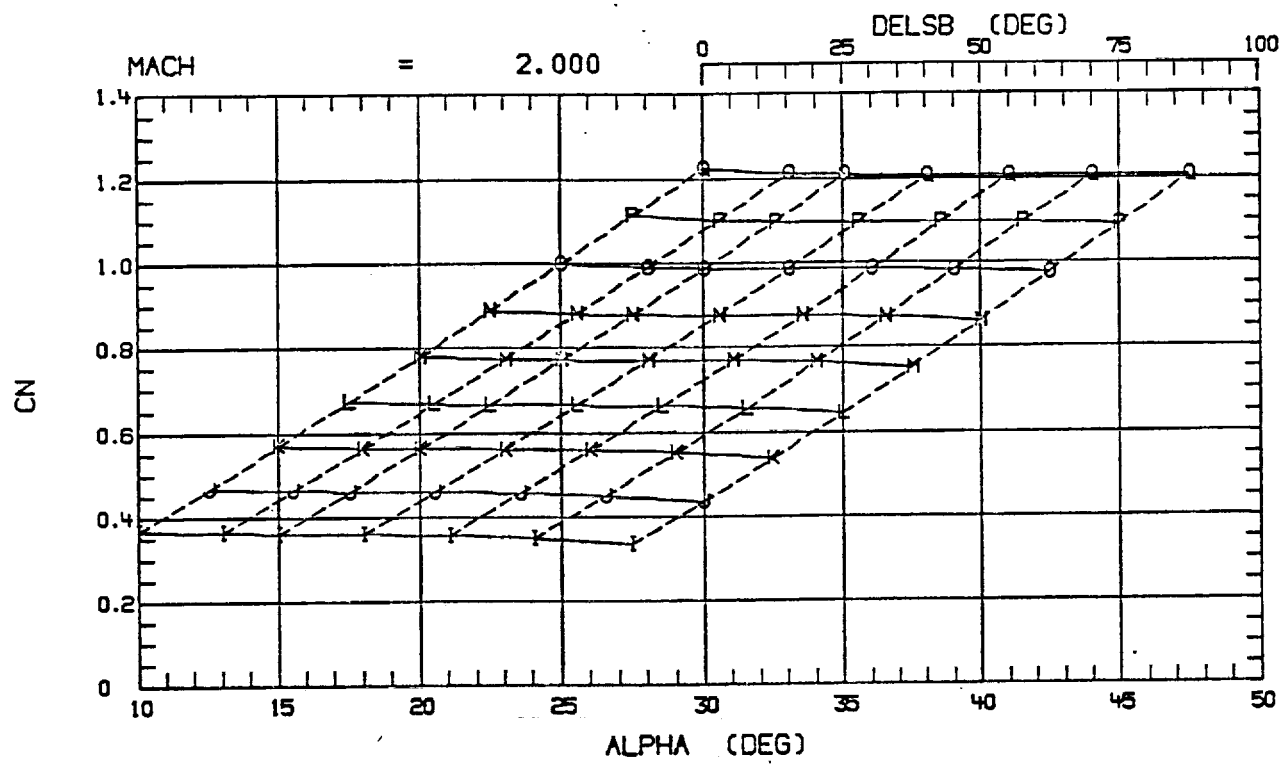
FIGURE 4.1.1.1-28
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.38633	0.46617	0.56837	0.67292	0.77971	0.88949	0.99891	1.11050	1.22276
15.000	0.36177	0.46122	0.56274	0.66636	0.77203	0.87961	0.98884	1.09937	1.21078
25.000	0.36016	0.45961	0.56099	0.66435	0.76966	0.87681	0.98559	1.09571	1.20678
40.000	0.35829	0.45797	0.55948	0.66287	0.76814	0.87520	0.98386	1.09386	1.20481
55.000	0.35511	0.45511	0.55700	0.66083	0.76660	0.87418	0.98339	1.09392	1.20538
70.000	0.34846	0.44884	0.55097	0.65553	0.76224	0.87096	0.98140	1.09318	1.20584
87.200	0.33375	0.43366	0.53538	0.64192	0.75020	0.86090	0.97322	1.08781	1.20268

ENGINEER DL
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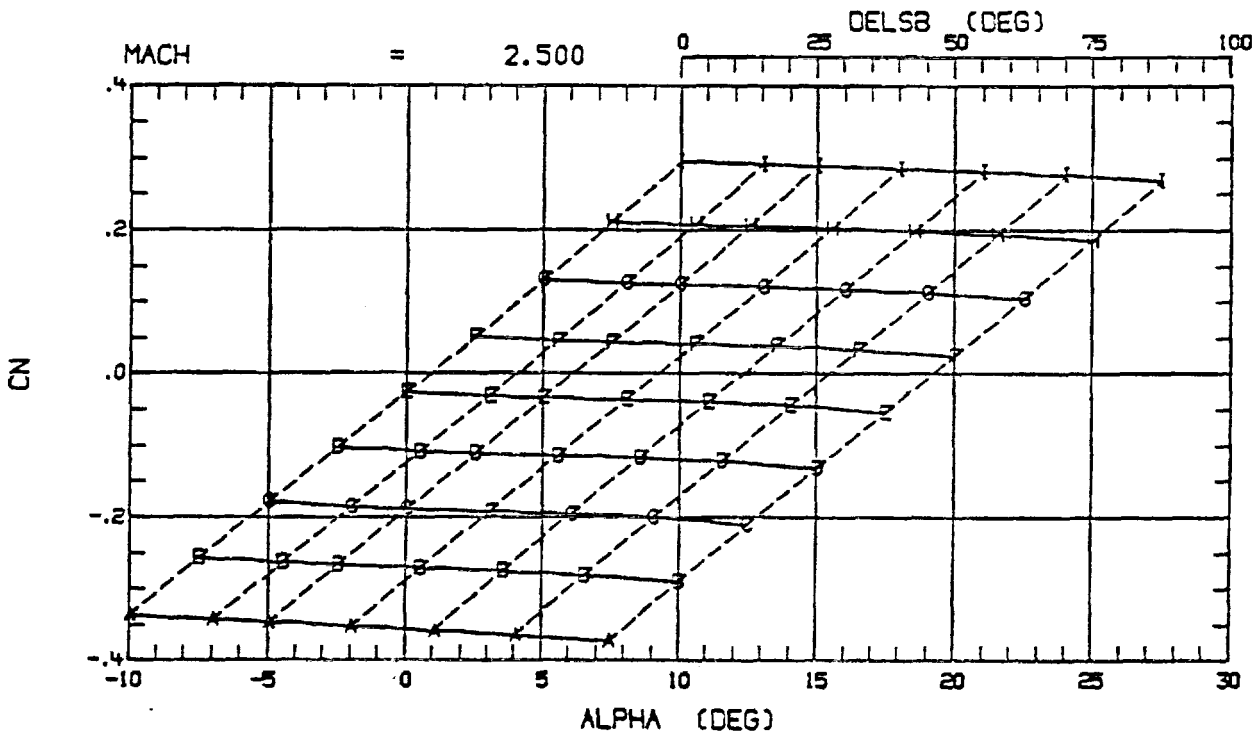
FIGURE 4.1.1.1-30
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-7.500	-5.000	-2.500	0.0	2.500	5.000	7.500	10.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.33763	-0.25727	-0.17942	-0.10298	-0.02657	0.05050	0.12920	0.21027	0.29434
15.000	-0.34279	-0.25390	-0.18634	-0.10936	-0.03226	0.04567	0.12509	0.20660	0.29076
25.000	-0.34650	-0.25731	-0.18937	-0.11204	-0.03464	0.04349	0.12299	0.20446	0.28846
40.000	-0.35242	-0.27168	-0.19276	-0.11488	-0.03728	0.04081	0.12009	0.20120	0.28482
55.000	-0.35869	-0.27614	-0.19619	-0.11725	-0.04019	0.03769	0.11662	0.19736	0.28060
70.000	-0.36525	-0.28177	-0.20127	-0.12289	-0.04498	0.03283	0.11164	0.19225	0.27541
87.200	-0.37306	-0.29103	-0.21122	-0.13277	-0.05481	0.02346	0.10293	0.18404	0.26774

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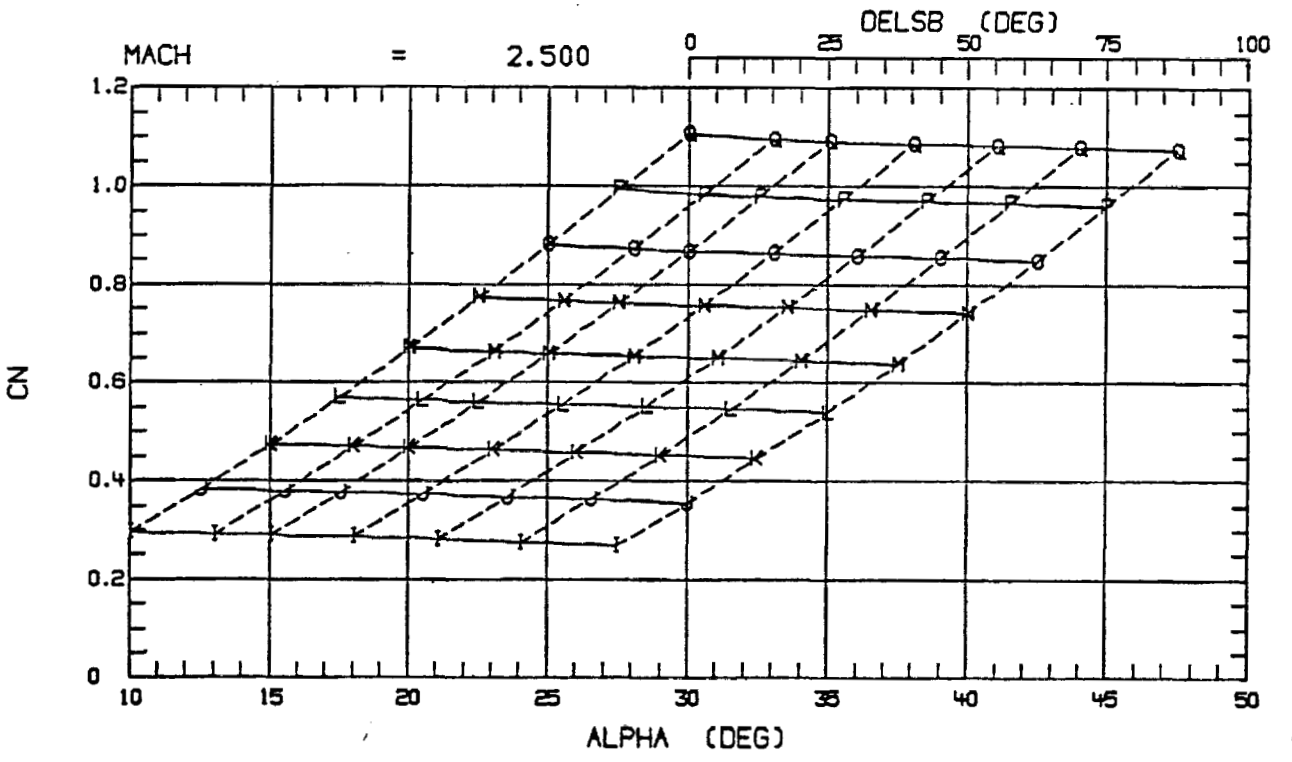
FIGURE 4.1.1.1-31
BASIC NORMAL FORCE COEFFICIENT



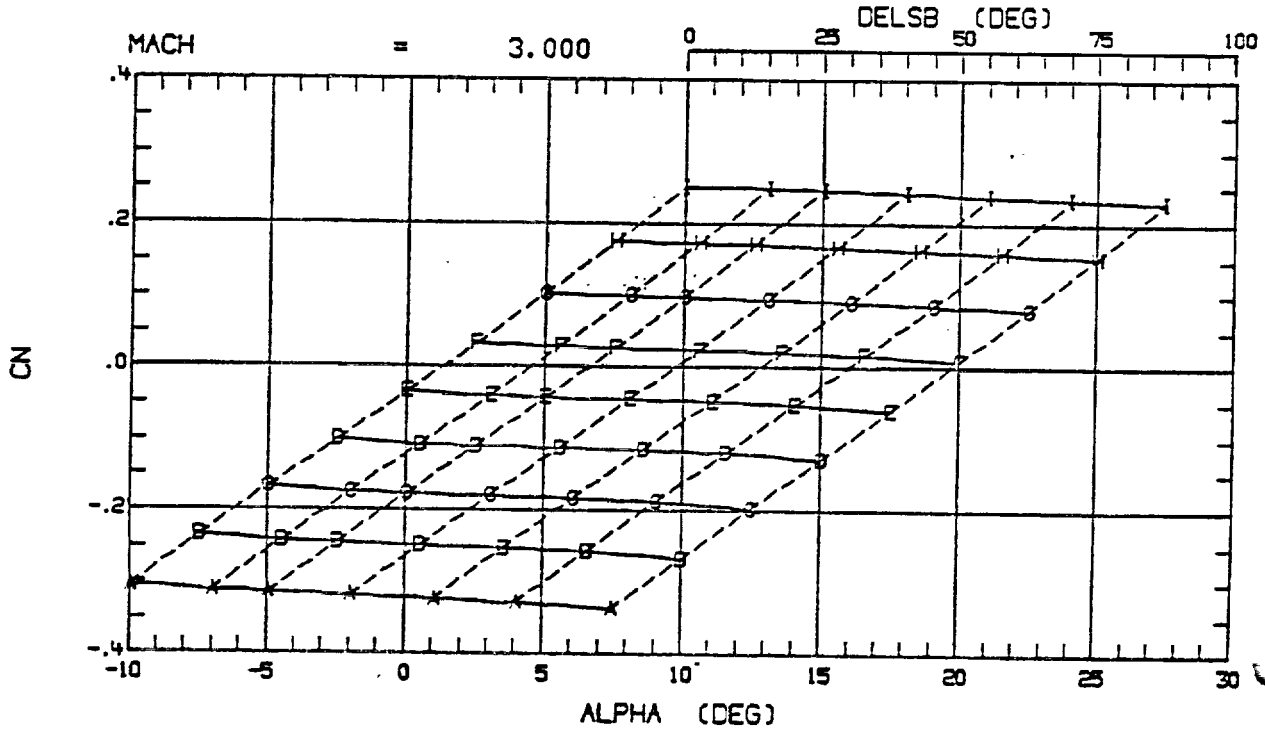
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.29434	0.38191	0.47336	0.56892	0.66866	0.77255	0.88037	0.99179	1.10625
15.000	0.29076	0.37805	0.46832	0.56340	0.66194	0.76450	0.87098	0.98115	1.09462
25.000	0.28846	0.37547	0.46590	0.56006	0.65817	0.76030	0.86640	0.97627	1.08954
40.000	0.28482	0.37142	0.46148	0.55533	0.65320	0.75519	0.86125	0.97121	1.08466
55.000	0.28060	0.36693	0.45681	0.55063	0.64859	0.75081	0.85722	0.96760	1.08154
70.000	0.27541	0.36171	0.45165	0.54561	0.64382	0.74638	0.85320	0.96404	1.07850
87.200	0.26774	0.35451	0.44484	0.53908	0.63750	0.74022	0.84718	0.95819	1.07296

ENGINEER D.
DATE 3-82

FIGURE 4.1.1.1-32
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

DELSB (DEG)	ALPHA (DEG) -10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
	NORMAL FORCE COEFFICIENT								
0.0	-0.30602	-0.23643	-0.16886	-0.10222	-0.03550	0.03226	0.10195	0.17437	0.25020
15.000	-0.31192	-0.24361	-0.17609	-0.10874	-0.04092	0.02503	0.09880	0.17202	0.24830
25.000	-0.31526	-0.24670	-0.17888	-0.11125	-0.04320	0.02593	0.09676	0.16996	0.24611
40.000	-0.31979	-0.25001	-0.18152	-0.11366	-0.04568	0.02315	0.09356	0.16627	0.24192
55.000	-0.32434	-0.25320	-0.18408	-0.11610	-0.04835	0.02003	0.08991	0.16207	0.23725
70.000	-0.32951	-0.25792	-0.18856	-0.12047	-0.05271	0.01565	0.08547	0.15759	0.23275
87.200	-0.33298	-0.26735	-0.19863	-0.13027	-0.06165	0.00789	0.07902	0.15239	0.22966

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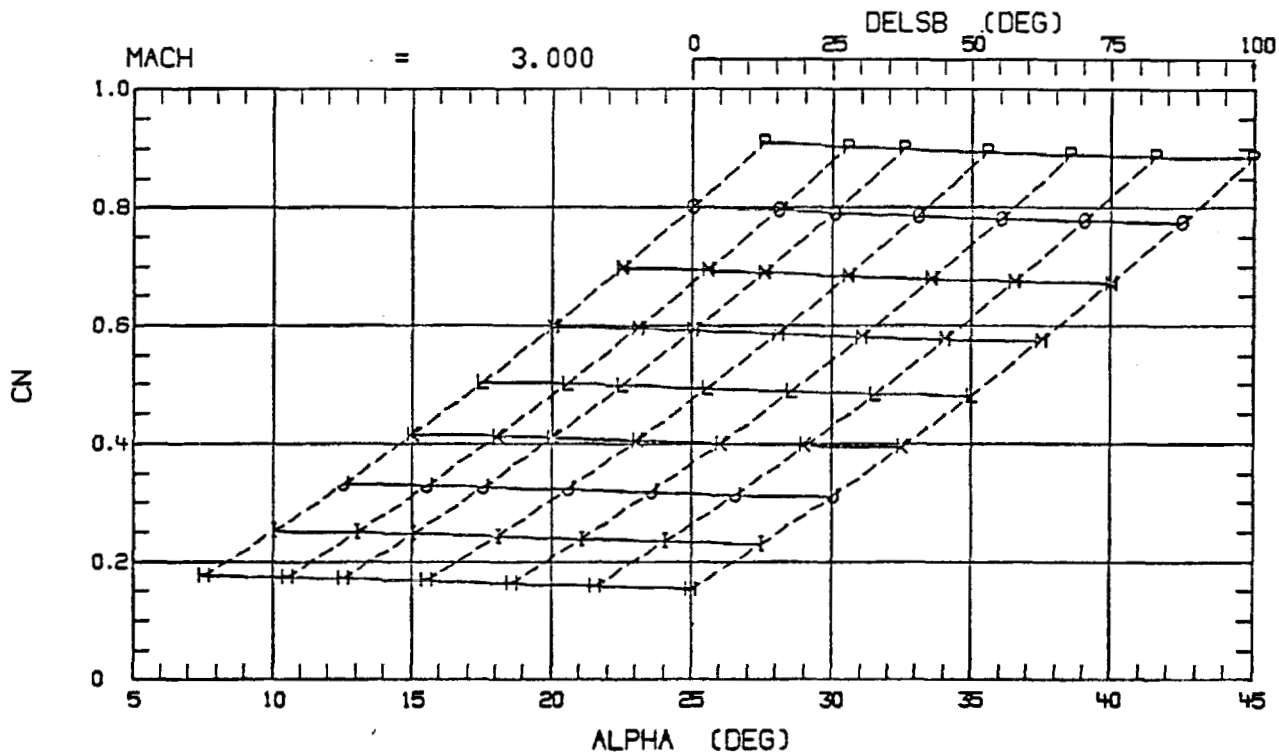
FIGURE 4.1.1.1-33
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.17437	0.25020	0.33003	0.41434	0.50344	0.59754	0.69668	0.80072	0.90936
15.000	0.17202	0.24830	0.32818	0.41214	0.50056	0.59369	0.69168	0.79450	0.90199
25.000	0.16996	0.24611	0.32578	0.40947	0.49756	0.59035	0.68801	0.79054	0.89779
40.000	0.16627	0.24192	0.32114	0.40444	0.49225	0.58487	0.68247	0.78506	0.89247
55.000	0.16207	0.23725	0.31611	0.39917	0.48692	0.57962	0.67744	0.78037	0.88823
70.000	0.15759	0.23275	0.31163	0.39477	0.48263	0.57550	0.67355	0.77675	0.88489
87.200	0.15239	0.22966	0.30941	0.39216	0.48036	0.57333	0.67126	0.77420	0.88200

ENGINEER D²
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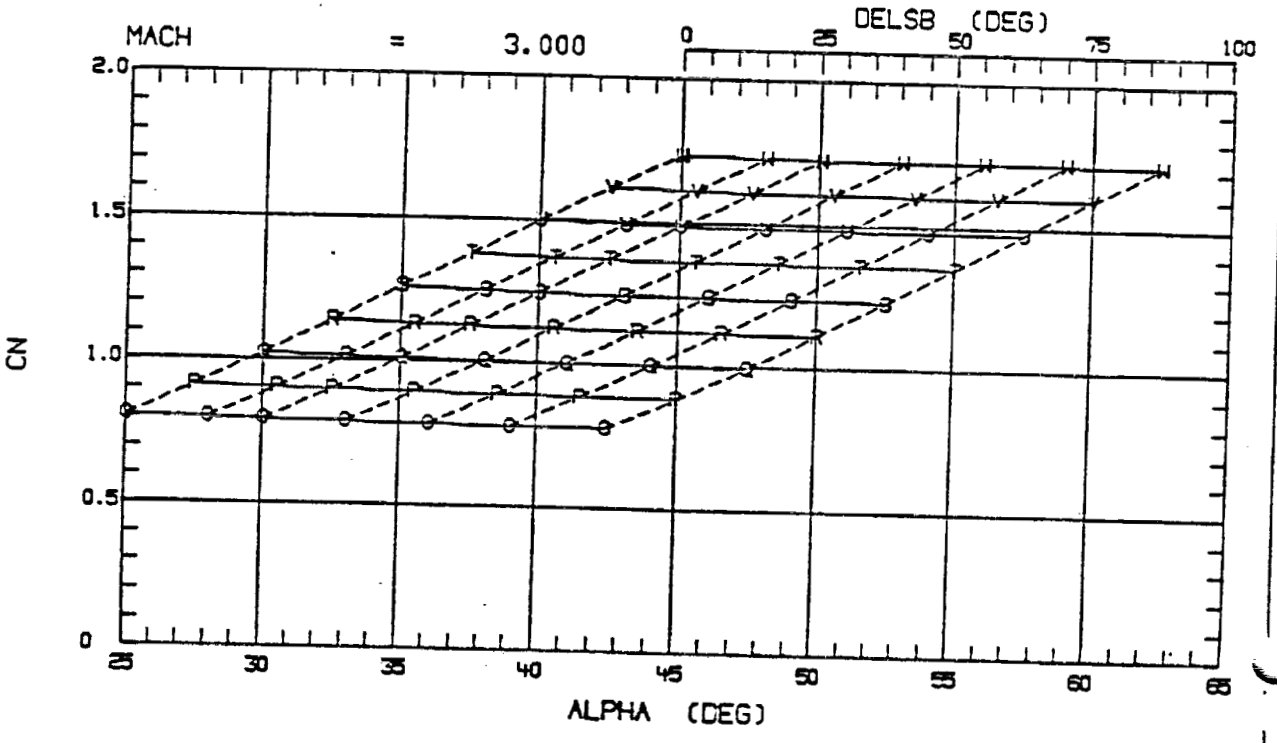
FIGURE 4.1.1.1-34
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

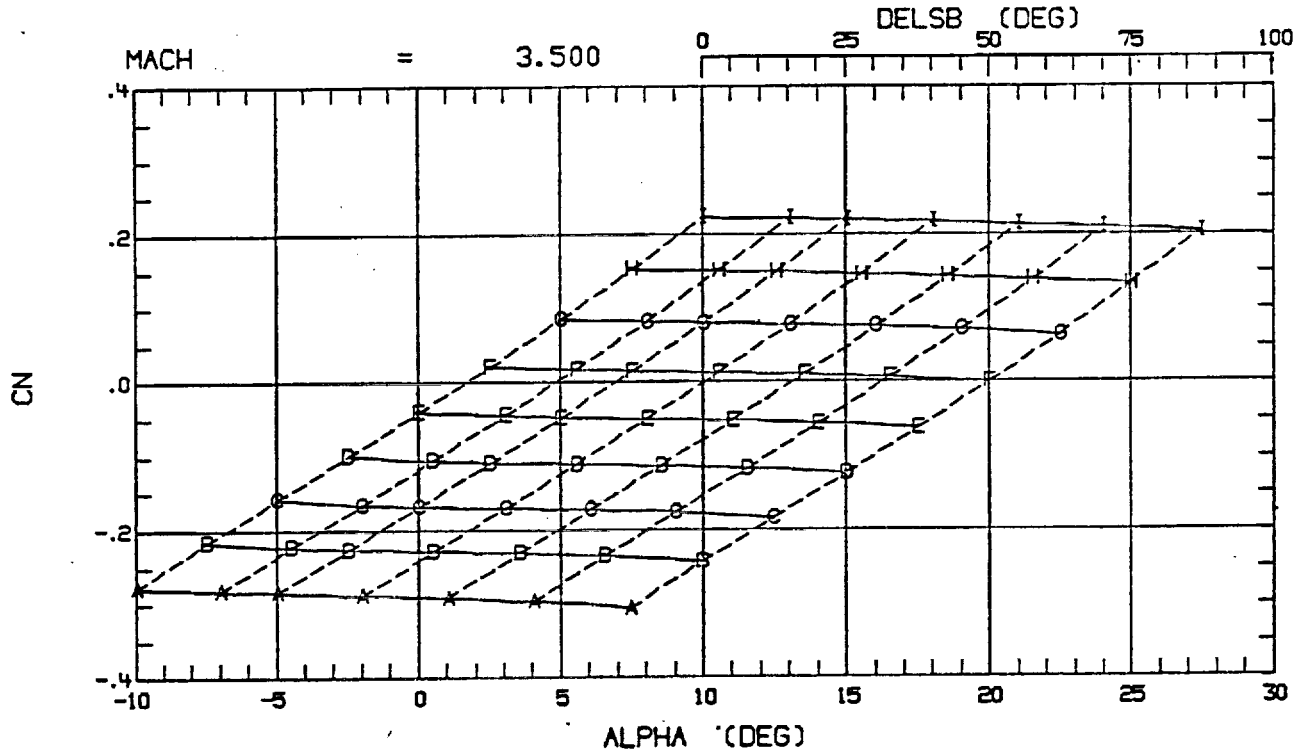
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.057 FT.
M.A.C. CW = 39.568 FT.
BODY LENGTH LB = 1290.0 IN.

DELSB (DEG)	ALPHA (DEG) 25.000 O	27.500 P	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W
	NORMAL FORCE COEFFICIENT								
0.0	0.80072	0.90536	1.02215	1.13839	1.25716	1.37738	1.49773	1.61662	1.73223
15.000	0.79450	0.90199	1.01376	1.12924	1.24785	1.36795	1.48883	1.60873	1.72577
25.000	0.79054	0.89779	1.00942	1.12487	1.24337	1.36388	1.48512	1.60549	1.72311
40.000	0.78506	0.89247	1.00438	1.12019	1.23911	1.36010	1.48183	1.60272	1.72085
55.000	0.78037	0.88823	1.00063	1.11655	1.23541	1.35738	1.48005	1.60127	1.71967
70.000	0.77675	0.88499	0.99762	1.11429	1.23407	1.35589	1.47835	1.59988	1.71852
87.200	0.77420	0.88200	0.99436	1.11071	1.23030	1.35207	1.47472	1.59662	1.71586

ENGINEER D.L.
DATE 3-87

FIGURE 4.1.1.1-35
BASIC NORMAL FORCE COEFFICIENT

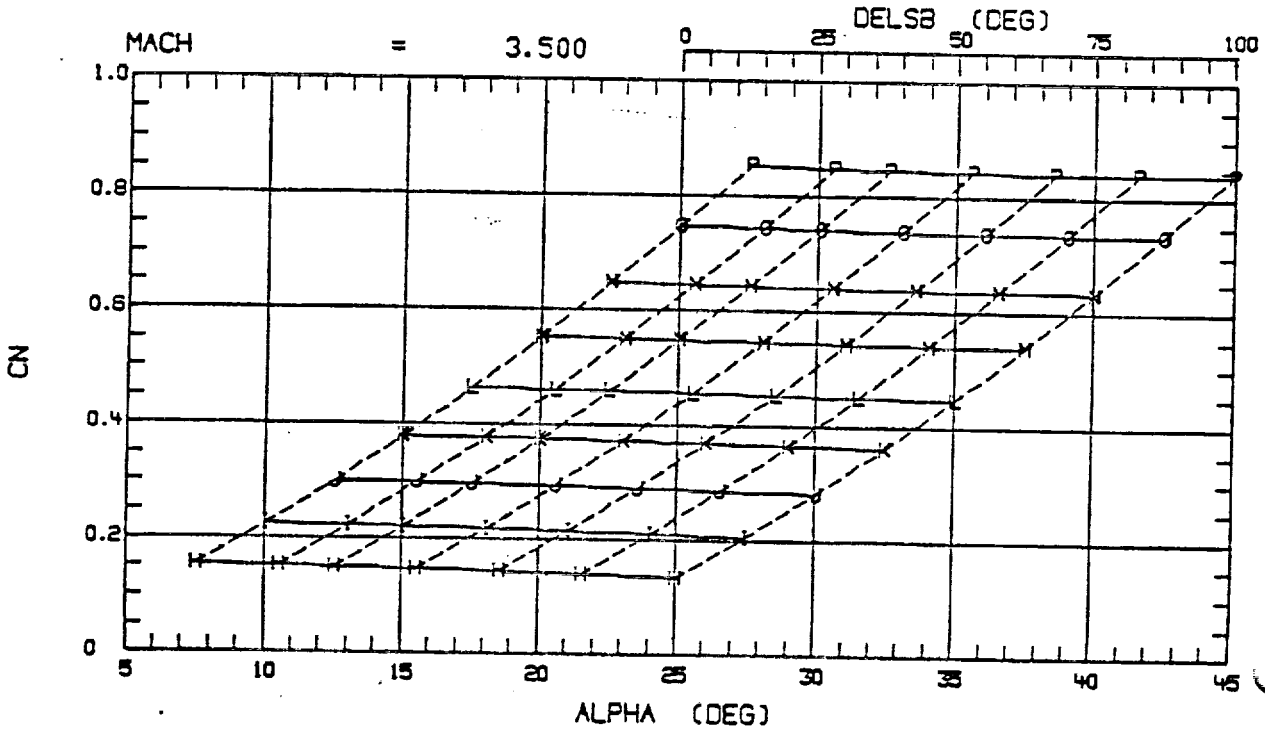


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.27847	-0.21809	-0.15286	-0.09983	-0.04008	0.02125	0.08497	0.15181	0.22241
15.000	-0.28281	-0.22431	-0.16560	-0.10618	-0.04552	0.01694	0.08178	0.14955	0.22080
25.000	-0.28509	-0.22685	-0.16830	-0.10875	-0.04786	0.01486	0.07994	0.14790	0.21925
40.000	-0.28828	-0.22974	-0.17087	-0.11124	-0.05038	0.01226	0.07723	0.14507	0.21632
55.000	-0.29198	-0.23241	-0.17310	-0.11345	-0.05280	0.00952	0.07414	0.14169	0.21276
70.000	-0.29711	-0.23643	-0.17664	-0.11689	-0.05636	0.00574	0.07016	0.13760	0.20869
87.200	-0.30590	-0.24460	-0.18439	-0.12431	-0.06347	-0.00101	0.06385	0.13183	0.20357

ENGINEER D²
DATE 3-82

FIGURE 4.1.1.1-36
BASIC NORMAL FORCE COEFFICIENT

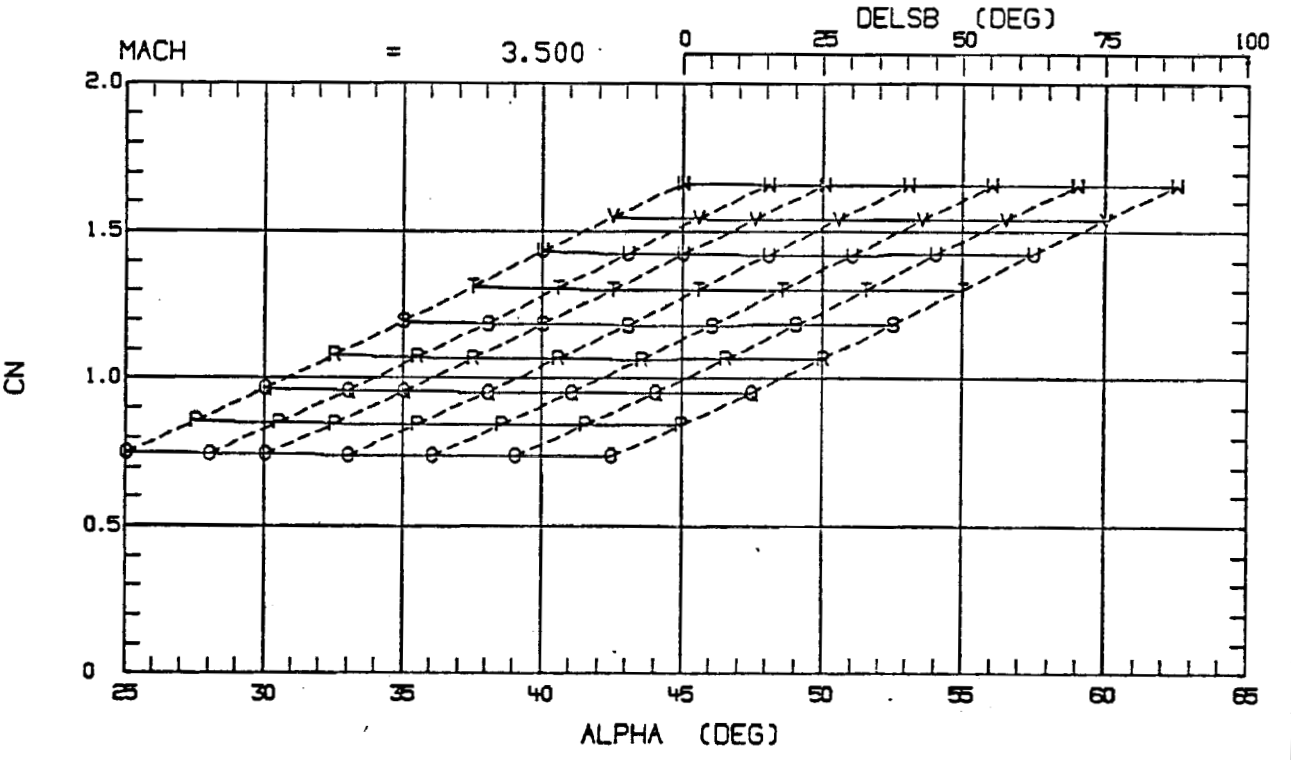


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.15181	0.22241	0.29731	0.37695	0.46165	0.55159	0.64681	0.74720	0.85246
15.000	0.14955	0.22080	0.29601	0.37550	0.45993	0.54923	0.64360	0.74306	0.84739
25.000	0.14790	0.21925	0.29449	0.37403	0.45823	0.54734	0.64150	0.74072	0.84484
40.000	0.14507	0.21632	0.29147	0.37097	0.45516	0.54430	0.63854	0.73787	0.84214
55.000	0.14169	0.21276	0.28786	0.36744	0.45186	0.54136	0.63604	0.73536	0.84065
70.000	0.13760	0.20869	0.28398	0.36329	0.44879	0.53887	0.63421	0.73473	0.84018
97.200	0.13183	0.20357	0.27960	0.36034	0.44610	0.53706	0.63324	0.73456	0.84070

ENGINEER D.
DATE 3-85

FIGURE 4.1.1.1-37
BASIC NORMAL FORCE COEFFICIENT

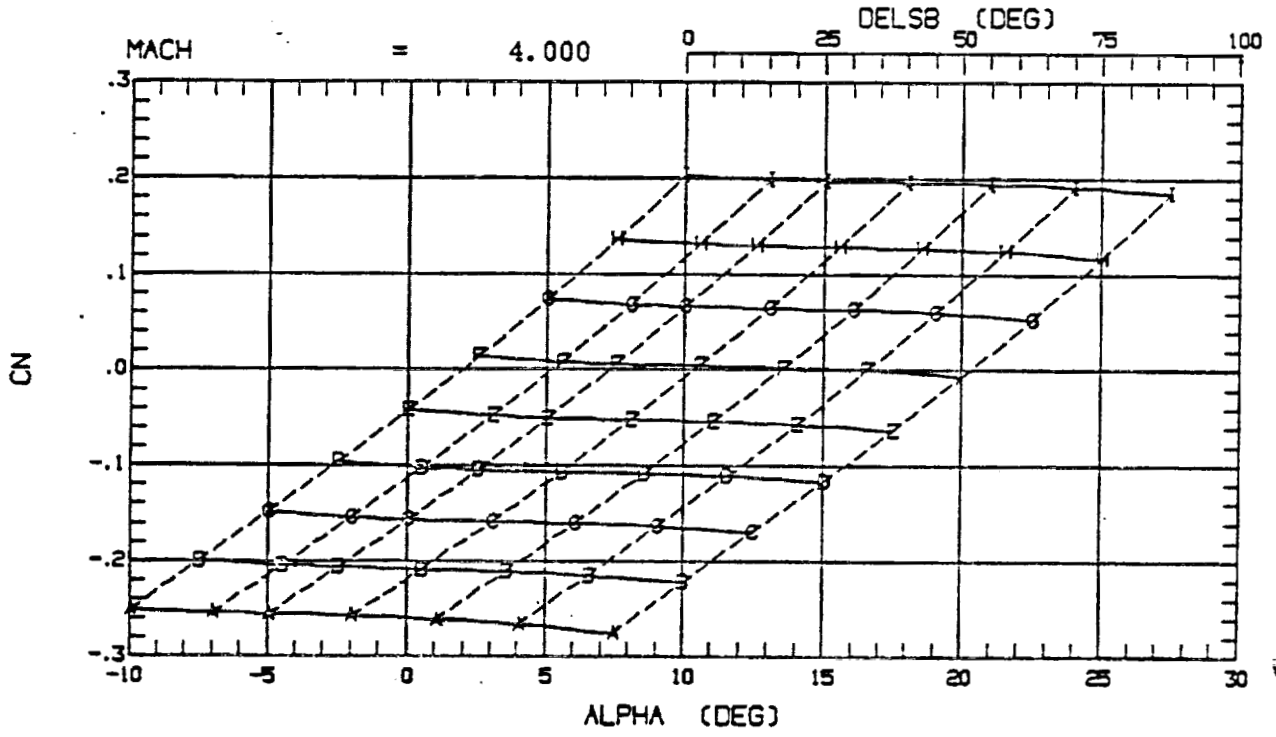


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	25.000	27.500	30.000	32.500	35.000	37.500	40.000	42.500	45.000
	O	P	Q	R	S	T	U	V	W
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.74720	0.85246	0.96215	1.07561	1.19198	1.31019	1.42897	1.54678	1.66184
15.000	0.74306	0.84739	0.95625	1.06908	1.18511	1.30334	1.42251	1.54110	1.65729
25.000	0.74072	0.84484	0.95353	1.06626	1.18229	1.30061	1.41998	1.53889	1.65548
40.000	0.73787	0.84214	0.95101	1.06393	1.18015	1.29870	1.41829	1.53739	1.65420
55.000	0.73586	0.84065	0.95000	1.06335	1.17994	1.29870	1.41839	1.53747	1.65412
70.000	0.73473	0.84018	0.95014	1.06398	1.18090	1.29983	1.41951	1.53838	1.65467
87.200	0.73456	0.84070	0.95121	1.06544	1.18255	1.30151	1.42100	1.53953	1.65535

ENGINEER D²
DATE 3-82

FIGURE 4.1.1.1-38
BASIC NORMAL FORCE COEFFICIENT



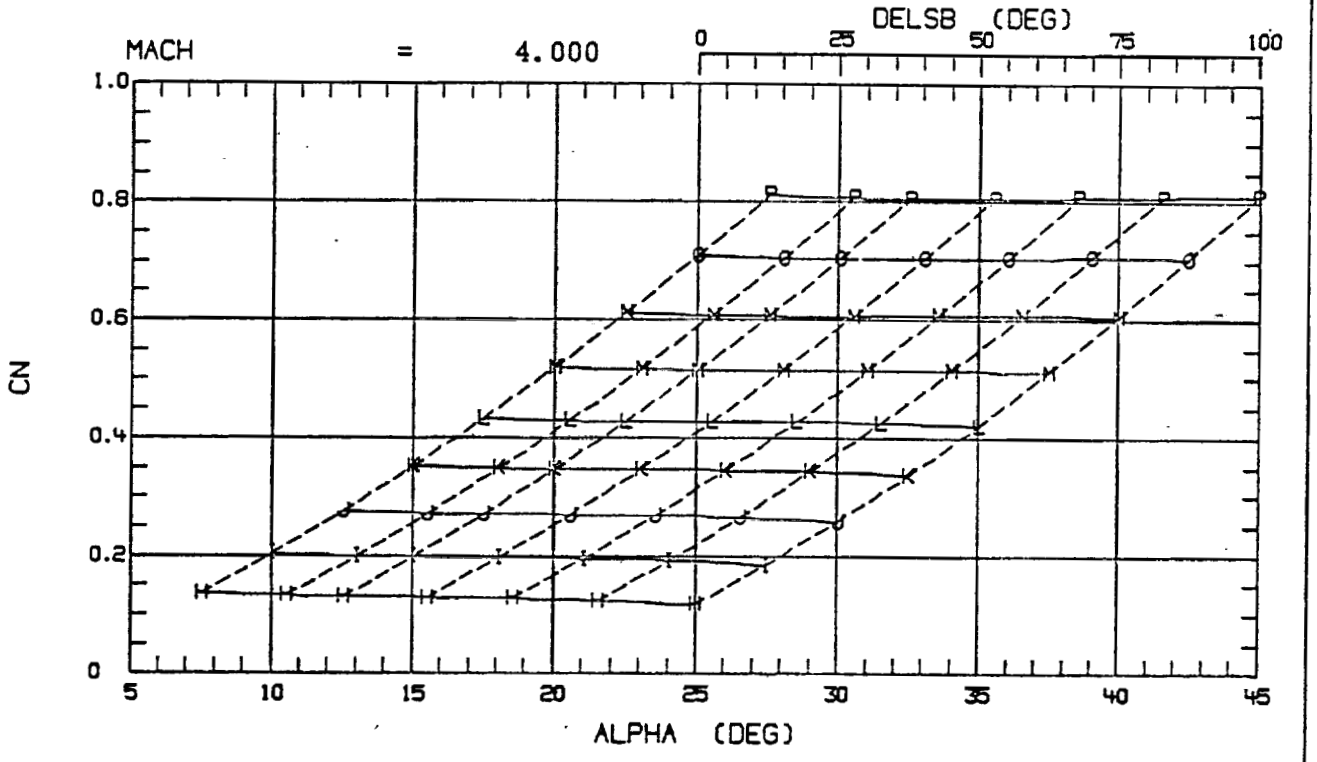
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.568 FT.
			BODY LENGTH	LB =	1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.25198	-0.20031	-0.14875	-0.09845	-0.04262	0.01351	0.07252	0.13534	0.20222
15.000	-0.25419	-0.20510	-0.15478	-0.10291	-0.04873	0.00793	0.06769	0.13100	0.19832
25.000	-0.25550	-0.20719	-0.15723	-0.10532	-0.05112	0.00578	0.06560	0.12937	0.19691
40.000	-0.25782	-0.20953	-0.15984	-0.10756	-0.05323	0.00383	0.06405	0.12783	0.19561
55.000	-0.26126	-0.21193	-0.16141	-0.10923	-0.05488	0.00214	0.06233	0.12517	0.19409
70.000	-0.26661	-0.21555	-0.16420	-0.11177	-0.05751	-0.00071	0.05927	0.12301	0.19103
87.200	-0.27613	-0.22258	-0.17025	-0.11761	-0.06352	-0.00727	0.05229	0.11591	0.19390

ENGINEER D.
DATE 3-82

FIGURE 4.1.1.1-39
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	7.500	10.000	12.500	15.000	17.500	20.000	22.500	25.000	27.500
	H	I	J	K	L	M	N	O	P
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.13534	0.20222	0.27372	0.35020	0.43190	0.51895	0.61135	0.70895	0.81146
15.000	0.13100	0.19832	0.27005	0.34653	0.42804	0.51473	0.60867	0.70378	0.80594
25.000	0.12937	0.19691	0.26880	0.34537	0.42688	0.51354	0.60539	0.70239	0.80434
40.000	0.12783	0.19561	0.26774	0.34456	0.42631	0.51318	0.60523	0.70240	0.80448
55.000	0.12617	0.19409	0.26649	0.34369	0.42592	0.51333	0.60595	0.70367	0.80624
70.000	0.12301	0.19103	0.26373	0.34145	0.42438	0.51263	0.60617	0.70483	0.80826
87.200	0.11581	0.18390	0.25701	0.33547	0.41947	0.50901	0.60403	0.70422	0.80916

ENGINEER D
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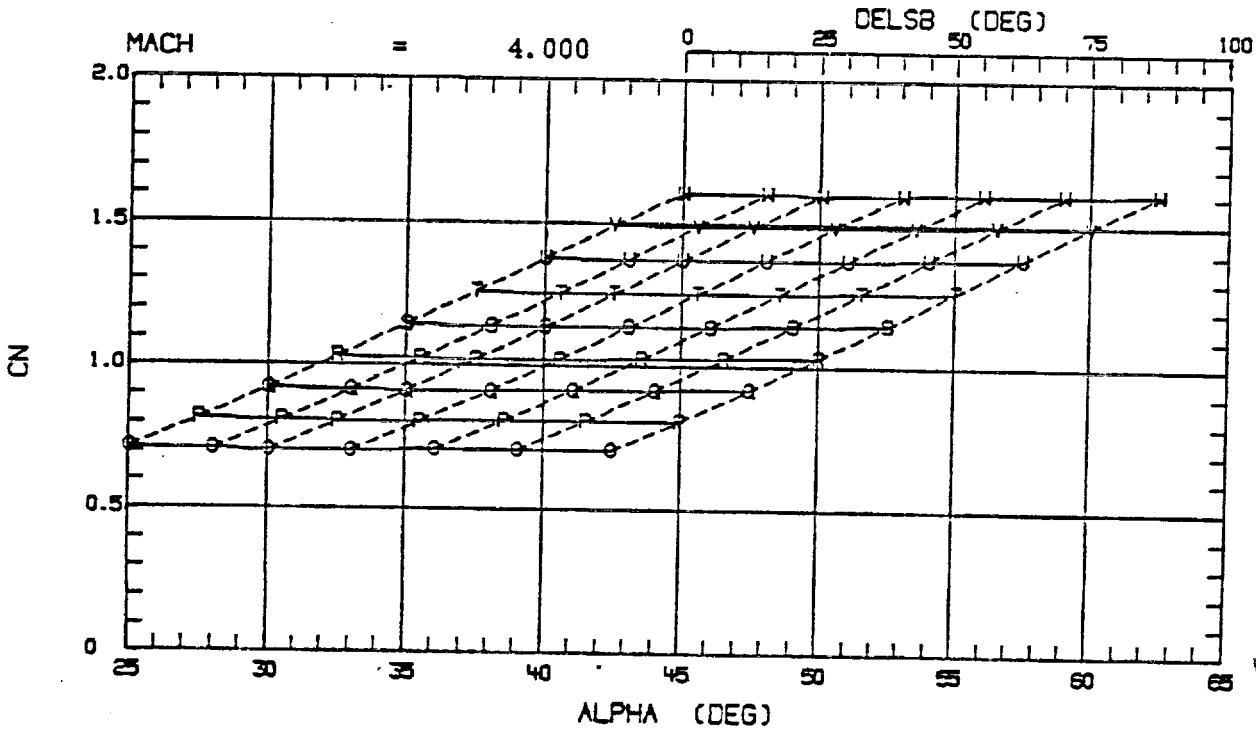
FIGURE 4.1.1.1-40
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	25.000	27.500	30.000	32.500	35.000	37.500	40.000	42.500	45.000
	O	P	Q	R	S	T	U	V	W
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.70895	0.81146	0.91842	1.02917	1.14295	1.25871	1.37524	1.49113	1.60472
15.000	0.70378	0.80594	0.91247	1.02311	1.13699	1.25318	1.37044	1.48734	1.60216
25.000	0.70239	0.80434	0.91089	1.02148	1.13538	1.25166	1.36909	1.48624	1.60138
40.000	0.70240	0.80448	0.91111	1.02175	1.13568	1.25193	1.36929	1.48635	1.60138
55.000	0.70367	0.80624	0.91327	1.02418	1.13820	1.25436	1.37146	1.48809	1.60255
70.000	0.70483	0.80825	0.91605	1.02752	1.14184	1.25803	1.37486	1.49094	1.60462
87.200	0.70422	0.80916	0.91829	1.03085	1.14594	1.26251	1.37929	1.49489	1.60772

ENGINEER D
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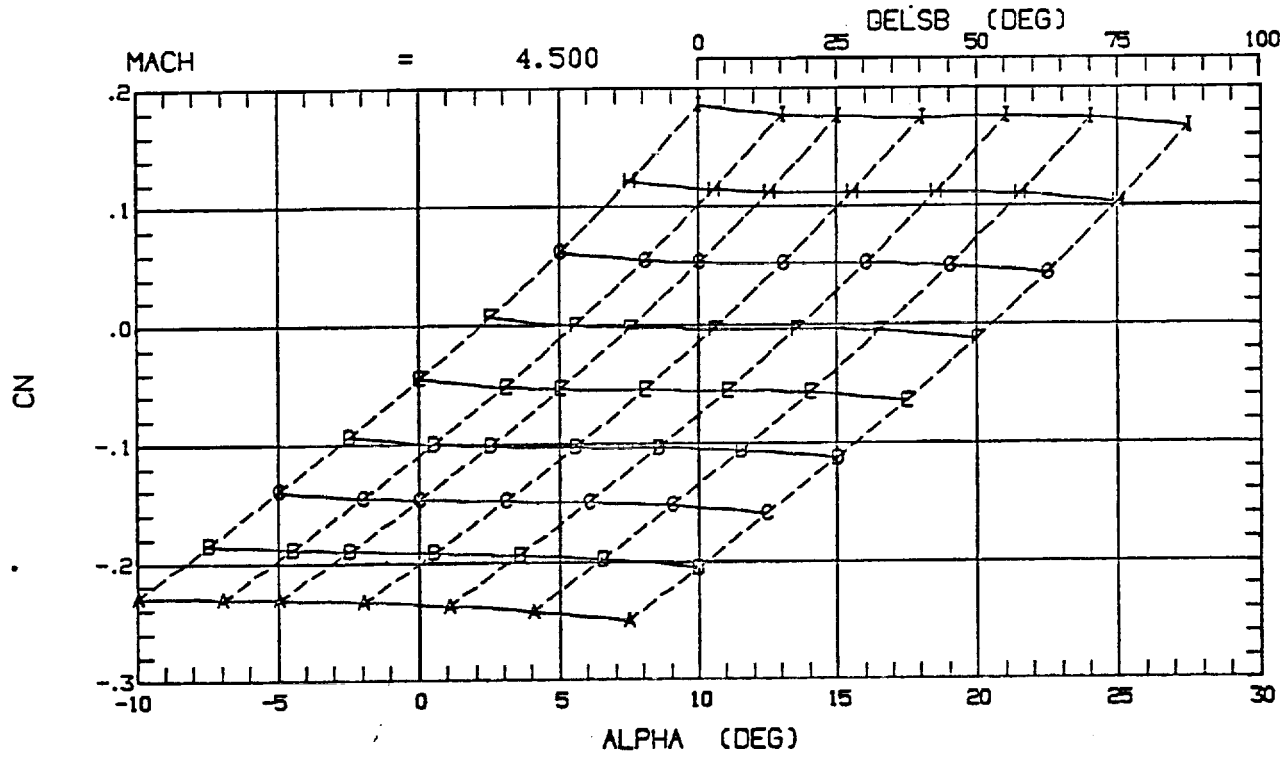
FIGURE 4.1.1.1-41
BASIC NORMAL FORCE COEFFICIENT

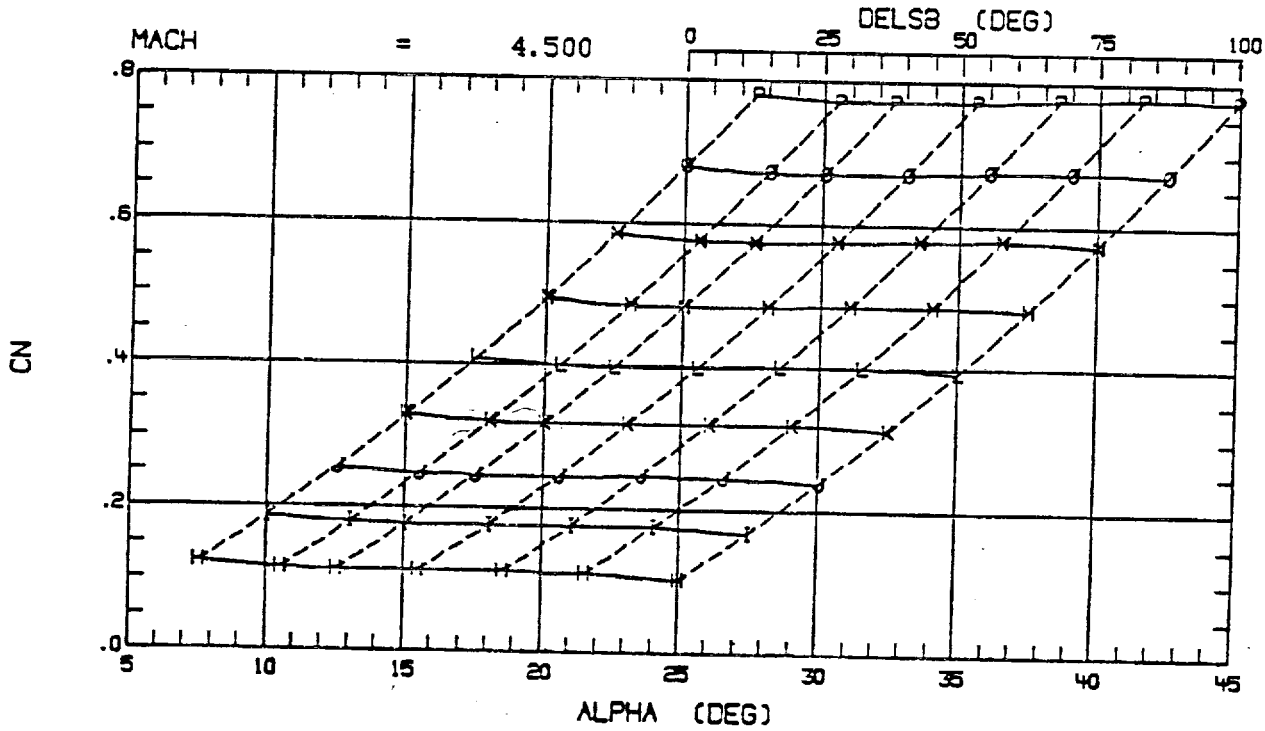


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.22991	-0.18561	-0.14052	-0.09389	-0.04502	0.00677	0.06208	0.12148	0.18543
15.000	-0.23094	-0.18929	-0.14591	-0.10032	-0.05204	-0.00057	0.05457	0.11386	0.17769
25.000	-0.23186	-0.19083	-0.14783	-0.10246	-0.05427	-0.00282	0.05236	0.11170	0.17560
40.000	-0.23391	-0.19258	-0.14936	-0.10382	-0.05549	-0.00399	0.05146	0.11099	0.17511
55.000	-0.23723	-0.19466	-0.15069	-0.10468	-0.05604	-0.00423	0.05131	0.11106	0.17546
70.000	-0.24229	-0.19825	-0.15339	-0.10691	-0.05805	-0.00612	0.04952	0.10941	0.17404
87.200	-0.25082	-0.20562	-0.16023	-0.11361	-0.06486	-0.01313	0.04233	0.10213	0.16682

ENGINEER D²
DATE 3-32

FIGURE 4.1.1.1-42
BASIC NORMAL FORCE COEFFICIENT

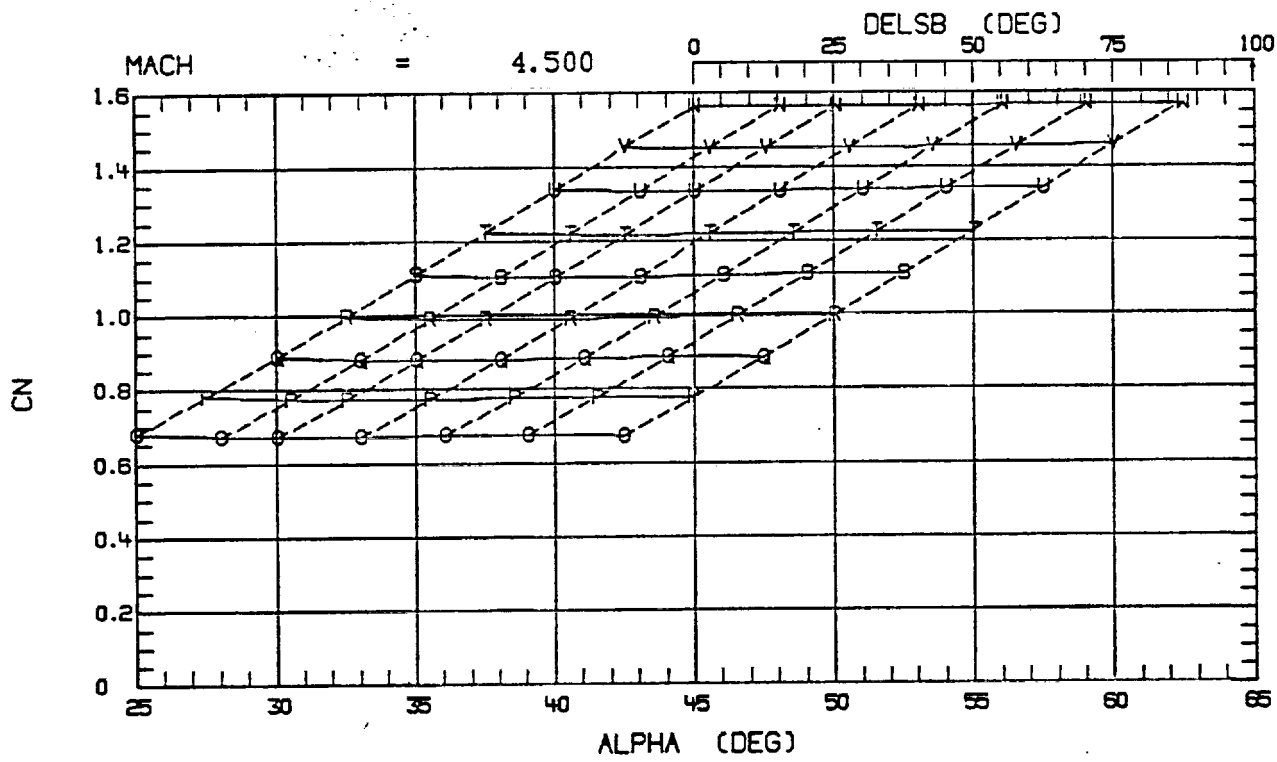


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1250.0 IN.

	ALPHA (DEG)								
	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.12148	0.18543	0.25433	0.32948	0.40907	0.49318	0.58377	0.67967	0.78054
15.000	0.11386	0.17769	0.24946	0.32043	0.39986	0.48480	0.57529	0.67120	0.77224
25.000	0.11170	0.17560	0.24442	0.31846	0.39792	0.48252	0.57347	0.66945	0.77060
40.000	0.11099	0.17511	0.24418	0.31848	0.39821	0.48349	0.57430	0.67051	0.77184
55.000	0.11106	0.17546	0.24467	0.31957	0.39975	0.48548	0.57673	0.67335	0.77500
70.000	0.10941	0.17404	0.24378	0.31892	0.39962	0.48595	0.57783	0.67504	0.77723
87.200	0.10213	0.16682	0.23681	0.31237	0.39369	0.48079	0.57356	0.67175	0.77495

ENGINEER D.
DATE 3-82

FIGURE 4.1.1.1-43
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	25.000 O	27.500 P	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.67967	0.78054	0.88593	0.99519	1.10751	1.22190	1.33717	1.45193	1.56459
15.000	0.67120	0.77224	0.87800	0.98785	1.10102	1.21649	1.33308	1.44932	1.56352
25.000	0.66945	0.77060	0.87647	0.98650	1.09986	1.21559	1.33245	1.44900	1.56352
40.000	0.67051	0.77184	0.87785	0.98795	1.10132	1.21697	1.33370	1.45003	1.56431
55.000	0.67335	0.77500	0.88122	0.99138	1.10466	1.22006	1.33637	1.45214	1.56574
70.000	0.67504	0.77723	0.88390	0.99435	1.10776	1.22309	1.33913	1.45446	1.56745
87.200	0.67175	0.77495	0.88261	0.99400	1.10821	1.22420	1.34069	1.45627	1.56929

ENGINEER D
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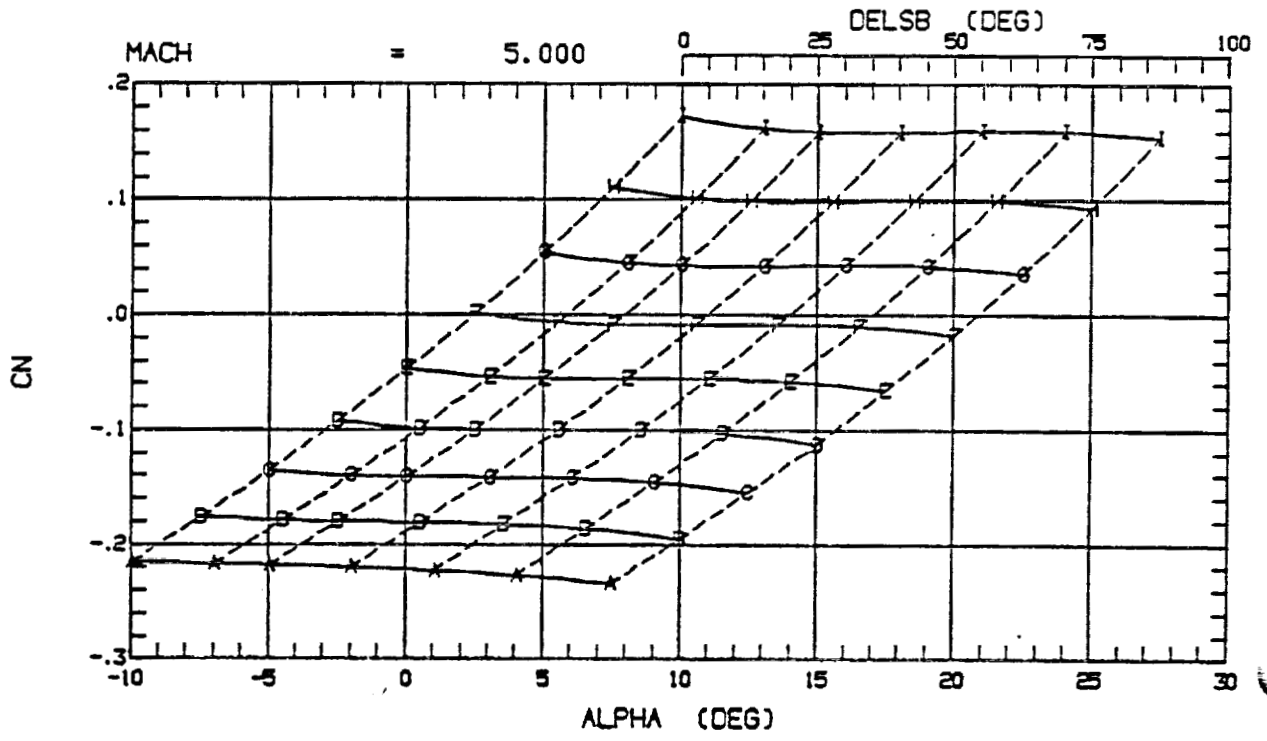
FIGURE 4.1.1.1-44
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.21614	-0.17654	-0.13571	-0.09296	-0.04760	0.00101	0.05345	0.11026	0.17190
15.000	-0.21720	-0.17956	-0.14034	-0.09892	-0.05469	-0.00706	0.04453	0.10061	0.16163
25.000	-0.21819	-0.18058	-0.14153	-0.10038	-0.05646	-0.00916	0.04213	0.09793	0.15873
40.000	-0.22029	-0.18167	-0.14205	-0.10066	-0.05671	-0.00948	0.04168	0.09737	0.15809
55.000	-0.22332	-0.18342	-0.14290	-0.10087	-0.05647	-0.00953	0.04247	0.09636	0.15927
70.000	-0.22751	-0.18721	-0.14617	-0.10353	-0.05850	-0.01035	0.04161	0.09799	0.15930
87.200	-0.23404	-0.19586	-0.15558	-0.11292	-0.06713	-0.01805	0.03488	0.09212	0.15410

ENGINEER D²
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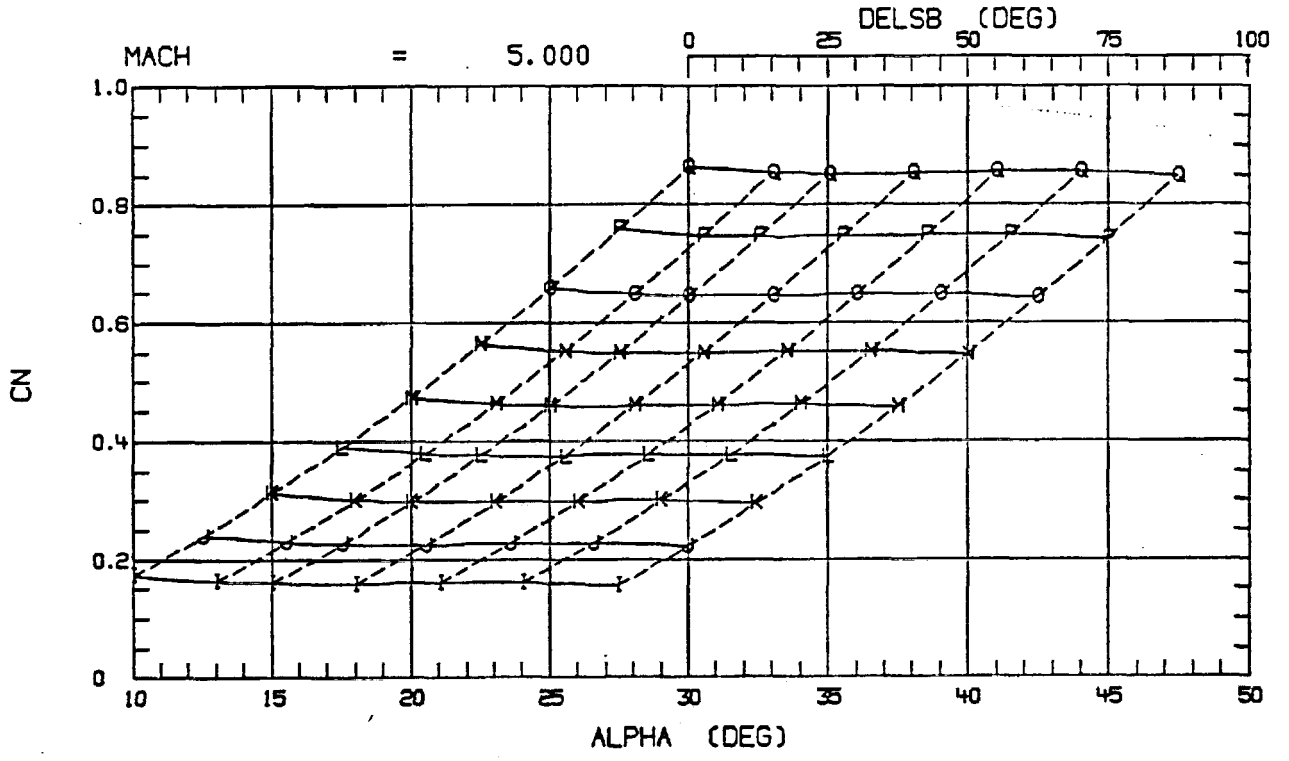
FIGURE 4.1.1.1-45
BASIC NORMAL FORCE COEFFICIENT

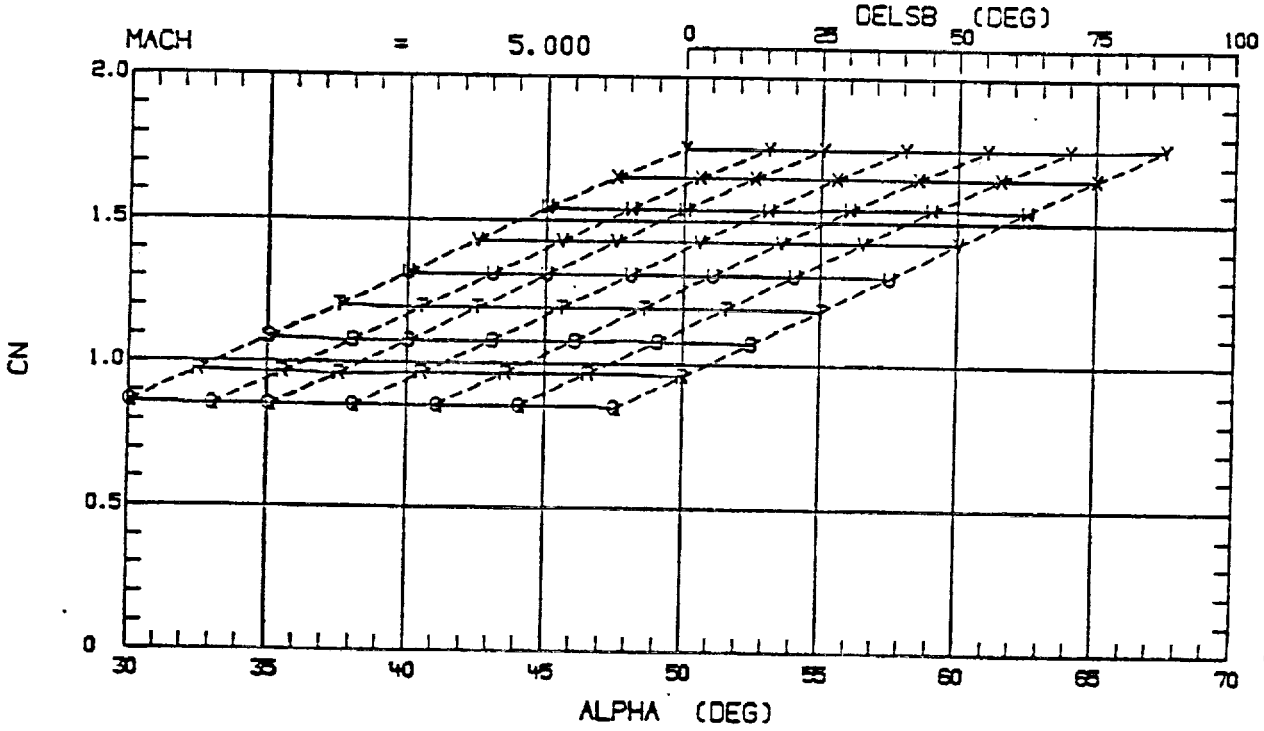


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.17190	0.23875	0.31110	0.38915	0.47295	0.56245	0.65750	0.75773	0.86266
15.000	0.16163	0.22799	0.29997	0.37780	0.46155	0.55121	0.64660	0.74740	0.85313
25.000	0.15873	0.22493	0.29694	0.37467	0.45851	0.54832	0.64394	0.74503	0.85107
40.000	0.15809	0.22429	0.29626	0.37422	0.45826	0.54831	0.64420	0.74555	0.85185
55.000	0.15927	0.22565	0.29782	0.37597	0.46019	0.55042	0.64643	0.74787	0.85418
70.000	0.15930	0.22599	0.29837	0.37665	0.46092	0.55112	0.64707	0.74840	0.85459
87.200	0.15410	0.22119	0.29371	0.37191	0.45591	0.54573	0.64125	0.74223	0.84821

ENGINEER DL
DATE 3-82

FIGURE 4.1.1.1-46
BASIC NORMAL FORCE COEFFICIENT

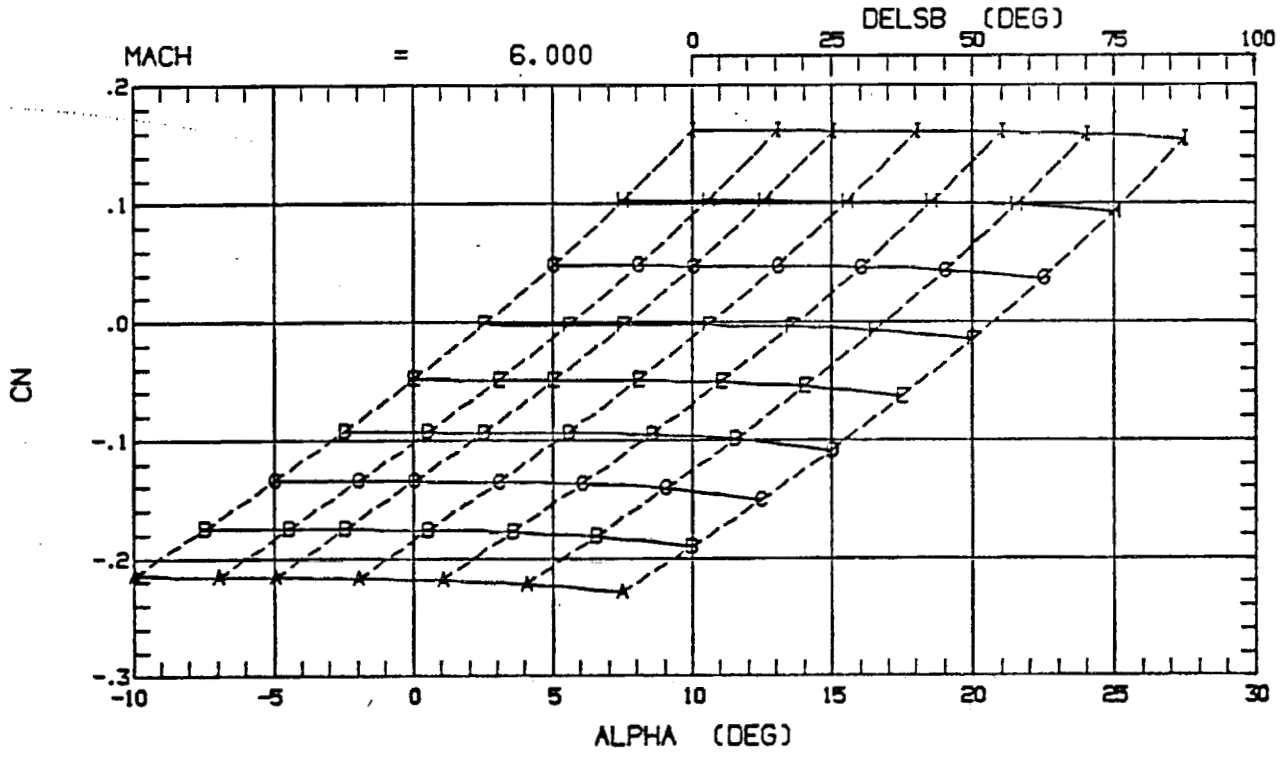


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1250.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.86256	0.97163	1.08380	1.19814	1.31342	1.42819	1.54078	1.64929	1.75157
15.000	0.85313	0.96311	1.07849	1.19222	1.30900	1.42533	1.53946	1.64935	1.75273
25.000	0.85107	0.96141	1.07516	1.19127	1.30840	1.42507	1.53946	1.64957	1.75308
40.000	0.85185	0.96238	1.07627	1.19241	1.30950	1.42601	1.54018	1.64999	1.75319
55.000	0.85418	0.96466	1.07841	1.19433	1.31111	1.42724	1.54098	1.65035	1.75315
70.000	0.85459	0.96495	1.07859	1.19442	1.31115	1.42727	1.54103	1.65046	1.75329
87.200	0.84621	0.95358	1.07250	1.18892	1.30656	1.42389	1.53906	1.64997	1.75419

ENGINEER D.L.
DATE 3-82

FIGURE 4.1.1.1-47
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.21528	-0.17506	-0.13450	-0.09271	-0.04887	-0.00219	0.04808	0.10257	0.16189
15.000	-0.21606	-0.17592	-0.13547	-0.09378	-0.04997	-0.00324	0.04715	0.10183	0.16137
25.000	-0.21649	-0.17614	-0.13560	-0.09389	-0.05009	-0.00337	0.04702	0.10172	0.16128
40.000	-0.21743	-0.17672	-0.13597	-0.09414	-0.05029	-0.00355	0.04683	0.10153	0.16110
55.000	-0.21932	-0.17851	-0.13763	-0.09566	-0.05166	-0.00477	0.04578	0.10063	0.16036
70.000	-0.22275	-0.18253	-0.14184	-0.09978	-0.05548	-0.00817	0.04287	0.09824	0.15847
87.200	-0.22940	-0.19121	-0.15141	-0.10940	-0.06454	-0.01625	0.03598	0.09255	0.15416

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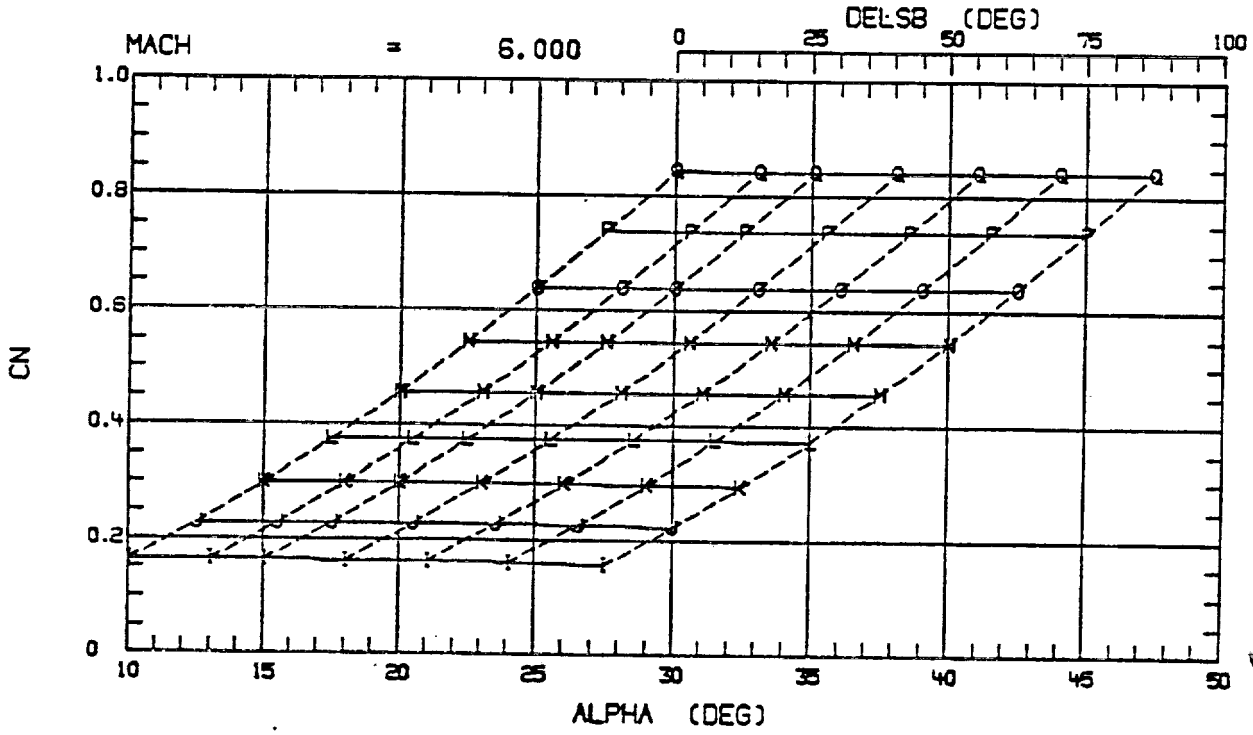
FIGURE 4.1.1.1-48
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.16189	0.22949	0.29678	0.37299	0.45528	0.54362	0.63786	0.73767	0.84254
15.000	0.16137	0.22920	0.29667	0.37299	0.45524	0.54339	0.63723	0.73641	0.84042
25.000	0.16128	0.22915	0.29665	0.37297	0.45523	0.54332	0.63705	0.73604	0.83979
40.000	0.16110	0.22899	0.29662	0.37290	0.45518	0.54330	0.63703	0.73601	0.83970
55.000	0.16036	0.22840	0.29609	0.37261	0.45504	0.54331	0.63720	0.73634	0.84020
70.000	0.15847	0.22399	0.29510	0.37200	0.45476	0.54330	0.63742	0.73676	0.84079
87.200	0.15416	0.22087	0.29302	0.37076	0.45417	0.54317	0.63755	0.73699	0.84100

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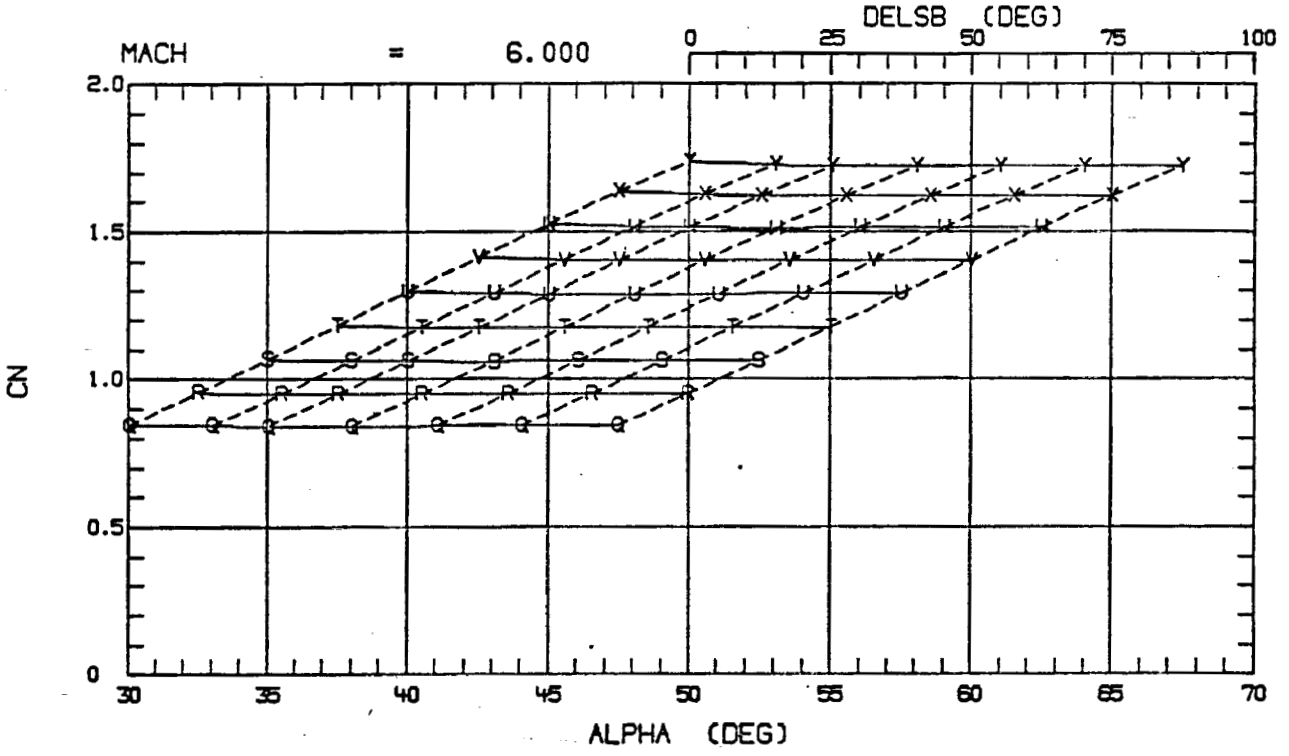
FIGURE 4.1.1.1-49
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.84254	0.95180	1.06456	1.17971	1.29593	1.41168	1.52515	1.63429	1.73676
15.000	0.84042	0.94857	1.06001	1.17367	1.28830	1.40245	1.51444	1.62238	1.72413
25.000	0.83979	0.94761	1.05863	1.17181	1.28592	1.39953	1.51102	1.61852	1.72000
40.000	0.83970	0.94742	1.05830	1.17129	1.28517	1.39853	1.50975	1.61701	1.71830
55.000	0.84020	0.94808	1.05911	1.17226	1.28629	1.39978	1.51109	1.61841	1.71969
70.000	0.84079	0.94885	1.06006	1.17338	1.28759	1.40126	1.51275	1.62020	1.72157
87.200	0.84100	0.94893	1.05996	1.17309	1.28713	1.40086	1.51207	1.61953	1.72095

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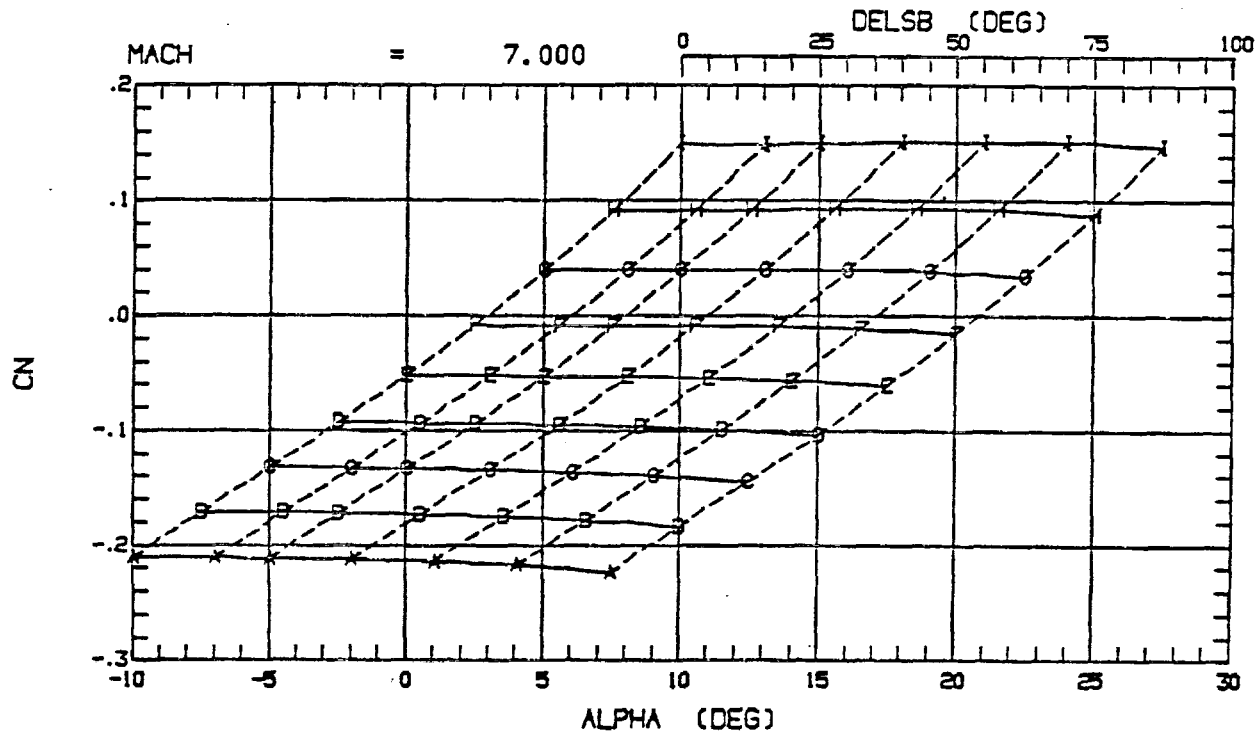
FIGURE 4.1.1.1-50
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1250.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.21112	-0.17128	-0.13248	-0.09326	-0.05233	-0.00857	0.03902	0.09124	0.14879
15.000	-0.21169	-0.17190	-0.13314	-0.09395	-0.05302	-0.00922	0.03943	0.09074	0.14840
25.000	-0.21202	-0.17247	-0.13375	-0.09445	-0.05333	-0.00930	0.03860	0.09113	0.14895
40.000	-0.21294	-0.17377	-0.13506	-0.09548	-0.05391	-0.00935	0.03906	0.09205	0.15023
55.000	-0.21456	-0.17583	-0.13705	-0.09714	-0.05507	-0.00994	0.03904	0.09254	0.15112
70.000	-0.21779	-0.17894	-0.13994	-0.09972	-0.05727	-0.01173	0.03768	0.09161	0.15060
87.200	-0.22402	-0.18415	-0.14463	-0.10420	-0.06171	-0.01614	0.03337	0.08734	0.14696

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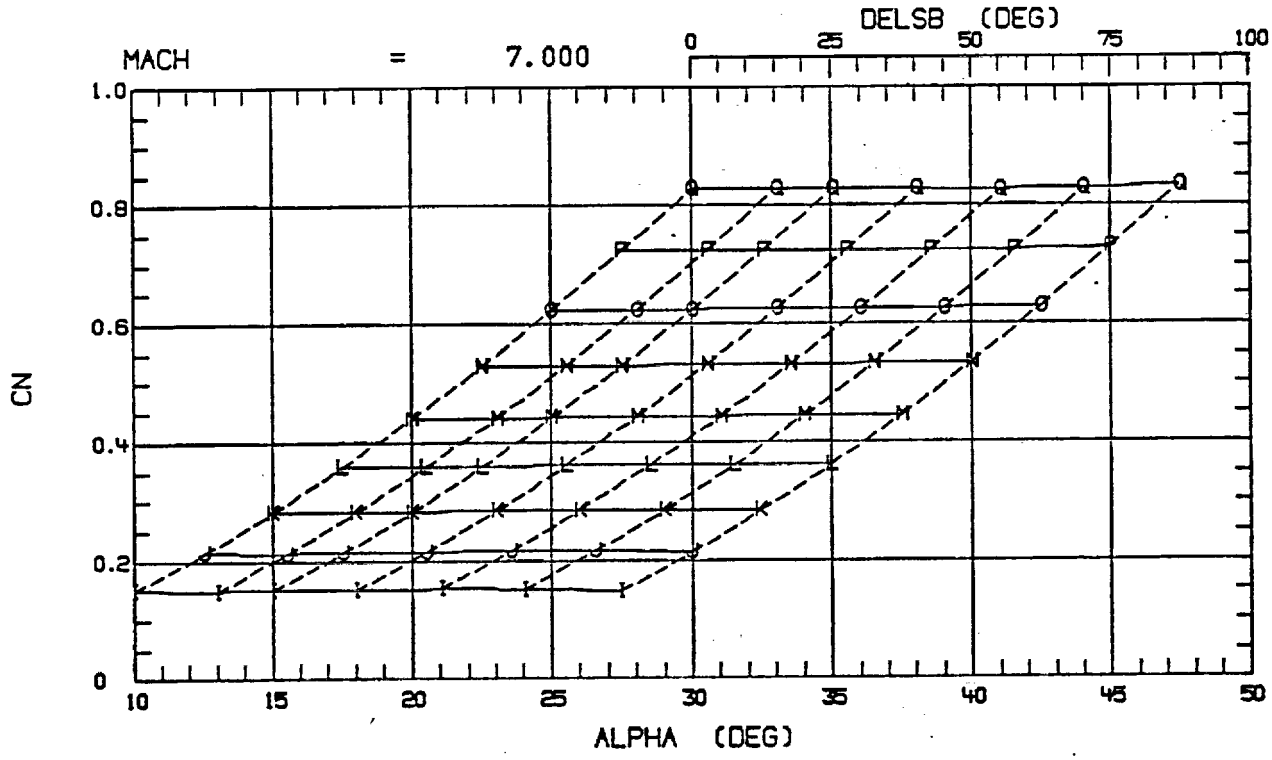
FIGURE 4.1.1.1-51
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.14879	0.21213	0.28165	0.35750	0.43972	0.52817	0.62253	0.72236	0.82700
15.000	0.14840	0.21189	0.28155	0.35755	0.43990	0.52847	0.62292	0.72279	0.82744
25.000	0.14895	0.21256	0.28224	0.35821	0.44046	0.52885	0.62307	0.72267	0.82701
40.000	0.15023	0.21403	0.28377	0.35963	0.44163	0.52964	0.62338	0.72241	0.82616
55.000	0.15112	0.21521	0.28511	0.36098	0.44286	0.53063	0.62404	0.72270	0.82600
70.000	0.15060	0.21509	0.28535	0.36156	0.44373	0.53175	0.62537	0.72418	0.82761
87.200	0.14696	0.21206	0.28318	0.36041	0.44377	0.53311	0.62911	0.72829	0.83307

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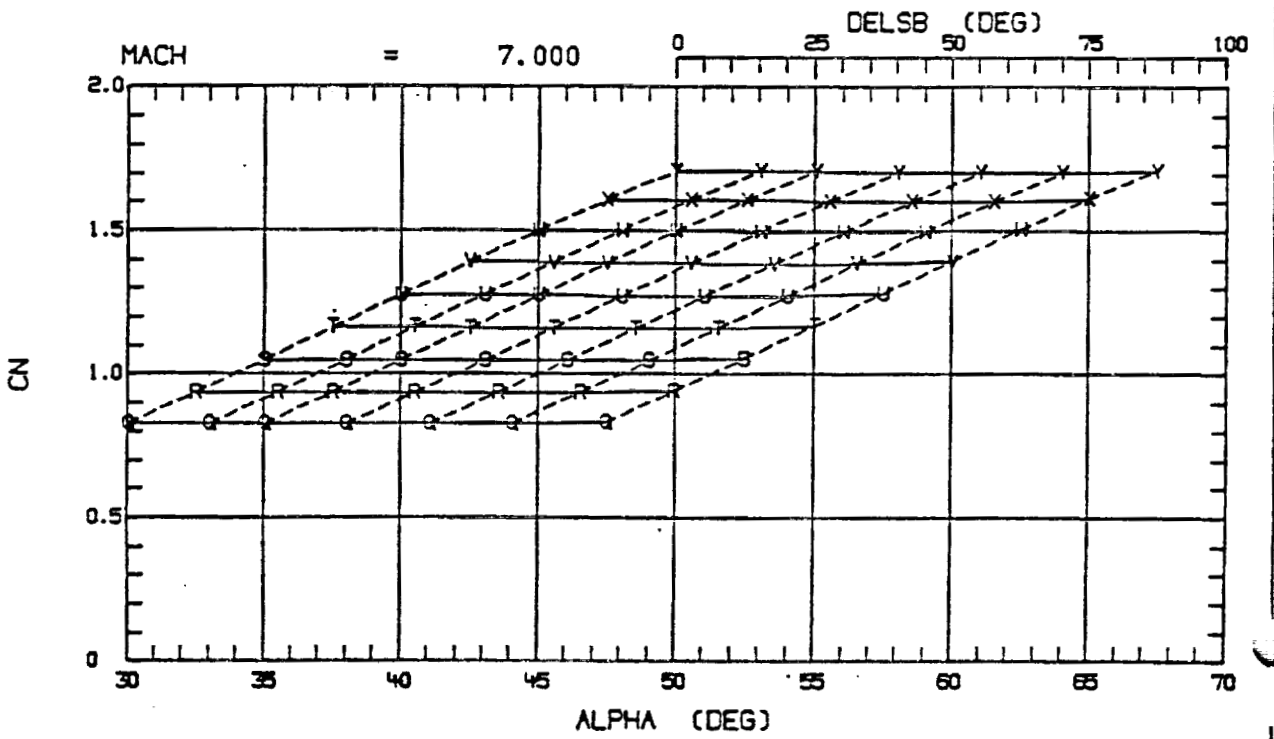
DATE

FIGURE 4.1.1.1-52
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.82700	0.93567	1.04741	1.16108	1.27537	1.38894	1.49994	1.60555	1.70700
15.000	0.82744	0.93603	1.04765	1.16112	1.27516	1.38829	1.49889	1.60516	1.70512
25.000	0.82701	0.93531	1.04662	1.15981	1.27360	1.38653	1.49699	1.60322	1.70320
40.000	0.82516	0.93387	1.04461	1.15731	1.27072	1.38342	1.49381	1.60012	1.70040
55.000	0.82500	0.93327	1.04360	1.15594	1.26908	1.38162	1.49197	1.59840	1.69894
70.000	0.82761	0.93456	1.04533	1.15768	1.27080	1.38329	1.49355	1.59987	1.70026
87.200	0.83307	0.94160	1.05299	1.16610	1.27967	1.39224	1.50220	1.60778	1.70699

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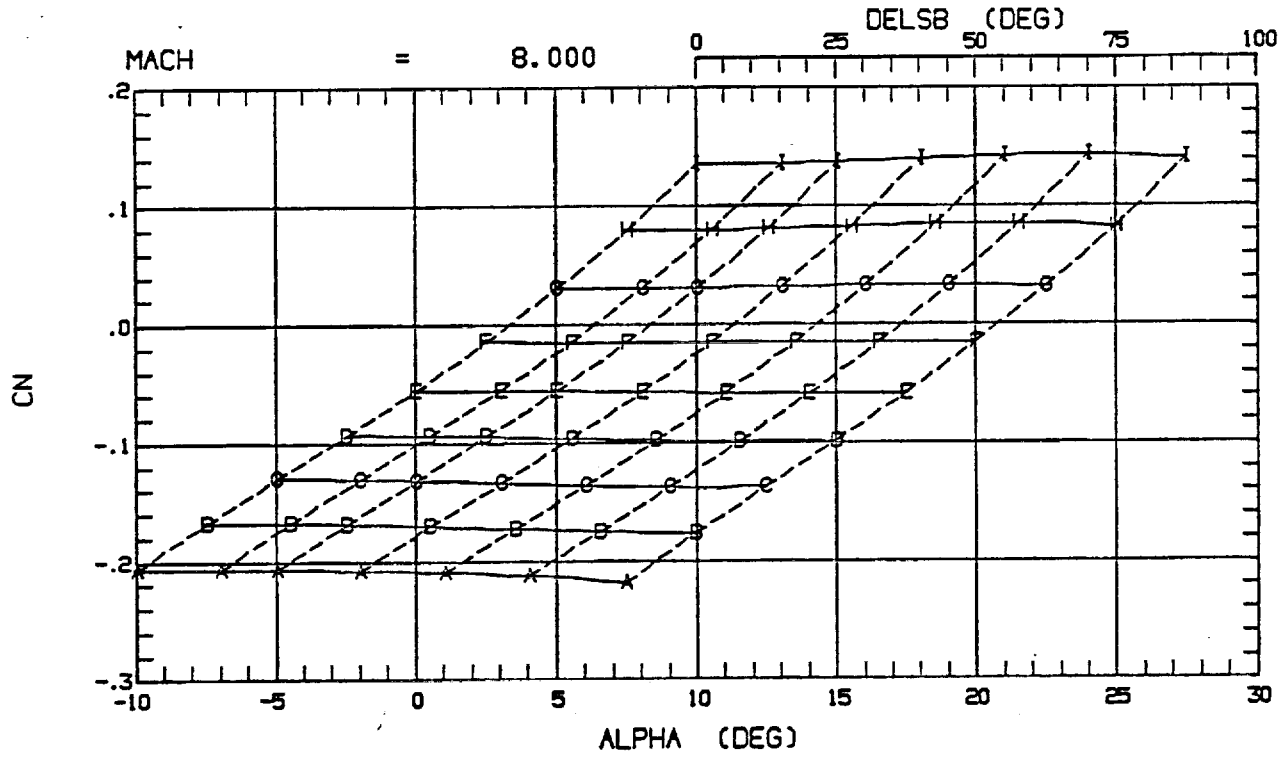
FIGURE 4.1.1.1-53
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.20696	-0.16750	-0.13046	-0.09381	-0.05580	-0.01496	0.02985	0.07992	0.13569
15.000	-0.20733	-0.16789	-0.13082	-0.09412	-0.05608	-0.01521	0.02970	0.07986	0.13544
25.000	-0.20755	-0.16881	-0.13190	-0.09501	-0.05658	-0.01523	0.03017	0.08055	0.13653
40.000	-0.20825	-0.17081	-0.13416	-0.09683	-0.05754	-0.01515	0.03129	0.08258	0.13936
55.000	-0.20983	-0.17315	-0.13647	-0.09862	-0.05848	-0.01511	0.03230	0.08445	0.14187
70.000	-0.21282	-0.17535	-0.13805	-0.09966	-0.05907	-0.01530	0.03248	0.08497	0.14274
87.200	-0.21884	-0.17709	-0.13785	-0.09901	-0.05888	-0.01603	0.03075	0.08243	0.13976

ENGINEER D²
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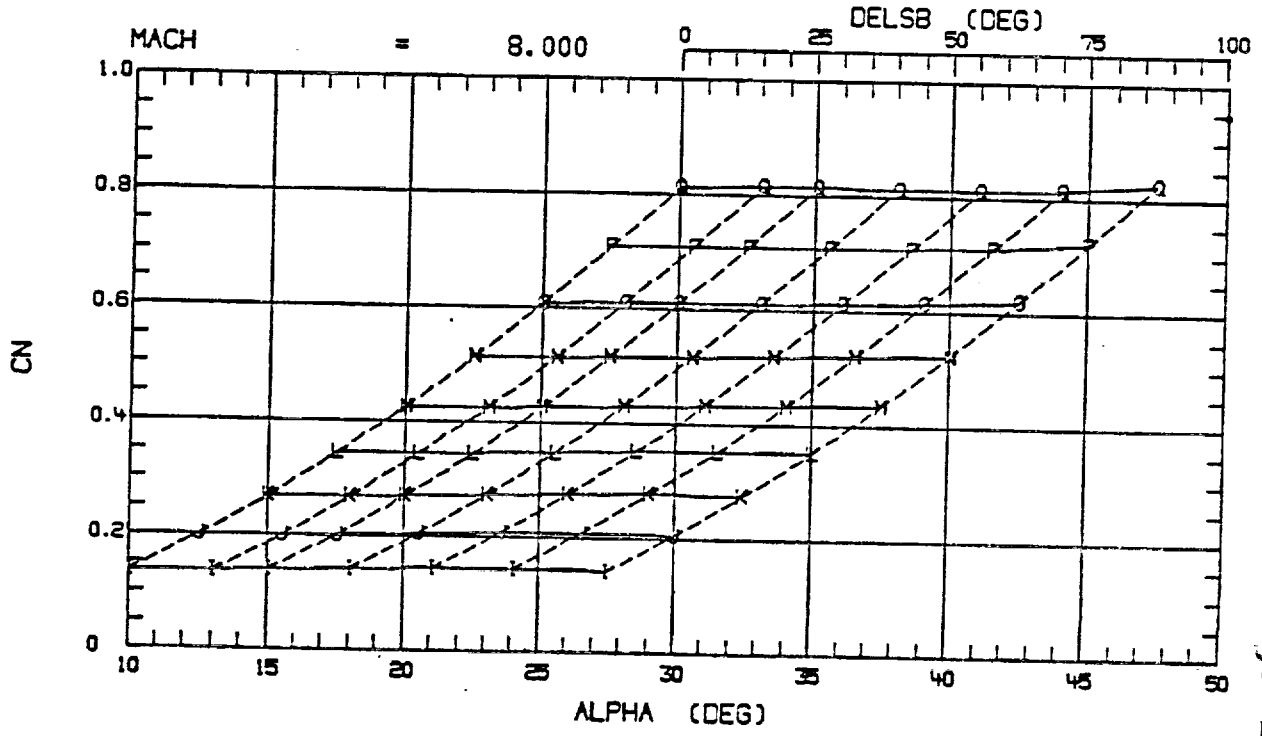
FIGURE 4.1.1.1-54
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.13569	0.19778	0.26652	0.34202	0.42417	0.51272	0.60721	0.70704	0.81147
15.000	0.13544	0.19759	0.26644	0.34212	0.42457	0.51355	0.60862	0.70917	0.81444
25.000	0.13663	0.19896	0.26784	0.34344	0.42589	0.51439	0.60910	0.70930	0.81424
40.000	0.13936	0.20207	0.27103	0.34637	0.42909	0.51599	0.60973	0.70883	0.81253
55.000	0.14187	0.20502	0.27413	0.34935	0.43068	0.51795	0.61089	0.70904	0.81181
70.000	0.14274	0.20619	0.27561	0.35112	0.43270	0.52021	0.61333	0.71161	0.81444
87.200	0.13976	0.20329	0.27334	0.35005	0.43337	0.52305	0.61865	0.71959	0.82511

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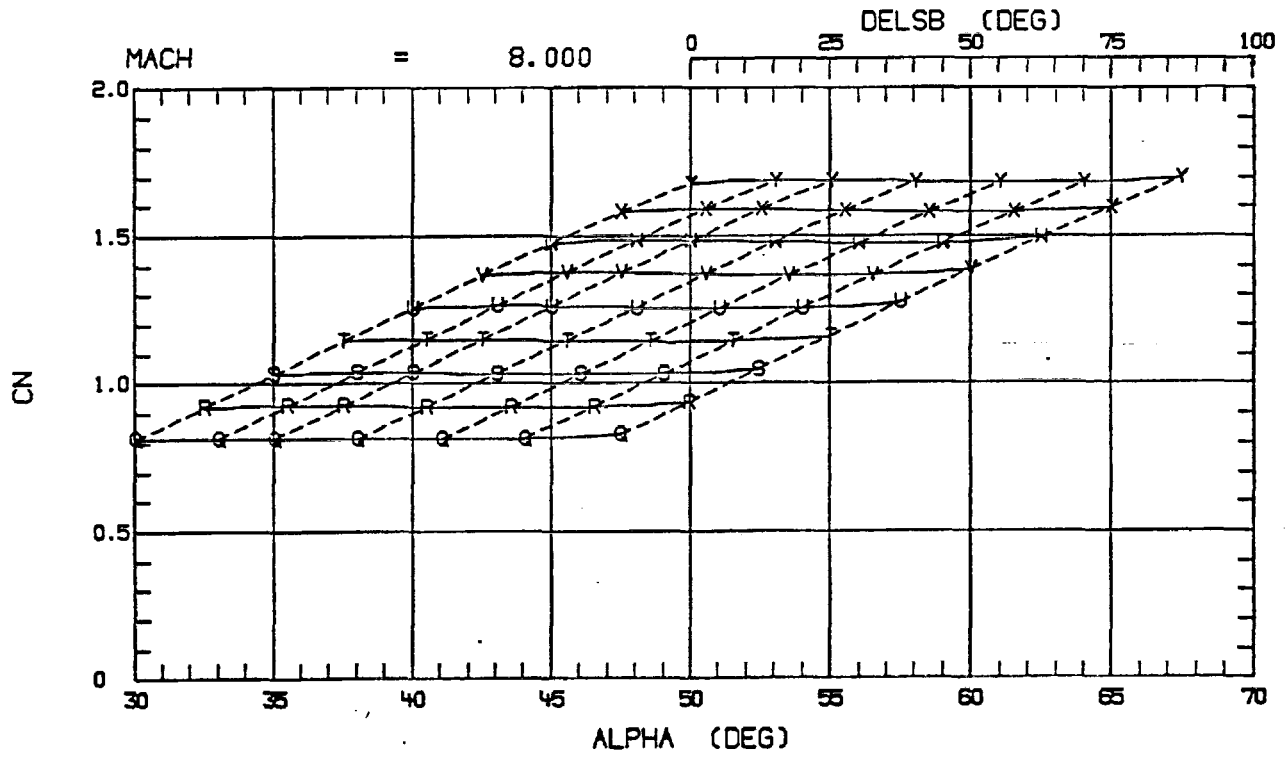
FIGURE 4.1.1.1-55
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000	32.500	35.000	37.500	40.000	42.500	45.000	47.500	50.000
	Q	R	S	T	U	V	W	X	Y
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.81147	0.91955	1.03027	1.14245	1.25482	1.36600	1.47452	1.57881	1.67725
15.000	0.81444	0.92350	1.03528	1.14857	1.26202	1.37414	1.48335	1.58793	1.68612
25.000	0.81424	0.92302	1.03461	1.14781	1.26128	1.37354	1.48299	1.58792	1.68643
40.000	0.81263	0.92032	1.03092	1.14333	1.25627	1.36831	1.47787	1.58324	1.68252
55.000	0.81181	0.91846	1.02807	1.13961	1.25187	1.36346	1.47287	1.57841	1.67821
70.000	0.81444	0.92107	1.03061	1.14199	1.25401	1.36531	1.47438	1.57953	1.67898
87.200	0.82511	0.93427	1.04601	1.15911	1.27221	1.38382	1.49233	1.59604	1.69306

ENGINEER D.
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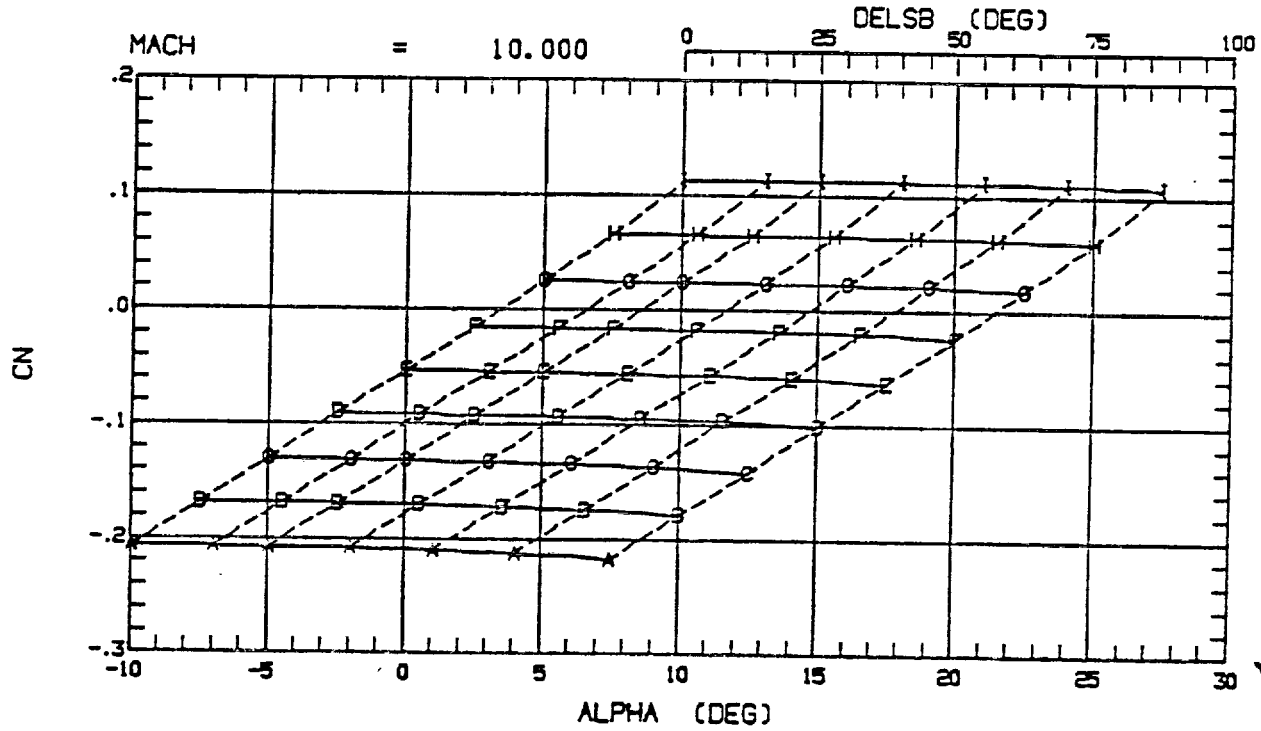
FIGURE 4.1.1.1-56
BASIC NORMAL FORCE COEFFICIENT

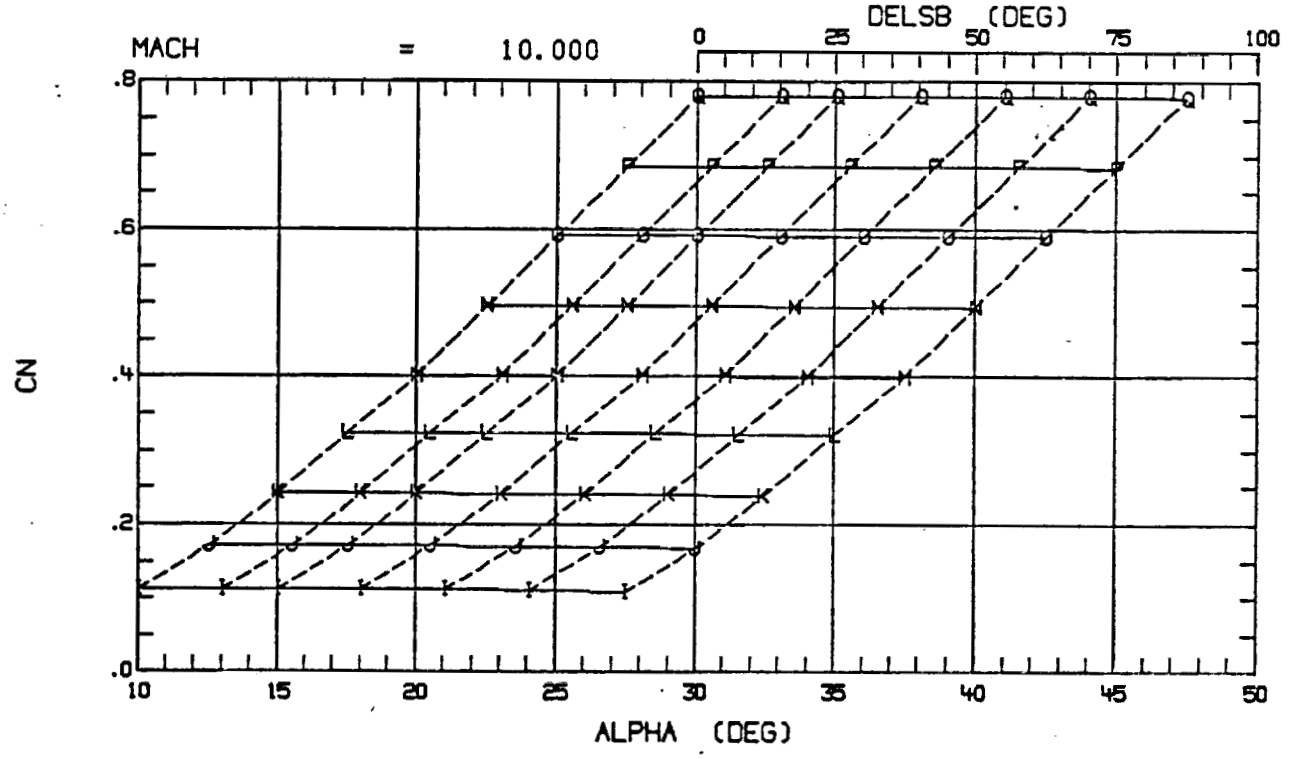


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.20774	-0.16889	-0.13093	-0.09106	-0.05330	-0.01549	0.02465	0.06514	0.11248
15.000	-0.20796	-0.16934	-0.13202	-0.09225	-0.05460	-0.01643	0.02405	0.06487	0.11248
25.000	-0.20810	-0.16995	-0.13270	-0.09300	-0.05540	-0.01700	0.02370	0.06470	0.11248
40.000	-0.20925	-0.17109	-0.13382	-0.09405	-0.05640	-0.01790	0.02289	0.06398	0.11185
55.000	-0.21099	-0.17277	-0.13543	-0.09556	-0.05780	-0.01913	0.02183	0.06306	0.11107
70.000	-0.21325	-0.17505	-0.13763	-0.09756	-0.05960	-0.02061	0.02061	0.06208	0.11030
87.200	-0.21531	-0.17989	-0.14230	-0.10195	-0.06370	-0.02440	0.01711	0.05901	0.10760

ENGINEER D.L.
DATE 3-92

FIGURE 4.1.1.1-57
BASIC NORMAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.11248	0.17030	0.24079	0.32300	0.40000	0.49500	0.58999	0.68430	0.78000
15.000	0.11248	0.17030	0.24079	0.32300	0.40000	0.49500	0.58999	0.68430	0.78000
25.000	0.11248	0.17030	0.24079	0.32300	0.40000	0.49500	0.58999	0.68430	0.78000
40.000	0.11185	0.16973	0.24029	0.32256	0.39861	0.49470	0.58979	0.68420	0.78000
55.000	0.11107	0.16904	0.23966	0.32196	0.39901	0.49430	0.58958	0.68402	0.77982
70.000	0.11030	0.16839	0.23911	0.32146	0.39855	0.49389	0.58921	0.68375	0.77965
87.200	0.10760	0.16629	0.23754	0.32038	0.39789	0.49314	0.58837	0.68291	0.77850

ENGINEER D²
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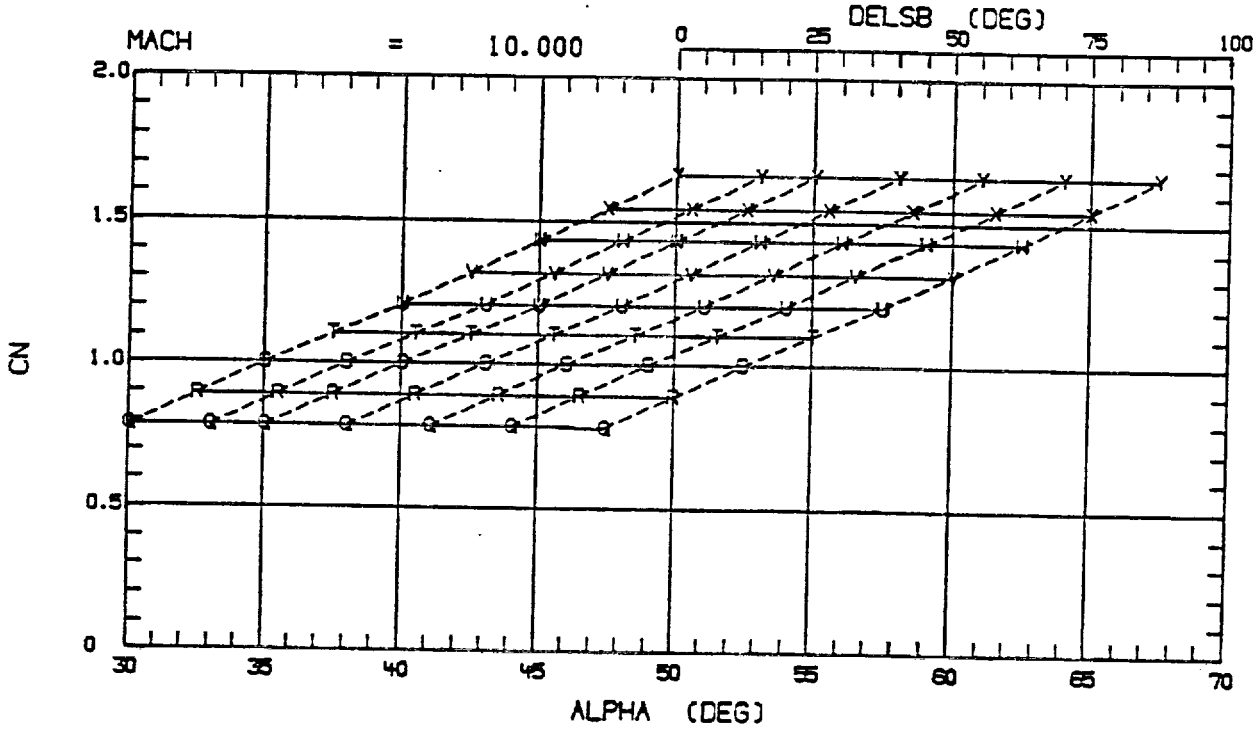
FIGURE 4.1.1.1-58
BASIC NORMAL FORCE COEFFICIENT



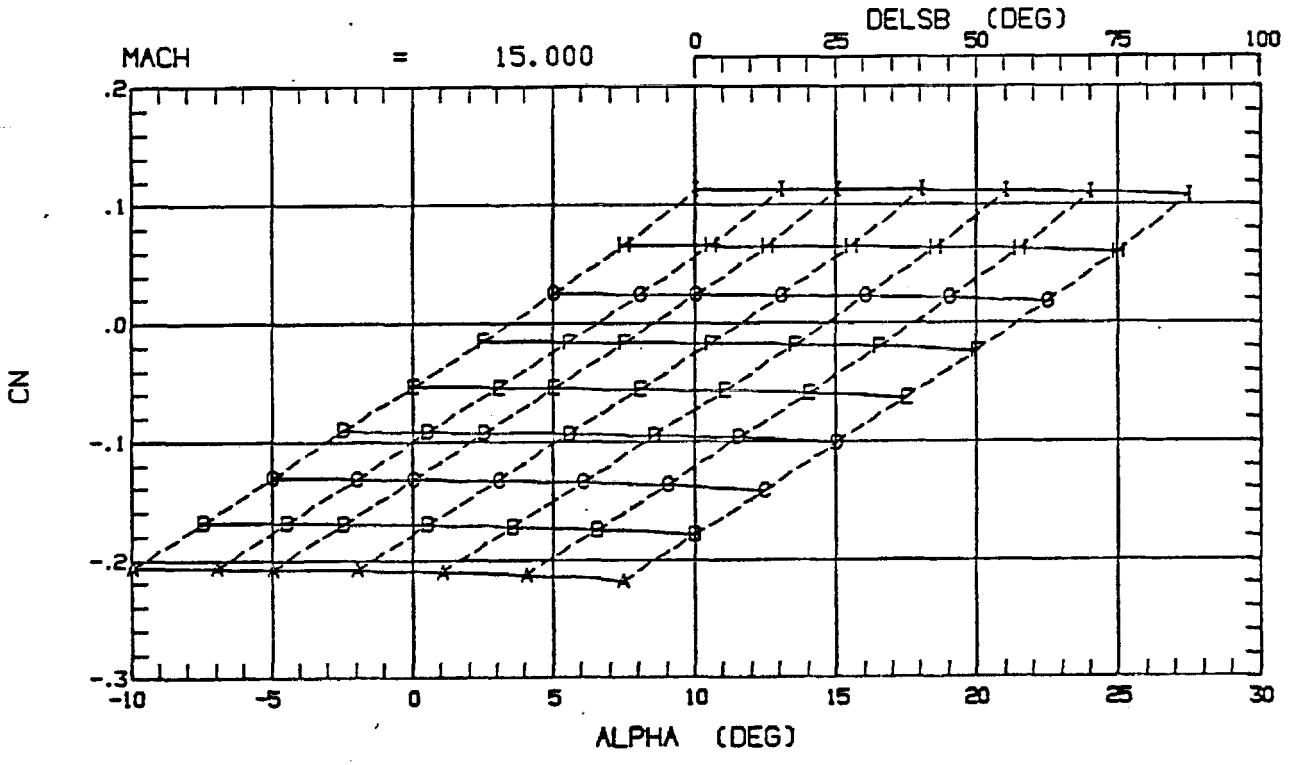
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
15.000	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
25.000	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
40.000	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
55.000	0.77982	0.88904	0.99995	1.10144	1.20500	1.31624	1.43000	1.54353	1.66000
70.000	0.77965	0.88893	0.99990	1.10142	1.20500	1.31624	1.43000	1.54353	1.66000
87.200	0.77960	0.88813	0.99932	1.10113	1.20500	1.31624	1.43000	1.54353	1.66000

ENGINEER D.
DATE 3-83

FIGURE 4.1.1.1-59
BASIC NORMAL FORCE COEFFICIENT

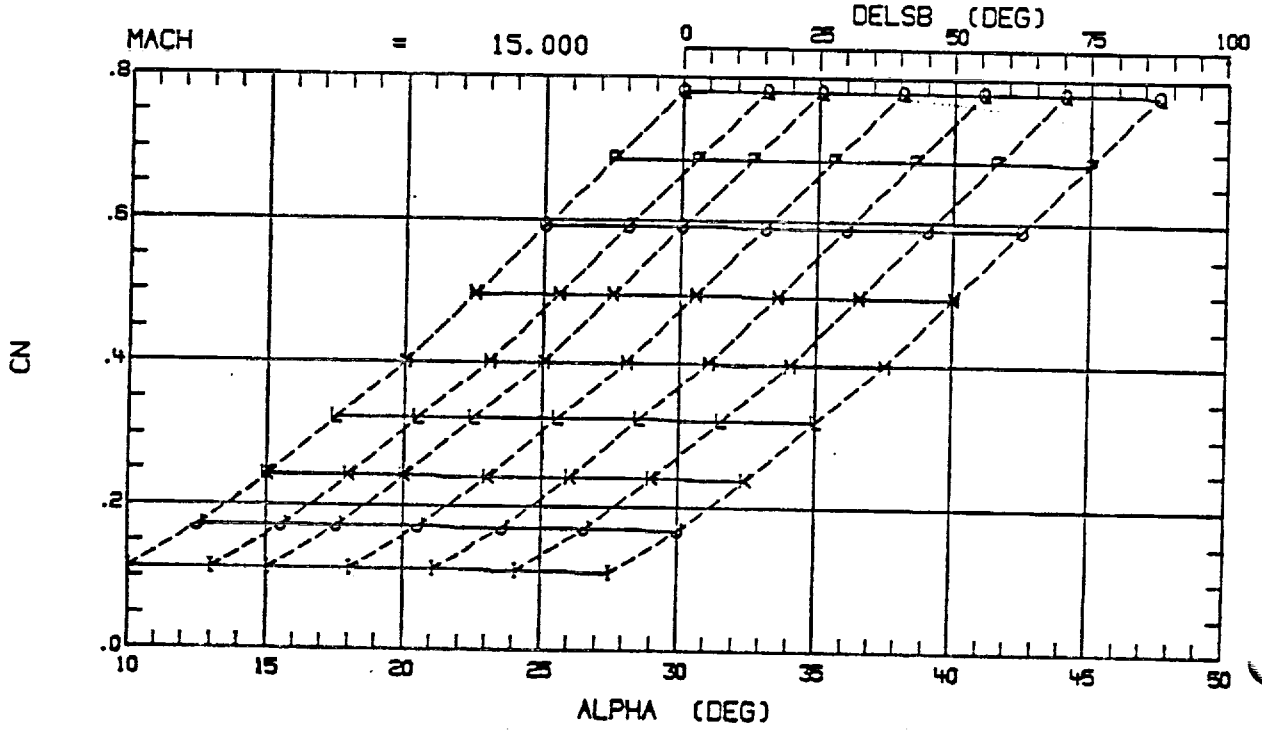


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000	-7.500	-5.000	-2.500	0.0	2.500	5.000	7.500	10.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.20774	-0.16869	-0.13093	-0.09106	-0.05330	-0.01549	0.02465	0.06514	0.11248
15.000	-0.20796	-0.16954	-0.13202	-0.09226	-0.05460	-0.01643	0.02406	0.06487	0.11248
25.000	-0.20810	-0.16995	-0.13270	-0.09300	-0.05540	-0.01700	0.02370	0.06470	0.11248
40.000	-0.20925	-0.17109	-0.13382	-0.09405	-0.05640	-0.01790	0.02299	0.06398	0.11185
55.000	-0.21099	-0.17277	-0.13543	-0.09556	-0.05780	-0.01913	0.02183	0.06306	0.11107
70.000	-0.21335	-0.17505	-0.13763	-0.09756	-0.05960	-0.02061	0.02061	0.06208	0.11030
87.200	-0.21831	-0.17989	-0.14230	-0.10195	-0.06370	-0.02440	0.01711	0.05901	0.10760

ENGINEER D.
DATE 3-82

FIGURE 4.1.1.1-60
BASIC NORMAL FORCE COEFFICIENT

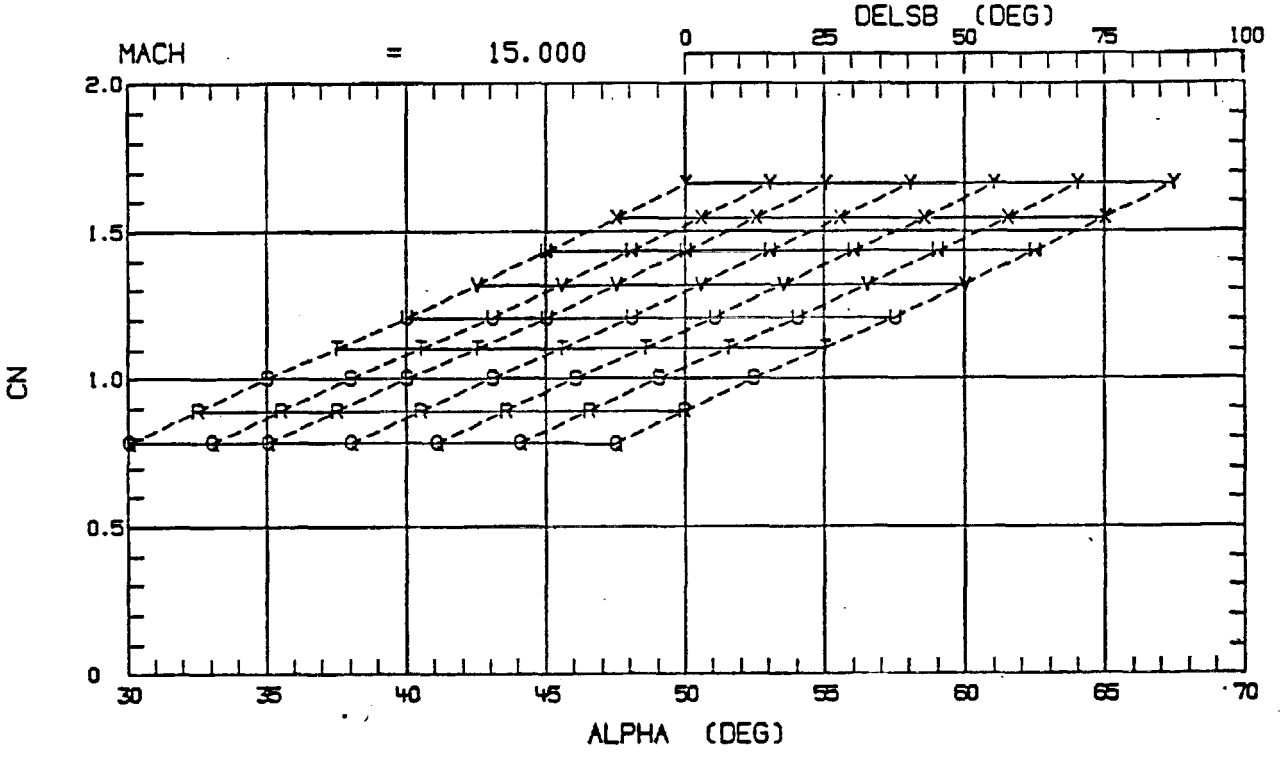


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.11248	0.17030	0.24079	0.32300	0.40000	0.49500	0.58999	0.68430	0.78000
15.000	0.11248	0.17030	0.24079	0.32300	0.40000	0.49500	0.58999	0.68430	0.78000
25.000	0.11248	0.17030	0.24079	0.32300	0.40000	0.49500	0.58999	0.68430	0.78000
40.000	0.11185	0.16973	0.24029	0.32256	0.39961	0.49470	0.58979	0.68420	0.78000
55.000	0.11107	0.16904	0.23966	0.32195	0.39901	0.49430	0.58958	0.68402	0.77982
70.000	0.11030	0.16839	0.23911	0.32146	0.39855	0.49389	0.58921	0.68375	0.77965
87.200	0.10760	0.16629	0.23754	0.32038	0.39789	0.49314	0.58837	0.68291	0.77860

ENGINEER D²
DATE 7-82

FIGURE 4.1.1.1-61
BASIC NORMAL FORCE COEFFICIENT

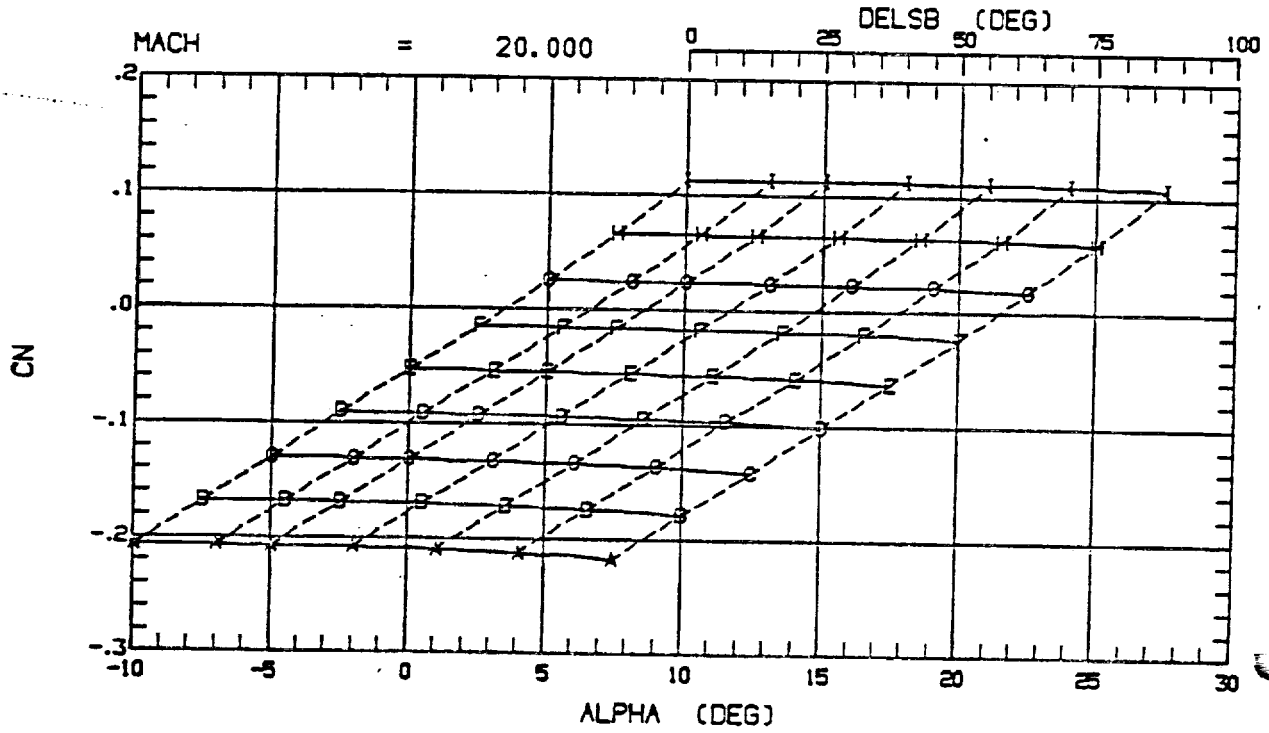


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
15.000	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
25.000	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
40.000	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
55.000	0.77982	0.88904	0.99995	1.10144	1.20500	1.31624	1.43000	1.54353	1.66000
70.000	0.77965	0.88993	0.99990	1.10142	1.20500	1.31624	1.43000	1.54353	1.66000
87.200	0.77860	0.88813	0.99932	1.10113	1.20500	1.31624	1.43000	1.54353	1.66000

ENGINEER D
DATE 3-81

FIGURE 4.1.1.1-62
BASIC NORMAL FORCE COEFFICIENT

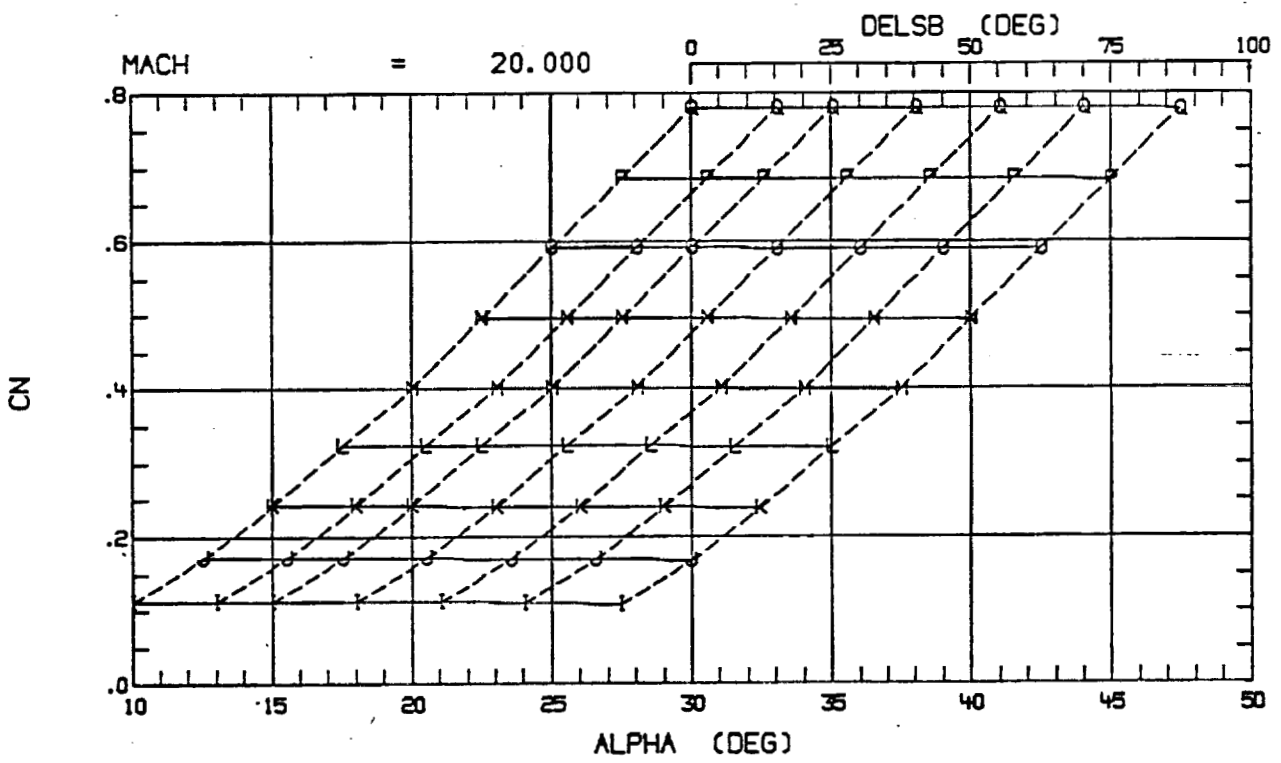


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	-0.20774	-0.16889	-0.13093	-0.09106	-0.05330	-0.01549	0.02465	0.06514	0.11248
15.000	-0.20796	-0.16984	-0.13202	-0.09225	-0.05460	-0.01643	0.02406	0.06487	0.11248
25.000	-0.20810	-0.16995	-0.13270	-0.09300	-0.05540	-0.01700	0.02370	0.06470	0.11248
40.000	-0.20925	-0.17109	-0.13362	-0.09405	-0.05640	-0.01790	0.02289	0.06398	0.11185
55.000	-0.21099	-0.17277	-0.13543	-0.09556	-0.05780	-0.01913	0.02183	0.06306	0.11107
70.000	-0.21336	-0.17505	-0.13763	-0.09756	-0.05960	-0.02061	0.02061	0.06208	0.11030
87.200	-0.21931	-0.17989	-0.14230	-0.10195	-0.06370	-0.02440	0.01711	0.05901	0.10760

ENGINEER D
DATE 7-82

FIGURE 4.1.1.1-63
BASIC NORMAL FORCE COEFFICIENT



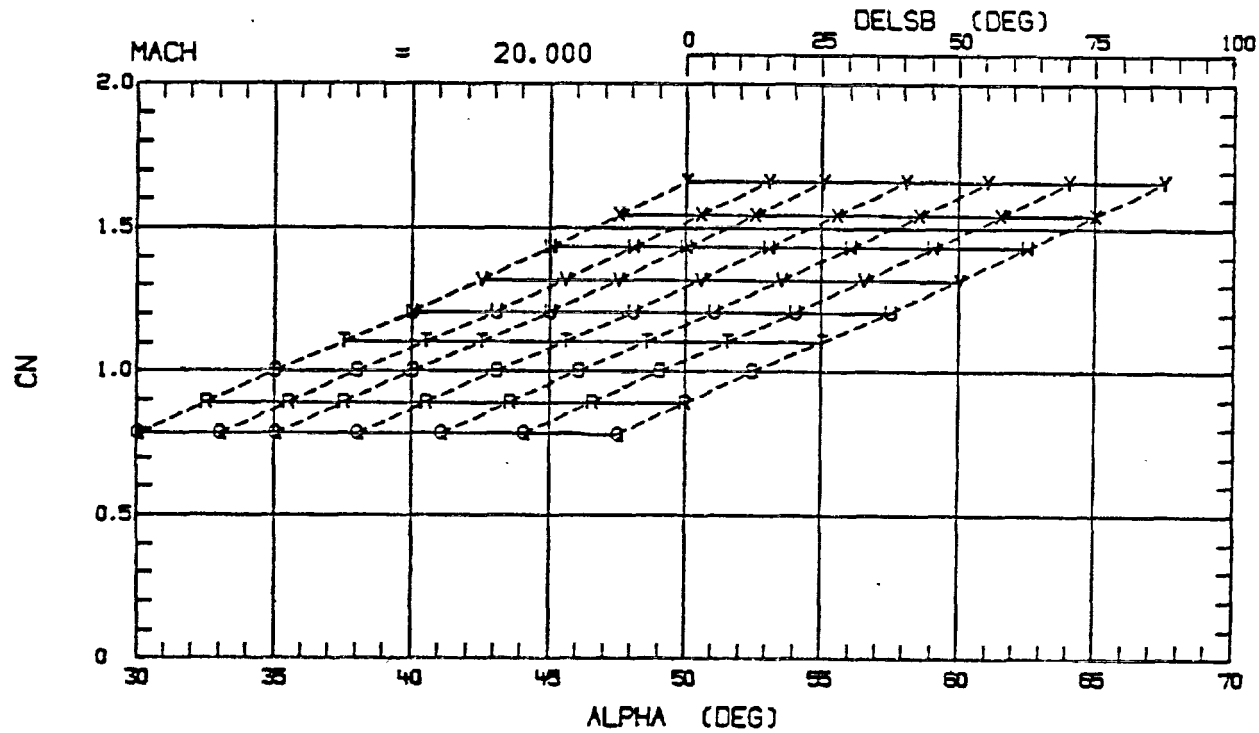
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.11248	0.17030	0.24079	0.32300	0.40000	0.49500	0.58999	0.68430	0.78000
15.000	0.11248	0.17030	0.24079	0.32300	0.40000	0.49500	0.58999	0.68430	0.78000
25.000	0.11248	0.17030	0.24079	0.32300	0.40000	0.49500	0.58999	0.68430	0.78000
40.000	0.11185	0.16973	0.24029	0.32256	0.39951	0.49470	0.58979	0.68420	0.78000
55.000	0.11107	0.16904	0.23966	0.32196	0.39901	0.49430	0.58958	0.68402	0.77982
70.000	0.11030	0.16839	0.23911	0.32146	0.39855	0.49389	0.58921	0.68375	0.77965
87.200	0.10760	0.16629	0.23754	0.32038	0.39789	0.49314	0.58837	0.68291	0.77860

ENGINEER D.
DATE 3-82

FIGURE 4.1.1.1-64
BASIC NORMAL FORCE COEFFICIENT

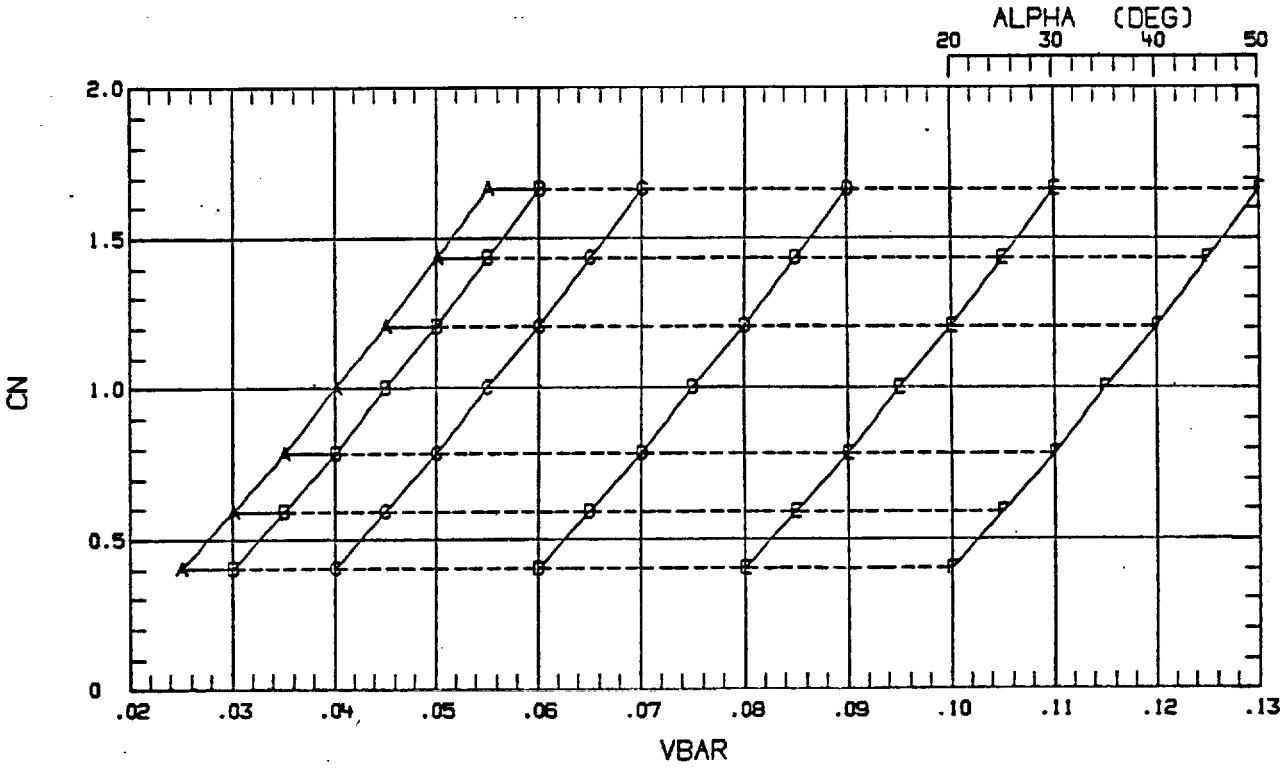


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	NORMAL FORCE COEFFICIENT								
0.0	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
15.000	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
25.000	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
40.000	0.78000	0.88915	1.00000	1.10146	1.20500	1.31624	1.43000	1.54353	1.66000
55.000	0.77982	0.88904	0.99995	1.10144	1.20500	1.31624	1.43000	1.54353	1.66000
70.000	0.77965	0.88893	0.99990	1.10142	1.20500	1.31624	1.43000	1.54353	1.66000
87.200	0.77860	0.88813	0.99952	1.10113	1.20500	1.31624	1.43000	1.54353	1.66000

ENGINEER D
DATE 3-8

FIGURE 4.1.1.1-65
BASIC NORMAL FORCE COEFFICIENT

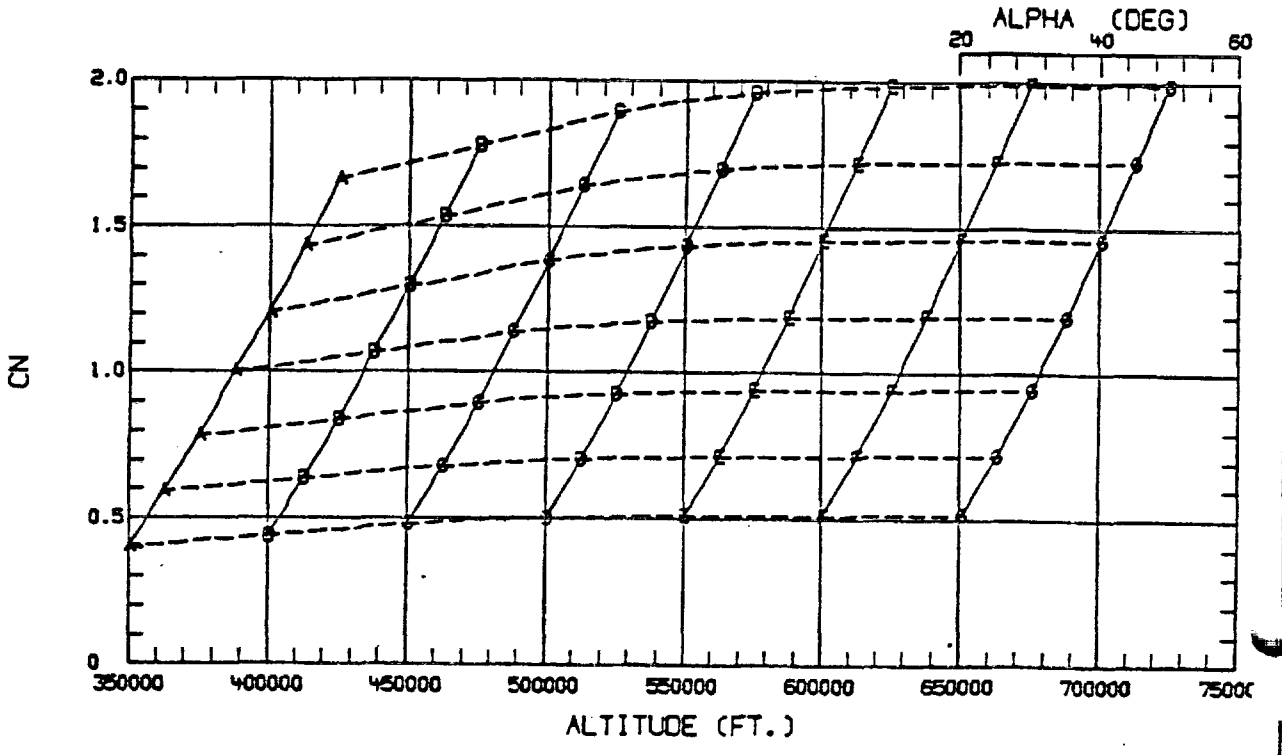


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	VBAR					
	0.005 A	0.010 B	0.020 C	0.040 D	0.060 E	0.080 F
ALPHA (DEG)	VISCOUS NORMAL FORCE COEFFICIENT					
20.000	0.40000	0.40000	0.40000	0.40000	0.40000	0.40000
25.000	0.59000	0.59000	0.59000	0.59000	0.59000	0.59000
30.000	0.78000	0.78000	0.78000	0.78000	0.78000	0.78000
35.000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
40.000	1.20500	1.20500	1.20500	1.20500	1.20500	1.20500
45.000	1.43000	1.43000	1.43000	1.43000	1.43000	1.43000
50.000	1.66000	1.66000	1.66000	1.66000	1.66000	1.66000

ENGINEER NASA
DATE

FIGURE 4.1.1.1-66
BASIC NORMAL FORCE COEFFICIENT

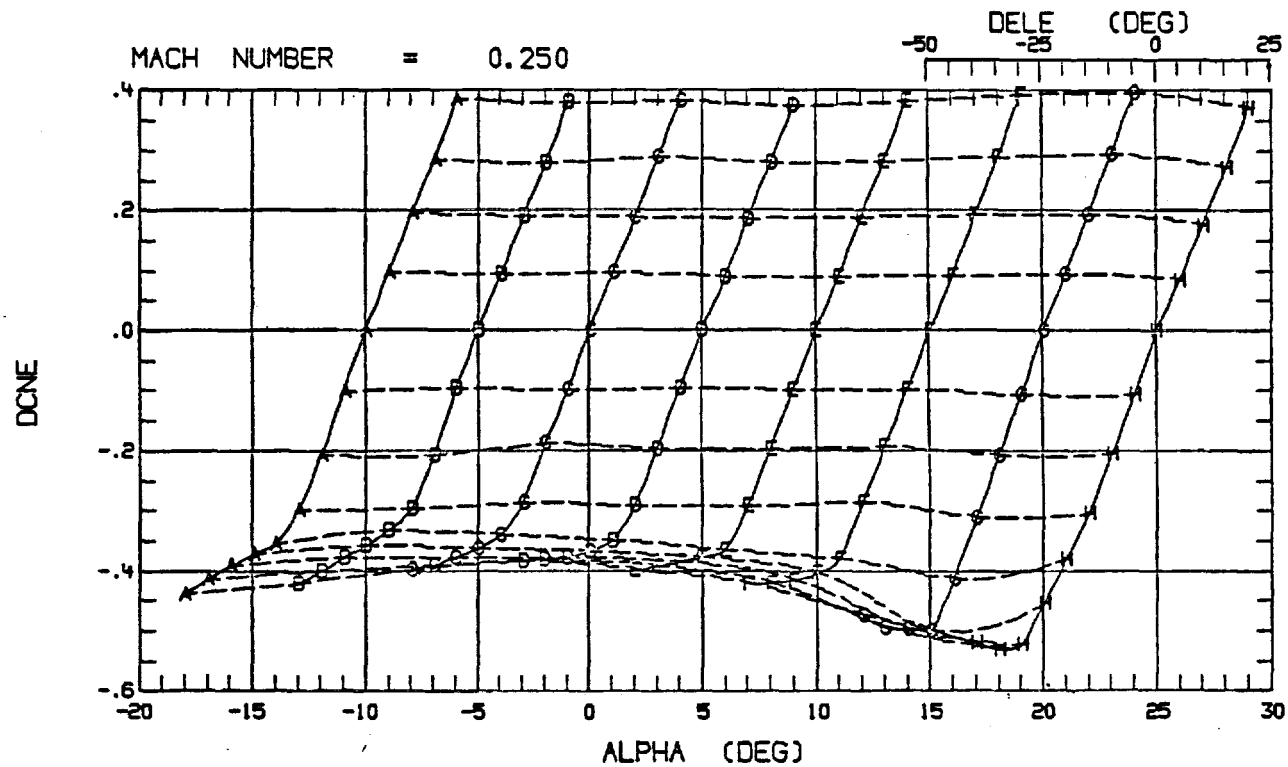


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALTITUDE NORMAL FORCE						
20.000	0.40000	0.43820	0.47800	0.49930	0.50740	0.50990	0.51030
25.000	0.55000	0.63280	0.67730	0.70120	0.71020	0.71310	0.71350
30.000	0.78000	0.83600	0.89440	0.92570	0.93750	0.94120	0.94180
35.000	1.00000	1.06630	1.13530	1.17230	1.18630	1.19070	1.19140
40.000	1.20500	1.29210	1.38300	1.43160	1.45000	1.45580	1.45670
45.000	1.43000	1.53190	1.63820	1.69500	1.71650	1.72330	1.72440
50.000	1.66000	1.77500	1.89490	1.95900	1.98330	1.99090	1.99210

ENGINEER NASA
DATE

FIGURE 4.1.1.1-67
BASIC NORMAL FORCE COEFFICIENT

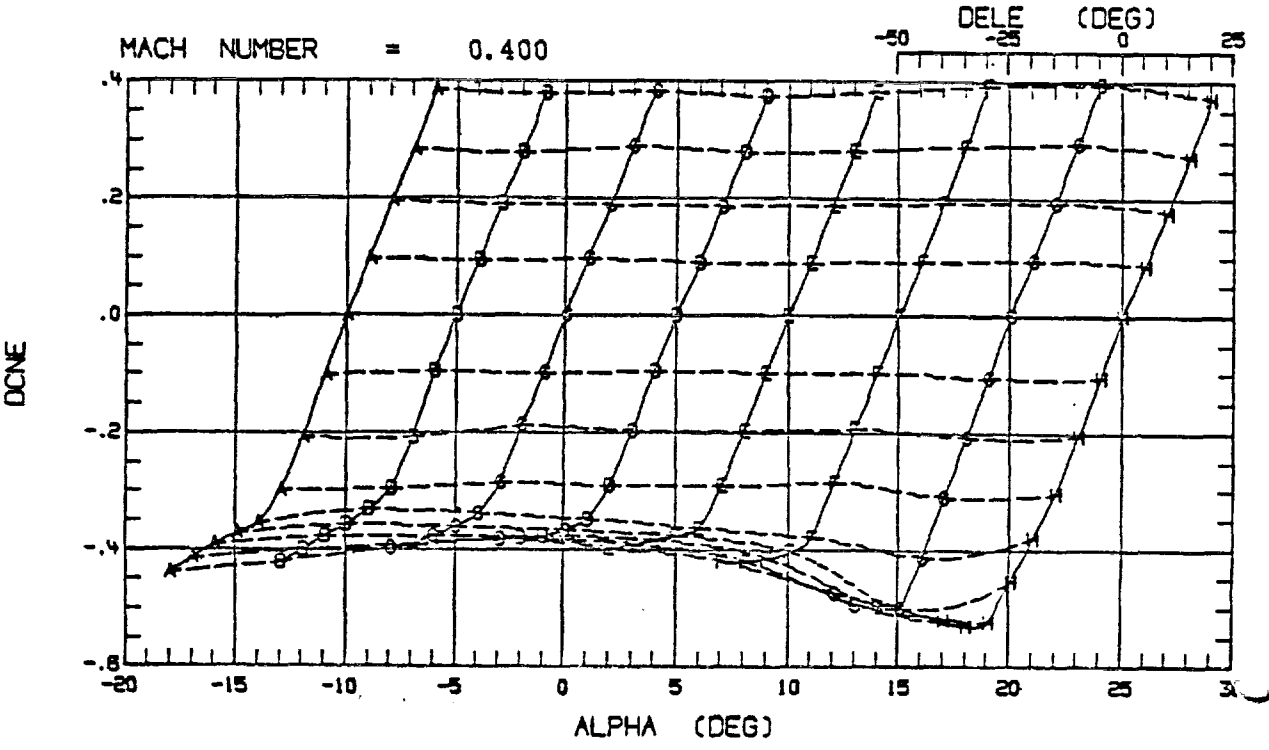


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.43913	-0.42131	-0.39900	-0.38317	-0.39973	-0.42213	-0.47498	-0.52100
-35.000	-0.41452	-0.40204	-0.39100	-0.38213	-0.39352	-0.42144	-0.49616	-0.53170
-30.000	-0.39287	-0.37981	-0.37800	-0.37910	-0.38639	-0.41668	-0.49859	-0.52393
-25.000	-0.37464	-0.35849	-0.36300	-0.36910	-0.37909	-0.40568	-0.50218	-0.45592
-20.000	-0.35740	-0.33401	-0.34100	-0.35122	-0.36669	-0.38262	-0.41565	-0.38199
-15.000	-0.30036	-0.29684	-0.28800	-0.29323	-0.29272	-0.28816	-0.31274	-0.30470
-10.000	-0.20985	-0.20886	-0.19000	-0.19803	-0.19817	-0.19503	-0.20988	-0.20728
-5.000	-0.10148	-0.09832	-0.10000	-0.09824	-0.09894	-0.09932	-0.10844	-0.10851
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.09619	0.09299	0.09500	0.08845	0.08892	0.09018	0.09345	0.08313
10.000	0.19437	0.18846	0.18800	0.18530	0.18746	0.19093	0.19224	0.17445
15.000	0.28316	0.27859	0.28800	0.27761	0.29194	0.28892	0.29242	0.27060
20.000	0.38399	0.37924	0.38200	0.37370	0.38180	0.39292	0.39415	0.36894

ENGINEER DCO
DATE 10/4/78

FIGURE 4.1.1.1-68
EFFECT OF ELEVON



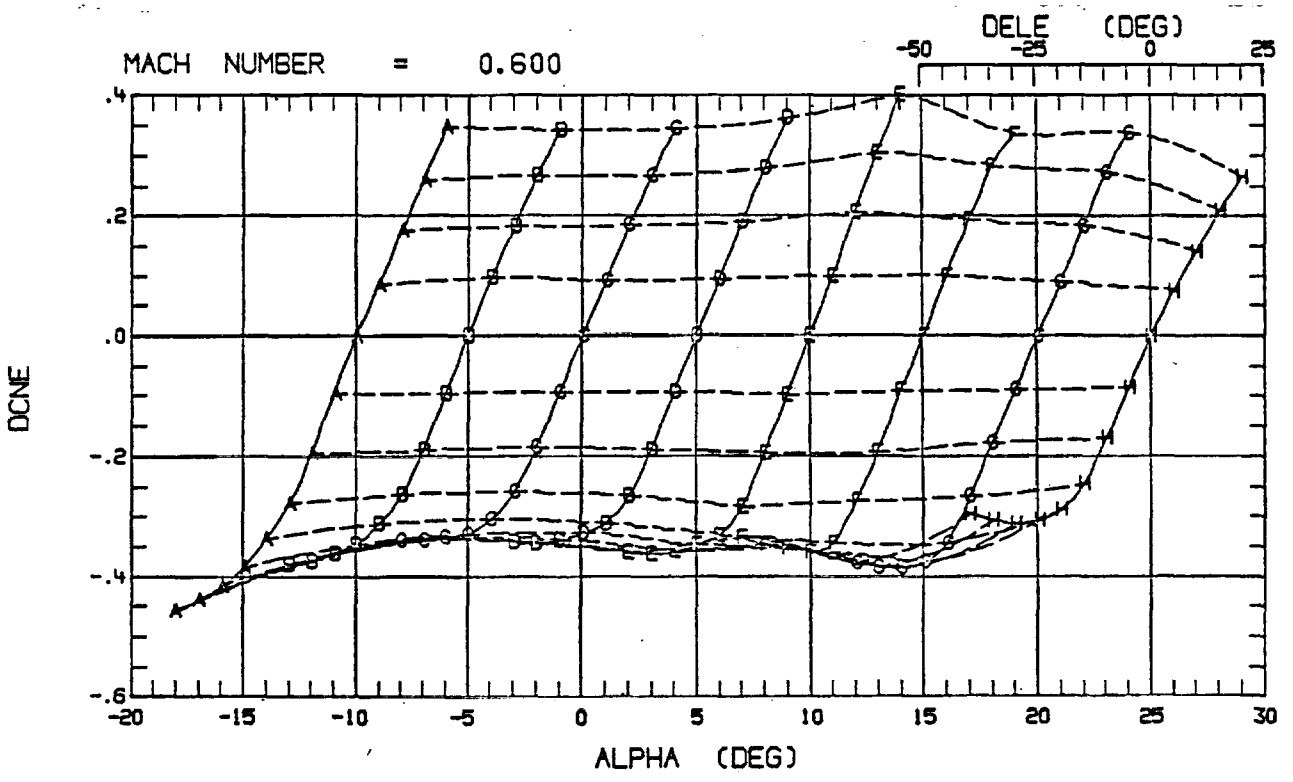
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.43913	-0.42131	-0.39900	-0.38317	-0.39973	-0.42213	-0.47498	-0.52100
-35.000	-0.41452	-0.40204	-0.39100	-0.38213	-0.39352	-0.42144	-0.49616	-0.53170
-30.000	-0.39287	-0.37981	-0.37800	-0.37910	-0.38639	-0.41668	-0.49859	-0.52393
-25.000	-0.37464	-0.35849	-0.36300	-0.36910	-0.37909	-0.40568	-0.50218	-0.45592
-20.000	-0.35740	-0.33401	-0.34100	-0.35122	-0.36669	-0.38292	-0.41565	-0.38199
-15.000	-0.30036	-0.29684	-0.28800	-0.29323	-0.29272	-0.28816	-0.31274	-0.30470
-10.000	-0.20985	-0.20886	-0.19000	-0.19803	-0.19817	-0.19503	-0.20988	-0.20728
-5.000	-0.10148	-0.09832	-0.10000	-0.09824	-0.09894	-0.09932	-0.10844	-0.10851
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.09619	0.09299	0.09500	0.08845	0.08892	0.09018	0.09345	0.08313
10.000	0.19437	0.18846	0.18800	0.18530	0.18746	0.19093	0.19224	0.17445
15.000	0.28316	0.27859	0.29800	0.27761	0.28194	0.28892	0.29242	0.27060
20.000	0.38399	0.37924	0.38200	0.37370	0.38180	0.39292	0.39415	0.36894

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-69
EFFECT OF ELEVON

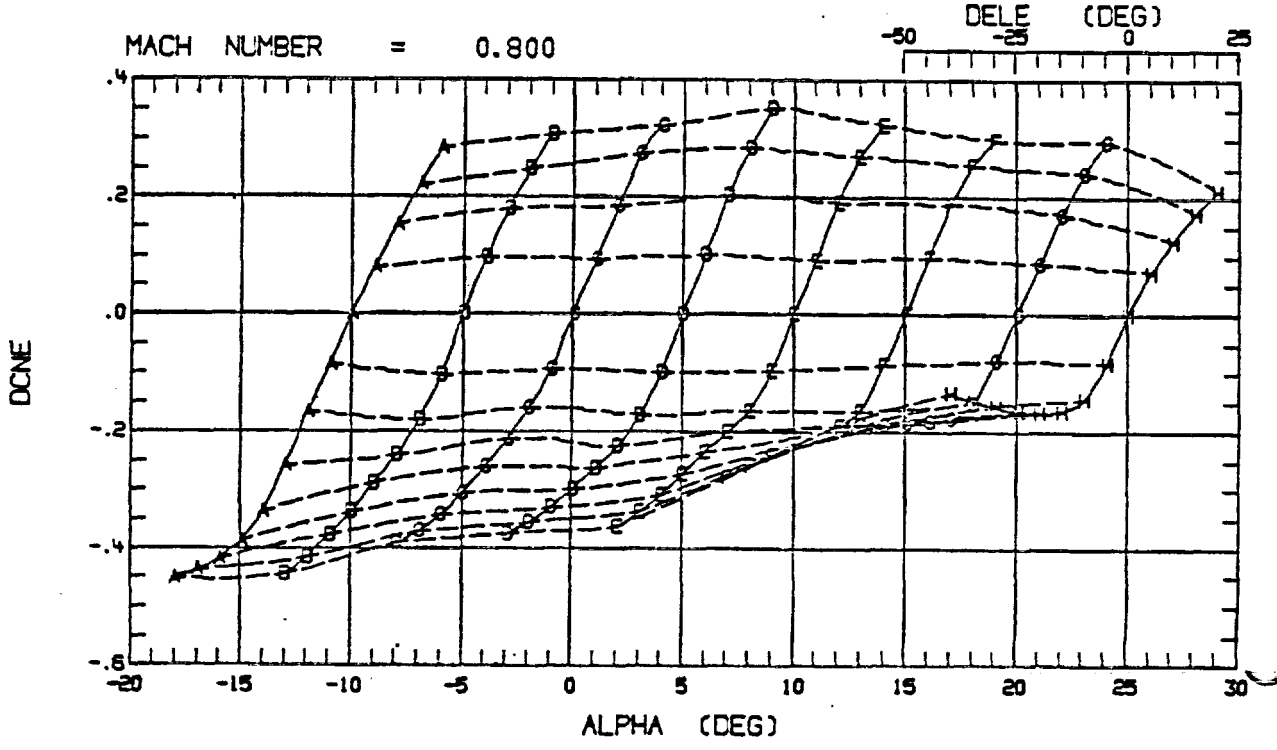


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.45821	-0.38280	-0.34200	-0.34335	-0.36044	-0.33661	-0.37852	-0.29746
-35.000	-0.44113	-0.37589	-0.34000	-0.34639	-0.36467	-0.34859	-0.38564	-0.30750
-30.000	-0.41817	-0.36301	-0.33600	-0.34055	-0.36004	-0.35454	-0.38804	-0.31301
-25.000	-0.38637	-0.34758	-0.33000	-0.32960	-0.34940	-0.36029	-0.37779	-0.30756
-20.000	-0.33882	-0.31422	-0.30600	-0.31258	-0.33229	-0.34625	-0.34609	-0.28920
-15.000	-0.28113	-0.26566	-0.26100	-0.26864	-0.28495	-0.27580	-0.26869	-0.24799
-10.000	-0.19673	-0.19137	-0.18600	-0.19062	-0.19551	-0.19427	-0.17839	-0.17164
-5.000	-0.09645	-0.09651	-0.09500	-0.09408	-0.09877	-0.09263	-0.09107	-0.08673
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.08309	0.09499	0.09000	0.09360	0.09801	0.09882	0.08680	0.07322
10.000	0.17434	0.18148	0.18300	0.18873	0.20495	0.19069	0.18121	0.13917
15.000	0.25839	0.26546	0.26500	0.27827	0.30470	0.28063	0.27033	0.20593
20.000	0.34613	0.34229	0.34400	0.36092	0.39895	0.33484	0.33740	0.26382

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-70
EFFECT OF ELEVON

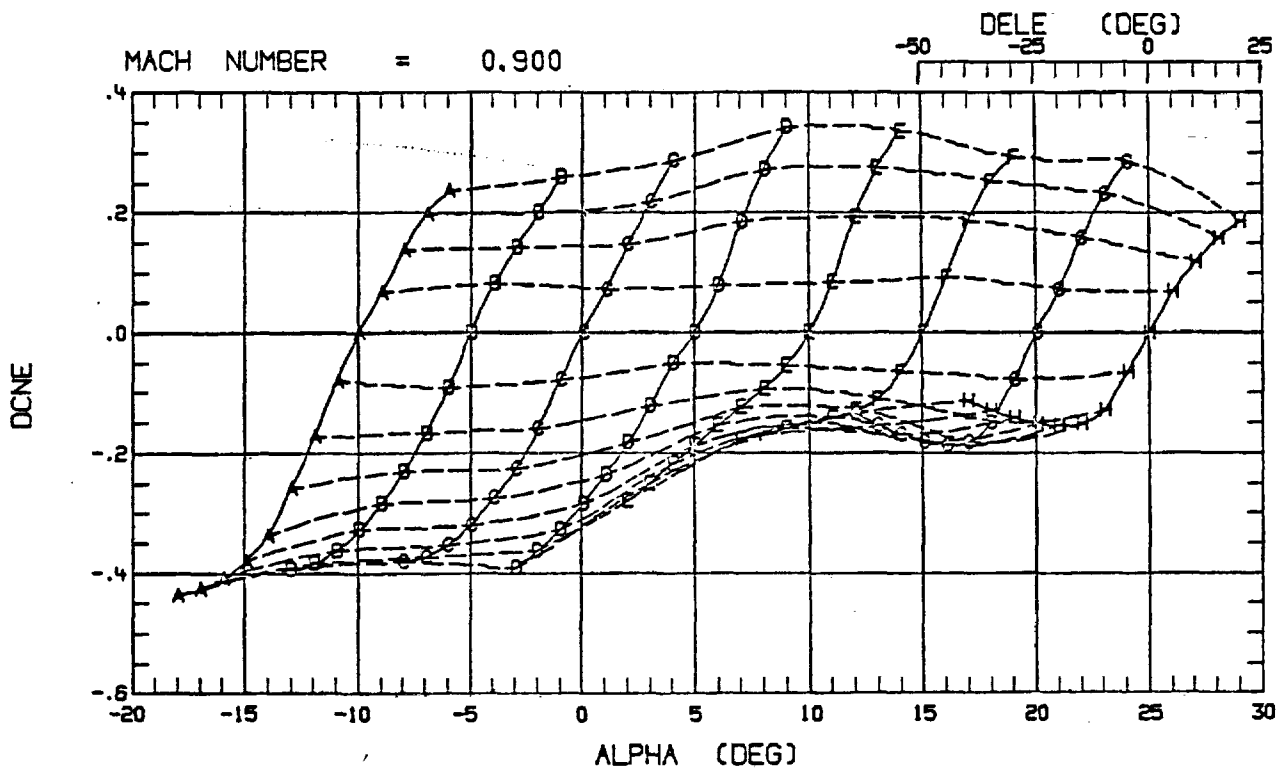


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.45183	-0.44512	-0.39300	-0.37583	-0.36485	-0.27929	-0.19060	-0.13676
-35.000	-0.43827	-0.41725	-0.37200	-0.35635	-0.33977	-0.26113	-0.18962	-0.14859
-30.000	-0.41892	-0.37835	-0.34400	-0.33197	-0.30952	-0.24209	-0.18848	-0.15861
-25.000	-0.38876	-0.33958	-0.30700	-0.30023	-0.27386	-0.22393	-0.18734	-0.16591
-20.000	-0.33795	-0.28984	-0.26300	-0.26424	-0.23641	-0.20526	-0.18449	-0.16867
-15.000	-0.25971	-0.24331	-0.21300	-0.22734	-0.20191	-0.19014	-0.17762	-0.16530
-10.000	-0.15762	-0.18193	-0.16000	-0.17433	-0.16527	-0.16515	-0.15448	-0.14549
-5.000	-0.08761	-0.10465	-0.09500	-0.10105	-0.09706	-0.08780	-0.08091	-0.08450
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.07767	0.09507	0.09400	0.09967	0.08996	0.09522	0.06552	0.07006
10.000	0.15165	0.17966	0.16400	0.20185	0.19035	0.18638	0.16801	0.12454
15.000	0.21979	0.24666	0.27400	0.28254	0.26729	0.25172	0.23959	0.17229
20.000	0.29258	0.30725	0.32200	0.35291	0.32011	0.29626	0.29235	0.20958

ENGINEER DCO
DATE 10-7-78

FIGURE 4.1.1.1-71
EFFECT OF ELEVON



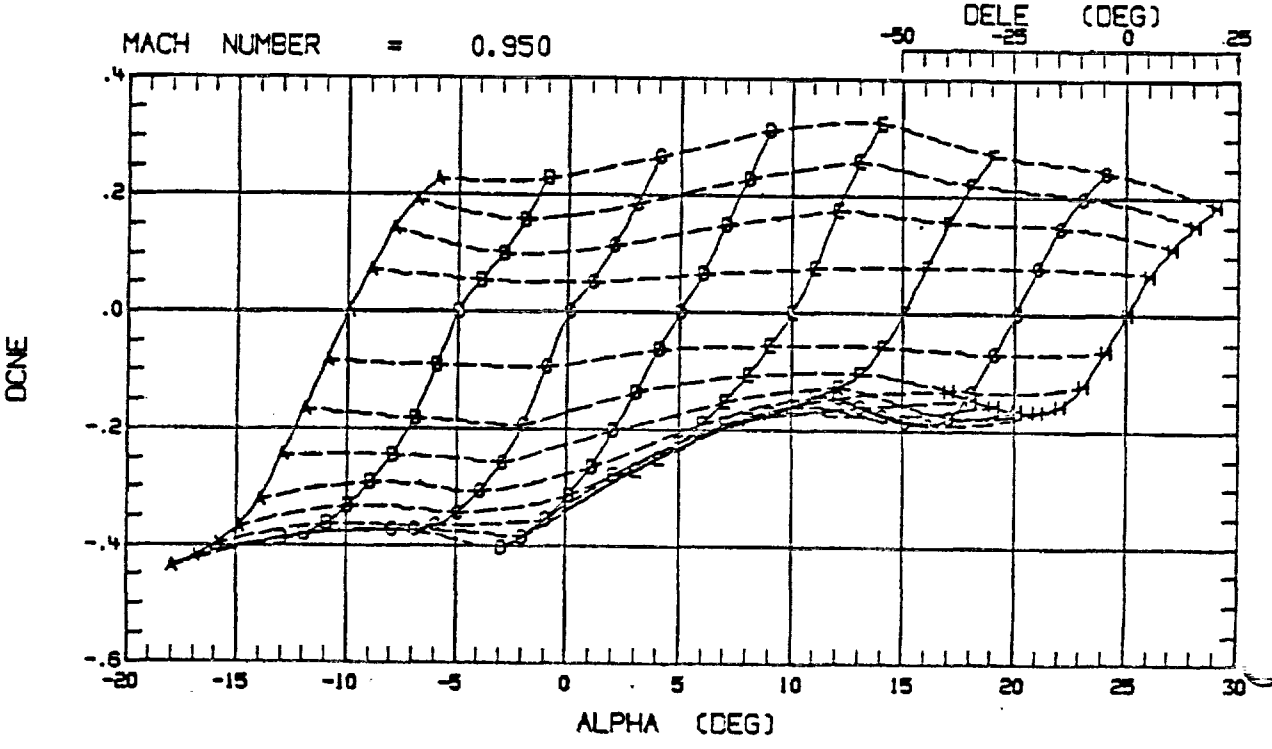
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.43671	-0.39521	-0.38200	-0.39159	-0.28104	-0.17952	-0.13469	-0.11600
-35.000	-0.42634	-0.38535	-0.37300	-0.36341	-0.25133	-0.16993	-0.15595	-0.13046
-30.000	-0.41008	-0.36355	-0.35300	-0.32898	-0.21880	-0.16034	-0.17139	-0.14332
-25.000	-0.38201	-0.32962	-0.32000	-0.28619	-0.18798	-0.15198	-0.18368	-0.15256
-20.000	-0.33795	-0.28589	-0.27600	-0.23734	-0.15621	-0.14310	-0.18884	-0.15610
-15.000	-0.26066	-0.23188	-0.22800	-0.18425	-0.12652	-0.13074	-0.18284	-0.15271
-10.000	-0.17467	-0.16729	-0.16200	-0.12409	-0.09399	-0.11162	-0.15158	-0.12974
-5.000	-0.08182	-0.09187	-0.08000	-0.05275	-0.05674	-0.06737	-0.07892	-0.06703
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.06386	0.08002	0.07000	0.07741	0.08156	0.09109	0.07122	0.06704
10.000	0.13675	0.14046	0.14500	0.18366	0.19215	0.18470	0.15550	0.11514
15.000	0.19762	0.19936	0.21700	0.27138	0.27255	0.25146	0.22983	0.15719
20.000	0.23479	0.25666	0.28500	0.34096	0.33459	0.29020	0.28290	0.18452

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-72
EFFECT OF ELEVON

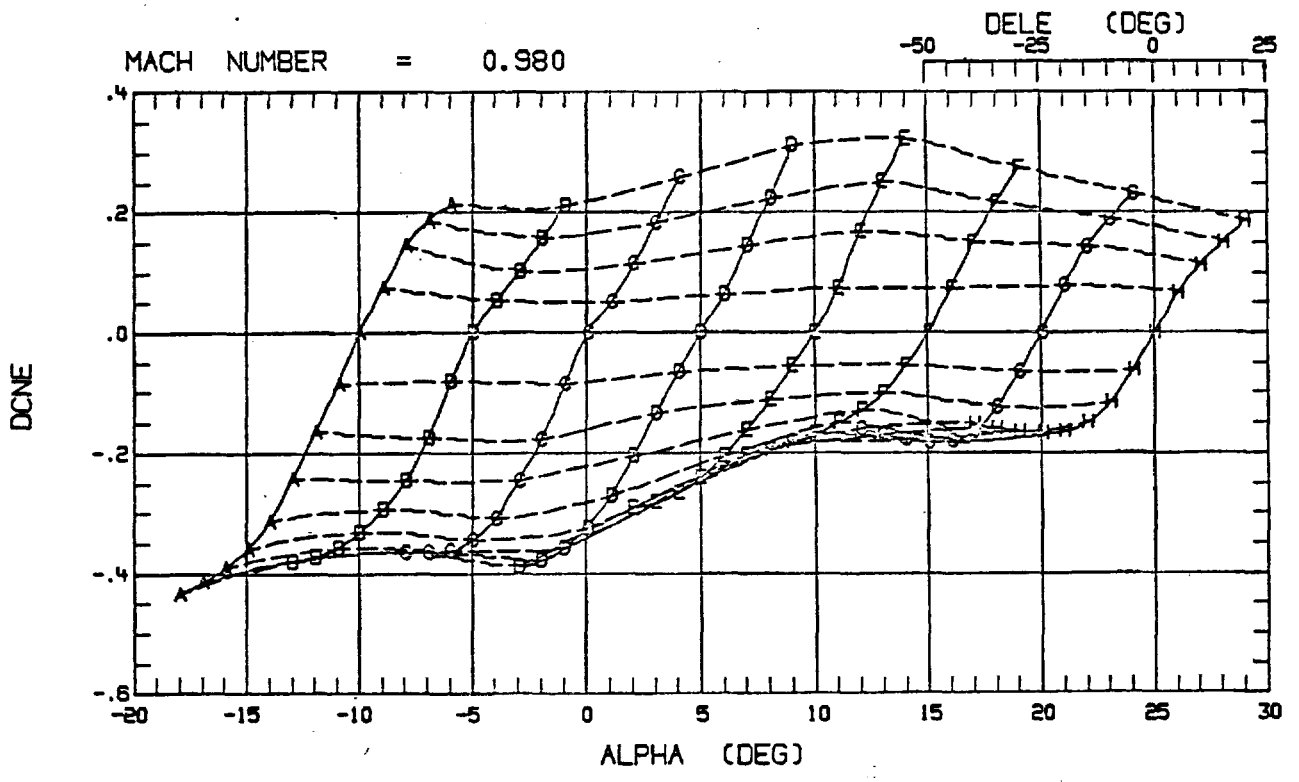


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.43785	-0.38986	-0.37300	-0.40455	-0.29111	-0.19174	-0.14469	-0.13322
-35.000	-0.42016	-0.38209	-0.37500	-0.38567	-0.27193	-0.18301	-0.16150	-0.14711
-30.000	-0.39915	-0.36441	-0.36700	-0.35579	-0.25156	-0.17342	-0.17643	-0.15786
-25.000	-0.36890	-0.33365	-0.34500	-0.31697	-0.22541	-0.16067	-0.18667	-0.16633
-20.000	-0.32363	-0.29388	-0.30900	-0.25706	-0.19065	-0.14419	-0.19106	-0.16805
-15.000	-0.24834	-0.24605	-0.26000	-0.20517	-0.15235	-0.12980	-0.17874	-0.15780
-10.000	-0.16788	-0.18423	-0.19300	-0.13821	-0.10813	-0.10396	-0.13524	-0.12364
-5.000	-0.08576	-0.09166	-0.09500	-0.06475	-0.05744	-0.05894	-0.07052	-0.06459
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.06963	0.05180	0.05000	0.06450	0.07467	0.07724	0.07694	0.06539
10.000	0.14152	0.09737	0.11300	0.14871	0.17373	0.15507	0.14731	0.11187
15.000	0.18891	0.15731	0.18400	0.22850	0.25691	0.21674	0.19797	0.15089
20.000	0.22555	0.22686	0.26500	0.31116	0.32306	0.26759	0.24104	0.18329

ENGINEER DCO
DATE 10-4-72

FIGURE 4.1.1.1-73
EFFECT OF ELEVON

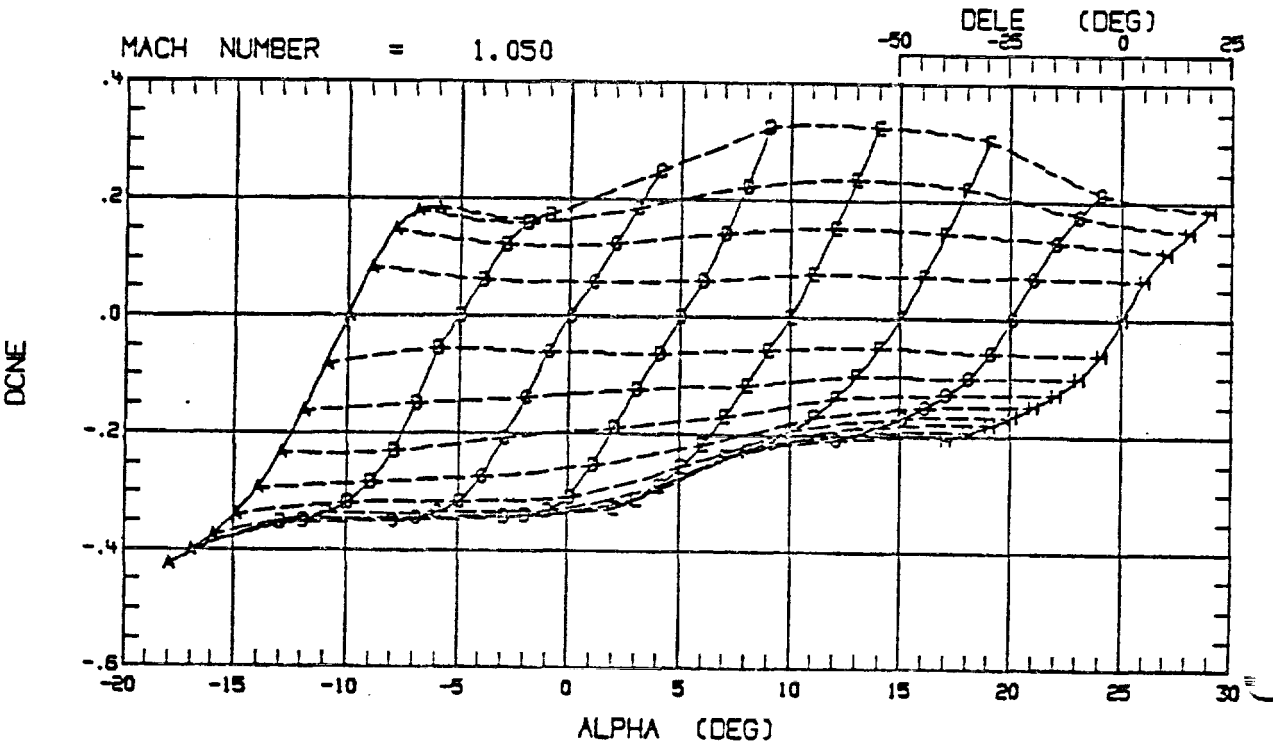


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.43505	-0.38094	-0.36669	-0.38985	-0.29178	-0.20475	-0.16043	-0.15337
-35.000	-0.41536	-0.37411	-0.36699	-0.37964	-0.28401	-0.19546	-0.17064	-0.16057
-30.000	-0.39249	-0.35826	-0.36370	-0.35961	-0.26759	-0.18437	-0.17888	-0.16495
-25.000	-0.36054	-0.33272	-0.34625	-0.32530	-0.24218	-0.16958	-0.18469	-0.16801
-20.000	-0.31512	-0.29506	-0.30991	-0.27232	-0.20542	-0.15082	-0.18037	-0.16625
-15.000	-0.24371	-0.24835	-0.24602	-0.20621	-0.16304	-0.13086	-0.16606	-0.15159
-10.000	-0.16610	-0.17735	-0.17902	-0.13513	-0.11385	-0.10235	-0.12568	-0.11835
-5.000	-0.08633	-0.08299	-0.08718	-0.06766	-0.05714	-0.05611	-0.06716	-0.06353
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.07312	0.05191	0.05050	0.06311	0.07347	0.07384	0.07674	0.06498
10.000	0.14396	0.10003	0.11294	0.14466	0.16588	0.14987	0.14194	0.11108
15.000	0.18514	0.15588	0.18128	0.22281	0.24909	0.21367	0.18710	0.14682
20.000	0.21324	0.20940	0.25848	0.31041	0.32234	0.27230	0.22926	0.18364

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.1-74
EFFECT OF ELEVON



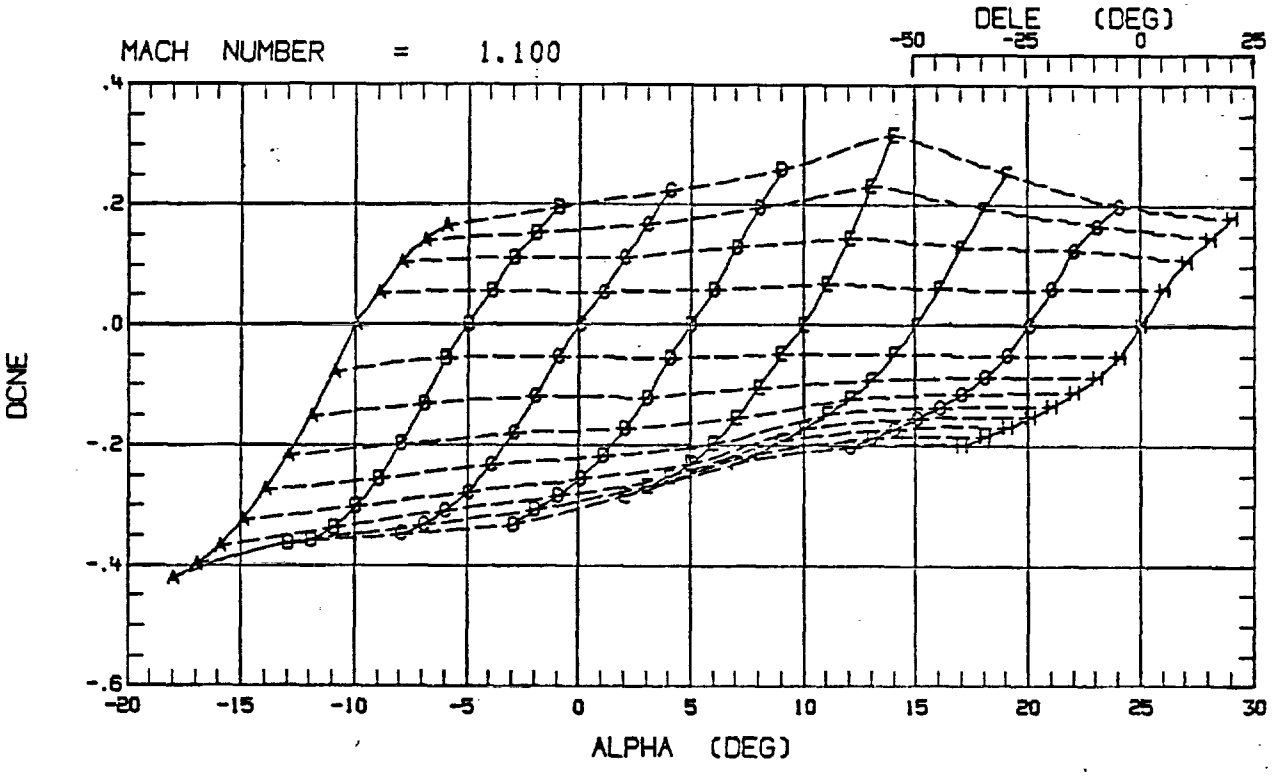
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.42587	-0.35449	-0.35100	-0.34386	-0.32737	-0.24037	-0.20900	-0.20615
-35.000	-0.40264	-0.35013	-0.34600	-0.34209	-0.31219	-0.22918	-0.19964	-0.19614
-30.000	-0.37657	-0.33938	-0.33700	-0.33340	-0.28925	-0.21335	-0.18557	-0.18340
-25.000	-0.34059	-0.32044	-0.31800	-0.30952	-0.25820	-0.19436	-0.17138	-0.16913
-20.000	-0.29525	-0.28413	-0.27600	-0.25367	-0.21822	-0.17226	-0.15339	-0.15171
-15.000	-0.23551	-0.23309	-0.20900	-0.19074	-0.17110	-0.13834	-0.13164	-0.12982
-10.000	-0.16399	-0.15143	-0.14000	-0.12573	-0.11690	-0.09958	-0.10356	-0.10186
-5.000	-0.08386	-0.05648	-0.06200	-0.06475	-0.05581	-0.05192	-0.06054	-0.06155
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.08136	0.05960	0.05700	0.06099	0.07276	0.06881	0.06871	0.06476
10.000	0.14645	0.11984	0.12300	0.14226	0.15194	0.14309	0.12943	0.11021
15.000	0.17799	0.15774	0.16500	0.22231	0.23455	0.21907	0.17350	0.14631
20.000	0.18485	0.17153	0.24800	0.32481	0.32445	0.29976	0.21253	0.18526

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-75
EFFECT OF ELEVON

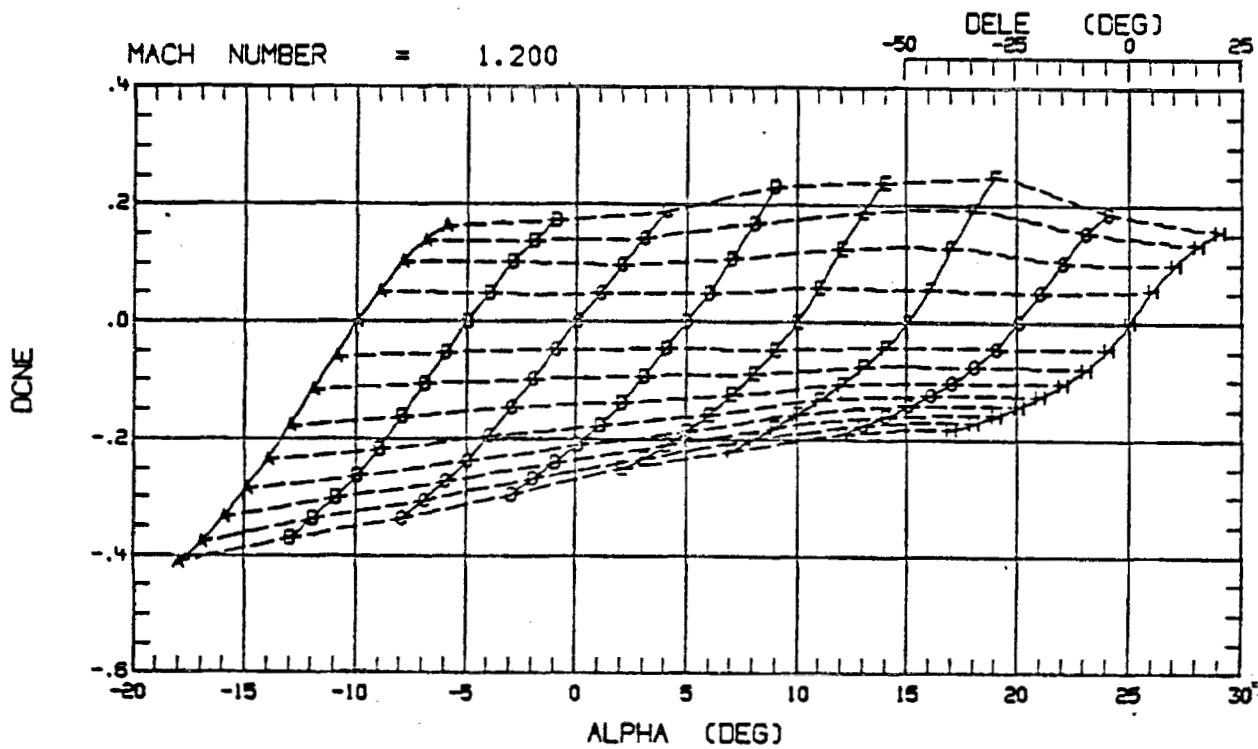


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.42245	-0.36322	-0.35000	-0.33269	-0.28531	-0.23194	-0.20365	-0.20179
-35.000	-0.39998	-0.35871	-0.33400	-0.30896	-0.27031	-0.21488	-0.18973	-0.18684
-30.000	-0.36836	-0.33799	-0.31000	-0.28619	-0.25423	-0.19417	-0.17296	-0.17147
-25.000	-0.32670	-0.30312	-0.27900	-0.25830	-0.23108	-0.17304	-0.15583	-0.15431
-20.000	-0.27544	-0.25719	-0.23400	-0.22041	-0.19890	-0.14896	-0.13703	-0.13487
-15.000	-0.21885	-0.20018	-0.18200	-0.17331	-0.15670	-0.12353	-0.11505	-0.11344
-10.000	-0.15302	-0.13251	-0.12000	-0.12214	-0.10537	-0.09262	-0.08781	-0.08772
-5.000	-0.07987	-0.05610	-0.05500	-0.05678	-0.04959	-0.04947	-0.05171	-0.05318
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.05295	0.05406	0.05300	0.05792	0.06685	0.05908	0.05870	0.06031
10.000	0.10311	0.11092	0.11100	0.12904	0.14291	0.12963	0.12432	0.10603
15.000	0.13943	0.15232	0.16700	0.19325	0.22956	0.19105	0.16433	0.14334
20.000	0.16284	0.19558	0.22300	0.25715	0.31697	0.24926	0.19755	0.17840

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-76
EFFECT OF ELEVON



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.41251	-0.37195	-0.33800	-0.29683	-0.25232	-0.22303	-0.19215	-0.18306
-35.000	-0.37869	-0.33885	-0.30700	-0.27007	-0.23445	-0.20214	-0.17659	-0.17302
-30.000	-0.33655	-0.30376	-0.27500	-0.24123	-0.21255	-0.18025	-0.16189	-0.16025
-25.000	-0.28878	-0.26525	-0.23900	-0.21239	-0.18833	-0.15740	-0.14404	-0.14523
-20.000	-0.23736	-0.21876	-0.19700	-0.17857	-0.16000	-0.13332	-0.12618	-0.12820
-15.000	-0.17842	-0.16405	-0.14800	-0.13950	-0.12658	-0.10705	-0.10423	-0.10754
-10.000	-0.11846	-0.10851	-0.10000	-0.09429	-0.09066	-0.07640	-0.07715	-0.08122
-5.000	-0.06082	-0.05447	-0.04900	-0.04778	-0.04831	-0.04393	-0.04562	-0.04766
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.04980	0.04617	0.04600	0.04782	0.05810	0.05399	0.04990	0.05431
10.000	0.10004	0.09971	0.09500	0.10678	0.12460	0.12507	0.10075	0.09913
15.000	0.13689	0.13695	0.14200	0.16674	0.18624	0.18994	0.15072	0.13198
20.000	0.16147	0.17207	0.18700	0.23020	0.23854	0.24833	0.18474	0.15492

ENGINEER DSG
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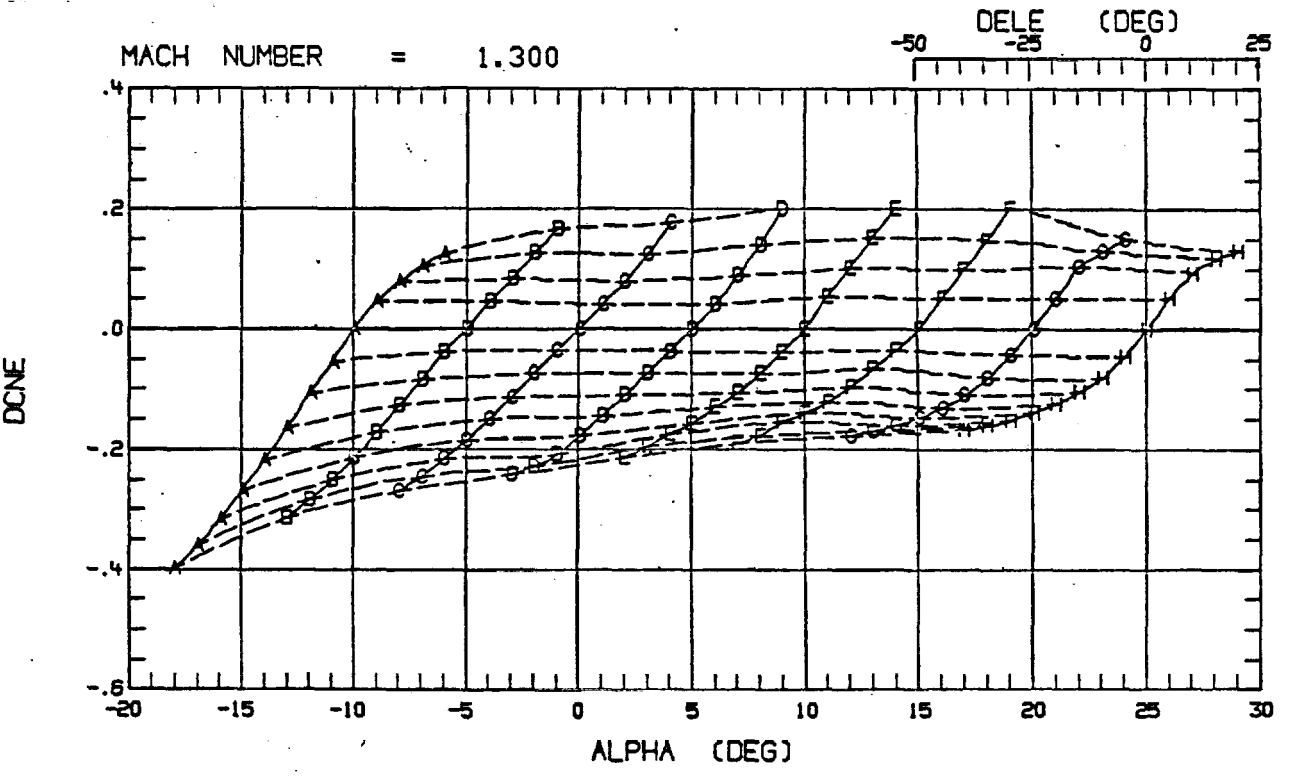
FIGURE 4.1.1.1-77
EFFECT OF ELEVON



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.40065	-0.31526	-0.27000	-0.24328	-0.21464	-0.19086	-0.17821	-0.16914
-35.000	-0.36130	-0.28554	-0.24600	-0.22923	-0.19685	-0.17769	-0.17033	-0.16204
-30.000	-0.31818	-0.25278	-0.21700	-0.21017	-0.17692	-0.15507	-0.16138	-0.15219
-25.000	-0.26987	-0.21518	-0.18600	-0.17921	-0.15775	-0.14065	-0.14829	-0.13941
-20.000	-0.21940	-0.17458	-0.15100	-0.14533	-0.13153	-0.12166	-0.13222	-0.12461
-15.000	-0.16724	-0.12814	-0.11400	-0.11122	-0.10752	-0.09693	-0.11089	-0.10507
-10.000	-0.10825	-0.08486	-0.07500	-0.07415	-0.07554	-0.06628	-0.08338	-0.08190
-5.000	-0.05573	-0.03873	-0.03600	-0.03786	-0.03846	-0.03704	-0.04424	-0.04551
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.04403	0.04407	0.04000	0.04070	0.05233	0.04883	0.04995	0.05034
10.000	0.07644	0.08151	0.07800	0.08659	0.09943	0.09690	0.10254	0.08962
15.000	0.10316	0.12474	0.12300	0.13914	0.15081	0.14716	0.12755	0.11669
20.000	0.12451	0.16563	0.17600	0.19992	0.19961	0.19878	0.14851	0.12863

ENGINEER DCo
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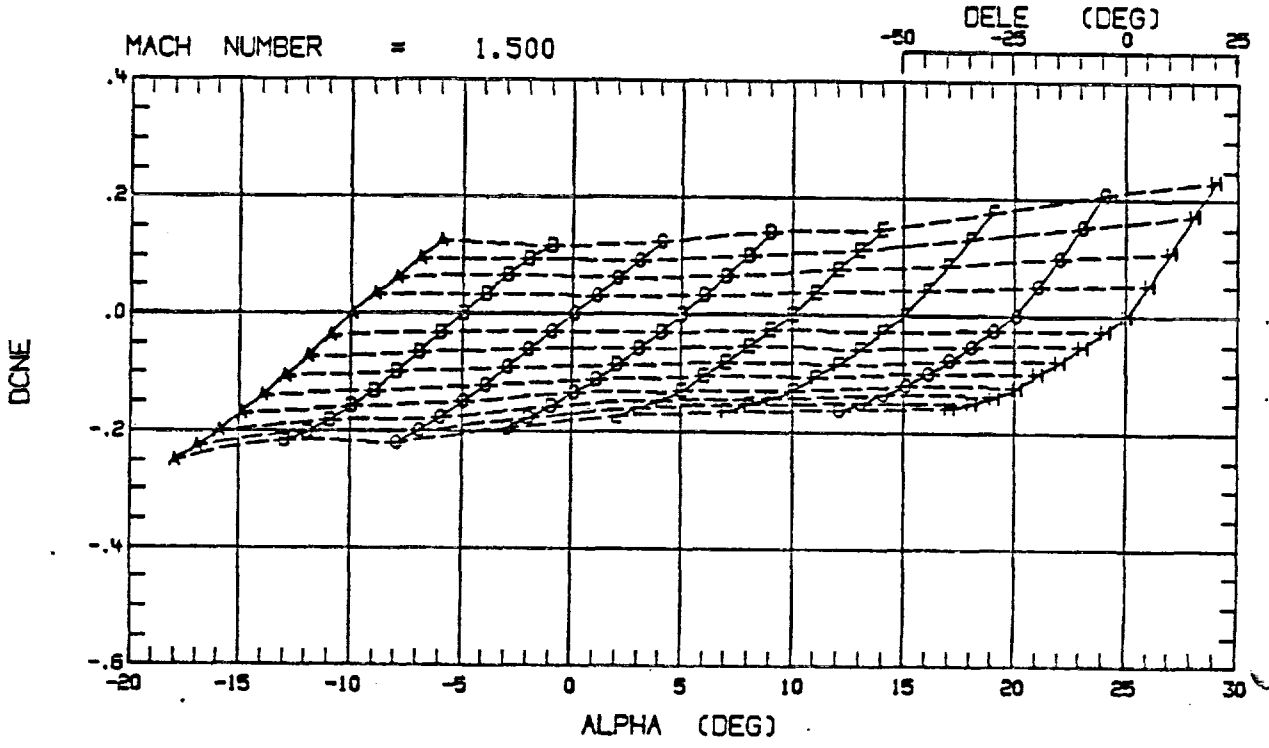
FIGURE 4.1.1.1-78
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.25126	-0.21725	-0.22071	-0.19612	-0.17532	-0.16669	-0.16336	-0.15770
-35.000	-0.22801	-0.20330	-0.20103	-0.17790	-0.16070	-0.15405	-0.15087	-0.15058
-30.000	-0.20137	-0.18340	-0.17821	-0.15874	-0.14707	-0.14440	-0.13551	-0.13992
-25.000	-0.17106	-0.15969	-0.15060	-0.13548	-0.13110	-0.12940	-0.12074	-0.12480
-20.000	-0.14064	-0.13187	-0.12363	-0.11373	-0.10488	-0.10660	-0.09949	-0.10050
-15.000	-0.10753	-0.10041	-0.09235	-0.08807	-0.08121	-0.08650	-0.07835	-0.07918
-10.000	-0.07579	-0.06755	-0.06076	-0.05955	-0.05491	-0.05890	-0.05308	-0.05379
-5.000	-0.03813	-0.03301	-0.03029	-0.03216	-0.02719	-0.02947	-0.02701	-0.02738
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.03125	0.03211	0.03005	0.03169	0.03760	0.04289	0.04863	0.05294
10.000	0.05952	0.06557	0.06064	0.06568	0.07686	0.08589	0.09753	0.10801
15.000	0.09217	0.09323	0.08980	0.10167	0.11125	0.13012	0.15163	0.17033
20.000	0.12451	0.11589	0.12316	0.14178	0.14498	0.17747	0.20761	0.23068

ENGINEER DCO
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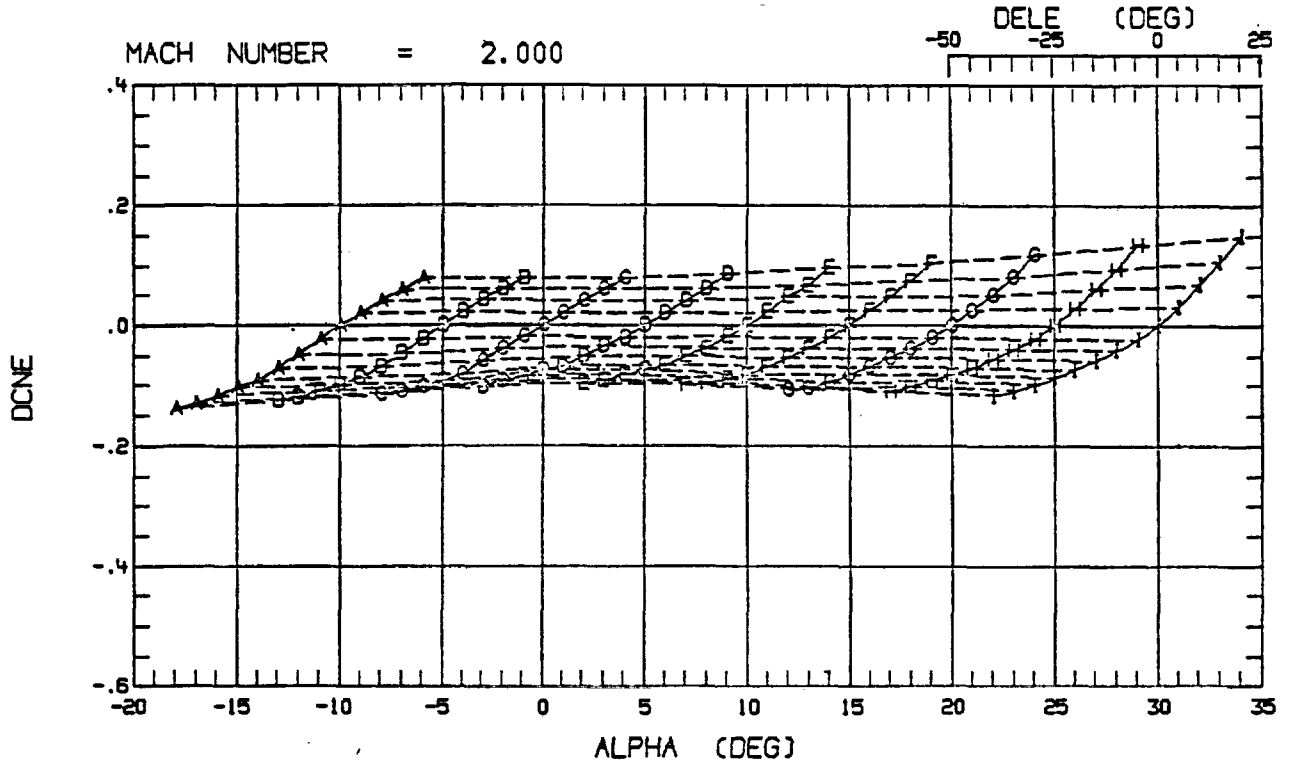
FIGURE 4.1.1.1-79
EFFECT OF ELEVON



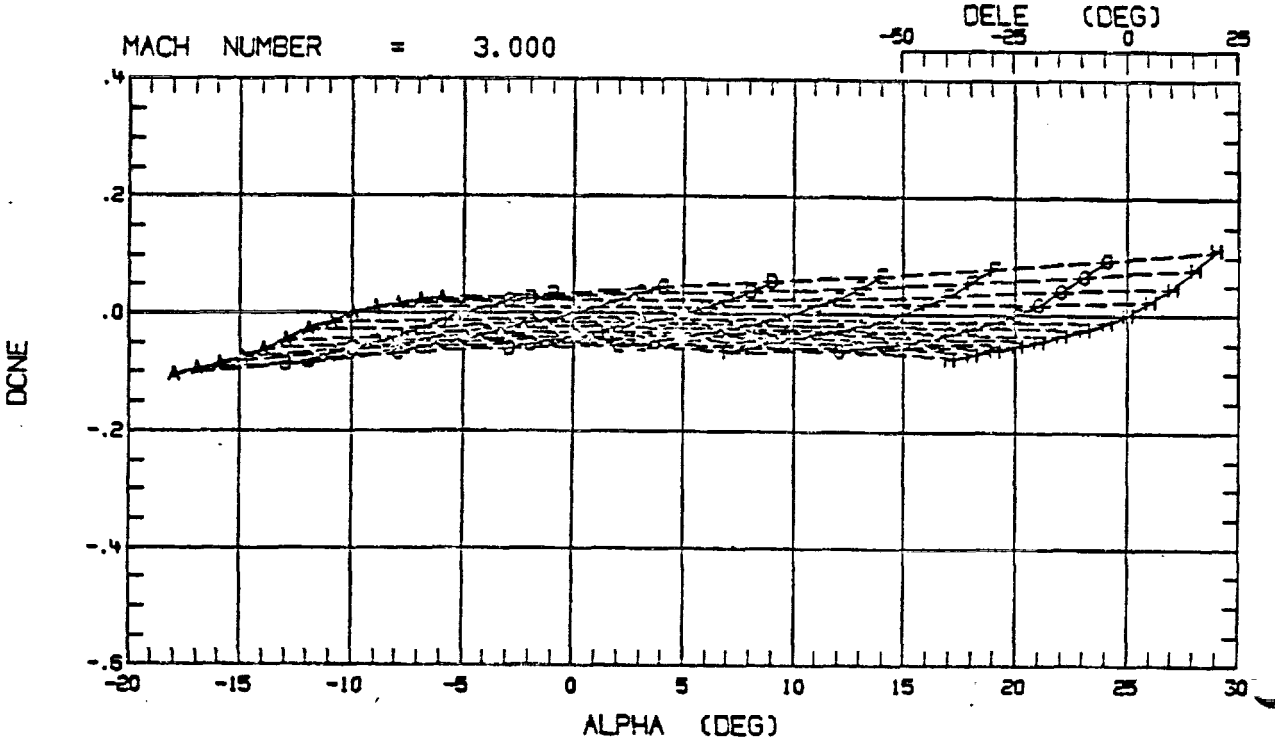
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT								
-40.000	-0.13882	-0.12580	-0.11500	-0.10225	-0.09640	-0.09982	-0.10653	-0.11097	-0.11843
-35.000	-0.13130	-0.11970	-0.11000	-0.09285	-0.09127	-0.09673	-0.10500	-0.10378	-0.10987
-30.000	-0.11887	-0.10961	-0.10300	-0.08545	-0.08336	-0.08952	-0.09560	-0.09301	-0.09958
-25.000	-0.10365	-0.09959	-0.09300	-0.07584	-0.07502	-0.08354	-0.08244	-0.08301	-0.08842
-20.000	-0.09137	-0.08668	-0.08100	-0.06921	-0.06668	-0.06957	-0.06895	-0.07249	-0.07429
-15.000	-0.07182	-0.06914	-0.06000	-0.05275	-0.05260	-0.05437	-0.05417	-0.05630	-0.05930
-10.000	-0.04835	-0.04752	-0.04000	-0.03504	-0.03800	-0.03936	-0.03905	-0.04081	-0.04281
-5.000	-0.02442	-0.02417	-0.02000	-0.02019	-0.01993	-0.02165	-0.02162	-0.02314	-0.02395
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01908	0.02096	0.01900	0.01936	0.02091	0.02410	0.02546	0.02755	0.03005
10.000	0.03875	0.04174	0.03900	0.03998	0.04628	0.04678	0.05101	0.05950	0.06670
15.000	0.05817	0.06023	0.05900	0.06078	0.06580	0.07340	0.08006	0.09399	0.10535
20.000	0.07678	0.07666	0.07800	0.08491	0.09471	0.10376	0.11808	0.13289	0.14810

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-80
EFFECT OF ELEVON



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.10457	-0.08852	-0.07000	-0.06137	-0.05735	-0.06620	-0.06508	-0.07636
-35.000	-0.09576	-0.08283	-0.06000	-0.05374	-0.05312	-0.05873	-0.05861	-0.06933
-30.000	-0.08796	-0.06919	-0.05200	-0.04708	-0.04692	-0.05030	-0.05425	-0.06186
-25.000	-0.07651	-0.06069	-0.04500	-0.04132	-0.03939	-0.04283	-0.04955	-0.05440
-20.000	-0.06210	-0.05120	-0.03700	-0.03461	-0.03482	-0.03439	-0.04297	-0.04652
-15.000	-0.04606	-0.04081	-0.02700	-0.02482	-0.02711	-0.02982	-0.03511	-0.03661
-10.000	-0.02803	-0.02742	-0.01700	-0.01694	-0.02039	-0.02210	-0.02409	-0.02579
-5.000	-0.01548	-0.01421	-0.01000	-0.01005	-0.01118	-0.01269	-0.01427	-0.01462
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00916	0.00905	0.00900	0.01018	0.01448	0.01604	0.01752	0.02265
10.000	0.01535	0.01992	0.02200	0.02253	0.02439	0.03215	0.04076	0.04567
15.000	0.02215	0.02464	0.03400	0.03708	0.04501	0.05561	0.06605	0.07860
20.000	0.02502	0.03153	0.04500	0.05372	0.06534	0.07862	0.09339	0.11012

ENGINEER Dca
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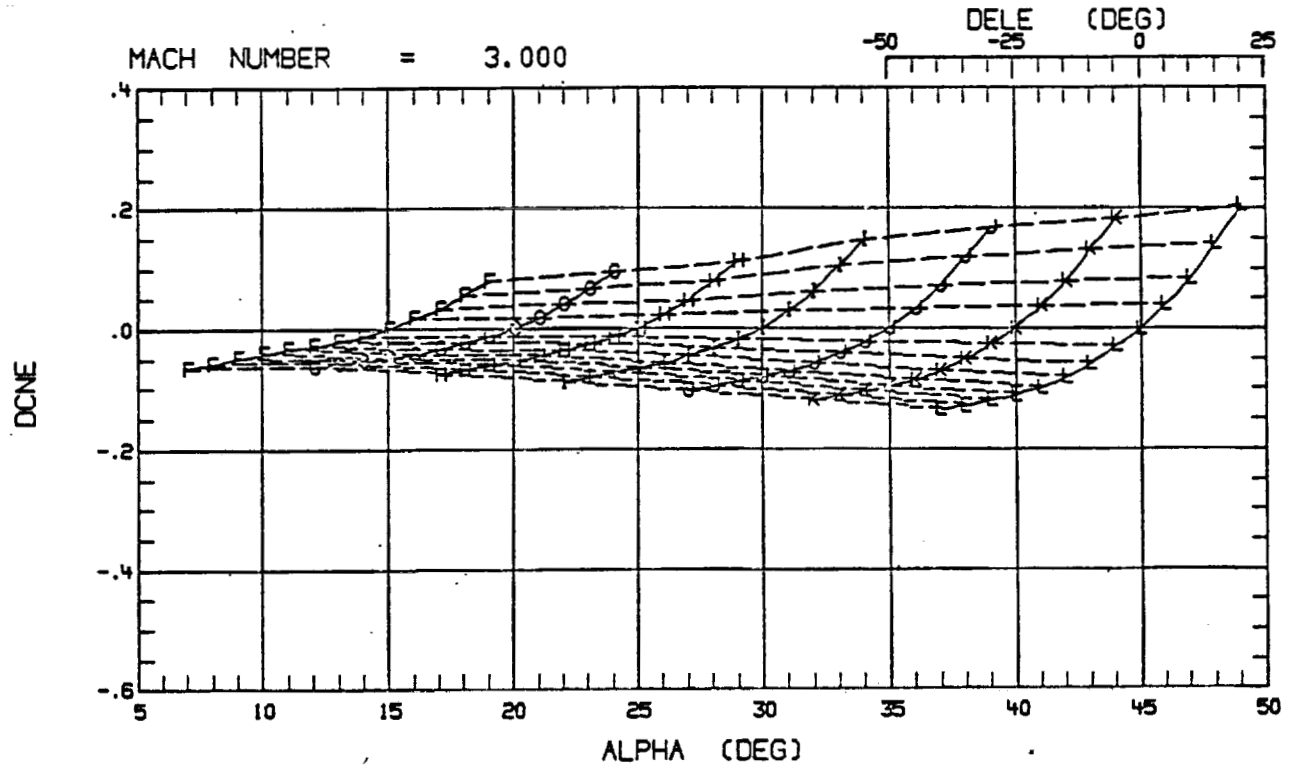
FIGURE 4.1.1.1-81
EFFECT OF ELEVON

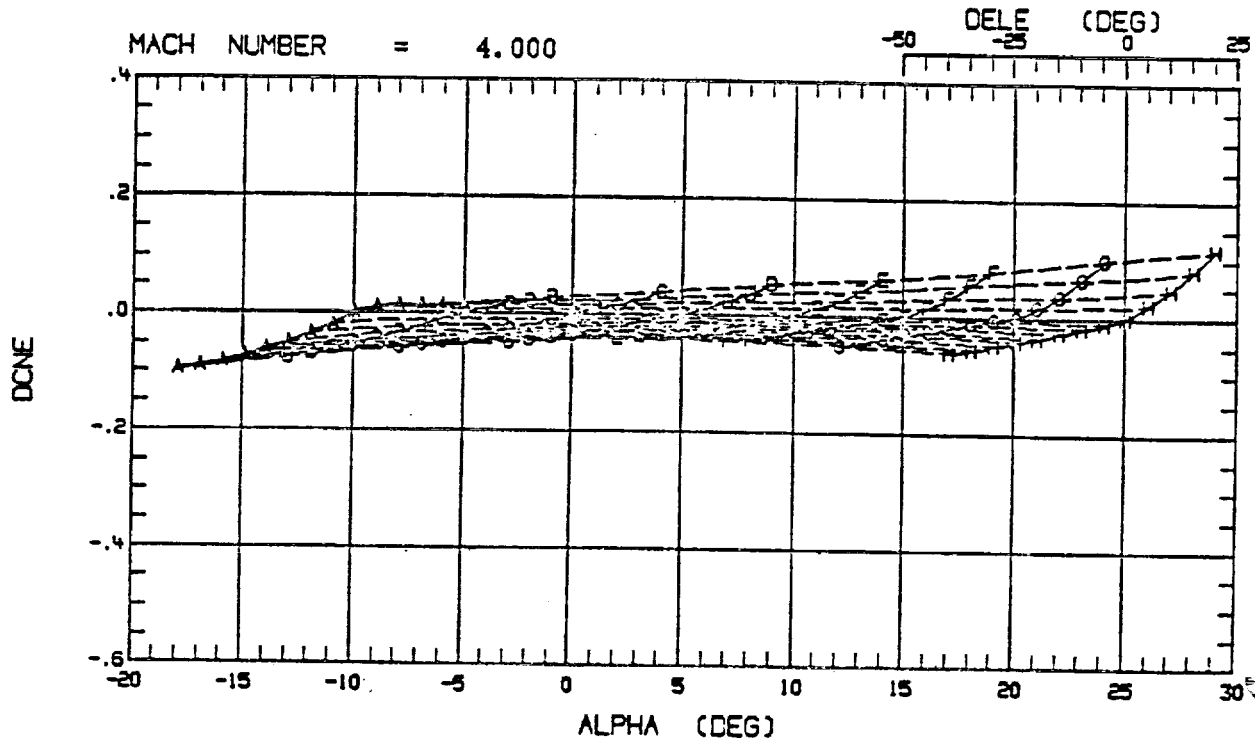


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT						
-40.000	-0.06620	-0.06508	-0.07636	-0.09046	-0.10530	-0.12130	-0.13672
-35.000	-0.05873	-0.05861	-0.06933	-0.08255	-0.09748	-0.11363	-0.12952
-30.000	-0.05030	-0.05425	-0.06186	-0.07427	-0.08953	-0.10595	-0.12126
-25.000	-0.04283	-0.04955	-0.05440	-0.06696	-0.08202	-0.09783	-0.11160
-20.000	-0.03439	-0.04297	-0.04652	-0.05903	-0.07339	-0.08713	-0.09934
-15.000	-0.02982	-0.03511	-0.03661	-0.04677	-0.05958	-0.07266	-0.08335
-10.000	-0.02210	-0.02409	-0.02579	-0.03352	-0.04233	-0.05148	-0.05992
-5.000	-0.01289	-0.01427	-0.01462	-0.01876	-0.02270	-0.02652	-0.03019
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01604	0.01752	0.02265	0.02819	0.03306	0.03736	0.03912
10.000	0.03215	0.04076	0.04567	0.05937	0.06961	0.07775	0.08338
15.000	0.05561	0.06605	0.07860	0.10290	0.11832	0.12998	0.14021
20.000	0.07862	0.09339	0.11012	0.14630	0.16599	0.18291	0.20343

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-82
EFFECT OF ELEVON



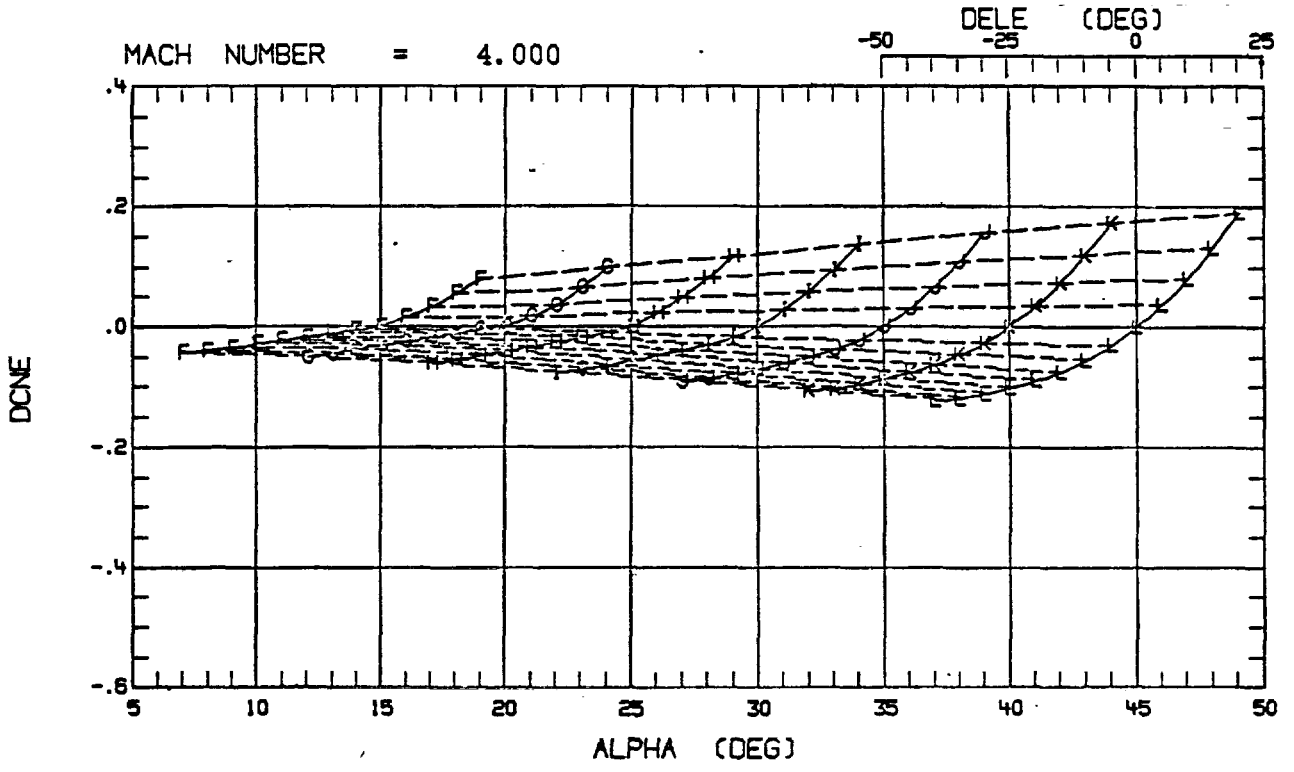
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.09746	-0.07621	-0.06000	-0.04912	-0.04059	-0.04540	-0.05107	-0.06317
-35.000	-0.09178	-0.06849	-0.05500	-0.04370	-0.03766	-0.04064	-0.04673	-0.05733
-30.000	-0.08414	-0.06091	-0.05000	-0.03915	-0.03328	-0.03549	-0.03851	-0.04957
-25.000	-0.07385	-0.05346	-0.04300	-0.03339	-0.02870	-0.03003	-0.03204	-0.04268
-20.000	-0.06258	-0.04605	-0.03600	-0.02863	-0.02595	-0.02429	-0.02700	-0.03579
-15.000	-0.05077	-0.03464	-0.02900	-0.02074	-0.02013	-0.01797	-0.01957	-0.02761
-10.000	-0.03601	-0.02335	-0.02000	-0.01395	-0.01521	-0.01299	-0.01307	-0.01930
-5.000	-0.02048	-0.01113	-0.01200	-0.00697	-0.00823	-0.00657	-0.00607	-0.01072
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00843	0.00715	0.00800	0.01014	0.01243	0.01508	0.01589	0.02271
10.000	0.01160	0.01412	0.01500	0.02146	0.02323	0.03174	0.03558	0.04775
15.000	0.01170	0.01992	0.02400	0.03578	0.04125	0.05464	0.06391	0.08028
20.000	0.01072	0.02577	0.03600	0.05111	0.06211	0.07825	0.09812	0.11629

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-83
EFFECT OF ELEVON

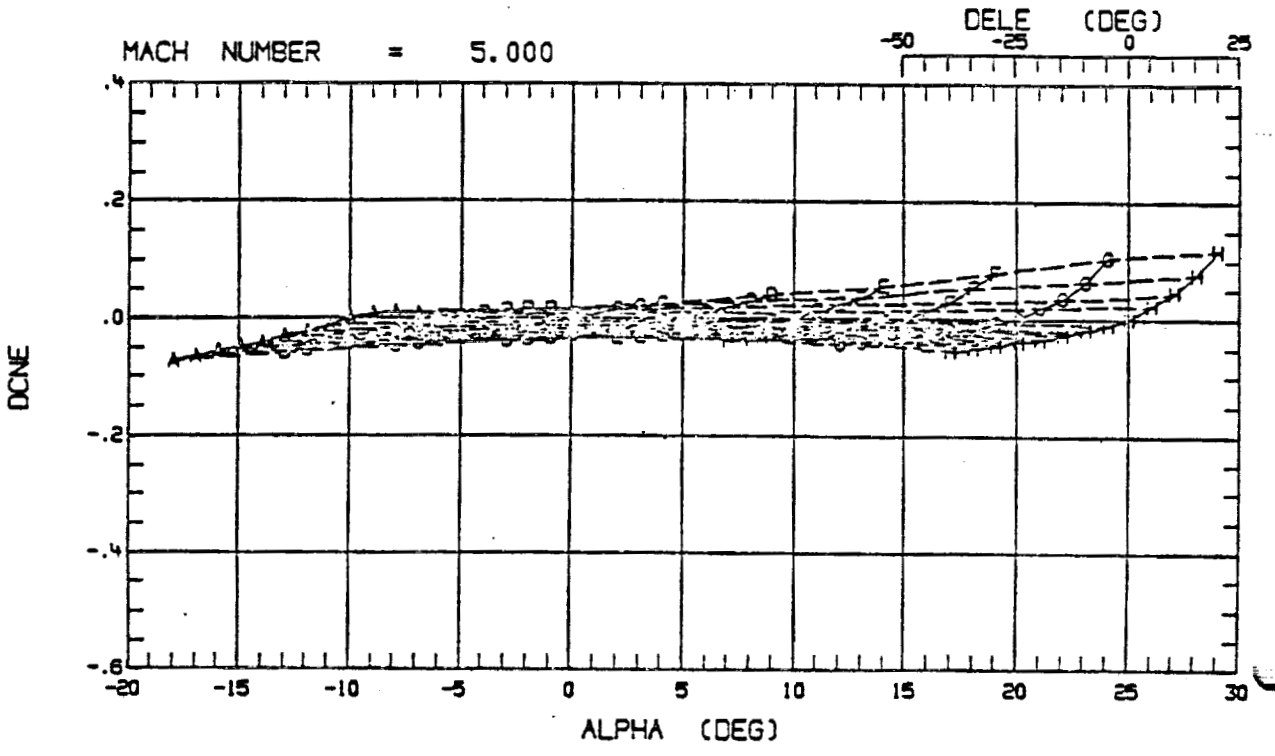


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT						
-40.000	-0.04540	-0.05107	-0.06317	-0.07737	-0.09172	-0.10703	-0.12263
-35.000	-0.04064	-0.04673	-0.05733	-0.07194	-0.08756	-0.10415	-0.12009
-30.000	-0.03549	-0.03851	-0.04957	-0.06585	-0.08086	-0.09686	-0.11230
-25.000	-0.03003	-0.03204	-0.04268	-0.05752	-0.07235	-0.08816	-0.10330
-20.000	-0.02429	-0.02700	-0.03579	-0.04944	-0.06290	-0.07715	-0.09098
-15.000	-0.01797	-0.01957	-0.02761	-0.04116	-0.05259	-0.06481	-0.07692
-10.000	-0.01289	-0.01307	-0.01930	-0.03242	-0.03976	-0.04765	-0.05681
-5.000	-0.00657	-0.00607	-0.01072	-0.01949	-0.02371	-0.02825	-0.03226
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01508	0.01589	0.02271	0.02595	0.02975	0.03384	0.03641
10.000	0.03174	0.03558	0.04775	0.05731	0.06568	0.07319	0.07997
15.000	0.05464	0.06391	0.08028	0.09416	0.10734	0.11934	0.13002
20.000	0.07826	0.09812	0.11629	0.13642	0.15528	0.17249	0.18856

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-84
EFFECT OF ELEVON



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.07367	-0.06043	-0.04600	-0.04022	-0.03398	-0.03874	-0.04492	-0.05733
-35.000	-0.06599	-0.05370	-0.04500	-0.03677	-0.03260	-0.03529	-0.04053	-0.05176
-30.000	-0.05734	-0.04714	-0.03800	-0.03310	-0.02826	-0.03184	-0.03614	-0.04706
-25.000	-0.05015	-0.04162	-0.03300	-0.02845	-0.02562	-0.02826	-0.03154	-0.04137
-20.000	-0.04295	-0.03510	-0.02800	-0.02471	-0.02198	-0.02468	-0.02695	-0.03663
-15.000	-0.03204	-0.02671	-0.02100	-0.01893	-0.01726	-0.01889	-0.02107	-0.02870
-10.000	-0.02506	-0.01733	-0.01400	-0.01304	-0.01630	-0.01309	-0.01895	-0.01995
-5.000	-0.01336	-0.00905	-0.00700	-0.00602	-0.00626	-0.00655	-0.00769	-0.01105
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00553	0.00615	0.00700	0.00915	0.01144	0.01372	0.01871	0.02296
10.000	0.00964	0.01213	0.01400	0.01830	0.02316	0.02764	0.03325	0.04357
15.000	0.00759	0.01295	0.01900	0.02972	0.03510	0.05283	0.06253	0.07587
20.000	0.00255	0.01377	0.02400	0.04014	0.05415	0.07786	0.10323	0.11511

ENGINEER DCO
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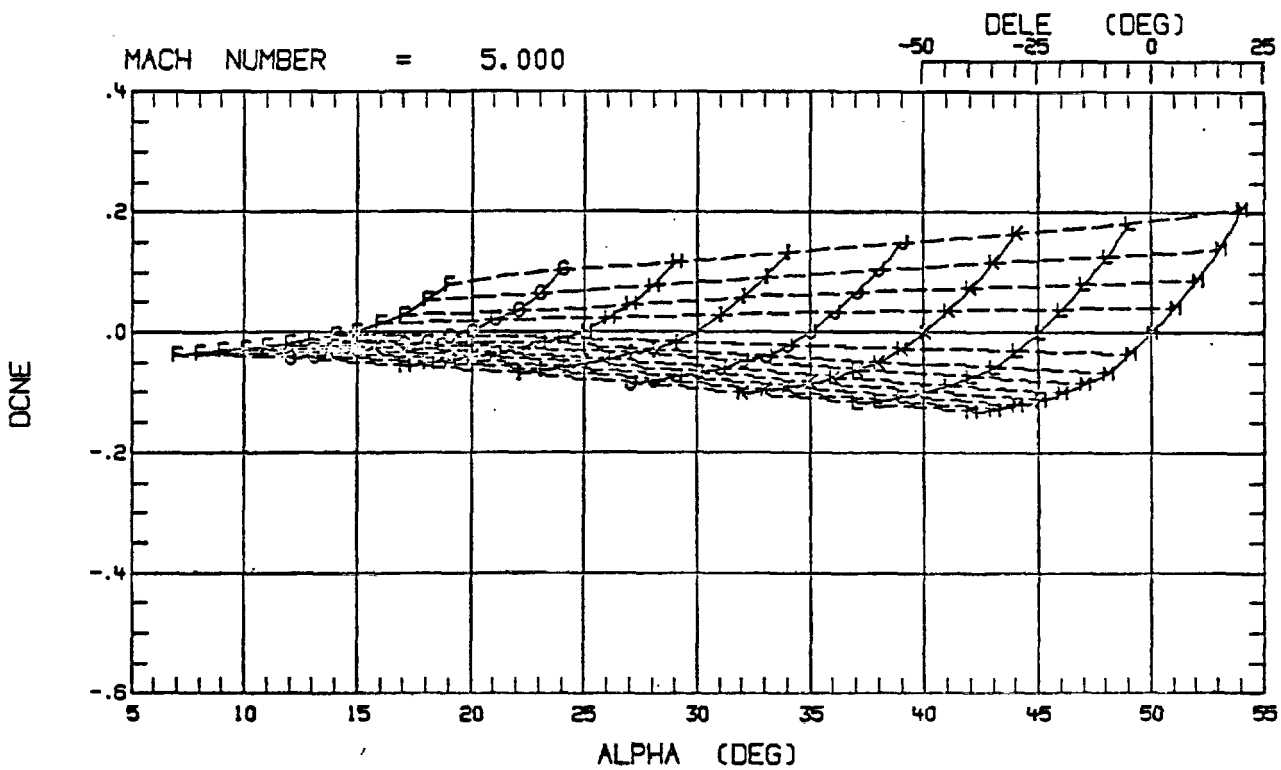
FIGURE 4.1.1.1-85
EFFECT OF ELEVON



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.03874	-0.04492	-0.05733	-0.07044	-0.08667	-0.10349	-0.11889	-0.13330
-35.000	-0.03529	-0.04053	-0.05176	-0.06510	-0.08151	-0.09832	-0.11442	-0.12963
-30.000	-0.03184	-0.03614	-0.04706	-0.05975	-0.07577	-0.09244	-0.10814	-0.12298
-25.000	-0.02826	-0.03154	-0.04137	-0.05299	-0.06907	-0.08579	-0.10087	-0.11462
-20.000	-0.02468	-0.02695	-0.03663	-0.04709	-0.06161	-0.07670	-0.09047	-0.10321
-15.000	-0.01889	-0.02107	-0.02870	-0.03703	-0.04984	-0.06327	-0.07574	-0.08707
-10.000	-0.01309	-0.01895	-0.01995	-0.03038	-0.04074	-0.05066	-0.06013	-0.06901
-5.000	-0.00655	-0.00769	-0.01105	-0.01761	-0.02312	-0.02793	-0.03233	-0.03647
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01372	0.01871	0.02296	0.02805	0.03192	0.03517	0.03809	0.04068
10.000	0.02764	0.03325	0.04357	0.05638	0.06512	0.07257	0.07954	0.08570
15.000	0.05283	0.06263	0.07587	0.08969	0.10261	0.11499	0.12630	0.13746
20.000	0.07786	0.10323	0.11511	0.13209	0.14776	0.16355	0.18226	0.20428

ENGINEER DCO
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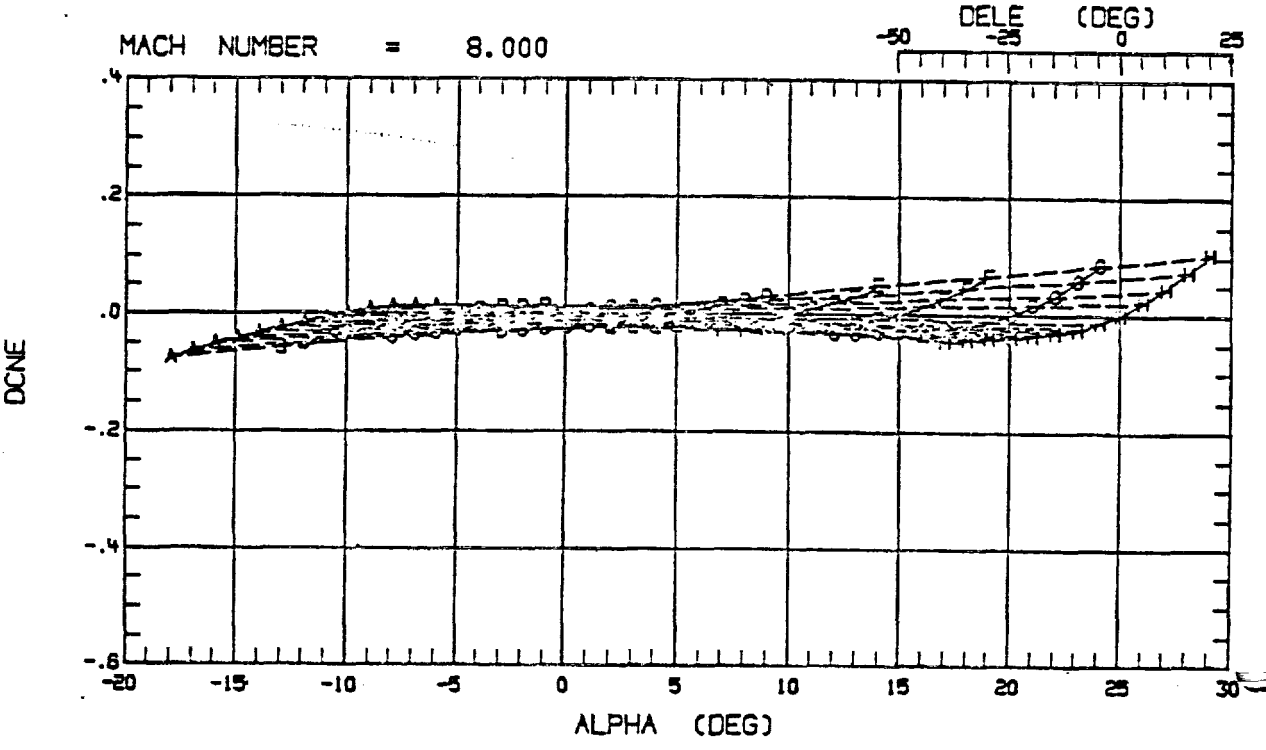
FIGURE 4.1.1.1-86
EFFECT OF ELEVON



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.07722	-0.05815	-0.04200	-0.03172	-0.02413	-0.02957	-0.03445	-0.04694
-35.000	-0.06486	-0.05058	-0.03700	-0.03000	-0.02339	-0.02798	-0.03298	-0.04512
-30.000	-0.05250	-0.04202	-0.03300	-0.02729	-0.02365	-0.02735	-0.03245	-0.04245
-25.000	-0.04323	-0.03454	-0.02800	-0.02448	-0.02179	-0.02552	-0.02970	-0.03947
-20.000	-0.03395	-0.02807	-0.02300	-0.02167	-0.01994	-0.02369	-0.02674	-0.03654
-15.000	-0.02487	-0.02170	-0.01900	-0.01778	-0.01797	-0.02066	-0.02338	-0.03142
-10.000	-0.01580	-0.01432	-0.01200	-0.01488	-0.01502	-0.01764	-0.01962	-0.02630
-5.000	-0.00740	-0.00717	-0.00700	-0.00695	-0.00997	-0.00832	-0.01299	-0.01362
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00557	0.00509	0.00500	0.00715	0.00938	0.01327	0.01555	0.02166
10.000	0.01077	0.01017	0.01000	0.01429	0.01803	0.02655	0.03267	0.04427
15.000	0.01084	0.01011	0.01000	0.02264	0.02975	0.04555	0.05776	0.07362
20.000	0.01224	0.01105	0.01100	0.02999	0.04862	0.06549	0.08403	0.10297

ENGINEER DCO
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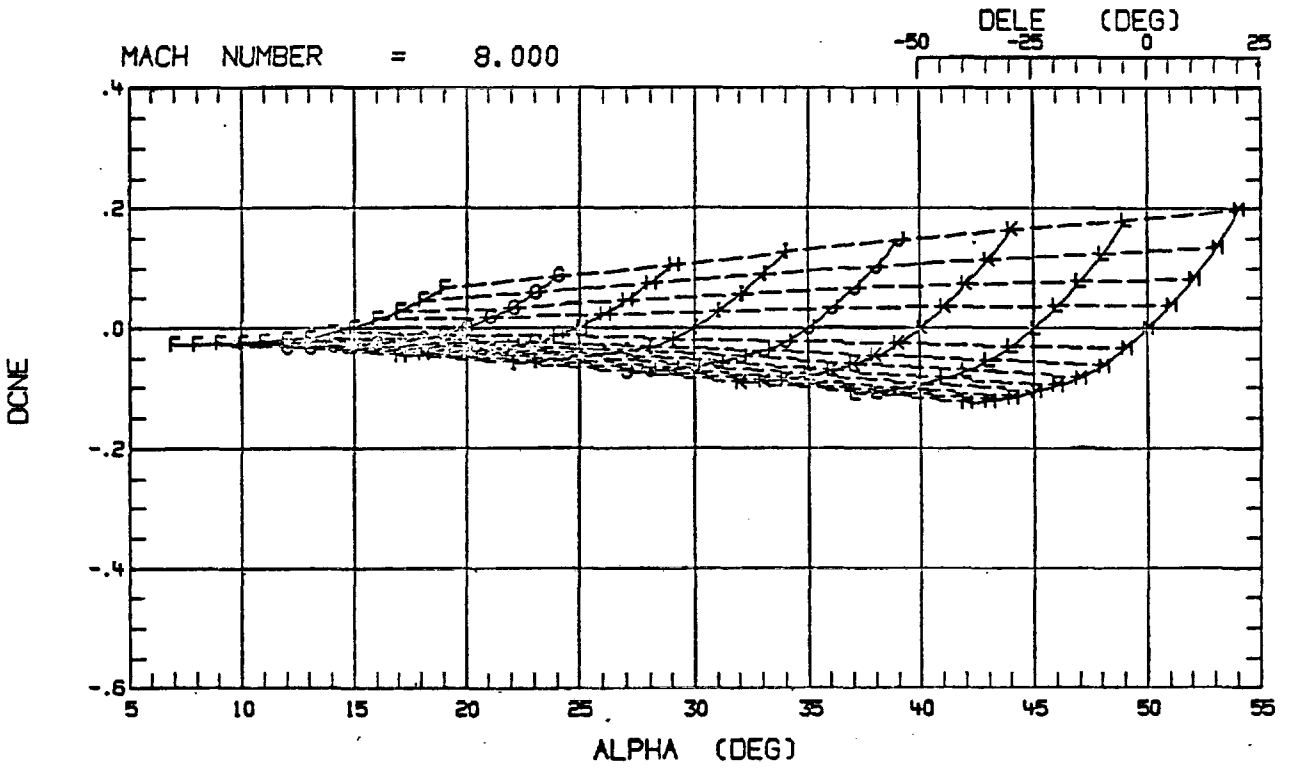
FIGURE 4.1.1.1-87
EFFECT OF ELEVON



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.02957	-0.03445	-0.04694	-0.05977	-0.07577	-0.09287	-0.10962	-0.12641
-35.000	-0.02798	-0.03298	-0.04512	-0.05667	-0.07331	-0.09063	-0.10677	-0.12220
-30.000	-0.02735	-0.03245	-0.04245	-0.05357	-0.07030	-0.08743	-0.10272	-0.11672
-25.000	-0.02552	-0.02970	-0.03947	-0.04941	-0.06485	-0.08085	-0.09472	-0.10695
-20.000	-0.02369	-0.02674	-0.03654	-0.04524	-0.05879	-0.07292	-0.08583	-0.09775
-15.000	-0.02066	-0.02338	-0.03142	-0.03924	-0.05002	-0.06147	-0.07282	-0.08375
-10.000	-0.01764	-0.01962	-0.02630	-0.03325	-0.04013	-0.04765	-0.05543	-0.06322
-5.000	-0.00832	-0.01299	-0.01362	-0.02047	-0.02380	-0.02761	-0.03116	-0.03443
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01327	0.01555	0.02166	0.02669	0.03080	0.03396	0.03602	0.03708
10.000	0.02655	0.03267	0.04427	0.05586	0.06499	0.07197	0.07662	0.07965
15.000	0.04555	0.05776	0.07362	0.08796	0.10108	0.11281	0.12304	0.13345
20.000	0.06549	0.08403	0.10297	0.12472	0.14500	0.16285	0.17929	0.19712

ENGINEER DCO
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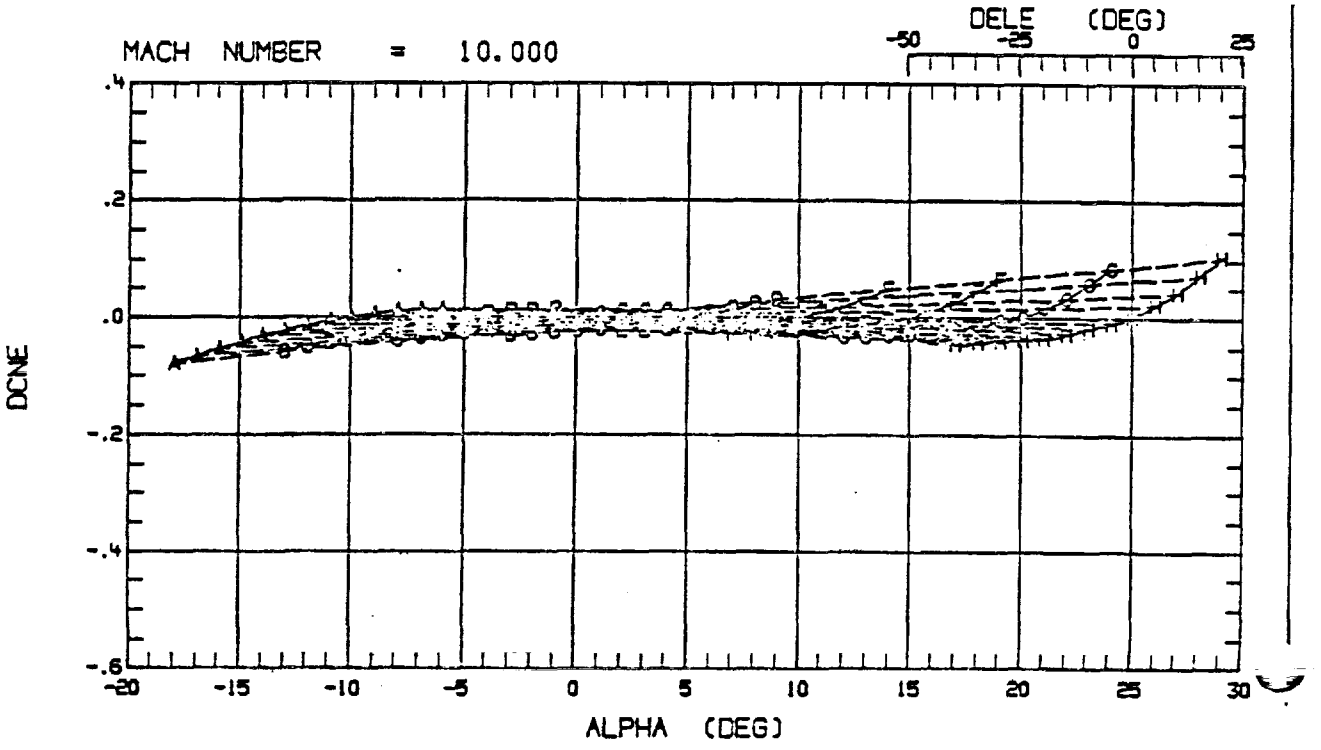
FIGURE 4.1.1.1-88
EFFECT OF ELEVON

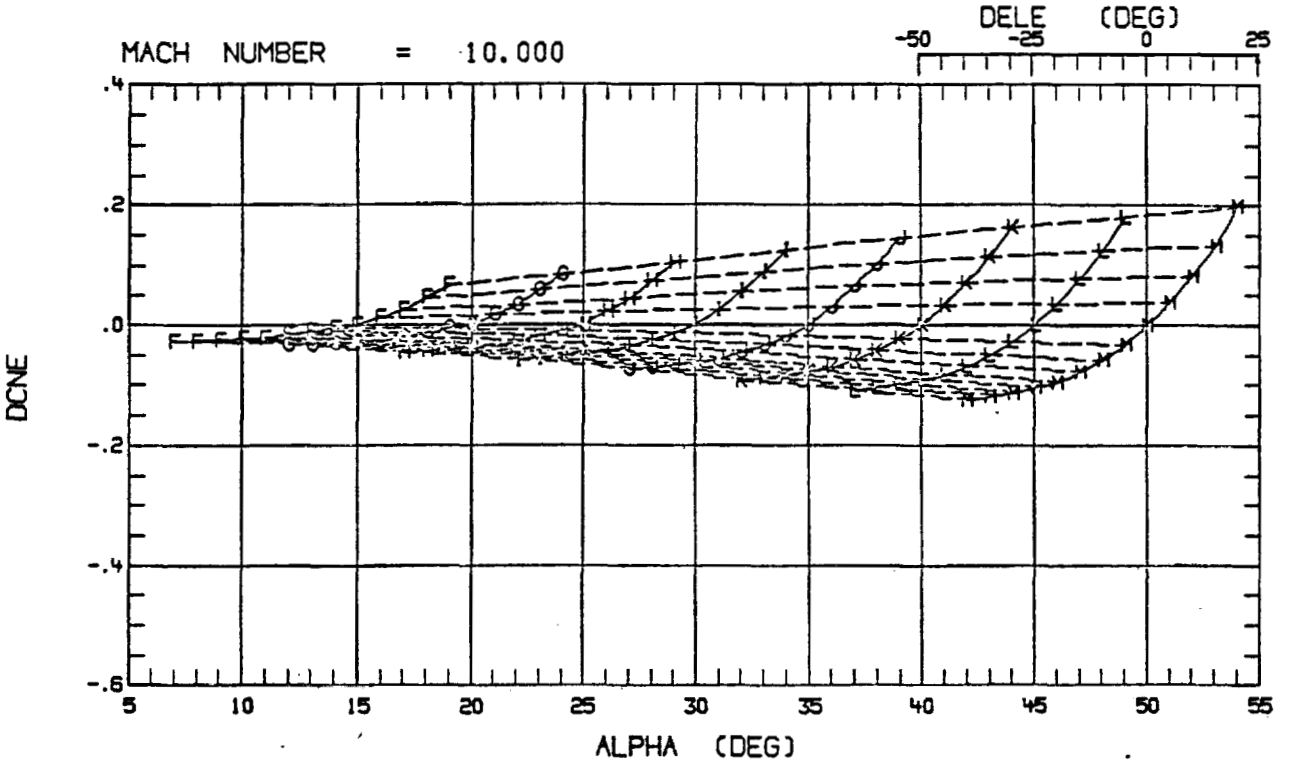


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.07889	-0.05933	-0.04200	-0.03170	-0.02408	-0.02950	-0.03441	-0.04694
-35.000	-0.06632	-0.05070	-0.03700	-0.02898	-0.02331	-0.02790	-0.03298	-0.04422
-30.000	-0.05472	-0.04308	-0.03200	-0.02625	-0.02154	-0.02630	-0.03158	-0.04150
-25.000	-0.04337	-0.03458	-0.02800	-0.02346	-0.01973	-0.02448	-0.02966	-0.03852
-20.000	-0.03203	-0.02708	-0.02300	-0.02066	-0.01792	-0.02265	-0.02778	-0.03550
-15.000	-0.02399	-0.01972	-0.01700	-0.01479	-0.01400	-0.01675	-0.02083	-0.02866
-10.000	-0.01499	-0.01336	-0.01100	-0.00991	-0.00909	-0.01179	-0.01485	-0.01991
-5.000	-0.00733	-0.00618	-0.00600	-0.00495	-0.00503	-0.00540	-0.00694	-0.00996
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00455	0.00409	0.00400	0.00712	0.00835	0.01226	0.01555	0.02166
10.000	0.00970	0.00917	0.00900	0.01325	0.01792	0.02454	0.03257	0.04328
15.000	0.01072	0.01010	0.01000	0.02062	0.03275	0.04450	0.05776	0.07259
20.000	0.01220	0.01103	0.01000	0.02999	0.04760	0.06447	0.08393	0.10280

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-89
EFFECT OF ELEVON

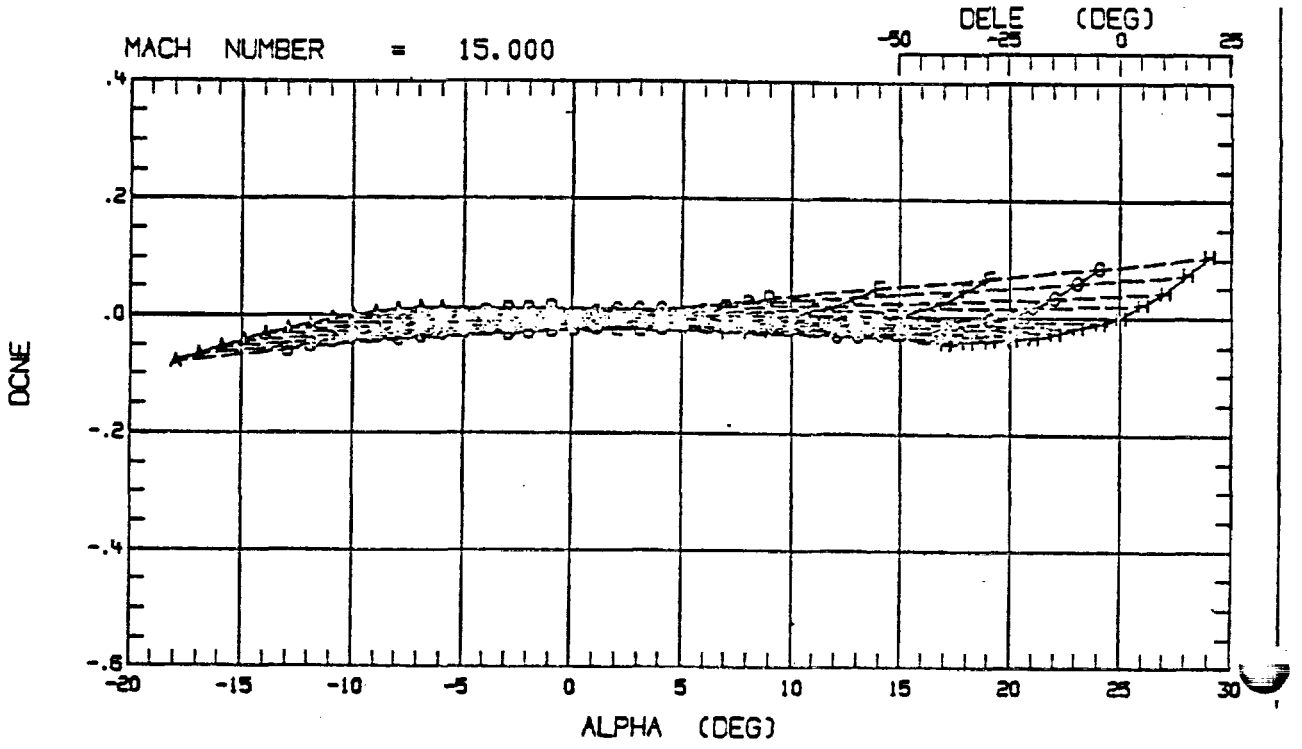


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.02950	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.02790	-0.03298	-0.04422	-0.05575	-0.07212	-0.08929	-0.10507	-0.12015
-30.000	-0.02630	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02448	-0.02966	-0.03852	-0.04849	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02265	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.01675	-0.02083	-0.02866	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01179	-0.01485	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00540	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01226	0.01555	0.02166	0.02507	0.02928	0.03268	0.03504	0.03658
10.000	0.02454	0.03267	0.04328	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.04450	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.06447	0.08393	0.10280	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER OCO
DATE 10-4-72

FIGURE 4.1.1.1-90
EFFECT OF ELEVON

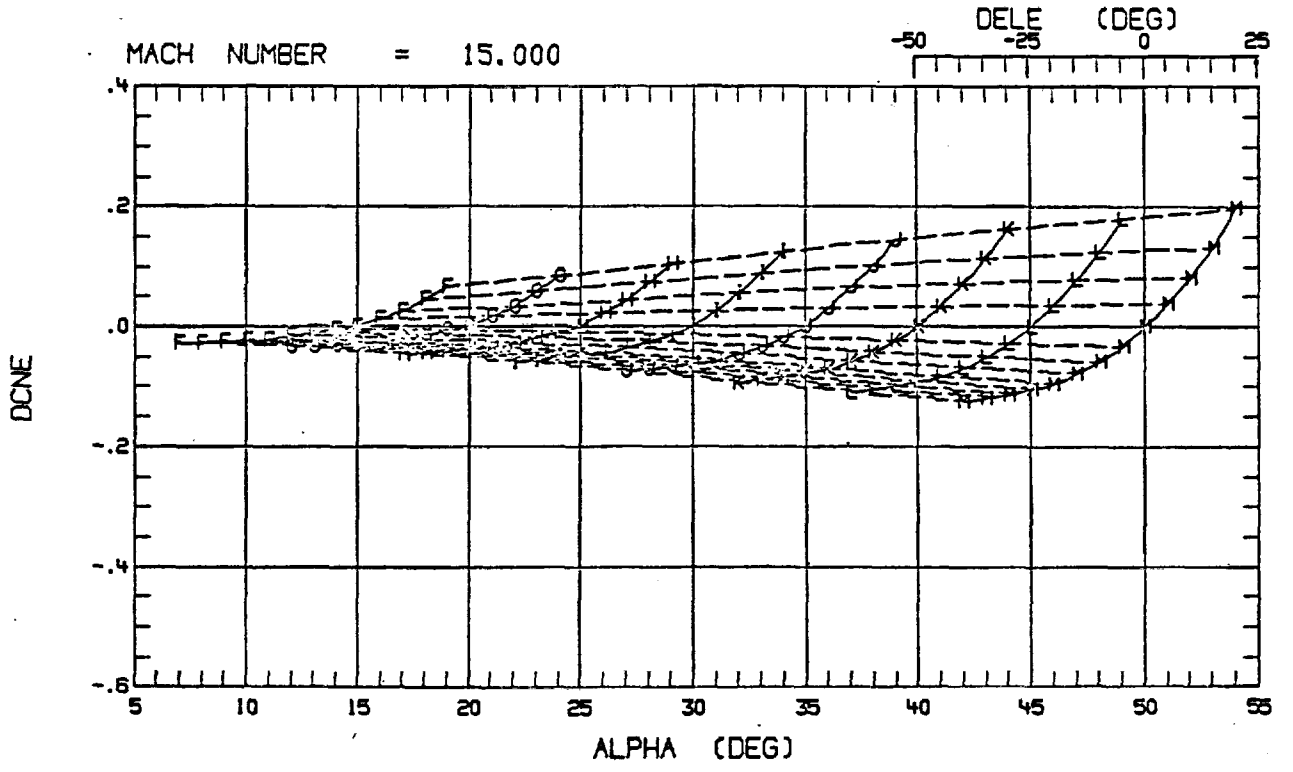


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.07889	-0.05933	-0.04200	-0.03170	-0.02408	-0.02950	-0.03441	-0.04694
-35.000	-0.06632	-0.05070	-0.03700	-0.02998	-0.02331	-0.02790	-0.03298	-0.04422
-30.000	-0.05472	-0.04308	-0.03200	-0.02525	-0.02154	-0.02630	-0.03158	-0.04150
-25.000	-0.04337	-0.03458	-0.02800	-0.02346	-0.01973	-0.02448	-0.02966	-0.03852
-20.000	-0.03203	-0.02708	-0.02300	-0.02066	-0.01792	-0.02265	-0.02778	-0.03650
-15.000	-0.02399	-0.01972	-0.01700	-0.01479	-0.01400	-0.01675	-0.02083	-0.02866
-10.000	-0.01499	-0.01336	-0.01100	-0.00991	-0.00909	-0.01179	-0.01485	-0.01991
-5.000	-0.00733	-0.00618	-0.00600	-0.00495	-0.00503	-0.00540	-0.00694	-0.00996
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00455	0.00409	0.00400	0.00712	0.00835	0.01226	0.01555	0.02166
10.000	0.00970	0.00917	0.00900	0.01325	0.01792	0.02454	0.03267	0.04329
15.000	0.01072	0.01010	0.01000	0.02062	0.03275	0.04450	0.05776	0.07259
20.000	0.01220	0.01103	0.01000	0.02999	0.04760	0.06447	0.08393	0.10290

ENGINEER Dsa
DATE 10-4-72

FIGURE 4.1.1.1-91
EFFECT OF ELEVON

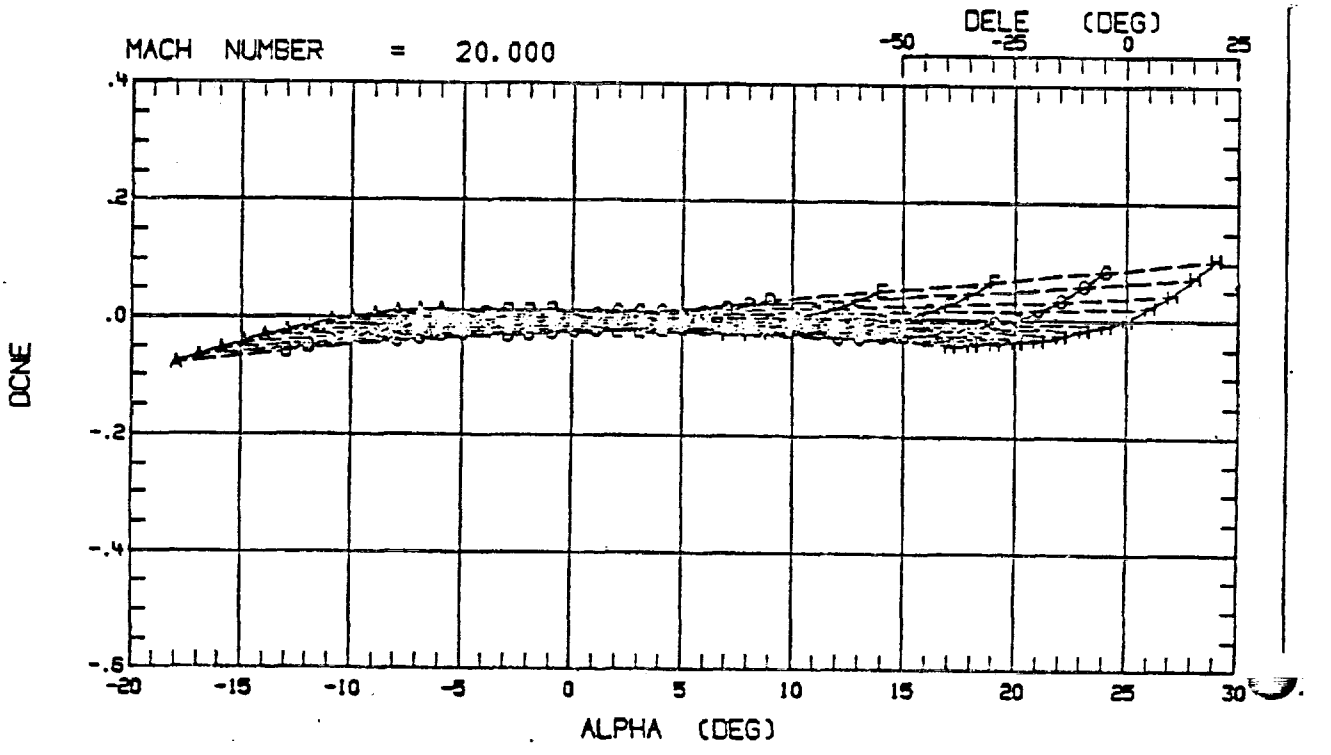


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.02950	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.02790	-0.03298	-0.04422	-0.05575	-0.07212	-0.08929	-0.10507	-0.12015
-30.000	-0.02630	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02448	-0.02966	-0.03852	-0.04849	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02265	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.01675	-0.02083	-0.02866	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01179	-0.01485	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00540	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01226	0.01555	0.02166	0.02507	0.02928	0.03268	0.03504	0.03658
10.000	0.02454	0.03267	0.04329	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.04450	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.06447	0.08393	0.10280	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-92
EFFECT OF ELEVON



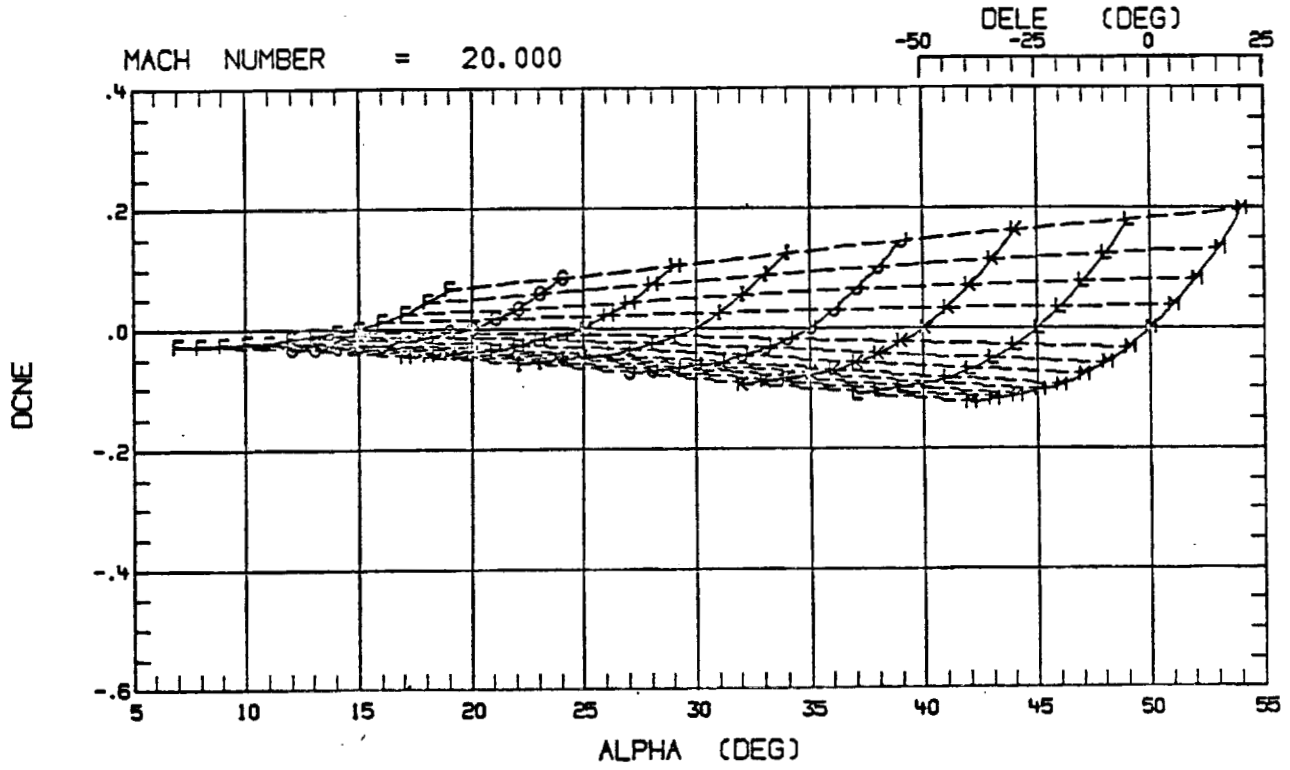
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.07889	-0.05933	-0.04200	-0.03170	-0.02408	-0.02550	-0.03441	-0.04694
-35.000	-0.06632	-0.05070	-0.03700	-0.02898	-0.02331	-0.02790	-0.03298	-0.04422
-30.000	-0.05472	-0.04308	-0.03200	-0.02625	-0.02154	-0.02630	-0.03158	-0.04150
-25.000	-0.04337	-0.03458	-0.02800	-0.02346	-0.01973	-0.02448	-0.02966	-0.03852
-20.000	-0.03203	-0.02708	-0.02300	-0.02066	-0.01792	-0.02265	-0.02778	-0.03650
-15.000	-0.02399	-0.01972	-0.01700	-0.01479	-0.01400	-0.01675	-0.02083	-0.02866
-10.000	-0.01499	-0.01336	-0.01100	-0.00991	-0.00909	-0.01179	-0.01485	-0.01991
-5.000	-0.00733	-0.00618	-0.00600	-0.00495	-0.00503	-0.00540	-0.00694	-0.00996
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00455	0.00409	0.00400	0.00712	0.00835	0.01226	0.01555	0.02166
10.000	0.00970	0.00917	0.00900	0.01325	0.01792	0.02454	0.03267	0.04328
15.000	0.01072	0.01010	0.01000	0.02062	0.03275	0.04450	0.05776	0.07259
20.000	0.01220	0.01103	0.01000	0.02999	0.04760	0.06447	0.08393	0.10280

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-93
EFFECT OF ELEVON

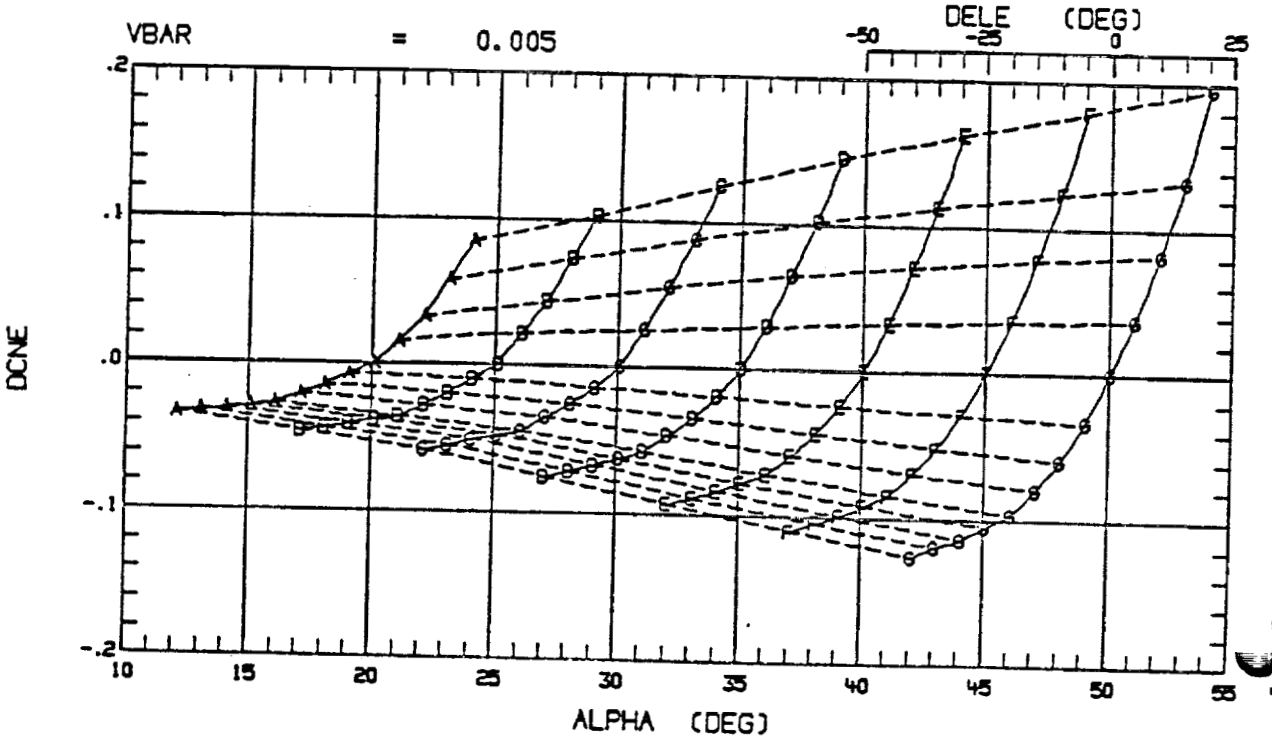


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT							
-40.000	-0.02950	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.02790	-0.03298	-0.04422	-0.05575	-0.07212	-0.08929	-0.10587	-0.12015
-30.000	-0.02630	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02448	-0.02966	-0.03852	-0.04849	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02265	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.01675	-0.02083	-0.02866	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01179	-0.01485	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00540	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01226	0.01555	0.02166	0.02507	0.02928	0.03268	0.03504	0.03658
10.000	0.02454	0.03267	0.04328	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.04450	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.06447	0.08393	0.10280	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.1-94
EFFECT OF ELEVON



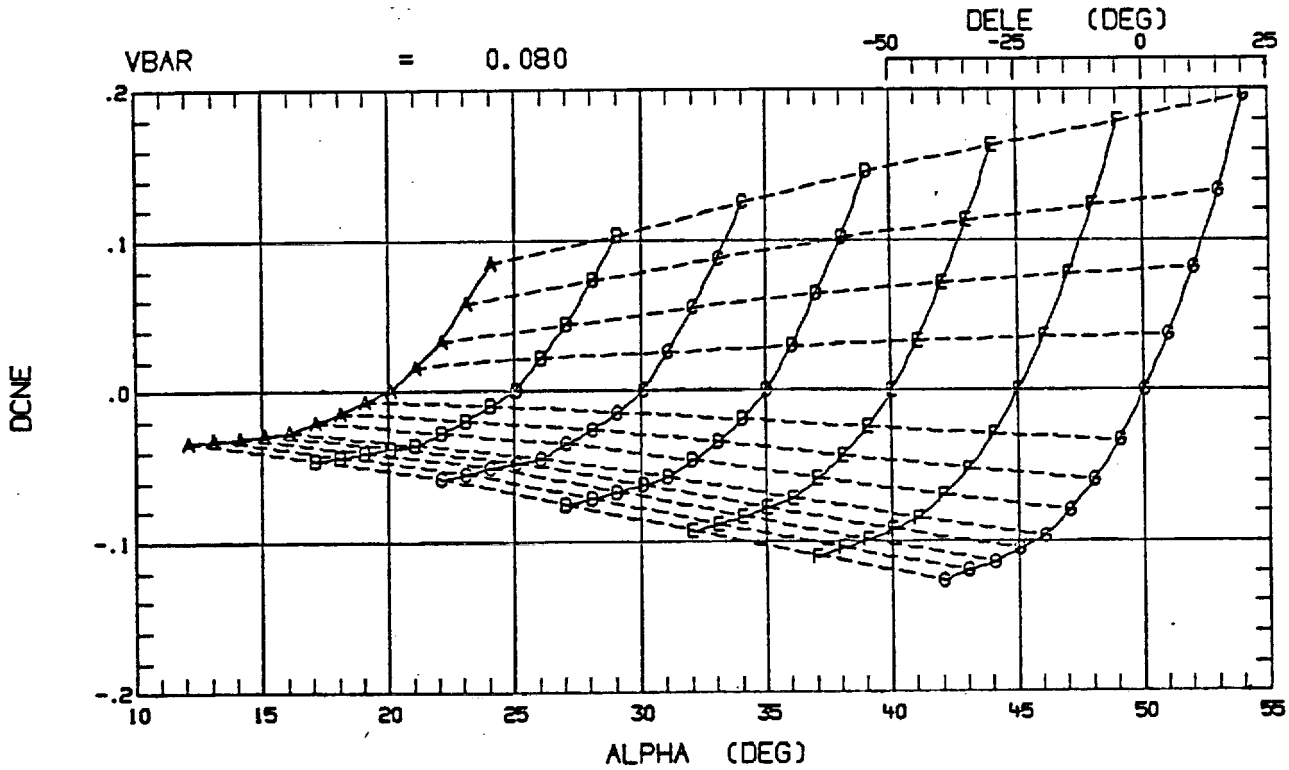
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) 20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
	ELEVON NORMAL FORCE INCREMENT						
-40.000	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.03298	-0.04422	-0.05575	-0.07212	-0.08929	-0.10507	-0.12015
-30.000	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02966	-0.03852	-0.04849	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.02083	-0.02866	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01485	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01555	0.02166	0.02507	0.02929	0.03258	0.03504	0.03658
10.000	0.03267	0.04328	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.08393	0.10280	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER NASA
DATE

FIGURE 4.1.1.1-95
EFFECT OF ELEVON

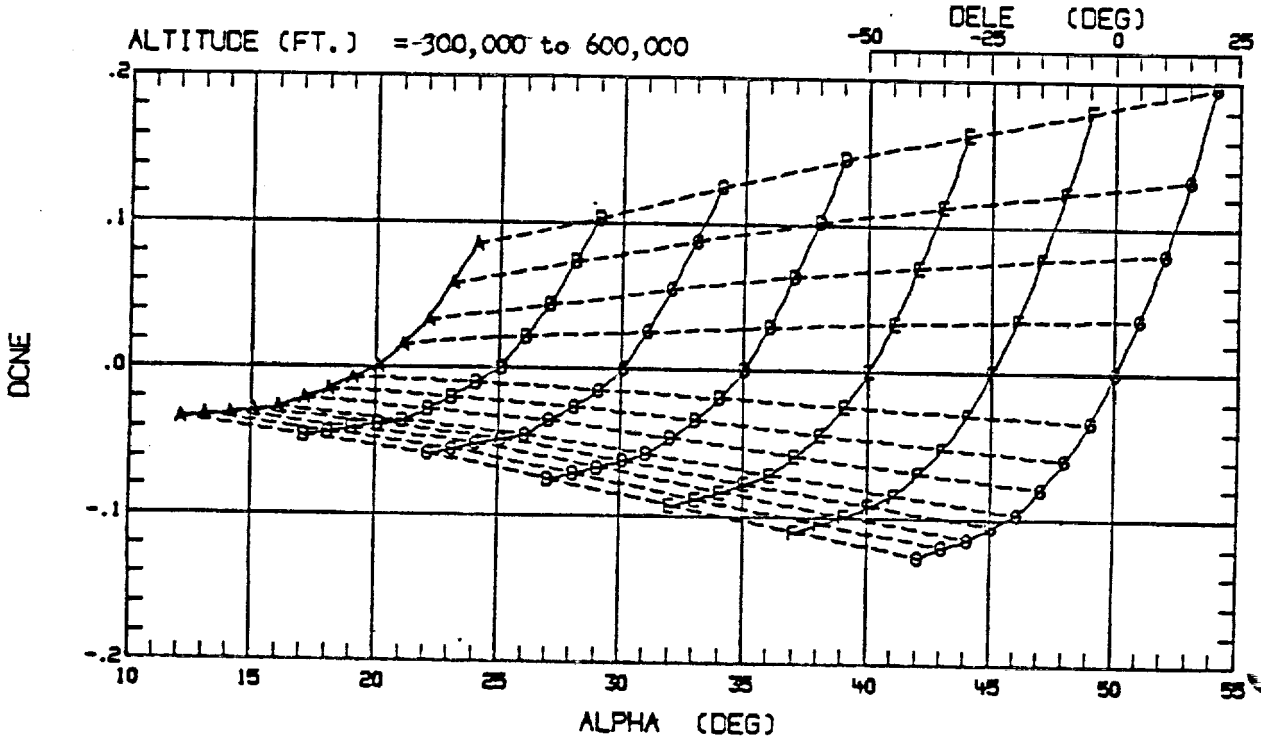


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON NORMAL FORCE INCREMENT						
-40.000	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.03298	-0.04422	-0.05575	-0.07212	-0.08929	-0.10507	-0.12015
-30.000	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02966	-0.03852	-0.04849	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.02083	-0.02866	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01485	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01555	0.02166	0.02507	0.02928	0.03268	0.03504	0.03658
10.000	0.03267	0.04328	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.08393	0.10280	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER NASA
DATE

FIGURE 4.1.1.1-96
EFFECT OF ELEVON



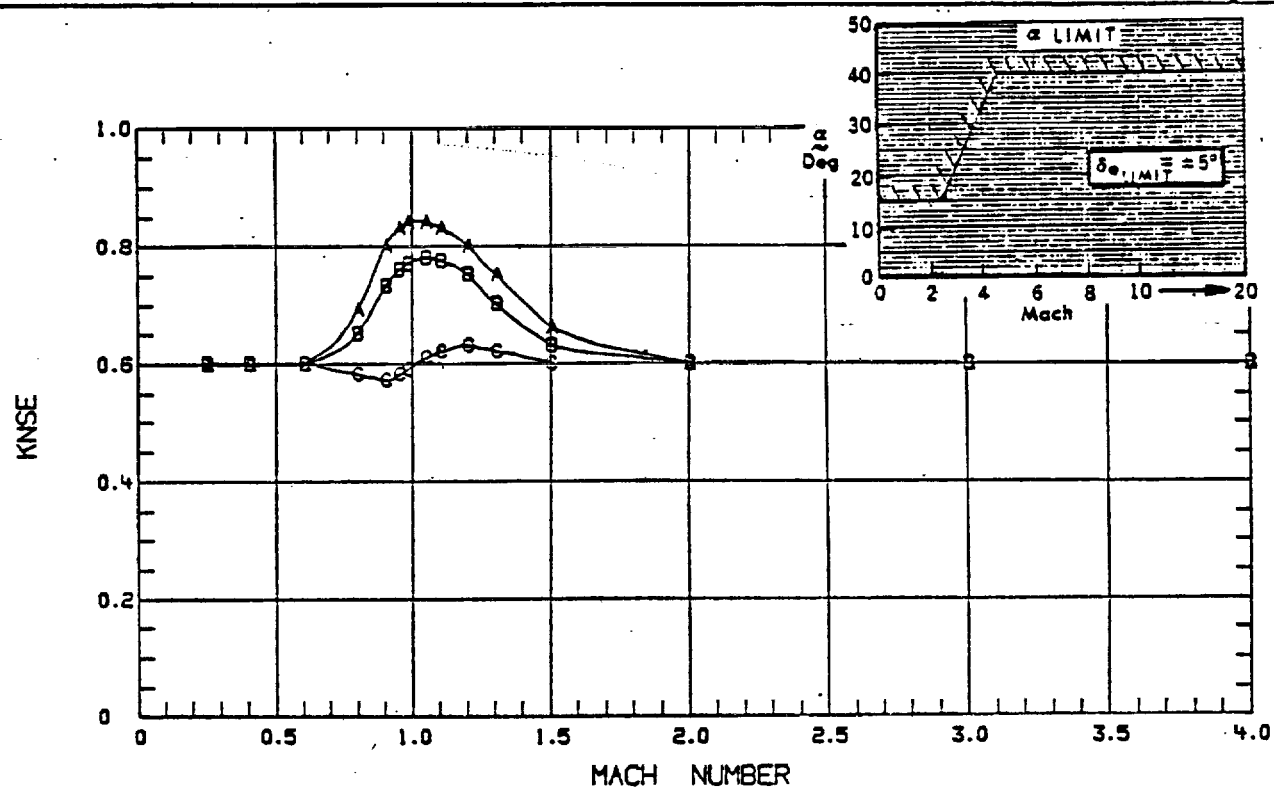
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) 20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
	ELEVON NORMAL FORCE INCREMENT						
-40.000	-0.03441	-0.04694	-0.05905	-0.07587	-0.09370	-0.11032	-0.12656
-35.000	-0.03298	-0.04422	-0.05675	-0.07212	-0.08929	-0.10507	-0.12015
-30.000	-0.03158	-0.04150	-0.05159	-0.06758	-0.08411	-0.09960	-0.11430
-25.000	-0.02966	-0.03852	-0.04649	-0.06319	-0.07842	-0.09251	-0.10574
-20.000	-0.02778	-0.03650	-0.04534	-0.05835	-0.07196	-0.08489	-0.09718
-15.000	-0.02083	-0.02866	-0.03583	-0.04718	-0.05917	-0.06998	-0.07989
-10.000	-0.01485	-0.01991	-0.02627	-0.03483	-0.04395	-0.05230	-0.06008
-5.000	-0.00694	-0.00996	-0.01491	-0.01964	-0.02454	-0.02930	-0.03391
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01555	0.02166	0.02507	0.02928	0.03268	0.03504	0.03658
10.000	0.03257	0.04329	0.05489	0.06385	0.07114	0.07689	0.08143
15.000	0.05776	0.07259	0.08760	0.10106	0.11269	0.12251	0.13204
20.000	0.08393	0.10280	0.12447	0.14471	0.16246	0.17871	0.19640

ENGINEER NASA
DATE

FIGURE 4.1.1.1-97
EFFECT OF ELEVON



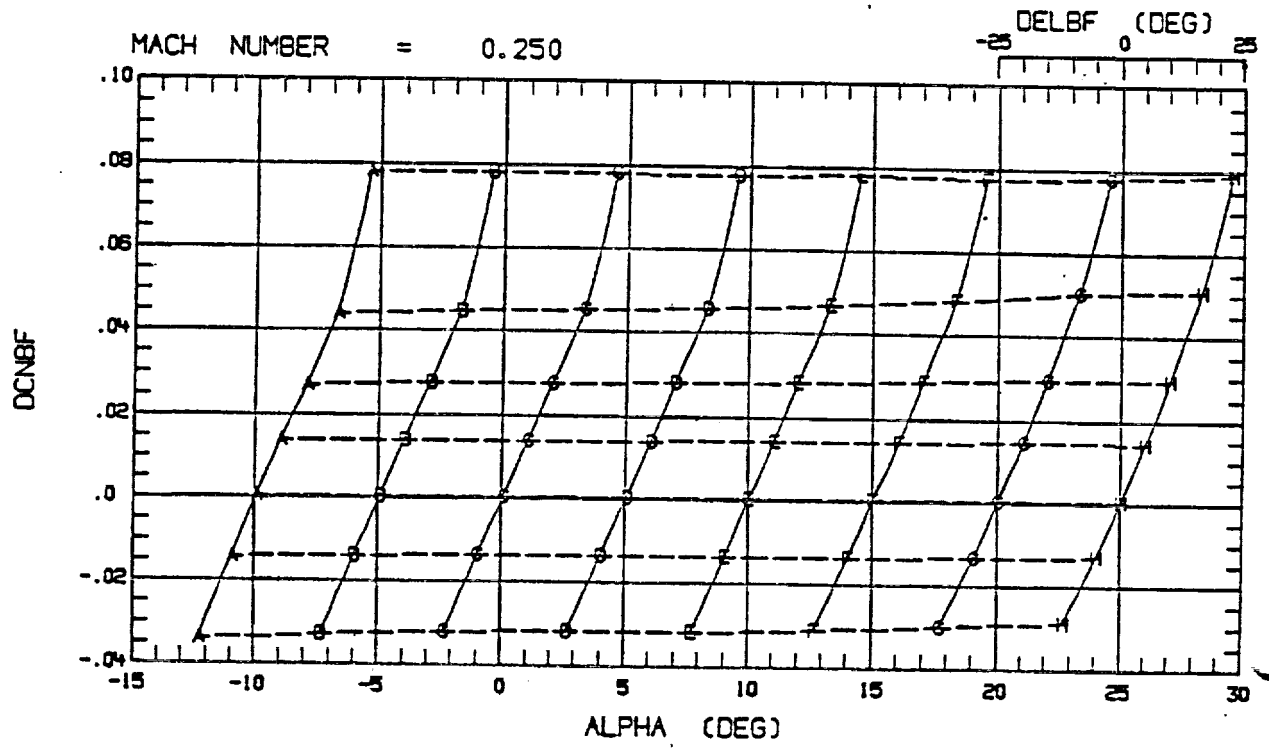
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	DELE (DEG)		
	-5.000 A	0.0 B	5.000 C
MACH NUMBER	NORMAL FORCE PARTIAL SPAN FACTOR		
0.250	0.60000	0.60000	0.60000
0.400	0.60000	0.60000	0.60000
0.600	0.60000	0.60000	0.60000
0.800	0.69000	0.65000	0.58000
0.900	0.80000	0.73000	0.57000
0.950	0.83000	0.76000	0.58000
0.980	0.84000	0.77000	0.59000
1.050	0.84000	0.78000	0.61000
1.100	0.83000	0.77500	0.62000
1.200	0.80000	0.75000	0.63000
1.300	0.75000	0.70000	0.62000
1.500	0.66000	0.63000	0.60000
2.000	0.60000	0.60000	0.60000
3.000	0.60000	0.60000	0.60000
4.000	0.60000	0.60000	0.60000
5.000	0.60000	0.60000	0.60000
8.000	0.60000	0.60000	0.60000
10.000	0.60000	0.60000	0.60000
15.000	0.60000	0.60000	0.60000
20.000	0.60000	0.60000	0.60000

NOTE: In the event partial span factors are required which exceed the given limits, the Aero Data Unit at Rockwell Internation'l should be contacted *before* extrapolation of the given data.

ENGINEER WMZ
DATE 10-4-78 REV 1-26-79

FIGURE 4.1.1.1-98
ELEVON PARTIAL SPAN FACTOR

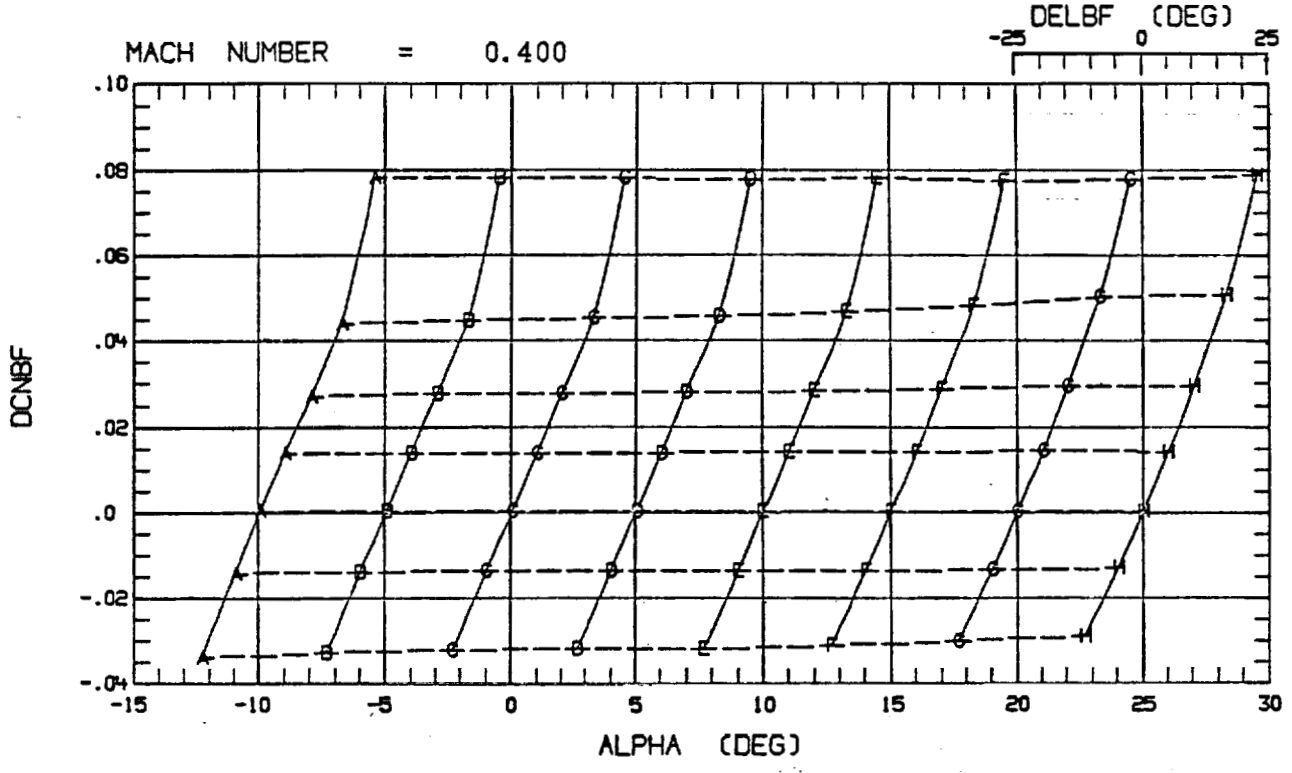


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELBF (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.03407	-0.03291	-0.03220	-0.03187	-0.03180	-0.03109	-0.03005	-0.02693
-5.000	-0.01430	-0.01398	-0.01379	-0.01372	-0.01376	-0.01365	-0.01346	-0.01312
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01349	0.01382	0.01380	0.01382	0.01396	0.01409	0.01426	0.01411
10.000	0.02692	0.02752	0.02761	0.02774	0.02912	0.02966	0.02938	0.02927
16.300	0.04392	0.04474	0.04520	0.04567	0.04663	0.04815	0.05017	0.05047
22.500	0.07780	0.07801	0.07780	0.07770	0.07782	0.07719	0.07762	0.07861

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-99
EFFECT OF BODY FLAP

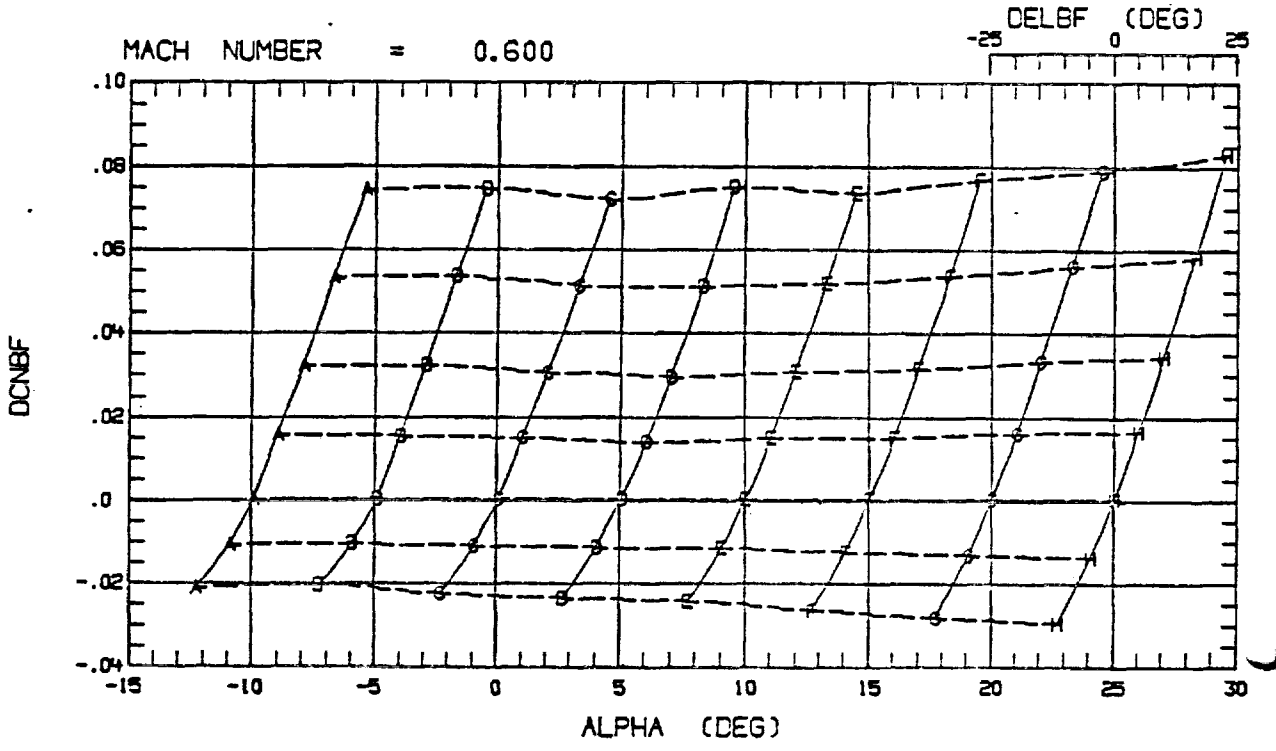


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.03407	-0.03291	-0.03220	-0.03187	-0.03180	-0.03109	-0.03005	-0.02893
-5.000	-0.01430	-0.01398	-0.01379	-0.01372	-0.01376	-0.01365	-0.01346	-0.01312
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01349	0.01382	0.01380	0.01382	0.01396	0.01409	0.01426	0.01411
10.000	0.02692	0.02752	0.02761	0.02774	0.02812	0.02866	0.02938	0.02927
16.300	0.04392	0.04474	0.04520	0.04567	0.04663	0.04815	0.05017	0.05047
22.500	0.07780	0.07801	0.07780	0.07770	0.07782	0.07719	0.07762	0.07861

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-100
EFFECT OF BODY FLAP

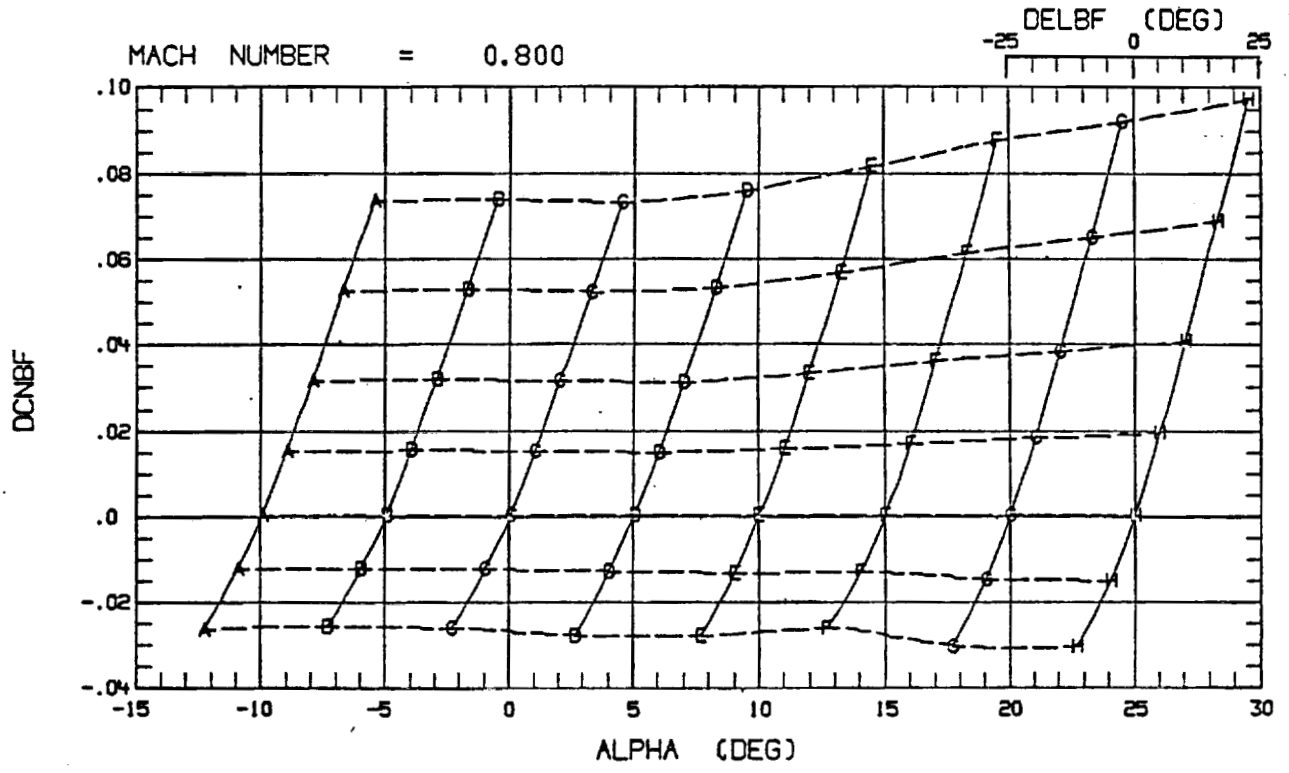


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.02116	-0.02050	-0.02267	-0.02361	-0.02434	-0.02661	-0.02818	-0.02980
-5.000	-0.01078	-0.01058	-0.01112	-0.01142	-0.01171	-0.01258	-0.01326	-0.01395
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01550	0.01525	0.01455	0.01363	0.01458	0.01481	0.01589	0.01629
10.000	0.03210	0.03201	0.03053	0.02925	0.03068	0.03133	0.03316	0.03426
16.300	0.05318	0.05332	0.05111	0.05112	0.05181	0.05347	0.05578	0.05809
22.500	0.07416	0.07446	0.07182	0.07484	0.07345	0.07651	0.07884	0.08251

ENGINEER Wum2
DATE 9-30-78

FIGURE 4.1.1.1-101
EFFECT OF BODY FLAP

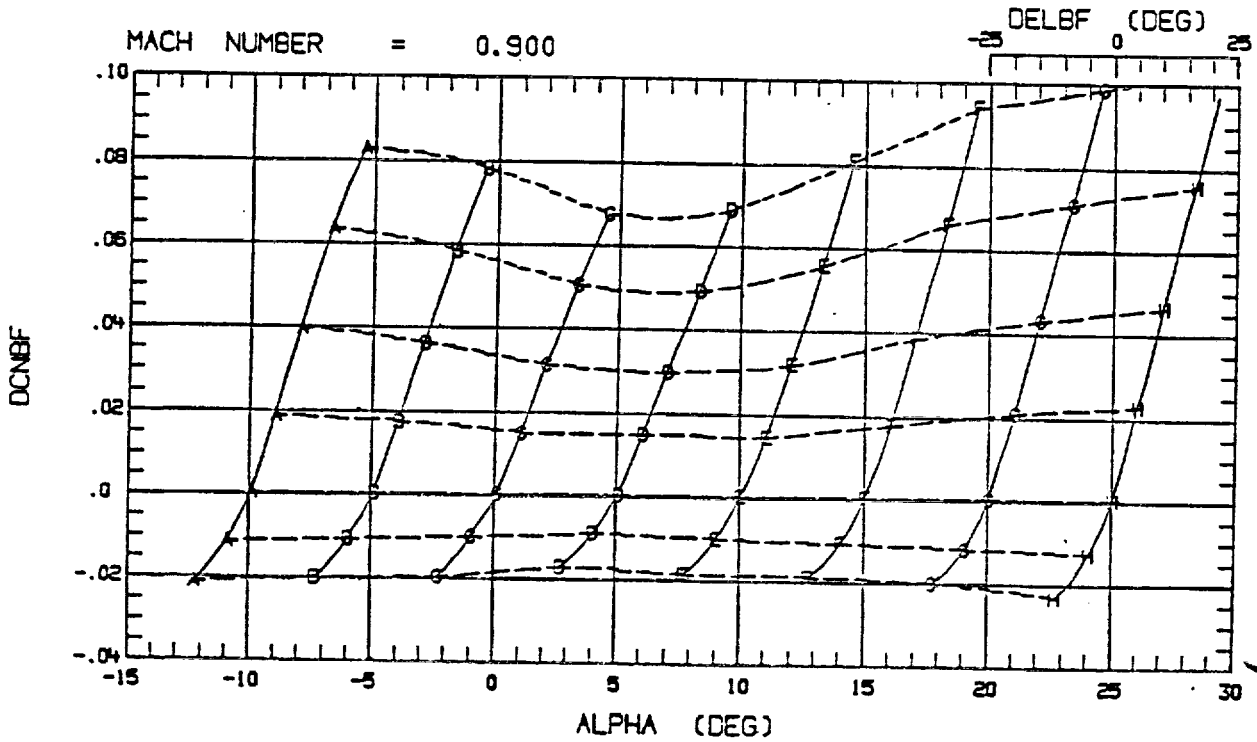


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000. H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.02634	-0.02561	-0.02630	-0.02784	-0.02783	-0.02522	-0.03033	-0.03051
-5.000	-0.01240	-0.01220	-0.01238	-0.01294	-0.01321	-0.01302	-0.01462	-0.01495
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01502	0.01528	0.01515	0.01481	0.01562	0.01687	0.01817	0.01917
10.000	0.03135	0.03176	0.03139	0.03116	0.03313	0.03596	0.03835	0.04059
16.300	0.05231	0.05273	0.05215	0.05308	0.05672	0.06128	0.06485	0.06856
22.500	0.07336	0.07358	0.07291	0.07592	0.08142	0.08743	0.09193	0.09702

ENGINEER LUM Z
DATE 9-21-78

FIGURE 4.1.1.1-102
EFFECT OF BODY FLAP

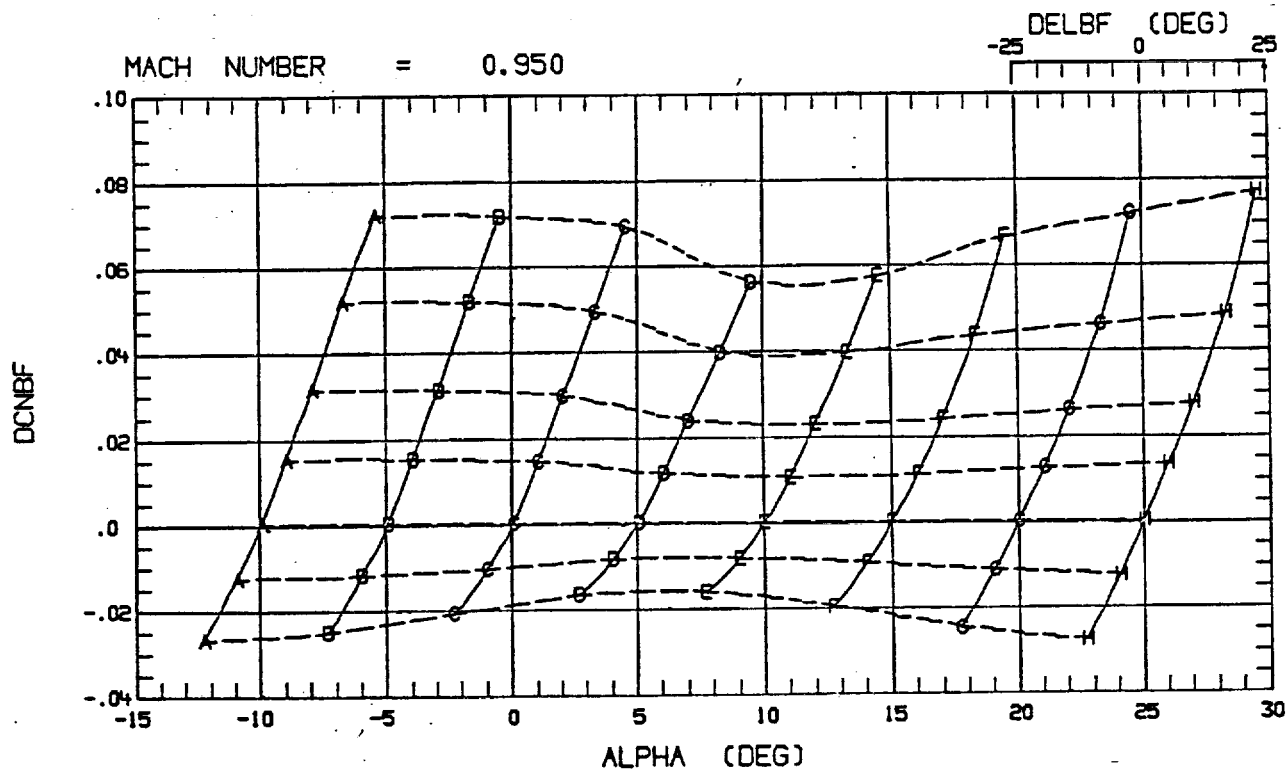


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.02099	-0.02027	-0.01973	-0.01710	-0.01863	-0.01898	-0.02016	-0.02332
-5.000	-0.01147	-0.01086	-0.01009	-0.00917	-0.01013	-0.01100	-0.01176	-0.01313
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01851	0.01732	0.01478	0.01466	0.01440	0.01772	0.02093	0.02250
10.000	0.03970	0.03618	0.03100	0.02981	0.03172	0.03853	0.04301	0.04623
16.300	0.06337	0.05819	0.05010	0.04918	0.05552	0.06586	0.07092	0.07563
22.500	0.08272	0.07789	0.06731	0.06856	0.08085	0.09390	0.09860	0.10414

ENGINEER WMZ
DATE 4-30-78

FIGURE 4.1.1.1-103
EFFECT OF BODY FLAP

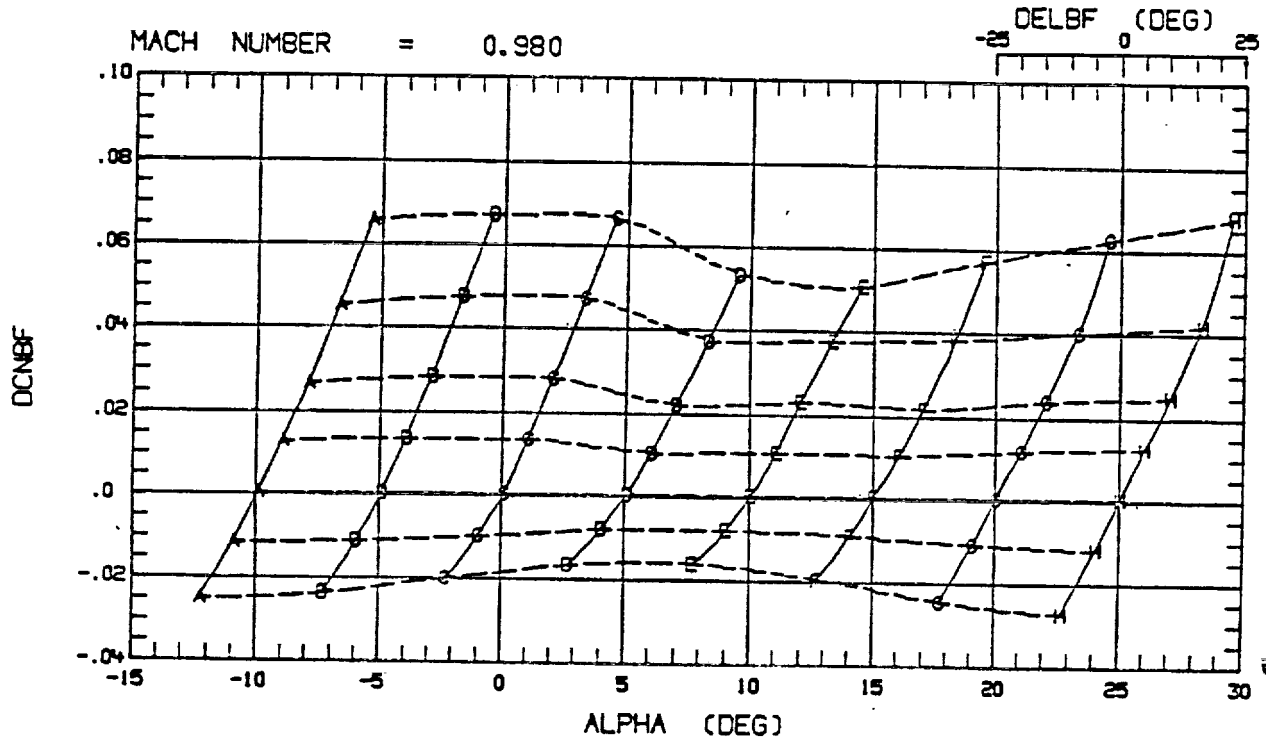


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000. H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.02670	-0.02506	-0.02072	-0.01660	-0.01627	-0.01967	-0.02460	-0.02773
-5.000	-0.01247	-0.01193	-0.01036	-0.00831	-0.00820	-0.00959	-0.01139	-0.01257
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01512	0.01516	0.01420	0.01143	0.01059	0.01119	0.01245	0.01340
10.000	0.03129	0.03121	0.02963	0.02374	0.02294	0.02406	0.02598	0.02761
16.300	0.05173	0.05154	0.04934	0.03965	0.03961	0.04352	0.04614	0.04851
22.500	0.07189	0.07171	0.06906	0.05581	0.05748	0.06675	0.07194	0.07702

ENGINEER WMZ
DATE 9-30-78

FIGURE 4.1.1.1-104
EFFECT OF BODY FLAP

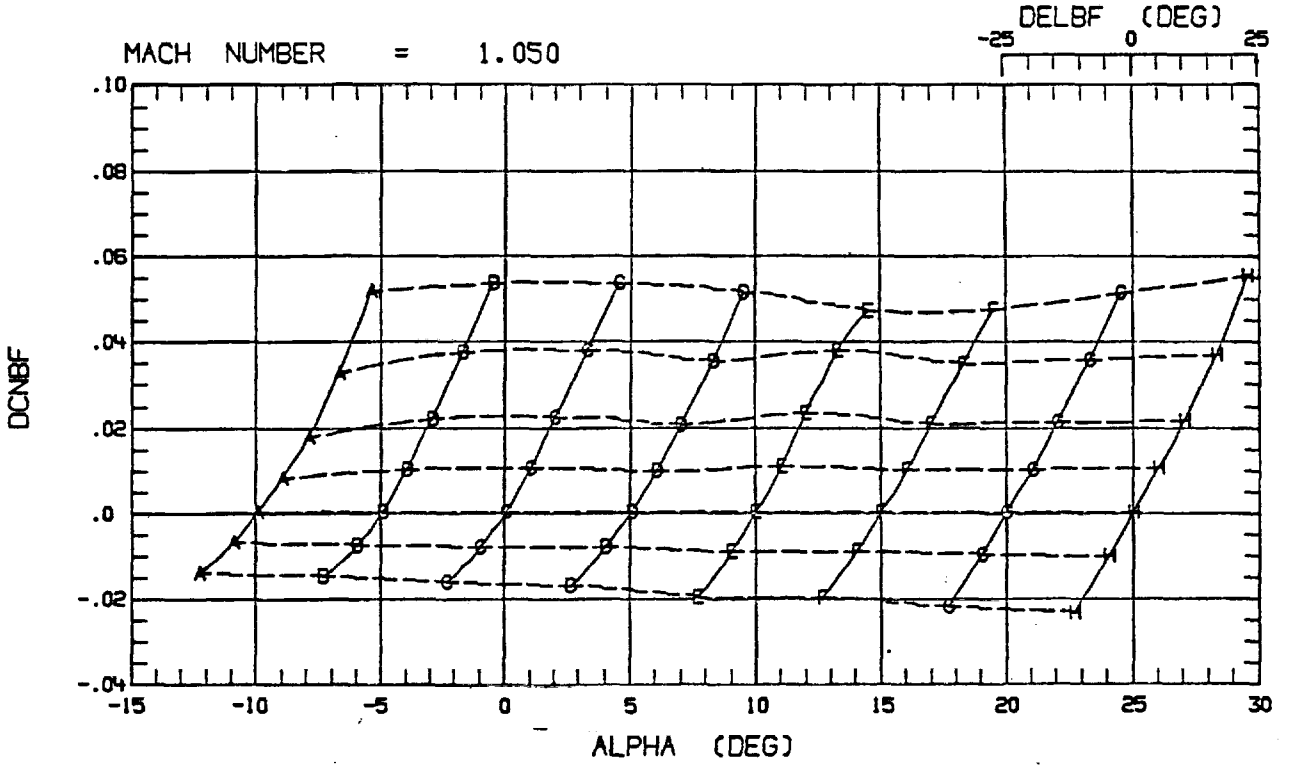


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELBF (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.02508	-0.02377	-0.01998	-0.01654	-0.01625	-0.01975	-0.02488	-0.02754
-5.000	-0.01149	-0.01122	-0.00994	-0.00810	-0.00803	-0.00921	-0.01103	-0.01202
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01264	0.01341	0.01316	0.01015	0.01058	0.01025	0.01155	0.01222
10.000	0.02543	0.02816	0.02787	0.02167	0.02278	0.02159	0.02366	0.02459
16.300	0.04535	0.04744	0.04698	0.03712	0.03750	0.03806	0.03999	0.04179
22.500	0.06561	0.06705	0.06635	0.05324	0.05051	0.05715	0.06229	0.06754

ENGINEER [illegible]
DATE 4-27-78

FIGURE 4.1.1.1-105
EFFECT OF BODY FLAP

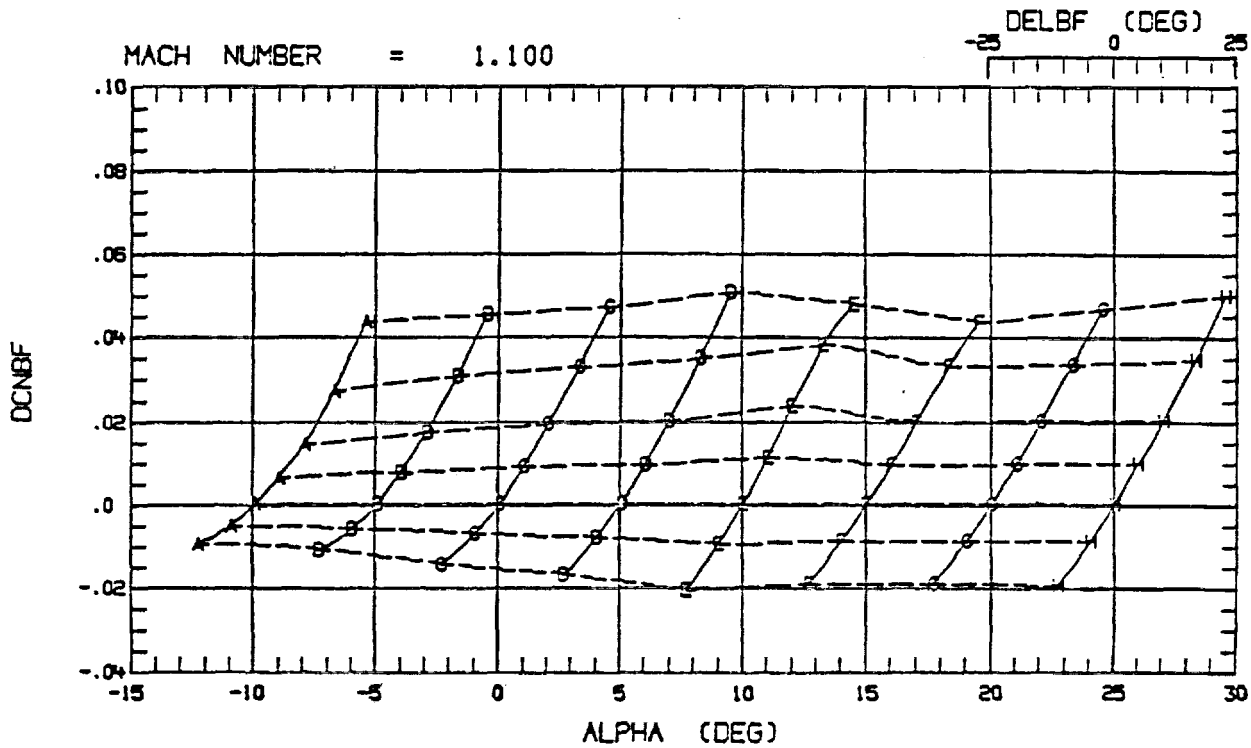


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.01422	-0.01476	-0.01613	-0.01704	-0.01975	-0.01971	-0.02194	-0.02337
-5.000	-0.00701	-0.00756	-0.00802	-0.00814	-0.00920	-0.00896	-0.00977	-0.01031
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00810	0.01021	0.01054	0.00960	0.01093	0.00993	0.01023	0.01052
10.000	0.01752	0.02199	0.02236	0.02047	0.02328	0.02075	0.02115	0.02137
16.300	0.03256	0.03753	0.03776	0.03545	0.03793	0.03478	0.03585	0.03690
22.500	0.05150	0.05348	0.05340	0.05145	0.04717	0.04752	0.05126	0.05513

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-106
EFFECT OF BODY FLAP



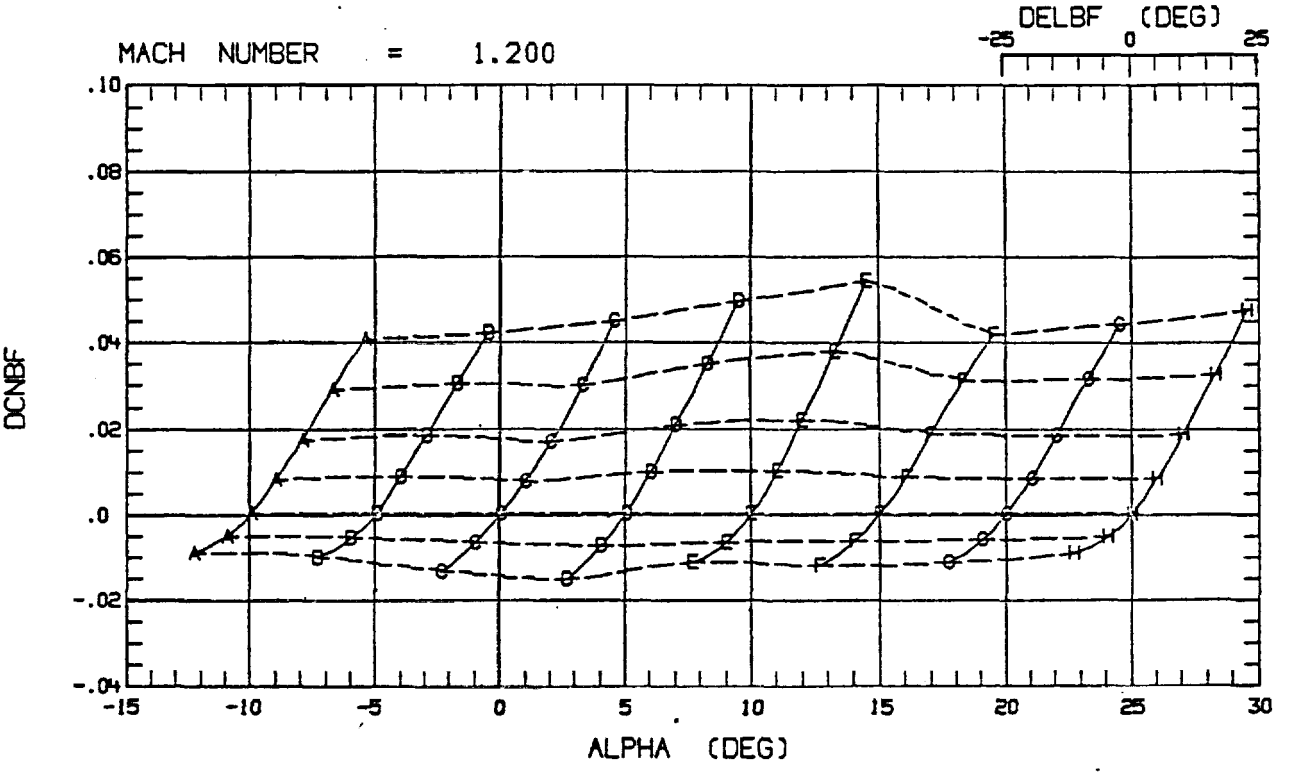
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00935	-0.01070	-0.01427	-0.01705	-0.02040	-0.01908	-0.01901	-0.01936
-5.000	-0.00504	-0.00573	-0.00705	-0.00810	-0.00943	-0.00863	-0.00865	-0.00882
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00634	0.00778	0.00894	0.00949	0.01120	0.00949	0.00957	0.00965
10.000	0.01425	0.01726	0.01918	0.02016	0.02349	0.01968	0.01998	0.02014
16.300	0.02723	0.03071	0.03286	0.03484	0.03809	0.03307	0.03367	0.03449
22.500	0.04362	0.04536	0.04705	0.05051	0.04764	0.04363	0.04666	0.04983

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-107
EFFECT OF BODY FLAP

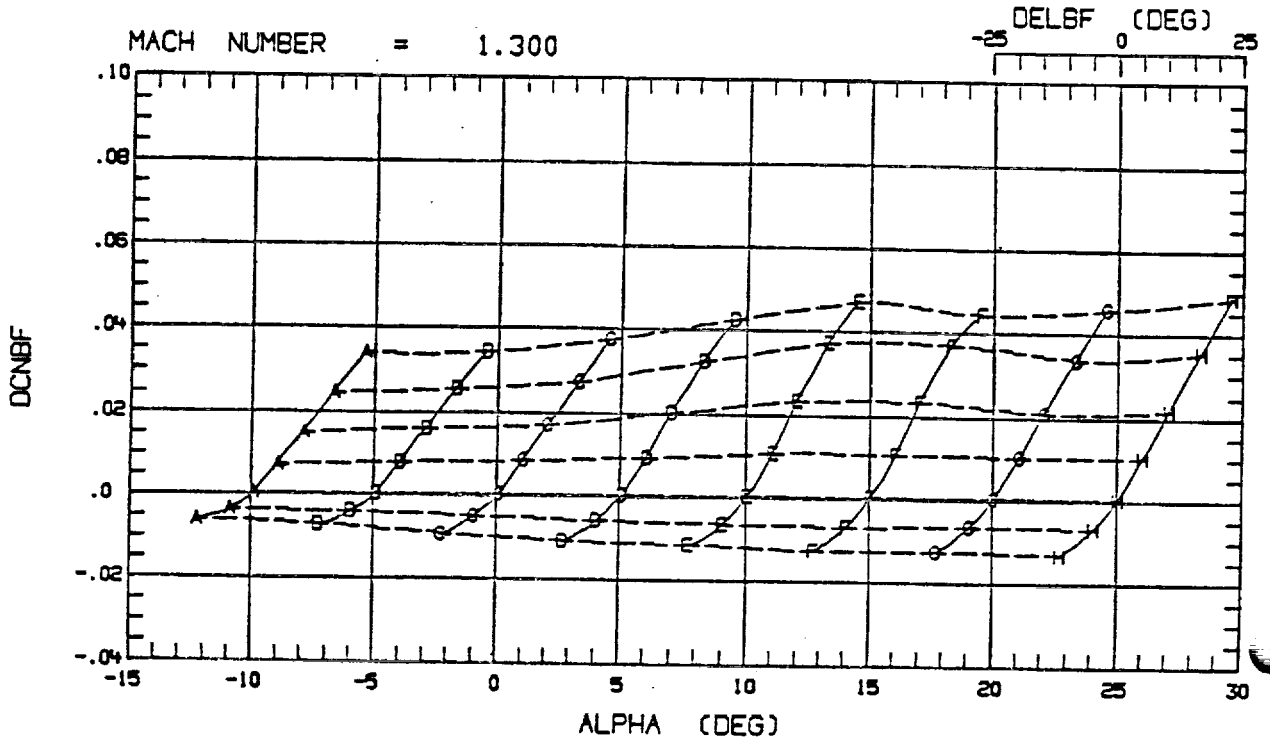


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00892	-0.01011	-0.01352	-0.01503	-0.01125	-0.01209	-0.01128	-0.00906
-5.000	-0.00503	-0.00550	-0.00659	-0.00745	-0.00643	-0.00622	-0.00598	-0.00533
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00790	0.00872	0.00775	0.00968	0.01006	0.00852	0.00834	0.00831
10.000	0.01716	0.01819	0.01669	0.02060	0.02199	0.01875	0.01834	0.01851
16.300	0.02902	0.03020	0.02986	0.03491	0.03780	0.03120	0.03140	0.03243
22.500	0.04078	0.04217	0.04500	0.04954	0.05409	0.04188	0.04435	0.04724

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-108
EFFECT OF BODY FLAP



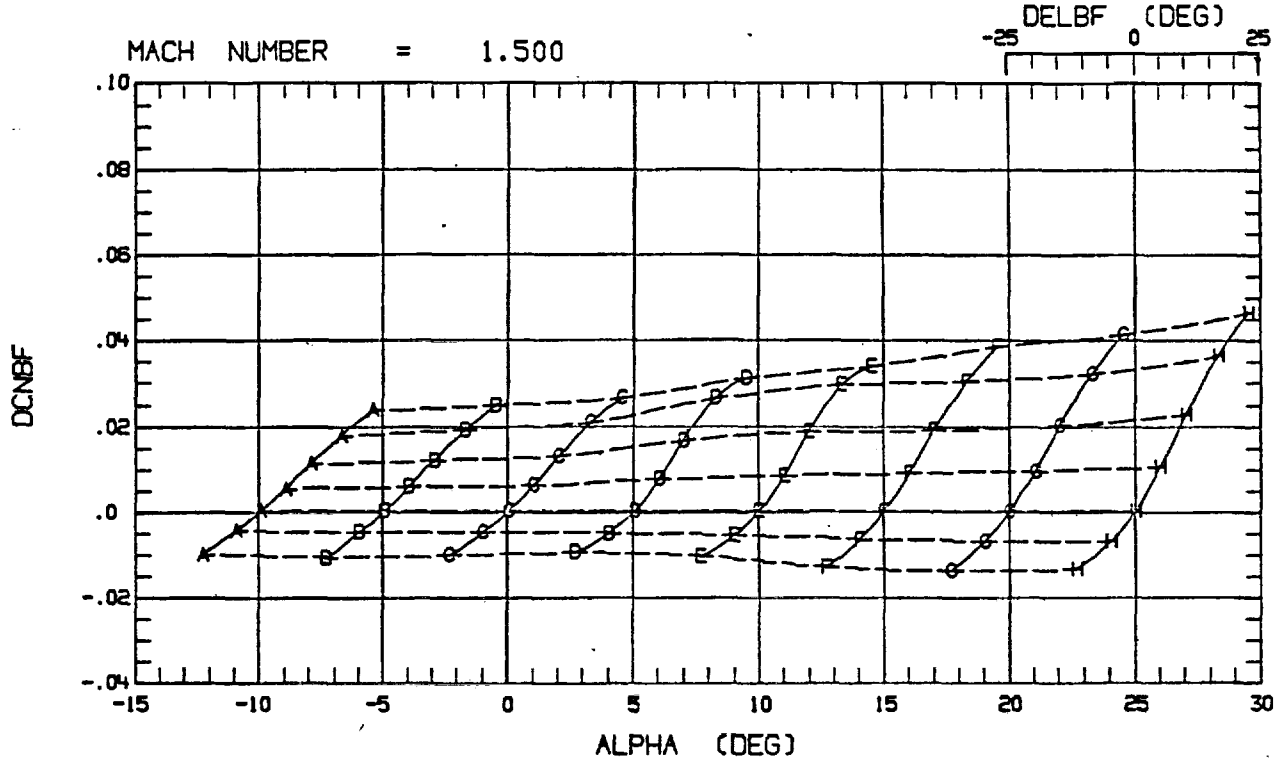
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELBF (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00614	-0.00725	-0.00941	-0.01090	-0.01175	-0.01278	-0.01264	-0.01341
-5.000	-0.00378	-0.00423	-0.00505	-0.00593	-0.00654	-0.00686	-0.00658	-0.00696
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00708	0.00766	0.00828	0.00919	0.01056	0.01052	0.01004	0.01023
10.000	0.01469	0.01588	0.01669	0.02008	0.02312	0.02313	0.02079	0.02148
16.300	0.02427	0.02550	0.02718	0.03247	0.03699	0.03684	0.03367	0.03534
22.500	0.03377	0.03423	0.03740	0.04250	0.04701	0.04426	0.04554	0.04863

ENGINEER WMZ
DATE 9-31-78

FIGURE 4.1.1.1-109
EFFECT OF BODY FLAP

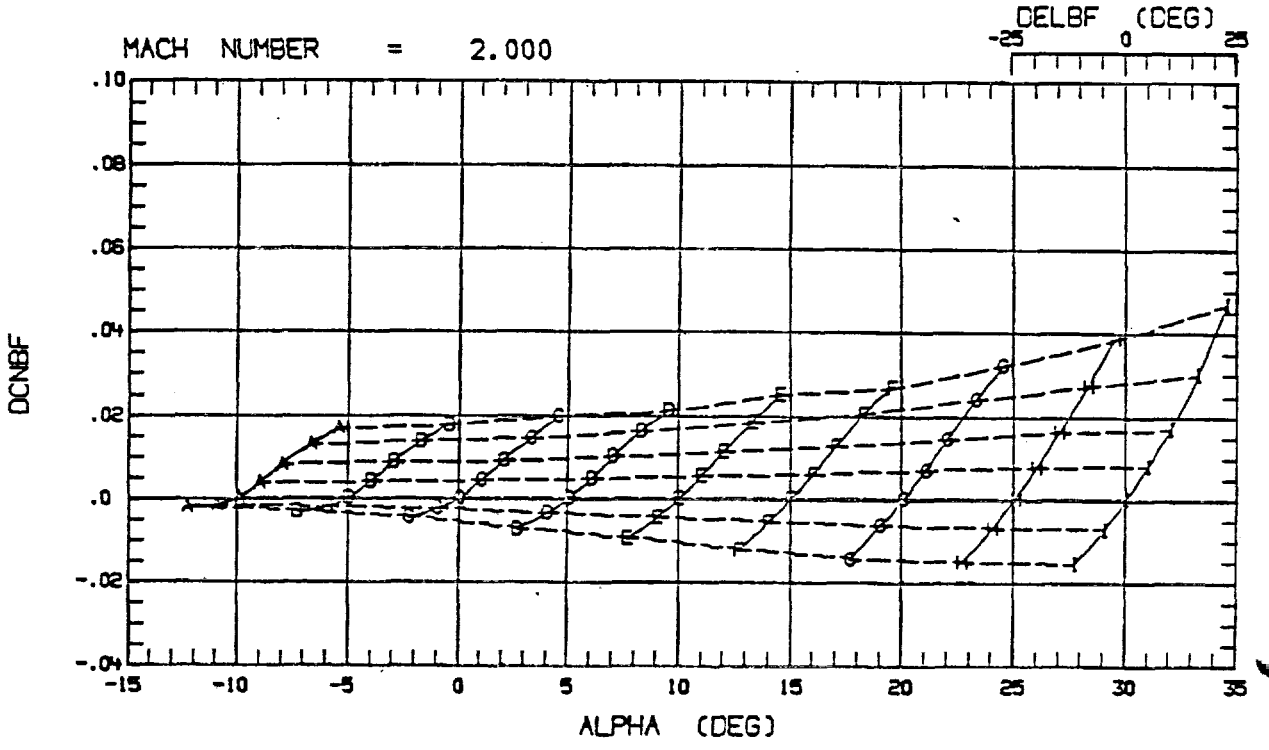


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.01002	-0.01069	-0.01019	-0.00956	-0.01057	-0.01300	-0.01383	-0.01330
-5.000	-0.00456	-0.00488	-0.00484	-0.00504	-0.00560	-0.00646	-0.00685	-0.00699
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00528	0.00568	0.00604	0.00744	0.00838	0.00893	0.00955	0.01055
10.000	0.01103	0.01192	0.01297	0.01657	0.01864	0.01889	0.01995	0.02257
16.300	0.01773	0.01904	0.02077	0.02628	0.02952	0.03033	0.03217	0.03625
22.500	0.02343	0.02452	0.02633	0.03106	0.03383	0.03838	0.04120	0.04632

ENGINEER WMZ
DATE 9-30-78

FIGURE 4.1.1.1-110
EFFECT OF BODY FLAP

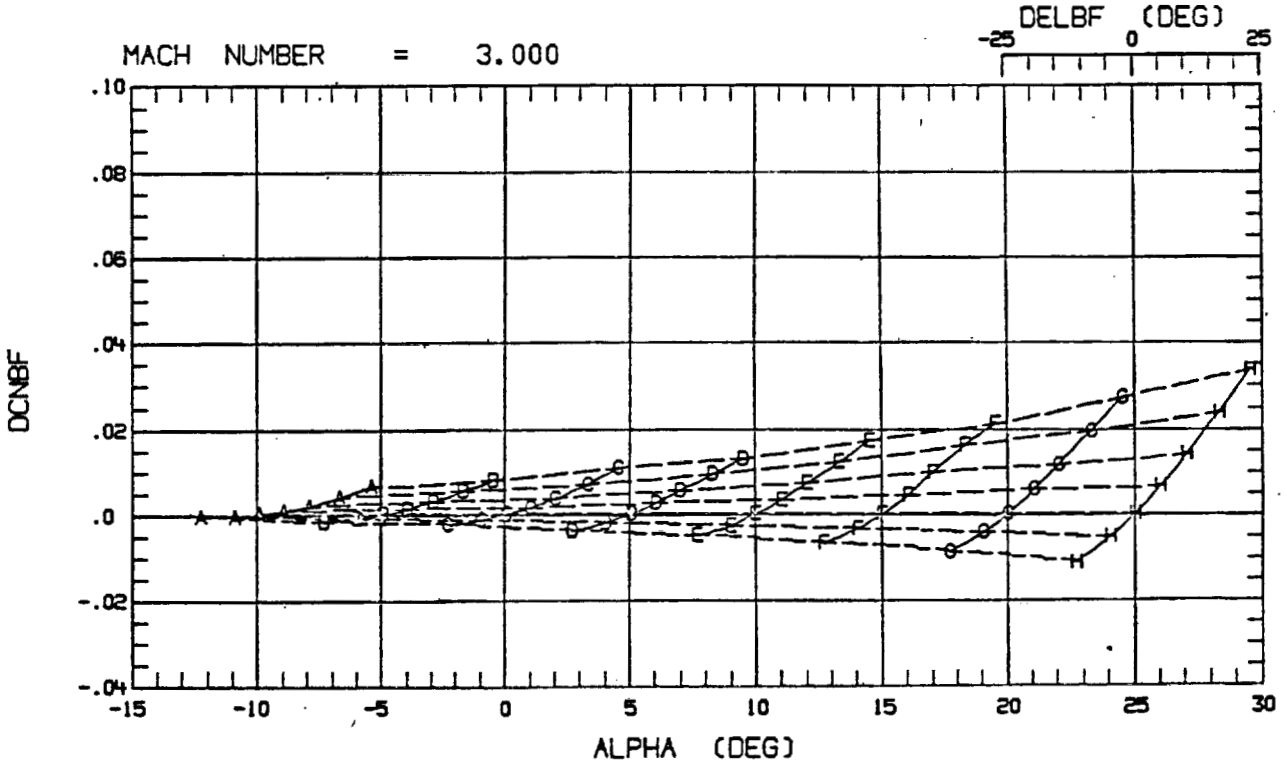


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT								
-11.700	-0.00197	-0.00299	-0.00439	-0.00722	-0.00960	-0.01213	-0.01427	-0.01495	-0.01541
-5.000	-0.00158	-0.00198	-0.00249	-0.00354	-0.00446	-0.00545	-0.00640	-0.00685	-0.00721
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00364	0.00391	0.00429	0.00464	0.00532	0.00598	0.00694	0.00765	0.00797
10.000	0.00799	0.00863	0.00891	0.00999	0.01107	0.01248	0.01444	0.01600	0.01675
16.300	0.01280	0.01377	0.01444	0.01613	0.01818	0.02051	0.02392	0.02706	0.03005
22.500	0.01674	0.01767	0.01958	0.02094	0.02491	0.02588	0.03204	0.03848	0.04671

ENGINEER Wang
DATE 9-21-78

FIGURE 4.1.1.1-111
EFFECT OF BODY FLAP

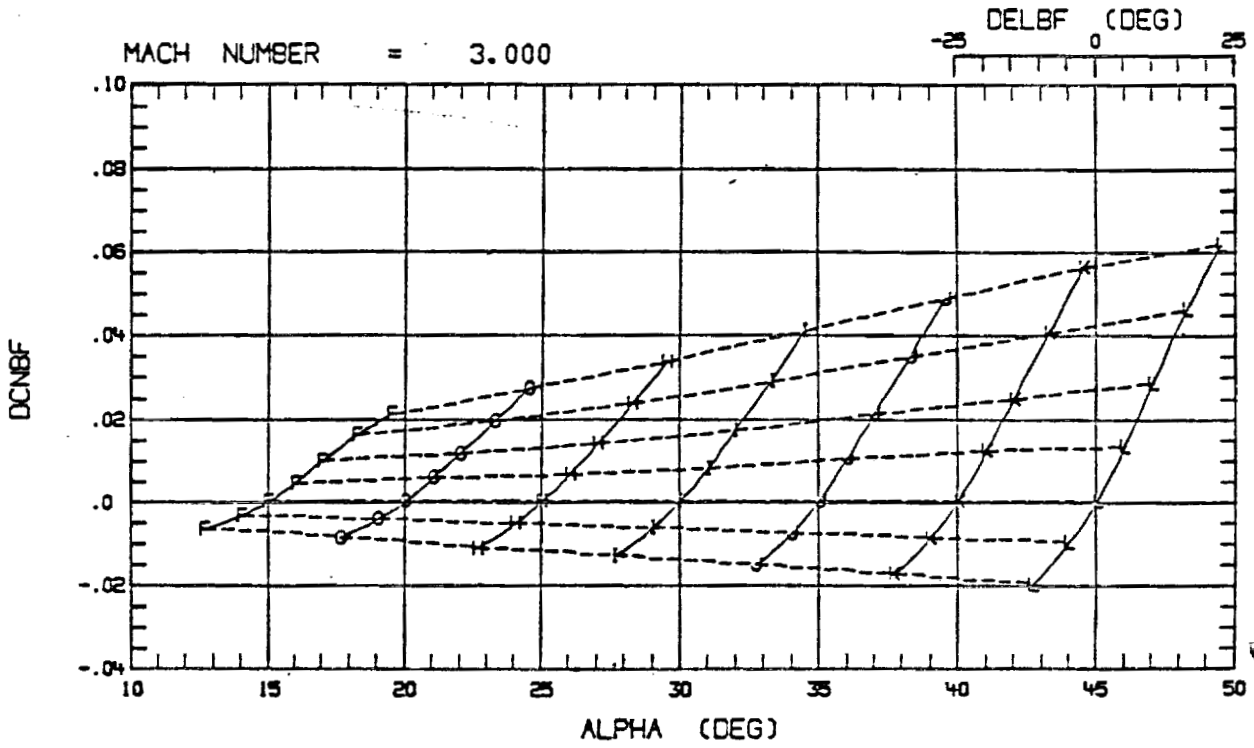


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00049	-0.00175	-0.00222	-0.00378	-0.00500	-0.00653	-0.00856	-0.01110
-5.000	-0.00045	-0.00097	-0.00124	-0.00191	-0.00252	-0.00330	-0.00421	-0.00534
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00081	0.00135	0.00169	0.00265	0.00344	0.00456	0.00567	0.00652
10.000	0.00198	0.00302	0.00381	0.00557	0.00727	0.00988	0.01168	0.01385
16.300	0.00394	0.00544	0.00707	0.00931	0.01223	0.01607	0.01942	0.02361
22.500	0.00640	0.00804	0.01089	0.01306	0.01725	0.02121	0.02719	0.03371

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-112
EFFECT OF BODY FLAP

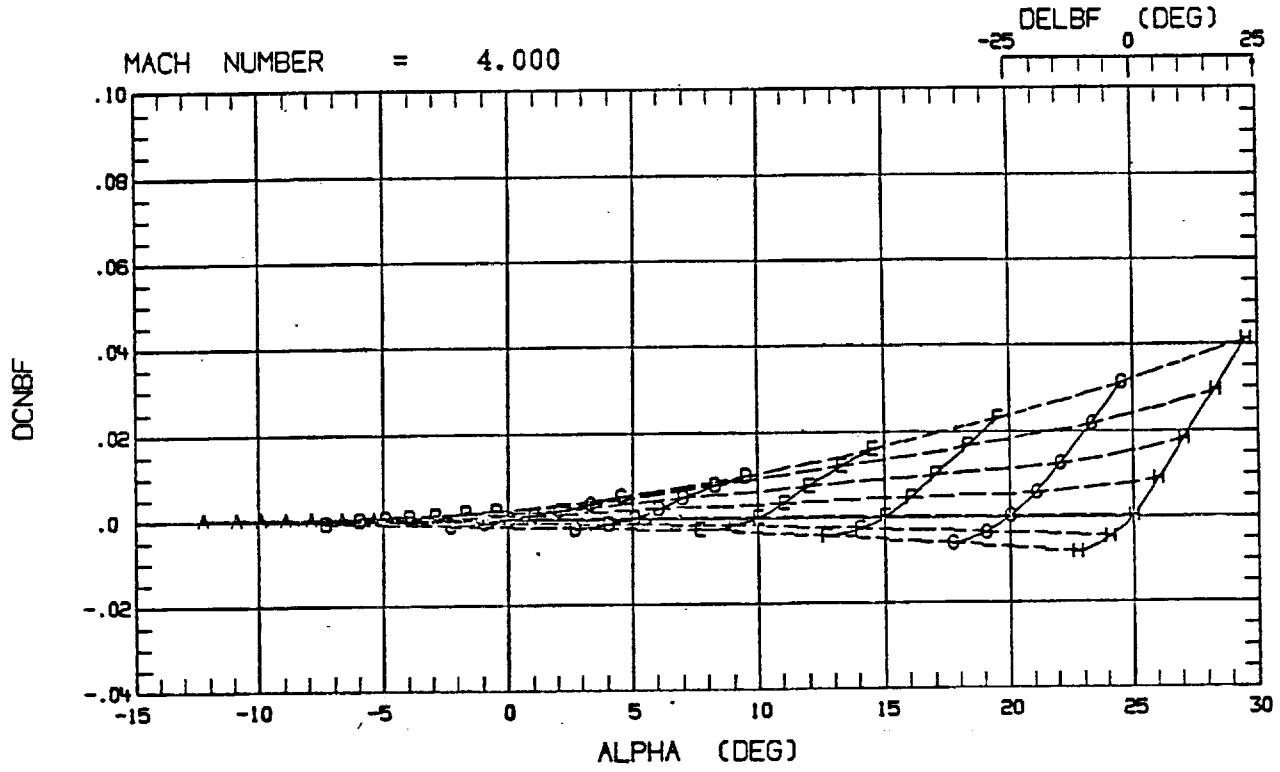


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT						
-11.700	-0.00653	-0.00856	-0.01110	-0.01299	-0.01528	-0.01741	-0.01980
-5.000	-0.00330	-0.00421	-0.00534	-0.00635	-0.00753	-0.00865	-0.00984
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00456	0.00567	0.00652	0.00806	0.01029	0.01213	0.01336
10.000	0.00988	0.01168	0.01385	0.01707	0.02113	0.02480	0.02656
16.300	0.01607	0.01942	0.02361	0.02895	0.03498	0.04070	0.04632
22.500	0.02121	0.02719	0.03371	0.04116	0.04893	0.05627	0.06152

ENGINEER WMZ
DATE 9-13-78

FIGURE 4.1.1.1-113
EFFECT OF BODY FLAP

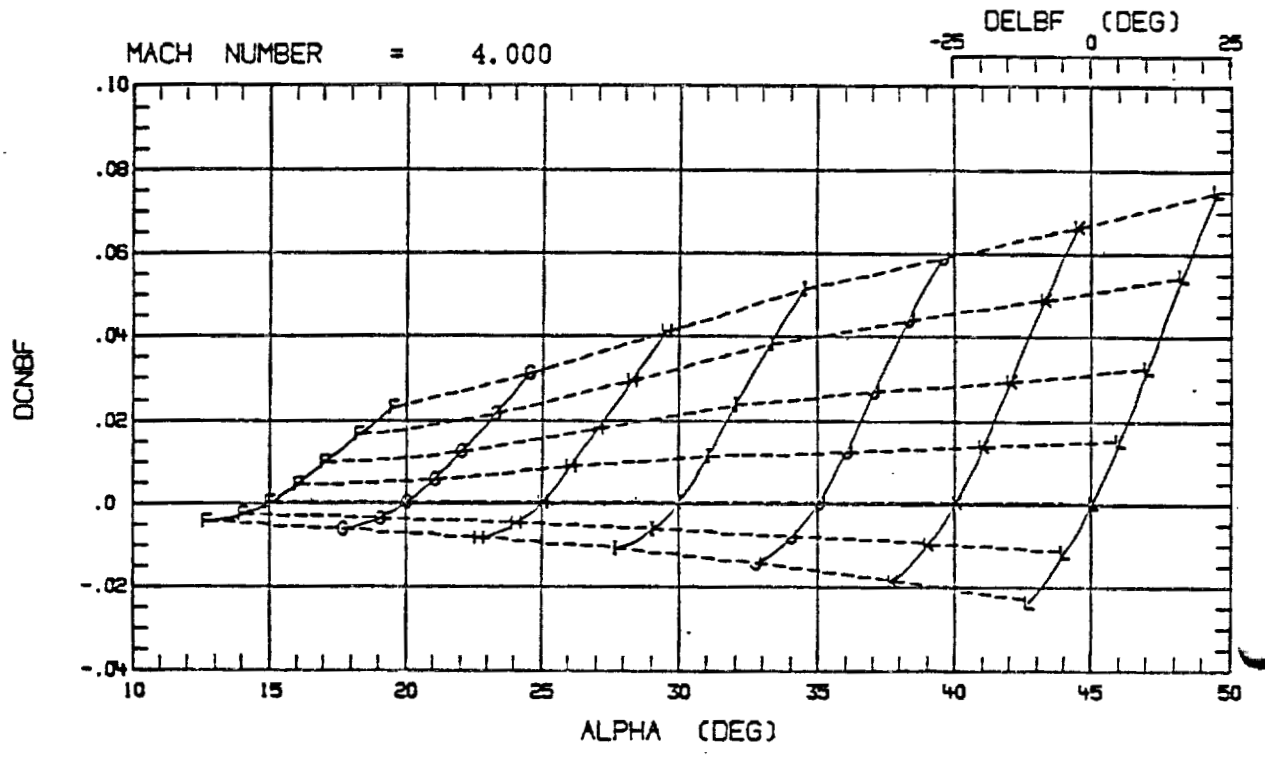


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	0.0	-0.00085	-0.00160	-0.00221	-0.00286	-0.00456	-0.00636	-0.00847
-5.000	-0.00002	-0.00038	-0.00078	-0.00127	-0.00180	-0.00268	-0.00364	-0.00492
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00007	0.00040	0.00094	0.00215	0.00344	0.00456	0.00549	0.00859
10.000	0.00020	0.00083	0.00201	0.00465	0.00735	0.00976	0.01221	0.01779
16.300	0.00030	0.00140	0.00350	0.00747	0.01184	0.01641	0.02141	0.02944
22.500	0.0	0.00200	0.00510	0.00979	0.01576	0.02305	0.03119	0.04103

ENGINEER WMZ
DATE 4-31-78

FIGURE 4.1.1.1-114
EFFECT OF BODY FLAP

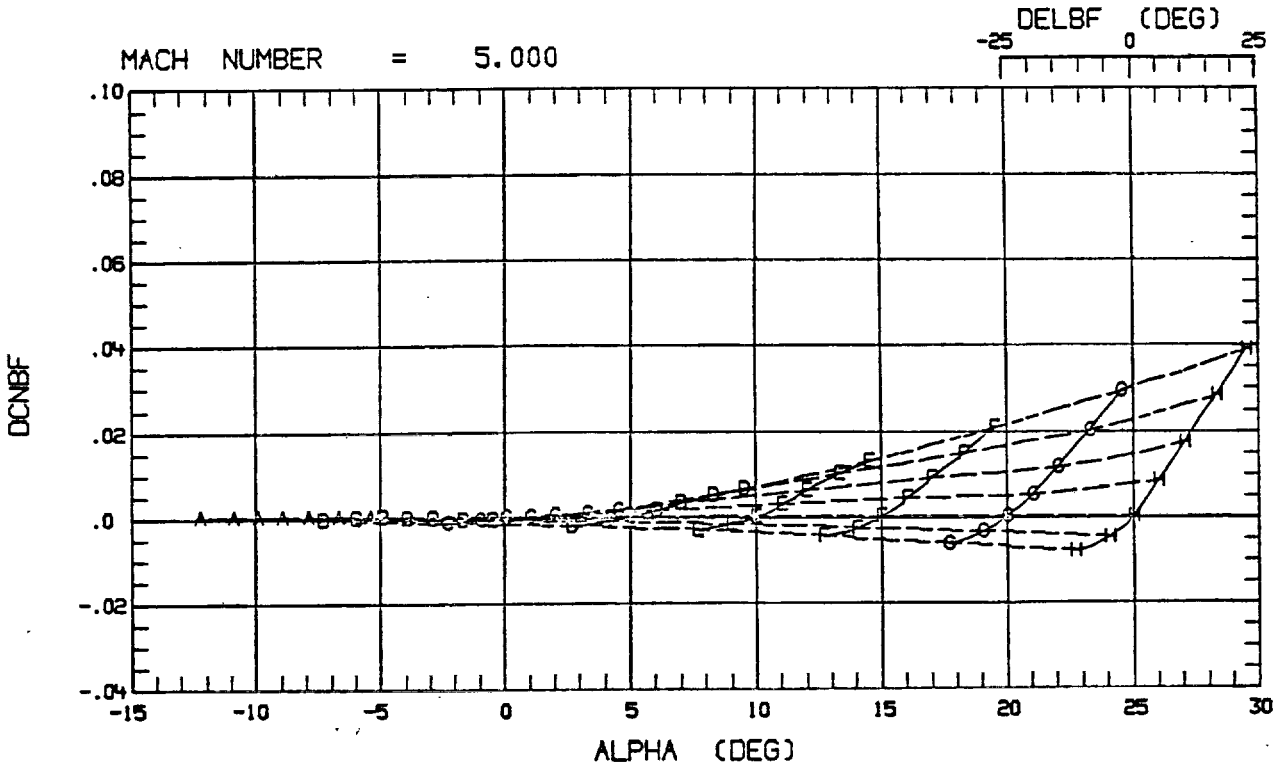


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT						
-11.700	-0.00456	-0.00636	-0.00847	-0.01103	-0.01457	-0.01874	-0.02361
-5.000	-0.00268	-0.00364	-0.00492	-0.00639	-0.00795	-0.00969	-0.01167
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00456	0.00549	0.00859	0.01102	0.01230	0.01351	0.01505
10.000	0.00976	0.01221	0.01779	0.02346	0.02568	0.02940	0.03241
16.300	0.01641	0.02141	0.02944	0.03814	0.04382	0.04900	0.05455
22.500	0.02305	0.03119	0.04103	0.05127	0.05878	0.06638	0.07472

ENGINEER WMZ
DATE 9-11-78

FIGURE 4.1.1.1-115
EFFECT OF BODY FLAP

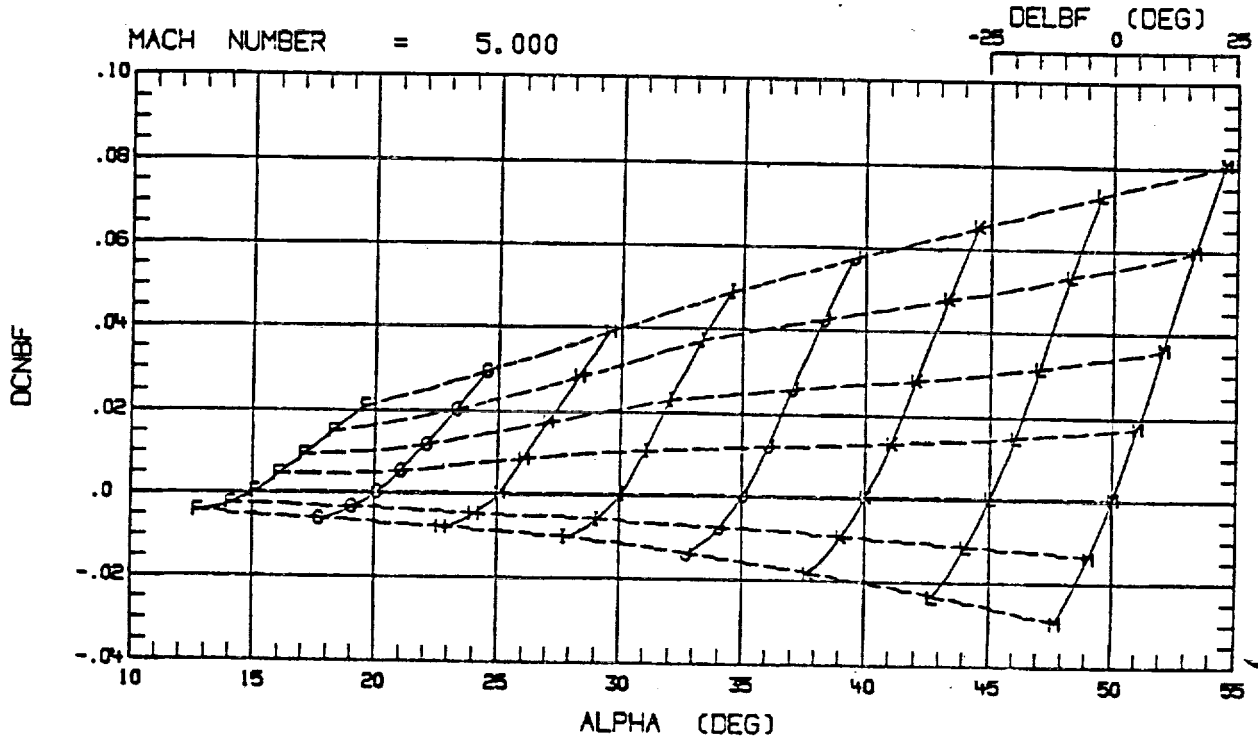


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	0.0	-0.00069	-0.00140	-0.00214	-0.00295	-0.00460	-0.00632	-0.00812
-5.000	0.0	-0.00019	-0.00051	-0.00108	-0.00170	-0.00259	-0.00354	-0.00471
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00010	0.00028	0.00148	0.00286	0.00424	0.00523	0.00849
10.000	0.0	-0.00038	0.00039	0.00321	0.00621	0.00896	0.01157	0.01729
16.300	0.0	-0.00056	0.00070	0.00513	0.00996	0.01487	0.02020	0.02827
22.500	0.0	-0.00039	0.00140	0.00650	0.01299	0.02067	0.02928	0.03896

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-116
EFFECT OF BODY FLAP

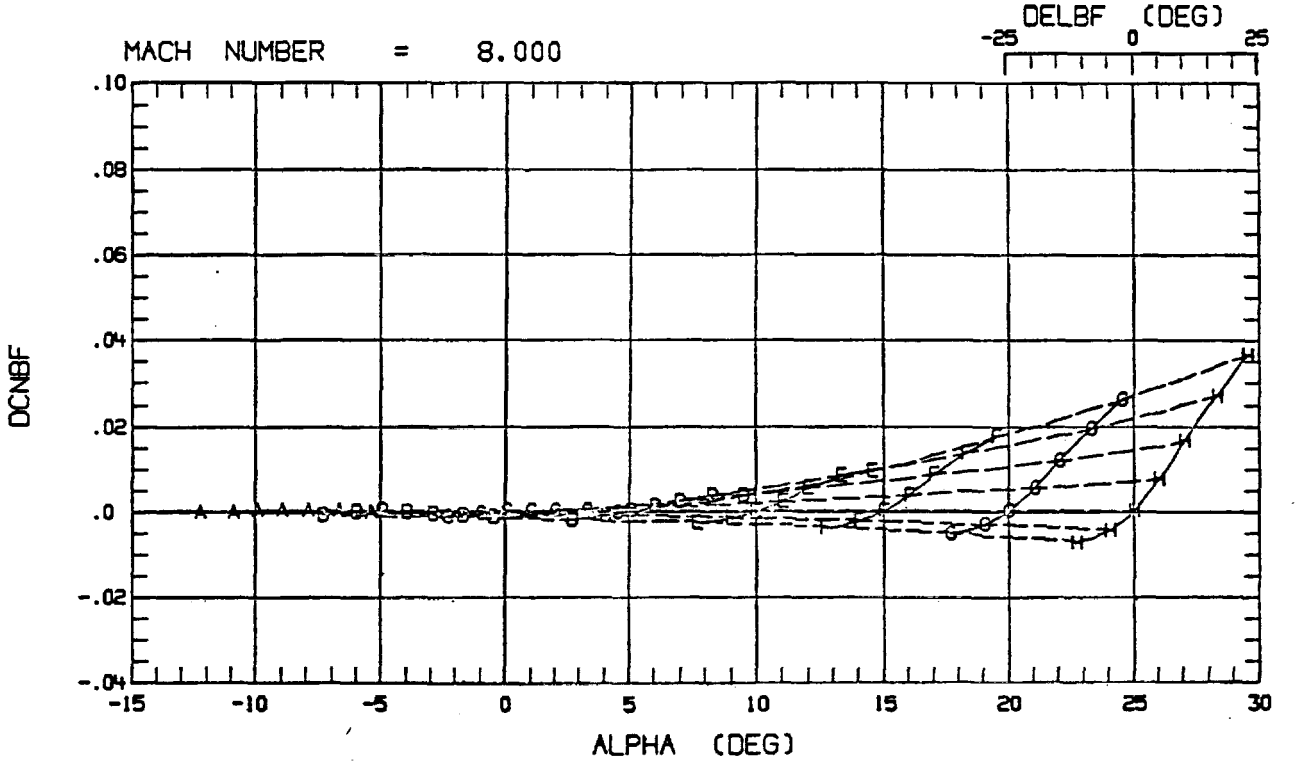


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB = 1290.3 IN.	

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00460	-0.00632	-0.00812	-0.01025	-0.01392	-0.01840	-0.02369	-0.02986
-5.000	-0.00259	-0.00354	-0.00471	-0.00605	-0.00765	-0.00948	-0.01161	-0.01407
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00424	0.00523	0.00649	0.01063	0.01173	0.01299	0.01469	0.01725
10.000	0.00896	0.01157	0.01729	0.02285	0.02571	0.02925	0.03159	0.03594
16.300	0.01487	0.02020	0.02927	0.03700	0.04253	0.04760	0.05329	0.05947
22.500	0.02067	0.02929	0.03896	0.04899	0.05720	0.06515	0.07294	0.08030

ENGINEER WWZ
DATE 4-21-78

FIGURE 4.1.1.1-117
EFFECT OF BODY FLAP

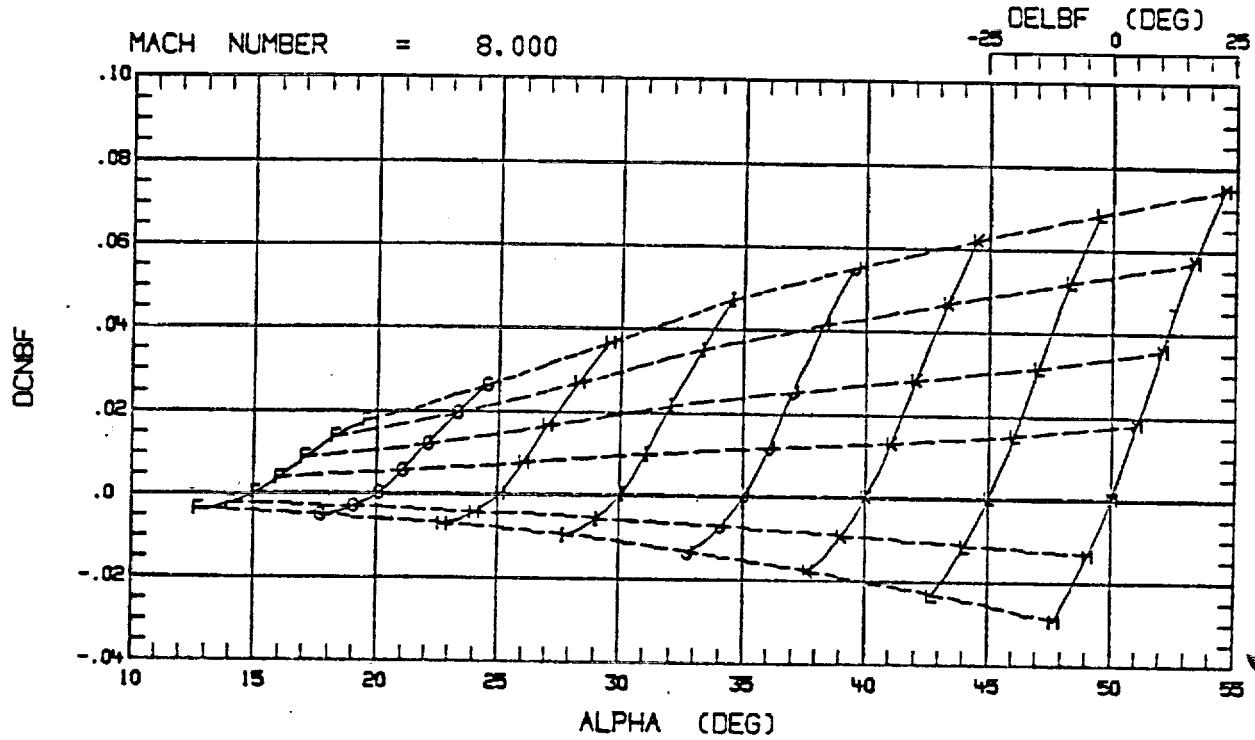


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00030	-0.00082	-0.00140	-0.00201	-0.00265	-0.00382	-0.00531	-0.00718
-5.000	-0.00010	-0.00020	-0.00046	-0.00093	-0.00148	-0.00225	-0.00315	-0.00431
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00007	-0.00026	0.00015	0.00110	0.00234	0.00388	0.00552	0.00761
10.000	0.00009	-0.00056	0.00012	0.00238	0.00534	0.00855	0.01193	0.01640
16.300	0.00003	-0.00091	0.0	0.00379	0.00841	0.01368	0.01946	0.02690
22.500	-0.00018	-0.00122	-0.00020	0.00360	0.00944	0.01739	0.02617	0.03651

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-118
EFFECT OF BODY FLAP

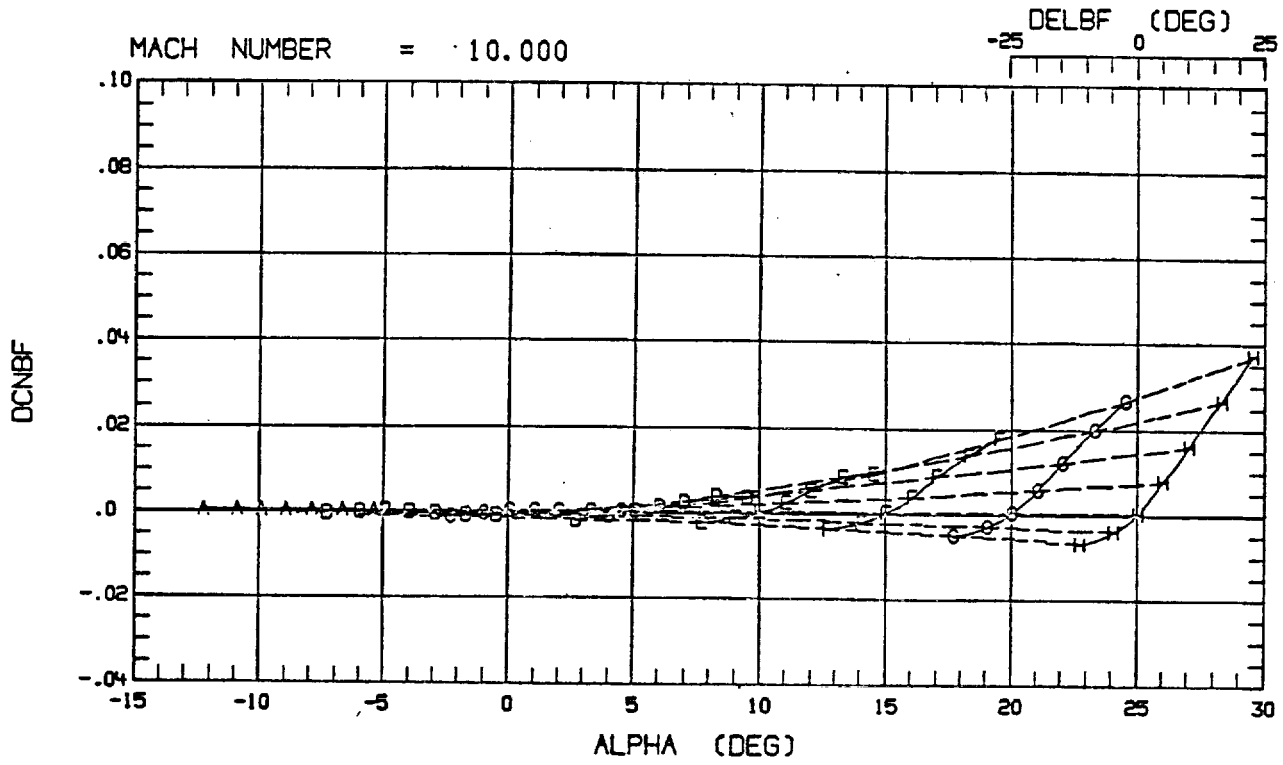


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00382	-0.00531	-0.00718	-0.00968	-0.01357	-0.01813	-0.02336	-0.02940
-5.000	-0.00225	-0.00315	-0.00431	-0.00572	-0.00744	-0.00932	-0.01141	-0.01374
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00388	0.00552	0.00761	0.00979	0.01147	0.01307	0.01508	0.01781
10.000	0.00855	0.01193	0.01640	0.02143	0.02506	0.02823	0.03149	0.03564
16.300	0.01368	0.01946	0.02690	0.03512	0.04120	0.04667	0.05192	0.05702
22.500	0.01739	0.02617	0.03651	0.04703	0.05488	0.06199	0.06841	0.07426

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-119
EFFECT OF BODY FLAP

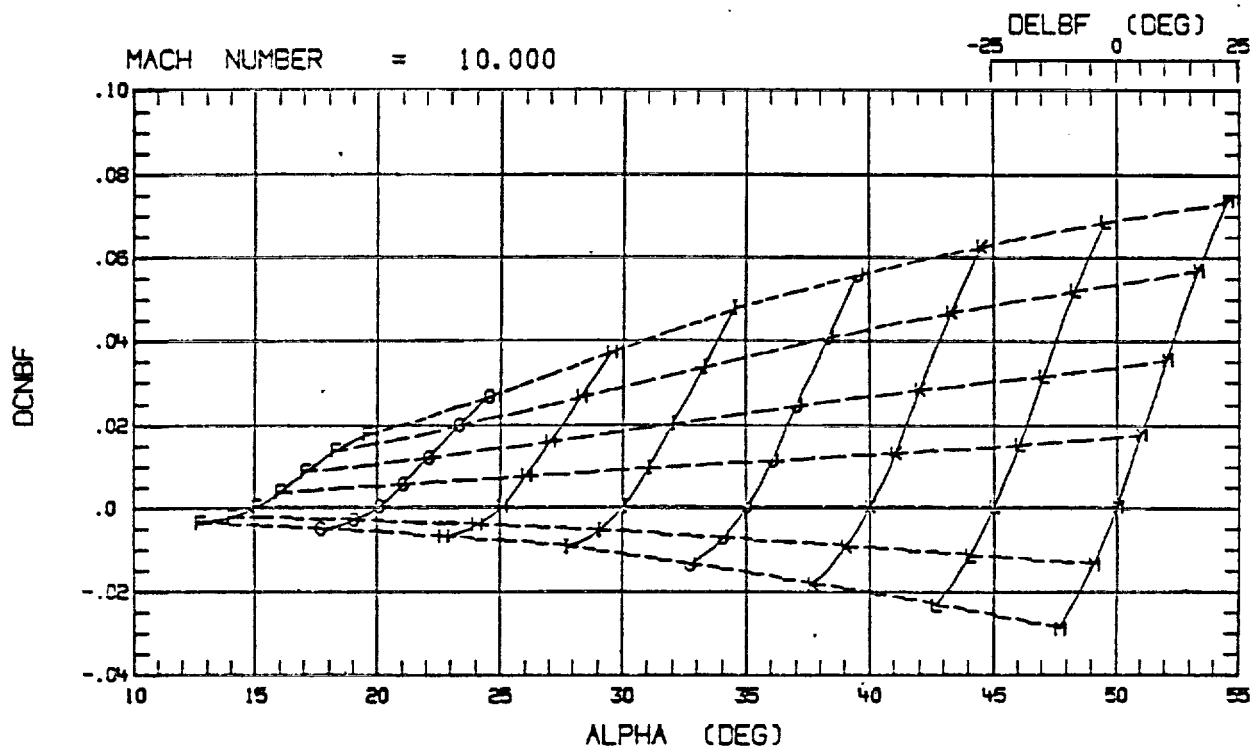


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	0.0	-0.00067	-0.00130	-0.00186	-0.00247	-0.00360	-0.00510	-0.00697
-5.000	0.0	-0.00015	-0.00042	-0.00087	-0.00141	-0.00218	-0.00310	-0.00421
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00022	0.0	0.00107	0.00227	0.00378	0.00554	0.00756
10.000	0.0	-0.00062	0.0	0.00233	0.00527	0.00851	0.01200	0.01587
16.300	0.0	-0.00094	0.0	0.00371	0.00834	0.01374	0.01966	0.02652
22.500	0.0	-0.00097	0.0	0.00345	0.00916	0.01751	0.02660	0.03717

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-120
EFFECT OF BODY FLAP

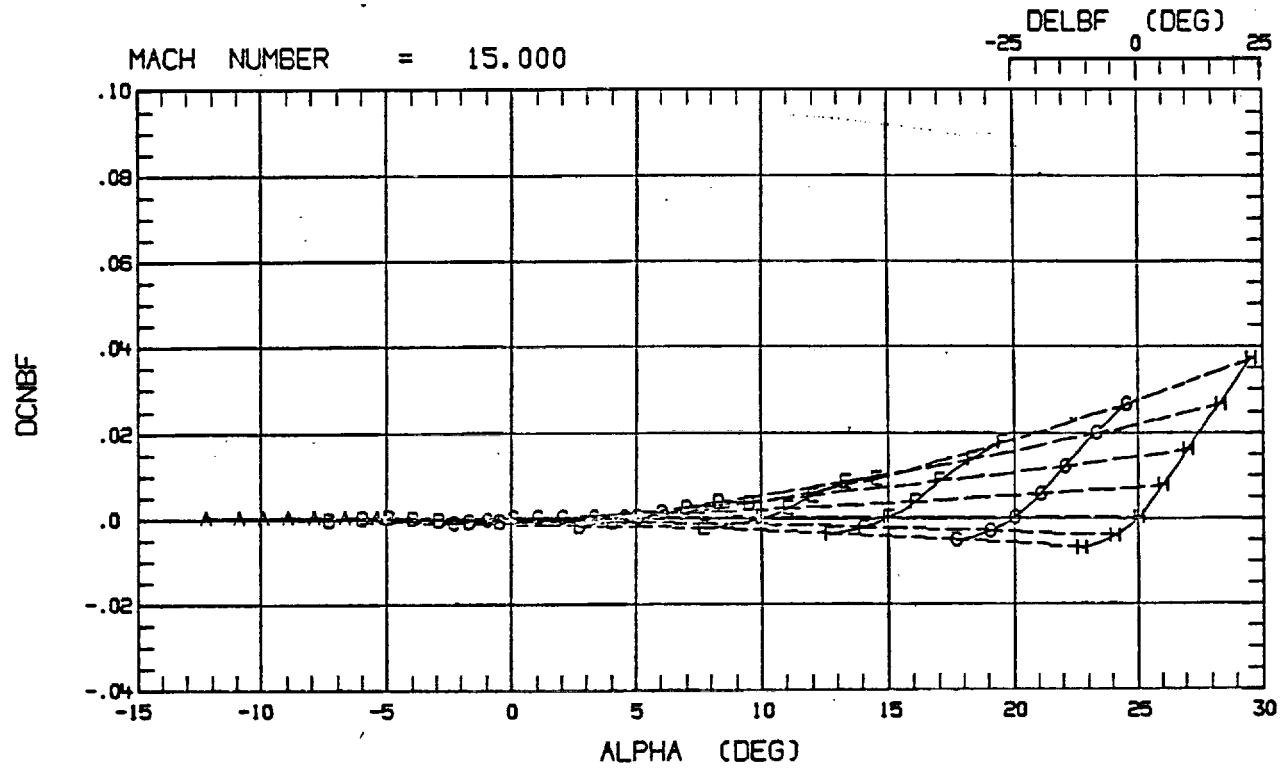


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00360	-0.00510	-0.00697	-0.00949	-0.01358	-0.01832	-0.02336	-0.02902
-5.000	-0.00218	-0.00310	-0.00421	-0.00556	-0.00739	-0.00939	-0.01141	-0.01358
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00378	0.00554	0.00756	0.00938	0.01120	0.01303	0.01505	0.01771
10.000	0.00851	0.01200	0.01587	0.01992	0.02433	0.02821	0.03149	0.03536
16.300	0.01374	0.01966	0.02652	0.03368	0.04050	0.04678	0.05197	0.05651
22.500	0.01751	0.02560	0.03717	0.04771	0.05559	0.06247	0.06827	0.07323

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-121
EFFECT OF BODY FLAP

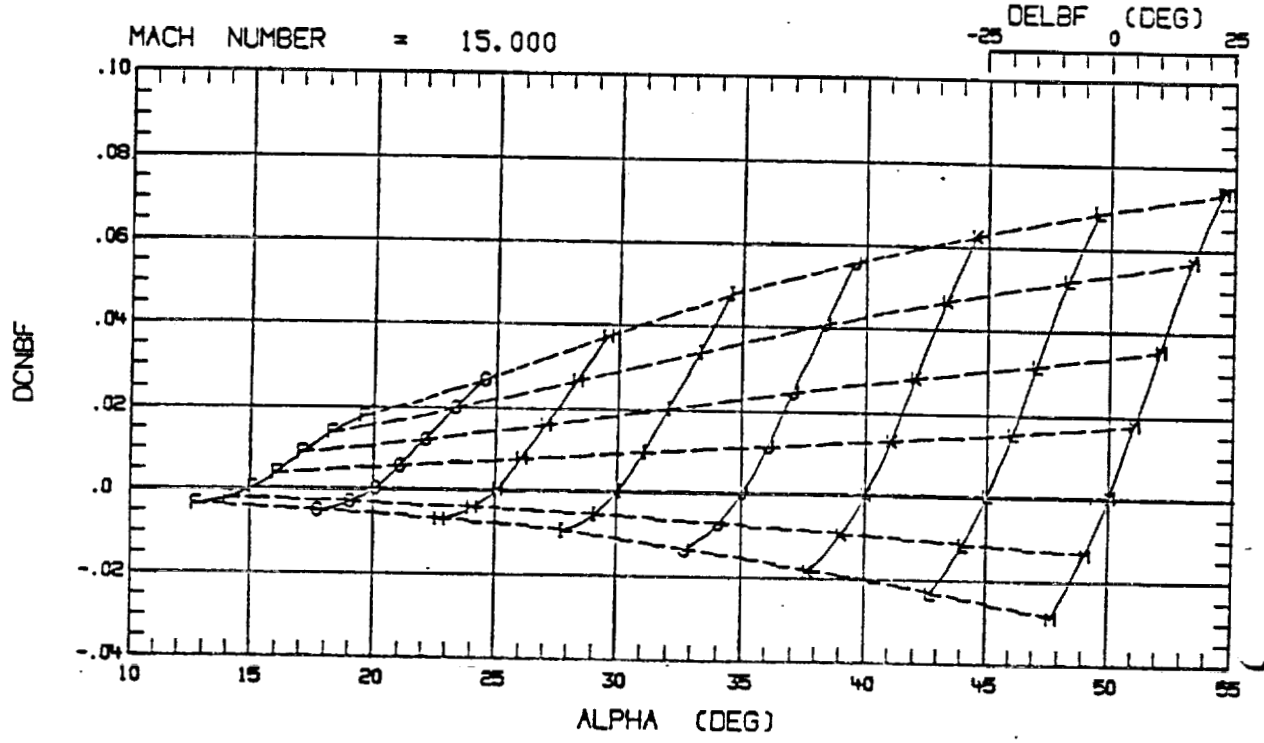


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	0.0	-0.00067	-0.00130	-0.00186	-0.00247	-0.00360	-0.00510	-0.00697
-5.000	0.0	-0.00015	-0.00042	-0.00087	-0.00141	-0.00218	-0.00310	-0.00421
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00022	0.0	0.00107	0.00227	0.00378	0.00554	0.00756
10.000	0.0	-0.00062	0.0	0.00233	0.00527	0.00851	0.01200	0.01587
16.300	0.0	-0.00094	0.0	0.00371	0.00834	0.01374	0.01966	0.02652
22.500	0.0	-0.00097	0.0	0.00345	0.00916	0.01751	0.02660	0.03717

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-122
EFFECT OF BODY FLAP

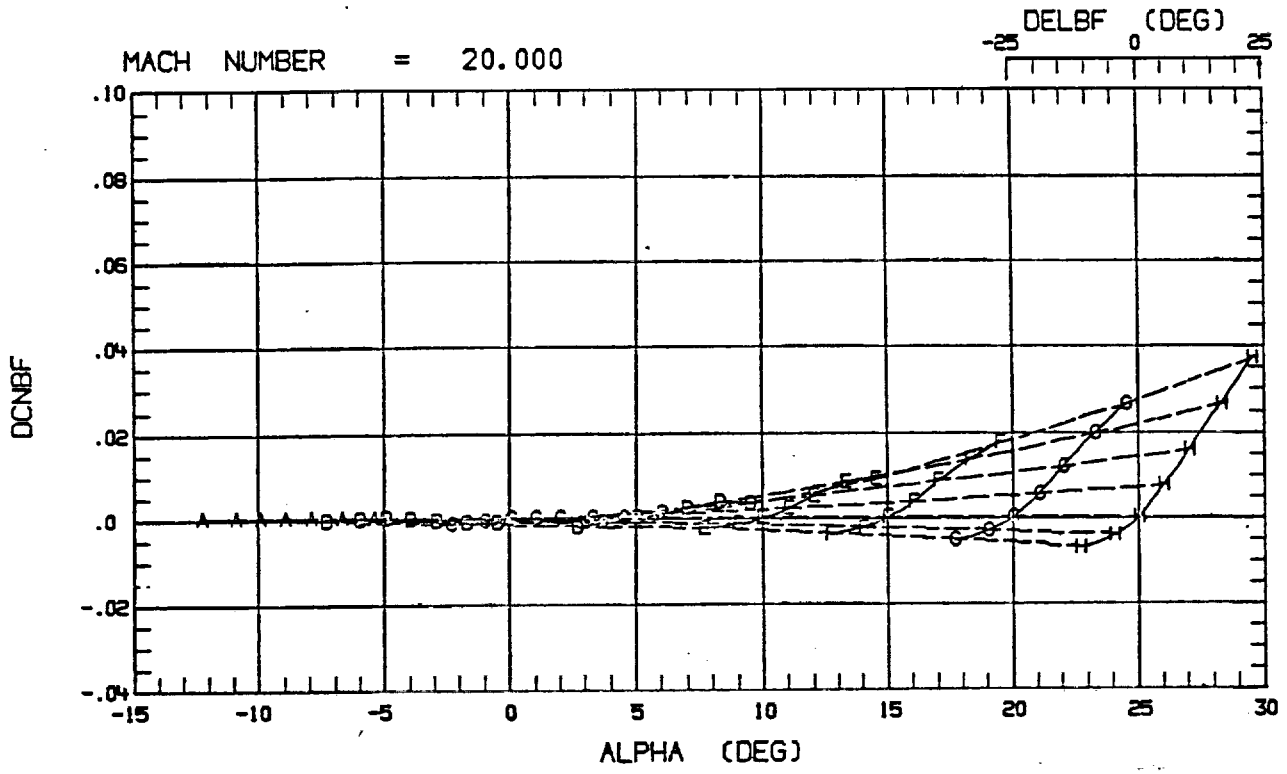


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00360	-0.00510	-0.00697	-0.00949	-0.01358	-0.01832	-0.02336	-0.02902
-5.000	-0.00218	-0.00310	-0.00421	-0.00556	-0.00739	-0.00939	-0.01141	-0.01358
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00378	0.00554	0.00756	0.00938	0.01120	0.01303	0.01505	0.01771
10.000	0.00851	0.01200	0.01587	0.01992	0.02433	0.02921	0.03149	0.03536
16.300	0.01374	0.01966	0.02652	0.03368	0.04050	0.04678	0.05197	0.05651
22.500	0.01751	0.02560	0.03717	0.04771	0.05559	0.06247	0.06827	0.07323

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-123
EFFECT OF BODY FLAP

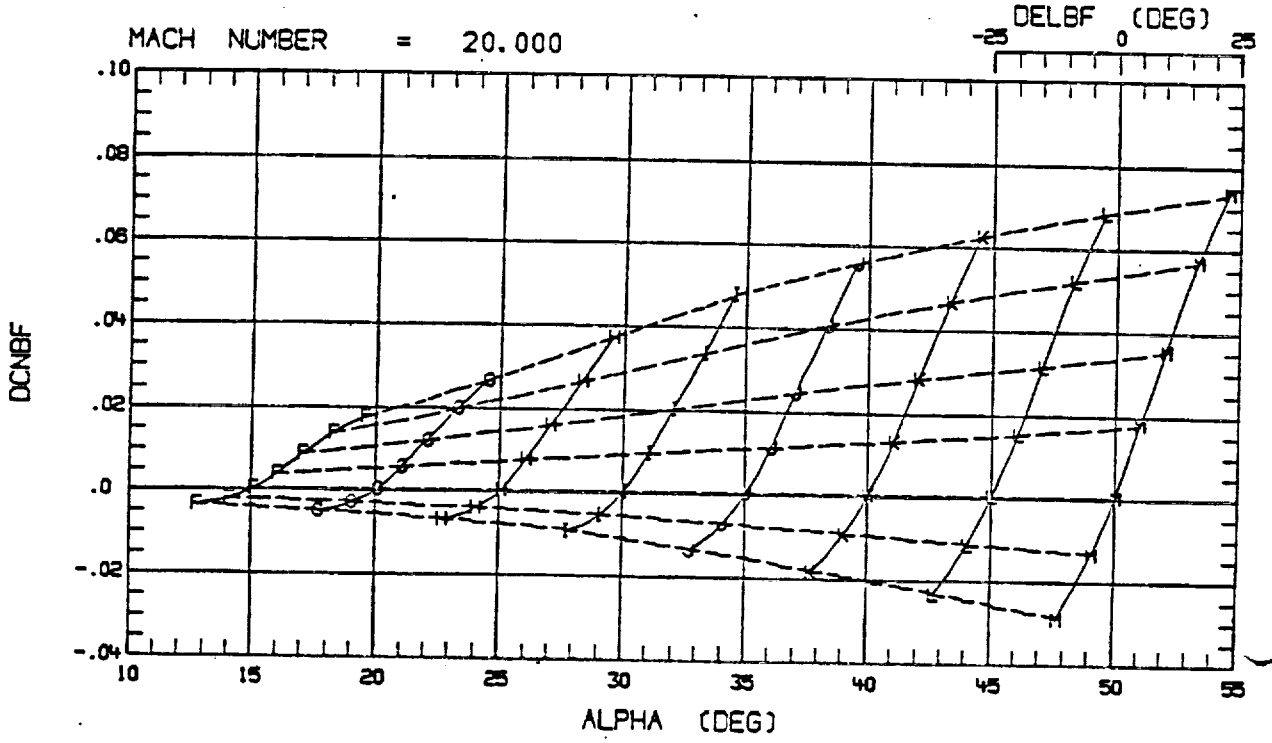


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	0.0	-0.00067	-0.00130	-0.00186	-0.00247	-0.00350	-0.00510	-0.00697
-5.000	0.0	-0.00015	-0.00042	-0.00087	-0.00141	-0.00218	-0.00310	-0.00421
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00022	0.0	0.00107	0.00227	0.00378	0.00554	0.00756
10.000	0.0	-0.00062	0.0	0.00233	0.00527	0.00851	0.01200	0.01587
16.300	0.0	-0.00094	0.0	0.00371	0.00834	0.01374	0.01966	0.02652
22.500	0.0	-0.00097	0.0	0.00345	0.00916	0.01751	0.02660	0.03717

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-124
EFFECT OF BODY FLAP



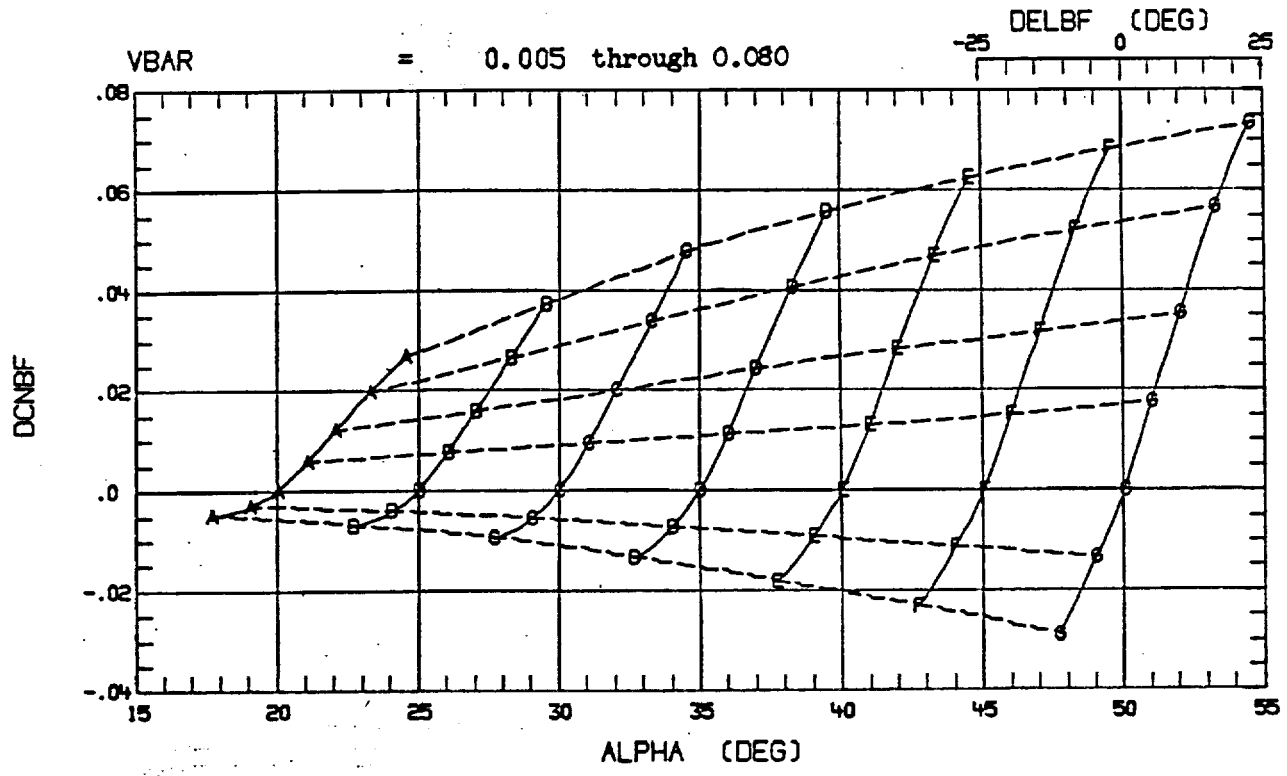
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODYFLAP NORMAL FORCE INCREMENT							
-11.700	-0.00360	-0.00510	-0.00697	-0.00949	-0.01358	-0.01832	-0.02336	-0.02902
-5.000	-0.00218	-0.00310	-0.00421	-0.00556	-0.00739	-0.00939	-0.01141	-0.01358
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00378	0.00554	0.00756	0.00938	0.01120	0.01303	0.01505	0.01771
10.000	0.00851	0.01200	0.01587	0.01992	0.02433	0.02821	0.03149	0.03536
16.300	0.01374	0.01966	0.02652	0.03368	0.04050	0.04678	0.05197	0.05651
22.500	0.01751	0.02560	0.03717	0.04771	0.05559	0.06247	0.06827	0.07323

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.1-125
EFFECT OF BODY FLAP

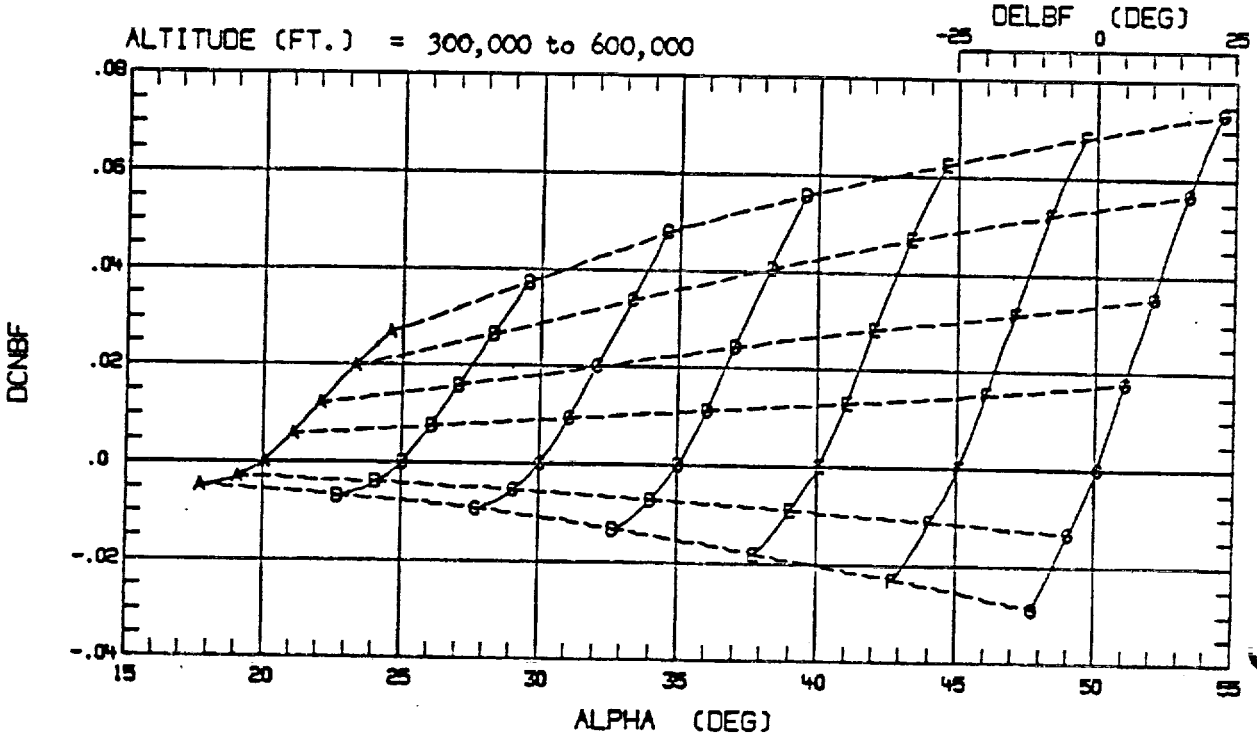


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP NORMAL FORCE INCREMEN						
-11.700	-0.00510	-0.00697	-0.00949	-0.01358	-0.01832	-0.02336	-0.02902
-5.000	-0.00310	-0.00421	-0.00556	-0.00739	-0.00939	-0.01141	-0.01358
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00554	0.00756	0.00938	0.01120	0.01303	0.01505	0.01771
10.000	0.01200	0.01587	0.01992	0.02433	0.02821	0.03149	0.03536
16.300	0.01966	0.02652	0.03368	0.04050	0.04678	0.05197	0.05651
22.500	0.02660	0.03717	0.04771	0.05559	0.06247	0.06827	0.07323

ENGINEER NASA
DATE

FIGURE 4.1.1.1-126
EFFECT OF BODY FLAP



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

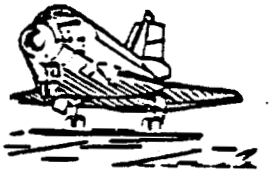
	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP NORMAL FORCE INCREMEN						
-11.700	-0.00510	-0.00697	-0.00949	-0.01358	-0.01832	-0.02336	-0.02902
-5.000	-0.00310	-0.00421	-0.00556	-0.00739	-0.00939	-0.01141	-0.01358
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00554	0.00756	0.00938	0.01120	0.01303	0.01505	0.01771
10.000	0.01200	0.01587	0.01992	0.02433	0.02821	0.03149	0.03536
16.300	0.01966	0.02652	0.03368	0.04050	0.04678	0.05197	0.05651
22.500	0.02660	0.03717	0.04771	0.05559	0.06247	0.06827	0.07323

ENGINEER NASA
DATE

FIGURE 4.1.1.1-127
EFFECT OF BODY FLAP

Landing Gear Down

$$\Delta C_{N_{\substack{GROUND\\EFFECT}}} = C_{N_{\substack{GROUND\\EFFECT}}} - C_{N_{\substack{FREE\\STREAM}}}$$



CONFIGURATION

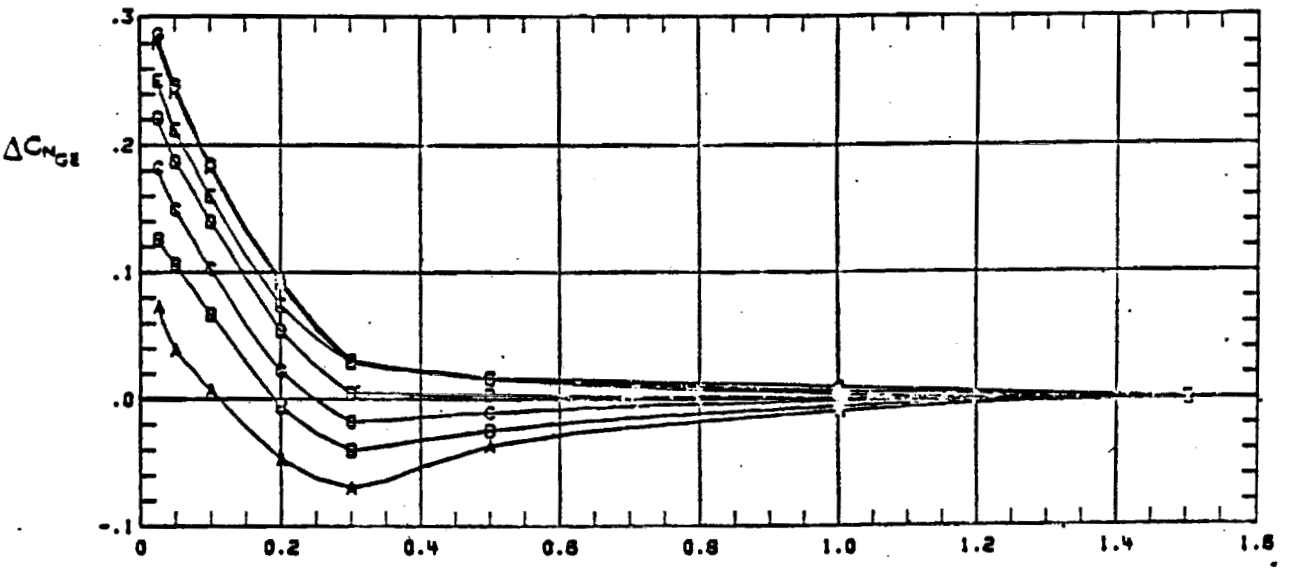
BASELINE ORBITER VEHICLE

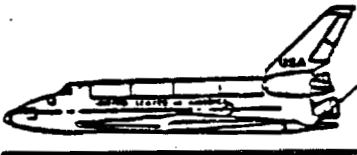
CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1076.70, Y_o = BL 0.00, Z_o = WL 375.00

REFERENCE DIMENSIONS

AREA S_w = 2690.000 ft²
SPAN b_w = 78.056 ft
MAC c_w = 38.560 ft
BODY LENGTH L_B = 1290.300 in

$\delta_e = 15.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} =$ ALL



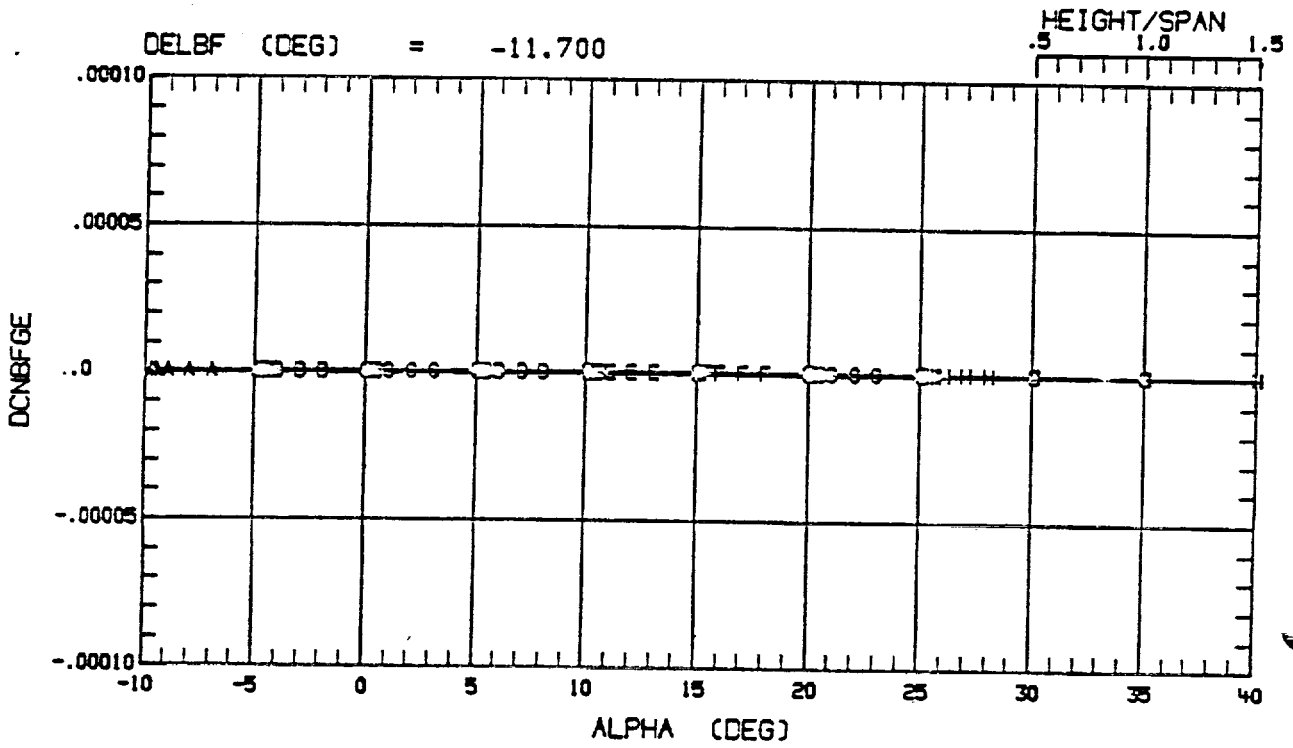


Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Normal Force Coefficient, $\Delta C_{N_{GRND\ EFFECT}}$						
0.025	0.07221	0.12500	0.18098	0.22068	0.24976	0.27946	0.28555
0.050	0.03845	0.10500	0.14884	0.18640	0.21058	0.23999	0.24560
0.100	0.00658	0.06640	0.10137	0.13958	0.15870	0.18100	0.18431
0.200	-0.04734	-0.00560	0.02197	0.05382	0.07388	0.08962	0.09381
0.300	-0.06948	-0.03980	-0.01769	0.00490	0.02860	0.02929	0.03064
0.500	-0.03704	-0.02480	-0.01034	0.00254	0.01624	0.01648	0.01661
1.000	-0.00998	-0.00600	-0.00200	0.0	0.00293	0.00577	0.00940
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: J³
DATE: 10-19-77
REVISED:

Figure 4.1.1.1-138
GROUND EFFECT

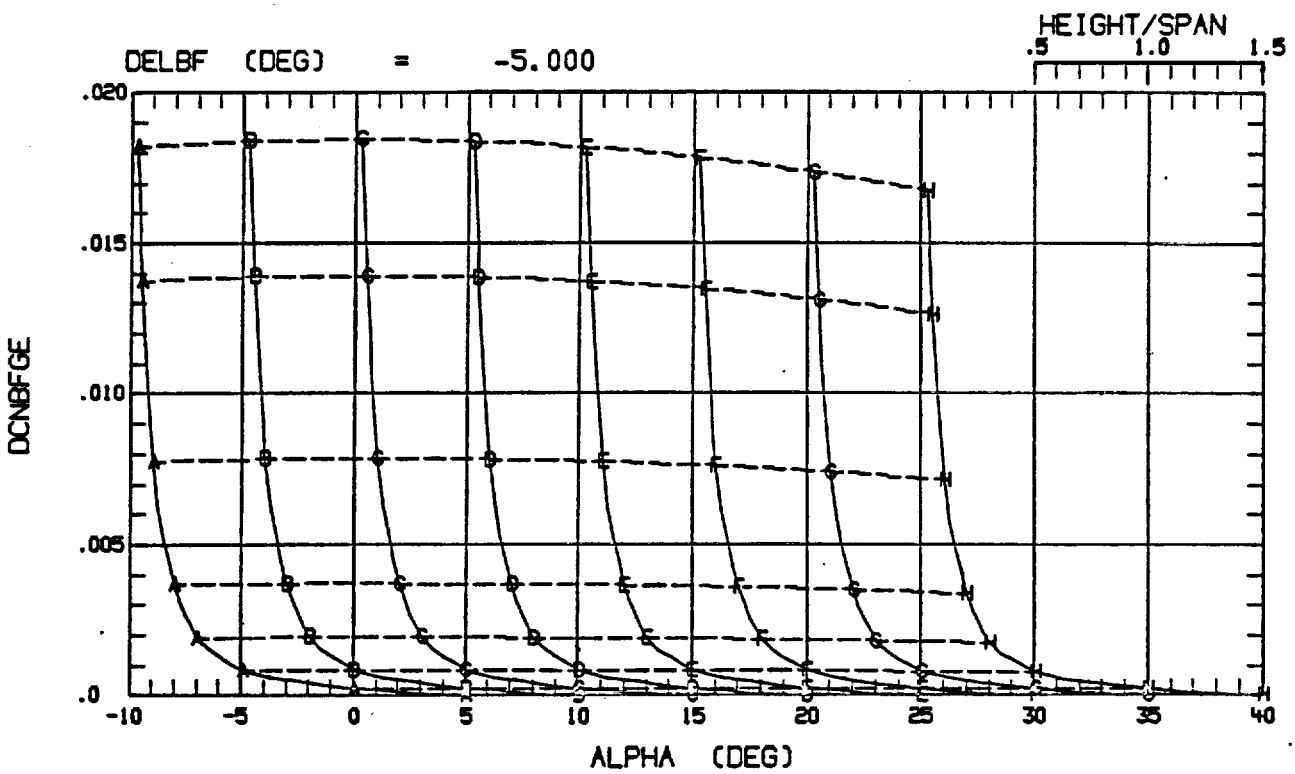


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF NORMAL FORCE CO							
0.025	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.1-139
GROUND EFFECT BODY FLAP NORMAL FORCE COEFF. INCREMENT

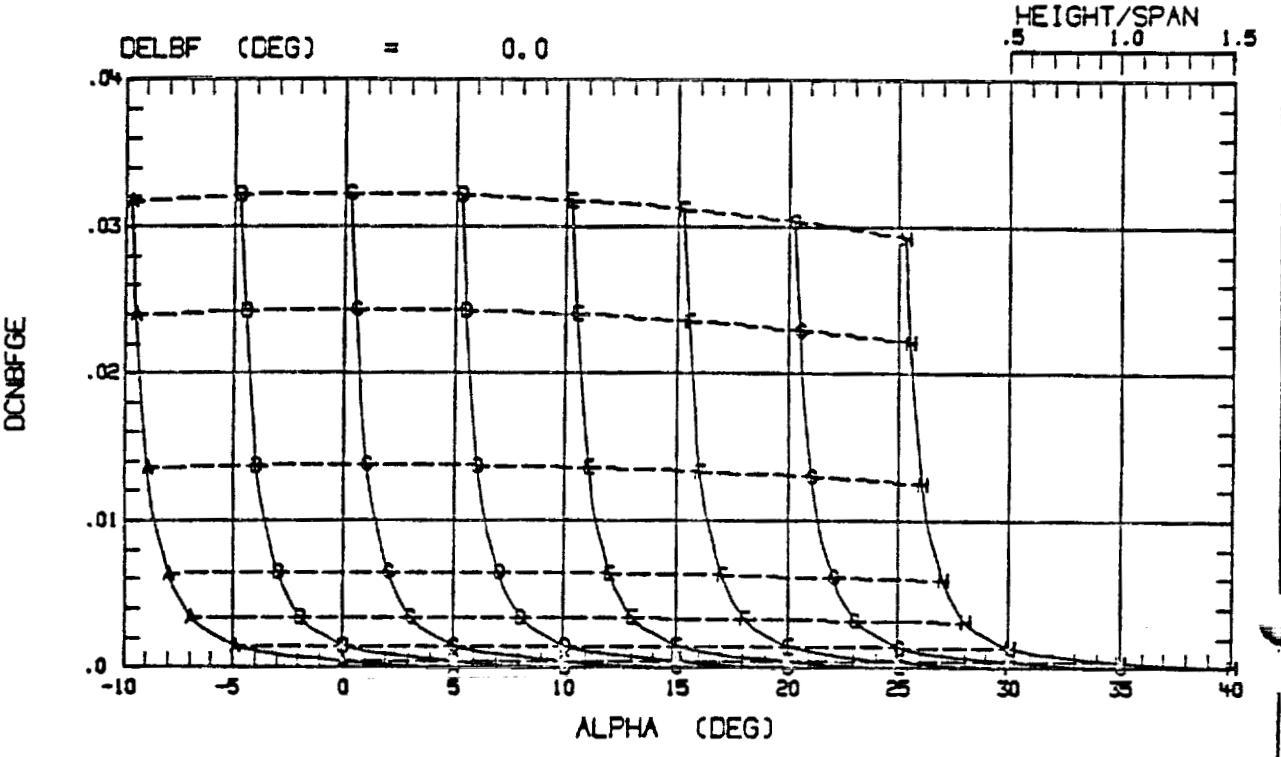


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
HEIGHT/SPAN	GROUND EFFECT BF NORMAL FORCE CO							
0.025	0.01818	0.01836	0.01841	0.01834	0.01813	0.01778	0.01730	0.01669
0.050	0.01371	0.01385	0.01388	0.01383	0.01367	0.01341	0.01304	0.01258
0.100	0.00773	0.00780	0.00782	0.00779	0.00770	0.00755	0.00735	0.00709
0.200	0.00363	0.00368	0.00368	0.00367	0.00362	0.00355	0.00346	0.00334
0.300	0.00189	0.00191	0.00191	0.00190	0.00188	0.00184	0.00179	0.00173
0.500	0.00082	0.00083	0.00083	0.00083	0.00082	0.00080	0.00078	0.00075
1.000	0.00022	0.00022	0.00022	0.00022	0.00022	0.00021	0.00021	0.00020
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.1-140
GROUND EFFECT BODY FLAP NORMAL FORCE COEFF. INCREMENT

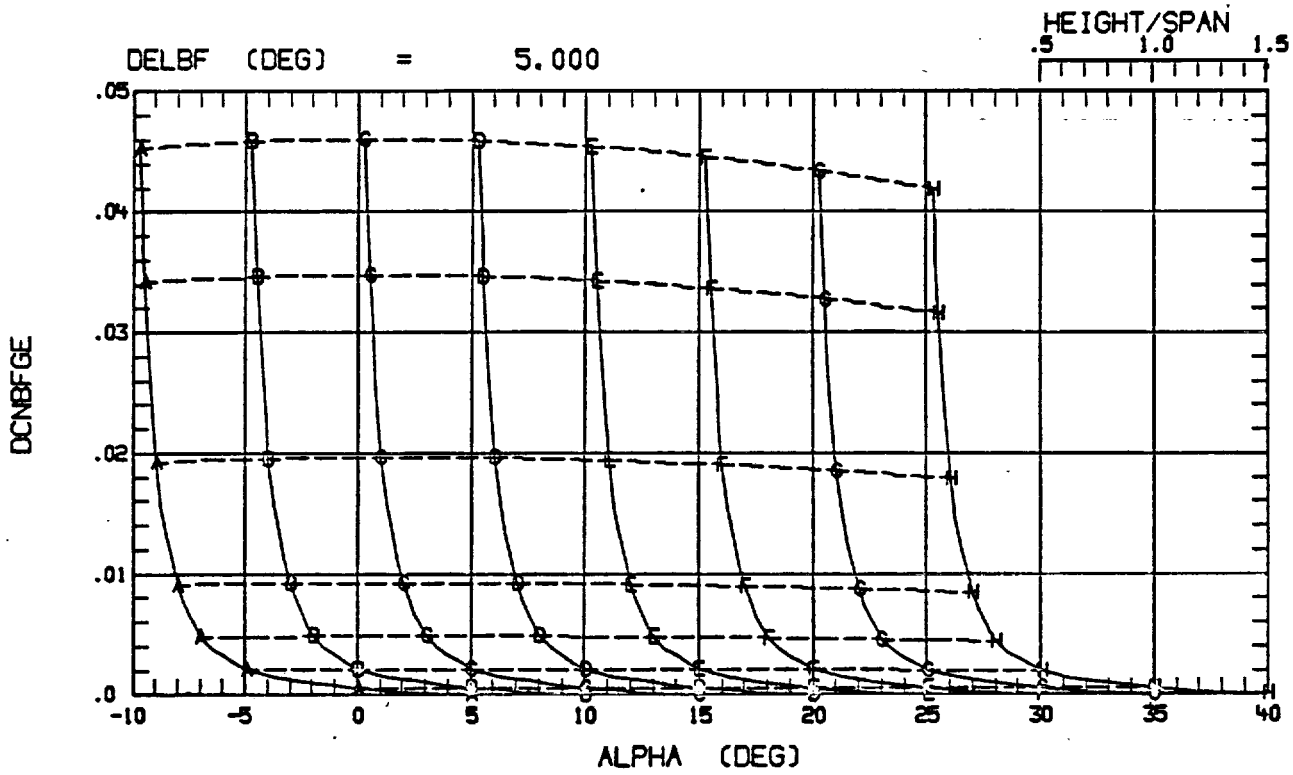


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF NORMAL FORCE CO							
0.025	0.03171	0.03208	0.03220	0.03208	0.03171	0.03110	0.03026	0.02918
0.050	0.02391	0.02419	0.02428	0.02419	0.02391	0.02345	0.02292	0.02201
0.100	0.01348	0.01364	0.01369	0.01364	0.01348	0.01322	0.01296	0.01241
0.200	0.00634	0.00642	0.00644	0.00642	0.00634	0.00622	0.00605	0.00584
0.300	0.00330	0.00334	0.00335	0.00334	0.00330	0.00324	0.00315	0.00304
0.500	0.00143	0.00144	0.00145	0.00144	0.00143	0.00140	0.00136	0.00131
1.000	0.00038	0.00039	0.00039	0.00039	0.00038	0.00038	0.00037	0.00035
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.1-141
GROUND EFFECT BODY FLAP NORMAL FORCE COEFF. INCREMENT

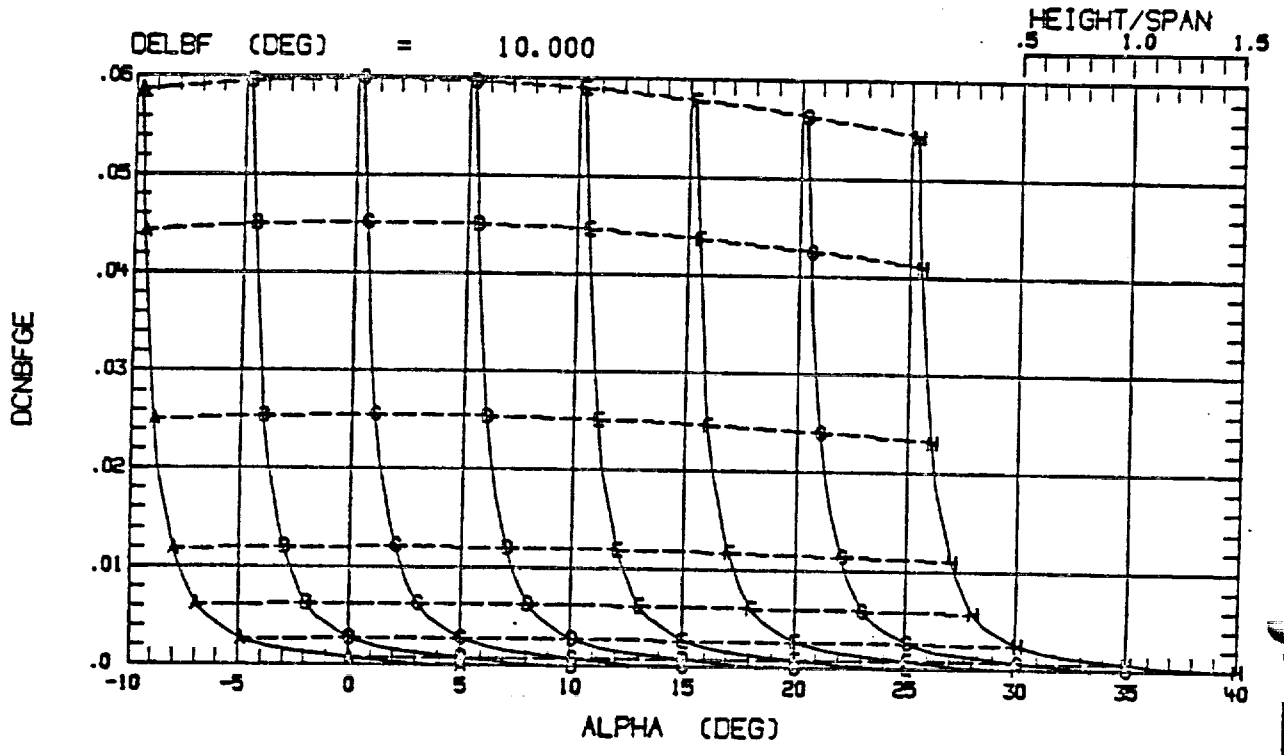


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF NORMAL FORCE CO							
0.025	0.04520	0.04580	0.04600	0.04582	0.04530	0.04443	0.04323	0.04169
0.050	0.03408	0.03453	0.03468	0.03455	0.03415	0.03350	0.03259	0.03143
0.100	0.01921	0.01947	0.01955	0.01948	0.01925	0.01888	0.01837	0.01772
0.200	0.00904	0.00916	0.00920	0.00916	0.00906	0.00889	0.00865	0.00834
0.300	0.00470	0.00476	0.00478	0.00476	0.00471	0.00462	0.00449	0.00433
0.500	0.00204	0.00206	0.00207	0.00206	0.00204	0.00200	0.00195	0.00188
1.000	0.00054	0.00055	0.00055	0.00055	0.00054	0.00053	0.00052	0.00050
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.1-142
GROUND EFFECT BODY FLAP NORMAL FORCE COEFF. INCREMENT

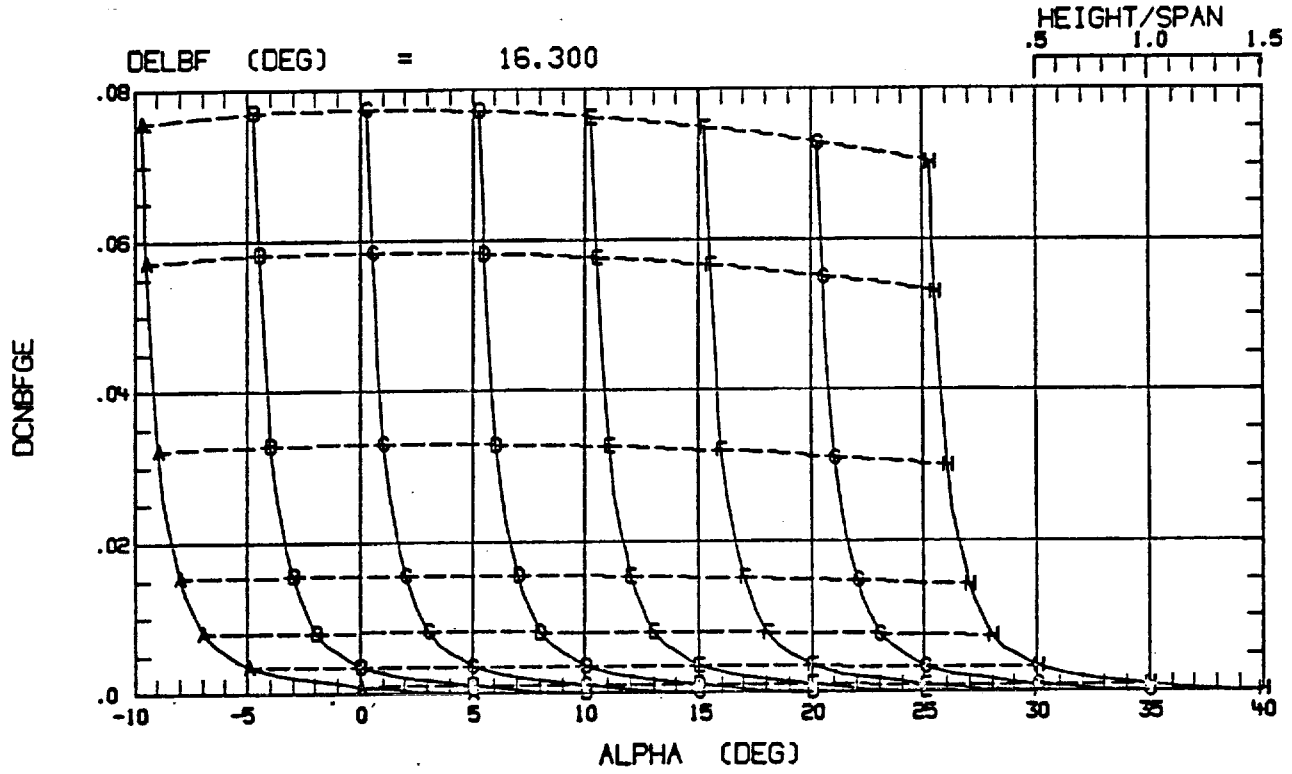


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF NORMAL FORCE CO							
0.025	0.05864	0.05952	0.05981	0.05958	0.05890	0.05777	0.05620	0.05421
0.050	0.04421	0.04488	0.04510	0.04493	0.04441	0.04356	0.04238	0.04087
0.100	0.02492	0.02529	0.02542	0.02532	0.02503	0.02455	0.02389	0.02304
0.200	0.01173	0.01190	0.01196	0.01191	0.01178	0.01155	0.01124	0.01084
0.300	0.00610	0.00619	0.00622	0.00620	0.00613	0.00601	0.00584	0.00564
0.500	0.00264	0.00268	0.00269	0.00268	0.00265	0.00260	0.00253	0.00244
1.000	0.00070	0.00072	0.00072	0.00072	0.00071	0.00070	0.00068	0.00065
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER _____ FIGURE 4.1.1.1-143

DATE _____ GROUND EFFECT BODY FLAP NORMAL FORCE COEFF. INCREMENT

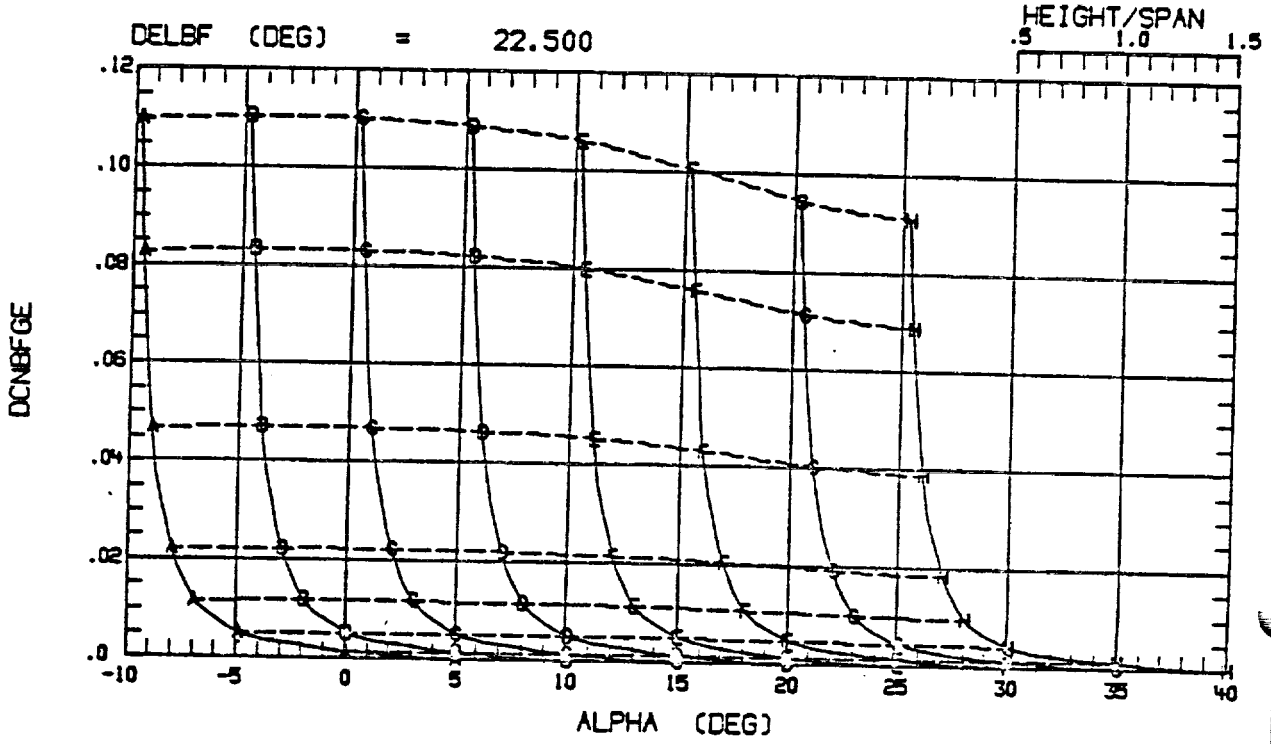


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF NORMAL FORCE CO							
0.025	0.07563	0.07688	0.07740	0.07711	0.07622	0.07476	0.07273	0.07015
0.050	0.05703	0.05797	0.05836	0.05814	0.05747	0.05637	0.05484	0.05289
0.100	0.03214	0.03268	0.03290	0.03277	0.03240	0.03178	0.03092	0.02982
0.200	0.01513	0.01537	0.01548	0.01542	0.01524	0.01495	0.01455	0.01403
0.300	0.00787	0.00800	0.00805	0.00802	0.00793	0.00778	0.00756	0.00730
0.500	0.00341	0.00346	0.00348	0.00347	0.00343	0.00336	0.00327	0.00315
1.000	0.00091	0.00093	0.00093	0.00093	0.00092	0.00090	0.00087	0.00084
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

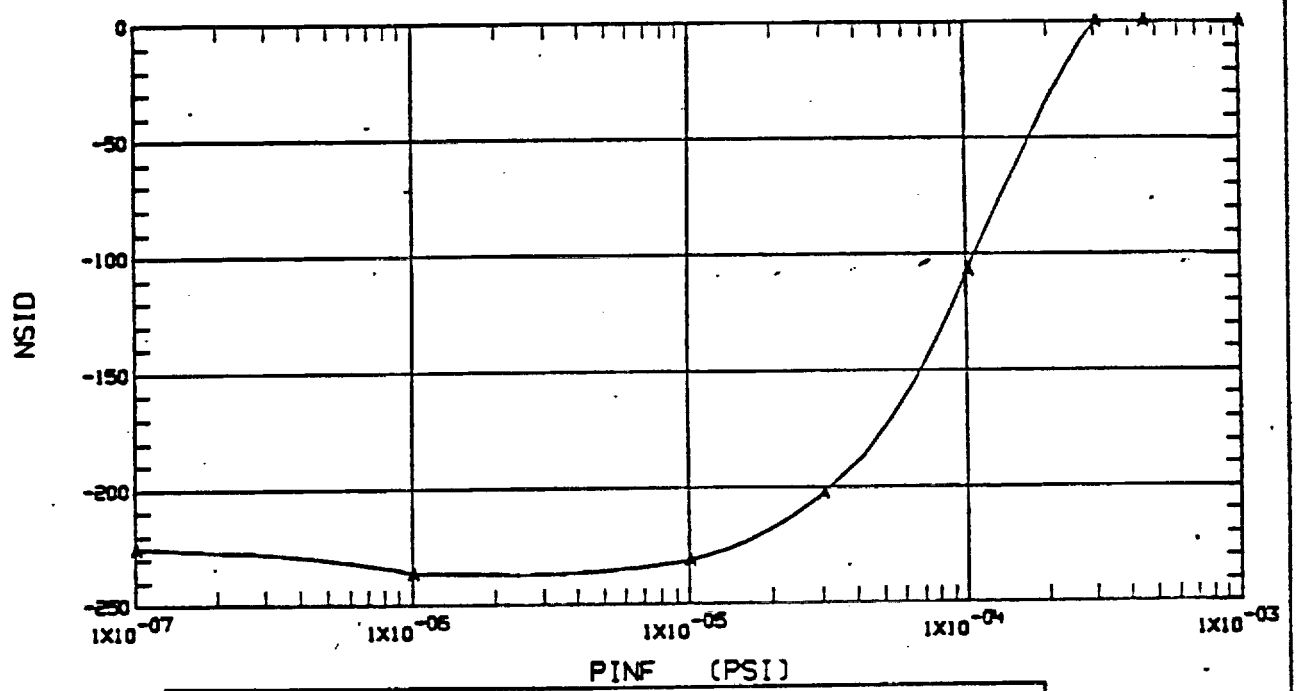
FIGURE 4.1.1.1-144
GROUND EFFECT BODY FLAP NORMAL FORCE COEFF. INCREMENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

HEIGHT/SPAN	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	GROUND EFFECT BF NORMAL FORCE CO							
0.025	0.10951	0.11038	0.11000	0.10848	0.10557	0.10012	0.09406	0.09072
0.050	0.08257	0.08322	0.08294	0.08179	0.07960	0.07549	0.07093	0.06841
0.100	0.04654	0.04691	0.04675	0.04610	0.04487	0.04255	0.03997	0.03855
0.200	0.02190	0.02208	0.02200	0.02170	0.02111	0.02002	0.01881	0.01814
0.300	0.01138	0.01148	0.01144	0.01129	0.01098	0.01041	0.00978	0.00943
0.500	0.00492	0.00497	0.00495	0.00488	0.00475	0.00450	0.00423	0.00408
1.000	0.00131	0.00132	0.00132	0.00131	0.00127	0.00120	0.00113	0.00109
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____ FIGURE 4.1.1.1-145
DATE_____ GROUND EFFECT BODY FLAP NORMAL FORCE COEFF. INCREMENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	$N_{SURF\ IMP}$ LB/ft NORMAL FOR
1.000E-07	-225.660
1.000E-06	-236.400
1.000E-05	-231.520
3.000E-05	-203.190
1.000E-04	-107.460
3.000E-04	0.0
4.500E-04	0.0
1.000E-03	0.0

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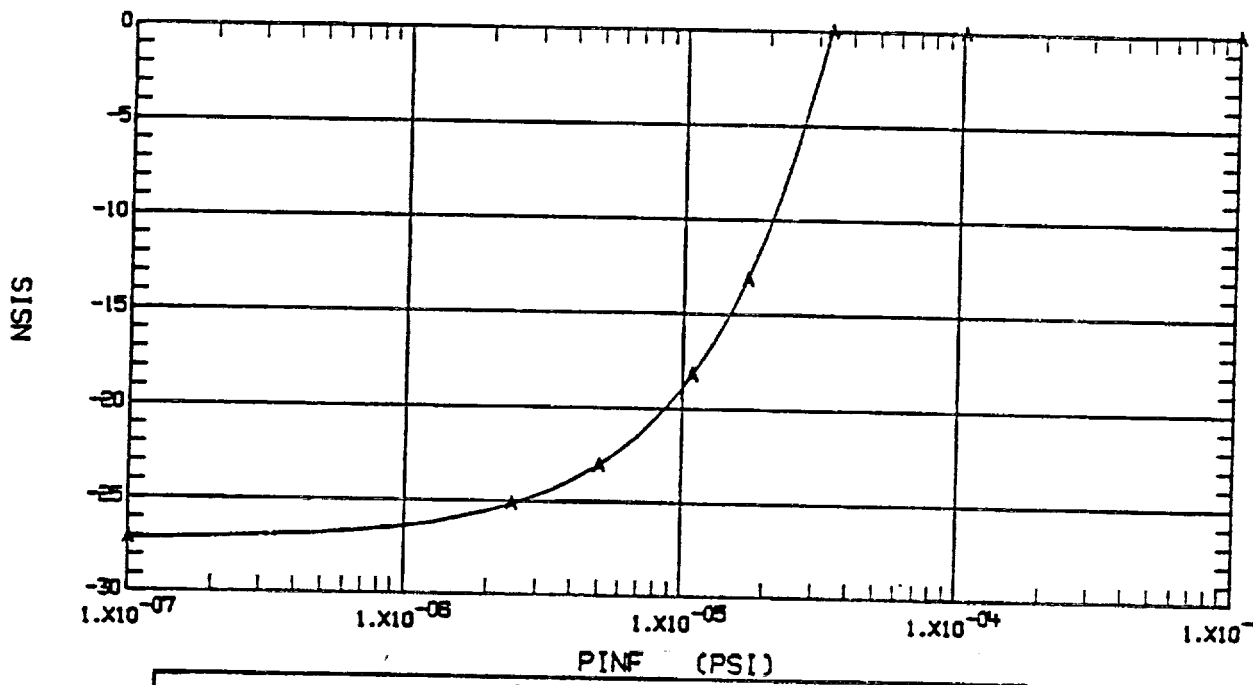
DATE 10/4/75

FIGURE 4.1.1.1- 146
NORMAL FORCE SURFACE IMPINGEMENT.DOWN-FIRING



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	$N_{SURF\ IMP}$ lb/in NORMAL FOR
1.000E-07	-27.200
2.410E-06	-25.200
4.970E-06	-23.100
1.070E-05	-18.300
1.680E-05	-13.200
3.290E-05	0.0
1.000E-04	0.0
1.000E-03	0.0

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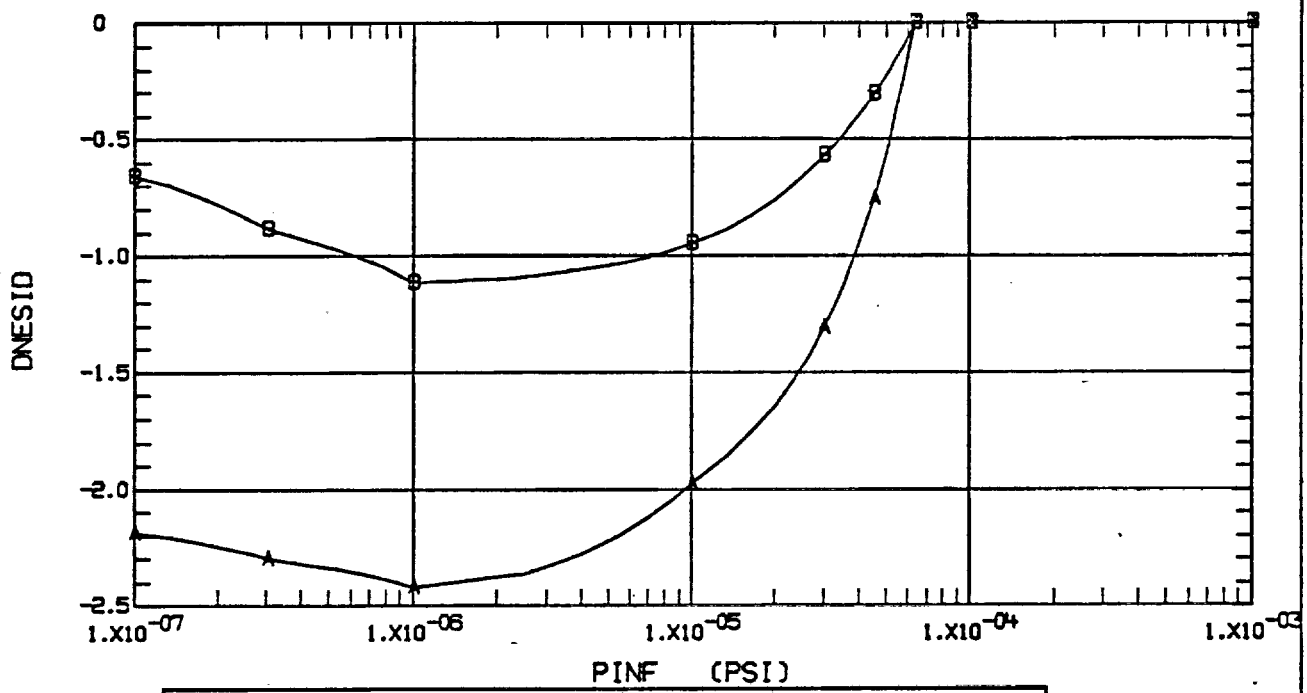
FIGURE 4.1.1.1-147
NORMAL FORCE SURFACE IMPINGEMENT, SIDE-FIRING

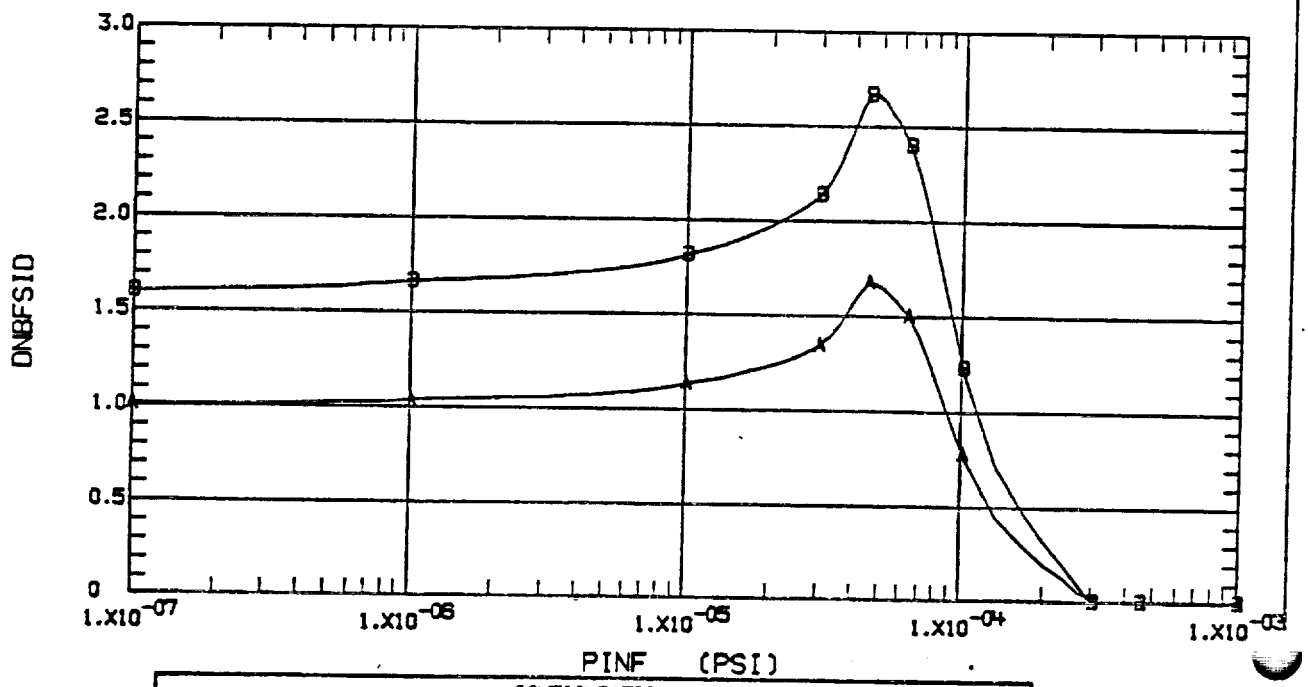


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	$\partial N/\partial\delta_e$ ~ lb/n-deg	
	$\delta_e < 0$	$\delta_e > 0$
PINF (PSI)	DE NORMAL FORCE SI.DF	
1.000E-07	-2.190	-0.660
3.000E-07	-2.300	-0.890
1.000E-06	-2.420	-1.120
1.000E-05	-1.980	-0.950
3.000E-05	-1.310	-0.570
4.500E-05	-0.760	-0.310
6.300E-05	0.0	0.0
1.000E-04	0.0	0.0
1.000E-03	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.1-148
ELEVON NORMAL FORCE SURFACE IMPINGEMENT, DOWN-FIRING



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	$\partial N/\partial\delta_{sp}$ ~ lb/m-deg	
	$\delta_{sp}<0$	$\delta_{sp}>0$
PINF (PSI)	DBF NORMAL FORCE SI.D	
1.000E-07	1.000	1.600
1.000E-06	1.030	1.660
1.000E-05	1.130	1.810
3.000E-05	1.340	2.140
4.500E-05	1.670	2.670
6.300E-05	1.500	2.400
1.000E-04	0.770	1.230
3.000E-04	0.0	0.0
4.500E-04	0.0	0.0
1.000E-03	0.0	0.0

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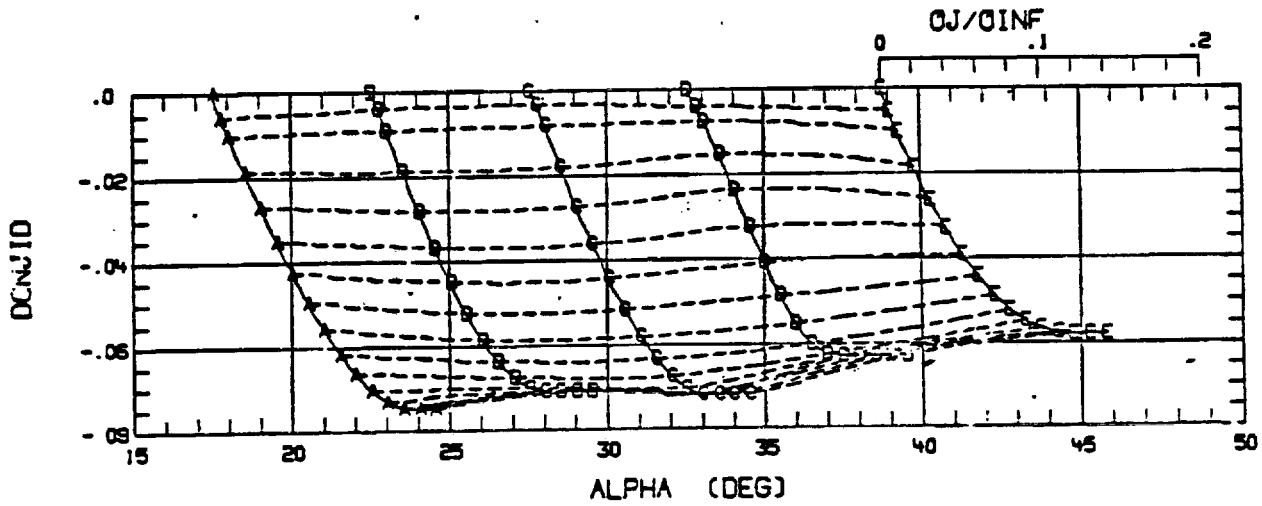
DATE_____

FIGURE 4.1.1.1-149
BODYFLAP NORMAL FORCE SURFACE IMPINGEMENT.DOWN-FIRING



OJ/OINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	NORMAL FORCE JI.DF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00591	-0.00404	-0.00307	-0.00405	-0.00543
0.0100	-0.01022	-0.00903	-0.00816	-0.00749	-0.01005
0.0200	-0.01875	-0.01881	-0.01808	-0.01523	-0.01854
0.0300	-0.02708	-0.02921	-0.02752	-0.02374	-0.02639
0.0400	-0.03511	-0.03705	-0.03638	-0.03250	-0.03330
0.0500	-0.04272	-0.04520	-0.04454	-0.04102	-0.03935
0.0600	-0.04979	-0.05250	-0.05187	-0.04881	-0.04455
0.0700	-0.05621	-0.05881	-0.05825	-0.05534	-0.04891
0.0800	-0.06188	-0.06396	-0.06359	-0.06014	-0.05242
0.0900	-0.06667	-0.06781	-0.06774	-0.06269	-0.05509
0.1000	-0.07047	-0.07021	-0.07060	-0.06297	-0.05690
0.1100	-0.07318	-0.07100	-0.07204	-0.06297	-0.05787
0.1200	-0.07467	-0.07100	-0.07195	-0.06297	-0.05798
0.1300	-0.07467	-0.07100	-0.07195	-0.06297	-0.05798
0.1400	-0.07467	-0.07100	-0.07195	-0.06297	-0.05798

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\Delta C_{N_{JI}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	NORMAL FORCE JI.DF					
17.500	-0.0016	-0.8620	-0.1470	18.8000	0.0050	0.1200
22.500	0.0010	-1.0100	0.4590	25.2000	0.0050	0.1100
27.500	0.0021	-1.0400	1.1600	19.7000	0.0050	0.1200
32.500	-0.0010	-0.5690	-8.8000	83.4000	0.0050	0.0950
38.750	-0.0006	-0.9970	4.2400	0.0	0.0050	0.1200

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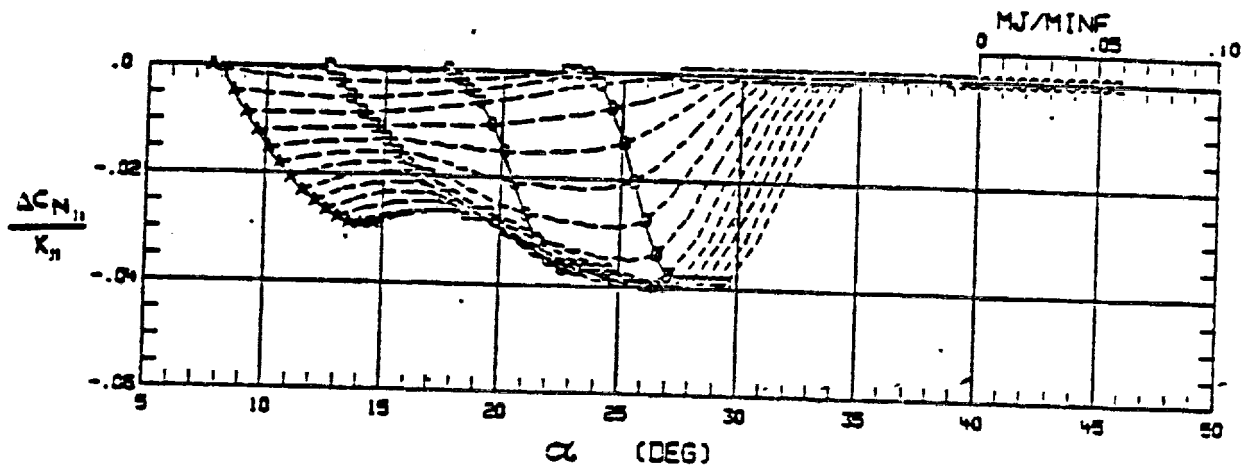
FIGURE 4.1.1.1-150
NORMAL FORCE JET INTERACTION.DOWN-FIRING



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	39.750 G
	NORMAL FORCE J1,SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00013	-0.00055	-0.00039	-0.00002	0.0	0.0	0.0
0.005	-0.00067	-0.00276	-0.00195	-0.00011	0.0	0.0	0.0
0.010	-0.00483	-0.00588	-0.00389	-0.00022	0.0	0.0	0.0
0.015	-0.00667	-0.00946	-0.00518	-0.00207	0.0	0.0	0.0
0.020	-0.01220	-0.01109	-0.01024	-0.00568	0.0	0.0	0.0
0.025	-0.01541	-0.01359	-0.01546	-0.01312	0.0	0.0	0.0
0.030	-0.01831	-0.01594	-0.02119	-0.02042	0.0	0.0	0.0
0.035	-0.02029	-0.01815	-0.02594	-0.02752	0.0	0.0	0.0
0.040	-0.02316	-0.02022	-0.03177	-0.03377	0.0	0.0	0.0
0.045	-0.02511	-0.02214	-0.03537	-0.03791	0.0	0.0	0.0
0.050	-0.02675	-0.02393	-0.03702	-0.03908	0.0	0.0	0.0
0.055	-0.02907	-0.02557	-0.03702	-0.03908	0.0	0.0	0.0
0.060	-0.02908	-0.02707	-0.03702	-0.03908	0.0	0.0	0.0
0.065	-0.02908	-0.02707	-0.03702	-0.03908	0.0	0.0	0.0
0.070	-0.02908	-0.02707	-0.03702	-0.03908	0.0	0.0	0.0

$$\frac{\dot{m}_1}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_1}{\phi_\infty}\right)\left(\frac{v_\infty}{v_1}\right)\left(\sin\theta_1\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{q_\infty}\right)$$

v_1 = exit velocity — fps
v_∞ = freestream velocity — fps
θ_1 = nozzle half angle at exit

$$\frac{\Delta C_{N_{J1}}}{K_{J1}} = A_0 + A_1\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	A003.MIN.MAX A_0	A_1	A_2	A_3	$(\dot{m}_1/\dot{m}_\infty)_{MIN}$	$(\dot{m}_1/\dot{m}_\infty)_{MAX}$
	NORMAL FORCE J1,SF					
7.500	0.00380	-0.92590	6.29930	0.0	0.00500	0.06000
12.500	0.00030	-0.62550	2.83980	0.0	0.00500	0.06000
17.500	-0.00710	0.98400	-72.60001	827.00000	0.01000	0.05000
22.500	-0.00870	1.85000	-113.00000	1277.00000	0.01000	0.05000
27.500	0.0	0.0	0.0	0.0	0.00500	0.06000
32.500	0.0	0.0	0.0	0.0	0.00500	0.06000
39.750	0.0	0.0	0.0	0.0	0.00500	0.06000

$K_{J1} = 1.0$

Interpolate for α's not shown after calculation. of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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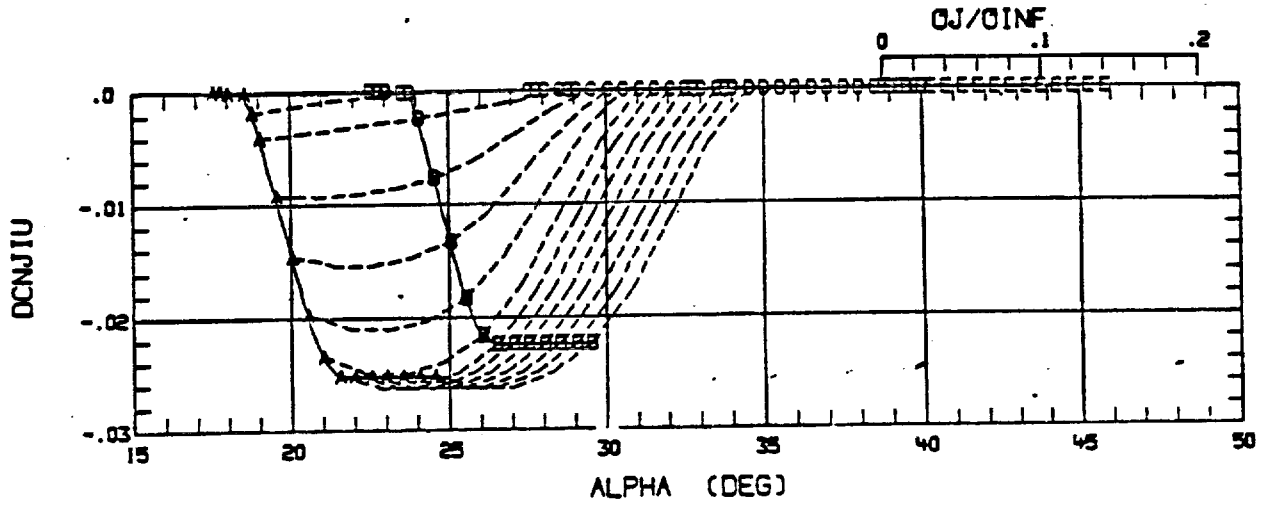
FIGURE 4.1.1.1-151
NORMAL FORCE JET INTERACTION.SIDE-FIRING



OJ/OINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	NORMAL FORCE JI.UF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00004	-0.00002	0.0	0.0	0.0
0.0100	-0.00009	-0.00005	0.0	0.0	0.0
0.0200	-0.00017	-0.00010	0.0	0.0	0.0
0.0250	-0.00191	-0.00012	0.0	0.0	0.0
0.0300	-0.00406	-0.00233	0.0	0.0	0.0
0.0400	-0.00920	-0.00764	0.0	0.0	0.0
0.0500	-0.01472	-0.01333	0.0	0.0	0.0
0.0600	-0.01980	-0.01836	0.0	0.0	0.0
0.0700	-0.02359	-0.02172	0.0	0.0	0.0
0.0800	-0.02523	-0.02241	0.0	0.0	0.0
0.0900	-0.02523	-0.02241	0.0	0.0	0.0
0.1000	-0.02523	-0.02241	0.0	0.0	0.0
0.1100	-0.02523	-0.02241	0.0	0.0	0.0
0.1200	-0.02523	-0.02241	0.0	0.0	0.0
0.1300	-0.02523	-0.02241	0.0	0.0	0.0
0.1400	-0.02523	-0.02241	0.0	0.0	0.0

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\Delta C_{N_{JI}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	NORMAL FORCE JI.UF					
17.500	0.0005	0.2980	-18.3000	141.0000	0.0200	0.0800
22.500	0.0013	0.3900	-22.1000	169.0000	0.0250	0.0900
27.500	0.0	0.0	0.0	0.0	0.0050	0.1200
32.500	0.0	0.0	0.0	0.0	0.0050	0.1200
38.750	0.0	0.0	0.0	0.0	0.0050	0.1200

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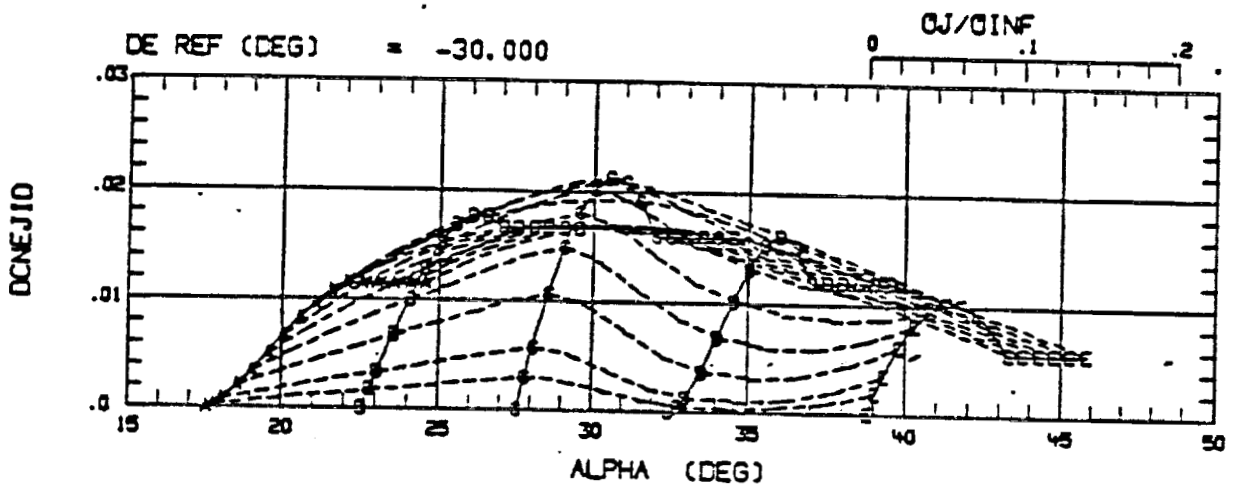
FIGURE 4.1.1.1-152
NORMAL FORCE JET INTERACTION.UP-FIRING



QJ/QINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DE NORMAL FORCE JET				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.00033	0.00168	0.00291	0.00042	0.00179
0.0100	0.00077	0.00337	0.00566	0.00120	0.00340
0.0200	0.00152	0.00671	0.01062	0.00360	0.00611
0.0300	0.00335	0.00987	0.01476	0.00670	0.00812
0.0400	0.00494	0.01259	0.01796	0.00989	0.00943
0.0500	0.00658	0.01503	0.02011	0.01297	0.01005
0.0600	0.00816	0.01673	0.02109	0.01515	0.00997
0.0700	0.00985	0.01784	0.02077	0.01602	0.00920
0.0800	0.01066	0.01762	0.01905	0.01508	0.00773
0.0900	0.01137	0.01651	0.01580	0.01184	0.00655
0.1000	0.01137	0.01651	0.01580	0.01184	0.00655
0.1100	0.01137	0.01651	0.01580	0.01184	0.00655
0.1200	0.01137	0.01651	0.01580	0.01184	0.00655
0.1300	0.01137	0.01651	0.01580	0.01184	0.00655
0.1400	0.01137	0.01651	0.01580	0.01184	0.00655

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$$\left(\Delta C_N\right)_{\delta_{e_{REF}} = -30^\circ} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DE NORMAL FORCE JET					
17.500	0.0	0.0636	2.5000	-18.8000	0.0050	0.0900
22.500	0.0	0.3340	0.5860	-25.1000	0.0050	0.0900
27.500	0.0	0.6970	-2.9100	-19.7000	0.0050	0.0900
32.500	0.0	0.0439	8.4800	-83.4000	0.0050	0.0900
38.750	0.0	0.3750	-3.4800	0.0	0.0050	0.0900

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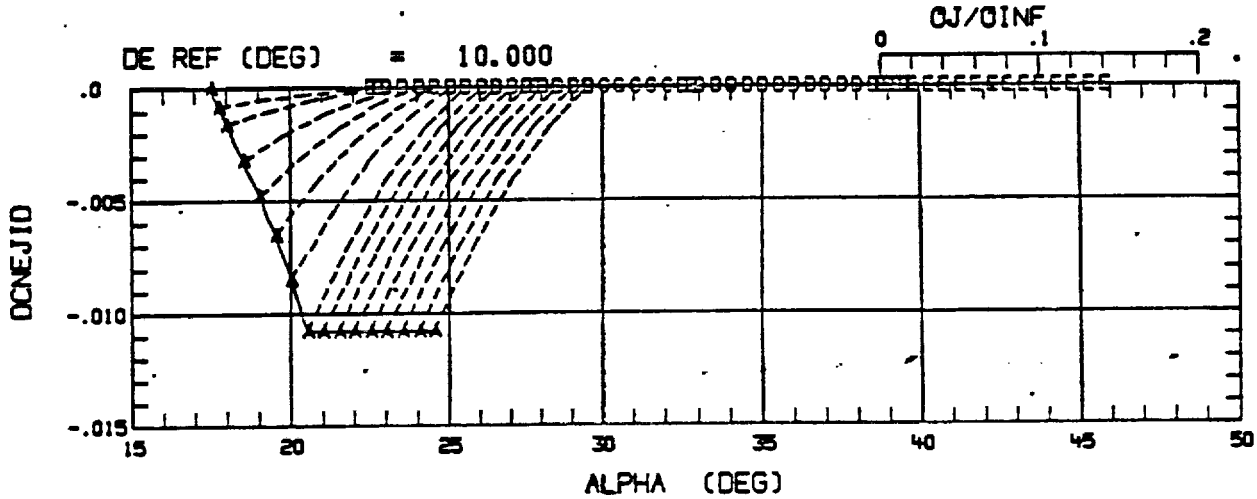
FIGURE 4.1.1.1-153
ELEVON NORMAL FORCE JET INTERACTION, DOWN-FIRING



CJ/CINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DE NORMAL FORCE JI.DF				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00085	0.0	0.0	0.0	0.0
0.0100	-0.00166	0.0	0.0	0.0	0.0
0.0200	-0.00323	0.0	0.0	0.0	0.0
0.0300	-0.00482	0.0	0.0	0.0	0.0
0.0400	-0.00655	0.0	0.0	0.0	0.0
0.0500	-0.00852	0.0	0.0	0.0	0.0
0.0600	-0.01086	0.0	0.0	0.0	0.0
0.0700	-0.01086	0.0	0.0	0.0	0.0
0.0800	-0.01086	0.0	0.0	0.0	0.0
0.0900	-0.01086	0.0	0.0	0.0	0.0
0.1000	-0.01086	0.0	0.0	0.0	0.0
0.1100	-0.01086	0.0	0.0	0.0	0.0
0.1200	-0.01086	0.0	0.0	0.0	0.0
0.1300	-0.01086	0.0	0.0	0.0	0.0
0.1400	-0.01086	0.0	0.0	0.0	0.0

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\left(\Delta C_N\right)_{\delta_{e_{REF}} = +10^\circ} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DE NORMAL FORCE JI.DF					
17.500	0.0	-0.1740	1.0100	-18.5000	0.0050	0.0600
22.500	0.0	0.0	0.0	0.0	0.0050	0.0600
27.500	0.0	0.0	0.0	0.0	0.0050	0.0600
32.500	0.0	0.0	0.0	0.0	0.0050	0.0600
38.750	0.0	0.0	0.0	0.0	0.0050	0.0600

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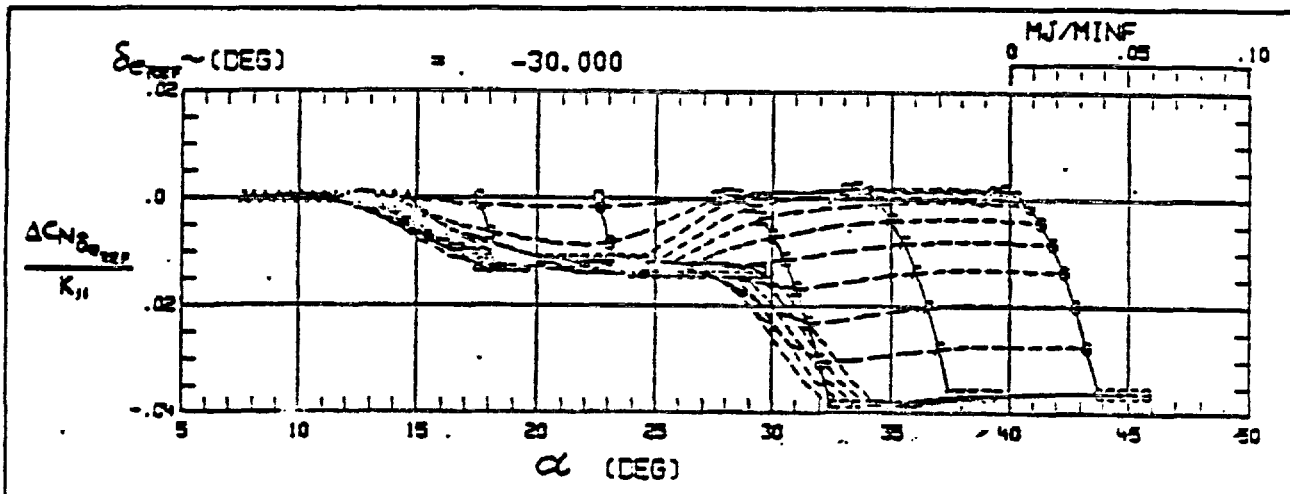
FIGURE 4.1.1.1-154
ELEVON NORMAL FORCE JET INTERACTION.DOWN-FIRING



MJ/MINF	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	DE NORMAL FORCE JI SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	0.0	-0.00008	-0.00135	-0.00170	0.00011	0.00030	0.00026
0.005	0.0	-0.00041	-0.00679	-0.00851	0.00054	0.00148	0.00129
0.010	0.0	-0.00102	-0.01058	-0.01278	0.00010	0.00191	0.00147
0.015	0.0	-0.00182	-0.01198	-0.01376	-0.00133	0.00099	0.00057
0.020	0.0	-0.00281	-0.01198	-0.01376	-0.00374	-0.00093	-0.00142
0.025	0.0	-0.00399	-0.01198	-0.01376	-0.00714	-0.00410	-0.00450
0.030	0.0	-0.00538	-0.01198	-0.01376	-0.01152	-0.00637	-0.00257
0.035	0.0	-0.00693	-0.01198	-0.01376	-0.01689	-0.01379	-0.01393
0.040	0.0	-0.00868	-0.01198	-0.01376	-0.02324	-0.02035	-0.02029
0.045	0.0	-0.01063	-0.01198	-0.01376	-0.03058	-0.02803	-0.02772
0.050	0.0	-0.01277	-0.01198	-0.01376	-0.03890	-0.03695	-0.03625
0.055	0.0	-0.01277	-0.01198	-0.01376	-0.03890	-0.03695	-0.03625
0.060	0.0	-0.01277	-0.01198	-0.01376	-0.03890	-0.03695	-0.03625
0.065	0.0	-0.01277	-0.01198	-0.01376	-0.03890	-0.03695	-0.03625
0.070	0.0	-0.01277	-0.01198	-0.01376	-0.03890	-0.03695	-0.03625

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\Phi_j}{\Phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-4}\left(\frac{v_\infty}{a_\infty}\right)$$

v_j = exit velocity — fps
v_∞ = freestream velocity — fps
θ_j = nozzle half angle at exit

$$\frac{\Delta C_{N_{\delta_{e_{REF}}}}}{K_{jt}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	A003,MIN,MAX A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	DE NORMAL FORCE JI SF					
7.500	0.0	0.0	0.0	0.0	0.00500	0.05000
12.500	0.0	-0.06370	-3.83510	0.0	0.00500	0.05000
17.500	0.0	-1.70000	72.50000	-927.00000	0.00500	0.01500
22.500	0.0	-2.19000	104.00000	-1277.00000	0.00500	0.01500
27.500	0.0	0.20700	-19.70000	0.0	0.00500	0.05000
32.500	0.0	0.41100	-23.00000	0.0	0.00500	0.05000
38.750	0.0	0.38500	-21.90000	0.0	0.00500	0.05000

$K_{jt} = 1.0$

Interpolate for α's not shown after calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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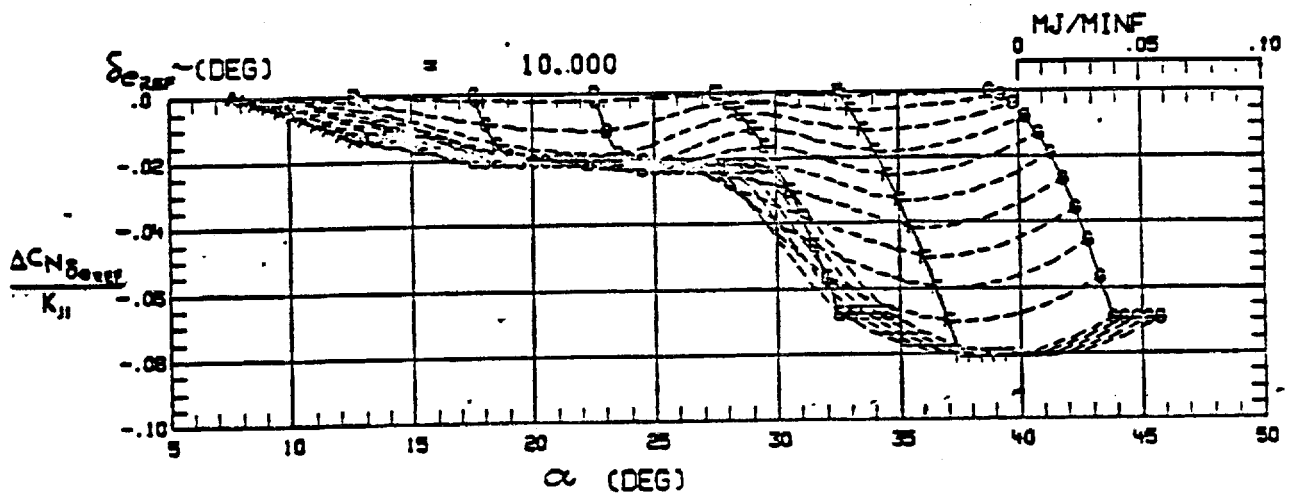
FIGURE 4.1.1.1-155
ELEVON NORMAL FORCE JET INTERACTION.SIDE-FIRING



MJ/MINF	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	DE NORMAL FORCE JI.SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00019	-0.00057	-0.00188	-0.00229	-0.00057	-0.00112	-0.00029
0.005	-0.00097	-0.00297	-0.00938	-0.01143	-0.00287	-0.00562	-0.00147
0.010	-0.00203	-0.00556	-0.01555	-0.01848	-0.00661	-0.01180	-0.00416
0.015	-0.00317	-0.00806	-0.01911	-0.02208	-0.01121	-0.01652	-0.00907
0.020	-0.00441	-0.01037	-0.02070	-0.02322	-0.01659	-0.02590	-0.01320
0.025	-0.00574	-0.01249	-0.02092	-0.02283	-0.02301	-0.03362	-0.01955
0.030	-0.00716	-0.01442	-0.02092	-0.02293	-0.03021	-0.04200	-0.02712
0.035	-0.00867	-0.01617	-0.02092	-0.02293	-0.03827	-0.05092	-0.03591
0.040	-0.01027	-0.01773	-0.02092	-0.02293	-0.04720	-0.06040	-0.04592
0.045	-0.01196	-0.01910	-0.02092	-0.02293	-0.05699	-0.07042	-0.05715
0.050	-0.01374	-0.02029	-0.02092	-0.02293	-0.06765	-0.08100	-0.06960
0.055	-0.01374	-0.02029	-0.02092	-0.02293	-0.06765	-0.08100	-0.06960
0.060	-0.01374	-0.02029	-0.02092	-0.02293	-0.06765	-0.08100	-0.06960
0.065	-0.01374	-0.02029	-0.02092	-0.02293	-0.06765	-0.08100	-0.06960
0.070	-0.01374	-0.02029	-0.02092	-0.02293	-0.06765	-0.08100	-0.06960

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{q_\infty}\right)$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

$$\frac{\Delta C_{N_{JI}}}{K_{JI}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	A003,MIN,MAX A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	DE NORMAL FORCE JI.SF					
7.500	0.0	-0.18450	-1.80710	0.0	0.00500	0.05000
12.500	0.0	-0.59330	3.75160	0.0	0.00500	0.05000
17.500	0.0	-2.24000	76.80000	-827.00000	0.00500	0.02500
22.500	0.0	-2.79000	107.00000	-1277.00000	0.00500	0.02500
27.500	0.0	-0.48800	-17.30000	0.0	0.00500	0.05000
32.500	0.0	-1.07000	-11.00000	0.0	0.00500	0.05000
38.750	0.0	-0.17200	-24.39999	0.0	0.00500	0.05000

$K_{JI} = 1.0$

Interpolate for α's not shown after calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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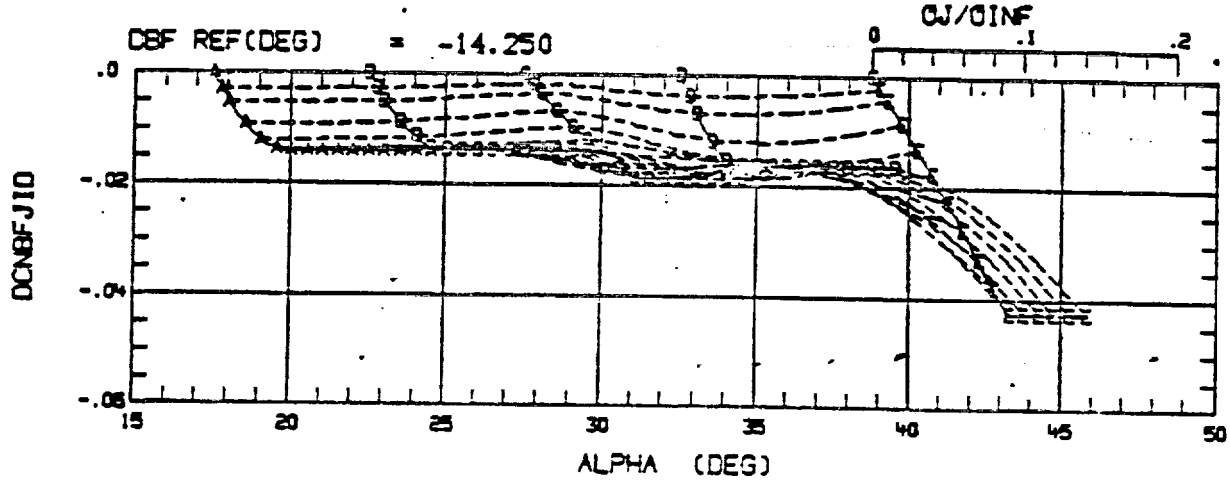
FIGURE 4.1.1.1- 156
ELEVON NORMAL FORCE JET INTERACTION.SIDE-FIRING



OJ/OINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DBF NORMAL FORCE JET				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00292	-0.00263	-0.00184	-0.00374	-0.00208
0.0100	-0.00529	-0.00495	-0.00354	-0.00692	-0.00420
0.0200	-0.00929	-0.00873	-0.00664	-0.01191	-0.00857
0.0300	-0.01211	-0.01149	-0.00940	-0.01545	-0.01311
0.0400	-0.01386	-0.01339	-0.01194	-0.01634	-0.01793
0.0500	-0.01413	-0.01372	-0.01439	-0.01634	-0.02272
0.0600	-0.01413	-0.01372	-0.01666	-0.01634	-0.02778
0.0700	-0.01413	-0.01372	-0.01866	-0.01634	-0.03302
0.0800	-0.01413	-0.01372	-0.01866	-0.01634	-0.03844
0.0900	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289
0.1000	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289
0.1100	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289
0.1200	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289
0.1300	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289
0.1400	-0.01413	-0.01372	-0.01866	-0.01634	-0.04289

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$$\Delta C_{N_{\delta_{BF_{REF}}}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	DBF NORMAL FORCE JET					
17.500	0.0	-0.5560	7.0400	-18.8000	0.0050	0.0424
22.500	0.0	-0.5580	6.5900	-25.2000	0.0050	0.0423
27.500	0.0	-0.3810	2.8500	-19.7000	0.0050	0.0670
32.500	0.0	-0.8060	12.2000	-93.4000	0.0050	0.0331
38.750	0.0	-0.4110	-0.3680	0.0	0.0050	0.0880

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FIGURE 4.1.1.1-157
BODYFLAP NORMAL FORCE JET INTERACTION.DOWN-FIRING

4.1.1.2 AXIAL FORCE COEFFICIENT. The Orbiter Vehicle aerodynamic axial force coefficient is defined in this section. The basic aerodynamic axial force coefficient data are presented in three forms: 1) as a function of speedbrake, angle of attack and Mach number from M = 0.25 through M = 20; 2) as a function of angle of attack and the viscous interaction parameter ($\bar{V}_\infty^{1}$) from 0.005 (equivalent to M = 13.6) through 0.08 (equivalent to 300,000 feet of altitude); and 3) as a function of angle of attack and altitude from 300,000 feet to 600,000 feet. Orbital aerodynamic characteristics are included in Appendix C. RCS jet thrust, thrust impingement, and flow field changes due to jet plumes are also included in this section [4.1.1.2[. Uncertainties associated with the axial force characteristics are available in Section 6.0.

The RCS flow field interaction data are presented as a contribution to the axial force (A) rather than the coefficient (C_A) since the terms due to jet thrust and impingement are independent of dynamic pressure and cannot, therefore, be normalized in the conventional manner. CAUTION should be observed when applying these terms in the flight regime where the RCS is used in conjunction with the aerodynamic force (cf. Section 3.6); i.e., the aerodynamic coefficient must be converted to a dimensional force *before* adding the RCS flow field interaction effect (see also Appendix B).

The total axial force is:

$$A_{TOTAL} = \bar{q}\, S\, C_{A_{TOTAL_{AERO}}} + A_{RCS}$$

The total axial force coefficient is obtained by summing up the basic data (all surfaces zero except speed brake) with auxiliary data (control surface deflections, ground effect, flexibility). All of the total data (basic plus auxiliary) are given at specified conditions. Linear interpolations are to be used at the intermediate positions.

*The total aerodynamic axial force coefficient is obtained by the following equation:

$$C_{A_{TOTAL_{AERO}}} = C_{A_{BASIC}} + [\Delta C_{A_{ELEVATOR}} + \Delta C_{A_{AILERON}}]_{ELEVON} + \Delta C_{A_{BODY\ FLAP}} + \Delta C_{A_{RUDDER}} + \Delta C_{A_{SPEED\ BRAKE}}$$
$$+ \Delta C_{A_{FLEX}} + \Delta C_{A_{LANDING\ GEAR}} + \Delta C_{A_{GROUND\ EFFECT}} + \Delta C_{A_{SILTS\ POD}}$$

where,

$C_{A_{BASIC}}$ = Basic, full-scale, freestream, rigid body axial force coefficient (Figures 4.1.1.2-1 through-67)

NOTE: 1) All control surfaces neutral *except* $\delta_{SB} = 25°$.

$\Delta C_{A_{ELEVATOR}}$ = Change in axial force coefficient due to elevon (elevator) deflection, δ_e. (Figures 4.1.1.2-68 through-97)

*Refer to Appendix D when using digitized data.

$\Delta C_{A_{AILERON}}$ = Change in axial force coefficient due to aileron deflection, δ_a.

$= \frac{1}{2}(\Delta C_{A_{e_{\delta_e=\delta_{e_L}}}} + \Delta C_{A_{e_{\delta_e=\delta_{e_R}}}}) - \Delta C_{A_{e_{\delta_e=\delta_{e_{TRIM}}}}}$

$\Delta C_{A_{BODY\ FLAP}}$ = Change in axial force coefficient due to body flap deflection, δ_{BF}. (Figures 4.1.1.2-98 through-126)

$\Delta C_{A_{RUDDER}}$ = Change in axial force coefficient due to rudder deflection, δ_r. (Assume zero)

$\Delta C_{A_{SPEED\ BRAKE}}$ = Change in axial force coefficient due to speed brake deflection, δ_{SB}. (Figures 4.1.1.2-1 through -65)

$= C_{A_{\delta_{SB}=\delta_{SB}}} - C_{A_{\delta_{SB}=25}}$

$\Delta C_{A_{FLEX}}$ = Change in axial force coefficient due to aeroelastic deformation.

$= \Delta C_{D_{FLEX}} \cos\alpha - \Delta C_{L_{FLEX}} \sin\alpha$

where, $\Delta C_{L_{FLEX}}$ = flexible lift increment (cf. Section 4.1.2.1)

$\Delta C_{D_{FLEX}}$ = flexible drag increment (cf. Section 4.1.2.2)

$\Delta C_{A_{LANDING\ GEAR}}$ = Change in axial force coefficient due to fully extended landing gear. (Figure 4.1.1.2-127)

NOTE: 1. See Section 4.1.2.2 for landing gear drag during deployment.

$\Delta C_{A_{GROUND\ EFFECT}}$ = Change in axial force coefficient due to proximity of ground, f(h/b)

NOTE: 1. See Section 3.4 for ground clearance and scrape attitude.

$= \Delta C_{A_{GE_{\delta_{BF}=-11.7°}}} + \Delta C_{A_{BF_{GE}}}$

$\Delta C_{A_{GE_{\delta_{BF}=-11.7°}}}$ = Incremental axial force coefficient in ground effect with $\delta_{BF} = -11.7°$ (Figures 4.1.1.2-126 through -137)

$\Delta C_{A_{BF_{GE}}}$ = Incremental axial force coefficient in ground effect for various δ_{BF} deflections (Figures 4.1.1.2- 138 through -144)

$\Delta C_{A_{SILTS\ POD}}$ = Change in axial force coefficient due to addition of SILTS pod.

$= \Delta C_{D_{SILTS\ POD}} \cos\alpha - \Delta C_{L_{SILTS\ POD}} \sin\alpha$ ($\Delta C_{L_{SILTS}}$ - cf Section 4.1.2.1) ($\Delta C_{D_{SILTS}}$ - cf Section 4.1.2.2)

RCS flow field interactions have been subdivided into three components:

1. RCS JET THRUST (subscript JT)
2. RCS JET PLUME IMPINGEMENT (subscript IMP)
3. RCS JET PLUME EFFECT ON FLOW FIELD (subscript JI)

*The effect of the RCS may be described as a dimensional axial force (pounds) in terms of the significant contributing elements by:

$$A_{RCS} = A_{JT} + [A_{SURF} + \Delta A_{ELEVON} + \Delta A_{BODY\ FLAP}]_{IMP} + \bar{q}\, S[\Delta C_A + \Delta C_{A_{ELEVON}} + \Delta C_{A_{BODY\ FLAP}}]_{JI}$$

where,

A_{JT} = Axial force resulting from number (n) of jets being fired (Reference data only). (cf. Appendix B)

$$= \sum_{OJG} [A_{JET} \cdot n] \sim lb$$

NOTE: 1. OJG - operating jet group
2. Values given in Figure B-1 are for reference only.

$A_{SURF\ IMP}$ = Axial force resulting from jet impingement on Orbiter Vehicle surface(s). (Figure 4.1.1.2-145 and 146)

$$= \sum_{OJG} [A_{SURF\ IMP} \cdot n] \sim lb$$

$A_{ELEVON\ IMP}$ = Change in axial force due to effect of impingement on elevon effectiveness. (Figure 4.1.1.2-147)

$$= \sum_{OJG} [\frac{\partial A}{\partial \delta_e} \delta_e \cdot n] \sim lb$$

$A_{BODY\ FLAP\ IMP}$ = Change in axial force due to effect of impingement on body flap effectiveness. (Figure 4.1.1.2-148)

$$= \sum_{OJG} [\frac{\partial A}{\partial \delta_{BF}} \delta_{BF} \cdot n] \sim lb$$

$\Delta C_{A_{JI}}$ = Change in axial force coefficient due to jet interaction. (Figures 4.1.1.2-149 through -151)

$$= \sum_{OJG} [\Delta C_{A_{JI}}]$$

*Refer to Appendix D when using digitized data.

$\Delta C_{A_{\substack{ELEVON \\ JI}}}$ = Change in axial force coefficient due to jet interaction effect on elevon effectiveness.

$$= \sum_{OJG} \left[(\Delta C_A)_{\delta_{e_{REF}}} \left(\frac{\delta_e}{\delta_{e_{REF}}} \right)^{0.75} \right]$$

NOTE: 1. Down-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.2-152

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (No effect)

2. Side-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.2-153)

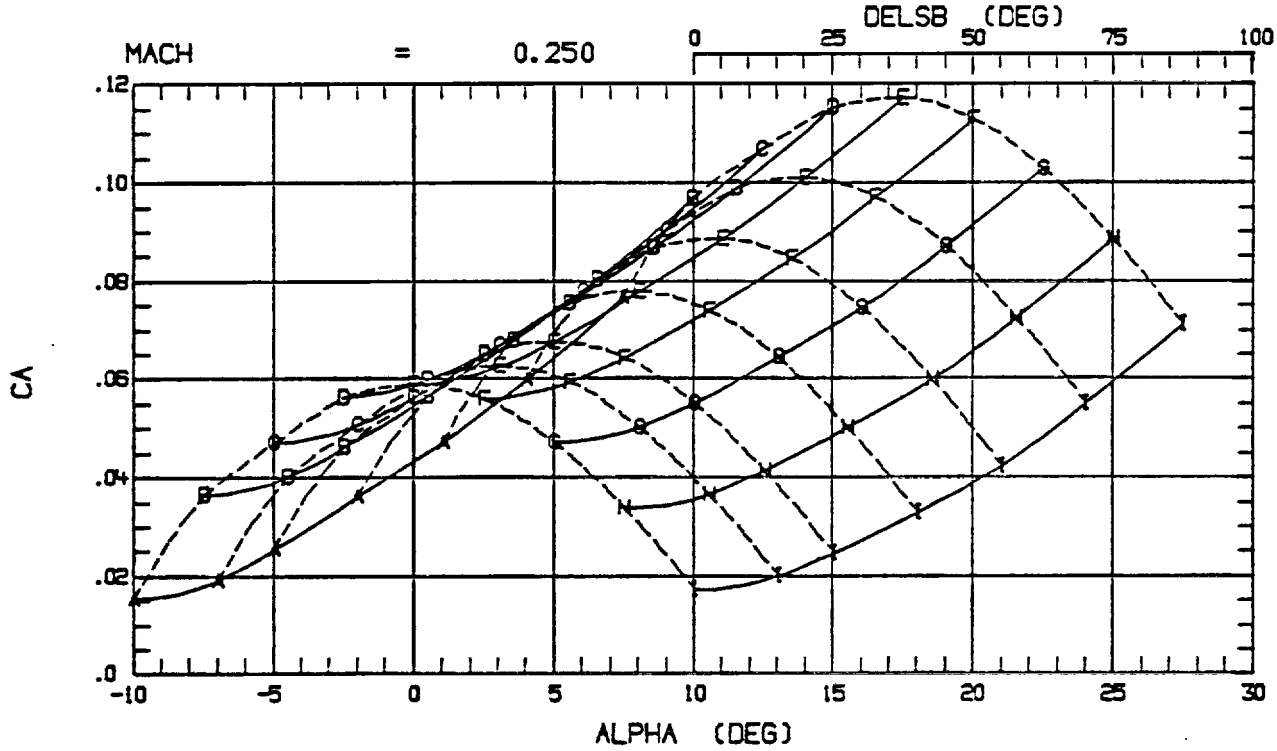
$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.1.1.2-154)

3. Up-firing jets (No effect)

$\Delta C_{A_{\substack{BODY \\ FLAP \\ JI}}}$ = Change in axial force coefficient due to jet interaction effect on body flap effectiveness. (No effect)

$$= \sum_{OJG} \left[(\Delta C_A)_{\delta_{BF_{REF}}} \left(\frac{\delta_{BF}}{\delta_{BF_{REF}}} \right)^{0.75} \right]$$

The total RCS effect, A_{RCS}, during thrust build-up and decay is obtained by reducing the full thrust value by the ratio of momentary thrust (see Ref. 4-3) to full thrust.



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.01512	0.03622	0.04687	0.05605	0.05870	0.05567	0.04681	0.03339	0.01700
15.000	0.01900	0.03998	0.05060	0.05974	0.06240	0.05918	0.05007	0.03636	0.01966
25.000	0.02520	0.04585	0.05610	0.06500	0.06740	0.06410	0.05490	0.04110	0.02428
40.000	0.03580	0.05641	0.06663	0.07534	0.07755	0.07378	0.06414	0.04992	0.03272
55.000	0.04704	0.06761	0.07781	0.08635	0.08840	0.08423	0.07420	0.05960	0.04204
70.000	0.05968	0.08005	0.09016	0.09868	0.10080	0.09673	0.08681	0.07225	0.05475
87.200	0.07643	0.09664	0.10665	0.11499	0.11700	0.11272	0.10274	0.08929	0.07098

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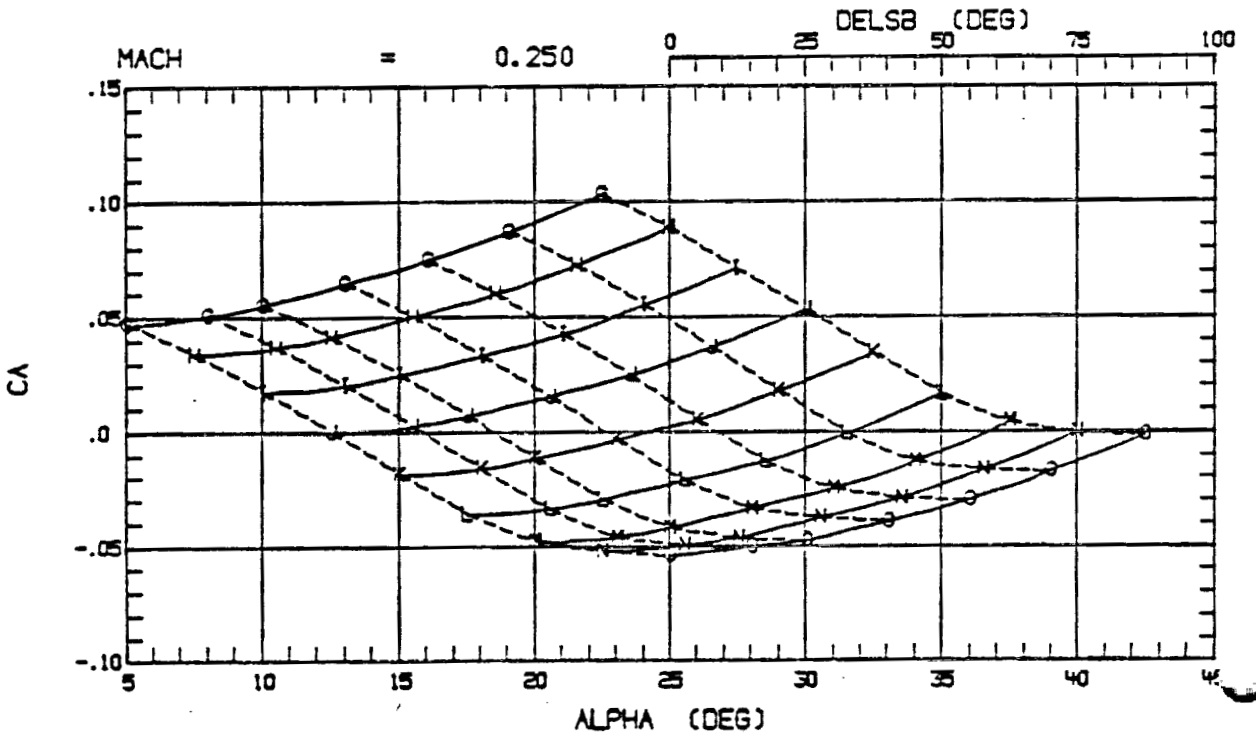
FIGURE 4.1.1.2-1
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2550.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.04681	0.03339	0.01700	-0.00025	-0.01869	-0.03625	-0.04623	-0.05255	-0.05414
15.000	0.05007	0.03638	0.01966	0.00217	-0.01650	-0.03430	-0.04649	-0.05006	-0.05076
25.000	0.05490	0.04110	0.02429	0.00670	-0.01210	-0.03000	-0.04230	-0.04650	-0.04780
40.000	0.06414	0.04992	0.03272	0.01513	-0.00365	-0.02155	-0.03383	-0.03812	-0.03946
55.000	0.07420	0.05960	0.04204	0.02405	0.00493	-0.01307	-0.02542	-0.02932	-0.03023
70.000	0.08681	0.07225	0.05475	0.03657	0.01732	-0.00050	-0.01337	-0.01708	-0.01776
87.200	0.10274	0.08829	0.07098	0.05302	0.03404	0.01606	0.00325	-0.00060	-0.00195

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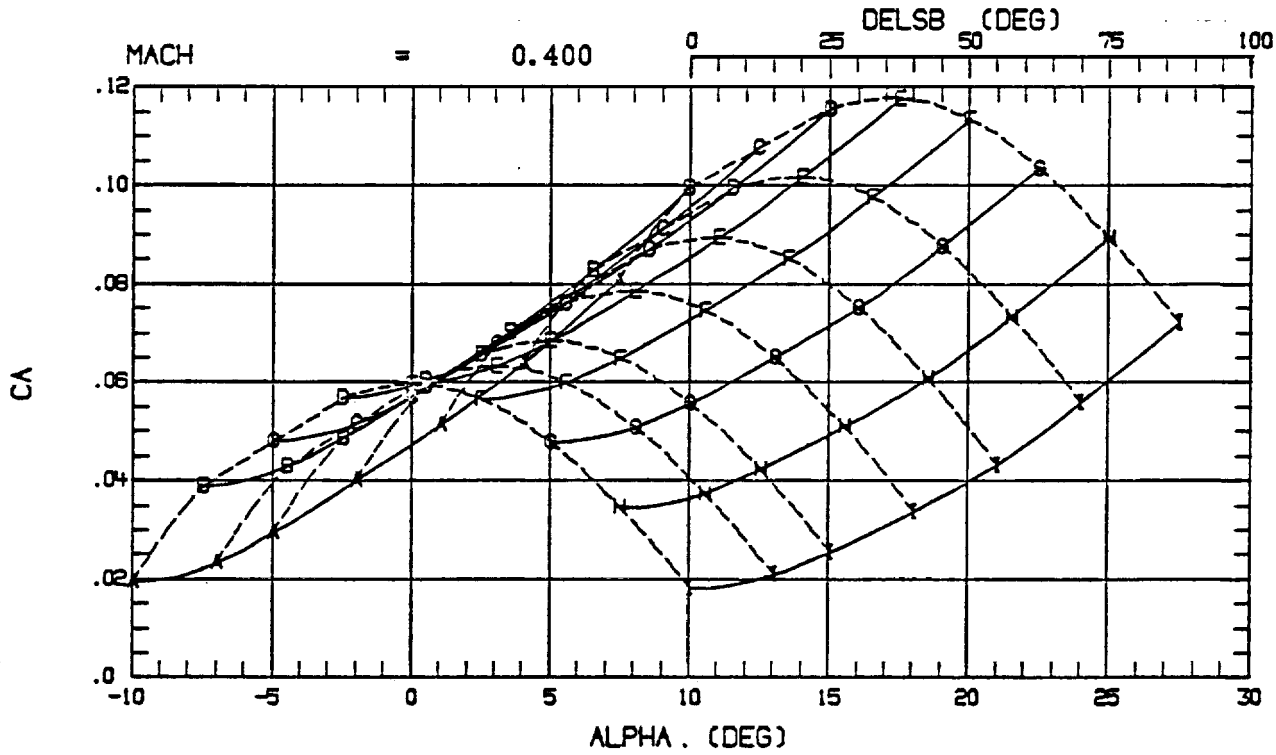
FIGURE 4.1.1.2-2
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-7.500	-5.000	-2.500	0.0	2.500	5.000	7.500	10.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.01912	0.03876	0.04777	0.05884	0.05940	0.05629	0.04741	0.03428	0.01790
15.000	0.02300	0.04252	0.05150	0.06023	0.06310	0.05978	0.05067	0.03726	0.02057
25.000	0.02920	0.04838	0.05700	0.06548	0.06810	0.06470	0.05650	0.04200	0.02520
40.000	0.03980	0.05894	0.06754	0.07584	0.07825	0.07438	0.06474	0.05082	0.03363
55.000	0.05104	0.07015	0.07872	0.08684	0.08910	0.08483	0.07481	0.06050	0.04295
70.000	0.06368	0.08258	0.09107	0.09917	0.10150	0.09733	0.08742	0.07315	0.05566
87.200	0.08043	0.09918	0.10755	0.11548	0.11770	0.11333	0.10335	0.08917	0.07189

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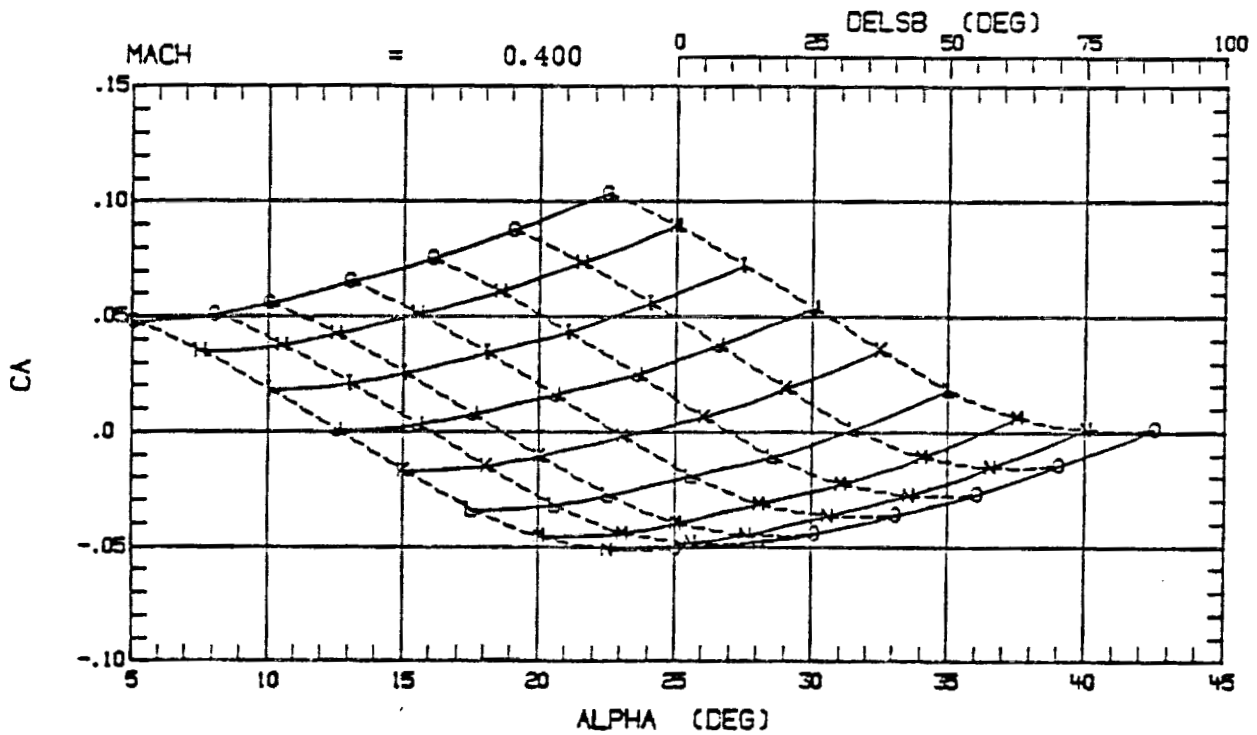
FIGURE 4.1.1.2-3
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000	7.500	10.000	12.500	15.000	17.500	20.000	22.500	25.000
	G	H	I	J	K	L	M	N	O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.04741	0.03429	0.01790	0.00036	-0.01760	-0.03446	-0.04623	-0.05146	-0.05136
15.000	0.05067	0.03726	0.02057	0.00278	-0.01542	-0.03250	-0.04449	-0.04887	-0.04796
25.000	0.05550	0.04200	0.02520	0.00730	-0.01100	-0.02920	-0.04030	-0.04530	-0.04500
40.000	0.06474	0.05082	0.03363	0.01574	-0.00257	-0.01975	-0.03183	-0.03692	-0.03667
55.000	0.07481	0.06050	0.04295	0.02466	0.00602	-0.01129	-0.02342	-0.02912	-0.02744
70.000	0.08742	0.07315	0.05566	0.03718	0.01841	0.00090	-0.01137	-0.01589	-0.01497
97.200	0.10335	0.08917	0.07189	0.05363	0.03514	0.01786	0.00586	0.00060	0.00084

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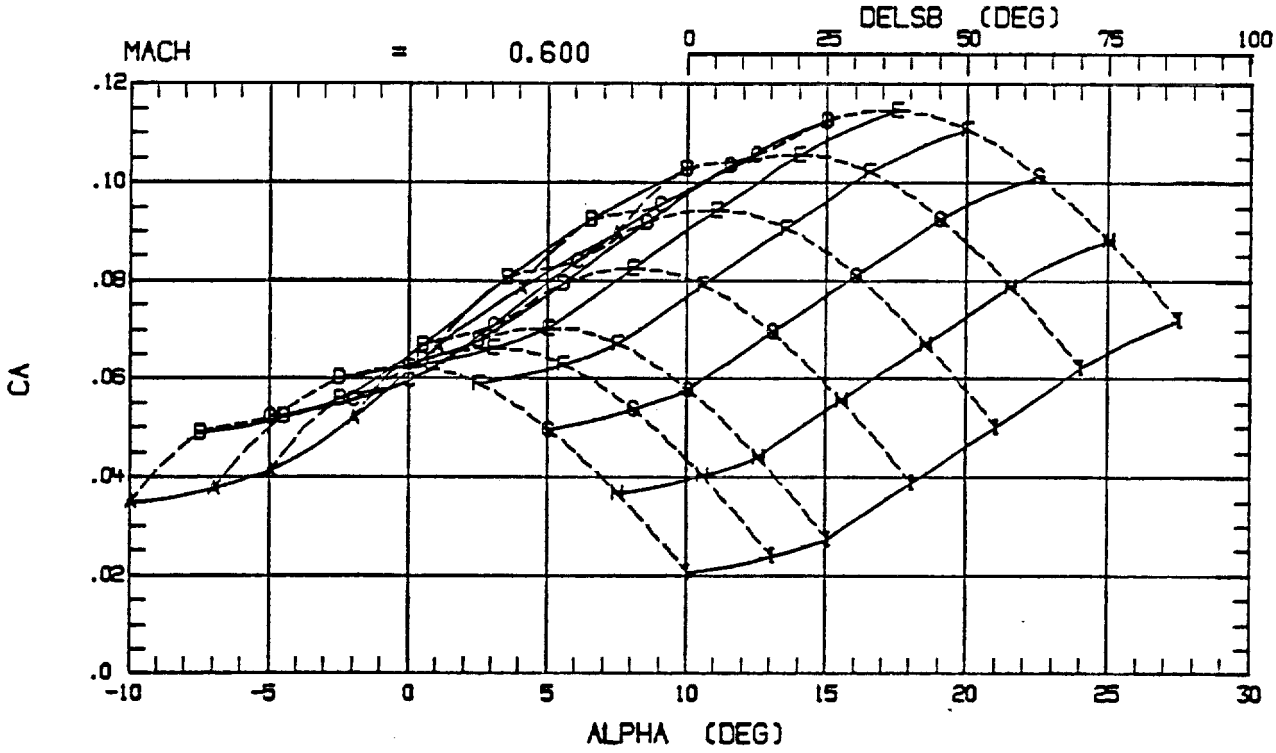
FIGURE 4.1.1.2-4
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-7.500	-5.000	-2.500	0.0	2.500	5.000	7.500	10.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.03462	0.04877	0.05211	0.05994	0.06214	0.05877	0.04940	0.03640	0.02041
15.000	0.03758	0.05193	0.05552	0.06363	0.06617	0.06295	0.05356	0.04009	0.02363
25.000	0.04120	0.05570	0.05940	0.06760	0.07020	0.06690	0.05759	0.04390	0.02722
40.000	0.05170	0.06659	0.07067	0.07924	0.08232	0.07887	0.06933	0.05552	0.03872
55.000	0.06638	0.08045	0.08381	0.09176	0.09422	0.09054	0.08077	0.06686	0.04994
70.000	0.07829	0.09214	0.09530	0.10312	0.10548	0.10192	0.09238	0.07872	0.06203
87.200	0.08949	0.10267	0.10523	0.11249	0.11437	0.11071	0.10114	0.08801	0.07192

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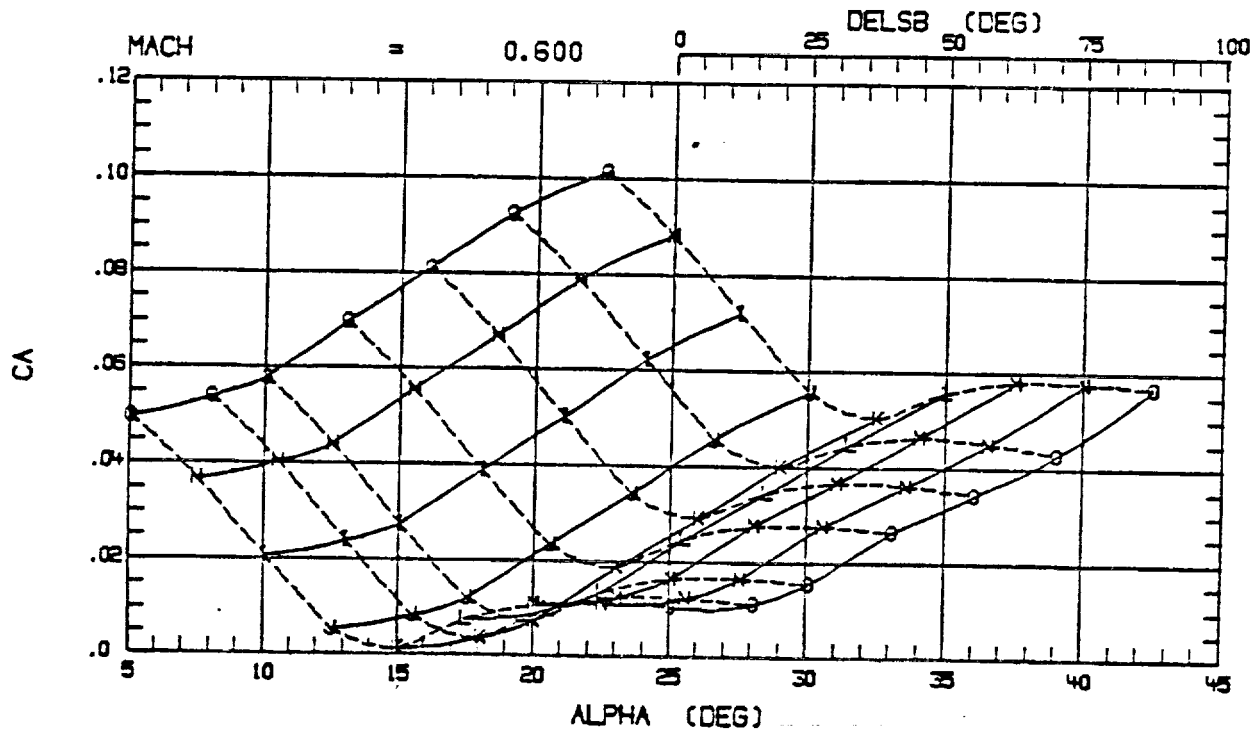
FIGURE 4.1.1.2-5
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.04940	0.03540	0.02041	0.00530	0.00110	0.00753	0.01068	0.01104	0.01040
15.000	0.05356	0.04009	0.02363	0.00817	0.00359	0.00960	0.01229	0.01216	0.01101
25.000	0.05759	0.04390	0.02722	0.01180	0.00730	0.01340	0.01620	0.01620	0.01520
40.000	0.06933	0.05552	0.03872	0.02319	0.01847	0.02457	0.02735	0.02726	0.02613
55.000	0.08077	0.06686	0.04994	0.03404	0.02998	0.03446	0.03658	0.03585	0.03406
70.000	0.09238	0.07872	0.06203	0.04550	0.03982	0.04468	0.04620	0.04487	0.04252
97.200	0.10114	0.08801	0.07192	0.05553	0.05018	0.05562	0.05734	0.05785	0.05655

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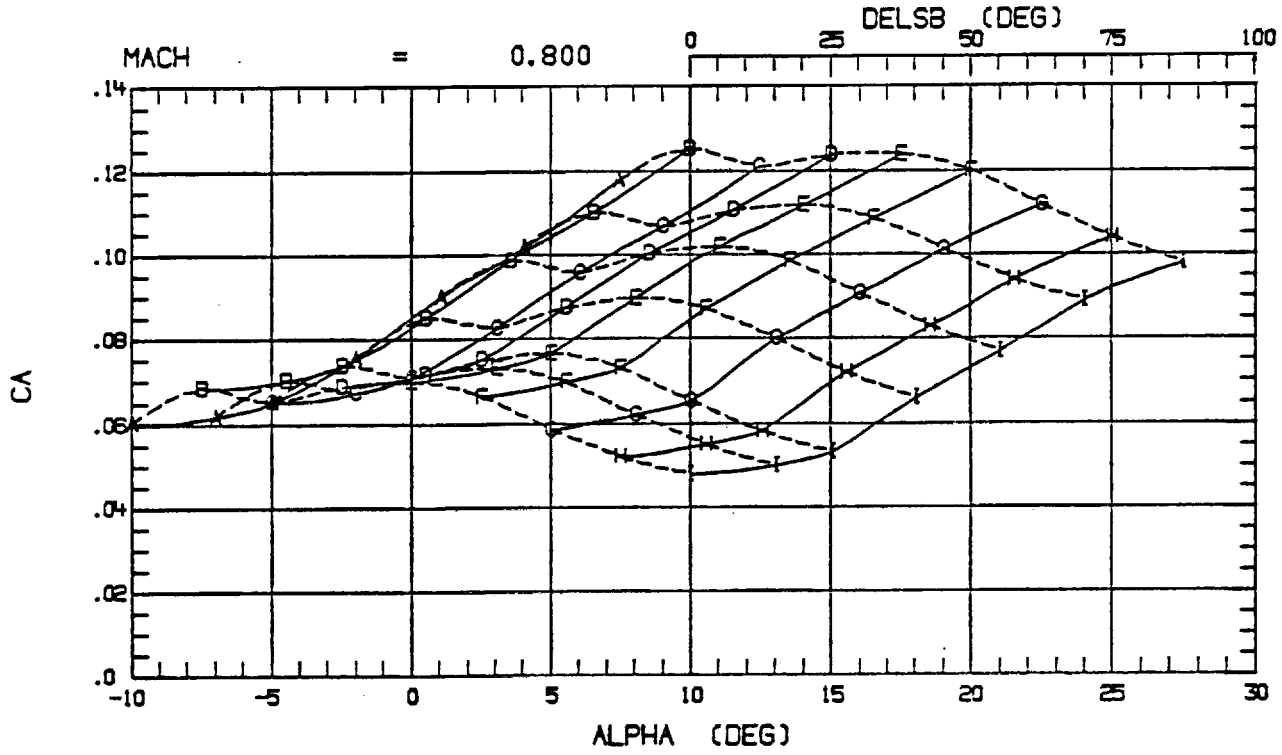
FIGURE 4.1.1.2-6
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06013	0.06831	0.06487	0.06861	0.06967	0.06620	0.05844	0.05186	0.04745
15.000	0.06137	0.07006	0.06711	0.07134	0.07297	0.06948	0.06181	0.05476	0.04988
25.000	0.06490	0.07357	0.07060	0.07480	0.07630	0.07290	0.06500	0.05780	0.05260
40.000	0.07541	0.08475	0.08248	0.08742	0.08972	0.08696	0.07978	0.07173	0.06582
55.000	0.08990	0.09865	0.09566	0.10003	0.10180	0.09841	0.09052	0.08255	0.07690
70.000	0.10155	0.10990	0.10656	0.11037	0.11146	0.10845	0.10104	0.09392	0.08882
87.200	0.11767	0.12512	0.12084	0.12367	0.12376	0.11985	0.11154	0.10368	0.09789

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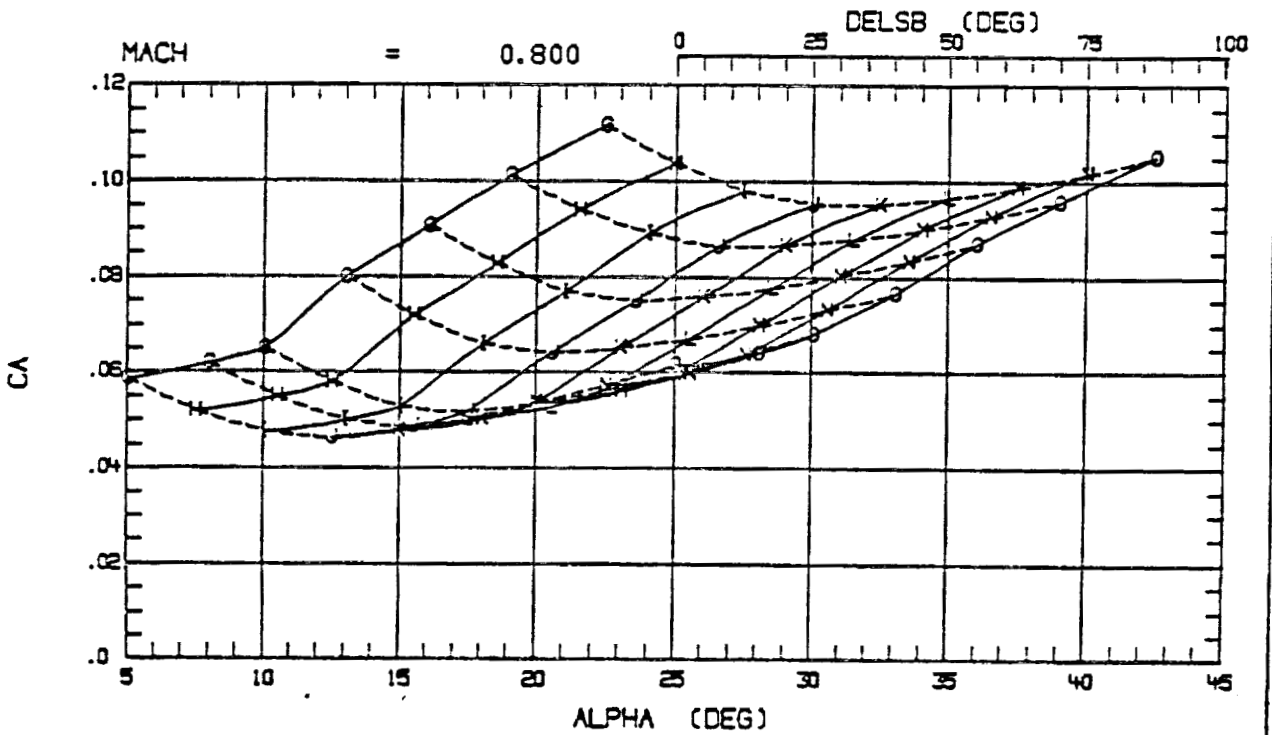
FIGURE 4.1.1.2-7
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.588 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.05844	0.05186	0.04745	0.04622	0.04771	0.05029	0.05351	0.05730	0.06140
15.000	0.06181	0.05476	0.04988	0.04866	0.05015	0.05274	0.05594	0.05975	0.06386
25.000	0.06500	0.05780	0.05290	0.05180	0.05350	0.05630	0.05970	0.06370	0.06800
40.000	0.07978	0.07173	0.06562	0.06407	0.06503	0.06707	0.06973	0.07300	0.07659
55.000	0.09052	0.08295	0.07690	0.07496	0.07574	0.07763	0.08014	0.08329	0.08677
70.000	0.10104	0.09392	0.08862	0.08622	0.08641	0.08776	0.08982	0.09259	0.09575
97.200	0.11154	0.10368	0.09789	0.09507	0.09514	0.09649	0.09865	0.10163	0.10515

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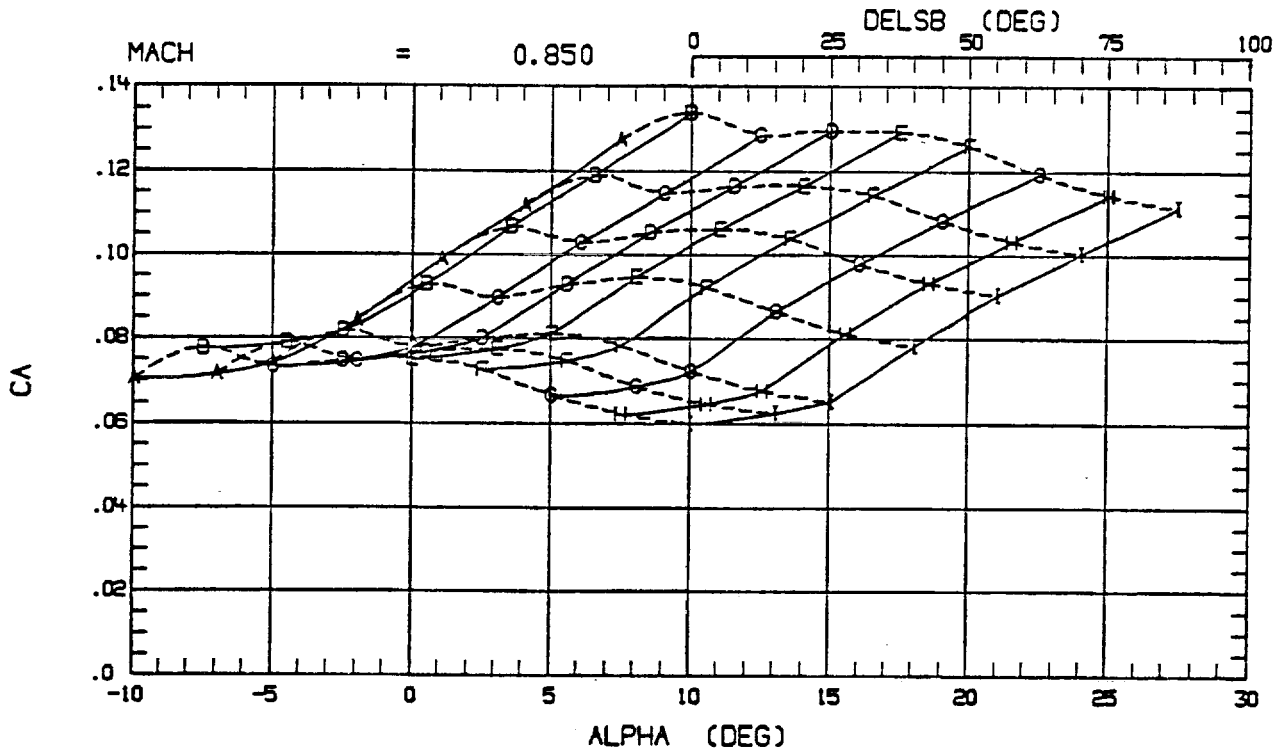
FIGURE 4.1.1.2-8
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.07042	0.07763	0.07304	0.07476	0.07510	0.07245	0.06641	0.06194	0.05961
15.000	0.07127	0.07888	0.07468	0.07680	0.07753	0.07470	0.06848	0.06432	0.06233
25.000	0.07400	0.08181	0.07780	0.08010	0.08100	0.07820	0.07200	0.06740	0.06500
40.000	0.08416	0.09276	0.08956	0.09265	0.09435	0.09203	0.08622	0.08108	0.07806
55.000	0.09861	0.10656	0.10267	0.10506	0.10601	0.10362	0.09763	0.09292	0.09028
70.000	0.11145	0.11883	0.11433	0.11607	0.11632	0.11390	0.10794	0.10302	0.10012
87.200	0.12708	0.13361	0.12934	0.12939	0.12907	0.12574	0.11892	0.11396	0.11108

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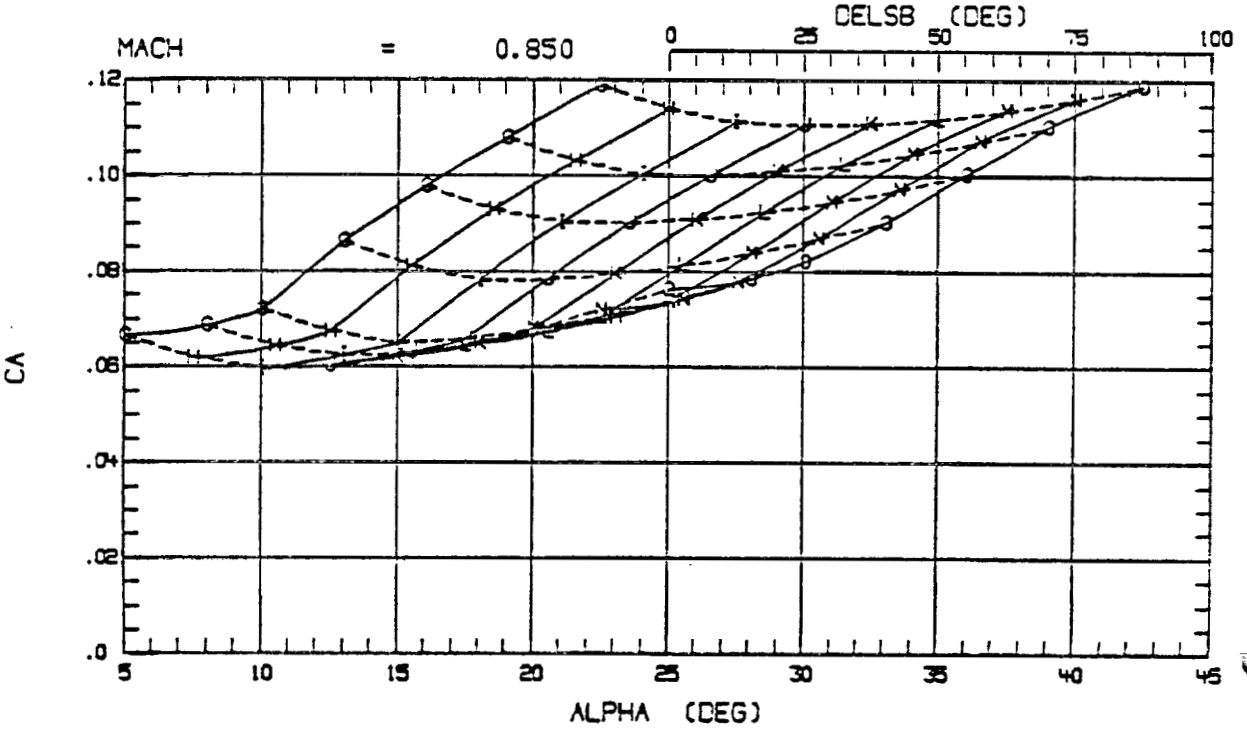
FIGURE 4.1.1.2-9
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06641	0.06194	0.05561	0.06036	0.06216	0.06469	0.06794	0.07185	0.07618
15.000	0.06648	0.06432	0.06233	0.06303	0.06477	0.06720	0.07036	0.07414	0.07833
25.000	0.07200	0.06740	0.06500	0.06590	0.06780	0.07040	0.07370	0.07760	0.08190
40.000	0.08622	0.08108	0.07806	0.07824	0.07940	0.08121	0.08370	0.08679	0.09024
55.000	0.09763	0.09292	0.09029	0.09010	0.09087	0.09230	0.09440	0.09710	0.10018
70.000	0.10794	0.10302	0.10012	0.09997	0.10078	0.10224	0.10436	0.10710	0.11021
97.200	0.11692	0.11396	0.11108	0.11044	0.11079	0.11183	0.11358	0.11599	0.11884

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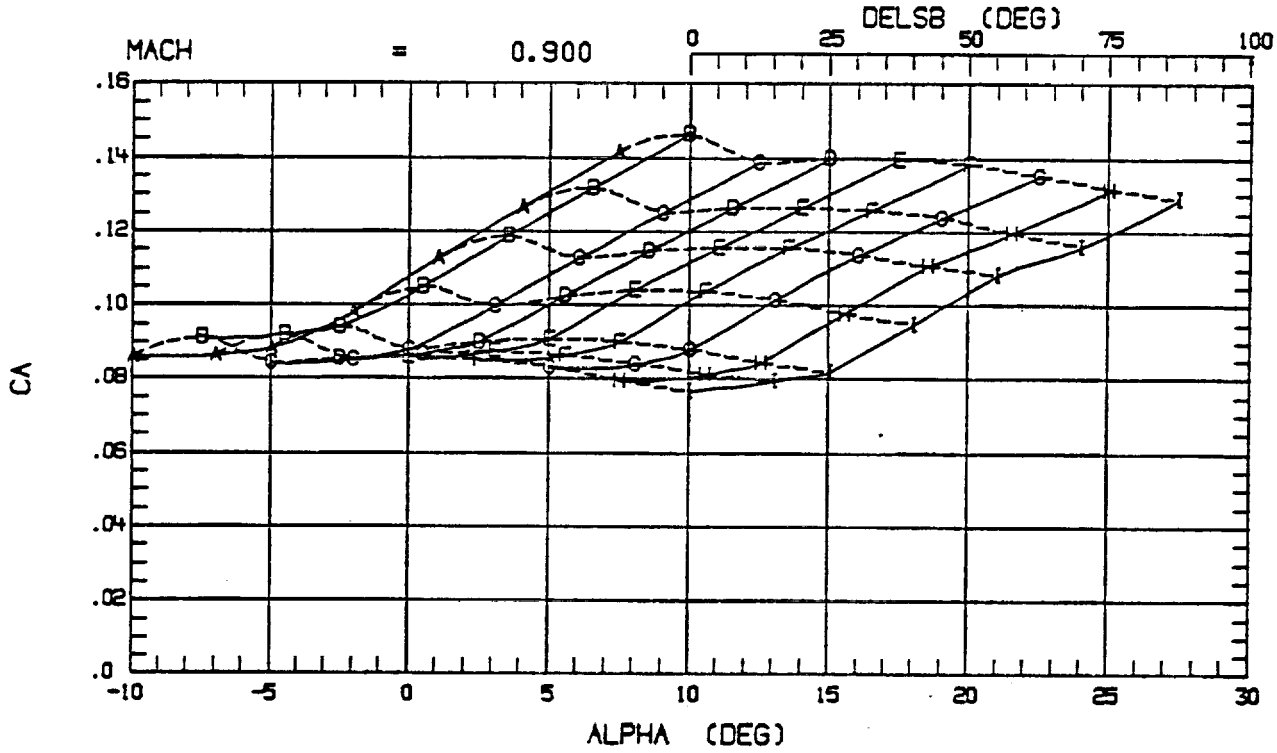
FIGURE 4.1.1.2-10
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.08571	0.09083	0.08391	0.08531	0.08553	0.08501	0.08298	0.07911	0.07628
15.000	0.08615	0.09158	0.08495	0.08667	0.08719	0.08622	0.08375	0.08098	0.07928
25.000	0.08810	0.09393	0.08770	0.08980	0.09070	0.08990	0.08760	0.08410	0.08170
40.000	0.09789	0.10465	0.09933	0.10229	0.10398	0.10341	0.10123	0.09751	0.09478
55.000	0.11234	0.11845	0.11237	0.11447	0.11523	0.11513	0.11335	0.11029	0.10817
70.000	0.12636	0.13167	0.12480	0.12614	0.12519	0.12565	0.12343	0.11921	0.11593
87.200	0.14148	0.14599	0.13854	0.13950	0.13938	0.13793	0.13489	0.13134	0.12977

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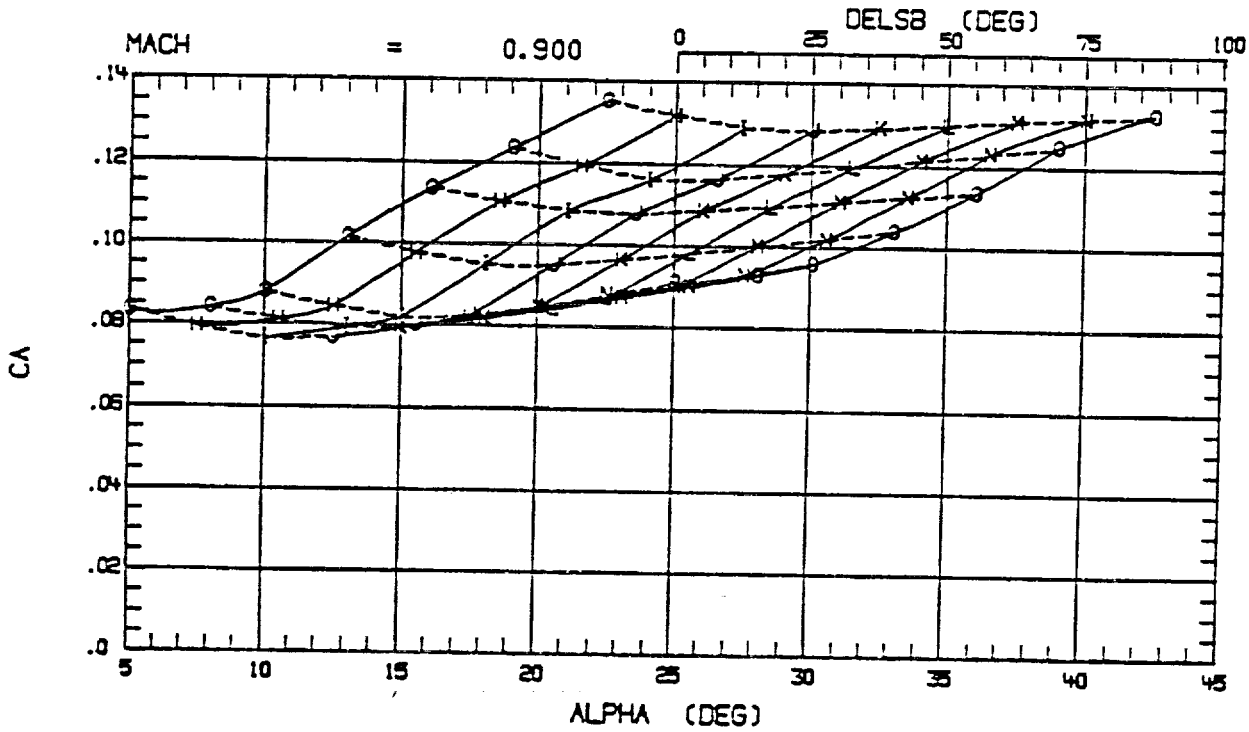
FIGURE 4.1.1.2-11
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06298	0.07911	0.07629	0.07891	0.07911	0.08167	0.08460	0.08760	0.09085
15.000	0.08375	0.08098	0.07929	0.07982	0.08189	0.08427	0.08699	0.08973	0.09259
25.000	0.08760	0.08410	0.08170	0.08240	0.08460	0.08710	0.08990	0.09270	0.09570
40.000	0.10123	0.09751	0.09478	0.09481	0.09627	0.09797	0.09990	0.10176	0.10377
55.000	0.11335	0.11029	0.10817	0.10763	0.10851	0.10958	0.11089	0.11211	0.11349
70.000	0.12343	0.11921	0.11593	0.11612	0.11765	0.11931	0.12113	0.12292	0.12457
87.200	0.13489	0.13134	0.12977	0.12921	0.12994	0.12978	0.13074	0.13155	0.13244

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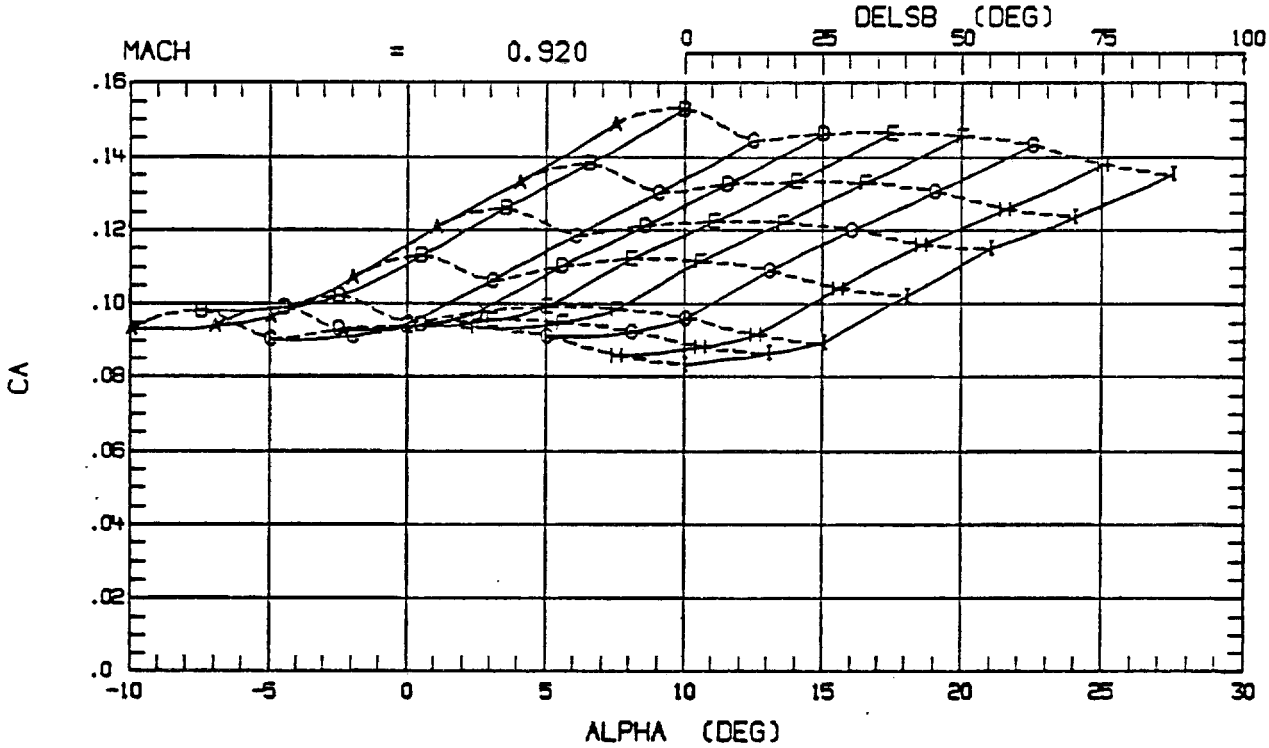
FIGURE 4.1.1.2-12
BASIC AXIAL FORCE COEFFICIENT

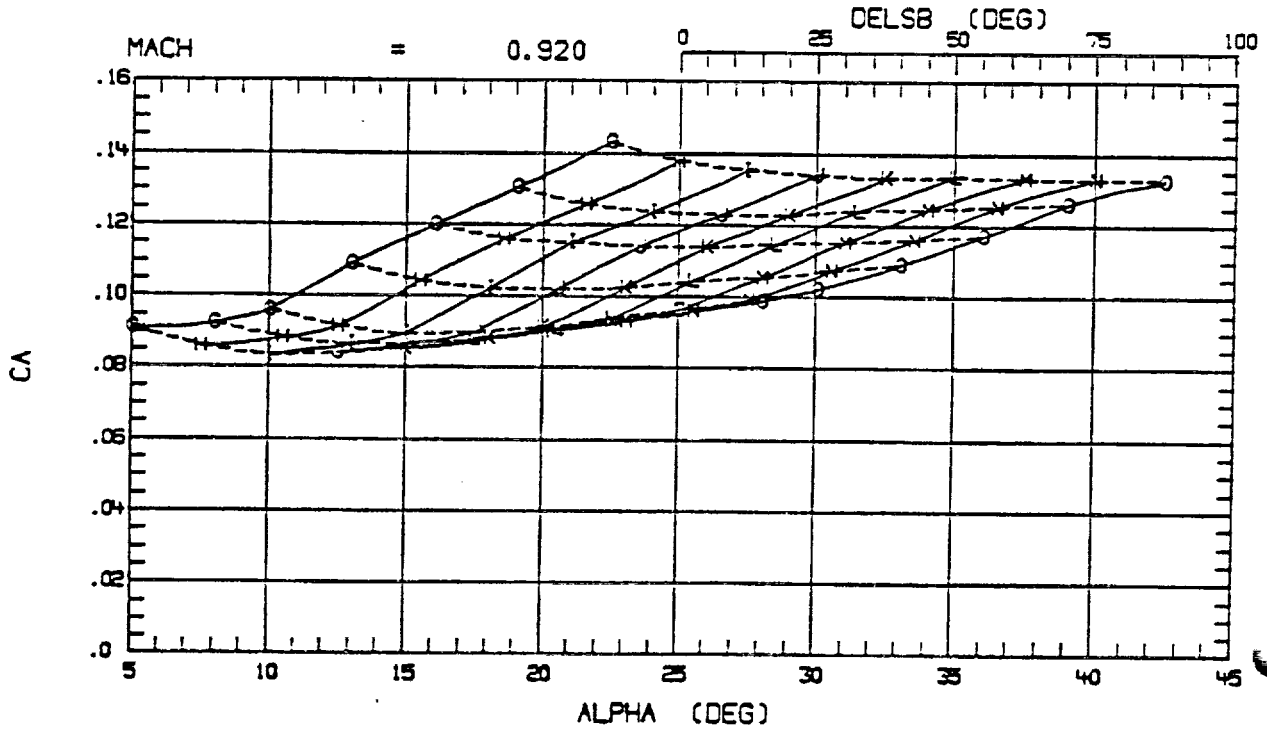


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.09310	0.09798	0.09019	0.09282	0.09378	0.09326	0.09083	0.08575	0.08341
15.000	0.09369	0.09873	0.09109	0.09403	0.09529	0.09474	0.09234	0.08796	0.08637
25.000	0.09640	0.10180	0.09450	0.09760	0.09900	0.09840	0.09590	0.09120	0.08930
40.000	0.10665	0.11276	0.10615	0.10989	0.11189	0.11136	0.10879	0.10404	0.10208
55.000	0.12043	0.12576	0.11831	0.12110	0.12212	0.12199	0.11972	0.11588	0.11476
70.000	0.13298	0.13788	0.13000	0.13239	0.13300	0.13257	0.13025	0.12547	0.12342
87.200	0.14867	0.15284	0.14430	0.14616	0.14636	0.14556	0.14277	0.13755	0.13505

ENGINEER D[illegible]
DATE 3-82

FIGURE 4.1.1.2-13
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000	7.500	10.000	12.500	15.000	17.500	20.000	22.500	25.000
	G	H	I	J	K	L	M	N	O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.09083	0.08575	0.08341	0.08387	0.08510	0.08792	0.09022	0.09311	0.09627
15.000	0.09234	0.08796	0.08637	0.08682	0.08802	0.09077	0.09296	0.09575	0.09876
25.000	0.09590	0.09120	0.08930	0.08990	0.09120	0.09400	0.09620	0.09890	0.10180
40.000	0.10879	0.10404	0.10208	0.10188	0.10231	0.10418	0.10538	0.10703	0.10882
55.000	0.11972	0.11588	0.11476	0.11388	0.11358	0.11470	0.11511	0.11593	0.11689
70.000	0.13025	0.12547	0.12342	0.12294	0.12277	0.12399	0.12445	0.12525	0.12609
87.200	0.14277	0.13755	0.13505	0.13382	0.13301	0.13342	0.13297	0.13278	0.13258

ENGINEER D²
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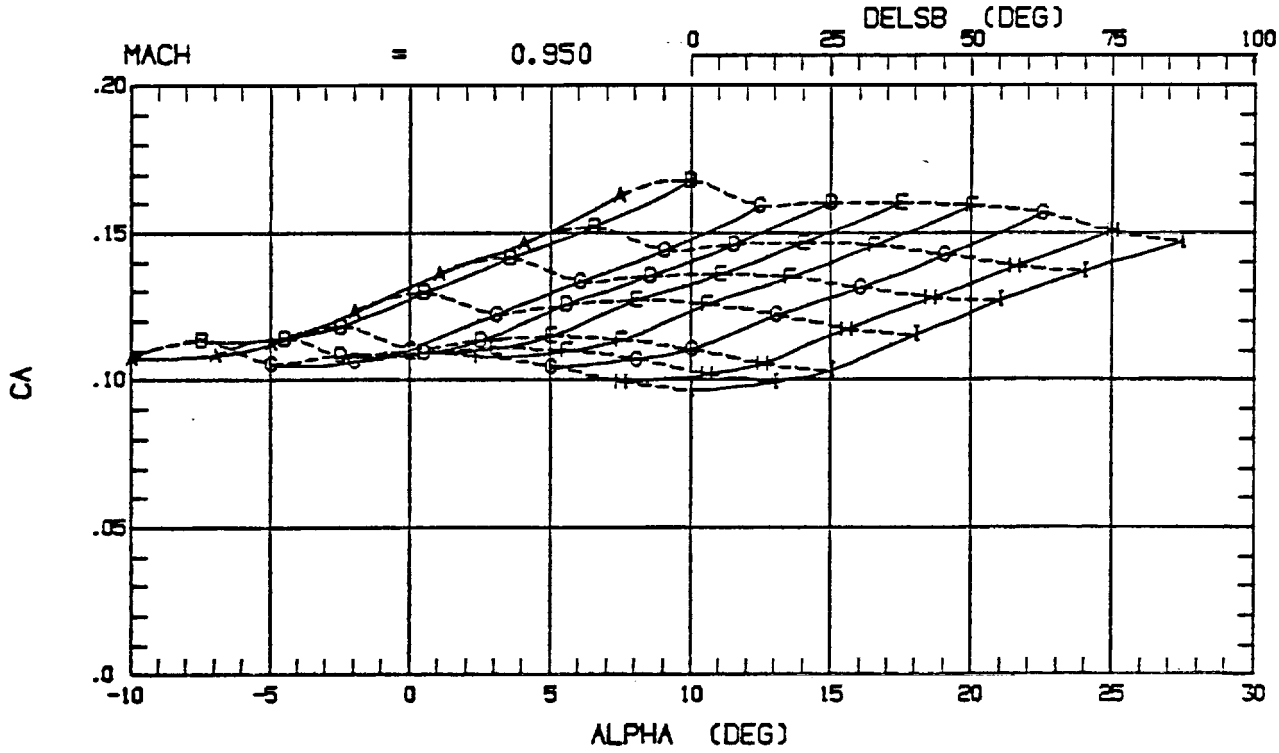
FIGURE 4.1.1.2-14
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-7.500	-5.000	-2.500	0.0	2.500	5.000	7.500	10.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.10734	0.11308	0.10530	0.10799	0.10920	0.10768	0.10417	0.09888	0.09620
15.000	0.10817	0.11383	0.10597	0.10898	0.11050	0.10960	0.10676	0.10159	0.09910
25.000	0.11200	0.11797	0.11040	0.11320	0.11450	0.11320	0.10990	0.10500	0.10280
40.000	0.12294	0.12929	0.12207	0.12520	0.12680	0.12534	0.12164	0.11698	0.11511
55.000	0.13574	0.14111	0.13289	0.13498	0.13551	0.13433	0.13083	0.12741	0.12675
70.000	0.14606	0.15158	0.14348	0.14565	0.14626	0.14523	0.14200	0.13802	0.13674
87.200	0.16263	0.16747	0.15865	0.16006	0.15987	0.15905	0.15614	0.15002	0.14657

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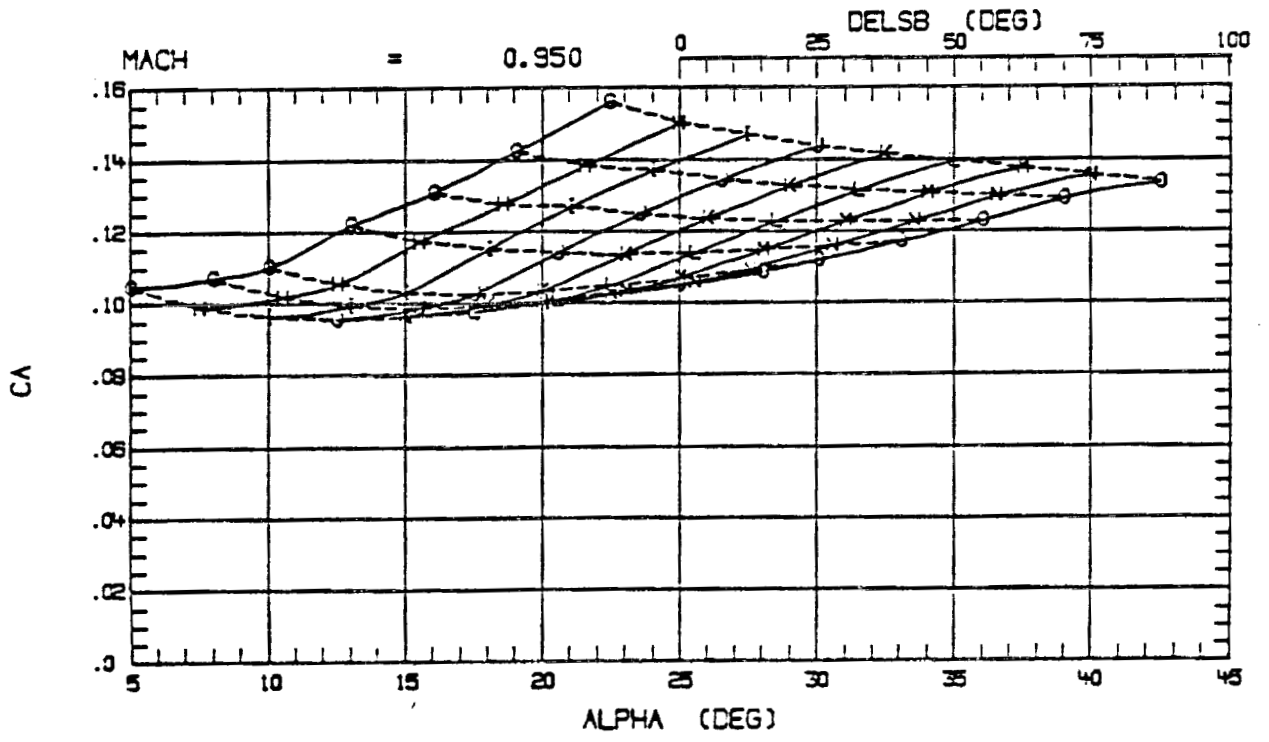
FIGURE 4.1.1.2-15
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.10417	0.09888	0.09620	0.09535	0.09618	0.09785	0.09970	0.10218	0.10494
15.000	0.10676	0.10159	0.09910	0.09858	0.09932	0.10088	0.10300	0.10558	0.10842
25.000	0.10990	0.10500	0.10290	0.10240	0.10319	0.10470	0.10670	0.10900	0.11150
40.000	0.12184	0.11698	0.11511	0.11372	0.11347	0.11388	0.11467	0.11572	0.11692
55.000	0.13083	0.12741	0.12575	0.12451	0.12333	0.12272	0.12249	0.12245	0.12253
70.000	0.14200	0.13802	0.13674	0.13416	0.13284	0.13137	0.13049	0.12968	0.12991
87.200	0.15814	0.15002	0.14657	0.14351	0.14122	0.13924	0.13736	0.13542	0.13336

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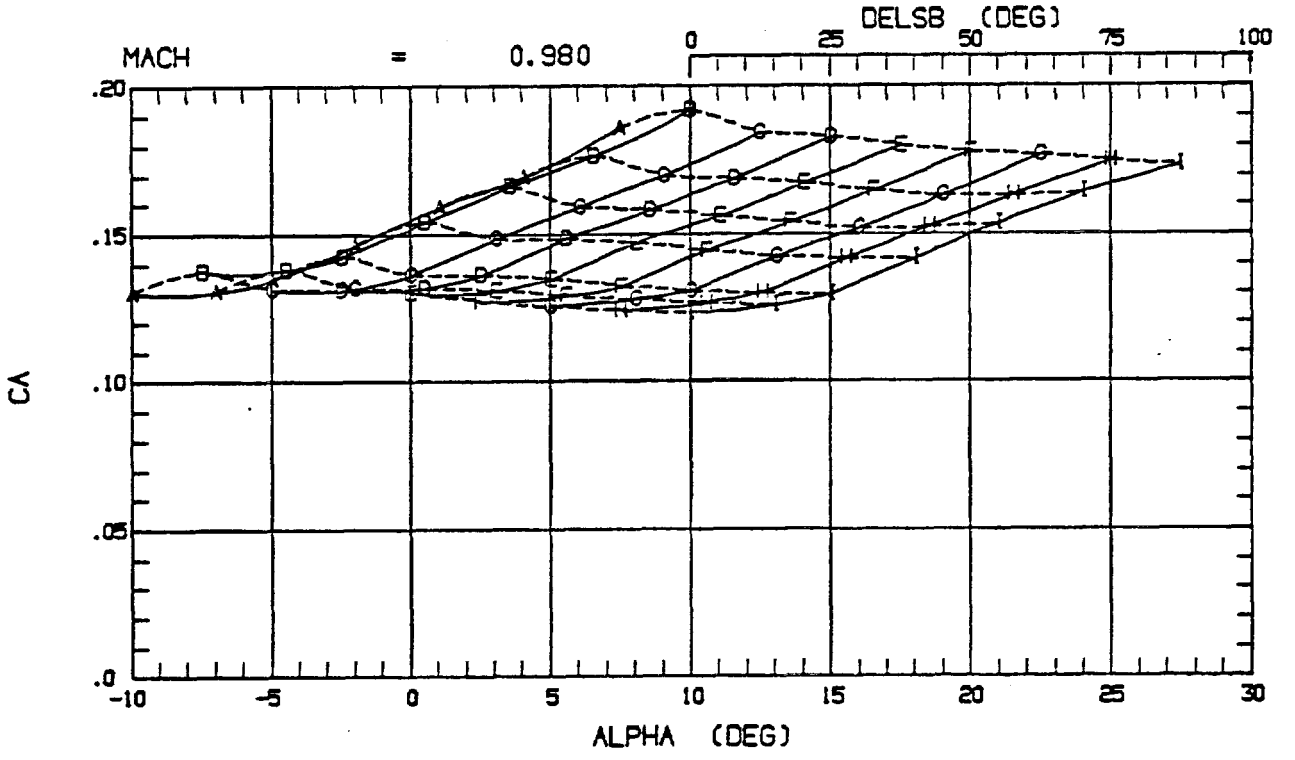
FIGURE 4.1.1.2-16
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.12971	0.13712	0.13106	0.13092	0.12980	0.12706	0.12522	0.12389	0.12313
15.000	0.13040	0.13767	0.13147	0.13155	0.13066	0.12877	0.12783	0.12648	0.12576
25.000	0.13450	0.14199	0.13600	0.13580	0.13460	0.13220	0.13070	0.12980	0.12960
40.000	0.14631	0.15395	0.14808	0.14801	0.14692	0.14430	0.14234	0.14169	0.14180
55.000	0.15908	0.16581	0.15803	0.15804	0.15603	0.15358	0.15172	0.15219	0.15339
70.000	0.16917	0.17616	0.16959	0.16873	0.16681	0.16449	0.16288	0.16299	0.16376
87.200	0.18562	0.19184	0.18441	0.18273	0.17993	0.17781	0.17684	0.17448	0.17305

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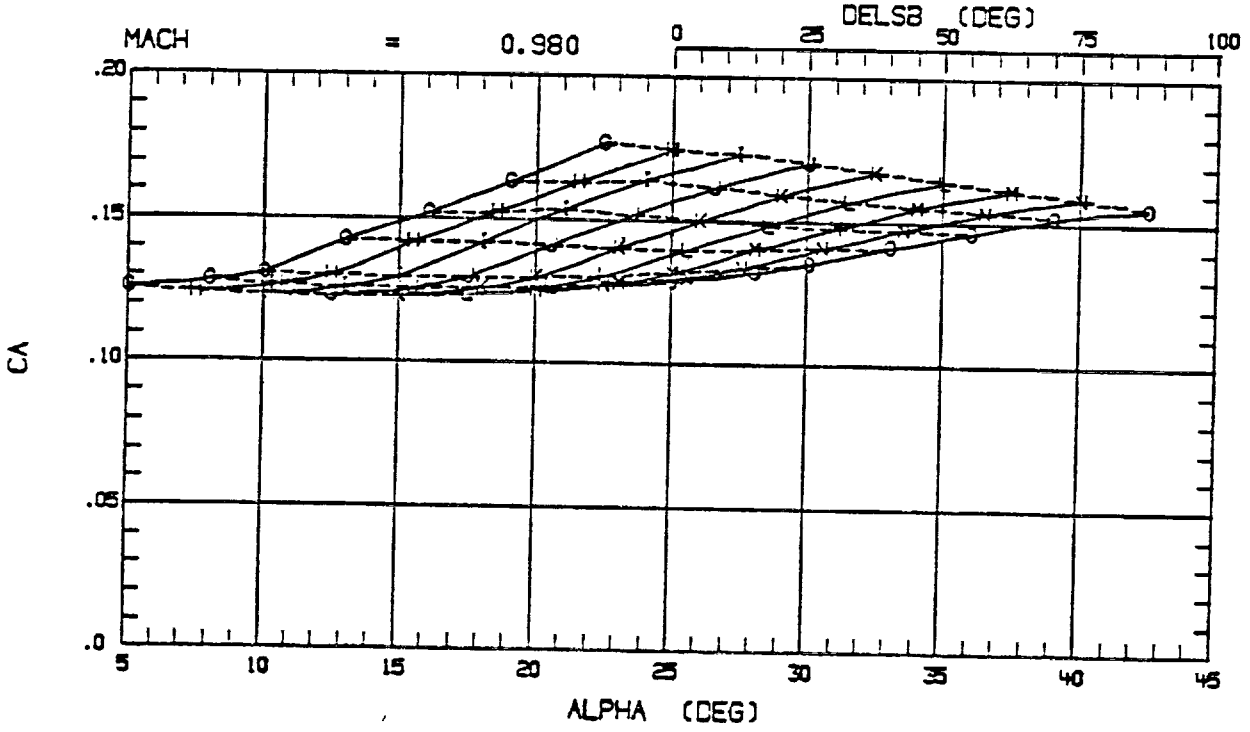
FIGURE 4.1.1.2-17
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.12522	0.12389	0.12313	0.12277	0.12270	0.12336	0.12468	0.12668	0.12863
15.000	0.12783	0.12648	0.12576	0.12563	0.12573	0.12646	0.12783	0.12982	0.13175
25.000	0.13070	0.12980	0.12960	0.12950	0.12960	0.13030	0.13160	0.13340	0.13510
40.000	0.14234	0.14169	0.14180	0.14081	0.13994	0.13966	0.13990	0.14050	0.14093
55.000	0.15172	0.15219	0.15339	0.15154	0.14976	0.14844	0.14758	0.14710	0.14642
70.000	0.16298	0.16299	0.16376	0.16141	0.15899	0.15683	0.15501	0.15350	0.15167
87.200	0.17854	0.17449	0.17306	0.17023	0.16712	0.16406	0.16114	0.15832	0.15501

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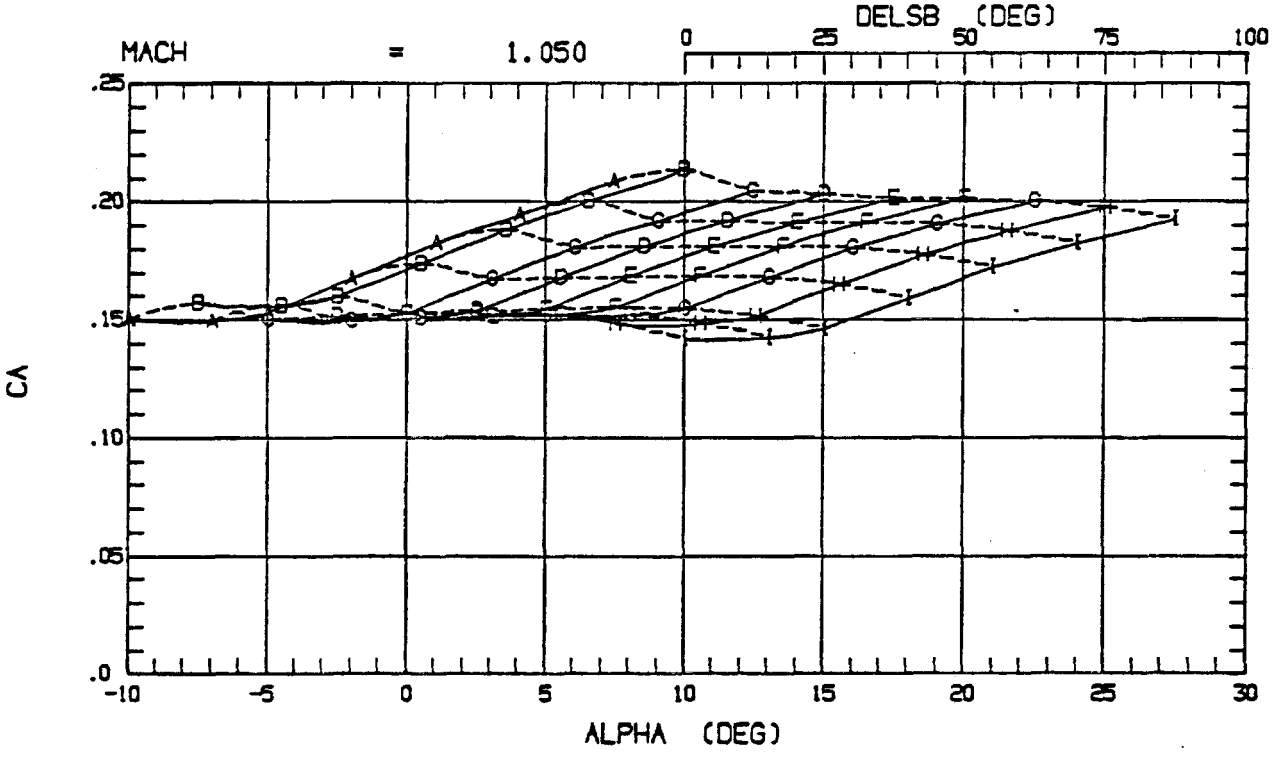
FIGURE 4.1.1.2-18
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.14968	0.15648	0.15006	0.15121	0.15209	0.15235	0.15162	0.14763	0.14143
15.000	0.14917	0.15577	0.14914	0.15021	0.15099	0.15179	0.15161	0.14803	0.14232
25.000	0.15270	0.15927	0.15250	0.15350	0.15410	0.15470	0.15430	0.15110	0.14580
40.000	0.16717	0.17354	0.16667	0.16741	0.16785	0.16827	0.16763	0.16426	0.15876
55.000	0.18200	0.18786	0.18049	0.18069	0.18058	0.18099	0.18033	0.17714	0.17176
70.000	0.19428	0.19976	0.19194	0.19162	0.19096	0.19116	0.19031	0.18728	0.18205
87.200	0.20824	0.21290	0.20419	0.20285	0.20111	0.20095	0.19977	0.19712	0.19226

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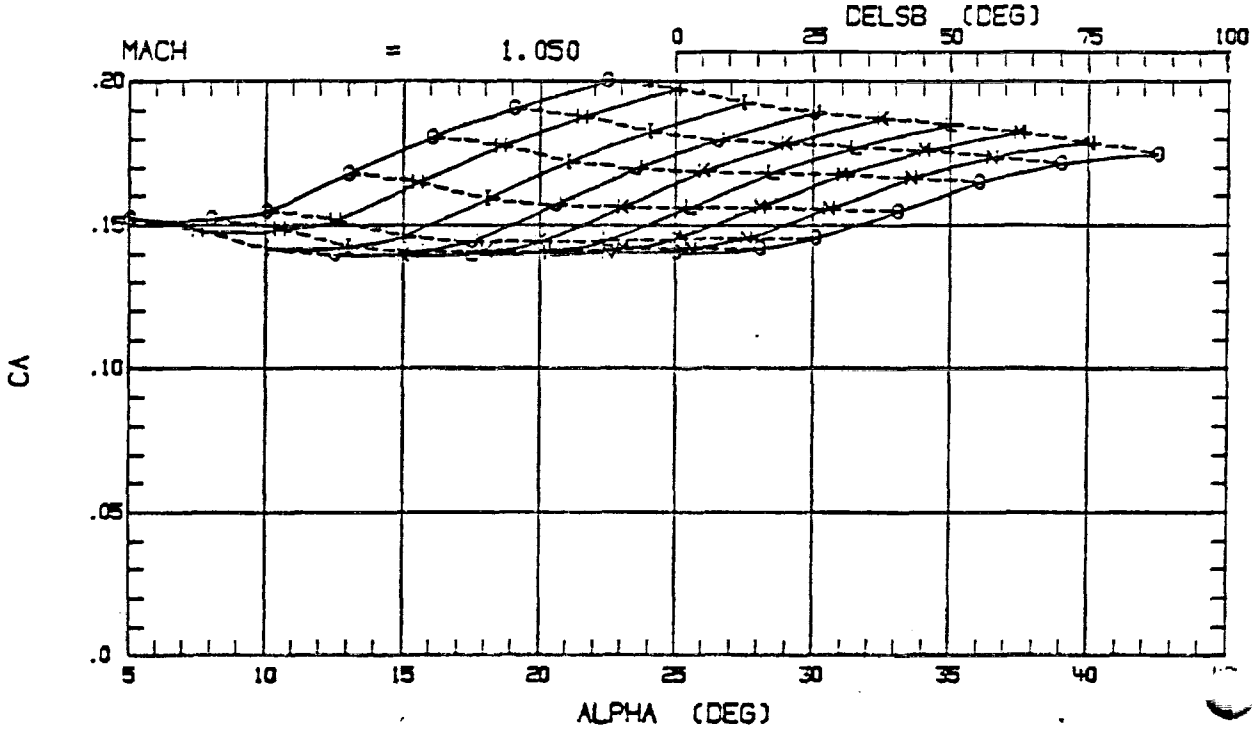
FIGURE 4.1.1.2-19
BASIC AXIAL FORCE COEFFICIENT

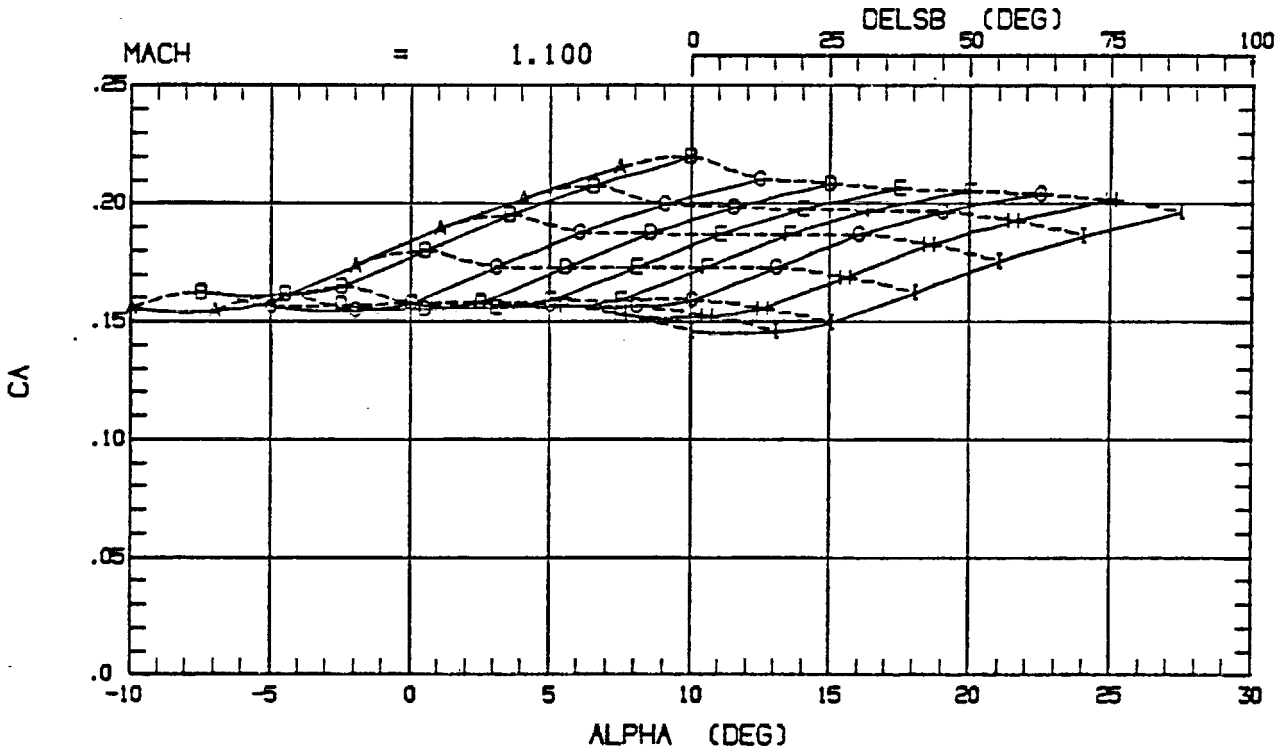


CONFIGURATION			
BASELINE ORBITER VEHICLE.		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.15162	0.14763	0.14143	0.13946	0.13913	0.13948	0.13986	0.13994	0.13995
15.000	0.15161	0.14803	0.14232	0.14054	0.14040	0.14088	0.14138	0.14153	0.14161
25.000	0.15430	0.15110	0.14580	0.14410	0.14400	0.14450	0.14500	0.14510	0.14510
40.000	0.16763	0.16425	0.15876	0.15685	0.15605	0.15599	0.15586	0.15523	0.15444
55.000	0.18033	0.17714	0.17176	0.16934	0.16836	0.16784	0.16718	0.16597	0.16455
70.000	0.19031	0.18729	0.18205	0.17957	0.17800	0.17685	0.17539	0.17330	0.17086
87.200	0.19977	0.19712	0.19225	0.18998	0.18674	0.18457	0.18199	0.17857	0.17432

ENGINEER D.L.
DATE 3-91

FIGURE 4.1.1.2-20
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.15527	0.16210	0.15581	0.15684	0.15749	0.15755	0.15703	0.15239	0.14529
15.000	0.15431	0.16090	0.15438	0.15486	0.15556	0.15597	0.15578	0.15185	0.14553
25.000	0.15790	0.16432	0.15760	0.15790	0.15840	0.15888	0.15880	0.15510	0.14900
40.000	0.17348	0.17952	0.17243	0.17235	0.17248	0.17275	0.17245	0.16844	0.16198
55.000	0.18892	0.19468	0.18730	0.18692	0.18676	0.18685	0.18638	0.18212	0.17537
70.000	0.20200	0.20715	0.19912	0.19805	0.19715	0.19689	0.19605	0.19222	0.18590
87.200	0.21499	0.21924	0.21020	0.20803	0.20596	0.20515	0.20373	0.20099	0.19580

ENGINEER D
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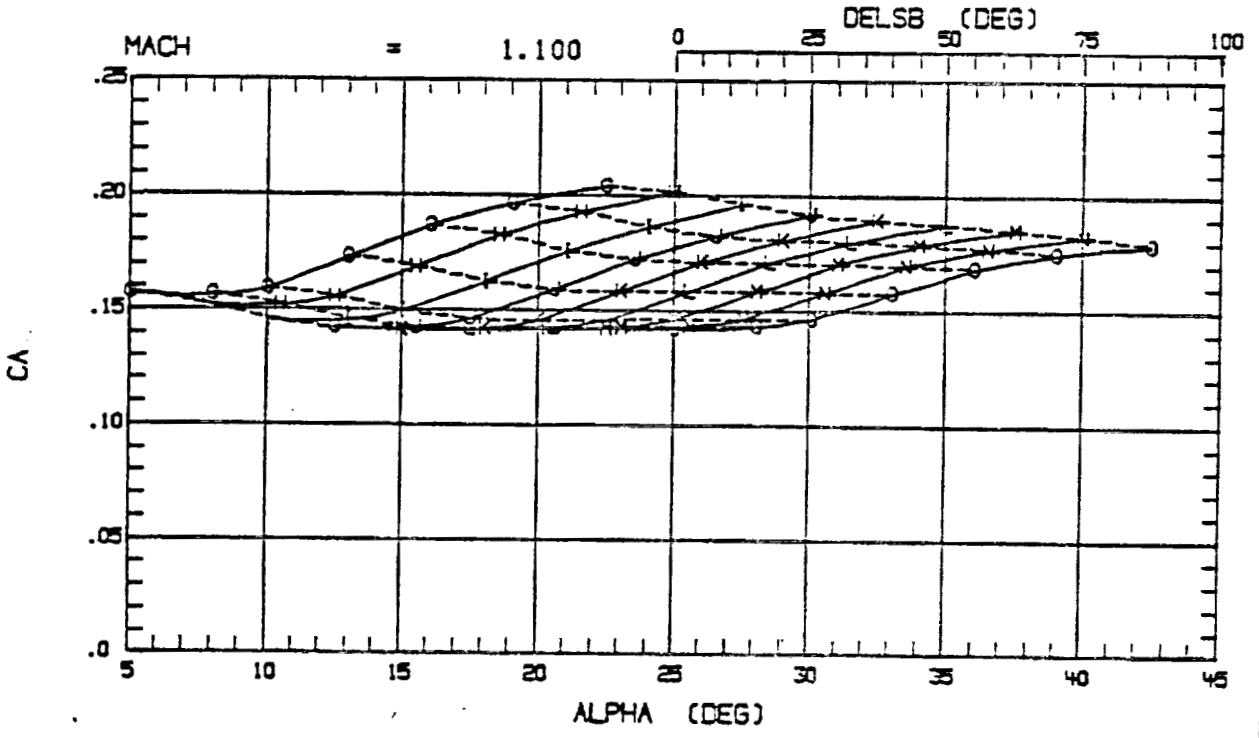
FIGURE 4.1.1.2-21
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.15703	0.15239	0.14629	0.14182	0.14100	0.14122	0.14140	0.14152	0.14158
15.000	0.15578	0.15185	0.14653	0.14229	0.14185	0.14206	0.14240	0.14266	0.14295
25.000	0.15880	0.15510	0.14900	0.14580	0.14519	0.14560	0.14590	0.14610	0.14620
40.000	0.17245	0.16844	0.16198	0.15862	0.15778	0.15789	0.15783	0.15762	0.15723
55.000	0.18638	0.18212	0.17537	0.17184	0.17073	0.17047	0.16996	0.16921	0.16821
70.000	0.19605	0.19222	0.18590	0.18201	0.18042	0.17955	0.17831	0.17671	0.17474
87.200	0.20373	0.20099	0.19580	0.19136	0.18902	0.18722	0.18487	0.18198	0.17256

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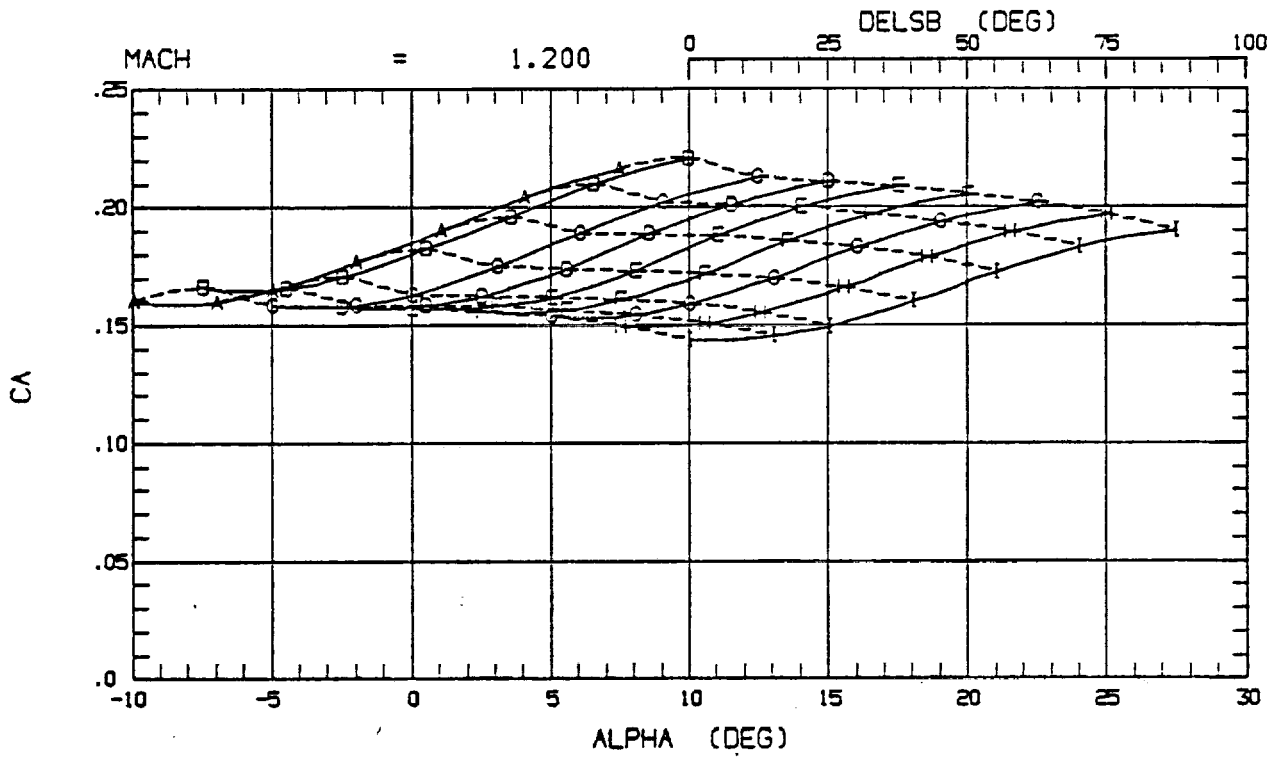
FIGURE 4.1.1.2-22
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.15999	0.16538	0.15805	0.15731	0.15673	0.15522	0.15341	0.14913	0.14325
15.000	0.15934	0.16517	0.15827	0.15792	0.15772	0.15599	0.15399	0.15037	0.14522
25.000	0.16440	0.16894	0.16270	0.16200	0.16140	0.16030	0.15890	0.15490	0.14940
40.000	0.17629	0.18181	0.17445	0.17353	0.17261	0.17128	0.16956	0.16533	0.15961
55.000	0.18953	0.19557	0.18868	0.18818	0.18765	0.18534	0.18263	0.17816	0.17219
70.000	0.20386	0.20936	0.20190	0.20078	0.19962	0.19678	0.19354	0.18893	0.18277
87.200	0.21569	0.22049	0.21229	0.21041	0.20845	0.20525	0.20169	0.19647	0.18971

ENGINEER D
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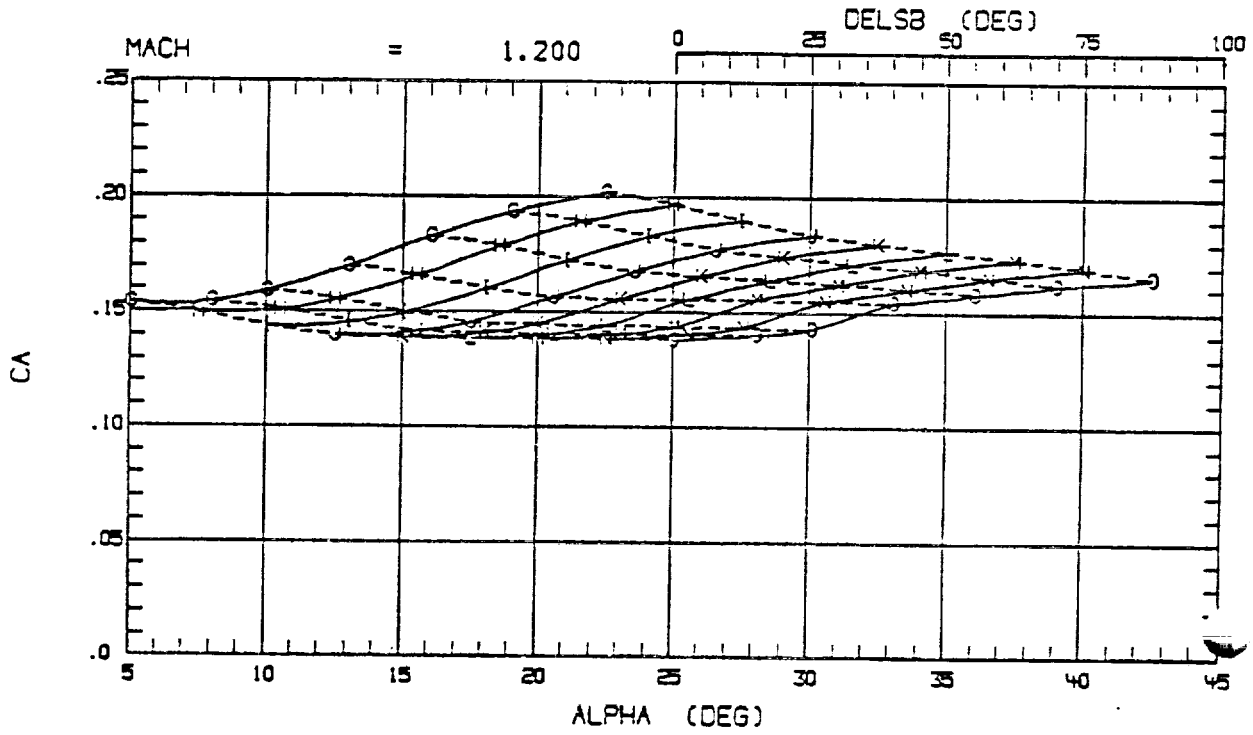
FIGURE 4.1.1.2-23
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000	7.500	10.000	12.500	15.000	17.500	20.000	22.500	25.000
	G	H	I	J	K	L	M	N	O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.15341	0.14913	0.14325	0.13933	0.13865	0.13840	0.13838	0.13821	0.13796
15.000	0.15399	0.15037	0.14522	0.14134	0.14069	0.14046	0.14043	0.14023	0.13994
25.000	0.15890	0.15490	0.14940	0.14530	0.14440	0.14391	0.14360	0.14310	0.14250
40.000	0.16956	0.16533	0.15961	0.15600	0.15550	0.15529	0.15517	0.15477	0.15417
55.000	0.18263	0.17816	0.17219	0.16729	0.16542	0.16373	0.16208	0.16006	0.15778
70.000	0.19354	0.18893	0.18277	0.17674	0.17370	0.17088	0.16807	0.16492	0.16153
97.200	0.20169	0.19647	0.18971	0.18317	0.17958	0.17613	0.17267	0.16880	0.16467

ENGINEER D2
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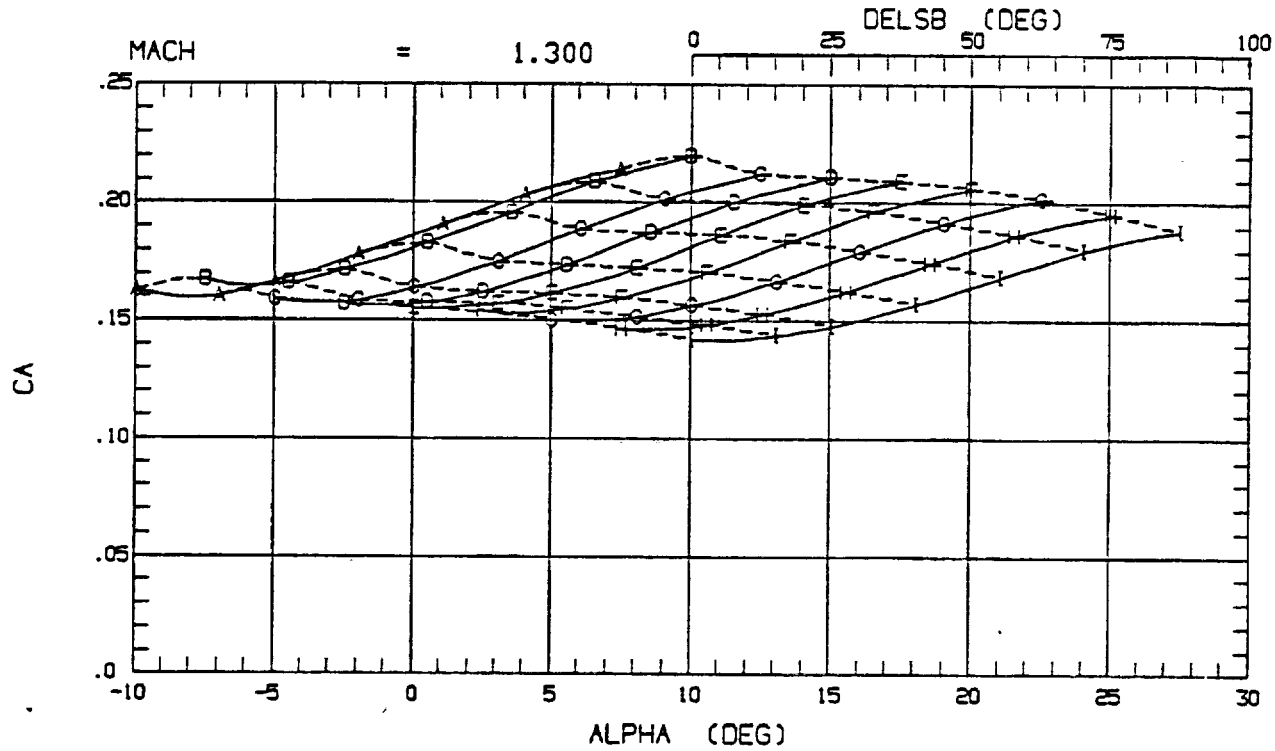
FIGURE 4.1.1.2-24
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.16238	0.16671	0.15862	0.15663	0.15509	0.15328	0.15000	0.14615	0.14145
15.000	0.15997	0.16532	0.15814	0.15731	0.15681	0.15472	0.15114	0.14764	0.14334
25.000	0.16610	0.17103	0.16340	0.16210	0.16110	0.15930	0.15600	0.15200	0.14720
40.000	0.17753	0.18245	0.17473	0.17326	0.17200	0.16994	0.16630	0.16189	0.15667
55.000	0.19043	0.19571	0.18833	0.18716	0.18619	0.18345	0.17909	0.17401	0.16815
70.000	0.20310	0.20846	0.20113	0.19992	0.19889	0.19581	0.19111	0.18587	0.17975
87.200	0.21414	0.21937	0.21189	0.21037	0.20901	0.20589	0.20121	0.19499	0.19790

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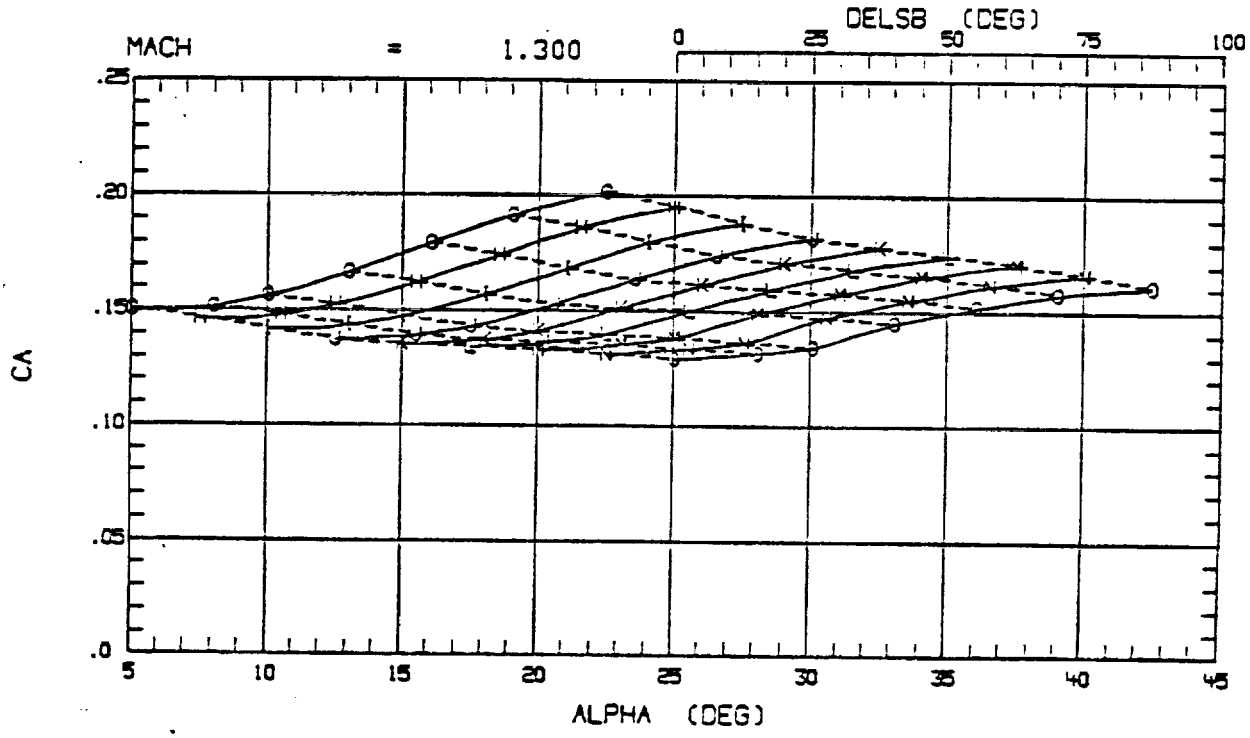
FIGURE 4.1.1.2-25
BASIC AXIAL FORCE COEFFICIENT

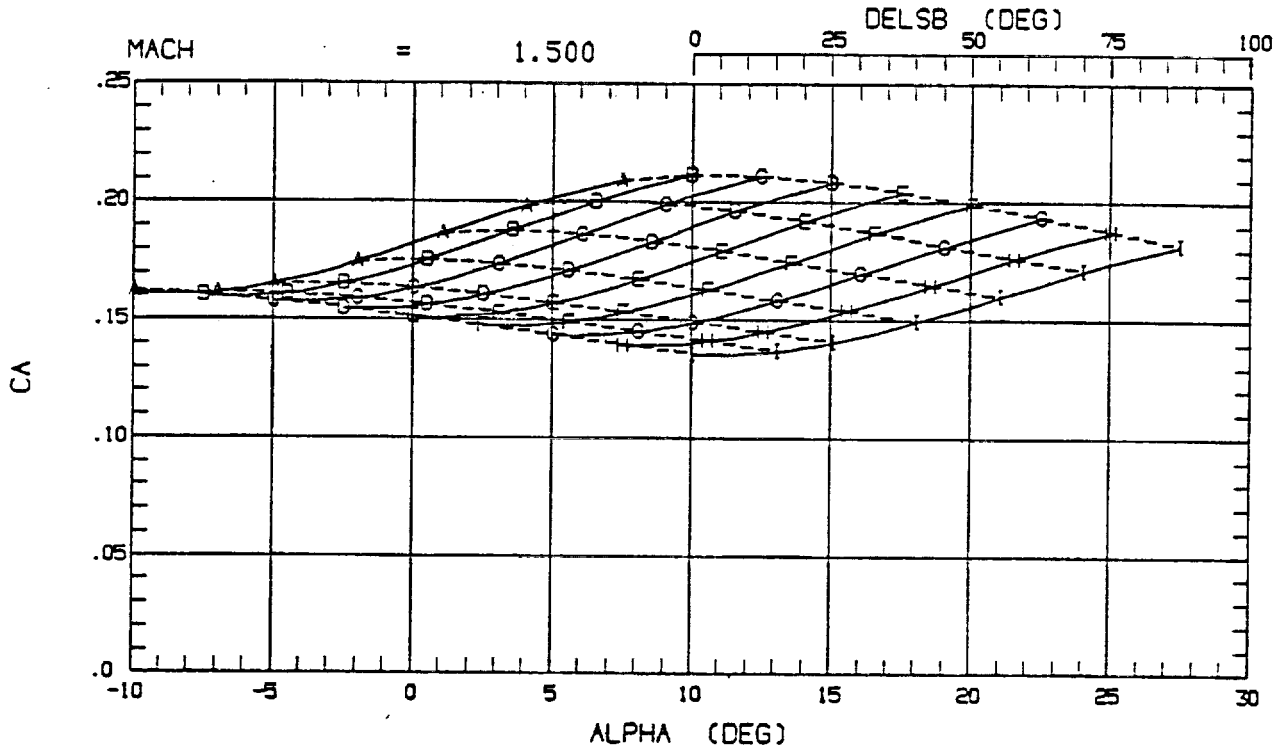


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.15000	0.14615	0.14145	0.13707	0.13519	0.13400	0.13271	0.13090	0.12980
15.000	0.15114	0.14784	0.14334	0.13902	0.13721	0.13614	0.13499	0.13332	0.13137
25.000	0.15600	0.15200	0.14720	0.14270	0.14070	0.13940	0.13800	0.13610	0.13390
40.000	0.16630	0.16189	0.15667	0.15254	0.15086	0.14982	0.14866	0.14695	0.14498
55.000	0.17909	0.17401	0.16815	0.16343	0.16110	0.15929	0.15725	0.15463	0.15159
70.000	0.19111	0.18587	0.17975	0.17401	0.17065	0.16787	0.16469	0.16129	0.15734
87.200	0.20121	0.19499	0.18790	0.19152	0.17745	0.17388	0.17005	0.16557	0.16064

ENGINEER
DATE

FIGURE 4.1.1.2-26
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.16157	0.15999	0.15747	0.15433	0.15078	0.14700	0.14311	0.13920	0.13531
15.000	0.16107	0.16049	0.15860	0.15580	0.15240	0.14863	0.14466	0.14063	0.13661
25.000	0.16470	0.16469	0.16302	0.16022	0.15671	0.15277	0.14864	0.14446	0.14034
40.000	0.17419	0.17490	0.17341	0.17045	0.16660	0.16226	0.15775	0.15327	0.14895
55.000	0.18624	0.18754	0.18617	0.18303	0.17883	0.17407	0.16913	0.16427	0.15965
70.000	0.19826	0.20006	0.19892	0.19580	0.19144	0.18640	0.18109	0.17580	0.17069
87.200	0.20869	0.21099	0.21046	0.20788	0.20385	0.19886	0.19331	0.18748	0.18157

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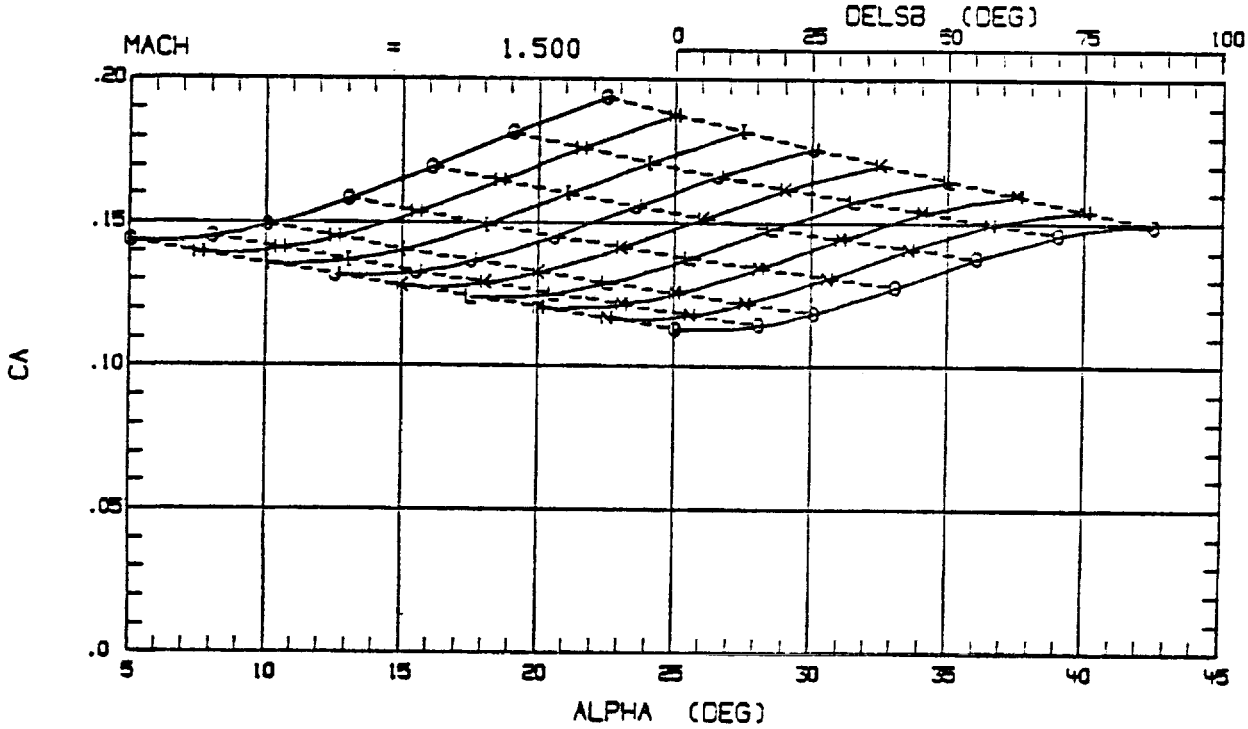
FIGURE 4.1.1.2-27
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.14311	0.13920	0.13531	0.13146	0.12767	0.12394	0.12024	0.11656	0.11298
15.000	0.14466	0.14063	0.13661	0.13255	0.12878	0.12501	0.12132	0.11770	0.11413
25.000	0.14884	0.14446	0.14034	0.13634	0.13249	0.12877	0.12519	0.12170	0.11827
40.000	0.15775	0.15327	0.14895	0.14486	0.14100	0.13736	0.13393	0.13062	0.12738
55.000	0.16913	0.16427	0.15965	0.15531	0.15129	0.14755	0.14404	0.14070	0.13744
70.000	0.18109	0.17580	0.17069	0.16586	0.16135	0.15712	0.15313	0.14931	0.14559
87.200	0.19331	0.18748	0.18157	0.17572	0.17001	0.16449	0.15915	0.15399	0.14895

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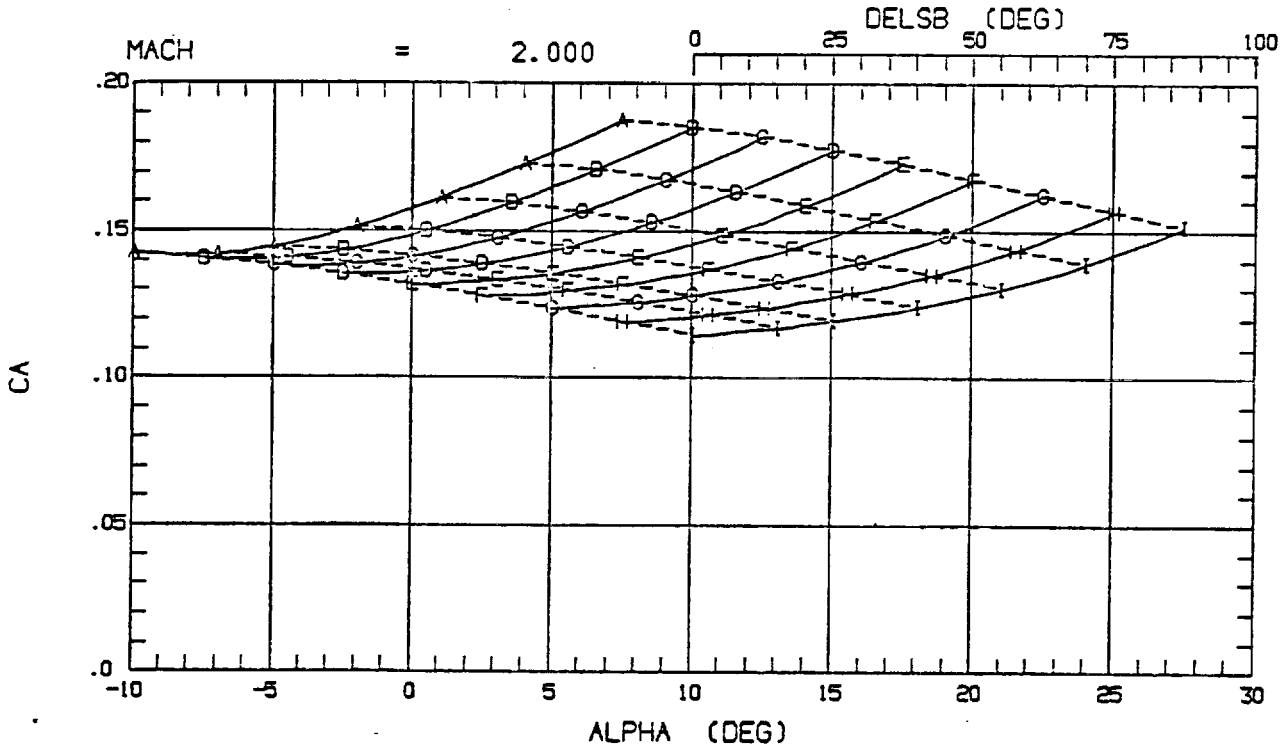
FIGURE 4.1.1.2-28
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.569 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.14213	0.14035	0.13788	0.13482	0.13128	0.12737	0.12319	0.11884	0.11442
15.000	0.14176	0.14054	0.13858	0.13599	0.13286	0.12929	0.12540	0.12126	0.11693
25.000	0.14421	0.14305	0.14106	0.13840	0.13520	0.13159	0.12767	0.12353	0.11925
40.000	0.15112	0.14974	0.14737	0.14425	0.14054	0.13668	0.13249	0.12819	0.12335
55.000	0.16099	0.15922	0.15628	0.15256	0.14835	0.14387	0.13923	0.13469	0.13016
70.000	0.17272	0.17063	0.16724	0.16301	0.15829	0.15332	0.14831	0.14337	0.13854
87.200	0.18710	0.18501	0.18159	0.17725	0.17238	0.16718	0.16184	0.15649	0.15116

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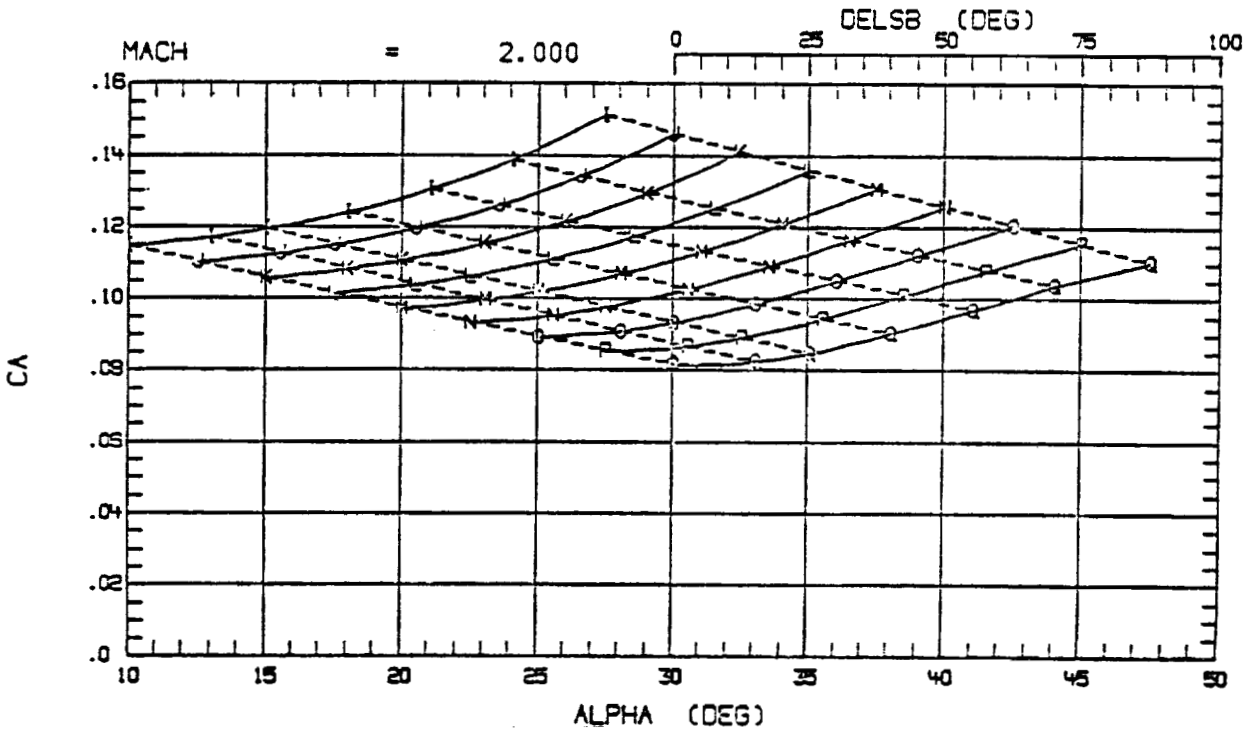
FIGURE 4.1.1.2-29
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.569 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.11442	0.10998	0.10550	0.10130	0.09712	0.09305	0.08910	0.08523	0.08143
15.000	0.11696	0.11256	0.10813	0.10370	0.09931	0.09497	0.09068	0.08646	0.08227
25.000	0.11925	0.11489	0.11049	0.10610	0.10173	0.09740	0.09310	0.08885	0.08462
40.000	0.12385	0.11950	0.11519	0.11091	0.10663	0.10249	0.09832	0.09416	0.09000
55.000	0.13016	0.12573	0.12141	0.11719	0.11304	0.10893	0.10484	0.10075	0.09662
70.000	0.13854	0.13387	0.12934	0.12493	0.12031	0.11633	0.11206	0.10776	0.10342
87.300	0.15116	0.14591	0.14074	0.13565	0.13055	0.12547	0.12039	0.11530	0.10833

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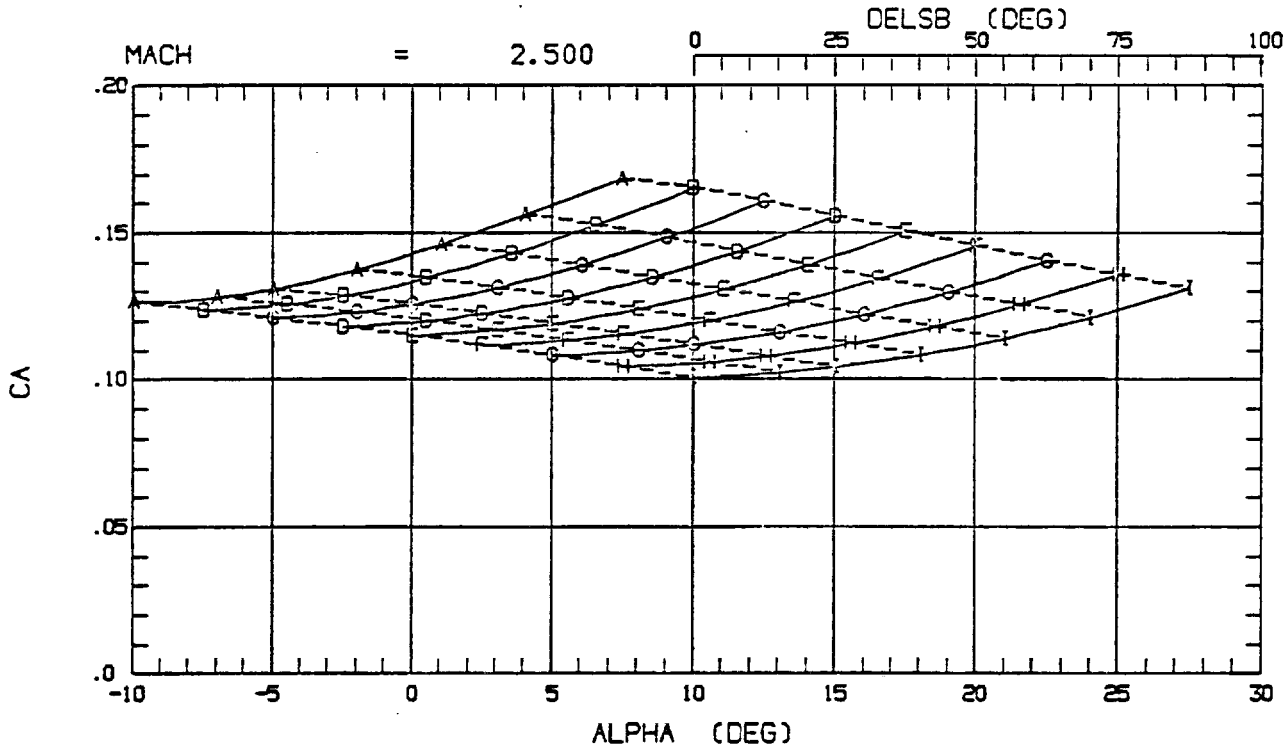
FIGURE 4.1.1.2-30
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2650.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.12624	0.12347	0.12075	0.11769	0.11482	0.11149	0.10792	0.10417	0.10028
15.000	0.12768	0.12551	0.12291	0.11993	0.11656	0.11316	0.10930	0.10574	0.10194
25.000	0.13057	0.12833	0.12555	0.12237	0.11891	0.11527	0.11151	0.10772	0.10392
40.000	0.13720	0.13446	0.13119	0.12758	0.12377	0.11937	0.11595	0.11204	0.10816
55.000	0.14593	0.14257	0.13872	0.13461	0.13040	0.12619	0.12203	0.11793	0.11389
70.000	0.15597	0.15229	0.14799	0.14340	0.13876	0.13417	0.12969	0.12533	0.12104
87.200	0.16811	0.16494	0.16053	0.15558	0.15042	0.14530	0.14035	0.13567	0.13091

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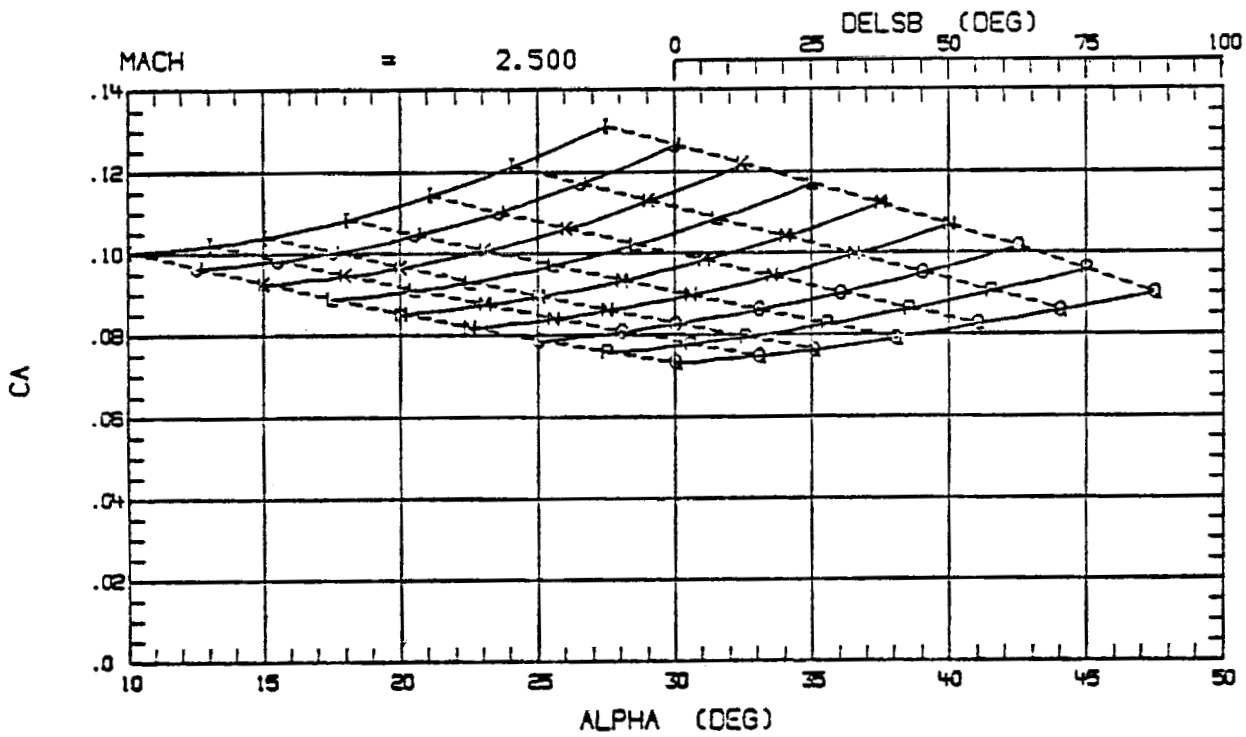
FIGURE 4.1.1.2-31
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.638 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.10029	0.09635	0.09246	0.08868	0.08507	0.08169	0.07856	0.07568	0.07304
15.000	0.10194	0.09815	0.09443	0.09080	0.08730	0.08393	0.08070	0.07762	0.07465
25.000	0.10392	0.10016	0.09646	0.09294	0.08931	0.08599	0.08285	0.07932	0.07618
40.000	0.10816	0.10434	0.10057	0.09684	0.09316	0.08951	0.08595	0.08243	0.07901
55.000	0.11389	0.10990	0.10593	0.10196	0.09799	0.09402	0.09003	0.08612	0.08227
70.000	0.12104	0.11680	0.11254	0.10822	0.10384	0.09937	0.09484	0.09029	0.08580
87.200	0.13091	0.12539	0.12162	0.11681	0.11181	0.10653	0.10114	0.09556	0.09431

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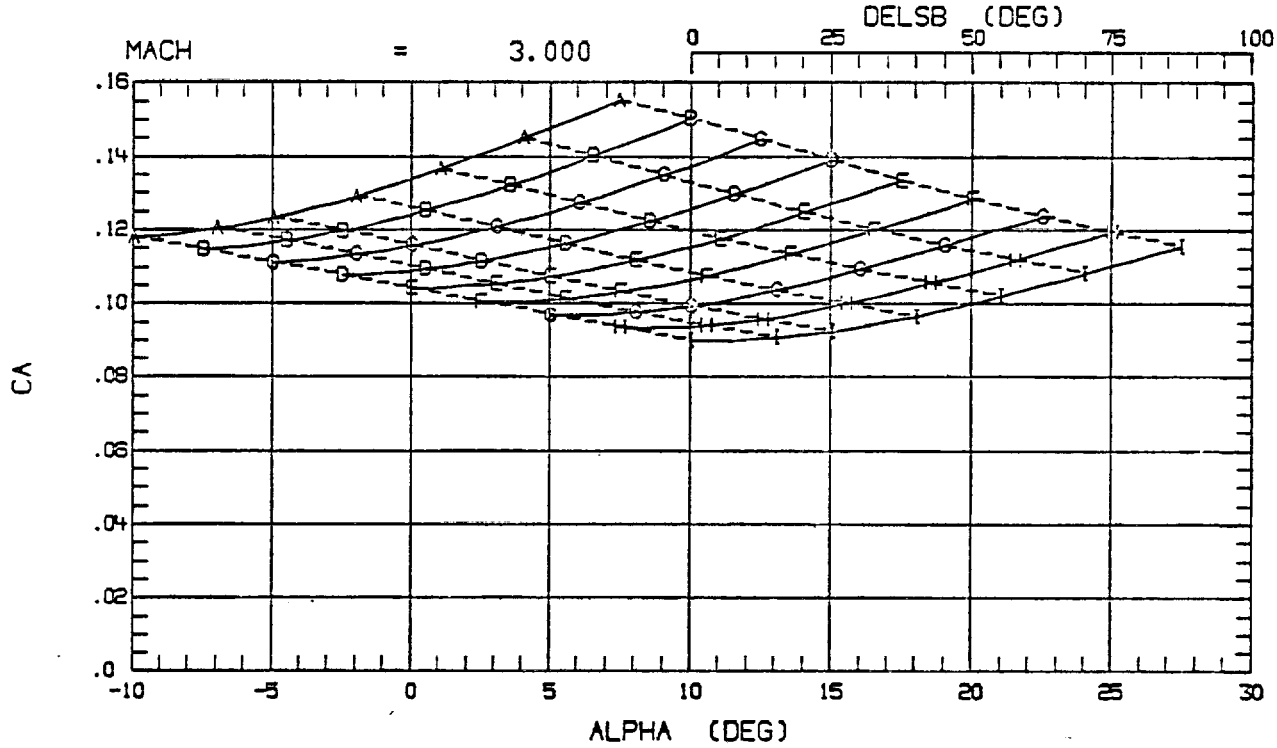
FIGURE 4.1.1.2-32
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1230.0 IN.

	ALPHA (DEG)								
	-10.000	-7.500	-5.000	-2.500	0.0	2.500	5.000	7.500	10.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.11780	0.11440	0.11095	0.10746	0.10391	0.10034	0.09678	0.09328	0.08987
15.000	0.12005	0.11689	0.11317	0.10918	0.10513	0.10116	0.09737	0.09381	0.09051
25.000	0.12293	0.11958	0.11562	0.11138	0.10712	0.10300	0.09913	0.09555	0.09226
40.000	0.12892	0.12500	0.12059	0.11604	0.11158	0.10734	0.10340	0.09977	0.09642
55.000	0.13642	0.13165	0.12699	0.12214	0.11749	0.11315	0.10912	0.10540	0.10192
70.000	0.14468	0.13990	0.13463	0.12942	0.12448	0.11991	0.11571	0.11181	0.10814
87.200	0.15605	0.15030	0.14468	0.13889	0.13334	0.12822	0.12358	0.11935	0.11541

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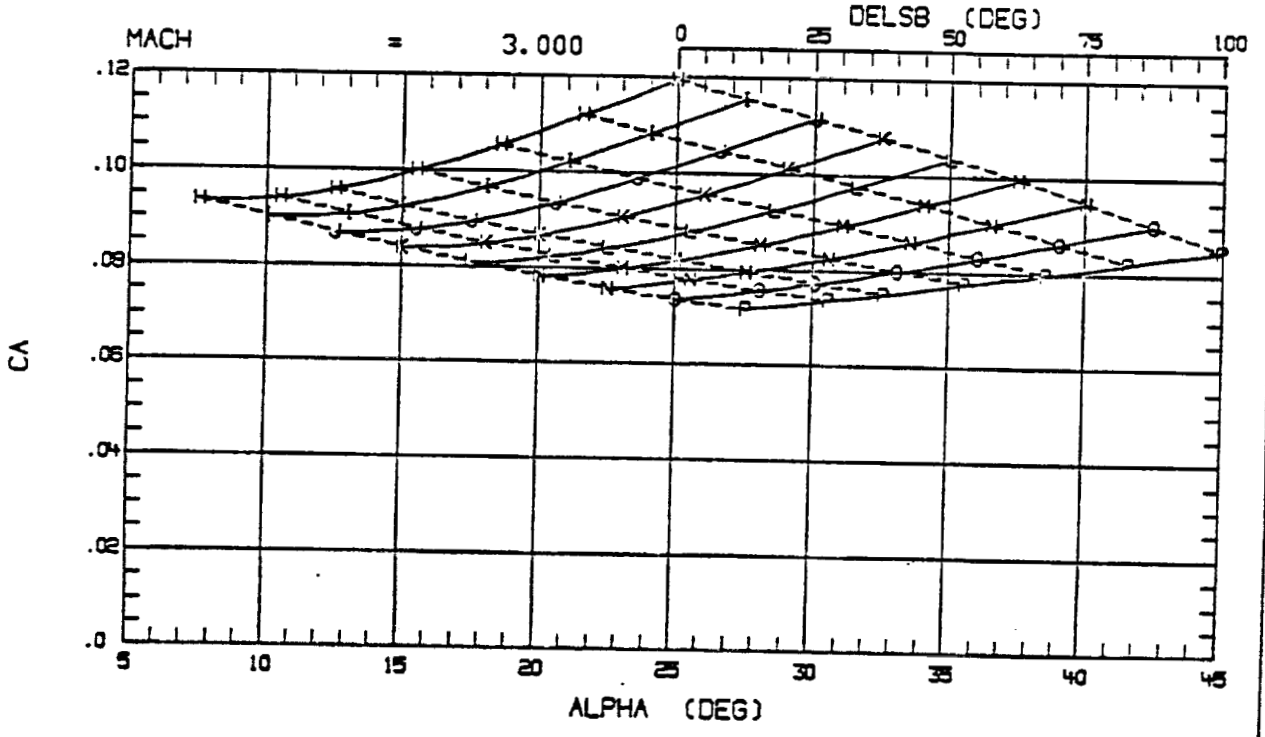
FIGURE 4.1.1.2-33
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 72.057 FT.
MOMENT REFERENCE	ZO = WL	373.0 IN.	M.A.C.	CW = 39.569 FT.
			BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.09328	0.09987	0.08859	0.09349	0.08060	0.07794	0.07555	0.07343	0.07157
15.000	0.09381	0.09051	0.08747	0.08488	0.08210	0.07973	0.07753	0.07548	0.07356
25.000	0.09555	0.09226	0.08925	0.08649	0.08393	0.08153	0.07926	0.07709	0.07500
40.000	0.09977	0.09642	0.09332	0.09042	0.08764	0.08497	0.08235	0.07978	0.07726
55.000	0.10540	0.10192	0.09861	0.09541	0.09226	0.08911	0.08595	0.08278	0.07963
70.000	0.11181	0.10814	0.10459	0.10104	0.09745	0.09375	0.08993	0.08601	0.08205
87.200	0.11935	0.11541	0.11169	0.10773	0.10370	0.09940	0.09479	0.08990	0.08492

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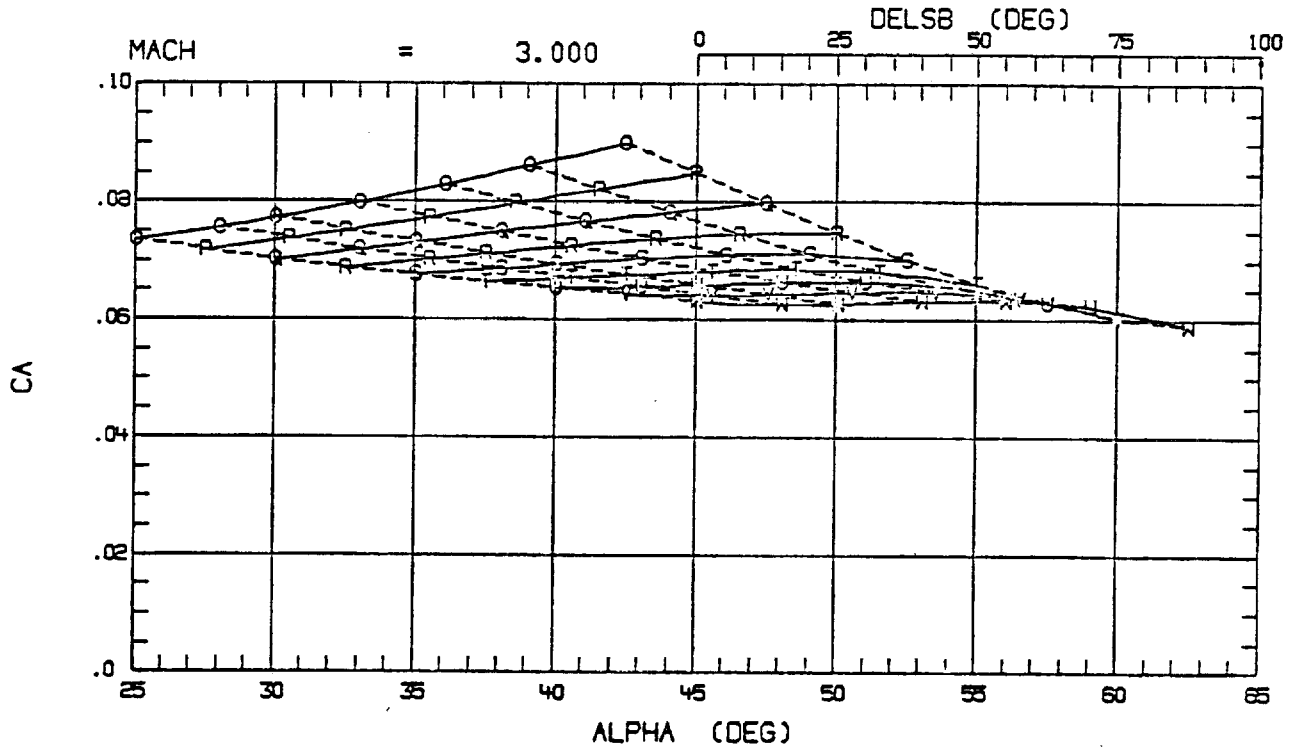
FIGURE 4.1.1.2-34
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	25.000 O	27.500 P	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.07343	0.07157	0.06997	0.06859	0.06739	0.06630	0.06527	0.06419	0.06296
15.000	0.07548	0.07355	0.07176	0.07005	0.06843	0.06689	0.06539	0.06390	0.06237
25.000	0.07709	0.07500	0.07299	0.07104	0.06918	0.06741	0.06572	0.06410	0.06250
40.000	0.07978	0.07726	0.07481	0.07244	0.07020	0.06813	0.06623	0.06452	0.06295
55.000	0.08278	0.07963	0.07655	0.07361	0.07098	0.06843	0.06631	0.06453	0.06306
70.000	0.08601	0.08205	0.07814	0.07441	0.07097	0.06795	0.06544	0.06350	0.06211
87.200	0.08990	0.08482	0.07938	0.07468	0.07004	0.06595	0.06294	0.06023	0.05975

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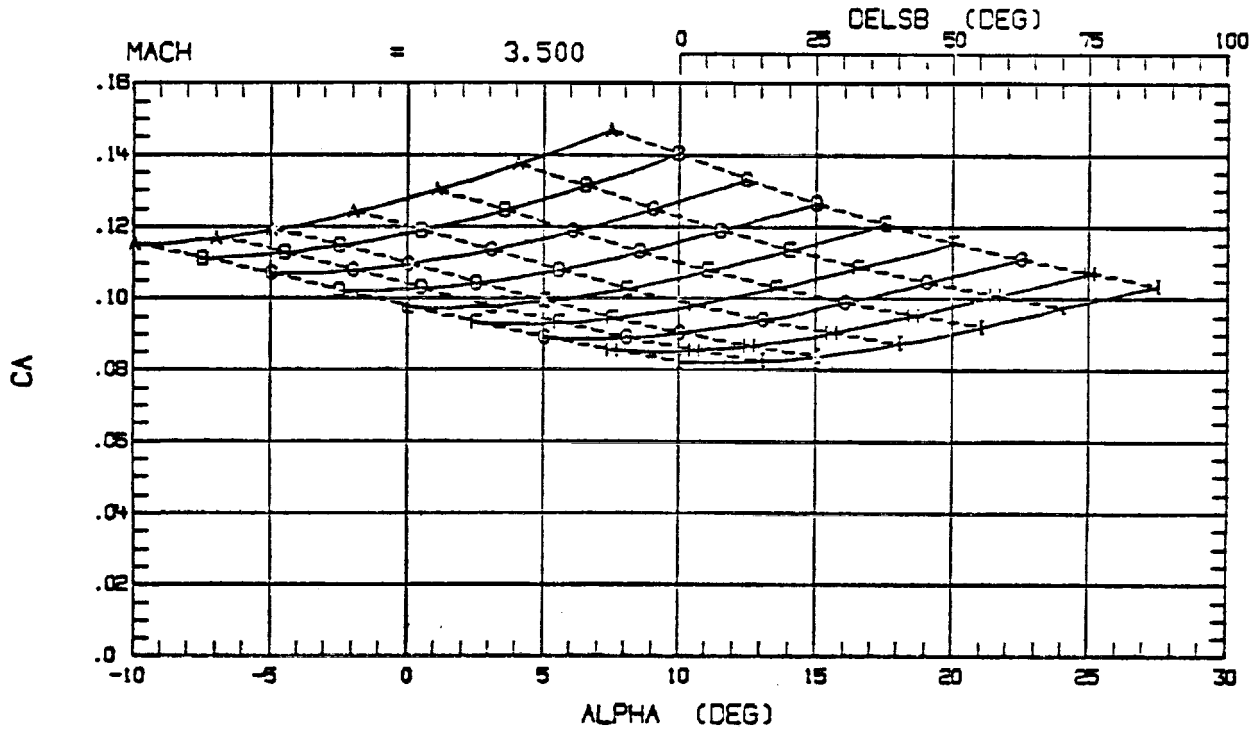
FIGURE 4.1.1.2-35
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.569 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.11480	0.11106	0.10567	0.10201	0.09739	0.09259	0.09924	0.09533	0.09212
15.000	0.11665	0.11262	0.10774	0.10259	0.09765	0.09291	0.09379	0.09526	0.09227
25.000	0.11852	0.11458	0.10944	0.10409	0.09893	0.09422	0.09009	0.08659	0.09395
40.000	0.12368	0.11877	0.11329	0.10774	0.10251	0.09778	0.09356	0.09015	0.09719
55.000	0.12986	0.12431	0.11846	0.11278	0.10746	0.10272	0.09858	0.09502	0.09195
70.000	0.13719	0.13101	0.12473	0.11875	0.11329	0.10844	0.10421	0.10053	0.09729
87.200	0.14667	0.13990	0.13297	0.12537	0.12041	0.11519	0.11093	0.10678	0.10332

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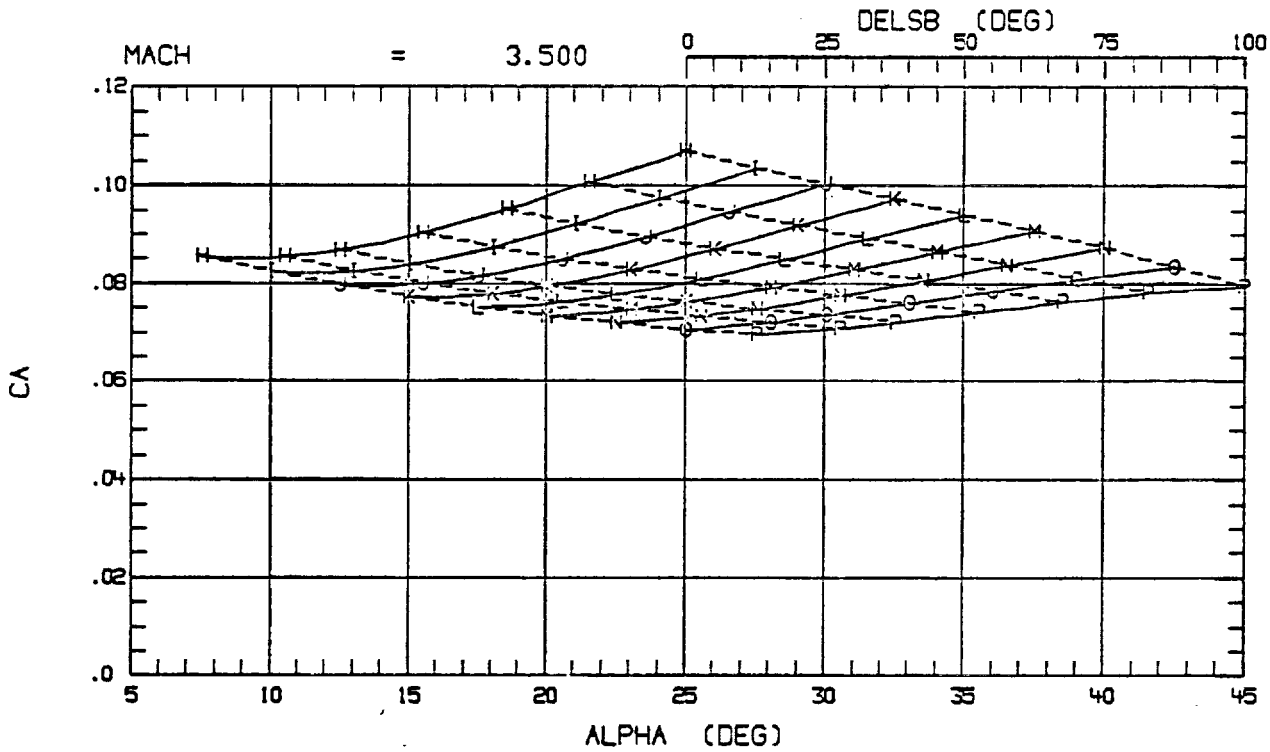
FIGURE 4.1.1.2-36
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2990.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.08533	0.08212	0.07936	0.07699	0.07496	0.07324	0.07176	0.07048	0.06937
15.000	0.08525	0.08227	0.07979	0.07775	0.07603	0.07455	0.07323	0.07200	0.07061
25.000	0.08658	0.08365	0.08123	0.07923	0.07753	0.07605	0.07467	0.07334	0.07202
40.000	0.09015	0.08719	0.08471	0.08259	0.08071	0.07899	0.07733	0.07569	0.07402
55.000	0.09502	0.09195	0.08927	0.08697	0.08465	0.08250	0.08037	0.07822	0.07604
70.000	0.10053	0.09729	0.09436	0.09162	0.08895	0.08628	0.08353	0.08071	0.07782
87.200	0.10678	0.10332	0.10013	0.09702	0.09386	0.09052	0.08697	0.08330	0.07929

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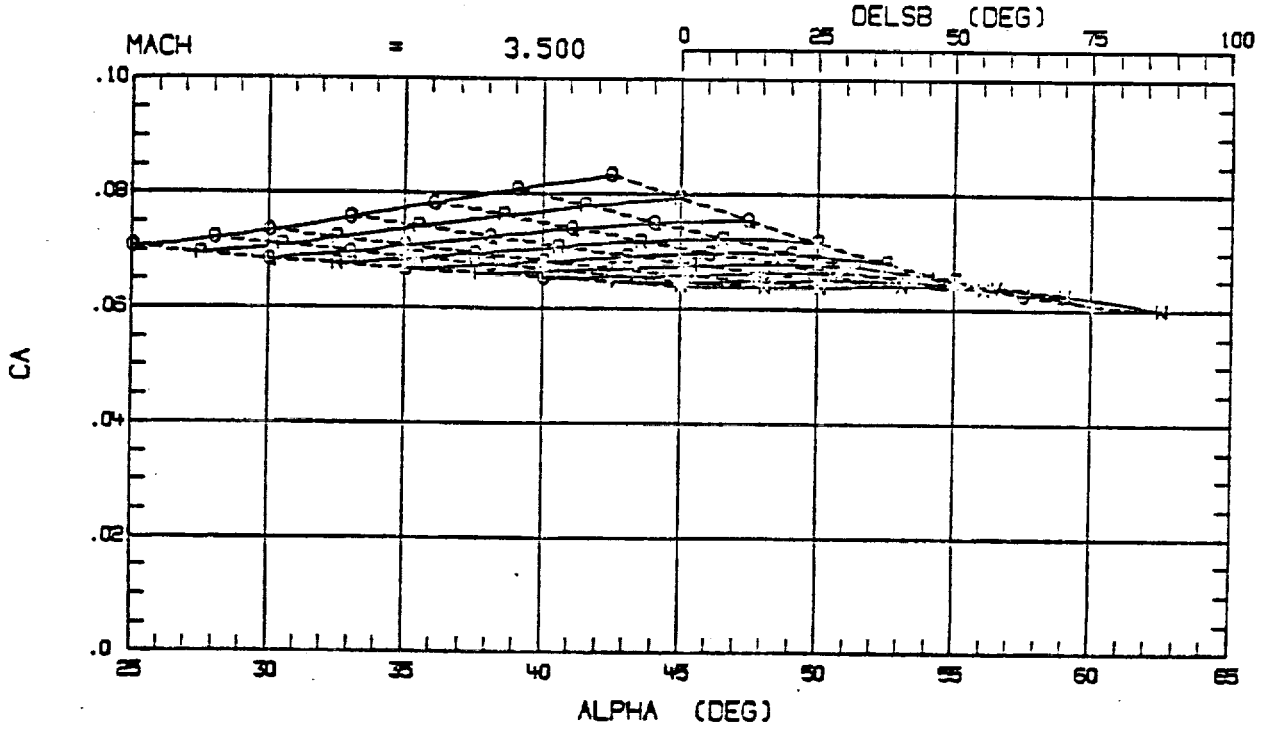
FIGURE 4.1.1.2-37
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	25.000 O	27.500 P	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.07048	0.06937	0.06837	0.06750	0.06671	0.06598	0.06530	0.06460	0.06386
15.000	0.07200	0.07091	0.06986	0.06893	0.06743	0.06640	0.06543	0.06455	0.06371
25.000	0.07334	0.07202	0.07070	0.06938	0.06809	0.06686	0.06573	0.06471	0.06379
40.000	0.07559	0.07402	0.07234	0.07067	0.06905	0.06753	0.06614	0.06493	0.06387
55.000	0.07822	0.07604	0.07385	0.07170	0.06965	0.06776	0.06612	0.06472	0.06357
70.000	0.08071	0.07782	0.07494	0.07213	0.06950	0.06716	0.06519	0.06385	0.06252
87.200	0.08320	0.07929	0.07532	0.07148	0.06793	0.06497	0.06245	0.06078	0.05999

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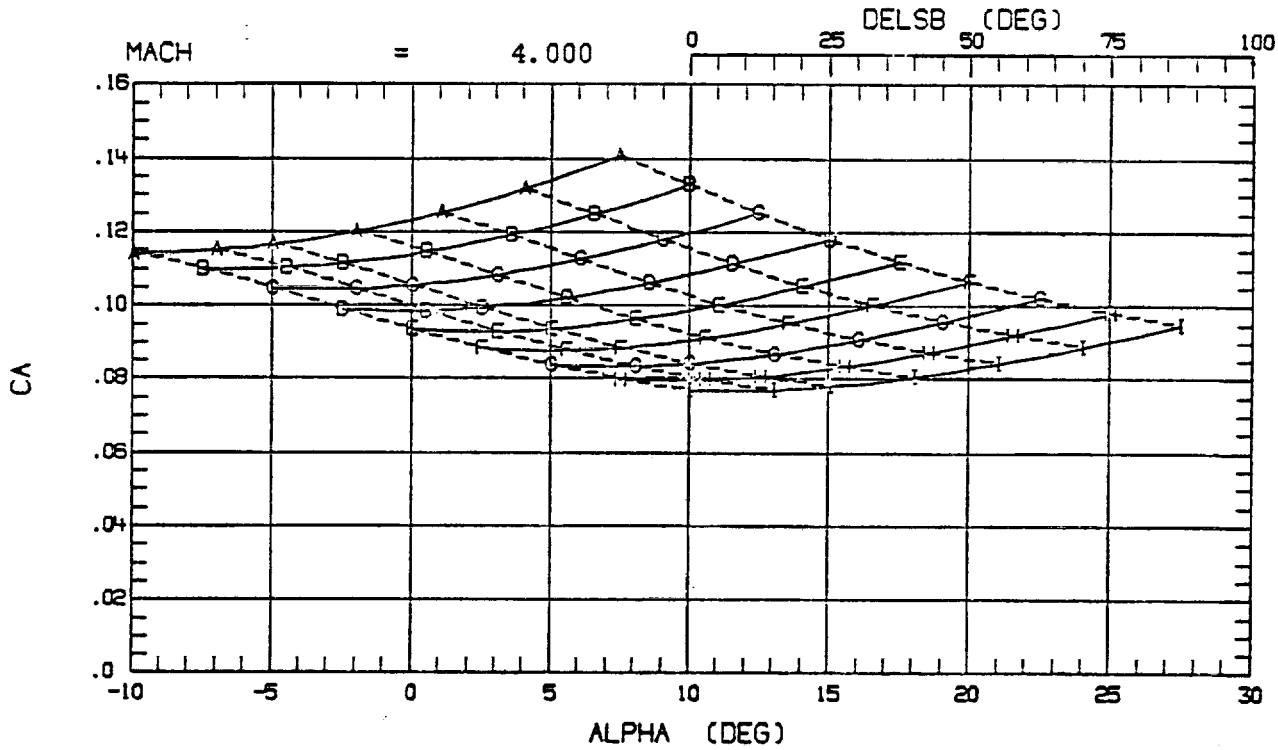
FIGURE 4.1.1.2-38
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1260.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.11384	0.10971	0.10445	0.09878	0.09320	0.08805	0.08355	0.07976	0.07670
15.000	0.11483	0.11010	0.10437	0.09838	0.09285	0.08782	0.08315	0.07960	0.07682
25.000	0.11635	0.11129	0.10533	0.09921	0.09344	0.08831	0.08398	0.08049	0.07779
40.000	0.11991	0.11437	0.10813	0.10188	0.09606	0.09092	0.08660	0.08311	0.08037
55.000	0.12497	0.11865	0.11234	0.10596	0.10009	0.09493	0.09055	0.08696	0.08407
70.000	0.13148	0.12462	0.11769	0.11112	0.10516	0.09994	0.09548	0.09174	0.08863
87.200	0.14070	0.13290	0.12493	0.11795	0.11177	0.10643	0.10186	0.09794	0.09455

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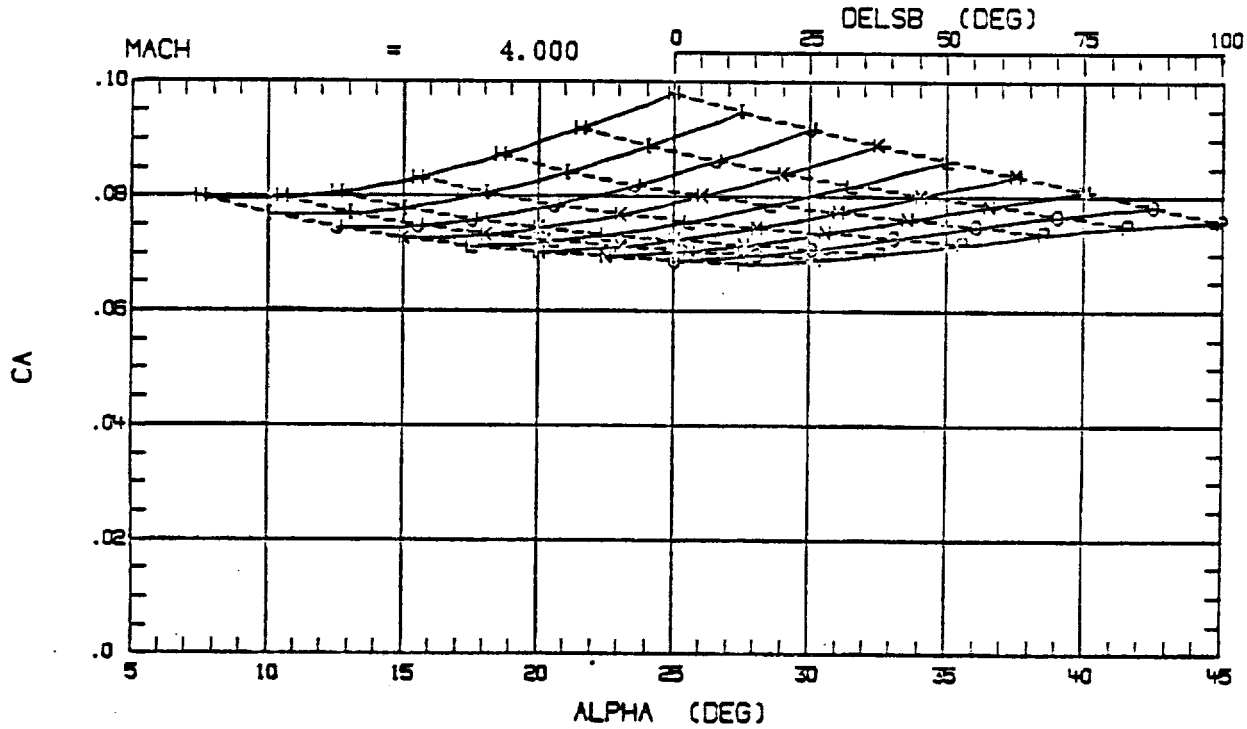
DATE 3-82

FIGURE 4.1.1.2-39
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	7.500	10.000	12.500	15.000	17.500	20.000	22.500	25.000	27.500
	H	I	J	K	L	M	N	O	P
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.07976	0.07670	0.07430	0.07248	0.07112	0.07010	0.06930	0.06863	0.06800
15.000	0.07960	0.07682	0.07472	0.07316	0.07200	0.07111	0.07034	0.06951	0.06894
25.000	0.08049	0.07779	0.07575	0.07425	0.07312	0.07222	0.07144	0.07084	0.06978
40.000	0.08311	0.08037	0.07828	0.07669	0.07546	0.07443	0.07349	0.07253	0.07180
55.000	0.08695	0.08407	0.08178	0.07953	0.07843	0.07710	0.07534	0.07457	0.07323
70.000	0.09174	0.08963	0.08503	0.08381	0.08184	0.08002	0.07825	0.07647	0.07465
87.200	0.09794	0.09455	0.09153	0.08975	0.08809	0.08544	0.08078	0.07808	0.07595

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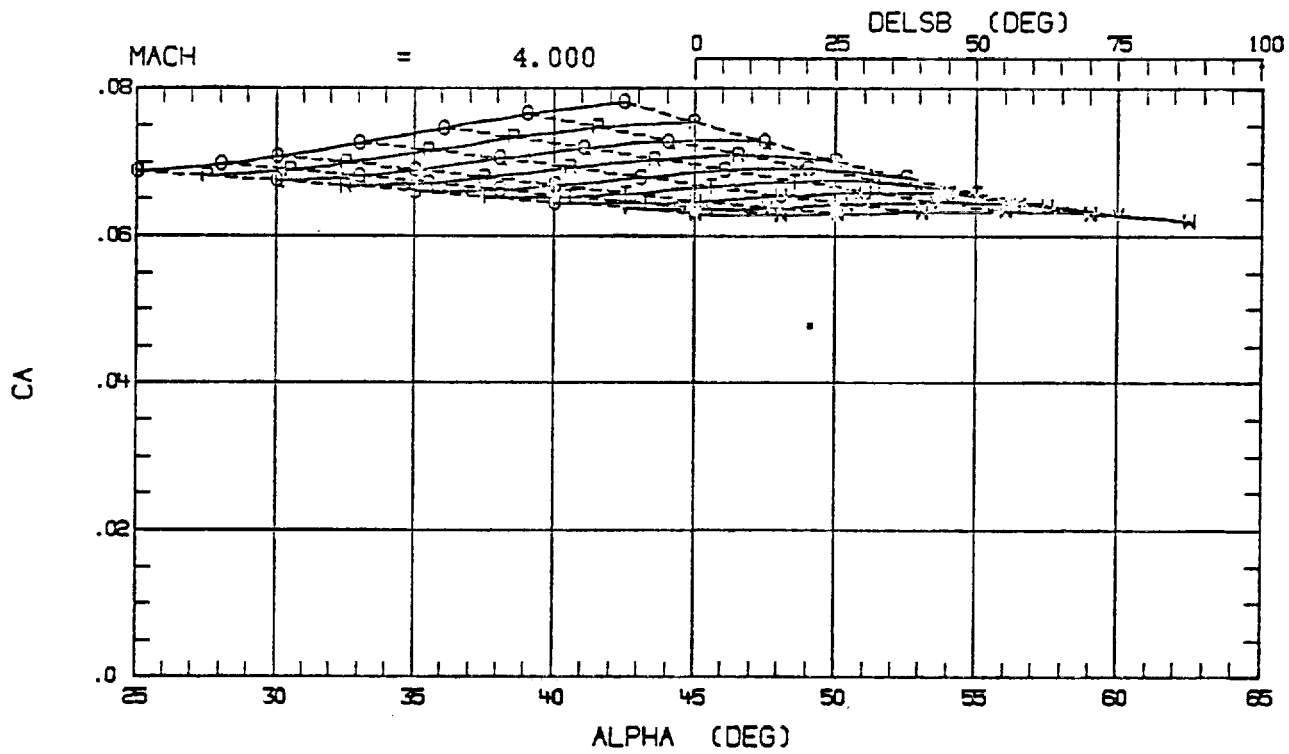
FIGURE 4.1.1.2-40
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.563 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	25.000 O	27.500 P	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06563	0.06800	0.06737	0.06670	0.06598	0.06523	0.06446	0.06367	0.06286
15.000	0.06961	0.06984	0.06800	0.06710	0.06615	0.06521	0.06431	0.06350	0.06279
25.000	0.07064	0.06978	0.06884	0.06781	0.06673	0.06564	0.06462	0.06371	0.06290
40.000	0.07253	0.07150	0.07037	0.06914	0.06786	0.06656	0.06532	0.06417	0.06314
55.000	0.07457	0.07323	0.07183	0.07034	0.06882	0.06730	0.06584	0.06448	0.06325
70.000	0.07647	0.07465	0.07278	0.07091	0.06906	0.06730	0.06569	0.06424	0.06293
87.200	0.07803	0.07535	0.07266	0.07009	0.06772	0.06586	0.06399	0.06276	0.06191

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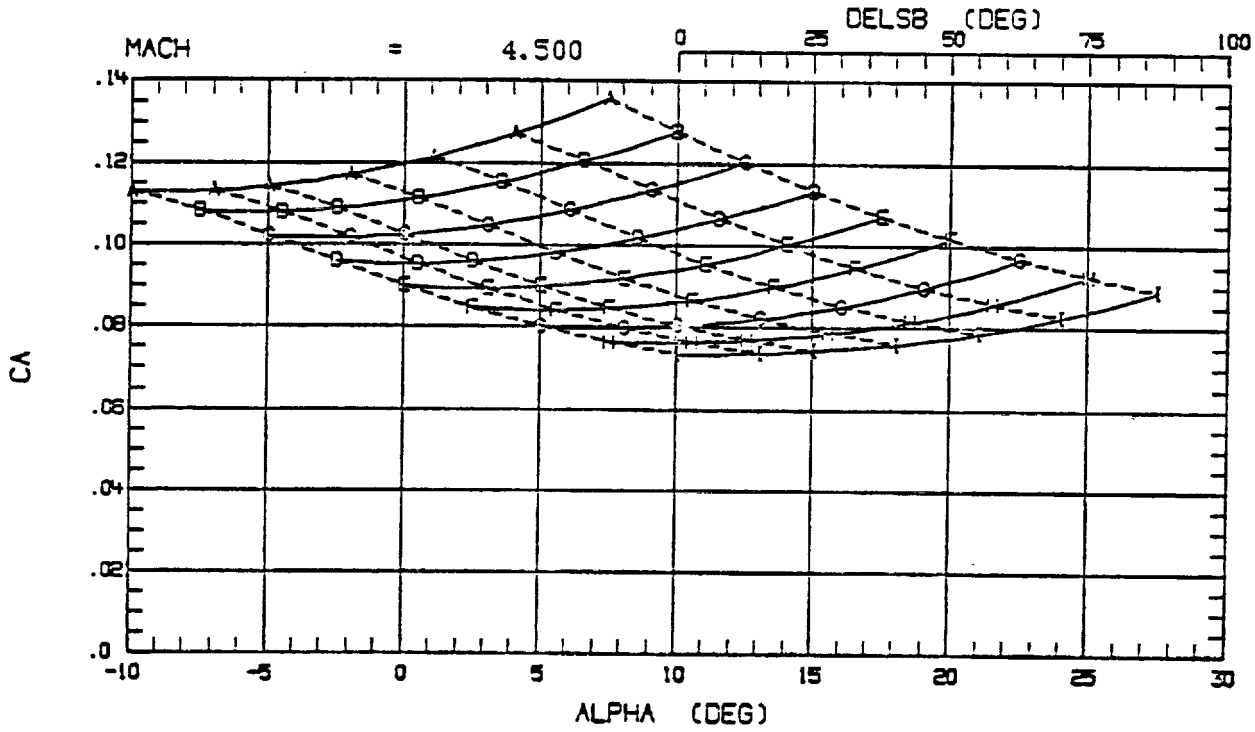
FIGURE 4.1.1.2-41
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.563 FT.
		BODY LENGTH	LS = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.11253	0.10791	0.10204	0.09563	0.09394	0.09444	0.07922	0.07608	0.07220
15.000	0.11296	0.10775	0.10158	0.09525	0.08928	0.09402	0.07962	0.07614	0.07353
25.000	0.11403	0.10560	0.10227	0.09393	0.08990	0.08452	0.08014	0.07659	0.07413
40.000	0.11650	0.11117	0.10463	0.09601	0.09184	0.08844	0.08194	0.07840	0.07574
55.000	0.12125	0.11515	0.10837	0.10160	0.09530	0.08974	0.09507	0.08131	0.07841
70.000	0.12712	0.12034	0.11327	0.10640	0.10003	0.09442	0.08960	0.08560	0.08235
87.200	0.13663	0.12758	0.12001	0.11313	0.10693	0.10147	0.09694	0.09242	0.08870

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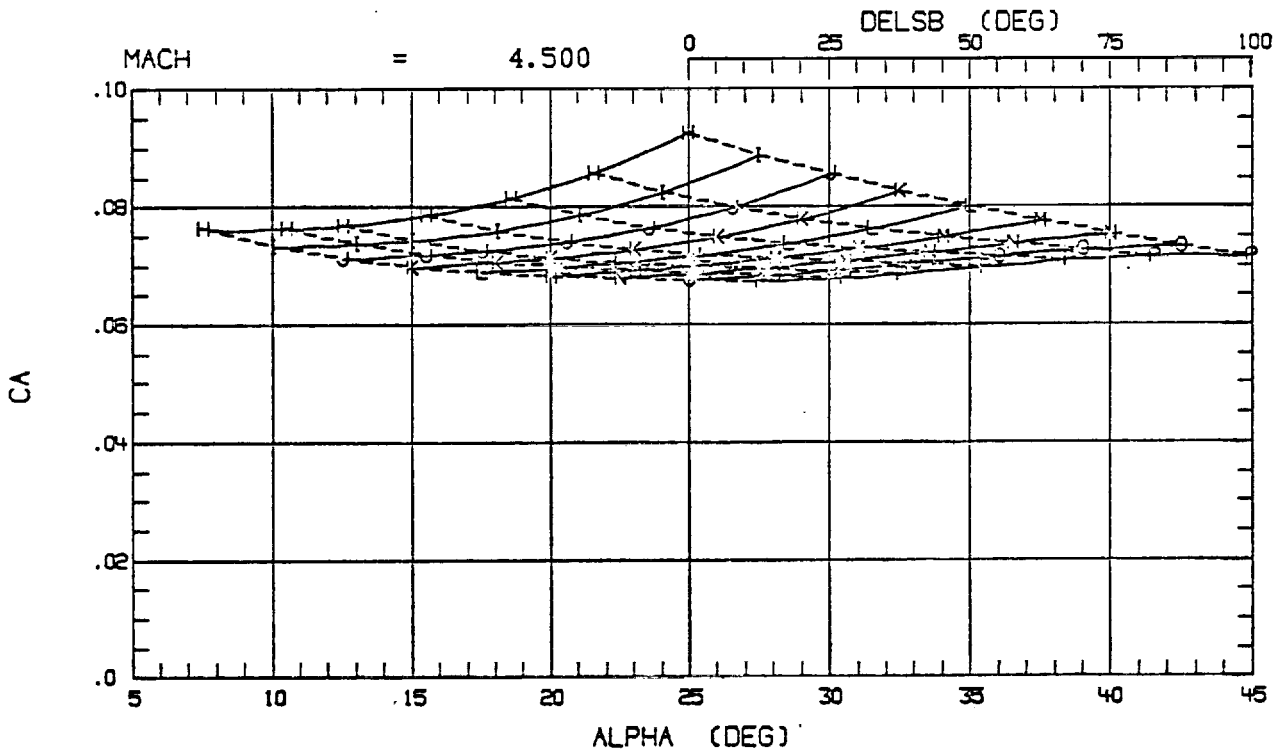
FIGURE 4.1.1.2-42
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	7.500	10.000	12.500	15.000	17.500	20.000	22.500	25.000	27.500
	H	I	J	K	L	M	N	O	P
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.07608	0.07320	0.07110	0.06965	0.06872	0.06814	0.06778	0.06749	0.06720
15.000	0.07614	0.07353	0.07166	0.07041	0.06959	0.06905	0.06862	0.06821	0.06773
25.000	0.07669	0.07413	0.07232	0.07110	0.07032	0.06978	0.06936	0.06892	0.06839
40.000	0.07840	0.07574	0.07385	0.07253	0.07170	0.07112	0.07065	0.07018	0.06959
55.000	0.08131	0.07841	0.07625	0.07470	0.07359	0.07276	0.07209	0.07143	0.07072
70.000	0.08560	0.08235	0.07976	0.07771	0.07608	0.07474	0.07357	0.07249	0.07141
87.200	0.09242	0.08370	0.08542	0.08250	0.07886	0.07745	0.07623	0.07316	0.07125

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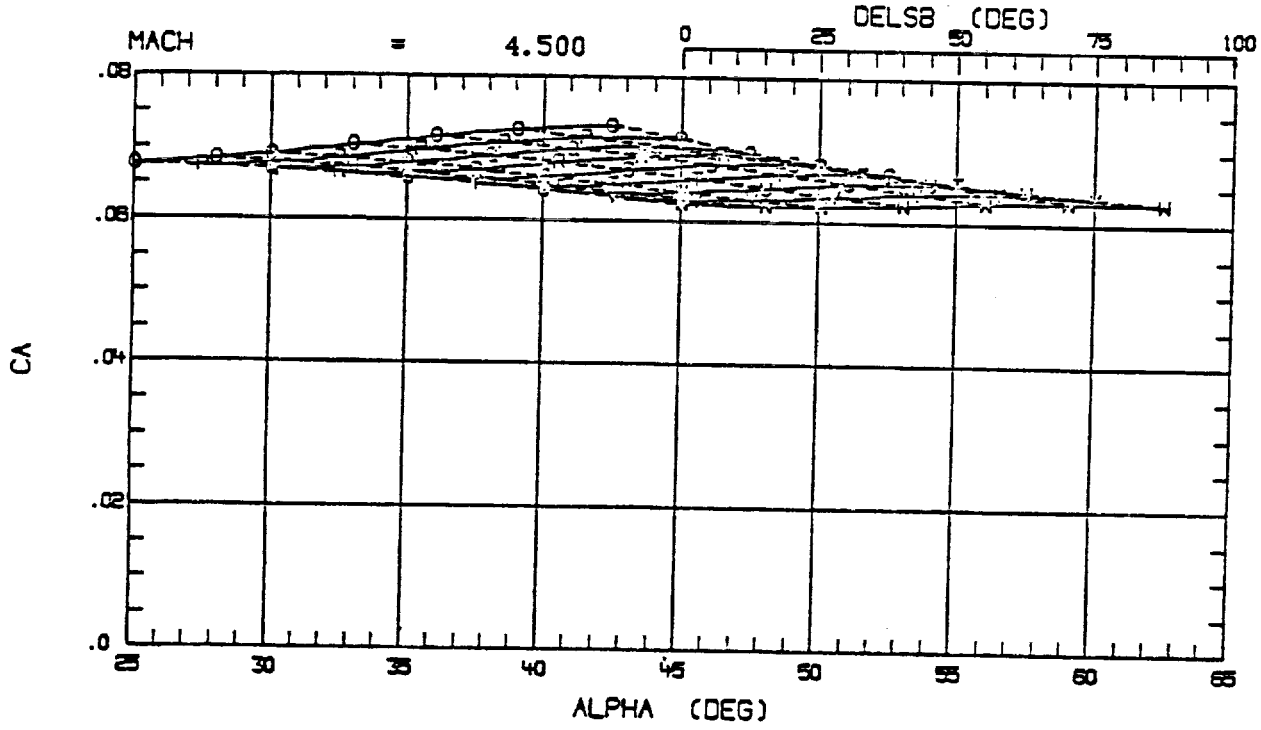
FIGURE 4.1.1.2-43
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.523 FT.
			BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	25.000 O	27.500 P	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06749	0.06720	0.06682	0.06632	0.06569	0.06496	0.06414	0.06326	0.06236
15.000	0.06921	0.06773	0.06712	0.06638	0.06554	0.06463	0.06372	0.06294	0.06205
25.000	0.06692	0.06639	0.05772	0.06690	0.06595	0.06495	0.06394	0.06297	0.06211
40.000	0.07018	0.06959	0.06885	0.06796	0.06692	0.06579	0.06462	0.06349	0.06240
55.000	0.07143	0.07072	0.06987	0.06889	0.05778	0.06656	0.06529	0.06402	0.06277
70.000	0.07249	0.07141	0.07031	0.06915	0.06794	0.06669	0.06544	0.06420	0.06300
87.200	0.07316	0.07125	0.06949	0.06791	0.06650	0.06530	0.06430	0.06349	0.06278

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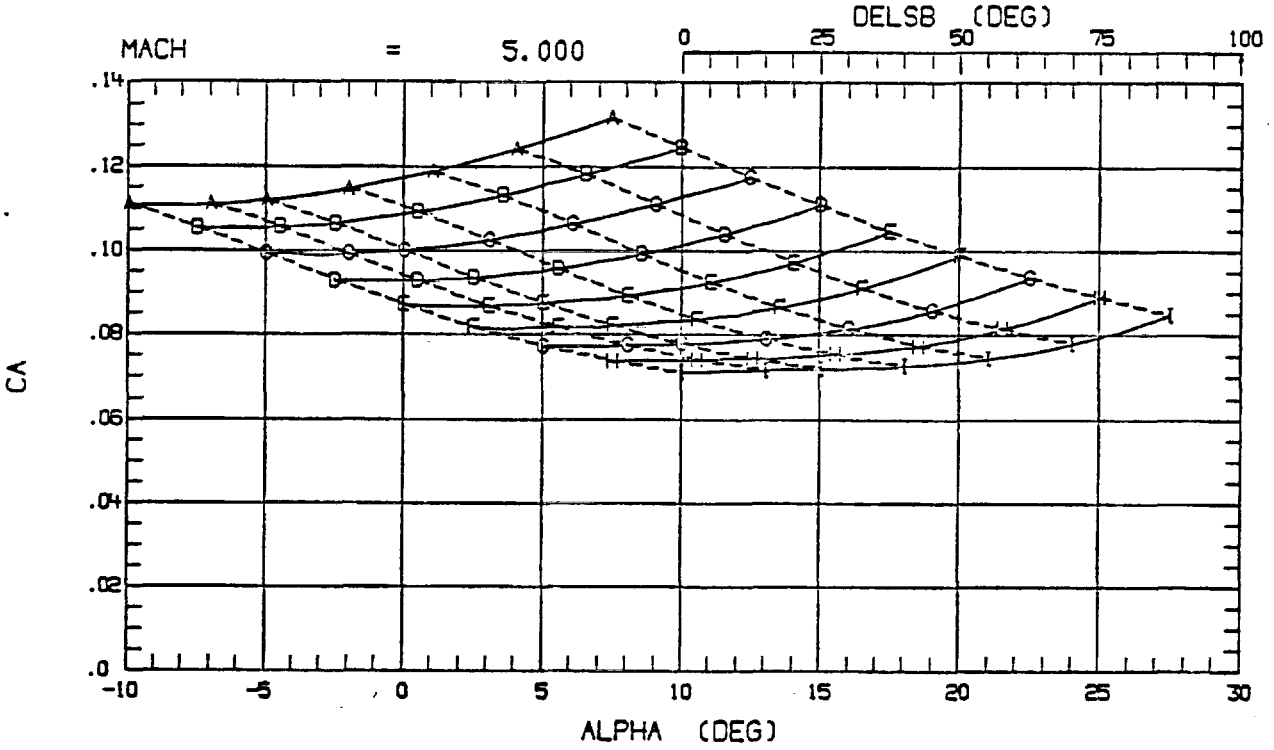
FIGURE 4.1.1.2-44
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000	-7.500	-5.000	-2.500	0.0	2.500	5.000	7.500	10.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.11071	0.10534	0.09915	0.09283	0.08688	0.08160	0.07717	0.07365	0.07100
15.000	0.11085	0.10536	0.09907	0.09272	0.08680	0.08163	0.07735	0.07401	0.07155
25.000	0.11183	0.10633	0.09993	0.09342	0.08735	0.08204	0.07767	0.07427	0.07180
40.000	0.11452	0.10904	0.10244	0.09562	0.08918	0.08352	0.07883	0.07518	0.07252
55.000	0.11858	0.11299	0.10620	0.09912	0.09237	0.08635	0.08130	0.07728	0.07426
70.000	0.12390	0.11789	0.11096	0.10384	0.09705	0.09091	0.08561	0.08122	0.07772
87.200	0.13139	0.12431	0.11735	0.11070	0.10447	0.09973	0.09352	0.08894	0.08469

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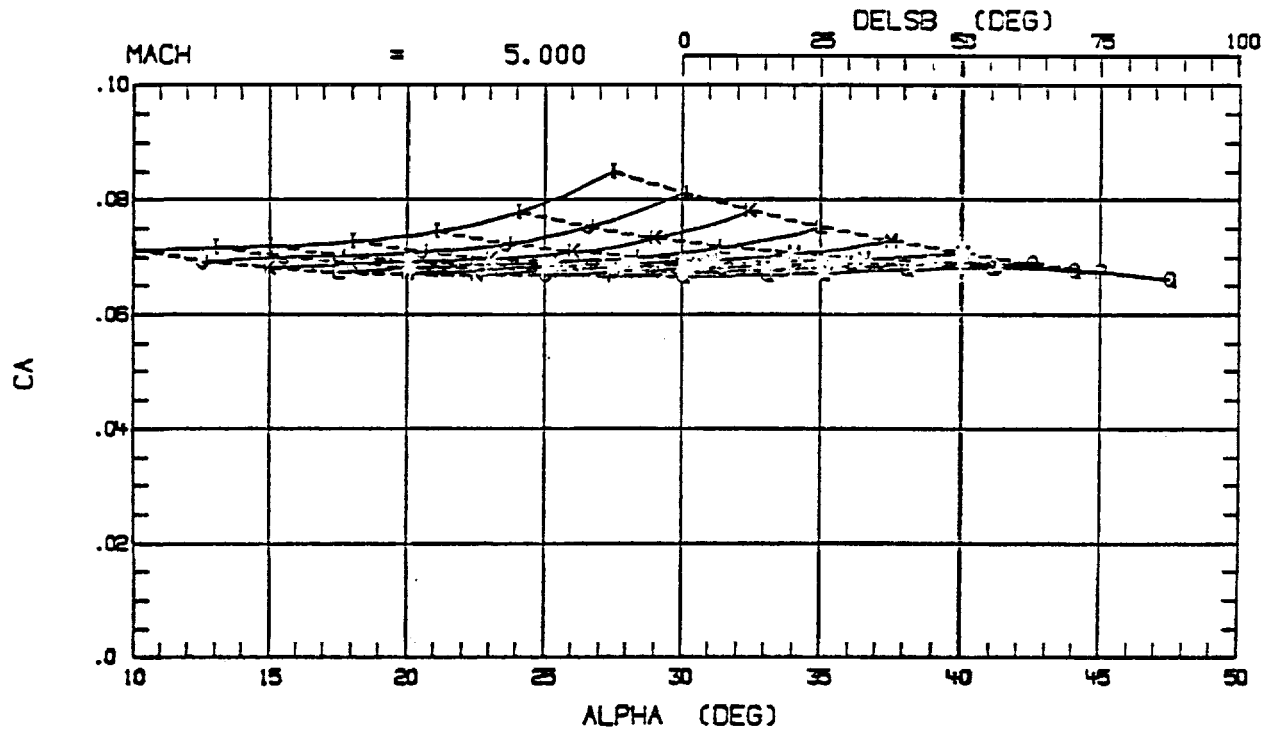
FIGURE 4.1.1.2-45
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.037 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.583 FT.
		BODY LENGTH	LB = 1250.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.07100	0.06913	0.06793	0.06722	0.06688	0.06674	0.06658	0.06660	0.06644
15.000	0.07155	0.06985	0.06876	0.06813	0.06779	0.06758	0.06740	0.06714	0.06675
25.000	0.07180	0.07012	0.06907	0.06850	0.06819	0.06803	0.06783	0.06766	0.06713
40.000	0.07252	0.07071	0.06960	0.06900	0.06871	0.06856	0.06841	0.06815	0.06771
55.000	0.07425	0.07213	0.07072	0.06986	0.06937	0.06906	0.06880	0.06846	0.06799
70.000	0.07772	0.07501	0.07301	0.07153	0.07045	0.06963	0.06894	0.06829	0.06761
87.200	0.08469	0.08102	0.07781	0.07501	0.07269	0.07050	0.06870	0.06719	0.06593

ENGINEER
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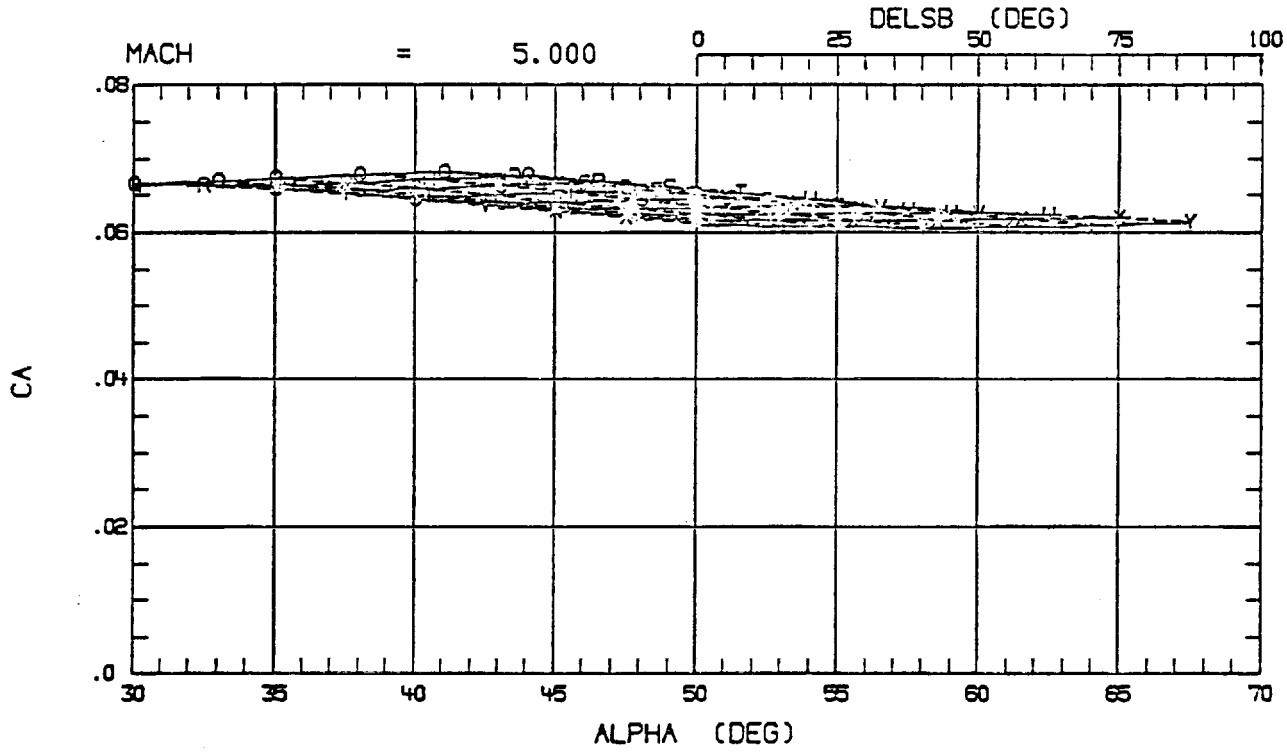
FIGURE 4.1.1.2-46
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06644	0.06514	0.06569	0.06511	0.06441	0.06364	0.06283	0.06195	0.06097
15.000	0.06675	0.06621	0.06554	0.06476	0.06394	0.06311	0.06232	0.06156	0.06076
25.000	0.06713	0.06653	0.06577	0.06490	0.06398	0.06308	0.06224	0.06144	0.06063
40.000	0.06771	0.06708	0.06626	0.06532	0.06430	0.06329	0.06234	0.06145	0.06059
55.000	0.06799	0.06735	0.06652	0.06558	0.06455	0.06352	0.06252	0.06158	0.06064
70.000	0.06761	0.06688	0.06608	0.06521	0.06433	0.06345	0.06259	0.06174	0.06054
87.200	0.06593	0.06489	0.06408	0.06345	0.06297	0.06260	0.06227	0.06187	0.06127

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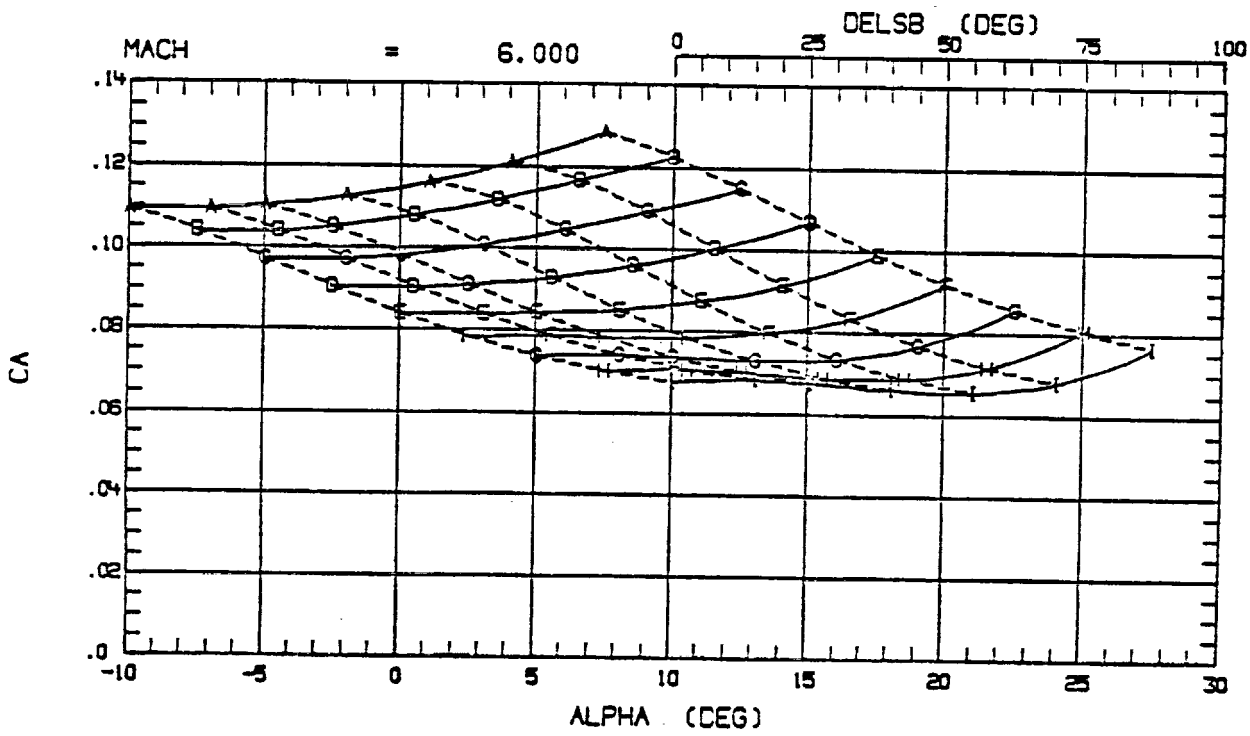
FIGURE 4.1.1.2-47
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.10897	0.10361	0.09707	0.09027	0.08325	0.07621	0.07335	0.06993	0.06736
15.000	0.10919	0.10368	0.09707	0.09029	0.08325	0.07845	0.07395	0.07052	0.06606
25.000	0.10999	0.10477	0.09803	0.09090	0.08415	0.07827	0.07349	0.06999	0.06738
40.000	0.11225	0.10769	0.10087	0.09276	0.08507	0.07828	0.07278	0.06957	0.06594
55.000	0.11591	0.11173	0.10442	0.09591	0.08725	0.07859	0.07333	0.06956	0.06665
70.000	0.12090	0.11646	0.10894	0.10010	0.09127	0.08329	0.07863	0.07152	0.06794
87.200	0.12934	0.12216	0.11451	0.10563	0.09899	0.09181	0.08556	0.08051	0.07637

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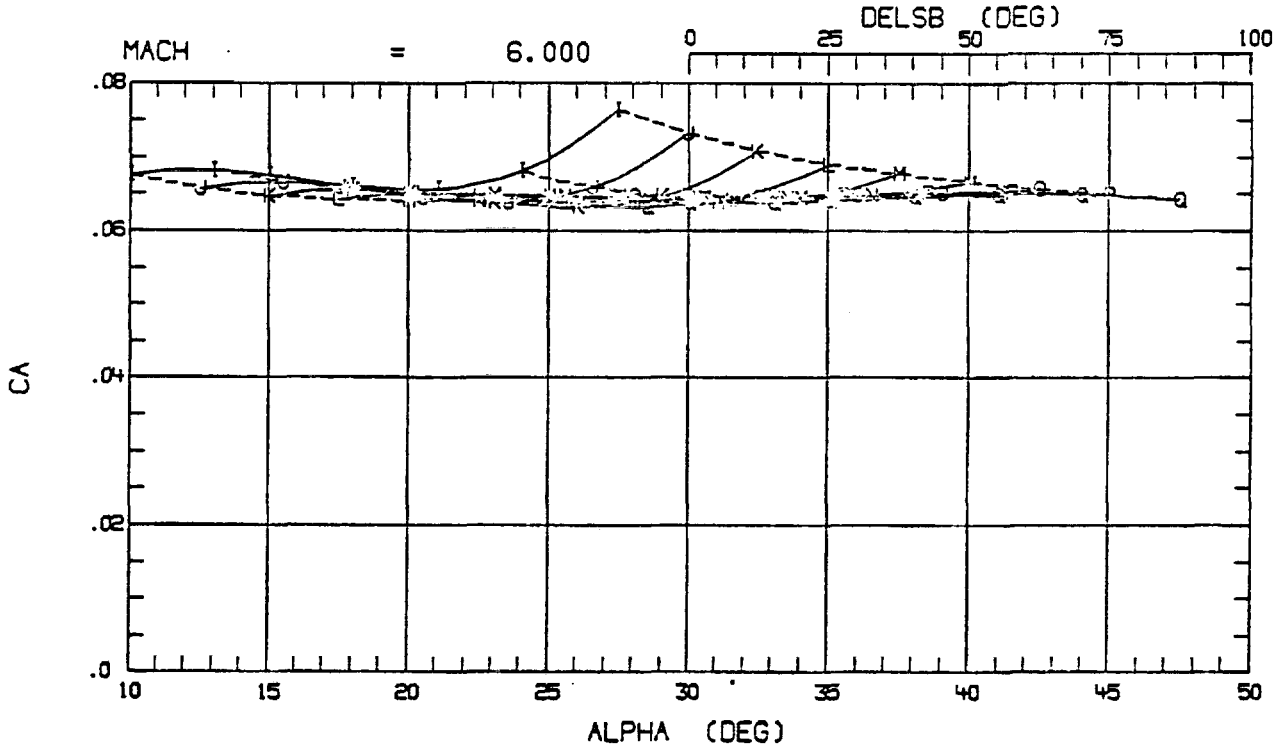
FIGURE 4.1.1.2-4c
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06736	0.06565	0.06464	0.06417	0.06402	0.06403	0.06405	0.06399	0.06374
15.000	0.06806	0.06644	0.06548	0.06498	0.06475	0.06463	0.06447	0.06420	0.06377
25.000	0.06738	0.06582	0.06499	0.06466	0.06461	0.06464	0.06461	0.06442	0.06401
40.000	0.06594	0.06438	0.06373	0.06369	0.06402	0.06443	0.06472	0.06475	0.06448
55.000	0.06555	0.06379	0.06312	0.06319	0.06369	0.06431	0.06481	0.06502	0.06486
70.000	0.06794	0.06572	0.06459	0.06426	0.06441	0.06474	0.06503	0.06511	0.06487
87.200	0.07637	0.07315	0.07071	0.06839	0.06753	0.06548	0.06561	0.06465	0.06411

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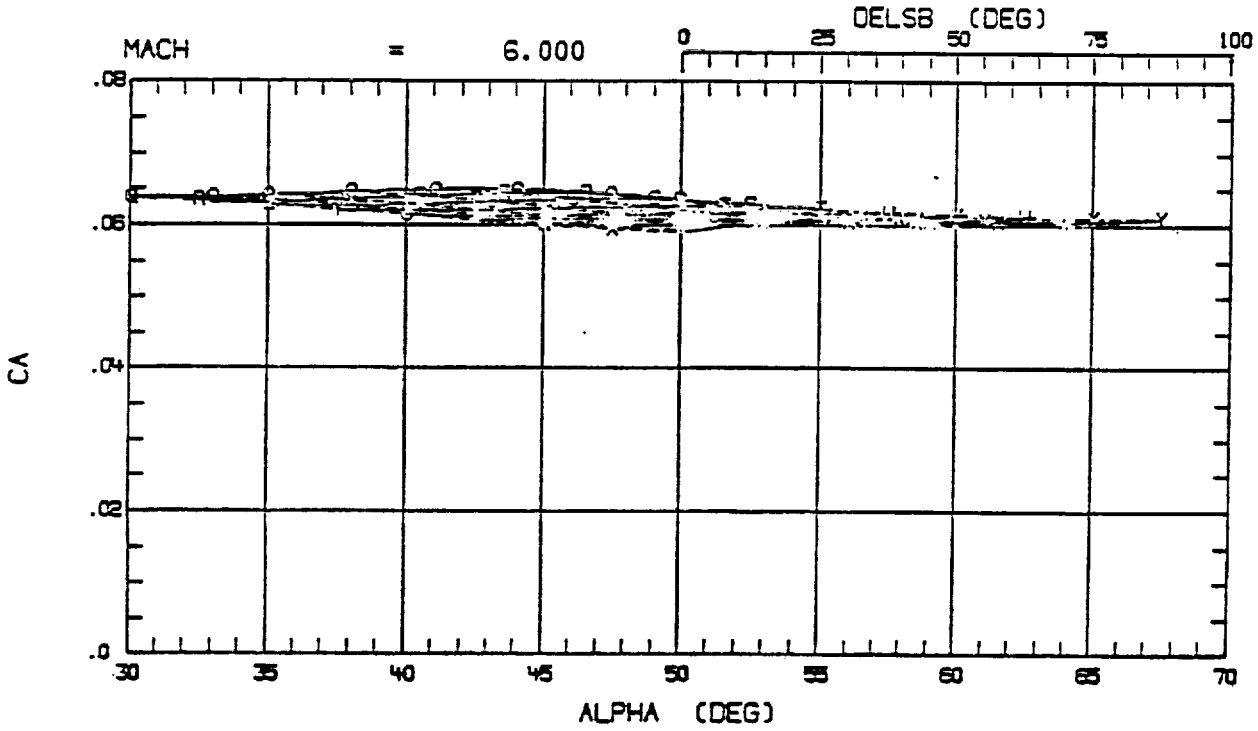
FIGURE 4.1.1.2-49
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.588 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06374	0.06331	0.06272	0.06202	0.06127	0.06055	0.05991	0.05938	0.05890
15.000	0.06377	0.05321	0.06254	0.05184	0.06119	0.05071	0.06042	0.06030	0.06027
25.000	0.06401	0.06342	0.06299	0.05193	0.05125	0.06074	0.06050	0.06050	0.06064
40.000	0.06448	0.06391	0.06311	0.05222	0.05137	0.05073	0.06041	0.06043	0.06068
55.000	0.06466	0.06432	0.06349	0.06250	0.05152	0.06074	0.06029	0.06022	0.06045
70.000	0.06487	0.06432	0.05361	0.06255	0.06162	0.06085	0.06037	0.06023	0.06035
87.200	0.06411	0.06340	0.06271	0.06209	0.05157	0.06122	0.06103	0.06097	0.06090

ENGINEER D-
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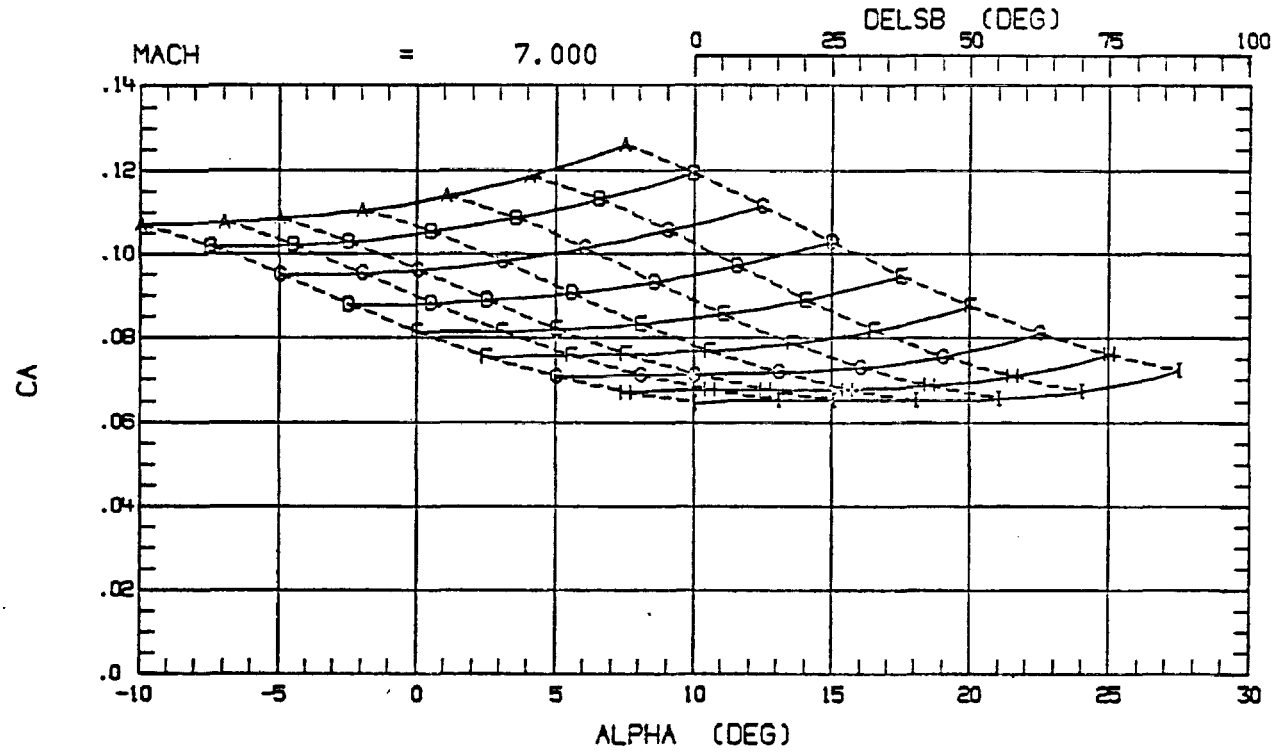
FIGURE 4.1.1.2-50
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.563 FT.
		BODY LENGTH	LB = 1250.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.10685	0.10164	0.09496	0.08792	0.08122	0.07535	0.07057	0.06693	0.06447
15.000	0.10739	0.10187	0.09509	0.08805	0.08145	0.07573	0.07109	0.06760	0.06519
25.000	0.10820	0.10273	0.09587	0.08868	0.08192	0.07602	0.07124	0.06765	0.06516
40.000	0.11026	0.10505	0.09803	0.09047	0.08323	0.07625	0.07165	0.06769	0.06497
55.000	0.11354	0.10848	0.10125	0.09326	0.08549	0.07656	0.07282	0.06844	0.06535
70.000	0.11827	0.11295	0.10541	0.09708	0.08894	0.08160	0.07545	0.07053	0.06714
87.200	0.12577	0.11921	0.11119	0.10274	0.09462	0.08730	0.08105	0.07556	0.07202

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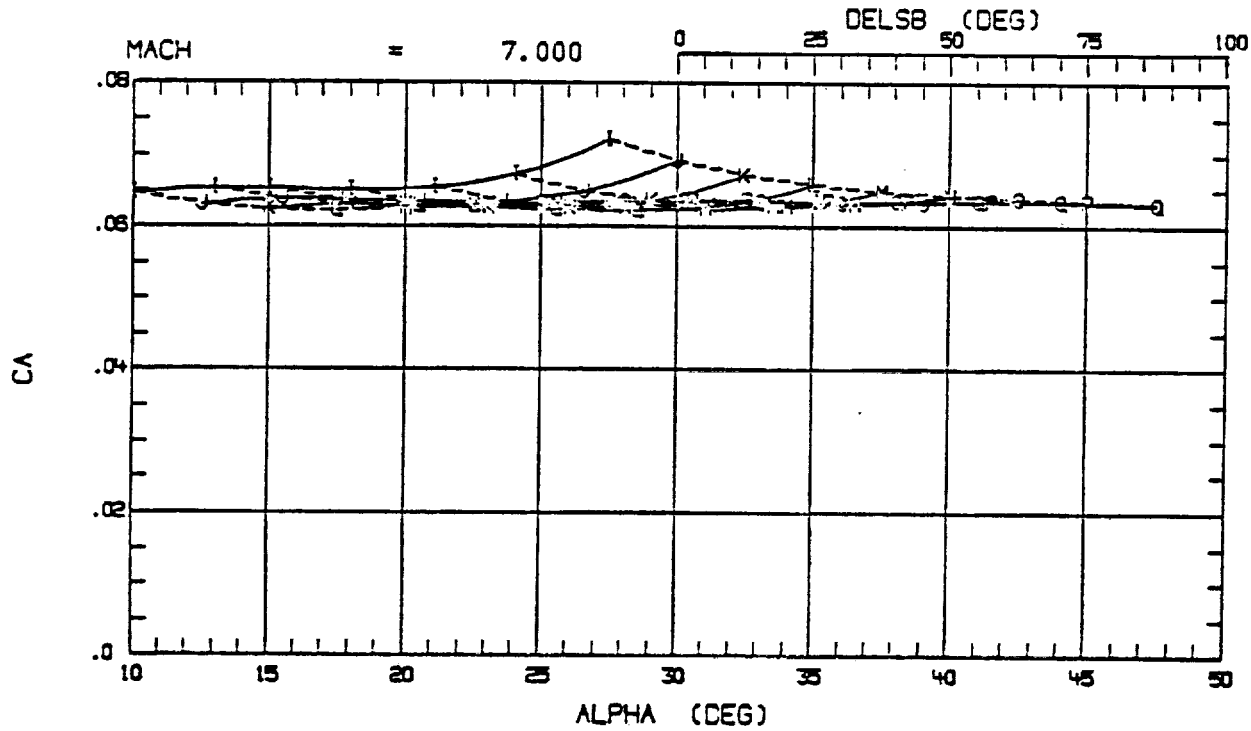
FIGURE 4.1.1.2-51
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06447	0.06296	0.06225	0.06213	0.06235	0.06273	0.06311	0.06335	0.06339
15.000	0.05519	0.05372	0.05299	0.05279	0.05291	0.05316	0.05337	0.05346	0.05338
25.000	0.05516	0.05365	0.05292	0.05273	0.05295	0.05312	0.05335	0.05346	0.05335
40.000	0.05497	0.05331	0.05252	0.05233	0.05253	0.05237	0.05321	0.05339	0.05336
55.000	0.05535	0.05343	0.05245	0.05217	0.05233	0.05270	0.05307	0.05332	0.05334
70.000	0.05714	0.05483	0.05350	0.05290	0.05290	0.05295	0.05317	0.05330	0.05325
87.200	0.07202	0.06911	0.06709	0.06571	0.06483	0.06425	0.06383	0.06345	0.06303

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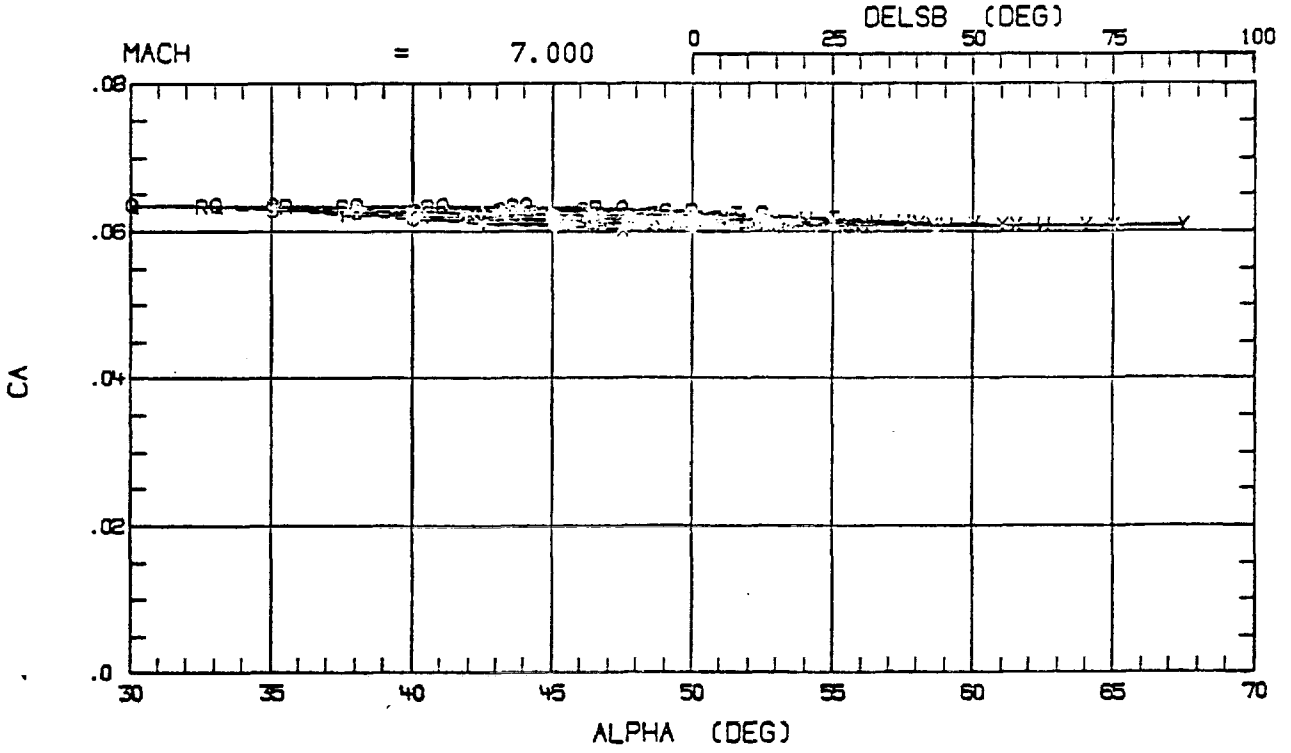
FIGURE 4.1.1.2-52
BASIC AXIAL FORCE COEFFICIENT

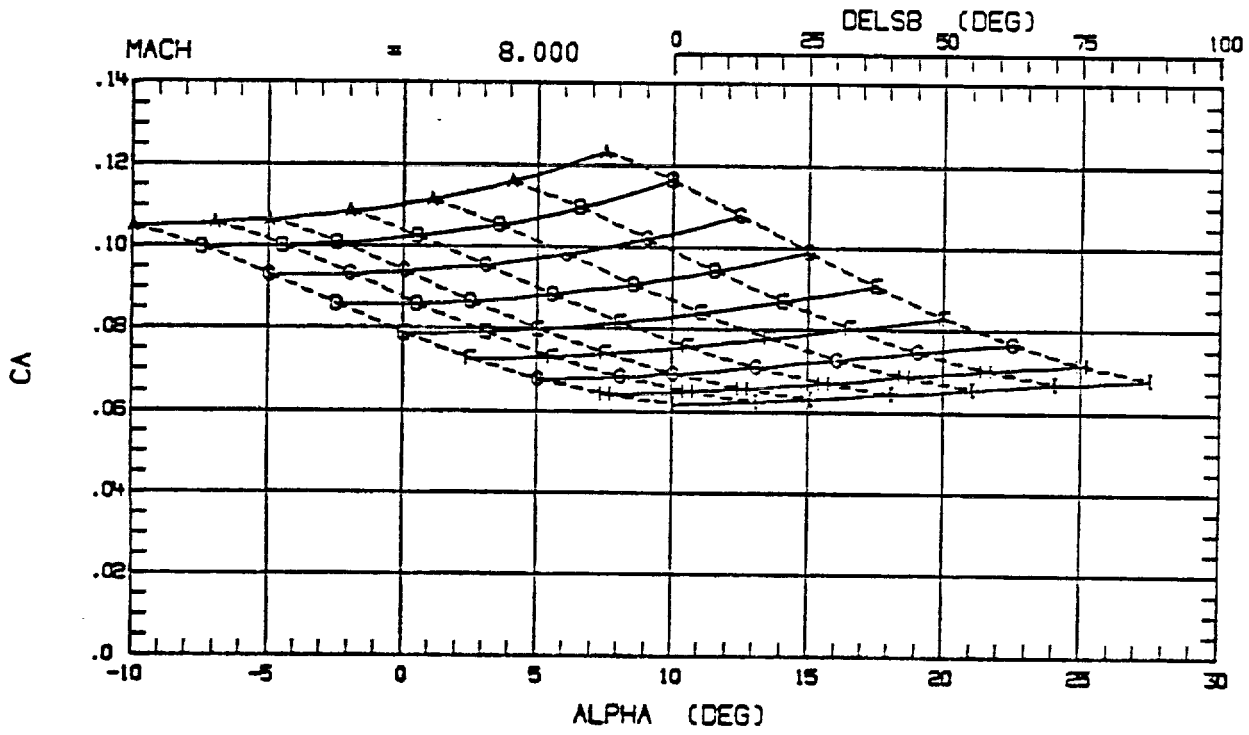


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06339	0.06319	0.06278	0.06222	0.06160	0.06101	0.06051	0.06015	0.05988
15.000	0.06336	0.06305	0.06259	0.06203	0.06148	0.06101	0.06071	0.06057	0.06056
25.000	0.06335	0.06305	0.06258	0.06203	0.06149	0.06104	0.06079	0.06071	0.06075
40.000	0.06336	0.06311	0.06256	0.06211	0.06154	0.06110	0.06082	0.06076	0.06082
55.000	0.06334	0.06313	0.06271	0.06216	0.06158	0.06110	0.06079	0.06069	0.06074
70.000	0.06326	0.06301	0.06259	0.06206	0.06151	0.06104	0.06073	0.06063	0.06065
87.200	0.06303	0.06257	0.06206	0.06157	0.06113	0.06083	0.06088	0.06069	0.06076

ENGINEER D.L.
DATE 3-82

FIGURE 4.1.1.2-53
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.10466	0.09957	0.09277	0.08648	0.07864	0.07248	0.06759	0.06398	0.06160
15.000	0.10553	0.10000	0.09305	0.08677	0.07892	0.07299	0.06822	0.06468	0.06232
25.000	0.10534	0.10085	0.09367	0.08845	0.07968	0.07330	0.06903	0.06544	0.06299
40.000	0.10926	0.10234	0.09536	0.09819	0.09145	0.07554	0.07056	0.06688	0.06416
55.000	0.11125	0.10515	0.09905	0.09075	0.08386	0.07773	0.07258	0.06846	0.06542
70.000	0.11572	0.10935	0.10186	0.09412	0.08674	0.08014	0.07455	0.07005	0.06663
87.200	0.12310	0.11623	0.10777	0.09991	0.09044	0.08290	0.07855	0.07152	0.06776

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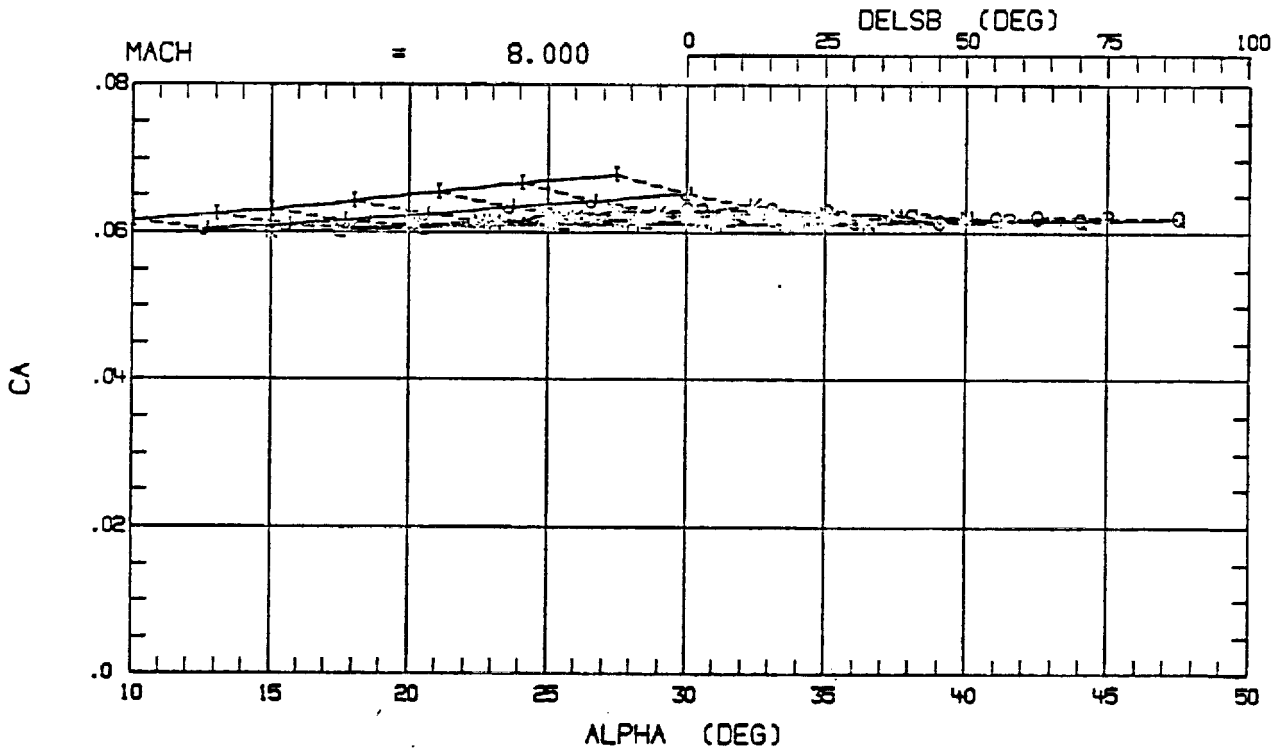
FIGURE 4.1.1.2-54
BASIC AXIAL FORCE COEFFICIENT

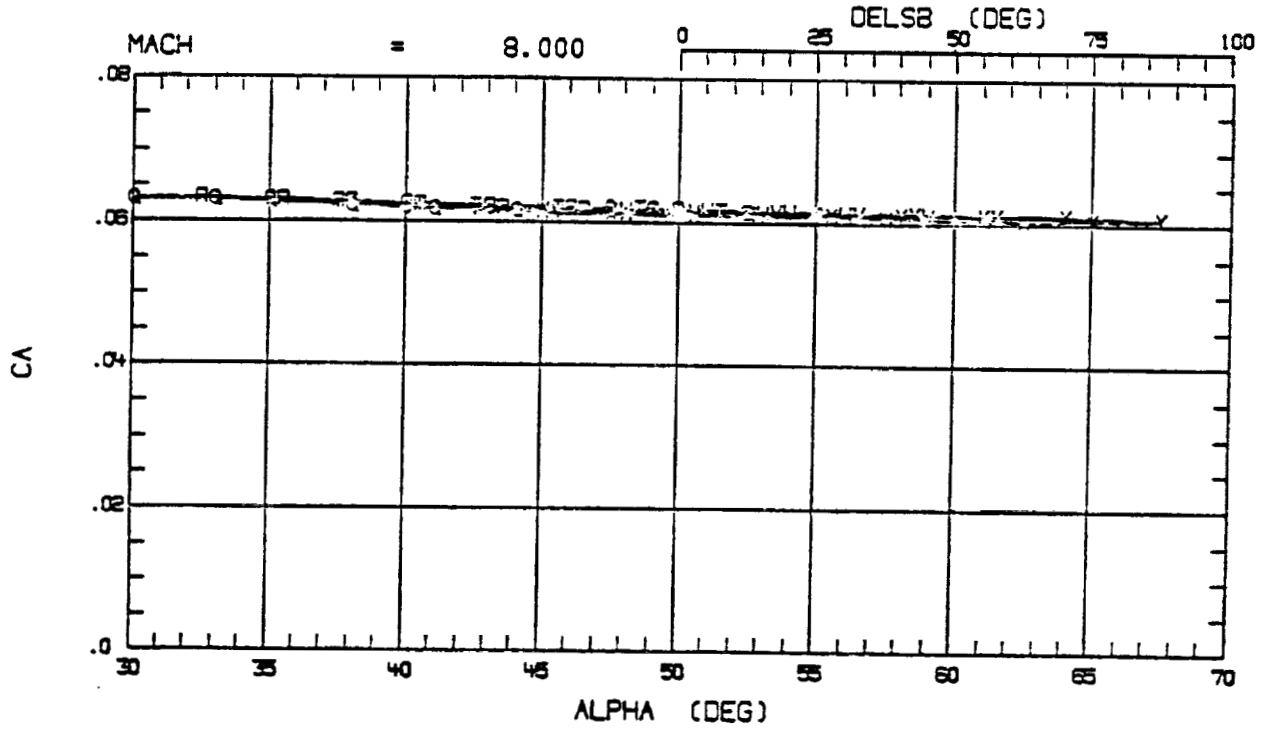


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06160	0.06031	0.05988	0.06003	0.06067	0.06142	0.06214	0.06271	0.06302
15.000	0.06232	0.06099	0.06049	0.06059	0.06105	0.06166	0.06226	0.06271	0.06293
25.000	0.06299	0.06152	0.06086	0.06080	0.06110	0.06159	0.06209	0.06248	0.06269
40.000	0.06416	0.06239	0.06141	0.06102	0.06105	0.06132	0.06167	0.06200	0.06222
55.000	0.06542	0.06329	0.06196	0.06127	0.06103	0.06109	0.06131	0.06156	0.06178
70.000	0.06663	0.06419	0.06260	0.06168	0.06127	0.06118	0.06128	0.06144	0.06159
87.200	0.06776	0.06515	0.06349	0.06256	0.06214	0.06202	0.06203	0.06203	0.06194

ENGINEER D²
DATE 3-15-72

FIGURE 4.1.1.2-55
BASIC AXIAL FORCE COEFFICIENT



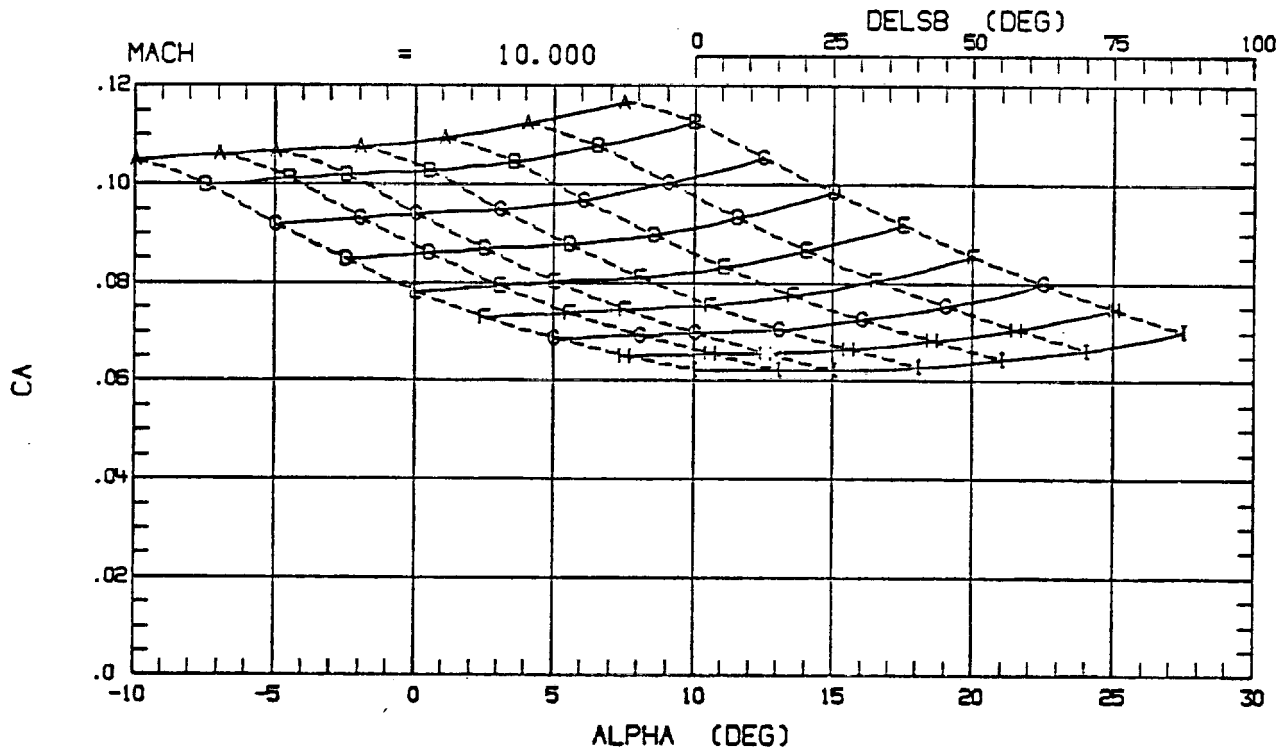
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.569 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.05302	0.05307	0.05286	0.05248	0.05202	0.05158	0.05125	0.05110	0.05103
15.000	0.05293	0.05291	0.05257	0.05228	0.05183	0.05141	0.05112	0.05097	0.05096
25.000	0.05259	0.05270	0.05251	0.05218	0.05180	0.05144	0.05116	0.05103	0.05097
40.000	0.05222	0.05229	0.05222	0.05203	0.05179	0.05154	0.05133	0.05118	0.05106
55.000	0.05178	0.05190	0.05192	0.05184	0.05171	0.05155	0.05141	0.05129	0.05112
70.000	0.05153	0.05166	0.05164	0.05156	0.05143	0.05130	0.05120	0.05113	0.05105
97.200	0.05154	0.05173	0.05141	0.05104	0.05059	0.05044	0.05037	0.05045	0.05065

ENGINEER
DATE

FIGURE 4.1.1.2-56
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.10464	0.09989	0.09159	0.09455	0.07790	0.07275	0.06846	0.06501	0.06200
15.000	0.10592	0.10099	0.09296	0.08588	0.07920	0.07378	0.06917	0.06537	0.06200
25.000	0.10670	0.10160	0.09380	0.08670	0.08000	0.07440	0.06960	0.06560	0.06200
40.000	0.10749	0.10266	0.09473	0.08756	0.08099	0.07531	0.07042	0.06634	0.06265
55.000	0.10924	0.10451	0.09669	0.08965	0.08300	0.07729	0.07236	0.06812	0.06429
70.000	0.11228	0.10774	0.10012	0.09306	0.08640	0.08037	0.07509	0.07048	0.06624
87.200	0.11679	0.11259	0.10530	0.09931	0.09170	0.08532	0.07967	0.07465	0.06997

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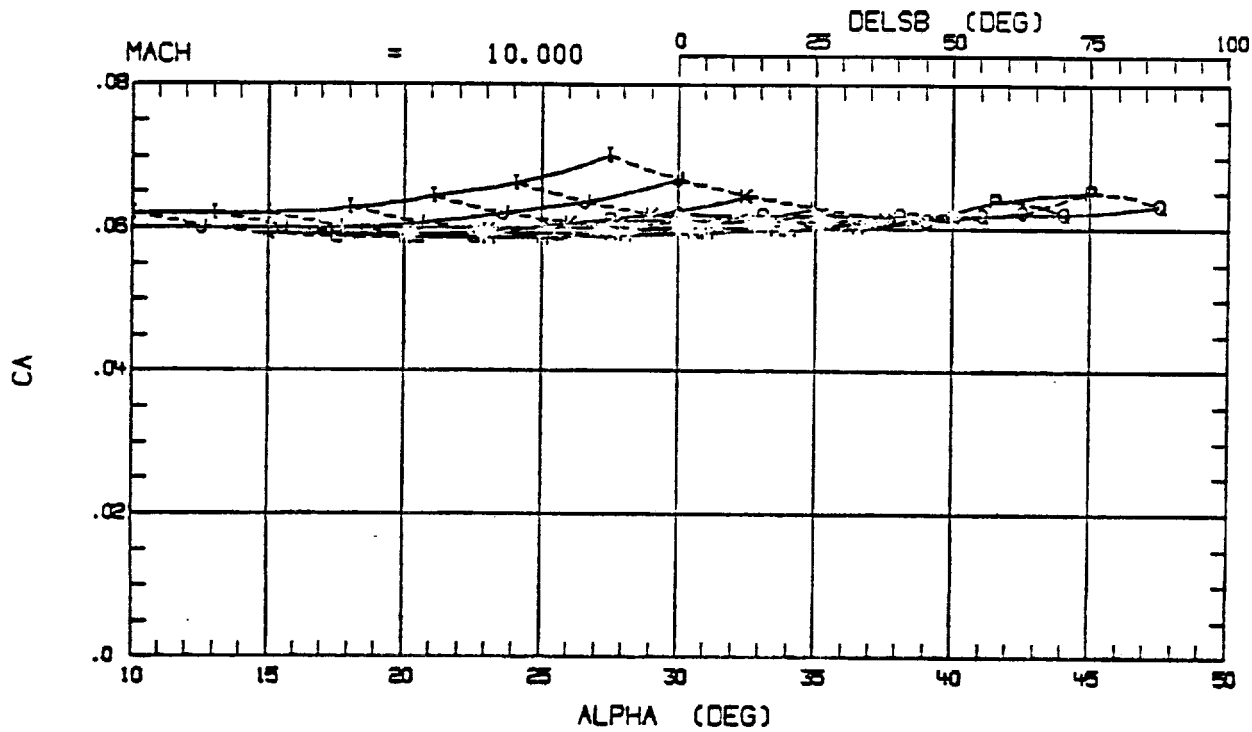
FIGURE 4.1.1.2-57
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.569 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06200	0.06000	0.05900	0.05860	0.05850	0.05900	0.06000	0.06085	0.06170
15.000	0.06200	0.06000	0.05900	0.05860	0.05850	0.05900	0.06000	0.06095	0.06170
25.000	0.06200	0.06000	0.05900	0.05860	0.05850	0.05900	0.06000	0.06095	0.06170
40.000	0.06263	0.06098	0.05950	0.05905	0.05899	0.05933	0.06026	0.06098	0.06170
55.000	0.06429	0.06192	0.06056	0.05977	0.05929	0.05967	0.06052	0.06116	0.06180
70.000	0.06624	0.06352	0.06178	0.06084	0.05977	0.06011	0.06032	0.06370	0.06190
87.200	0.05997	0.06573	0.06443	0.06269	0.06119	0.05145	0.06219	0.06490	0.06309

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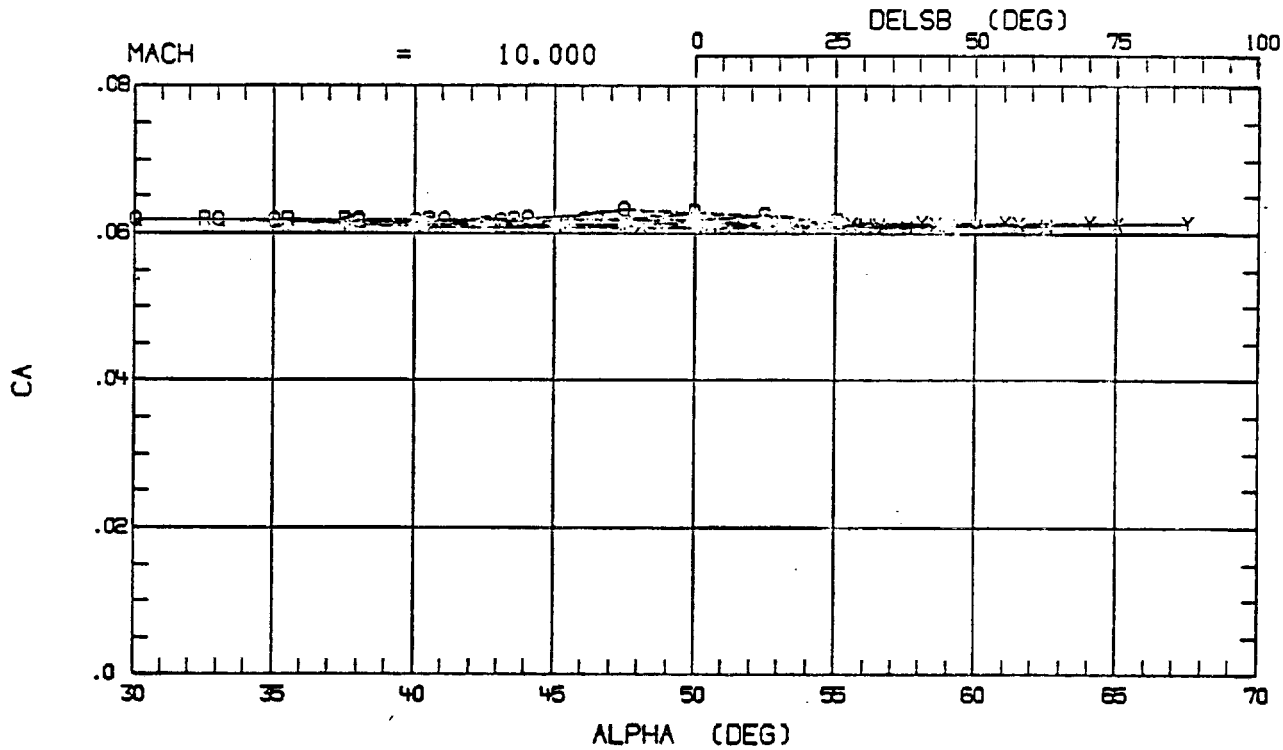
FIGURE 4.1.1.2-58
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06170	0.06164	0.06160	0.06120	0.06080	0.06090	0.06100	0.06115	0.06130
15.000	0.06170	0.06164	0.06160	0.06120	0.06080	0.06090	0.06100	0.06115	0.06130
25.000	0.06170	0.06164	0.06160	0.06120	0.06080	0.06090	0.06100	0.06115	0.06130
40.000	0.06170	0.06164	0.06160	0.06120	0.06080	0.06090	0.06100	0.06115	0.06130
55.000	0.06180	0.06171	0.06164	0.06122	0.06080	0.06090	0.06100	0.06115	0.06130
70.000	0.06190	0.06178	0.06167	0.06123	0.06080	0.06090	0.06100	0.06115	0.06130
87.200	0.06308	0.06269	0.06228	0.06154	0.06080	0.06090	0.06100	0.06115	0.06130

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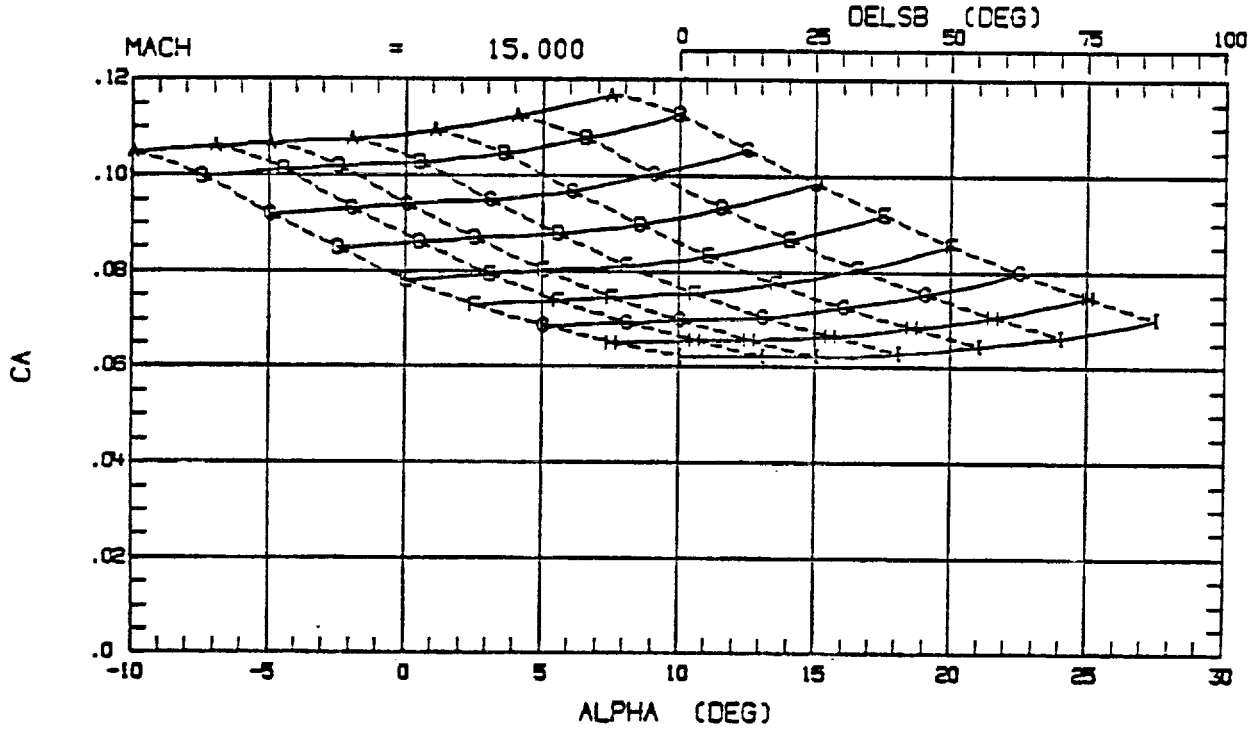
FIGURE 4.1.1.2-59
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.538 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.10464	0.09969	0.09159	0.08455	0.07790	0.07275	0.06946	0.06601	0.05200
15.000	0.10552	0.10099	0.09296	0.08588	0.07920	0.07378	0.06917	0.06537	0.05200
25.000	0.10570	0.10160	0.09380	0.08670	0.08000	0.07440	0.06960	0.06550	0.05200
40.000	0.10749	0.10256	0.09473	0.08756	0.08099	0.07531	0.07042	0.06634	0.05265
55.000	0.10924	0.10451	0.09669	0.08965	0.08300	0.07729	0.07236	0.06812	0.06429
70.000	0.11229	0.10774	0.10012	0.09306	0.08640	0.08037	0.07509	0.07048	0.06624
87.200	0.11679	0.11259	0.10530	0.09931	0.09170	0.08532	0.07957	0.07485	0.06997

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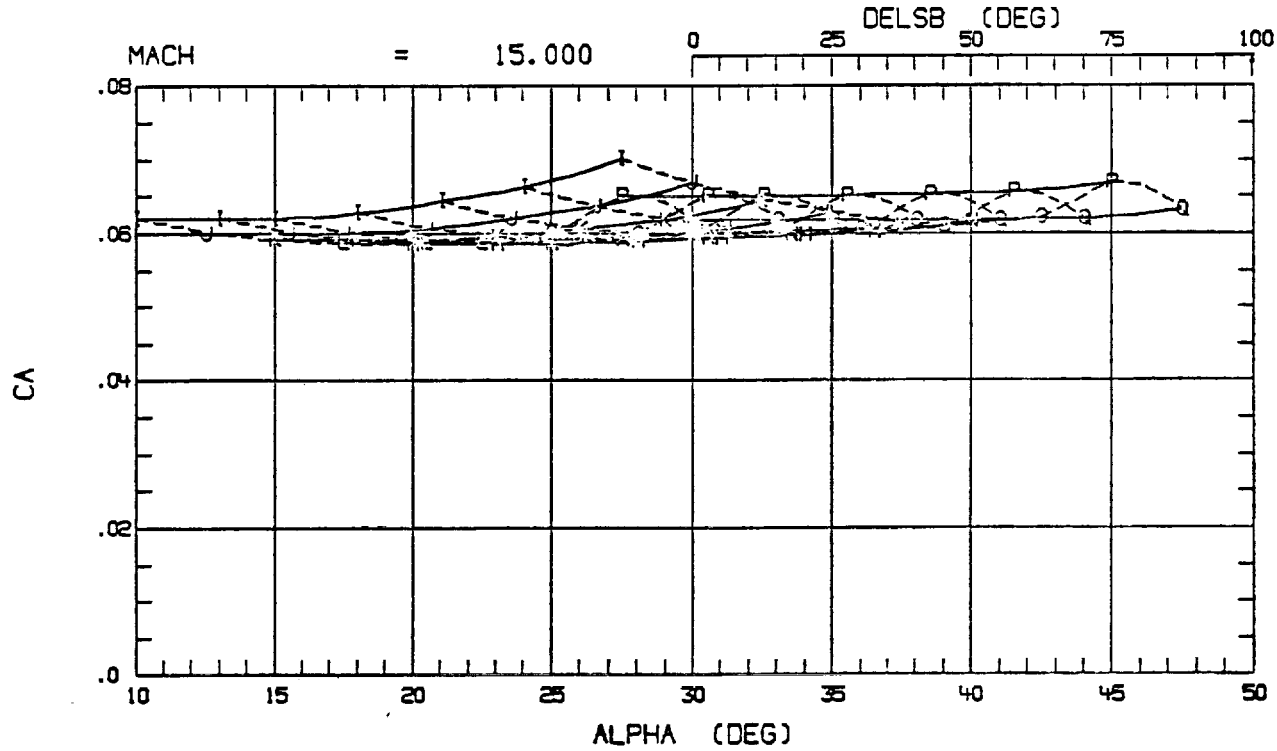
FIGURE 4.1.1.2-60
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06200	0.06000	0.05900	0.05860	0.05850	0.05900	0.06000	0.06493	0.06170
15.000	0.06200	0.06000	0.05900	0.05860	0.05850	0.05900	0.06000	0.06493	0.06170
25.000	0.06200	0.06000	0.05900	0.05860	0.05850	0.05900	0.06000	0.06493	0.06170
40.000	0.06285	0.06058	0.05950	0.05905	0.05888	0.05933	0.06026	0.06507	0.06170
55.000	0.06428	0.06192	0.06056	0.05977	0.05929	0.05967	0.06052	0.06525	0.06180
70.000	0.06624	0.06352	0.06178	0.06064	0.05977	0.06011	0.06092	0.06350	0.06190
87.200	0.06997	0.06673	0.06443	0.06253	0.06118	0.06145	0.06219	0.06572	0.06308

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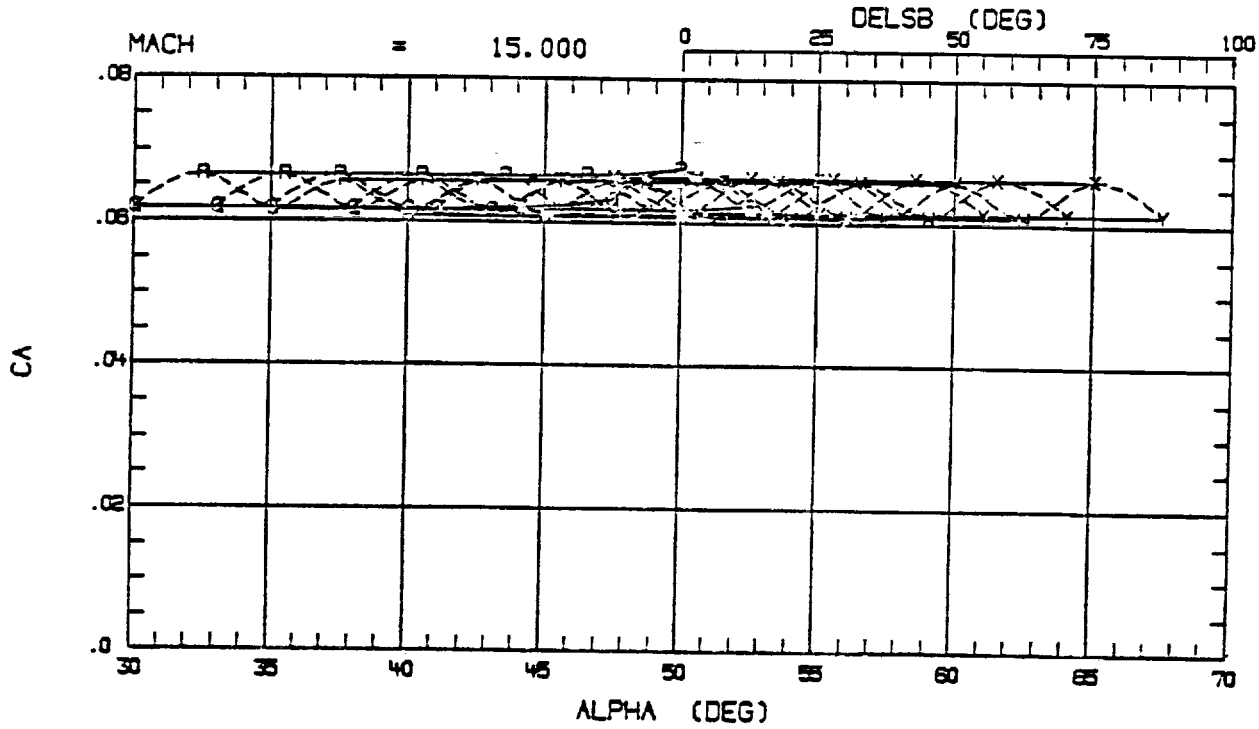
FIGURE 4.1.1.2-61
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06170	0.06639	0.06160	0.06561	0.05080	0.06576	0.06100	0.06611	0.06130
15.000	0.06170	0.06639	0.06160	0.06561	0.05080	0.06576	0.06100	0.06611	0.06130
25.000	0.06170	0.06639	0.06160	0.06561	0.06080	0.06576	0.06100	0.06611	0.06130
40.000	0.06170	0.06639	0.06160	0.06561	0.06080	0.06576	0.06100	0.06611	0.06130
55.000	0.06160	0.06646	0.06164	0.06563	0.06080	0.06576	0.06100	0.06611	0.06130
70.000	0.06190	0.06653	0.06167	0.06565	0.06080	0.06576	0.06100	0.06611	0.06130
87.200	0.06309	0.06743	0.06229	0.06596	0.06080	0.06576	0.06100	0.06611	0.06130

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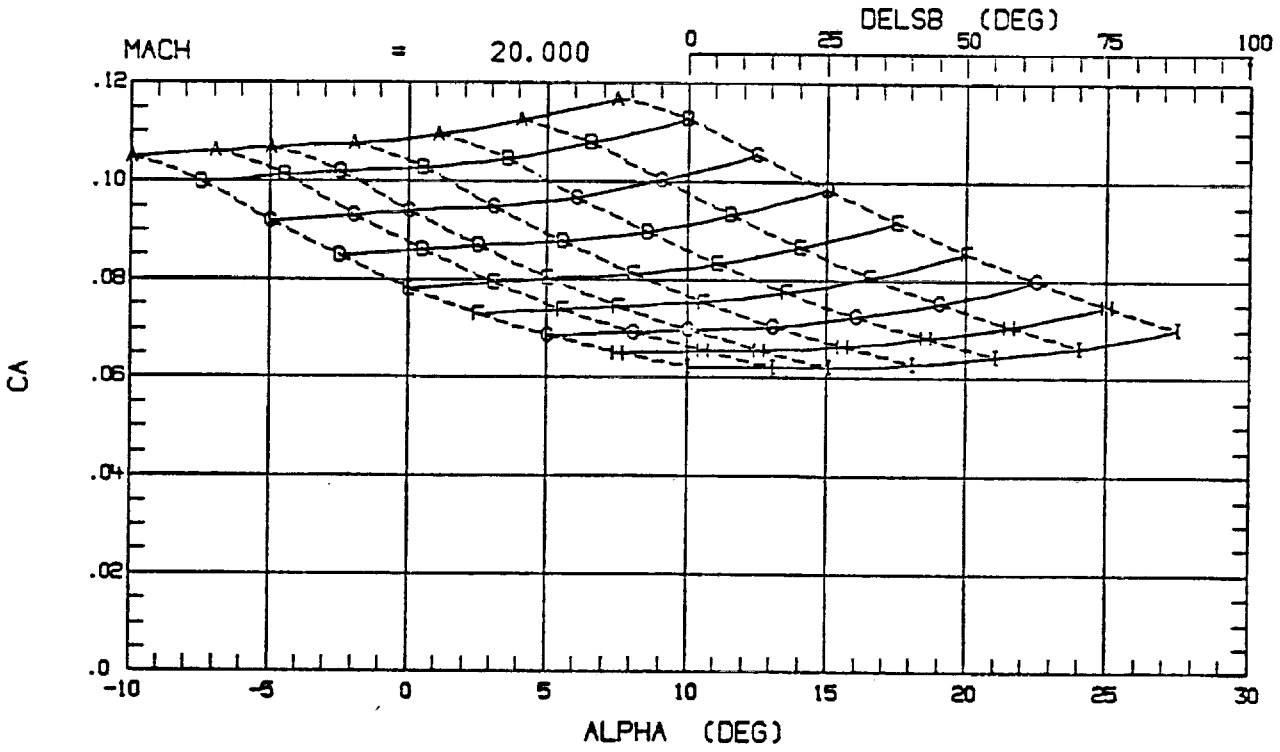
FIGURE 4.1.1.2-62
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.569 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.10464	0.09969	0.09159	0.08455	0.07790	0.07275	0.06846	0.06501	0.06200
15.000	0.10592	0.10099	0.09296	0.08568	0.07920	0.07378	0.06917	0.06537	0.06200
25.000	0.10670	0.10180	0.09380	0.08670	0.08000	0.07440	0.06960	0.06560	0.06200
40.000	0.10749	0.10266	0.09473	0.08766	0.08099	0.07531	0.07042	0.06634	0.06285
55.000	0.10924	0.10451	0.09669	0.08965	0.08300	0.07729	0.07236	0.06812	0.06428
70.000	0.11229	0.10774	0.10012	0.09306	0.08640	0.08037	0.07509	0.07048	0.06624
87.200	0.11679	0.11259	0.10530	0.09831	0.09170	0.08532	0.07967	0.07465	0.06997

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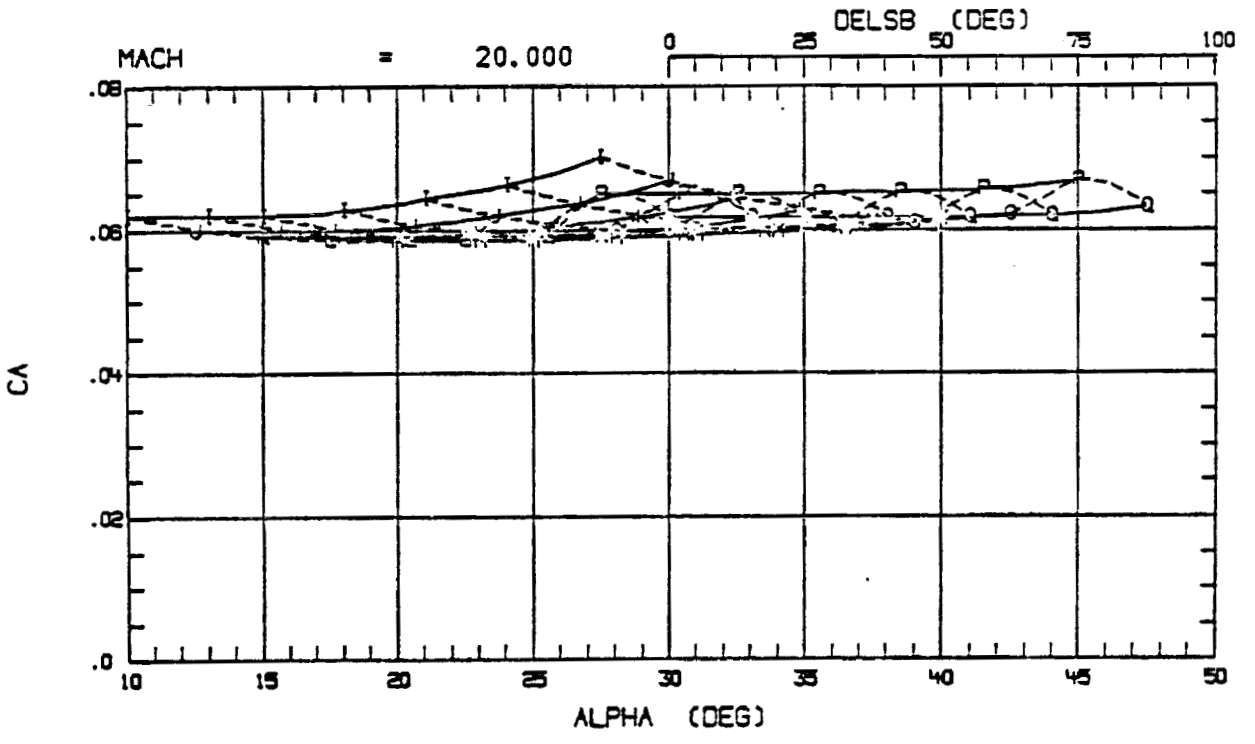
FIGURE 4.1.1.2-63
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.563 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06200	0.06000	0.05900	0.05860	0.05850	0.05900	0.06000	0.06493	0.06170
15.000	0.06200	0.06000	0.05900	0.05860	0.05850	0.05900	0.06000	0.06493	0.06170
25.000	0.06200	0.06000	0.05900	0.05860	0.05850	0.05900	0.06000	0.06493	0.06170
40.000	0.06255	0.06059	0.05860	0.05505	0.05688	0.05933	0.06025	0.06507	0.06170
55.000	0.06423	0.06192	0.06056	0.05977	0.05929	0.05967	0.06052	0.06525	0.06180
70.000	0.06524	0.06352	0.06178	0.06064	0.05977	0.06011	0.06092	0.06550	0.06190
87.200	0.06997	0.06573	0.06443	0.06258	0.06118	0.06145	0.06219	0.06572	0.06302

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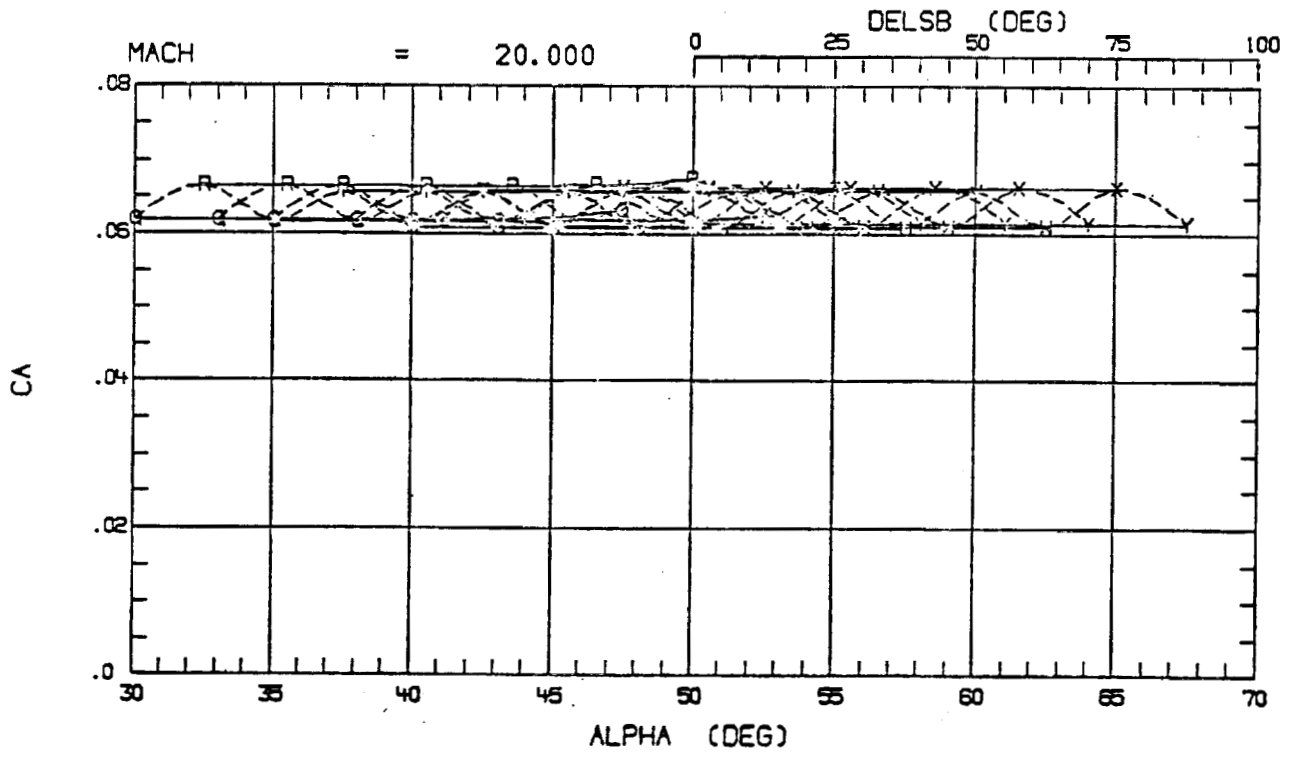
FIGURE 4.1.1.2-64
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	AXIAL FORCE COEFFICIENT								
0.0	0.06170	0.06639	0.06160	0.06561	0.06080	0.06576	0.06100	0.06611	0.06130
15.000	0.06170	0.06639	0.06160	0.06561	0.06080	0.06576	0.06100	0.06611	0.06130
25.000	0.06170	0.06639	0.06160	0.06561	0.06080	0.06576	0.06100	0.06611	0.06130
40.000	0.06170	0.06639	0.06160	0.06561	0.06080	0.06576	0.06100	0.06611	0.06130
55.000	0.06180	0.06646	0.06164	0.06563	0.06080	0.06576	0.06100	0.06611	0.06130
70.000	0.06190	0.06653	0.06167	0.06565	0.06080	0.06576	0.06100	0.06611	0.06130
87.200	0.06308	0.06743	0.06228	0.06596	0.06080	0.06576	0.06100	0.06611	0.06130

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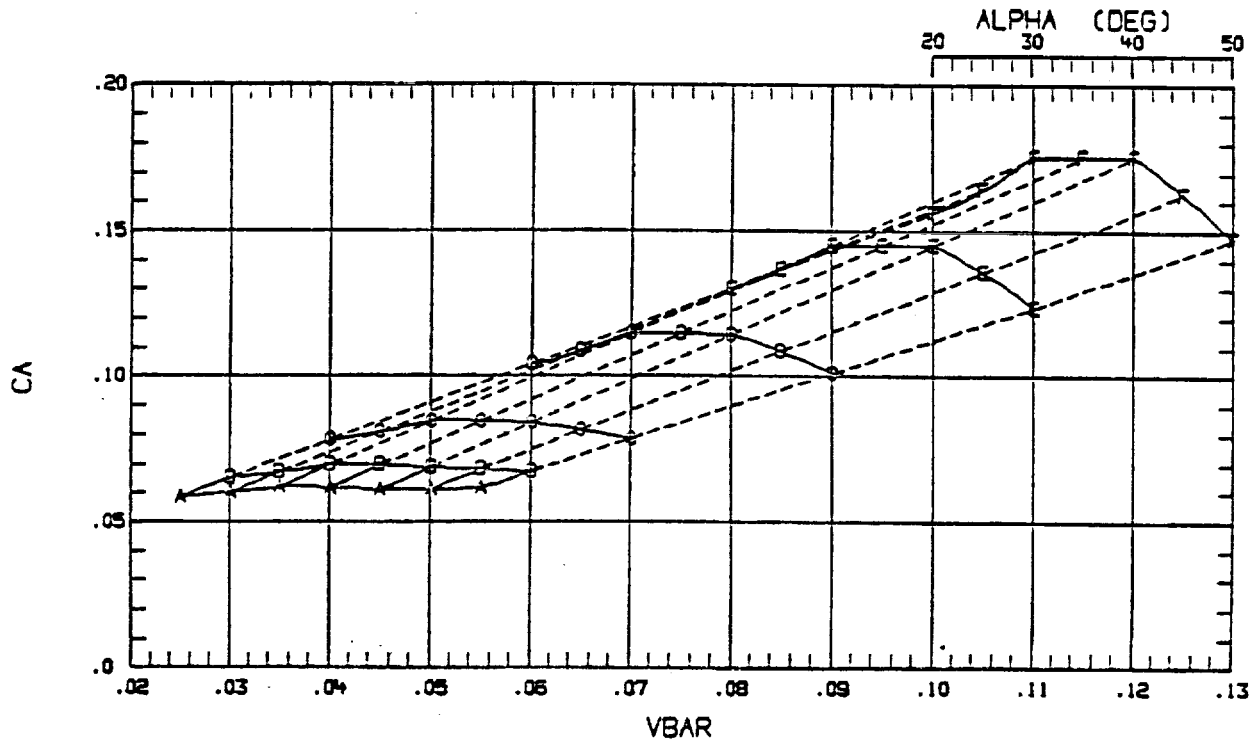
FIGURE 4.1.1.2-65
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	VBAR					
	0.005	0.010	0.020	0.040	0.060	0.080
	A	B	C	D	E	F
ALPHA (DEG)	VISCOUS AXIAL FORCE COEFFICIENT					
20.000	0.05850	0.06500	0.07800	0.10400	0.13000	0.15600
25.000	0.06000	0.06690	0.08080	0.10850	0.13630	0.16400
30.000	0.06170	0.06930	0.08440	0.11460	0.14480	0.17500
35.000	0.06160	0.06930	0.08440	0.11460	0.14480	0.17500
40.000	0.06080	0.06840	0.08360	0.11410	0.14450	0.17500
45.000	0.06100	0.06780	0.08130	0.10840	0.13540	0.16250
50.000	0.06130	0.06690	0.07830	0.10100	0.12350	0.14700

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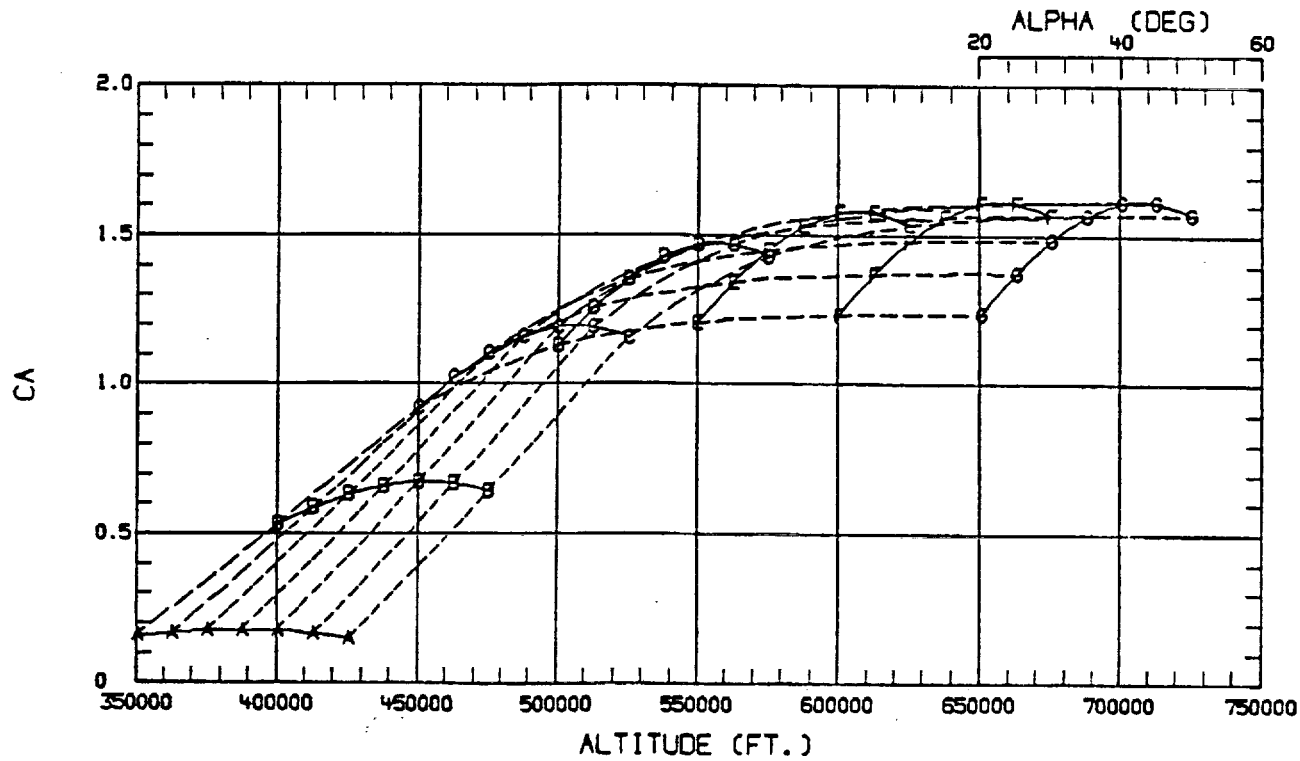
FIGURE 4.1.1.2-66
BASIC AXIAL FORCE COEFFICIENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALTITUDE AXIAL FORCE						
20.000	0.15600	0.52910	0.91800	1.12600	1.20470	1.22960	1.23350
25.000	0.16400	0.58230	1.01830	1.25150	1.33980	1.36770	1.37200
30.000	0.17500	0.62780	1.09990	1.35230	1.44780	1.47810	1.48270
35.000	0.17500	0.65570	1.15690	1.42490	1.52630	1.55840	1.56340
40.000	0.17500	0.67170	1.18950	1.46650	1.57120	1.60440	1.60950
45.000	0.16250	0.66380	1.18640	1.46600	1.57170	1.60520	1.61040
50.000	0.14700	0.63930	1.15250	1.42700	1.53080	1.56370	1.56880

ENGINEER NASA
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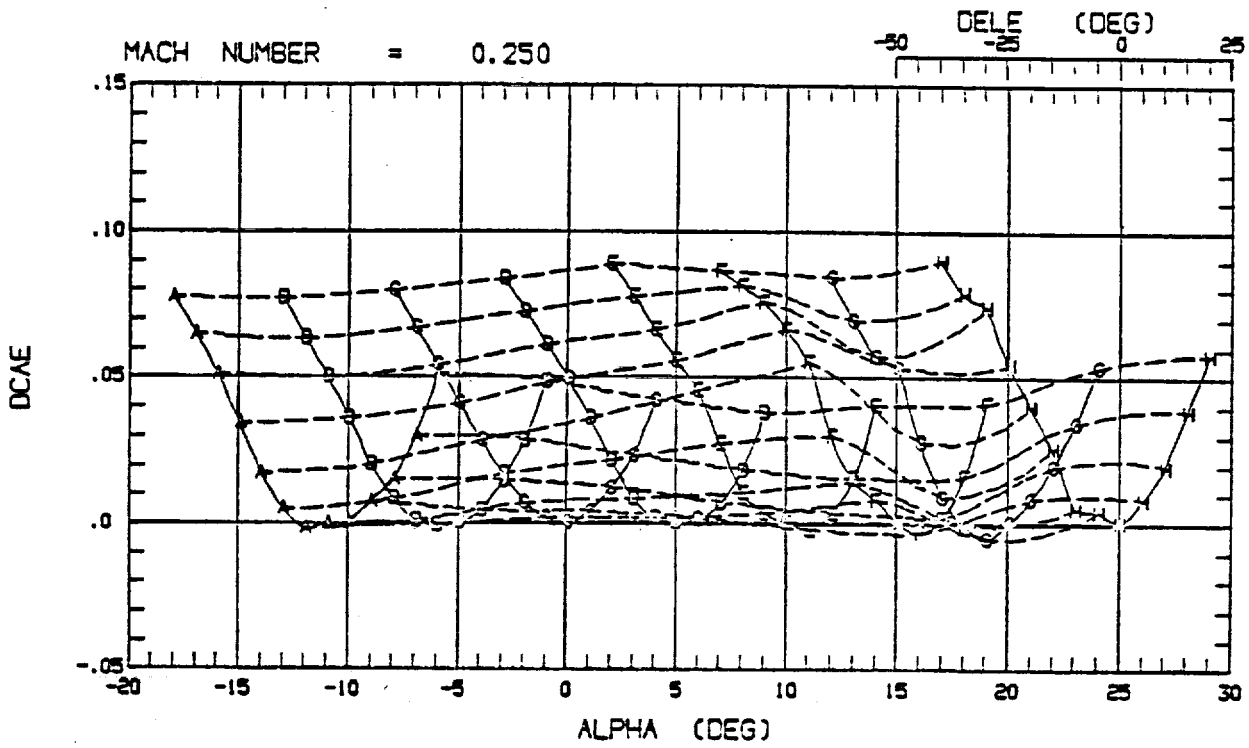
FIGURE 4.1.1.2-67
BASIC AXIAL FORCE COEFFICIENT



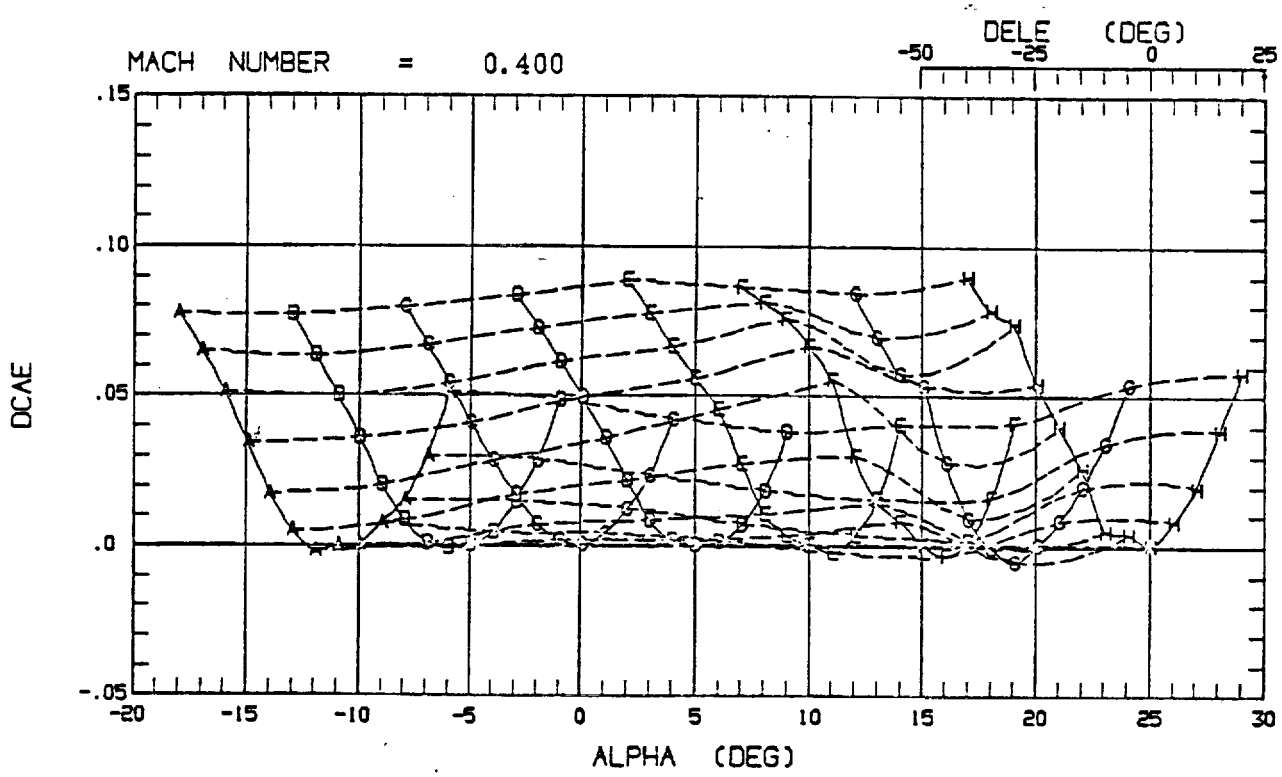
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2590.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.07752	0.07697	0.07960	0.08361	0.08835	0.08598	0.08381	0.08947
-35.000	0.06460	0.06320	0.06700	0.07258	0.07751	0.08083	0.06949	0.07835
-30.000	0.05126	0.05009	0.05400	0.06127	0.06610	0.07541	0.05696	0.07373
-25.000	0.03426	0.03589	0.04100	0.04936	0.05567	0.06625	0.05295	0.05393
-20.000	0.01710	0.01997	0.02800	0.03575	0.04536	0.05495	0.02752	0.03976
-15.000	0.00461	0.00816	0.01700	0.02164	0.02724	0.02959	0.00911	0.02568
-10.000	-0.00197	0.00080	0.00700	0.00629	0.01057	0.01395	-0.00066	0.00507
-5.000	-0.00033	-0.00057	0.00200	0.00157	0.00323	0.00798	-0.00555	0.00393
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00731	0.00412	0.00400	0.00130	-0.00248	-0.00346	0.00823	0.00791
10.000	0.01488	0.01448	0.01200	0.00688	0.00350	0.00164	0.01942	0.01917
15.000	0.02952	0.02839	0.02300	0.01787	0.01527	0.01576	0.03446	0.03844
20.000	0.05095	0.04824	0.04200	0.03757	0.04031	0.04069	0.05373	0.05768

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-66
EFFECT OF ELEVON

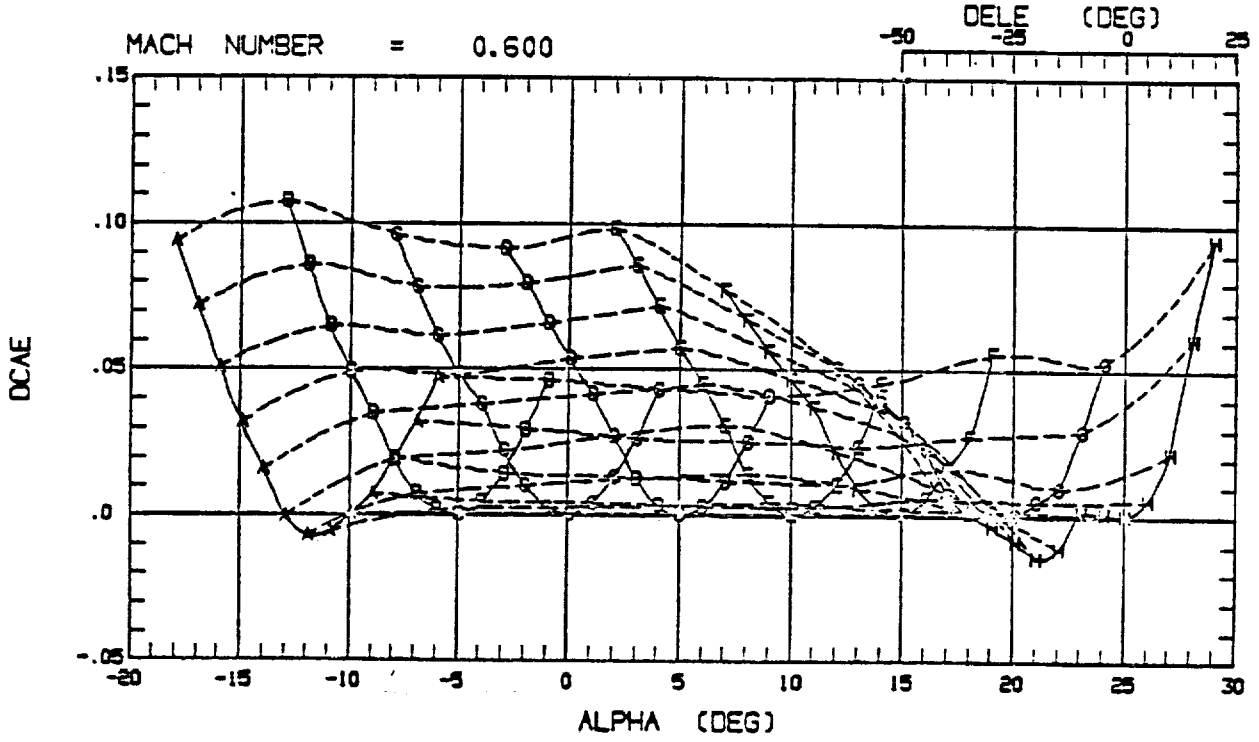


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.07752	0.07697	0.07960	0.08361	0.08835	0.08598	0.08381	0.08947
-35.000	0.06460	0.06320	0.06700	0.07258	0.07751	0.08083	0.06949	0.07835
-30.000	0.05126	0.05009	0.05400	0.06127	0.06610	0.07541	0.05696	0.07373
-25.000	0.03426	0.03589	0.04100	0.04936	0.05567	0.06625	0.05295	0.05393
-20.000	0.01710	0.01997	0.02800	0.03575	0.04536	0.05495	0.02752	0.03976
-15.000	0.00461	0.00816	0.01700	0.02164	0.02724	0.02959	0.00911	0.02569
-10.000	-0.00197	0.00080	0.00700	0.00829	0.01057	0.01395	-0.00066	0.00507
-5.000	-0.00033	-0.00057	0.00200	0.00157	0.00323	0.00798	-0.00555	0.00393
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00731	0.00412	0.00400	0.00130	-0.00248	-0.00346	0.00823	0.00791
10.000	0.01488	0.01448	0.01200	0.00688	0.00350	0.00164	0.01942	0.01917
15.000	0.02962	0.02839	0.02300	0.01787	0.01527	0.01576	0.03446	0.03844
20.000	0.05095	0.04824	0.04200	0.03757	0.04031	0.04069	0.05373	0.05768

ENGINEER D.C.O.
DATE 10-4-78

FIGURE 4.1.1.2-69
EFFECT OF ELEVON



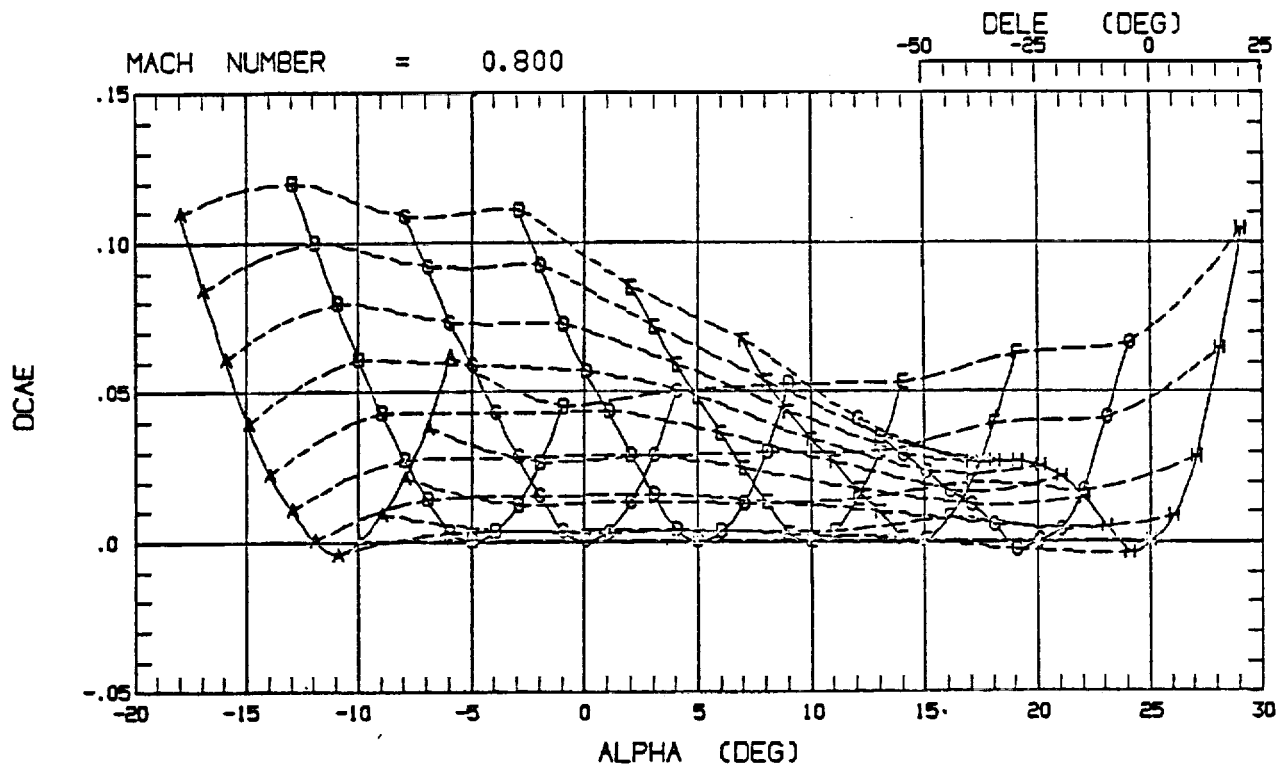
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.09355	0.10724	0.09560	0.09127	0.09808	0.07674	0.05061	0.00333
-35.000	0.07159	0.08556	0.07800	0.07949	0.08563	0.06680	0.04555	0.00072
-30.000	0.05076	0.06461	0.06100	0.06593	0.07161	0.05618	0.03907	-0.00399
-25.000	0.03169	0.04889	0.04800	0.05343	0.05704	0.04633	0.03215	-0.00895
-20.000	0.01540	0.03475	0.03800	0.04140	0.04468	0.03687	0.02274	-0.01443
-15.000	-0.00083	0.01892	0.02200	0.02732	0.03095	0.02162	0.00734	-0.01125
-10.000	-0.00727	0.00735	0.01000	0.01266	0.01417	0.00909	0.00108	0.00104
-5.000	-0.00584	0.00160	0.00250	0.00321	0.00422	0.00204	0.00122	0.00094
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00673	0.00430	0.00400	0.00295	0.00303	0.00561	0.00459	0.00558
10.000	0.01906	0.01387	0.01300	0.01160	0.01057	0.01620	0.00960	0.02161
15.000	0.03185	0.02925	0.02600	0.02534	0.02345	0.02730	0.02931	0.06065
20.000	0.04682	0.04601	0.04300	0.04070	0.04541	0.05574	0.05279	0.09499

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-70
EFFECT OF ELEVON

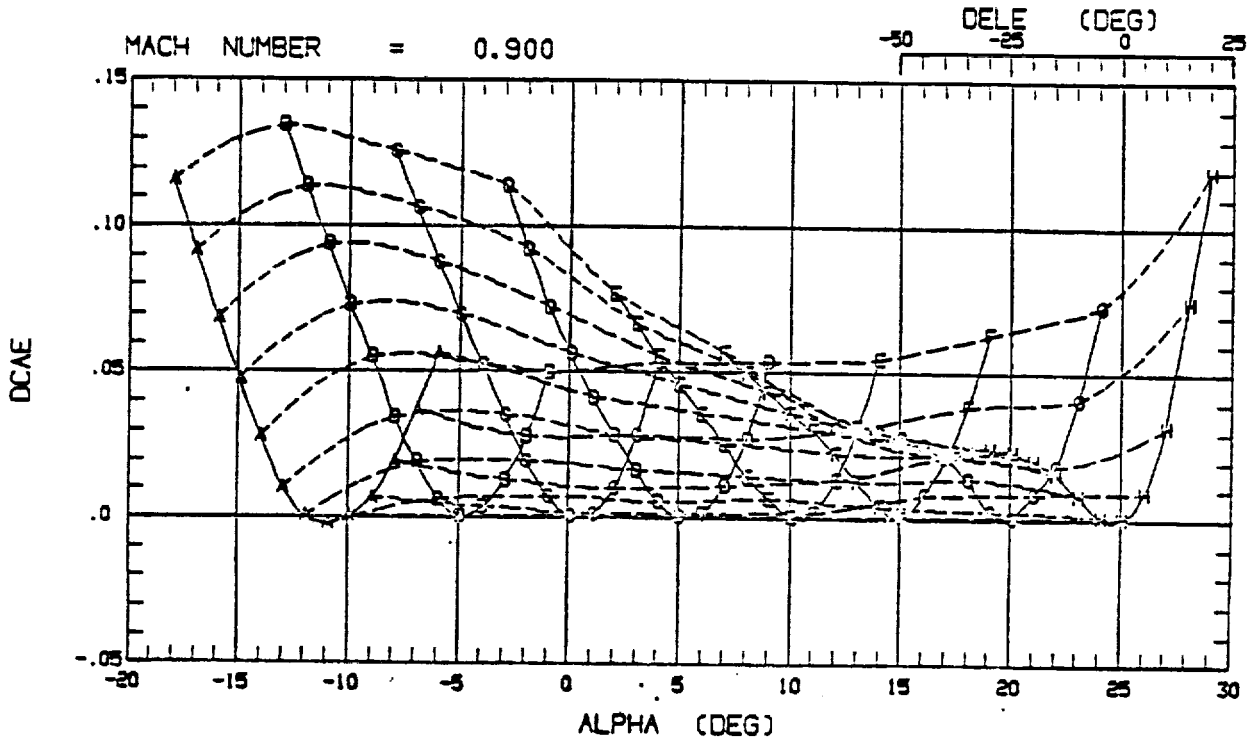


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.10920	0.11966	0.10850	0.11017	0.08464	0.06655	0.04064	0.02615
-35.000	0.08417	0.09951	0.09150	0.09191	0.07138	0.05320	0.03454	0.02681
-30.000	0.06078	0.07933	0.07300	0.07221	0.05864	0.04313	0.02891	0.02663
-25.000	0.03949	0.06063	0.05850	0.05638	0.04778	0.03360	0.02328	0.02517
-20.000	0.02195	0.04290	0.04300	0.04319	0.03559	0.02601	0.01649	0.02161
-15.000	0.01016	0.02740	0.02800	0.02892	0.02393	0.01678	0.01197	0.01463
-10.000	0.00040	0.01420	0.01500	0.01525	0.01290	0.00957	0.00536	0.00506
-5.000	-0.00418	0.00289	0.00350	0.00382	0.00239	0.00075	-0.00301	-0.00374
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00872	0.00330	0.00300	0.00333	0.00343	0.00762	0.00399	0.00827
10.000	0.02105	0.01170	0.01300	0.01245	0.01416	0.01942	0.01717	0.02810
15.000	0.03774	0.02610	0.02850	0.02948	0.03004	0.03919	0.04135	0.06421
20.000	0.06171	0.04495	0.05000	0.05244	0.05322	0.06245	0.06642	0.10421

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-71
EFFECT OF ELEVON



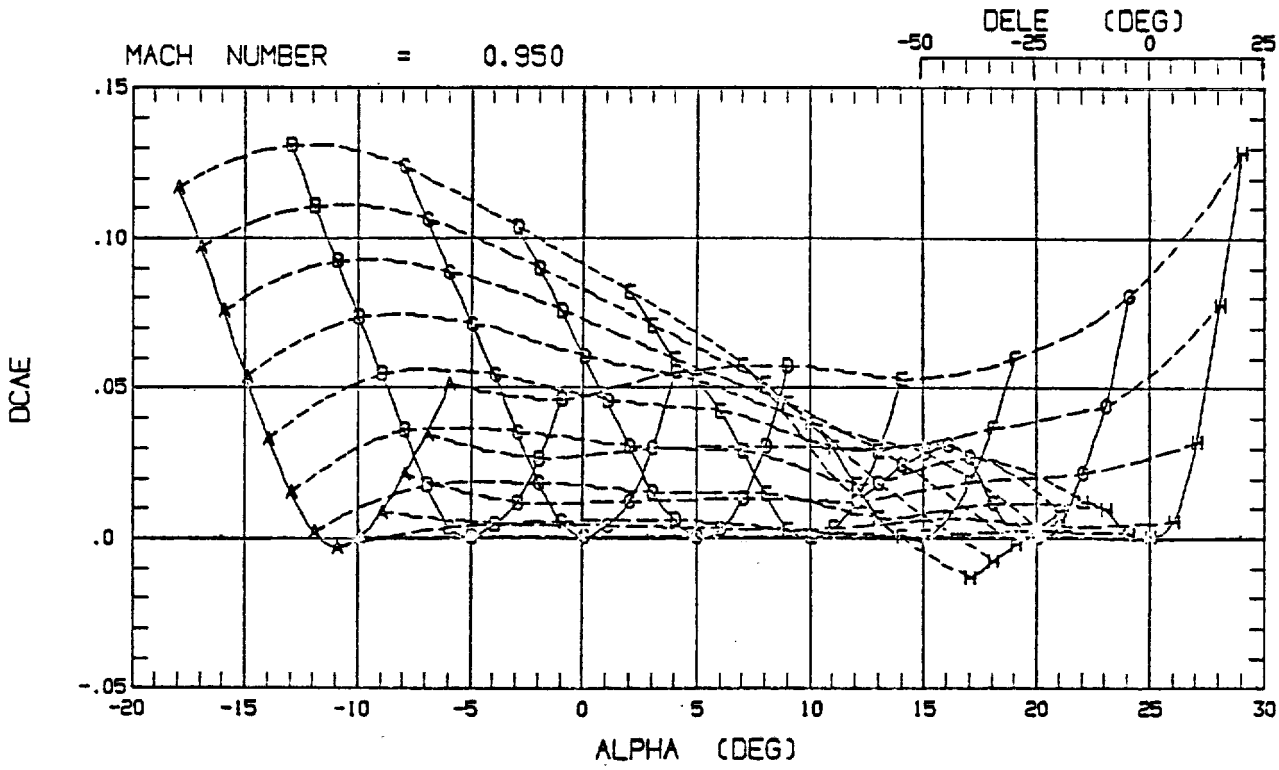
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.11562	0.13437	0.12500	0.11355	0.07616	0.05639	0.03051	0.02059
-35.000	0.09135	0.11335	0.10600	0.09152	0.06615	0.04967	0.03059	0.02310
-30.000	0.06823	0.09367	0.08700	0.07195	0.05483	0.04296	0.02907	0.02391
-25.000	0.04729	0.07305	0.06950	0.05616	0.04533	0.03565	0.02748	0.02303
-20.000	0.02774	0.05509	0.05200	0.04034	0.03547	0.03006	0.02499	0.02016
-15.000	0.00979	0.03442	0.03500	0.02917	0.02536	0.02209	0.02100	0.01550
-10.000	0.00007	0.01899	0.01900	0.01588	0.01403	0.01231	0.01335	0.00209
-5.000	-0.00244	0.00602	0.00700	0.00512	0.00545	0.00356	0.00244	0.00058
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00639	0.00329	0.00100	0.00136	0.00187	0.00769	0.00856	0.00990
10.000	0.01914	0.01229	0.00970	0.01103	0.01283	0.02091	0.01790	0.03160
15.000	0.03677	0.02748	0.02800	0.02695	0.03115	0.03822	0.04085	0.07444
20.000	0.05633	0.04956	0.05300	0.05349	0.05473	0.06304	0.07252	0.11685

ENGINEER DCO
DATE 10-9-78

FIGURE 4.1.1.2-72
EFFECT OF ELEVON

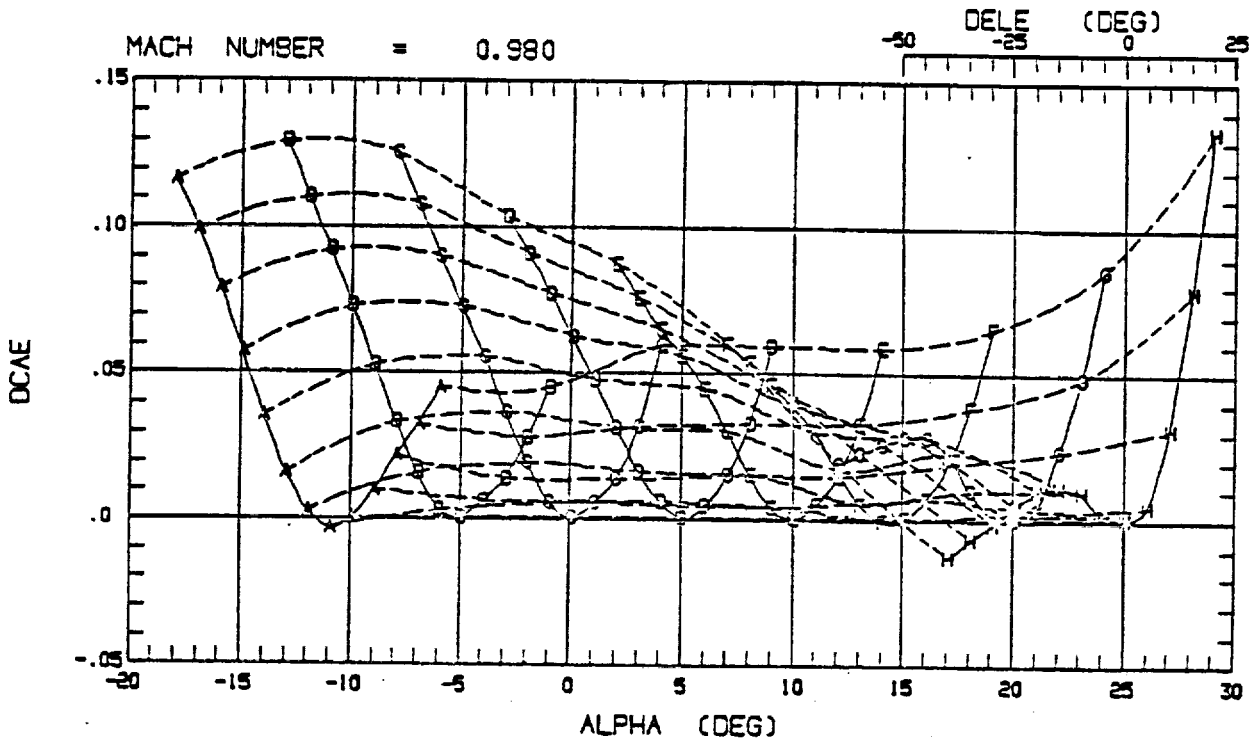


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.11633	0.13052	0.12350	0.10315	0.08155	0.05717	0.01180	-0.01357
-35.000	0.09661	0.11062	0.10600	0.08945	0.07029	0.05111	0.01824	-0.00787
-30.000	0.07533	0.09209	0.08800	0.07530	0.05908	0.04440	0.02399	-0.00252
-25.000	0.05355	0.07320	0.07100	0.06005	0.05193	0.03788	0.02804	0.00297
-20.000	0.03290	0.05459	0.05400	0.04545	0.04174	0.02984	0.03059	0.00874
-15.000	0.01480	0.03569	0.03500	0.03000	0.02859	0.01774	0.02643	0.01179
-10.000	0.00188	0.01751	0.01800	0.01510	0.01450	0.00612	0.01145	0.00933
-5.000	-0.00314	0.00353	0.00550	0.00567	0.00251	0.00026	0.00215	0.00110
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00822	0.00453	0.00400	0.00299	0.00308	0.00622	0.00381	0.00537
10.000	0.02089	0.01153	0.01200	0.01309	0.01202	0.01849	0.02173	0.03169
15.000	0.03433	0.02631	0.02950	0.03020	0.02893	0.03614	0.04394	0.07749
20.000	0.05114	0.04595	0.05500	0.05710	0.05270	0.05978	0.08041	0.12804

ENGINEER DCa
DATE 10-9-78

FIGURE 4.1.1.2-73
EFFECT OF ELEVON



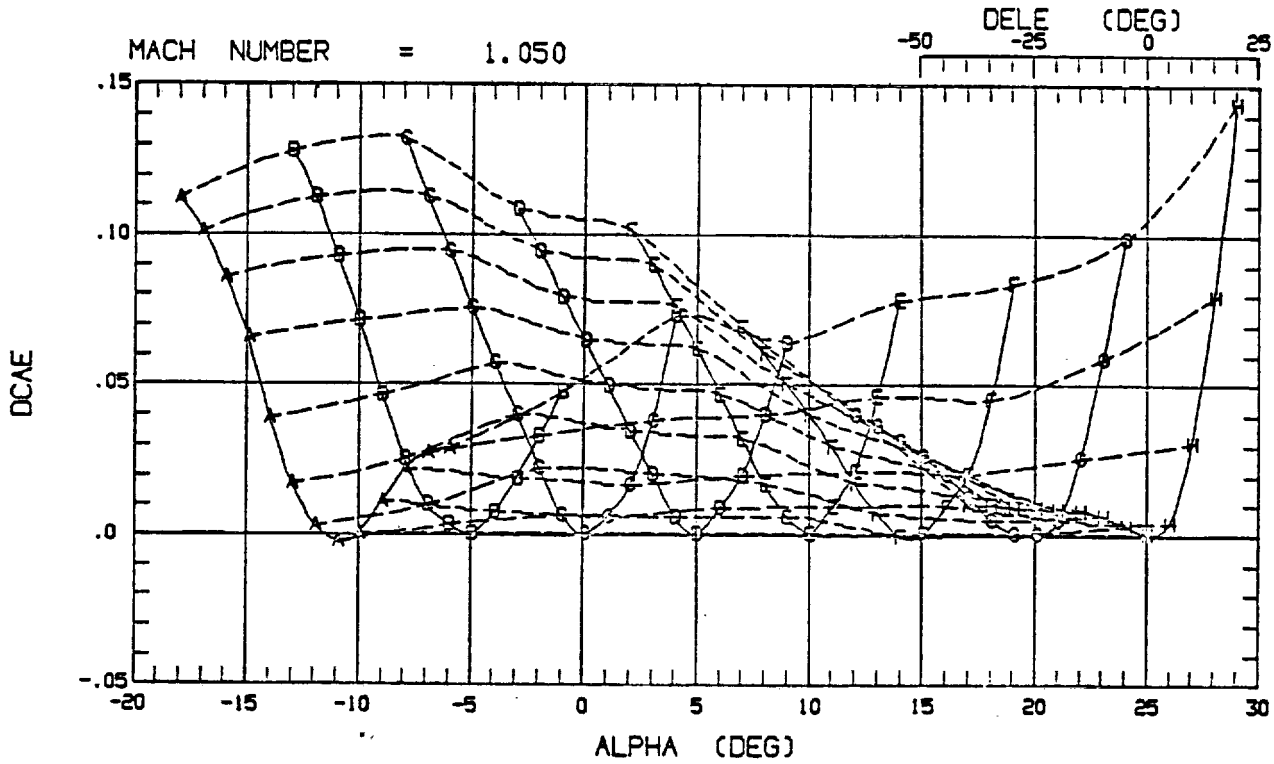
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.11608	0.12903	0.12514	0.10324	0.08669	0.05967	0.01881	-0.01295
-35.000	0.09890	0.11013	0.10748	0.09045	0.07558	0.05332	0.02254	-0.00685
-30.000	0.07908	0.09189	0.08950	0.07702	0.06450	0.04586	0.02581	-0.00164
-25.000	0.05732	0.07267	0.07223	0.06221	0.05567	0.03859	0.02936	0.00429
-20.000	0.03522	0.05245	0.05509	0.04733	0.04437	0.02969	0.02795	0.00990
-15.000	0.01571	0.03312	0.03615	0.03135	0.02999	0.01652	0.02299	0.01111
-10.000	0.00243	0.01559	0.01882	0.01602	0.01493	0.00502	0.00965	0.00919
-5.000	-0.00315	0.00294	0.00536	0.00592	0.00357	-0.00062	0.00154	0.00159
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00914	0.00606	0.00511	0.00437	0.00478	0.00684	0.00308	0.00449
10.000	0.02132	0.01346	0.01337	0.01475	0.01433	0.01879	0.02340	0.03142
15.000	0.03231	0.02789	0.03170	0.03291	0.03282	0.03810	0.04837	0.07849
20.000	0.04490	0.04498	0.05948	0.05923	0.05842	0.06510	0.08572	0.13301

ENGINEER DCO
DATE 10-7-72

FIGURE 4.1.1.2-74
EFFECT OF ELEVON

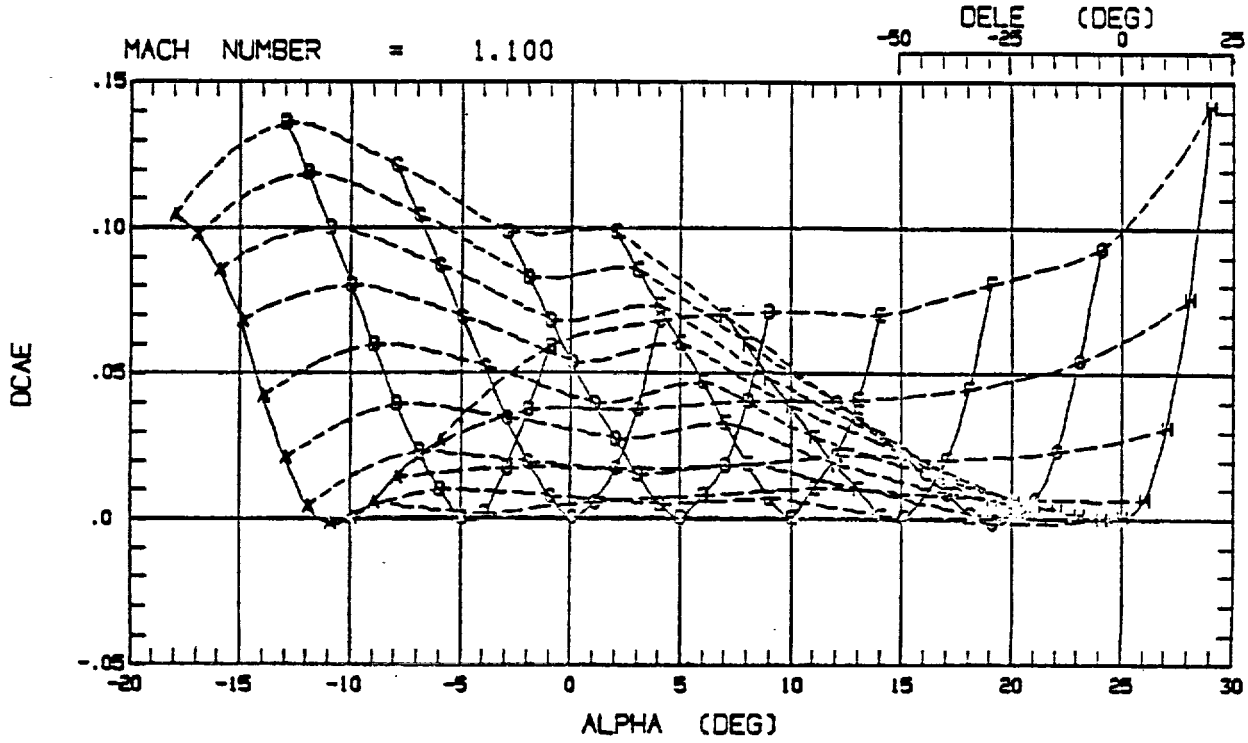


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.11175	0.12779	0.13150	0.10838	0.10139	0.06886	0.03978	0.00985
-35.000	0.10092	0.11241	0.11250	0.09417	0.08957	0.06037	0.03627	0.01003
-30.000	0.08551	0.09277	0.09400	0.07886	0.07568	0.04992	0.03104	0.00895
-25.000	0.06576	0.07134	0.07550	0.06492	0.06177	0.03966	0.02619	0.00880
-20.000	0.03902	0.04641	0.05700	0.04930	0.04660	0.02939	0.02007	0.00829
-15.000	0.01686	0.02528	0.04000	0.03425	0.03169	0.01688	0.01258	0.00791
-10.000	0.00287	0.00984	0.02200	0.02003	0.01655	0.00701	0.00492	0.00634
-5.000	-0.00240	0.00309	0.00630	0.00567	0.00598	-0.00058	0.00033	0.00288
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.01079	0.00722	0.00600	0.00872	0.00951	0.00952	0.00458	0.00401
10.000	0.02176	0.01852	0.01650	0.01968	0.02093	0.02015	0.02540	0.03048
15.000	0.02712	0.03287	0.03800	0.03978	0.04597	0.04483	0.05859	0.07952
20.000	0.02853	0.04733	0.07300	0.06393	0.07784	0.08325	0.09884	0.14411

ENGINEER DCO
DATE 12-4-78

FIGURE 4.1.1.2-75
EFFECT OF ELEVON



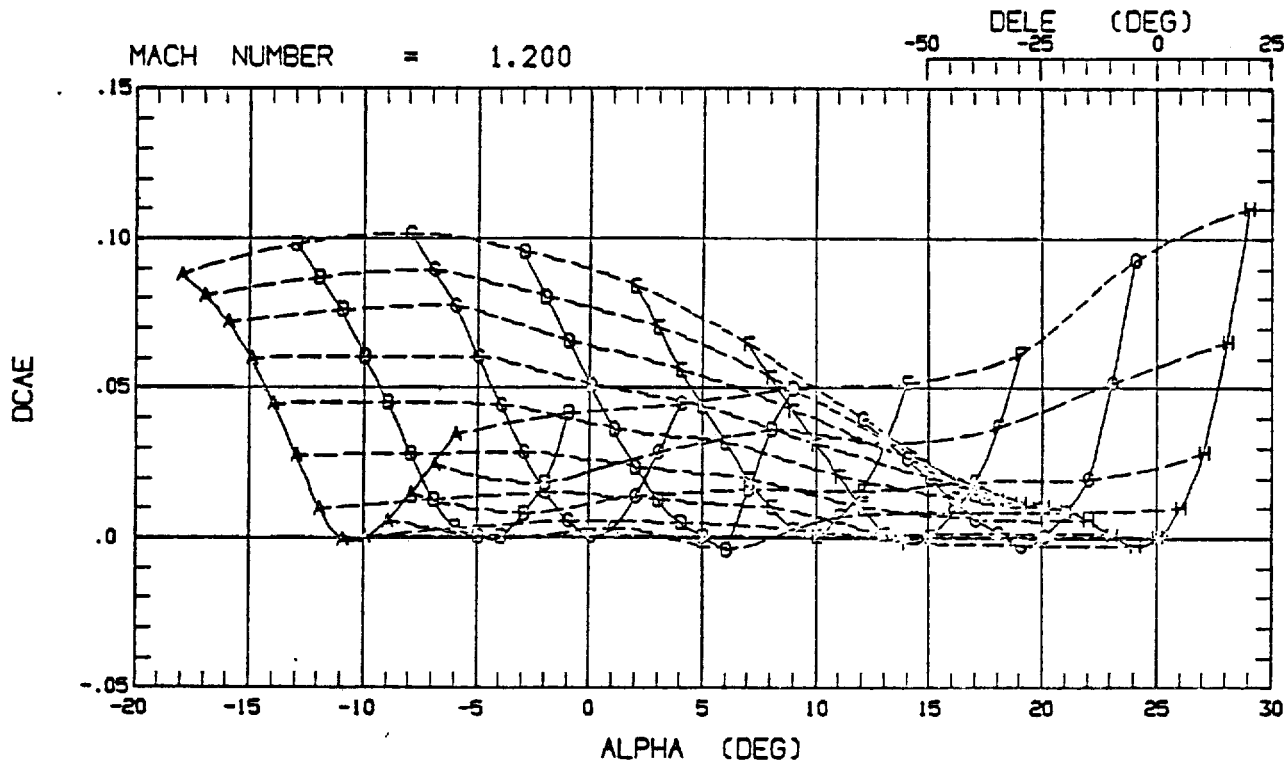
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.10382	0.13566	0.12100	0.09837	0.09303	0.06940	0.03566	0.01211
-35.000	0.09732	0.11869	0.10400	0.08274	0.08523	0.05565	0.03425	0.00867
-30.000	0.08503	0.09992	0.08630	0.06770	0.07275	0.04809	0.02772	0.00614
-25.000	0.06760	0.07989	0.06900	0.05372	0.06004	0.03809	0.02213	0.00509
-20.000	0.04180	0.05991	0.05200	0.03936	0.04675	0.02749	0.01529	0.00419
-15.000	0.02031	0.03920	0.03450	0.02701	0.03271	0.01809	0.00946	0.00291
-10.000	0.00399	0.02304	0.01900	0.01520	0.01658	0.00991	0.00142	0.00118
-5.000	-0.00200	0.01015	0.00750	0.00497	0.00671	0.00083	-0.00172	-0.00047
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00546	0.00172	0.00550	0.00799	0.01055	0.00798	0.00630	0.00630
10.000	0.01412	0.01723	0.01700	0.01782	0.02151	0.02014	0.02296	0.03099
15.000	0.02123	0.03742	0.03750	0.04031	0.04076	0.04457	0.05394	0.07550
20.000	0.02568	0.05927	0.06800	0.07086	0.07002	0.08022	0.09251	0.14124

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-7b
EFFECT OF ELEVON



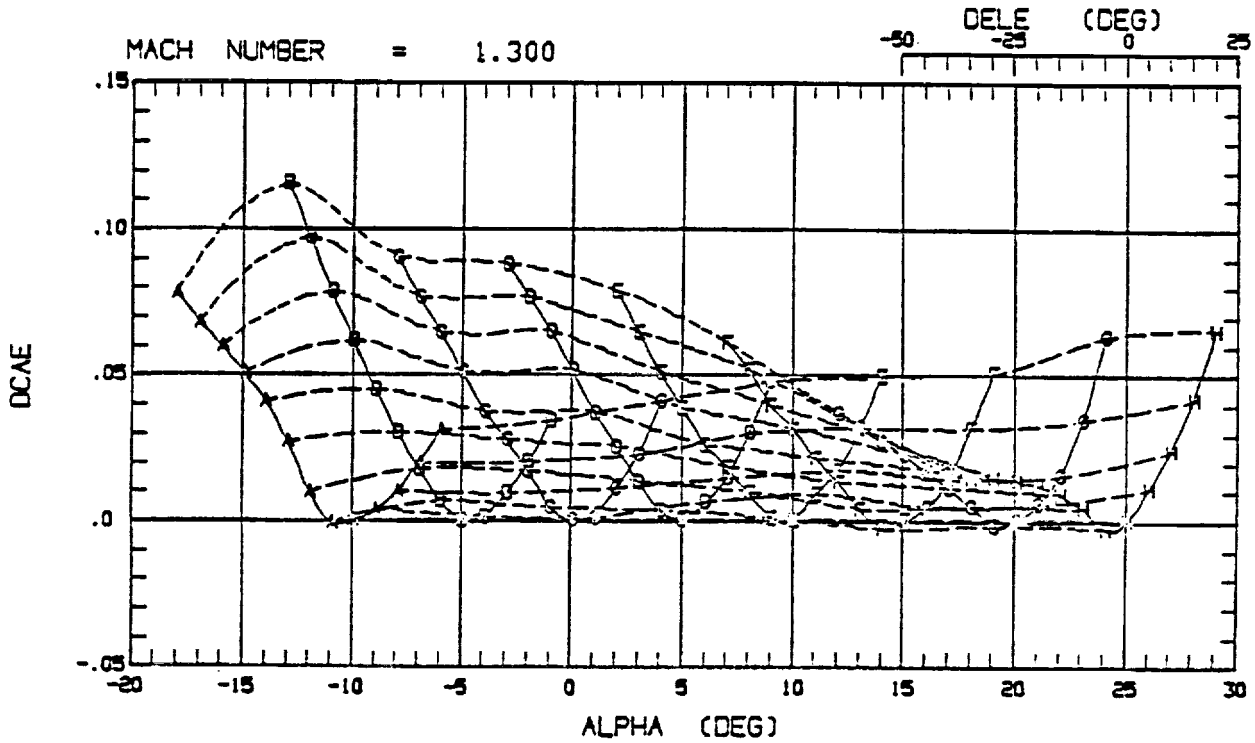
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.08780	0.09795	0.10150	0.09523	0.08358	0.06401	0.03929	0.01441
-35.000	0.08026	0.08680	0.08900	0.07984	0.06977	0.05313	0.03235	0.01227
-30.000	0.07165	0.07581	0.07700	0.06527	0.05576	0.04209	0.02593	0.01129
-25.000	0.05986	0.06011	0.06000	0.05070	0.04336	0.03079	0.01944	0.01035
-20.000	0.04466	0.04511	0.04400	0.03570	0.03126	0.02019	0.01294	0.00902
-15.000	0.02713	0.02781	0.02800	0.02325	0.01927	0.01005	0.00601	0.00601
-10.000	0.00957	0.01259	0.01500	0.01226	0.00989	0.00080	0.00148	0.00091
-5.000	-0.00057	0.00306	0.00550	0.00458	0.00243	-0.00169	-0.00255	-0.00282
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00553	0.00002	0.00300	-0.00418	0.00702	0.00831	0.00844	0.00998
10.000	0.01429	0.00772	0.01350	0.01575	0.01560	0.01856	0.01952	0.02903
15.000	0.02414	0.01800	0.02800	0.03560	0.03113	0.03659	0.05156	0.06534
20.000	0.03446	0.04115	0.04450	0.04963	0.05136	0.06132	0.09239	0.10981

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-77
EFFECT OF ELEVON



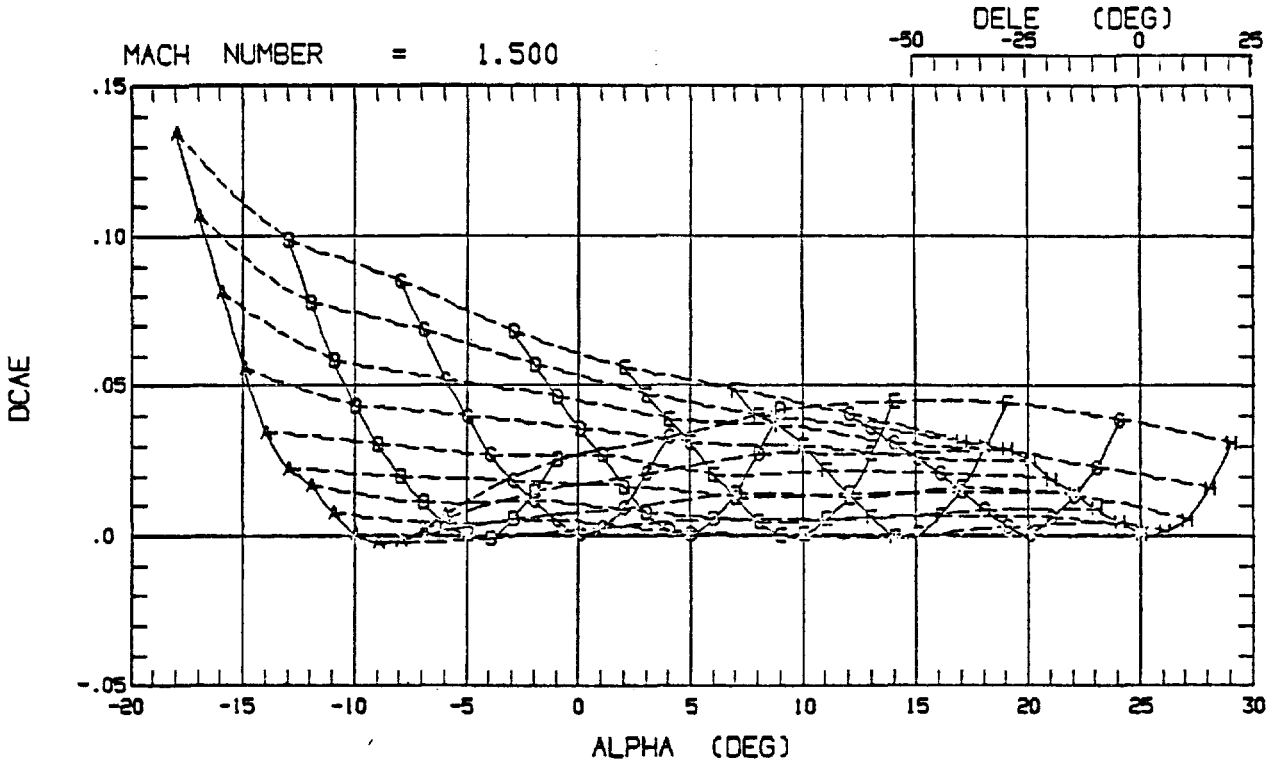
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.07811	0.11546	0.09000	0.08774	0.07846	0.06046	0.03666	0.01597
-35.000	0.06799	0.09698	0.07650	0.07627	0.06416	0.05165	0.03199	0.01454
-30.000	0.05955	0.07827	0.06400	0.06456	0.05049	0.03948	0.02734	0.01438
-25.000	0.05050	0.06148	0.05100	0.05131	0.03827	0.03147	0.02237	0.01337
-20.000	0.04072	0.04495	0.03750	0.03701	0.02573	0.02121	0.01684	0.01199
-15.000	0.02707	0.03045	0.02750	0.02529	0.01794	0.01303	0.01110	0.00894
-10.000	0.00924	0.01767	0.01650	0.01301	0.00928	0.00378	0.00481	0.00420
-5.000	-0.00069	0.00663	0.00450	0.00331	0.00069	-0.00302	-0.00167	-0.00294
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00370	0.00115	0.00100	0.00629	0.00885	0.00452	0.00556	0.01095
10.000	0.00592	0.00914	0.01100	0.01451	0.01679	0.01389	0.01567	0.02419
15.000	0.01951	0.01995	0.02250	0.02999	0.03179	0.03148	0.03467	0.04202
20.000	0.03099	0.03437	0.04100	0.04776	0.04939	0.05025	0.06301	0.06325

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-78
EFFECT OF ELEVON

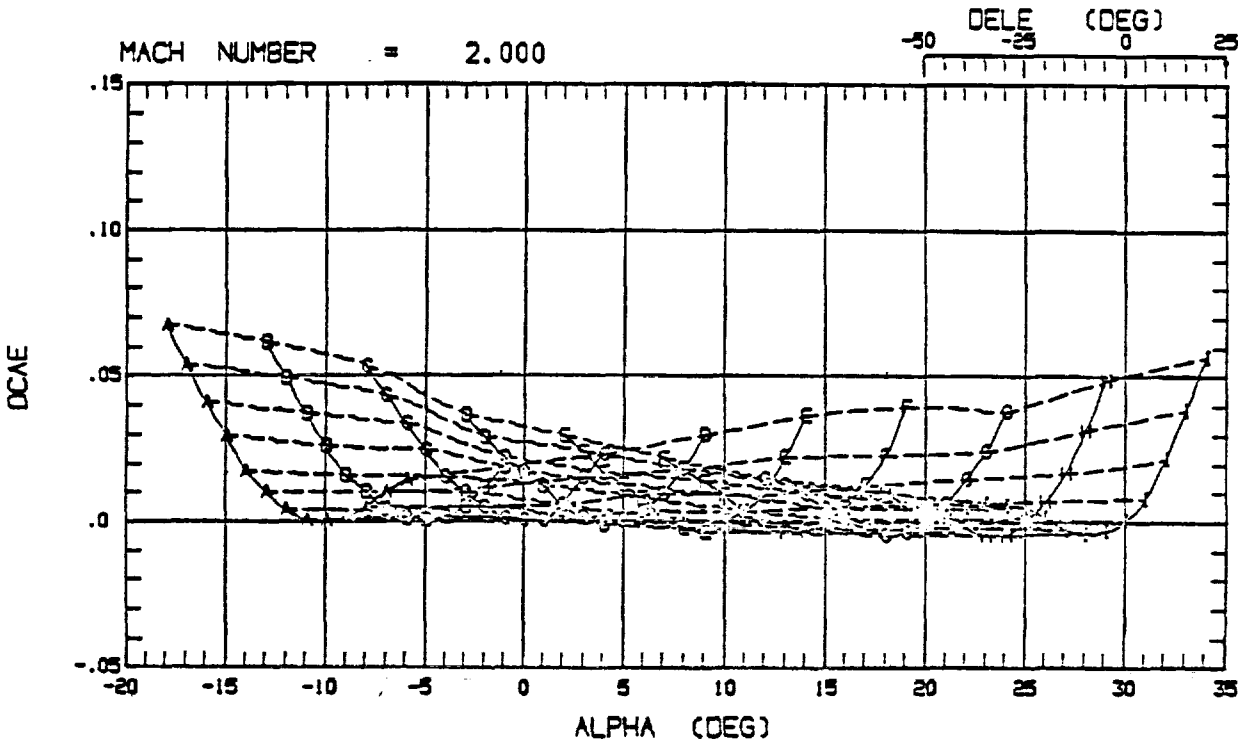


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.13433	0.09823	0.08467	0.06758	0.05549	0.04815	0.04014	0.03121
-35.000	0.10613	0.07731	0.06803	0.05644	0.04669	0.03982	0.03568	0.02983
-30.000	0.08115	0.05822	0.05140	0.04577	0.03852	0.03647	0.03061	0.02857
-25.000	0.05566	0.04313	0.03948	0.03534	0.03075	0.02962	0.02578	0.02518
-20.000	0.03432	0.03018	0.02660	0.02655	0.02014	0.02144	0.02064	0.01877
-15.000	0.02210	0.01968	0.01814	0.01619	0.01263	0.01375	0.01448	0.01413
-10.000	0.01669	0.01069	0.01123	0.00740	0.00448	0.00577	0.00838	0.00864
-5.000	0.00718	0.00370	0.00470	0.00111	-0.00017	-0.00076	0.00291	0.00434
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00246	-0.00108	0.00249	0.00549	0.00544	0.00645	0.00586	0.00118
10.000	-0.00164	0.00513	0.00913	0.01415	0.01264	0.01576	0.01308	0.00498
15.000	0.00191	0.01466	0.02046	0.02731	0.02700	0.02957	0.02272	0.01548
20.000	0.00693	0.02539	0.03274	0.04179	0.04467	0.04386	0.03830	0.03092

ENGINEER DCO
DATE 10-9-78

FIGURE 4.1.1.2-79
EFFECT OF ELEVON

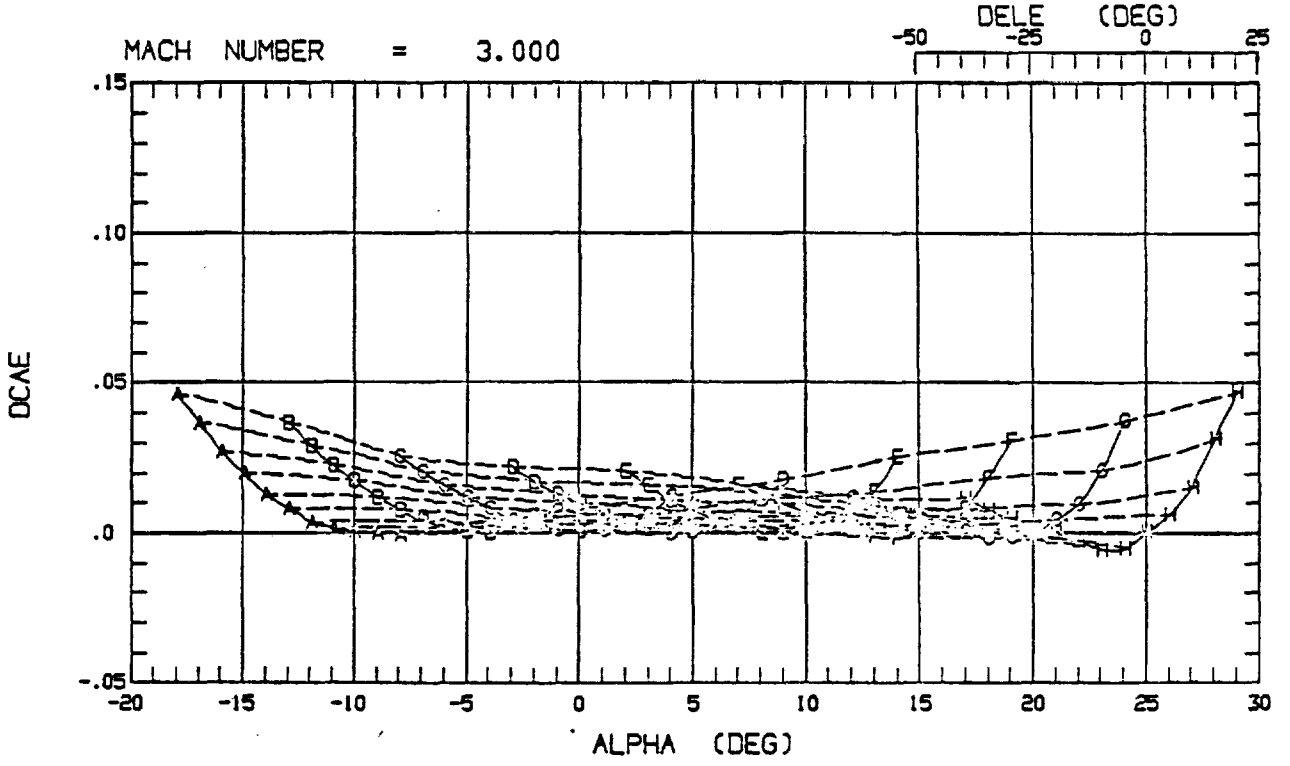


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
	ELEVON AXIAL FORCE INCREMENT								
-40.000	0.06742	0.06107	0.05310	0.03605	0.02918	0.02157	0.01430	0.01048	0.00487
-35.000	0.05361	0.04875	0.04300	0.02870	0.02371	0.01764	0.01258	0.00933	0.00570
-30.000	0.04068	0.03659	0.03300	0.02153	0.01673	0.01363	0.00925	0.00641	0.00553
-25.000	0.02925	0.02542	0.02400	0.01667	0.01221	0.00892	0.00447	0.00417	0.00486
-20.000	0.01719	0.01550	0.01500	0.01208	0.00770	0.00311	0.00062	0.00070	0.00132
-15.000	0.00998	0.01001	0.01000	0.00512	0.00115	-0.00200	-0.00263	-0.00243	-0.00271
-10.000	0.00356	0.00387	0.00500	0.00106	-0.00244	-0.00395	-0.00494	-0.00469	-0.00415
-5.000	0.00025	0.00090	0.00100	-0.00125	-0.00359	-0.00352	-0.00384	-0.00466	-0.00349
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00123	0.00133	0.0	0.00333	0.00342	0.00493	0.00563	0.00702	0.00805
10.000	0.00480	0.00476	0.00600	0.00955	0.00910	0.01231	0.01442	0.01639	0.02153
15.000	0.00995	0.01149	0.01500	0.01777	0.02191	0.02278	0.02407	0.03120	0.03848
20.000	0.01374	0.01875	0.02300	0.02971	0.03610	0.03949	0.03790	0.04837	0.05552

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-60
EFFECT OF ELEVON

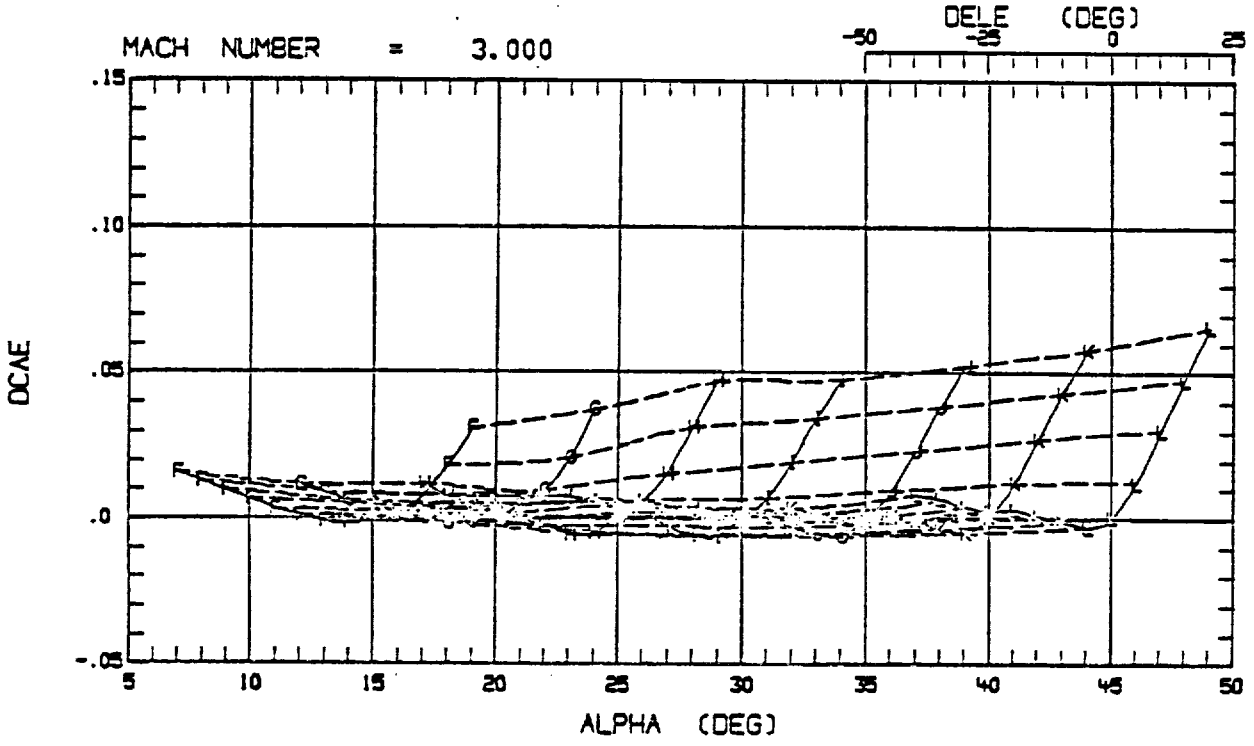


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04594	0.03652	0.02500	0.02143	0.02027	0.01567	0.01124	0.01133
-35.000	0.03632	0.02869	0.02000	0.01675	0.01546	0.01263	0.00856	0.00750
-30.000	0.02663	0.02205	0.01550	0.01265	0.01030	0.00934	0.00591	0.00457
-25.000	0.01931	0.01677	0.01150	0.00954	0.00695	0.00630	0.00420	0.00165
-20.000	0.01241	0.01158	0.00800	0.00604	0.00411	0.00300	0.00181	-0.00038
-15.000	0.00782	0.00747	0.00400	0.00318	0.00173	0.00074	0.00001	-0.00279
-10.000	0.00349	0.00362	0.00300	0.00148	-0.00047	-0.00133	-0.00187	-0.00563
-5.000	0.00143	0.00177	0.00100	-0.00012	-0.00006	-0.00172	-0.00119	-0.00532
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00011	-0.00021	0.00100	0.00162	0.00151	0.00191	0.00427	0.00599
10.000	-0.00065	0.00174	0.00300	0.00506	0.00585	0.00795	0.00954	0.01512
15.000	0.00106	0.00517	0.00600	0.01091	0.01339	0.01823	0.02066	0.03132
20.000	0.00208	0.00677	0.01200	0.01738	0.02503	0.03070	0.03731	0.04685

ENGINEER Dco
DATE 10-4-78

FIGURE 4.1.1.2-81
EFFECT OF ELEVON



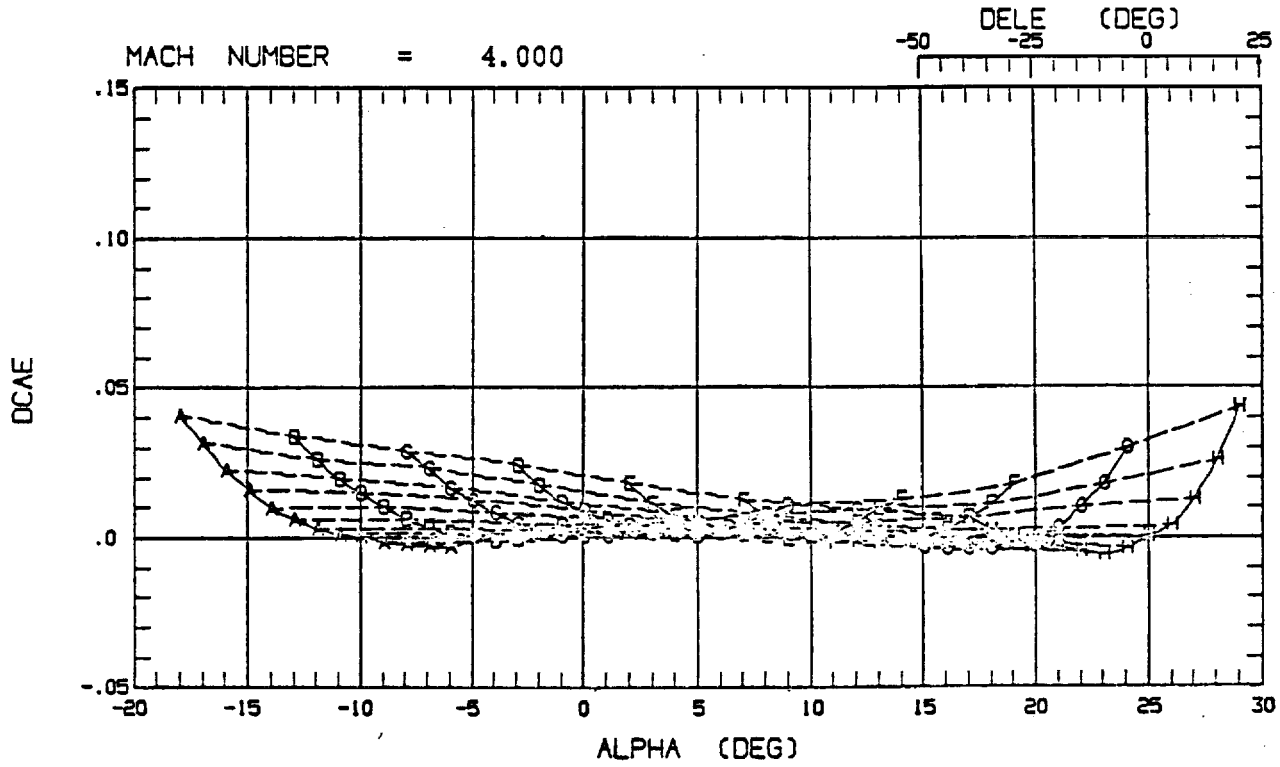
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000	20.000	25.000	30.000	35.000	40.000	45.000
	F	G	H	I	J	K	L
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT						
-40.000	0.01567	0.01124	0.01133	0.00731	0.00391	0.00323	0.00788
-35.000	0.01263	0.00858	0.00750	0.00702	0.00298	0.00149	0.00624
-30.000	0.00934	0.00591	0.00457	0.00535	0.00116	-0.00026	0.00371
-25.000	0.00630	0.00420	0.00165	0.00402	0.00006	-0.00146	0.00241
-20.000	0.00300	0.00181	-0.00038	0.00175	0.00030	0.00040	0.00294
-15.000	0.00074	0.00001	-0.00279	-0.00302	-0.00315	-0.00103	0.00097
-10.000	-0.00133	-0.00187	-0.00563	-0.00605	-0.00554	-0.00379	-0.00141
-5.000	-0.00172	-0.00119	-0.00532	-0.00649	-0.00626	-0.00516	-0.00332
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00191	0.00427	0.00599	0.00682	0.00926	0.01186	0.01208
10.000	0.00795	0.00964	0.01512	0.01884	0.02299	0.02732	0.03035
15.000	0.01823	0.02066	0.03132	0.03423	0.03835	0.04299	0.04740
20.000	0.03070	0.03731	0.04685	0.04740	0.05224	0.05774	0.06573

ENGINEER DCo
DATE 10-4-73

FIGURE 4.1.1.2-82
EFFECT OF ELEVON

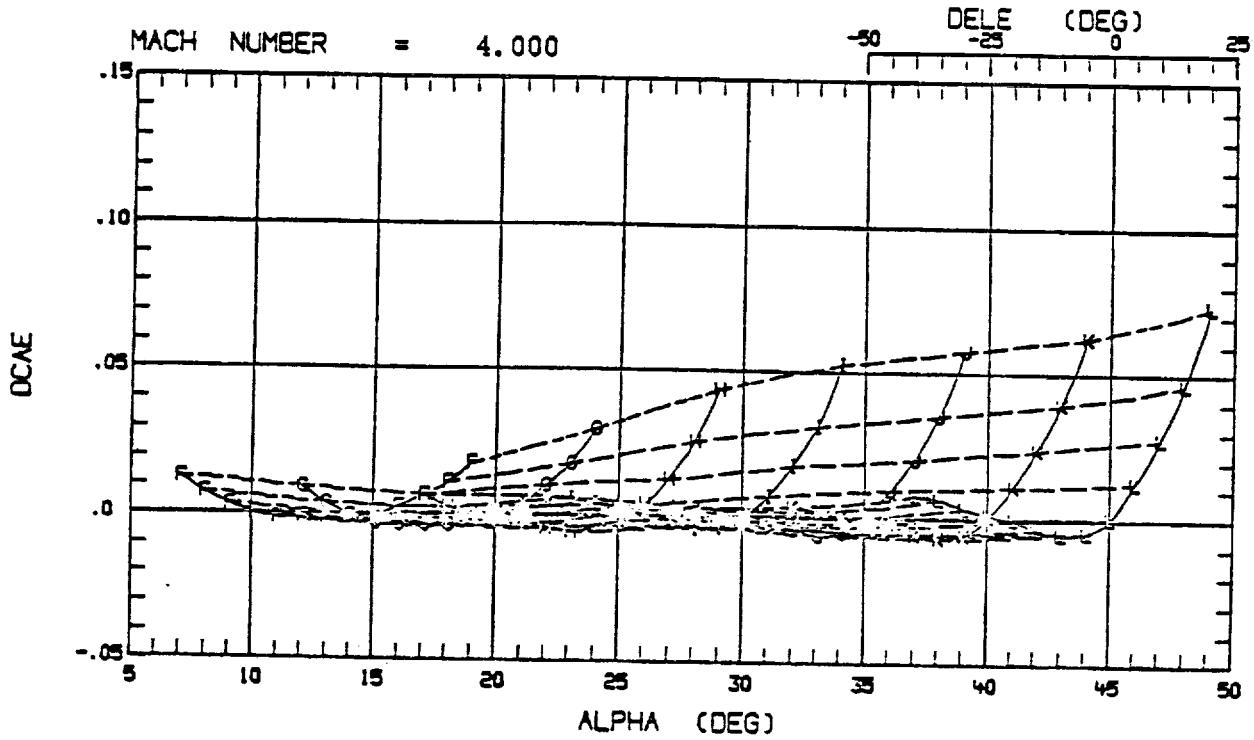


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04019	0.03349	0.02840	0.02377	0.01741	0.01216	0.00880	0.00651
-35.000	0.03103	0.02563	0.02270	0.01687	0.01101	0.00675	0.00317	0.00246
-30.000	0.02223	0.01926	0.01600	0.01146	0.00709	0.00278	-0.00056	0.00017
-25.000	0.01571	0.01440	0.01200	0.00844	0.00425	-0.00003	-0.00324	-0.00161
-20.000	0.00938	0.01002	0.00800	0.00552	0.00255	-0.00177	-0.00401	-0.00339
-15.000	0.00577	0.00580	0.00450	0.00392	0.00101	-0.00140	-0.00405	-0.00478
-10.000	0.00269	0.00298	0.00200	0.00122	0.00014	-0.00172	-0.00376	-0.00590
-5.000	0.00096	0.00103	0.00050	0.00061	-0.00058	-0.00134	-0.00205	-0.00405
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00176	-0.00138	0.0	0.00112	0.00136	0.00217	0.00273	0.00375
10.000	-0.00242	-0.00077	0.00200	0.00435	0.00504	0.00640	0.01004	0.01249
15.000	-0.00301	0.00174	0.00500	0.00741	0.00938	0.01072	0.01771	0.02546
20.000	-0.00319	0.00376	0.00400	0.01049	0.01250	0.01775	0.02984	0.04353

ENGINEER D.Co
DATE 10-4-78

FIGURE 4.1.1.2-83
EFFECT OF ELEVON



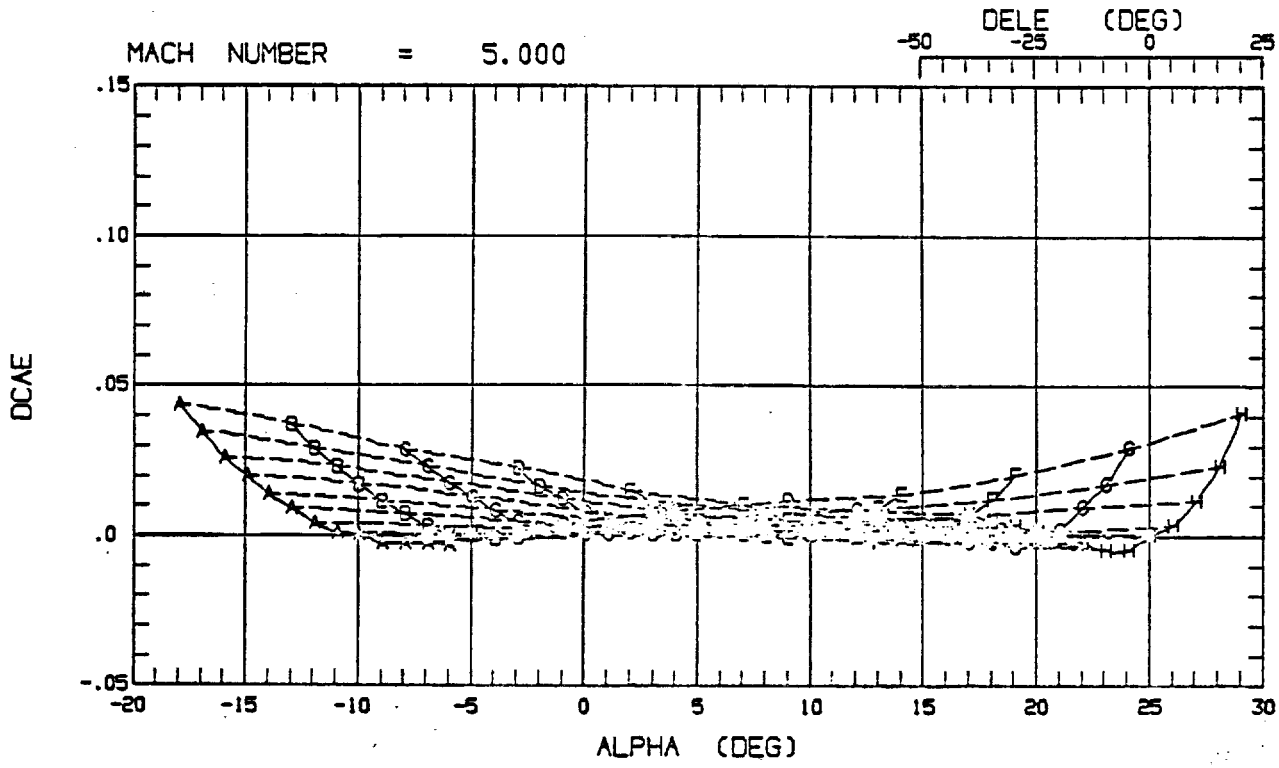
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT						
-40.000	0.01216	0.00880	0.00651	0.00599	0.00325	0.00313	0.00764
-35.000	0.00675	0.00317	0.00246	0.00539	0.00222	0.00189	0.00630
-30.000	0.00278	-0.00056	0.00017	0.00395	0.00046	-0.00031	0.00349
-25.000	-0.00003	-0.00324	-0.00161	0.00238	-0.00134	-0.00239	0.00117
-20.000	-0.00177	-0.00401	-0.00339	0.00037	-0.00265	-0.00327	-0.00047
-15.000	-0.00140	-0.00405	-0.00478	-0.00129	-0.00450	-0.00557	-0.00356
-10.000	-0.00172	-0.00376	-0.00590	-0.00415	-0.00622	-0.00701	-0.00519
-5.000	-0.00134	-0.00205	-0.00405	-0.00376	-0.00510	-0.00567	-0.00468
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00217	0.00273	0.00375	0.00695	0.00936	0.01077	0.01220
10.000	0.00640	0.01004	0.01249	0.01726	0.02030	0.02344	0.02782
15.000	0.01072	0.01771	0.02546	0.03109	0.03532	0.03954	0.04622
20.000	0.01775	0.02984	0.04353	0.05229	0.05742	0.06243	0.07330

ENGINEER DCD
DATE 10-4-78

FIGURE 4.1.1.2-34
EFFECT OF ELEVON

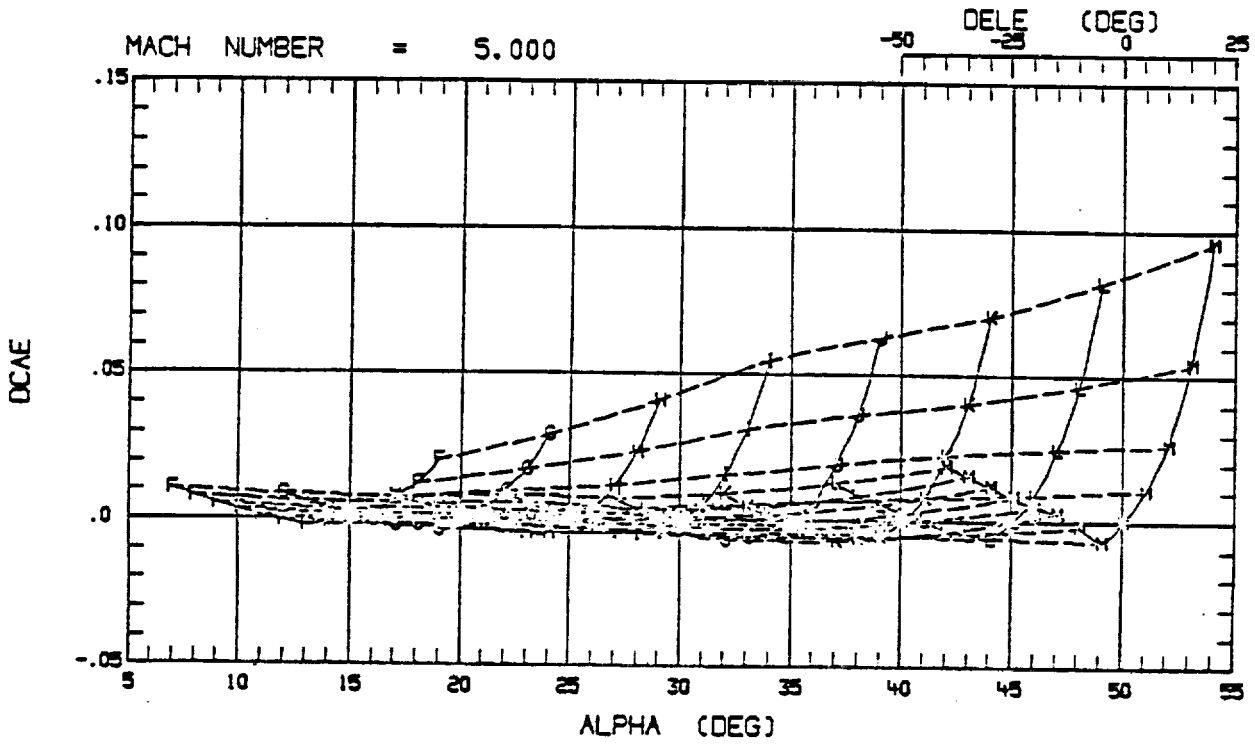


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04347	0.03677	0.02830	0.02219	0.01462	0.00997	0.00816	0.00720
-35.000	0.03447	0.02863	0.02270	0.01576	0.01093	0.00739	0.00560	0.00494
-30.000	0.02573	0.02248	0.01710	0.01173	0.00671	0.00480	0.00304	0.00319
-25.000	0.01949	0.01674	0.01250	0.00751	0.00442	0.00271	0.00105	0.00120
-20.000	0.01324	0.01108	0.00790	0.00437	0.00205	0.00061	-0.00094	-0.00046
-15.000	0.00897	0.00700	0.00420	0.00166	0.0	-0.00094	-0.00233	-0.00239
-10.000	0.00391	0.00300	0.00120	0.00014	-0.00027	-0.00260	-0.00236	-0.00493
-5.000	0.00089	0.00021	0.00060	0.00002	-0.00093	-0.00125	-0.00359	-0.00478
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00258	-0.00147	0.00040	0.00131	0.00154	0.00098	0.00170	0.00309
10.000	-0.00287	-0.00095	0.00070	0.00262	0.00465	0.00657	0.00950	0.01157
15.000	-0.00272	0.00113	0.00440	0.00694	0.00904	0.01172	0.01711	0.02310
20.000	-0.00349	0.00321	0.00810	0.01134	0.01340	0.02013	0.02926	0.04099

ENGINEER 10-4-78
DATE DEC

FIGURE 4.1.1.2-85
EFFECT OF ELEVON



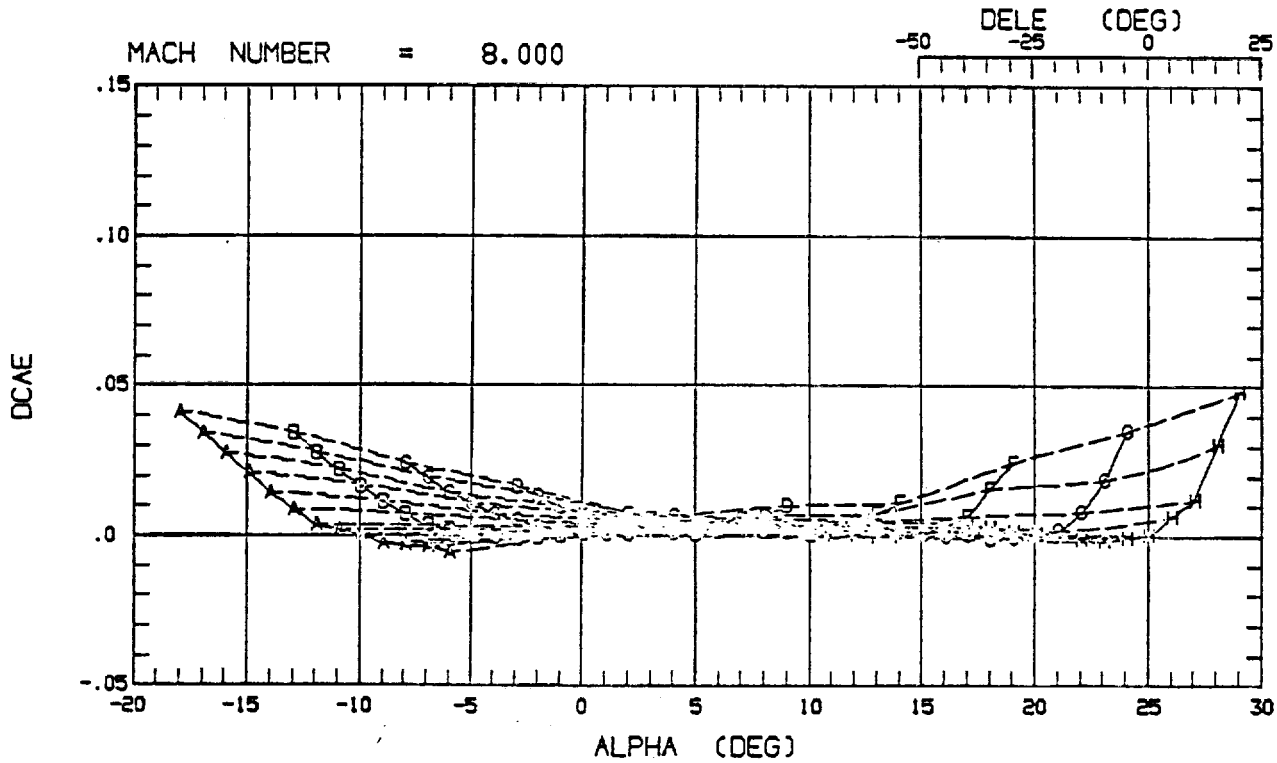
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.00997	0.00816	0.00720	0.00799	0.00698	0.00990	0.01280	0.01669
-35.000	0.00739	0.00560	0.00494	0.00525	0.00336	0.00417	0.00827	0.01524
-30.000	0.00480	0.00304	0.00319	0.00251	0.00075	0.00185	0.00554	0.01168
-25.000	0.00271	0.00105	0.00120	0.00022	-0.00197	-0.00112	0.00237	0.00625
-20.000	0.00061	-0.00094	-0.00046	-0.00155	-0.00343	-0.00274	0.00004	0.00477
-15.000	-0.00094	-0.00233	-0.00239	-0.00414	-0.00667	-0.00696	-0.00361	0.00265
-10.000	-0.00250	-0.00236	-0.00493	-0.00463	-0.00594	-0.00592	-0.00445	-0.00177
-5.000	-0.00125	-0.00359	-0.00478	-0.00450	-0.00475	-0.00529	-0.00600	-0.00710
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00098	0.00170	0.00309	0.00459	0.00615	0.00769	0.00910	0.01064
10.000	0.00657	0.00950	0.01157	0.01525	0.01917	0.02239	0.02456	0.02622
15.000	0.01172	0.01711	0.02310	0.03135	0.03619	0.04058	0.04658	0.05399
20.000	0.02013	0.02926	0.04093	0.05479	0.06293	0.07045	0.08204	0.09570

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-86
EFFECT OF ELEVON



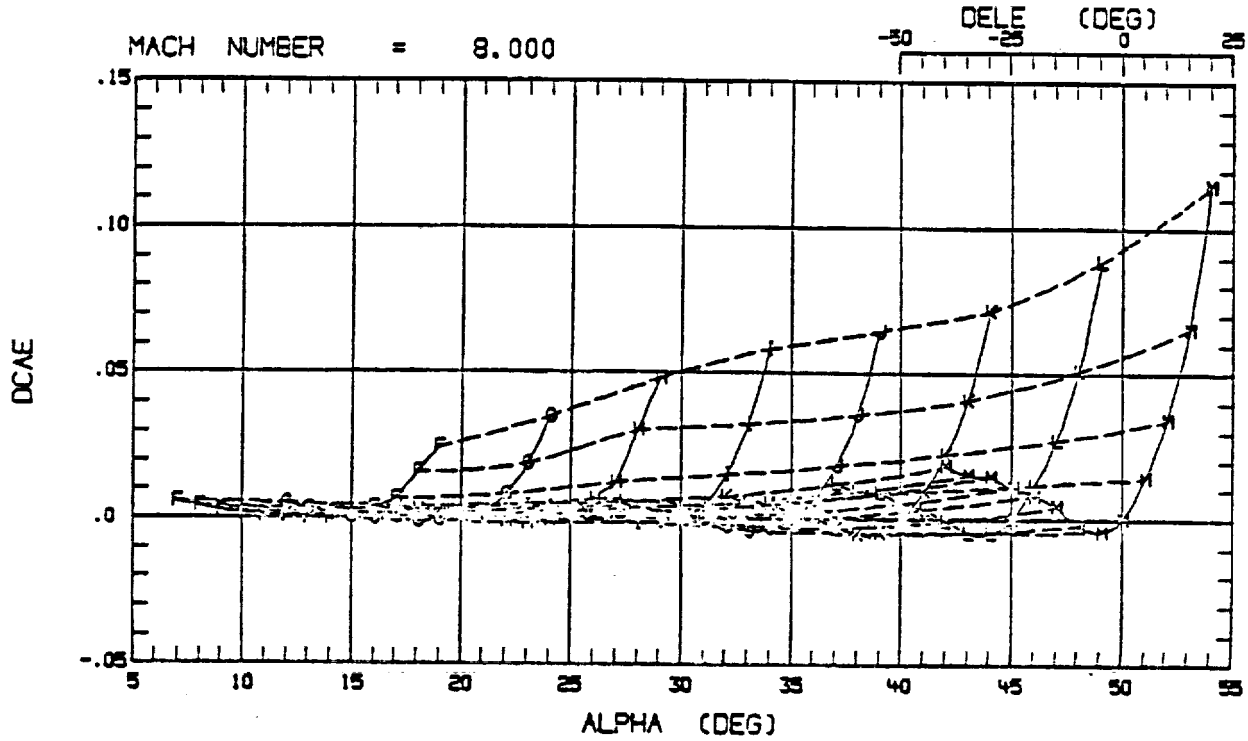
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04061	0.03366	0.02380	0.01613	0.00710	0.00554	0.00477	0.00346
-35.000	0.03385	0.02740	0.01890	0.01276	0.00555	0.00377	0.00296	0.00261
-30.000	0.02709	0.02132	0.01390	0.00931	0.00407	0.00226	0.00149	0.00126
-25.000	0.02061	0.01615	0.01050	0.00706	0.00313	0.00135	0.00027	0.00053
-20.000	0.01402	0.01100	0.00700	0.00471	0.00209	0.00045	-0.00038	-0.00028
-15.000	0.00861	0.00704	0.00490	0.00326	0.00175	0.00015	0.00010	-0.00113
-10.000	0.00321	0.00306	0.00280	0.00200	0.00123	-0.00014	-0.00127	-0.00197
-5.000	0.00164	0.00158	0.00140	0.00091	0.00105	-0.00015	-0.00059	-0.00082
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00278	-0.00076	0.00030	0.00138	0.00139	0.00317	0.00179	0.00623
10.000	-0.00348	-0.00152	0.00050	0.00266	0.00434	0.00635	0.00790	0.01213
15.000	-0.00388	-0.00082	0.00250	0.00635	0.00745	0.01544	0.01835	0.03011
20.000	-0.00607	-0.00004	0.00610	0.01002	0.01082	0.02417	0.03497	0.04809

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-87
EFFECT OF ELEVON

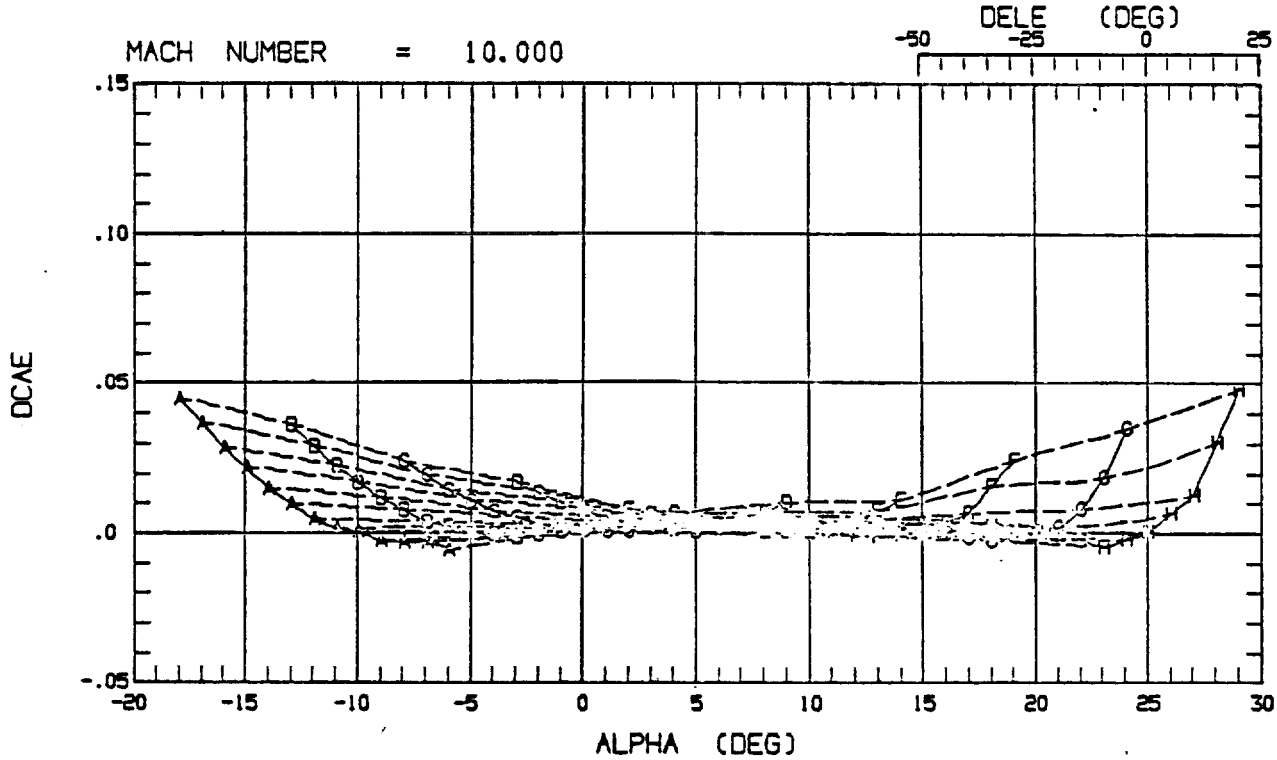


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.00554	0.00477	0.00346	0.00448	0.00511	0.00756	0.01182	0.01794
-35.000	0.00377	0.00296	0.00261	0.00385	0.00340	0.00555	0.00937	0.01495
-30.000	0.00226	0.00149	0.00126	0.00322	0.00247	0.00470	0.00885	0.01433
-25.000	0.00135	0.00027	0.00053	0.00243	0.00066	0.00166	0.00517	0.01078
-20.000	0.00045	-0.00038	-0.00028	0.00164	-0.00028	0.00022	0.00308	0.00805
-15.000	0.00015	0.00010	-0.00113	0.00003	-0.00257	-0.00325	-0.00087	0.00413
-10.000	-0.00014	-0.00127	-0.00197	-0.00159	-0.00413	-0.00545	-0.00470	-0.00214
-5.000	-0.00015	-0.00059	-0.00082	-0.00146	-0.00348	-0.00490	-0.00499	-0.00409
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00317	0.00179	0.00623	0.00422	0.00651	0.00936	0.01152	0.01415
10.000	0.00635	0.00790	0.01213	0.01475	0.01785	0.02198	0.02712	0.03420
15.000	0.01544	0.01835	0.03011	0.03235	0.03557	0.04110	0.05091	0.06498
20.000	0.02417	0.03497	0.04809	0.05901	0.06437	0.07117	0.08978	0.11449

ENGINEER Dce
DATE 12-4-78

FIGURE 4.1.1.2-88
EFFECT OF ELEVON

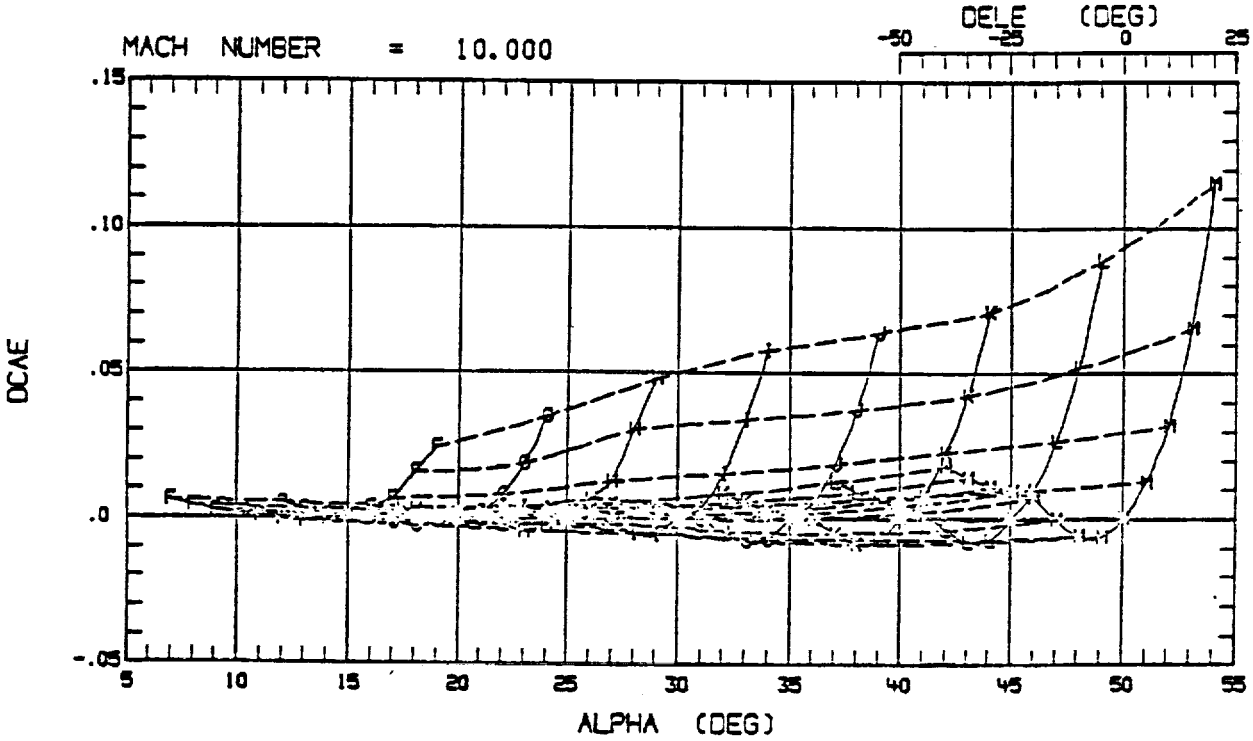


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04427	0.03556	0.02380	0.01632	0.00739	0.00583	0.00486	0.00346
-35.000	0.03634	0.02879	0.01890	0.01298	0.00604	0.00406	0.00296	0.00219
-30.000	0.02813	0.02193	0.01400	0.00973	0.00451	0.00229	0.00096	0.00092
-25.000	0.02139	0.01665	0.01060	0.00727	0.00328	0.00138	0.00037	0.00020
-20.000	0.01466	0.01118	0.00710	0.00482	0.00204	0.00048	-0.00032	-0.00019
-15.000	0.00938	0.00741	0.00480	0.00310	0.00125	-0.00069	-0.00168	-0.00230
-10.000	0.00436	0.00355	0.00250	0.00147	0.00028	-0.00150	-0.00279	-0.00484
-5.000	0.00125	0.00177	0.00120	0.00073	0.00028	-0.00083	-0.00152	-0.00242
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00275	-0.00085	0.0	0.00108	0.00127	0.00324	0.00179	0.00623
10.000	-0.00316	-0.00161	0.0	0.00225	0.00374	0.00657	0.00790	0.01237
15.000	-0.00319	-0.00072	0.00250	0.00623	0.00722	0.01541	0.01835	0.03026
20.000	-0.00587	0.00016	0.00630	0.01011	0.01080	0.02424	0.03469	0.04773

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-89
EFFECT OF ELEVON



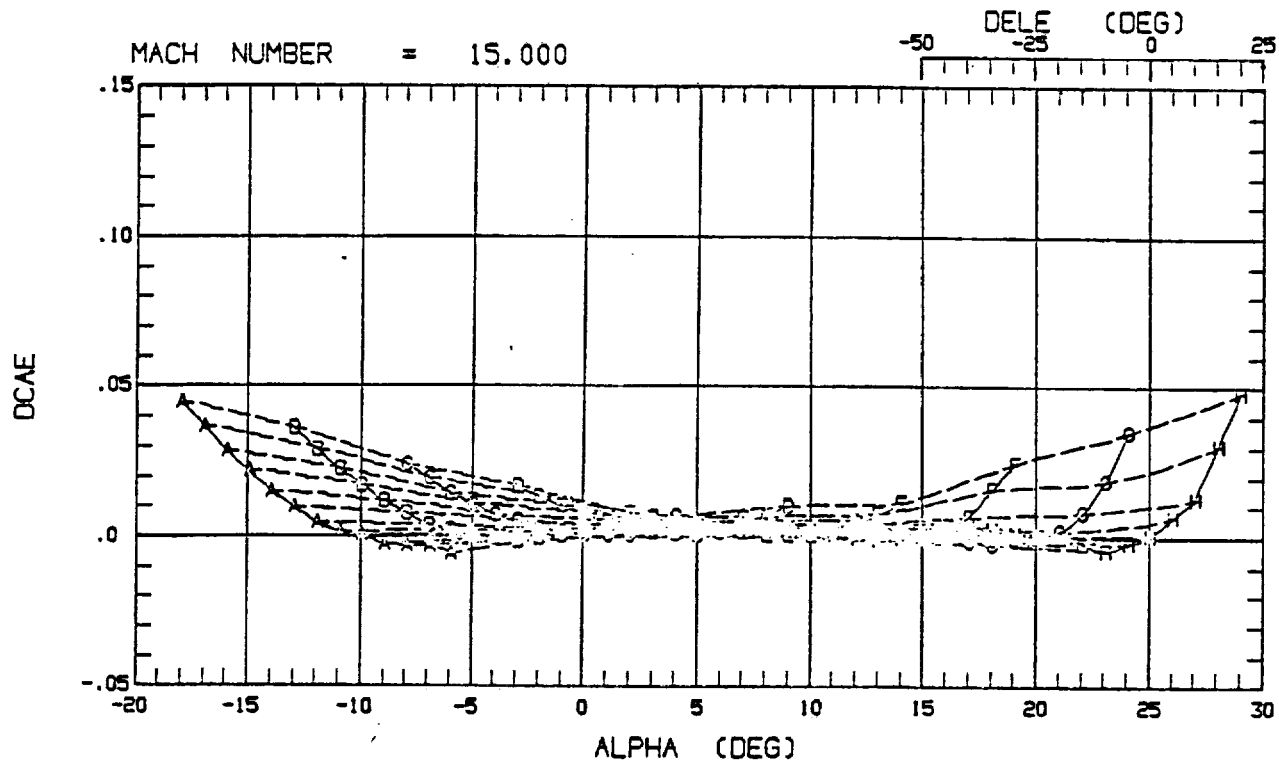
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.360 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.00583	0.00485	0.00346	0.00372	0.00498	0.00813	0.01236	0.01782
-35.000	0.00406	0.00296	0.00219	0.00344	0.00335	0.00560	0.00913	0.01406
-30.000	0.00229	0.00096	0.00092	0.00255	0.00112	0.00244	0.00576	0.01114
-25.000	0.00138	0.00037	0.00020	0.00201	0.00042	0.00144	0.00435	0.00918
-20.000	0.00048	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00069	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00150	-0.00279	-0.00484	-0.00550	-0.00790	-0.00881	-0.00811	-0.00503
-5.000	-0.00083	-0.00152	-0.00242	-0.00583	-0.00713	-0.00747	-0.00721	-0.00626
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00324	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00657	0.00790	0.01237	0.01507	0.01847	0.02255	0.02569	0.03177
15.000	0.01541	0.01835	0.03026	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.02424	0.03469	0.04773	0.05758	0.06391	0.07071	0.08874	0.11520

ENGINEER DCo
DATE 10-4-78

FIGURE 4.1.1.2-90
EFFECT OF ELEVON

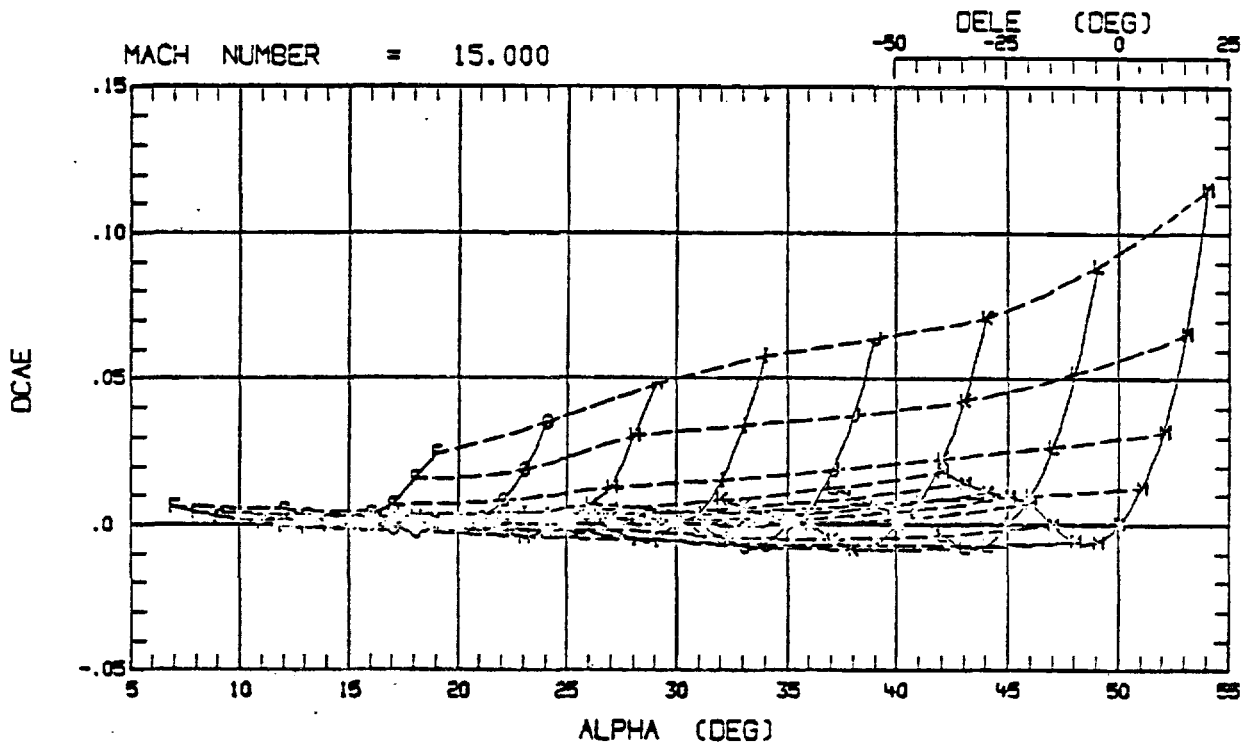


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04427	0.03556	0.02380	0.01632	0.00739	0.00583	0.00486	0.00346
-35.000	0.03634	0.02879	0.01890	0.01298	0.00604	0.00406	0.00296	0.00219
-30.000	0.02813	0.02193	0.01400	0.00973	0.00451	0.00229	0.00096	0.00092
-25.000	0.02139	0.01665	0.01060	0.00727	0.00328	0.00138	0.00037	0.00020
-20.000	0.01466	0.01118	0.00710	0.00482	0.00204	0.00048	-0.00032	-0.00019
-15.000	0.00938	0.00741	0.00480	0.00310	0.00125	-0.00069	-0.00168	-0.00230
-10.000	0.00436	0.00355	0.00250	0.00147	0.00028	-0.00150	-0.00279	-0.00484
-5.000	0.00125	0.00177	0.00120	0.00073	0.00028	-0.00083	-0.00152	-0.00242
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00275	-0.00085	0.0	0.00108	0.00127	0.00324	0.00179	0.00623
10.000	-0.00316	-0.00161	0.0	0.00225	0.00374	0.00657	0.00790	0.01237
15.000	-0.00319	-0.00072	0.00250	0.00623	0.00722	0.01541	0.01835	0.03026
20.000	-0.00587	0.00016	0.00630	0.01011	0.01080	0.02424	0.03469	0.04773

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-91
EFFECT OF ELEVON

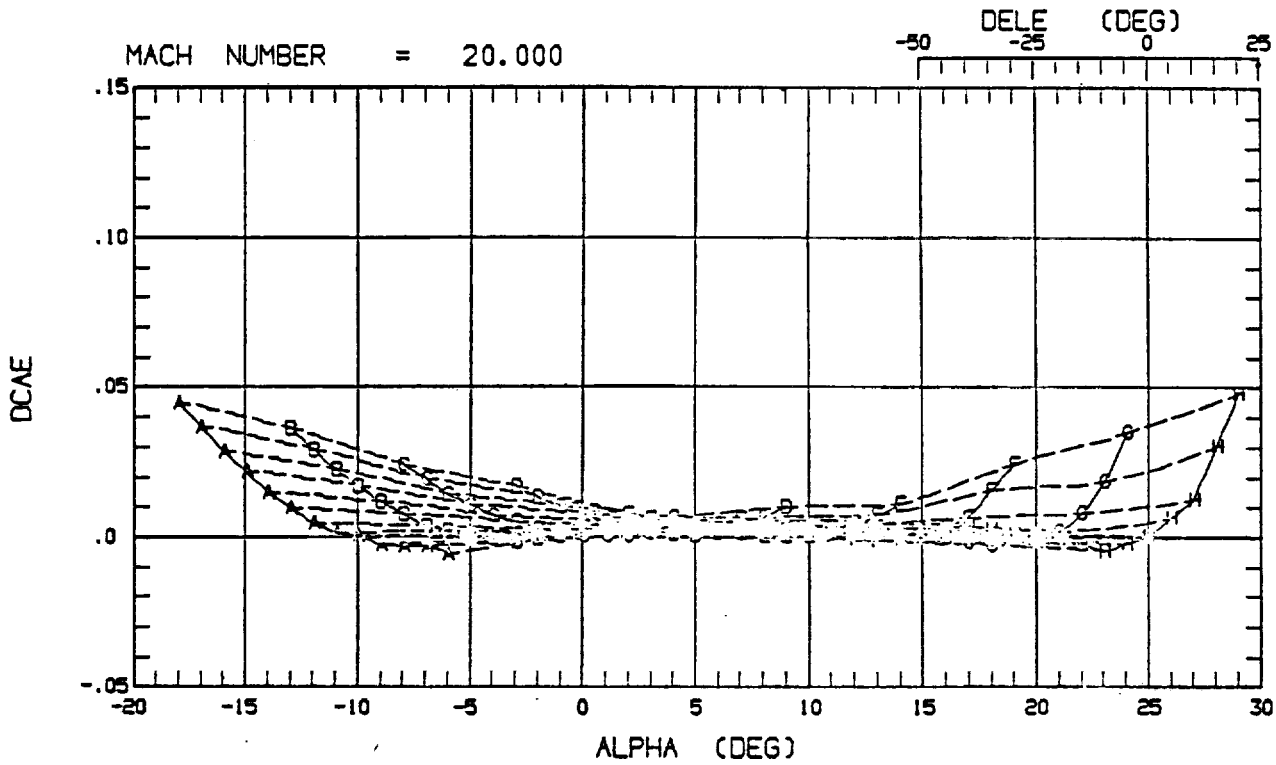


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.00583	0.00486	0.00346	0.00372	0.00458	0.00813	0.01236	0.01782
-35.000	0.00408	0.00256	0.00219	0.00344	0.00335	0.00550	0.00913	0.01406
-30.000	0.00229	0.00098	0.00092	0.00255	0.00112	0.00244	0.00576	0.01114
-25.000	0.00138	0.00037	0.00020	0.00201	0.00042	0.00144	0.00436	0.00918
-20.000	0.00048	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00069	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00150	-0.00279	-0.00484	-0.00550	-0.00790	-0.00981	-0.00811	-0.00603
-5.000	-0.00083	-0.00152	-0.00242	-0.00593	-0.00713	-0.00747	-0.00721	-0.00626
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00324	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00657	0.00790	0.01237	0.01507	0.01847	0.02255	0.02669	0.03177
15.000	0.01541	0.01835	0.03026	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.02424	0.03469	0.04773	0.05758	0.06391	0.07071	0.08874	0.11520

ENGINEER DGO
DATE 10-4-78

FIGURE 4.1.1.2-92
EFFECT OF ELEVON



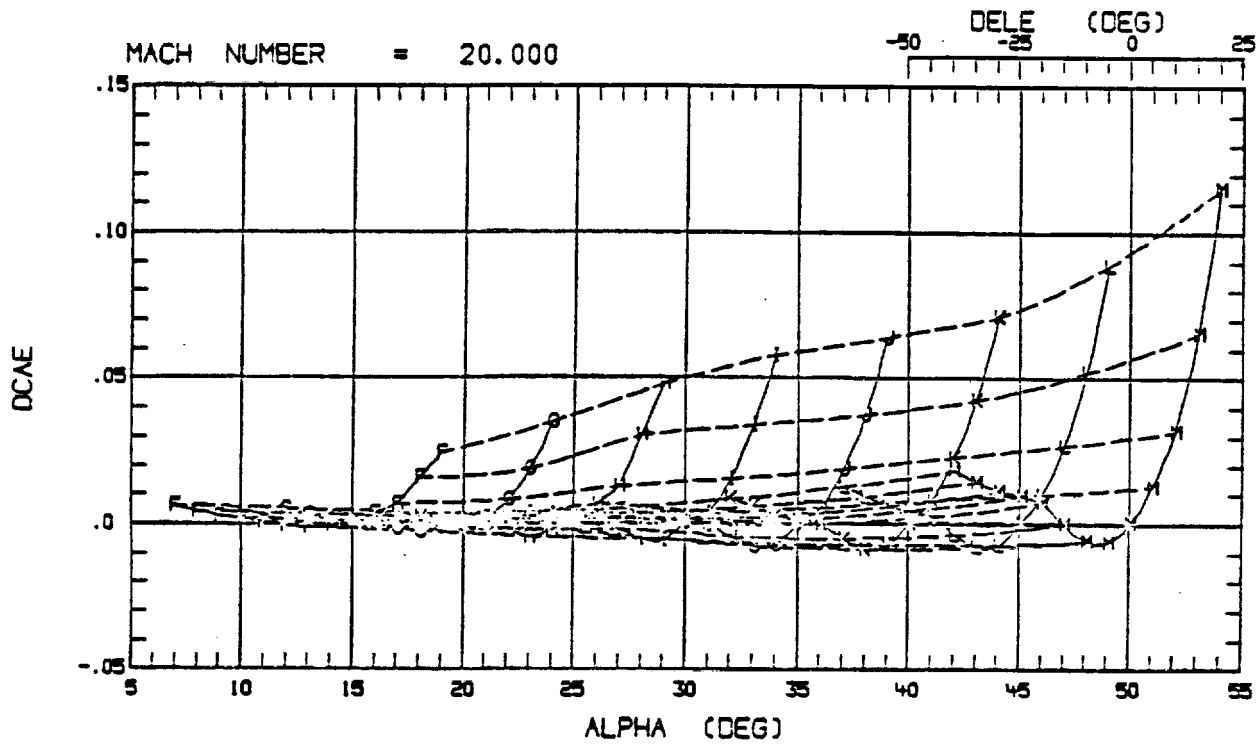
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.04427	0.03556	0.02380	0.01632	0.00739	0.00583	0.00486	0.00346
-35.000	0.03634	0.02879	0.01890	0.01298	0.00604	0.00406	0.00296	0.00219
-30.000	0.02813	0.02193	0.01400	0.00973	0.00451	0.00229	0.00096	0.00092
-25.000	0.02139	0.01665	0.01060	0.00727	0.00328	0.00138	0.00037	0.00020
-20.000	0.01466	0.01118	0.00710	0.00482	0.00204	0.00048	-0.00032	-0.00019
-15.000	0.00938	0.00741	0.00480	0.00310	0.00125	-0.00069	-0.00168	-0.00230
-10.000	0.00436	0.00355	0.00250	0.00147	0.00028	-0.00150	-0.00279	-0.00484
-5.000	0.00125	0.00177	0.00120	0.00073	0.00028	-0.00083	-0.00152	-0.00242
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00275	-0.00085	0.0	0.00108	0.00127	0.00324	0.00179	0.00623
10.000	-0.00316	-0.00161	0.0	0.00225	0.00374	0.00657	0.00790	0.01237
15.000	-0.00319	-0.00072	0.00250	0.00623	0.00722	0.01541	0.01835	0.03026
20.000	-0.00587	0.00016	0.00630	0.01011	0.01080	0.02424	0.03469	0.04773

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-93
EFFECT OF ELEVON



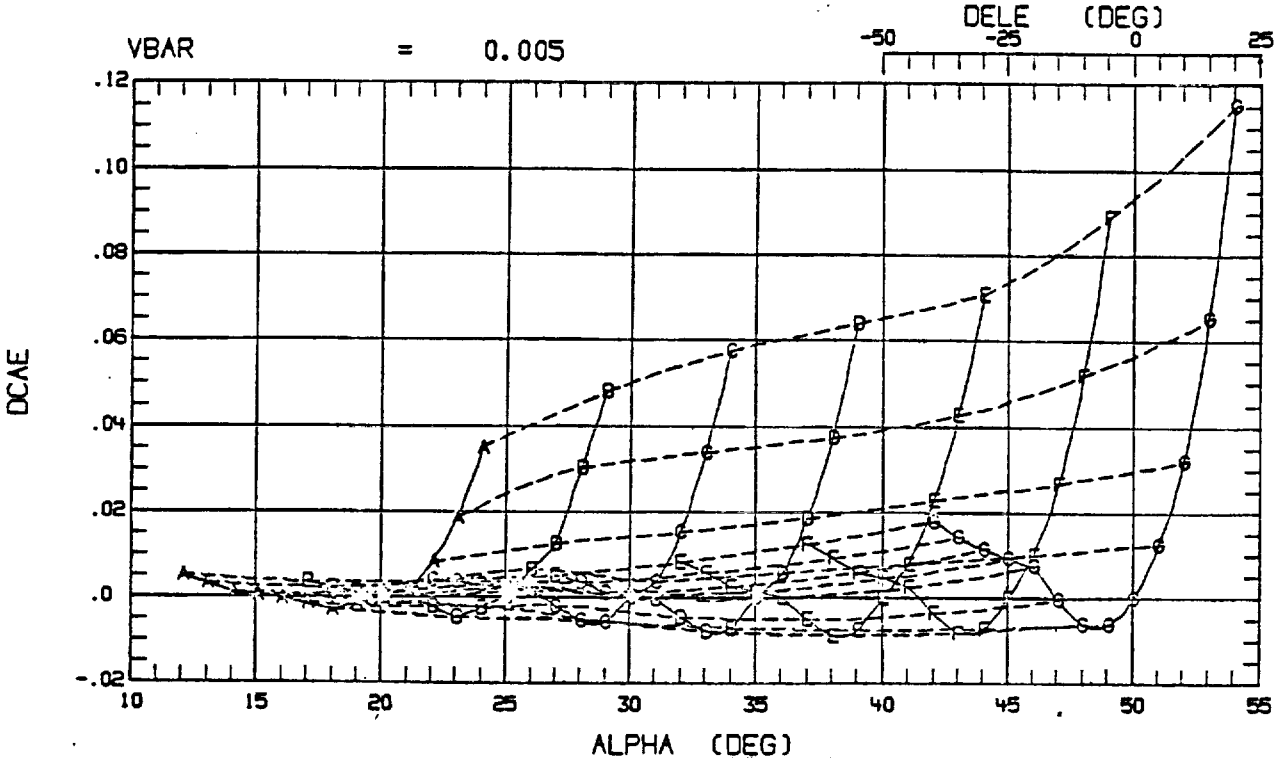
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT							
-40.000	0.00583	0.00486	0.00346	0.00372	0.00498	0.00813	0.01236	0.01782
-35.000	0.00406	0.00296	0.00219	0.00344	0.00335	0.00560	0.00913	0.01406
-30.000	0.00229	0.00096	0.00092	0.00265	0.00112	0.00244	0.00576	0.01114
-25.000	0.00138	0.00037	0.00020	0.00201	0.00042	0.00144	0.00436	0.00918
-20.000	0.00048	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00069	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00150	-0.00279	-0.00464	-0.00550	-0.00790	-0.00881	-0.00811	-0.00603
-5.000	-0.00083	-0.00152	-0.00242	-0.00583	-0.00713	-0.00747	-0.00721	-0.00526
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00324	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00657	0.00790	0.01237	0.01507	0.01847	0.02255	0.02569	0.03177
15.000	0.01541	0.01835	0.03026	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.02424	0.03469	0.04773	0.05758	0.06391	0.07071	0.08874	0.11520

ENGINEER DCO
DATE 10-4-78

FIGURE 4.1.1.2-94
EFFECT OF ELEVON

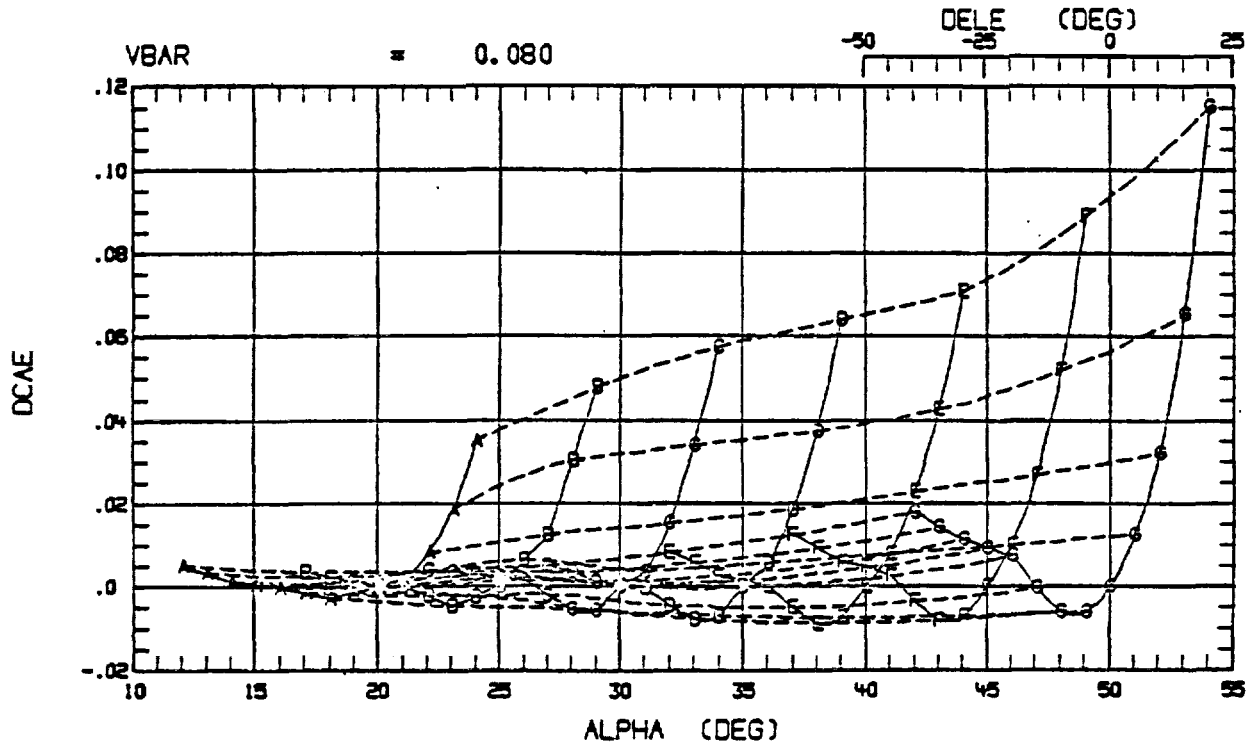


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT						
-40.000	0.00486	0.00346	0.00372	0.00498	0.00813	0.01236	0.01782
-35.000	0.00296	0.00219	0.00344	0.00335	0.00560	0.00913	0.01406
-30.000	0.00096	0.00092	0.00265	0.00112	0.00244	0.00576	0.01114
-25.000	0.00037	0.00020	0.00201	0.00042	0.00144	0.00436	0.00918
-20.000	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00279	-0.00484	-0.00550	-0.00790	-0.00881	-0.00811	-0.00603
-5.000	-0.00152	-0.00242	-0.00583	-0.00713	-0.00747	-0.00721	-0.00626
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00790	0.01237	0.01507	0.01847	0.02255	0.02669	0.03177
15.000	0.01835	0.03026	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.03469	0.04773	0.05758	0.06391	0.07071	0.08874	0.11520

ENGINEER NASA
DATE

FIGURE 4.1.1.2-95
EFFECT OF ELEVON

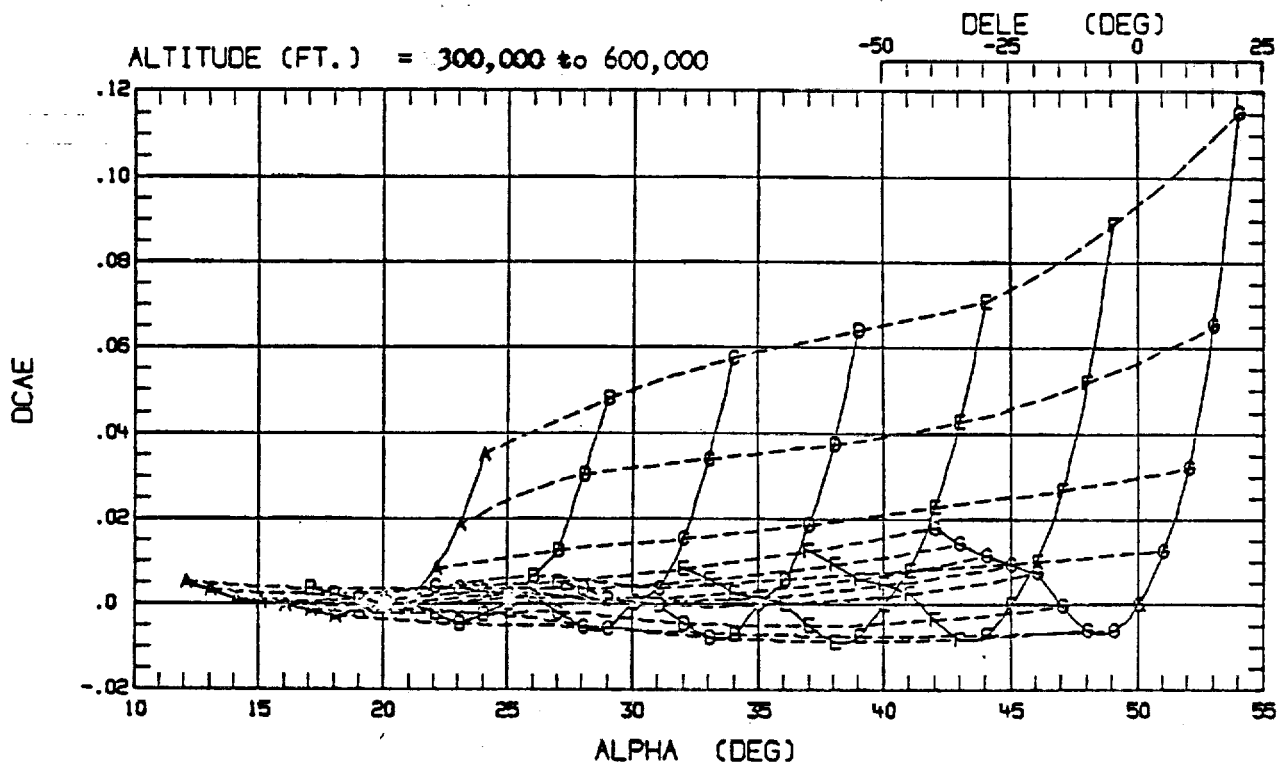


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT						
-40.000	0.00485	0.00346	0.00372	0.00498	0.00813	0.01236	0.01782
-35.000	0.00296	0.00219	0.00344	0.00335	0.00560	0.00913	0.01406
-30.000	0.00096	0.00092	0.00265	0.00112	0.00244	0.00576	0.01114
-25.000	0.00037	0.00020	0.00201	0.00042	0.00144	0.00436	0.00918
-20.000	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00279	-0.00484	-0.00550	-0.00790	-0.00881	-0.00811	-0.00603
-5.000	-0.00152	-0.00242	-0.00593	-0.00713	-0.00747	-0.00721	-0.00625
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00790	0.01237	0.01507	0.01847	0.02255	0.02669	0.03177
15.000	0.01835	0.03025	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.03469	0.04773	0.05738	0.06391	0.07071	0.08874	0.11520

ENGINEER NASA
DATE

FIGURE 4.1.1.2-96
EFFECT OF ELEVON

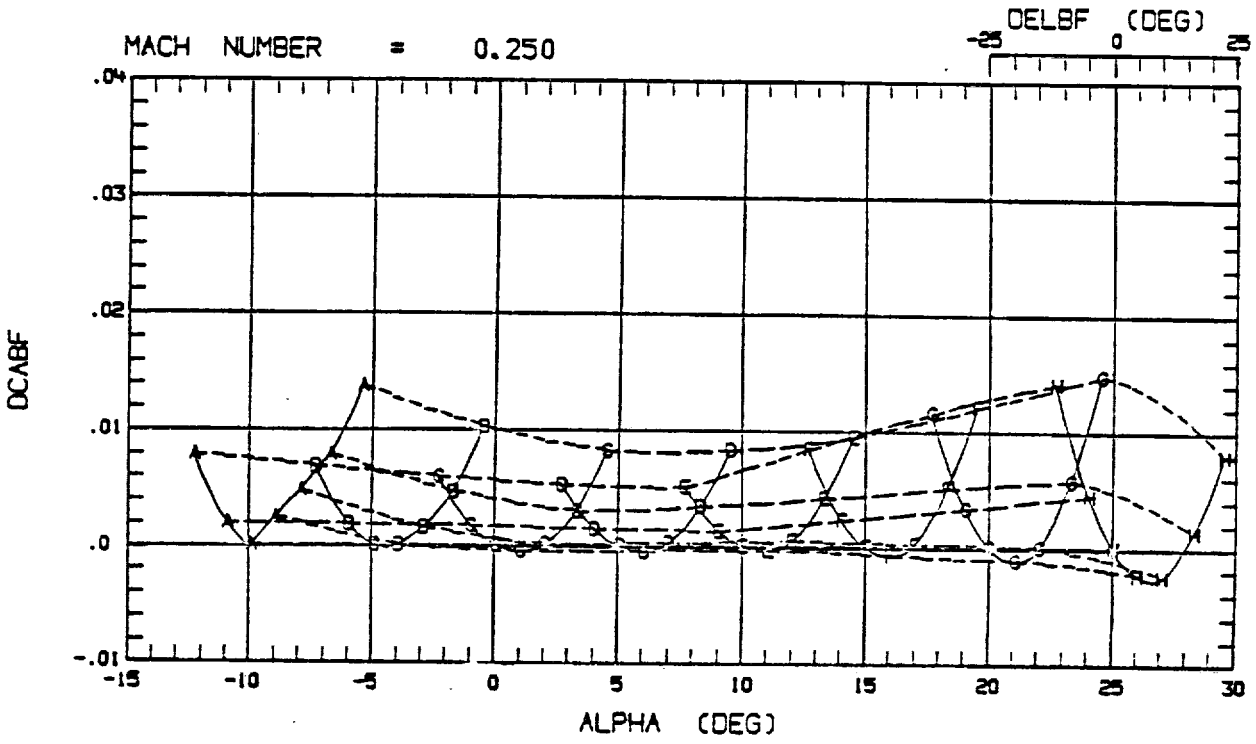


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON AXIAL FORCE INCREMENT						
-40.000	0.00486	0.00346	0.00372	0.00498	0.00813	0.01236	0.01782
-35.000	0.00296	0.00219	0.00344	0.00335	0.00560	0.00913	0.01406
-30.000	0.00096	0.00092	0.00265	0.00112	0.00244	0.00576	0.01114
-25.000	0.00037	0.00020	0.00201	0.00042	0.00144	0.00436	0.00918
-20.000	-0.00032	-0.00019	0.00147	-0.00052	-0.00019	0.00244	0.00722
-15.000	-0.00168	-0.00230	-0.00206	-0.00462	-0.00518	-0.00370	-0.00046
-10.000	-0.00279	-0.00484	-0.00550	-0.00790	-0.00881	-0.00811	-0.00603
-5.000	-0.00152	-0.00242	-0.00583	-0.00713	-0.00747	-0.00721	-0.00626
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00179	0.00623	0.00342	0.00544	0.00783	0.00994	0.01242
10.000	0.00790	0.01237	0.01507	0.01847	0.02255	0.02669	0.03177
15.000	0.01835	0.03026	0.03372	0.03729	0.04251	0.05180	0.06511
20.000	0.03469	0.04773	0.05758	0.06391	0.07071	0.08874	0.11520

ENGINEER NASA
DATE

FIGURE 4.1.1.2-97
EFFECT OF ELEVON

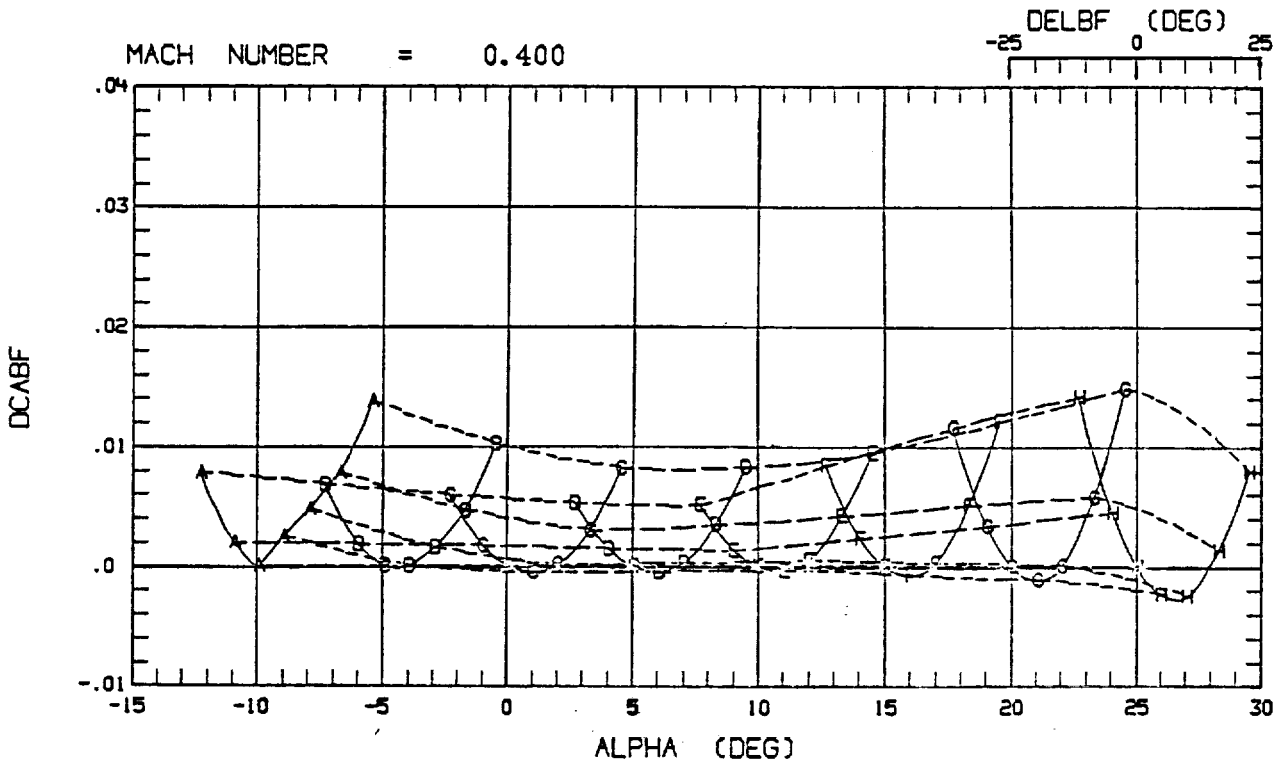


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00780	0.00675	0.00590	0.00522	0.00510	0.00838	0.01158	0.01415
-5.000	0.00197	0.00185	0.00170	0.00145	0.00135	0.00235	0.00334	0.00450
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00238	0.00004	-0.00054	-0.00042	-0.00032	-0.00073	-0.00116	-0.00240
10.000	0.00475	0.00157	0.00013	0.00026	0.00048	0.00029	-0.00001	-0.00257
16.300	0.00774	0.00464	0.00300	0.00340	0.00417	0.00506	0.00568	0.00129
22.500	0.01372	0.01014	0.00820	0.00825	0.00943	0.01203	0.01474	0.00792

ENGINEER W.M.Z.
DATE 4-21-78

FIGURE 4.1.1.2-98
EFFECT OF BODY FLAP

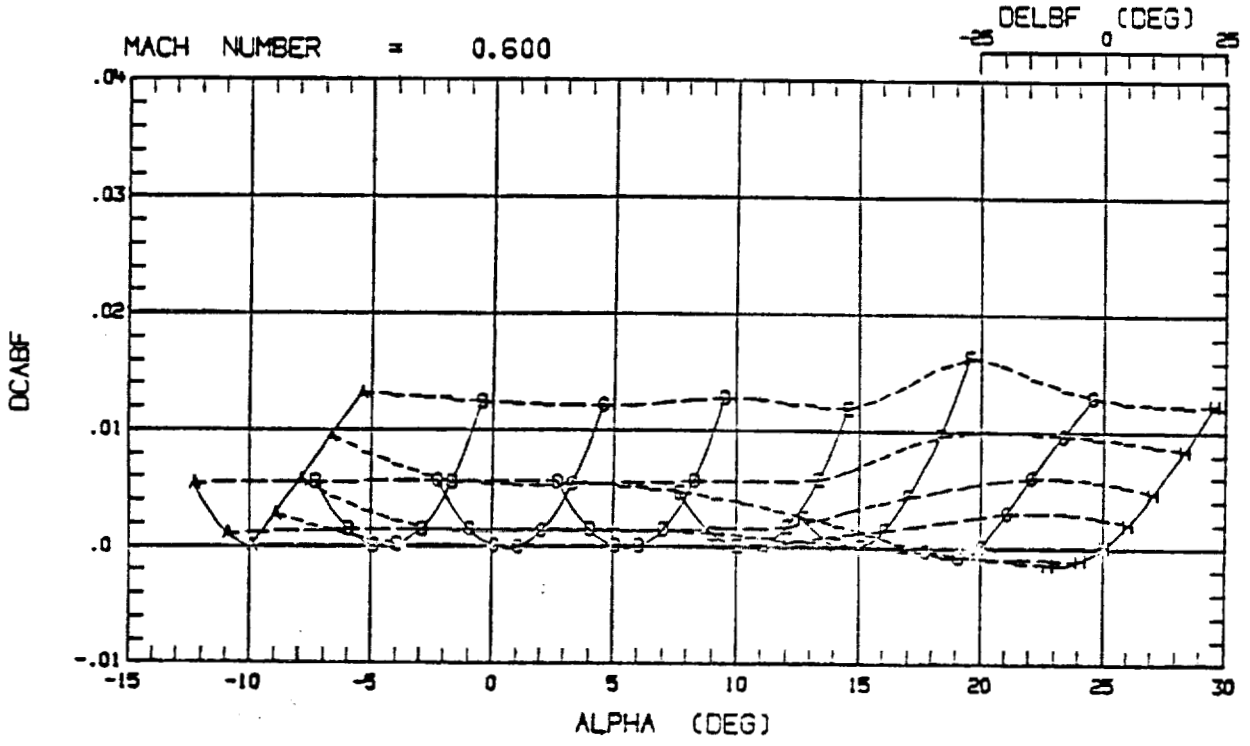


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00780	0.00675	0.00590	0.00522	0.00510	0.00838	0.01158	0.01415
-5.000	0.00197	0.00185	0.00170	0.00145	0.00135	0.00235	0.00334	0.00450
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00238	0.00004	-0.00054	-0.00042	-0.00032	-0.00073	-0.00116	-0.00240
10.000	0.00475	0.00157	0.00013	0.00026	0.00048	0.00029	-0.00001	-0.00257
16.300	0.00774	0.00464	0.00300	0.00340	0.00417	0.00506	0.00568	0.00129
22.500	0.01372	0.01014	0.00820	0.00825	0.00943	0.01203	0.01474	0.00792

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-99
EFFECT OF BODY FLAP

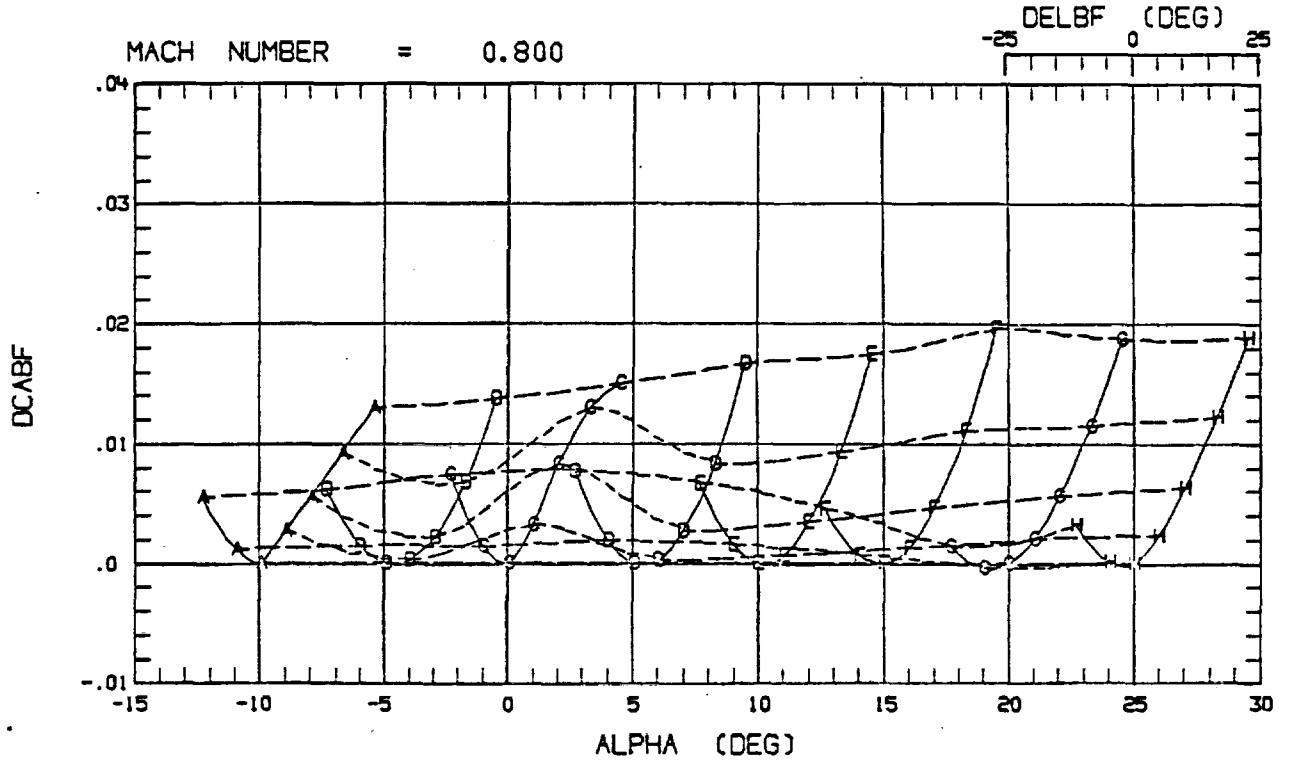


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00541	0.00548	0.00563	0.00552	0.00455	0.00250	-0.00038	-0.00155
-5.000	0.00107	0.00138	0.00144	0.00138	0.00106	0.00011	-0.00082	-0.00111
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00273	0.00010	-0.00008	-0.00003	0.00015	0.00146	0.00294	0.00196
10.000	0.00566	0.00147	0.00126	0.00138	0.00172	0.00437	0.00595	0.00455
16.300	0.00938	0.00548	0.00530	0.00561	0.00573	0.00959	0.00949	0.00822
22.500	0.01308	0.01234	0.01202	0.01256	0.01184	0.01625	0.01291	0.01223

ENGINEER WMZ
DATE 3-21-78

FIGURE 4.1.1.2-100
EFFECT OF BODY FLAP

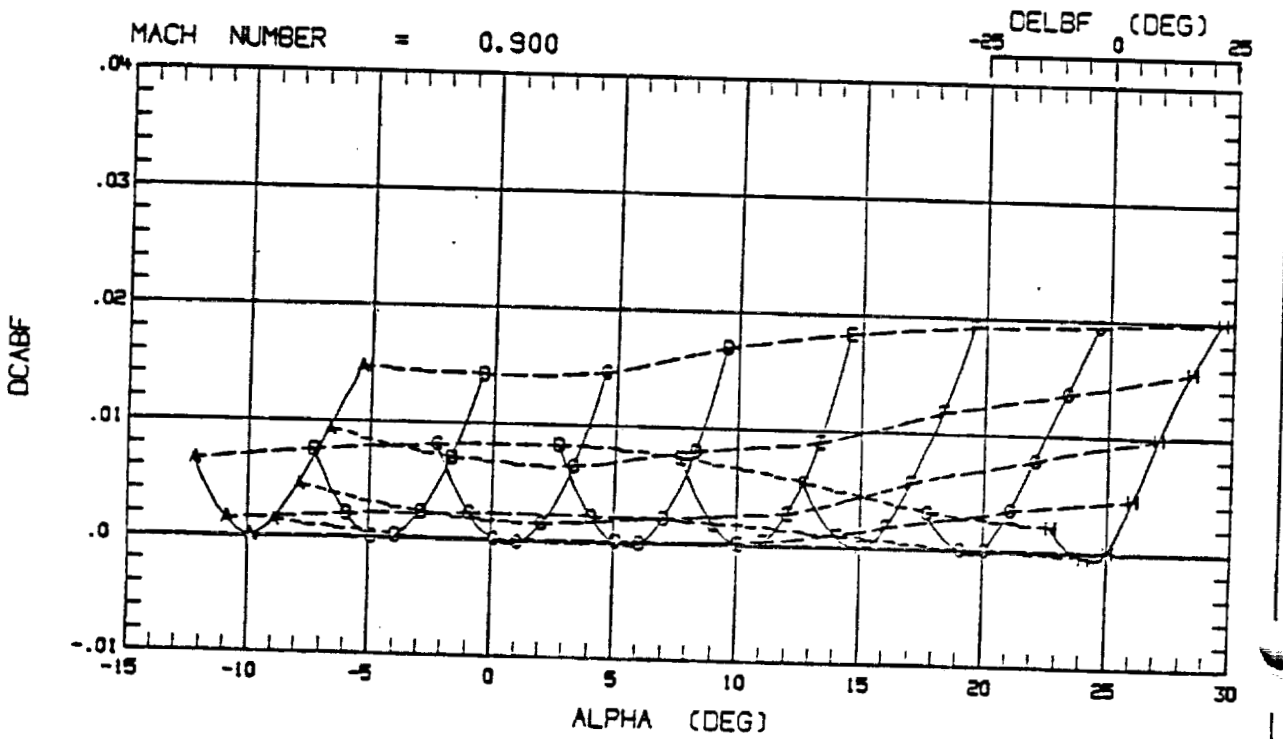


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00551	0.00608	0.00735	0.00767	0.00664	0.00453	0.00146	0.00319
-5.000	0.00111	0.00148	0.00144	0.00189	0.00149	0.00066	-0.00037	0.00014
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00265	0.00028	0.00319	0.00028	0.00068	0.00129	0.00201	0.00234
10.000	0.00553	0.00217	0.00830	0.00266	0.00341	0.00459	0.00558	0.00629
16.300	0.00922	0.00675	0.01291	0.00832	0.00923	0.01102	0.01151	0.01216
22.500	0.01294	0.01367	0.01494	0.01664	0.01735	0.01954	0.01868	0.01876

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-101
EFFECT OF BODY FLAP



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

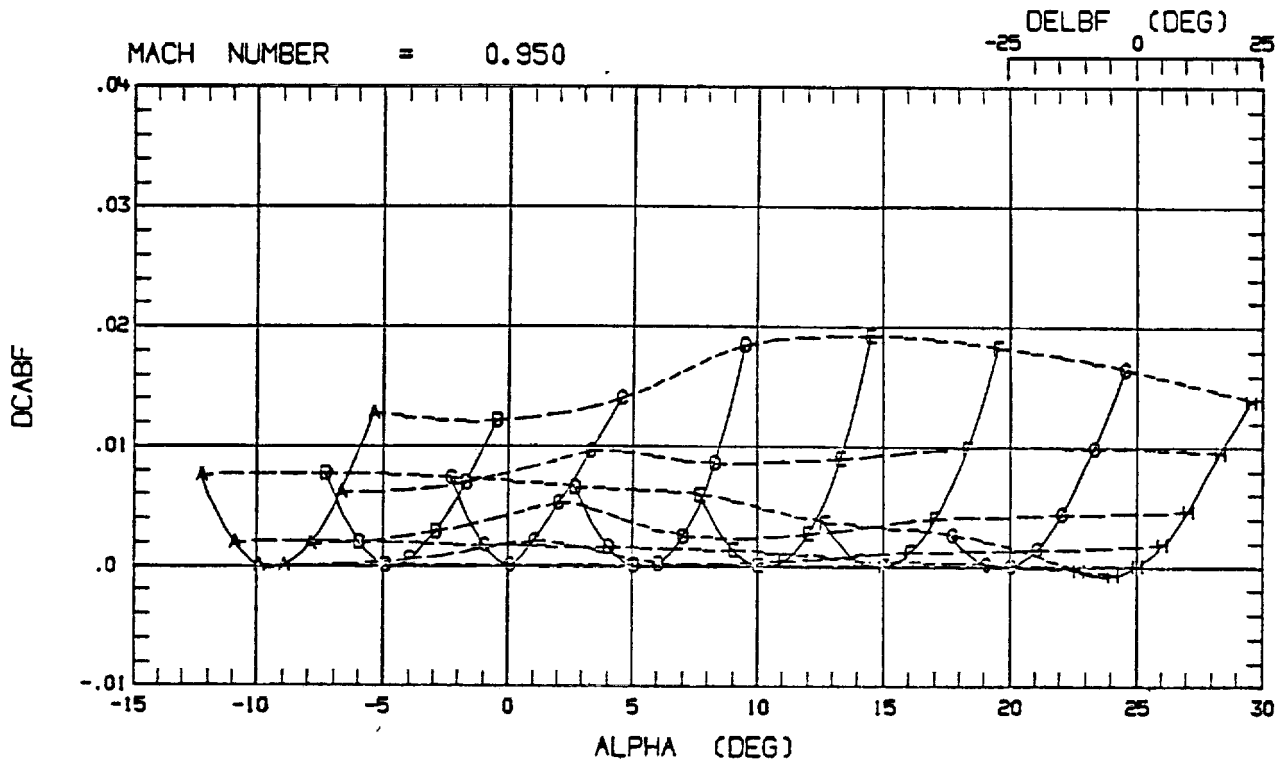
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.056 FT.
M.A.C. CW = 39.560 FT.
BODY LENGTH LB = 1290.3 IN.

DELBF (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00645	0.00742	0.00804	0.00816	0.00720	0.00532	0.00308	0.00205
-5.000	0.00143	0.00191	0.00215	0.00208	0.00168	0.00087	0.0	-0.00048
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00127	0.00021	-0.00027	-0.00013	0.00027	0.00174	0.00340	0.00444
10.000	0.00436	0.00215	0.00136	0.00208	0.00269	0.00558	0.00782	0.00983
16.300	0.00914	0.00689	0.00632	0.00791	0.00898	0.01178	0.01356	0.01549
22.500	0.01459	0.01414	0.01443	0.01689	0.01835	0.01914	0.01945	0.01965

ENGINEER LMM
DATE 9-22-78

FIGURE 4.1.1.2-102
EFFECT OF BODY FLAP



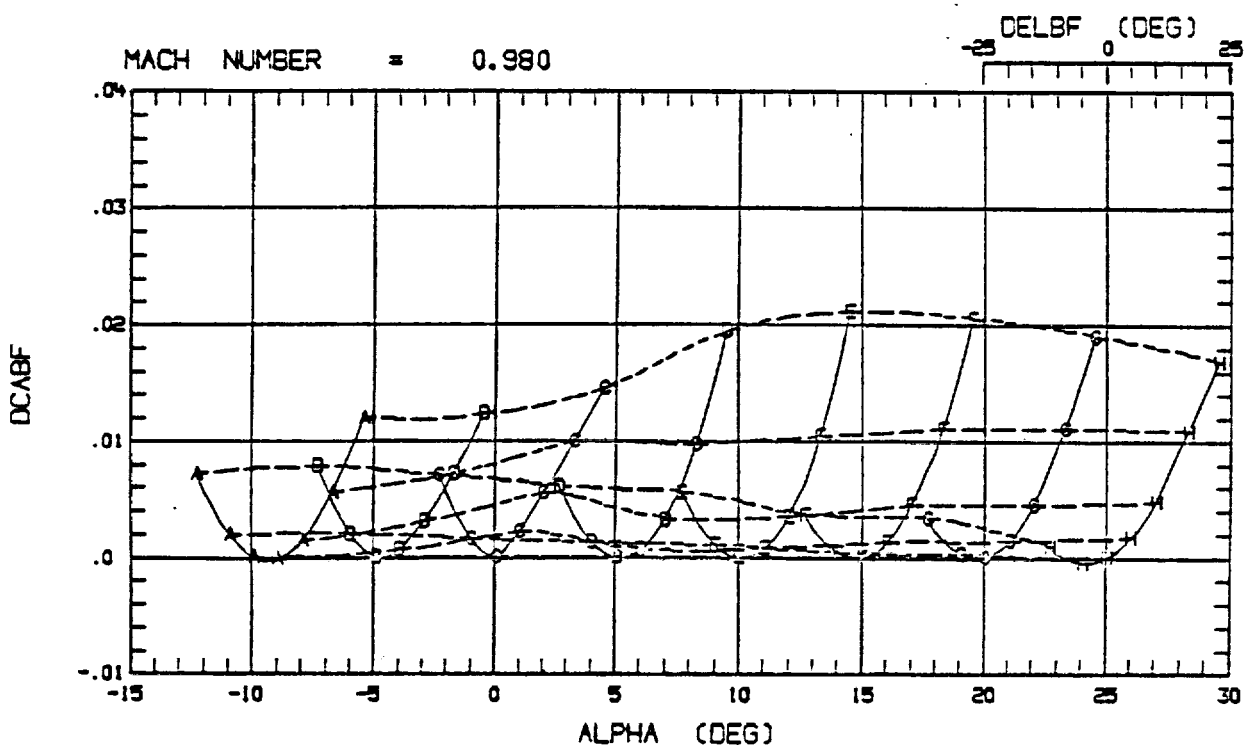
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00748	0.00767	0.00726	0.00654	0.00588	0.00361	0.00257	-0.00031
-5.000	0.00198	0.00199	0.00166	0.00150	0.00125	0.00046	0.00011	-0.00079
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00002	0.00052	0.00203	0.00021	0.00040	0.00115	0.00138	0.00175
10.000	0.00174	0.00280	0.00521	0.00241	0.00267	0.00394	0.00430	0.00456
16.300	0.00608	0.00691	0.00948	0.00854	0.00895	0.00983	0.00981	0.00938
22.500	0.01268	0.01210	0.01398	0.01847	0.01916	0.01821	0.01638	0.01374

ENGINEER WMZ
DATE 9-11-78

FIGURE 4.1.1.2-103
EFFECT OF BODY FLAP

Rockwell International
Space Division

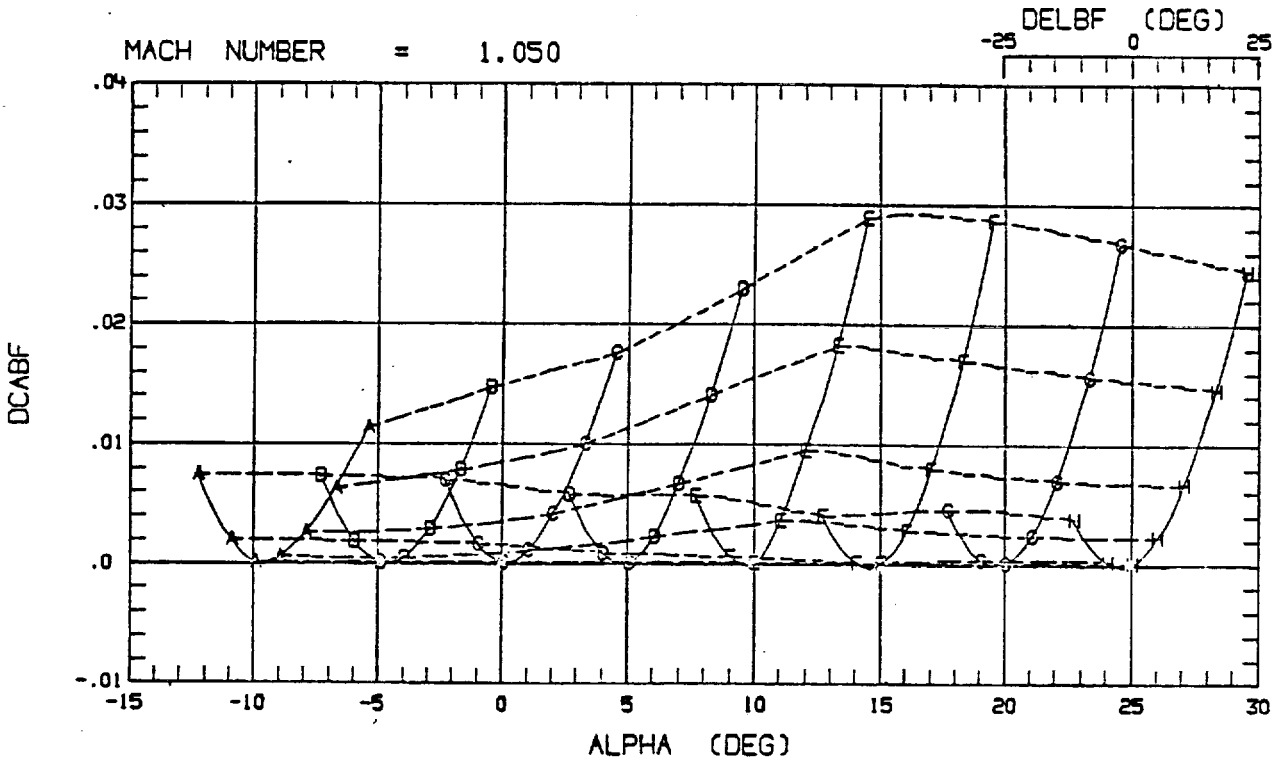


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00716	0.00771	0.00698	0.00600	0.00552	0.00358	0.00329	0.00068
-5.000	0.00192	0.00198	0.00154	0.00124	0.00103	0.00036	0.00025	-0.00051
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00016	0.00062	0.00217	0.00063	0.00074	0.00134	0.00136	0.00172
10.000	0.00139	0.00304	0.00548	0.00323	0.00347	0.00444	0.00442	0.00475
16.300	0.00554	0.00718	0.00989	0.00965	0.01037	0.01102	0.01103	0.01085
22.500	0.01194	0.01229	0.01452	0.01950	0.02114	0.02048	0.01895	0.01677

ENGINEER Wm Z
DATE 4-21-78

FIGURE 4.1.1.2-104
EFFECT OF BODY FLAP



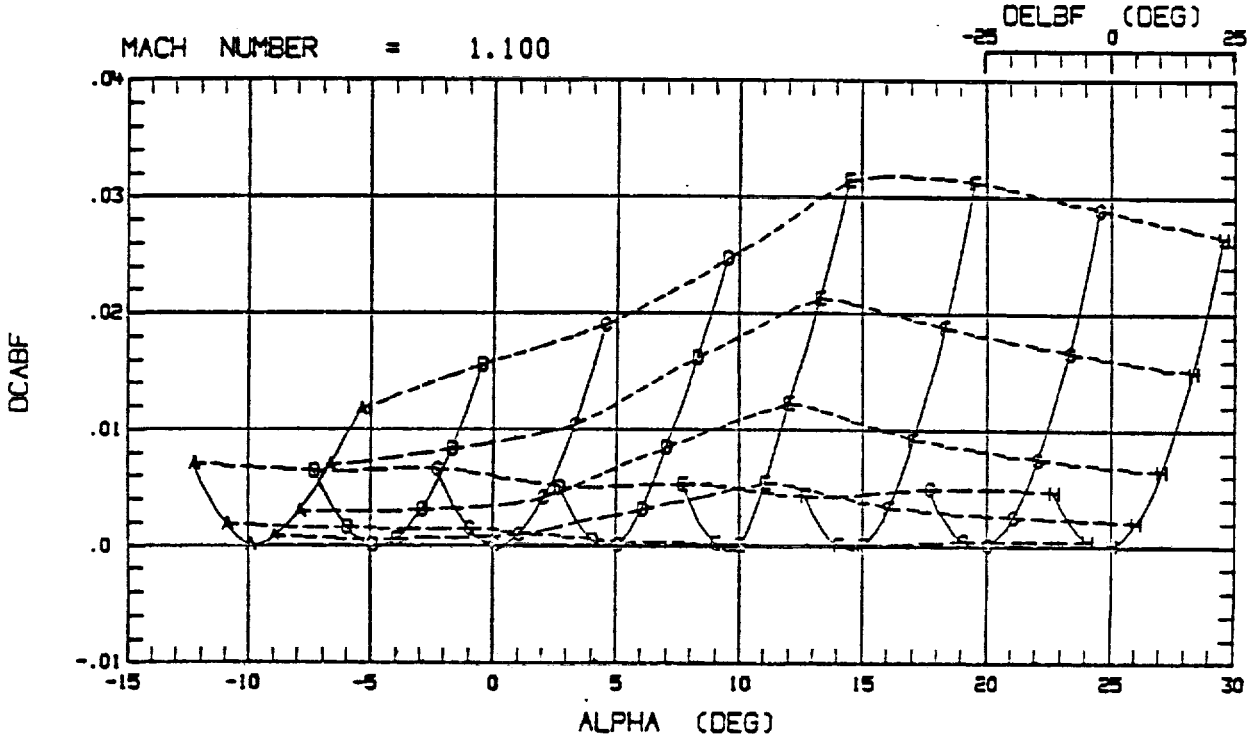
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00736	0.00728	0.00694	0.00570	0.00566	0.00401	0.00451	0.00368
-5.000	0.00193	0.00180	0.00153	0.00082	0.00051	0.00006	0.00033	0.00014
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00050	0.00045	0.00098	0.00218	0.00357	0.00271	0.00229	0.00218
10.000	0.00254	0.00285	0.00409	0.00667	0.00943	0.00785	0.00694	0.00658
16.300	0.00628	0.00780	0.00996	0.01404	0.01820	0.01687	0.01549	0.01449
22.500	0.01126	0.01459	0.01760	0.02290	0.02889	0.02862	0.02562	0.02436

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-105
EFFECT OF BODY FLAP

Rockwell International
Space Division



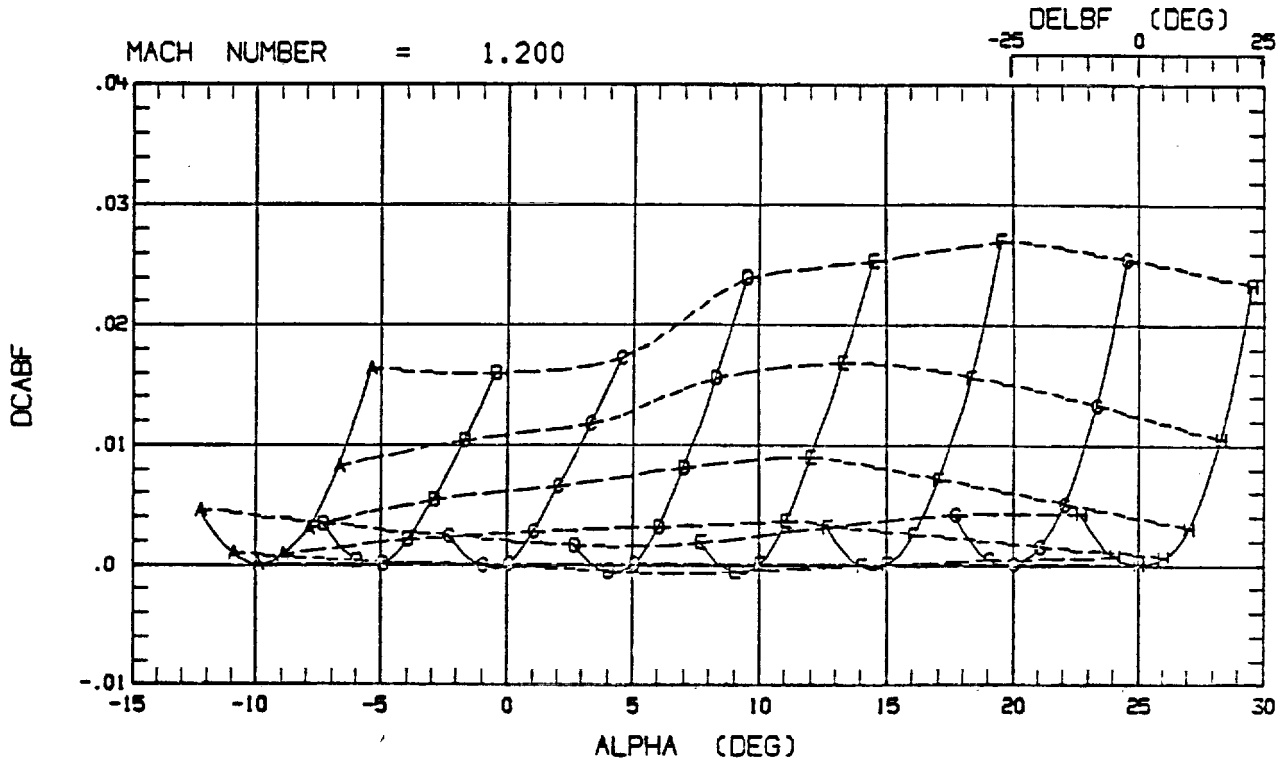
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00698	0.00642	0.00654	0.00501	0.00524	0.00418	0.00479	0.00462
-5.000	0.00177	0.00149	0.00137	0.00045	0.00014	-0.00002	0.00035	0.00041
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00074	0.00057	0.00094	0.00313	0.00539	0.00321	0.00240	0.00199
10.000	0.00298	0.00304	0.00403	0.00842	0.01222	0.00907	0.00734	0.00631
16.300	0.00683	0.00825	0.01031	0.01610	0.02127	0.01869	0.01648	0.01481
22.500	0.01175	0.01551	0.01890	0.02459	0.03142	0.03113	0.02978	0.02641

ENGINEER [illegible]
DATE 4-11-78

FIGURE 4.1.1.2-106
EFFECT OF BODY FLAP

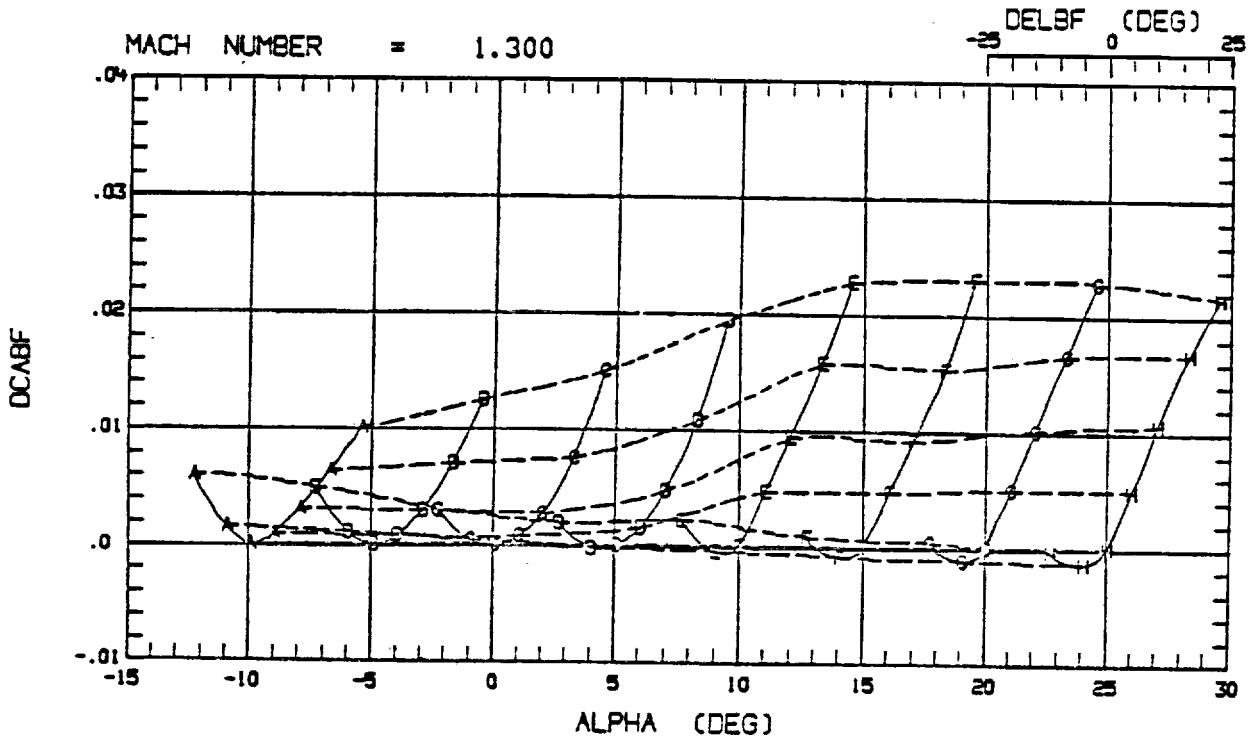


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00452	0.00329	0.00227	0.00150	0.00174	0.00313	0.00410	0.00423
-5.000	0.00087	0.00031	-0.00012	-0.00065	-0.00066	-0.00012	0.00037	0.00061
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00076	0.00200	0.00271	0.00313	0.00354	0.00245	0.00146	0.00056
10.000	0.00296	0.00537	0.00653	0.00807	0.00892	0.00704	0.00502	0.00294
16.300	0.00816	0.01033	0.01168	0.01551	0.01672	0.01557	0.01318	0.01039
22.500	0.01633	0.01590	0.01710	0.02394	0.02533	0.02598	0.02536	0.02321

ENGINEER Wuwz
DATE 9-21-78

FIGURE 4.1.1.2-107
EFFECT OF BODY FLAP

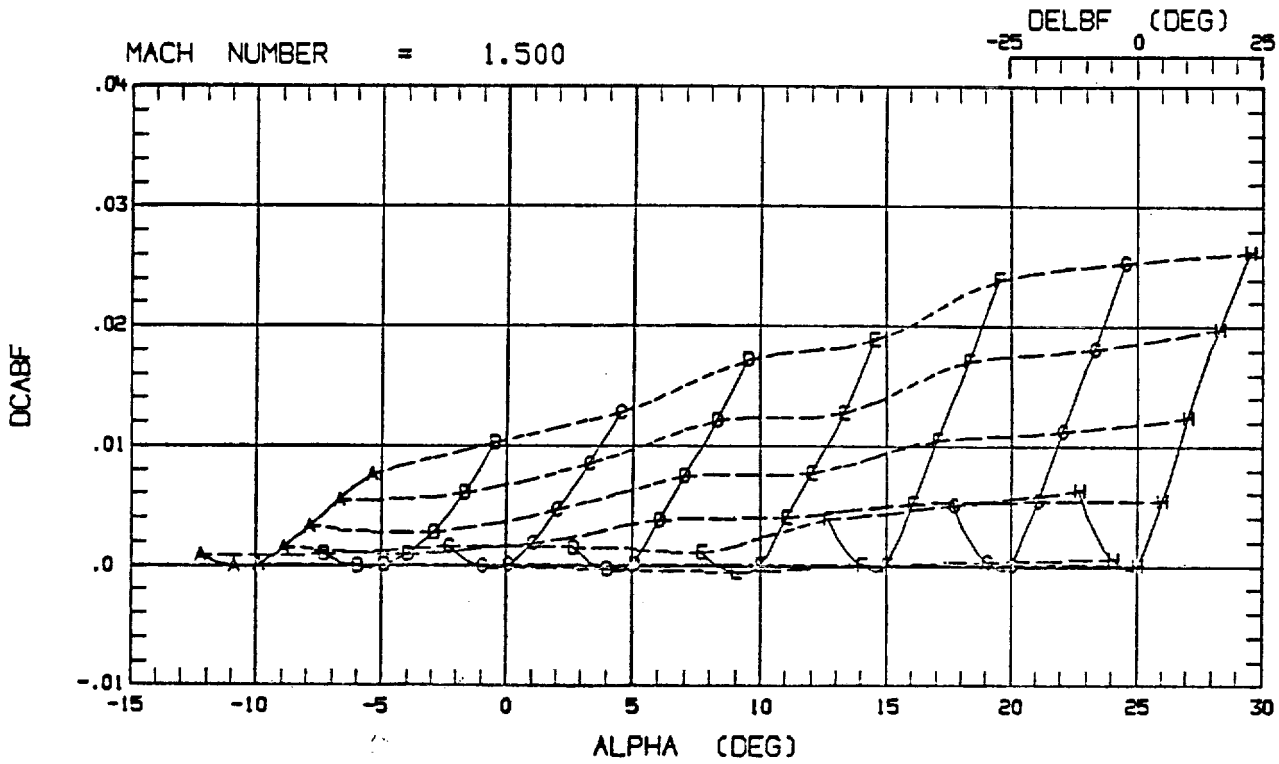


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00603	0.00488	0.00300	0.00192	0.00218	0.00076	0.00035	-0.00037
-5.000	0.00150	0.00108	0.00042	-0.00017	-0.00045	-0.00087	-0.00110	-0.00134
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00093	0.00074	0.00075	0.00158	0.00471	0.00472	0.00503	0.00465
10.000	0.00308	0.00290	0.00274	0.00468	0.00944	0.00913	0.01011	0.01052
16.300	0.00631	0.00701	0.00752	0.01086	0.01577	0.01530	0.01648	0.01662
22.500	0.01002	0.01242	0.01498	0.01944	0.02269	0.02303	0.02290	0.02146

ENGINEER _____
DATE _____

FIGURE 4.1.1.2-108
EFFECT OF BODY FLAP

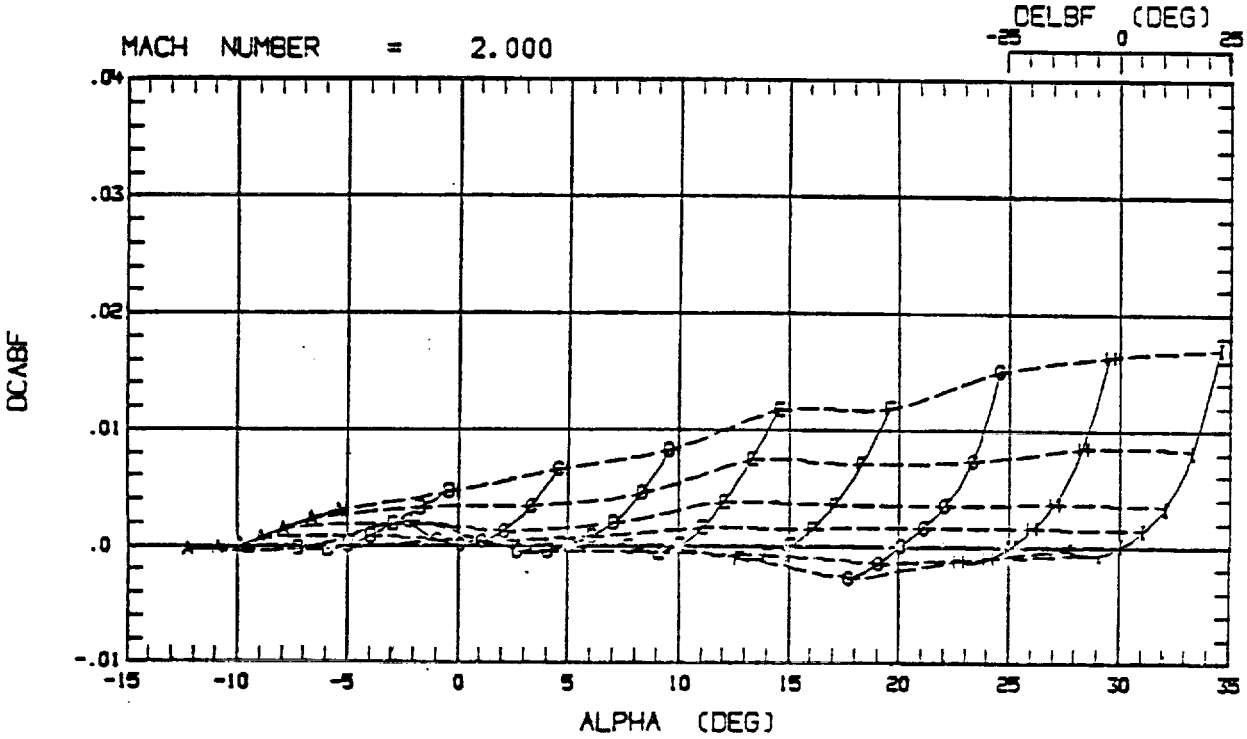


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00083	0.00089	0.00149	0.00146	0.00100	0.00378	0.00497	0.00620
-5.000	-0.00012	-0.00015	-0.00014	-0.00041	-0.00061	-0.00002	0.00029	0.00057
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00136	0.00097	0.00180	0.00369	0.00402	0.00510	0.00531	0.00540
10.000	0.00315	0.00274	0.00455	0.00733	0.00770	0.01046	0.01113	0.01237
16.300	0.00540	0.00597	0.00846	0.01208	0.01271	0.01703	0.01806	0.01974
22.500	0.00754	0.01020	0.01272	0.01718	0.01875	0.02394	0.02531	0.02513

ENGINEER WMZ
DATE 9-24-78

FIGURE 4.1.1.2-109
EFFECT OF BODY FLAP



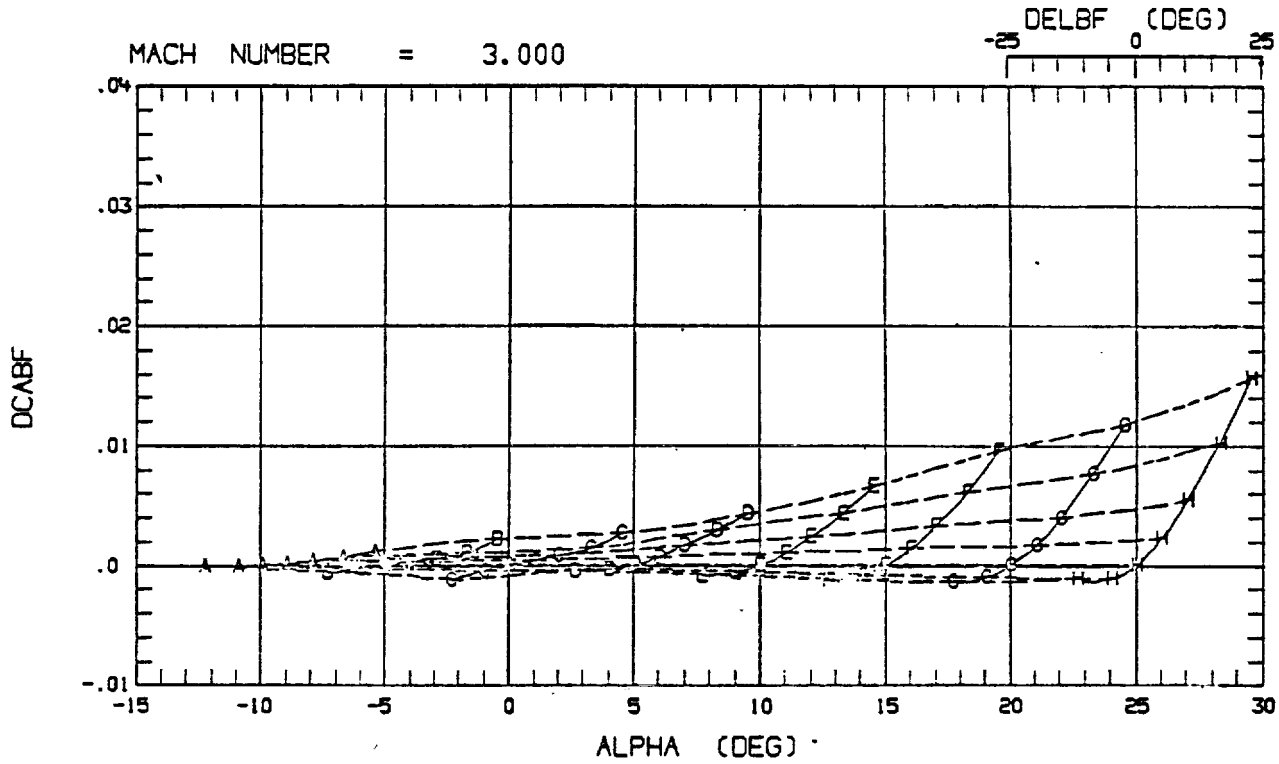
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000	30.000
	A	B	C	D	E	F	G	H	I
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT								
-11.700	-0.00035	-0.00026	0.00210	-0.00048	-0.00010	-0.00115	-0.00279	-0.00130	-0.00032
-5.000	-0.00028	-0.00032	0.00044	-0.00048	-0.00057	-0.00089	-0.00144	-0.00103	-0.00070
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00064	0.00079	0.00025	0.00080	0.00149	0.00146	0.00161	0.00151	0.00131
10.000	0.00141	0.00185	0.00122	0.00197	0.00376	0.00348	0.00340	0.00360	0.00326
16.300	0.00226	0.00321	0.00336	0.00441	0.00740	0.00698	0.00725	0.00834	0.00905
22.500	0.00295	0.00456	0.00648	0.00911	0.01170	0.01181	0.01494	0.01626	0.01691

ENGINEER WMZ
DATE 9-27-78

FIGURE 4.1.1.2-110
EFFECT OF BODY FLAP



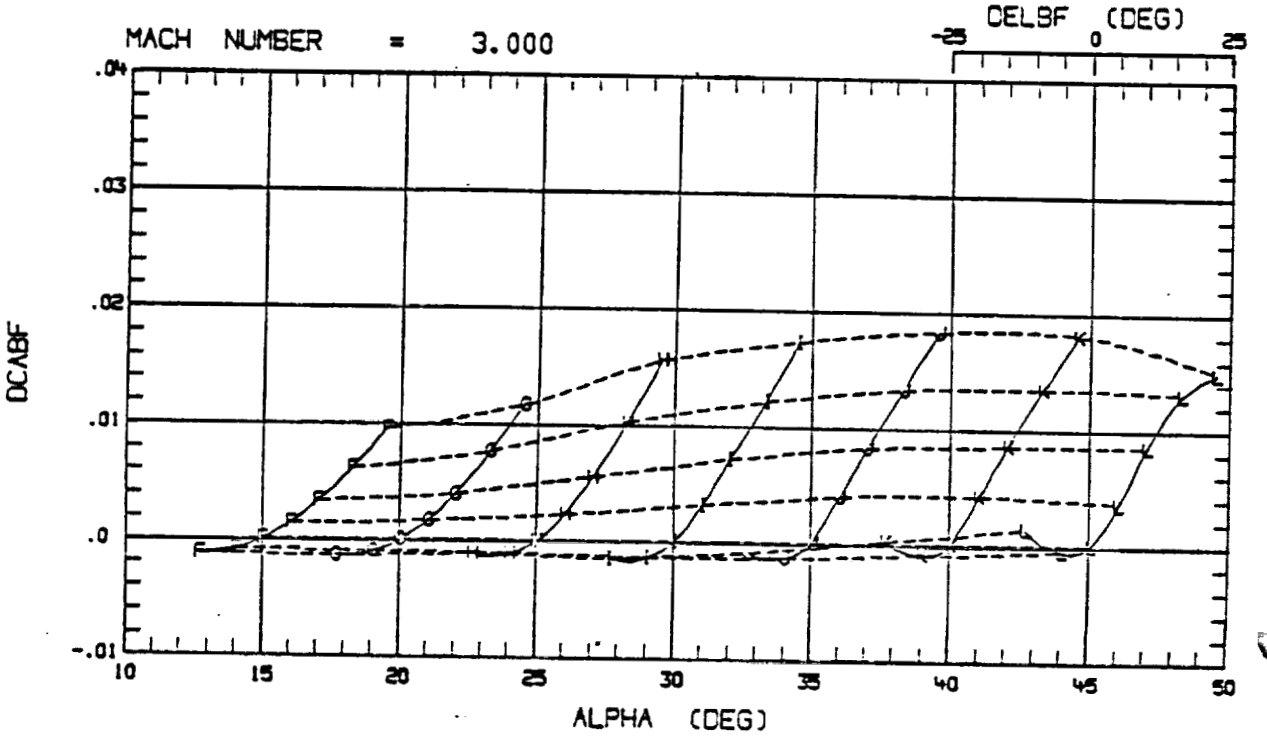
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	-0.00009	-0.00065	-0.00119	-0.00047	-0.00083	-0.00120	-0.00141	-0.00117
-5.000	-0.00008	-0.00029	-0.00049	-0.00037	-0.00059	-0.00084	-0.00102	-0.00113
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00014	0.00029	0.00044	0.00071	0.00102	0.00143	0.00163	0.00227
10.000	0.00035	0.00056	0.00081	0.00164	0.00240	0.00330	0.00401	0.00547
16.300	0.00069	0.00098	0.00136	0.00293	0.00440	0.00616	0.00763	0.01024
22.500	0.00113	0.00221	0.00267	0.00430	0.00661	0.00960	0.01176	0.01563

ENGINEER Wm Z
DATE 9-21-78

FIGURE 4.1.1.2-111
EFFECT OF BODY FLAP

Rockwell International
Space Division

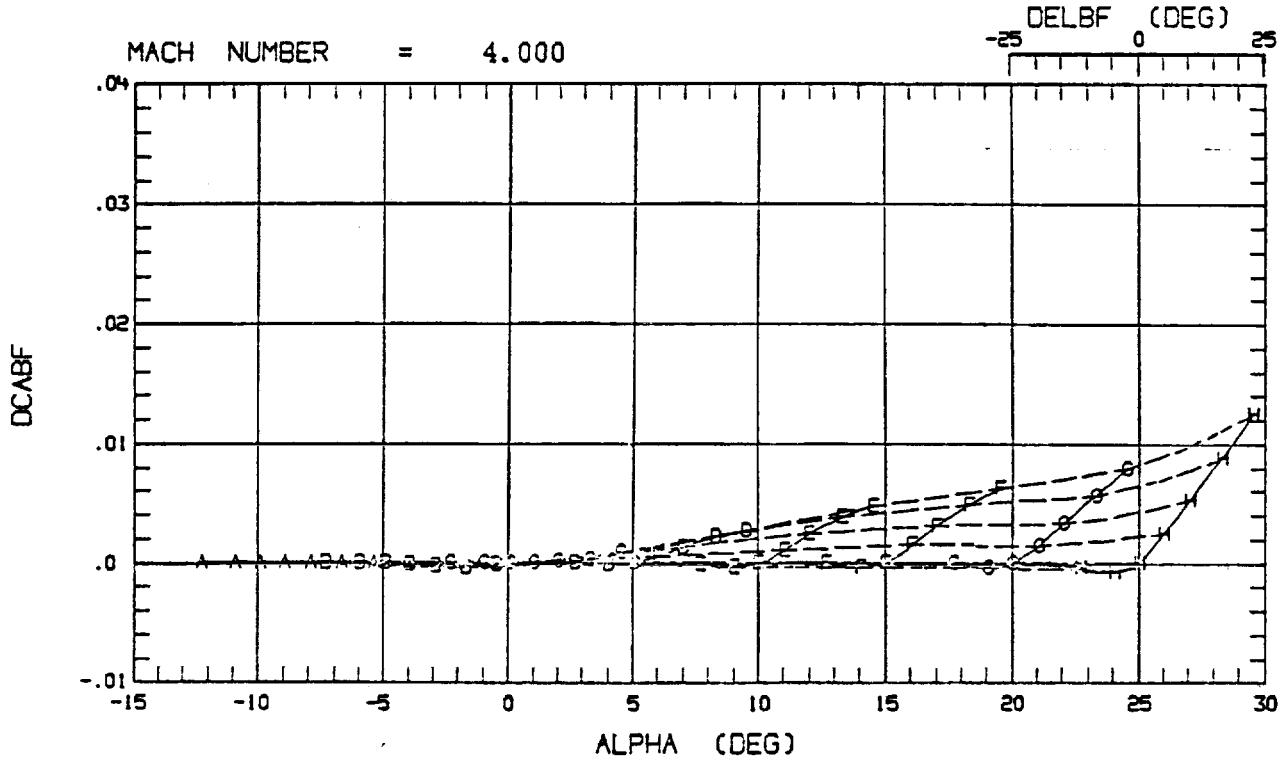


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT						
-11.700	-0.00120	-0.00141	-0.00117	-0.00151	-0.00090	0.00025	0.00141
-5.000	-0.00084	-0.00102	-0.00113	-0.00138	-0.00127	-0.00091	-0.00050
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00143	0.00163	0.00227	0.00318	0.00410	0.00421	0.00357
10.000	0.00330	0.00401	0.00547	0.00708	0.00824	0.00849	0.00858
16.300	0.00616	0.00763	0.01024	0.01215	0.01335	0.01350	0.01308
22.500	0.00960	0.01176	0.01563	0.01729	0.01830	0.01805	0.01485

ENGINEER [illegible]
DATE 5-22-78

FIGURE 4.1.1.2-112
EFFECT OF BODY FLAP

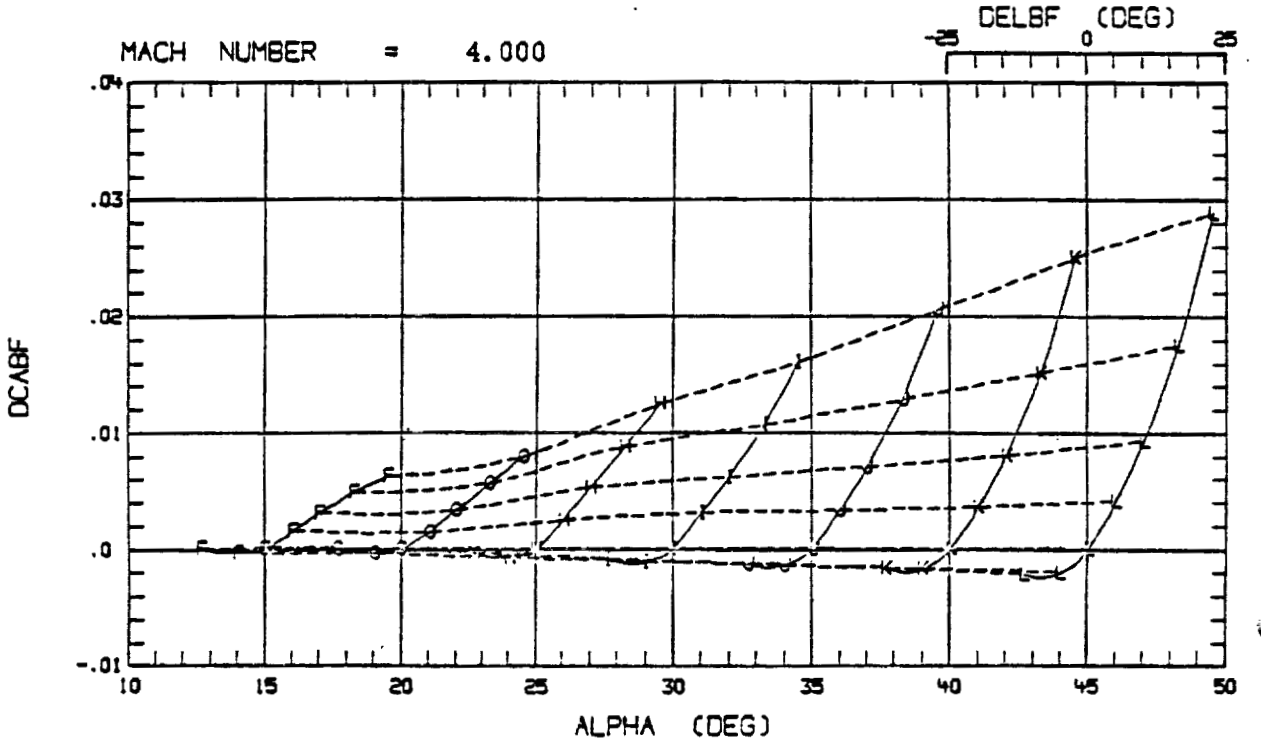


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.0	0.0	0.0	-0.00002	-0.00010	0.0	0.00008	-0.00031
-5.000	0.0	0.00003	-0.00002	-0.00016	-0.00031	-0.00035	-0.00039	-0.00075
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00001	-0.00010	0.00004	0.00058	0.00104	0.00149	0.00147	0.00247
10.000	0.00003	-0.00026	0.00010	0.00135	0.00240	0.00310	0.00330	0.00526
16.300	0.00005	-0.00038	0.00030	0.00215	0.00380	0.00484	0.00562	0.00683
22.500	0.0	-0.00008	0.00090	0.00271	0.00473	0.00625	0.00791	0.01241

ENGINEER LUMZ
DATE 9-31-78

FIGURE 4.1.1.2-113
EFFECT OF BODY FLAP

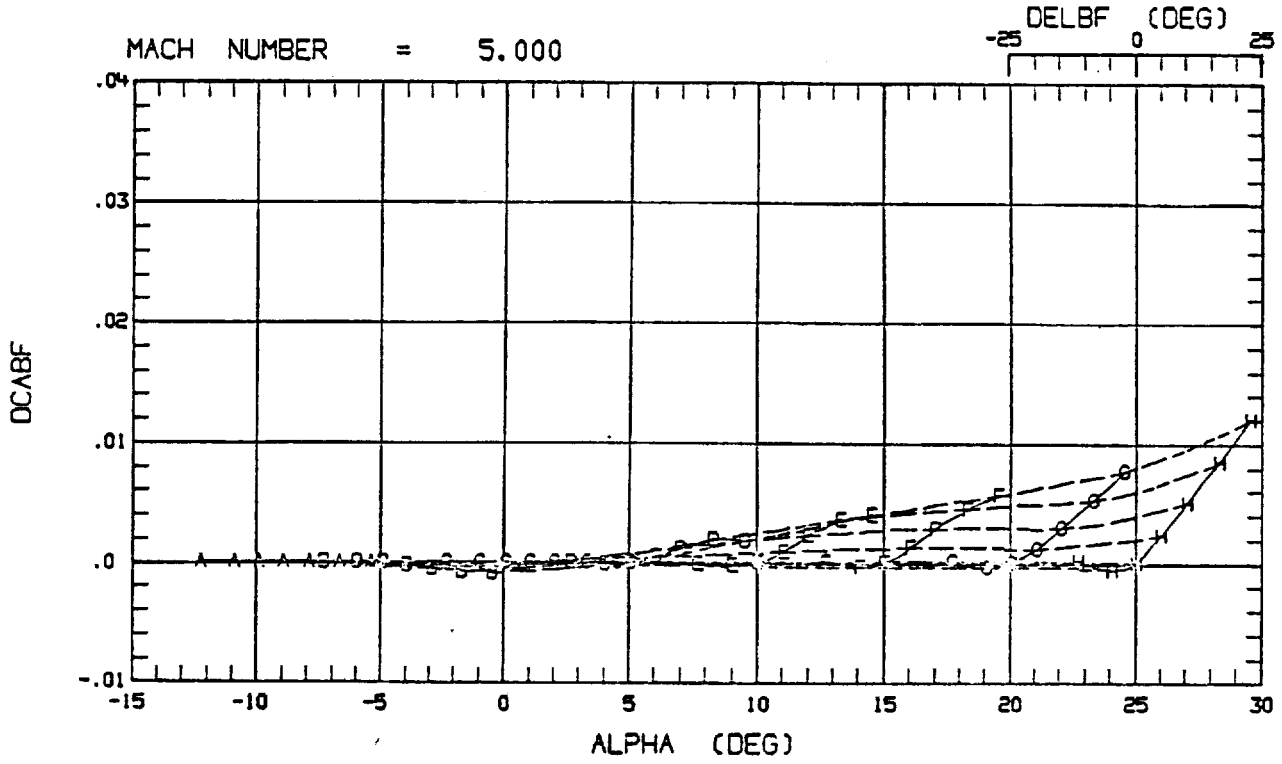


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000	20.000	25.000	30.000	35.000	40.000	45.000
	F	G	H	I	J	K	L
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT						
-11.700	0.0	0.00008	-0.00031	-0.00091	-0.00128	-0.00164	-0.00216
-5.000	-0.00036	-0.00039	-0.00075	-0.00108	-0.00137	-0.00165	-0.00199
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00149	0.00147	0.00247	0.00309	0.00331	0.00357	0.00410
10.000	0.00310	0.00330	0.00526	0.00615	0.00704	0.00799	0.00933
16.300	0.00484	0.00562	0.00883	0.01066	0.01290	0.01515	0.01750
22.500	0.00625	0.00791	0.01241	0.01601	0.02054	0.02497	0.02987

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.1.1.2-114
EFFECT OF BODY FLAP

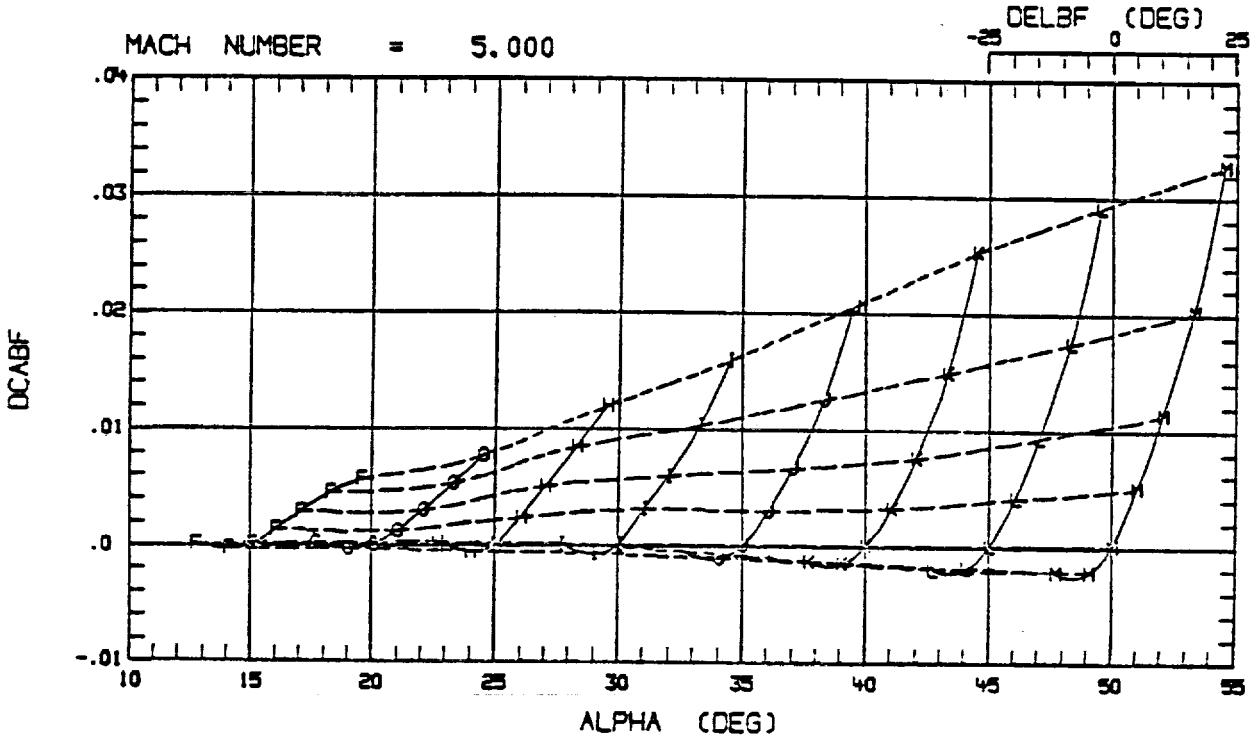


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.0	0.00001	0.0	-0.00002	-0.00009	0.00003	0.00017	0.00021
-5.000	0.0	0.00005	0.0	-0.00015	-0.00029	-0.00032	-0.00033	-0.00055
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00018	0.0	0.00048	0.00092	0.00130	0.00121	0.00237
10.000	0.0	-0.00045	0.0	0.00122	0.00227	0.00288	0.00290	0.00502
16.300	0.0	-0.00070	0.0	0.00188	0.00352	0.00450	0.00521	0.00644
22.500	0.0	-0.00080	0.0	0.00180	0.00391	0.00566	0.00765	0.01193

ENGINEER LWM2
DATE 9-21-78

FIGURE 4.1.1.2-115
EFFECT OF BODY FLAP



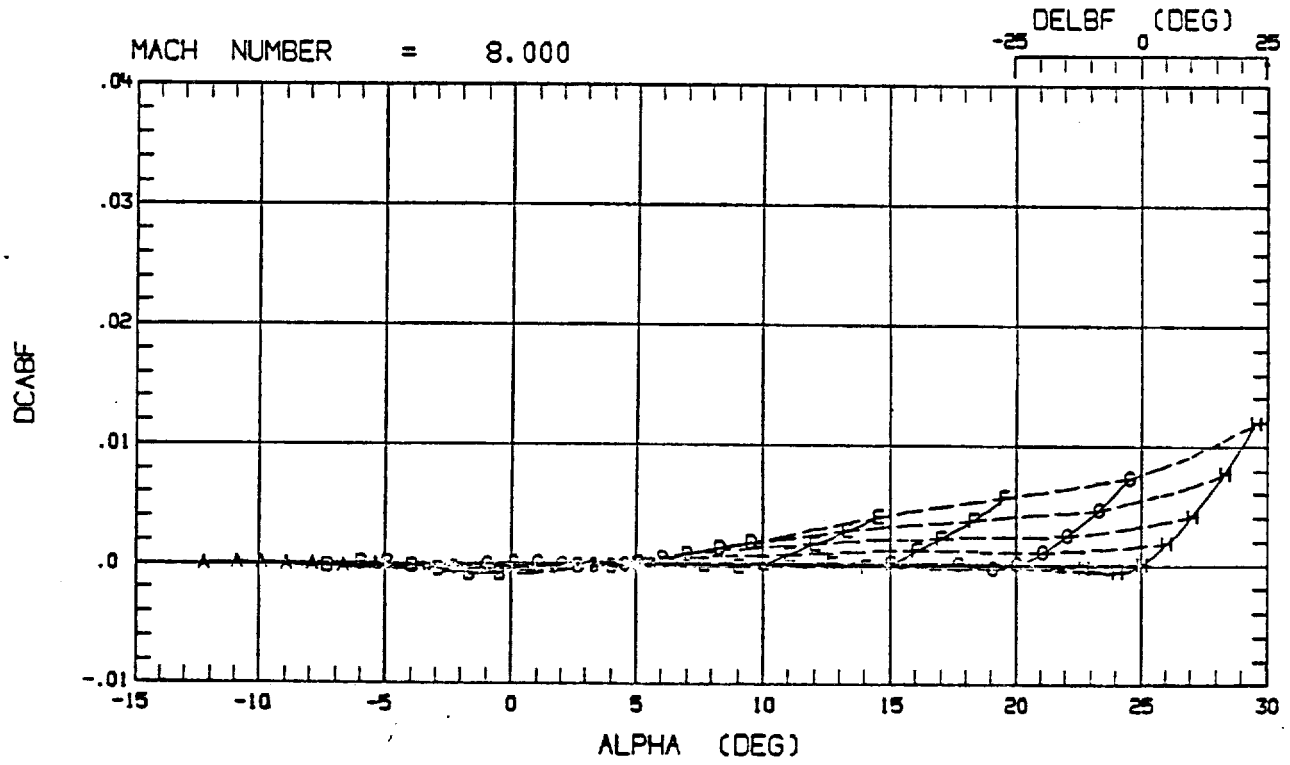
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00003	0.00017	0.00021	0.00003	-0.00062	-0.00140	-0.00198	-0.00221
-5.000	-0.00032	-0.00033	-0.00055	-0.00074	-0.00113	-0.00155	-0.00192	-0.00220
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00130	0.00121	0.00237	0.00307	0.00294	0.00321	0.00403	0.00500
10.000	0.00268	0.00290	0.00502	0.00591	0.00659	0.00750	0.00929	0.01126
16.300	0.00450	0.00521	0.00844	0.01028	0.01258	0.01488	0.01743	0.02014
22.500	0.00556	0.00765	0.01193	0.01588	0.02062	0.02522	0.02907	0.03265

ENGINEER WMZ
DATE 3-31-78

FIGURE 4.1.1.2-116
EFFECT OF BODY FLAP



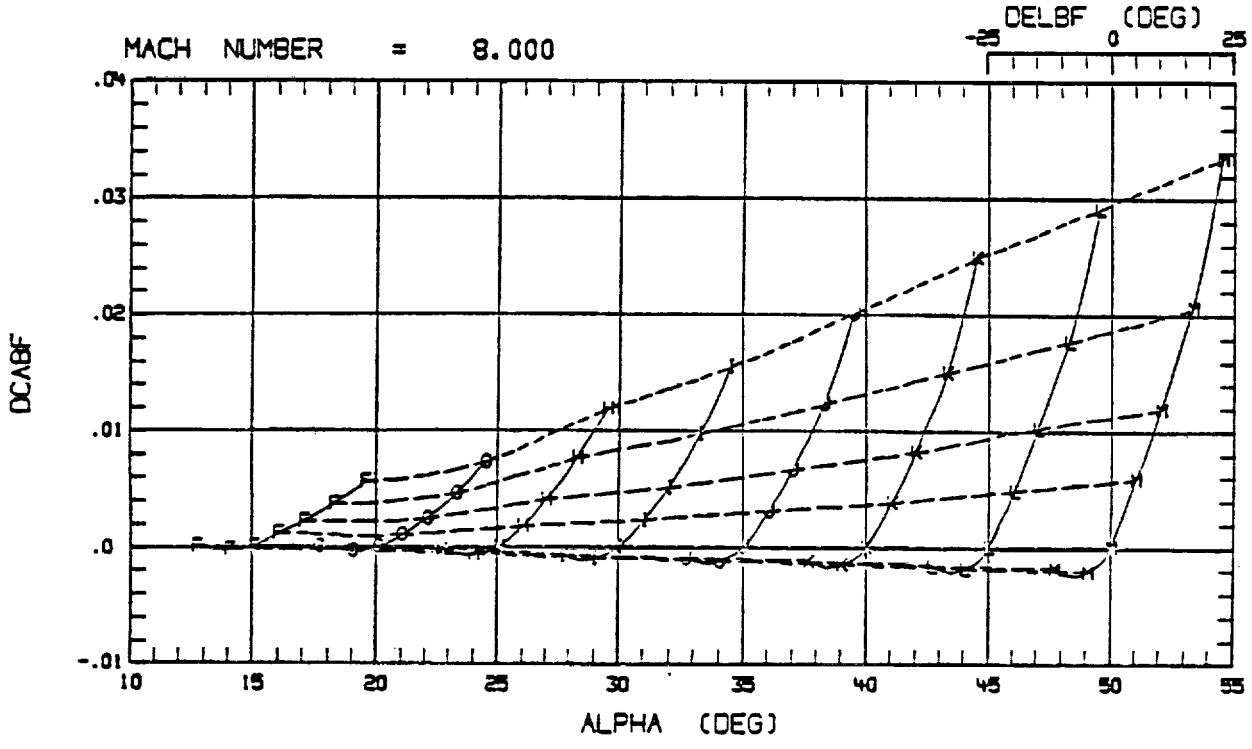
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	-0.00005	-0.00023	-0.00030	-0.00023	-0.00004	0.00003	0.00002	-0.00029
-5.000	-0.00001	-0.00002	-0.00008	-0.00017	-0.00022	-0.00027	-0.00033	-0.00066
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00004	-0.00021	-0.00003	0.00037	0.00083	0.00116	0.00101	0.00176
10.000	-0.00012	-0.00054	-0.00014	0.00080	0.00171	0.00221	0.00242	0.00409
16.300	-0.00020	-0.00083	-0.00020	0.00128	0.00278	0.00373	0.00462	0.00764
22.500	-0.00013	-0.00092	-0.00010	0.00181	0.00402	0.00559	0.00729	0.01182

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-117
EFFECT OF BODY FLAP

Rockwell International
Space Division



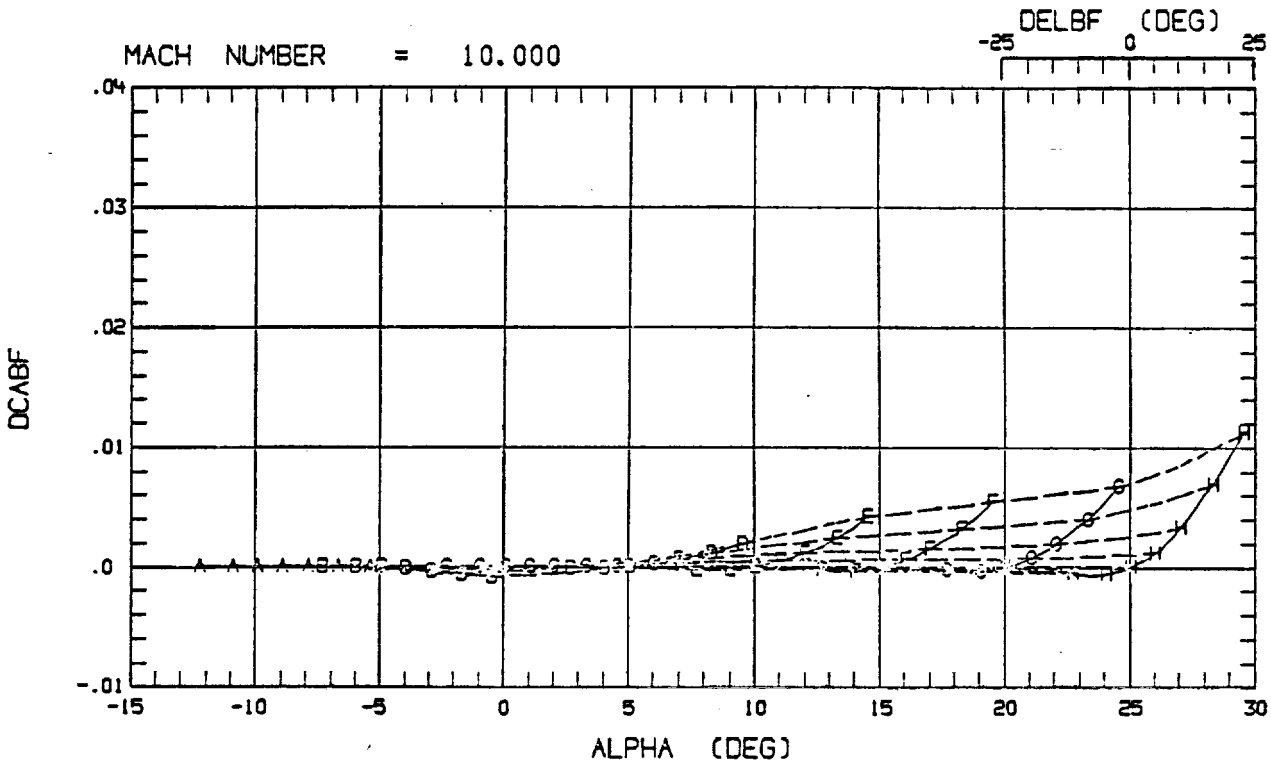
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.00003	0.00002	-0.00029	-0.00076	-0.00099	-0.00123	-0.00160	-0.00193
-5.000	-0.00027	-0.00033	-0.00066	-0.00096	-0.00123	-0.00150	-0.00182	-0.00211
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00116	0.00101	0.00176	0.00233	0.00308	0.00380	0.00482	0.00582
10.000	0.00221	0.00242	0.00409	0.00511	0.00660	0.00819	0.01024	0.01187
16.300	0.00373	0.00462	0.00764	0.00963	0.01229	0.01501	0.01768	0.02056
22.500	0.00559	0.00729	0.01182	0.01546	0.02005	0.02487	0.02911	0.03346

ENGINEER WMZ
DATE 4-26-79

FIGURE 4.1.1.2-118
EFFECT OF BODY FLAP

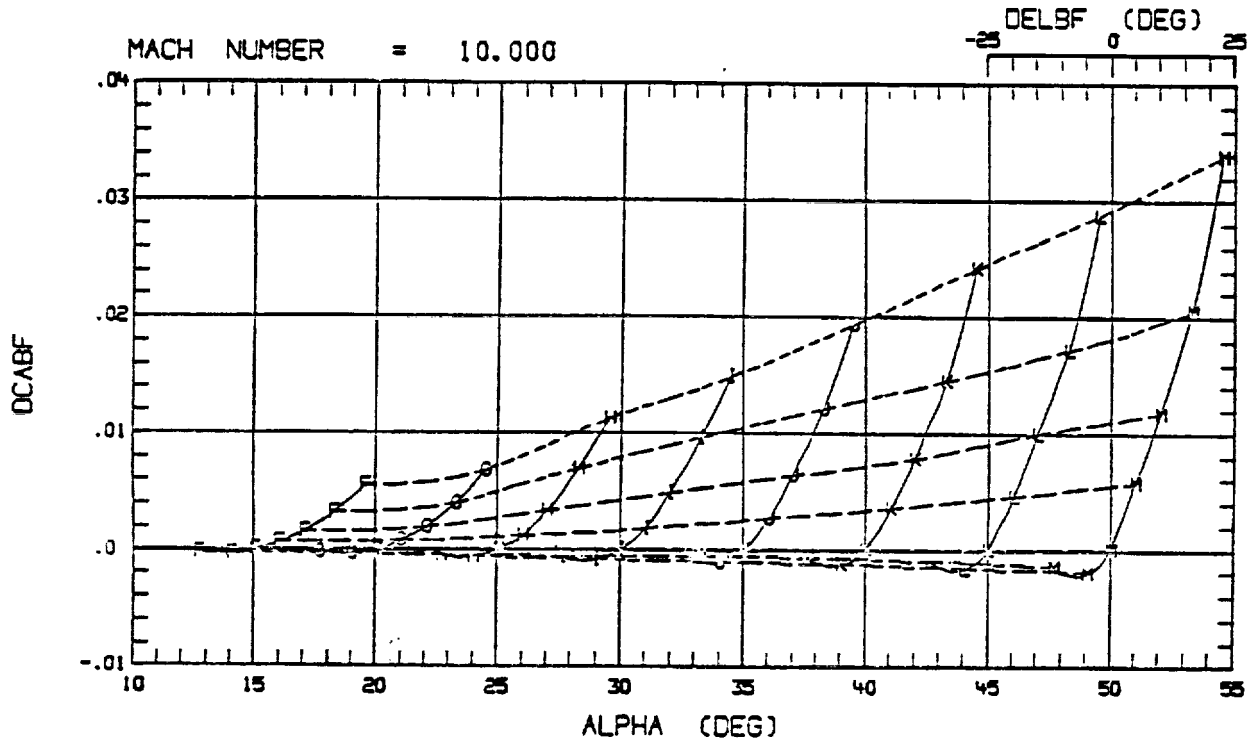


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.0	0.00001	0.0	-0.00005	-0.00017	-0.00024	-0.00027	-0.00044
-5.000	0.0	0.00005	0.0	-0.00010	-0.00023	-0.00031	-0.00038	-0.00065
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00013	0.0	0.00025	0.00049	0.00063	0.00073	0.00112
10.000	0.0	-0.00030	0.0	0.00060	0.00118	0.00152	0.00191	0.00332
16.300	0.0	-0.00055	0.0	0.00117	0.00239	0.00317	0.00402	0.00692
22.500	0.0	-0.00080	0.0	0.00197	0.00417	0.00546	0.00671	0.01122

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-119
EFFECT OF BODY FLAP

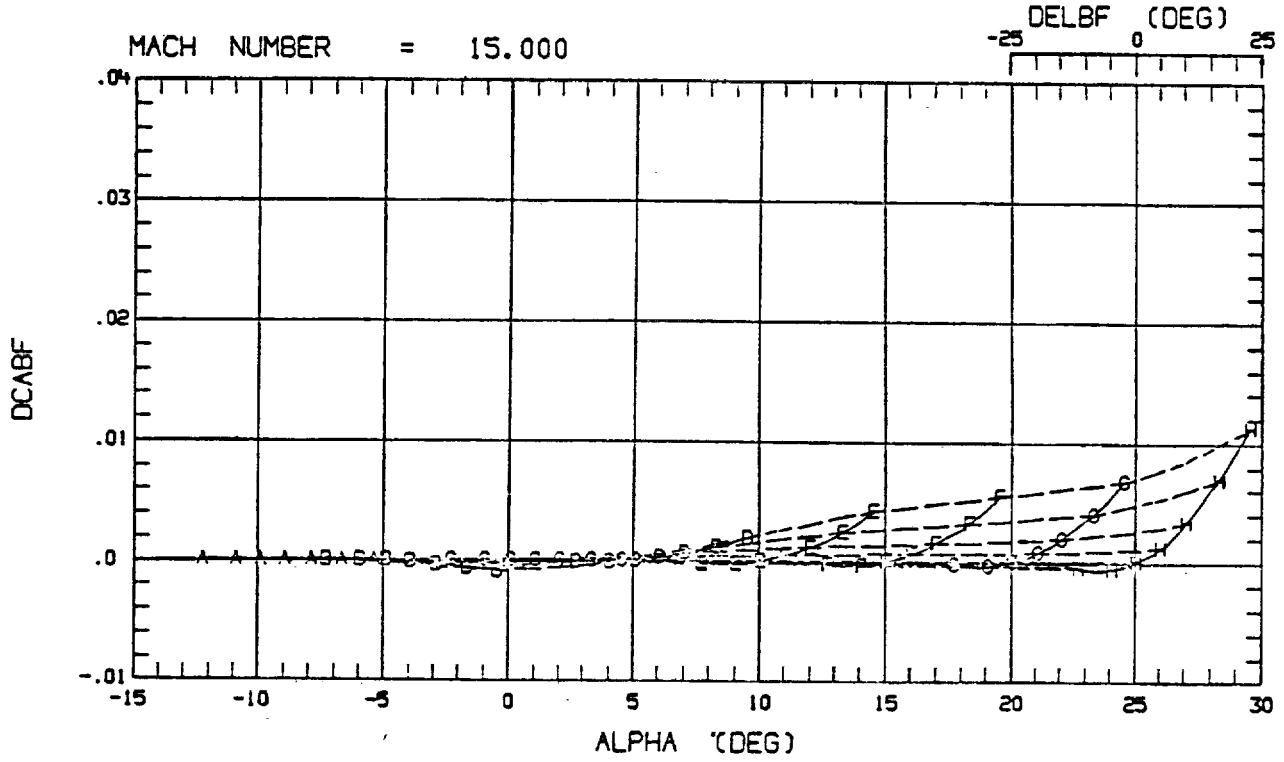


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	-0.00024	-0.00027	-0.00044	-0.00064	-0.00066	-0.00068	-0.00105	-0.00151
-5.000	-0.00031	-0.00038	-0.00065	-0.00091	-0.00110	-0.00128	-0.00161	-0.00198
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00063	0.00073	0.00112	0.00179	0.00259	0.00354	0.00462	0.00576
10.000	0.00152	0.00191	0.00332	0.00488	0.00632	0.00781	0.00991	0.01171
16.300	0.00317	0.00402	0.00692	0.00954	0.01211	0.01453	0.01720	0.02040
22.500	0.00546	0.00571	0.01122	0.01483	0.01931	0.02420	0.02876	0.03377

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-120
EFFECT OF BODY FLAP

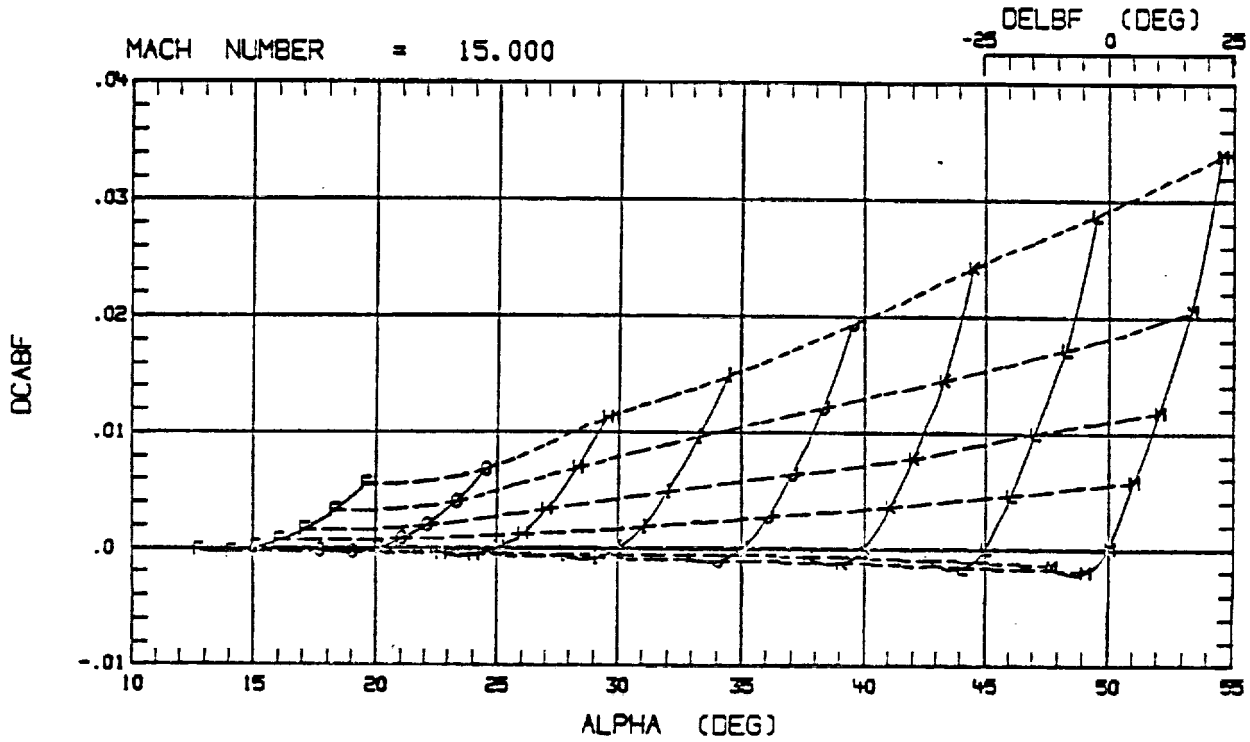


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.0	0.00001	0.0	-0.00005	-0.00017	-0.00024	-0.00027	-0.00044
-5.000	0.0	0.00005	0.0	-0.00010	-0.00023	-0.00031	-0.00038	-0.00065
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00013	0.0	0.00025	0.00049	0.00063	0.00073	0.00112
10.000	0.0	-0.00030	0.0	0.00060	0.00118	0.00152	0.00191	0.00332
16.300	0.0	-0.00055	0.0	0.00117	0.00239	0.00317	0.00402	0.00692
22.500	0.0	-0.00080	0.0	0.00197	0.00417	0.00546	0.00671	0.01122

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-121
EFFECT OF BODY FLAP

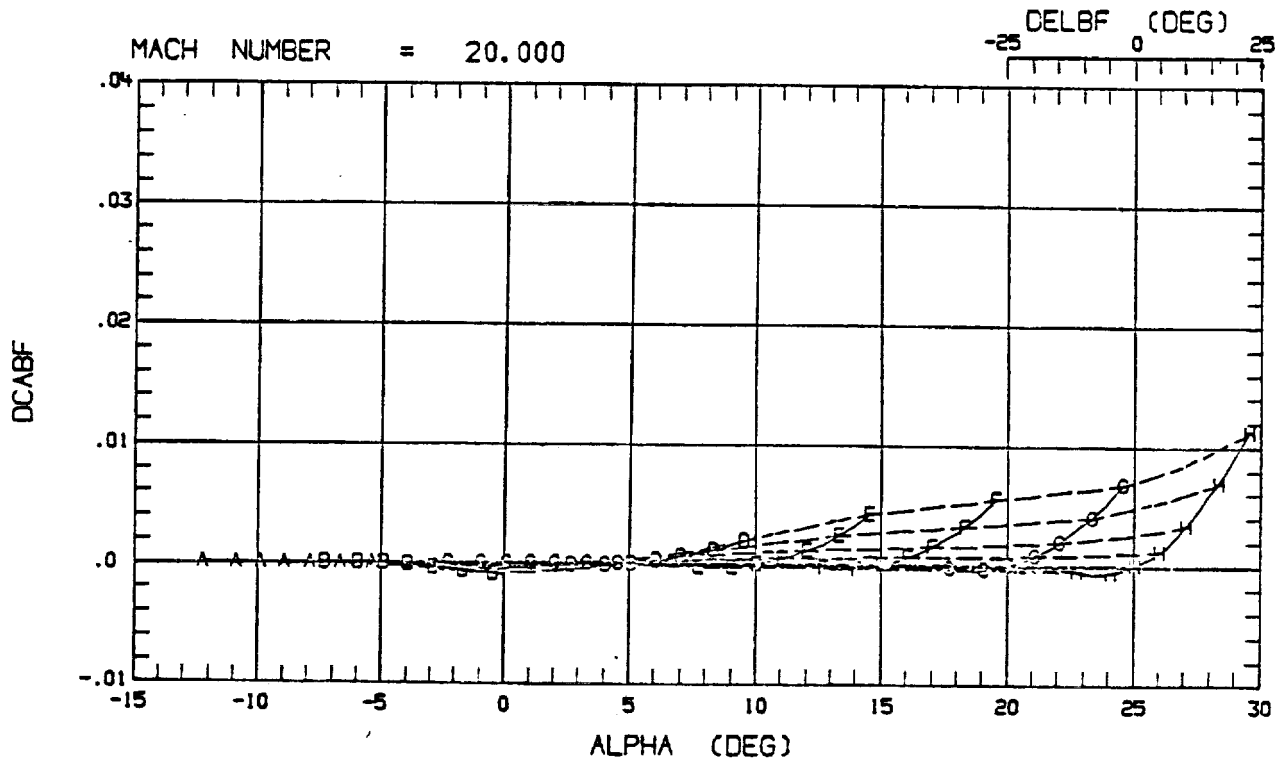


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	-0.00024	-0.00027	-0.00044	-0.00064	-0.00066	-0.00058	-0.00105	-0.00151
-5.000	-0.00031	-0.00038	-0.00065	-0.00091	-0.00110	-0.00128	-0.00161	-0.00199
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00063	0.00073	0.00112	0.00179	0.00269	0.00354	0.00462	0.00576
10.000	0.00152	0.00191	0.00332	0.00488	0.00632	0.00781	0.00991	0.01171
16.300	0.00317	0.00402	0.00692	0.00954	0.01211	0.01453	0.01720	0.02040
22.500	0.00546	0.00671	0.01122	0.01483	0.01931	0.02420	0.02976	0.03577

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-122
EFFECT OF BODY FLAP



CONFIGURATION

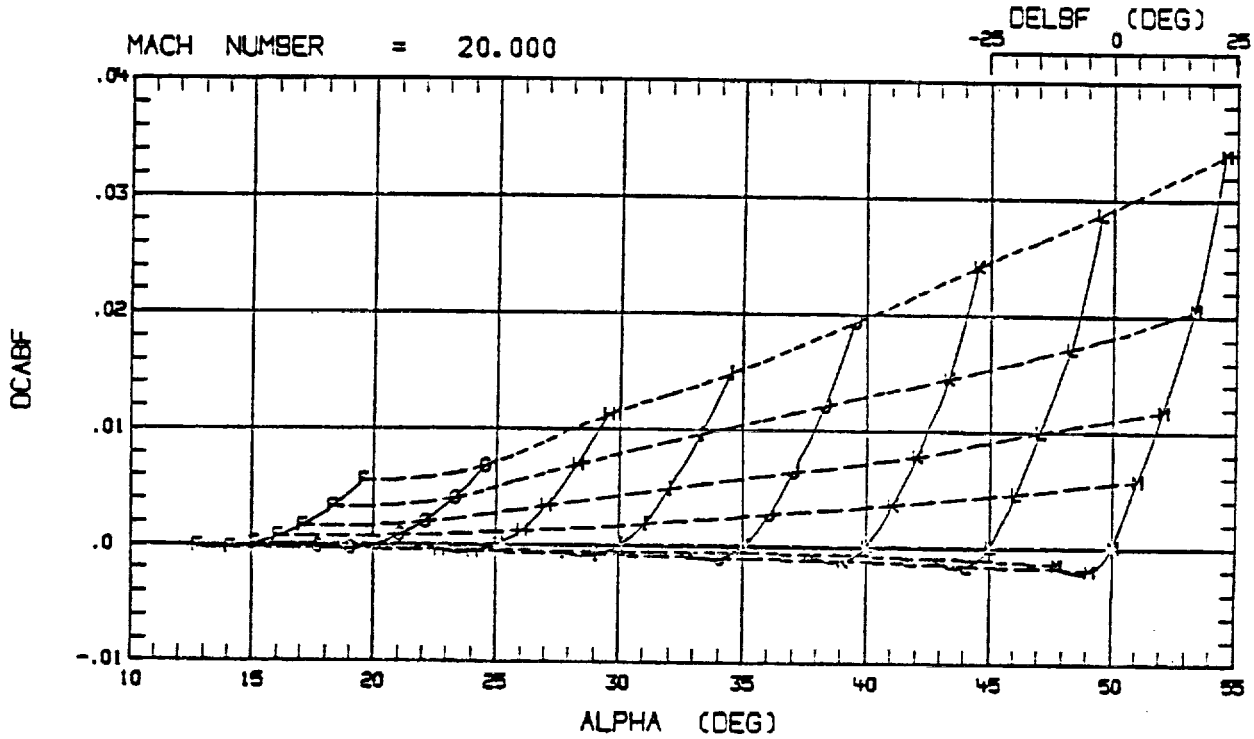
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	0.0	0.00001	0.0	-0.00005	-0.00017	-0.00024	-0.00027	-0.00044
-5.000	0.0	0.00005	0.0	-0.00010	-0.00023	-0.00031	-0.00038	-0.00065
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.0	-0.00013	0.0	0.00025	0.00049	0.00063	0.00073	0.00112
10.000	0.0	-0.00030	0.0	0.00060	0.00118	0.00152	0.00191	0.00332
16.300	0.0	-0.00055	0.0	0.00117	0.00239	0.00317	0.00402	0.00692
22.500	0.0	-0.00080	0.0	0.00197	0.00417	0.00546	0.00671	0.01122

ENGINEER WMZ
DATE 9-21-78

FIGURE 4.1.1.2-123
EFFECT OF BODY FLAP

Rockwell International
Space Division



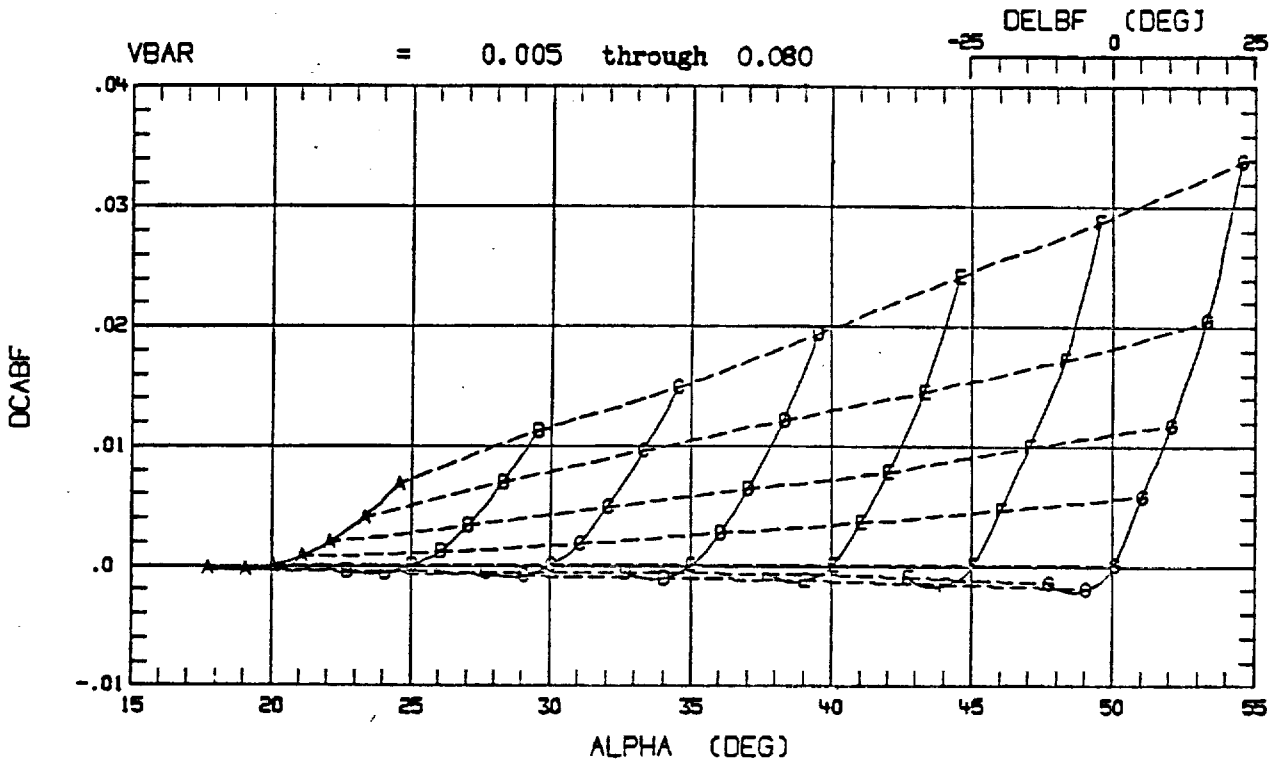
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00	SQ.FT.
CR	YO = BL	0.0 IN.	WING SPAN	BW = 79.055	FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT							
-11.700	-0.00024	-0.00027	-0.00044	-0.00054	-0.00066	-0.00068	-0.00105	-0.00151
-5.000	-0.00031	-0.00038	-0.00065	-0.00091	-0.00110	-0.00129	-0.00161	-0.00198
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00063	0.00073	0.00112	0.00179	0.00269	0.00354	0.00462	0.00576
10.000	0.00152	0.00191	0.00332	0.00488	0.00632	0.00781	0.00991	0.01171
16.300	0.00317	0.00402	0.00692	0.00954	0.01211	0.01453	0.01720	0.02040
22.500	0.00546	0.00671	0.01122	0.01483	0.01931	0.02420	0.02976	0.03377

ENGINEER WMZ
DATE 4-21-78

FIGURE 4.1.1.2-124
EFFECT OF BODY FLAP

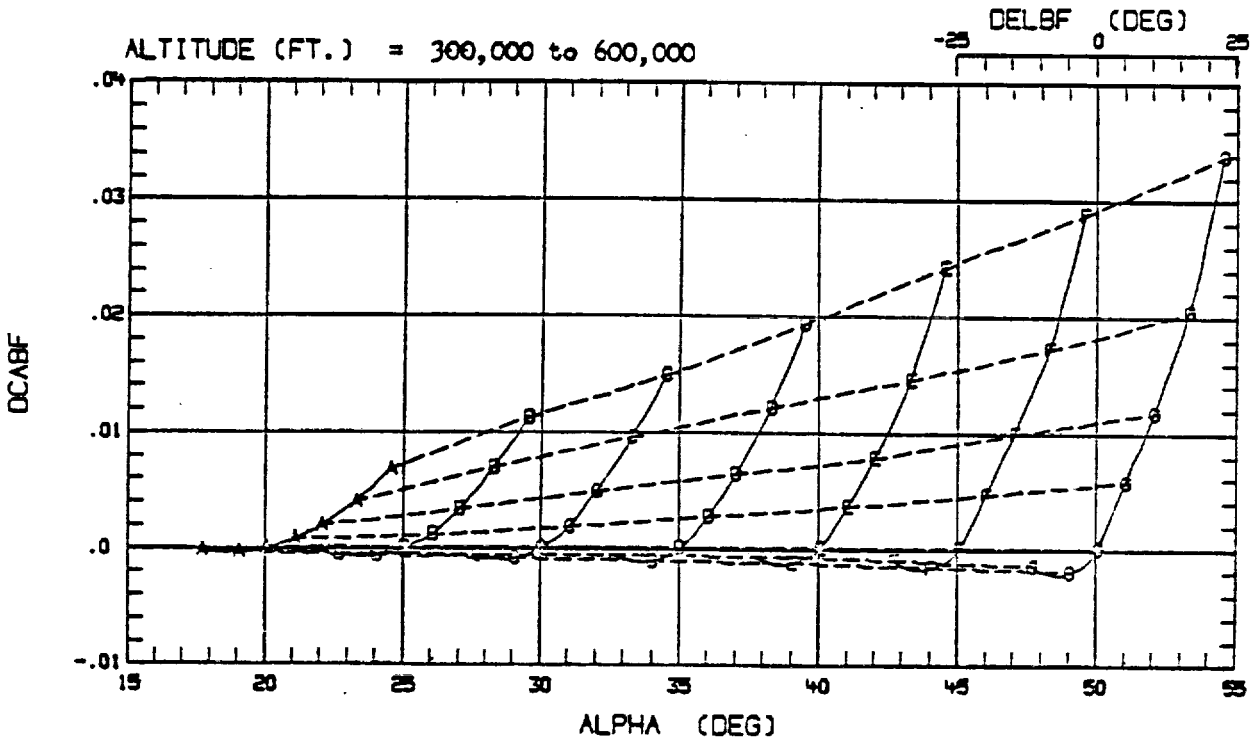


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	A	B	C	D	E	F	G
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT						
-11.700	-0.00027	-0.00044	-0.00064	-0.00066	-0.00068	-0.00105	-0.00151
-5.000	-0.00038	-0.00065	-0.00091	-0.00110	-0.00128	-0.00161	-0.00198
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00073	0.00112	0.00179	0.00269	0.00354	0.00462	0.00576
10.000	0.00191	0.00332	0.00488	0.00632	0.00781	0.00991	0.01171
16.300	0.00402	0.00692	0.00954	0.01211	0.01453	0.01720	0.02040
22.500	0.00671	0.01122	0.01483	0.01931	0.02420	0.02876	0.03377

ENGINEER_____
DATE_____

FIGURE 4.1.1.2-125
EFFECT OF BODY FLAP

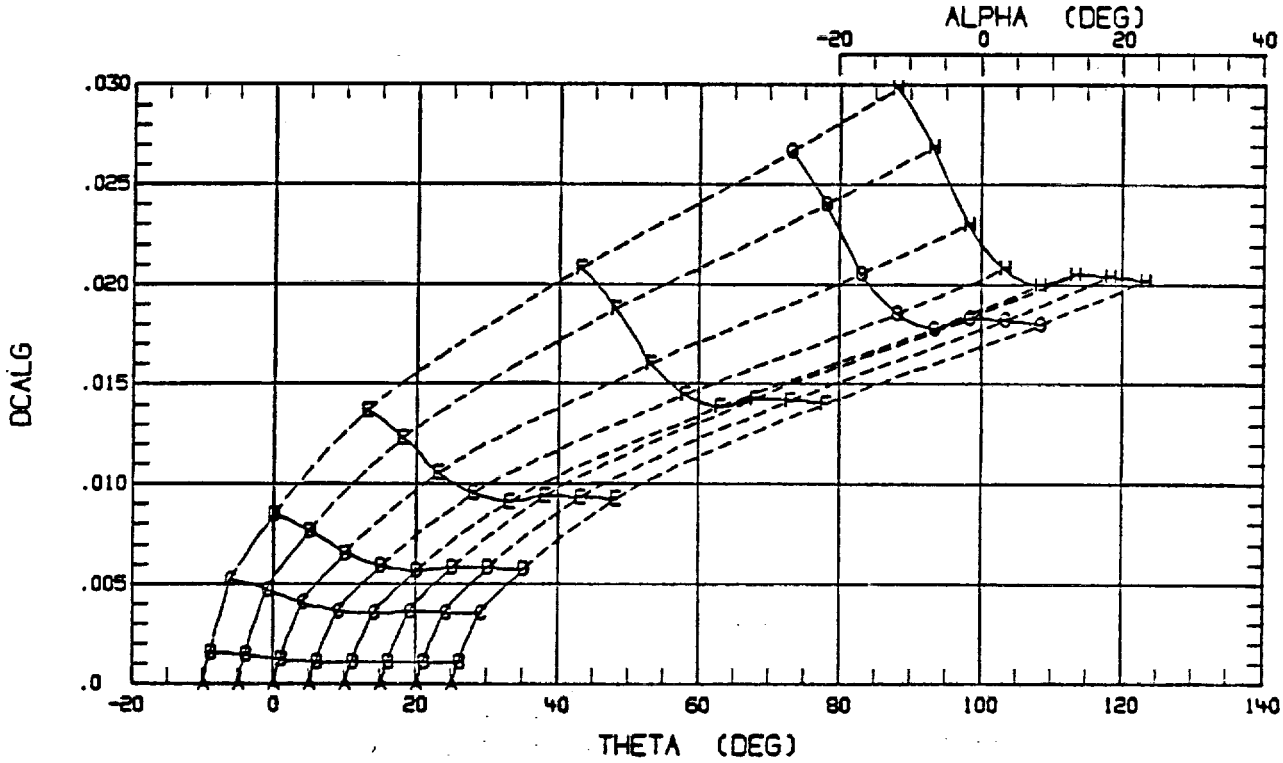


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP AXIAL FORCE INCREMENT						
-11.700	-0.00027	-0.00044	-0.00064	-0.00066	-0.00068	-0.00105	-0.00151
-5.000	-0.00038	-0.00065	-0.00091	-0.00110	-0.00128	-0.00161	-0.00198
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	0.00073	0.00112	0.00179	0.00269	0.00354	0.00462	0.00576
10.000	0.00191	0.00332	0.00488	0.00632	0.00781	0.00991	0.01171
16.300	0.00402	0.00692	0.00954	0.01211	0.01453	0.01720	0.02040
22.500	0.00671	0.01122	0.01463	0.01931	0.02420	0.02976	0.03377

ENGINEER _____
DATE _____

FIGURE 4.1.1.2-126
EFFECT OF BODY FLAP



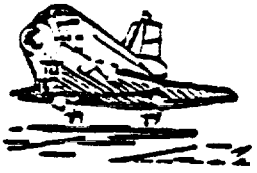
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	THETA (DEG)							
	0.0	1.000	4.000	10.000	23.000	53.000	83.000	98.000
	A	B	C	D	E	F	G	H
ALPHA (DEG)	LANDING GEAR AXIAL FORCE COEFFIC							
-10.000	0.0	0.00155	0.00520	0.00844	0.01364	0.02078	0.02663	0.02968
-5.000	0.0	0.00141	0.00467	0.00760	0.01227	0.01870	0.02395	0.02687
0.0	0.0	0.00120	0.00400	0.00650	0.01050	0.01600	0.02050	0.02300
5.000	0.0	0.00109	0.00361	0.00586	0.00948	0.01444	0.01850	0.02075
10.000	0.0	0.00104	0.00347	0.00563	0.00909	0.01385	0.01776	0.01992
15.000	0.0	0.00107	0.00357	0.00579	0.00936	0.01426	0.01828	0.02050
20.000	0.0	0.00106	0.00354	0.00576	0.00930	0.01418	0.01817	0.02039
25.000	0.0	0.00106	0.00351	0.00570	0.00921	0.01403	0.01798	0.02017

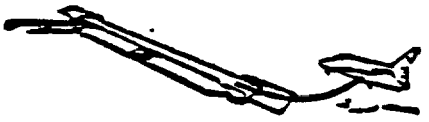
ENGINEER DAD
DATE 10-30-74

FIGURE 4.1.1.2-127
LANDING GEAR AXIAL FORCE COEFFICIENT INCREMENT

Landing Gear Down



$$\Delta C_{A_{\substack{GROUND\\EFFECT}}} = C_{A_{\substack{GROUND\\EFFECT}}} - C_{A_{\substack{FREE\\STREAM}}}$$



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = [illegible], Y_o = [illegible], Z_o = [illegible]

REFERENCE DIMENSIONS

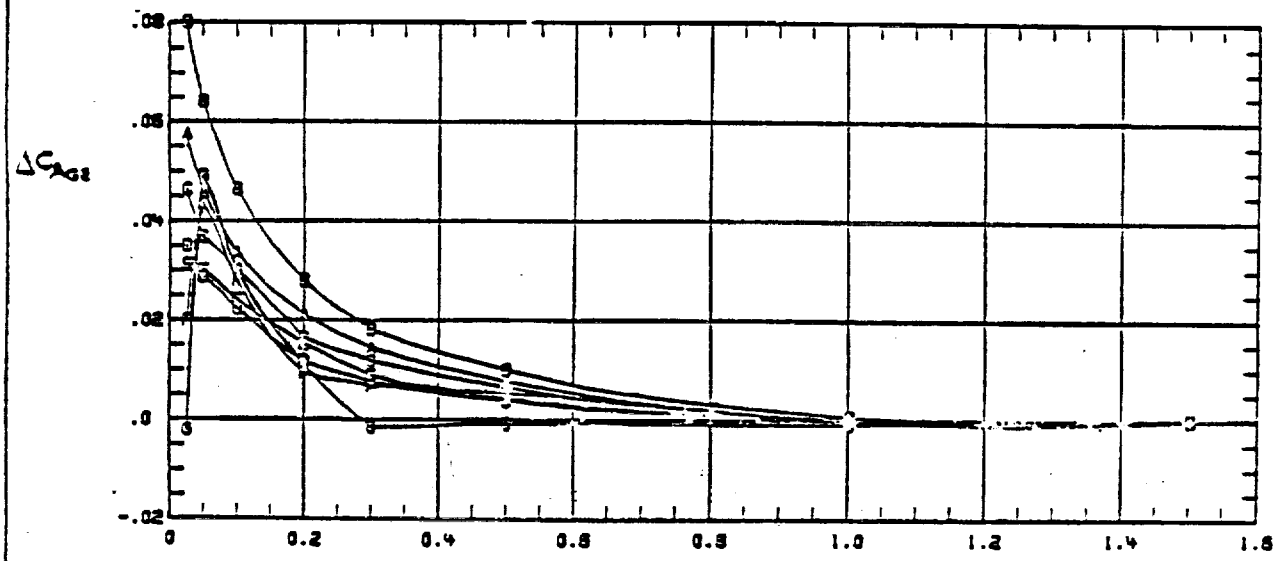
AREA S_w = [illegible] ft²

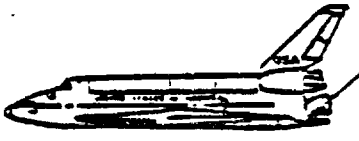
SPAN b_w = [illegible] ft

MAC c_w = [illegible] ft

BODY LENGTH L_b = [illegible] in

$\delta_e = -40.000$ $\delta_{BF} = -11.7°$ δ_{SB} = ALL





Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.05748	0.08000	0.04629	0.03479	0.03105	0.01978	-0.00225
0.050	0.04603	0.06400	0.03664	0.02977	0.02972	0.04346	0.04889
0.100	0.03337	0.04630	0.02991	0.02231	0.02393	0.02774	0.02994
0.200	0.02094	0.02770	0.01646	0.01153	0.01533	0.00930	0.01085
0.300	0.01440	0.01820	0.01177	0.00749	0.00872	0.00673	-0.00166
0.500	0.00750	0.00980	0.00629	0.00365	0.00411	0.00524	-0.00087
1.000	-0.00020	0.00050	0.0	-0.00029	0.00015	-0.00021	-0.00086
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [signature]
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-12c
GROUND EFFECT

Landing Gear Down

$$\Delta C_{A_{\substack{GROUND\\EFFECT}}} = C_{A_{\substack{GROUND\\EFFECT}}} - C_{A_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1078.70; Y_o = BL 0.00; Z_o = WL -[illegible]

REFERENCE DIMENSIONS

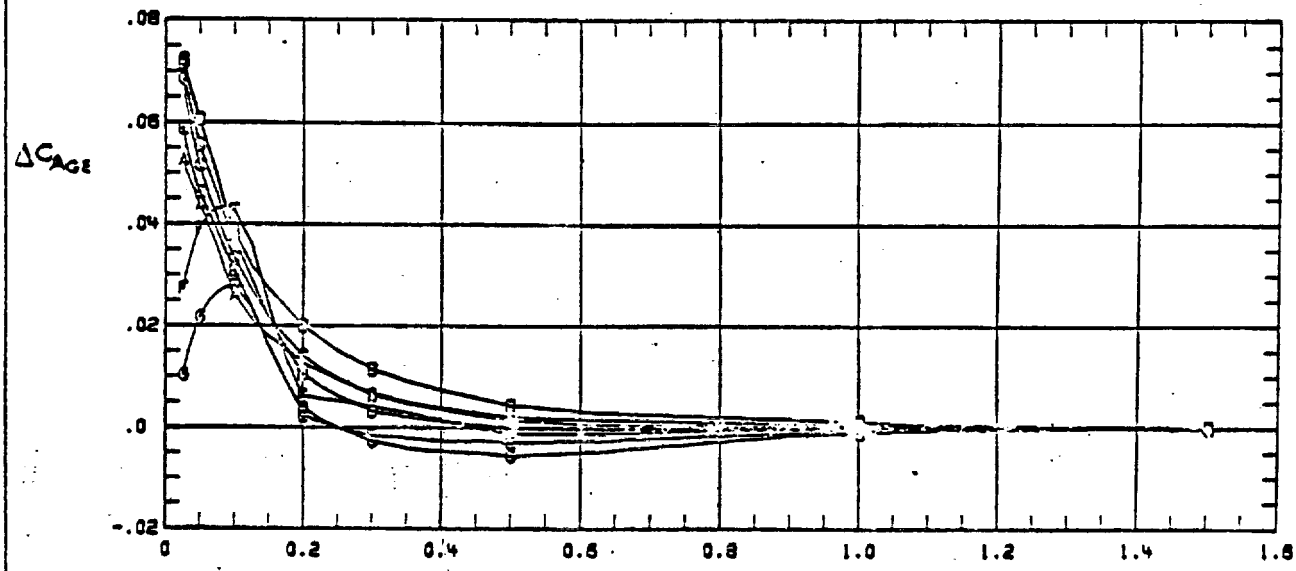
AREA S_w = 2690.000 ft²

SPAN b_w = 78.056 ft

MAC c_w = 39.560 ft

BODY LENGTH L_B = 1290.300 in

$\delta_e = -30.000$ $\delta_{BF} = -11.7°$ δ_{SB} = ALL



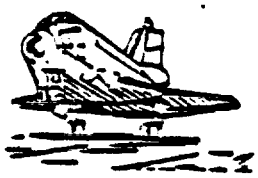
Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.05229	0.07200	0.06813	0.07114	0.05857	0.02722	0.01016
0.050	0.04350	0.06030	0.05112	0.05543	0.04590	0.03908	0.02167
0.100	0.02610	0.03830	0.03333	0.03686	0.03084	0.04250	0.02785
0.200	0.01269	0.01990	0.01397	0.01056	0.00220	0.00619	0.00381
0.300	0.00663	0.01140	0.00644	0.00316	-0.00150	0.00399	-0.00276
0.500	0.00198	0.00440	0.00143	-0.00008	-0.00307	-0.00129	-0.00549
1.000	0.00051	0.00100	0.0	-0.00029	-0.00083	0.00027	-0.00086
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [signature]
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-129
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE

REFERENCE DIMENSIONS

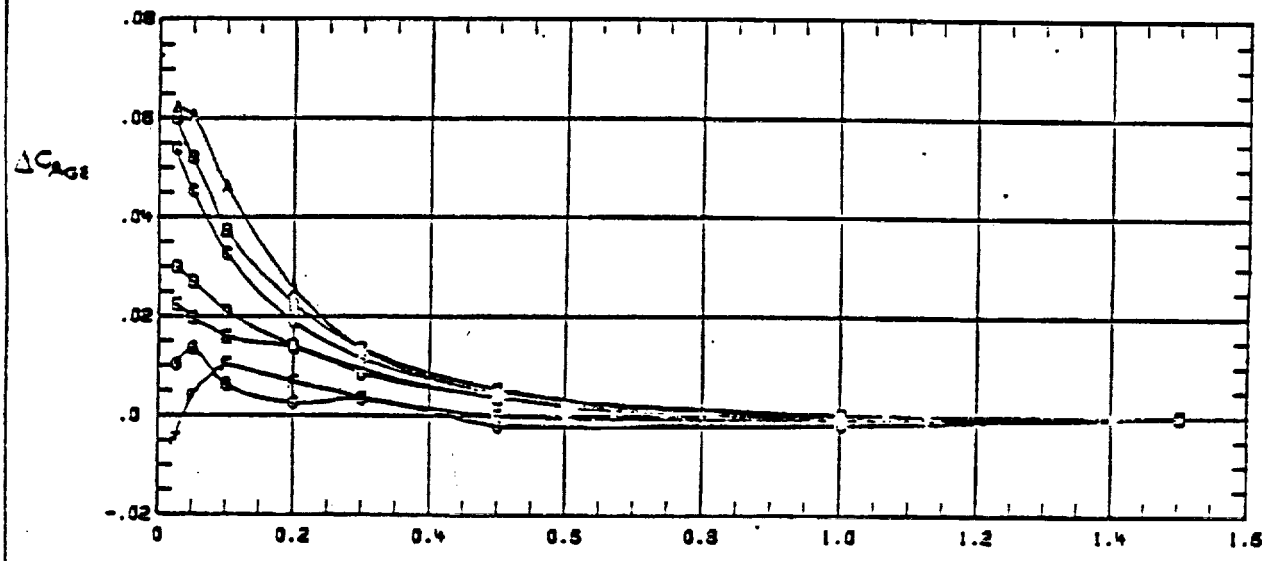
AREA

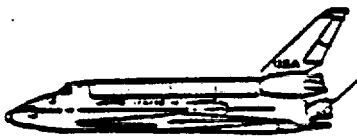
SPAN

MAC

BODY LENGTH

$\delta_e = -20.000$ $\delta_{SF} = -11.7°$ $\delta_{SB} = ALL$





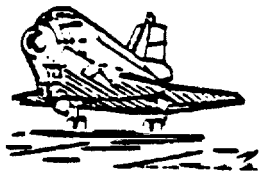
Reference Point for h/b
X_o 1506.84
Z_o 292.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.06208	0.05970	0.05365	0.02991	0.02235	-0.00463	0.01035
0.050	0.06027	0.05180	0.04498	0.02581	0.01971	0.00375	0.01333
0.100	0.04590	0.03710	0.03242	0.02087	0.01577	0.01023	0.00604
0.200	0.02530	0.02230	0.01861	0.01392	0.01366	0.00675	0.00251
0.300	0.01307	0.01340	0.01132	0.00844	0.00918	0.00353	0.00342
0.500	0.00389	0.00510	0.00454	0.00362	0.00342	-0.00019	-0.00207
1.000	-0.00070	0.0	0.00029	0.00029	0.0	-0.00055	-0.00171
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

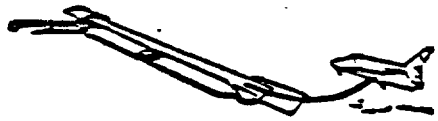
ENGINEER: [signature]
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-130
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$



CONFIGURATION

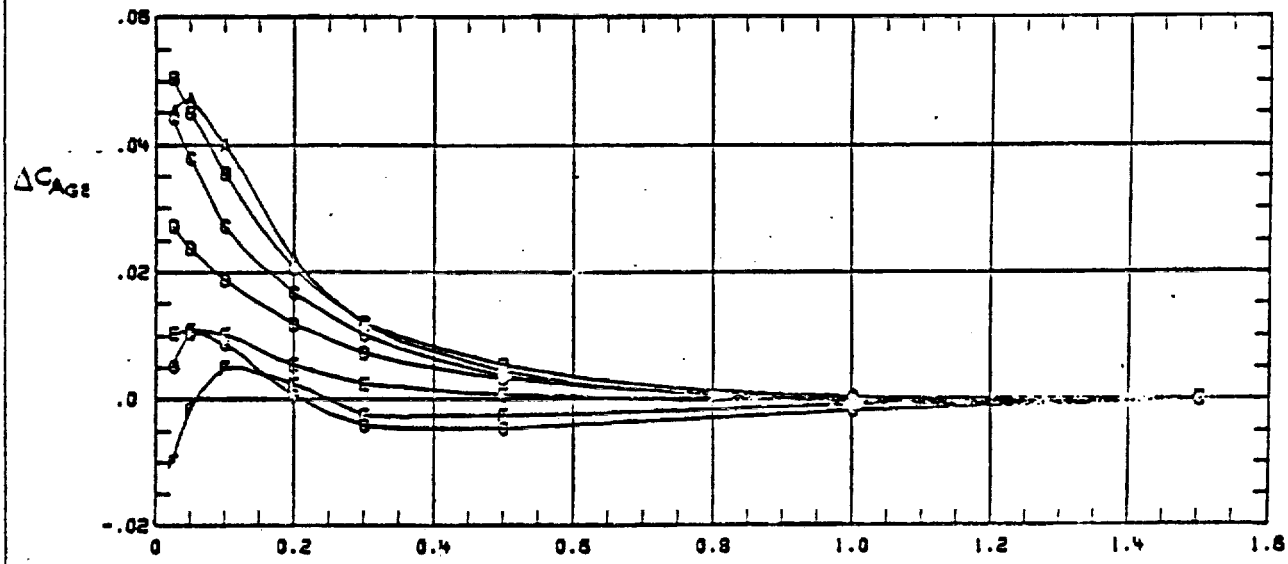
BASELINE ORBITER VEHICLE

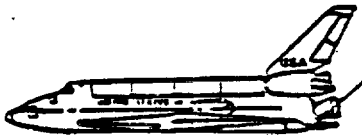
CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = 1078.70, Y_o = 0.00, Z_o = 275.08

REFERENCE DIMENSIONS

AREA S_w = 2690.000 ft²
SPAN b_w = 78.056 ft
MAC $\bar{c}_w$ = 35.560 ft
BODY LENGTH L_B = 1296.300 in

$\delta_e = -15.000$ $\delta_{BF} = -11.7°$ δ_{SB} = ALL





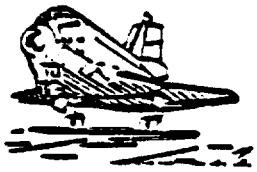
Reference Point for h/b
X_o 1506.34
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.04522	0.05030	0.04398	0.02713	0.01019	-0.00995	0.00506
0.050	0.04707	0.04510	0.03781	0.02357	0.01071	-0.00175	0.01019
0.100	0.03975	0.03530	0.02712	0.01862	0.01005	0.00490	0.00852
0.200	0.02193	0.02050	0.01671	0.01178	0.00528	0.00220	0.00041
0.300	0.01178	0.01200	0.01003	0.00713	0.00236	-0.00258	-0.00429
0.500	0.00433	0.00530	0.00358	0.00317	0.00061	-0.00271	-0.00473
1.000	-0.00056	0.0	0.00007	0.0	-0.00042	-0.00110	-0.00205
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-131
GROUND EFFECT

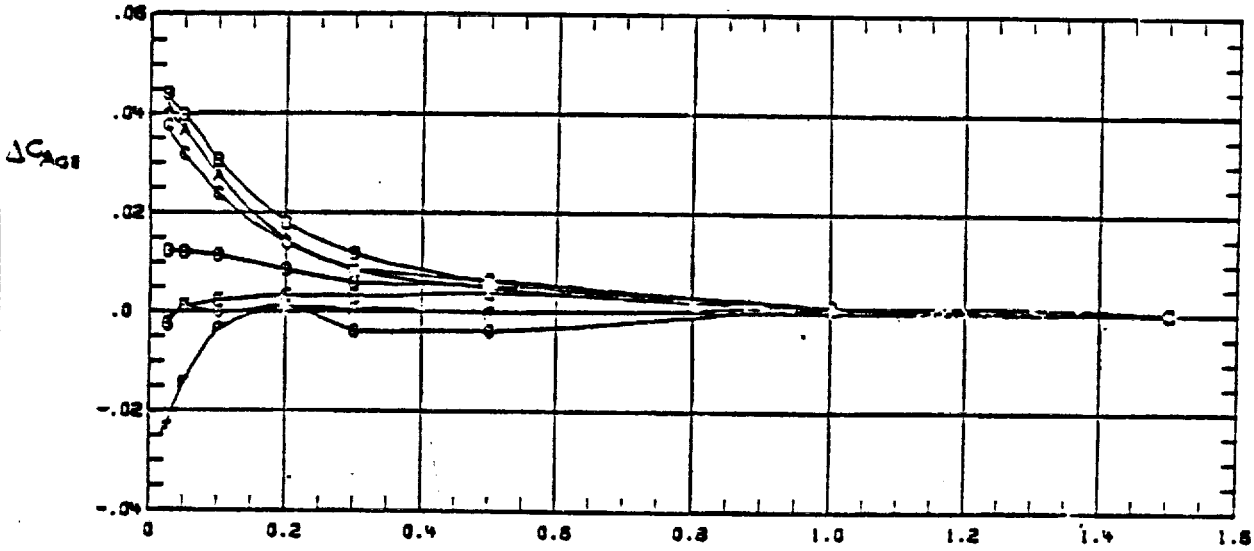
Landing Gear Down



$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$

CONFIGURATION
BASELINE SHUTTLE VEHICLE
CENTER OF GRAVITY ON MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -10.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$



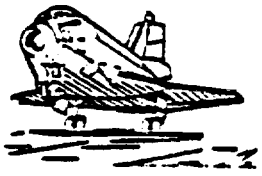
Reference Point
for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.04082	0.04380	0.03730	0.01234	-0.00143	-0.02351	-0.00270
0.050	0.03658	0.03950	0.03164	0.01203	0.00096	-0.01440	0.00071
0.100	0.02733	0.03050	0.02358	0.01127	0.00223	-0.00369	-0.00017
0.200	0.01425	0.01780	0.01357	0.00831	0.00307	0.00073	0.00119
0.300	0.00816	0.01150	0.00843	0.00571	0.00299	0.00052	-0.00379
0.500	0.00484	0.00590	0.00819	0.00523	0.00369	-0.00040	-0.00380
1.000	0.00101	0.00100	0.00100	0.00099	0.00077	0.00069	0.00085
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 10-14-77
REVISED:

Figure 4.1.1.2-132
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{\substack{GROUND\\EFFECT}}} = C_{A_{\substack{GROUND\\EFFECT}}} - C_{A_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE

REFERENCE DIMENSIONS

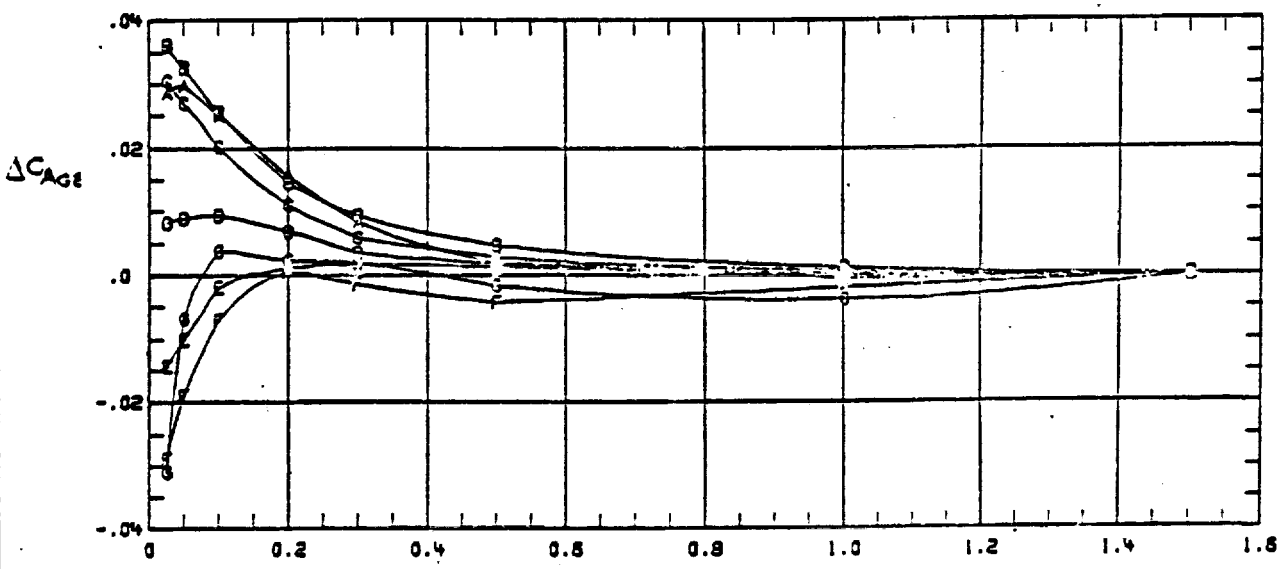
AREA

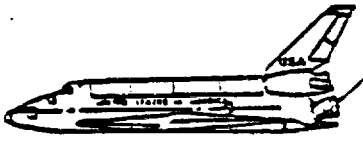
SPAN

MAC

BODY LENGTH

$\delta_e = -5.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} =$ ALL





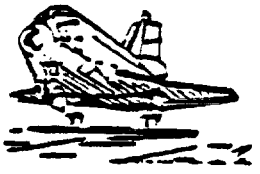
Reference Point for h/b
X_o 1506.34
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.02855	0.03610	0.03032	0.00817	-0.01454	-0.02999	-0.03100
0.050	0.02969	0.03240	0.02596	0.00889	-0.01014	-0.01922	-0.00697
0.100	0.02502	0.02550	0.02000	0.00918	-0.00197	-0.00727	0.00361
0.200	0.01546	0.01440	0.01092	0.00670	0.00110	0.00045	0.00214
0.300	0.00828	0.00920	0.00582	0.00332	0.00167	-0.00153	0.00178
0.500	0.00180	0.00450	0.00277	0.00172	0.00122	-0.00430	-0.00171
1.000	0.00058	0.00100	0.00050	0.00008	-0.00048	-0.00207	-0.00393
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: JB
DATE: 10-19-72
REVISED:

Figure 4.1.1.2-133
GROUND EFFECT

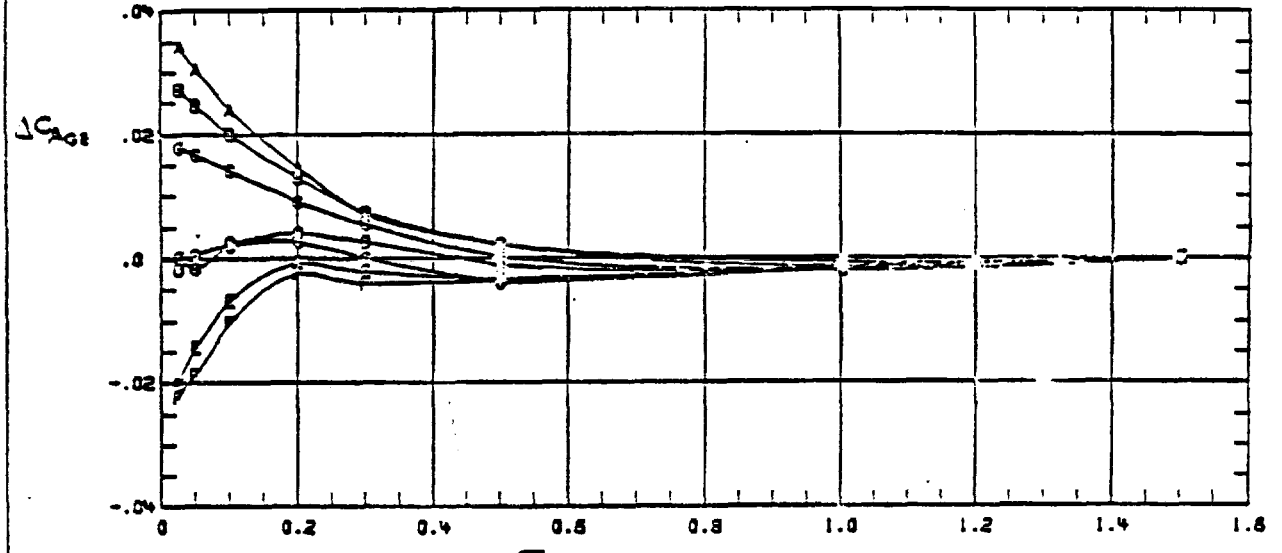
Landing Gear Down

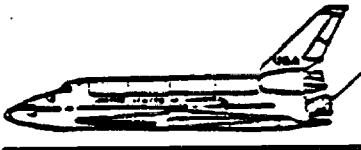


$$\Delta C_{A_{\substack{GROUND\\EFFECT}}} = C_{A_{\substack{GROUND\\EFFECT}}} - C_{A_{\substack{FREE\\STREAM}}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = 0.0$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$





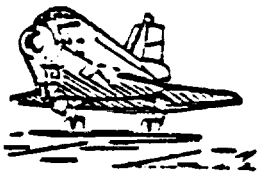
Reference Point
for h/b
X_o 1306.24
Z_o 232.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.03413	0.02720	0.01776	-0.00187	-0.02019	-0.02232	0.00020
0.050	0.03049	0.02460	0.01651	0.00034	-0.01453	-0.01884	-0.00170
0.100	0.02391	0.01990	0.01393	0.00227	-0.00694	-0.01039	0.00173
0.200	0.01441	0.01270	0.00887	0.00388	-0.00086	-0.00248	0.00241
0.300	0.00865	0.00720	0.00523	0.00244	-0.00221	-0.00411	-0.00006
0.500	0.00193	0.00190	0.00006	-0.00122	-0.00351	-0.00387	-0.00403
1.000	-0.00085	-0.00150	-0.00200	-0.00198	-0.00168	-0.00158	-0.00205
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-134
GROUND EFFECT

Landing Gear Down



$$\Delta C_{A_{\substack{GROUND\\EFFECT}}} = C_{A_{\substack{GROUND\\EFFECT}}} - C_{A_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1076.70; Y_o = BL 0.00; Z_o = WL 375.38

REFERENCE DIMENSIONS

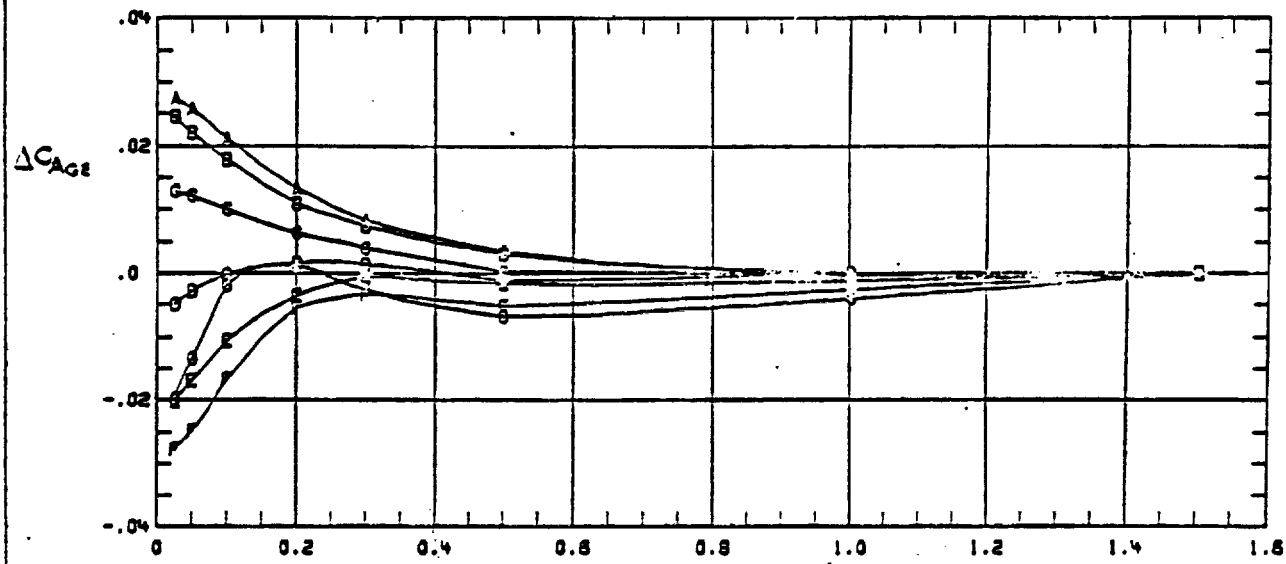
AREA S_w = 2590.000 ft²

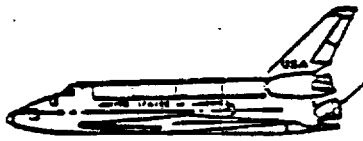
SPAN b_w = 78.056 ft

MAC c_w = 39.560 ft

BODY LENGTH L_B = 1230.300 in

$\delta_e = 5.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$





Reference Point for h/b
X_o 1506.84
Z_o 282.71

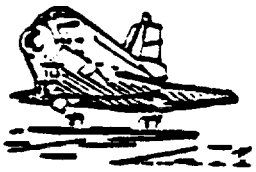
HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.02735	0.02450	0.01283	-0.00505	-0.02026	-0.02783	-0.01988
0.050	0.02565	0.02190	0.01198	-0.00288	-0.01699	-0.02497	-0.01341
0.100	0.02096	0.01770	0.00986	-0.00028	-0.01073	-0.01687	-0.00203
0.200	0.01317	0.01090	0.00619	0.00164	-0.00366	-0.00563	0.00116
0.300	0.00833	0.00740	0.00396	0.00140	-0.00050	-0.00343	-0.00281
0.500	0.00332	0.00290	0.00013	-0.00119	-0.00186	-0.00524	-0.00693
1.000	-0.00028	0.0	0.0	-0.00028	-0.00125	-0.00276	-0.00410
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [signature]
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-135
GROUND EFFECT

Landing Gear Down

$$\Delta C_{A_{GROUND\ EFFECT}} = C_{A_{GROUND\ EFFECT}} - C_{A_{FREE\ STREAM}}$$



CONFIGURATION

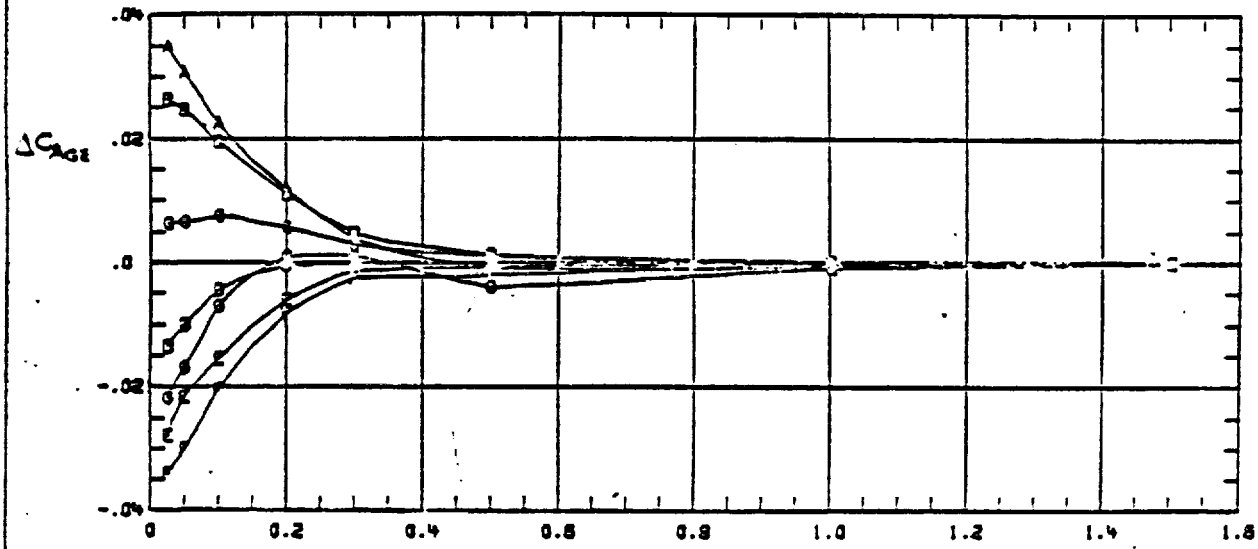
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY
OR
MOMENT REFERENCE

REFERENCE DIMENSIONS

AREA
SPAN
MAC
MOMENT LENGTH

$\delta_e = 10.000$ $\delta_{sp} = -11.7°$ $\delta_{sb} =$ ALL



Reference Point
for h/b
X_o 1506.84
Z_o 232.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GROUND\ EFFECT}}$						
0.025	0.03482	0.02520	0.00625	-0.01388	-0.02901	-0.03411	-0.02189
0.050	0.03068	0.02460	0.00655	-0.01013	-0.02168	-0.03017	-0.01704
0.100	0.02238	0.01930	0.00742	-0.00456	-0.01549	-0.02048	-0.00718
0.200	0.01151	0.01090	0.00541	-0.00087	-0.00812	-0.00844	0.00074
0.300	0.00355	0.00460	0.00278	-0.00024	-0.00143	-0.00259	0.00080
0.500	-0.00109	0.00110	0.00083	-0.00027	-0.00090	-0.00225	-0.00418
1.000	-0.00058	0.0	0.0	0.0	-0.00021	-0.00055	-0.00103
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-130
GROUND EFFECT

Landing Gear Down

$$\Delta C_{A_{\substack{GROUND\\EFFECT}}} = C_{A_{\substack{GROUND\\EFFECT}}} - C_{A_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1076.70, Y_o = BL 0.00, Z_o = WL 375.00

REFERENCE DIMENSIONS

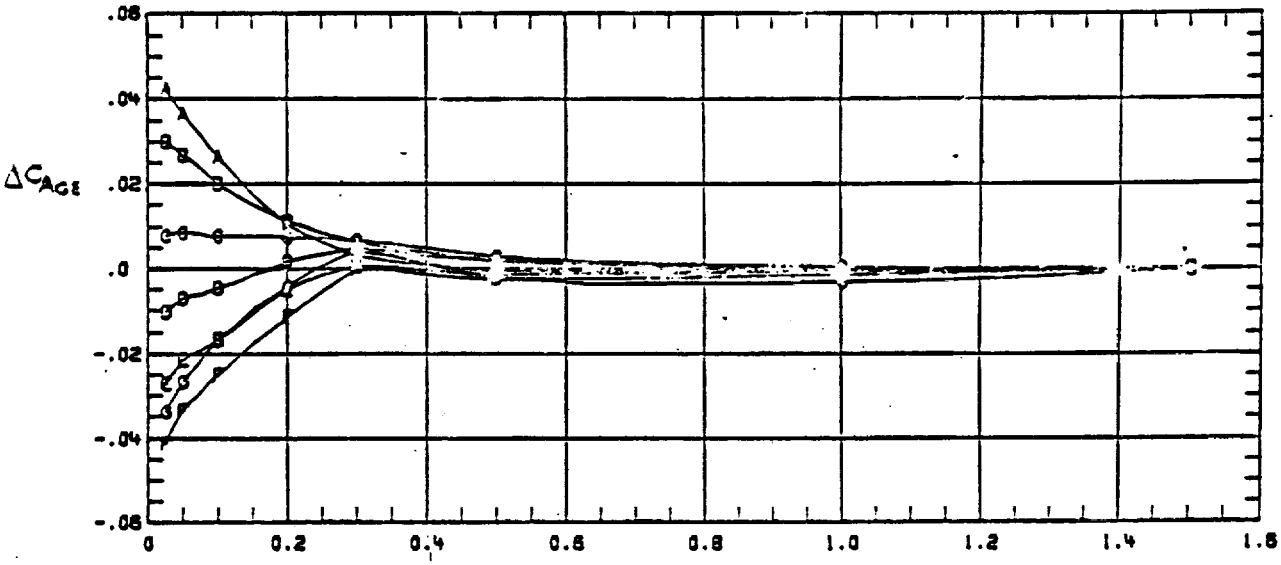
AREA S_w = 2690.000 ft²

SPAN b_w = 78.056 ft

MAC c_w = 39.580 ft

BODY LENGTH L_B = 1290.300 in

$\delta_e = 15.000$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$

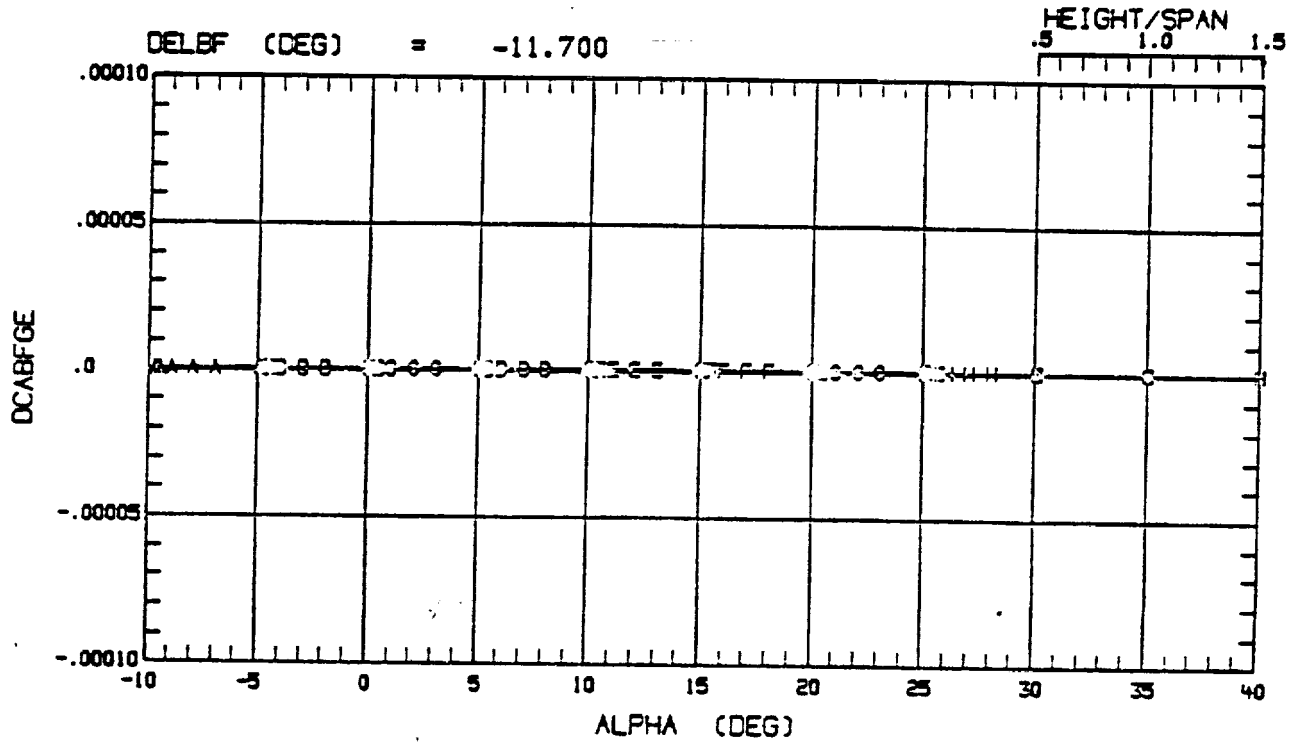


Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Axial Force Coefficient, $\Delta C_{A_{GRND\ EFFECT}}$						
0.025	0.04254	0.02990	0.00769	-0.01052	-0.02743	-0.04123	-0.03412
0.050	0.03647	0.02570	0.00834	-0.00731	-0.02176	-0.03378	-0.02692
0.100	0.02532	0.01990	0.00755	-0.00487	-0.01666	-0.02506	-0.01696
0.200	0.01042	0.01100	0.00739	0.00142	-0.00497	-0.01145	-0.00424
0.300	0.00306	0.00630	0.00655	0.00466	0.00036	-0.00018	0.00407
0.500	-0.00069	0.00190	0.00253	0.00155	-0.00151	-0.00275	-0.00232
1.000	-0.00070	0.0	0.00014	0.0	-0.00062	-0.00165	-0.00342
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [signature]
DATE: 10-19-77
REVISED:

Figure 4.1.1.2-137
GROUND EFFECT

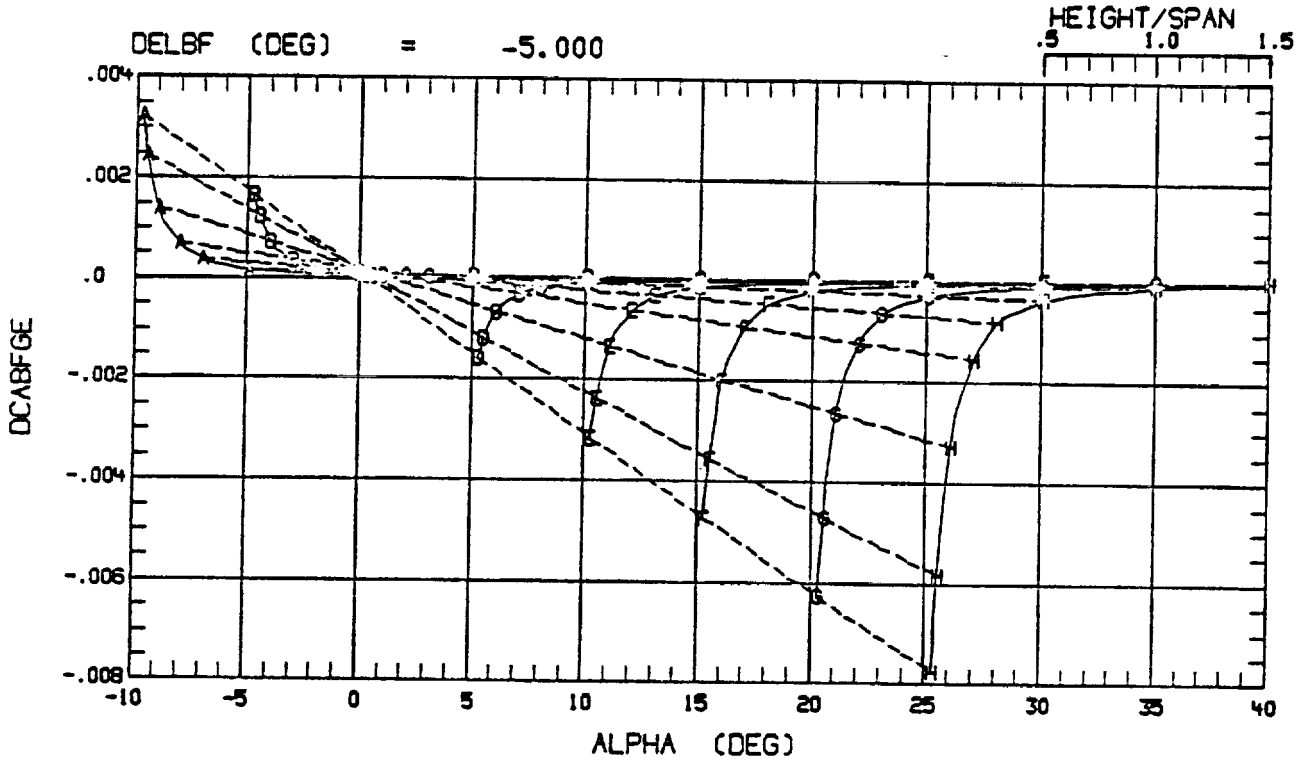


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF AXIAL FORCE COE							
0.025	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.2-138
GROUND EFFECT BODY FLAP AXIAL FORCE COEFF. INCREMENT

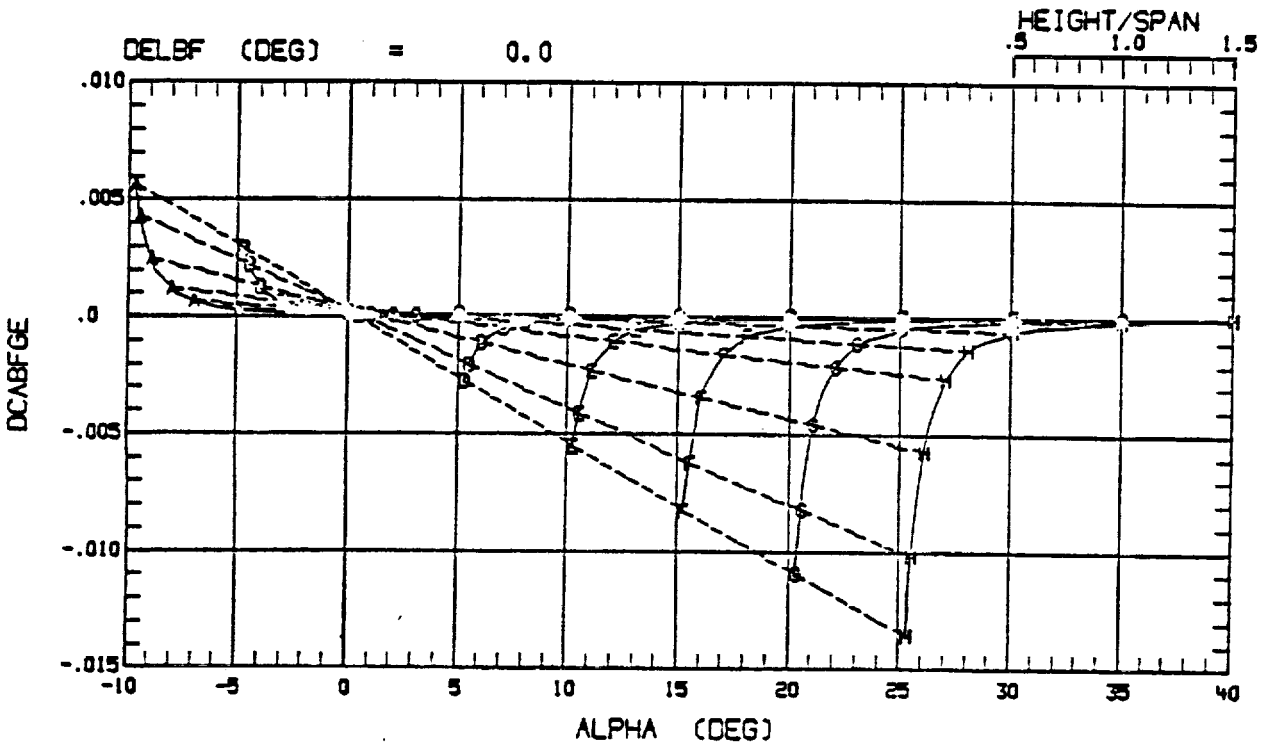


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF AXIAL FORCE COE							
0.025	0.00321	0.00161	0.0	-0.00160	-0.00320	-0.00476	-0.00630	-0.00778
0.050	0.00242	0.00121	0.0	-0.00121	-0.00241	-0.00359	-0.00475	-0.00587
0.100	0.00136	0.00068	0.0	-0.00068	-0.00136	-0.00202	-0.00267	-0.00330
0.200	0.00064	0.00032	0.0	-0.00032	-0.00064	-0.00095	-0.00126	-0.00156
0.300	0.00033	0.00017	0.0	-0.00017	-0.00033	-0.00049	-0.00065	-0.00081
0.500	0.00014	0.00007	0.0	-0.00007	-0.00014	-0.00021	-0.00028	-0.00035
1.000	0.00004	0.00002	0.0	-0.00002	-0.00004	-0.00006	-0.00008	-0.00009
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

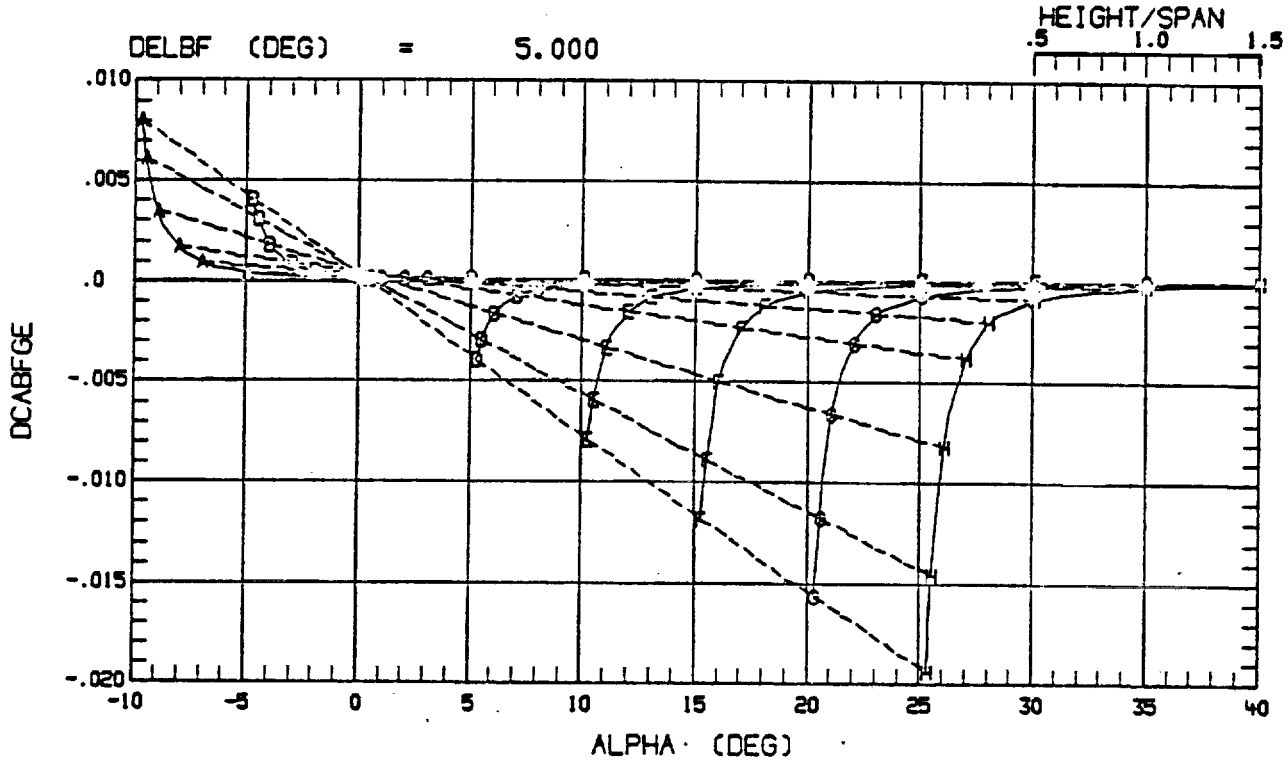
FIGURE 4.1.1.2-139
GROUND EFFECT BODY FLAP AXIAL FORCE COEFF. INCREMENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
HEIGHT/SPAN	GROUND EFFECT BF AXIAL FORCE CCE							
0.025	0.00559	0.00291	0.0	-0.00291	-0.00559	-0.00833	-0.01101	-0.01361
0.050	0.00422	0.00212	0.0	-0.00212	-0.00422	-0.00629	-0.00830	-0.01025
0.100	0.00238	0.00119	0.0	-0.00119	-0.00238	-0.00354	-0.00468	-0.00579
0.200	0.00112	0.00056	0.0	-0.00056	-0.00112	-0.00167	-0.00220	-0.00272
0.300	0.00058	0.00029	0.0	-0.00029	-0.00058	-0.00087	-0.00115	-0.00142
0.500	0.00025	0.00013	0.0	-0.00013	-0.00025	-0.00038	-0.00050	-0.00061
1.000	0.00007	0.00003	0.0	-0.00003	-0.00007	-0.00010	-0.00013	-0.00016
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____ FIGURE 4.1.1.2-140
DATE_____ GROUND EFFECT BODY FLAP AXIAL FORCE COEFF. INCREMENT

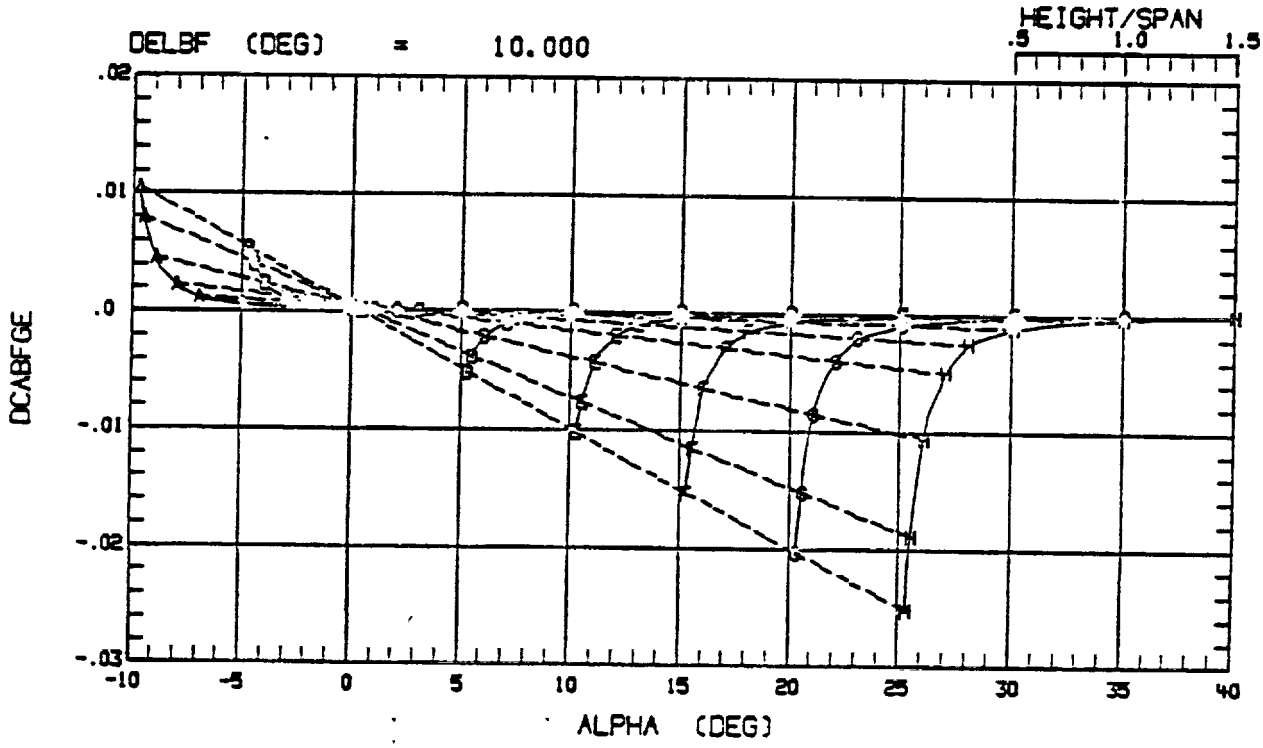


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF AXIAL FORCE COE							
0.025	0.00797	0.00401	0.0	-0.00401	-0.00799	-0.01191	-0.01573	-0.01944
0.050	0.00601	0.00302	0.0	-0.00302	-0.00602	-0.00898	-0.01186	-0.01466
0.100	0.00339	0.00170	0.0	-0.00170	-0.00339	-0.00506	-0.00669	-0.00826
0.200	0.00159	0.00080	0.0	-0.00080	-0.00160	-0.00238	-0.00315	-0.00389
0.300	0.00083	0.00042	0.0	-0.00042	-0.00083	-0.00124	-0.00163	-0.00202
0.500	0.00036	0.00018	0.0	-0.00018	-0.00036	-0.00054	-0.00071	-0.00087
1.000	0.00010	0.00005	0.0	-0.00005	-0.00010	-0.00014	-0.00019	-0.00023
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.2-141
GROUND EFFECT BODY FLAP AXIAL FORCE COEFF. INCREMENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

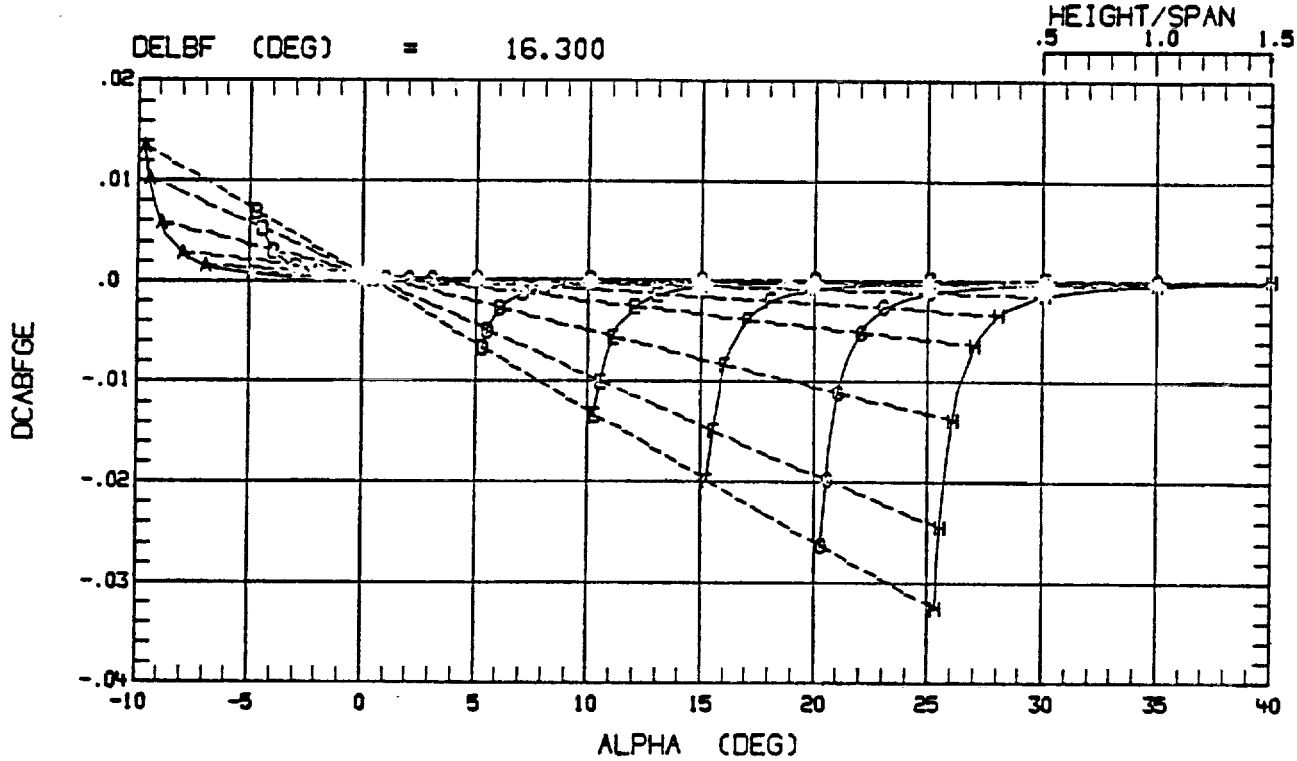
	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF AXIAL FORCE COE							
0.025	0.01034	0.00521	0.0	-0.00521	-0.01039	-0.01548	-0.02046	-0.02528
0.050	0.00780	0.00393	0.0	-0.00393	-0.00783	-0.01167	-0.01543	-0.01906
0.100	0.00439	0.00221	0.0	-0.00222	-0.00441	-0.00658	-0.00869	-0.01074
0.200	0.00207	0.00104	0.0	-0.00104	-0.00208	-0.00310	-0.00409	-0.00505
0.300	0.00107	0.00054	0.0	-0.00054	-0.00108	-0.00161	-0.00213	-0.00253
0.500	0.00047	0.00023	0.0	-0.00023	-0.00047	-0.00070	-0.00092	-0.00114
1.000	0.00012	0.00006	0.0	-0.00006	-0.00013	-0.00019	-0.00025	-0.00030
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER _____

DATE _____

FIGURE 4.1.1.2-142

GROUND EFFECT BODY FLAP AXIAL FORCE COEFF. INCREMENT

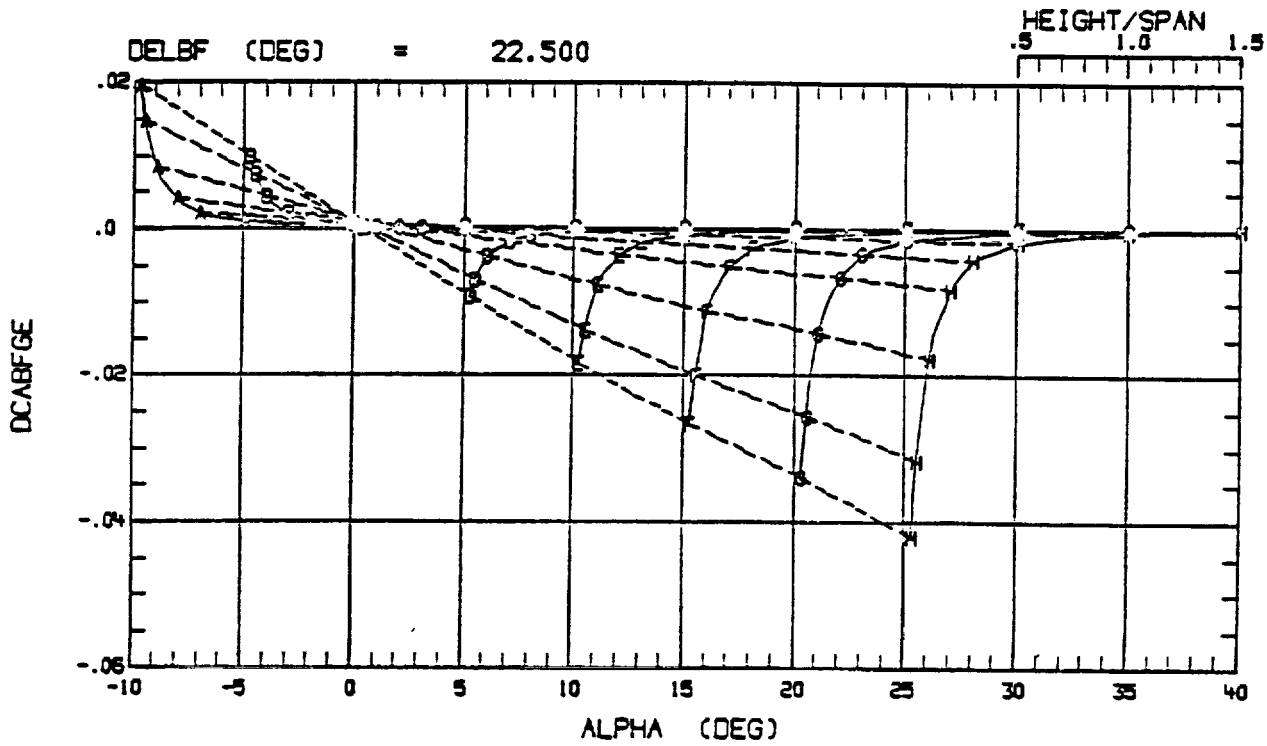


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF AXIAL FORCE COE							
0.025	0.01334	0.00673	0.0	-0.00675	-0.01344	-0.02003	-0.02647	-0.03271
0.050	0.01006	0.00507	0.0	-0.00509	-0.01013	-0.01510	-0.01996	-0.02466
0.100	0.00567	0.00286	0.0	-0.00287	-0.00571	-0.00852	-0.01125	-0.01390
0.200	0.00267	0.00134	0.0	-0.00135	-0.00269	-0.00401	-0.00529	-0.00654
0.300	0.00139	0.00070	0.0	-0.00070	-0.00140	-0.00208	-0.00275	-0.00340
0.500	0.00060	0.00030	0.0	-0.00030	-0.00060	-0.00090	-0.00119	-0.00147
1.000	0.00016	0.00008	0.0	-0.00008	-0.00016	-0.00024	-0.00032	-0.00039
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.2-143
GROUND EFFECT BODY FLAP AXIAL FORCE COEFF. INCREMENT

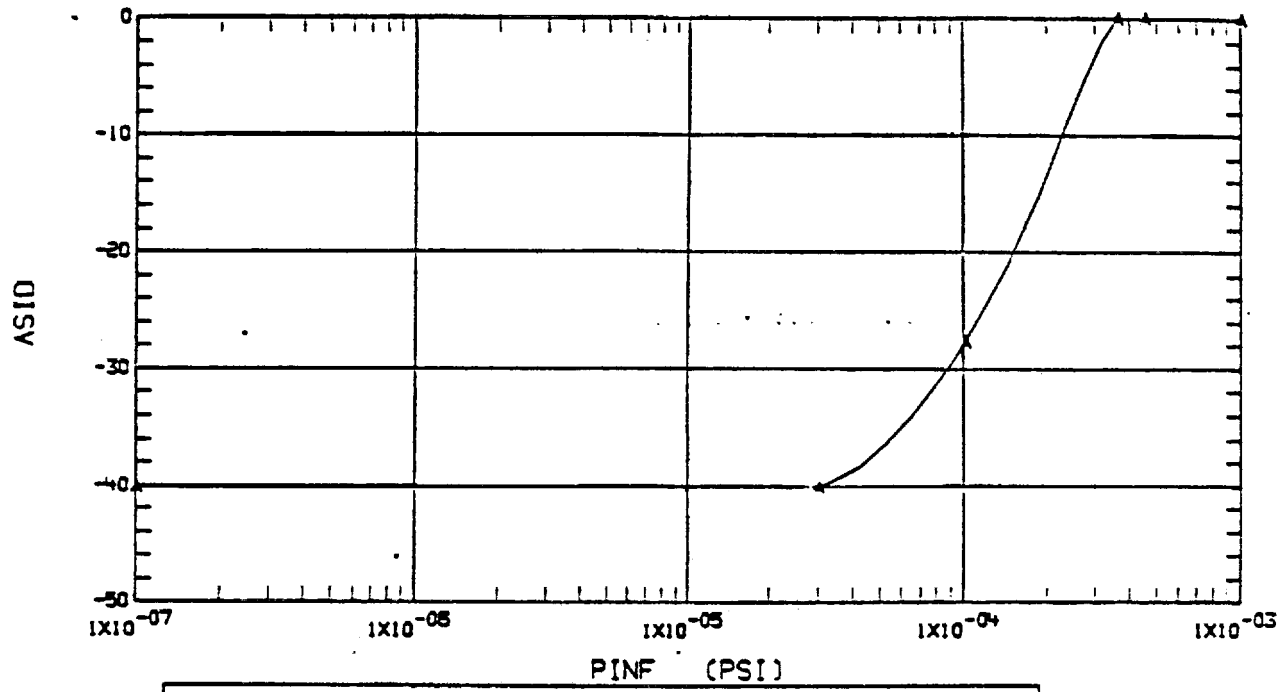


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF AXIAL FORCE COE							
0.025	0.01931	0.00966	0.0	-0.00949	-0.01862	-0.02583	-0.03424	-0.04230
0.050	0.01456	0.00729	0.0	-0.00716	-0.01404	-0.02023	-0.02582	-0.03190
0.100	0.00821	0.00410	0.0	-0.00403	-0.00791	-0.01140	-0.01455	-0.01798
0.200	0.00386	0.00193	0.0	-0.00190	-0.00372	-0.00537	-0.00685	-0.00846
0.300	0.00201	0.00100	0.0	-0.00099	-0.00194	-0.00279	-0.00356	-0.00440
0.500	0.00087	0.00043	0.0	-0.00043	-0.00084	-0.00121	-0.00154	-0.00190
1.000	0.00023	0.00012	0.0	-0.00011	-0.00022	-0.00032	-0.00041	-0.00051
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.2-144
GROUND EFFECT BODY FLAP AXIAL FORCE COEFF. INCREMENT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	A_{SURF} ~ IMP lb/ft	AXIAL FORC
1.000E-07		-0.186
3.000E-05		-0.186
1.000E-04		-27.818
3.600E-04		0.0
4.500E-04		0.0
1.000E-03		0.0

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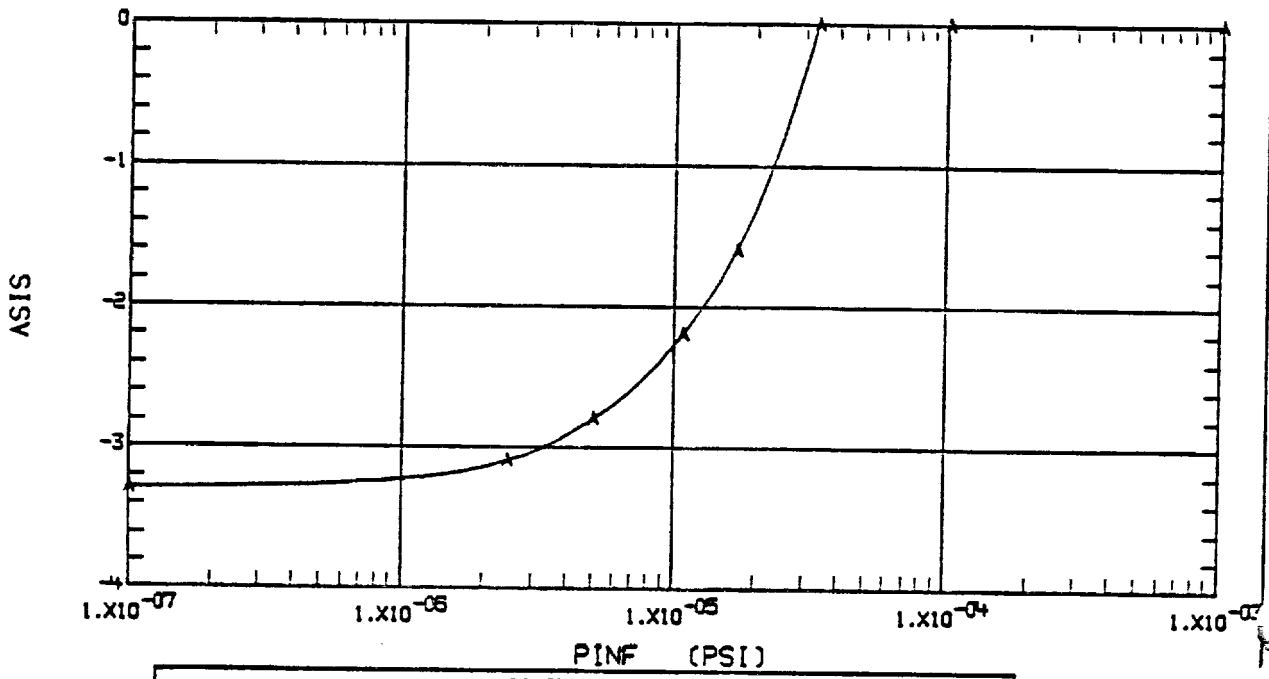
FIGURE 4.1.1.2-145
AXIAL FORCE SURFACE IMPINGEMENT.DOWN-FIRING

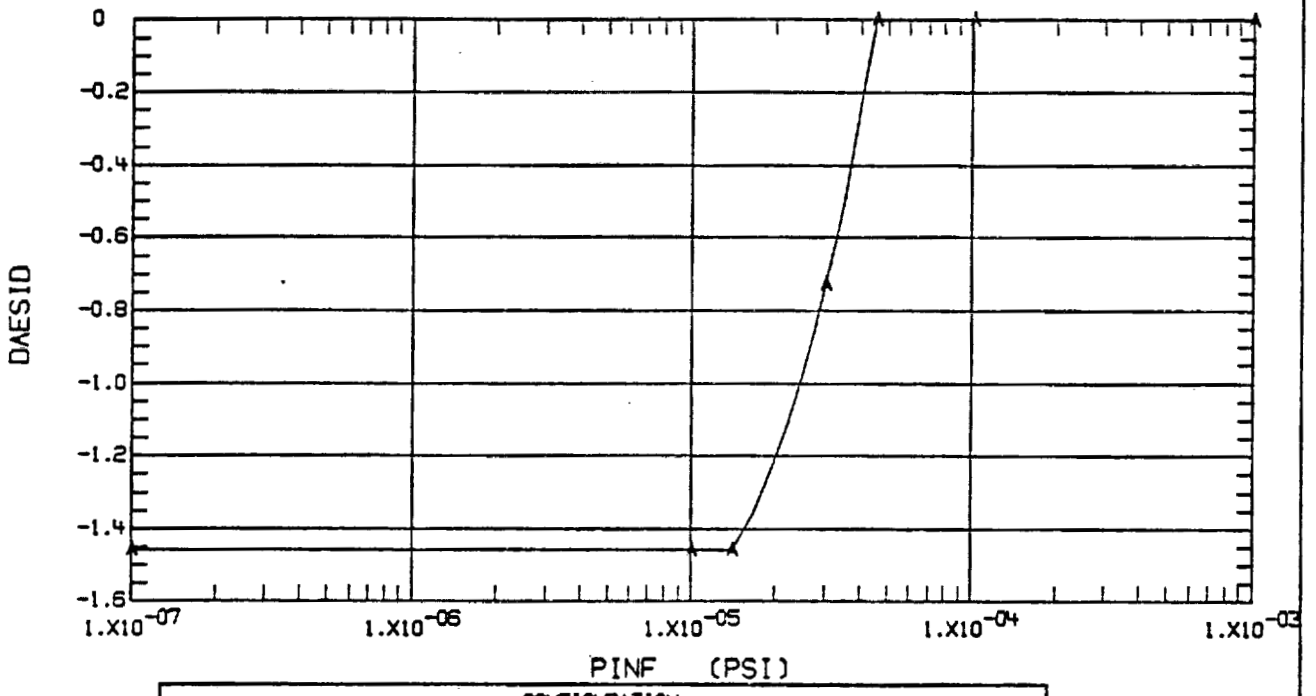


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	$A_{SURF\ IMP}$ lb/in AXIAL FORC
1.000E-07	-3.300
2.410E-06	-3.100
4.970E-06	-2.800
1.070E-05	-2.200
1.580E-05	-1.600
3.290E-05	0.0
1.000E-04	0.0
1.000E-03	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.2-146
AXIAL FORCE SURFACE IMPINGEMENT.SIDE-FIRING



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

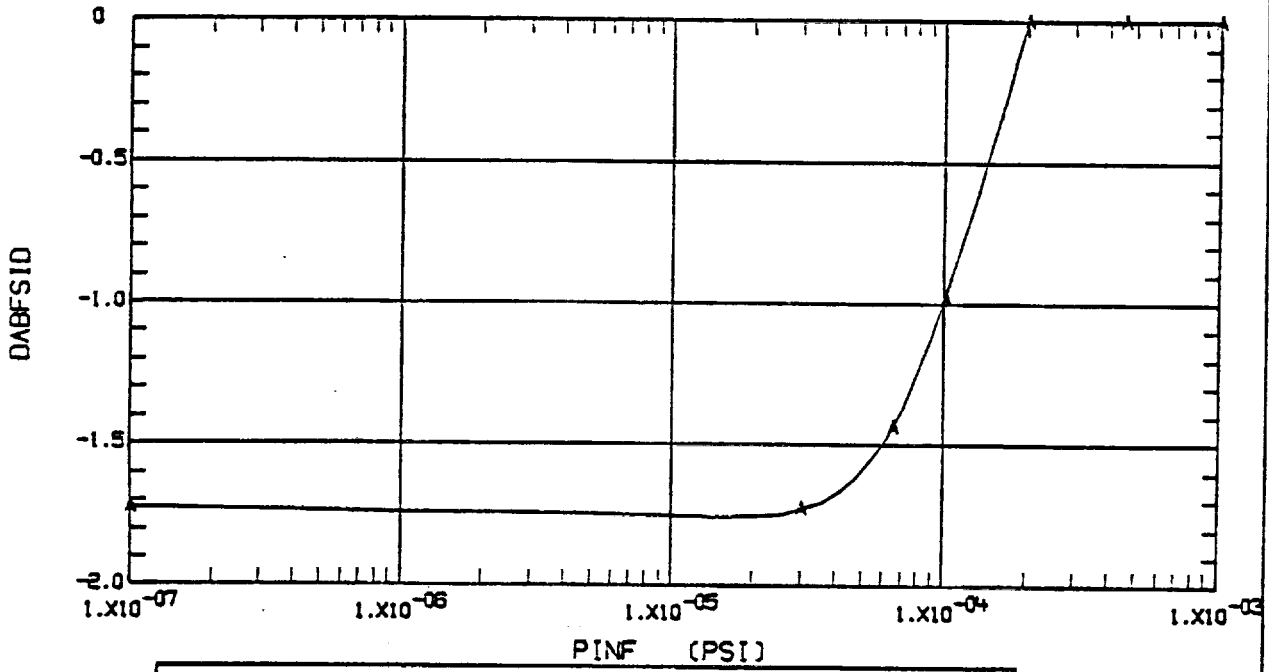
PINF (PSI)	$\frac{\partial A}{\partial \delta_e} \sim \frac{lb}{n\text{-}deg}$ DE AXIAL F
1.000E-07	-1.460
1.000E-05	-1.460
1.400E-05	-1.460
3.000E-05	-0.730
4.500E-05	0.0
1.000E-04	0.0
1.000E-03	0.0

ENGINEER_____

DATE_____

FIGURE 4.1.1.2-147

ELEVON AXIAL FORCE SURFACE IMPINGEMENT.DOWN-FIRING



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

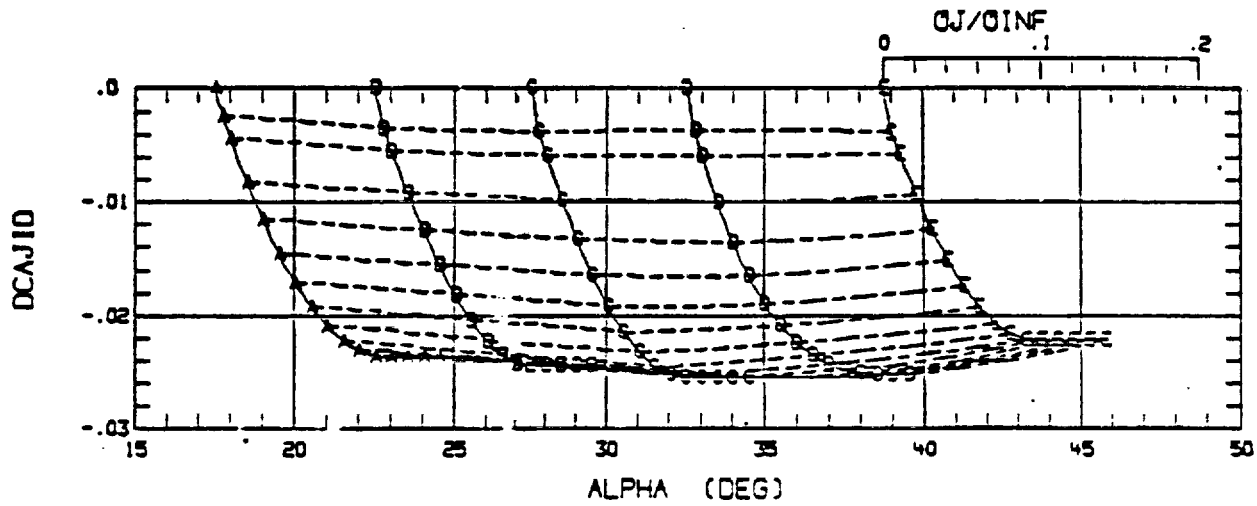
PINF (PSI)	$\frac{\partial A}{\partial \delta_{BF}} \sim \frac{lb}{n\text{-}deg}$ DBF AXIAL
1.000E-07	-1.730
3.000E-05	-1.730
6.500E-05	-1.440
1.000E-04	-0.980
2.000E-04	0.0
4.500E-04	0.0
1.000E-03	0.0

ENGINEER_____

DATE_____

FIGURE 4.1.1.2-14c

BODYFLAP AXIAL FORCE SURFACE IMPINGEMENT.DOWN-FIRIN



CJ/CINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	37.500 E
	AXIAL FORCE [illegible]				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00246	-0.00353	-0.00380	-0.00368	-0.00390
0.0100	-0.00451	-0.00550	-0.00591	-0.00588	-0.00[illegible]
0.0200	-0.00830	-0.00931	-0.00985	-0.01011	-0.00[illegible]
0.0300	-0.01168	-0.01260	-0.01340	-0.01361	-0.01245
0.0400	-0.01454	-0.01564	-0.01654	-0.01684	-0.01[illegible]
0.0500	-0.01717	-0.01828	-0.01925	-0.01897	-0.01[illegible]
0.0600	-0.01930	-0.02051	-0.02150	-0.02092	-0.01932
0.0700	-0.02100	-0.02227	-0.02327	-0.02[illegible]	-0.02[illegible]
0.0800	-0.02229	-0.02354	-0.02454	-0.02347	-0.02[illegible]
0.0900	-0.02315	-0.02429	-0.02528	-0.02437	-0.02317
0.1000	-0.02360	-0.02447	-0.02547	-0.02459	-0.02317
0.1100	-0.02360	-0.02447	-0.02547	-0.02[illegible]	-0.02317
0.1200	-0.02360	-0.02447	-0.02547	-0.02[illegible]	-0.02317
0.1300	-0.02360	-0.02447	-0.02547	-0.02[illegible]	-0.02317
0.1400	-0.02360	-0.02447	-0.02[illegible]	-0.02[illegible]	-0.02317

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate

v_j = exit velocity

n = number of thrusters

$A_{ref} = 1\ ft^2$

$S_{ref} = 2690\ ft^2$

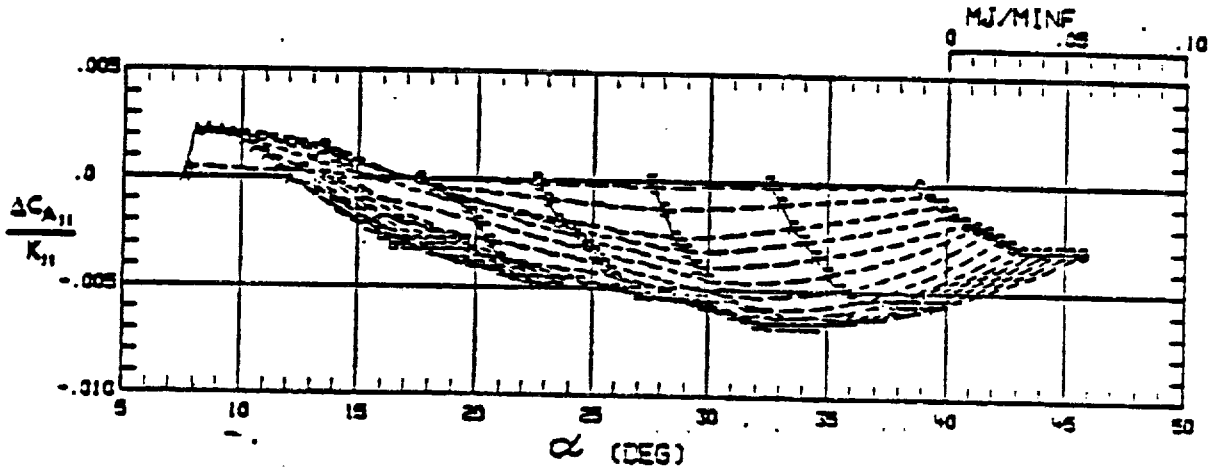
$$\Delta C_{A_{jt}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	AXIAL FORCE [illegible]					
17.500	-0.0003	-0.4420	2.0900	0.0	0.0050	0.1000
22.500	-0.0015	-0.4130	1.2600	5.7300	0.0050	0.1000
27.500	-0.0016	-0.4480	1.7100	3.8300	0.0050	0.1000
32.500	-0.0012	-0.5130	3.5400	-7.7900	0.0050	0.1200
37.500	-0.0019	-0.4090	1.3[illegible]	2.1300	0.0050	0.1000

ENGINEER [illegible]
DATE 10/24/75

FIGURE 4.1.1.2-149
AXIAL FORCE JET INTERACTION, DOWN-FIRING



MJ/MINF	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	37.750 G
	AXIAL FORCE JI.SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	0.00042	0.00023	-0.00007	-0.00019	-0.00027	-0.00021	-0.00009
0.005	0.00211	0.00117	-0.00036	-0.00096	-0.00133	-0.00104	-0.00043
0.010	0.00214	0.00137	-0.00072	-0.00193	-0.00266	-0.00209	-0.00085
0.015	0.00208	0.00100	-0.00083	-0.00227	-0.00329	-0.00274	-0.00129
0.020	0.00193	0.00023	-0.00133	-0.00277	-0.00397	-0.00348	-0.00172
0.025	0.00170	-0.00075	-0.00208	-0.00337	-0.00484	-0.00427	-0.00191
0.030	0.00138	-0.00175	-0.00293	-0.00398	-0.00529	-0.00497	-0.00219
0.035	0.00098	-0.00259	-0.00376	-0.00465	-0.00593	-0.00550	-0.00246
0.040	0.00048	-0.00308	-0.00442	-0.00500	-0.00585	-0.00578	-0.00273
0.045	-0.00010	-0.00304	-0.00478	-0.00525	-0.00553	-0.00569	-0.00309
0.050	-0.00010	-0.00304	-0.00478	-0.00525	-0.00558	-0.00553	-0.00309
0.055	-0.00010	-0.00304	-0.00478	-0.00525	-0.00558	-0.00569	-0.00309
0.060	-0.00010	-0.00304	-0.00478	-0.00525	-0.00558	-0.00569	-0.00309
0.065	-0.00010	-0.00304	-0.00478	-0.00525	-0.00558	-0.00569	-0.00309
0.070	-0.00010	-0.00304	-0.00478	-0.00525	-0.00558	-0.00569	-0.00309

$$\frac{\dot{m}_i}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_i}{\omega_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-4}\left(\frac{v_\infty}{v_j}\right)$$

v_j = exit velocity — fps
v_∞ = freestream velocity — fps
θ_j = nozzle half angle at exit

$$\frac{\Delta C_{A_{JI}}}{K_{JI}} = A_0 + A_1\left(\frac{\dot{m}_i}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_i}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_i}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	ACCS.MIN.MAX A_0	A_1	A_2	A_3	$(\dot{m}_i/\dot{m}_\infty)_{MIN}$	$(\dot{m}_i/\dot{m}_\infty)_{MAX}$
	AXIAL FORCE JI.SF					
7.500	0.00200	0.03140	-1.72250	0.0	0.00500	0.04500
12.500	0.00020	0.28190	-18.95000	246.34780	0.00500	0.04500
17.500	-0.00220	0.29000	-16.00000	184.00000	0.01000	0.04500
22.500	-0.00200	0.07150	-7.38000	92.50000	0.01000	0.05000
27.500	-0.00170	-0.08740	-3.42000	56.30000	0.01000	0.05000
32.500	-0.00150	0.00670	-7.80000	124.00000	0.01000	0.04500
37.750	-0.00210	0.38000	-3.57000	31.20000	0.02000	0.04500

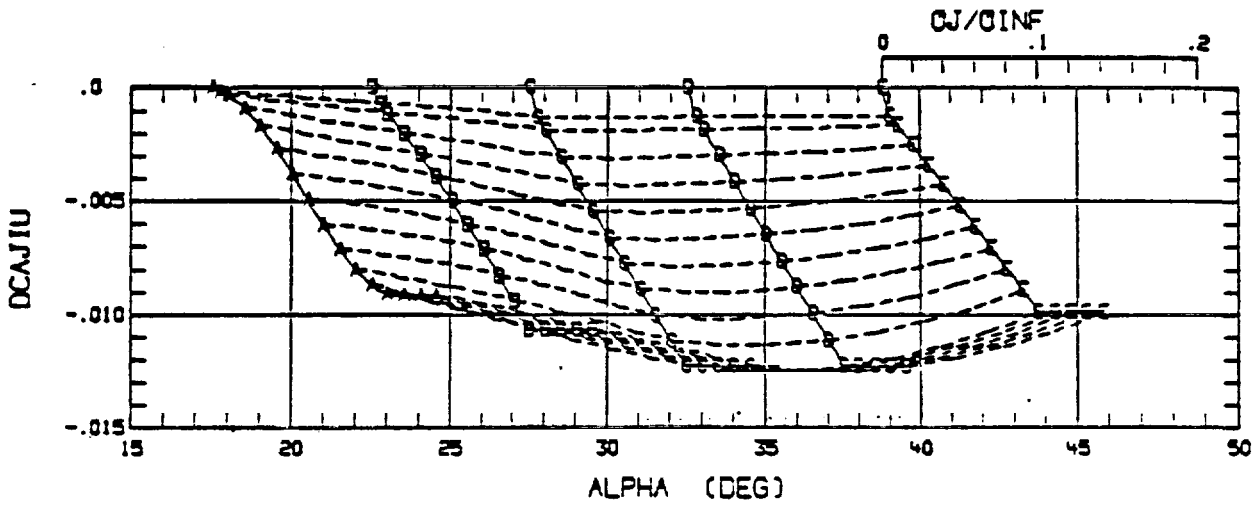
$K_{JI} = 1.0$

Interpolate for α's not shown after calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

ENGINEER AP
DATE 4/15/71

FIGURE 4.1.1.2-150
AXIAL FORCE JET INTERACTION, SIDE-FIRING



CJ/CINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	36.750 E
	AXIAL FORCE JET UP				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00019	-0.00073	-0.00131	-0.00129	-0.00123
0.0100	-0.00036	-0.00116	-0.00191	-0.00185	-0.00166
0.0200	-0.00092	-0.00226	-0.00312	-0.00300	-0.00263
0.0300	-0.00173	-0.00300	-0.00431	-0.00416	-0.00362
0.0400	-0.00272	-0.00398	-0.00549	-0.00532	-0.00431
0.0500	-0.00382	-0.00500	-0.00665	-0.00648	-0.00521
0.0600	-0.00497	-0.00606	-0.00781	-0.00764	-0.00613
0.0700	-0.00610	-0.00716	-0.00896	-0.00881	-0.00705
0.0800	-0.00714	-0.00830	-0.01006	-0.00997	-0.00798
0.0900	-0.00804	-0.00947	-0.01121	-0.01114	-0.00893
0.1000	-0.00872	-0.01069	-0.01231	-0.01231	-0.00968
0.1100	-0.00912	-0.01069	-0.01231	-0.01231	-0.00989
0.1200	-0.00918	-0.01069	-0.01231	-0.01231	-0.00989
0.1300	-0.00918	-0.01069	-0.01231	-0.01231	-0.00989
0.1400	-0.00918	-0.01069	-0.01231	-0.01231	-0.00989

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

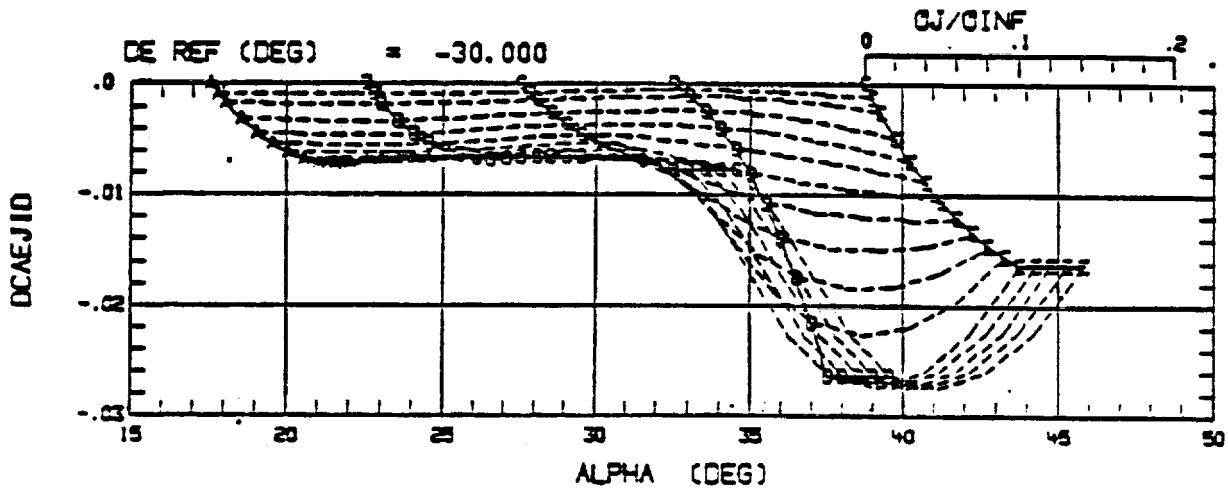
$$\Delta C_{A_{jt}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) + A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown *after* calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	AXIAL FORCE JET UP					
17.500	-0.0001	-0.0022	-1.8700	10.5000	0.0050	0.1200
22.500	-0.0003	-0.0941	-0.1980	0.0	0.0050	0.1000
27.500	-0.0007	-0.1220	0.0586	0.0	0.0050	0.1000
32.500	-0.0007	-0.1150	-0.0115	0.0	0.0050	0.1000
36.750	-0.0008	-0.0857	-0.0509	0.0	0.0050	0.1000

ENGINEER [illegible]
DATE 10/4/73

FIGURE 4.1.1.2-151
AXIAL FORCE JET INTERACTION.UP-FIRING



CJ/CINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DE AXIAL FORCE [illegible]				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00089	-0.00098	-0.00075	-0.00054	-0.00134
0.0100	-0.00172	-0.00187	-0.00144	-0.00112	-0.00252
0.0200	-0.00320	-0.00338	-0.00257	-0.00246	-0.00499
0.0300	-0.00445	-0.00456	-0.00372	-0.00406	-0.00712
0.0400	-0.00548	-0.00545	-0.00461	-0.00558	-0.00902
0.0500	-0.00627	-0.00609	-0.00535	-0.00622	-0.01072
0.0600	-0.00684	-0.00651	-0.00599	-0.01088	-0.01221
0.0700	-0.00718	-0.00673	-0.00653	-0.01399	-0.01351
0.0800	-0.00729	-0.00681	-0.00700	-0.01760	-0.01464
0.0900	-0.00716	-0.00676	-0.00743	-0.02174	-0.01551
0.1000	-0.00680	-0.00663	-0.00783	-0.02548	-0.01643
0.1100	-0.00680	-0.00663	-0.00783	-0.02548	-0.01643
0.1200	-0.00680	-0.00663	-0.00783	-0.02548	-0.01643
0.1300	-0.00680	-0.00663	-0.00783	-0.02548	-0.01643
0.1400	-0.00680	-0.00663	-0.00783	-0.02548	-0.01643

$$\frac{\phi_1}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

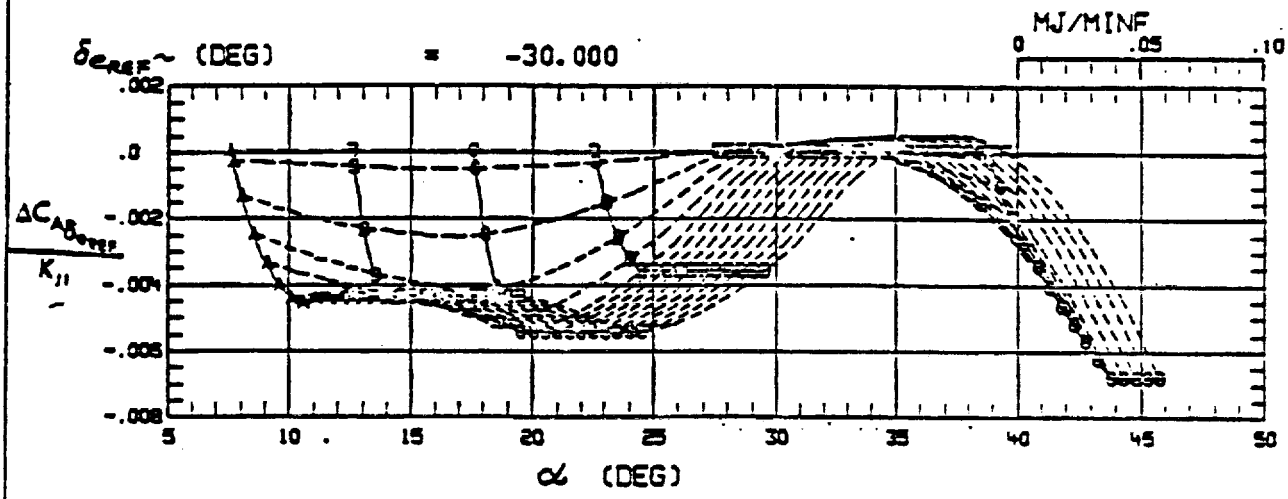
$$\Delta C_{A_{\delta_{EQ}=-38°}} = A_0 + A_1\left(\frac{\phi_1}{\phi_\infty}\right) + A_2\left(\frac{\phi_1}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_1}{\phi_\infty}\right)^3$$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_1/\phi_\infty)_{MIN}$	$(\phi_1/\phi_\infty)_{MAX}$
	DE AXIAL FORCE [illegible]					
17.500	0.0	-0.1830	1.1500	0.0	0.0050	0.1000
22.500	0.0	-0.2060	1.9700	-5.7300	0.0050	0.1000
27.500	0.0	-0.1550	1.1500	-3.8300	0.0050	0.1000
32.500	0.0	-0.1030	-0.9350	-7.7900	0.0050	0.1000
38.750	0.0	-0.2750	1.3200	-2.1300	0.0050	0.1000

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.1.1.2-152
ELEVON AXIAL FORCE JET INTERACTION, DOWN-FIRING



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	DE AXIAL FORCE J1,SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00027	-0.00047	-0.00050	-0.00030	0.0	0.0	-0.00021
0.005	-0.00137	-0.00235	-0.00250	-0.00151	0.0	0.0	-0.00106
0.010	-0.00250	-0.00375	-0.00414	-0.00257	0.0	0.0	-0.00198
0.015	-0.00338	-0.00439	-0.00508	-0.00324	0.0	0.0	-0.00277
0.020	-0.00402	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00348
0.025	-0.00441	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00407
0.030	-0.00455	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00464
0.035	-0.00445	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00517
0.040	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00569
0.045	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00524
0.050	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00582
0.055	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00582
0.060	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00582
0.065	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00582
0.070	-0.00442	-0.00439	-0.00545	-0.00360	0.0	0.0	-0.00582

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_j}{\phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\theta_j\right)^{1/2} = 8.296 \times 10^{-6}\left(\frac{v_\infty}{\bar{q}_\infty}\right) \qquad \frac{\Delta C_{A_{\delta_{e_{REF}}}}}{K_{J1}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

v_j = exit velocity ~ fps
v_∞ = freestream velocity ~ fps
θ_j = nozzle half angle at exit

$K_{J1} = 1.0$

ALPHA (DEG)	A003,MIN,MAX A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{m}_\infty)_{MIN}$	$(\dot{m}_j/\dot{m}_\infty)_{MAX}$
	DE AXIAL FORCE J1,SF					
7.500	0.0	-0.29910	4.91370	0.0	0.00500	0.03560
12.500	0.0	-0.57820	22.58200	-246.37460	0.00500	0.01500
17.500	0.0	-0.59300	19.70000	-164.00000	0.00500	0.02000
22.500	0.0	-0.35300	10.50000	-92.50000	0.00500	0.02000
27.500	0.0	0.0	0.0	0.0	0.00500	0.05000
32.500	0.0	0.0	0.0	0.0	0.00500	0.05000
38.750	0.0	-0.22900	3.43000	-31.50001	0.00500	0.05000

Interpolate for α's not shown after calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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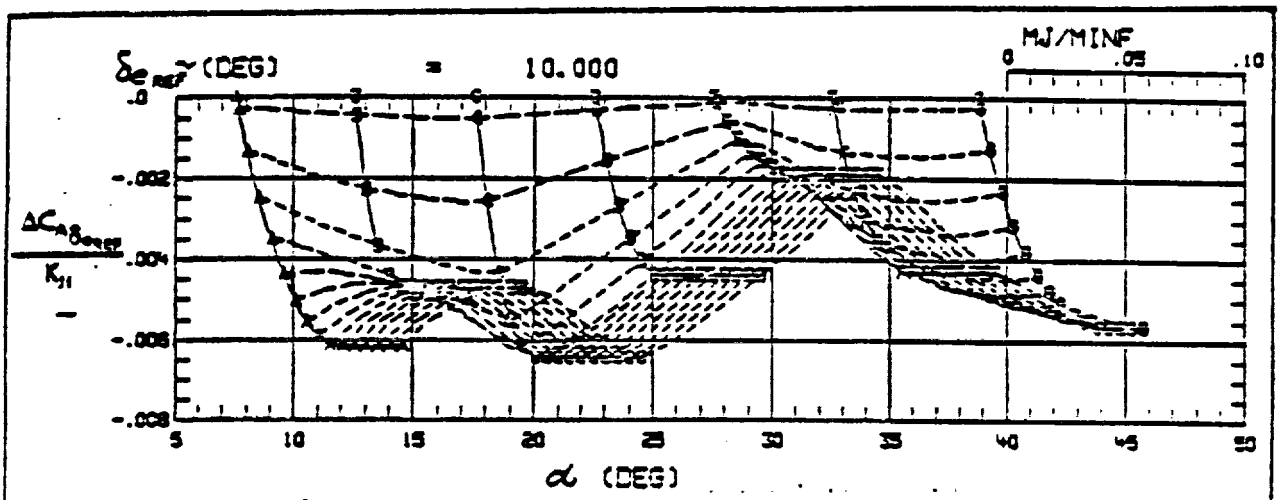
FIGURE 4.1.1.2-153
ELEVON AXIAL FORCE JET INTERACTION, SIDE-FIRING



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	DE AXIAL FORCE J1 SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00027	-0.00046	-0.00052	-0.00031	-0.00012	-0.00027	-0.00025
0.005	-0.00134	-0.00229	-0.00259	-0.00154	-0.00060	-0.00137	-0.00127
0.010	-0.00251	-0.00371	-0.00437	-0.00258	-0.00103	-0.00233	-0.00232
0.015	-0.00352	-0.00445	-0.00553	-0.00350	-0.00134	-0.00305	-0.00317
0.020	-0.00437	-0.00471	-0.00617	-0.00405	-0.00156	-0.00355	-0.00395
0.025	-0.00505	-0.00471	-0.00645	-0.00442	-0.00174	-0.00394	-0.00439
0.030	-0.00557	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00460
0.035	-0.00593	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00511
0.040	-0.00612	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00534
0.045	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00552
0.050	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00557
0.055	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00557
0.060	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00557
0.065	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00557
0.070	-0.00616	-0.00471	-0.00645	-0.00442	-0.00192	-0.00432	-0.00557

$$\frac{\dot{m}_1}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_1}{\phi_\infty}\right)\left(\frac{v_\infty}{v_1}\right)\left(\sin\theta_1\right)^{1/2} = 8.296 \times 10^{-4}\left(\frac{v_\infty}{\phi_\infty}\right)$$

v_1 = exit velocity — fps
v_∞ = freestream velocity — fps
θ_1 = nozzle half angle at exit

$$\frac{\Delta C_{A_{\delta_{e_{REF}}}}}{K_{J1}} = A_0 + A_1\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	A003, MIN, MAX A_0	A_1	A_2	A_3	$(\dot{m}_1/\dot{m}_\infty)_{MIN}$	$(\dot{m}_1/\dot{m}_\infty)_{MAX}$
	DE AXIAL FORCE J1 SF					
7.500	0.0	-0.29410	3.27660	0.0	0.00500	0.04330
12.500	0.0	-0.55530	20.92740	-246.34750	0.00500	0.02000
17.500	0.0	-0.60300	18.39999	-184.00000	0.00500	0.02500
22.500	0.0	-0.35200	9.32000	-92.50000	0.00500	0.02500
27.500	0.0	-0.14000	4.22000	-56.30000	0.00500	0.03000
32.500	0.0	-0.31900	9.55000	-124.00000	0.00500	0.03000
38.750	0.0	-0.27700	4.85000	-31.60001	0.00500	0.05000

$K_{J1} = 1.0$

Interpolate for α's not shown *after* calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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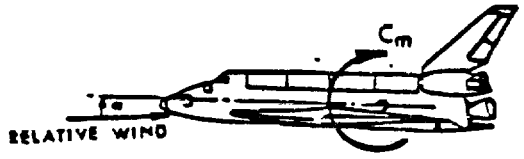
DATE [illegible]

FIGURE 4.1.1.2-154
ELEVON AXIAL FORCE JET INTERACTION-SIDE-FIRING

4.1.1.3 PITCHING MOMENT COEFFICIENT. The Orbiter Vehicle aerodynamic pitching moment coefficient is defined in this section. The basic aerodynamic pitching moment coefficient data are presented in three forms: 1) as function of speed brake angle, angle of attack, and Mach number from M = 0.25 through M = 20; 2) as a function of angle of attack and the viscous interaction parameter ($\bar{V}'_\infty$) from 0.005 (equivalent to M = 13.6) through 0.8 (equivalent to 300,000 feet of altitude); and 3) as a function of angle of attack and altitude from 300,000 feet through 600,000 feet. Orbital aerodynamic characteristics are included in Appendix C. RCS jet thrust, thrust impingement, and flow field changes due to jet plumes are also included in this section [4.1.1.3]. Uncertainties associated with the pitching moment characteristics are available in Section 6.0.



The RCS flow field interaction data are presented as a contribution to the total pitching moment (M) rather than the coefficient (C_m) since the terms due to jet thrust and impingement are independent of dynamic pressure and cannot, therefore, be normalized in the conventional manner. CAUTION should be observed when applying these terms in the flight regime where RCS is used in conjunction with the aerodynamic pitching moment (cf. Section 3.6); i.e., the aerodynamic pitching moment coefficient must be converted to a dimensional moment *before* adding the RCS flow field interaction effect (see also Appendix B).

The total pitching moment is:

$$M_{TOTAL} = \bar{q}\, S\bar{c}\, C_{m_{\substack{TOTAL \\ AERO}}} + M_{RCS}$$

The total pitching moment coefficient is obtained by summing up the basic data (all surfaces at zero except speed brake) with auxiliary data (from control surface deflections, ground effect, flexibility, etc.). All of these total data (basic plus auxiliary) are given at specified conditions. Linear interpolation is to be used at the intermediate positions.

* The total aerodynamic pitching moment coefficient about 65 percent of the body length (FS 1076.7, WL 375.0, BL 0.0) is obtained by the following equation:

$$C_{m_{\substack{TOTAL \\ AERO}_{0.65L_B}}} = C_{m_{BASIC}} + [\Delta C_{m_{ELEVATOR}} + \Delta C_{m_{AILERON}}]_{ELEVON} + \Delta C_{m_{\substack{BODY \\ FLAP}}} + \Delta C_{m_{RUDDER}} + \Delta C_{m_{\substack{SPEED \\ BRAKE}}}$$

$$+ C_{m_{\dot{\alpha}}} \frac{\dot{\alpha}\bar{c}}{2V} + [C_{m_q} + \Delta C_{m_{q_{\substack{SB \\ BF}}}}] \frac{q\bar{c}}{2V} + \Delta C_{m_{FLEX}} + \Delta C_{m_{\substack{LANDING \\ GEAR}}} + \Delta C_{m_{\substack{GROUND \\ EFFECT}}} + \Delta C_{m_{\substack{SILTS \\ POD}}}$$

*Refer to Appendix D when using digitized data.

NOTE: The increment presented in Appendix E should be added to the total from above calculations to account for OV102 manufacturing misalignment.

where,

$C_{m_{BASIC}}$ = Basic, full-scale, freestream, rigid-body pitching moment coefficient about $0.65L_B$ (Figures 4.1.1.3-1 through -67)

NOTE: 1. All control surfaces neutral *except* $\delta_{s_B} = 25°$.

2. For Moment Reference Center other than $0.65L_B$,

$$C_{m_{MRC}} = C_{m_{0.65L_B}} + \frac{\Delta x}{\bar{c}} C_N - \frac{\Delta z}{\bar{c}} C_A$$

where $\Delta x = x_{MRC} - 1076.7$ inches

$\Delta z = z_{MRC} - 375$ inches

3. Moment transfer of (2) applies to all following increments and/or slopes except as noted.

$\Delta C_{m_{ELEVATOR}}$ = Change in pitching moment coefficient due to elevon (elevator) deflection, δ_e, when inboard and outboard angles are equal. (Figures 4.1.1.3-68 through -98)

NOTE: 1. Partial span factor, K_m, to be used for elevon-body flap interconnect flight system where δ_e is limited to $\pm 5°$ and inboard and outboard angles are not equal. (Figure 4.1.1.3-99)

$$\Delta C_{m_{e_{\delta_{e_i} \neq \delta_{e_o}}}} = K_m \Delta C_{m_{e_{\delta_e = \delta_{e_i}}}} + (1 - K_m) \Delta C_{m_{e_{\delta_e = \delta_{e_o}}}}$$

$\Delta C_{m_{AILERON}}$ = Change in pitching moment coefficient due to aileron deflection, δ_a.

$$= \frac{1}{2}\left[K_{m_{(\delta_{a_L})}} \Delta C_{m_{e_{L_i}}} + (1 - K_{m_{(\delta_{a_L})}}) \Delta C_{m_{e_{L_o}}} + K_{m_{(\delta_{a_R})}} \Delta C_{m_{e_{R_i}}} + (1 - K_{m_{(\delta_{a_R})}}) \Delta C_{m_{e_{R_o}}}\right] - \Delta C_{m_{ELEVATOR}}$$

$\Delta C_{m_{BODY\ FLAP}}$ = Change in pitching moment coefficient due to body flap deflection, δ_{bf} (Figures 4.1.1.3-100 through -133)

$\Delta C_{m_{RUDDER}}$ = Change in pitching moment coefficient due to rudder deflection, δ_r. (Assume zero)

$\Delta C_{m_{SPEED\ BRAKE}}$ = Change in pitching moment coefficient due to speed brake deflection, δ_{SB}. (Figures 4.1.1.3-1 through -65)

$= C_{m_{\delta_{SB}=\delta_{SB}}} - C_{m_{\delta_{SB}=25}}$

$C_{m_{\dot{\alpha}}}$ = Change in pitching moment coefficient due to rate of change of angle of attack, $\dot{\alpha}$, (per radian).* (see NOTE 1, C_{m_q})

C_{m_q} = Change in pitching moment coefficient due to pitch rate, q, (per radian).* (Figures 4.1.1.3-134 through-135)

NOTE: 1. As presented herein, $C_{m_q} \equiv C_{m_q} + C_{m_{\dot{\alpha}}}$ and should be treated as C_{m_q}.

CAUTION: DO NOT EXTRAPOLATE ROTARY DERIVATIVES. If angle of attack limits are exceeded, the Aerodynamics unit must be consulted.

$\Delta C_{m_{q_{SB}}}$ = Incremental effect of speed brake/body flap on pitch damping. (Figure 4.1.1.3-136)

$$= \left[K_{SB}\left(\frac{\delta_{SB}-25}{75}\right) + \left(1-K_{SB}\right)\left(\frac{\delta_{BF}}{13.75}\right)\right]\Delta C_{m_{q_{SB=100,\ BF=13.75}}}$$

NOTE: 1. For normal simulations, use $K_{SB} = 0.5$

2. For sensitivity studies, assume K_{SB} can be either 0 or 1.

$\Delta C_{m_{FLEX}}$ = Change in pitching moment coefficient due to aeroelastic deformation.

$$= \Delta C^F_{m_o} - (1-\eta_N)(C_m - C_{m_o})^R_{BASIC} - \left(\frac{\Delta x_{AC}}{\bar{c}}\right)^F \eta_N (C_N - C_{N_o})^R_{BASIC}$$

$$- (1-\eta_{M_e})\left(\Delta C^R_{m_e} + \Delta C_{m_{AILERON}}\right) - (1-\eta_{M_{BF}})\ \Delta C^R_{m_{BF}}$$

$$- (1-\eta_{M_{SB}})\ \Delta C^R_{m_{SB}} - (1-\eta_{M_q})\ C^R_{m_{\bar{q}}}\ \frac{q\bar{c}}{2V}$$

where

$(C_m - C_{m_o})^R_{BASIC} = C_{m_{\alpha=\alpha,\ \delta_{SB}=25}} - C_{m_{\alpha=0,\ \delta_{SB}=25}}$ (Figures 4.1.1.3-1 through -67)

$(C_N - C_{N_o})^R_{BASIC} = C_{N_{\alpha=\alpha,\ \delta_{SB}=25}} - C_{N_{\alpha=0,\ \delta_{SB}=25}}$ (Figures 4.1.1.1-1 through -67)

the flexible (F) to rigid (R) ratios are

η_N = basic normal force (Figure 4.1.1.3-137)

η_{M_e} = elevon (Figure 4.1.1.3-138)

*For rotary derivative transfer equations see NASA SP -3070, "Summary of Transformation Equations and Equations of Motion Used in Free Flight and Wind Tunnel Data Reduction and Analysis," Gainer, T. G., and S. Hoffman, Langley Research Center, Hampton, Virginia (1972).

$\eta_{M_{BF}}$ = body flap (Figure 4.1.1.3-139)

$\eta_{M_{SB}}$ = speed brake (Assume 1.0)

η_{M_q} = pitch rate (Figure 4.1.1.3-140)

and, $\Delta C^f_{m_o}$ = flexible intercept at $\alpha = 0°$ (Figure 4.1.1.3-141)

$\left(\frac{\Delta X_{AC}}{\bar{c}}\right)^f$ = shift in aerodynamic center due to aero-elasticity. (Figure 4.1.1.3-142)

NOTE: 1. Detailed discussion of aero-elasticity may be obtained from Appendix A.

$\Delta C_{m_{LANDING\ GEAR}}$ = Change in pitching moment coefficient due to extension of landing gear. (Figure 4.1.1.3-143)

$\Delta C_{m_{GROUND\ EFFECT}}$ = Change in pitching moment coefficient due to proximity of ground, f(h/b).

$= \Delta C_{m_{GE_{\delta_{BF}=-11.7°}}} + \Delta C_{m_{BF_{GE}}}$

$\Delta C_{m_{GE_{\delta_{BF}=-11.7°}}}$ = Incremental pitching moment coefficient in ground effect with $\delta_{BF} = -11.7°$ (Figures 4.1.1.3-144 through -153)

$\Delta C_{m_{BF_{GE}}}$ = Incremental pitching moment coefficient in ground effect for various δ_{BF} deflections (Figures 4.1.1.3-154 through -160)

$\Delta C_{m_{SILTS\ POD}}$ = Change in pitching moment coefficient due to addition of SILTS pod.

$= -0.000635152 + 0.000881151\ M - 0.000173119\ M^2$ for $M \leq 6.0$

= zero for $M > 6.0$

RCS flow field interactions have been subdivided into three components:

1. RCS JET THRUST (subscript JT)
2. RCS JET PLUME IMPINGEMENT (subscript IMP)
3. RCS JET PLUME EFFECT ON FLOW FIELD (subscript JI)

*The effect of the RCS may be described as a dimensional pitching moment (foot-pounds) in terms of the significant contributing elements by:

$$M_{RCS} = M_{JT} + [M_{SURF} + \Delta M_{ELEVON} + \Delta M_{BODY\ FLAP}]_{IMP} + \bar{q}\, S\bar{c}[\Delta C_m + \Delta C_{m_{ELEVON}} + \Delta C_{m_{BODY\ FLAP}}]_{JI}$$

where,

M_{JT} = Pitching moment resulting from number (n) of jets being fired (Reference data only). (cf. Appendix B)

$$= \sum_{OJG} [M_{JET} \cdot n] \sim \text{ft-lb}$$

NOTE: 1. OJG = operating jet group (cf. Figure B-1)

$M_{SURF\ IMP}$ = Pitching moment resulting from jet impingement on Orbiter Vehicle surfaces(s) (Figure 4.1.1.3-161 and -162)

$$= \sum_{OJG} [M_{SURF\ IMP} \cdot n] \sim \text{ft-lb}$$

$\Delta M_{ELEVON\ IMP}$ = Change in pitching moment due to effect of impingement on elevon effectiveness. (Figure 4.1.1.3-163)

$$= \sum_{OJG} \left[\frac{\partial M}{\partial \delta_e} \cdot n \cdot \delta_e\right] \sim \text{ft-lb}$$

$\Delta M_{BODY\ FLAP}$ = Change in pitching moment due to effect of impingement on body flap effectiveness. (Figure 4.1.1.3-164)

$$= \sum_{OJG} \left[\frac{\partial M}{\partial \delta_{BF}} \cdot n \cdot \delta_{BF}\right] \sim \text{ft-lb}$$

$\Delta C_{m_{JI}}$ = Change in pitching moment coefficient due to jet interaction. (Figure 4.1.1.3-165 through -167)

$$= \sum_{OJG} [\Delta C_{m_{JI}}]$$

$\Delta C_{m_{ELEVON\ JI}}$ = Change in pitching moment coefficient due to jet interaction effect on elevon effectiveness.

$$= \sum_{OJG} \left[(\Delta C_m)_{\delta_{e_{REF}}} \cdot (\delta_e/\delta_{e_{REF}})^{0.75}\right]$$

*Refer to Appendix D when using digitized data.

NOTE: 1. Down-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.3-168)

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.1.1.3-169)

2. Side-firing jets

$\delta_e < 0°$, $\delta_{e_{REF}} = -30°$ (Figure 4.1.1.3-170)

$\delta_e > 0°$, $\delta_{e_{REF}} = +10°$ (Figure 4.1.1.3-171)

3. Up-firing jets (No effect)

$\Delta C_{m_{\substack{BODY \\ FLAP}}}$ = Change in pitching moment coefficient due to jet interaction effect on body flap effectiveness.

$$= \sum_{OJG} \left[(\Delta C_m)_{\delta_{BF_{REF}}} (\delta_{BF}/\delta_{BF_{REF}})^{0.75} \right]$$

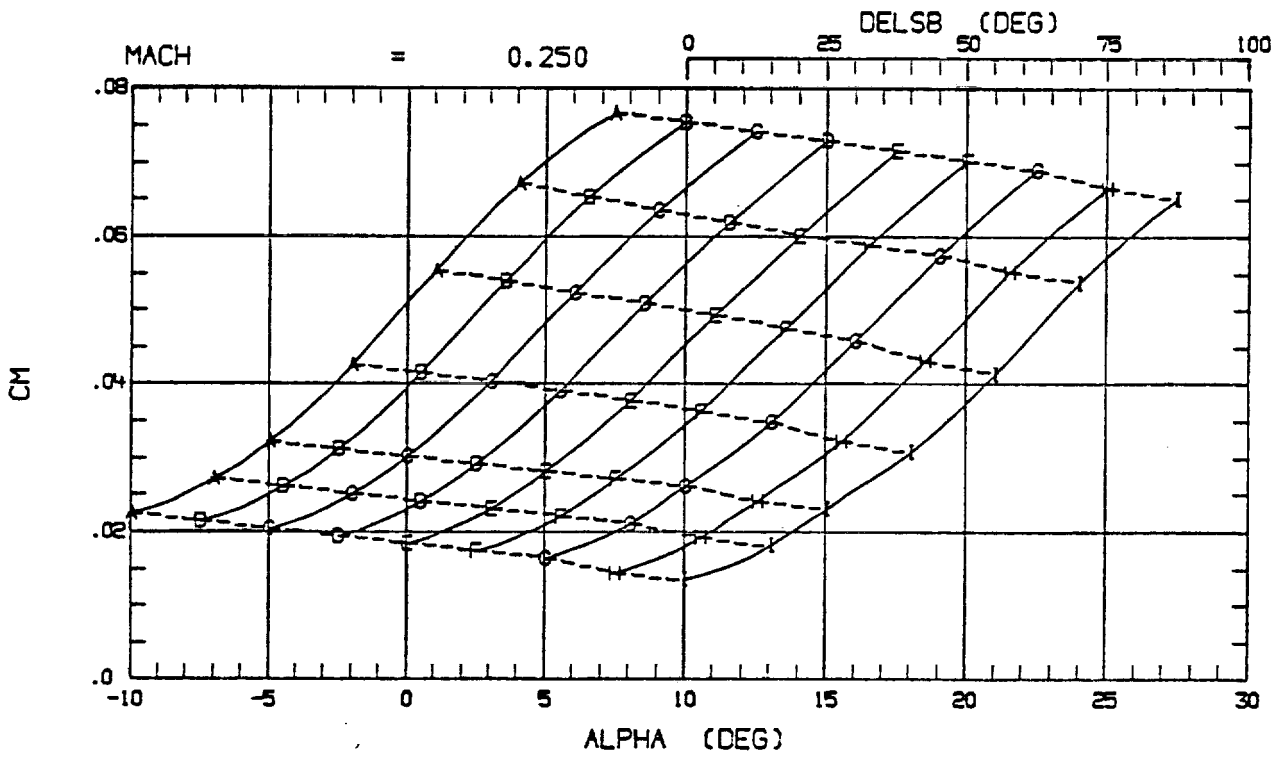
NOTE: 1. Down-firing jets

$\delta_{BF} < 0°$, $\delta_{BF_{REF}} = -14.25°$ (Figure 4.1.1.3-172)

$\delta_{BF} > 0°$ (No effect)

2. Side-firing jets (No effect)

3. Up-firing jets (No effect)



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.02230	0.02130	0.02030	0.01930	0.01830	0.01730	0.01630	0.01430	0.01330
15.000	0.02700	0.02600	0.02500	0.02400	0.02300	0.02200	0.02100	0.01900	0.01800
25.000	0.03200	0.03100	0.03000	0.02900	0.02800	0.02700	0.02600	0.02400	0.02300
40.000	0.04250	0.04136	0.04023	0.03894	0.03765	0.03614	0.03463	0.03211	0.03060
55.000	0.05630	0.05378	0.05227	0.05068	0.04910	0.04740	0.04570	0.04300	0.04130
70.000	0.06710	0.06521	0.06332	0.06166	0.06000	0.05867	0.05735	0.05503	0.05370
87.200	0.07660	0.07535	0.07410	0.07280	0.07150	0.07012	0.06875	0.06637	0.06500

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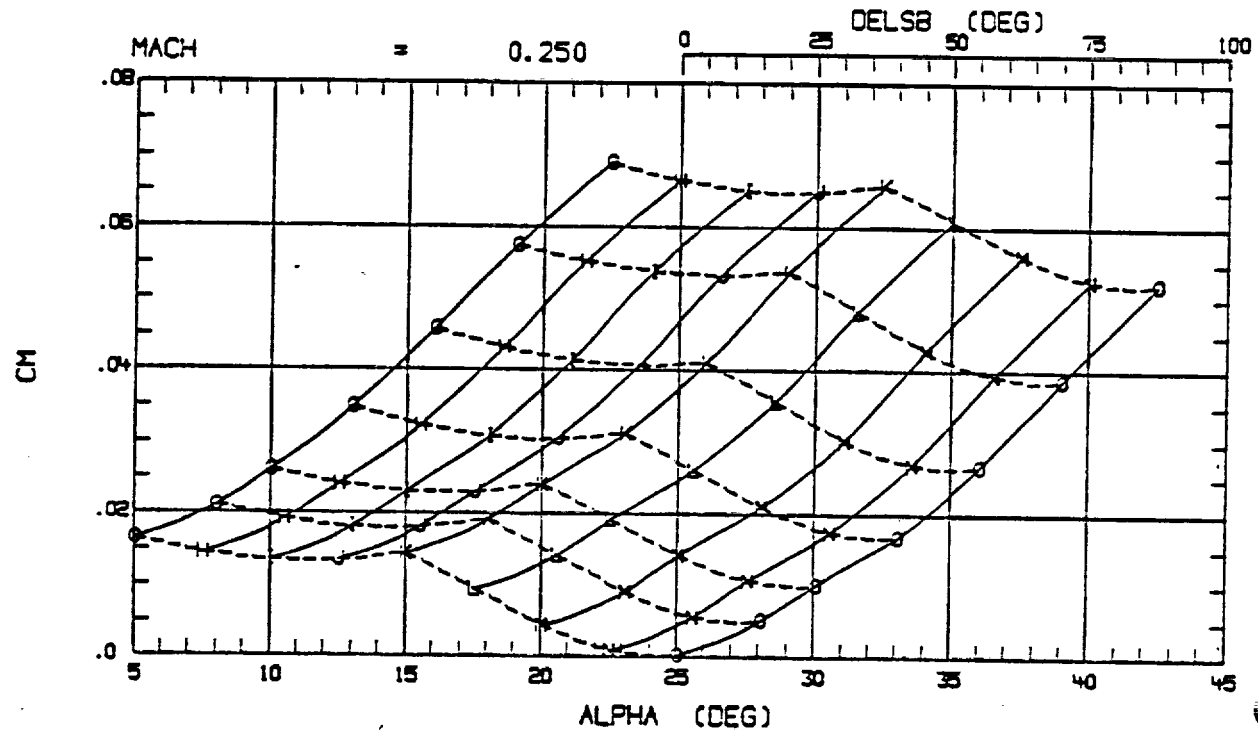
FIGURE 4.1.1.3-1
BASIC PITCHING MOMENT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2550.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.01630	0.01430	0.01330	0.01330	0.01430	0.00930	0.00430	0.00080	0.00030
15.000	0.02100	0.01900	0.01800	0.01800	0.01900	0.01400	0.00900	0.00550	0.00500
25.000	0.02500	0.02400	0.02300	0.02300	0.02400	0.01900	0.01400	0.01050	0.01000
40.000	0.03463	0.03211	0.03060	0.03037	0.03114	0.02600	0.02085	0.01727	0.01670
55.000	0.04570	0.04300	0.04130	0.04057	0.04104	0.03552	0.03000	0.02680	0.02660
70.000	0.05735	0.05503	0.05370	0.05317	0.05365	0.04812	0.04260	0.03910	0.03860
97.200	0.06675	0.06637	0.06500	0.06489	0.06578	0.06079	0.05580	0.05240	0.05200

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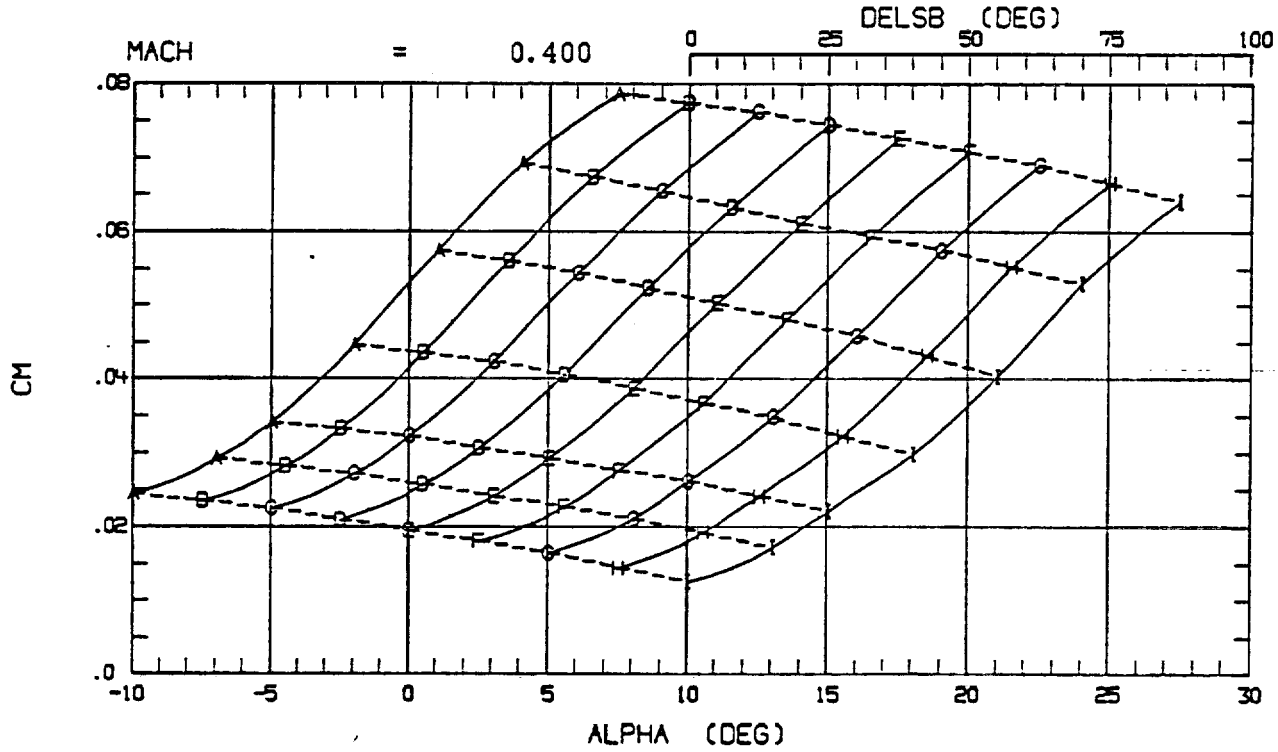
FIGURE 4.1.1.3-2
BASIC PITCHING MOMENT COEFFICIENT

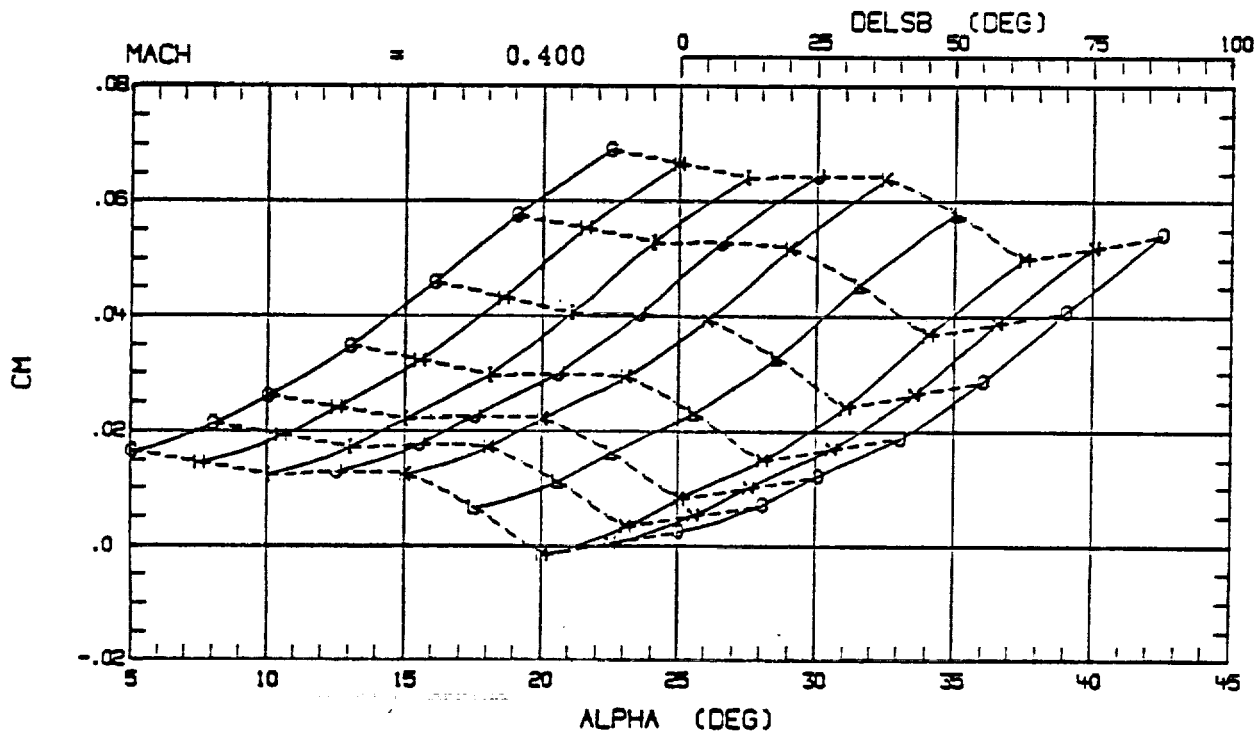


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.02430	0.02330	0.02230	0.02080	0.01930	0.01780	0.01630	0.01430	0.01230
15.000	0.02900	0.02800	0.02700	0.02550	0.02400	0.02250	0.02100	0.01900	0.01700
25.000	0.03400	0.03300	0.03200	0.03050	0.02900	0.02750	0.02500	0.02400	0.02200
40.000	0.04450	0.04336	0.04223	0.04044	0.03865	0.03664	0.03463	0.03211	0.02960
55.000	0.05730	0.05579	0.05427	0.05218	0.05010	0.04790	0.04570	0.04300	0.04030
70.000	0.06910	0.06721	0.06532	0.06316	0.06100	0.05917	0.05735	0.05503	0.05270
87.200	0.07860	0.07735	0.07610	0.07430	0.07250	0.07062	0.06875	0.06637	0.06400

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-3
BASIC PITCHING MOMENT COEFFICIENT

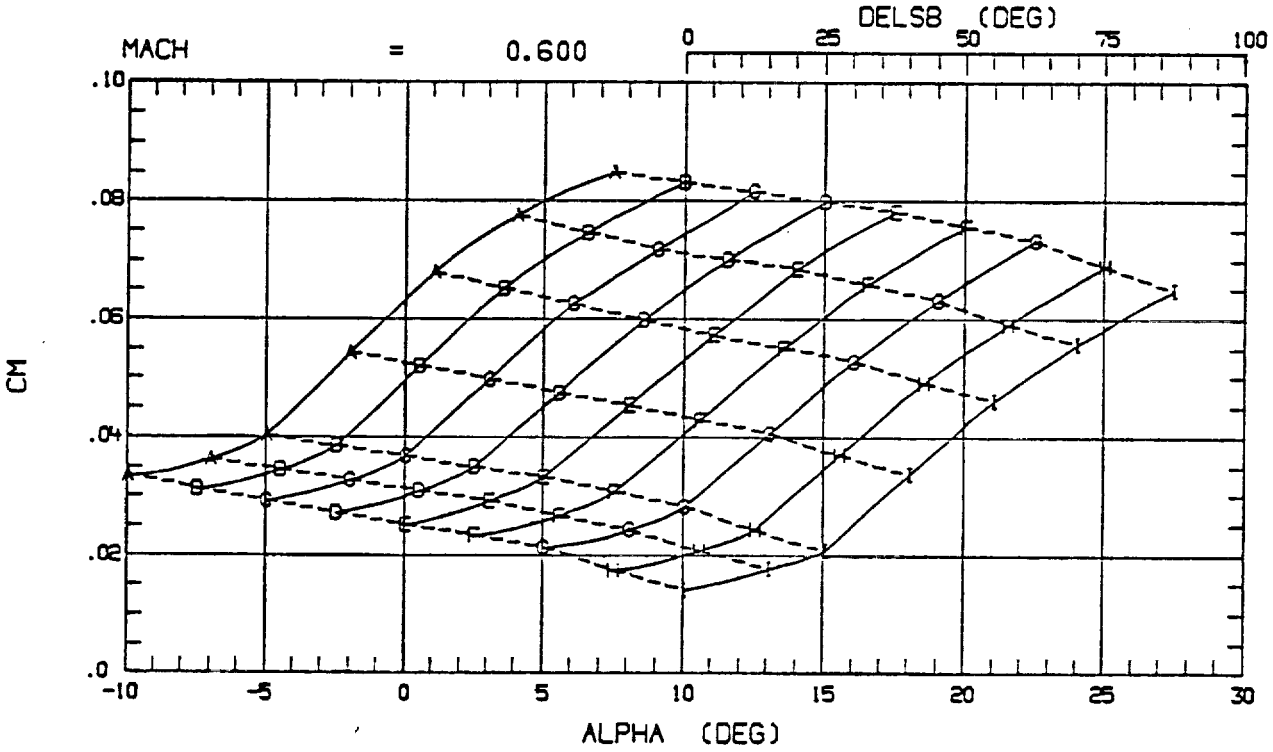


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.01630	0.01430	0.01230	0.01290	0.01230	0.00630	-0.00170	0.00030	0.00230
15.000	0.02100	0.01900	0.01700	0.01750	0.01700	0.01100	0.00300	0.00500	0.00700
25.000	0.02500	0.02400	0.02200	0.02250	0.02200	0.01600	0.00800	0.01000	0.01200
40.000	0.03463	0.03211	0.02960	0.02987	0.02914	0.02299	0.01485	0.01678	0.01870
55.000	0.04570	0.04300	0.04030	0.04017	0.03904	0.03252	0.02400	0.02630	0.02960
70.000	0.05735	0.05503	0.05270	0.05257	0.05165	0.04512	0.03660	0.03860	0.04060
87.200	0.06875	0.06637	0.06400	0.06439	0.06378	0.05779	0.04990	0.05190	0.05400

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-4
BASIC PITCHING MOMENT COEFFICIENT

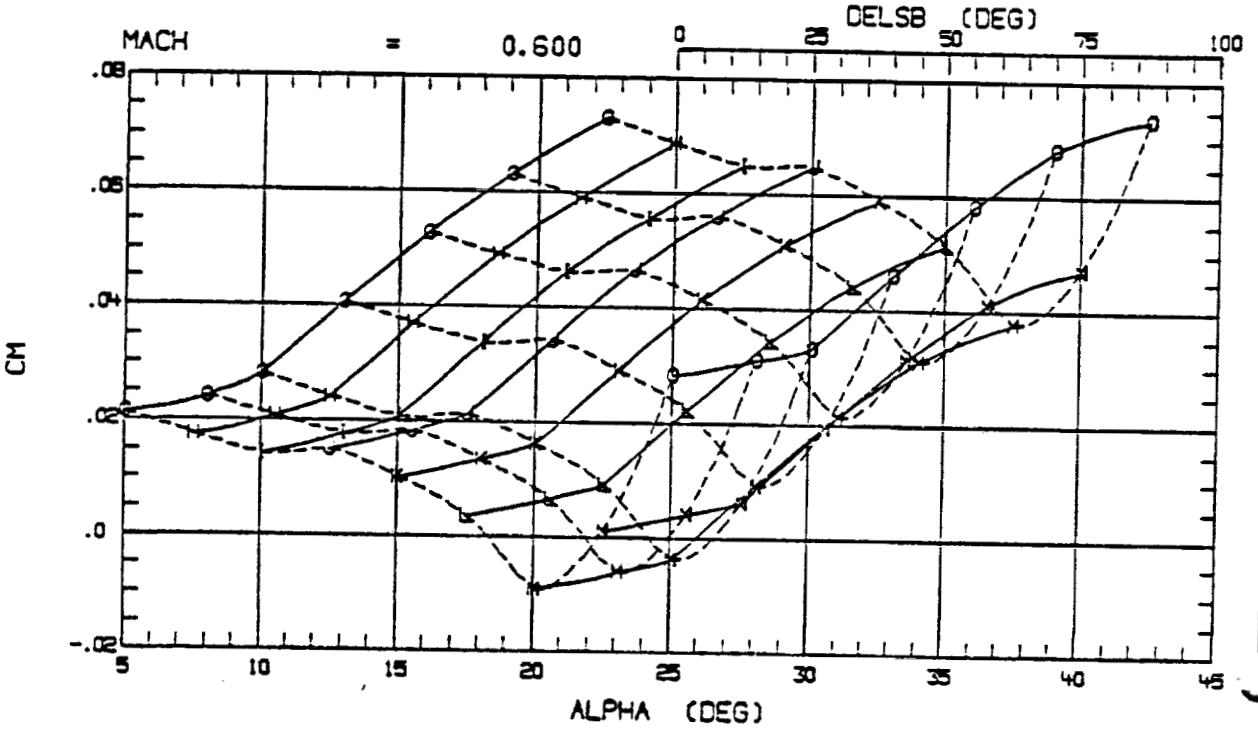


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I.
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.03314	0.03109	0.02904	0.02694	0.02494	0.02304	0.02114	0.01729	0.01393
15.000	0.03603	0.03427	0.03250	0.03069	0.02897	0.02648	0.02400	0.02050	0.01750
25.000	0.04000	0.03825	0.03650	0.03470	0.03300	0.03050	0.02500	0.02400	0.02050
40.000	0.05407	0.05184	0.04960	0.04731	0.04513	0.04276	0.04040	0.03676	0.03362
55.000	0.06776	0.06507	0.06239	0.05965	0.05702	0.05423	0.05265	0.04906	0.04537
70.000	0.07750	0.07449	0.07149	0.06983	0.06629	0.06584	0.06300	0.05900	0.05550
87.200	0.08470	0.08302	0.08135	0.07962	0.07800	0.07550	0.07300	0.06866	0.06483

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-5
BASIC PITCHING MOMENT COEFFICIENT

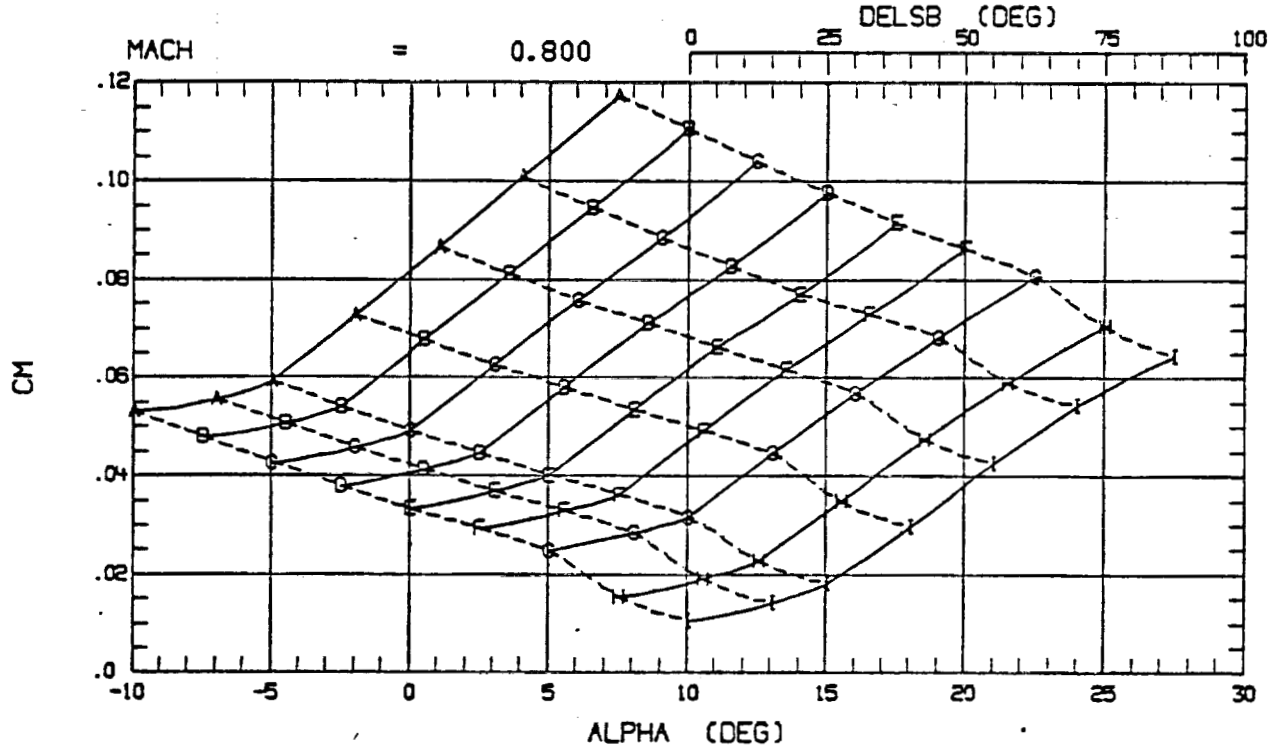


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.02114	0.01729	0.01353	0.01473	0.01003	0.00333	-0.00937	0.00093	0.02923
15.000	0.02400	0.02050	0.01750	0.01915	0.01330	0.00645	-0.00640	0.00375	0.03090
25.000	0.02900	0.02400	0.02050	0.02100	0.01600	0.00900	-0.00400	0.00600	0.03300
40.000	0.04040	0.03678	0.03362	0.03410	0.02907	0.02205	0.00904	0.01902	0.04600
55.000	0.05265	0.04905	0.04597	0.04941	0.04135	0.03429	0.02123	0.03117	0.05811
70.000	0.06300	0.05900	0.05550	0.05600	0.05100	0.04400	0.03100	0.04100	0.06600
87.200	0.07300	0.06866	0.06483	0.06466	0.05900	0.05133	0.03767	0.04700	0.07334

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-6
BASIC PITCHING MOMENT COEFFICIENT



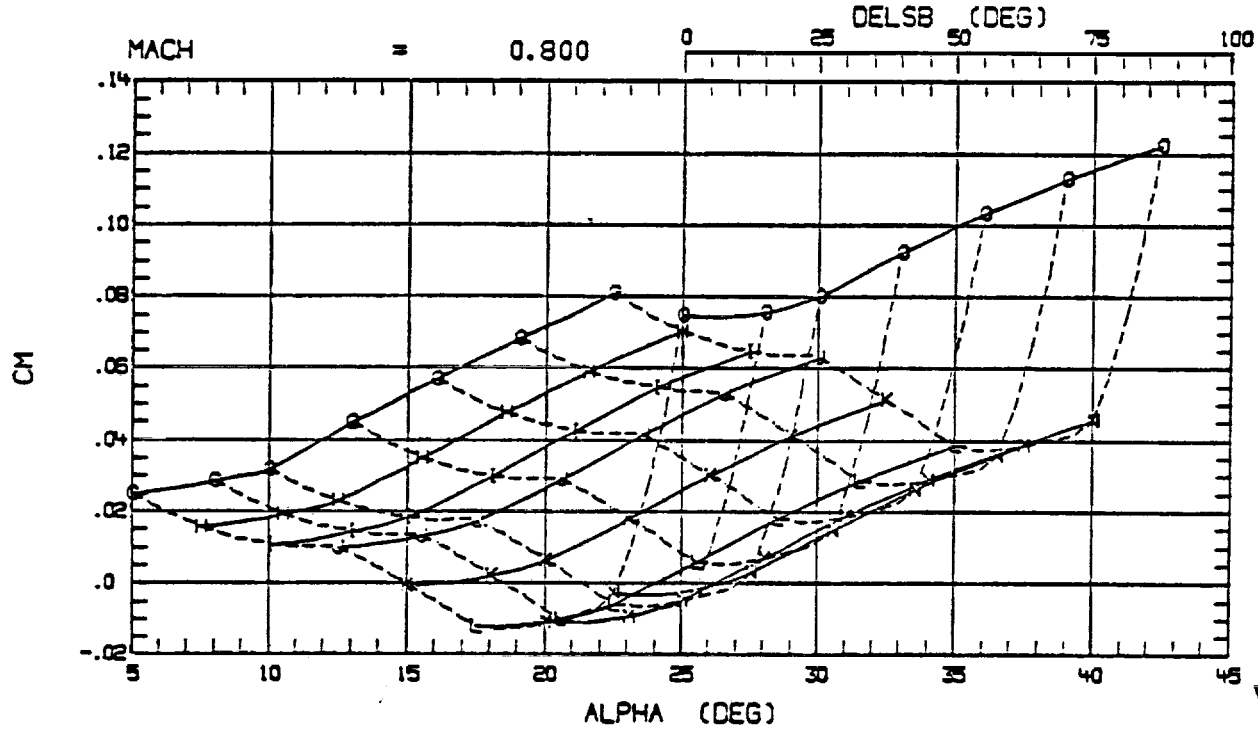
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.05288	0.04768	0.04247	0.03777	0.03306	0.02916	0.02475	0.01528	0.01030
15.000	0.05545	0.05052	0.04560	0.04118	0.03675	0.03278	0.02932	0.01888	0.01394
25.000	0.05900	0.05400	0.04900	0.04450	0.04000	0.03600	0.03150	0.02250	0.01800
40.000	0.07255	0.06749	0.06243	0.05788	0.05332	0.04913	0.04443	0.03474	0.02954
55.000	0.08639	0.08103	0.07568	0.07082	0.06597	0.06159	0.05671	0.04726	0.04231
70.000	0.10067	0.09445	0.08824	0.08252	0.07681	0.07267	0.06803	0.05886	0.05419
87.200	0.11718	0.11045	0.10373	0.09750	0.09128	0.08616	0.08054	0.07021	0.06439

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-7
BASIC PITCHING MOMENT COEFFICIENT

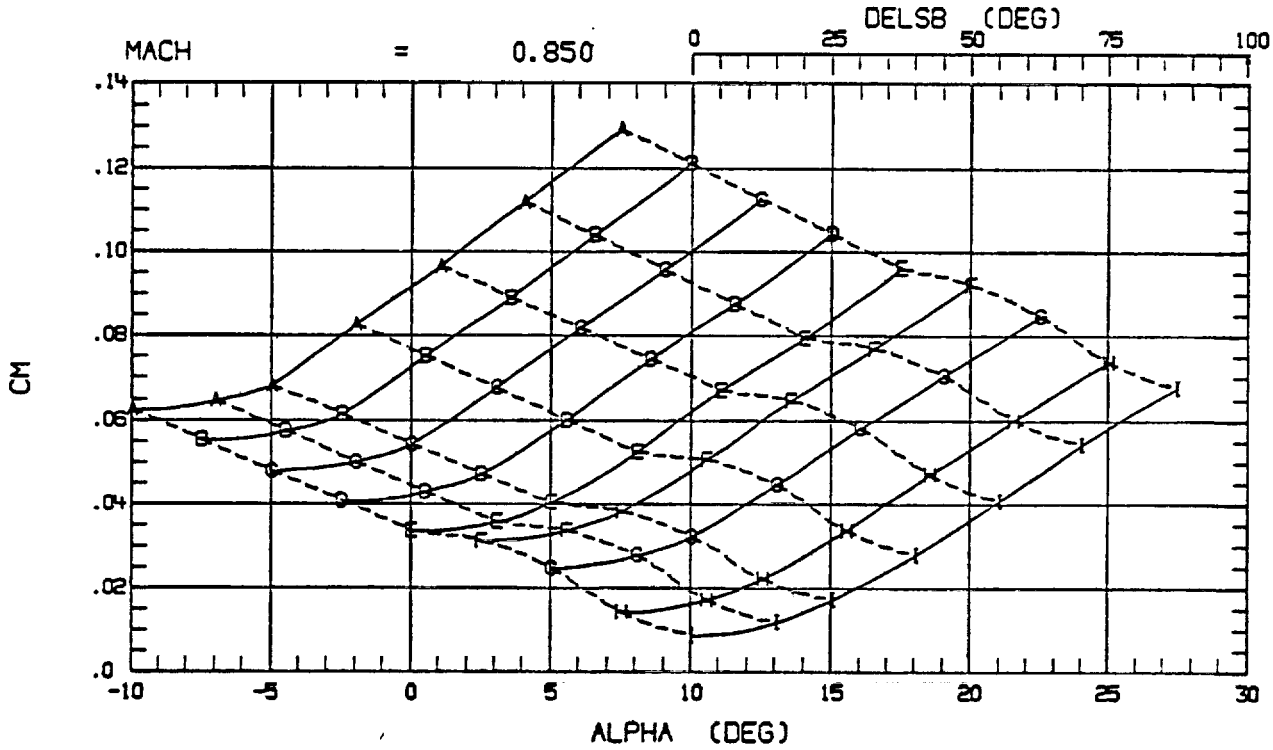


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.02475	0.01528	0.01030	0.00971	-0.00098	-0.01247	-0.01106	-0.00305	0.07476
15.000	0.02932	0.01888	0.01394	0.01286	0.00177	-0.01032	-0.00940	-0.00189	0.07543
25.000	0.03150	0.02250	0.01600	0.01700	0.00600	-0.00600	-0.00500	0.00250	0.08000
40.000	0.04443	0.03474	0.02954	0.02962	0.01770	0.00377	0.00625	0.01452	0.09200
55.000	0.05571	0.04726	0.04231	0.04112	0.02952	0.01772	0.01853	0.02593	0.10314
70.000	0.06803	0.05886	0.05419	0.05250	0.04100	0.02940	0.02981	0.03582	0.11252
87.200	0.08054	0.07021	0.06439	0.06259	0.05100	0.03830	0.03861	0.04551	0.12222

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-6
BASIC PITCHING MOMENT COEFFICIENT

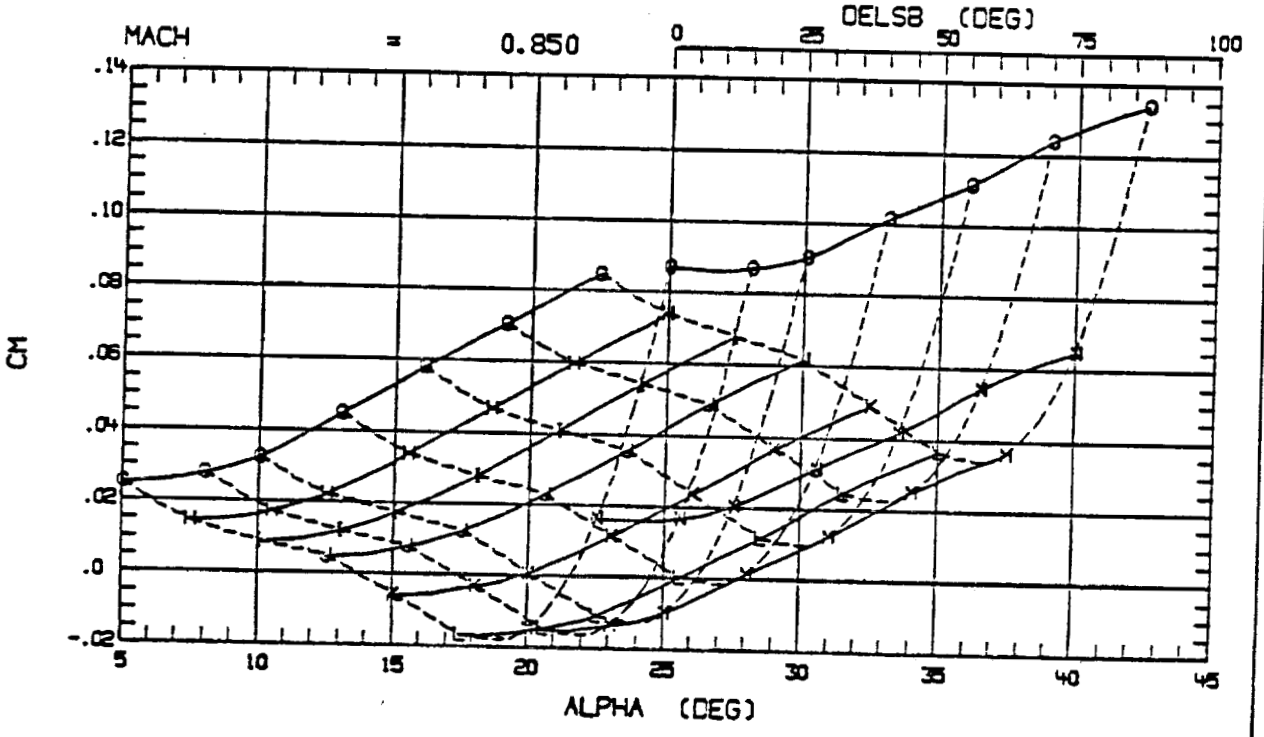


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.06206	0.05491	0.04775	0.04059	0.03344	0.03101	0.02457	0.01404	0.00850
15.000	0.06427	0.05709	0.04990	0.04271	0.03553	0.03354	0.02756	0.01711	0.01167
25.000	0.06600	0.06100	0.05400	0.04700	0.04000	0.03800	0.03200	0.02200	0.01700
40.000	0.08257	0.07497	0.06737	0.05977	0.05217	0.05030	0.04443	0.03354	0.02765
55.000	0.09629	0.08896	0.08163	0.07430	0.06697	0.06439	0.05781	0.04673	0.04085
70.000	0.11171	0.10362	0.09553	0.08744	0.07935	0.07681	0.07026	0.05968	0.05410
87.200	0.12909	0.12077	0.11246	0.10415	0.09583	0.09218	0.08452	0.07361	0.06769

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-9
BASIC PITCHING MOMENT COEFFICIENT



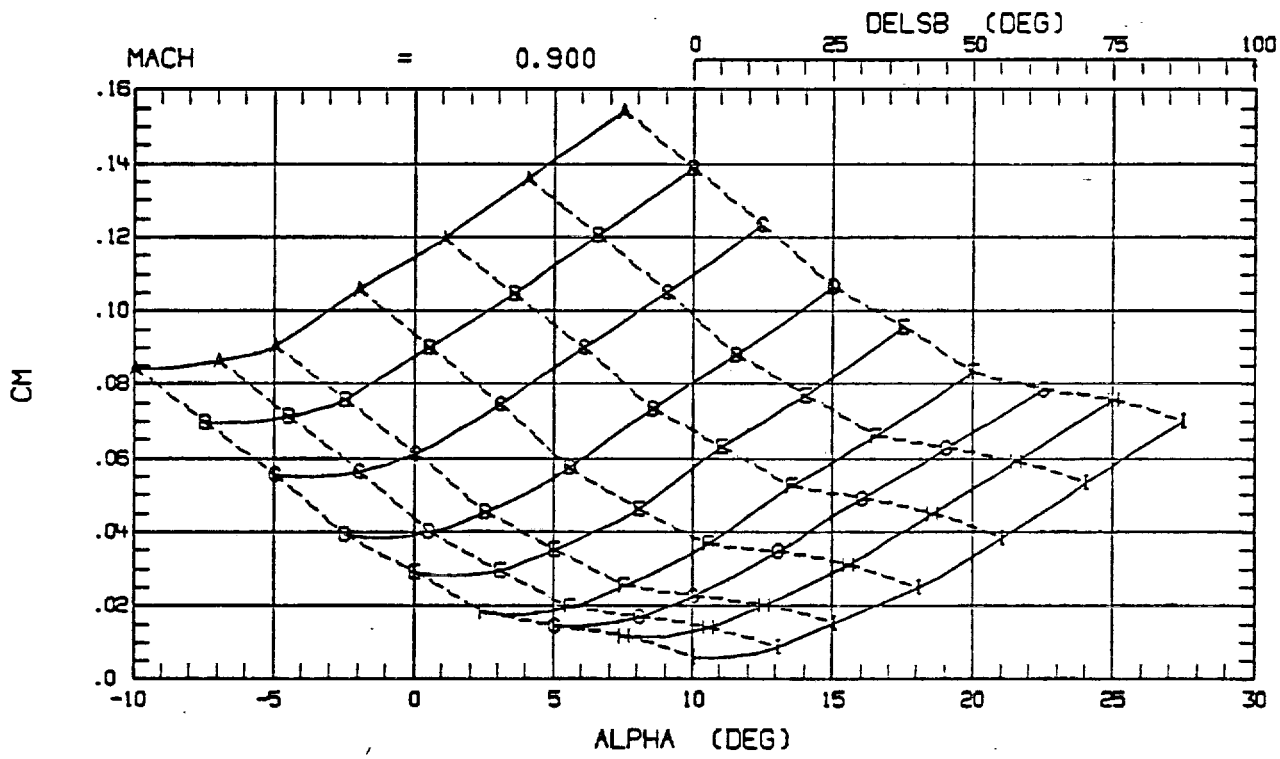
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.02457	0.01404	0.00250	0.00441	-0.00618	-0.01678	-0.01437	0.01604	0.08694
15.000	0.02756	0.01711	0.01167	0.00742	-0.00332	-0.01476	-0.01370	0.01851	0.09671
25.000	0.03200	0.02200	0.01700	0.01200	0.00050	-0.01100	-0.01000	0.02000	0.09000
40.000	0.04443	0.03354	0.02785	0.02277	0.01140	0.00002	0.00114	0.03127	0.10139
55.000	0.05781	0.04673	0.04085	0.03524	0.02334	0.01144	0.01203	0.04162	0.11122
70.000	0.07026	0.05968	0.05410	0.04654	0.03850	0.02445	0.02489	0.05435	0.12379
87.200	0.08452	0.07361	0.06789	0.06156	0.04993	0.03630	0.03616	0.06503	0.13390

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-10
BASIC PITCHING MOMENT COEFFICIENT

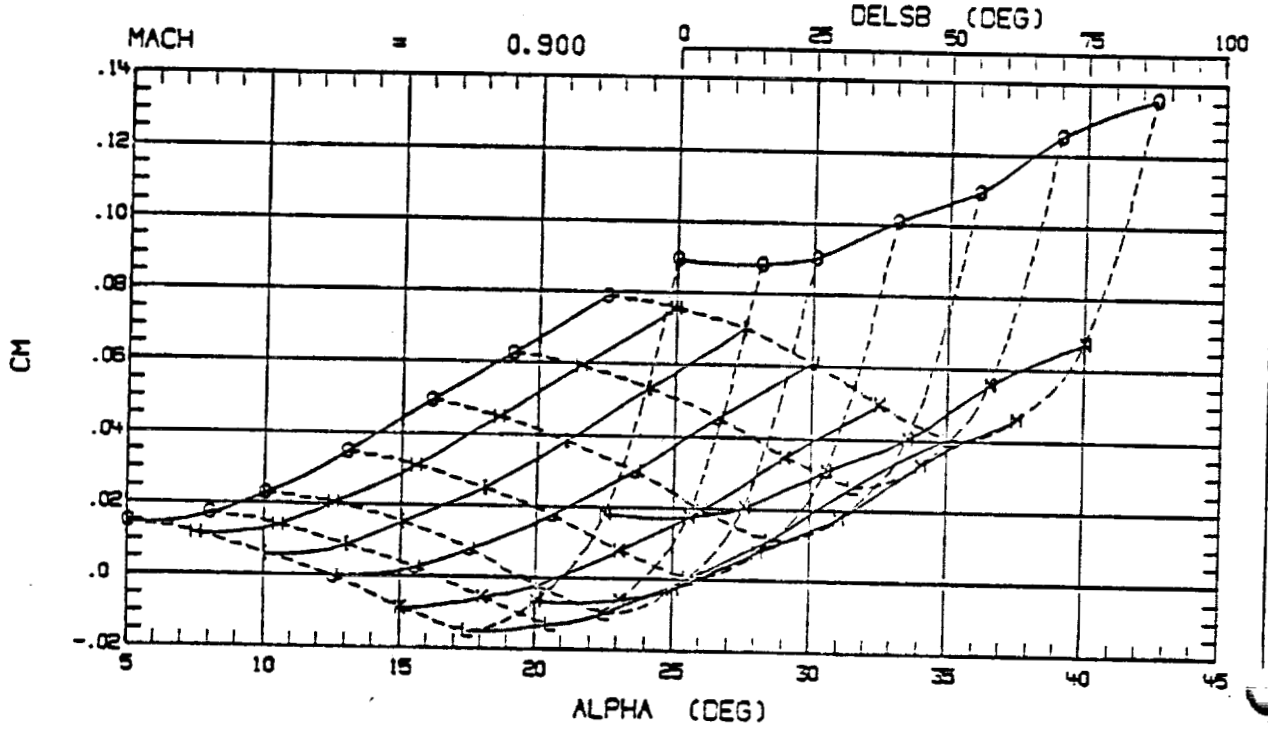


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.08424	0.06963	0.05503	0.03893	0.02982	0.01785	0.01439	0.01129	0.00570
15.000	0.08610	0.07115	0.05620	0.03975	0.02930	0.01929	0.01679	0.01385	0.00840
25.000	0.09000	0.07550	0.06100	0.04500	0.03500	0.02500	0.02250	0.02000	0.01500
40.000	0.10558	0.08994	0.07430	0.05716	0.04601	0.03647	0.03442	0.03083	0.02475
55.000	0.11919	0.10438	0.08958	0.07327	0.06297	0.05219	0.04891	0.04470	0.03799
70.000	0.13576	0.12029	0.10483	0.08786	0.07690	0.06595	0.06250	0.05900	0.05300
87.200	0.15399	0.13659	0.12319	0.10529	0.09539	0.08319	0.07950	0.07550	0.07000

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-11
BASIC PITCHING MOMENT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1076.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

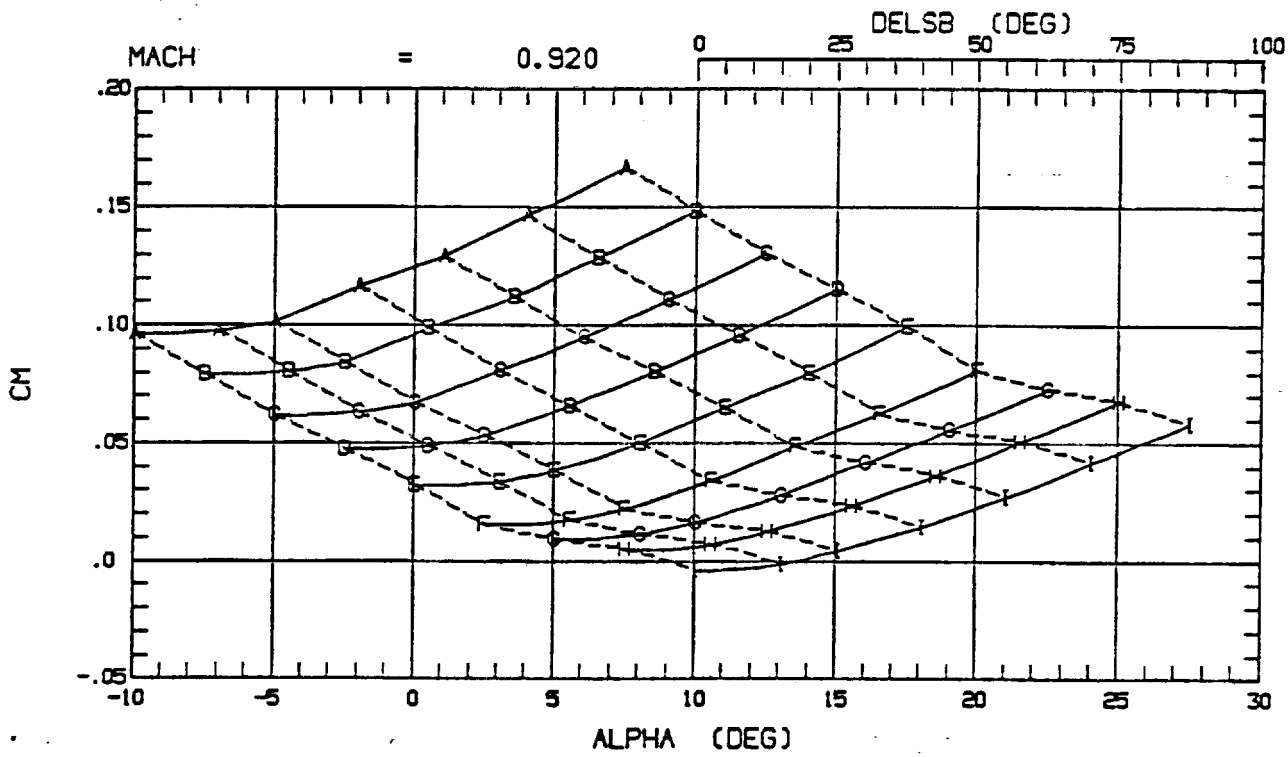
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.057 FT.
M.A.C. CW = 39.568 FT.
BODY LENGTH LB = 1290.3 IN.

DELSB (DEG)	ALPHA (DEG) 5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
	PITCHING MOMENT COEFFICIENT								
0.0	0.01439	0.01129	0.00570	-0.00039	-0.00895	-0.01508	-0.00668	0.01772	0.06913
15.000	0.01679	0.01325	0.00840	0.00250	-0.00591	-0.01320	-0.00500	0.01750	0.03800
25.000	0.02250	0.02000	0.01500	0.00750	-0.00250	-0.01000	-0.00300	0.02000	0.03000
40.000	0.03442	0.03083	0.02475	0.01742	0.00760	0.00027	0.00744	0.03061	0.10079
55.000	0.04891	0.04470	0.03799	0.02987	0.01926	0.01115	0.01753	0.03991	0.10930
70.000	0.06250	0.05900	0.05300	0.04499	0.03449	0.02549	0.03298	0.05547	0.12497
97.200	0.07850	0.07550	0.07000	0.06093	0.04936	0.04029	0.04572	0.05715	0.13558

ENGINEER _____
DATE _____

FIGURE 4.1.1.3-12
BASIC PITCHING MOMENT COEFFICIENT

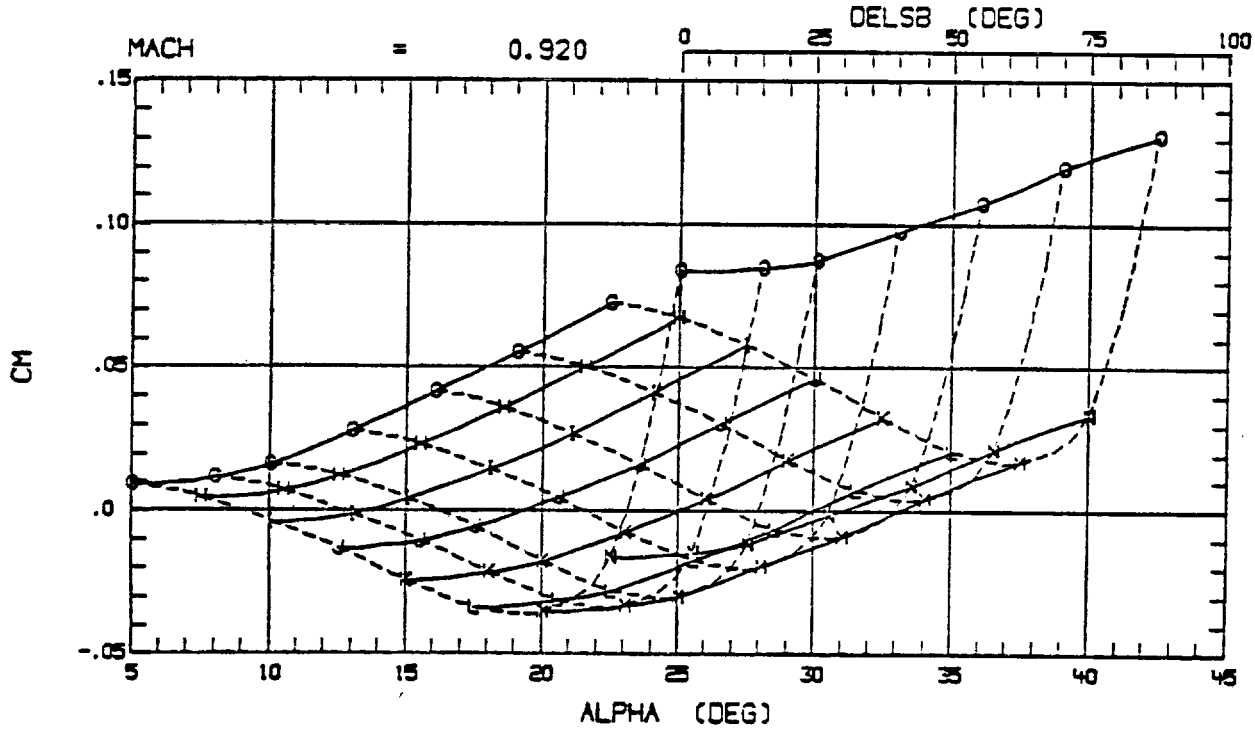


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.09574	0.07858	0.06142	0.04726	0.03209	0.01541	0.00873	0.00429	-0.00418
15.000	0.09746	0.08019	0.06292	0.04665	0.03338	0.01729	0.01117	0.00574	-0.00170
25.000	0.10100	0.08400	0.06700	0.05300	0.03800	0.02200	0.01600	0.01200	0.00400
40.000	0.11636	0.09841	0.08045	0.06550	0.04954	0.03358	0.02761	0.02294	0.01426
55.000	0.12904	0.11173	0.09441	0.08010	0.06478	0.04606	0.04135	0.03597	0.02669
70.000	0.14643	0.12846	0.11049	0.09651	0.07954	0.06230	0.05506	0.05007	0.04108
87.200	0.16631	0.14824	0.13017	0.11510	0.09903	0.08072	0.07240	0.06709	0.05779

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-13
BASIC PITCHING MOMENT COEFFICIENT

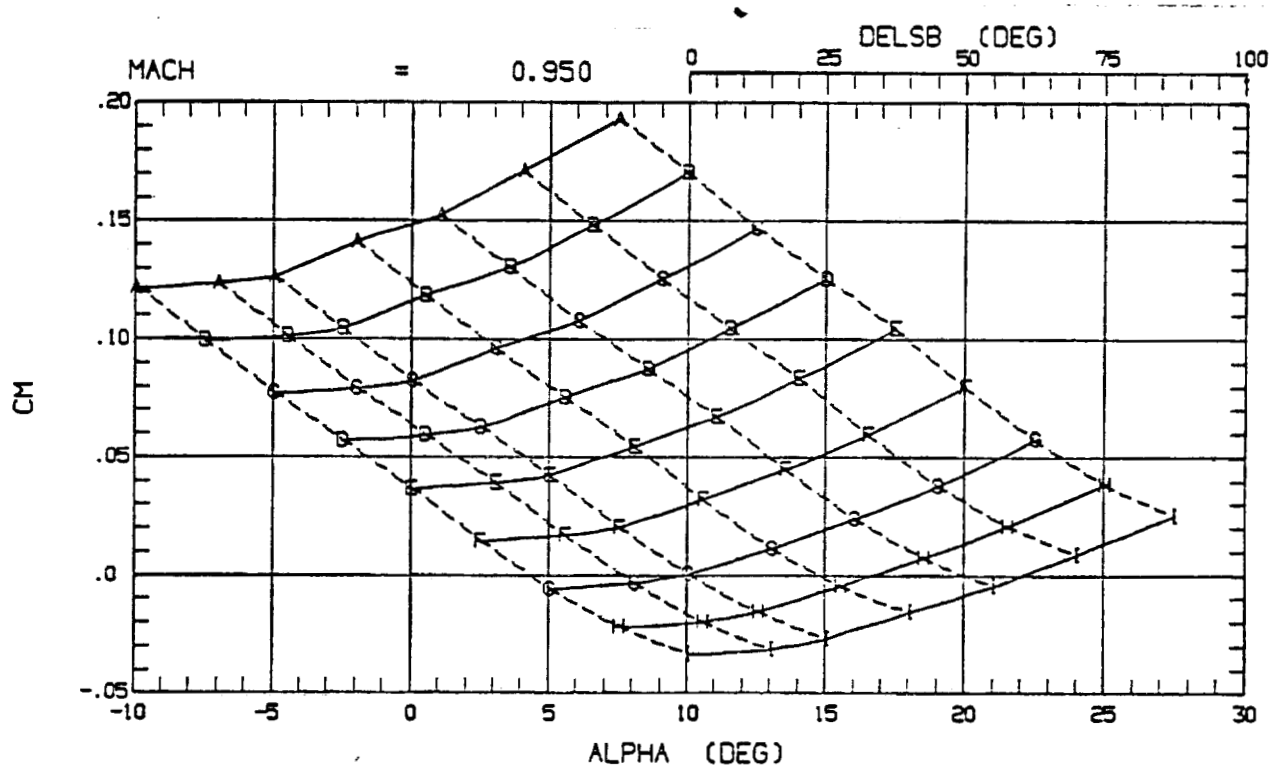


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.00873	0.00429	-0.00418	-0.01344	-0.02469	-0.03395	-0.03621	-0.01647	0.09329
15.000	0.01117	0.00674	-0.00170	-0.01067	-0.02165	-0.03145	-0.03326	-0.01490	0.08447
25.000	0.01600	0.01200	0.00400	-0.00600	-0.01800	-0.02900	-0.03000	-0.01200	0.08700
40.000	0.02761	0.02294	0.01426	0.00429	-0.00771	-0.01789	-0.01966	-0.00166	0.09735
55.000	0.04135	0.03597	0.02669	0.01614	0.00369	-0.00676	-0.00920	0.00635	0.10690
70.000	0.05506	0.05007	0.04108	0.03030	0.01753	0.00676	0.00399	0.02122	0.11945
87.200	0.07240	0.06709	0.05779	0.04612	0.03246	0.02080	0.01713	0.03347	0.13080

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-14
BASIC PITCHING MOMENT COEFFICIENT



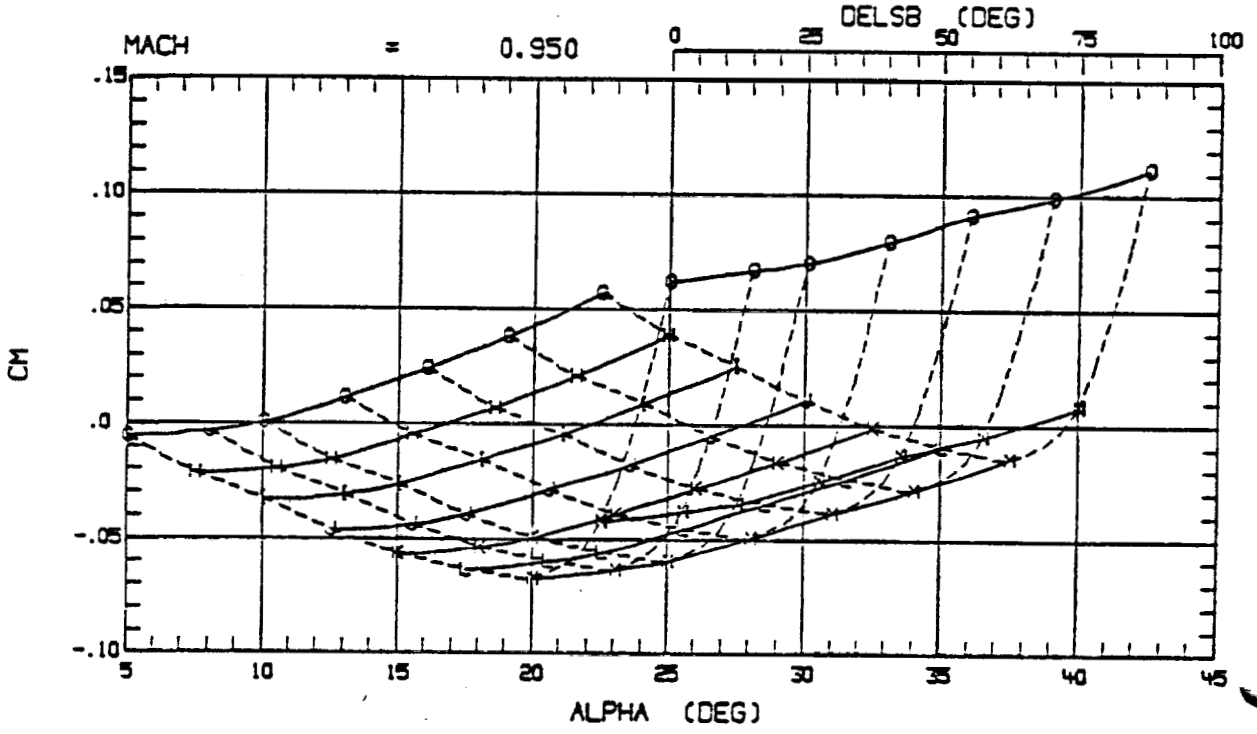
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I.
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.12150	0.09925	0.07700	0.05675	0.03650	0.01425	-0.00600	-0.02225	-0.03350
15.000	0.12300	0.10100	0.07900	0.05900	0.03900	0.01675	-0.00350	-0.01992	-0.03134
25.000	0.12500	0.10400	0.08200	0.06200	0.04200	0.02000	0.0	-0.01600	-0.02700
40.000	0.14102	0.11835	0.09568	0.07500	0.05433	0.03174	0.01114	-0.00491	-0.01597
55.000	0.15232	0.12999	0.10766	0.08733	0.06700	0.04437	0.02375	0.00686	-0.00502
70.000	0.17094	0.14795	0.12497	0.10398	0.08300	0.05933	0.03766	0.02067	0.00869
87.200	0.19330	0.16997	0.14665	0.12532	0.10400	0.07950	0.05700	0.03849	0.02497

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-15
BASIC PITCHING MOMENT COEFFICIENT



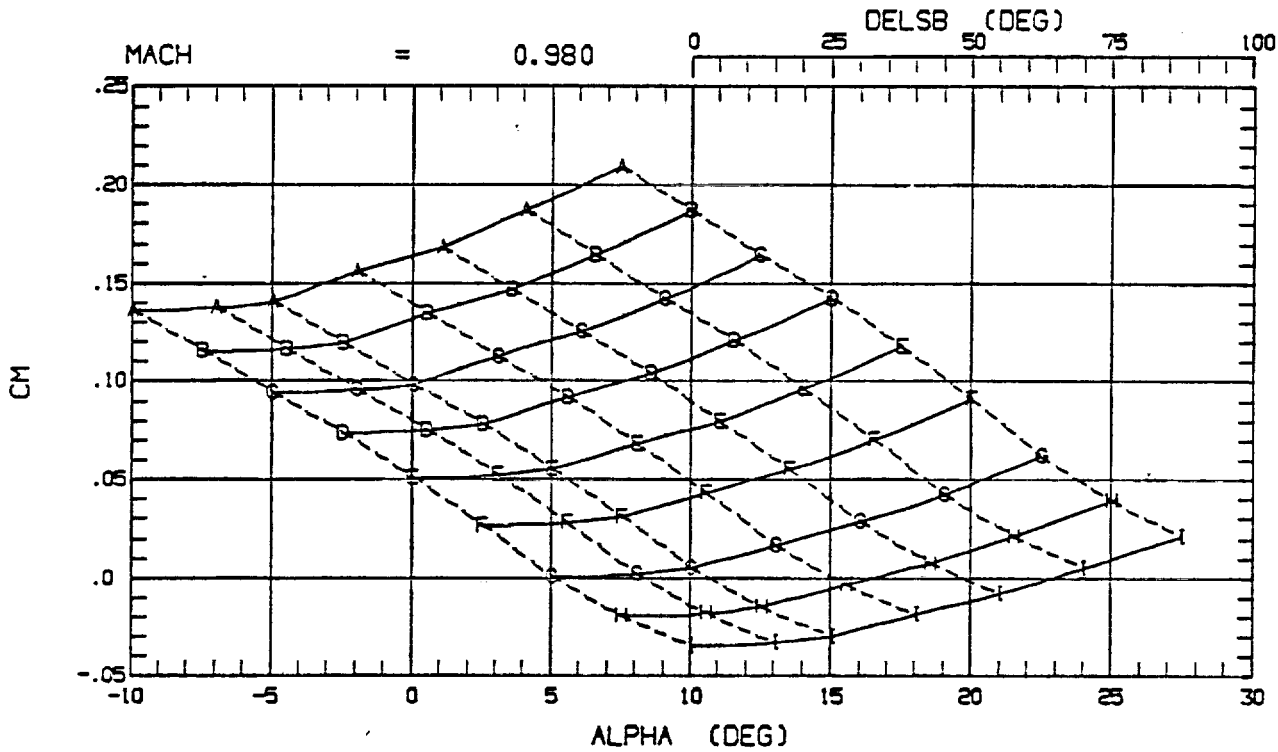
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.00600	-0.02225	-0.03350	-0.04675	-0.05700	-0.06375	-0.06750	-0.04275	0.06200
15.000	-0.00350	-0.01952	-0.03134	-0.04417	-0.05400	-0.06033	-0.06366	-0.03849	0.06668
25.000	0.0	-0.01600	-0.02700	-0.04000	-0.05000	-0.05250	-0.06000	-0.03500	0.07000
40.000	0.01114	-0.00491	-0.01597	-0.02919	-0.03942	-0.04613	-0.04985	-0.02507	0.07971
55.000	0.02375	0.00686	-0.00502	-0.01822	-0.02941	-0.03511	-0.03880	-0.01399	0.09081
70.000	0.03766	0.02067	0.00869	-0.00548	-0.01685	-0.02432	-0.02999	-0.00516	0.09667
97.200	0.05700	0.03849	0.02497	0.01017	-0.00164	-0.00994	-0.01525	0.00795	0.11114

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-16
BASIC PITCHING MOMENT COEFFICIENT



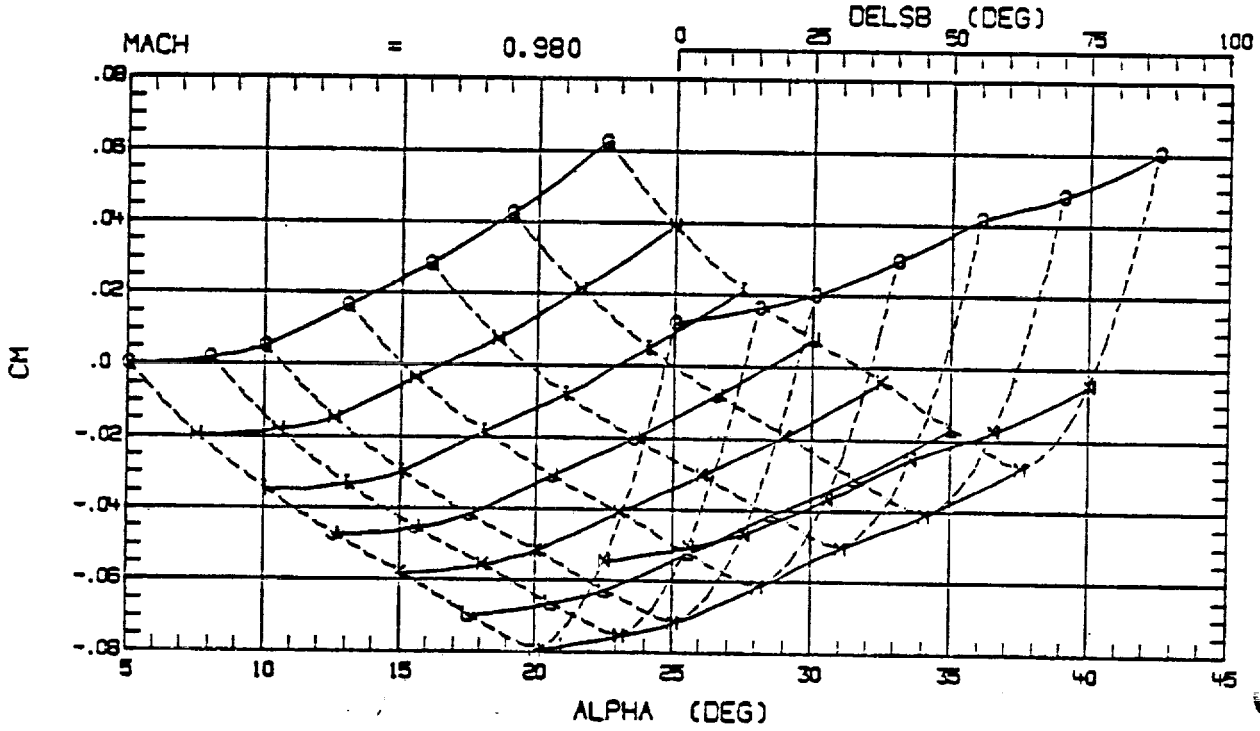
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.13614	0.11487	0.09361	0.07340	0.05019	0.02517	0.00015	-0.01989	-0.03494
15.000	0.13899	0.11608	0.09517	0.07519	0.05220	0.02793	0.00166	-0.01840	-0.03347
25.000	0.14000	0.11900	0.09800	0.07800	0.05500	0.03100	0.00500	-0.01500	-0.03000
40.000	0.15571	0.13410	0.11248	0.09168	0.06788	0.04308	0.01627	-0.00372	-0.01872
55.000	0.16807	0.14674	0.12541	0.10402	0.07963	0.05485	0.02909	0.00739	-0.00831
70.000	0.18676	0.16417	0.14159	0.12031	0.09603	0.07011	0.04220	0.02106	0.00493
87.200	0.20919	0.18650	0.16382	0.14214	0.11746	0.09085	0.06225	0.03909	0.02094

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-17
BASIC PITCHING MOMENT COEFFICIENT



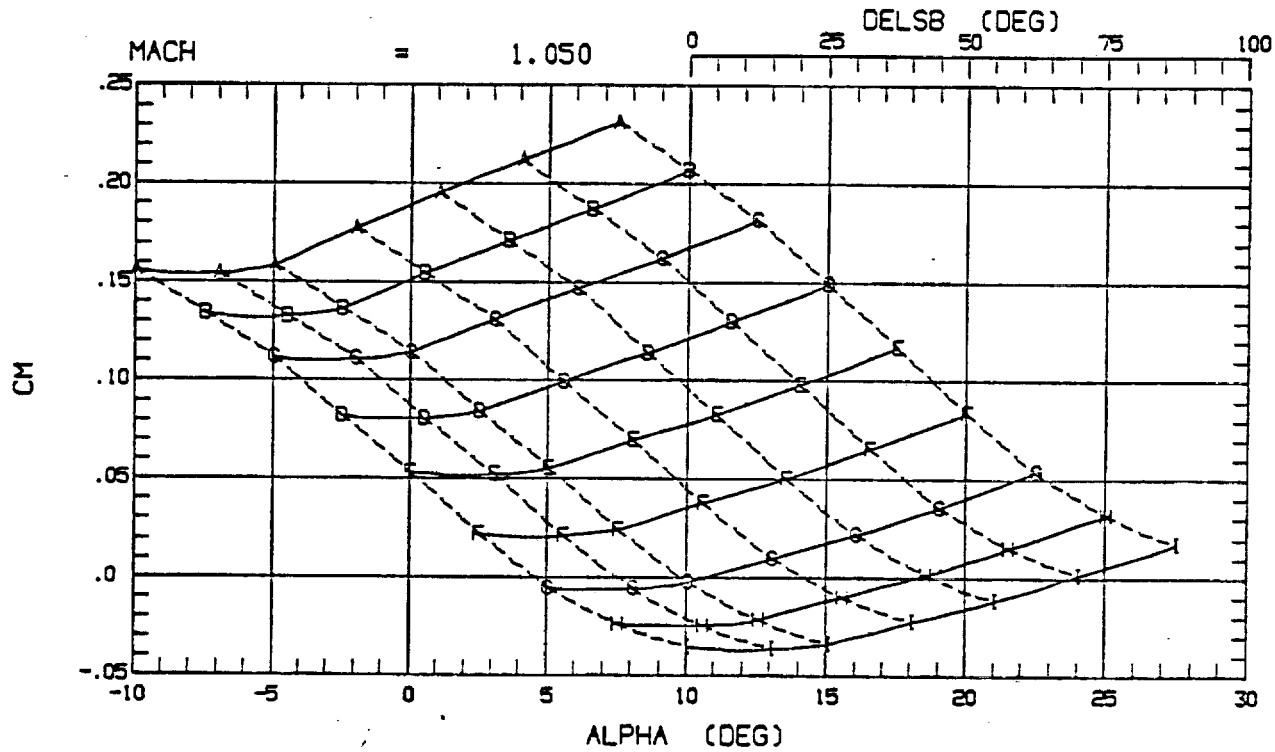
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.00015	-0.01989	-0.03494	-0.04770	-0.05846	-0.06994	-0.07941	-0.05472	0.01197
15.000	0.00166	-0.01840	-0.03347	-0.04567	-0.05588	-0.06673	-0.07559	-0.05062	0.01634
25.000	0.00500	-0.01500	-0.03000	-0.04200	-0.05200	-0.06300	-0.07200	-0.04700	0.02000
40.000	0.01627	-0.00372	-0.01872	-0.03096	-0.04121	-0.05253	-0.06186	-0.03715	0.02955
55.000	0.02909	0.00739	-0.00831	-0.02038	-0.03042	-0.04151	-0.05059	-0.02564	0.04132
70.000	0.04220	0.02106	0.00493	-0.00818	-0.01929	-0.03129	-0.04129	-0.01771	0.04787
87.200	0.05225	0.03909	0.02094	0.00753	-0.00387	-0.01698	-0.02908	-0.00499	0.05003

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-18
BASIC PITCHING MOMENT COEFFICIENT



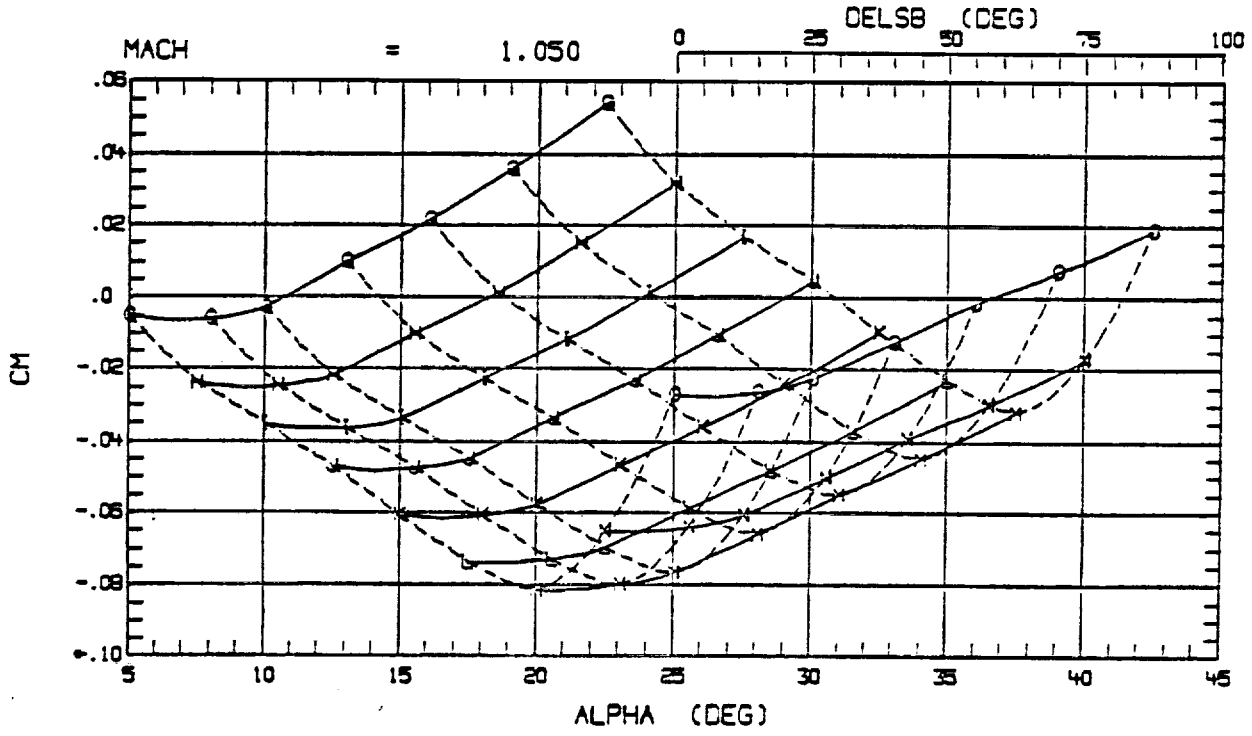
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.15529	0.13322	0.11115	0.08145	0.05275	0.02184	-0.00547	-0.02400	-0.03554
15.000	0.15377	0.13202	0.11029	0.08055	0.05183	0.02083	-0.00617	-0.02483	-0.03650
25.000	0.15800	0.13600	0.11400	0.08400	0.05500	0.02400	-0.00300	-0.02200	-0.03400
40.000	0.17891	0.15380	0.13068	0.09948	0.06927	0.03747	0.00967	-0.01007	-0.02291
55.000	0.19491	0.17076	0.14662	0.11402	0.08242	0.04984	0.02127	0.00112	-0.01203
70.000	0.21159	0.18676	0.16194	0.12936	0.09778	0.06470	0.03562	0.01478	0.00094
87.200	0.23118	0.20635	0.18153	0.14871	0.11690	0.08331	0.05372	0.03170	0.01668

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-19
BASIC PITCHING MOMENT COEFFICIENT



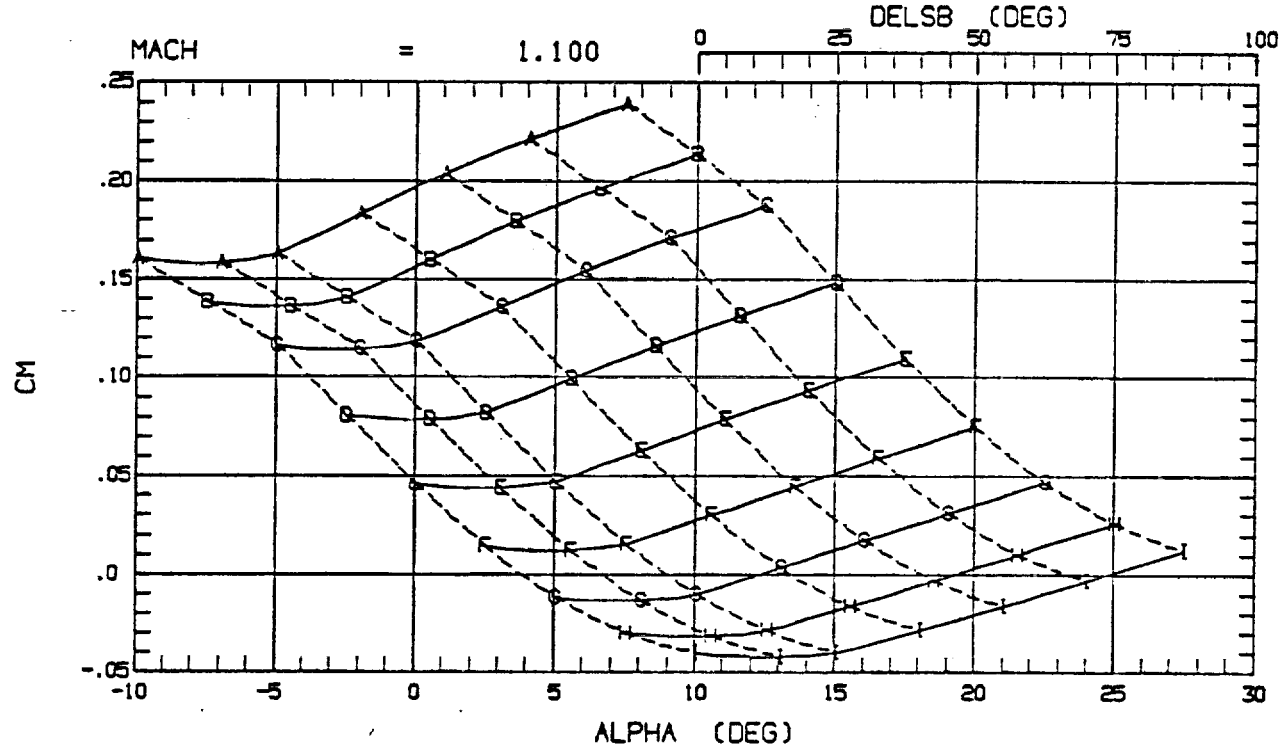
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1078.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.568 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.00547	-0.02400	-0.03554	-0.04736	-0.06119	-0.07328	-0.08158	-0.08543	-0.02729
15.000	-0.00617	-0.02493	-0.03650	-0.04775	-0.06099	-0.07311	-0.08024	-0.08443	-0.02662
25.000	-0.00300	-0.02200	-0.03400	-0.04500	-0.05800	-0.07000	-0.07700	-0.08100	-0.02300
40.000	0.00967	-0.01007	-0.02291	-0.03398	-0.04634	-0.05914	-0.06634	-0.07044	-0.01253
55.000	0.02127	0.00112	-0.01203	-0.02311	-0.03619	-0.04834	-0.05549	-0.03966	-0.00163
70.000	0.03562	0.01478	0.00094	-0.01084	-0.02461	-0.03734	-0.04507	-0.03001	0.00705
97.200	0.05372	0.03170	0.01668	0.00445	-0.00973	-0.02340	-0.03203	-0.01773	0.01952

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-20
BASIC PITCHING MOMENT COEFFICIENT

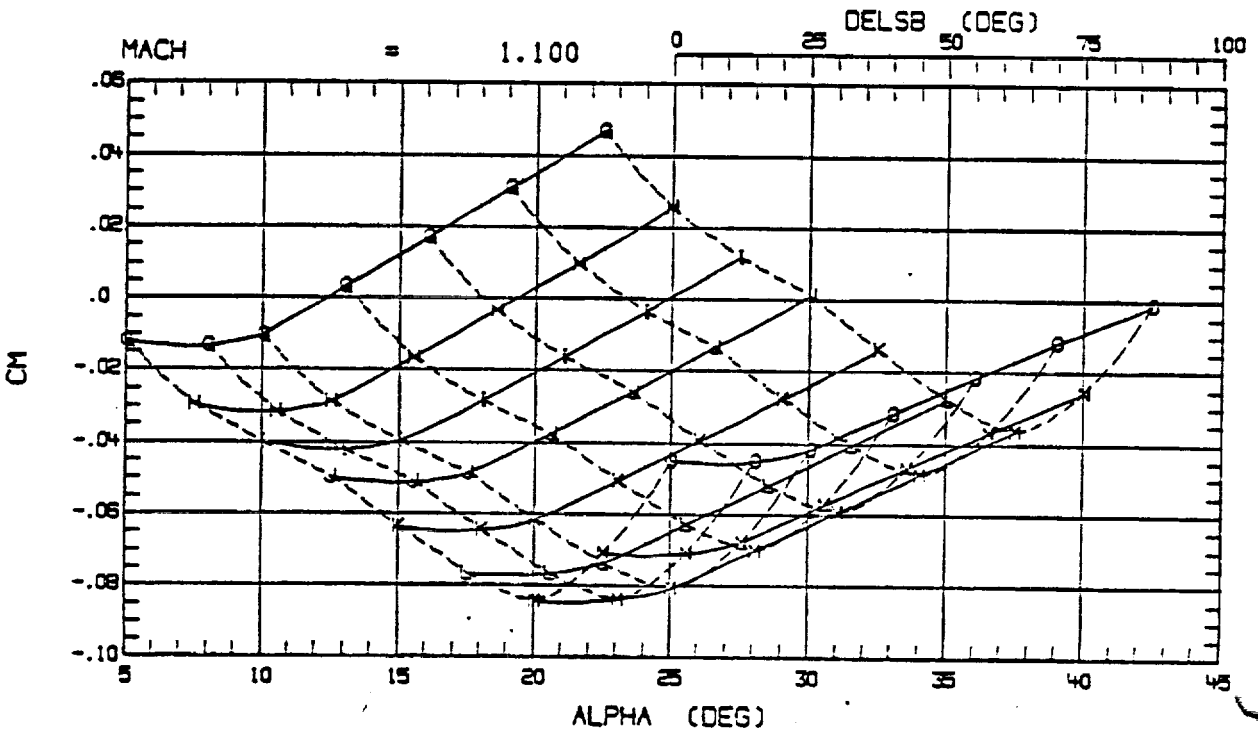


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-7.500	-5.000	-2.500	0.0	2.500	5.000	7.500	10.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.15994	0.13800	0.11616	0.08057	0.04598	0.01365	-0.01218	-0.02993	-0.04019
15.000	0.15797	0.13606	0.11416	0.07850	0.04385	0.01193	-0.01348	-0.03159	-0.04221
25.000	0.16250	0.14025	0.11800	0.08200	0.04700	0.01500	-0.01050	-0.02900	-0.04000
40.000	0.18303	0.15956	0.13609	0.09887	0.06265	0.02963	0.00311	-0.01655	-0.02971
55.000	0.20382	0.17909	0.15437	0.11589	0.07842	0.04439	0.01685	-0.00350	-0.01634
70.000	0.22132	0.19592	0.17053	0.13138	0.09324	0.05868	0.03062	0.00977	-0.00358
87.200	0.23880	0.21310	0.18740	0.14795	0.10950	0.07475	0.04650	0.02540	0.01180

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-21
BASIC PITCHING MOMENT COEFFICIENT

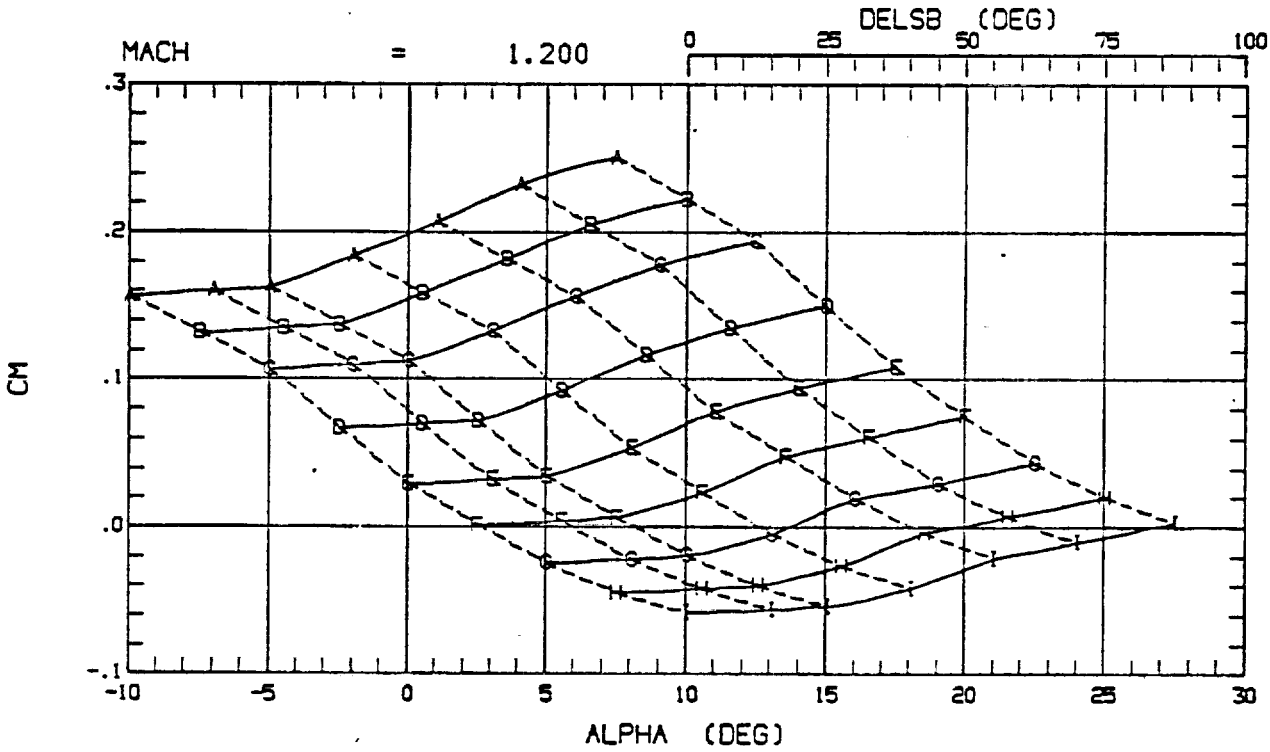


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.588 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01218	-0.02993	-0.04019	-0.05003	-0.06367	-0.07871	-0.08455	-0.07127	-0.04500
15.000	-0.01348	-0.03159	-0.04221	-0.05140	-0.06459	-0.07678	-0.08398	-0.07117	-0.04537
25.000	-0.01050	-0.02900	-0.04000	-0.04900	-0.06200	-0.07400	-0.08100	-0.06800	-0.04200
40.000	0.00311	-0.01655	-0.02971	-0.03785	-0.05100	-0.06314	-0.07029	-0.05744	-0.03158
55.000	0.01695	-0.00350	-0.01634	-0.02589	-0.03945	-0.05201	-0.05956	-0.04712	-0.02167
70.000	0.03062	0.00977	-0.00358	-0.01365	-0.02773	-0.04080	-0.04887	-0.03694	-0.01201
87.200	0.04650	0.02540	0.01190	0.00094	-0.01392	-0.02778	-0.03664	-0.02550	-0.00136

ENGINEER _____
DATE _____

FIGURE 4.1.1.3-22
BASIC PITCHING MOMENT COEFFICIENT



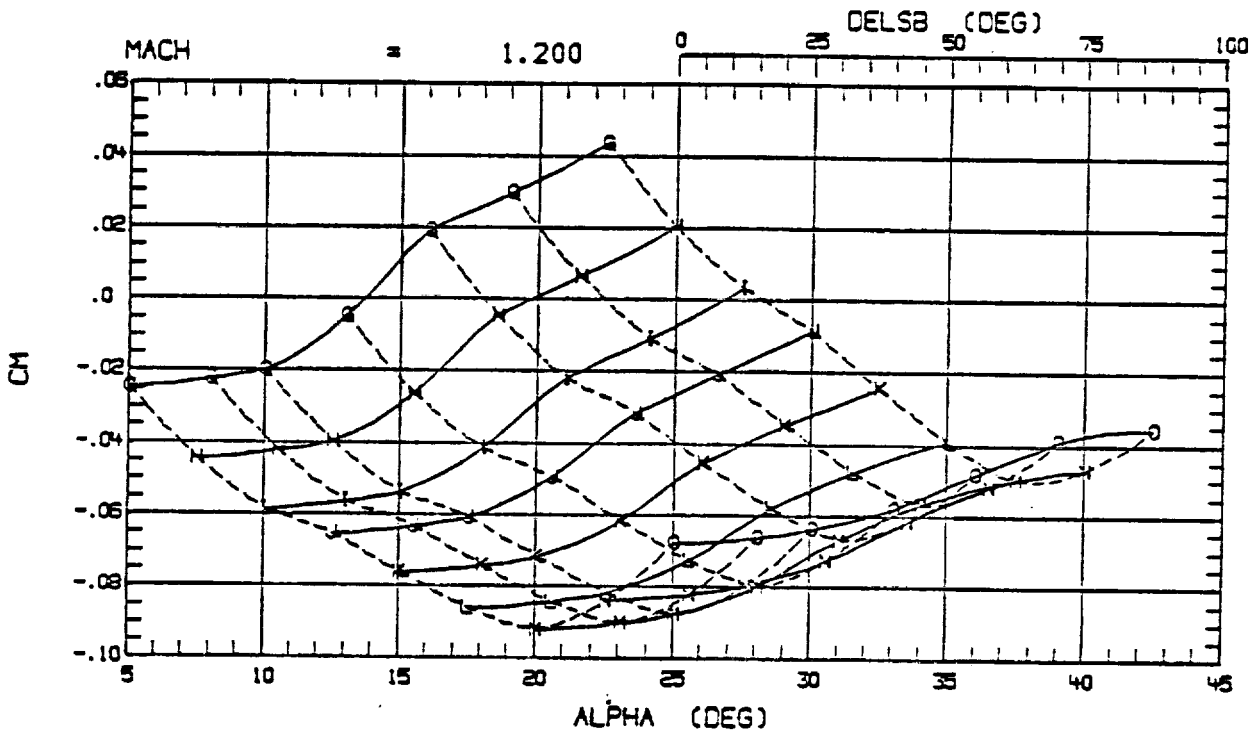
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.15600	0.13120	0.10640	0.05660	0.02880	0.00090	-0.02501	-0.04490	-0.05360
15.000	0.15950	0.13450	0.10950	0.06950	0.03150	0.00350	-0.02250	-0.04250	-0.05650
25.000	0.16200	0.13700	0.11200	0.07200	0.03400	0.00600	-0.02000	-0.04000	-0.05400
40.000	0.18356	0.15805	0.13254	0.09203	0.05352	0.02317	-0.00517	-0.02642	-0.04168
55.000	0.20635	0.18124	0.15613	0.11602	0.07791	0.04747	0.01904	-0.00448	-0.02200
70.000	0.23226	0.20463	0.17700	0.13437	0.09374	0.06059	0.02944	0.00622	-0.01100
87.200	0.25029	0.22171	0.19313	0.14955	0.10797	0.07471	0.04344	0.02022	0.00300

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-23
BASIC PITCHING MOMENT COEFFICIENT

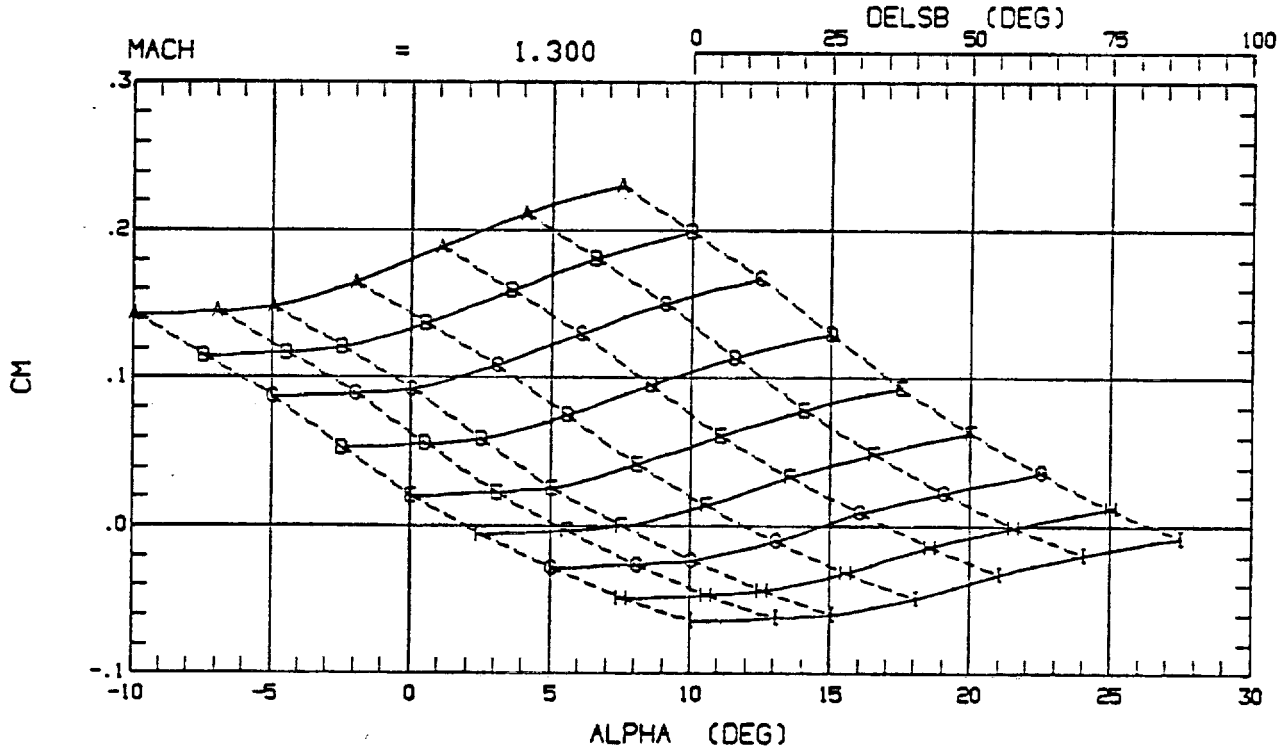


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02501	-0.04490	-0.05880	-0.06585	-0.07650	-0.08635	-0.09220	-0.09405	-0.06790
15.000	-0.02250	-0.04250	-0.05650	-0.06348	-0.07446	-0.08444	-0.09042	-0.08240	-0.06638
25.000	-0.02000	-0.04000	-0.05400	-0.06100	-0.07200	-0.08200	-0.08800	-0.08000	-0.06400
40.000	-0.00517	-0.02642	-0.04168	-0.04973	-0.06179	-0.07294	-0.07890	-0.07296	-0.05802
55.000	0.01904	-0.00448	-0.02200	-0.03175	-0.04250	-0.05825	-0.05700	-0.05175	-0.04950
70.000	0.02944	0.00622	-0.01100	-0.02100	-0.03500	-0.04600	-0.05700	-0.05200	-0.03900
87.200	0.04344	0.03022	0.00300	-0.00960	-0.02461	-0.03942	-0.05022	-0.04702	-0.03583

ENGINEER _____
DATE _____

FIGURE 4.1.1.3-24
BASIC PITCHING MOMENT COEFFICIENT

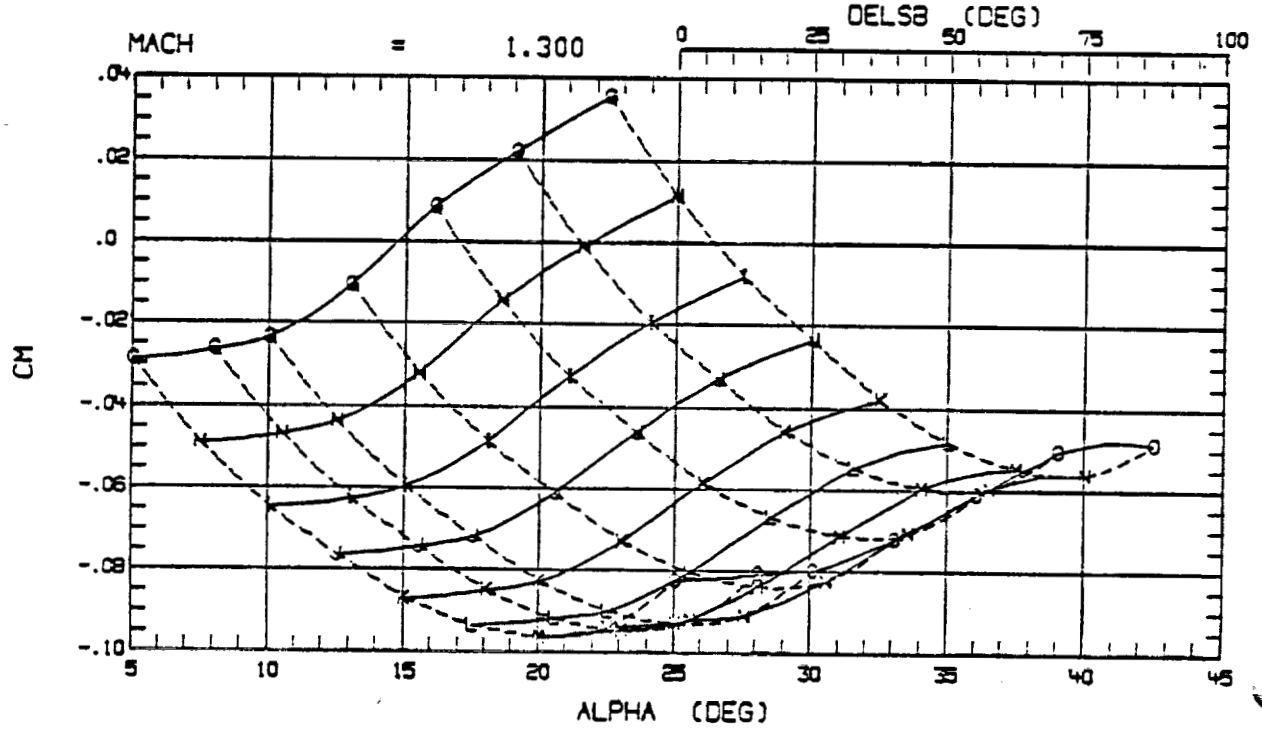


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000	-7.500	-5.000	-2.500	0.0	2.500	5.000	7.500	10.000
	A	B	C	D	E	F	G	H	I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.14225	0.11438	0.08651	0.05253	0.01975	-0.00629	-0.02982	-0.04905	-0.06477
15.000	0.14447	0.11666	0.08885	0.05504	0.02224	-0.00392	-0.02658	-0.04696	-0.06294
25.000	0.14800	0.12000	0.09200	0.05800	0.02500	-0.00100	-0.02350	-0.04400	-0.06000
40.000	0.16436	0.13628	0.10820	0.07412	0.04104	0.01334	-0.01096	-0.03212	-0.04898
55.000	0.18802	0.15888	0.12974	0.09459	0.06045	0.03256	0.00836	-0.01446	-0.03277
70.000	0.21113	0.18062	0.15012	0.11362	0.07812	0.04829	0.02196	-0.00110	-0.01967
87.200	0.22974	0.19836	0.16699	0.12961	0.09323	0.06264	0.03555	0.01134	-0.00237

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-25
BASIC PITCHING MOMENT COEFFICIENT



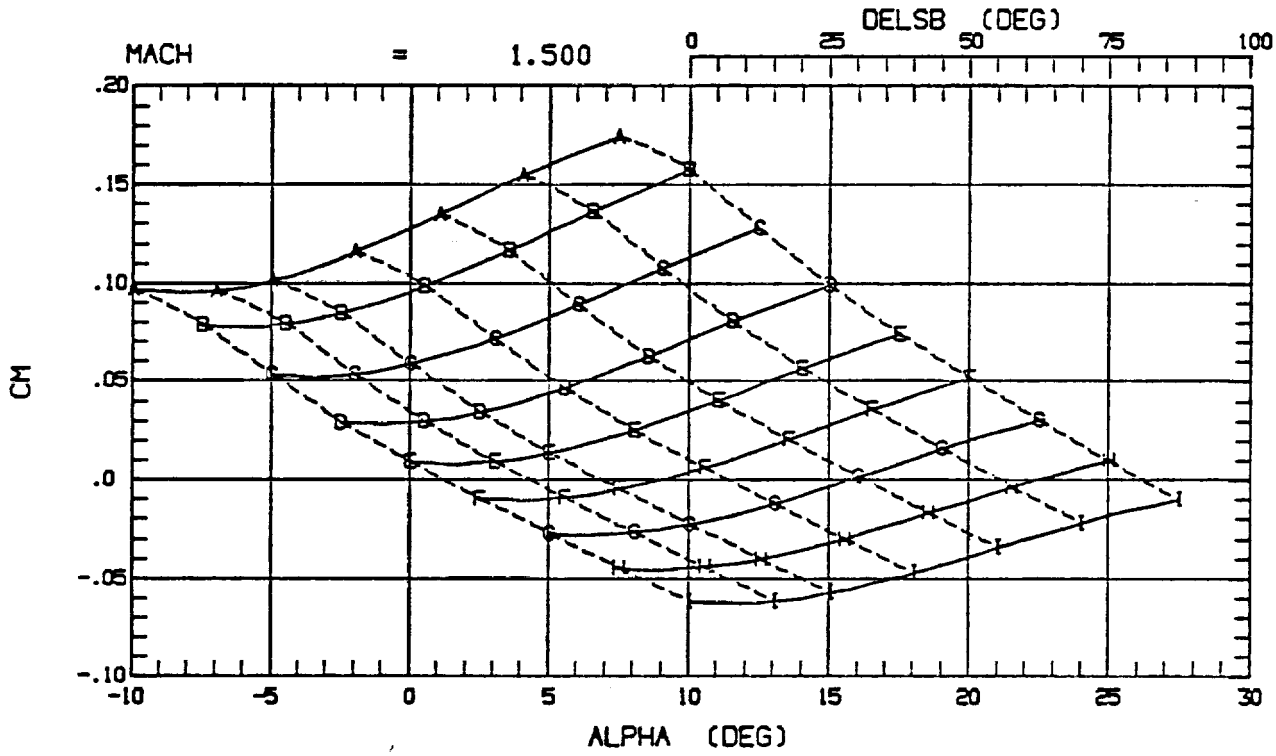
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02862	-0.04905	-0.06477	-0.07640	-0.08704	-0.09368	-0.09632	-0.09396	-0.08250
15.000	-0.02658	-0.04696	-0.06294	-0.07452	-0.08521	-0.09190	-0.09459	-0.09229	-0.08097
25.000	-0.02350	-0.04400	-0.06000	-0.07200	-0.08300	-0.09000	-0.09300	-0.09100	-0.08000
40.000	-0.01086	-0.03212	-0.04988	-0.06143	-0.07298	-0.08053	-0.08407	-0.08253	-0.07219
55.000	0.00938	-0.01446	-0.03277	-0.04621	-0.05868	-0.06709	-0.07153	-0.07098	-0.06142
70.000	0.02196	-0.00110	-0.01967	-0.03337	-0.04606	-0.05501	-0.05997	-0.05960	-0.05062
97.200	0.03555	0.01134	-0.00537	-0.02376	-0.03814	-0.04652	-0.05491	-0.05630	-0.04968

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-26
BASIC PITCHING MOMENT COEFFICIENT

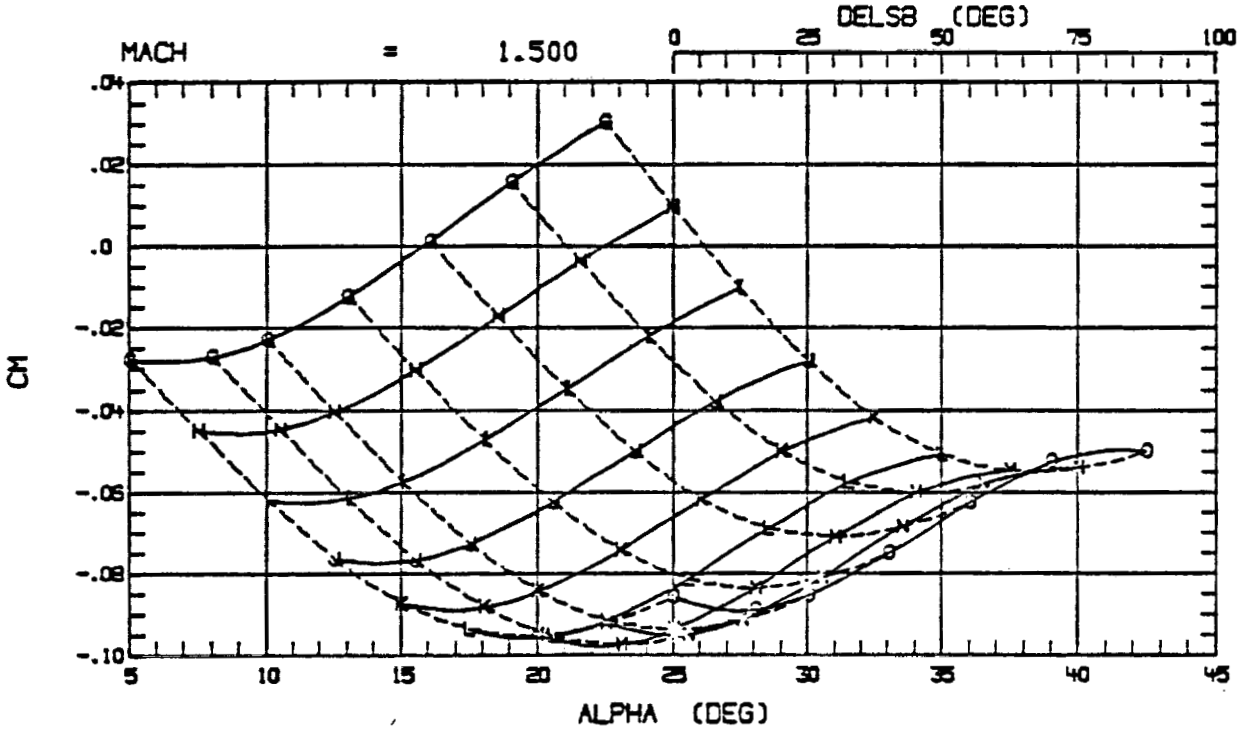


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.09670	0.07821	0.05271	0.02902	0.00856	-0.00990	-0.02771	-0.04529	-0.06197
15.000	0.09537	0.07874	0.05322	0.02927	0.00979	-0.00951	-0.02717	-0.04477	-0.06175
25.000	0.10057	0.08419	0.05838	0.03407	0.01329	-0.00519	-0.02296	-0.04063	-0.05769
40.000	0.11519	0.09799	0.07144	0.04635	0.02484	0.00575	-0.01246	-0.03040	-0.04758
55.000	0.13440	0.11616	0.08865	0.06254	0.04002	0.02002	0.00108	-0.01738	-0.03488
70.000	0.15464	0.13598	0.10745	0.08016	0.05646	0.03537	0.01547	-0.00384	-0.02207
87.200	0.17446	0.15723	0.12770	0.09891	0.07381	0.05142	0.03017	0.00938	-0.01047

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-27
BASIC PITCHING MOMENT COEFFICIENT

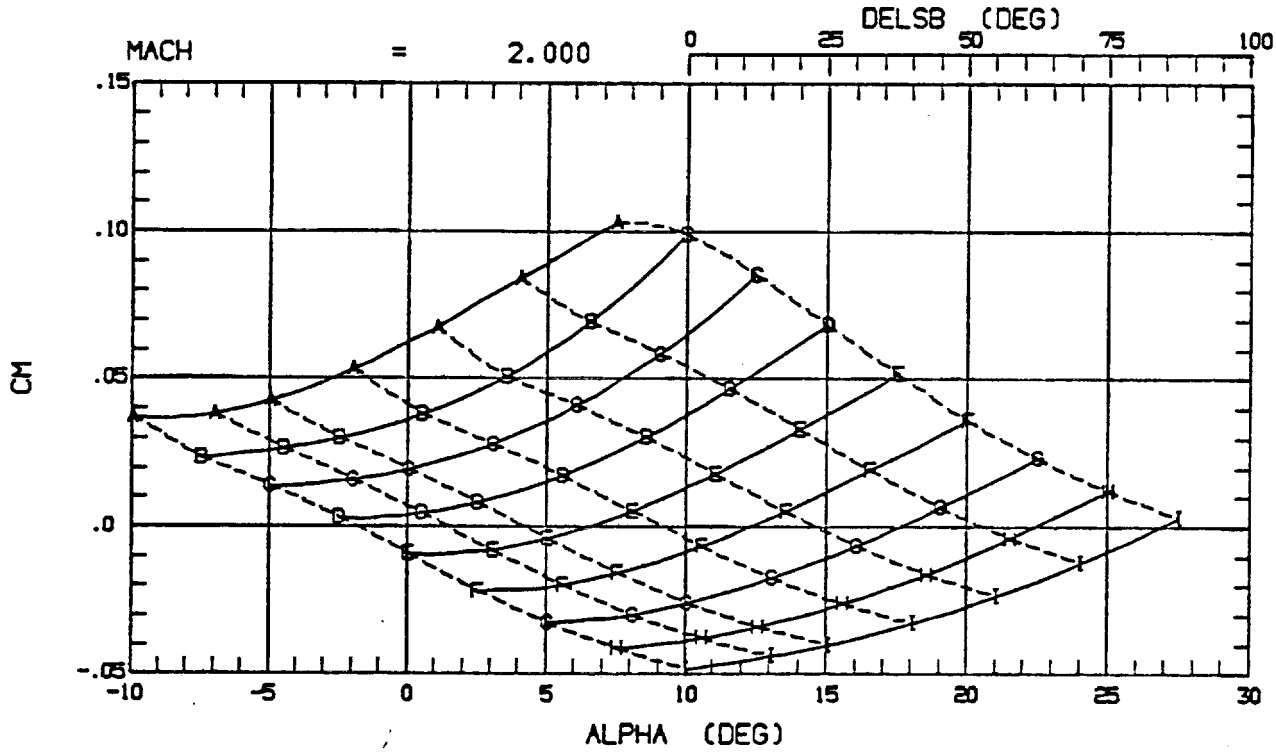


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1250.3 IN.

	ALPHA (DEG)								
	5.000 G	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02771	-0.04529	-0.06197	-0.07649	-0.08742	-0.09375	-0.09515	-0.09212	-0.08524
15.000	-0.02717	-0.04477	-0.06175	-0.07678	-0.08836	-0.09537	-0.09740	-0.09489	-0.08902
25.000	-0.02296	-0.04063	-0.05769	-0.07292	-0.08452	-0.09164	-0.09377	-0.09134	-0.08551
40.000	-0.01246	-0.03040	-0.04759	-0.06274	-0.07441	-0.08149	-0.08357	-0.08107	-0.07517
55.000	0.00108	-0.01738	-0.03468	-0.05020	-0.06193	-0.06903	-0.07111	-0.06863	-0.06274
70.000	0.01547	-0.00384	-0.02207	-0.03801	-0.05027	-0.05762	-0.06031	-0.05823	-0.05277
87.200	0.03017	0.00538	-0.01047	-0.02510	-0.04202	-0.05111	-0.05503	-0.05429	-0.05018

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-28
BASIC PITCHING MOMENT COEFFICIENT

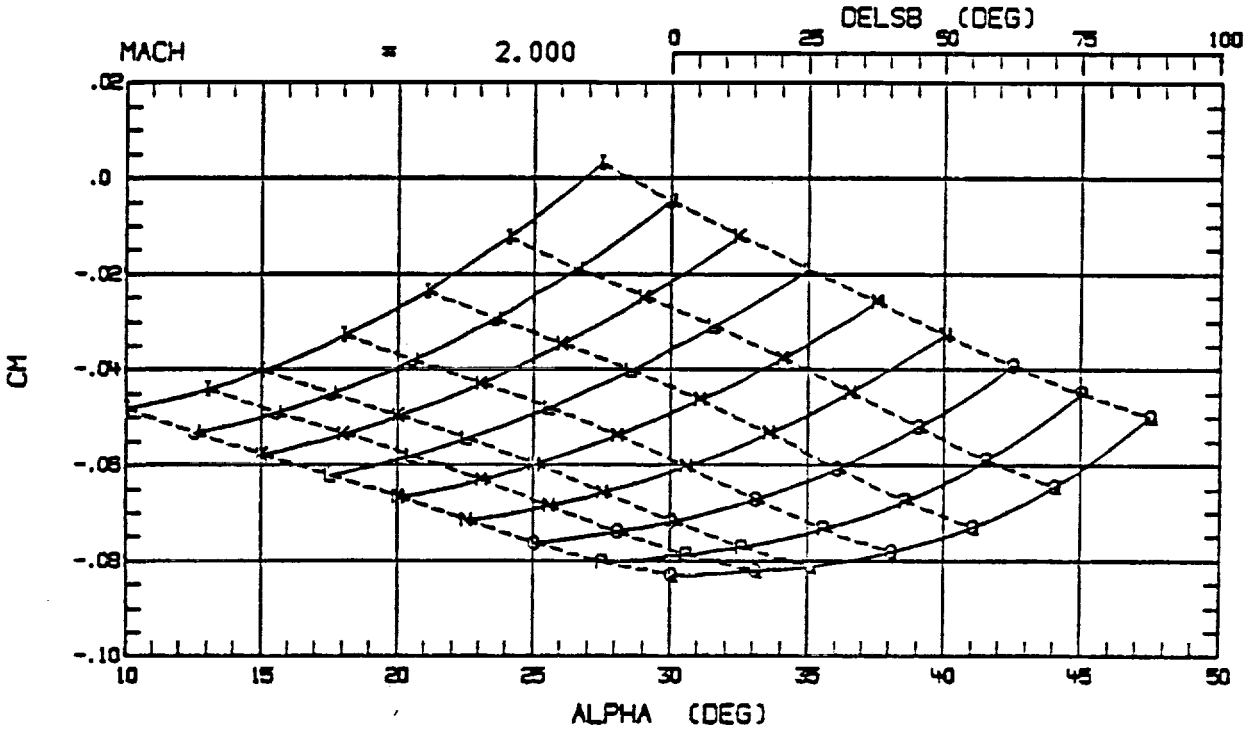


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1260.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	0.03692	0.02331	0.01348	0.00259	-0.00954	-0.02188	-0.03276	-0.04156	-0.04830
15.000	0.03783	0.02519	0.01572	0.00410	-0.00819	-0.01989	-0.02996	-0.03797	-0.04414
25.000	0.04217	0.02963	0.01921	0.00782	-0.00432	-0.01559	-0.02609	-0.03413	-0.04032
40.000	0.05300	0.03784	0.02775	0.01704	0.00505	-0.00698	-0.01770	-0.02535	-0.03299
55.000	0.06750	0.05085	0.04085	0.03008	0.01775	0.00495	-0.00672	-0.01630	-0.02371
70.000	0.08395	0.06912	0.05837	0.04637	0.03272	0.01884	0.00526	-0.00419	-0.01246
87.200	0.10300	0.09860	0.08515	0.06825	0.05127	0.03593	0.02296	0.01200	0.00290

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-29
BASIC PITCHING MOMENT COEFFICIENT

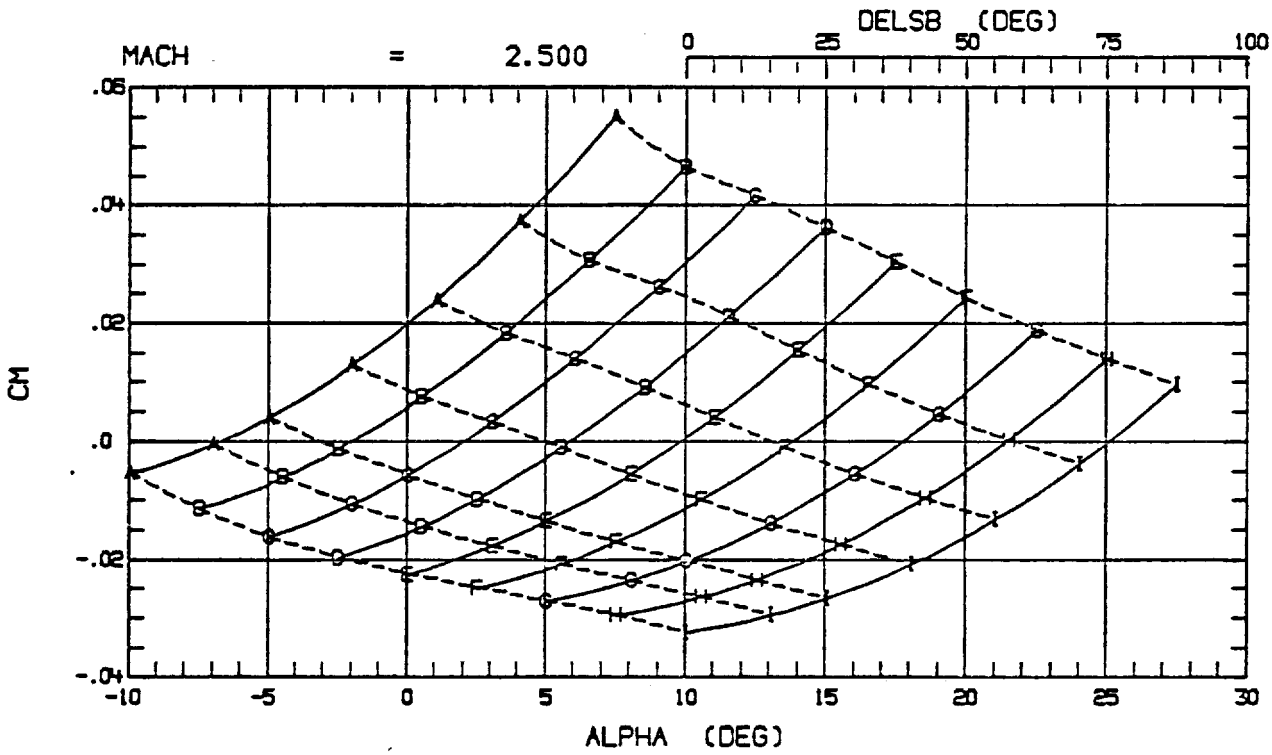


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.04830	-0.05351	-0.05798	-0.06230	-0.06690	-0.07174	-0.07647	-0.08052	-0.08336
15.000	-0.04414	-0.04909	-0.05356	-0.05817	-0.06325	-0.06871	-0.07415	-0.07894	-0.08240
25.000	-0.04032	-0.04529	-0.04983	-0.05461	-0.06000	-0.06592	-0.07193	-0.07732	-0.08131
40.000	-0.03299	-0.03825	-0.04303	-0.04811	-0.05395	-0.06051	-0.06732	-0.07357	-0.07837
55.000	-0.02371	-0.02956	-0.03479	-0.04027	-0.04651	-0.05355	-0.06089	-0.06772	-0.07310
70.000	-0.01246	-0.01915	-0.02512	-0.03116	-0.03776	-0.04494	-0.05230	-0.05914	-0.06466
87.200	0.00290	-0.00501	-0.01226	-0.01925	-0.02514	-0.03252	-0.03938	-0.04518	-0.04955

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-30
BASIC PITCHING MOMENT COEFFICIENT

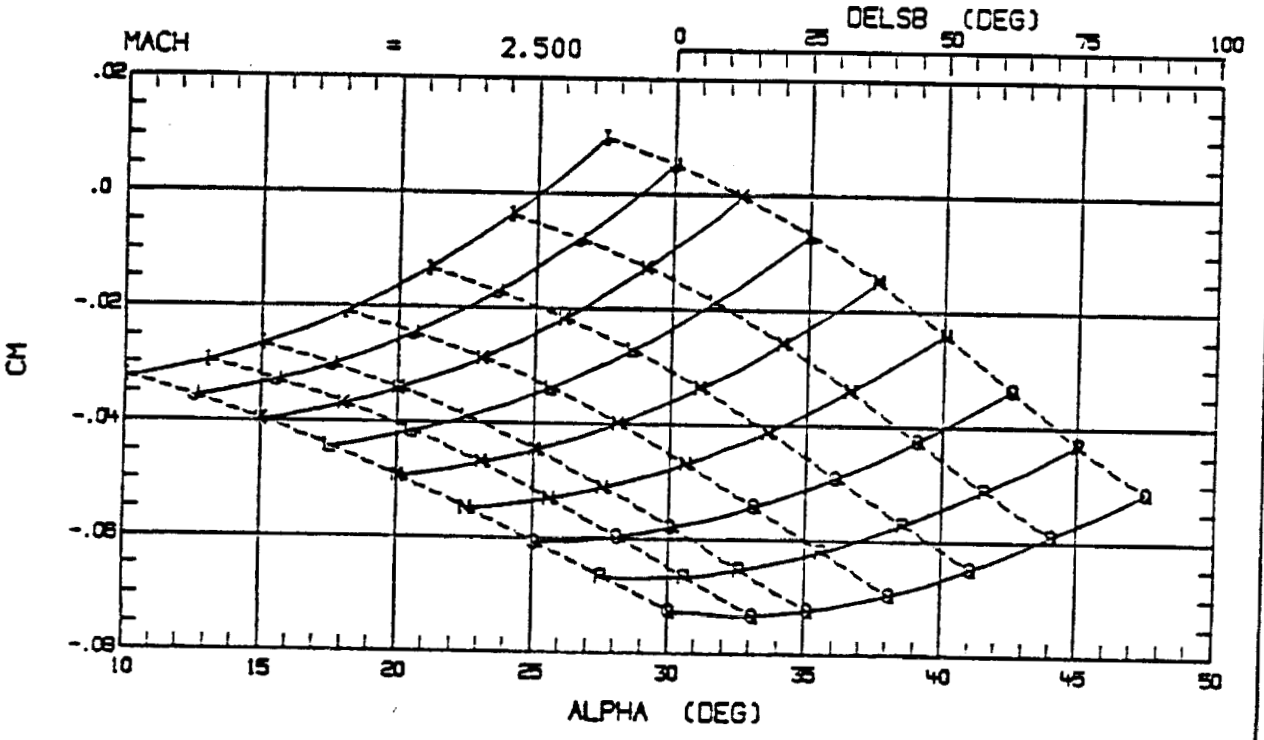


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.00557	-0.01168	-0.01633	-0.01985	-0.02252	-0.02458	-0.02725	-0.02970	-0.03254
15.000	-0.00077	-0.00636	-0.01083	-0.01462	-0.01796	-0.02098	-0.02382	-0.02684	-0.02984
25.000	0.00382	-0.00154	-0.00590	-0.00993	-0.01373	-0.01727	-0.02054	-0.02364	-0.02679
40.000	0.01267	0.00743	0.00314	-0.00127	-0.00581	-0.01015	-0.01409	-0.01764	-0.02104
55.000	0.02380	0.01823	0.01391	0.00911	0.00390	-0.00119	-0.00576	-0.00975	-0.01345
70.000	0.03707	0.03060	0.02608	0.02101	0.01529	0.00961	0.00451	0.00010	-0.00392
87.200	0.05480	0.04637	0.04139	0.03618	0.03025	0.02423	0.01873	0.01392	0.00952

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-31
BASIC PITCHING MOMENT COEFFICIENT



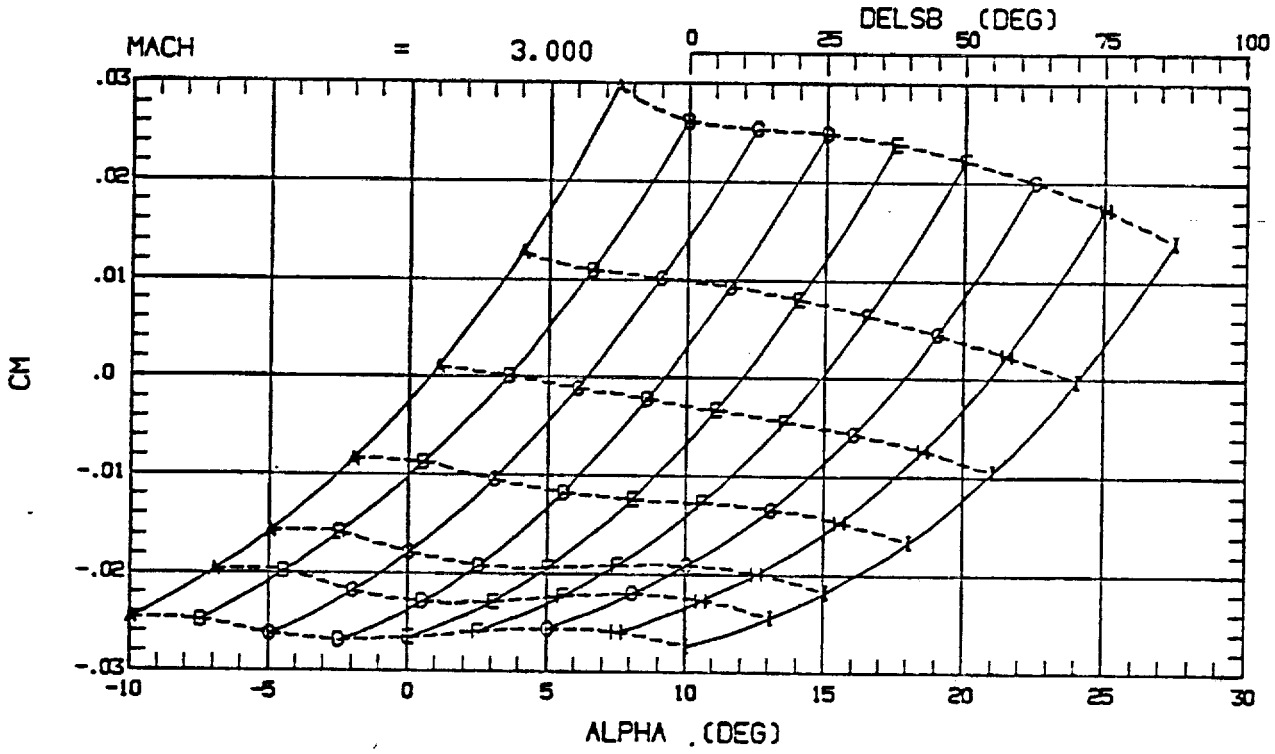
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 79.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.3 IN.

DELSB (DEG)	ALPHA (DEG) 10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
	PITCHING MOMENT COEFFICIENT								
0.0	-0.03254	-0.03691	-0.03989	-0.04447	-0.04959	-0.05513	-0.06094	-0.06662	-0.07256
15.000	-0.02984	-0.03304	-0.03701	-0.04169	-0.04713	-0.05326	-0.05987	-0.06668	-0.07329
25.000	-0.02579	-0.03024	-0.03429	-0.03910	-0.04477	-0.05122	-0.05824	-0.06546	-0.07246
40.000	-0.02104	-0.02467	-0.02989	-0.03599	-0.04005	-0.04698	-0.05449	-0.06217	-0.06956
55.000	-0.01345	-0.01732	-0.02183	-0.02730	-0.03386	-0.04130	-0.04929	-0.05736	-0.06502
70.000	-0.00392	-0.00809	-0.01297	-0.01852	-0.02505	-0.03414	-0.04275	-0.05130	-0.05927
87.200	0.00952	0.00495	-0.00043	-0.00705	-0.01502	-0.02410	-0.03373	-0.04318	-0.05170

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-32
BASIC PITCHING MOMENT COEFFICIENT

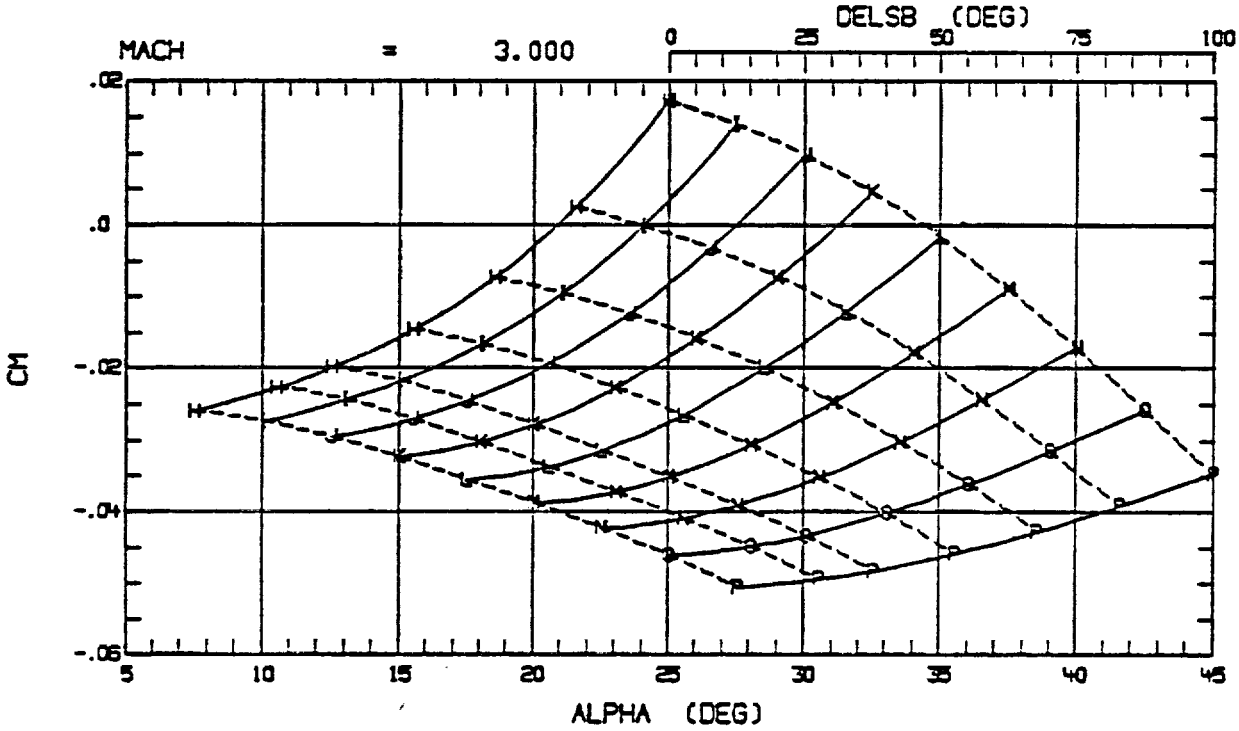


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02463	-0.02492	-0.02629	-0.02688	-0.02659	-0.02597	-0.02566	-0.02611	-0.02747
15.000	-0.01984	-0.01992	-0.02195	-0.02305	-0.02294	-0.02235	-0.02212	-0.02279	-0.02452
25.000	-0.01586	-0.01595	-0.01801	-0.01928	-0.01943	-0.01914	-0.01918	-0.02005	-0.02191
40.000	-0.00948	-0.00882	-0.01054	-0.01184	-0.01248	-0.01296	-0.01349	-0.01473	-0.01674
55.000	0.00092	-0.00001	-0.00117	-0.00232	-0.00340	-0.00451	-0.00581	-0.00748	-0.00967
70.000	0.01257	0.01090	0.01008	0.00920	0.00790	0.00627	0.00439	0.00225	-0.00029
87.200	0.02948	0.02605	0.02531	0.02480	0.02375	0.02209	0.01990	0.01720	0.01325

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-33
BASIC PITCHING MOMENT COEFFICIENT



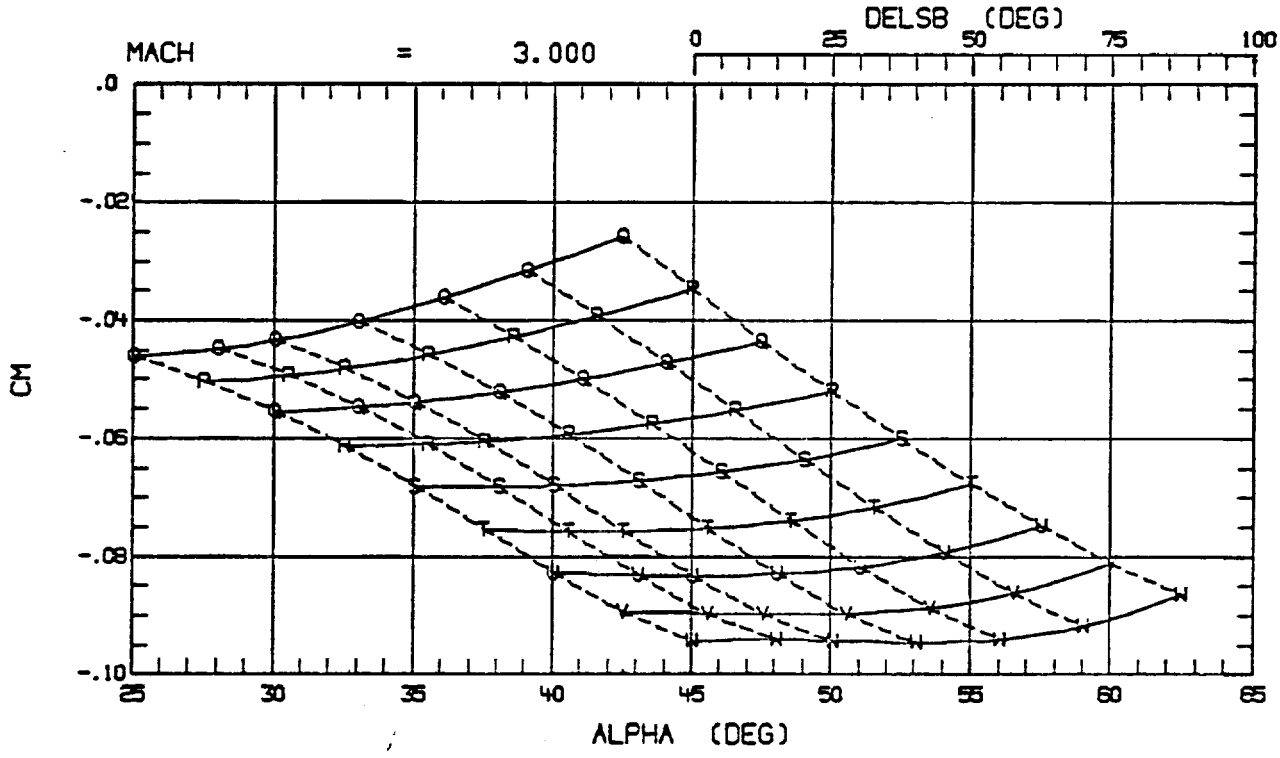
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02511	-0.02747	-0.02984	-0.03241	-0.03555	-0.03890	-0.04243	-0.04625	-0.05056
15.000	-0.02279	-0.02452	-0.02713	-0.03033	-0.03380	-0.03737	-0.04104	-0.04500	-0.04951
25.000	-0.02005	-0.02191	-0.02463	-0.02792	-0.03152	-0.03529	-0.03920	-0.04347	-0.04833
40.000	-0.01473	-0.01674	-0.01947	-0.02291	-0.02660	-0.03076	-0.03530	-0.04031	-0.04593
55.000	-0.00748	-0.00967	-0.01247	-0.01594	-0.02008	-0.02497	-0.03029	-0.03629	-0.04299
70.000	0.00225	-0.00029	-0.00344	-0.00738	-0.01220	-0.01793	-0.02446	-0.03185	-0.03932
87.200	0.01720	0.01385	0.00988	0.00449	-0.00178	-0.00905	-0.01718	-0.02525	-0.03474

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-34
BASIC PITCHING MOMENT COEFFICIENT

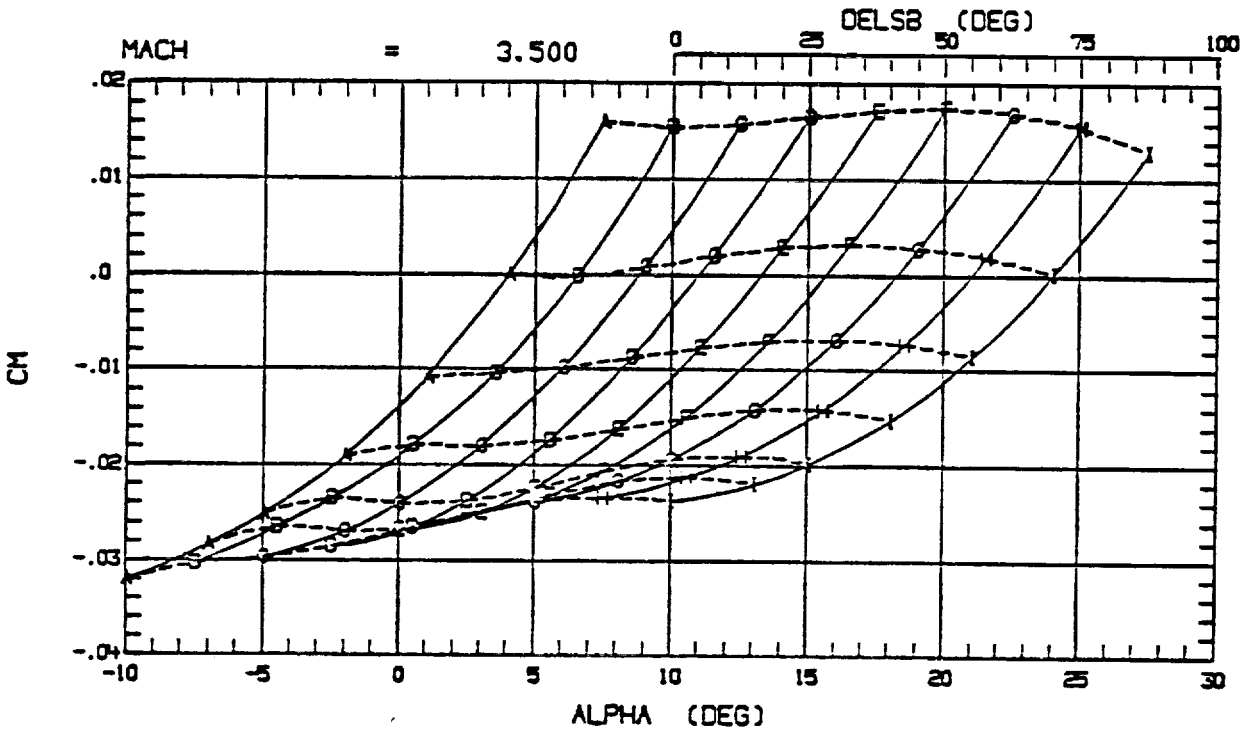


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	25.000 O	27.500 P	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.04625	-0.05056	-0.05560	-0.06151	-0.06825	-0.07558	-0.08293	-0.08952	-0.09444
15.000	-0.04500	-0.04951	-0.05485	-0.06115	-0.06832	-0.07594	-0.08337	-0.08973	-0.09416
25.000	-0.04347	-0.04833	-0.05402	-0.06065	-0.06808	-0.07591	-0.08347	-0.08990	-0.09436
40.000	-0.04031	-0.04593	-0.05231	-0.05946	-0.06726	-0.07533	-0.08311	-0.08981	-0.09461
55.000	-0.03629	-0.04299	-0.05006	-0.05774	-0.06580	-0.07399	-0.08187	-0.08882	-0.09409
70.000	-0.03165	-0.03932	-0.04730	-0.05545	-0.06364	-0.07172	-0.07945	-0.08641	-0.09197
87.200	-0.02585	-0.03474	-0.04356	-0.05209	-0.06018	-0.06779	-0.07484	-0.08119	-0.08652

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-35
BASIC PITCHING MOMENT COEFFICIENT



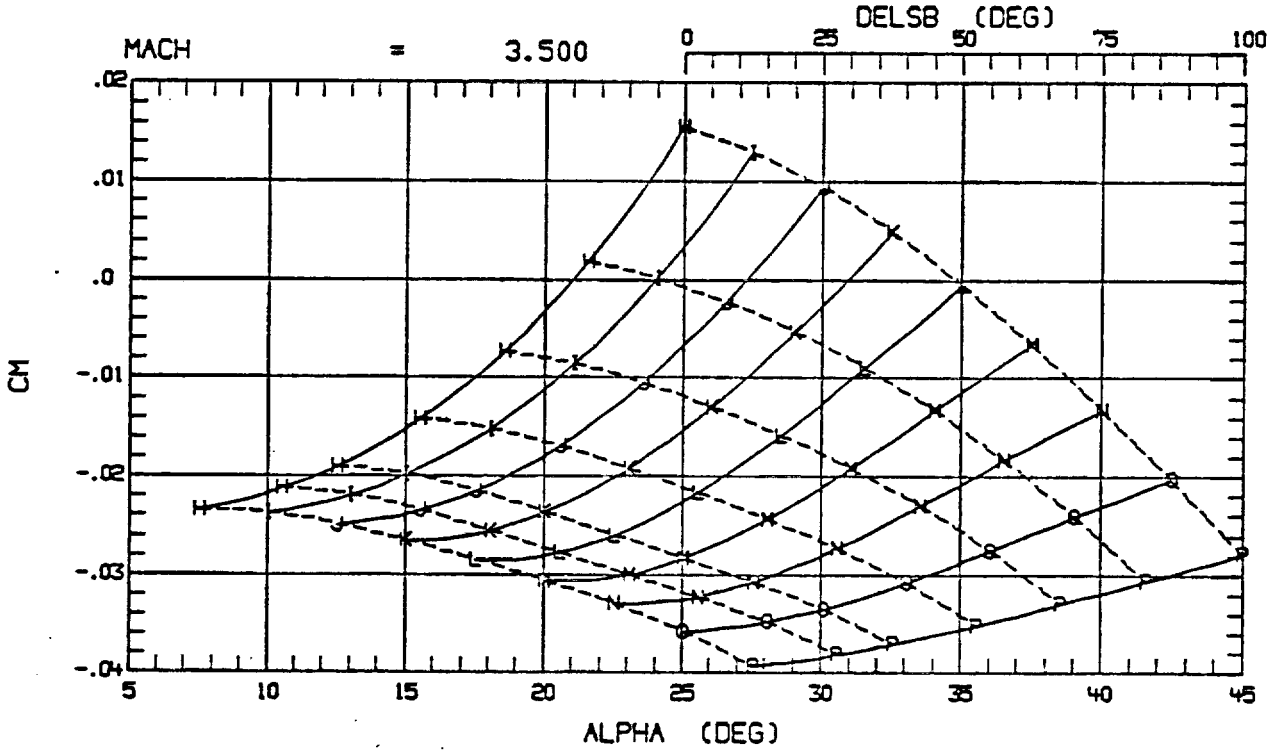
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.03209	-0.03046	-0.02978	-0.02959	-0.02931	-0.02519	-0.02394	-0.02349	-0.02389
15.000	-0.02941	-0.02859	-0.02702	-0.02664	-0.02513	-0.02322	-0.02178	-0.02134	-0.02201
25.000	-0.02524	-0.02350	-0.02411	-0.02381	-0.02242	-0.02067	-0.01938	-0.01909	-0.01989
40.000	-0.01908	-0.01799	-0.01802	-0.01746	-0.01626	-0.01498	-0.01419	-0.01427	-0.01526
55.000	-0.01094	-0.01044	-0.00978	-0.00880	-0.00778	-0.00707	-0.00591	-0.00745	-0.00870
70.000	-0.00008	-0.00030	0.00075	0.00194	0.00277	0.00305	0.00269	0.00167	-0.00001
87.200	0.01592	0.01540	0.01577	0.01650	0.01715	0.01735	0.01682	0.01536	0.01295

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-36
BASIC PITCHING MOMENT COEFFICIENT

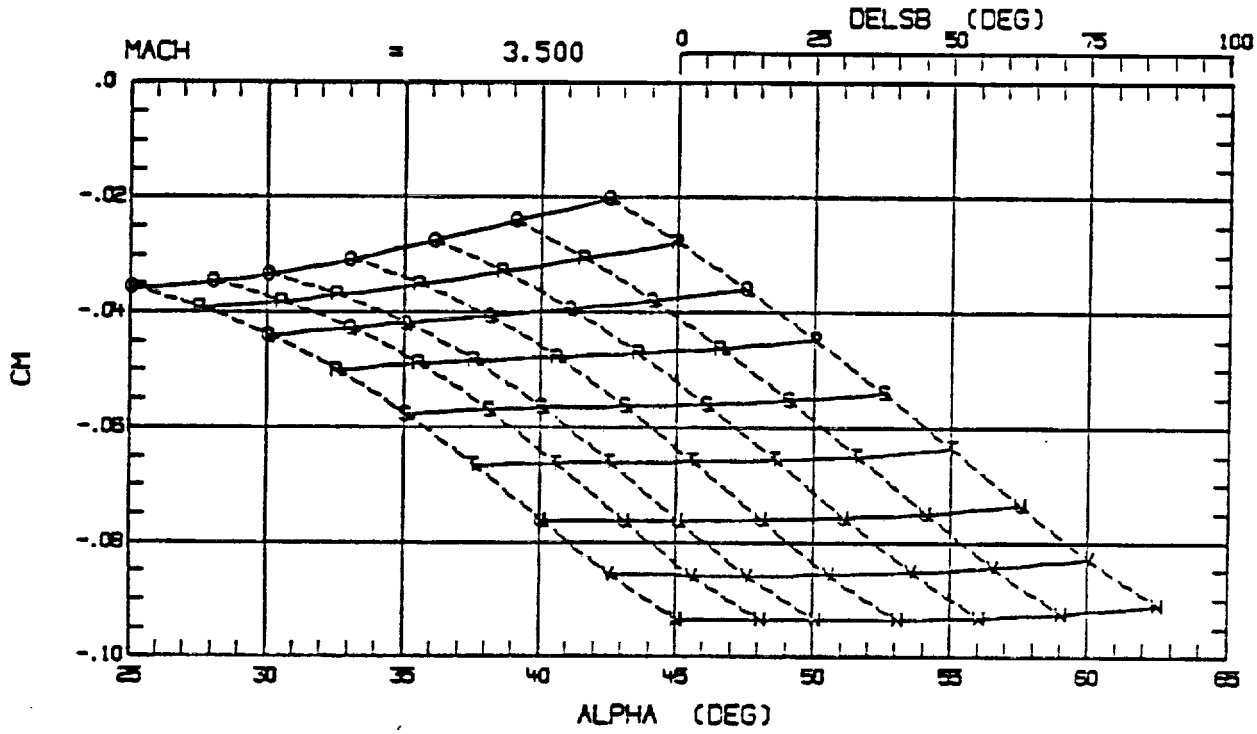


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02349	-0.02389	-0.02503	-0.02667	-0.02959	-0.03070	-0.03305	-0.03584	-0.03940
15.000	-0.02134	-0.02201	-0.02357	-0.02564	-0.02787	-0.03008	-0.03231	-0.03487	-0.03822
25.000	-0.01909	-0.01989	-0.02156	-0.02373	-0.02607	-0.02941	-0.03080	-0.03357	-0.03715
40.000	-0.01427	-0.01526	-0.01700	-0.01924	-0.02175	-0.02445	-0.02741	-0.03088	-0.03523
55.000	-0.00745	-0.00870	-0.01059	-0.01303	-0.01592	-0.01926	-0.02311	-0.02763	-0.03303
70.000	0.00167	-0.00001	-0.00237	-0.00539	-0.00907	-0.01341	-0.01843	-0.02417	-0.03070
87.200	0.01536	0.01285	0.00929	0.00477	-0.00050	-0.00666	-0.01329	-0.02041	-0.02801

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-37
BASIC PITCHING MOMENT COEFFICIENT

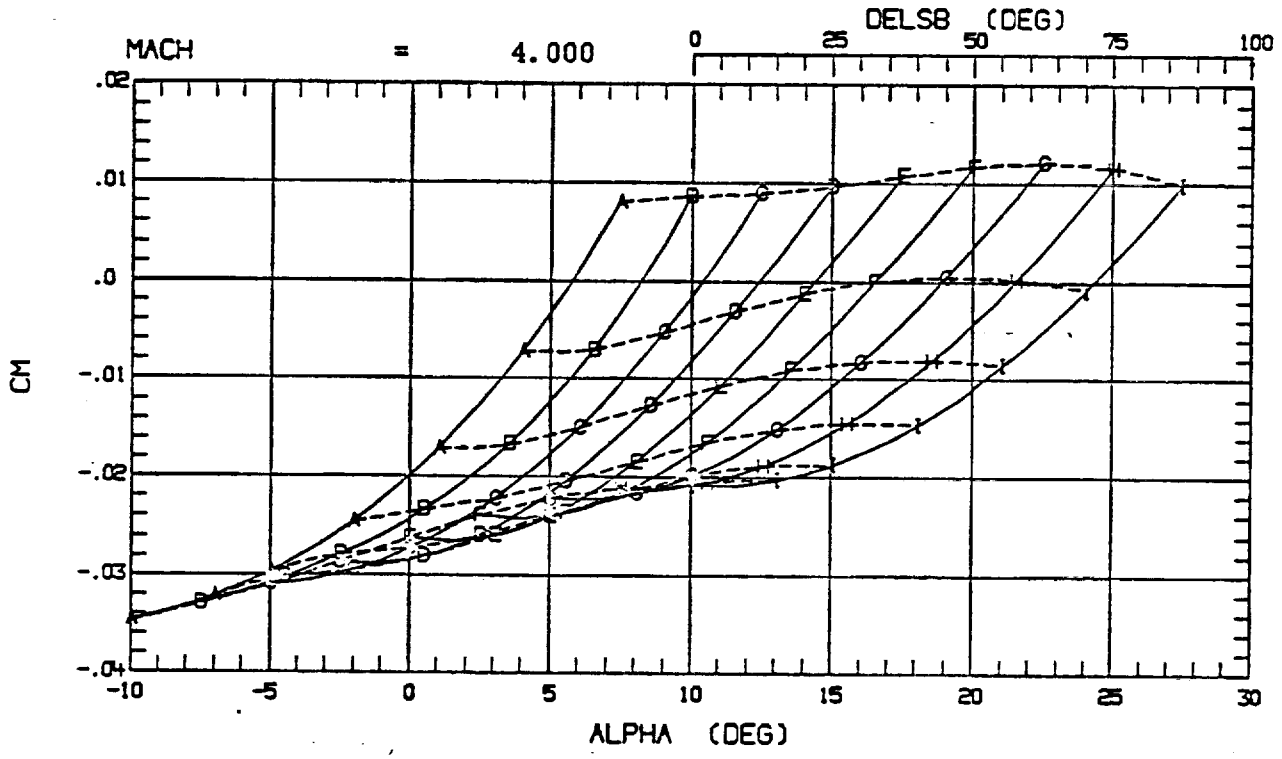


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 73.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	25.000 O	27.500 P	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.03584	-0.03940	-0.04411	-0.05023	-0.05785	-0.06676	-0.07637	-0.08572	-0.09559
15.000	-0.03487	-0.03822	-0.04294	-0.04909	-0.05704	-0.06639	-0.07639	-0.08595	-0.09573
25.000	-0.03357	-0.03715	-0.04203	-0.04853	-0.05672	-0.06625	-0.07638	-0.08599	-0.09577
40.000	-0.03088	-0.03523	-0.04081	-0.04785	-0.05640	-0.06609	-0.07624	-0.08584	-0.09568
55.000	-0.02763	-0.03303	-0.03962	-0.04720	-0.05605	-0.06579	-0.07586	-0.08558	-0.09329
70.000	-0.02417	-0.03070	-0.03807	-0.04633	-0.05543	-0.06516	-0.07509	-0.08454	-0.09254
87.200	-0.02041	-0.02901	-0.03612	-0.04491	-0.05407	-0.06378	-0.07363	-0.08301	-0.09107

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-38
BASIC PITCHING MOMENT COEFFICIENT



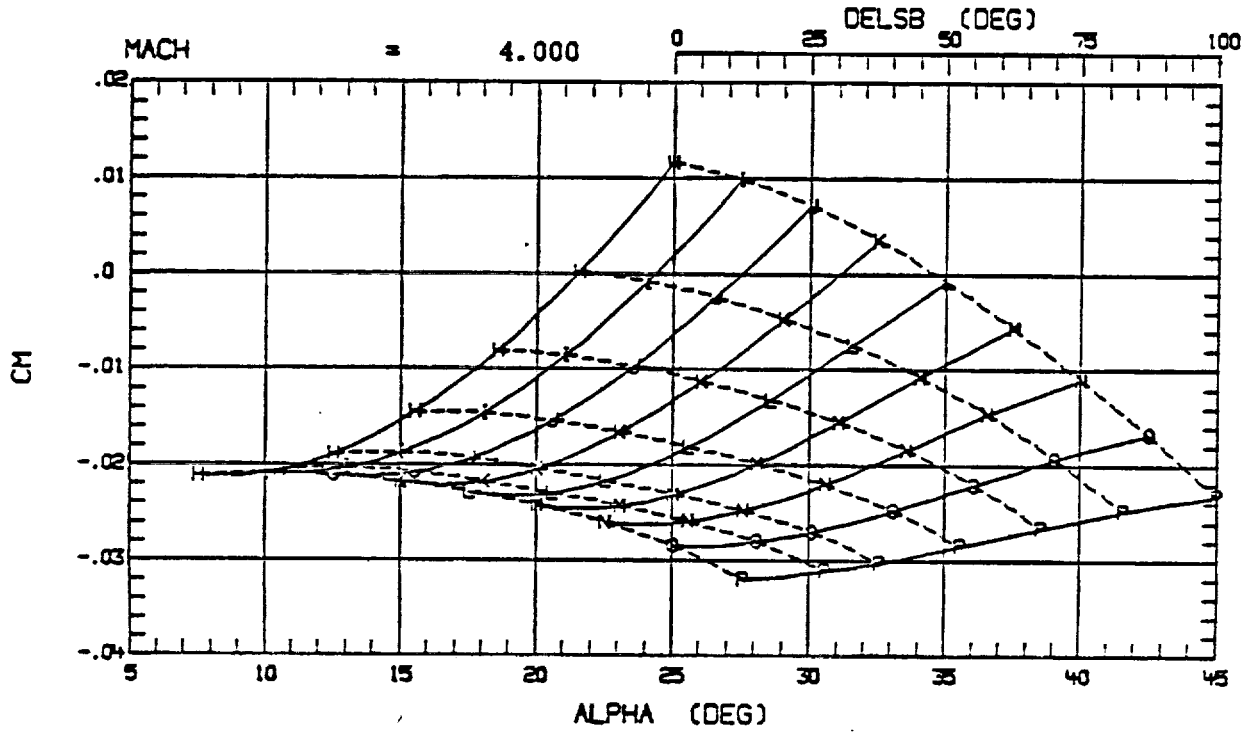
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.03470	-0.03302	-0.03106	-0.02870	-0.02622	-0.02398	-0.02227	-0.02124	-0.02090
15.000	-0.03219	-0.03027	-0.02954	-0.02817	-0.02604	-0.02371	-0.02179	-0.02095	-0.02039
25.000	-0.02973	-0.02802	-0.02737	-0.02605	-0.02399	-0.02176	-0.01995	-0.01894	-0.01881
40.000	-0.02455	-0.02343	-0.02230	-0.02057	-0.01850	-0.01656	-0.01518	-0.01456	-0.01471
55.000	-0.01718	-0.01671	-0.01497	-0.01277	-0.01071	-0.00915	-0.00829	-0.00816	-0.00870
70.000	-0.00720	-0.00707	-0.00529	-0.00313	-0.00129	-0.00009	0.00036	0.00005	-0.00096
87.200	0.00902	0.00856	0.00885	0.00958	0.01066	0.01164	0.01202	0.01146	0.00981

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-39
BASIC PITCHING MOMENT COEFFICIENT

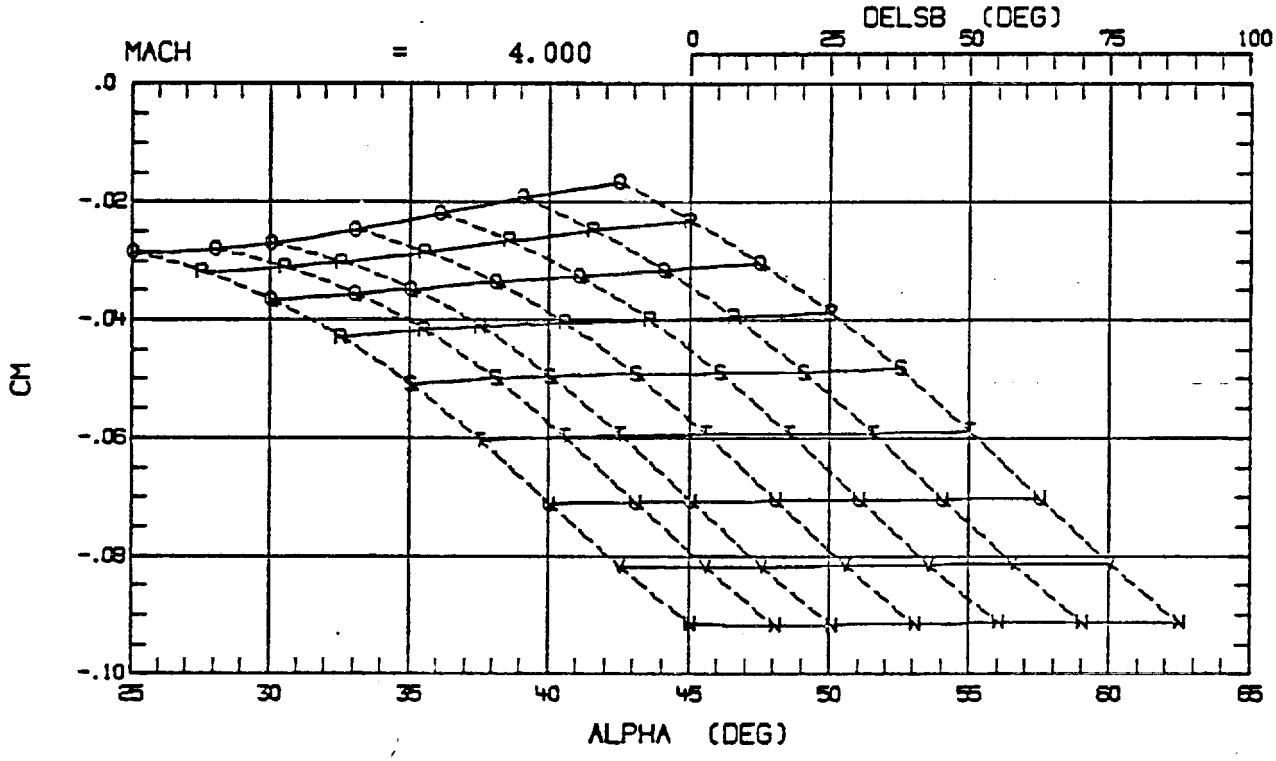


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1250.0 IN.

	ALPHA (DEG)								
	7.500	10.000	12.500	15.000	17.500	20.000	22.500	25.000	27.500
	H	I	J	K	L	M	N	O	P
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02124	-0.02090	-0.02115	-0.02187	-0.02294	-0.02434	-0.02517	-0.02984	-0.03205
15.000	-0.02085	-0.02039	-0.02087	-0.02184	-0.02307	-0.02445	-0.02506	-0.02918	-0.03123
25.000	-0.01894	-0.01881	-0.01940	-0.02047	-0.02177	-0.02323	-0.02452	-0.02715	-0.03033
40.000	-0.01455	-0.01471	-0.01550	-0.01671	-0.01822	-0.01957	-0.02210	-0.02466	-0.02863
55.000	-0.00816	-0.00870	-0.00980	-0.01135	-0.01329	-0.01552	-0.01849	-0.02211	-0.02574
70.000	0.00005	-0.00096	-0.00261	-0.00483	-0.00757	-0.01085	-0.01474	-0.01937	-0.02493
87.200	0.01146	0.00981	0.00708	0.00345	-0.00090	-0.00577	-0.01109	-0.01686	-0.02326

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-40
BASIC PITCHING MOMENT COEFFICIENT

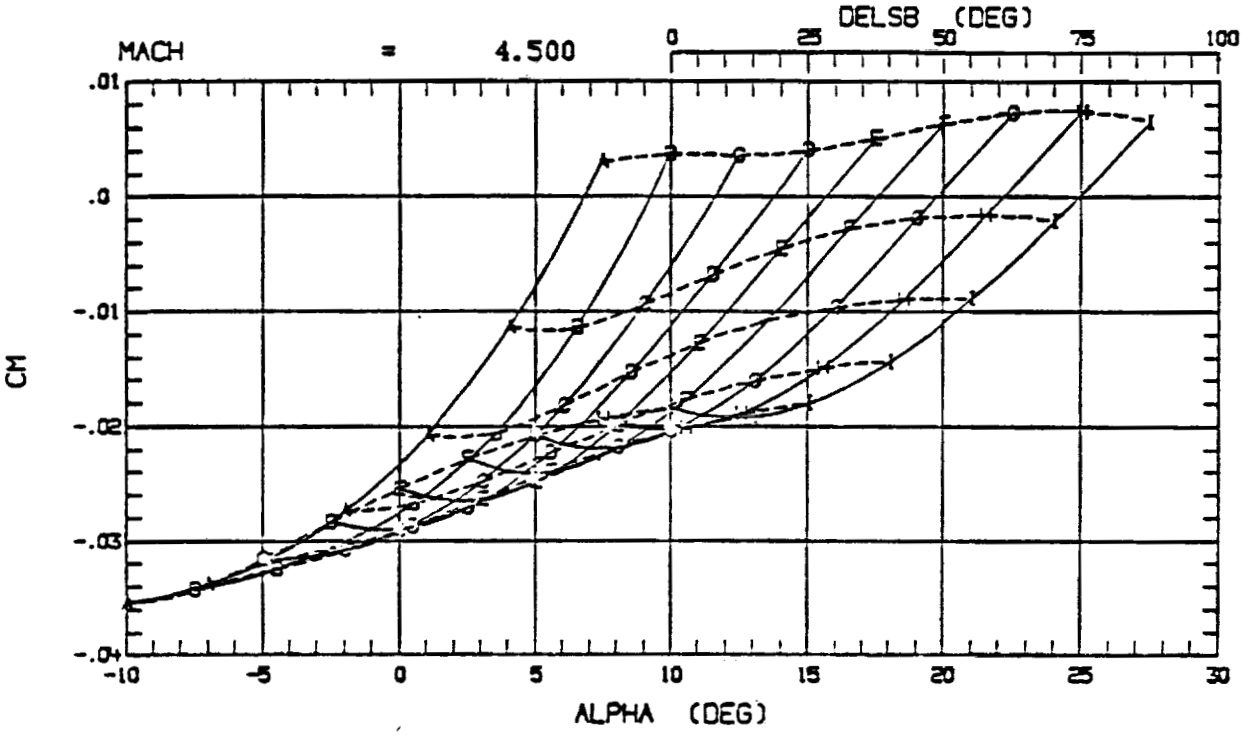


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH LB = 1290.0 IN.	

	ALPHA (DEG)								
	25.000 O	27.500 P	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02884	-0.03206	-0.03678	-0.04309	-0.05110	-0.06067	-0.07128	-0.08204	-0.09159
15.000	-0.02818	-0.03123	-0.03568	-0.04191	-0.05006	-0.05994	-0.07095	-0.08203	-0.09180
25.000	-0.02715	-0.03033	-0.03493	-0.04132	-0.04964	-0.05968	-0.07081	-0.08195	-0.09176
40.000	-0.02466	-0.02963	-0.03379	-0.04065	-0.04929	-0.05950	-0.07067	-0.08180	-0.09160
55.000	-0.02211	-0.02674	-0.03268	-0.04012	-0.04911	-0.05943	-0.07057	-0.08163	-0.09141
70.000	-0.01937	-0.02493	-0.03162	-0.03960	-0.04889	-0.05933	-0.07046	-0.08149	-0.09130
87.200	-0.01686	-0.02326	-0.03051	-0.03884	-0.04835	-0.05896	-0.07025	-0.08145	-0.09141

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-41
BASIC PITCHING MOMENT COEFFICIENT

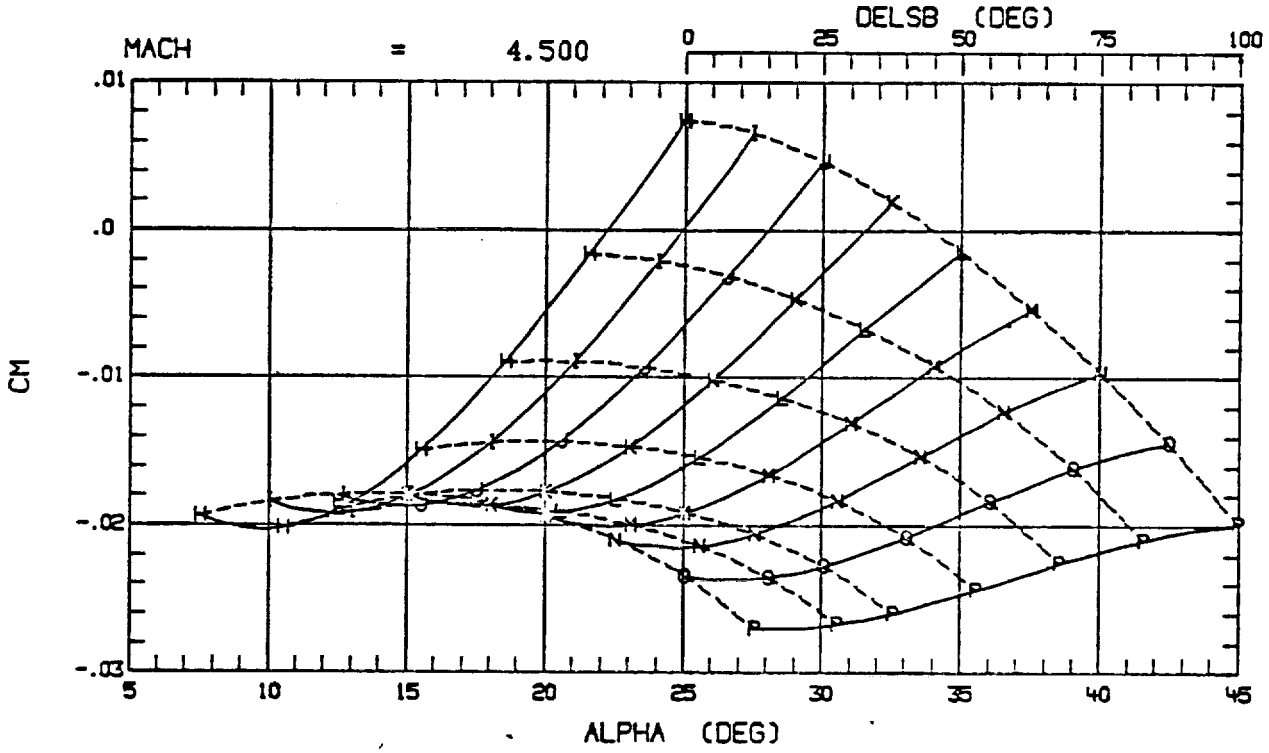


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	SW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1250.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.03538	-0.03432	-0.03160	-0.02946	-0.02548	-0.02293	-0.02050	-0.01941	-0.01844
15.000	-0.03381	-0.03246	-0.03089	-0.02882	-0.02842	-0.02399	-0.02185	-0.02021	-0.01916
25.000	-0.03191	-0.03072	-0.02921	-0.02719	-0.02484	-0.02251	-0.02049	-0.01898	-0.01806
40.000	-0.02748	-0.02560	-0.02487	-0.02240	-0.01952	-0.01775	-0.01608	-0.01499	-0.01444
55.000	-0.02081	-0.02095	-0.01629	-0.01541	-0.01292	-0.01087	-0.00981	-0.00901	-0.00257
70.000	-0.01149	-0.01150	-0.00944	-0.00686	-0.00455	-0.00298	-0.00194	-0.00172	-0.00218
87.200	0.00257	0.00325	0.00325	0.00339	0.00506	0.00533	0.00725	0.00738	0.00851

ENGINEER _____
DATE _____

FIGURE 4.1.1.3-42
BASIC PITCHING MOMENT COEFFICIENT

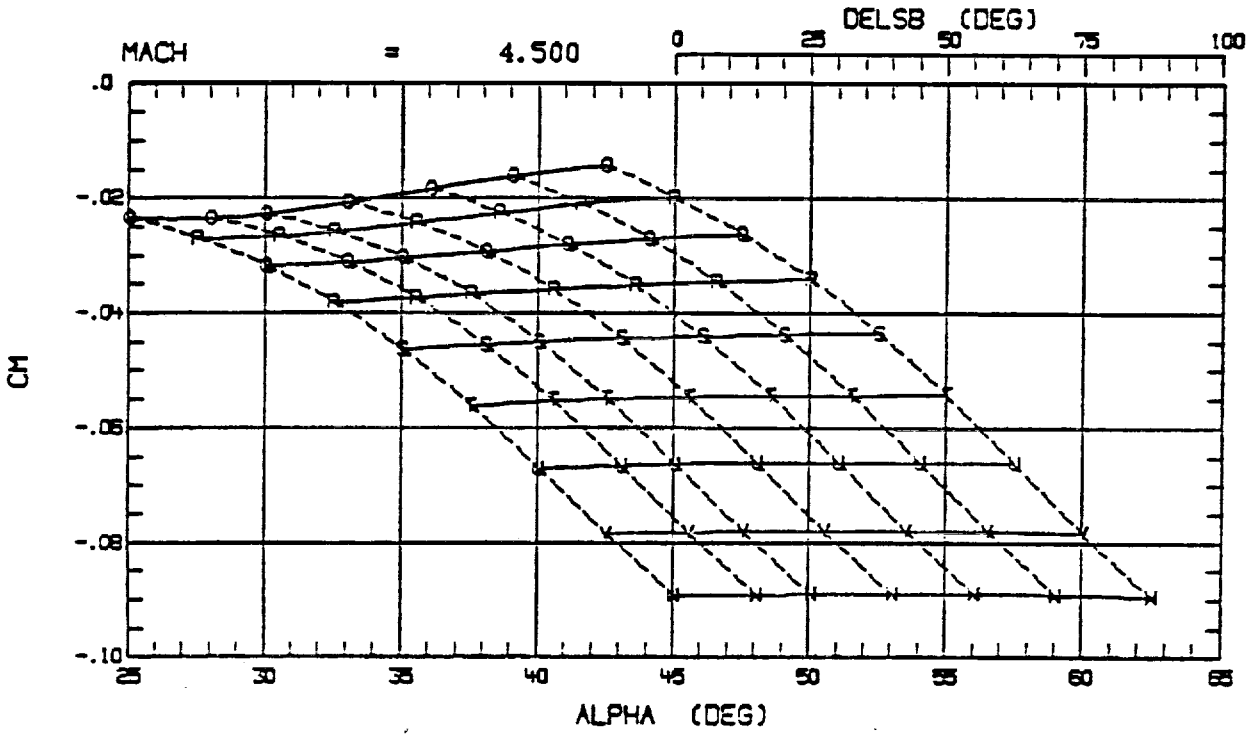


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	7.500 H	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01941	-0.01844	-0.01797	-0.01797	-0.01844	-0.01945	-0.02109	-0.02355	-0.02708
15.000	-0.02021	-0.01916	-0.01869	-0.01872	-0.01918	-0.02007	-0.02147	-0.02359	-0.02574
25.000	-0.01898	-0.01806	-0.01769	-0.01780	-0.01832	-0.01924	-0.02067	-0.02291	-0.02500
40.000	-0.01499	-0.01444	-0.01439	-0.01476	-0.01551	-0.01667	-0.01838	-0.02066	-0.02442
55.000	-0.00901	-0.00897	-0.00939	-0.01021	-0.01143	-0.01311	-0.01539	-0.01847	-0.02263
70.000	-0.00172	-0.00218	-0.00321	-0.00475	-0.00676	-0.00926	-0.01235	-0.01619	-0.02103
87.200	0.00738	0.00651	0.00462	0.00188	-0.00152	-0.00540	-0.00963	-0.01446	-0.01993

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-43
BASIC PITCHING MOMENT COEFFICIENT

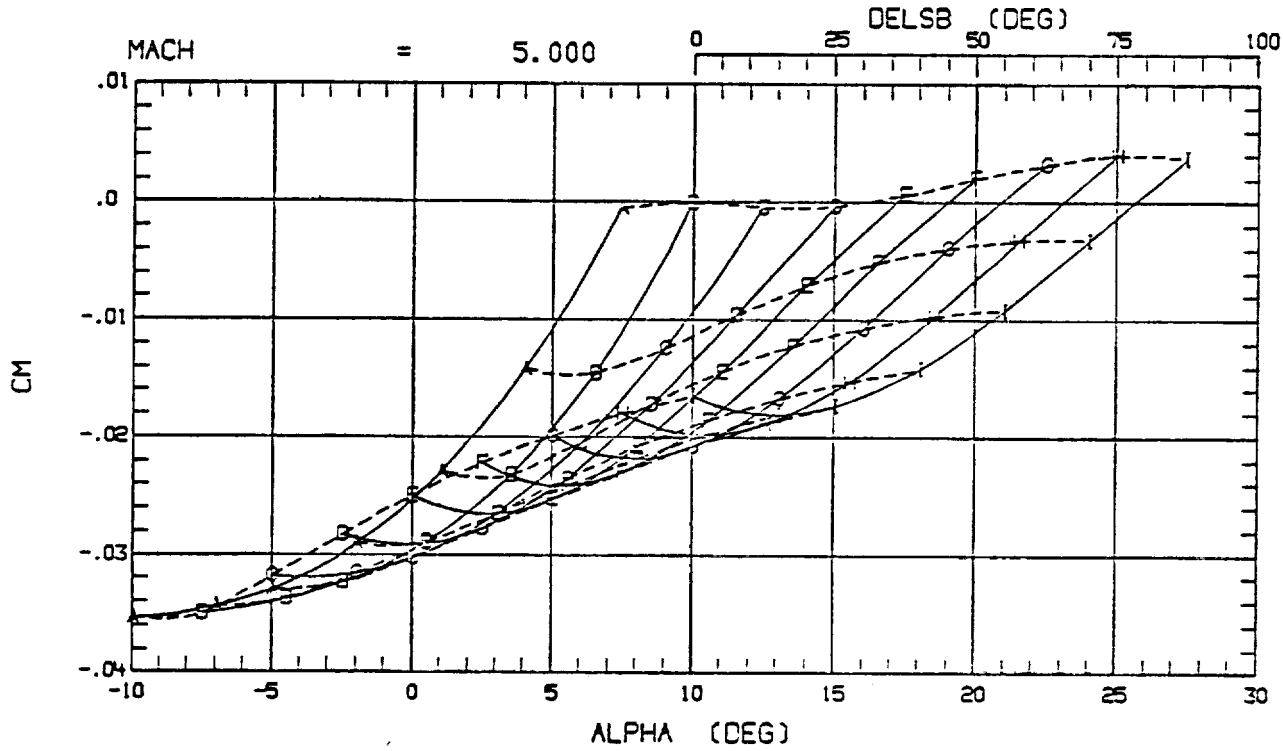


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.538 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	25.000 O	27.500 P	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02395	-0.02708	-0.03193	-0.03836	-0.04648	-0.05622	-0.05719	-0.07860	-0.08929
15.000	-0.02359	-0.02674	-0.03126	-0.03747	-0.04556	-0.05543	-0.05625	-0.07835	-0.08925
25.000	-0.02281	-0.02500	-0.03059	-0.03689	-0.04509	-0.05508	-0.05642	-0.07822	-0.08919
40.000	-0.02066	-0.02442	-0.02939	-0.03604	-0.04453	-0.05474	-0.05621	-0.07809	-0.08911
55.000	-0.01847	-0.02253	-0.02916	-0.03529	-0.04413	-0.05456	-0.05615	-0.07807	-0.08911
70.000	-0.01619	-0.02103	-0.02711	-0.03468	-0.04383	-0.05448	-0.05619	-0.07818	-0.08925
87.200	-0.01446	-0.01993	-0.02541	-0.03422	-0.04356	-0.05439	-0.05631	-0.07849	-0.08959

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-44
BASIC PITCHING MOMENT COEFFICIENT



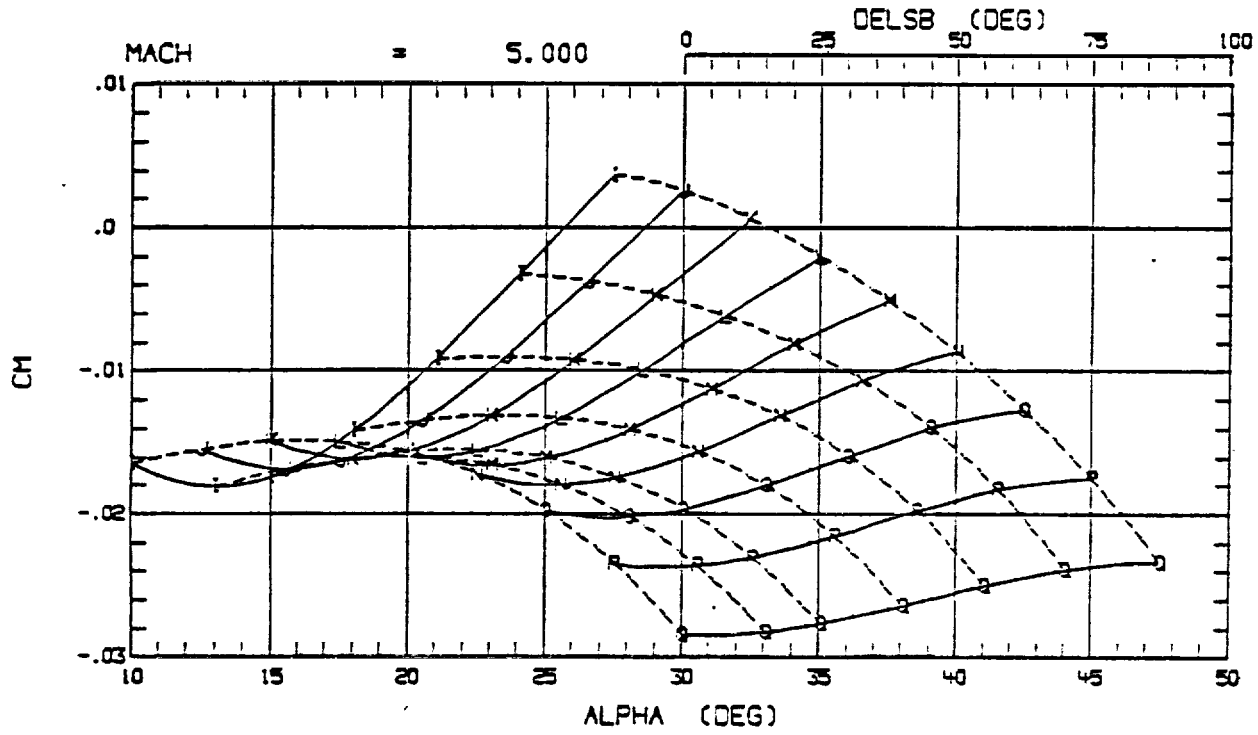
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.03538	-0.03505	-0.03191	-0.02827	-0.02497	-0.02220	-0.01991	-0.01802	-0.01652
15.000	-0.03447	-0.03381	-0.03166	-0.02912	-0.02658	-0.02415	-0.02188	-0.01985	-0.01814
25.000	-0.03298	-0.03242	-0.03030	-0.02780	-0.02533	-0.02301	-0.02088	-0.01898	-0.01741
40.000	-0.02913	-0.02896	-0.02649	-0.02357	-0.02090	-0.01885	-0.01681	-0.01534	-0.01421
55.000	-0.02302	-0.02324	-0.02053	-0.01728	-0.01444	-0.01228	-0.01076	-0.00977	-0.00923
70.000	-0.01429	-0.01457	-0.01244	-0.00969	-0.00718	-0.00523	-0.00395	-0.00332	-0.00328
87.200	-0.00056	-0.00010	-0.00052	-0.00037	0.00058	0.00195	0.00320	0.00395	0.00364

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-45
BASIC PITCHING MOMENT COEFFICIENT

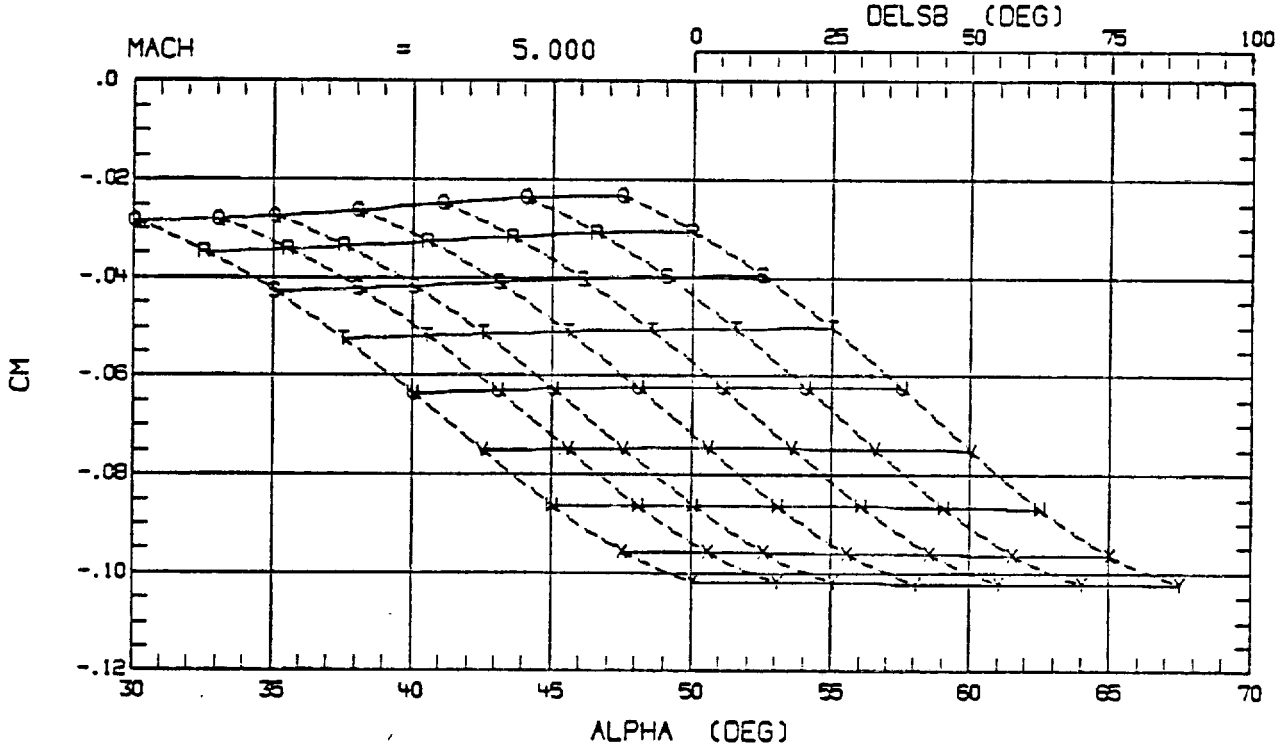


CONFIGURATION				
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW = 79.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01252	-0.01544	-0.01488	-0.01494	-0.01571	-0.01730	-0.01986	-0.02353	-0.02950
15.000	-0.01814	-0.01586	-0.01615	-0.01605	-0.01564	-0.01601	-0.02029	-0.02363	-0.02529
25.000	-0.01741	-0.01526	-0.01561	-0.01554	-0.01613	-0.01749	-0.01972	-0.02305	-0.02769
40.000	-0.01421	-0.01347	-0.01316	-0.01335	-0.01415	-0.01566	-0.01809	-0.02157	-0.02643
55.000	-0.00923	-0.00903	-0.00933	-0.01003	-0.01127	-0.01318	-0.01595	-0.01982	-0.02503
70.000	-0.00329	-0.00378	-0.00476	-0.00621	-0.00816	-0.01070	-0.01400	-0.01930	-0.02389
87.200	0.00364	0.00251	0.00056	-0.00205	-0.00515	-0.00869	-0.01273	-0.01752	-0.02338

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-46
BASIC PITCHING MOMENT COEFFICIENT



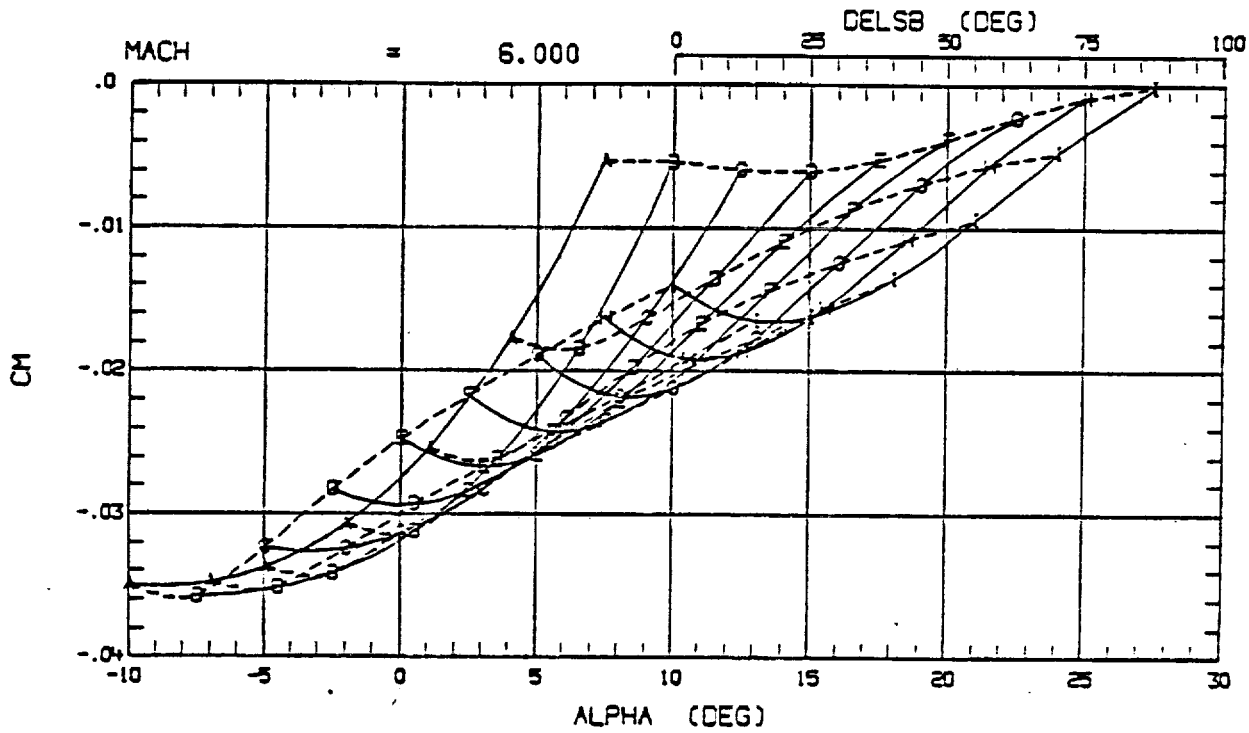
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.568 FT.
			BODY LENGTH	LB =	1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02950	-0.03496	-0.04304	-0.05271	-0.06369	-0.07534	-0.08660	-0.09601	-0.10196
15.000	-0.02829	-0.03447	-0.04238	-0.05200	-0.06308	-0.07493	-0.08642	-0.09602	-0.10203
25.000	-0.02769	-0.03391	-0.04188	-0.05160	-0.06290	-0.07478	-0.08639	-0.09607	-0.10211
40.000	-0.02643	-0.03298	-0.04111	-0.05110	-0.06253	-0.07470	-0.08644	-0.09619	-0.10224
55.000	-0.02503	-0.03185	-0.04042	-0.05072	-0.06241	-0.07476	-0.08659	-0.09634	-0.10235
70.000	-0.02389	-0.03103	-0.03991	-0.05048	-0.06239	-0.07490	-0.08679	-0.09650	-0.10239
87.200	-0.02338	-0.03068	-0.03967	-0.05037	-0.06244	-0.07508	-0.08702	-0.09665	-0.10231

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-47
BASIC PITCHING MOMENT COEFFICIENT

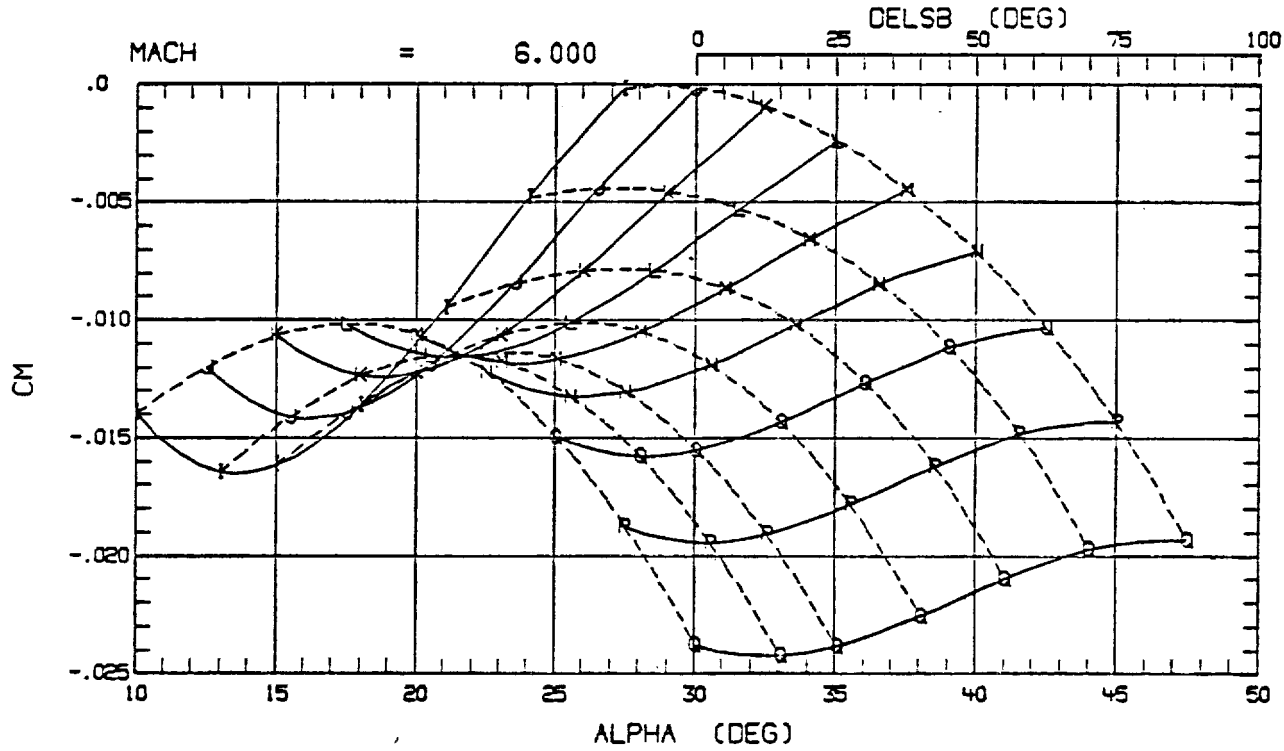


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.558 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.03507	-0.03582	-0.03243	-0.02937	-0.02476	-0.02166	-0.01992	-0.01535	-0.01399
15.000	-0.03484	-0.03321	-0.03244	-0.02939	-0.02673	-0.02429	-0.02150	-0.01915	-0.01650
25.000	-0.03382	-0.03418	-0.03141	-0.02941	-0.02586	-0.02356	-0.02122	-0.01973	-0.01621
40.000	-0.03073	-0.03129	-0.02931	-0.02498	-0.02219	-0.01966	-0.01774	-0.01566	-0.01328
55.000	-0.02549	-0.02524	-0.02330	-0.01980	-0.01679	-0.01440	-0.01247	-0.01035	-0.00949
70.000	-0.01776	-0.01847	-0.01637	-0.01357	-0.01093	-0.00871	-0.00696	-0.00525	-0.00421
87.200	-0.00539	-0.00546	-0.00503	-0.00605	-0.00526	-0.00387	-0.00229	-0.00096	-0.00019

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-48
BASIC PITCHING MOMENT COEFFICIENT



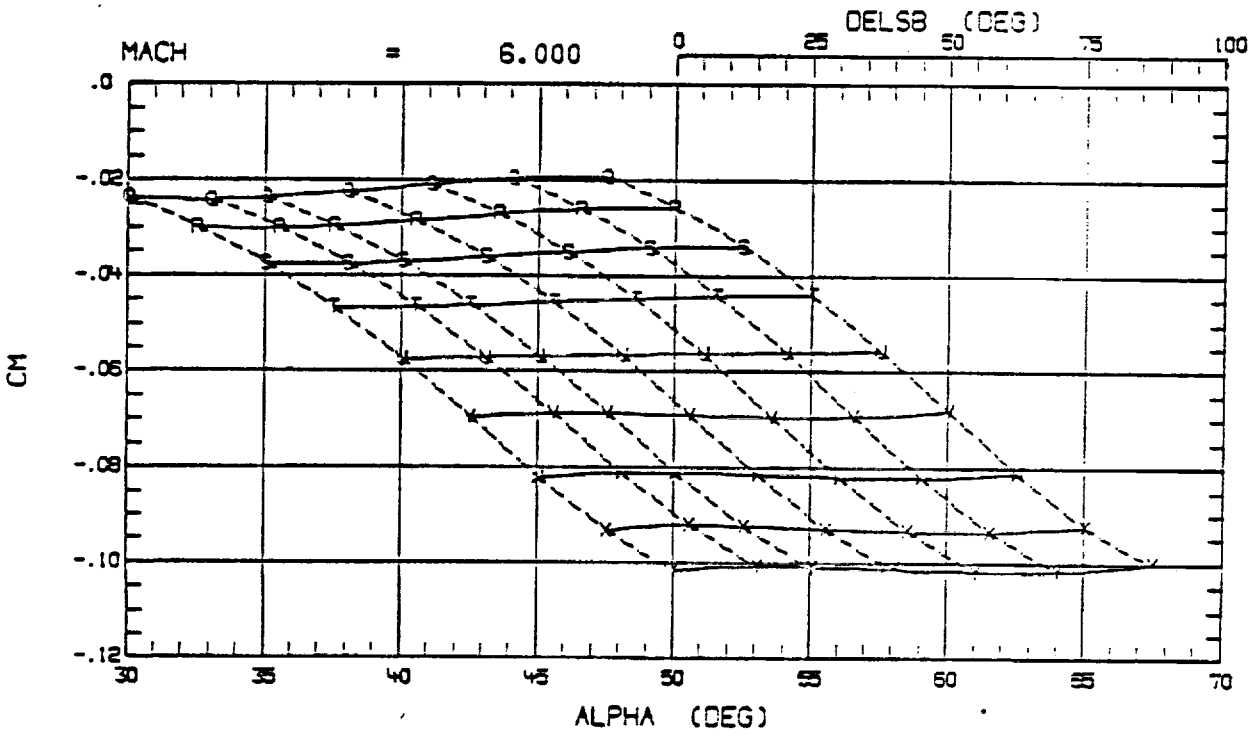
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01399	-0.01203	-0.01069	-0.01019	-0.01069	-0.01227	-0.01496	-0.01878	-0.02379
15.000	-0.01650	-0.01413	-0.01239	-0.01156	-0.01183	-0.01325	-0.01580	-0.01947	-0.02426
25.000	-0.01621	-0.01394	-0.01227	-0.01146	-0.01170	-0.01307	-0.01554	-0.01912	-0.02365
40.000	-0.01365	-0.01191	-0.01067	-0.01016	-0.01055	-0.01193	-0.01435	-0.01786	-0.02257
55.000	-0.00949	-0.00847	-0.00791	-0.00794	-0.00868	-0.01023	-0.01270	-0.01623	-0.02100
70.000	-0.00481	-0.00445	-0.00461	-0.00530	-0.00557	-0.00849	-0.01119	-0.01424	-0.01972
87.200	-0.00019	-0.00018	-0.00095	-0.00242	-0.00451	-0.00713	-0.01035	-0.01433	-0.01937

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-49
BASIC PITCHING MOMENT COEFFICIENT

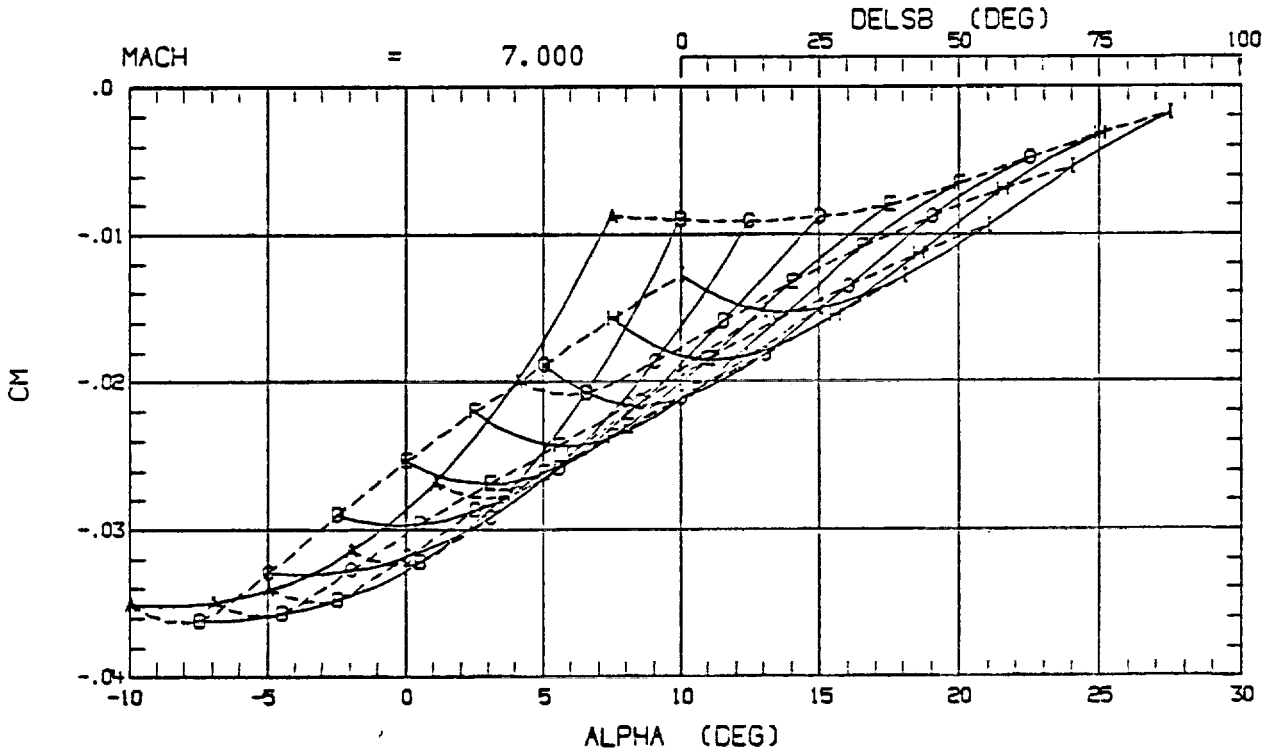


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02379	-0.03009	-0.03781	-0.04702	-0.05784	-0.06963	-0.08224	-0.09351	-0.10185
15.000	-0.02425	-0.03030	-0.03772	-0.04668	-0.05714	-0.06895	-0.08127	-0.09216	-0.10094
25.000	-0.02385	-0.02985	-0.03729	-0.04631	-0.05629	-0.06889	-0.08123	-0.09260	-0.10029
40.000	-0.02257	-0.02965	-0.03630	-0.04564	-0.05689	-0.06924	-0.08156	-0.09308	-0.10146
55.000	-0.02100	-0.02728	-0.03520	-0.04495	-0.05634	-0.06964	-0.08219	-0.09363	-0.10191
70.000	-0.01972	-0.02514	-0.03432	-0.04438	-0.05609	-0.06959	-0.08230	-0.09370	-0.10183
87.200	-0.01937	-0.02583	-0.03400	-0.04404	-0.05574	-0.06932	-0.08116	-0.09246	-0.10033

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-50
BASIC PITCHING MOMENT COEFFICIENT



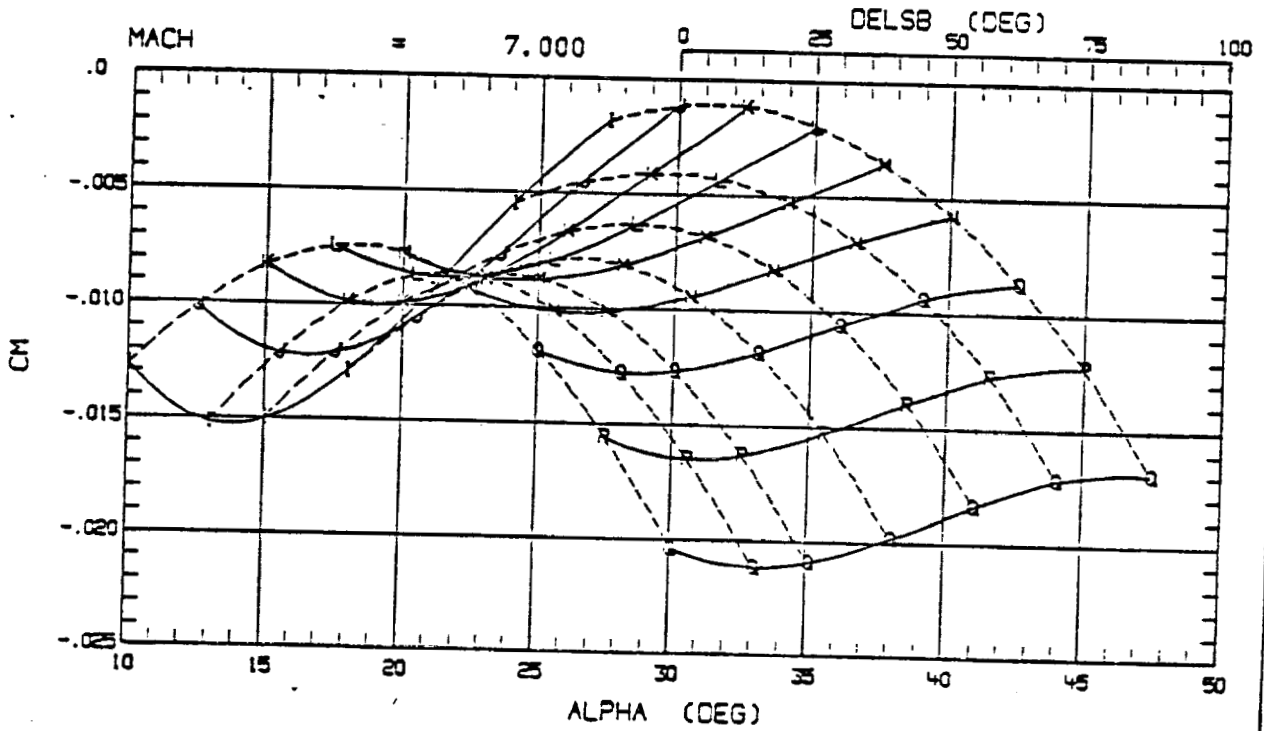
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 79.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.03513	-0.03627	-0.03303	-0.02904	-0.02538	-0.02207	-0.01899	-0.01574	-0.01275
15.000	-0.03500	-0.03574	-0.03262	-0.02984	-0.02592	-0.02437	-0.02159	-0.01847	-0.01520
25.000	-0.03416	-0.03484	-0.03191	-0.02878	-0.02616	-0.02375	-0.02115	-0.01819	-0.01506
40.000	-0.03150	-0.03229	-0.02925	-0.02589	-0.02305	-0.02059	-0.01914	-0.01555	-0.01293
55.000	-0.02588	-0.02779	-0.02492	-0.02147	-0.01845	-0.01587	-0.01356	-0.01139	-0.00941
70.000	-0.01998	-0.02092	-0.01873	-0.01596	-0.01330	-0.01091	-0.00879	-0.00697	-0.00550
87.200	-0.00881	-0.00906	-0.00915	-0.00885	-0.00798	-0.00659	-0.00488	-0.00320	-0.00186

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-51
BASIC PITCHING MOMENT COEFFICIENT



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY XO = FS 1075.7 IN.
OR YO = BL 0.0 IN.
MOMENT REFERENCE ZO = WL 375.0 IN.

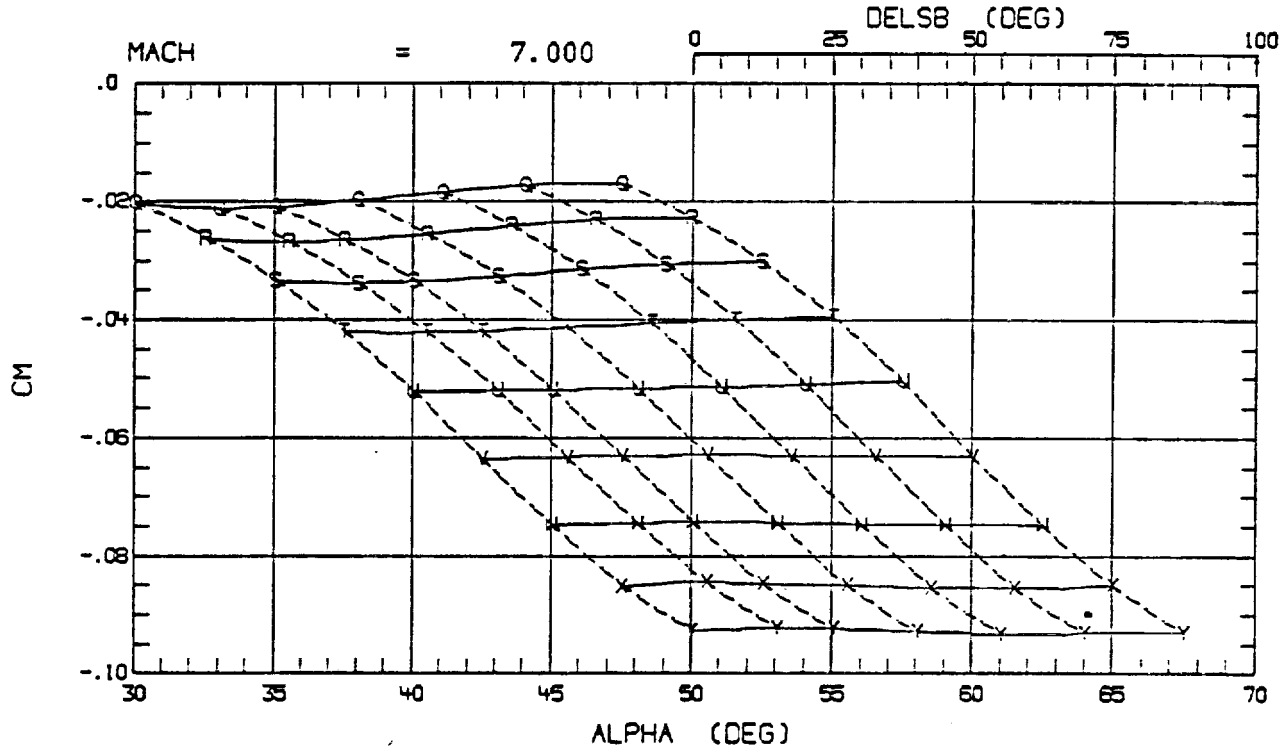
REFERENCE DIMENSIONS

WING AREA SW = 2690.00 SQ.FT.
WING SPAN BW = 78.057 FT.
M.A.C. CW = 39.562 FT.
BODY LENGTH LB = 1290.0 IN.

DELSB (DEG)	ALPHA (DEG) 10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
	PITCHING MOMENT COEFFICIENT								
0.0	-0.01275	-0.01018	-0.00934	-0.00750	-0.00781	-0.00931	-0.01194	-0.01564	-0.02041
15.000	-0.01520	-0.01219	-0.00990	-0.00970	-0.00979	-0.01019	-0.01280	-0.01650	-0.02121
25.000	-0.01506	-0.01215	-0.00993	-0.00974	-0.00980	-0.01015	-0.01270	-0.01632	-0.02096
40.000	-0.01293	-0.01056	-0.00879	-0.00792	-0.00912	-0.00948	-0.01186	-0.01532	-0.01986
55.000	-0.00941	-0.00777	-0.00669	-0.00635	-0.00565	-0.00625	-0.01061	-0.01395	-0.01841
70.000	-0.00550	-0.00451	-0.00411	-0.00435	-0.00530	-0.00696	-0.00941	-0.01275	-0.01722
87.200	-0.00196	-0.00114	-0.00117	-0.00198	-0.00354	-0.00573	-0.00867	-0.01232	-0.01624

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-52
BASIC PITCHING MOMENT COEFFICIENT

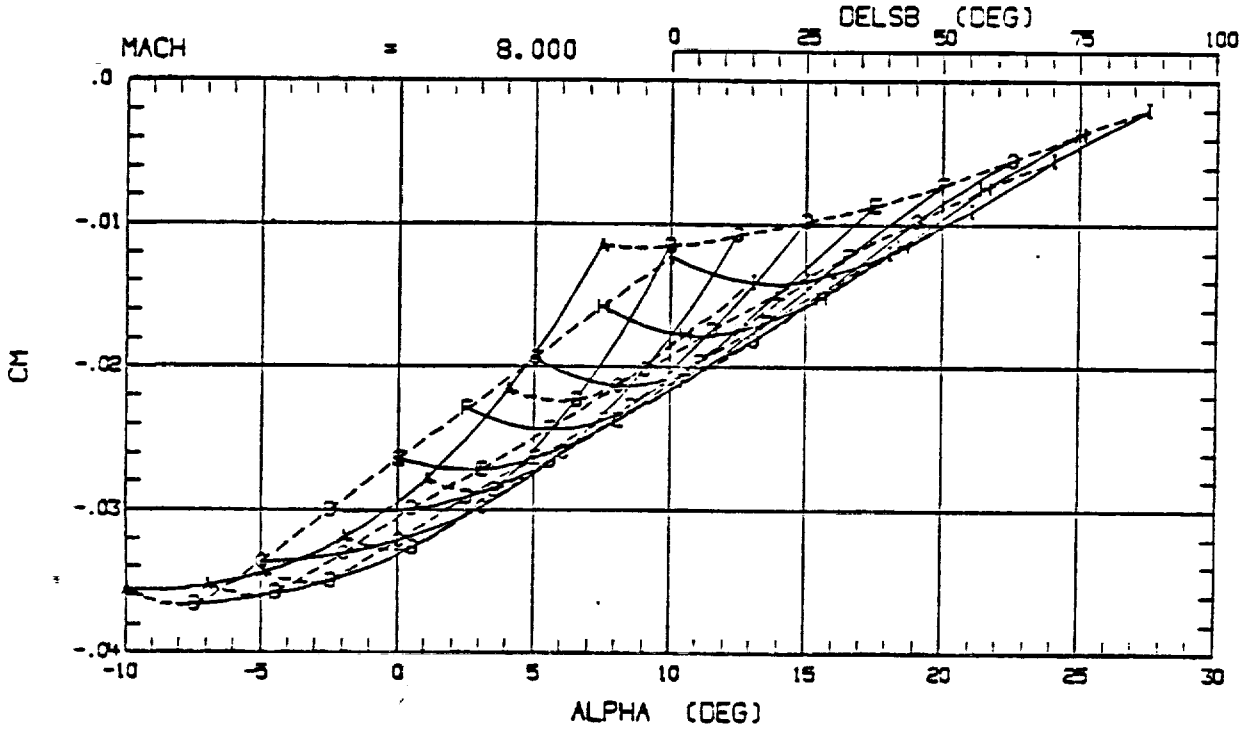


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000	32.500	35.000	37.500	40.000	42.500	45.000	47.500	50.000
	Q	R	S	T	U	V	W	X	Y
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.02041	-0.02532	-0.03353	-0.04219	-0.05233	-0.06383	-0.07500	-0.08536	-0.09293
15.000	-0.02121	-0.02695	-0.03390	-0.04225	-0.05211	-0.06333	-0.07458	-0.08457	-0.09239
25.000	-0.02096	-0.02666	-0.03361	-0.04202	-0.05198	-0.06315	-0.07442	-0.08482	-0.09251
40.000	-0.01986	-0.02558	-0.03270	-0.04141	-0.05177	-0.06306	-0.07452	-0.08513	-0.09298
55.000	-0.01841	-0.02420	-0.03156	-0.04067	-0.05150	-0.06309	-0.07475	-0.08550	-0.09338
70.000	-0.01722	-0.02308	-0.03061	-0.03999	-0.05113	-0.06314	-0.07495	-0.08564	-0.09327
87.200	-0.01694	-0.02292	-0.03028	-0.03954	-0.05053	-0.06312	-0.07494	-0.08513	-0.09324

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-53
BASIC PITCHING MOMENT COEFFICIENT

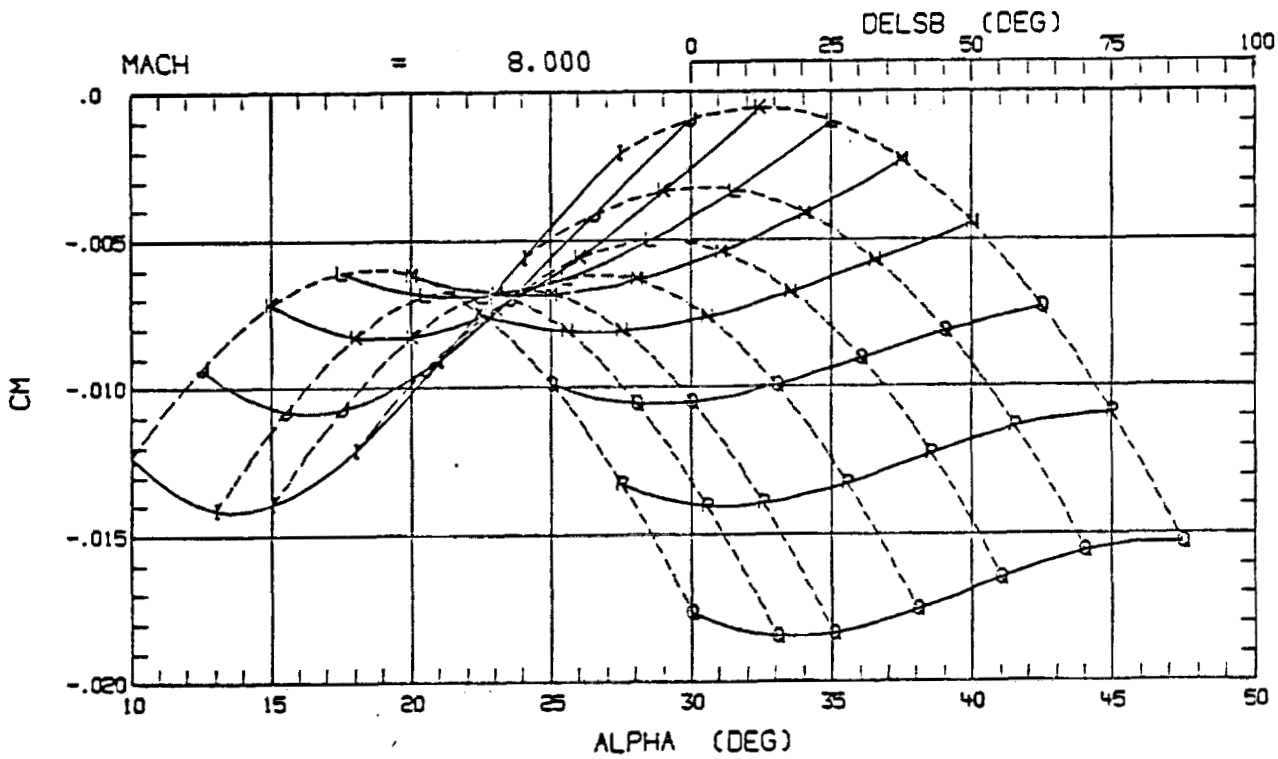


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.03585	-0.03664	-0.03372	-0.03003	-0.02545	-0.02297	-0.01941	-0.01579	-0.01232
15.000	-0.03530	-0.03528	-0.03306	-0.02996	-0.02719	-0.02441	-0.02131	-0.01730	-0.01415
25.000	-0.03445	-0.03300	-0.03216	-0.02910	-0.02541	-0.02378	-0.02083	-0.01748	-0.01396
40.000	-0.03203	-0.03269	-0.02984	-0.02561	-0.02374	-0.02104	-0.01822	-0.01518	-0.01212
55.000	-0.02798	-0.02968	-0.02599	-0.02272	-0.01970	-0.01692	-0.01422	-0.01157	-0.00909
70.000	-0.02167	-0.02238	-0.02024	-0.01748	-0.01478	-0.01234	-0.00962	-0.00756	-0.00561
87.200	-0.01155	-0.01159	-0.01081	-0.00965	-0.00872	-0.00729	-0.00554	-0.00371	-0.00207

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-54
BASIC PITCHING MOMENT COEFFICIENT



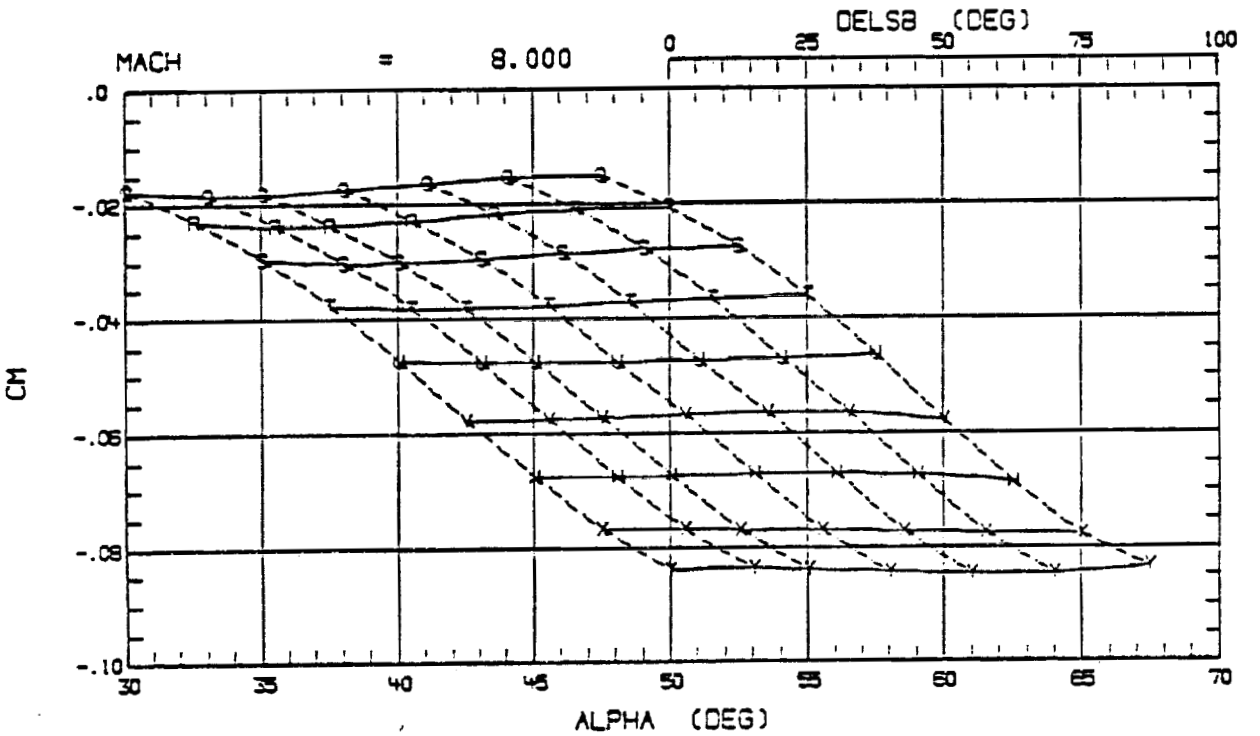
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	SW = 73.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01232	-0.00932	-0.00716	-0.00603	-0.00620	-0.00752	-0.00991	-0.01330	-0.01785
15.000	-0.01415	-0.01081	-0.00825	-0.00687	-0.00681	-0.00808	-0.01055	-0.01405	-0.01947
25.000	-0.01396	-0.01073	-0.00825	-0.00689	-0.00683	-0.00808	-0.01051	-0.01397	-0.01836
40.000	-0.01212	-0.00938	-0.00733	-0.00629	-0.00637	-0.00762	-0.00995	-0.01329	-0.01758
55.000	-0.00909	-0.00701	-0.00560	-0.00504	-0.00543	-0.00678	-0.00906	-0.01227	-0.01649
70.000	-0.00561	-0.00415	-0.00336	-0.00334	-0.00414	-0.00573	-0.00912	-0.01135	-0.01557
87.200	-0.00207	-0.00094	-0.00056	-0.00102	-0.00236	-0.00448	-0.00733	-0.01092	-0.01535

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-55
BASIC PITCHING MOMENT COEFFICIENT

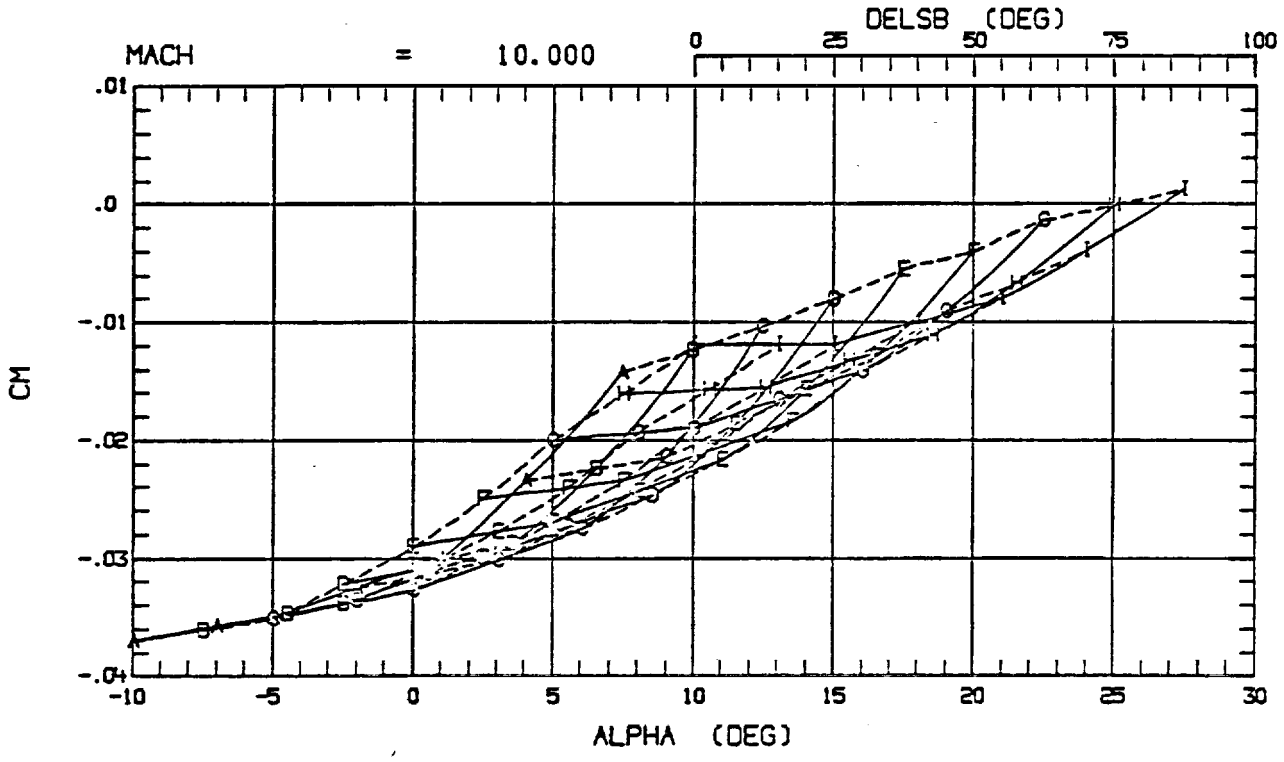


CONFIGURATION			
BASELINE OPSITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2650.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 33.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01785	-0.02305	-0.02971	-0.03783	-0.04752	-0.05782	-0.06776	-0.07701	-0.08401
15.000	-0.01947	-0.02385	-0.03036	-0.03825	-0.04766	-0.05771	-0.06774	-0.07699	-0.08324
25.000	-0.01938	-0.02374	-0.03027	-0.03821	-0.04769	-0.05742	-0.06781	-0.07704	-0.08403
40.000	-0.01758	-0.02297	-0.02954	-0.03784	-0.04765	-0.05689	-0.06737	-0.07718	-0.08450
55.000	-0.01849	-0.02191	-0.02976	-0.03727	-0.04747	-0.05655	-0.06730	-0.07738	-0.08425
70.000	-0.01557	-0.02103	-0.02900	-0.03671	-0.04714	-0.05670	-0.06781	-0.07759	-0.08471
87.200	-0.01535	-0.02087	-0.02779	-0.03633	-0.04625	-0.05732	-0.06870	-0.07781	-0.08346

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-56
BASIC PITCHING MOMENT COEFFICIENT



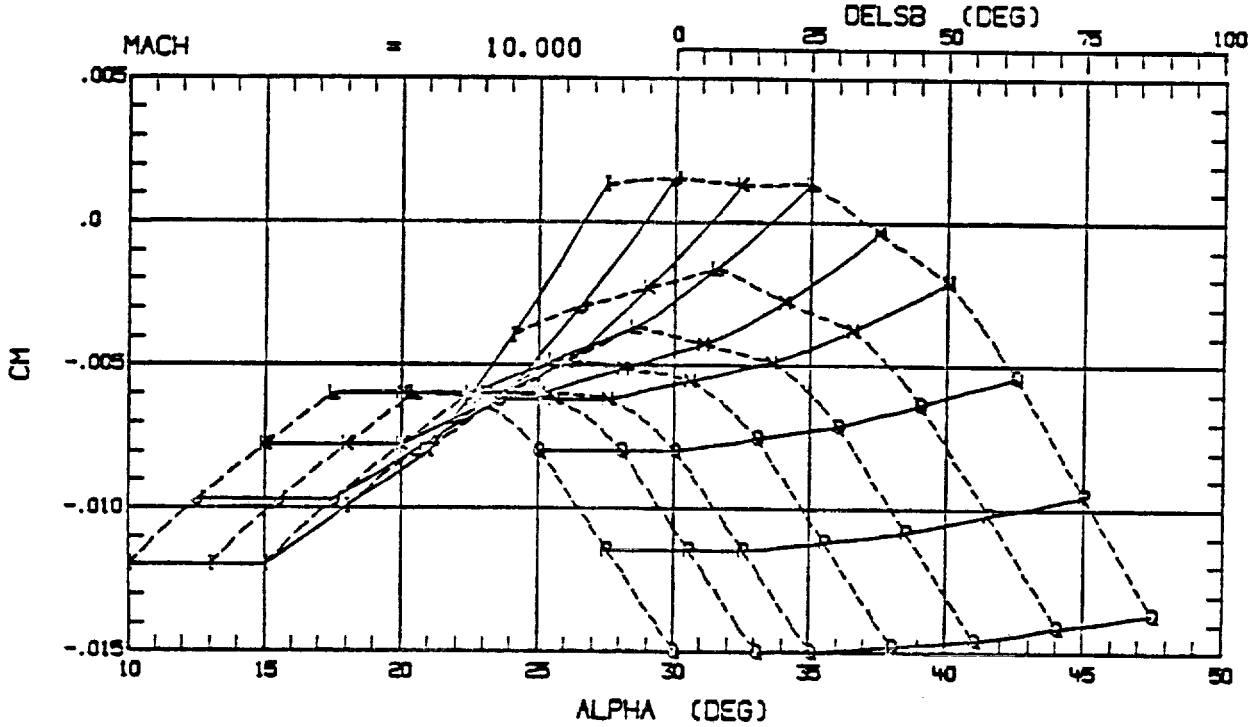
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2550.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 79.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.03710	-0.03613	-0.03516	-0.03223	-0.02910	-0.02507	-0.02005	-0.01612	-0.01200
15.000	-0.03580	-0.03475	-0.03370	-0.03095	-0.02780	-0.02410	-0.01940	-0.01580	-0.01200
25.000	-0.03500	-0.03390	-0.03280	-0.03000	-0.02700	-0.02350	-0.01900	-0.01560	-0.01200
40.000	-0.03255	-0.03138	-0.03021	-0.02739	-0.02437	-0.02099	-0.01660	-0.01339	-0.00999
55.000	-0.03012	-0.02887	-0.02762	-0.02479	-0.02175	-0.01847	-0.01420	-0.01119	-0.00798
70.000	-0.02355	-0.02250	-0.02145	-0.01870	-0.01575	-0.01297	-0.00920	-0.00570	-0.00400
87.200	-0.01440	-0.01241	-0.01042	-0.00811	-0.00560	-0.00403	-0.00145	-0.00017	0.00130

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-57
BASIC PITCHING MOMENT COEFFICIENT

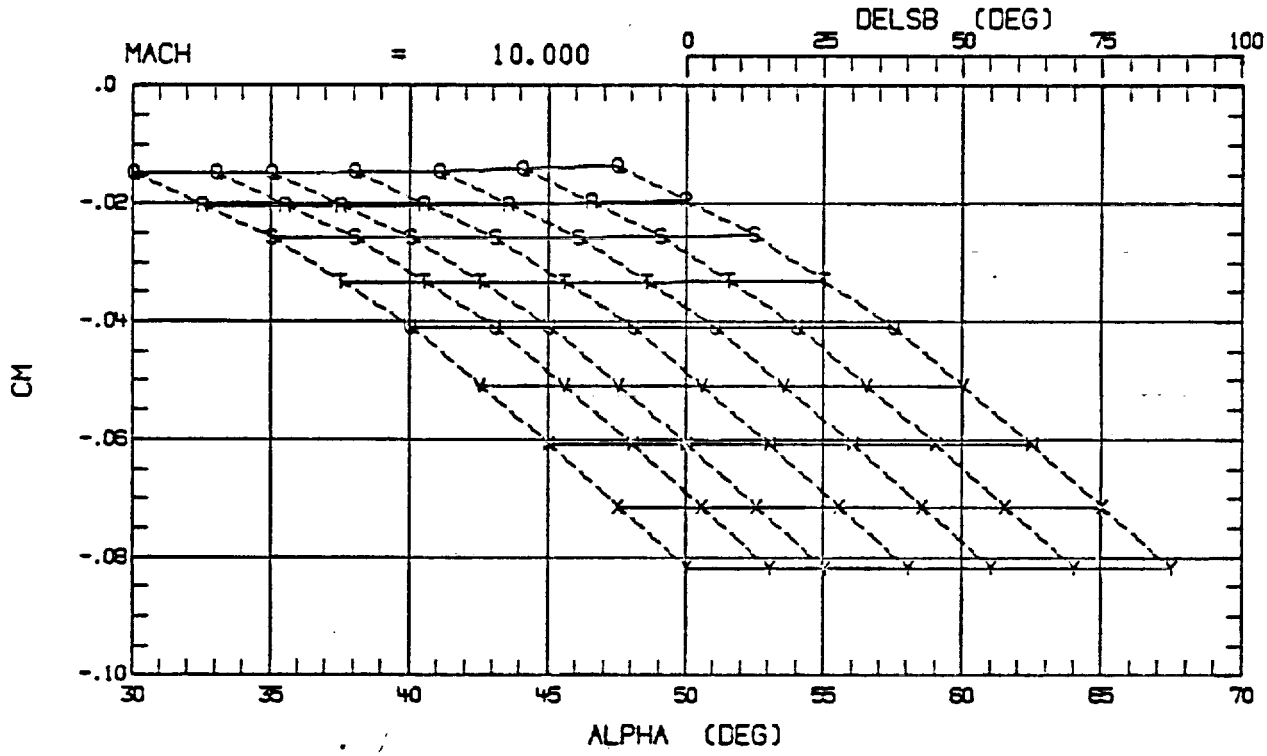


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01200	-0.00970	-0.00780	-0.00600	-0.00600	-0.00620	-0.00800	-0.01150	-0.01500
15.000	-0.01200	-0.00970	-0.00780	-0.00600	-0.00600	-0.00620	-0.00800	-0.01150	-0.01500
25.000	-0.01200	-0.00970	-0.00780	-0.00600	-0.00600	-0.00620	-0.00800	-0.01150	-0.01500
40.000	-0.00999	-0.00797	-0.00635	-0.00485	-0.00514	-0.00556	-0.00756	-0.01119	-0.01481
55.000	-0.00798	-0.00624	-0.00490	-0.00370	-0.00430	-0.00491	-0.00712	-0.01086	-0.01460
70.000	-0.00400	-0.00296	-0.00232	-0.00166	-0.00290	-0.00378	-0.00635	-0.01025	-0.01415
87.200	0.00130	0.00149	0.00129	0.00134	-0.00040	-0.00210	-0.00540	-0.00955	-0.01370

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-58
BASIC PITCHING MOMENT COEFFICIENT

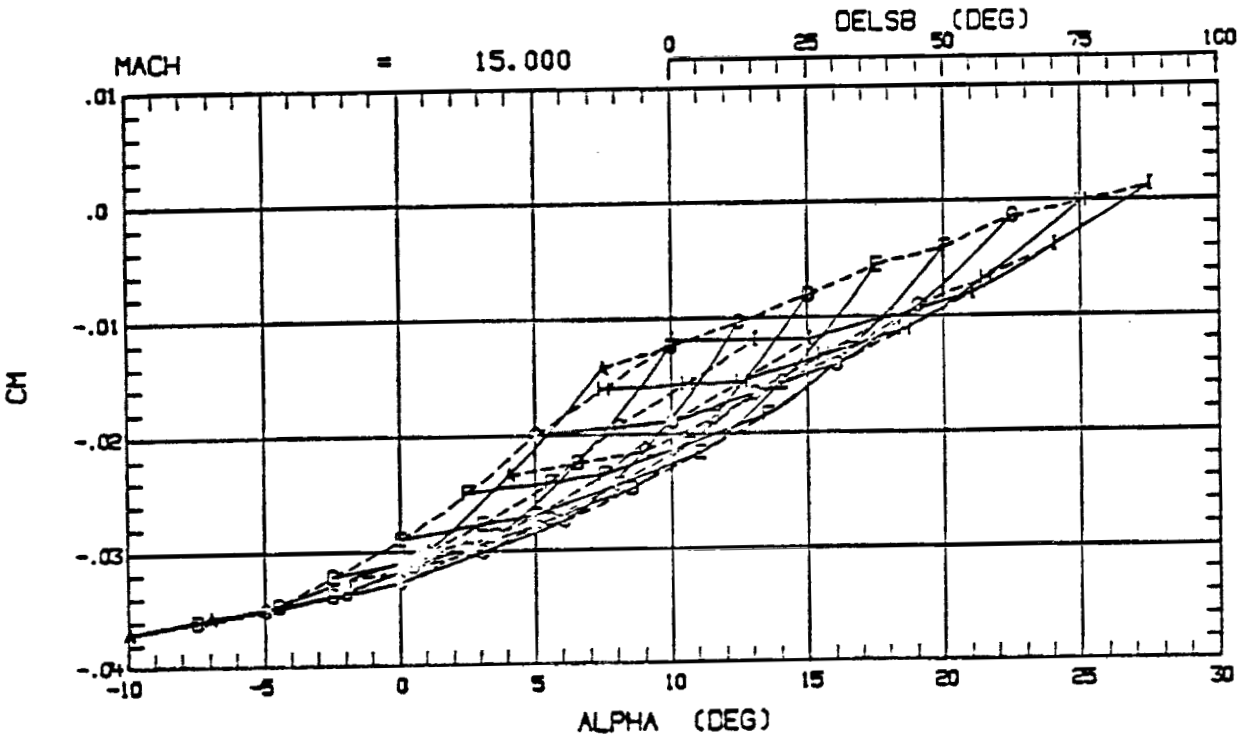


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.538 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01500	-0.02050	-0.02500	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
15.000	-0.01500	-0.02050	-0.02500	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
25.000	-0.01500	-0.02050	-0.02500	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
40.000	-0.01481	-0.02041	-0.02500	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
55.000	-0.01460	-0.02021	-0.02582	-0.03341	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
70.000	-0.01415	-0.01990	-0.02566	-0.03333	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
87.200	-0.01370	-0.01957	-0.02545	-0.03322	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-59
BASIC PITCHING MOMENT COEFFICIENT



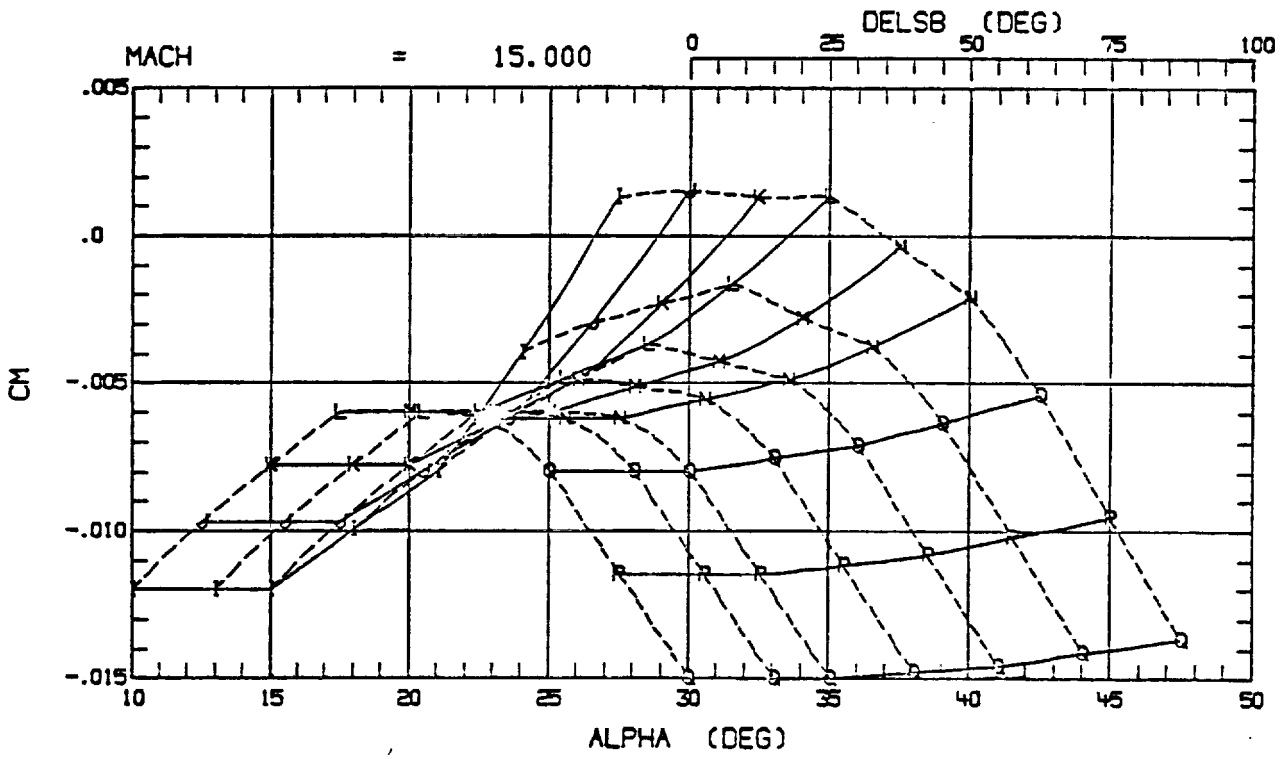
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	79.057 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.568 FT.
			BODY LENGTH	LB =	1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.03710	-0.03613	-0.03516	-0.03223	-0.02910	-0.02507	-0.02005	-0.01612	-0.01200
15.000	-0.03580	-0.03475	-0.03370	-0.03085	-0.02780	-0.02410	-0.01940	-0.01560	-0.01200
25.000	-0.03500	-0.03390	-0.03290	-0.03000	-0.02700	-0.02350	-0.01900	-0.01560	-0.01200
40.000	-0.03255	-0.03138	-0.03021	-0.02739	-0.02437	-0.02039	-0.01660	-0.01339	-0.00999
55.000	-0.03012	-0.02887	-0.02752	-0.02479	-0.02175	-0.01847	-0.01420	-0.01119	-0.00798
70.000	-0.02355	-0.02250	-0.02145	-0.01870	-0.01575	-0.01297	-0.00920	-0.00670	-0.00400
87.200	-0.01440	-0.01241	-0.01042	-0.00811	-0.00560	-0.00403	-0.00145	-0.00017	0.00139

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-60
BASIC PITCHING MOMENT COEFFICIENT

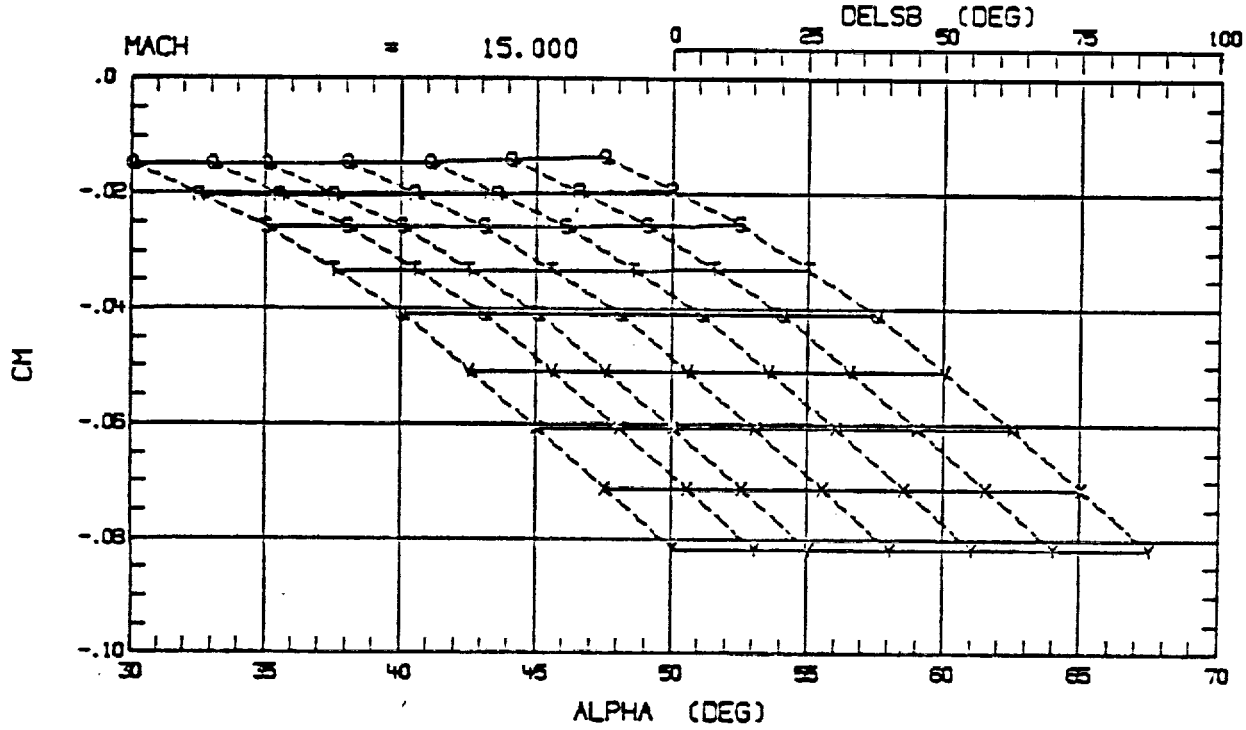


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01200	-0.00970	-0.00780	-0.00600	-0.00600	-0.00620	-0.00600	-0.01150	-0.01500
15.000	-0.01200	-0.00970	-0.00780	-0.00600	-0.00600	-0.00620	-0.00600	-0.01150	-0.01500
25.000	-0.01200	-0.00970	-0.00780	-0.00600	-0.00600	-0.00620	-0.00600	-0.01150	-0.01500
40.000	-0.00999	-0.00797	-0.00635	-0.00465	-0.00514	-0.00556	-0.00756	-0.01119	-0.01481
55.000	-0.00798	-0.00624	-0.00490	-0.00370	-0.00430	-0.00491	-0.00712	-0.01086	-0.01460
70.000	-0.00400	-0.00296	-0.00232	-0.00166	-0.00290	-0.00378	-0.00535	-0.01025	-0.01415
87.200	0.00130	0.00149	0.00129	0.00134	-0.00040	-0.00210	-0.00540	-0.00955	-0.01370

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-61
BASIC PITCHING MOMENT COEFFICIENT



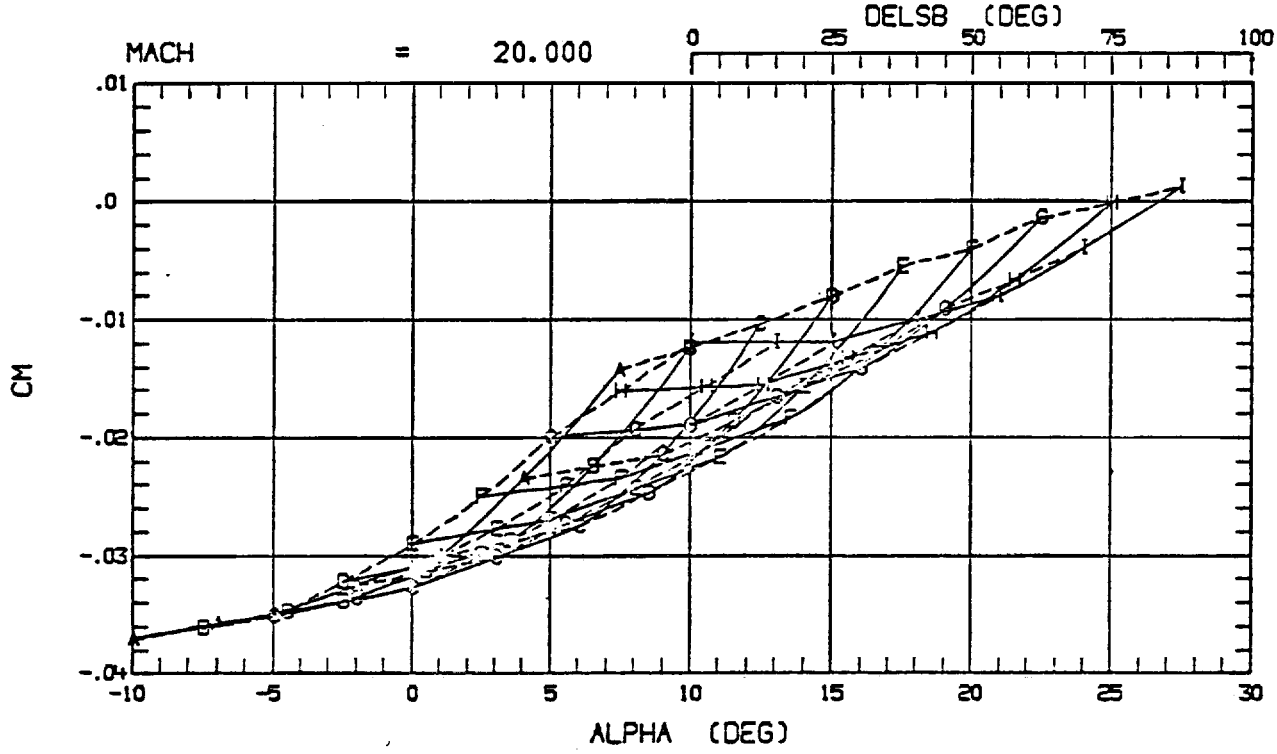
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01500	-0.02050	-0.02500	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
15.000	-0.01500	-0.02050	-0.02500	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
25.000	-0.01500	-0.02050	-0.02500	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
40.000	-0.01481	-0.02041	-0.02500	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
55.000	-0.01460	-0.02021	-0.02552	-0.03341	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
70.000	-0.01415	-0.01990	-0.02566	-0.03333	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
87.200	-0.01370	-0.01957	-0.02545	-0.03322	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-62
BASIC PITCHING MOMENT COEFFICIENT



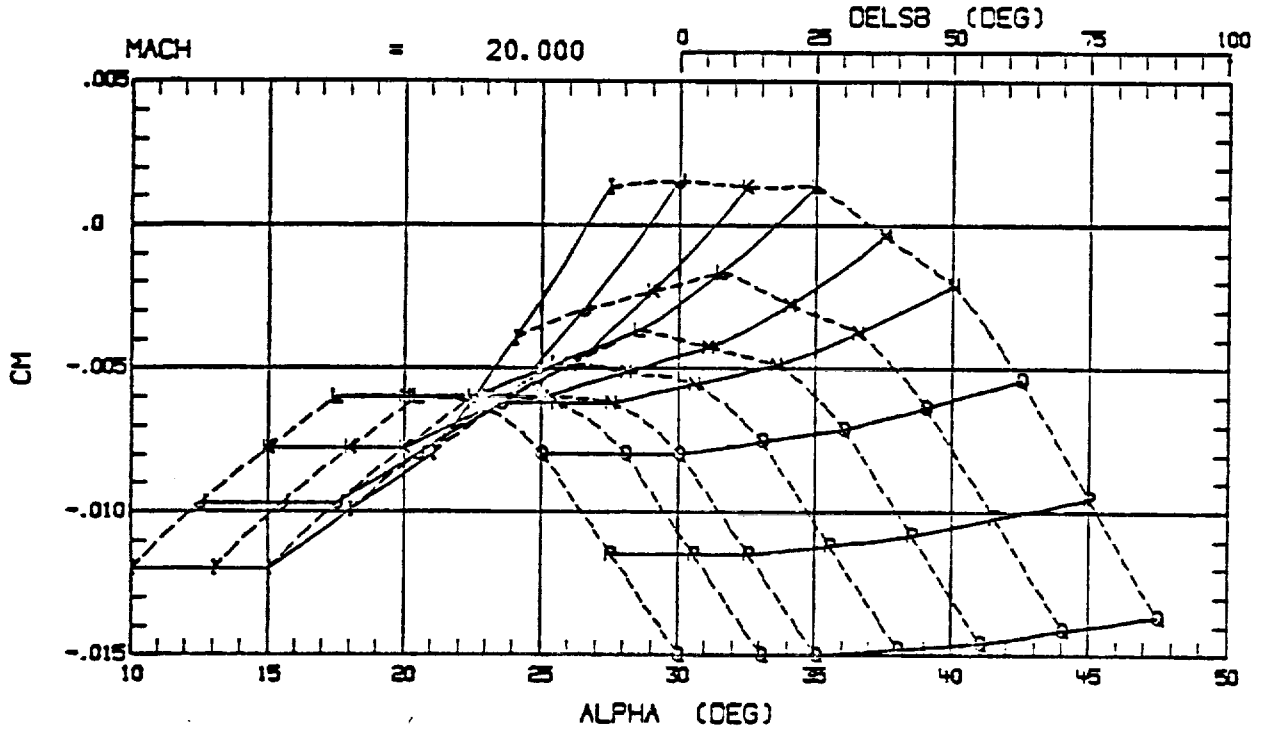
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2550.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.568 FT.
			BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	-10.000 A	-7.500 B	-5.000 C	-2.500 D	0.0 E	2.500 F	5.000 G	7.500 H	10.000 I
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.03710	-0.03613	-0.03516	-0.03223	-0.02910	-0.02507	-0.02005	-0.01612	-0.01200
15.000	-0.03590	-0.03475	-0.03370	-0.03085	-0.02780	-0.02410	-0.01940	-0.01580	-0.01200
25.000	-0.03500	-0.03390	-0.03280	-0.03000	-0.02700	-0.02350	-0.01900	-0.01560	-0.01200
40.000	-0.03255	-0.03138	-0.03021	-0.02739	-0.02437	-0.02099	-0.01660	-0.01339	-0.00999
55.000	-0.03012	-0.02887	-0.02762	-0.02479	-0.02175	-0.01847	-0.01420	-0.01119	-0.00798
70.000	-0.02355	-0.02250	-0.02145	-0.01870	-0.01575	-0.01297	-0.00920	-0.00670	-0.00400
87.200	-0.01440	-0.01241	-0.01042	-0.00811	-0.00560	-0.00403	-0.00145	-0.00017	0.00130

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-63
BASIC PITCHING MOMENT COEFFICIENT

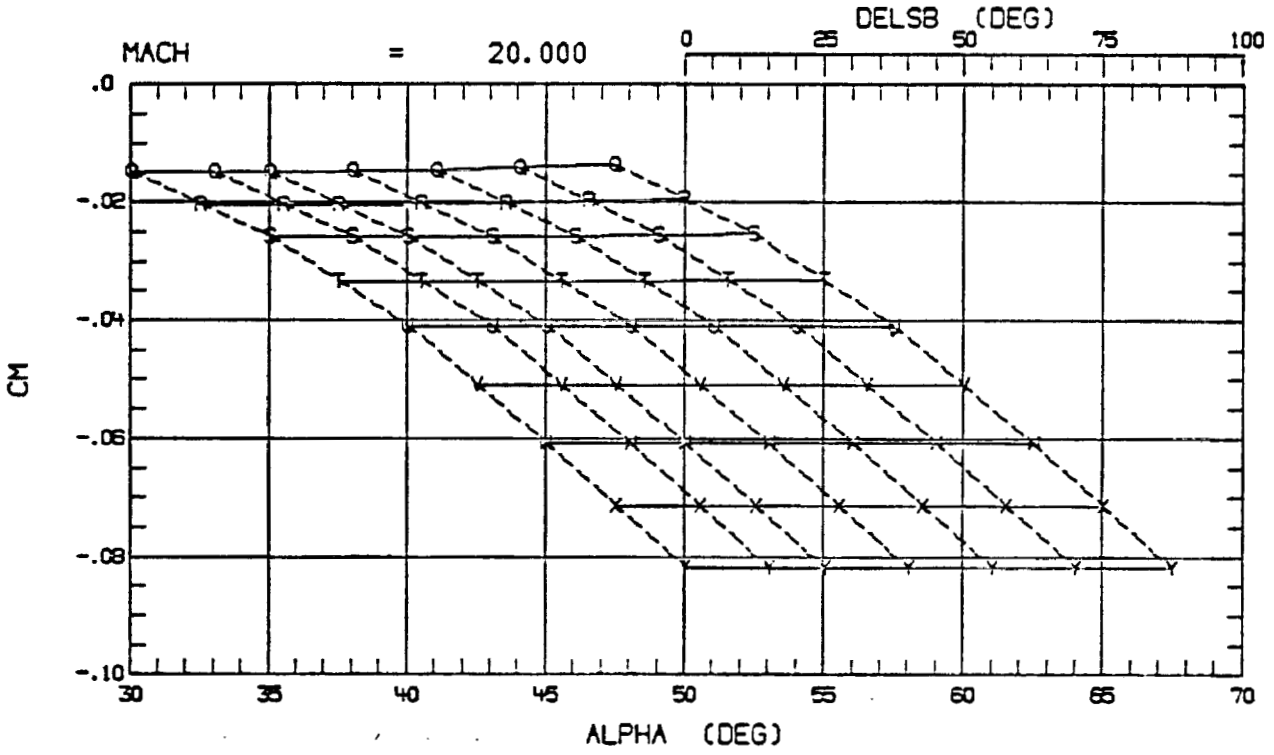


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.0 IN.

	ALPHA (DEG)								
	10.000 I	12.500 J	15.000 K	17.500 L	20.000 M	22.500 N	25.000 O	27.500 P	30.000 Q
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01200	-0.00970	-0.00780	-0.00600	-0.00600	-0.00620	-0.00800	-0.01150	-0.01500
15.000	-0.01200	-0.00970	-0.00790	-0.00500	-0.00600	-0.00620	-0.00900	-0.01150	-0.01500
25.000	-0.01200	-0.00970	-0.00760	-0.00500	-0.00500	-0.00620	-0.00900	-0.01150	-0.01500
40.000	-0.00999	-0.00797	-0.00635	-0.00485	-0.00514	-0.00556	-0.00756	-0.01119	-0.01481
55.000	-0.00799	-0.00624	-0.00490	-0.00370	-0.00430	-0.00491	-0.00712	-0.01086	-0.01460
70.000	-0.00400	-0.00296	-0.00232	-0.00165	-0.00290	-0.00379	-0.00635	-0.01025	-0.01415
87.200	0.00130	0.00149	0.00129	0.00134	-0.00040	-0.00210	-0.00540	-0.00955	-0.01370

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-64
BASIC PITCHING MOMENT COEFFICIENT



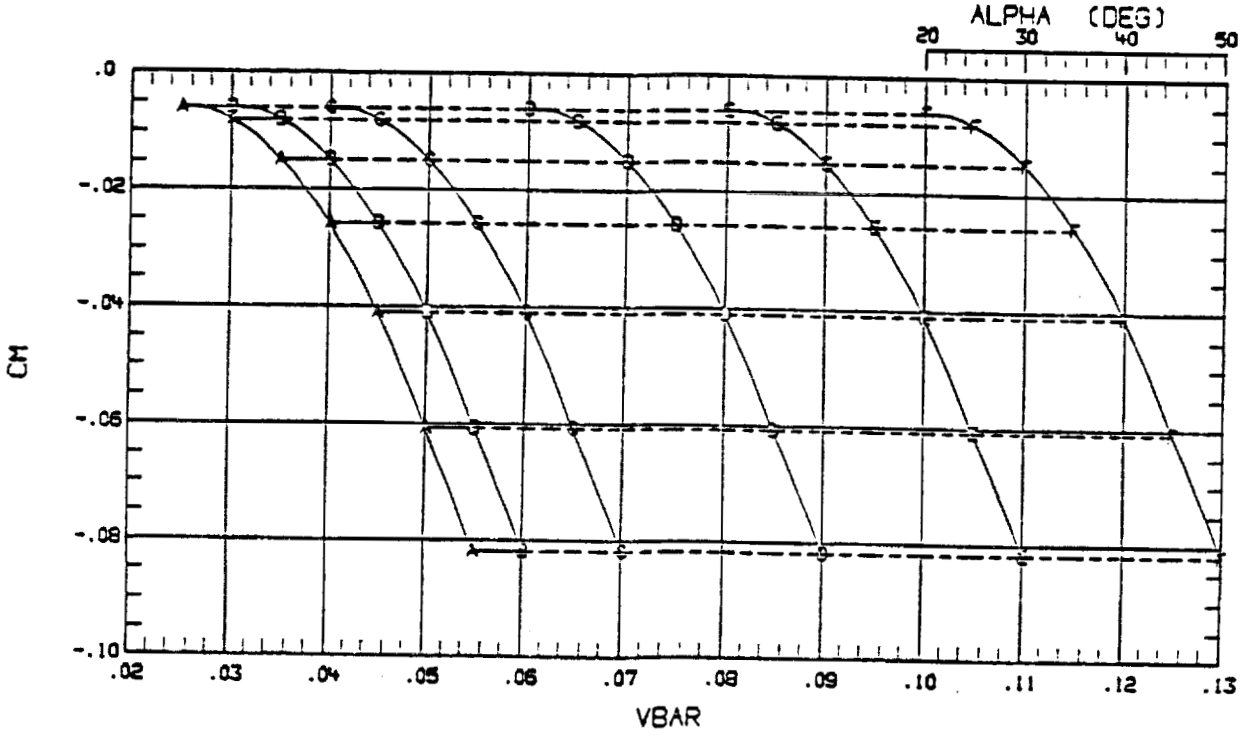
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 79.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1250.0 IN.

	ALPHA (DEG)								
	30.000 Q	32.500 R	35.000 S	37.500 T	40.000 U	42.500 V	45.000 W	47.500 X	50.000 Y
DELSB (DEG)	PITCHING MOMENT COEFFICIENT								
0.0	-0.01500	-0.02050	-0.02500	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
15.000	-0.01500	-0.02050	-0.02600	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
25.000	-0.01500	-0.02050	-0.02600	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
40.000	-0.01481	-0.02041	-0.02600	-0.03350	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
55.000	-0.01460	-0.02021	-0.02582	-0.03341	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
70.000	-0.01415	-0.01990	-0.02566	-0.03333	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200
87.200	-0.01370	-0.01957	-0.02545	-0.03322	-0.04100	-0.05100	-0.06100	-0.07150	-0.08200

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-65
BASIC PITCHING MOMENT COEFFICIENT

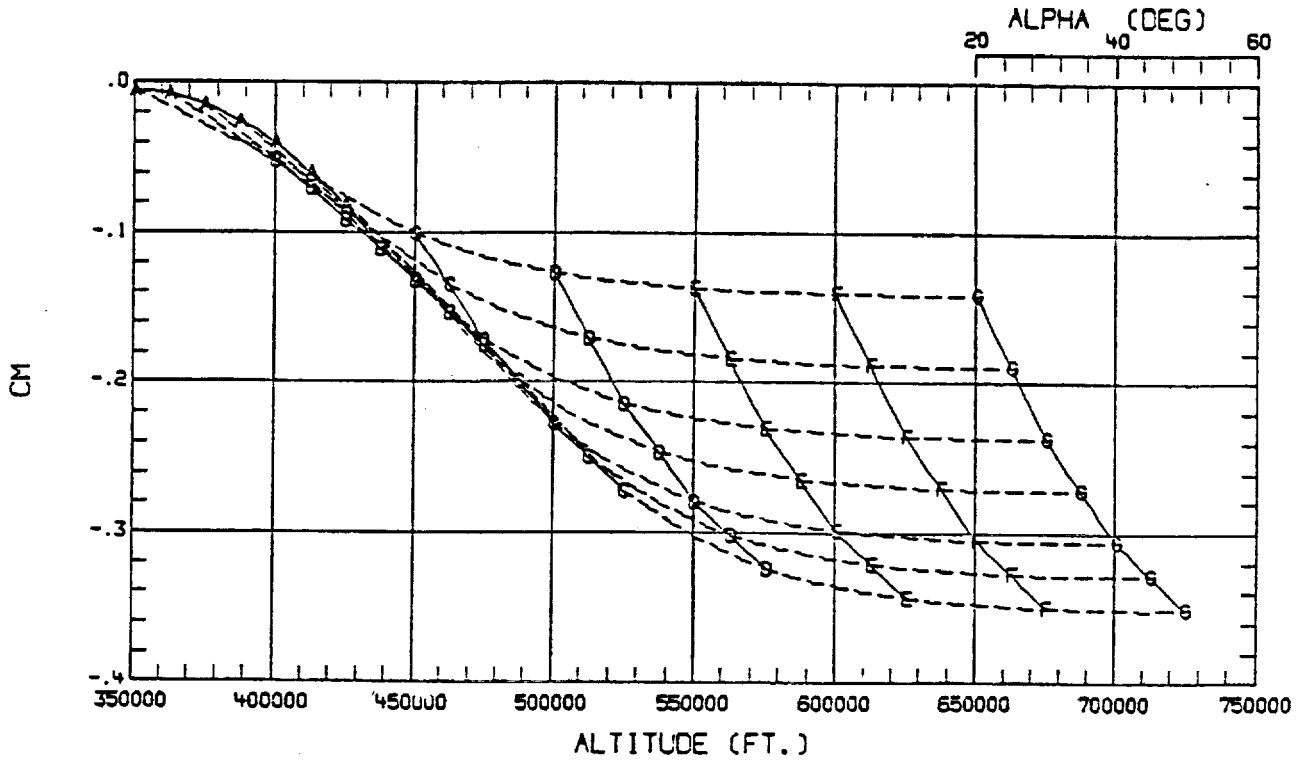


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 373.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	VBAR					
	0.005 A	0.010 B	0.020 C	0.040 D	0.060 E	0.080 F
ALPHA (DEG)	VIS. PITCHING MOMENT COEFFICIENT					
20.000	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600	-0.00600
25.000	-0.00800	-0.00800	-0.00800	-0.00800	-0.00800	-0.00800
30.000	-0.01500	-0.01500	-0.01500	-0.01500	-0.01500	-0.01500
35.000	-0.02500	-0.02500	-0.02500	-0.02500	-0.02500	-0.02500
40.000	-0.04100	-0.04100	-0.04100	-0.04100	-0.04100	-0.04100
45.000	-0.06100	-0.06100	-0.06100	-0.06100	-0.06100	-0.06100
50.000	-0.08200	-0.08200	-0.08200	-0.08200	-0.08200	-0.08200

ENGINEER NASA
DATE

FIGURE 4.1.1.3-66
BASIC PITCHING MOMENT COEFFICIENT

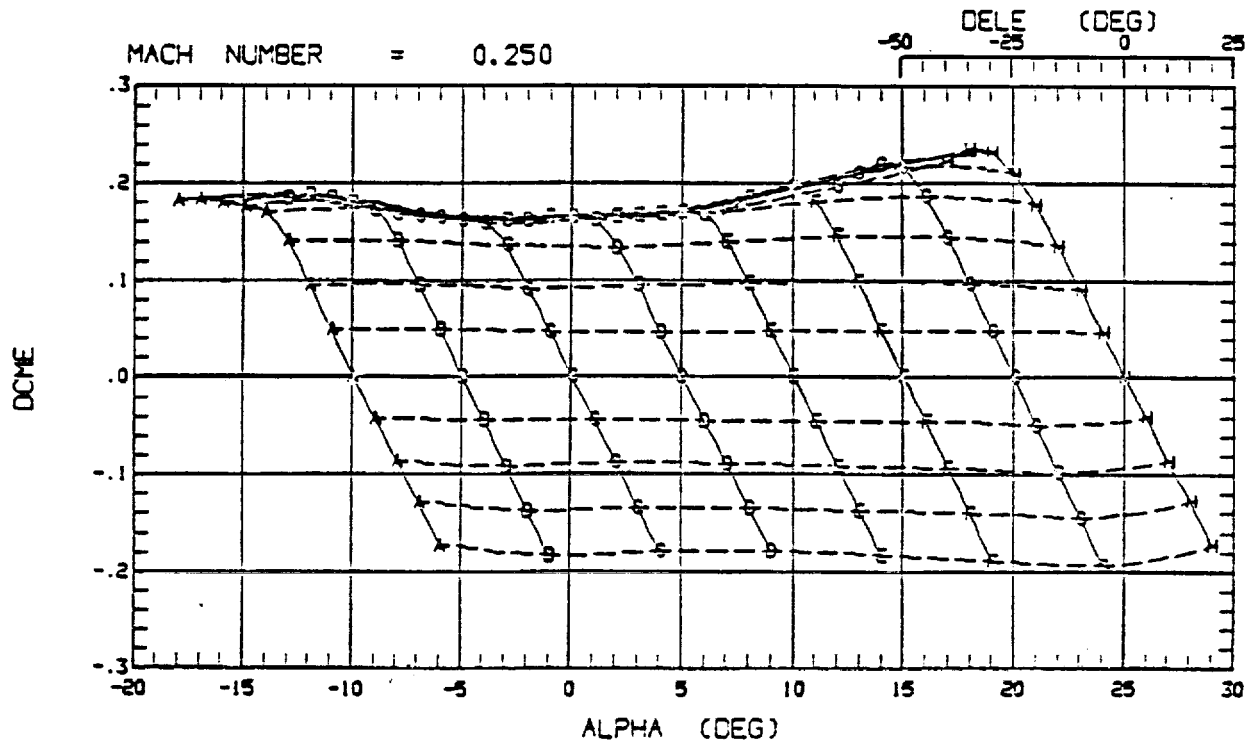


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALTITUDE (FT.)						
	300000.0 A	350000.0 B	400000.0 C	450000.0 D	500000.0 E	550000.0 F	600000.0 G
ALPHA (DEG)	HIGH ALTITUDE PITCHING MOMENT CO						
20.000	-0.00600	-0.05300	-0.10200	-0.12821	-0.13813	-0.14126	-0.14175
25.000	-0.00800	-0.07087	-0.13640	-0.17145	-0.18471	-0.18891	-0.18956
30.000	-0.01500	-0.09200	-0.17226	-0.21519	-0.23143	-0.23657	-0.23737
35.000	-0.02600	-0.11120	-0.20002	-0.24752	-0.26549	-0.27118	-0.27206
40.000	-0.04100	-0.13302	-0.22993	-0.28024	-0.29965	-0.30579	-0.30674
45.000	-0.06100	-0.15384	-0.25062	-0.30239	-0.32197	-0.32817	-0.32913
50.000	-0.08200	-0.17532	-0.27261	-0.32464	-0.34433	-0.35056	-0.35152

ENGINEER NASA
DATE

FIGURE 4.1.1.3-67
BASIC PITCHING MOMENT COEFFICIENT



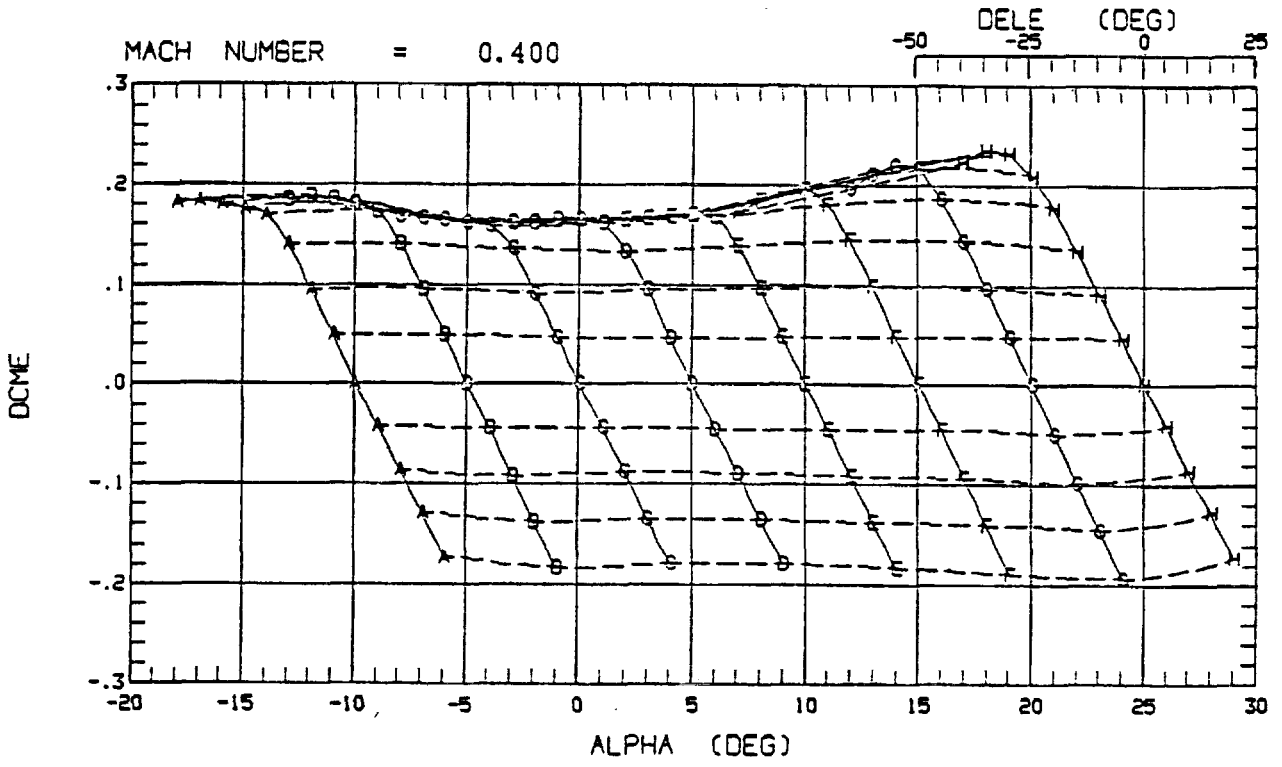
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.18130	0.19430	0.16800	0.16100	0.16400	0.17270	0.19590	0.22290
-35.000	0.18290	0.18680	0.16600	0.16200	0.16500	0.18380	0.21010	0.23390
-30.000	0.17970	0.18490	0.16400	0.16510	0.16800	0.19240	0.21920	0.23140
-25.000	0.17570	0.18030	0.16200	0.16500	0.16900	0.19540	0.21670	0.20810
-20.000	0.16910	0.17220	0.15800	0.16100	0.16800	0.18030	0.18530	0.17720
-15.000	0.13970	0.14000	0.13500	0.13300	0.13800	0.14430	0.14330	0.13400
-10.000	0.09420	0.09500	0.09000	0.09370	0.09600	0.09700	0.09570	0.09000
-5.000	0.04810	0.04910	0.04600	0.04500	0.04660	0.04760	0.04760	0.04510
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04300	-0.04410	-0.04410	-0.04510	-0.04510	-0.04500	-0.05010	-0.04150
10.000	-0.08750	-0.09220	-0.08900	-0.08960	-0.09220	-0.09470	-0.09920	-0.08660
15.000	-0.12950	-0.13870	-0.13500	-0.13570	-0.13970	-0.14100	-0.14530	-0.12960
20.000	-0.17300	-0.19430	-0.18000	-0.17970	-0.18430	-0.19040	-0.19440	-0.17420

ENGINEER DCO
DATE 9/13/83

FIGURE 4.1.1.3-66
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

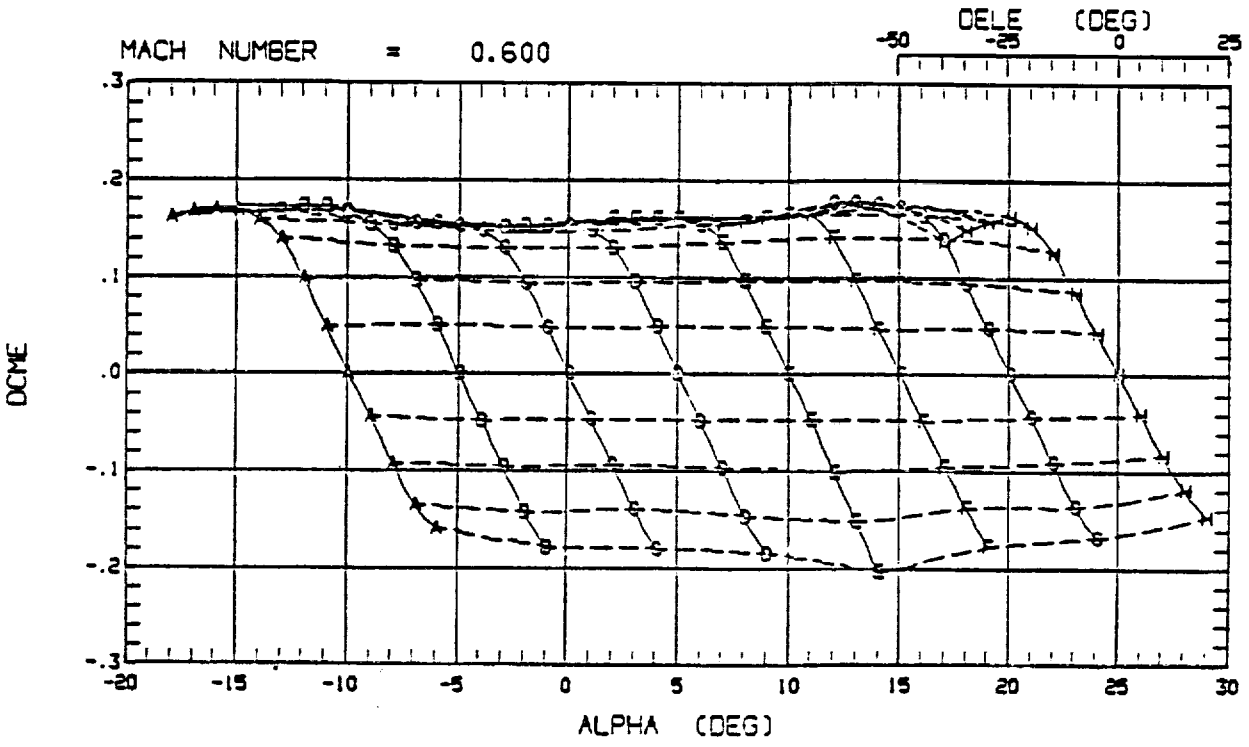
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 79.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.18130	0.18430	0.16800	0.16100	0.16400	0.17270	0.19590	0.22290
-35.000	0.18280	0.16680	0.16600	0.16200	0.16600	0.18380	0.21010	0.23390
-30.000	0.17970	0.18480	0.16400	0.16510	0.16800	0.19240	0.21920	0.23140
-25.000	0.17570	0.18030	0.16200	0.16500	0.16900	0.19540	0.21670	0.20810
-20.000	0.16910	0.17220	0.15800	0.16100	0.16800	0.18030	0.18580	0.17720
-15.000	0.13970	0.14000	0.13500	0.13300	0.13800	0.14430	0.14380	0.13400
-10.000	0.09420	0.09500	0.09000	0.09370	0.09600	0.09700	0.09570	0.09000
-5.000	0.04810	0.04910	0.04600	0.04500	0.04660	0.04750	0.04760	0.04510
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04300	-0.04410	-0.04410	-0.04510	-0.04510	-0.04500	-0.05010	-0.04150
10.000	-0.08750	-0.09220	-0.08900	-0.08960	-0.09220	-0.09470	-0.09920	-0.08660
15.000	-0.12950	-0.13870	-0.13500	-0.13570	-0.13870	-0.14100	-0.14580	-0.12860
20.000	-0.17300	-0.18430	-0.18000	-0.17970	-0.18430	-0.19040	-0.19440	-0.17420

ENGINEER GCO
DATE 2/13/78

FIGURE 4.1.1.3-69
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

Rockwell International
Space Division



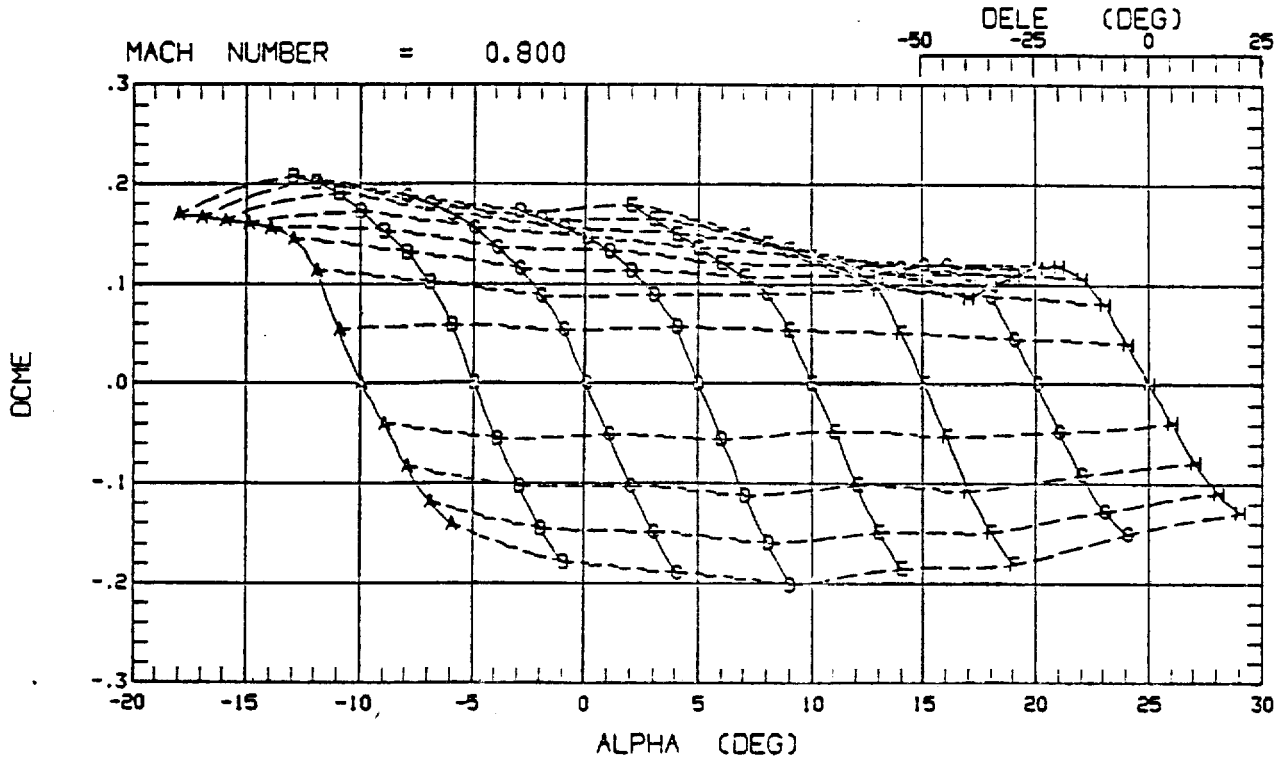
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1078.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.550 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.16140	0.16610	0.15350	0.15100	0.15950	0.15400	0.17610	0.13600
-35.000	0.16700	0.17190	0.15580	0.15210	0.16000	0.15750	0.17660	0.14770
-30.000	0.16950	0.17150	0.15500	0.15300	0.16000	0.16150	0.17560	0.15740
-25.000	0.16750	0.16550	0.15300	0.15300	0.15920	0.16450	0.17210	0.16090
-20.000	0.15890	0.15330	0.14700	0.14700	0.15400	0.16400	0.16350	0.15130
-15.000	0.13260	0.13150	0.12900	0.12950	0.13620	0.14000	0.13960	0.12540
-10.000	0.09750	0.09650	0.09350	0.09400	0.09600	0.09530	0.09240	0.08400
-5.000	0.04870	0.05000	0.04750	0.04800	0.04900	0.04600	0.04700	0.04200
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04370	-0.04800	-0.04700	-0.04200	-0.04700	-0.04600	-0.04470	-0.04160
10.000	-0.09240	-0.09650	-0.09450	-0.09700	-0.10200	-0.09600	-0.09190	-0.08310
15.000	-0.13550	-0.14300	-0.14000	-0.14700	-0.15300	-0.13800	-0.13760	-0.11940
20.000	-0.15990	-0.17900	-0.18100	-0.19600	-0.20400	-0.17600	-0.16930	-0.14820

ENGINEER GW
DATE 3/13/78

FIGURE 4.1.1.3-70
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



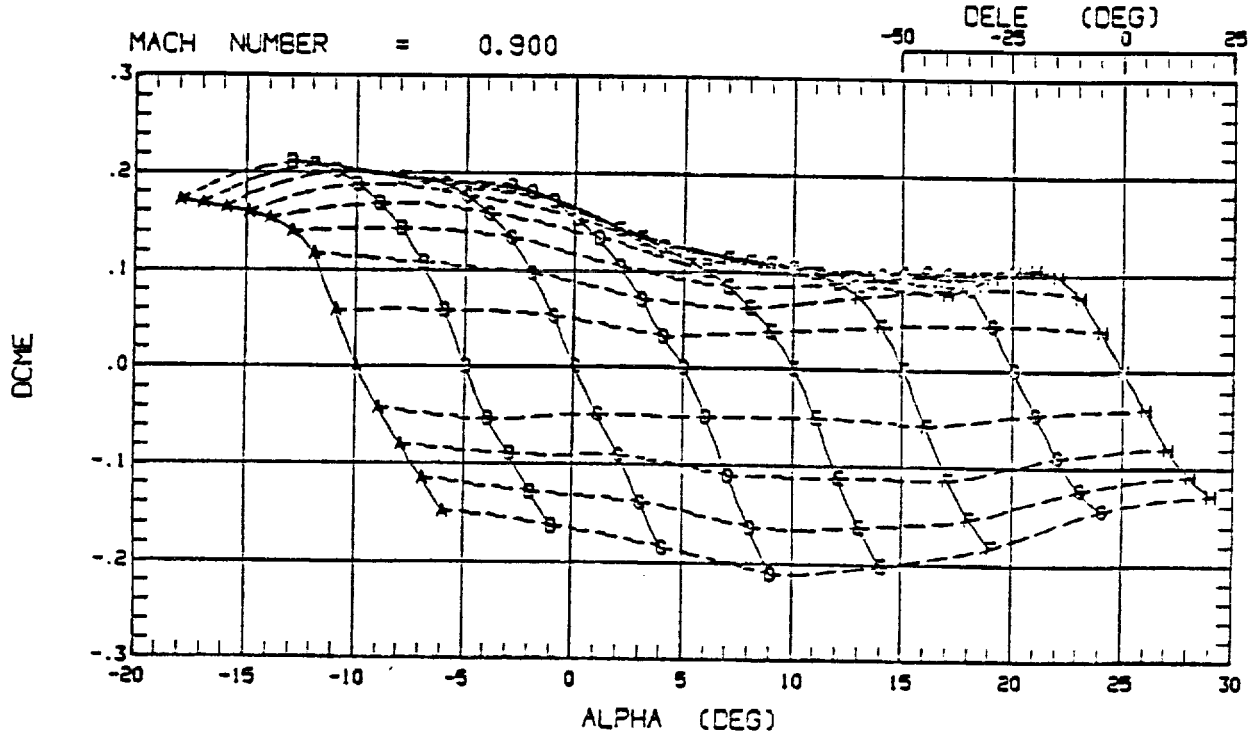
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.16840	0.20700	0.18750	0.17180	0.17800	0.14750	0.10360	0.06590
-35.000	0.16650	0.20100	0.17950	0.16430	0.16400	0.14080	0.10950	0.09720
-30.000	0.16370	0.19000	0.16950	0.15600	0.15000	0.13400	0.11500	0.10760
-25.000	0.16030	0.17150	0.15560	0.14600	0.13500	0.12600	0.11650	0.11550
-20.000	0.15590	0.15250	0.13600	0.13200	0.12000	0.11800	0.11940	0.11790
-15.000	0.14490	0.13100	0.11420	0.11230	0.10640	0.10880	0.10970	0.10520
-10.000	0.11310	0.10000	0.08700	0.08800	0.08950	0.09420	0.09700	0.07950
-5.000	0.05380	0.05800	0.05300	0.05580	0.05300	0.05000	0.04480	0.03970
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04080	-0.05600	-0.05250	-0.05600	-0.04800	-0.05400	-0.04900	-0.03390
10.000	-0.08450	-0.10320	-0.10400	-0.11300	-0.10250	-0.10800	-0.09200	-0.07900
15.000	-0.11870	-0.14650	-0.15000	-0.15980	-0.15000	-0.14950	-0.12760	-0.10900
20.000	-0.14140	-0.18030	-0.19100	-0.20200	-0.19610	-0.18150	-0.15080	-0.12950

ENGINEER Geo
DATE 9/13/78

FIGURE 4.1.1.3-71
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



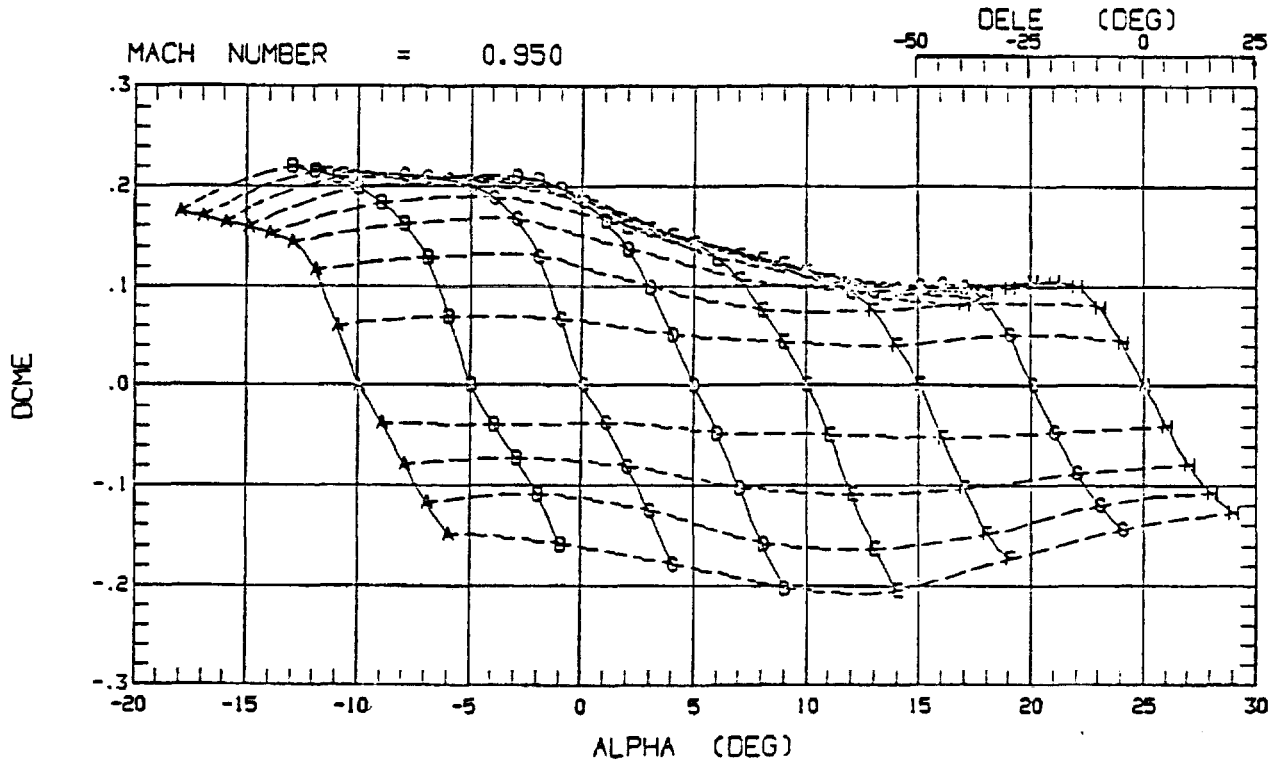
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.036 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.17100	0.21000	0.19380	0.18600	0.14150	0.11200	0.08990	0.07730
-35.000	0.16690	0.20770	0.19290	0.18000	0.13250	0.11000	0.09360	0.08950
-30.000	0.16350	0.20100	0.18700	0.17000	0.12350	0.10600	0.09680	0.09530
-25.000	0.15780	0.18770	0.17560	0.15250	0.11200	0.10420	0.09950	0.10150
-20.000	0.15180	0.16800	0.15700	0.13200	0.10000	0.09920	0.10070	0.10370
-15.000	0.13920	0.14150	0.13230	0.10300	0.08420	0.08900	0.09980	0.09680
-10.000	0.11510	0.10600	0.09800	0.07000	0.06300	0.07500	0.08430	0.07670
-5.000	0.05760	0.05800	0.05150	0.03200	0.03600	0.04400	0.04640	0.04100
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04290	-0.05400	-0.04900	-0.05100	-0.05000	-0.05500	-0.04500	-0.03990
10.000	-0.08120	-0.09000	-0.09150	-0.11100	-0.11300	-0.11400	-0.09030	-0.09020
15.000	-0.11550	-0.12900	-0.13950	-0.16400	-0.16350	-0.15400	-0.12410	-0.10940
20.000	-0.14930	-0.16400	-0.19600	-0.21200	-0.20300	-0.19200	-0.14420	-0.12900

ENGINEER [illegible]
DATE 9/13/78

FIGURE 4.1.1.3-72
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

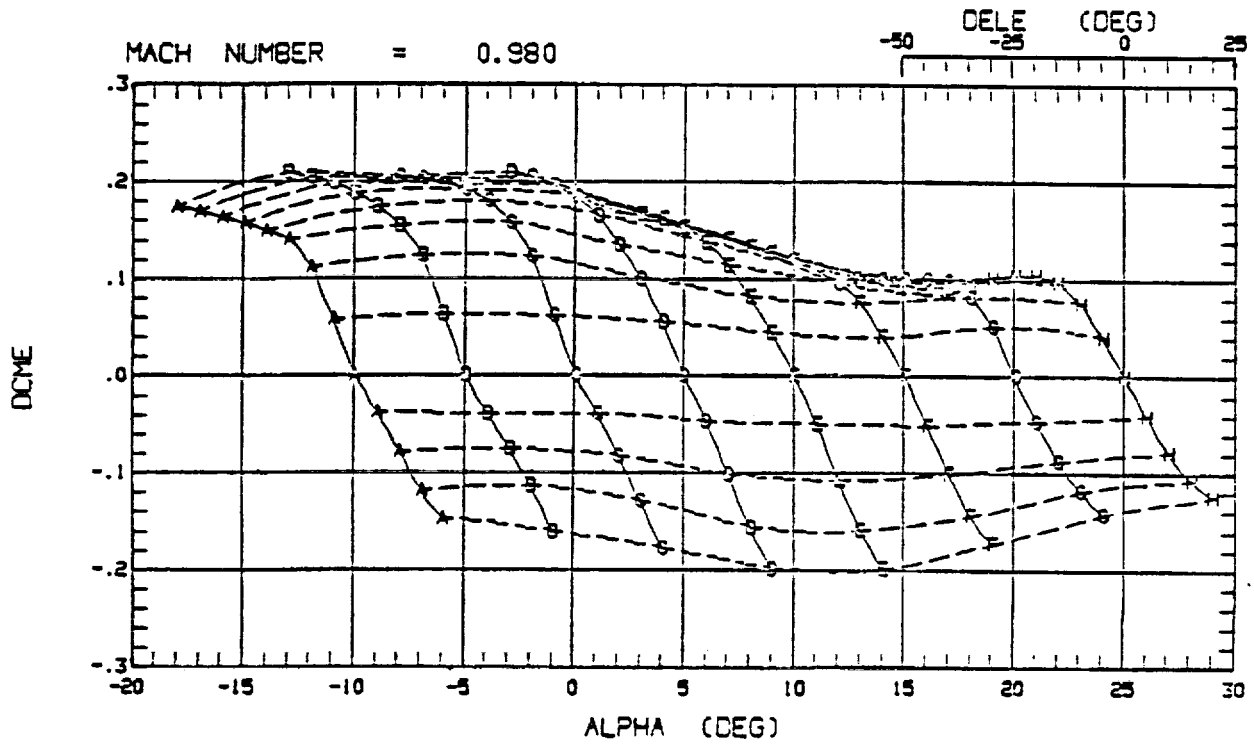


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.17350	0.21900	0.21000	0.20900	0.15900	0.13000	0.09230	0.08070
-35.000	0.16870	0.21400	0.20900	0.20500	0.15500	0.12500	0.09450	0.09050
-30.000	0.16340	0.20800	0.20500	0.19700	0.15000	0.12000	0.09570	0.09820
-25.000	0.15810	0.19830	0.19950	0.18450	0.14150	0.11300	0.09640	0.10290
-20.000	0.15170	0.18250	0.18800	0.16400	0.12700	0.10400	0.10010	0.10360
-15.000	0.14340	0.16150	0.16550	0.13500	0.10550	0.09400	0.09820	0.09970
-10.000	0.11500	0.12800	0.12950	0.09700	0.07500	0.07500	0.08290	0.07740
-5.000	0.06000	0.06900	0.06500	0.05000	0.04200	0.04000	0.05000	0.04190
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.03740	-0.04000	-0.03800	-0.04800	-0.05000	-0.05300	-0.04700	-0.04040
10.000	-0.07890	-0.07300	-0.08200	-0.10400	-0.11000	-0.10400	-0.08840	-0.07940
15.000	-0.11780	-0.11000	-0.12700	-0.16000	-0.16400	-0.14900	-0.11980	-0.10830
20.000	-0.14870	-0.16000	-0.18000	-0.20400	-0.20600	-0.17400	-0.14470	-0.12760

ENGINEER [illegible]
DATE 9/13/78

FIGURE 4.1.1.3-73
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



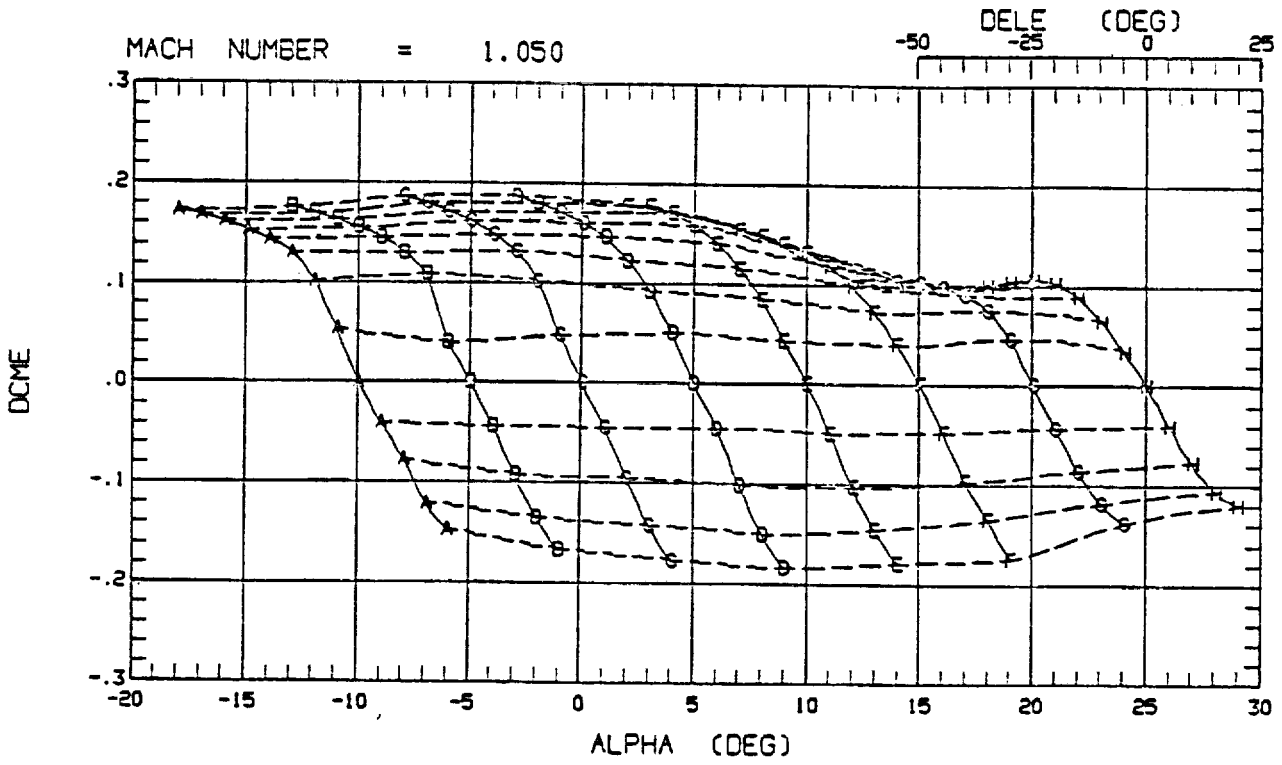
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 3590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	SW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.17389	0.20695	0.20433	0.20688	0.16744	0.13949	0.09486	0.08346
-35.000	0.16903	0.20345	0.20203	0.20354	0.16549	0.13323	0.09649	0.08296
-30.000	0.16308	0.19725	0.19713	0.19505	0.16146	0.12577	0.09830	0.09991
-25.000	0.15729	0.18807	0.19075	0.18355	0.15289	0.11248	0.09943	0.10373
-20.000	0.14911	0.17386	0.17897	0.16520	0.13862	0.10790	0.09861	0.10335
-15.000	0.14008	0.15440	0.15744	0.13347	0.11292	0.09614	0.09674	0.09656
-10.000	0.11155	0.12365	0.12175	0.09551	0.08021	0.07435	0.08146	0.07409
-5.000	0.05822	0.06297	0.05064	0.05408	0.04347	0.03935	0.05059	0.04010
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.03789	-0.04001	-0.03891	-0.04701	-0.05000	-0.05119	-0.04647	-0.04085
10.000	-0.07653	-0.07649	-0.08434	-0.10270	-0.10820	-0.10164	-0.08786	-0.07901
15.000	-0.11904	-0.11483	-0.12936	-0.15744	-0.15970	-0.14508	-0.11991	-0.10764
20.000	-0.14834	-0.15150	-0.17872	-0.19864	-0.19959	-0.17323	-0.14399	-0.12563

ENGINEER
DATE

FIGURE 4.1.1.3-74
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

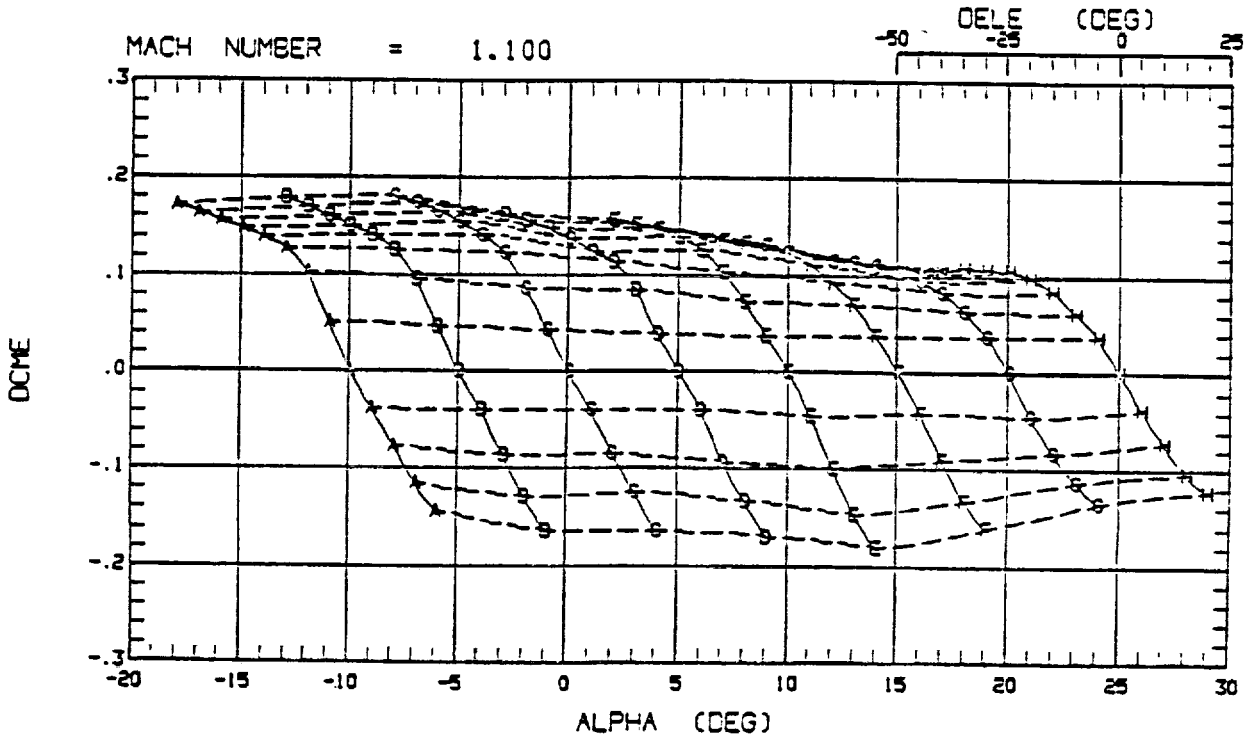


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.17250	0.17450	0.18600	0.18550	0.17700	0.15450	0.10430	0.09280
-35.000	0.16730	0.16880	0.17950	0.17950	0.17600	0.14800	0.10460	0.09910
-30.000	0.16100	0.16250	0.17100	0.17050	0.17000	0.14000	0.10430	0.10330
-25.000	0.15270	0.15470	0.16100	0.16000	0.15800	0.13150	0.10210	0.10550
-20.000	0.14240	0.14500	0.14800	0.14550	0.13970	0.11750	0.09780	0.10180
-15.000	0.12970	0.12970	0.13100	0.12200	0.11450	0.09750	0.09000	0.08800
-10.000	0.10080	0.10750	0.10100	0.09200	0.08400	0.07160	0.07520	0.06420
-5.000	0.05290	0.04000	0.04650	0.04950	0.04300	0.03900	0.04640	0.03350
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.04140	-0.04400	-0.04550	-0.04550	-0.05000	-0.04800	-0.04390	-0.04090
10.000	-0.07820	-0.09300	-0.09600	-0.10200	-0.10400	-0.09800	-0.08630	-0.07820
15.000	-0.12110	-0.13600	-0.14300	-0.15050	-0.14600	-0.13500	-0.11810	-0.10610
20.000	-0.14750	-0.16800	-0.17900	-0.18500	-0.18000	-0.17500	-0.13840	-0.11990

ENGINEER CCO
DATE 9/13/78

FIGURE 4.1.1.3-75
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



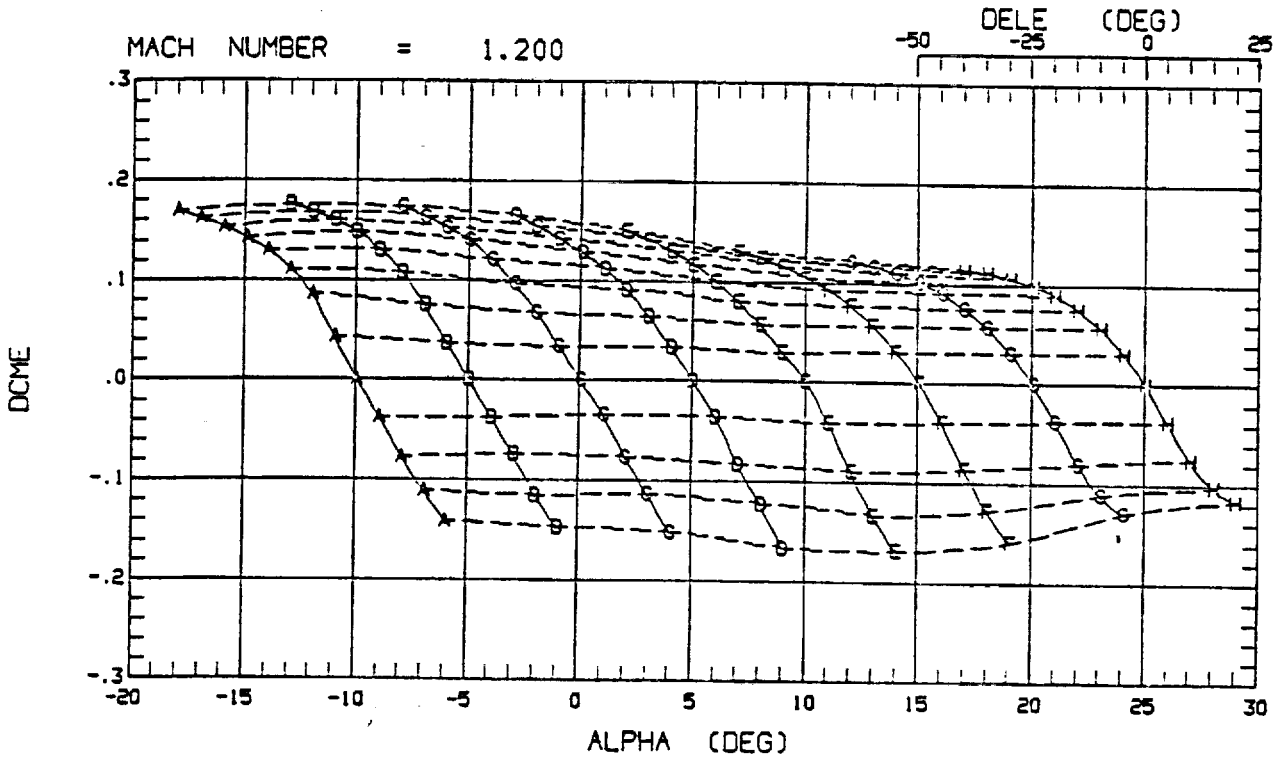
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7	IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0	IN.	WING SPAN	BW = 78.055	FT.
MOMENT REFERENCE	ZO = WL 375.0	IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.17110	0.17820	0.18020	0.16150	0.15500	0.13400	0.11430	0.10420
-35.000	0.16330	0.16940	0.17290	0.15550	0.15100	0.13200	0.11260	0.10780
-30.000	0.15560	0.15960	0.16470	0.14700	0.14500	0.12900	0.10940	0.10650
-25.000	0.14730	0.14990	0.15440	0.13700	0.13500	0.12200	0.10370	0.10450
-20.000	0.13950	0.14000	0.14050	0.12400	0.12500	0.11000	0.09440	0.09900
-15.000	0.12570	0.12520	0.12230	0.11250	0.10200	0.09200	0.08210	0.08350
-10.000	0.10170	0.09500	0.08550	0.08300	0.07200	0.06900	0.06270	0.06150
-5.000	0.05080	0.04630	0.04200	0.03850	0.03600	0.03800	0.03700	0.03670
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.03870	-0.04000	-0.04000	-0.04000	-0.04600	-0.04200	-0.04500	-0.03770
10.000	-0.07700	-0.08700	-0.08600	-0.09400	-0.10000	-0.09200	-0.08400	-0.07330
15.000	-0.11600	-0.13000	-0.12550	-0.13450	-0.14750	-0.13350	-0.11400	-0.10540
20.000	-0.14500	-0.16400	-0.15450	-0.17000	-0.18100	-0.15200	-0.13550	-0.12330

ENGINEER [illegible]
DATE 9/13/72

FIGURE 4.1.1.3-76
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



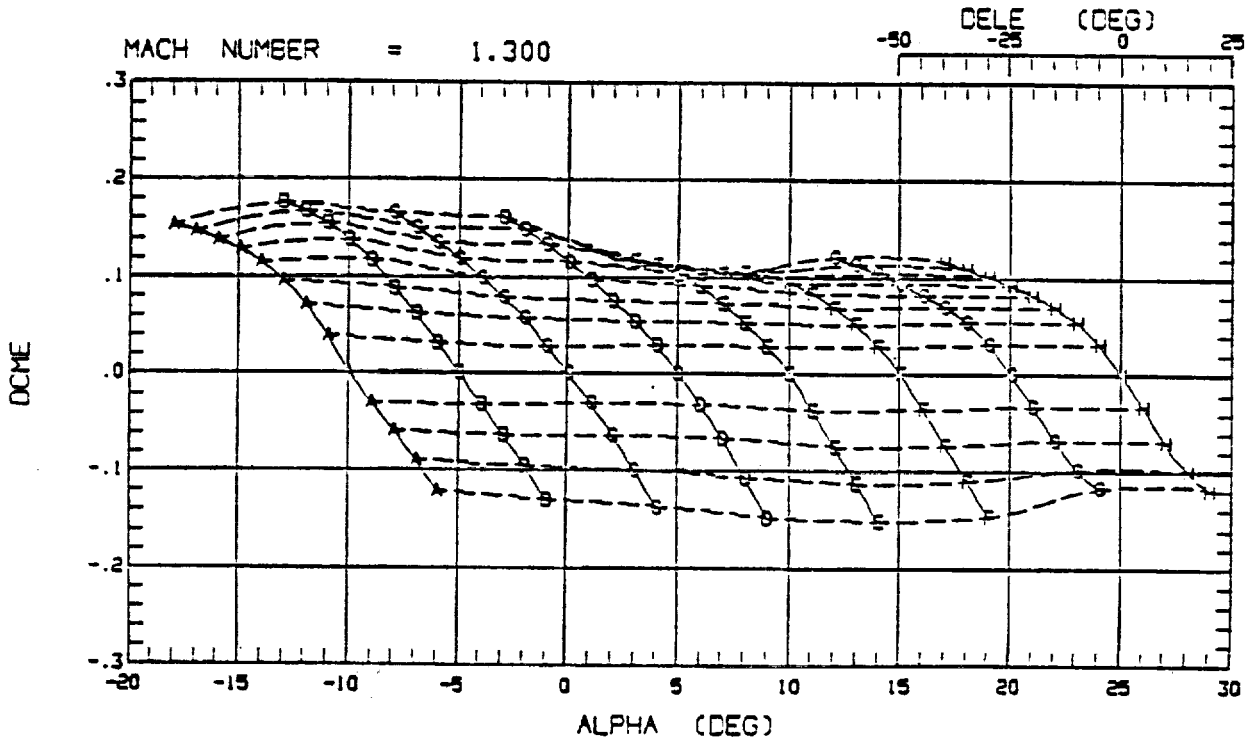
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.16880	0.17500	0.17290	0.16500	0.14910	0.13020	0.12060	0.11340
-35.000	0.16110	0.16820	0.16360	0.15360	0.14030	0.12300	0.11540	0.11050
-30.000	0.15280	0.15940	0.15280	0.14120	0.12990	0.11470	0.10910	0.10510
-25.000	0.14200	0.14810	0.13940	0.12730	0.11610	0.10390	0.10030	0.09820
-20.000	0.12910	0.12960	0.12000	0.11130	0.09870	0.09200	0.09000	0.08830
-15.000	0.11020	0.10610	0.09540	0.09040	0.07870	0.07610	0.07400	0.07460
-10.000	0.08460	0.07400	0.06690	0.06330	0.05570	0.05570	0.05570	0.05570
-5.000	0.04280	0.03620	0.03370	0.03370	0.02860	0.03110	0.03110	0.03110
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.03770	-0.03750	-0.03500	-0.03650	-0.04150	-0.04000	-0.03680	-0.03880
10.000	-0.07750	-0.07500	-0.07750	-0.08350	-0.09000	-0.08700	-0.08010	-0.07600
15.000	-0.11100	-0.11500	-0.11450	-0.12300	-0.13400	-0.12900	-0.11170	-0.10290
20.000	-0.14140	-0.14700	-0.15200	-0.16700	-0.16950	-0.15000	-0.13010	-0.11690

ENGINEER [illegible]
DATE 9/13/78

FIGURE 4.1.1.3-77
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



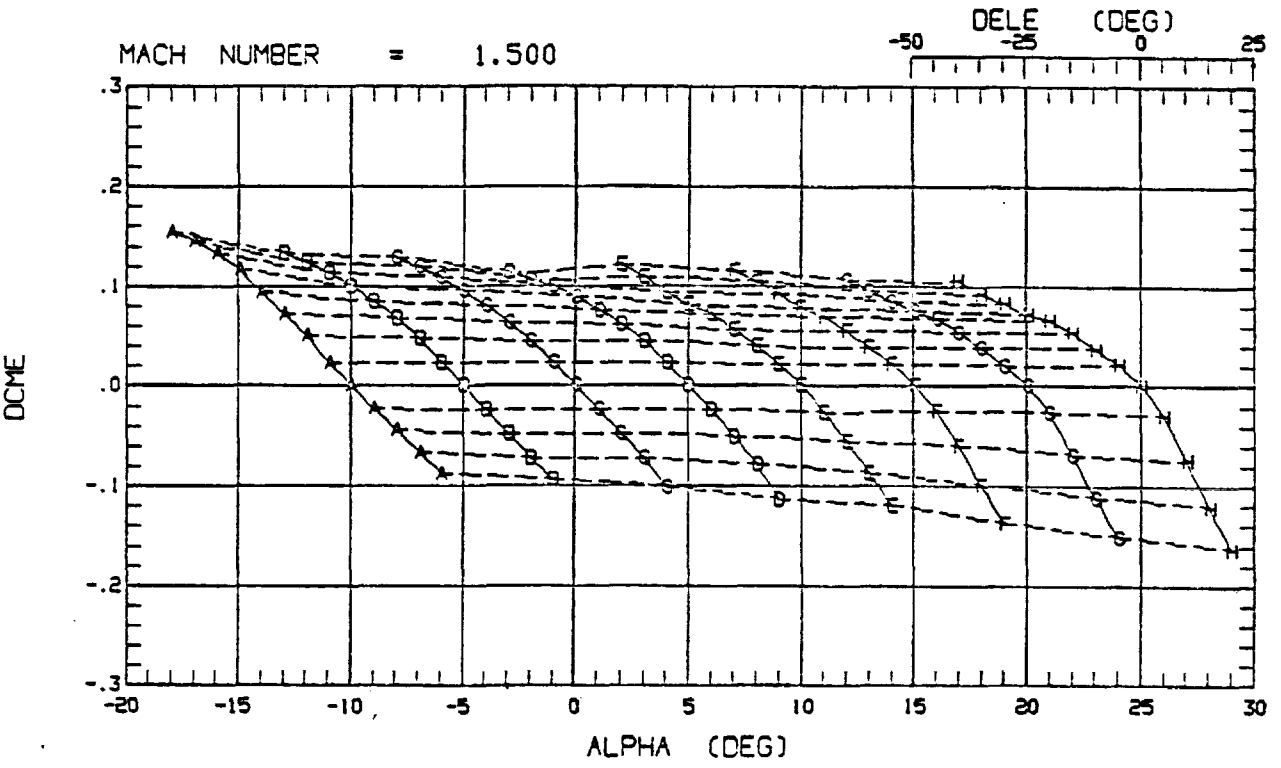
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	SW =	78.055 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.15300	0.17500	0.16400	0.16000	0.11800	0.10200	0.12040	0.11480
-35.000	0.14610	0.16600	0.15000	0.14750	0.11600	0.10350	0.11200	0.10900
-30.000	0.13770	0.15350	0.13400	0.13200	0.11180	0.10050	0.10310	0.10010
-25.000	0.12730	0.13850	0.11750	0.11450	0.10190	0.09350	0.09270	0.09120
-20.000	0.11390	0.11570	0.09900	0.09600	0.08950	0.08250	0.08070	0.08130
-15.000	0.09490	0.08700	0.07750	0.07450	0.07200	0.06750	0.06880	0.06860
-10.000	0.07050	0.06100	0.05570	0.05350	0.05200	0.04960	0.05290	0.05340
-5.000	0.03800	0.03000	0.02700	0.02950	0.02800	0.02750	0.03000	0.03000
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.03000	-0.03210	-0.03100	-0.03200	-0.03800	-0.03850	-0.03350	-0.03300
10.000	-0.05990	-0.06350	-0.06350	-0.06700	-0.07550	-0.07450	-0.06800	-0.07050
15.000	-0.09040	-0.09650	-0.10050	-0.10770	-0.11350	-0.11150	-0.09890	-0.09990
20.000	-0.12130	-0.13100	-0.13900	-0.14650	-0.15250	-0.14700	-0.11790	-0.11990

ENGINEER GCC
DATE 9/13/79

FIGURE 4.1.1.3-78
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

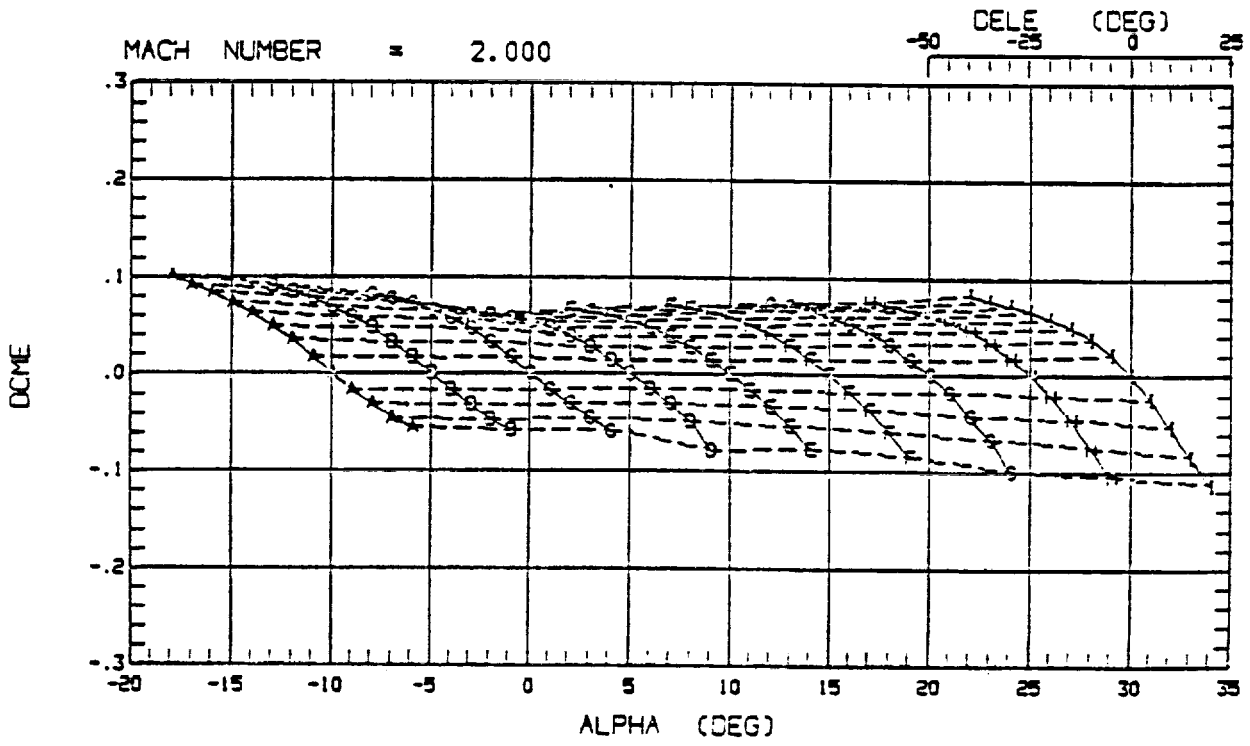


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.15421	0.13212	0.12756	0.11215	0.11979	0.11453	0.10569	0.10472
-35.000	0.14469	0.12319	0.11837	0.10562	0.10797	0.10348	0.09438	0.09210
-30.000	0.13203	0.11265	0.10759	0.09863	0.09303	0.09099	0.08438	0.08153
-25.000	0.11574	0.09920	0.09389	0.08853	0.08000	0.07773	0.07395	0.07148
-20.000	0.09231	0.08334	0.07965	0.07481	0.07118	0.06815	0.06697	0.06526
-15.000	0.07092	0.06755	0.06290	0.06054	0.05560	0.05448	0.05381	0.05297
-10.000	0.04979	0.04765	0.04415	0.04472	0.03929	0.03781	0.03764	0.03727
-5.000	0.02291	0.02344	0.02215	0.02231	0.02133	0.02165	0.02038	0.02090
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.02339	-0.02446	-0.02427	-0.02375	-0.02670	-0.02500	-0.02710	-0.03059
10.000	-0.04486	-0.04927	-0.04797	-0.05121	-0.05687	-0.06024	-0.06954	-0.07489
15.000	-0.06716	-0.07299	-0.07380	-0.07964	-0.08768	-0.10070	-0.11221	-0.12125
20.000	-0.08776	-0.09437	-0.10163	-0.11418	-0.12086	-0.13823	-0.15245	-0.16406

ENGINEER Geo
DATE 9/13/78

FIGURE 4.1.1.3-79
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



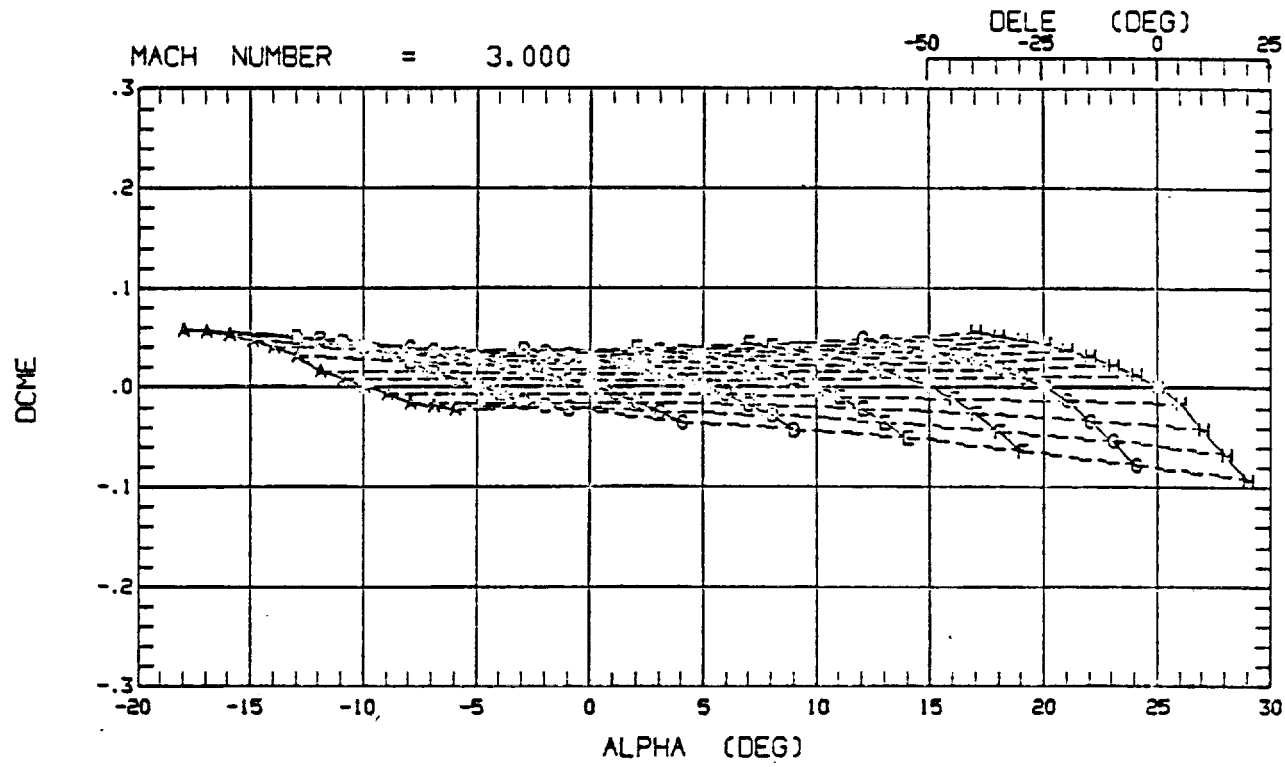
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2590.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.055 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT								
-40.000	0.10100	0.09010	0.08110	0.06000	0.06600	0.06950	0.07160	0.07530	0.08200
-35.000	0.09210	0.08400	0.07600	0.05900	0.05300	0.06700	0.07000	0.07070	0.07600
-30.000	0.08320	0.07700	0.07100	0.05700	0.05900	0.05300	0.06700	0.05600	0.07100
-25.000	0.07240	0.06800	0.06400	0.05300	0.05400	0.05900	0.05900	0.05370	0.06500
-20.000	0.06170	0.05800	0.05600	0.04700	0.04750	0.05000	0.05200	0.05330	0.05750
-15.000	0.04810	0.04700	0.04600	0.03800	0.03800	0.04100	0.04300	0.04500	0.04900
-10.000	0.03440	0.03200	0.03200	0.02700	0.02700	0.02900	0.03100	0.03250	0.03700
-5.000	0.01720	0.01600	0.01600	0.01400	0.01400	0.01500	0.01500	0.01700	0.02100
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01680	-0.01700	-0.01600	-0.01500	-0.01600	-0.01900	-0.01800	-0.02150	-0.02500
10.000	-0.03070	-0.03220	-0.03100	-0.03100	-0.03300	-0.03600	-0.04200	-0.04630	-0.05400
15.000	-0.04530	-0.04620	-0.04500	-0.04900	-0.05400	-0.06000	-0.06700	-0.07500	-0.08500
20.000	-0.05540	-0.05790	-0.05900	-0.07900	-0.07700	-0.08600	-0.10000	-0.10570	-0.11400

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.1.1.3-60
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

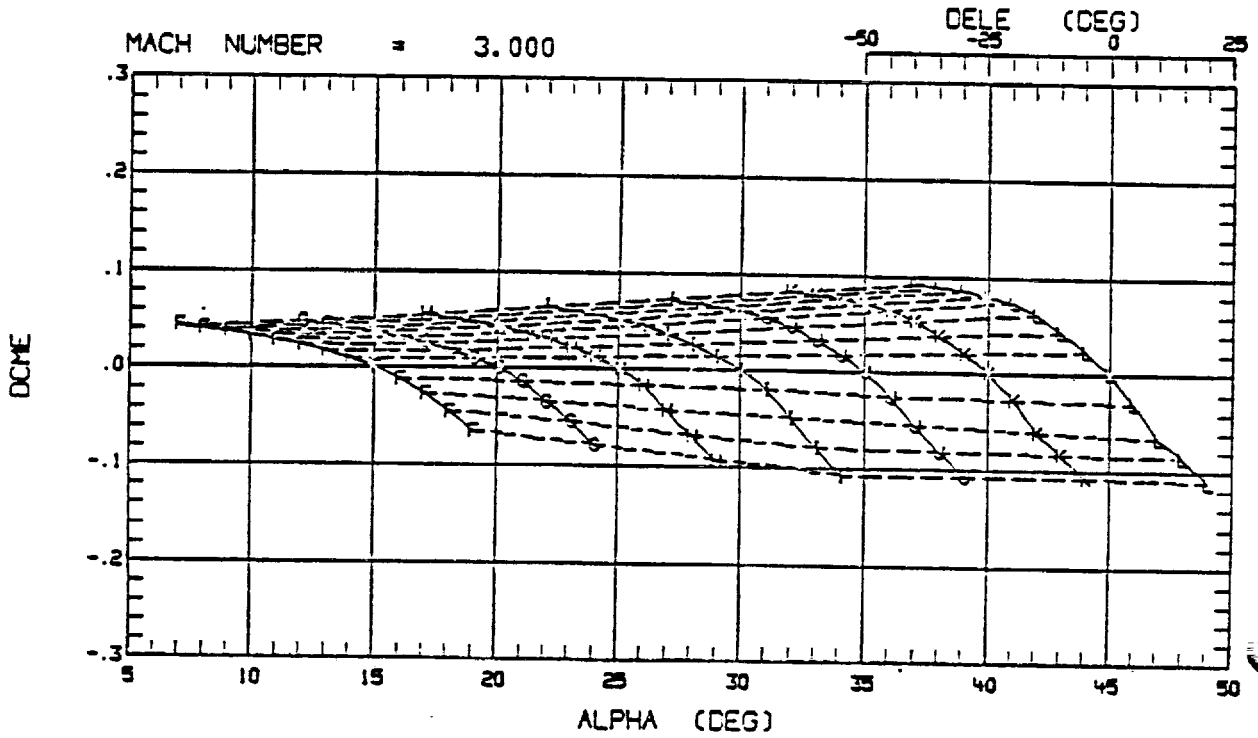


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1230.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05700	0.04920	0.03850	0.03650	0.03750	0.04210	0.04700	0.05420
-35.000	0.05546	0.04670	0.03570	0.03370	0.03570	0.03930	0.04370	0.05090
-30.000	0.05160	0.04430	0.03130	0.03030	0.03300	0.03610	0.04000	0.04710
-25.000	0.04610	0.03930	0.02730	0.02630	0.02930	0.03250	0.03600	0.04250
-20.000	0.04030	0.03400	0.02300	0.02400	0.02500	0.02900	0.03130	0.03730
-15.000	0.02980	0.02480	0.01780	0.01780	0.01977	0.02258	0.02520	0.03050
-10.000	0.01590	0.01420	0.01220	0.01220	0.01400	0.01620	0.01780	0.02200
-5.000	0.00820	0.00740	0.00640	0.00540	0.00740	0.00870	0.00950	0.01180
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00712	-0.00712	-0.00712	-0.00612	-0.01020	-0.01200	-0.01400	-0.01750
10.000	-0.01630	-0.01630	-0.01630	-0.01830	-0.02230	-0.02770	-0.03450	-0.04250
15.000	-0.02000	-0.02050	-0.02550	-0.02950	-0.03650	-0.04575	-0.05550	-0.06900
20.000	-0.02340	-0.02350	-0.03850	-0.04350	-0.05250	-0.06550	-0.07950	-0.09400

ENGINEER SCO
DATE 9/13/78

FIGURE 4.1.1.3-81
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



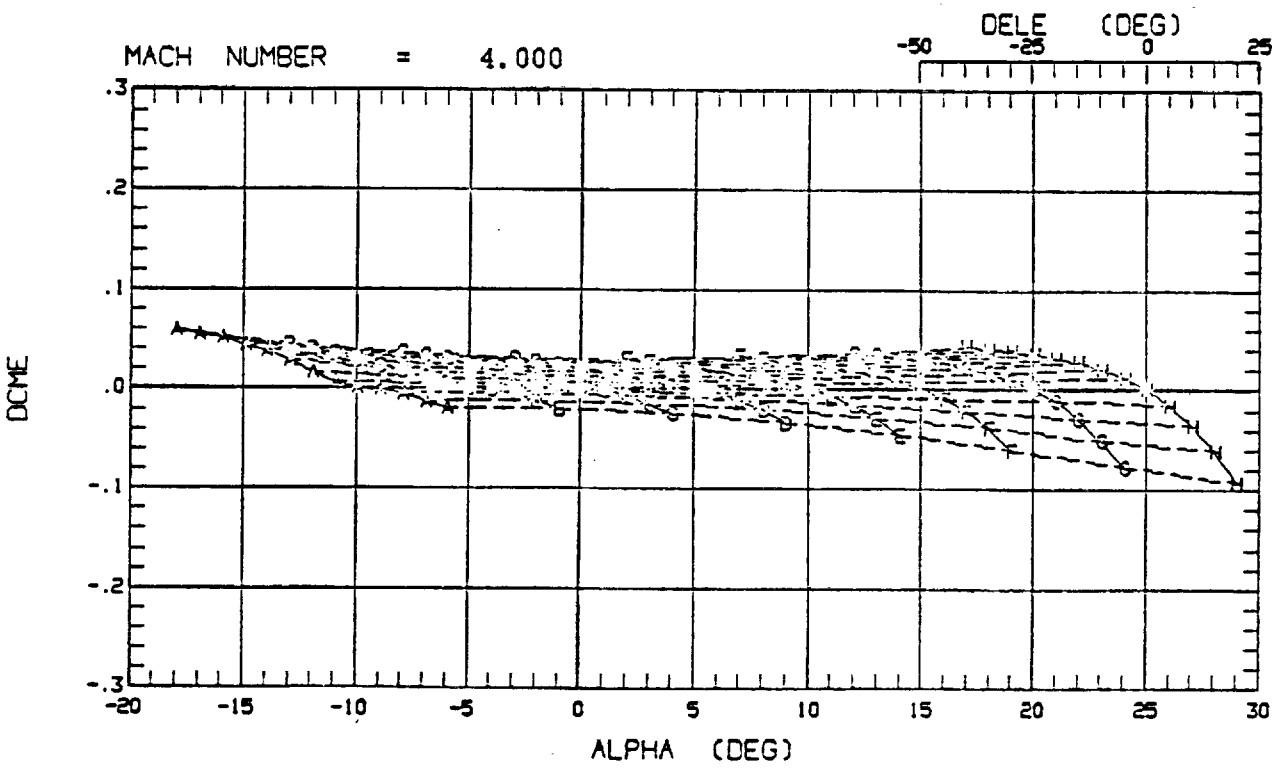
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	SW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT						
-40.000	0.04210	0.04700	0.05420	0.06330	0.07240	0.08180	0.09140
-35.000	0.03930	0.04370	0.05090	0.05960	0.06890	0.07860	0.08840
-30.000	0.03610	0.04000	0.04710	0.05560	0.06520	0.07510	0.08520
-25.000	0.03250	0.03600	0.04260	0.05080	0.06050	0.07000	0.07970
-20.000	0.02800	0.03130	0.03730	0.04500	0.05440	0.06390	0.07330
-15.000	0.02258	0.02520	0.03050	0.03660	0.04510	0.05360	0.06040
-10.000	0.01620	0.01780	0.02200	0.02620	0.03200	0.03790	0.04300
-5.000	0.00870	0.00950	0.01180	0.01430	0.01720	0.02030	0.02210
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01200	-0.01400	-0.01750	-0.02000	-0.02570	-0.02750	-0.03090
10.000	-0.02770	-0.03450	-0.04250	-0.04900	-0.05420	-0.06020	-0.06660
15.000	-0.04575	-0.05550	-0.06900	-0.07990	-0.08190	-0.08390	-0.08670
20.000	-0.06550	-0.07950	-0.09400	-0.10750	-0.10900	-0.10960	-0.11220

ENGINEER Geo
DATE 9/13/78

FIGURE 4.1.1.3-62
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



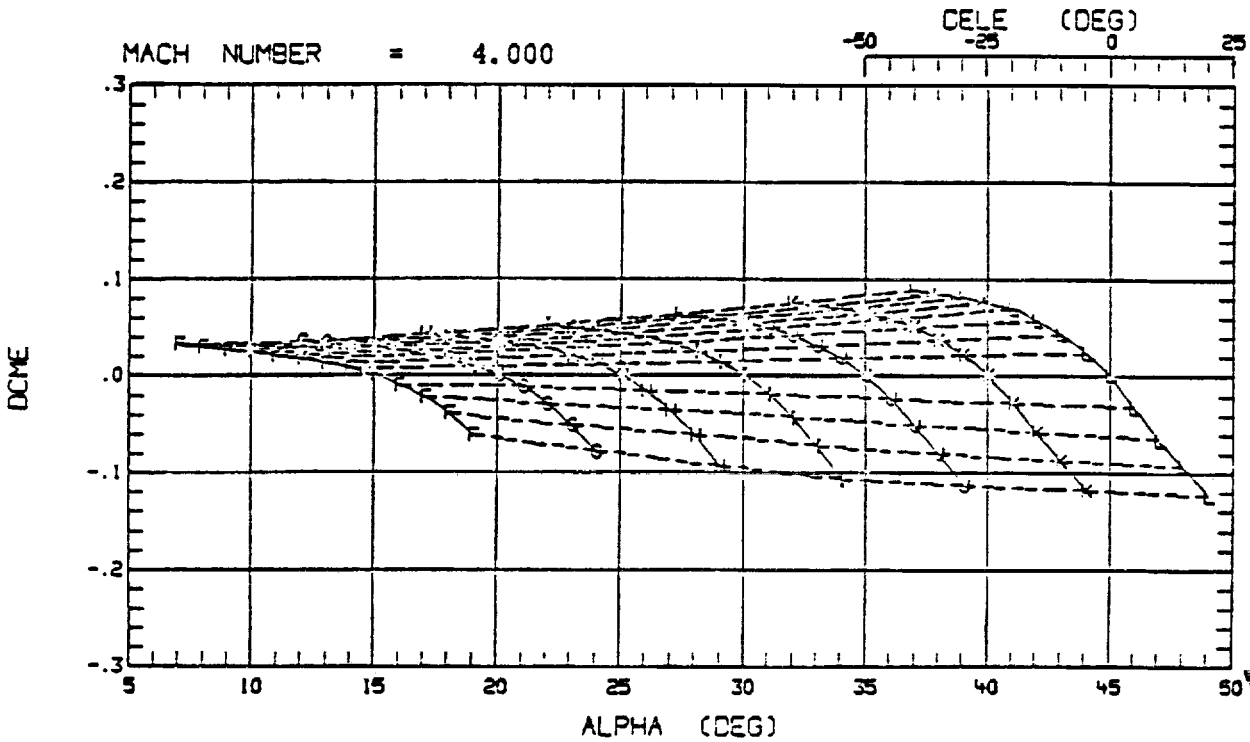
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) -10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05750	0.04230	0.03530	0.02930	0.02830	0.03170	0.03500	0.04260
-35.000	0.05380	0.03760	0.03160	0.02660	0.02560	0.02910	0.03300	0.04030
-30.000	0.05040	0.03320	0.02920	0.02320	0.02320	0.02660	0.03100	0.03770
-25.000	0.04310	0.02700	0.02300	0.01900	0.02000	0.02370	0.02840	0.03475
-20.000	0.03700	0.02200	0.01800	0.01600	0.01700	0.02050	0.02530	0.03110
-15.000	0.02720	0.01640	0.01340	0.01140	0.01340	0.01700	0.02150	0.02675
-10.000	0.01590	0.01030	0.00730	0.00630	0.00930	0.01275	0.01600	0.02020
-5.000	0.00570	0.00470	0.00270	0.00170	0.00470	0.00700	0.00900	0.01130
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00210	-0.00210	-0.00330	-0.00520	-0.00700	-0.01000	-0.01200	-0.01650
10.000	-0.00550	-0.00550	-0.00780	-0.01170	-0.01680	-0.02270	-0.03000	-0.03650
15.000	-0.01310	-0.01310	-0.01610	-0.02140	-0.02990	-0.04000	-0.05250	-0.06200
20.000	-0.02050	-0.02060	-0.02600	-0.03470	-0.04700	-0.06250	-0.07900	-0.09450

ENGINEER [illegible]
DATE 9/13/78

FIGURE 4.1.1.3-83
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

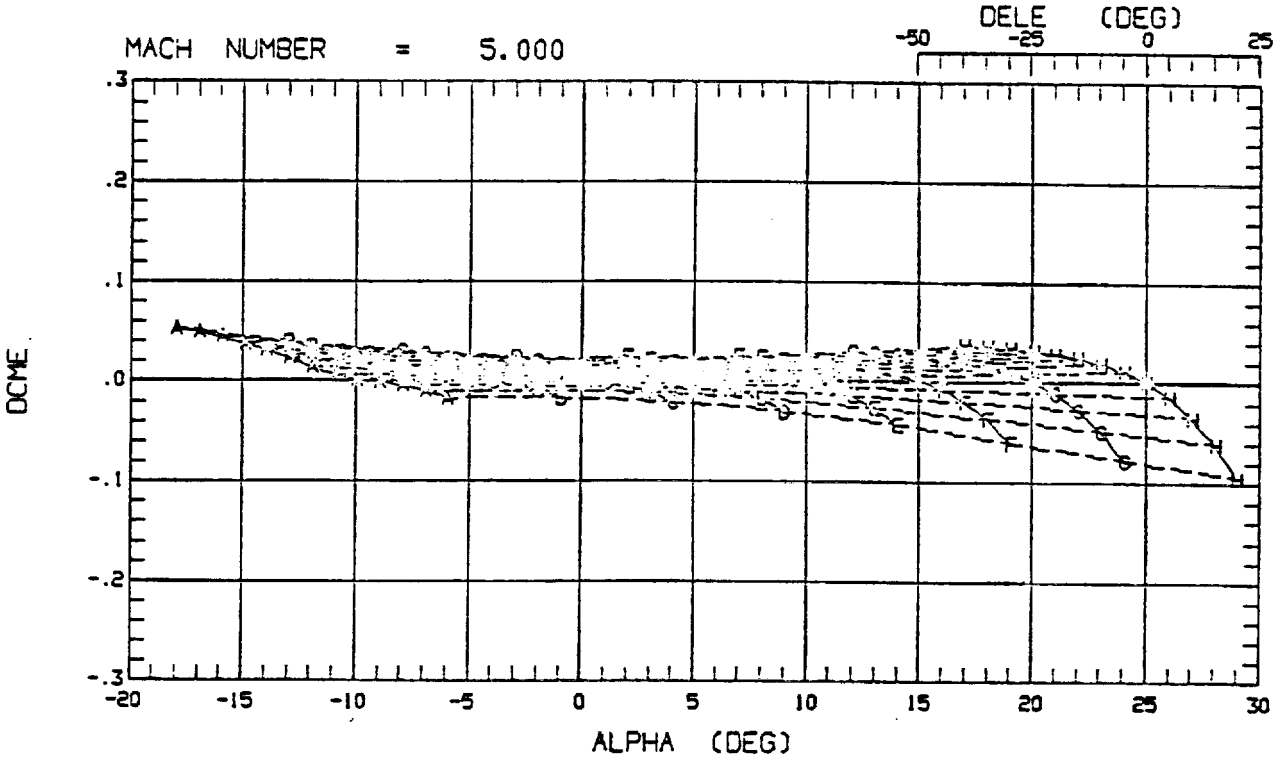


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT						
-40.000	0.03170	0.03500	0.04250	0.05180	0.06300	0.07520	0.08900
-35.000	0.02910	0.03300	0.04030	0.04920	0.06020	0.07210	0.08450
-30.000	0.02560	0.03100	0.03770	0.04660	0.05750	0.06900	0.08030
-25.000	0.02370	0.02840	0.03475	0.04320	0.05350	0.06420	0.07520
-20.000	0.02050	0.02530	0.03110	0.03900	0.04920	0.05980	0.06890
-15.000	0.01700	0.02150	0.02675	0.03310	0.04160	0.04980	0.05680
-10.000	0.01275	0.01600	0.02020	0.02500	0.03100	0.03690	0.04250
-5.000	0.00700	0.00900	0.01130	0.01425	0.01780	0.02130	0.02340
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01000	-0.01200	-0.01650	-0.01950	-0.02430	-0.02910	-0.03300
10.000	-0.02270	-0.03000	-0.03650	-0.04350	-0.05150	-0.05910	-0.06640
15.000	-0.04000	-0.05250	-0.06200	-0.07325	-0.08120	-0.08220	-0.09330
20.000	-0.06250	-0.07900	-0.09450	-0.10950	-0.11390	-0.11930	-0.12420

ENGINEER GCO
DATE 9/13/78

FIGURE 4.1.1.3-64
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

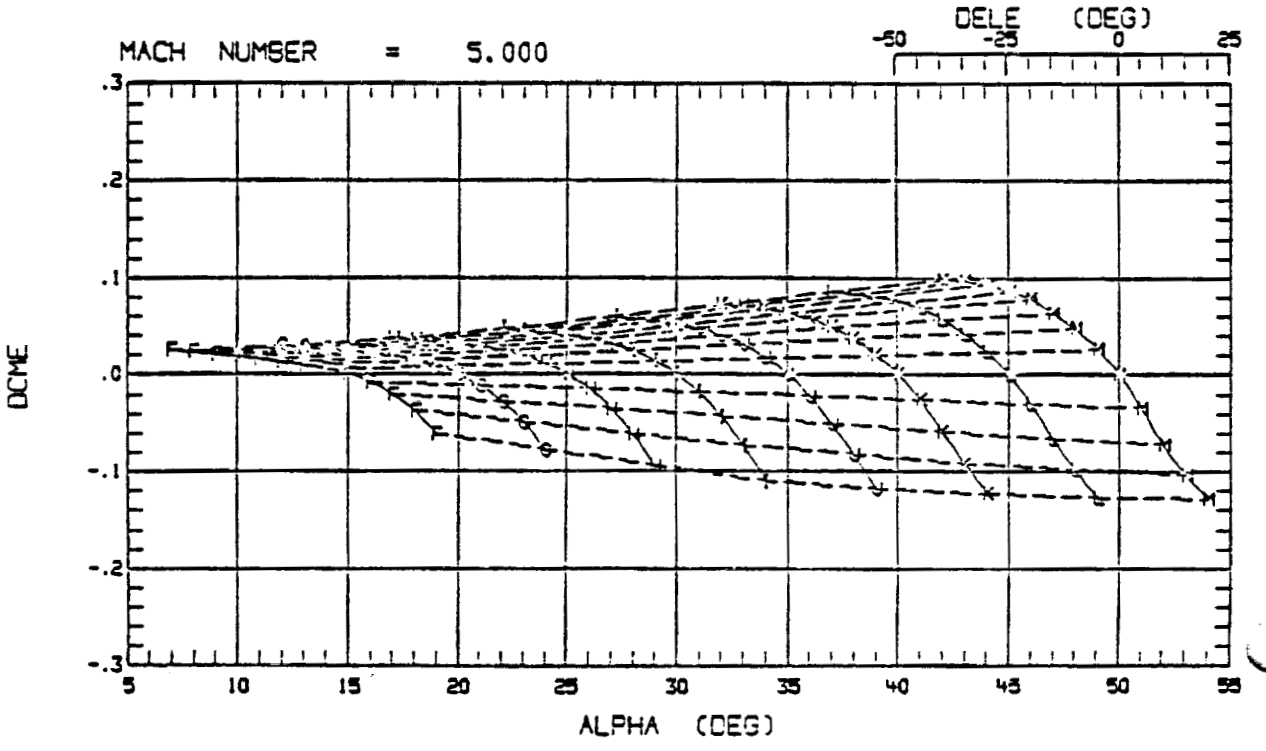


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05250	0.03740	0.02940	0.02240	0.02240	0.02420	0.02980	0.03650
-35.000	0.04650	0.03300	0.02600	0.01900	0.02010	0.02220	0.02710	0.03440
-30.000	0.04350	0.02750	0.02150	0.01550	0.01750	0.02025	0.02560	0.03290
-25.000	0.03670	0.02180	0.01680	0.01180	0.01480	0.01810	0.02350	0.03050
-20.000	0.03000	0.01620	0.01220	0.00920	0.01220	0.01550	0.02110	0.02770
-15.000	0.02260	0.01230	0.00930	0.00730	0.00930	0.01275	0.01820	0.02410
-10.000	0.01340	0.00740	0.00640	0.00440	0.00640	0.00930	0.01410	0.01670
-5.000	0.00640	0.00440	0.00340	0.00240	0.00335	0.00510	0.00600	0.01060
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00110	-0.00130	-0.00300	-0.00420	-0.00600	-0.00650	-0.01200	-0.01510
10.000	-0.00530	-0.00530	-0.00740	-0.01070	-0.01530	-0.02150	-0.02650	-0.03600
15.000	-0.01060	-0.01060	-0.01260	-0.01890	-0.02760	-0.03875	-0.05050	-0.06200
20.000	-0.01780	-0.01780	-0.02260	-0.03140	-0.04450	-0.06200	-0.07900	-0.09550

ENGINEER ECO
DATE 9/13/78

FIGURE 4.1.1.3-85
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



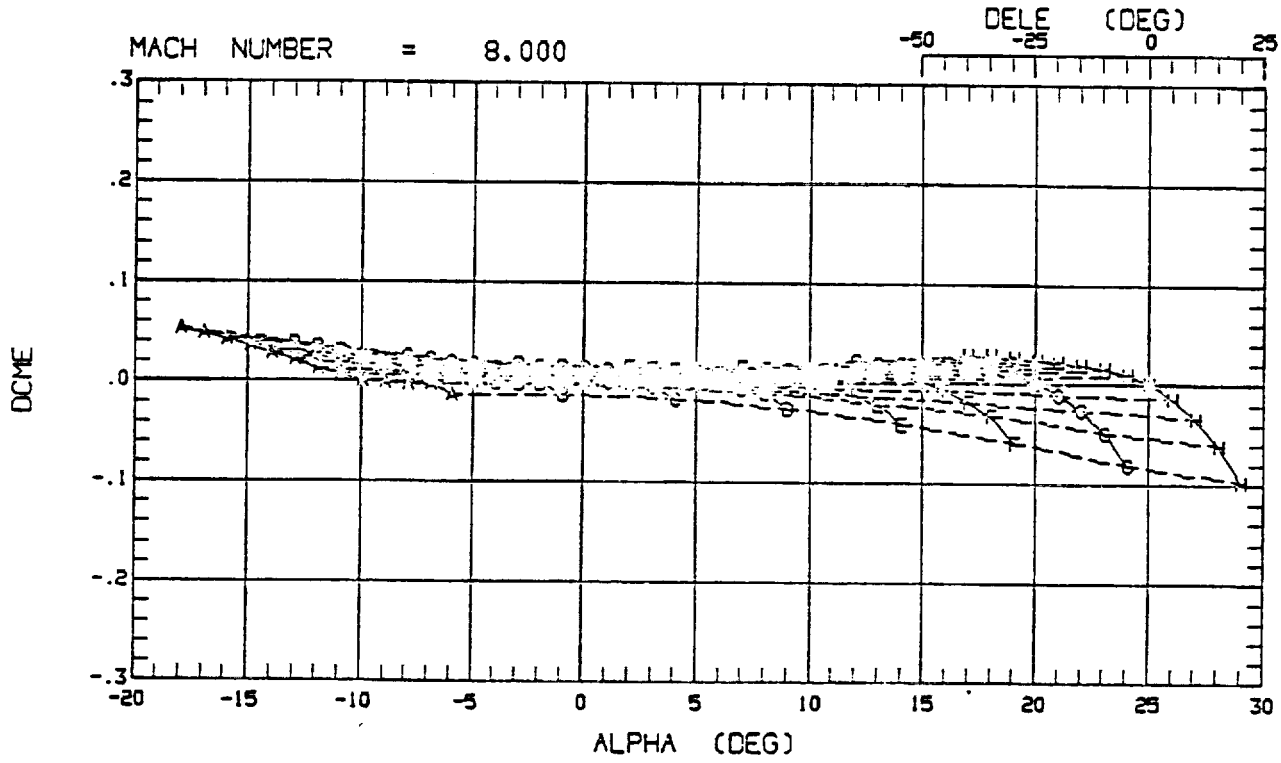
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1075.7	IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0	IN..	WING SPAN	BW = 78.055	FT.
MOMENT REFERENCE	ZO = WL 375.0	IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.02420	0.02660	0.03650	0.04650	0.05580	0.07170	0.08480	0.09820
-35.000	0.02220	0.02710	0.03440	0.04440	0.05670	0.06950	0.08240	0.09560
-30.000	0.02025	0.02550	0.03290	0.04200	0.05440	0.06710	0.07980	0.09270
-25.000	0.01810	0.02350	0.03050	0.03920	0.05000	0.06250	0.07400	0.08540
-20.000	0.01550	0.02110	0.02770	0.03600	0.04680	0.05760	0.06790	0.07790
-15.000	0.01275	0.01820	0.02410	0.03120	0.03970	0.04820	0.05600	0.06300
-10.000	0.00930	0.01410	0.01870	0.02400	0.03030	0.03640	0.04170	0.04650
-5.000	0.00510	0.00800	0.01060	0.01370	0.01670	0.01970	0.02270	0.02570
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00650	-0.01200	-0.01510	-0.01950	-0.02250	-0.02650	-0.03080	-0.03540
10.000	-0.02150	-0.02950	-0.03600	-0.04370	-0.05190	-0.06010	-0.06710	-0.07340
15.000	-0.03875	-0.05050	-0.06200	-0.07400	-0.08377	-0.09270	-0.09950	-0.10470
20.000	-0.06200	-0.07900	-0.09550	-0.11100	-0.11970	-0.12390	-0.12750	-0.12940

ENGINEER CW
DATE 9/23/78

FIGURE 4.1.1.3-66
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



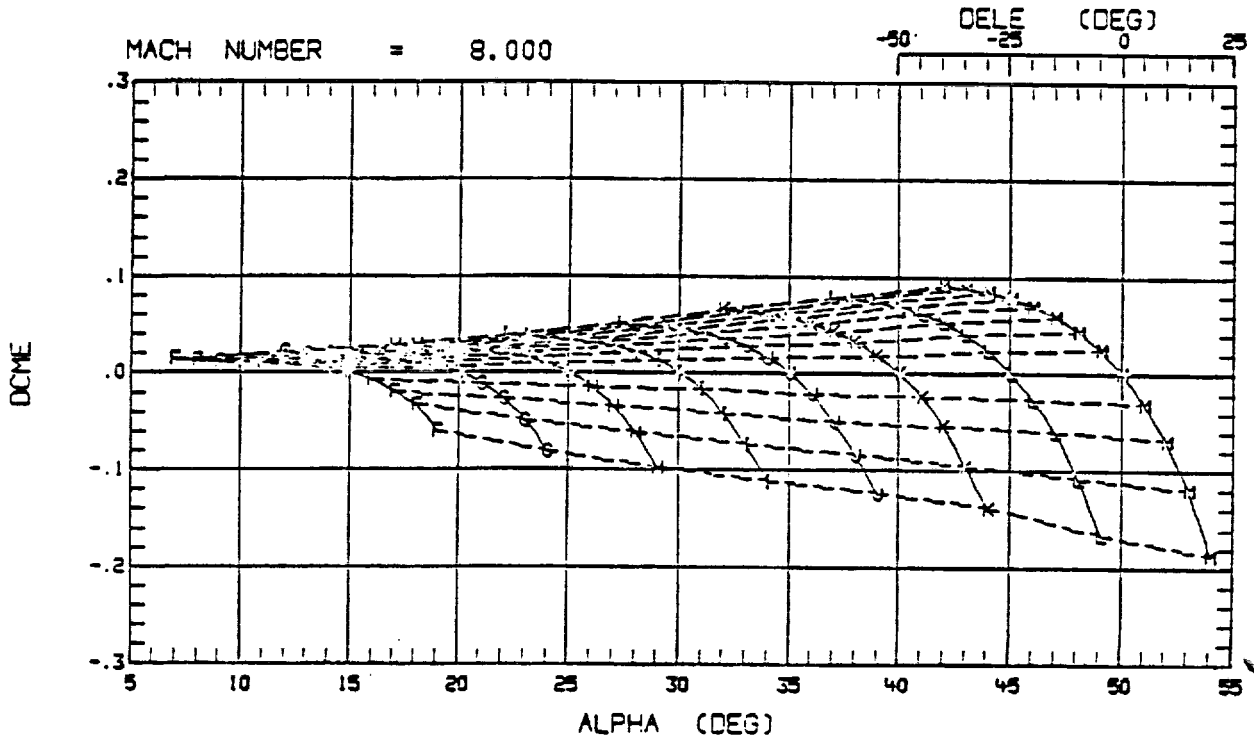
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.550 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05170	0.03720	0.02440	0.01650	0.01400	0.01390	0.02090	0.02800
-35.000	0.04680	0.03290	0.02180	0.01420	0.01220	0.01220	0.01900	0.02670
-30.000	0.04170	0.02850	0.01900	0.01330	0.01100	0.01100	0.01770	0.02540
-25.000	0.03460	0.02260	0.01620	0.01150	0.00910	0.01010	0.01620	0.02270
-20.000	0.02750	0.01710	0.01260	0.00990	0.00790	0.00990	0.01440	0.02170
-15.000	0.02090	0.01380	0.01100	0.00880	0.00700	0.00900	0.01230	0.01900
-10.000	0.01190	0.00760	0.00690	0.00620	0.00430	0.00620	0.00950	0.01510
-5.000	0.00730	0.00490	0.00450	0.00410	0.00320	0.00420	0.00580	0.00930
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00080	-0.00080	-0.00200	-0.00350	-0.00640	-0.00800	-0.01150	-0.01470
10.000	-0.00250	-0.00260	-0.00510	-0.00800	-0.01380	-0.02040	-0.02750	-0.03500
15.000	-0.00320	-0.00310	-0.00650	-0.01180	-0.02210	-0.03360	-0.04950	-0.06250
20.000	-0.01420	-0.01400	-0.01840	-0.02900	-0.04230	-0.06100	-0.08200	-0.09900

ENGINEER [illegible]
DATE 9/13/72

FIGURE 4.1.1.3-87
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

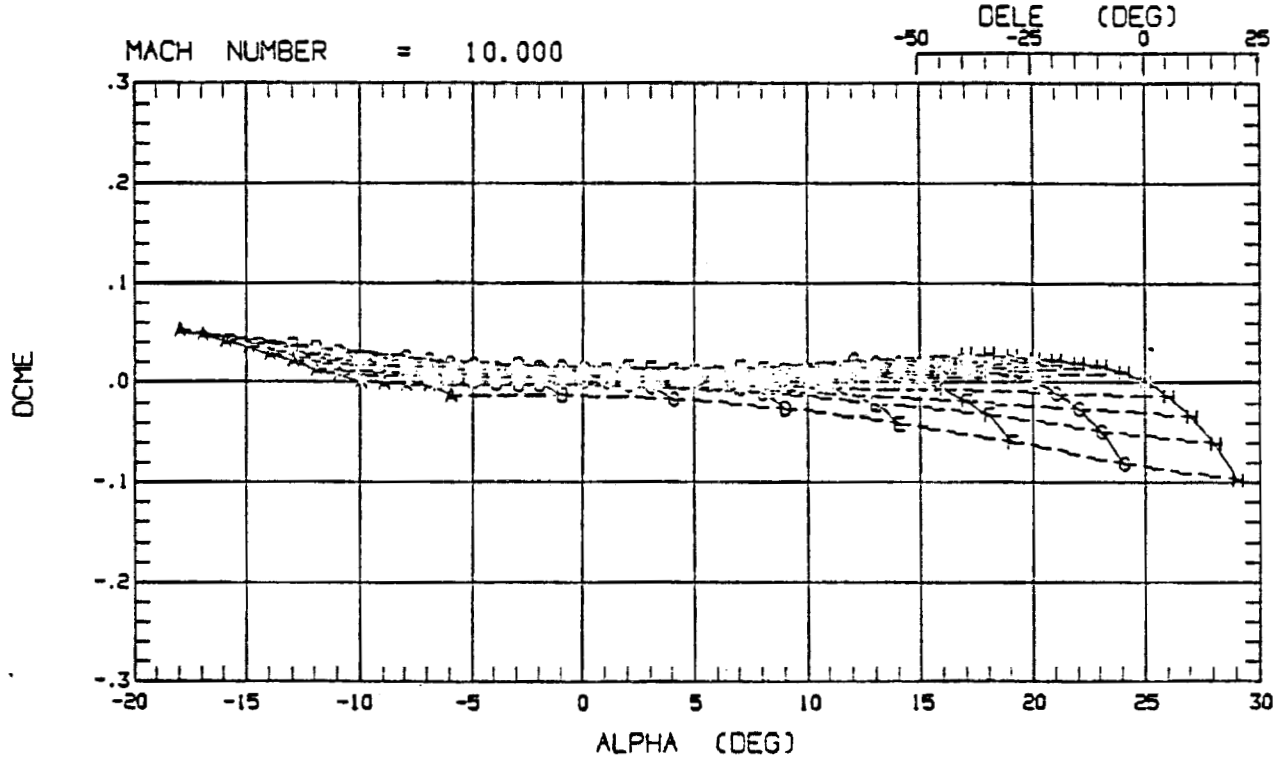
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	79.036 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.01390	0.02090	0.02900	0.03850	0.05070	0.06520	0.07820	0.09020
-35.000	0.01220	0.01900	0.02670	0.03700	0.04900	0.06260	0.07550	0.08750
-30.000	0.01100	0.01770	0.02540	0.03510	0.04675	0.05980	0.07250	0.08340
-25.000	0.01010	0.01620	0.02270	0.03300	0.04400	0.05570	0.06780	0.07730
-20.000	0.00990	0.01440	0.02170	0.03040	0.04050	0.05040	0.06130	0.05900
-15.000	0.00900	0.01230	0.01900	0.02580	0.03465	0.04250	0.05200	0.05780
-10.000	0.00620	0.00950	0.01510	0.02160	0.02700	0.03200	0.03940	0.04330
-5.000	0.00420	0.00550	0.00930	0.01275	0.01550	0.01800	0.02210	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00800	-0.01150	-0.01470	-0.01745	-0.02150	-0.02370	-0.02750	-0.03150
10.000	-0.02040	-0.02750	-0.03500	-0.04250	-0.05040	-0.05550	-0.06100	-0.07000
15.000	-0.03360	-0.04950	-0.06250	-0.07500	-0.08500	-0.09750	-0.10950	-0.12100
20.000	-0.05100	-0.08300	-0.09900	-0.11300	-0.12550	-0.14000	-0.16750	-0.19850

ENGINEER SCO
DATE 9/13/22

FIGURE 4.1.1.3-66
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

Rockwell International
Space Division



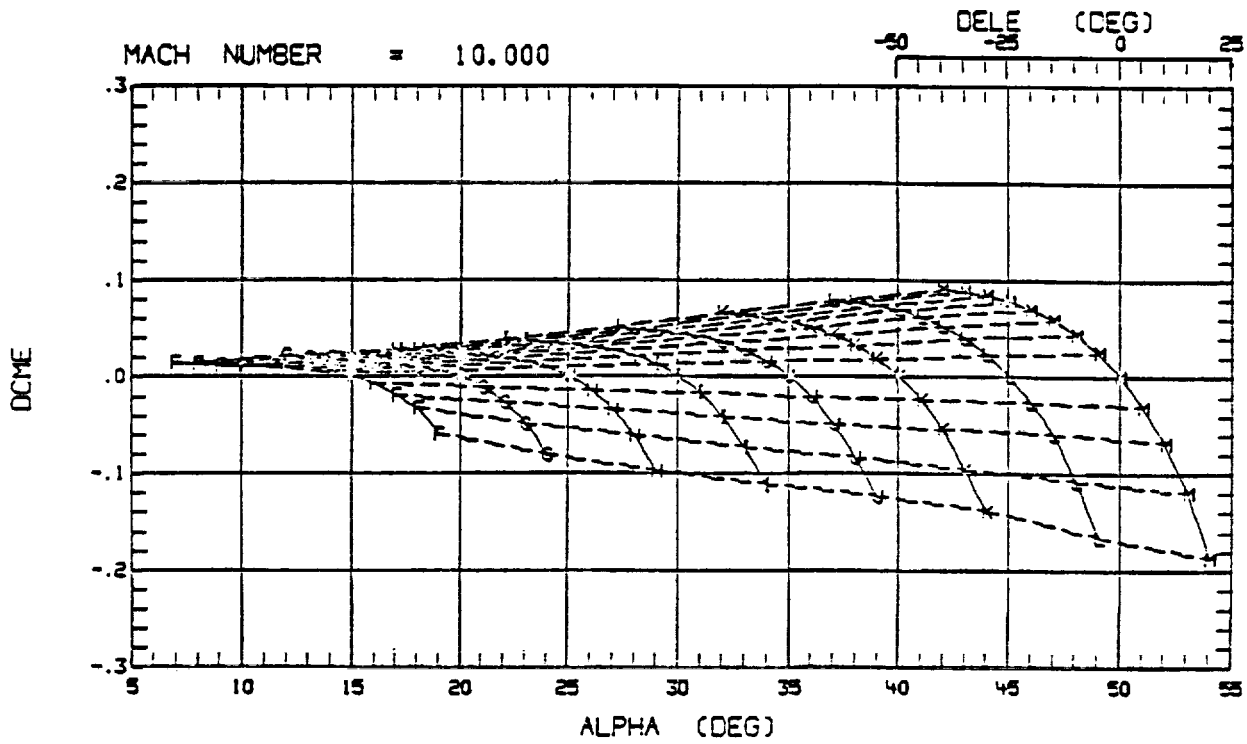
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05170	0.03720	0.02440	0.01650	0.01400	0.01390	0.02090	0.02900
-35.000	0.04680	0.03290	0.02180	0.01420	0.01220	0.01220	0.01900	0.02670
-30.000	0.04170	0.02950	0.01900	0.01330	0.01100	0.01100	0.01770	0.02540
-25.000	0.03460	0.02260	0.01620	0.01150	0.00910	0.01010	0.01620	0.02270
-20.000	0.02750	0.01710	0.01260	0.00990	0.00790	0.00990	0.01440	0.02170
-15.000	0.02090	0.01380	0.01100	0.00880	0.00700	0.00900	0.01230	0.01900
-10.000	0.01190	0.00760	0.00690	0.00620	0.00430	0.00620	0.00950	0.01510
-5.000	0.00730	0.00490	0.00450	0.00410	0.00320	0.00420	0.00580	0.00930
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00080	-0.00080	-0.00200	-0.00350	-0.00640	-0.00800	-0.01150	-0.01470
10.000	-0.00250	-0.00250	-0.00510	-0.00800	-0.01380	-0.02040	-0.02750	-0.03500
15.000	-0.00320	-0.00310	-0.00650	-0.01180	-0.02210	-0.03360	-0.04950	-0.06250
20.000	-0.01420	-0.01400	-0.01840	-0.02900	-0.04230	-0.06100	-0.08200	-0.09900

ENGINEER SCO
DATE 9/29/82

FIGURE 4.1.1.3-89
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

Rockwell International
Space Division



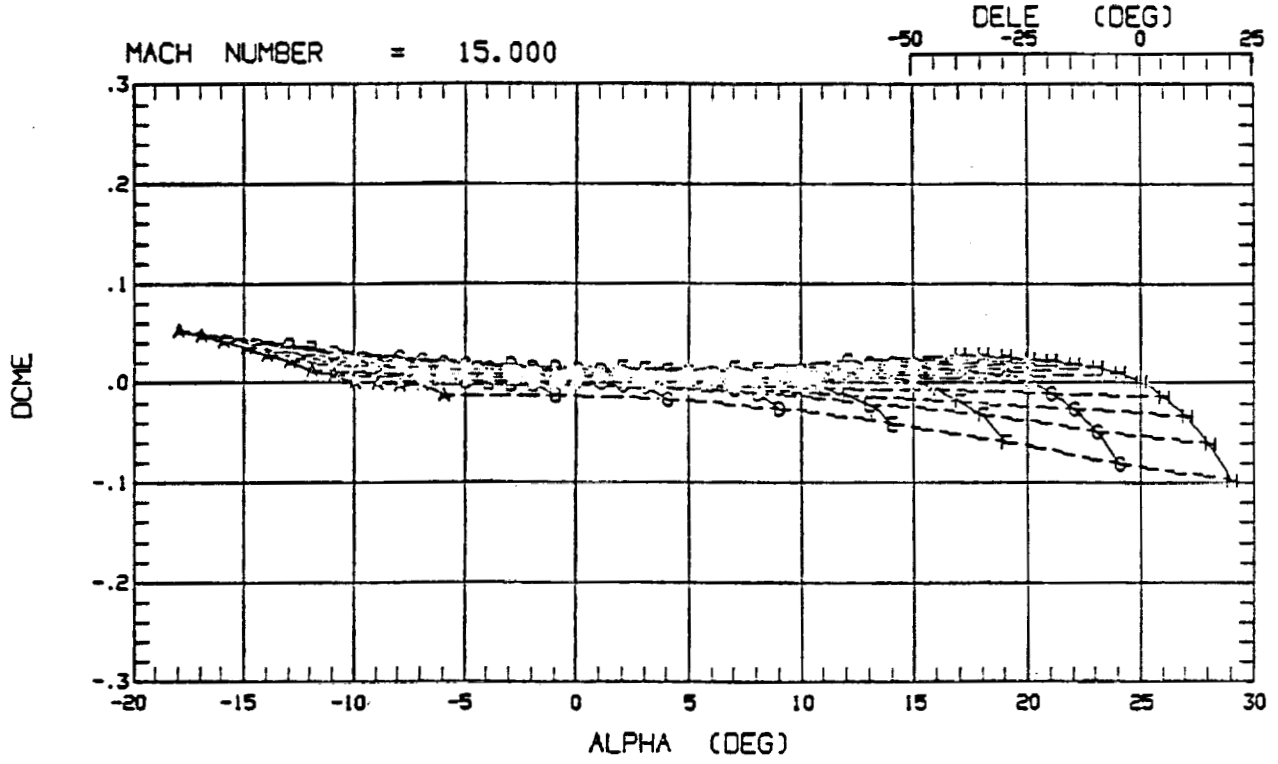
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1075.7 IN.	WING AREA	SW = 2550.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 75.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.01390	0.02090	0.02900	0.03650	0.05070	0.06520	0.07920	0.09020
-35.000	0.01220	0.01900	0.02570	0.03700	0.04900	0.06260	0.07550	0.08750
-30.000	0.01100	0.01770	0.02540	0.03510	0.04675	0.05950	0.07250	0.08340
-25.000	0.01010	0.01620	0.02270	0.03300	0.04400	0.05570	0.06730	0.07730
-20.000	0.00990	0.01440	0.02170	0.03040	0.04050	0.05040	0.06130	0.06900
-15.000	0.00900	0.01230	0.01900	0.02590	0.03485	0.04250	0.05200	0.05780
-10.000	0.00520	0.00950	0.01510	0.02160	0.02700	0.03200	0.03940	0.04330
-5.000	0.00420	0.00580	0.00930	0.01275	0.01560	0.01300	0.02210	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00900	-0.01150	-0.01470	-0.01745	-0.02150	-0.02370	-0.02750	-0.03150
10.000	-0.02040	-0.02750	-0.03500	-0.04250	-0.05040	-0.05550	-0.06100	-0.07000
15.000	-0.03360	-0.04950	-0.06250	-0.07500	-0.08500	-0.09750	-0.10950	-0.12100
20.000	-0.06100	-0.08200	-0.09900	-0.11300	-0.12550	-0.14000	-0.15750	-0.16850

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.1.1.3-90
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

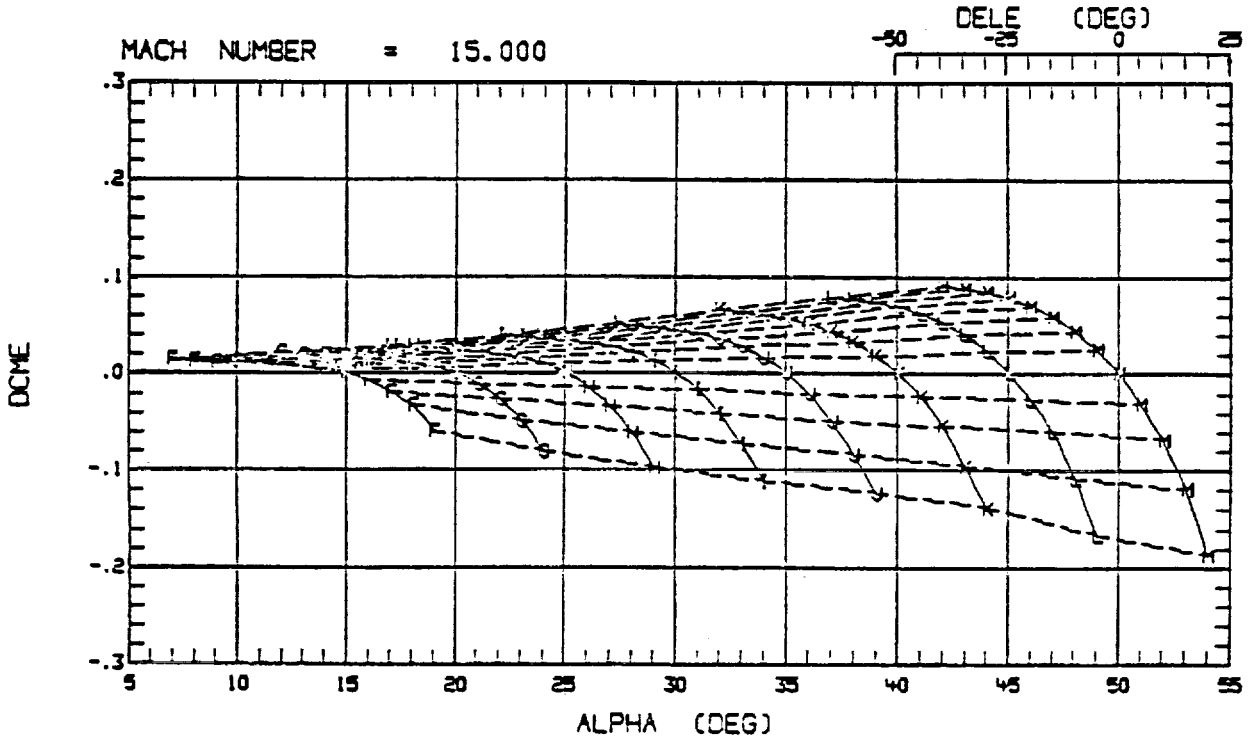


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05170	0.03720	0.02440	0.01650	0.01400	0.01390	0.02090	0.02800
-35.000	0.04680	0.03290	0.02180	0.01420	0.01220	0.01220	0.01900	0.02670
-30.000	0.04170	0.02950	0.01900	0.01330	0.01100	0.01100	0.01770	0.02540
-25.000	0.03460	0.02260	0.01620	0.01150	0.00910	0.01010	0.01620	0.02270
-20.000	0.02750	0.01710	0.01260	0.00990	0.00790	0.00990	0.01440	0.02170
-15.000	0.02090	0.01380	0.01100	0.00880	0.00700	0.00900	0.01230	0.01900
-10.000	0.01190	0.00760	0.00690	0.00620	0.00430	0.00620	0.00950	0.01510
-5.000	0.00730	0.00490	0.00450	0.00410	0.00320	0.00420	0.00590	0.00930
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00080	-0.00080	-0.00200	-0.00350	-0.00640	-0.00900	-0.01150	-0.01470
10.000	-0.00250	-0.00260	-0.00510	-0.00800	-0.01380	-0.02040	-0.02750	-0.03500
15.000	-0.00320	-0.00310	-0.00650	-0.01180	-0.02210	-0.03360	-0.04950	-0.06250
20.000	-0.01420	-0.01400	-0.01840	-0.02800	-0.04230	-0.06100	-0.08200	-0.09900

ENGINEER GCO
DATE 9/14/78

FIGURE 4.1.1.3-91
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



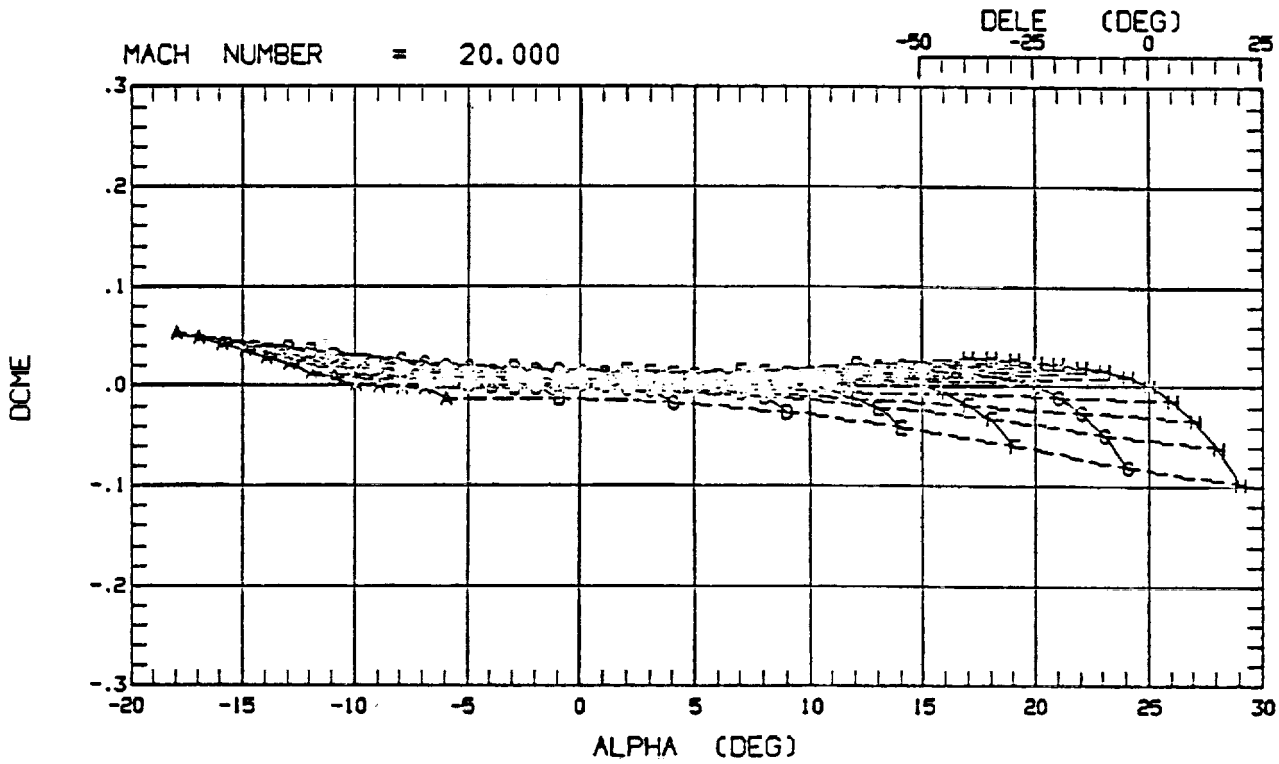
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.01390	0.02090	0.02800	0.03550	0.05070	0.06520	0.07820	0.09020
-35.000	0.01220	0.01900	0.02670	0.03700	0.04900	0.06250	0.07550	0.08750
-30.000	0.01100	0.01770	0.02540	0.03510	0.04675	0.05950	0.07250	0.08340
-25.000	0.01010	0.01620	0.02270	0.03300	0.04400	0.05570	0.06780	0.07730
-20.000	0.00990	0.01440	0.02170	0.03040	0.04050	0.05040	0.05130	0.06900
-15.000	0.00900	0.01230	0.01900	0.02680	0.03485	0.04250	0.05200	0.05780
-10.000	0.00620	0.00950	0.01510	0.02160	0.02700	0.03200	0.03940	0.04330
-5.000	0.00420	0.00580	0.00930	0.01275	0.01560	0.01800	0.02210	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00800	-0.01150	-0.01470	-0.01745	-0.02150	-0.02370	-0.02750	-0.03150
10.000	-0.02040	-0.02750	-0.03500	-0.04250	-0.05040	-0.05550	-0.06100	-0.07000
15.000	-0.03360	-0.04950	-0.06250	-0.07500	-0.08500	-0.09750	-0.10950	-0.12100
20.000	-0.06100	-0.08200	-0.09900	-0.11300	-0.12550	-0.14000	-0.15750	-0.16950

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.1.1.3-92
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT



CONFIGURATION

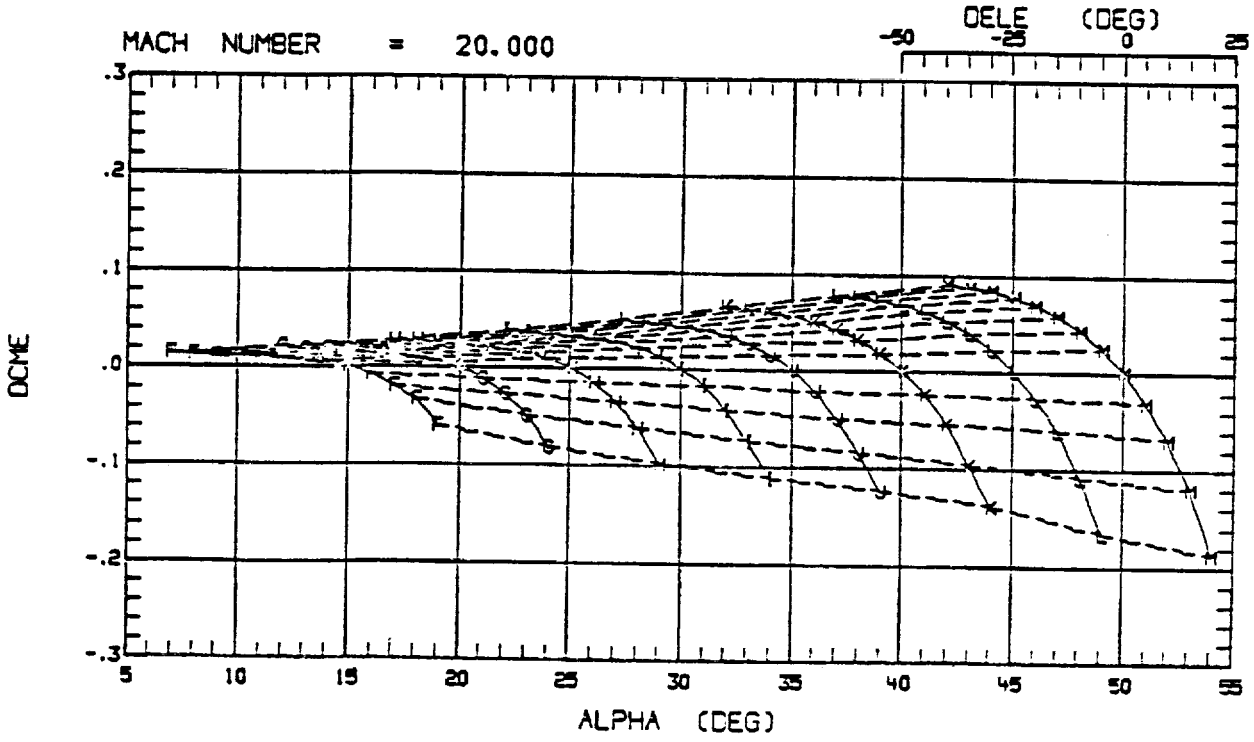
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	SW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELE (DEG)	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.05170	0.03720	0.02440	0.01650	0.01400	0.01390	0.02090	0.02800
-35.000	0.04680	0.03290	0.02180	0.01420	0.01220	0.01220	0.01900	0.02670
-30.000	0.04170	0.02850	0.01900	0.01330	0.01100	0.01100	0.01770	0.02540
-25.000	0.03460	0.02260	0.01620	0.01150	0.00910	0.01010	0.01620	0.02270
-20.000	0.02750	0.01710	0.01250	0.00990	0.00790	0.00990	0.01440	0.02170
-15.000	0.02090	0.01380	0.01100	0.00880	0.00700	0.00900	0.01230	0.01900
-10.000	0.01190	0.00760	0.00690	0.00620	0.00430	0.00620	0.00950	0.01510
-5.000	0.00730	0.00490	0.00450	0.00410	0.00320	0.00420	0.00580	0.00930
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00080	-0.00080	-0.00200	-0.00350	-0.00640	-0.00800	-0.01150	-0.01470
10.000	-0.00250	-0.00260	-0.00510	-0.00800	-0.01380	-0.02040	-0.02750	-0.03500
15.000	-0.00320	-0.00310	-0.00650	-0.01180	-0.02210	-0.03360	-0.04950	-0.06250
20.000	-0.01420	-0.01400	-0.01840	-0.02900	-0.04230	-0.06100	-0.08200	-0.09900

ENGINEER Sco
DATE 4/14/86

FIGURE 4.1.1.3-93
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

Rockwell International
Space Division



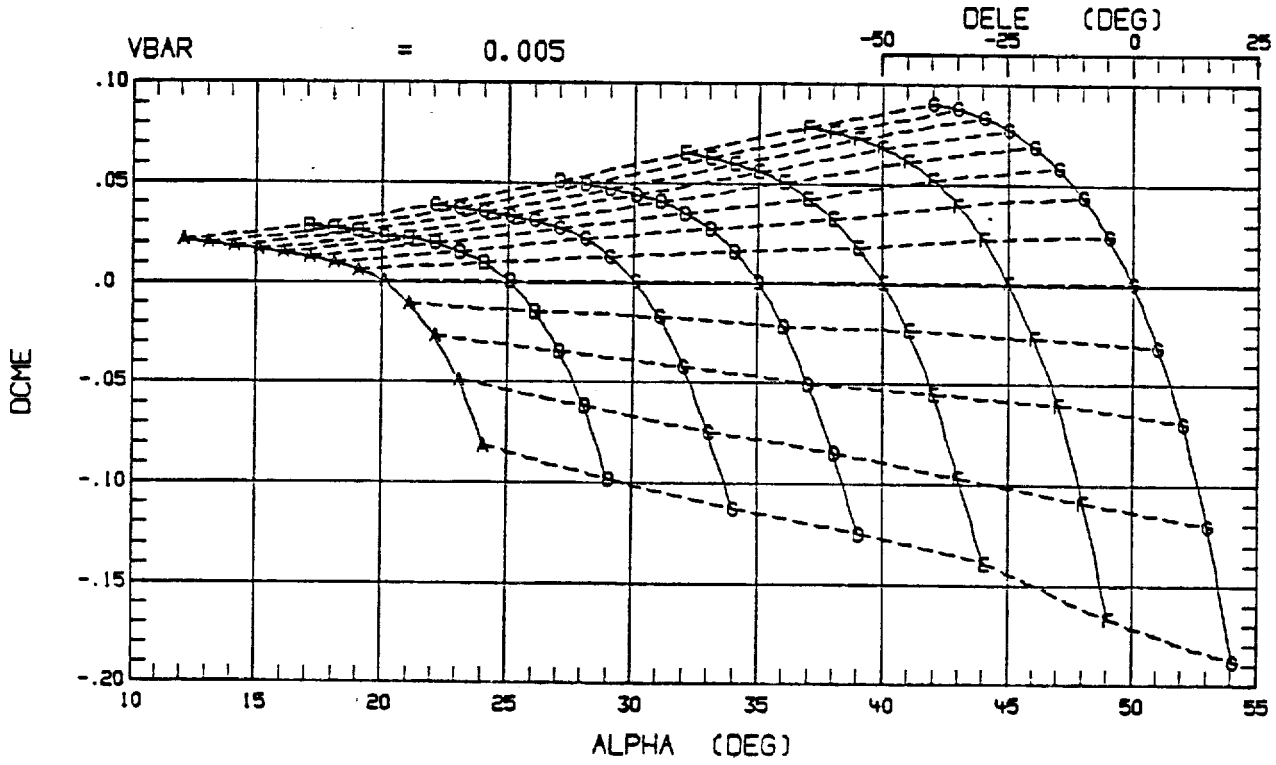
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

DELE (DEG)	ALPHA (DEG) 15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
	ELEVON PITCHING MOMENT INCREMENT							
-40.000	0.01390	0.02090	0.02900	0.03850	0.05070	0.06520	0.07620	0.09020
-35.000	0.01220	0.01900	0.02670	0.03700	0.04900	0.06260	0.07550	0.08730
-30.000	0.01100	0.01770	0.02540	0.03510	0.04675	0.05950	0.07260	0.08340
-25.000	0.01010	0.01620	0.02270	0.03300	0.04400	0.05570	0.06730	0.07730
-20.000	0.00990	0.01440	0.02170	0.03040	0.04050	0.05040	0.06130	0.06900
-15.000	0.00900	0.01230	0.01900	0.02680	0.03485	0.04250	0.05200	0.05780
-10.000	0.00620	0.00950	0.01510	0.02160	0.02700	0.03200	0.03940	0.04330
-5.000	0.00420	0.00580	0.00930	0.01275	0.01560	0.01800	0.02210	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00800	-0.01150	-0.01470	-0.01745	-0.02150	-0.02370	-0.02750	-0.03150
10.000	-0.02040	-0.02750	-0.03500	-0.04250	-0.05040	-0.05850	-0.06100	-0.07000
15.000	-0.03360	-0.04950	-0.06250	-0.07500	-0.08500	-0.09750	-0.10950	-0.12100
20.000	-0.05100	-0.06200	-0.09900	-0.11300	-0.12550	-0.14000	-0.15750	-0.15850

ENGINEER GCO
DATE 4/10/72

FIGURE 4.1.1.3-94
ELEVON PITCHING MOMENT COEFFICIENT INCREMENT

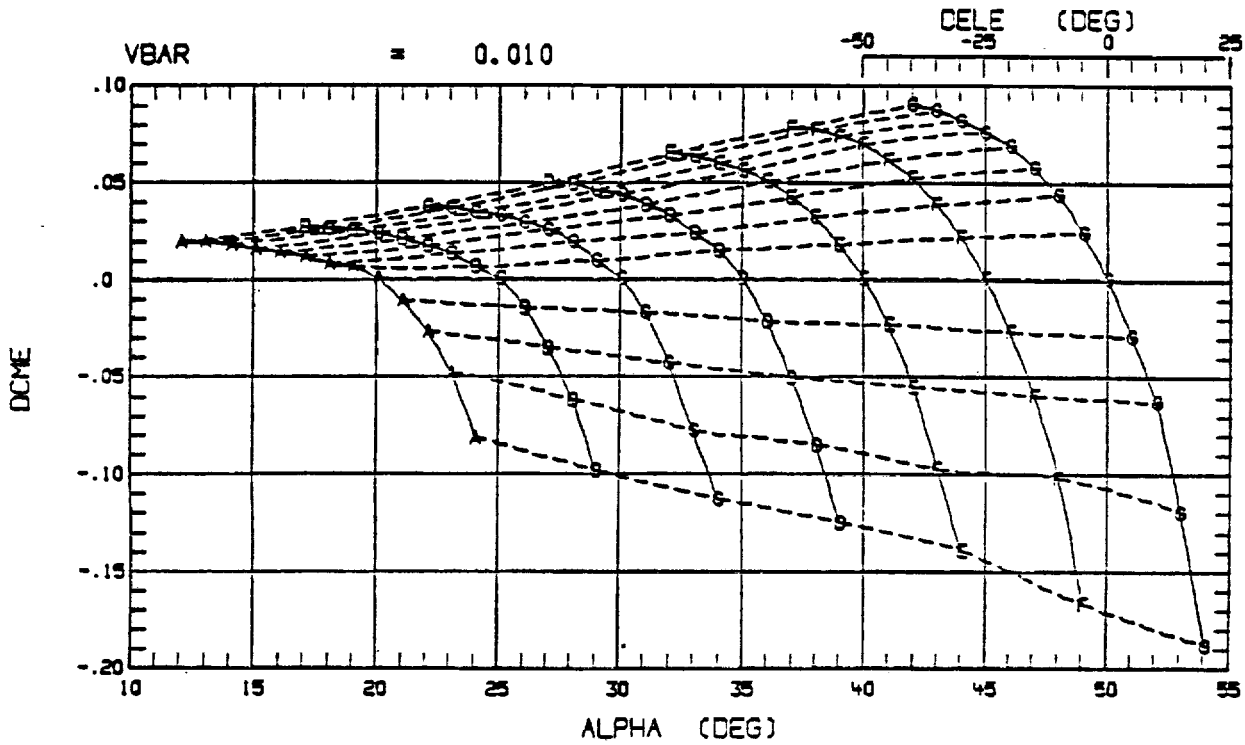


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON PITCHING MOMENT COEFFICIE						
-40.000	0.02090	0.02900	0.03850	0.05070	0.06520	0.07820	0.09020
-35.000	0.01900	0.02670	0.03700	0.04900	0.06260	0.07550	0.08750
-30.000	0.01770	0.02540	0.03510	0.04675	0.05950	0.07250	0.08340
-25.000	0.01620	0.02270	0.03300	0.04400	0.05570	0.06780	0.07730
-20.000	0.01440	0.02170	0.03040	0.04050	0.05040	0.06130	0.06900
-15.000	0.01230	0.01900	0.02680	0.03485	0.04250	0.05200	0.05780
-10.000	0.00950	0.01510	0.02160	0.02700	0.03200	0.03940	0.04330
-5.000	0.00580	0.00930	0.01275	0.01560	0.01600	0.02210	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01150	-0.01470	-0.01745	-0.02150	-0.02370	-0.02750	-0.03150
10.000	-0.02750	-0.03500	-0.04250	-0.05040	-0.05550	-0.06100	-0.07000
15.000	-0.04950	-0.06250	-0.07500	-0.08500	-0.09750	-0.10950	-0.12100
20.000	-0.08200	-0.09900	-0.11300	-0.12550	-0.14000	-0.16750	-0.19950

ENGINEER NASA
DATE

FIGURE 4.1.1.3-95
EFFECT OF ELEVON

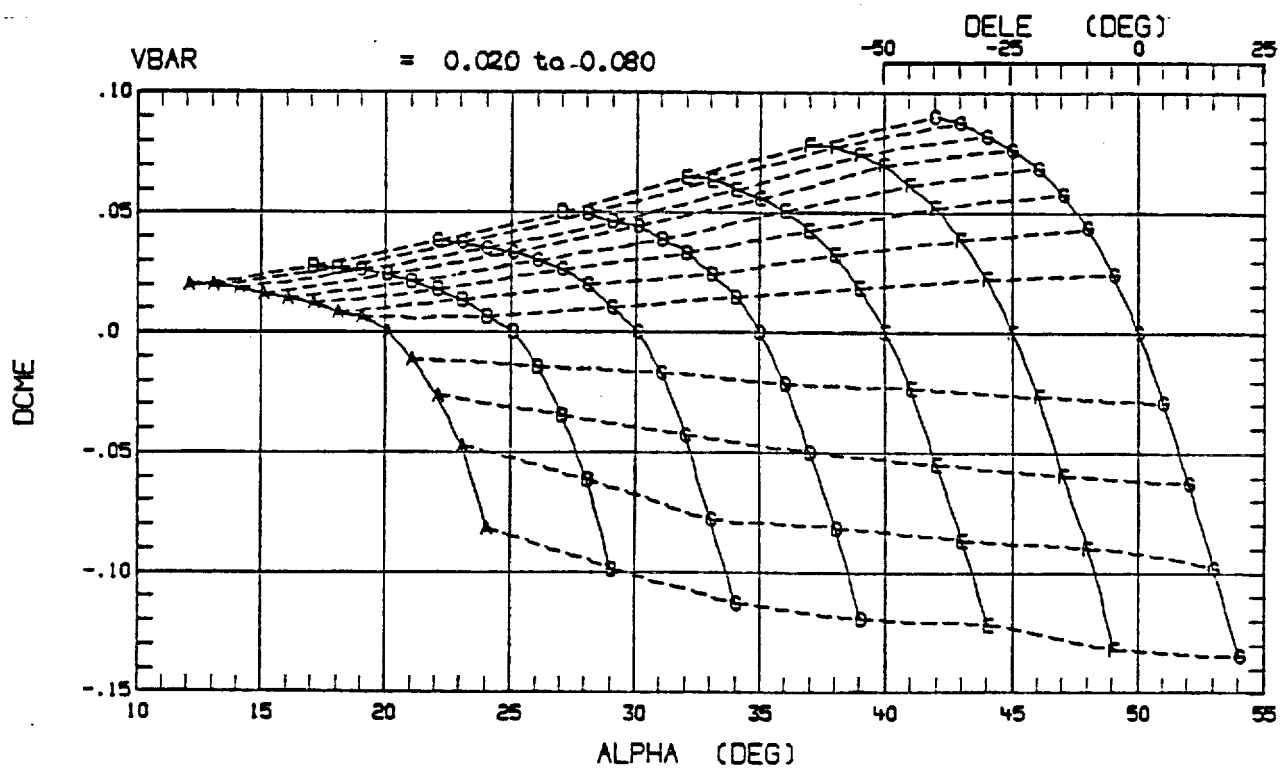


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON PITCHING MOMENT COEFFICIE						
-40.000	0.01920	0.02720	0.03770	0.04980	0.06470	0.07790	0.08980
-35.000	0.01920	0.02630	0.03690	0.04930	0.06350	0.07710	0.08720
-30.000	0.01800	0.02560	0.03480	0.04580	0.05970	0.07370	0.08190
-25.000	0.01560	0.02360	0.03300	0.04400	0.05570	0.06940	0.07600
-20.000	0.01390	0.02070	0.02950	0.03870	0.05040	0.06100	0.06650
-15.000	0.01160	0.01720	0.02570	0.03300	0.04250	0.05160	0.05730
-10.000	0.00790	0.01310	0.01910	0.02400	0.03200	0.03820	0.04330
-5.000	0.00600	0.00630	0.00970	0.01460	0.01800	0.02170	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01150	-0.01470	-0.01750	-0.02200	-0.02370	-0.02720	-0.02950
10.000	-0.02700	-0.03540	-0.04350	-0.05040	-0.05550	-0.06000	-0.06300
15.000	-0.04810	-0.06210	-0.07850	-0.08560	-0.09800	-0.10250	-0.12040
20.000	-0.08200	-0.09900	-0.11300	-0.12550	-0.14000	-0.15750	-0.16550

ENGINEER NASA
DATE

FIGURE 4.1.1.3-96
EFFECT OF ELEVON

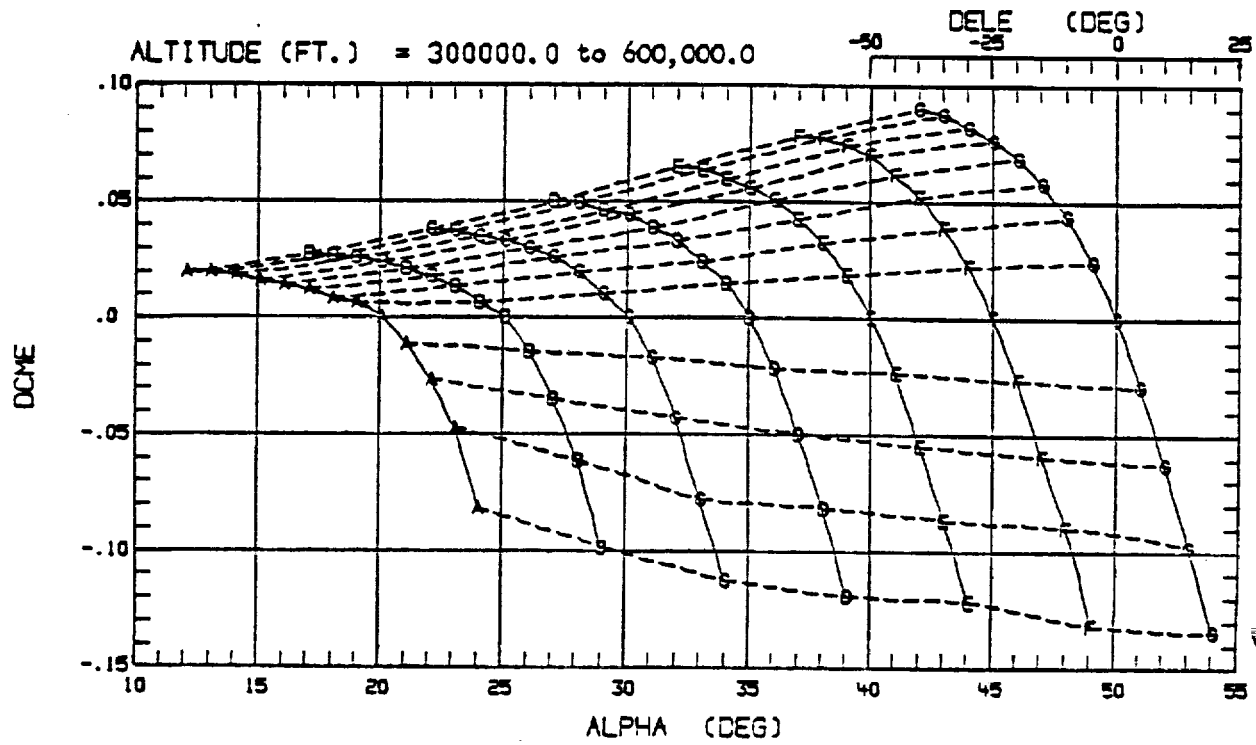


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELE (DEG)	ELEVON PITCHING MOMENT COEFFICIE						
-40.000	0.01920	0.02720	0.03770	0.04980	0.06470	0.07790	0.08980
-35.000	0.01920	0.02630	0.03690	0.04930	0.06350	0.07710	0.08720
-30.000	0.01800	0.02560	0.03480	0.04580	0.05970	0.07370	0.08190
-25.000	0.01560	0.02360	0.03300	0.04400	0.05570	0.06940	0.07600
-20.000	0.01390	0.02070	0.02950	0.03870	0.05040	0.06100	0.06850
-15.000	0.01160	0.01720	0.02570	0.03300	0.04250	0.05180	0.05730
-10.000	0.00790	0.01310	0.01910	0.02400	0.03200	0.03820	0.04330
-5.000	0.00600	0.00630	0.00970	0.01460	0.01800	0.02170	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01150	-0.01470	-0.01750	-0.02200	-0.02370	-0.02720	-0.02950
10.000	-0.02700	-0.03540	-0.04350	-0.05040	-0.05550	-0.06000	-0.06300
15.000	-0.04810	-0.06210	-0.07850	-0.08180	-0.08700	-0.09020	-0.09840
20.000	-0.08200	-0.09900	-0.11300	-0.11970	-0.12200	-0.13200	-0.13500

ENGINEER NASA
DATE

FIGURE 4.1.1.3-97
EFFECT OF ELEVON

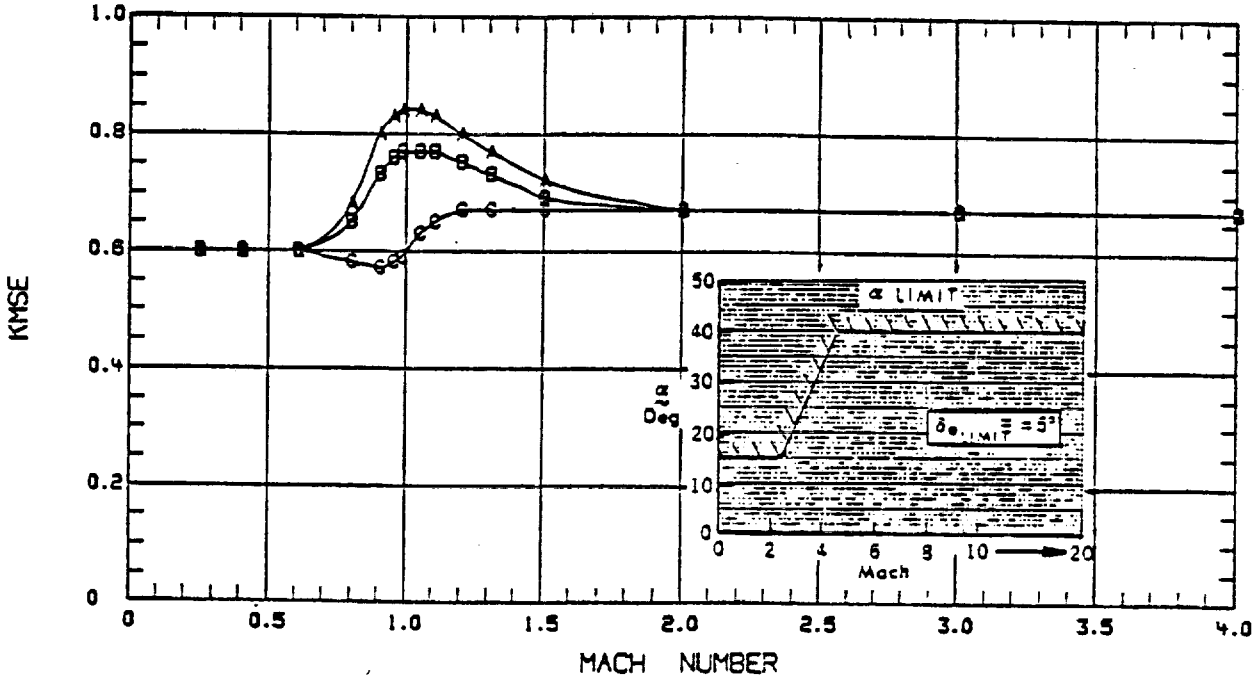


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1230.3 IN.

	ALPHA (DEG)						
	20.0 A	25.0 B	30.0 C	35.0 D	40.0 E	45.0 F	50.0 G
DELE (DEG)	ELEVON PITCHING MOMENT COEFFICIE						
-40.000	0.01920	0.02720	0.03770	0.04980	0.06470	0.07790	0.08980
-35.000	0.01920	0.02530	0.03690	0.04930	0.06350	0.07710	0.08720
-30.000	0.01800	0.02560	0.03480	0.04580	0.05970	0.07370	0.08190
-25.000	0.01560	0.02360	0.03300	0.04400	0.05570	0.06940	0.07600
-20.000	0.01390	0.02070	0.02950	0.03870	0.05040	0.06100	0.06650
-15.000	0.01160	0.01720	0.02570	0.03300	0.04250	0.05180	0.05730
-10.000	0.00790	0.01310	0.01910	0.02400	0.03200	0.03820	0.04330
-5.000	0.00600	0.00630	0.00970	0.01460	0.01800	0.02170	0.02400
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01150	-0.01470	-0.01750	-0.02200	-0.02370	-0.02720	-0.02950
10.000	-0.02700	-0.03540	-0.04350	-0.05040	-0.05550	-0.06000	-0.06300
15.000	-0.04810	-0.06210	-0.07850	-0.08180	-0.08700	-0.09020	-0.09640
20.000	-0.08200	-0.09900	-0.11300	-0.11970	-0.12200	-0.13200	-0.13500

ENGINEER NASA
DATE

FIGURE 4.1.1.3-98
EFFECT OF ELEVON



CONFIGURATION

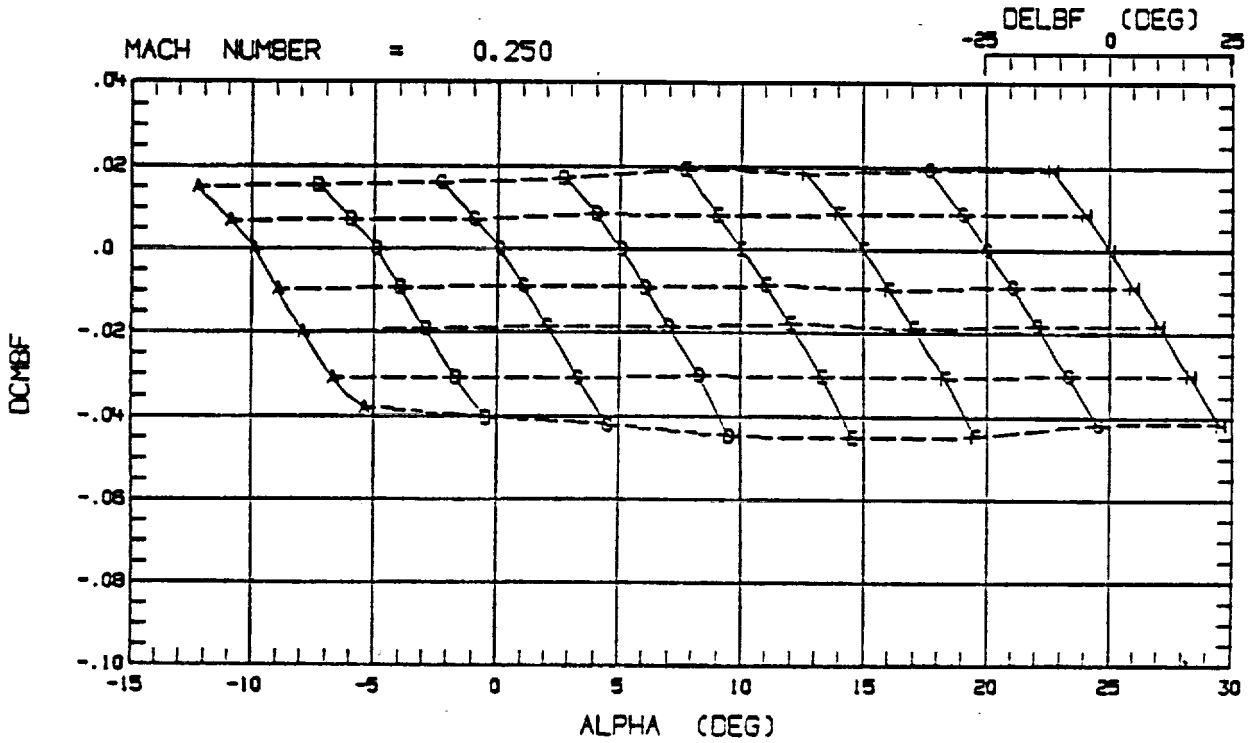
BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.		WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.		WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.		M.A.C.	CW = 39.560 FT.
			BODY LENGTH	LB = 1290.3 IN.

	DELE (DEG)		
	-5.000 A	0.0 B	5.000 C
MACH NUMBER	PITCHING MOM. PARTIAL SPAN FACTOR		
0.250	0.60000	0.60000	0.60000
0.400	0.60000	0.60000	0.60000
0.600	0.60000	0.60000	0.60000
0.800	0.68000	0.65000	0.58000
0.900	0.80000	0.73000	0.57000
0.950	0.83000	0.76000	0.58000
0.980	0.84000	0.77000	0.59000
1.050	0.84000	0.77000	0.63000
1.100	0.83000	0.77000	0.65000
1.200	0.80000	0.75000	0.67000
1.300	0.77000	0.73000	0.67000
1.500	0.72000	0.69000	0.67000
2.000	0.67000	0.67000	0.67000
3.000	0.67000	0.67000	0.67000
4.000	0.67000	0.67000	0.67000
5.000	0.67000	0.67000	0.67000
8.000	0.67000	0.67000	0.67000
10.000	0.67000	0.67000	0.67000
15.000	0.67000	0.67000	0.67000
20.000	0.67000	0.67000	0.67000

NOTE: In the event partial span factors are required which exceed the given limits, the Aero Data Unit at Rockwell International should be contacted before extrapolation of the given data.

ENGINEER ECD WMZ
DATE 9/13/78 REV 1-26-79

FIGURE 4.1.1.3-99
ELEVON PARTIAL SPAN FACTOR

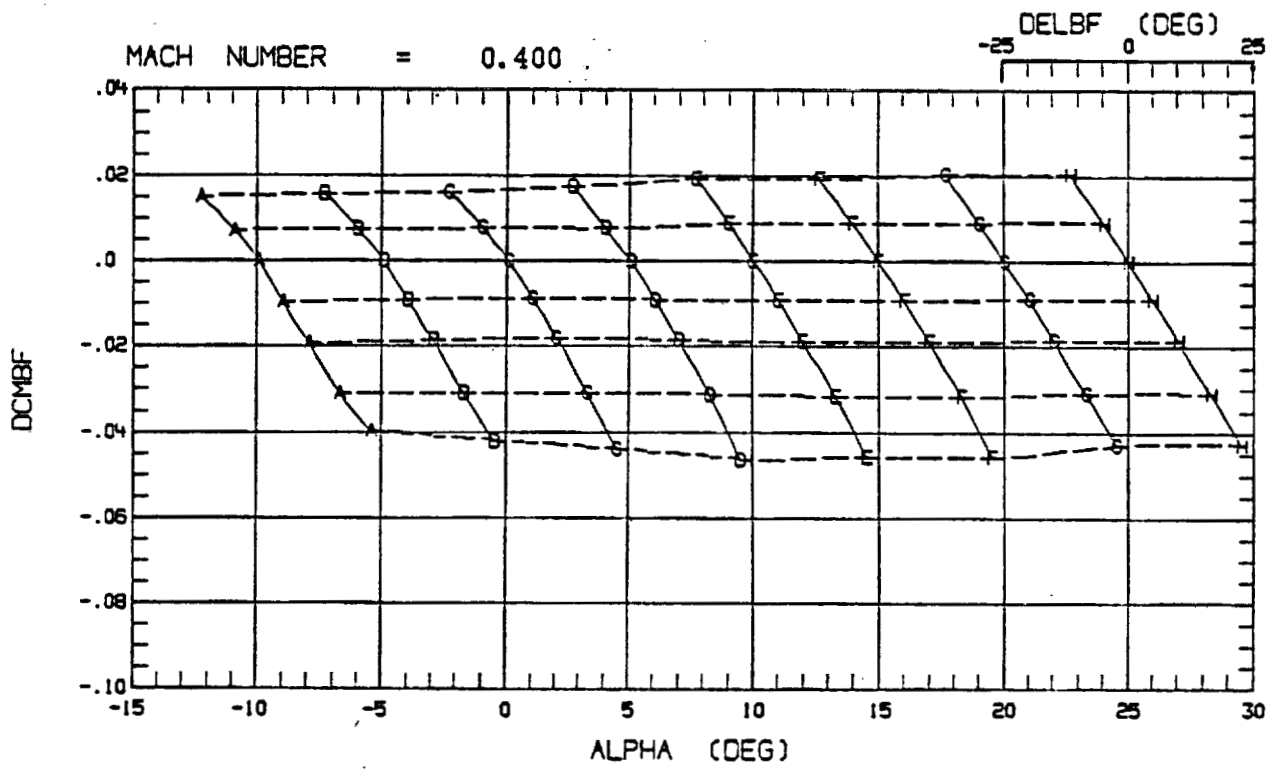


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI							
-11.700	0.01470	0.01530	0.01580	0.01700	0.01900	0.01810	0.01900	0.01900
-5.000	0.00670	0.00690	0.00710	0.00820	0.00800	0.00820	0.00850	0.00850
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00990	-0.00940	-0.00900	-0.00924	-0.00880	-0.00970	-0.00900	-0.00900
10.000	-0.02000	-0.01930	-0.01860	-0.01660	-0.01800	-0.01900	-0.01820	-0.01820
16.300	-0.03110	-0.03100	-0.03100	-0.03050	-0.03070	-0.03090	-0.03040	-0.03040
22.500	-0.03830	-0.04050	-0.04240	-0.04500	-0.04530	-0.04500	-0.04200	-0.04200

ENGINEER
DATE

FIGURE 4.1.1.3-100
EFFECT OF BODY FLAP

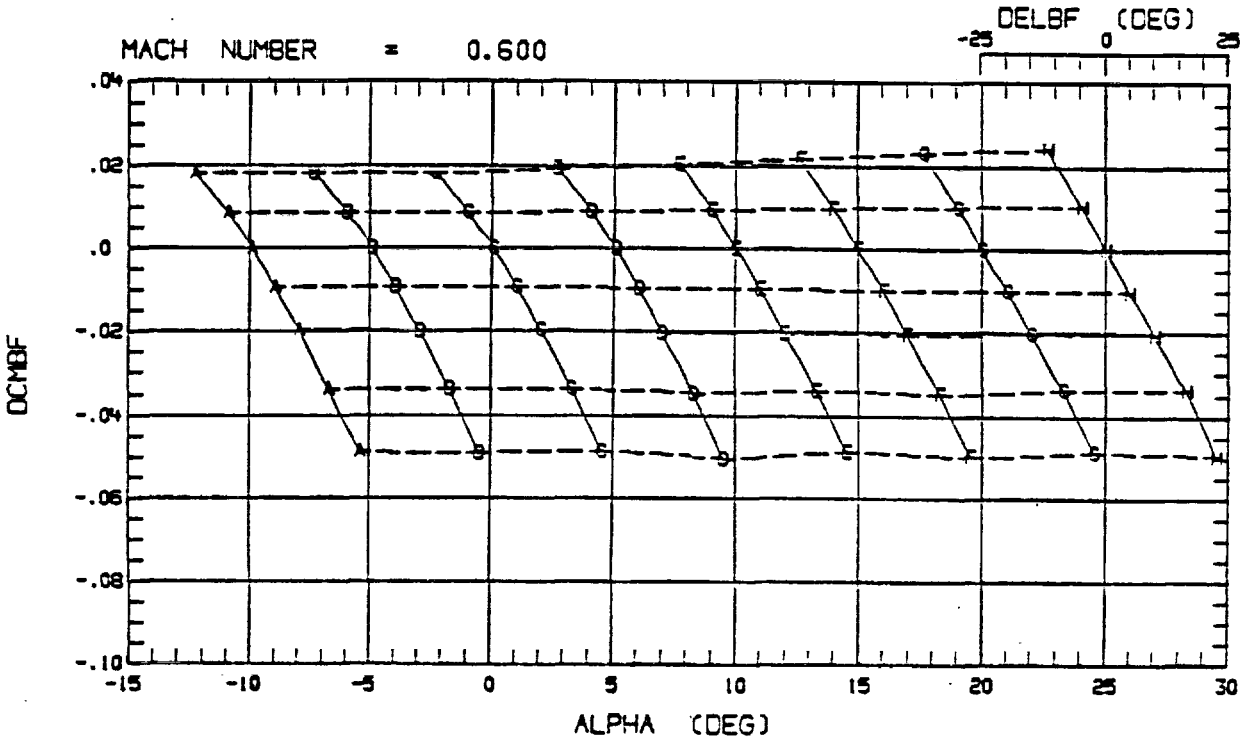


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI							
-11.700	0.01490	0.01550	0.01600	0.01720	0.01900	0.01900	0.02000	0.02000
-5.000	0.00710	0.00730	0.00750	0.00750	0.00867	0.00860	0.00890	0.00890
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00970	-0.00930	-0.00890	-0.00924	-0.00925	-0.00947	-0.00910	-0.00910
10.000	-0.01950	-0.01880	-0.01810	-0.01880	-0.01890	-0.01910	-0.01870	-0.01870
16.300	-0.03100	-0.03110	-0.03110	-0.03130	-0.03170	-0.03190	-0.03100	-0.03100
22.500	-0.04010	-0.04230	-0.04420	-0.04660	-0.04600	-0.04610	-0.04310	-0.04310

ENGINEER DGD
DATE 10-4-76

FIGURE 4.1.1.3-101
EFFECT OF BODY FLAP

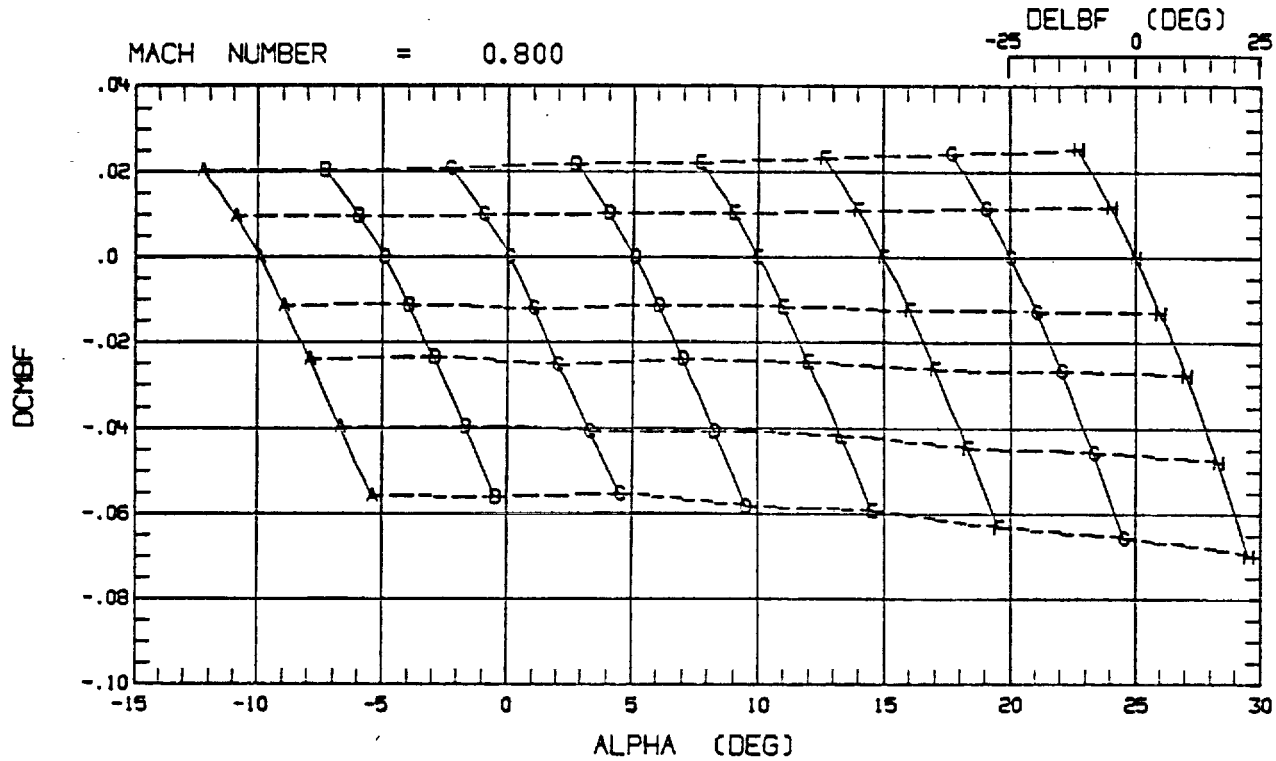


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 79.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.01800	0.01814	0.01790	0.01896	0.02012	0.02135	0.02300	0.02400
-5.000	0.00835	0.00840	0.00831	0.00872	0.00906	0.00952	0.00997	0.01030
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00942	-0.00946	-0.00942	-0.00969	-0.00978	-0.01014	-0.01012	-0.01033
10.000	-0.01983	-0.01988	-0.01983	-0.02030	-0.02024	-0.02087	-0.02038	-0.02067
16.300	-0.03400	-0.03406	-0.03394	-0.03487	-0.03429	-0.03512	-0.03400	-0.03400
22.500	-0.04900	-0.04905	-0.04880	-0.05045	-0.04997	-0.04990	-0.04900	-0.05000

ENGINEER WMZ
DATE 4-20-78

FIGURE 4.1.1.3-102
EFFECT OF BODY FLAP

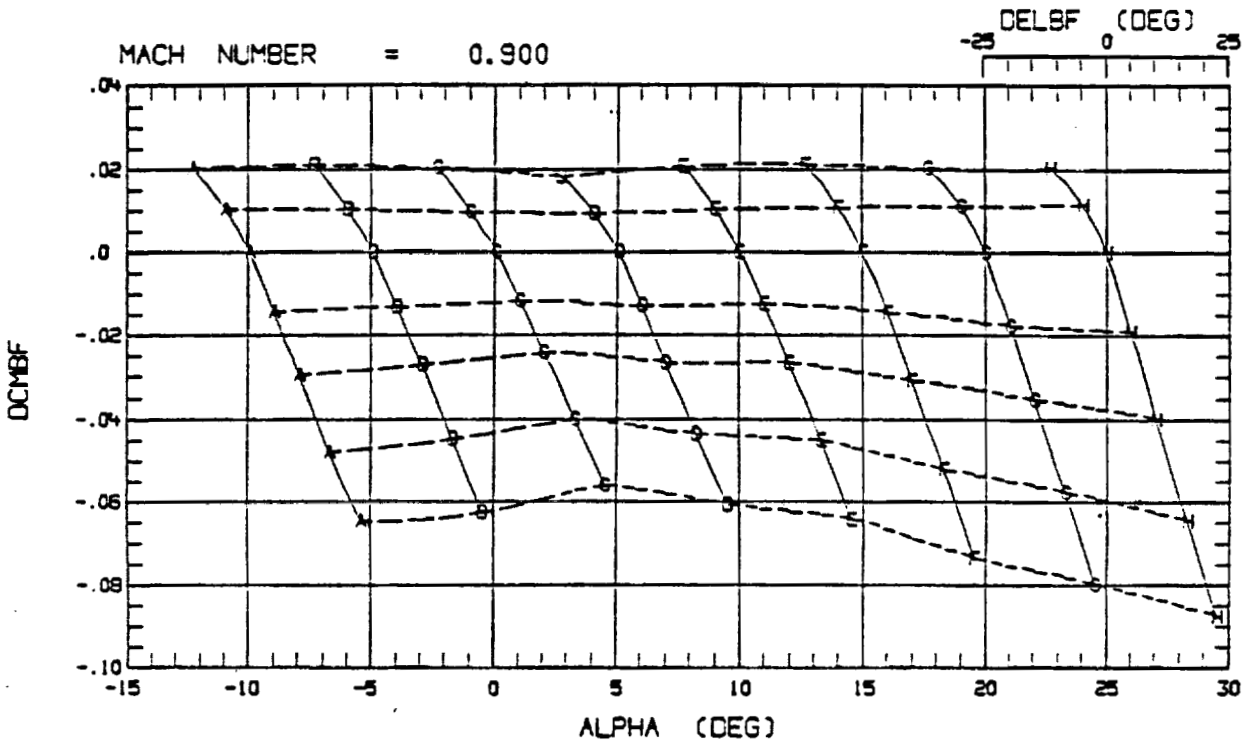


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.02000	0.02017	0.02040	0.02163	0.02182	0.02303	0.02400	0.02500
-5.000	0.00944	0.00948	0.00964	0.01004	0.01017	0.01078	0.01118	0.01165
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01157	-0.01136	-0.01226	-0.01149	-0.01183	-0.01264	-0.01277	-0.01313
10.000	-0.02403	-0.02376	-0.02523	-0.02412	-0.02483	-0.02655	-0.02691	-0.02771
16.300	-0.04000	-0.03986	-0.04092	-0.04092	-0.04196	-0.04482	-0.04600	-0.04800
22.500	-0.05600	-0.05615	-0.05562	-0.05829	-0.05951	-0.06350	-0.06600	-0.07000

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-103
EFFECT OF BODY FLAP

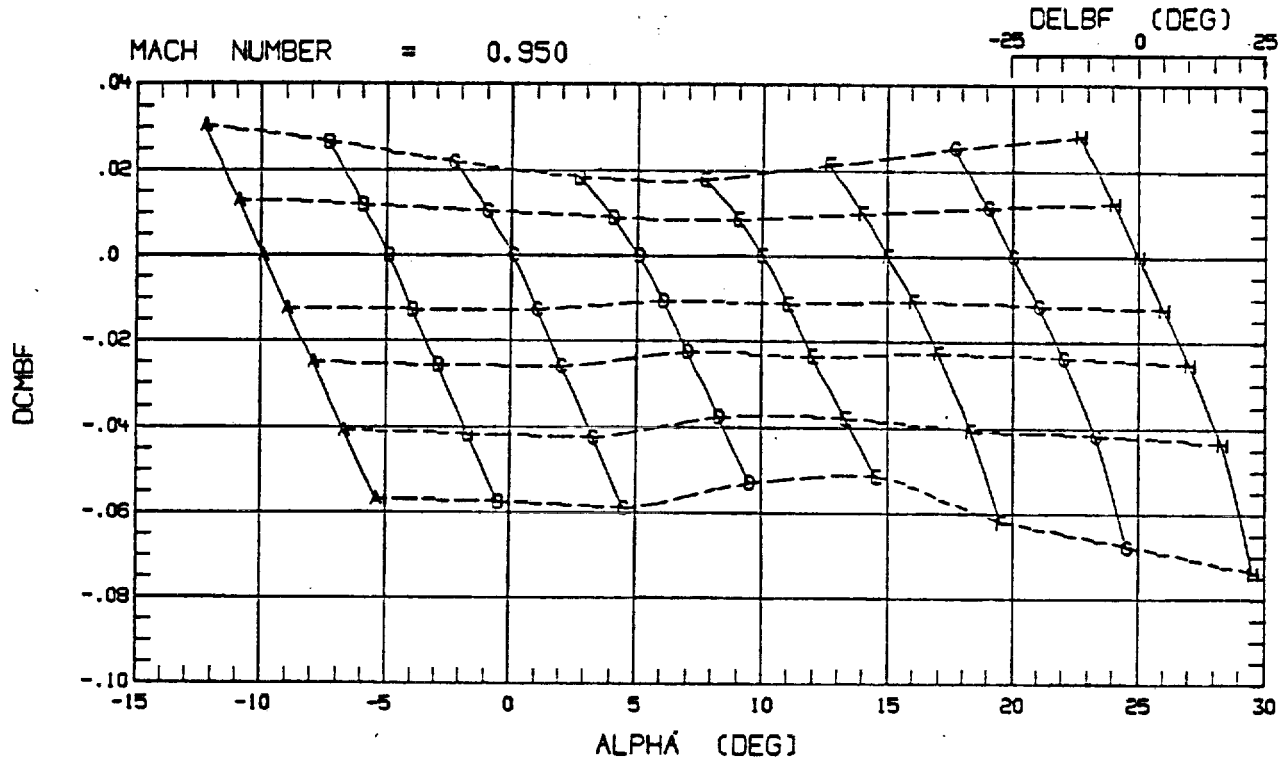


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.02000	0.02077	0.01993	0.01809	0.02061	0.02098	0.02000	0.02000
-5.000	0.01003	0.01005	0.00943	0.00910	0.01003	0.01066	0.01076	0.01127
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01429	-0.01314	-0.01177	-0.01311	-0.01255	-0.01467	-0.01776	-0.01929
10.000	-0.02563	-0.02714	-0.02431	-0.02672	-0.02569	-0.03107	-0.03559	-0.04014
16.300	-0.04800	-0.04493	-0.04027	-0.04389	-0.04537	-0.05229	-0.05800	-0.06500
22.500	-0.06500	-0.06265	-0.05619	-0.06098	-0.06455	-0.07372	-0.08000	-0.09500

ENGINEER [illegible]
DATE 4-10-78

FIGURE 4.1.1.3-104
EFFECT OF BODY FLAP

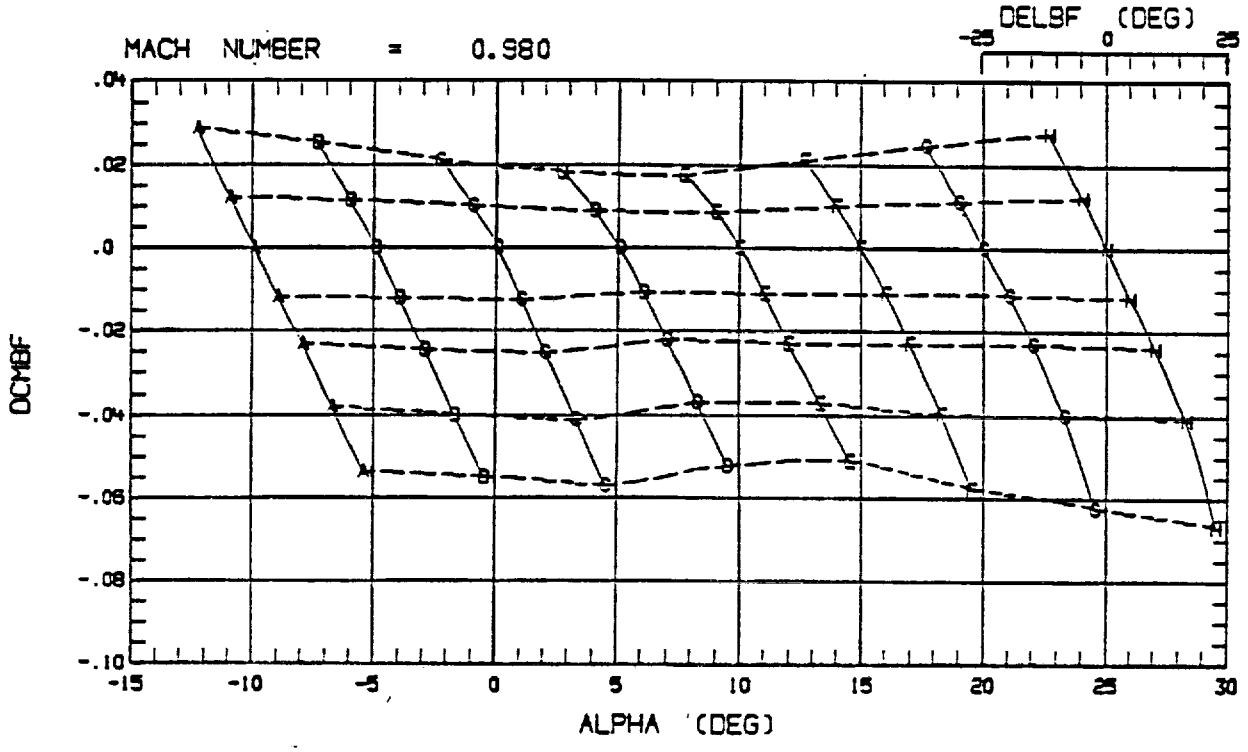


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.03000	0.02617	0.02149	0.01801	0.01762	0.02110	0.02500	0.02800
-5.000	0.01276	0.01159	0.01012	0.00863	0.00853	0.00986	0.01121	0.01233
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01262	-0.01279	-0.01280	-0.01078	-0.01136	-0.01091	-0.01172	-0.01255
10.000	-0.02512	-0.02577	-0.02602	-0.02259	-0.02361	-0.02296	-0.02387	-0.02549
16.300	-0.04100	-0.04196	-0.04271	-0.03783	-0.03822	-0.04085	-0.04200	-0.04400
22.500	-0.05700	-0.05773	-0.05922	-0.05319	-0.05158	-0.06224	-0.06800	-0.07400

ENGINEER WMZ
DATE 9-30-78

FIGURE 4.1.1.3-105
EFFECT OF BODY FLAP

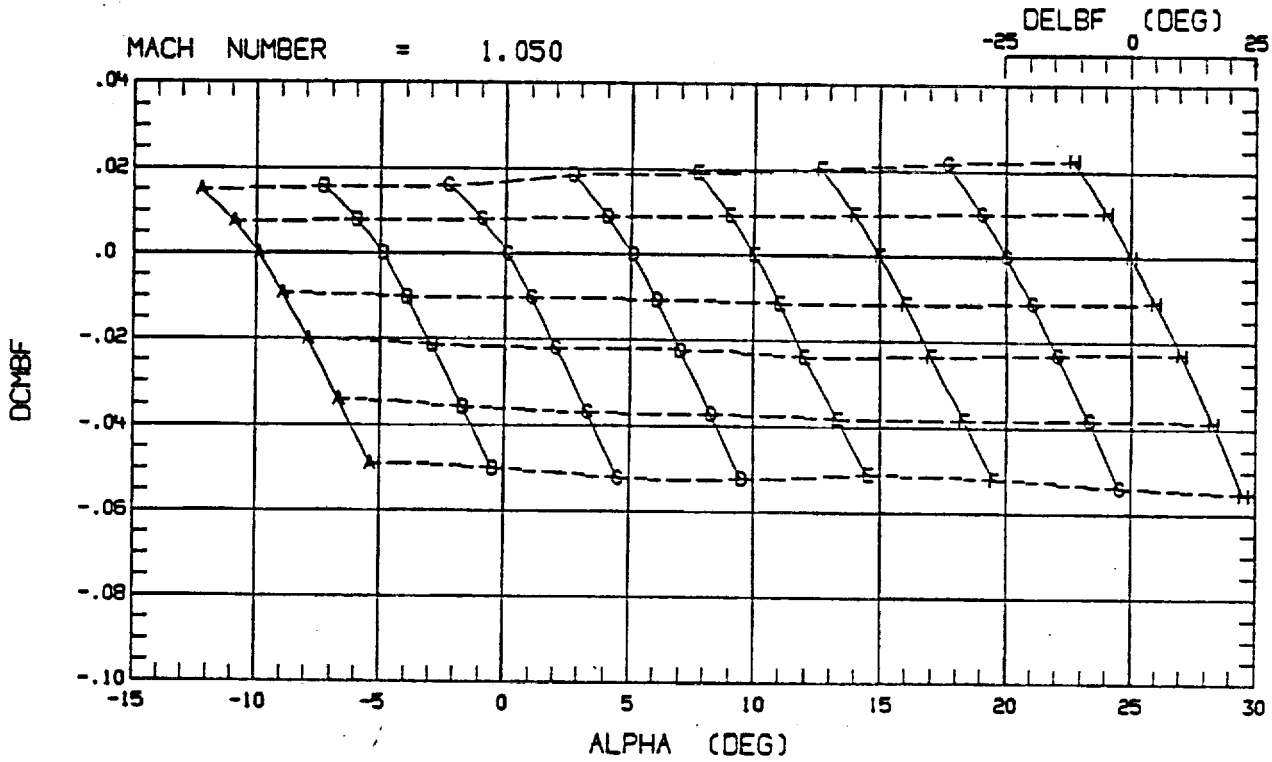


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
CR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.02949	0.02495	0.02072	0.01803	0.01741	0.02097	0.02444	0.02736
-5.000	0.01207	0.01106	0.00978	0.00859	0.00842	0.00976	0.01092	0.01193
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.01181	-0.01224	-0.01272	-0.01064	-0.01131	-0.01103	-0.01140	-0.01212
10.000	-0.02337	-0.02468	-0.02546	-0.02224	-0.02312	-0.02326	-0.02326	-0.02435
15.300	-0.03822	-0.04017	-0.04149	-0.03718	-0.03755	-0.04005	-0.04047	-0.04130
22.500	-0.05390	-0.05524	-0.05726	-0.05222	-0.05132	-0.05797	-0.06255	-0.06724

ENGINEER WMZ
DATE 9-18-78

FIGURE 4.1.1.3-106
EFFECT OF BODY FLAP

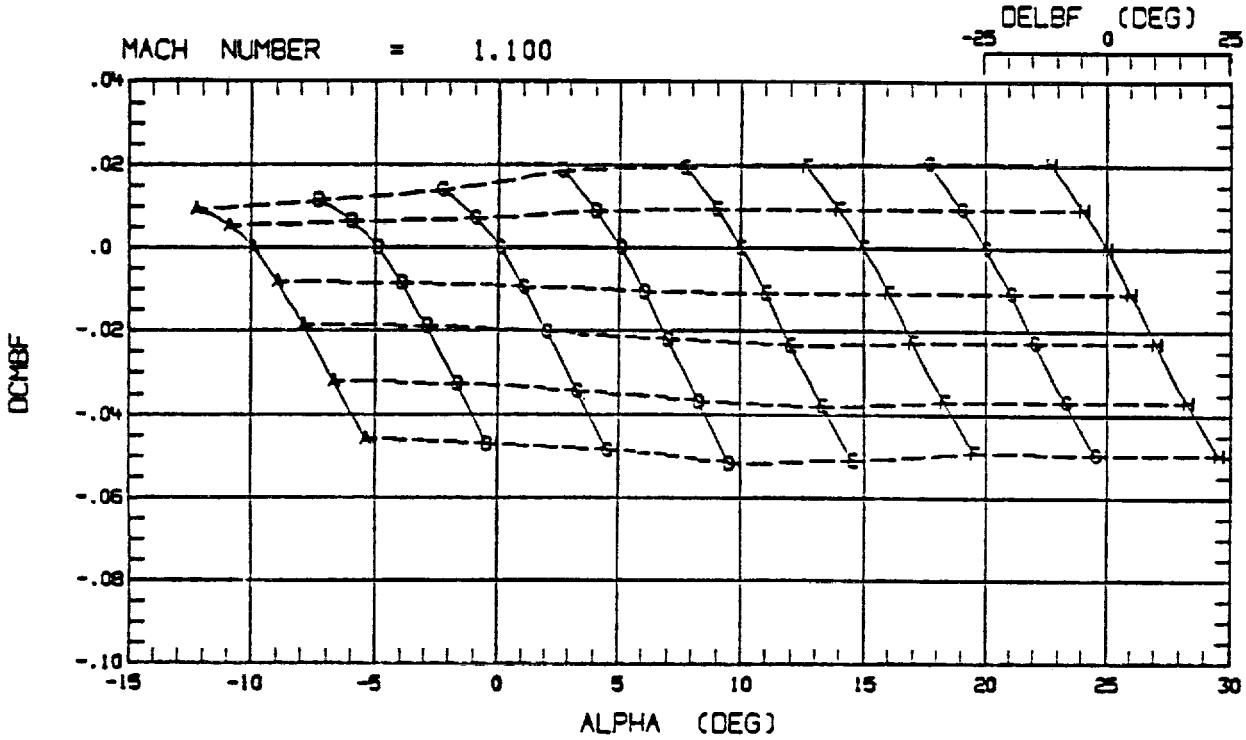


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.01472	0.01531	0.01574	0.01831	0.01889	0.02017	0.02154	0.02235
-5.000	0.00730	0.00762	0.00785	0.00870	0.00897	0.00937	0.00983	0.01012
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00929	-0.01029	-0.01051	-0.01072	-0.01138	-0.01158	-0.01115	-0.01098
10.000	-0.01995	-0.02154	-0.02217	-0.02239	-0.02388	-0.02363	-0.02309	-0.02291
16.300	-0.03422	-0.03596	-0.03722	-0.03742	-0.03854	-0.03839	-0.03854	-0.03882
22.500	-0.04903	-0.05042	-0.05241	-0.05254	-0.05138	-0.05248	-0.05411	-0.05575

ENGINEER WMZ
DATE 9-28-78

FIGURE 4.1.1.3-107
EFFECT OF BODY FLAP

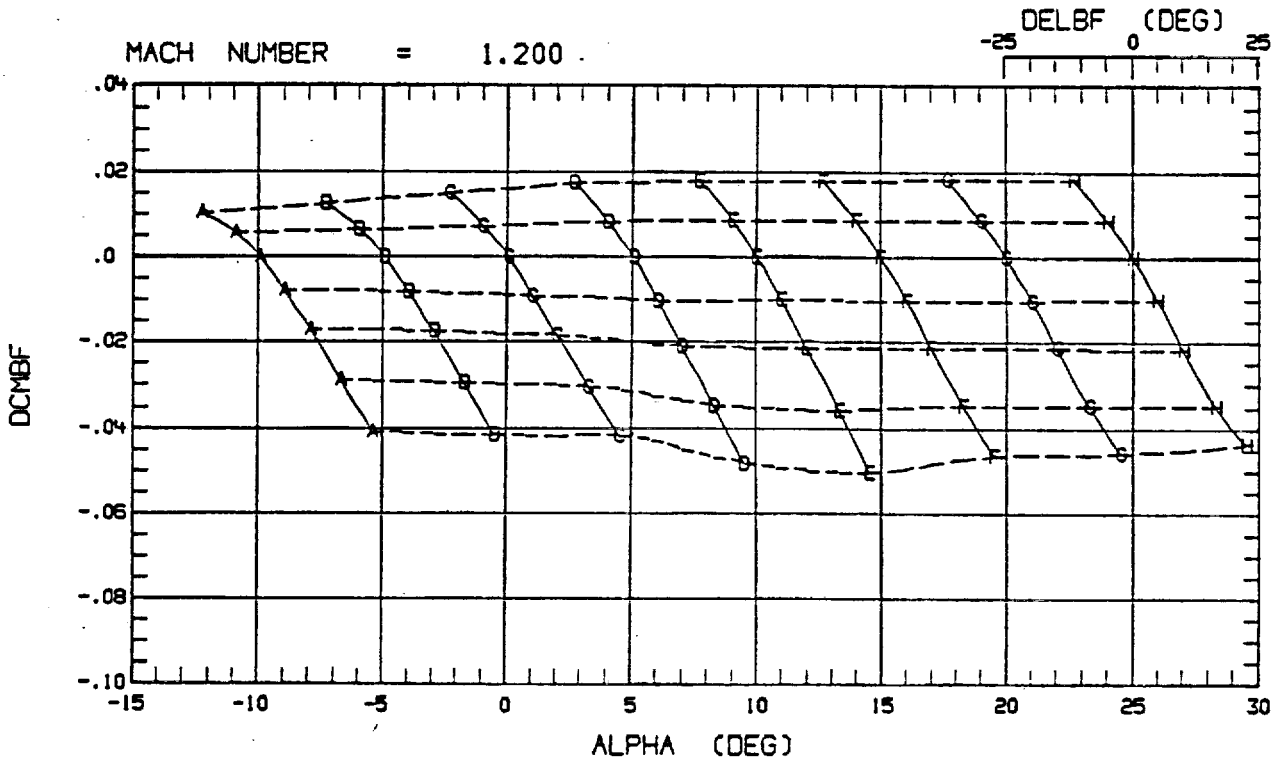


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00900	0.01124	0.01360	0.01837	0.01918	0.01941	0.02000	0.02000
-5.000	0.00527	0.00607	0.00696	0.00869	0.00905	0.00904	0.00923	0.00923
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00839	-0.00877	-0.00967	-0.01064	-0.01134	-0.01102	-0.01108	-0.01108
10.000	-0.01850	-0.01914	-0.02054	-0.02216	-0.02375	-0.02303	-0.02300	-0.02300
16.300	-0.03200	-0.03298	-0.03465	-0.03698	-0.03835	-0.03720	-0.03720	-0.03720
22.500	-0.04600	-0.04732	-0.04894	-0.05186	-0.05121	-0.04955	-0.05000	-0.05000

ENGINEER WMZ
DATE 8-26-78

FIGURE 4.1.1.3-106
EFFECT OF BODY FLAP

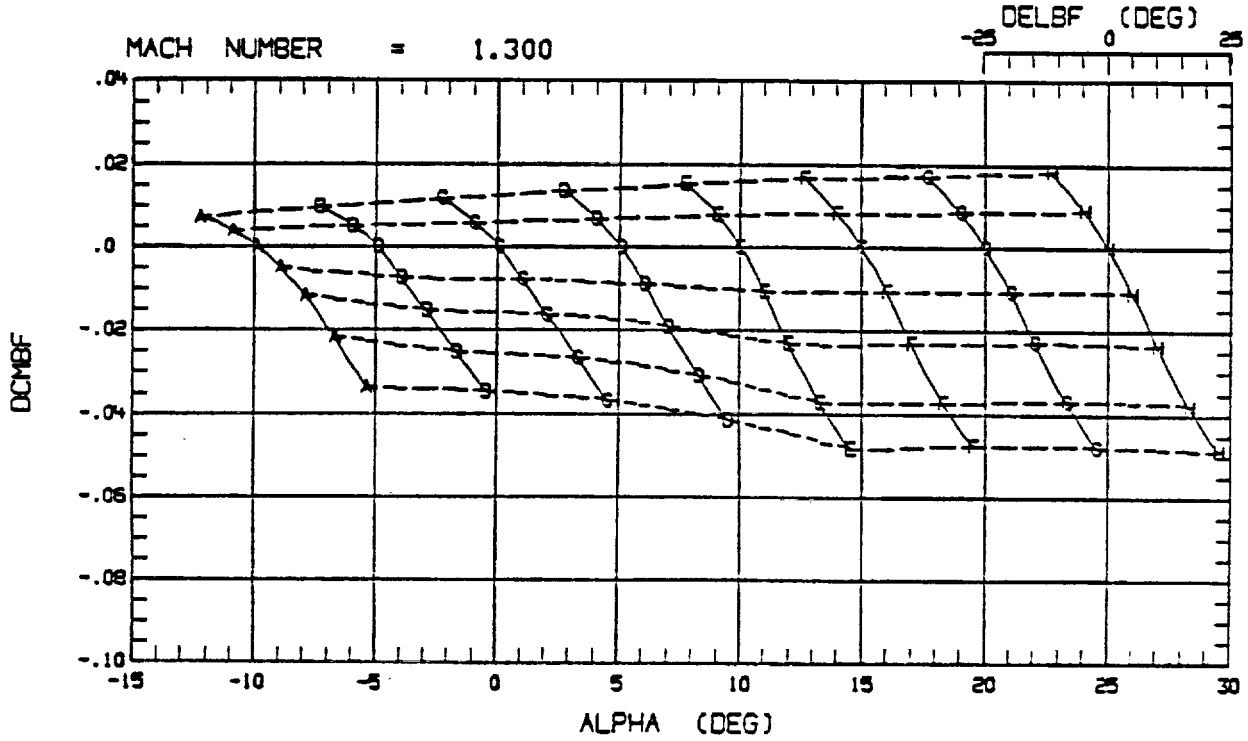


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.01000	0.01229	0.01480	0.01714	0.01753	0.01745	0.01800	0.01800
-5.000	0.00538	0.00618	0.00705	0.00813	0.00834	0.00823	0.00841	0.00841
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00803	-0.00835	-0.00927	-0.01029	-0.01027	-0.01031	-0.01028	-0.01018
10.000	-0.01716	-0.01766	-0.01878	-0.02110	-0.02148	-0.02160	-0.02164	-0.02176
16.300	-0.02900	-0.02971	-0.03055	-0.03481	-0.03594	-0.03487	-0.03487	-0.03487
22.500	-0.04100	-0.04189	-0.04195	-0.04842	-0.05051	-0.04653	-0.04600	-0.04400

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-109
EFFECT OF BODY FLAP



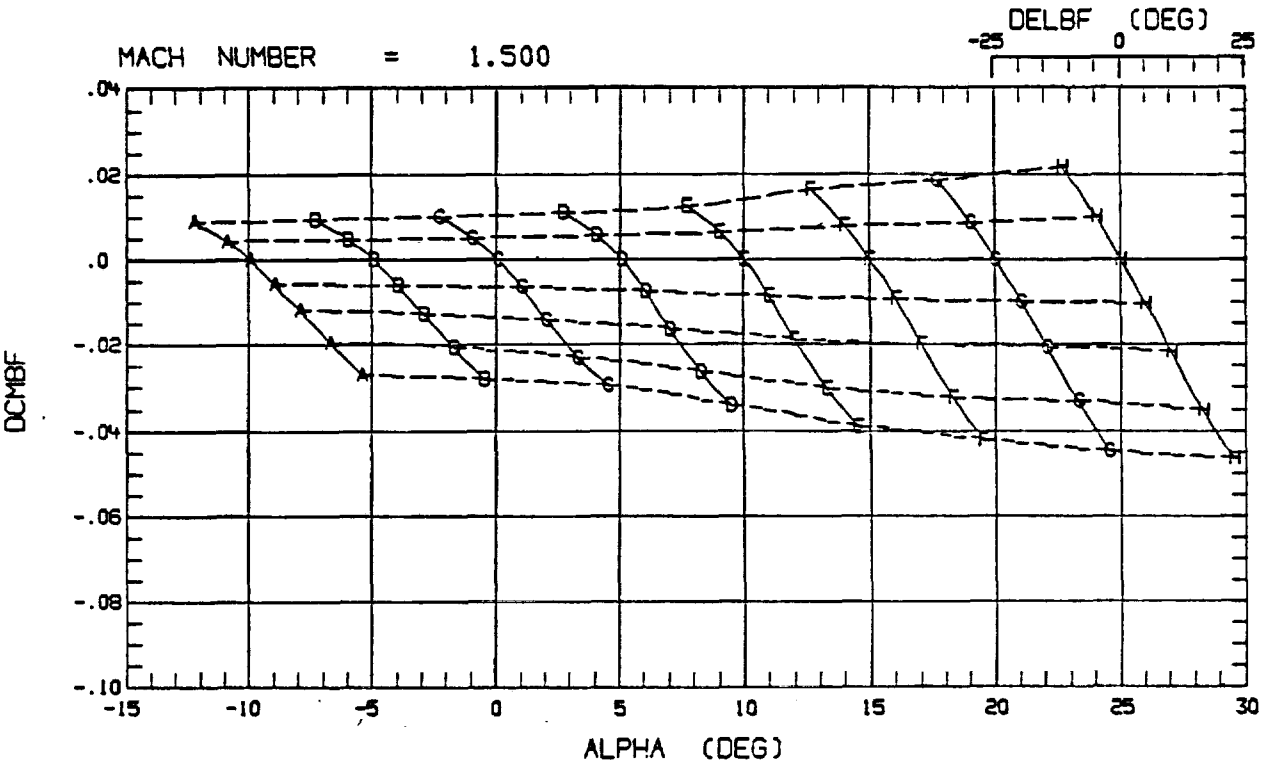
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS 1076.7	IN.	WING AREA	SW = 2690.00	SQ.FT.
OR	YO = BL 0.0	IN.	WING SPAN	BW = 78.056	FT.
MOMENT REFERENCE	ZO = WL 375.0	IN.	M.A.C.	CW = 39.560	FT.
			BODY LENGTH	LB = 1290.3	IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00700	0.00941	0.01141	0.01327	0.01500	0.01643	0.01700	0.01800
-5.000	0.00389	0.00492	0.00568	0.00660	0.00763	0.00809	0.00824	0.00864
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00525	-0.00784	-0.00807	-0.00920	-0.01081	-0.01081	-0.01077	-0.01106
10.000	-0.01184	-0.01545	-0.01638	-0.01927	-0.02341	-0.02338	-0.02305	-0.02369
16.300	-0.02200	-0.02530	-0.02686	-0.03114	-0.03750	-0.03742	-0.03700	-0.03800
22.500	-0.03400	-0.03502	-0.03722	-0.04193	-0.04837	-0.04774	-0.04200	-0.04900

ENGINEER wmz
DATE 6-26-78

FIGURE 4.1.1.3-110
EFFECT OF BODY FLAP

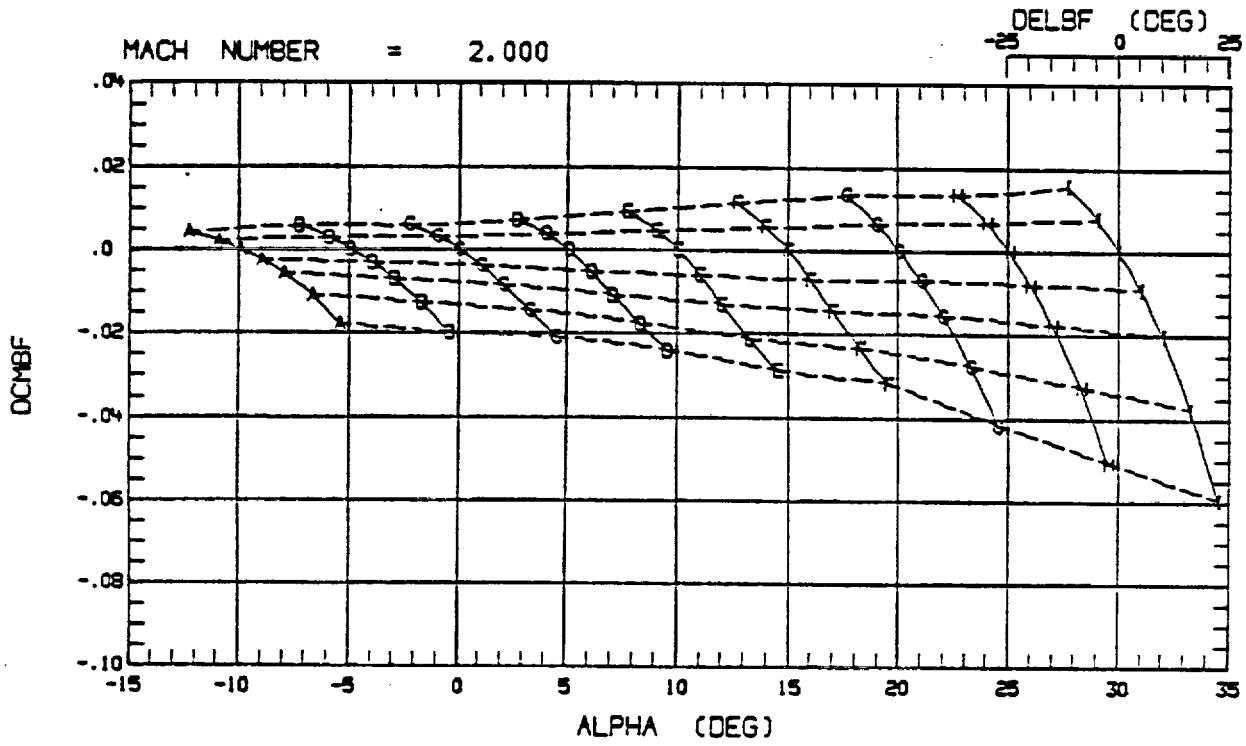


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00858	0.00914	0.00981	0.01073	0.01212	0.01627	0.01849	0.02159
-5.000	0.00423	0.00451	0.00489	0.00543	0.00617	0.00767	0.00846	0.00962
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00598	-0.00620	-0.00670	-0.00764	-0.00877	-0.00951	-0.00998	-0.01060
10.000	-0.01202	-0.01292	-0.01448	-0.01650	-0.01895	-0.02017	-0.02060	-0.02198
16.300	-0.01963	-0.02091	-0.02319	-0.02545	-0.03037	-0.03244	-0.03337	-0.03549
22.500	-0.02713	-0.02821	-0.02979	-0.03424	-0.03929	-0.04229	-0.04509	-0.04674

ENGINEER WMZ
DATE 9-10-78

FIGURE 4.1.1.3-111
EFFECT OF BODY FLAP



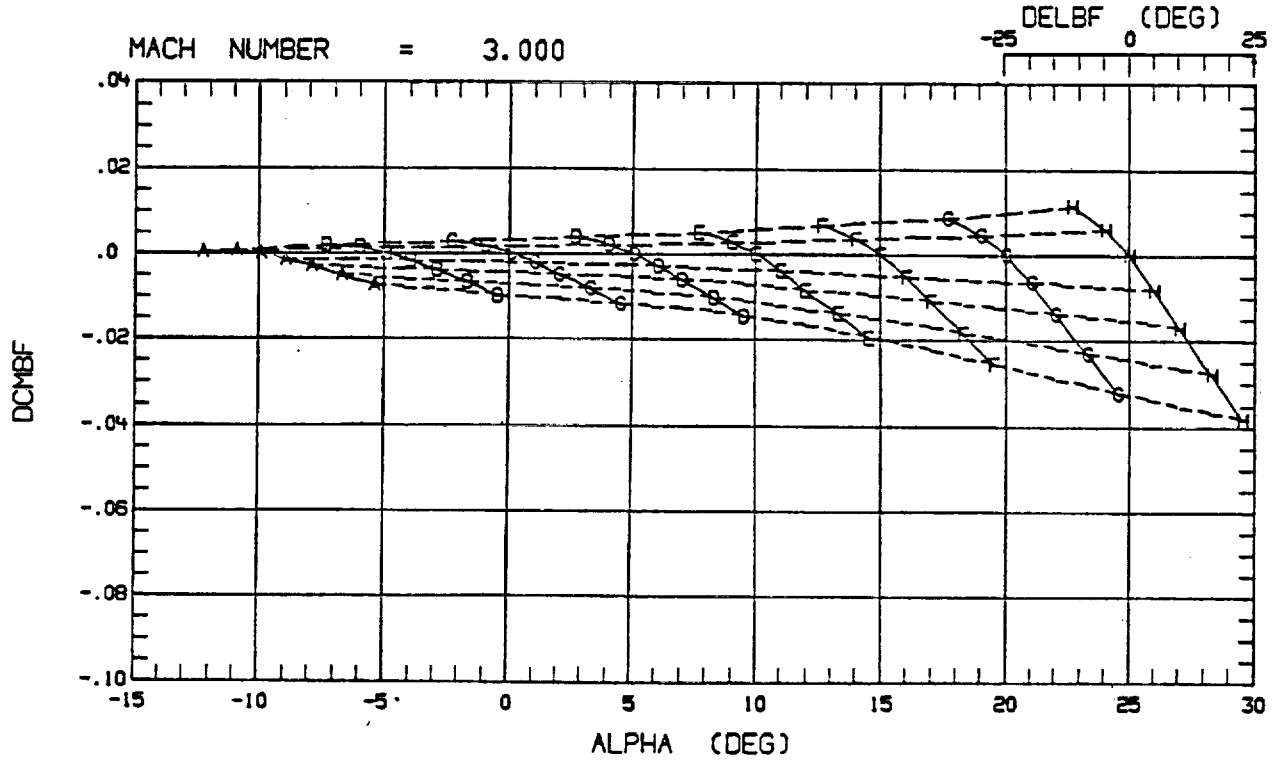
CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2590.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

	ALPHA (DEG)								
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H	30.000 I
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.								
-11.700	0.00400	0.00570	0.00578	0.00705	0.00909	0.01125	0.01324	0.01334	0.01534
-5.000	0.00211	0.00281	0.00297	0.00360	0.00452	0.00540	0.00636	0.00676	0.00778
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00261	-0.00331	-0.00403	-0.00531	-0.00637	-0.00709	-0.00736	-0.00823	-0.00937
10.000	-0.00575	-0.00715	-0.00867	-0.01101	-0.01320	-0.01467	-0.01575	-0.01799	-0.02044
16.300	-0.01100	-0.01300	-0.01481	-0.01784	-0.02138	-0.02377	-0.02900	-0.03300	-0.03800
22.500	-0.01800	-0.02000	-0.02112	-0.02416	-0.02997	-0.03221	-0.04200	-0.05100	-0.06000

ENGINEER WMZ
DATE 9-30-78

FIGURE 4.1.1.3-112
EFFECT OF BODY FLAP

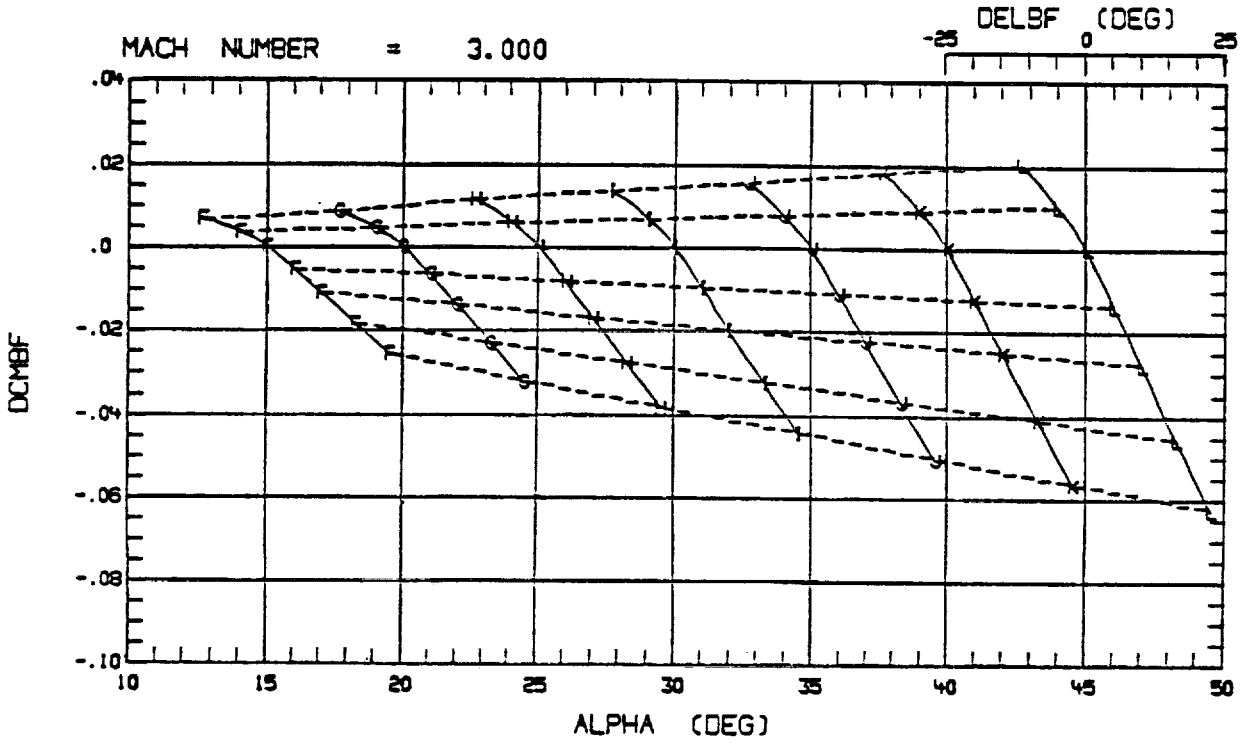


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00006	0.00180	0.00265	0.00375	0.00490	0.00669	0.00850	0.01137
-5.000	0.00041	0.00110	0.00148	0.00198	0.00253	0.00353	0.00447	0.00575
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00143	-0.00186	-0.00233	-0.00292	-0.00416	-0.00542	-0.00671	-0.00849
10.000	-0.00313	-0.00408	-0.00499	-0.00618	-0.00857	-0.01118	-0.01398	-0.01710
16.300	-0.00530	-0.00700	-0.00842	-0.01037	-0.01416	-0.01849	-0.02324	-0.02795
22.500	-0.00750	-0.01000	-0.01189	-0.01459	-0.01971	-0.02575	-0.03248	-0.03865

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-113
EFFECT OF BODY FLAP



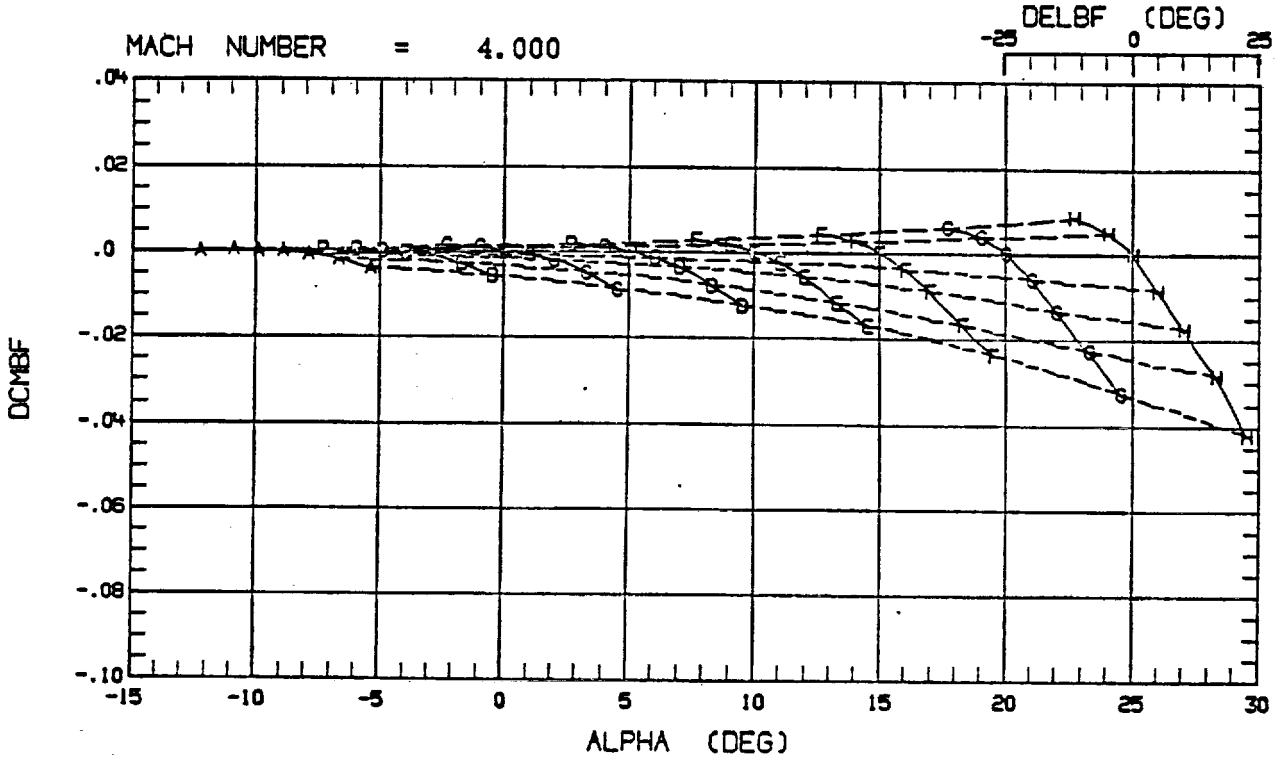
CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000	20.000	25.000	30.000	35.000	40.000	45.000
	F	G	H	I	J	K	L
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.						
-11.700	0.00669	0.00850	0.01137	0.01350	0.01550	0.01800	0.02000
-5.000	0.00353	0.00447	0.00575	0.00677	0.00775	0.00890	0.00988
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00542	-0.00671	-0.00849	-0.00981	-0.01131	-0.01250	-0.01390
10.000	-0.01118	-0.01398	-0.01710	-0.02000	-0.02271	-0.02551	-0.02930
16.300	-0.01849	-0.02324	-0.02795	-0.03250	-0.03700	-0.04150	-0.04600
22.500	-0.02575	-0.03248	-0.03865	-0.04450	-0.05100	-0.05700	-0.06300

ENGINEER WMZ
DATE 4-20-78

FIGURE 4.1.1.3-114
EFFECT OF BODY FLAP



CONFIGURATION

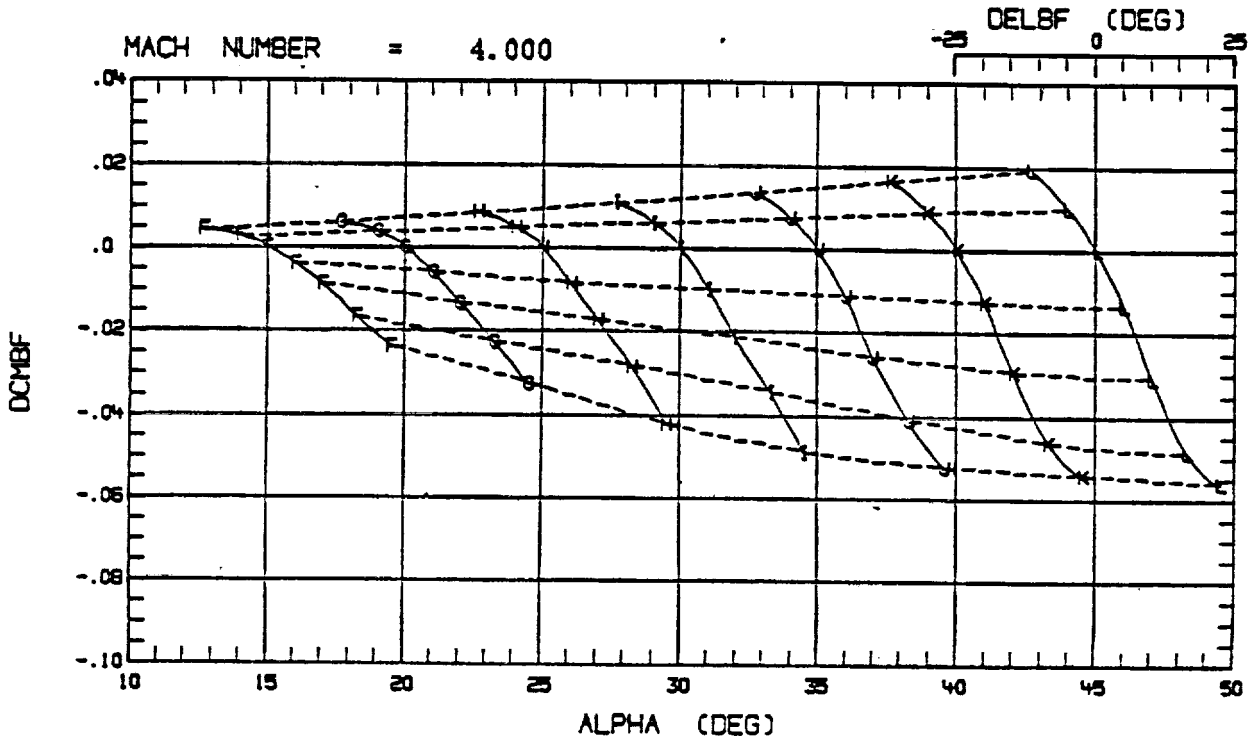
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00030	0.00115	0.00150	0.00255	0.00420	0.00603	0.00830
-5.000	0.00014	0.00032	0.00074	0.00106	0.00169	0.00261	0.00365	0.00480
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00028	-0.00052	-0.00100	-0.00156	-0.00249	-0.00396	-0.00619	-0.00875
10.000	-0.00069	-0.00123	-0.00225	-0.00366	-0.00584	-0.00915	-0.01349	-0.01763
16.300	-0.00195	-0.00305	-0.00495	-0.00781	-0.01175	-0.01702	-0.02304	-0.02870
22.500	-0.00420	-0.00590	-0.00890	-0.01250	-0.01720	-0.02400	-0.03280	-0.04260

ENGINEER D&D
DATE 10-5-73

FIGURE 4.1.1.3-115
EFFECT OF BODY FLAP

Rockwell International
Space Division

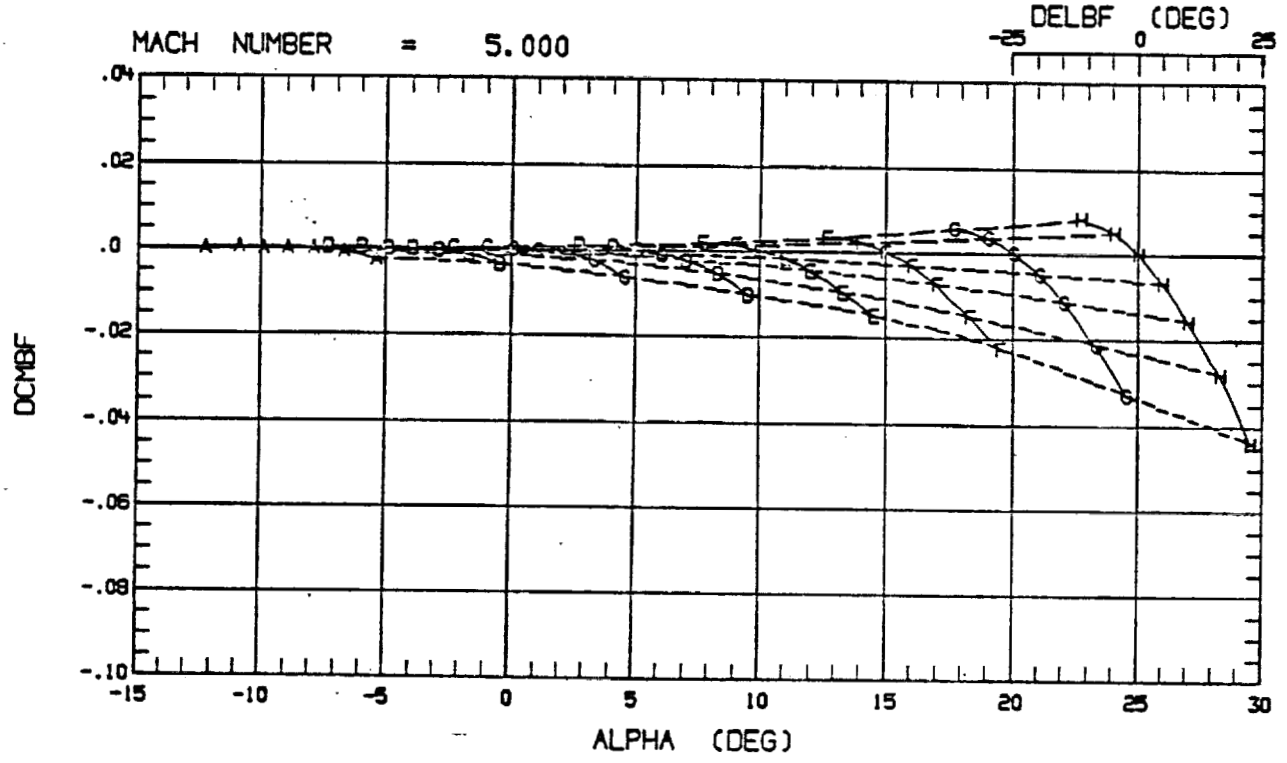


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.						
-11.700	0.00420	0.00603	0.00830	0.01075	0.01335	0.01606	0.01886
-5.000	0.00251	0.00365	0.00480	0.00604	0.00737	0.00866	0.00973
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00396	-0.00619	-0.00875	-0.01000	-0.01163	-0.01309	-0.01380
10.000	-0.00915	-0.01349	-0.01763	-0.02161	-0.02599	-0.02961	-0.03100
16.300	-0.01702	-0.02304	-0.02970	-0.03470	-0.04130	-0.04679	-0.04900
22.500	-0.02400	-0.03290	-0.04260	-0.04930	-0.05260	-0.05460	-0.05625

ENGINEER D.D.
DATE 10-5-78

FIGURE 4.1.1.3-116
EFFECT OF BODY FLAP

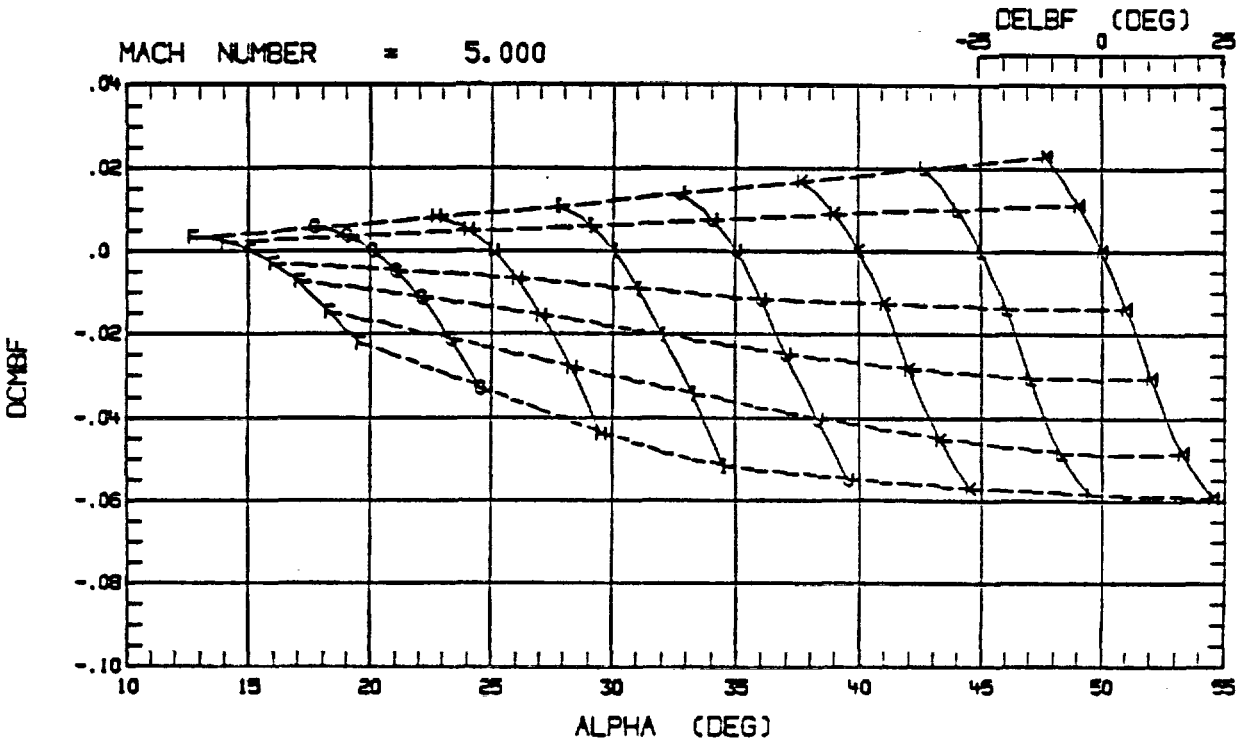


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00010	0.00020	0.00080	0.00160	0.00314	0.00538	0.00791
-5.000	0.00007	0.00014	0.00027	0.00067	0.00123	0.00214	0.00333	0.00465
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00013	-0.00022	-0.00045	-0.00105	-0.00194	-0.00330	-0.00497	-0.00702
10.000	-0.00030	-0.00052	-0.00107	-0.00249	-0.00463	-0.00777	-0.01148	-0.01584
16.300	-0.00090	-0.00140	-0.00275	-0.00560	-0.00967	-0.01520	-0.02150	-0.02830
22.500	-0.00270	-0.00380	-0.00660	-0.01030	-0.01510	-0.02250	-0.03320	-0.04420

ENGINEER DGD
DATE 10-5-77B

FIGURE 4.1.1.3-117
EFFECT OF BODY FLAP

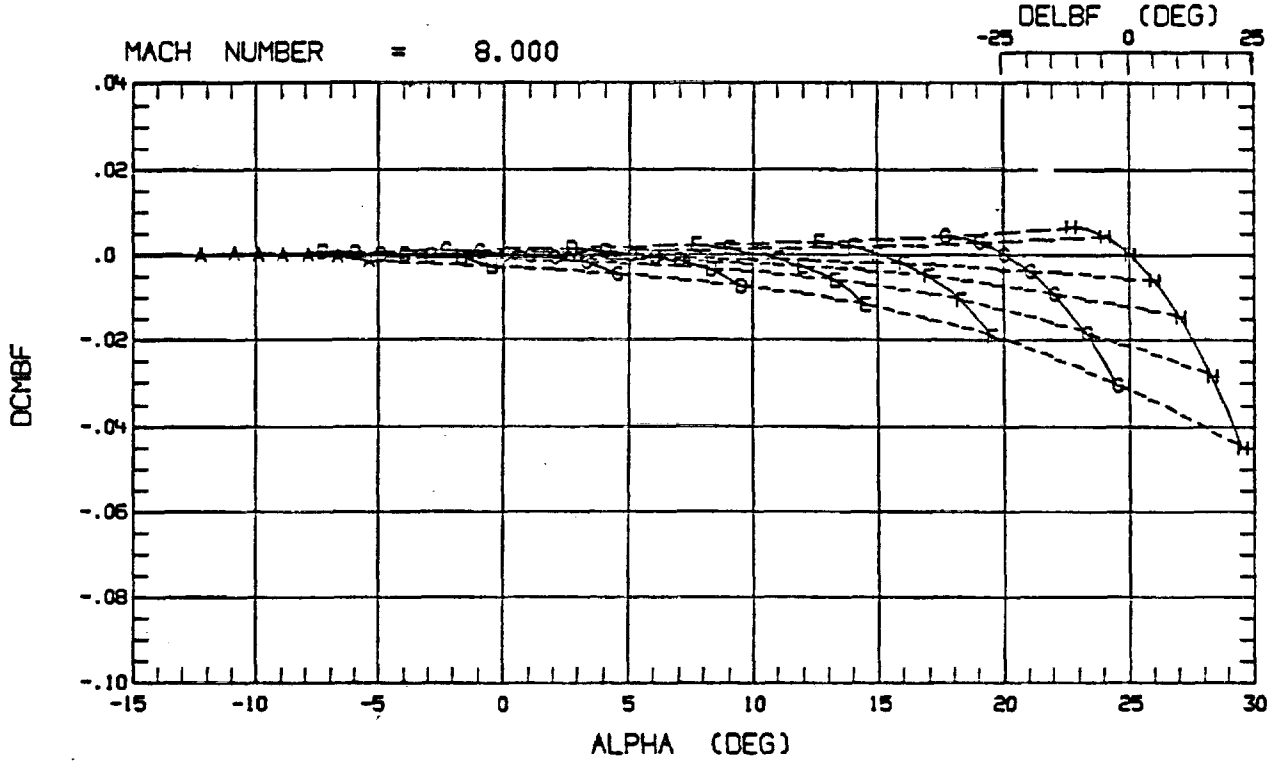


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00314	0.00538	0.00791	0.01062	0.01352	0.01662	0.01962	0.02262
-5.000	0.00214	0.00333	0.00465	0.00600	0.00740	0.00874	0.00996	0.01094
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00330	-0.00497	-0.00702	-0.00955	-0.01192	-0.01296	-0.01385	-0.01405
10.000	-0.00777	-0.01148	-0.01584	-0.02050	-0.02507	-0.02852	-0.03069	-0.03062
16.300	-0.01520	-0.02150	-0.02830	-0.03470	-0.04050	-0.04550	-0.04875	-0.04880
22.500	-0.02250	-0.03320	-0.04420	-0.05220	-0.05520	-0.05730	-0.05880	-0.05950

ENGINEER DGD
DATE 10-3-78

FIGURE 4.1.1.3-118
EFFECT OF BODY FLAP



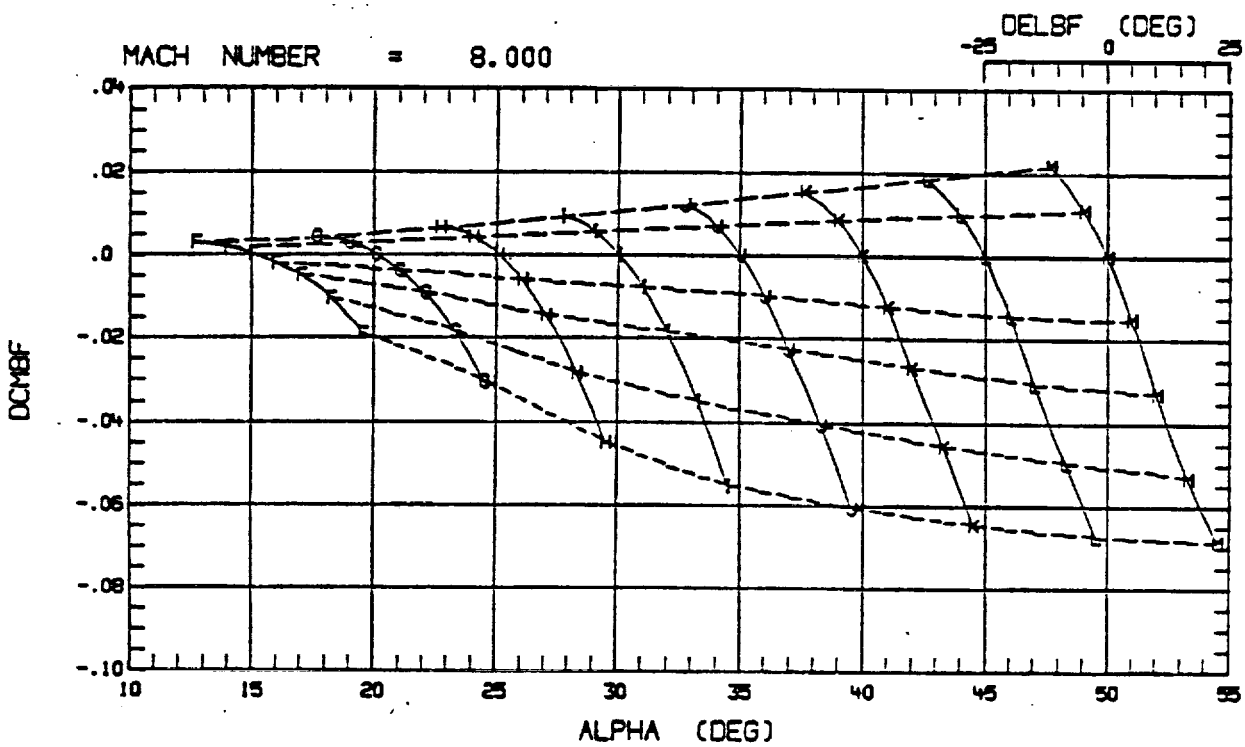
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00044	0.00088	0.00137	0.00198	0.00290	0.00398	0.00639
-5.000	0.00004	0.00022	0.00043	0.00071	0.00110	0.00170	0.00267	0.00417
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00007	-0.00024	-0.00048	-0.00083	-0.00136	-0.00229	-0.00403	-0.00632
10.000	-0.00016	-0.00049	-0.00099	-0.00175	-0.00298	-0.00520	-0.00948	-0.01479
16.300	-0.00050	-0.00100	-0.00200	-0.00360	-0.00620	-0.01080	-0.01875	-0.02850
22.500	-0.00170	-0.00300	-0.00490	-0.00760	-0.01200	-0.01950	-0.03070	-0.04530

ENGINEER WMZ
DATE 4-24-78

FIGURE 4.1.1.3-119
EFFECT OF BODY FLAP

Rockwell International
Space Division

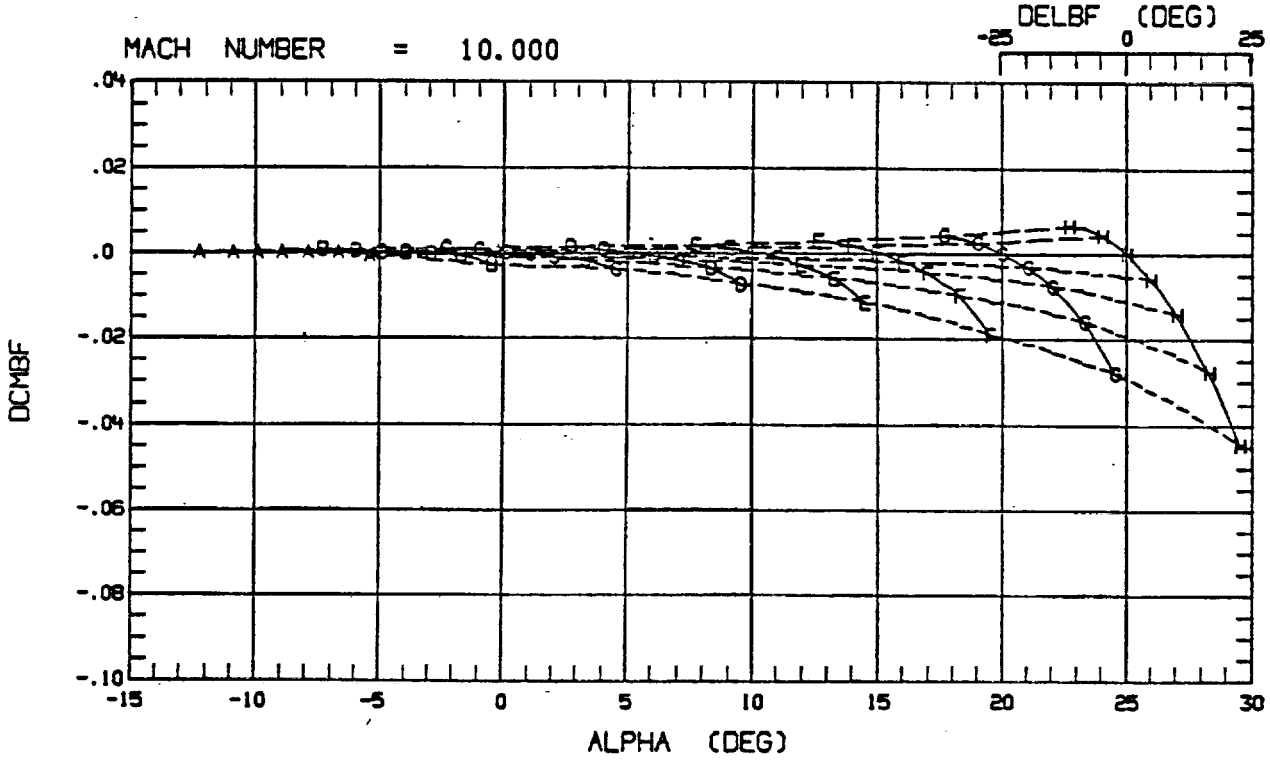


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00280	0.00398	0.00639	0.00910	0.01200	0.01510	0.01830	0.02160
-5.000	0.00170	0.00257	0.00417	0.00556	0.00691	0.00829	0.00962	0.01093
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00229	-0.00403	-0.00632	-0.00813	-0.01009	-0.01274	-0.01483	-0.01538
10.000	-0.00520	-0.00948	-0.01479	-0.01877	-0.02279	-0.02724	-0.03089	-0.03327
16.300	-0.01080	-0.01875	-0.02950	-0.03550	-0.04100	-0.04600	-0.05000	-0.05330
22.500	-0.01950	-0.03070	-0.04530	-0.05550	-0.06100	-0.06500	-0.06760	-0.06870

ENGINEER WMZ
DATE 9-30-78

FIGURE 4.1.1.3-120
EFFECT OF BODY FLAP

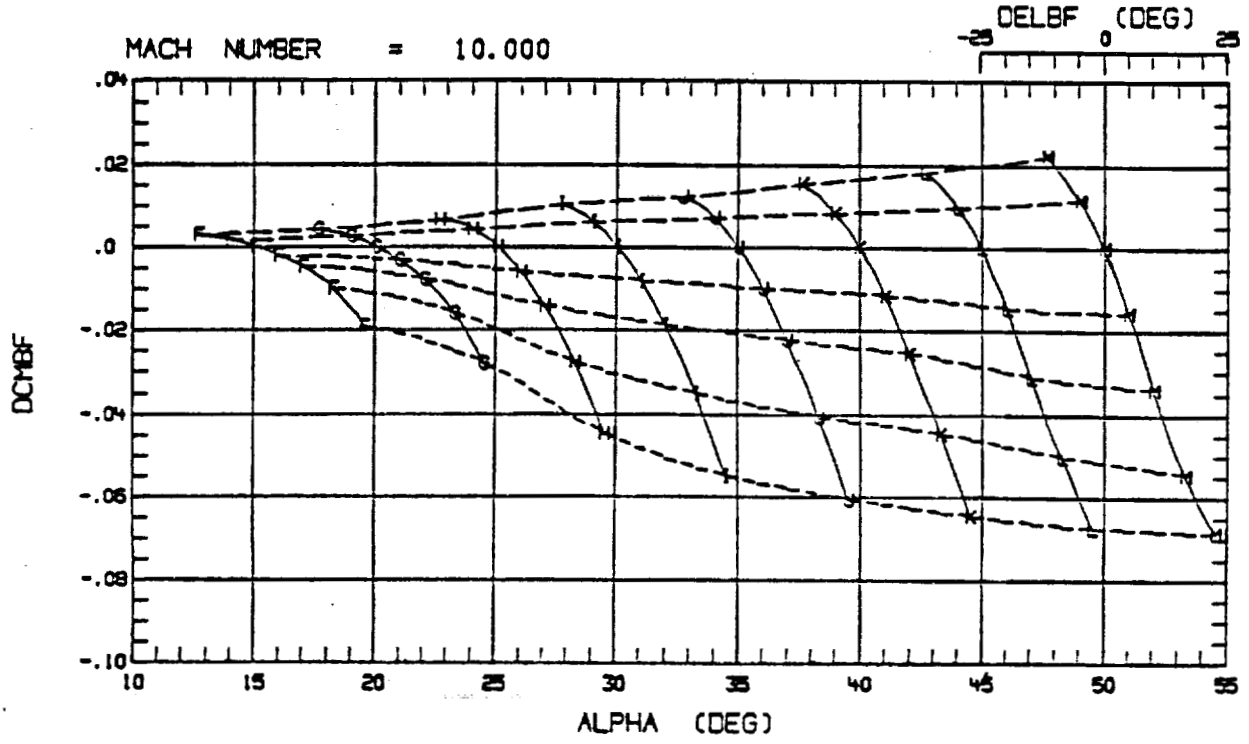


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00054	0.00098	0.00138	0.00178	0.00269	0.00408	0.00641
-5.000	0.00001	0.00024	0.00047	0.00072	0.00103	0.00162	0.00251	0.00414
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00003	-0.00024	-0.00051	-0.00084	-0.00132	-0.00213	-0.00343	-0.00616
10.000	-0.00006	-0.00049	-0.00105	-0.00179	-0.00293	-0.00479	-0.00786	-0.01438
16.300	-0.00020	-0.00086	-0.00200	-0.00366	-0.00617	-0.01015	-0.01610	-0.02800
22.500	-0.00070	-0.00292	-0.00390	-0.00746	-0.01180	-0.01922	-0.02820	-0.04510

ENGINEER WMZ
DATE 9-20-78

FIGURE 4.1.1.3-121
EFFECT OF BODY FLAP

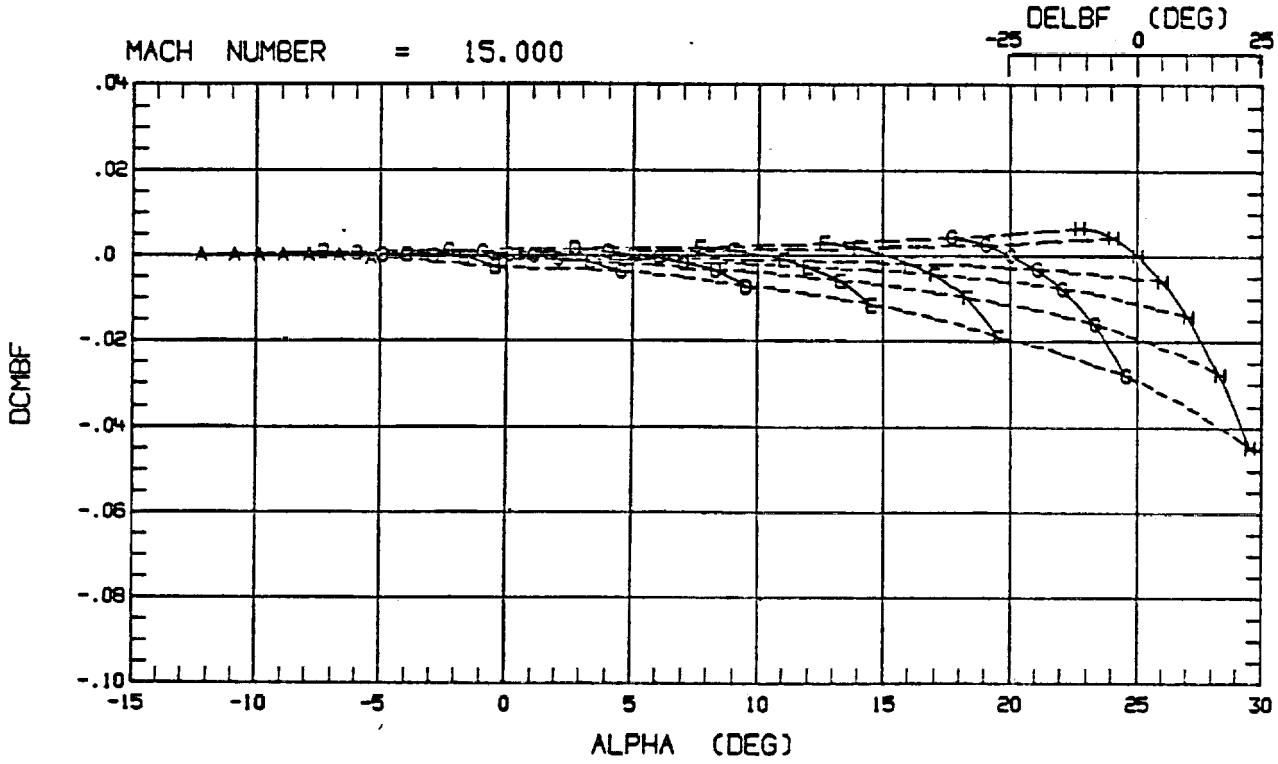


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00269	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00162	0.00251	0.00414	0.00587	0.00692	0.00818	0.00958	0.01111
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00213	-0.00343	-0.00616	-0.00825	-0.01004	-0.01178	-0.01485	-0.01567
10.000	-0.00479	-0.00786	-0.01438	-0.01886	-0.02268	-0.02590	-0.03135	-0.03434
16.300	-0.01015	-0.01610	-0.02800	-0.03550	-0.04090	-0.04500	-0.05060	-0.05480
22.500	-0.01922	-0.02920	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER Wm Z.
DATE 9-26-79

FIGURE 4.1.1.3-122
EFFECT OF BODY FLAP

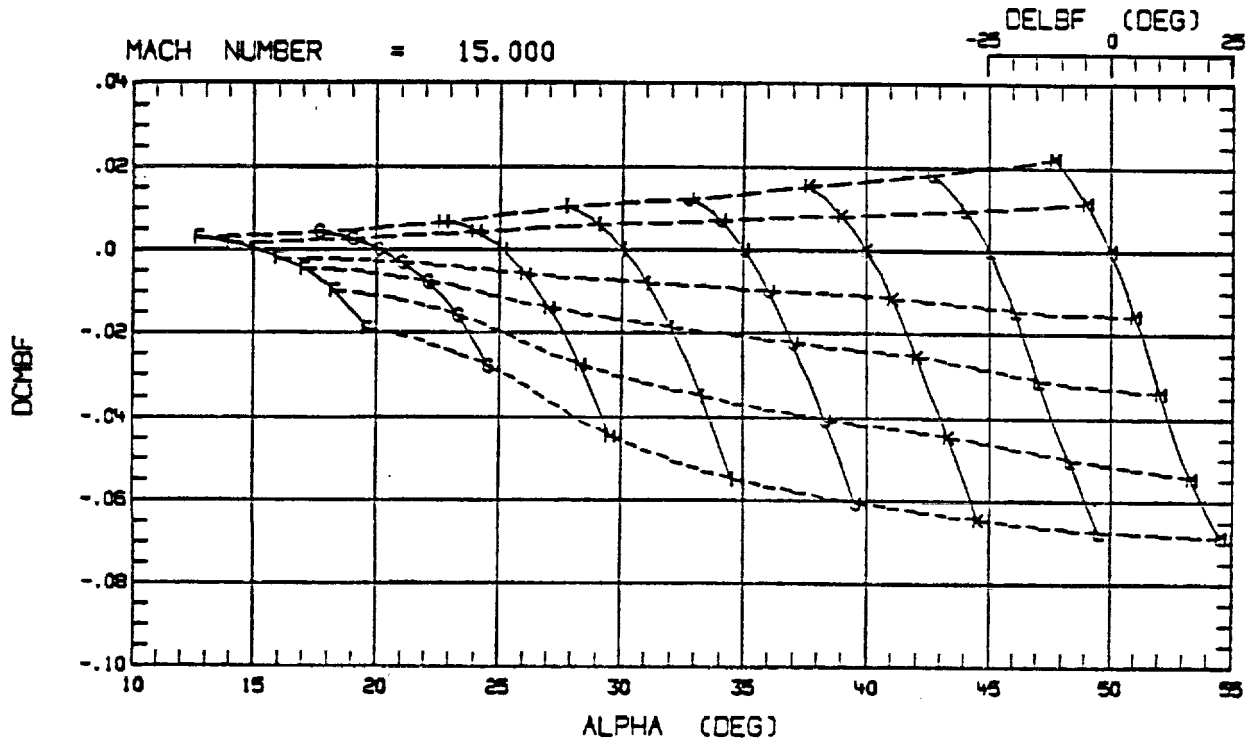


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00054	0.00098	0.00138	0.00178	0.00269	0.00408	0.00641
-5.000	0.00001	0.00024	0.00047	0.00072	0.00103	0.00162	0.00251	0.00414
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00003	-0.00024	-0.00051	-0.00084	-0.00132	-0.00213	-0.00343	-0.00616
10.000	-0.00006	-0.00049	-0.00105	-0.00179	-0.00293	-0.00479	-0.00786	-0.01438
16.300	-0.00020	-0.00086	-0.00200	-0.00366	-0.00617	-0.01015	-0.01610	-0.02800
22.500	-0.00070	-0.00292	-0.00390	-0.00746	-0.01180	-0.01922	-0.02920	-0.04510

ENGINEER Wmz
DATE 9-30-78

FIGURE 4.1.1.3-123
EFFECT OF BODY FLAP

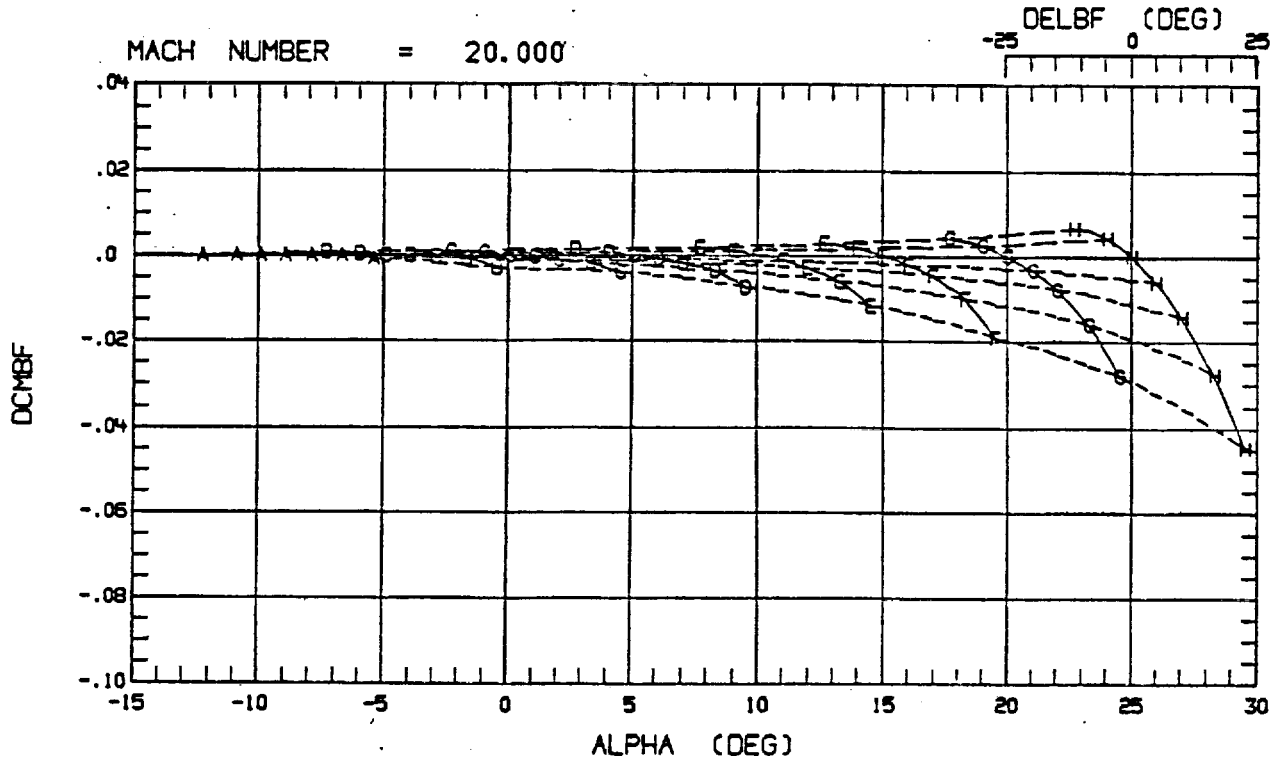


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000 F	20.000 G	25.000 H	30.000 I	35.000 J	40.000 K	45.000 L	50.000 M
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00259	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00162	0.00251	0.00414	0.00587	0.00692	0.00818	0.00959	0.01111
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00213	-0.00343	-0.00616	-0.00825	-0.01004	-0.01178	-0.01485	-0.01567
10.000	-0.00479	-0.00786	-0.01438	-0.01886	-0.02258	-0.02590	-0.03135	-0.03434
16.300	-0.01015	-0.01610	-0.02900	-0.03550	-0.04090	-0.04500	-0.05060	-0.05480
22.500	-0.01922	-0.02920	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER WMZ
DATE 4-30-78

FIGURE 4.1.1.3-124
EFFECT OF BODY FLAP

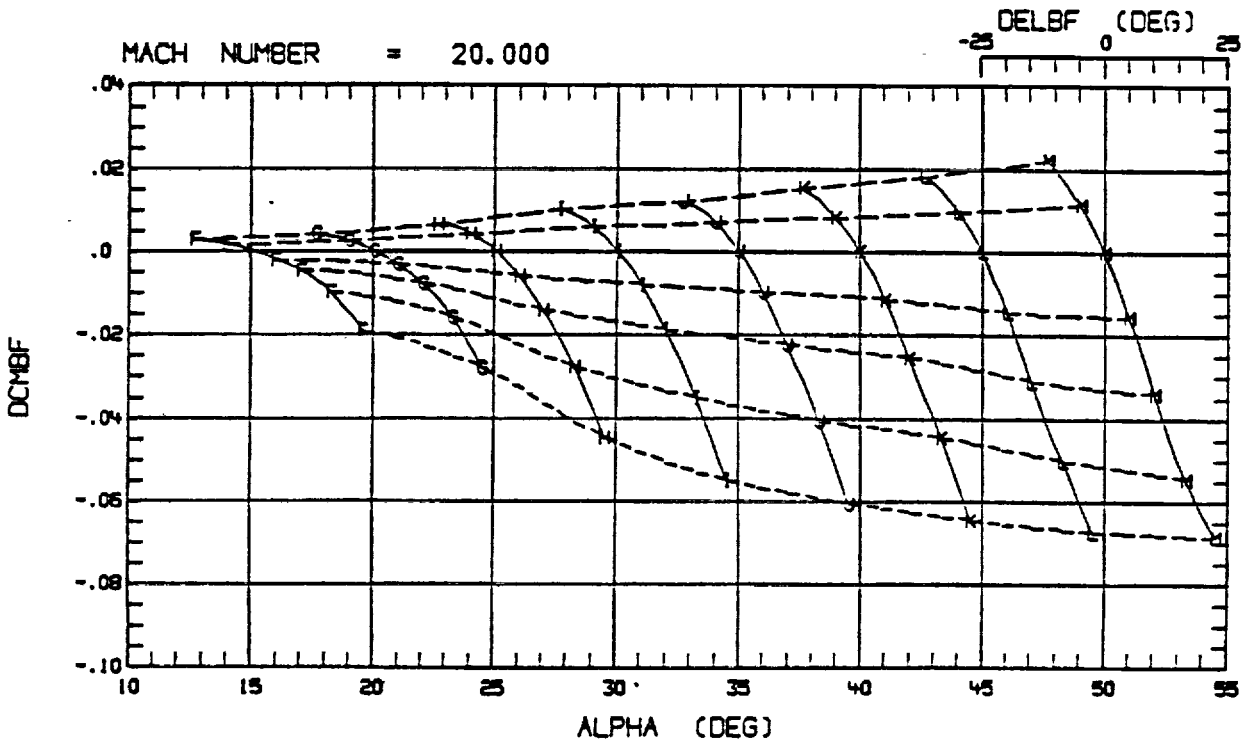


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.0	0.00054	0.00098	0.00138	0.00178	0.00269	0.00408	0.00641
-5.000	0.00001	0.00024	0.00047	0.00072	0.00103	0.00162	0.00251	0.00414
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00003	-0.00024	-0.00051	-0.00084	-0.00132	-0.00213	-0.00343	-0.00616
10.000	-0.00006	-0.00049	-0.00105	-0.00179	-0.00293	-0.00479	-0.00786	-0.01438
16.300	-0.00020	-0.00086	-0.00200	-0.00366	-0.00617	-0.01015	-0.01610	-0.02800
22.500	-0.00070	-0.00292	-0.00390	-0.00746	-0.01180	-0.01922	-0.02820	-0.04510

ENGINEER LMZ
DATE 9-20-78

FIGURE 4.1.1.3-125
EFFECT OF BODY FLAP

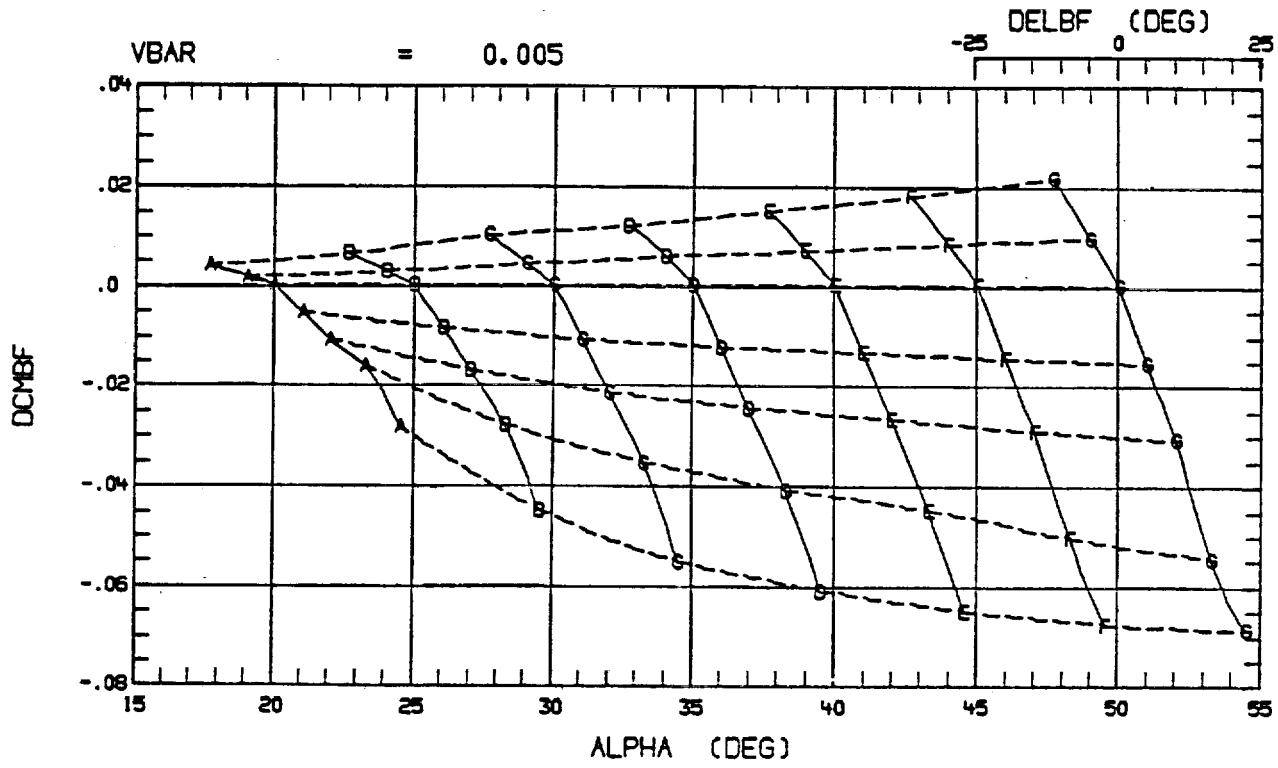


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
	F	G	H	I	J	K	L	M
DELBF (DEG)	BODY FLAP PITCHING MOMENT INCR.							
-11.700	0.00269	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00182	0.00251	0.00414	0.00587	0.00692	0.00818	0.00958	0.01111
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00213	-0.00343	-0.00616	-0.00825	-0.01004	-0.01178	-0.01485	-0.01567
10.000	-0.00479	-0.00786	-0.01438	-0.01886	-0.02258	-0.02590	-0.03135	-0.03434
16.300	-0.01015	-0.01610	-0.02900	-0.03550	-0.04090	-0.04500	-0.05060	-0.05480
22.500	-0.01922	-0.02920	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER WMZ
DATE 4-26-78

FIGURE 4.1.1.3-126
EFFECT OF BODY FLAP

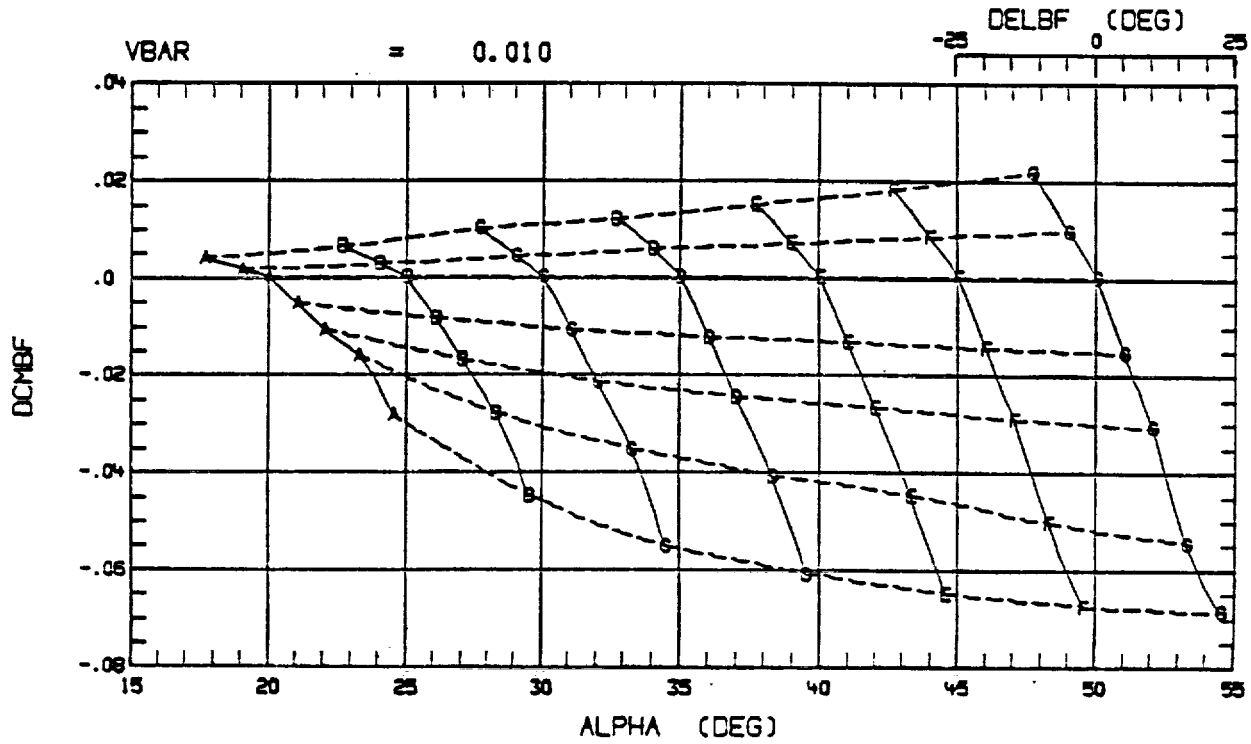


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00174	0.00274	0.00429	0.00583	0.00703	0.00839	0.00968
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00548	-0.00848	-0.01083	-0.01226	-0.01342	-0.01460	-0.01539
10.000	-0.01096	-0.01695	-0.02164	-0.02453	-0.02685	-0.02921	-0.03077
16.300	-0.01610	-0.02800	-0.03550	-0.04090	-0.04500	-0.05060	-0.05480
22.500	-0.02820	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER NASA
DATE

FIGURE 4.1.1.3-127
EFFECT OF BODY FLAP

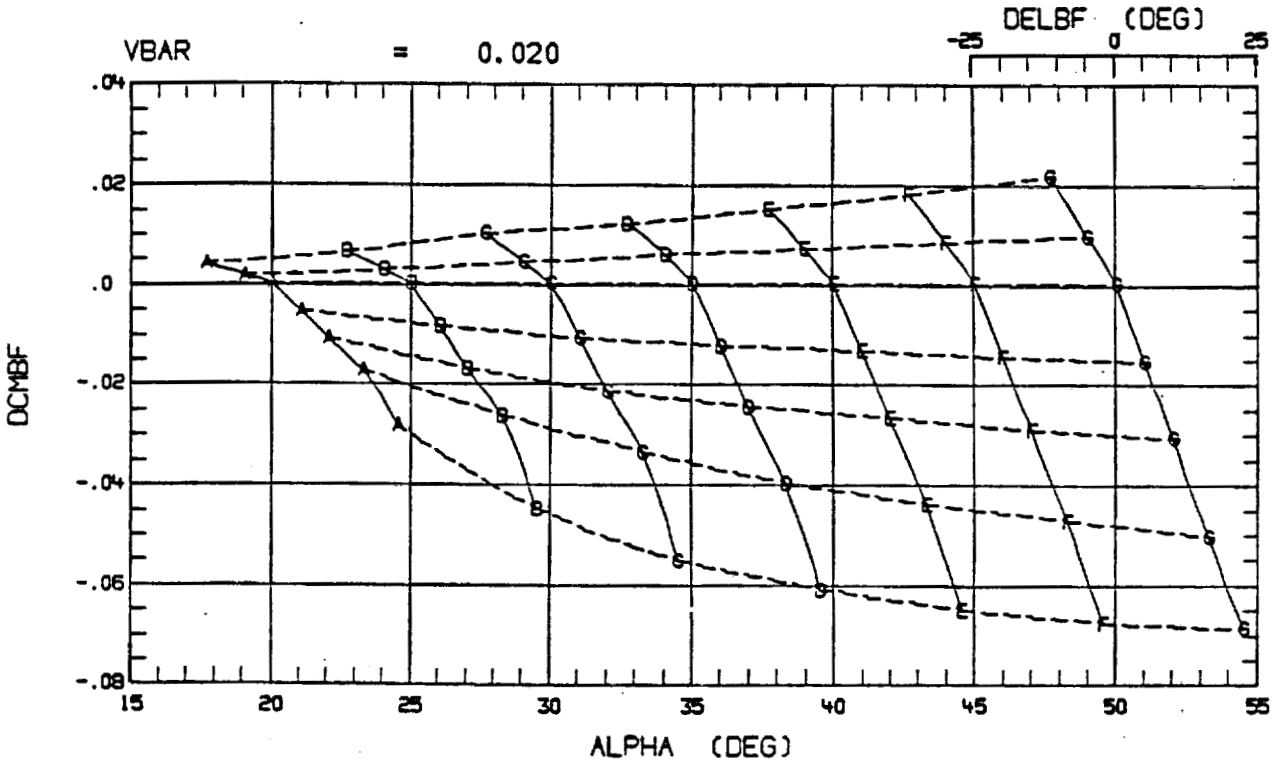


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00174	0.00274	0.00429	0.00583	0.00703	0.00839	0.00968
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00548	-0.00848	-0.01083	-0.01226	-0.01342	-0.01460	-0.01539
10.000	-0.01096	-0.01695	-0.02164	-0.02453	-0.02685	-0.02921	-0.03077
16.300	-0.01610	-0.02900	-0.03550	-0.04090	-0.04500	-0.05060	-0.05480
22.500	-0.02920	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER NASA
DATE

FIGURE 4.1.1.3-12c
EFFECT OF BODY FLAP



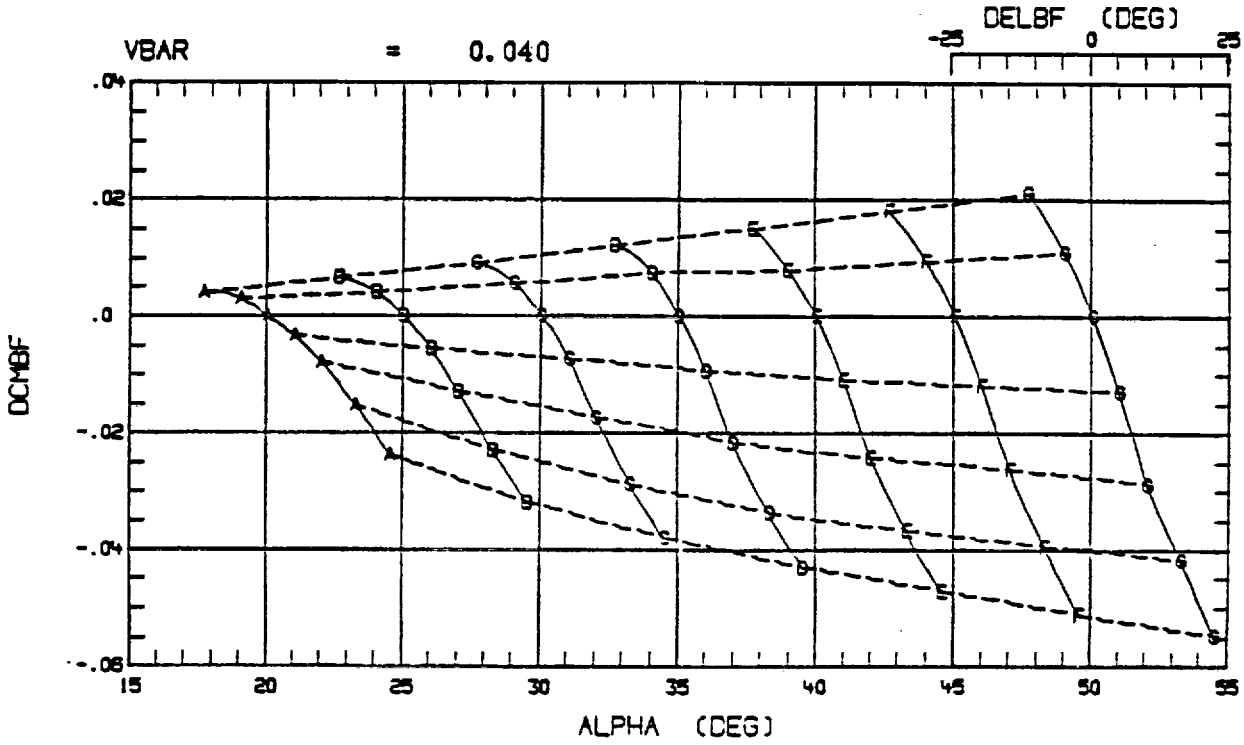
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH LB = 1290.3 IN.	

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00408	0.00641	0.01005	0.01205	0.01500	0.01804	0.02180
-5.000	0.00174	0.00274	0.00429	0.00583	0.00703	0.00839	0.00968
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00548	-0.00848	-0.01083	-0.01226	-0.01342	-0.01460	-0.01539
10.000	-0.01096	-0.01695	-0.02164	-0.02453	-0.02685	-0.02921	-0.03077
16.300	-0.01740	-0.02640	-0.03370	-0.03980	-0.04400	-0.04740	-0.05050
22.500	-0.02920	-0.04510	-0.05540	-0.06100	-0.06500	-0.06770	-0.06880

ENGINEER NASA
DATE

FIGURE 4.1.1.3-129
EFFECT OF BODY FLAP

Rockwell International
Space Division

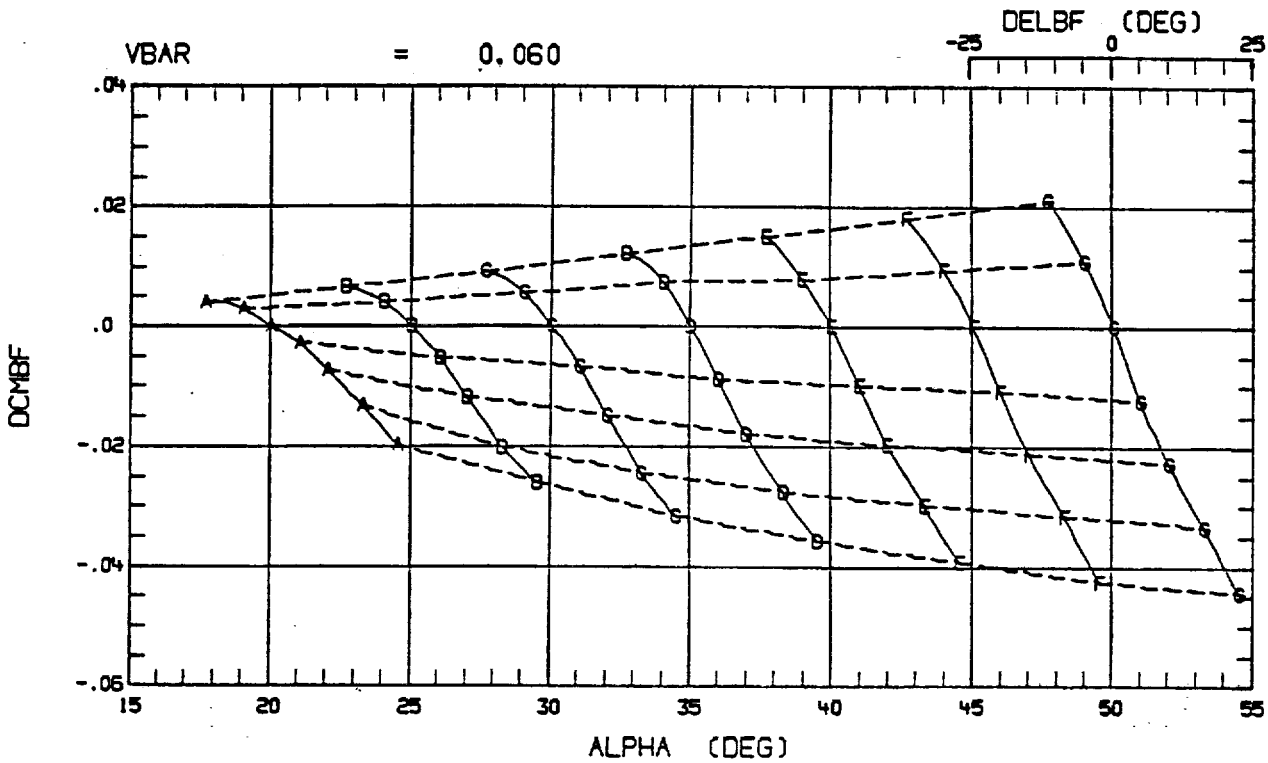


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00400	0.00650	0.00900	0.01200	0.01500	0.01780	0.02100
-5.000	0.00290	0.00390	0.00540	0.00730	0.00780	0.00930	0.01070
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00350	-0.00575	-0.00750	-0.00950	-0.01100	-0.01200	-0.01300
10.000	-0.00800	-0.01300	-0.01750	-0.02200	-0.02450	-0.02650	-0.02900
16.300	-0.01530	-0.02320	-0.02910	-0.03390	-0.03700	-0.03960	-0.04200
22.500	-0.02400	-0.03200	-0.03820	-0.04320	-0.04730	-0.05140	-0.05500

ENGINEER NASA
DATE

FIGURE 4.1.1.3-130
EFFECT OF BODY FLAP

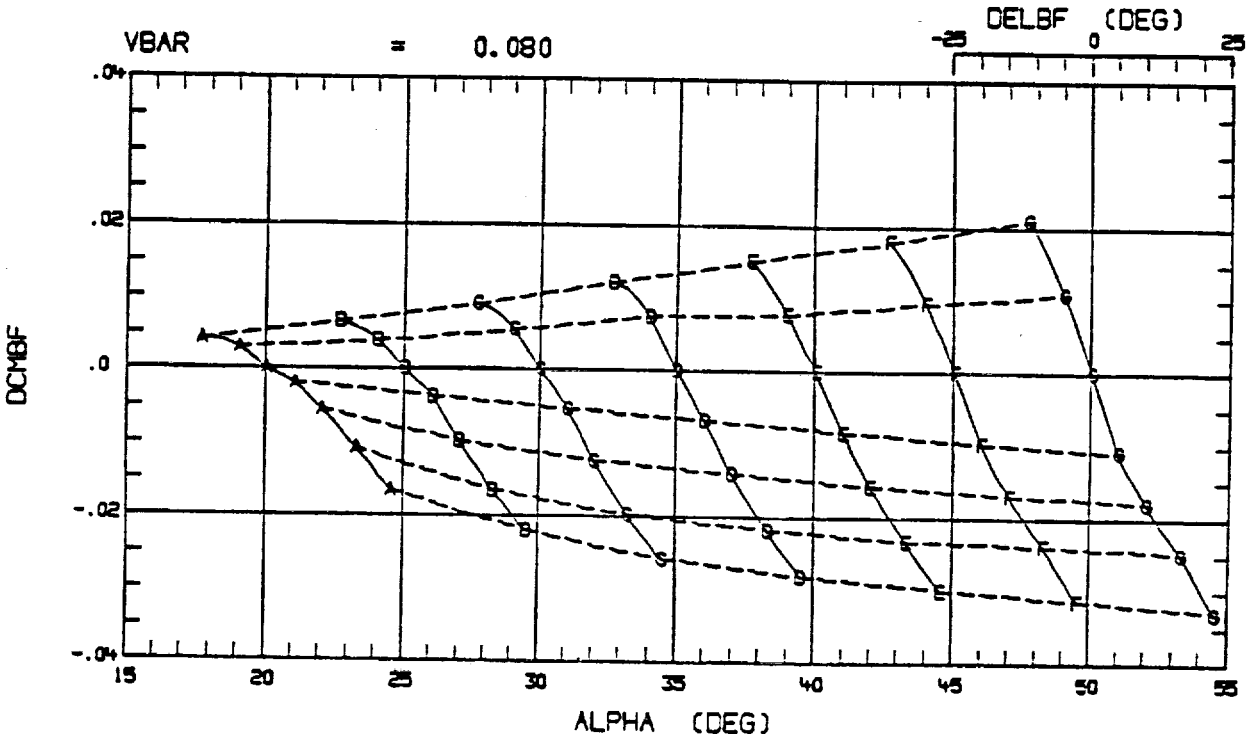


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00400	0.00650	0.00900	0.01200	0.01500	0.01780	0.02100
-5.000	0.00290	0.00390	0.00540	0.00730	0.00780	0.00930	0.01070
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00290	-0.00550	-0.00700	-0.00900	-0.01000	-0.01100	-0.01250
10.000	-0.00750	-0.01200	-0.01500	-0.01800	-0.02000	-0.02150	-0.02300
16.300	-0.01340	-0.02030	-0.02460	-0.02780	-0.03000	-0.03180	-0.03350
22.500	-0.02000	-0.02620	-0.03180	-0.03600	-0.03950	-0.04270	-0.04460

ENGINEER NASA
DATE

FIGURE 4.1.1.3-131
EFFECT OF BODY FLAP

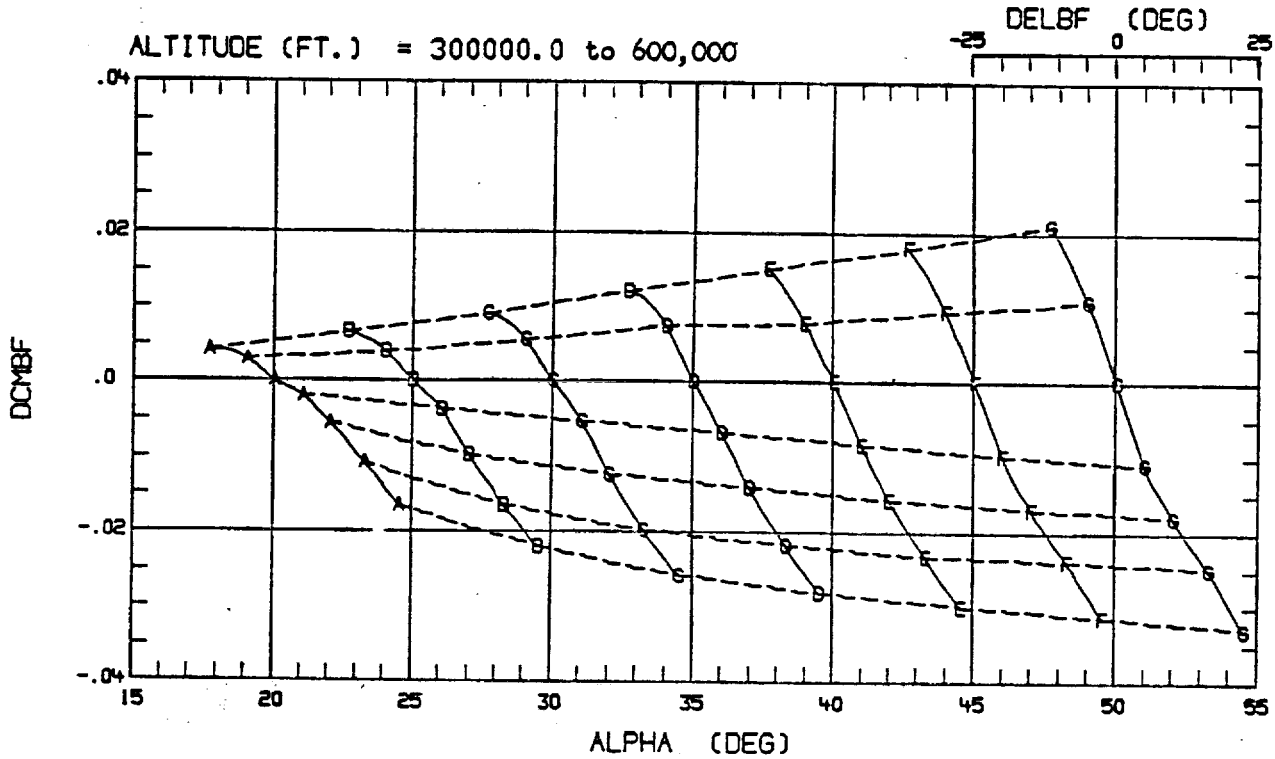


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.000 A	25.000 B	30.000 C	35.000 D	40.000 E	45.000 F	50.000 G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00400	0.00650	0.00900	0.01200	0.01500	0.01780	0.02100
-5.000	0.00290	0.00390	0.00540	0.00730	0.00780	0.00930	0.01070
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00200	-0.00380	-0.00550	-0.00700	-0.00850	-0.01000	-0.01100
10.000	-0.00570	-0.01000	-0.01250	-0.01430	-0.01580	-0.01700	-0.01800
16.300	-0.01100	-0.01660	-0.02000	-0.02190	-0.02330	-0.02400	-0.02500
22.500	-0.01670	-0.02220	-0.02500	-0.02930	-0.03000	-0.03150	-0.03300

ENGINEER NASA
DATE

FIGURE 4.1.1.3-132
EFFECT OF BODY FLAP



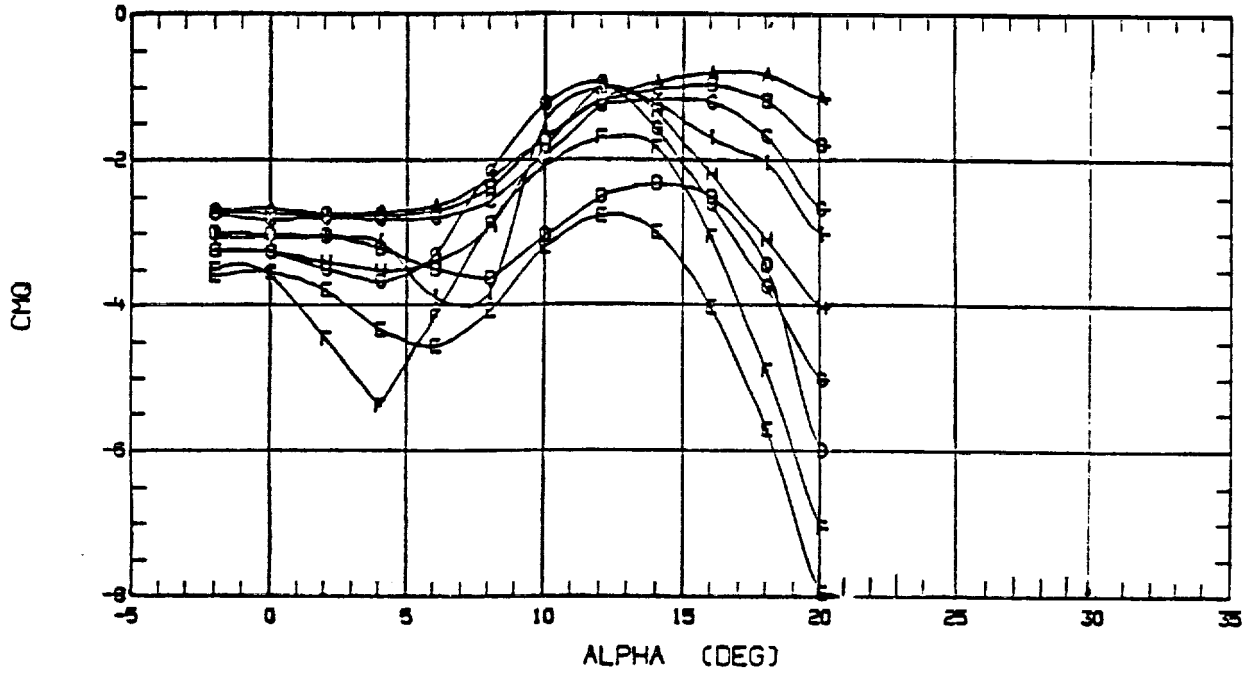
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)						
	20.0	25.0	30.0	35.0	40.0	45.0	50.0
	A	B	C	D	E	F	G
DELBF (DEG)	BODY FLAP PITCHING MOMENT COEFFI						
-11.700	0.00400	0.00650	0.00900	0.01200	0.01500	0.01780	0.02100
-5.000	0.00290	0.00390	0.00540	0.00730	0.00780	0.00930	0.01070
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.000	-0.00200	-0.00380	-0.00550	-0.00700	-0.00850	-0.01000	-0.01100
10.000	-0.00570	-0.01000	-0.01250	-0.01430	-0.01580	-0.01700	-0.01800
16.300	-0.01100	-0.01660	-0.02000	-0.02190	-0.02330	-0.02400	-0.02500
22.500	-0.01670	-0.02220	-0.02600	-0.02830	-0.03000	-0.03150	-0.03300

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-133
EFFECT OF BODY FLAP

DATA VALID FOR RANGE PRESENTED ONLY.
Angle of attack limits should not be exceeded without consulting the Aerodynamics group.



CONFIGURATION

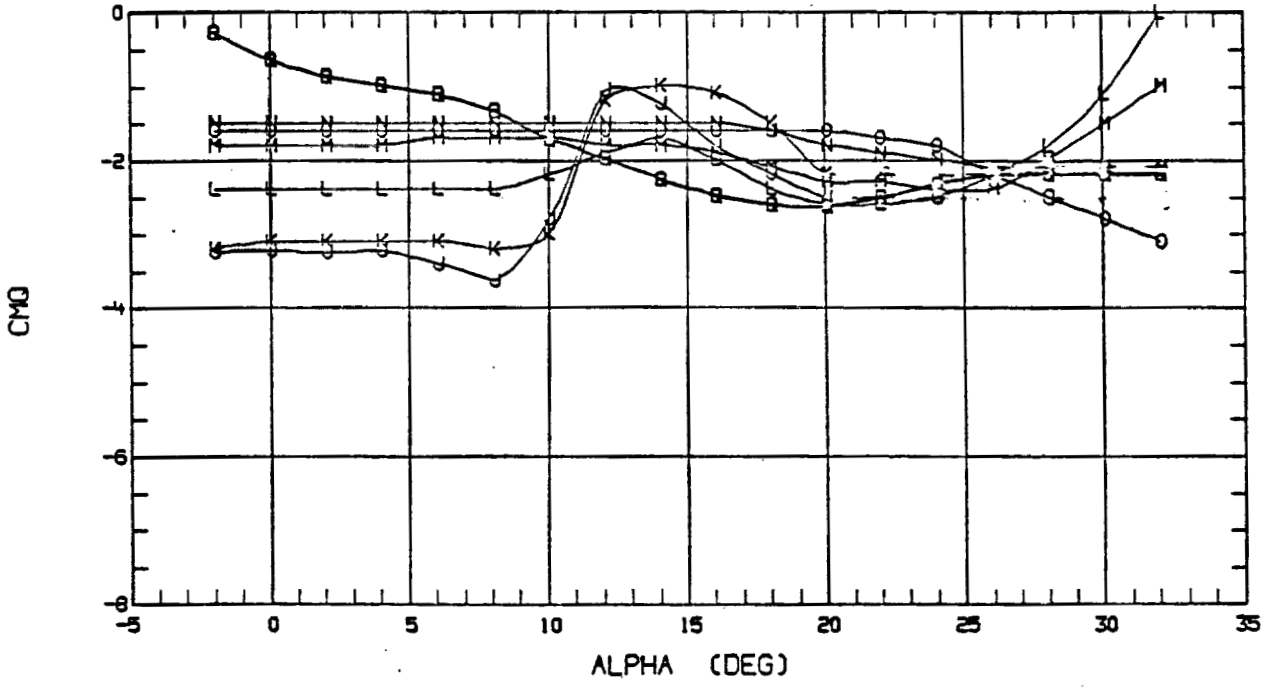
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

ALPHA (DEG)	MACH NUMBER 0.250 A	0.400 B	0.600 C	0.800 D	0.900 E	0.950 F	1.050 G	1.100 H	1.200 I
	PITCH DAMPING								
-2.000	-2.69800	-2.71900	-2.74800	-3.00000	-3.60000	-3.50300	-3.25100	-3.25100	-3.05000
0.0	-2.67200	-2.73700	-2.82400	-3.02500	-3.55400	-3.58100	-3.27700	-3.27700	-3.07600
2.000	-2.74800	-2.76900	-2.79800	-3.05100	-3.80600	-4.46600	-3.50500	-3.40300	-3.05100
4.000	-2.72000	-2.76400	-2.82300	-3.22700	-4.33600	-5.39600	-3.68100	-3.52900	-3.12500
6.000	-2.64700	-2.71100	-2.79800	-3.50300	-4.56500	-4.15700	-3.30300	-3.40400	-3.90700
8.000	-2.26900	-2.39800	-2.57200	-3.63000	-4.08400	-2.87400	-2.16700	-2.92400	-3.83200
10.000	-1.68900	-1.71700	-1.94100	-3.05100	-3.20200	-2.09300	-1.23500	-1.84000	-1.48800
12.000	-1.16100	-1.20300	-1.26100	-2.52100	-2.77300	-1.71400	-0.95700	-1.00800	-1.00800
14.000	-0.93300	-1.04100	-1.18500	-2.34400	-3.00000	-1.84100	-1.58600	-1.33600	-1.23500
16.000	-0.80700	-0.97900	-1.20900	-2.52100	-4.03400	-3.07600	-2.62300	-2.21600	-1.71500
18.000	-0.83200	-1.19900	-1.58900	-3.45300	-5.72300	-4.91500	-3.75500	-3.10000	-2.04200
20.000	-1.15900	-1.80700	-2.67200	-6.00100	-7.96600	-7.05500	-5.04200	-4.03400	-3.02400

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-134
PITCH DAMPING

DATA VALID FOR RANGE PRESENTED ONLY.
Angle of attack limits should not be exceeded without consulting the Aerodynamics group.



CONFIGURATION

BASELINE ORBITER VEHICLE			REFERENCE DIMENSIONS		
CENTER OF GRAVITY	XO = FS	1076.7 IN.	WING AREA	SW =	2690.00 SQ.FT.
OR	YO = BL	0.0 IN.	WING SPAN	BW =	78.056 FT.
MOMENT REFERENCE	ZO = WL	375.0 IN.	M.A.C.	CW =	39.560 FT.
			BODY LENGTH	LB =	1290.3 IN.

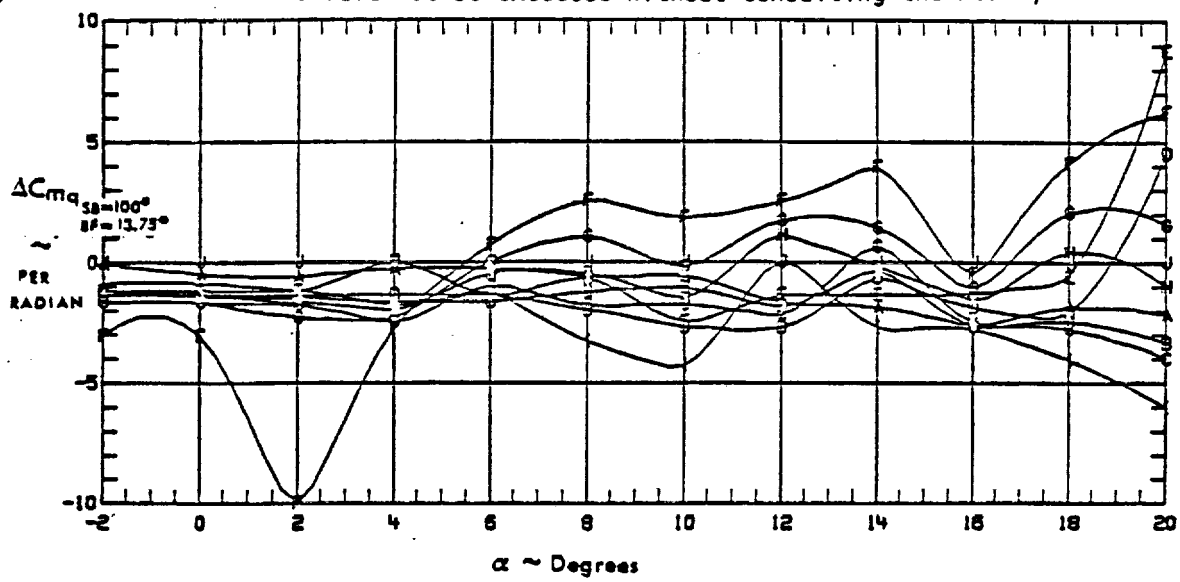
	MACH NUMBER								
	1.300	1.500	2.000	3.000	4.000	5.000	8.000	10.000	20.000
	J	K	L	M	N	O	P	Q	R
ALPHA (DEG)	PITCH DAMPING								
-2.000	-3.25200	-3.20000	-2.40000	-1.80000	-1.50000	-1.60000	-0.27800	-0.27800	-0.27800
0.0	-3.22700	-3.10000	-2.40000	-1.80000	-1.50000	-1.60000	-0.65300	-0.65300	-0.65300
2.000	-3.25200	-3.10000	-2.40000	-1.80000	-1.50000	-1.60000	-0.87600	-0.87600	-0.87600
4.000	-3.22700	-3.10000	-2.40000	-1.80000	-1.50000	-1.60000	-0.99800	-0.99800	-0.99800
6.000	-3.40400	-3.10000	-2.40000	-1.70000	-1.50000	-1.60000	-1.12200	-1.12200	-1.12200
8.000	-3.63000	-3.20000	-2.40000	-1.70000	-1.50000	-1.60000	-1.34500	-1.34500	-1.34500
10.000	-2.79800	-3.00000	-2.20000	-1.70000	-1.50000	-1.60000	-1.72200	-1.72200	-1.72200
12.000	-1.05900	-1.20000	-1.90000	-1.80000	-1.50000	-1.60000	-1.99300	-1.99300	-1.99300
14.000	-1.23500	-1.00000	-1.70000	-1.80000	-1.50000	-1.60000	-2.26700	-2.26700	-2.26700
16.000	-1.81500	-1.10000	-2.00000	-1.90000	-1.50000	-1.60000	-2.49000	-2.49000	-2.49000
18.000	-2.19300	-1.50000	-2.40000	-2.10000	-1.60000	-1.60000	-2.61400	-2.61400	-2.61400
20.000	-2.52000	-2.20000	-2.60000	-2.30000	-1.80000	-1.60000	-2.63800	-2.63800	-2.63800
22.000			-2.60000	-2.30000	-1.90000	-1.70000	-2.51100	-2.51100	-2.51100
24.000			-2.50000	-2.40000	-2.00000	-1.80000	-2.32900	-2.32900	-2.32900
26.000			-2.20000	-2.40000	-2.10000	-2.20000	-2.20200	-2.20200	-2.20200
28.000			-1.80000	-2.00000	-2.10000	-2.50000	-2.20200	-2.20200	-2.20200
30.000			-1.10000	-1.50000	-2.10000	-2.80000	-2.20200	-2.20200	-2.20200
32.000			0.0	-1.00000	-2.10000	-3.10000	-2.20200	-2.20200	-2.20200

ENGINEER
DATE

FIGURE 4.1.1.3-135
PITCH DAMPING

DATA VALID FOR RANGE PRESENTED ONLY

Angle of attack limits should not be exceeded without consulting the Aerodynamics Group



$$\Delta C_{m_{q_{\substack{SB\\BF}}}} = \left[K_{SB}\left(\frac{\delta_{SB}-25}{75}\right) + \left(1-K_{SB}\right)\left(\frac{\delta_{BF}}{13.75}\right)\right]\Delta C_{m_{q_{\substack{SB=100°\\BF=13.75°}}}}$$

NOTE: 1. For normal simulations, use $K_{SB} = 0.5$

2. For sensitivity studies, assume K_{SB} can be either 0 or 1.

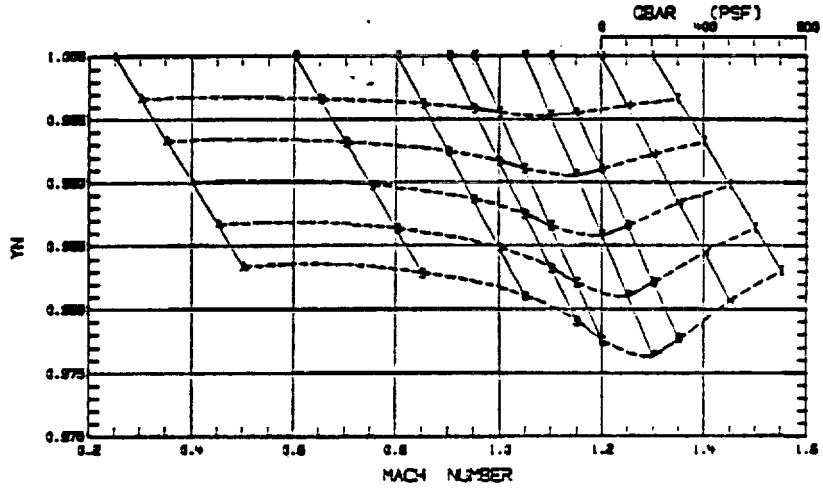
ALPHA (DEG)	MACH NUMBER 0.250 A	0.400 B	0.600 C	0.800 D	0.900 E	0.950 F	1.050 G	1.100 H	1.200 I	2.000 J
	SB - BF PITCH DAMPING INCREMENT									
-2.000	-0.10000	-1.22000	-1.70000	-1.40000	-1.20000	-3.10000	-1.70000	-1.40000	-0.90000	0.0
0.0	-0.50000	-1.42000	-1.70000	-1.40000	-1.20000	-3.10000	-1.70000	-1.40000	-0.90000	0.0
2.000	-0.60000	-1.50000	-1.80000	-1.40000	-1.20000	-10.00000	-2.30000	-1.70000	-1.20000	0.0
4.000	-0.30000	-1.67000	-2.50000	-1.40000	0.0	-2.80000	-2.30000	-2.00000	-1.80000	0.0
6.000	-0.30000	-1.65000	-1.00000	-1.40000	-1.40000	0.70000	0.0	-0.50000	-1.30000	0.0
8.000	-0.60000	-1.25000	-1.80000	-2.00000	-0.70000	2.50000	1.00000	-0.50000	-3.30000	0.0
10.000	-0.60000	-1.10000	-1.80000	-2.70000	-2.50000	1.80000	-0.20000	-1.50000	-4.30000	0.0
12.000	-1.70000	-1.85000	-2.20000	-2.70000	-1.40000	2.50000	1.70000	1.10000	0.0	0.0
14.000	-1.90000	-0.40000	0.60000	-0.70000	-1.40000	3.90000	1.40000	-0.20000	-2.70000	0.0
16.000	-2.60000	-2.65000	-2.50000	-1.90000	-1.30000	-0.50000	-1.10000	-1.60000	-2.80000	0.0
18.000	-1.90000	-2.50000	-2.80000	-2.10000	-0.60000	4.10000	2.00000	0.40000	-4.10000	0.0
20.000	-2.20000	-3.35000	-4.00000	4.50000	8.70000	6.20000	1.50000	-1.00000	-6.00000	0.0

FIGURE 4.1.1.3-136
PITCH DAMPING INCREMENT

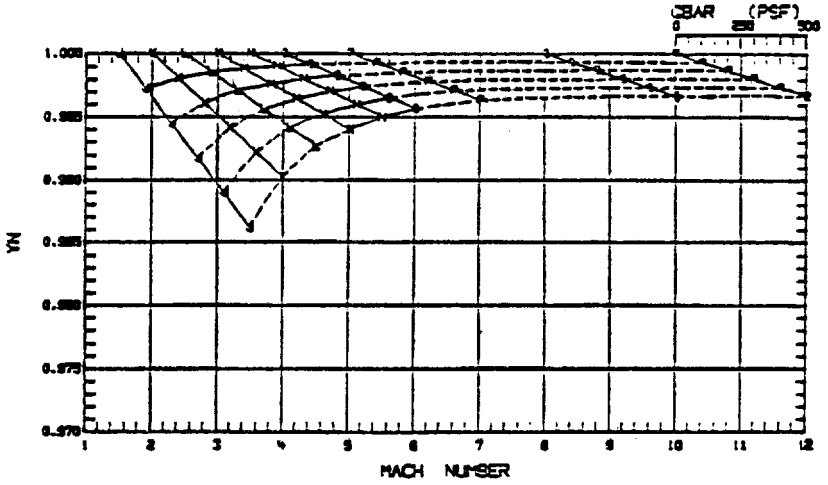
ENGINEER [illegible]
DATE 9/12/72

CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1078.7 IN.	WING AREA	SW = [illegible] SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = [illegible] FT.
MOMENT REFERENCE	ZO = WL 375.3 IN.	M.A.C.	CW = [illegible] FT.
		BODY LENGTH	LB = [illegible] IN.



QBAR (PSF)	MACH NUMBER 0.250 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
	F/R NORMAL FORCE (OR LIFT) SLOPE								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
200.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
300.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
400.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
500.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



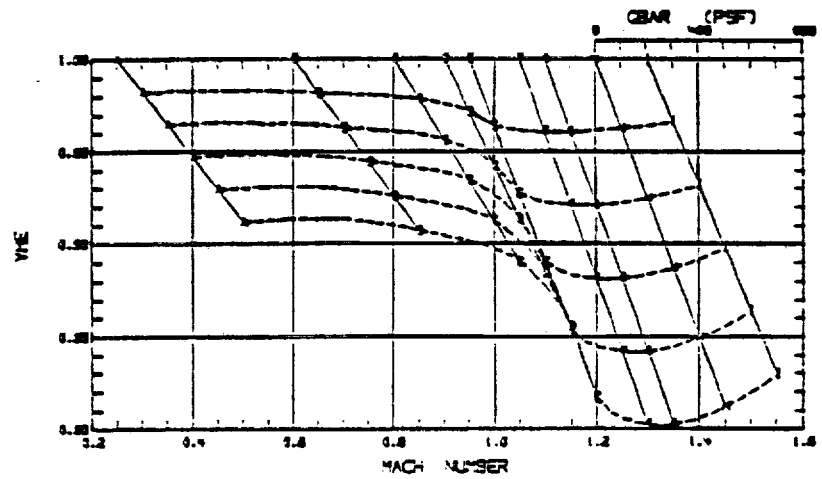
QBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	6.000 Q	10.000 R
	F/R NORMAL FORCE (OR LIFT) SLOPE								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
200.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
300.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
400.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
500.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

ENGINEER [illegible]
DATE 4-2-79

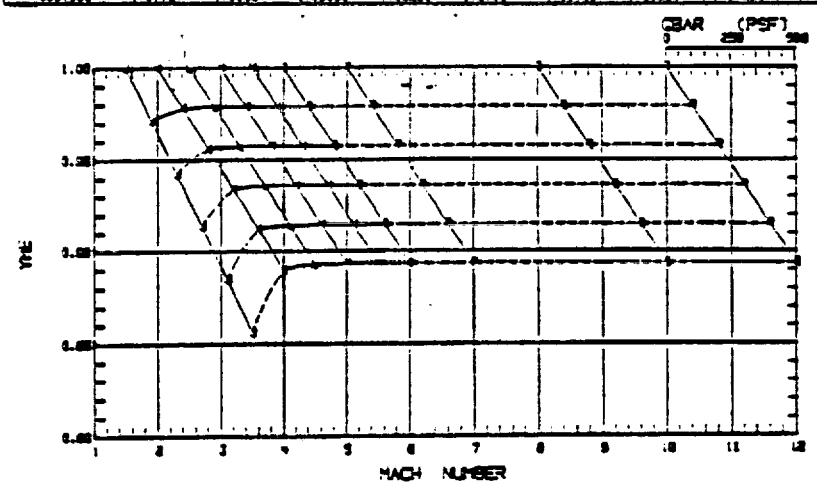
FIGURE 4.1.1.3-137
FLEX/RIGID NORMAL FORCE (OR LIFT) SLOPE WITH ALPHA

CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XB = FS 1076.7 IN.	WING AREA	SW = [illegible] SQ.FT.
OR	YB = SL 0.0 IN.	WING SPAN	SW = [illegible] FT.
MOMENT REFERENCE	ZB = WL [illegible] IN.	M.A.C.	CW = [illegible] FT.
		BODY LENGTH	LB = [illegible] IN.



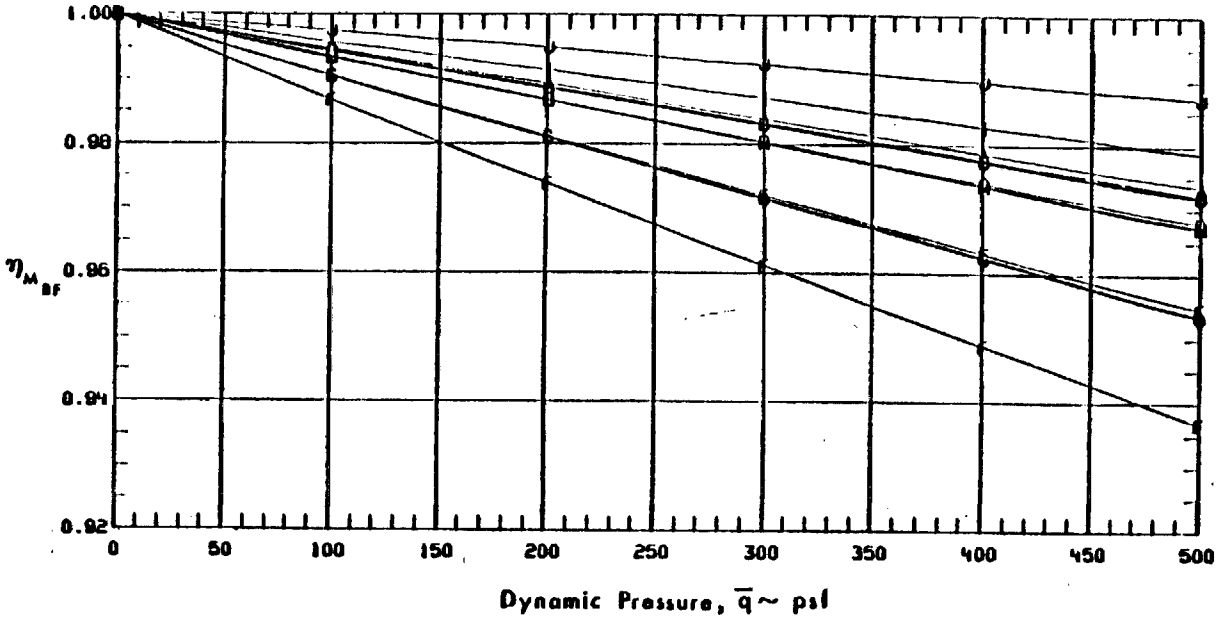
CBAR (PSF)	MACH NUMBER 0.250 A	0.800 B	0.900 C	0.950 D	0.950 E	1.000 F	1.100 G	1.200 H	1.300 I
	FOR ELEVON PITCHING MOM EFFECT								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
200.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
300.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
400.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
500.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

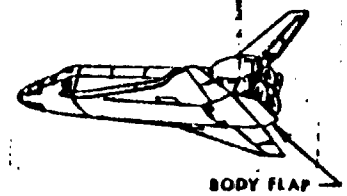


CBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	6.000 Q	10.000 R
	FOR ELEVON PITCHING MOM EFFECT								
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
200.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
300.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
400.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
500.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.1.1.3-138
FLEXIBLE/RIGID ELEVON PITCHING MOMENT EFFECTIVENESS





Body Flap Effectiveness

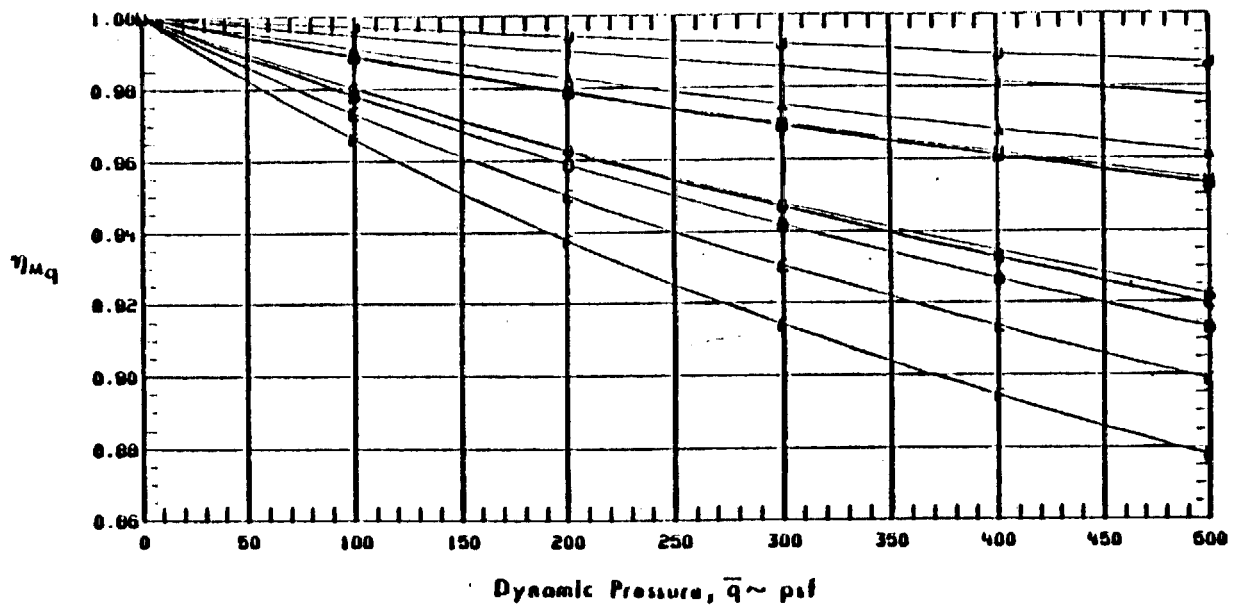
$$\eta_{M_{BF}} = \frac{C_{m_{\delta_{BF}}}^{F}}{C_{m_{\delta_{BF}}}^{R}}$$

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, $\eta_{M_{BF}}$									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99452	0.99427	0.99420	0.99331	0.99043	0.98665	0.99028	0.99325	0.99563	0.99738
200.000	0.98910	0.98862	0.98848	0.98673	0.98106	0.97365	0.98076	0.98659	0.99129	0.99478
300.000	0.98376	0.98303	0.98283	0.98025	0.97191	0.96100	0.97142	0.98002	0.98699	0.99219
400.000	0.97851	0.97753	0.97725	0.97388	0.96299	0.94873	0.96229	0.97352	0.98272	0.98961
500.000	0.97344	0.97205	0.97174	0.96779	0.95440	0.93671	0.95328	0.96704	0.97864	0.98709

ENGINEER: DJO
DATE: 9/2/77
REVISED:

Figure 4.1.1.3-139
AEROELASTIC RATIOS

Rockwell International
Space Division



Pitch Rate

$$\eta_{M_q} = \frac{C'_{m_q}}{C^R_{m_q}}$$

$\bar{q}$ ~ psf	Mach Number									
	A 0.250	B 0.600	C 0.900	D 0.950	E 1.050	F 1.200	G 1.500	H 2.000	I 3.000	J 5.000
	Flexible-to-Rigid Ratio, η_{M_q}									
0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
100.000	0.99095	0.98003	0.98010	0.97001	0.97295	0.96579	0.98008	0.98094	0.99470	0.99713
200.000	0.90264	0.97857	0.96231	0.95061	0.94981	0.93731	0.96270	0.97892	0.98996	0.99436
300.000	0.97502	0.96922	0.94649	0.94159	0.93018	0.91307	0.94757	0.96906	0.98547	0.99168
400.000	0.96801	0.96073	0.93236	0.92653	0.91330	0.89424	0.93419	0.96164	0.98121	0.98910
500.000	0.96148	0.95276	0.91970	0.91296	0.89064	0.87750	0.92214	0.95410	0.97718	0.98660

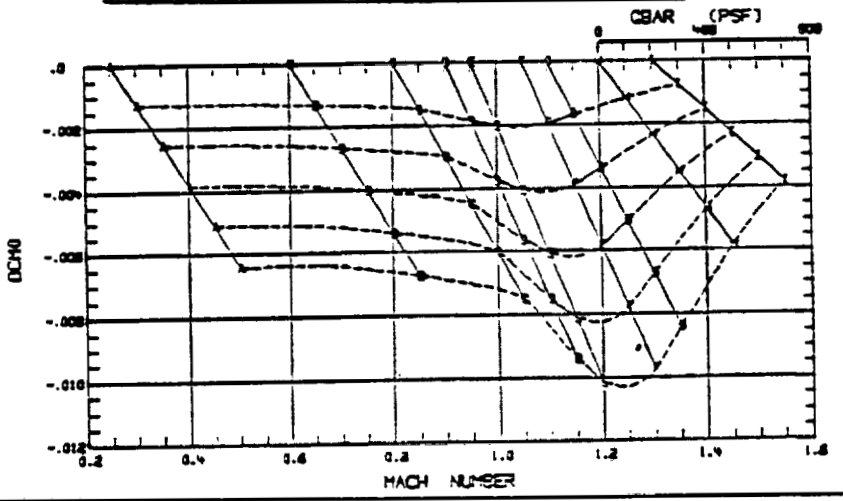
ENGINEER: DJD
DATE: 8/21/77
REVISED:

Figure 4.1.1.3-140
AEROELASTIC RATIOS

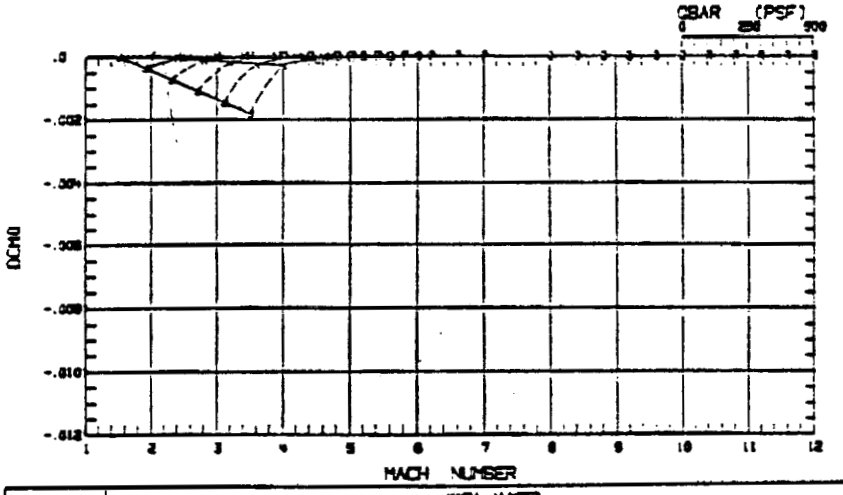
Rockwell International
Space Division

4.1.1.3-146

CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XG = FS 1078.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YG = BL 0.0 IN.	WING SPAN	BW = 78.058 FT.
MOMENT REFERENCE	ZG = WL 375.3 IN.	M.A.C.	CW = 38.580 FT.
		BODY LENGTH	LB = 1290.3 IN.



QBAR (PSF)	MACH NUMBER 0.250 A	0.500 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
	FLEX PITCH MOM INCR AT ALPHA=0								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	-0.00128	-0.00135	-0.00151	-0.00168	-0.00833	-0.00195	-0.00168	-0.00117	-0.00077
200.000	-0.00257	-0.00271	-0.00301	-0.00377	-0.00467	-0.00390	-0.00337	-0.00233	-0.00153
300.000	-0.00385	-0.00408	-0.00452	-0.00565	-0.00610	-0.00585	-0.00505	-0.00350	-0.00230
400.000	-0.00513	-0.00541	-0.00603	-0.00753	-0.00813	-0.00780	-0.00673	-0.00467	-0.00307
500.000	-0.00642	-0.00677	-0.00753	-0.00942	-0.01017	-0.00975	-0.00842	-0.00583	-0.00383



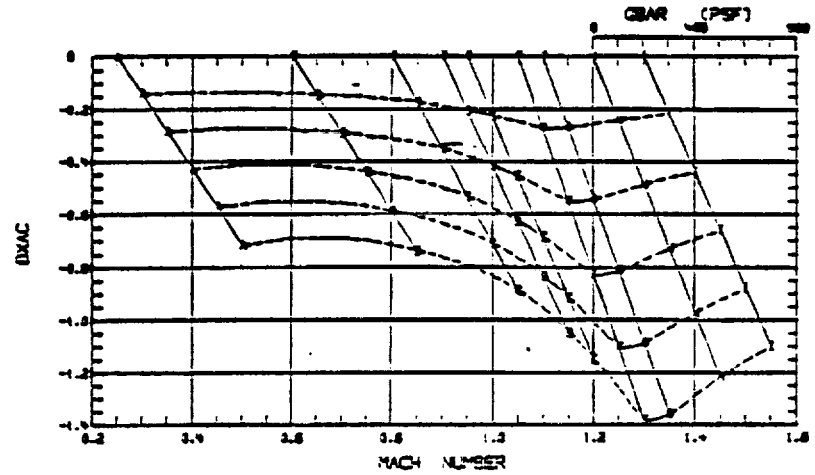
QBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	6.000 Q	10.000 R
	FLEX PITCH MOM INCR AT ALPHA=0								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	-0.00037	-0.00008	-0.00002	-0.00001	0.0	0.0	0.0	0.0	0.0
200.000	-0.00073	-0.00011	-0.00003	-0.00002	0.0	0.0	0.0	0.0	0.0
300.000	-0.00110	-0.00017	-0.00005	-0.00003	0.0	0.0	0.0	0.0	0.0
400.000	-0.00147	-0.00023	-0.00007	-0.00004	0.0	0.0	0.0	0.0	0.0
500.000	-0.00183	-0.00028	-0.00008	-0.00005	0.0	0.0	0.0	0.0	0.0

ENGINEER DED
DATE 4-2-79

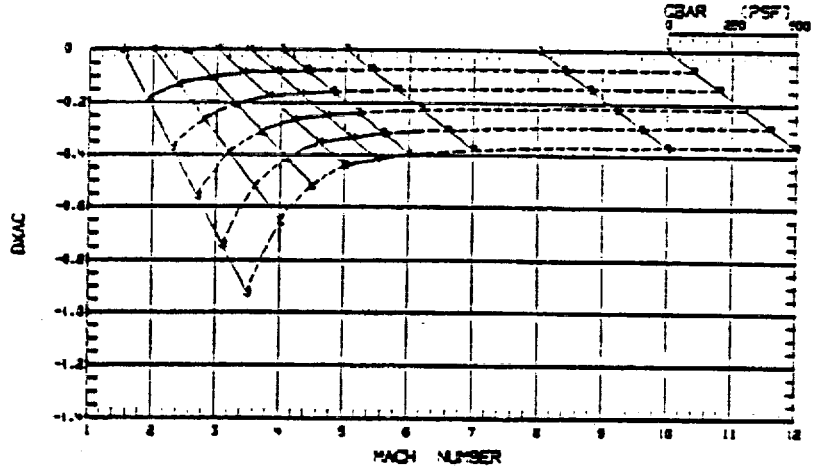
FIGURE 4.1.1.3-141
FLEX PITCHING MOMENT INCR. AT ZERO ANGLE OF ATTACK

CONFIGURATION

BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XG = FS 1678.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YG = BL 0.0 IN.	WING SPAN	BW = 78.058 FT.
MOMENT REFERENCE	ZG = WL 375.0 IN.	M.A.C.	CW = 38.580 FT.
		BODY LENGTH	LB = 1290.3 IN.



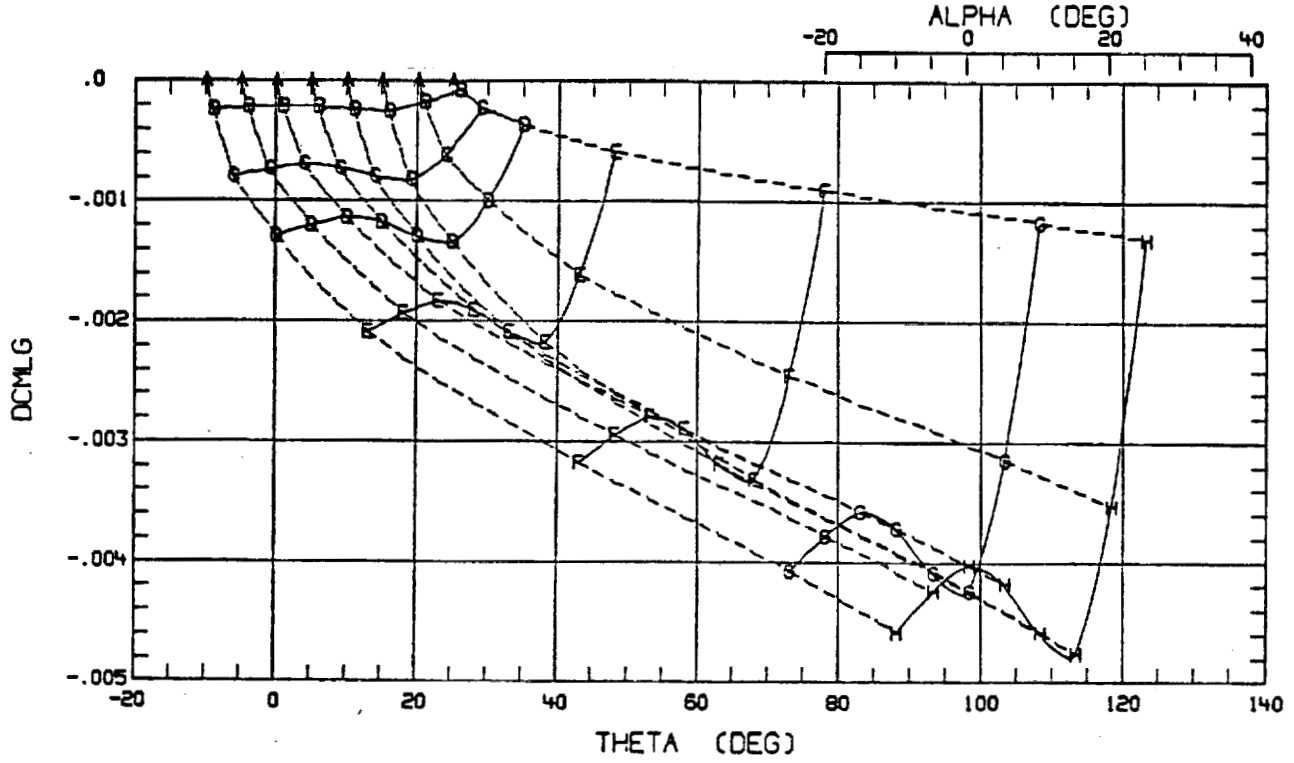
QBAR (PSF)	MACH NUMBER 0.200 A	0.600 B	0.800 C	0.900 D	0.950 E	1.050 F	1.100 G	1.200 H	1.300 I
	FLEX A.C. SHIFT (% MAC)								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	-0.14333	-0.14833	-0.17833	-0.21000	-0.23000	-0.27667	-0.27167	-0.24333	-0.22000
200.000	-0.28667	-0.28667	-0.33667	-0.42000	-0.46000	-0.53333	-0.54333	-0.46667	-0.44000
300.000	-0.43000	-0.44500	-0.53500	-0.62000	-0.68000	-0.83000	-0.81500	-0.73000	-0.68000
400.000	-0.57333	-0.58333	-0.71333	-0.84000	-0.92000	-1.10667	-1.08667	-0.97333	-0.88000
500.000	-0.71667	-0.74167	-0.88167	-1.05000	-1.15000	-1.38333	-1.35833	-1.21667	-1.10000



QBAR (PSF)	MACH NUMBER 1.500 J	2.000 K	2.500 L	3.000 M	3.500 N	4.000 O	5.000 P	6.000 Q	10.000 R
	FLEX A.C. SHIFT (% MAC)								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100.000	-0.18667	-0.13667	-0.10333	-0.08833	-0.08333	-0.07833	-0.07500	-0.07333	-0.07333
200.000	-0.37133	-0.28133	-0.25667	-0.17667	-0.15667	-0.15667	-0.15000	-0.14667	-0.14667
300.000	-0.58750	-0.38000	-0.31000	-0.28500	-0.25000	-0.23500	-0.22500	-0.22000	-0.22000
400.000	-0.74667	-0.52667	-0.41333	-0.35333	-0.33333	-0.31733	-0.30400	-0.29333	-0.29333
500.000	-0.98833	-0.65333	-0.51667	-0.44167	-0.41667	-0.39667	-0.38000	-0.36667	-0.36667

ENGINEER [signature]
DATE [illegible]

FIGURE 4.1.1.3-142
FLEX AERODYNAMIC CENTER SHIFT (% MAC.- = FWD SHIFT)



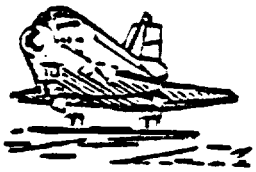
CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.055 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	THETA (DEG)							
	0.0	1.000	4.000	10.000	23.000	53.000	83.000	98.000
	A	B	C	D	E	F	G	H
ALPHA (DEG)	LANDING GEAR P.M. INCREMENT							
-10.000	0.0	-0.00024	-0.00080	-0.00130	-0.00210	-0.00319	-0.00409	-0.00459
-5.000	0.0	-0.00022	-0.00074	-0.00120	-0.00194	-0.00296	-0.00379	-0.00425
0.0	0.0	-0.00021	-0.00070	-0.00114	-0.00184	-0.00290	-0.00359	-0.00403
5.000	0.0	-0.00022	-0.00073	-0.00118	-0.00191	-0.00291	-0.00373	-0.00419
10.000	0.0	-0.00024	-0.00080	-0.00130	-0.00210	-0.00320	-0.00410	-0.00460
15.000	0.0	-0.00025	-0.00083	-0.00135	-0.00218	-0.00332	-0.00425	-0.00477
20.000	0.0	-0.00018	-0.00062	-0.00100	-0.00162	-0.00246	-0.00316	-0.00354
25.000	0.0	-0.00007	-0.00023	-0.00037	-0.00060	-0.00092	-0.00118	-0.00132

ENGINEER [illegible]
DATE 9/7/78

FIGURE 4.1.1.3-143
LANDING GEAR PITCHING MOMENT COEFFICIENT INCREMENT

Landing Gear Down



$$\Delta C_{m_{\substack{GROUND\\EFFECT}}} = C_{m_{\substack{GROUND\\EFFECT}}} - C_{m_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = [illegible] 1878.[illegible]; Y_o = [illegible] 0.[illegible]; Z_o = [illegible] -[illegible]

REFERENCE DIMENSIONS

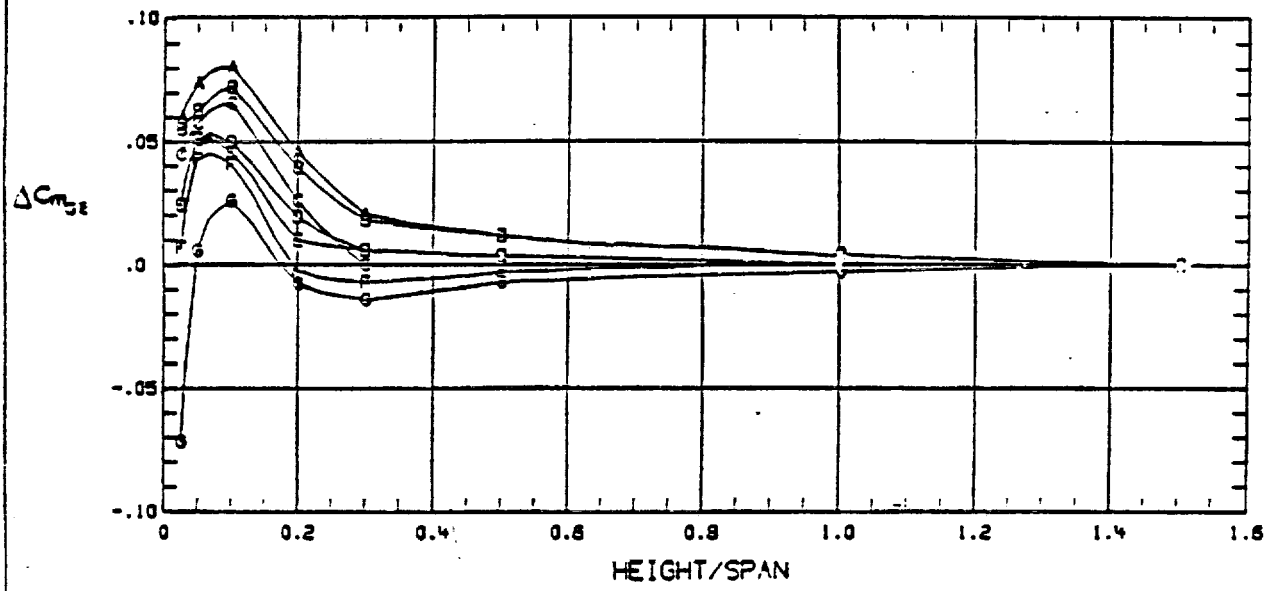
AREA S_w = 2590.000 ft²

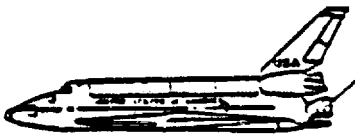
SPAN b_w = 78.056 ft

MAC c_w = 39.550 ft

BODY LENGTH L_b = 1298.300 in

δ_e = -40.000° δ_{BF} = -11.7° δ_{SB} = All





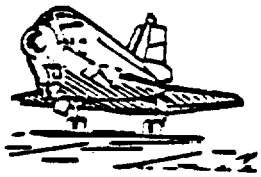
Reference Point for h/b
X_o 1506.34
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.06000	0.05470	0.04400	0.02400	0.02400	0.00670	-0.07200
0.050	0.07340	0.06270	0.05740	0.05070	0.05070	0.04270	0.00540
0.100	0.08010	0.07210	0.06550	0.04950	0.04550	0.04010	0.02550
0.200	0.04560	0.03890	0.02560	0.01890	0.00960	-0.00240	-0.00790
0.300	0.02040	0.01770	0.0	0.00570	0.00570	-0.00760	-0.01430
0.500	0.01130	0.01130	0.0	0.00330	0.00330	-0.00340	-0.00740
1.000	0.00400	0.00400	0.0	0.0	0.0	0.0	-0.00300
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: [illegible]
REVISED:

Figure 4.1.1.3-144
GROUND EFFECT

Landing Gear Down



$$\Delta C_{m_{\text{GROUND EFFECT}}} = C_{m_{\text{GROUND EFFECT}}} - C_{m_{\text{FREE STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1076.78; Y_o = BL 0.00; Z_o = WL 375.00

REFERENCE DIMENSIONS

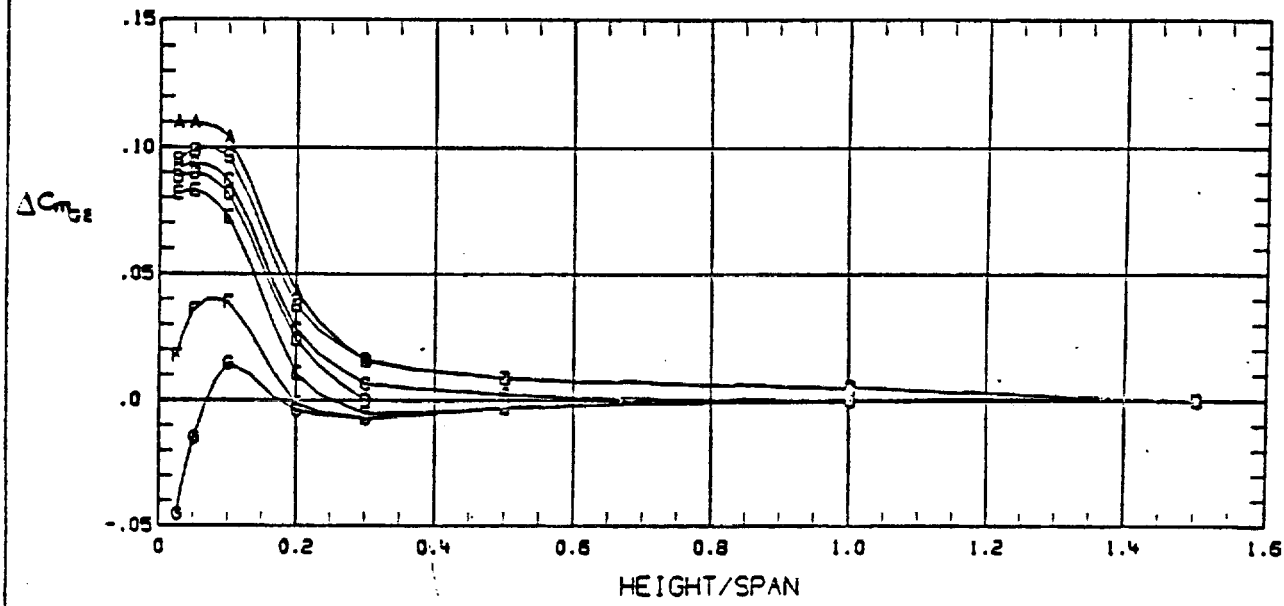
AREA S_w = 2690.000 ft²

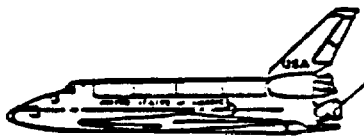
SPAN b_w = 78.056 ft

MAC c_w = 39.550 ft

BODY LENGTH L_B = 1290.300 in

δ_e = -30.000° δ_{BF} = -11.7° δ_{SB} = All



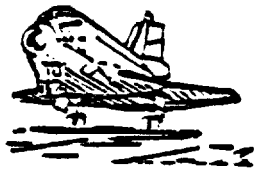


Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{\text{GRND EFFECT}}}$						
0.025	0.10930	0.09460	0.09060	0.08800	0.08130	0.01730	-0.04540
0.050	0.10930	0.09860	0.09330	0.08930	0.08260	0.03590	-0.01470
0.100	0.10390	0.09590	0.08650	0.08120	0.07190	0.03850	0.01450
0.200	0.04240	0.03710	0.02780	0.02380	0.01040	-0.00160	-0.00420
0.300	0.01560	0.01560	0.00630	0.0	-0.00570	-0.00700	-0.00700
0.500	0.00870	0.00870	0.00210	0.0	-0.00330	-0.00330	-0.00330
1.000	0.00500	0.00500	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE [illegible]
REVISED:

Figure 4.1.1.3-145
GROUND EFFECT

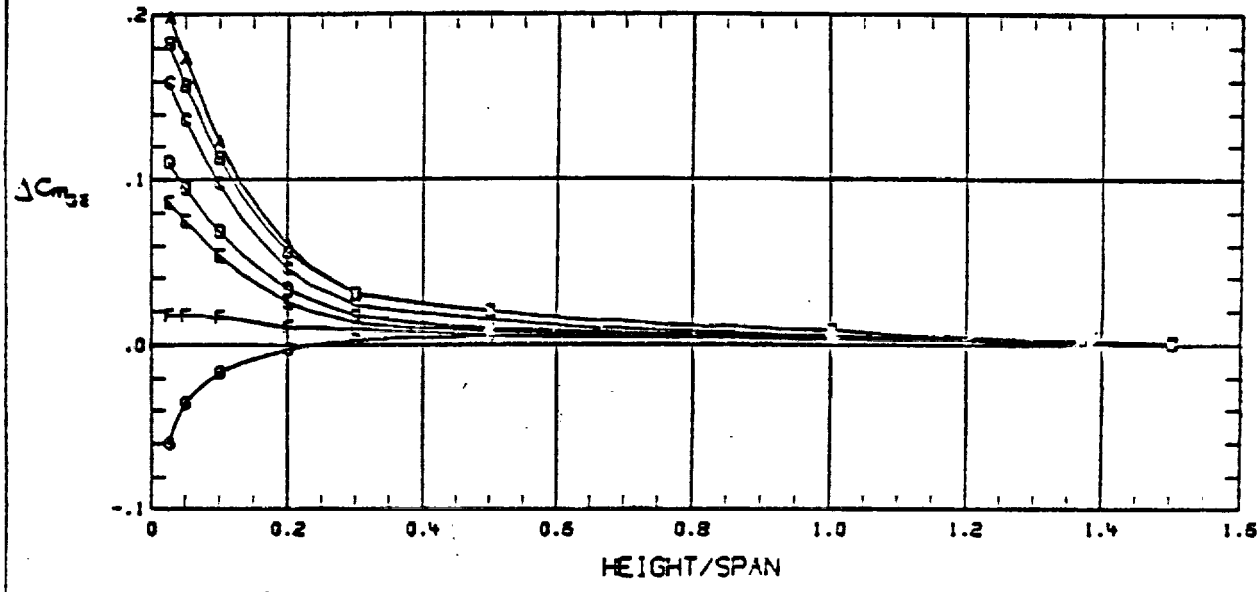


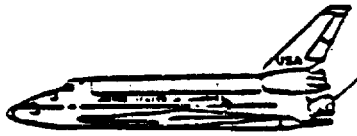
Landing Gear Down

$$\Delta C_{m_{\substack{GROUND\\EFFECT}}} = C_{m_{\substack{GROUND\\EFFECT}}} - C_{m_{\substack{FREE\\STREAM}}}$$

CONFIGURATION
BASELINE ORBITER VEHICLE
CENTER OF GRAVITY
OR
MOMENT REFERENCE
REFERENCE DIMENSIONS
AREA
SPAN
MAC
BODY LENGTH

$\delta_e = -20.000°$ $\delta_{BF} = -11.7°$ $\delta_{SB} = ALL$



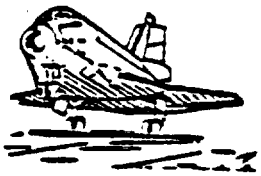


Reference Point
for h/b
X_o 1506.34
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GROUND\ EFFECT}}$						
0.025	0.19860	0.18260	0.15860	0.11060	0.08530	0.01730	-0.06000
0.050	0.17330	0.15730	0.13590	0.09460	0.07460	0.01730	-0.03610
0.100	0.12250	0.11320	0.09720	0.06790	0.05320	0.01590	-0.01750
0.200	0.05980	0.05580	0.04510	0.03310	0.02510	0.01040	-0.00290
0.300	0.03030	0.03030	0.02360	0.01700	0.01300	0.00900	0.00230
0.500	0.01940	0.01940	0.01410	0.00870	0.00740	0.00470	0.00470
1.000	0.00800	0.00800	0.00500	0.00500	0.00500	0.00300	0.00300
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER:
DATE: 9-14-77
REVISED:

Figure 4.1.1.3-146
GROUND EFFECT



Landing Gear Down

$$\Delta C_{m_{\substack{GROUND\\EFFECT}}} = C_{m_{\substack{GROUND\\EFFECT}}} - C_{m_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = 1078.78, Y_o = 0.00, Z_o = 375.00

REFERENCE DIMENSIONS

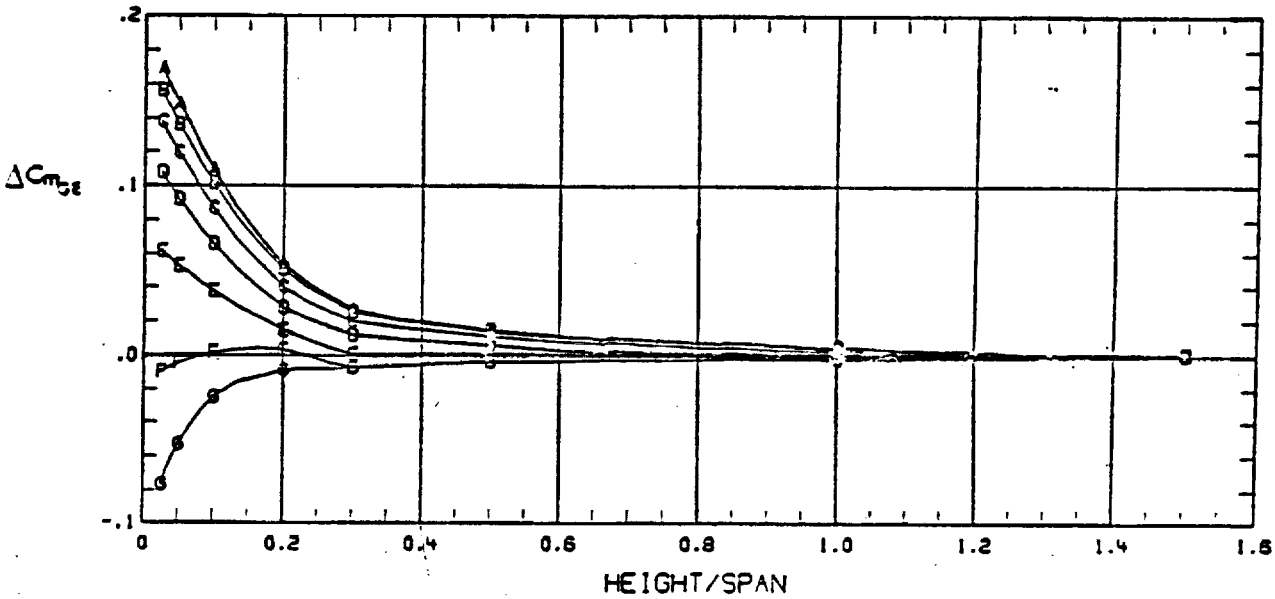
AREA S_w = 2690.000 ft²

SPAN b_w = 78.056 ft

MAC c_w = 38.560 ft

BODY LENGTH l_B = 1296.300 in

δ_e = -15.000° δ_{SP} = -11.7° δ_{SB} = All



Reference Point for h/b
X_o 1506.34
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.16930	0.15600	0.13730	0.10800	0.08130	-0.01070	-0.07730
0.050	0.14800	0.13600	0.11870	0.09200	0.05200	-0.00530	-0.05330
0.100	0.10930	0.10130	0.08670	0.06530	0.03730	0.00130	-0.02530
0.200	0.05330	0.05070	0.04000	0.02900	0.01470	0.00270	-0.00930
0.300	0.02670	0.02530	0.02000	0.01200	0.0	-0.00800	-0.00800
0.500	0.01330	0.01470	0.01070	0.00530	0.0	-0.00400	-0.00400
1.000	0.00500	0.00500	0.00300	0.0	0.0	-0.00200	-0.00200
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: JS
DATE: 9-14-77
REVISED:

Figure 4.1.1.3-147
GROUND EFFECT

Landing Gear Down

$$\Delta C_{m_{GROUND\ EFFECT}} = C_{m_{GROUND\ EFFECT}} - C_{m_{FREE\ STREAM}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE

REFERENCE DIMENSIONS

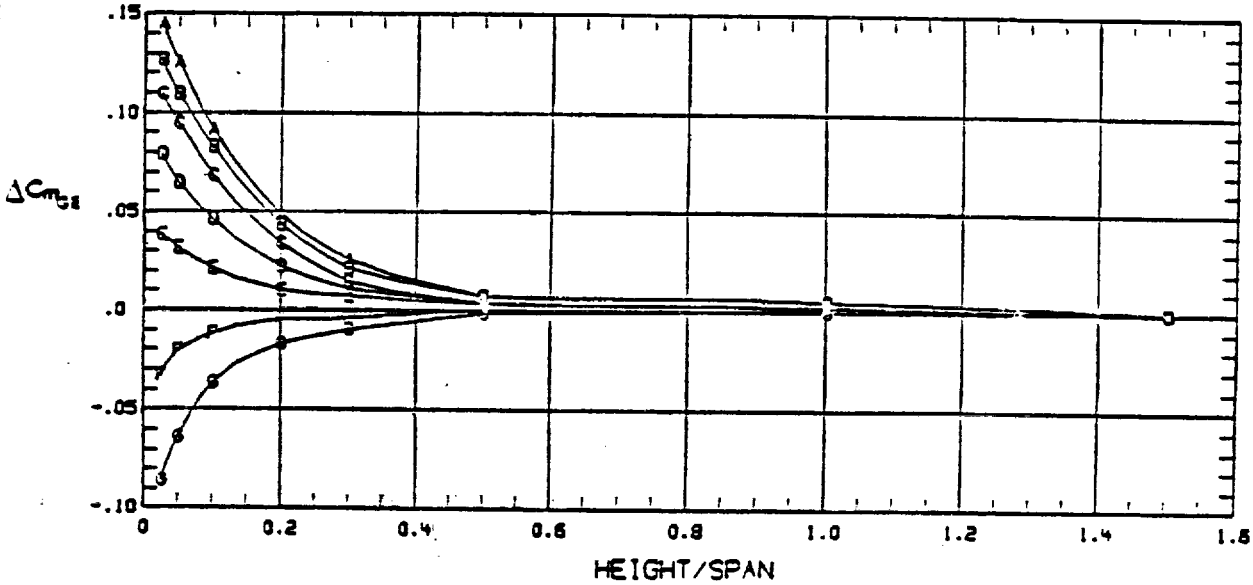
AREA

SPAN

MAC

BODY LENGTH

$\delta_e = -10.000°$ $\delta_{sp} = -11.7°$ $\delta_{sb} =$ All

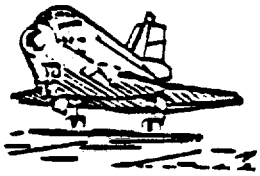


Reference Point for h/b
X_o 1506.34
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GROUND\ EFFECT}}$						
0.025	0.14470	0.12620	0.10910	0.07890	0.03800	-0.03300	-0.08600
0.050	0.12480	0.10900	0.09460	0.06430	0.03100	-0.02100	-0.06400
0.100	0.09170	0.08250	0.06810	0.04570	0.02070	-0.01200	-0.03700
0.200	0.04800	0.04270	0.03350	0.02160	0.01000	-0.00500	-0.01700
0.300	0.02520	0.02130	0.01470	0.01080	0.00700	-0.00400	-0.01000
0.500	0.00740	0.00740	0.00350	0.00350	0.00350	0.0	-0.00200
1.000	0.00500	0.00500	0.00200	0.00200	0.00200	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: 13
DATE 2-14-77
REVISED:

Figure 4.1.1.3-14c
GROUND EFFECT



Landing Gear Down

$$\Delta C_{m_{\substack{GROUND\\EFFECT}}} = C_{m_{\substack{GROUND\\EFFECT}}} - C_{m_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

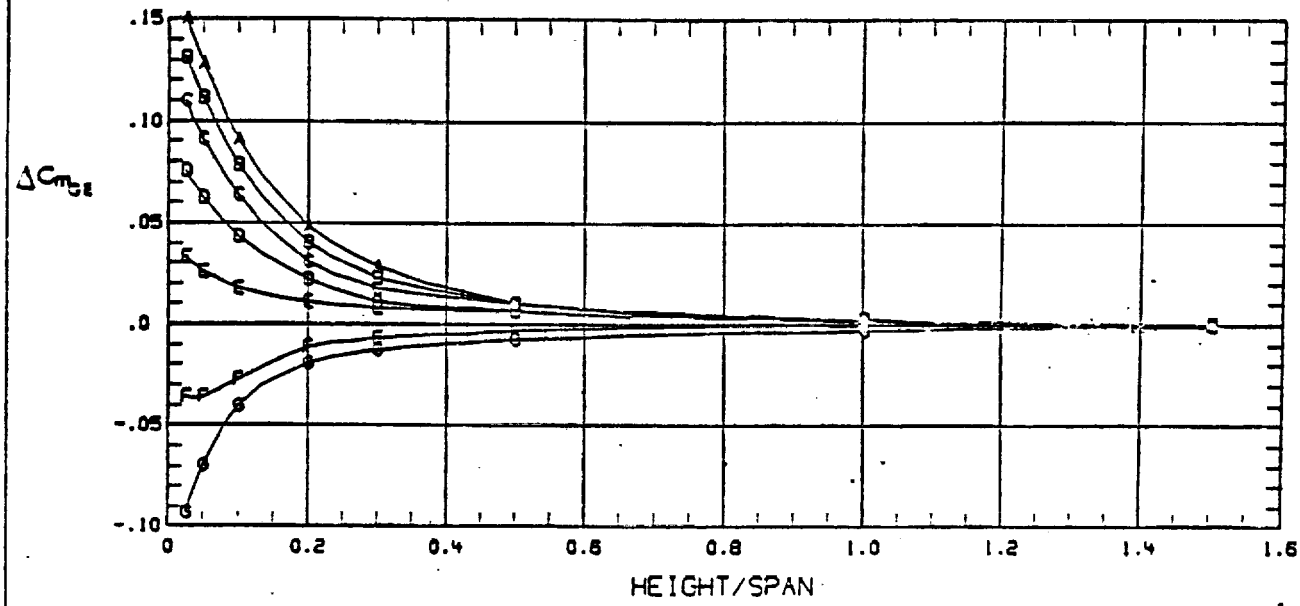
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1076.78, Y_o = BL 0.00, Z_o = WL 375.00

REFERENCE DIMENSIONS

AREA S_w = 2690.000 ft²
SPAN b_w = 78.056 ft
MAC c_w = 35.550 ft
BODY LENGTH L_B = 1290.500 in

δ_e = -5.000° δ_{BF} = -11.7° δ_{SB} = ALL



Reference Point for h/b
X_o 1506.84
Z_o 282.71

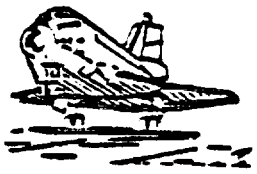
HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.15000	0.13110	0.10940	0.07500	0.03240	-0.03650	-0.09330
0.050	0.12930	0.11080	0.09050	0.06200	0.02560	-0.03650	-0.07030
0.100	0.09040	0.07830	0.06340	0.04300	0.01740	-0.02720	-0.04070
0.200	0.04840	0.04030	0.03080	0.02200	0.01060	-0.01110	-0.01920
0.300	0.02800	0.02250	0.01720	0.01100	0.00770	-0.00710	-0.01250
0.500	0.01020	0.01020	0.01020	0.00810	0.00810	-0.00330	-0.00740
1.000	0.00250	0.00250	0.00250	0.00200	0.00200	0.0	-0.00300
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 5-14-77
REVISED:

Figure 4.1.1.3-149
GROUND EFFECT

Rockwell International
Space Division

Landing Gear Down



$$\Delta C_{m_{\text{GROUND EFFECT}}} = C_{m_{\text{GROUND EFFECT}}} - C_{m_{\text{FREE STREAM}}}$$

CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1076.73; Y_o = WL 0.00; Z_o = WL 375.00

REFERENCE DIMENSIONS

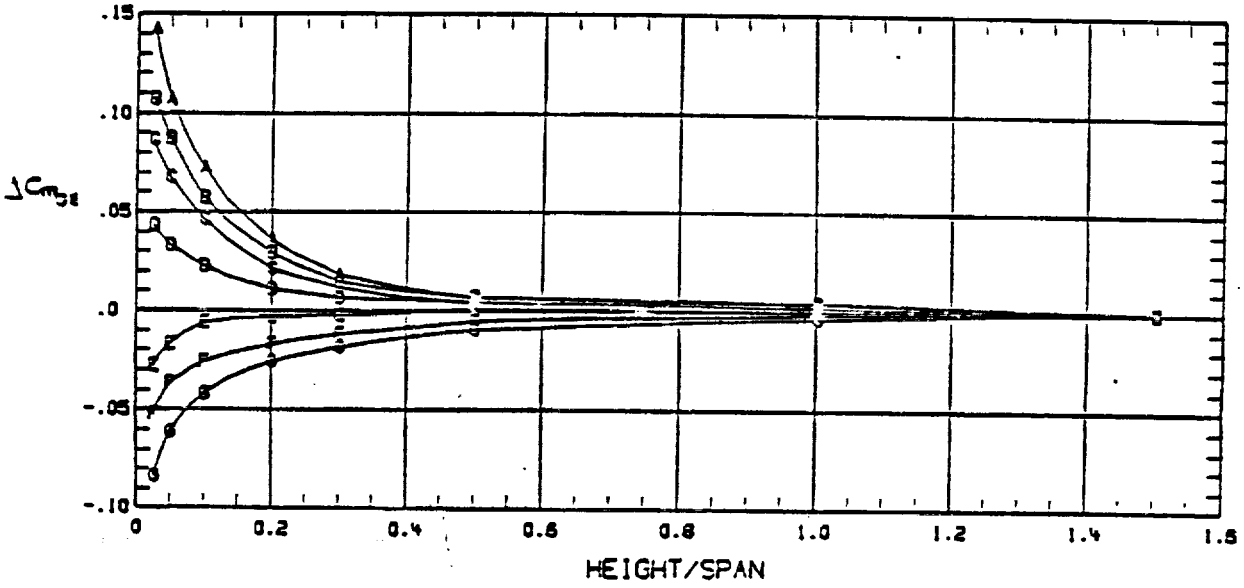
AREA S_w = 2690.000 ft²

SPAN b_w = 78.056 ft

MAC c_w = 39.560 ft

BODY LENGTH L_b = 1290.300 in

$\delta_e = 0.0°$ $\delta_{SF} = -11.7°$ δ_{SB} = All

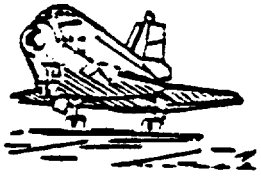


Reference Point for h/b
X_o 1306.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{\text{GRND EFFECT}}}$						
0.025	0.14300	0.10700	0.08600	0.04300	-0.02900	-0.05200	-0.08400
0.050	0.10700	0.08700	0.06700	0.03300	-0.01700	-0.03730	-0.06150
0.100	0.07200	0.05700	0.04600	0.02230	-0.00650	-0.02500	-0.04180
0.200	0.03550	0.02910	0.02130	0.01070	-0.00350	-0.01720	-0.02570
0.300	0.01820	0.01460	0.01140	0.00650	-0.00240	-0.01220	-0.01880
0.500	0.00660	0.00670	0.00400	0.00400	0.00020	-0.00570	-0.00960
1.000	0.00400	0.00400	0.00200	0.00200	0.0	-0.00200	-0.00400
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 9-14-77
REVISED:

Figure 4.1.1.3-150
GROUND EFFECT



Landing Gear Down

$$\Delta C_{m_{\substack{GROUND\\EFFECT}}} = C_{m_{\substack{GROUND\\EFFECT}}} - C_{m_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

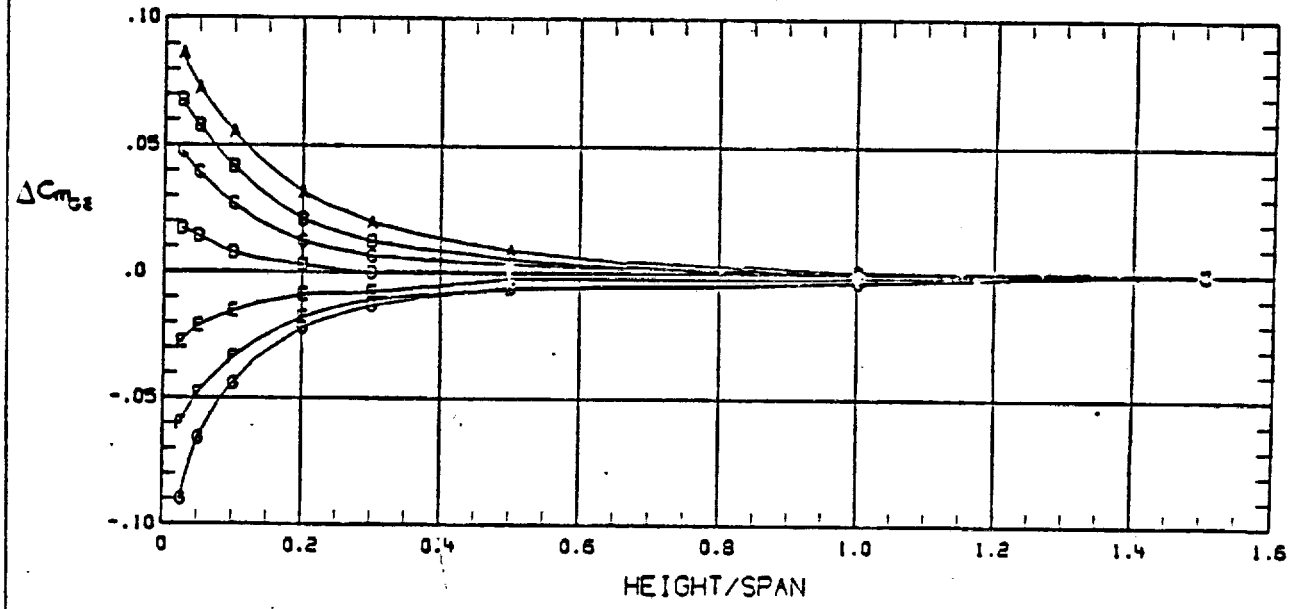
BASELINE ORBITER VEHICLE

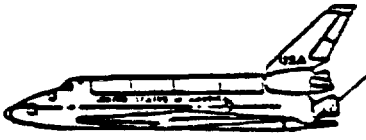
CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1078.70, Y_o = BL 0.00, Z_o = WL -375.30

REFERENCE DIMENSIONS

AREA	S_w = 2690.000 ft²
SPAN	b_w = 78.056 ft
MAC	$\bar{c}_w$ = 38.560 ft
BODY LENGTH	L_b = 1290.300 in

δ_e = 5.000° δ_{BF} = -11.7° δ_{SB} = All





Reference Point for h/b
X_o 1506.84
Z_o 282.71

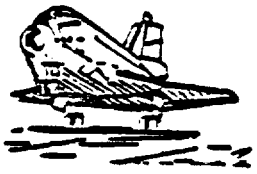
HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.08600	0.06700	0.04700	0.01700	-0.02800	-0.06000	-0.09000
0.050	0.07200	0.05700	0.03900	0.01360	-0.02120	-0.04840	-0.06620
0.100	0.05500	0.04140	0.02670	0.00710	-0.01550	-0.03390	-0.04410
0.200	0.03110	0.02060	0.01190	0.00240	-0.00930	-0.01770	-0.02200
0.300	0.01970	0.01220	0.00640	-0.00020	-0.00790	-0.01080	-0.01310
0.500	0.00860	0.00520	0.00320	-0.00010	-0.00290	-0.00690	-0.00640
1.300	0.00100	0.00050	0.00050	0.0	-0.00200	-0.00400	-0.00400
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 9-14-77
REVISED:

Figure 4.1.1.3-151
GROUND EFFECT

Landing Gear Down

$$\Delta C_{m_{\substack{GROUND\\EFFECT}}} = C_{m_{\substack{GROUND\\EFFECT}}} - C_{m_{\substack{FREE\\STREAM}}}$$



CONFIGURATION

BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE

REFERENCE DIMENSIONS

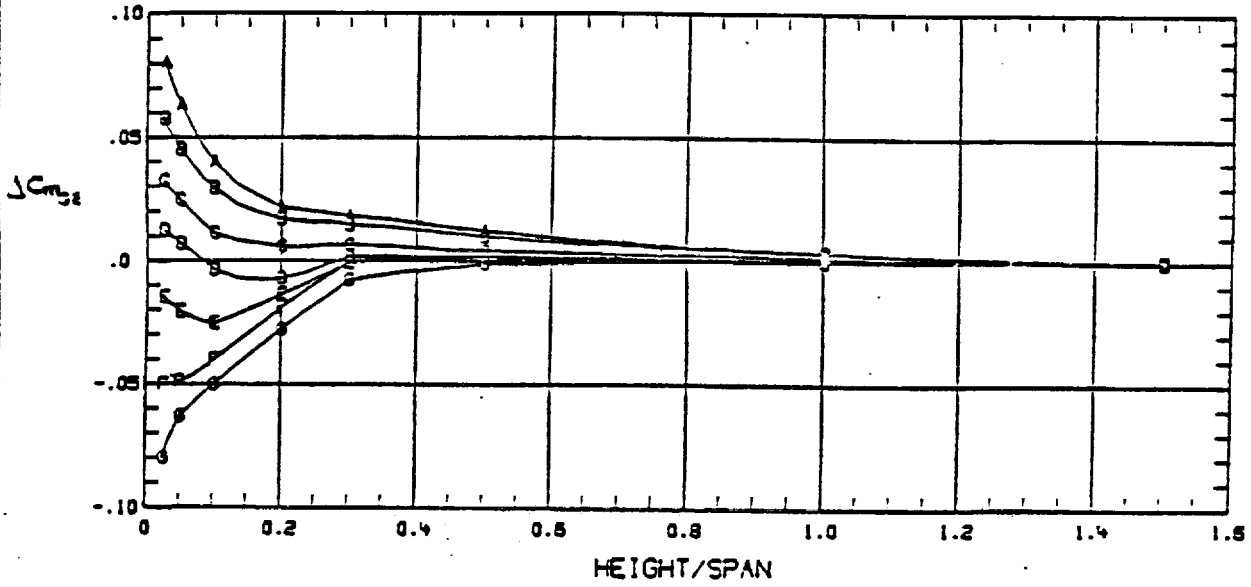
AREA

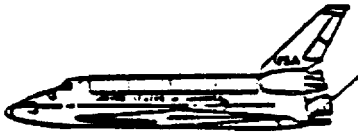
SPAN

MAC

BODY LENGTH

$\delta_e = 10.000°$ $\delta_{sp} = -11.7°$ $\delta_{sb} = ALL$



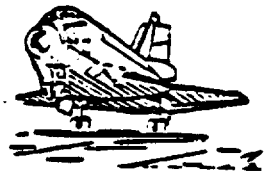


Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	Angle of Attack, α ~ Degrees						
	A -4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GROUND\ EFFECT}}$						
0.025	0.08000	0.05700	0.03200	0.01200	-0.01500	-0.05000	-0.08000
0.050	0.06310	0.04500	0.02410	0.00700	-0.02100	-0.04920	-0.06330
0.100	0.03960	0.02990	0.01110	-0.00400	-0.02530	-0.04040	-0.05020
0.200	0.02130	0.01650	0.00590	-0.00740	-0.01390	-0.01900	-0.02900
0.300	0.01810	0.01460	0.00590	0.00130	-0.00100	-0.00110	-0.00800
0.500	0.01180	0.00980	0.00400	0.00130	0.00130	0.00150	-0.00160
1.000	0.00300	0.00300	0.00100	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER:
DATE: 9-14-77
REVISED:

Figure 4.1.1.3-152
GROUND EFFECT



Landing Gear Down

$$\Delta C_{m_{\substack{GROUND\\EFFECT}}} = C_{m_{\substack{GROUND\\EFFECT}}} - C_{m_{\substack{FREE\\STREAM}}}$$

CONFIGURATION

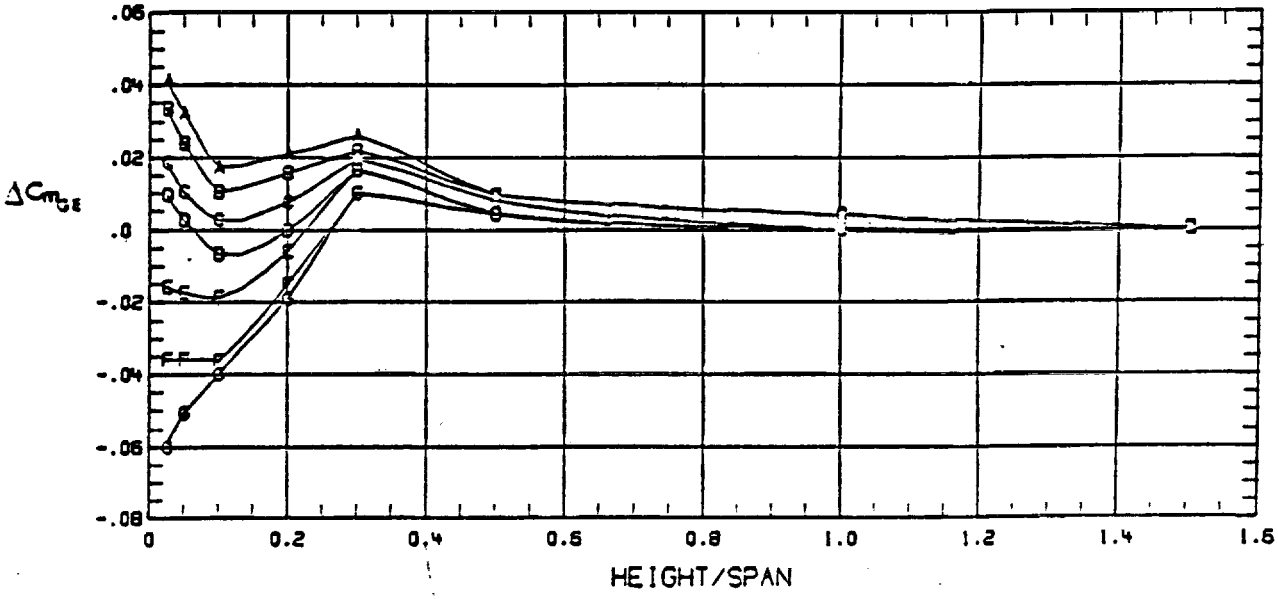
BASELINE ORBITER VEHICLE

CENTER OF GRAVITY OR MOMENT REFERENCE: X_o = FS 1078.70, Y_o = BL 0.00, Z_o = WL 375.39

REFERENCE DIMENSIONS

AREA S_w = 2690.000 ft²
SPAN b_w = 78.056 ft
MAC c_w = 39.550 ft
BODY LENGTH L_B = 1290.300 in

δ_e = 15.000° δ_{BF} = −11.7° δ_{SB} = All

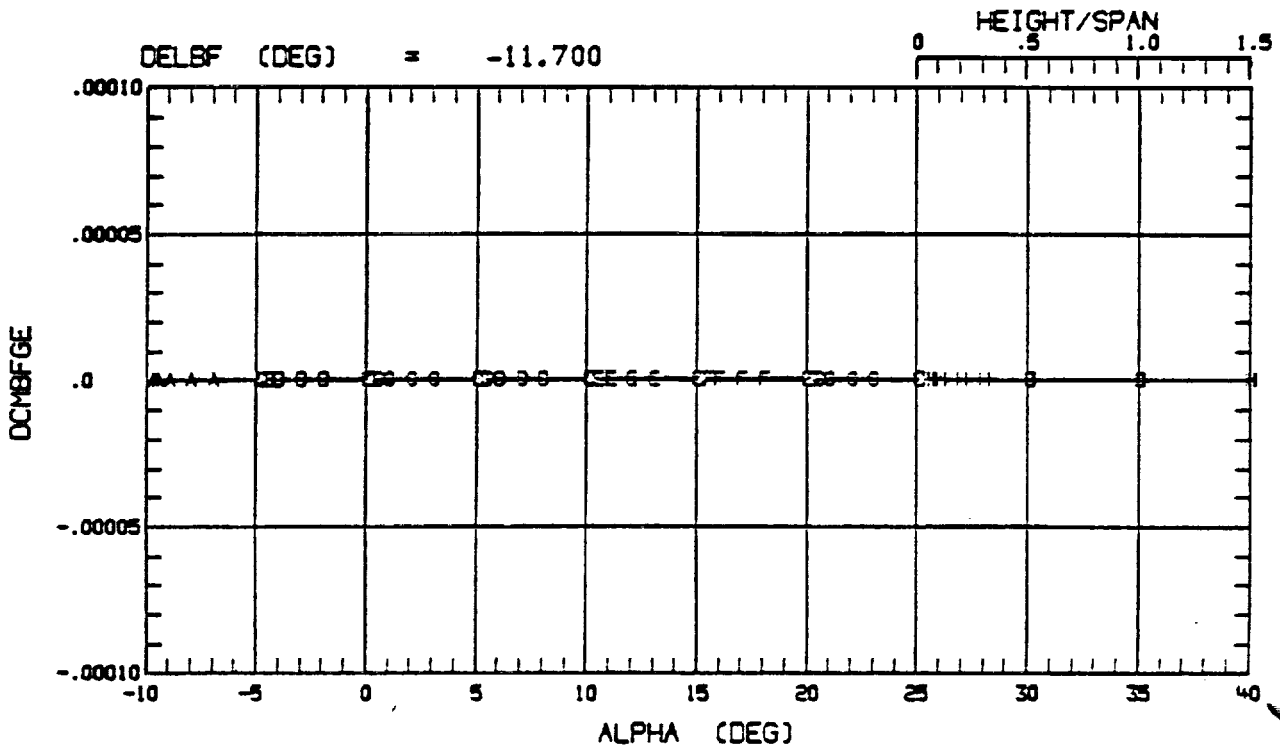


Reference Point for h/b
X_o 1506.84
Z_o 282.71

HEIGHT/SPAN h/b	A −4.000	B 0.0	C 4.000	D 8.000	E 12.000	F 16.000	G 20.000
	Angle of Attack, α ~ Degrees						
	Incremental Pitching Moment Coefficient, $\Delta C_{m_{GRND\ EFFECT}}$						
0.025	0.04130	0.03330	0.01860	0.00930	-0.01610	-0.03610	-0.06010
0.050	0.03190	0.02390	0.01050	0.00250	-0.01750	-0.03610	-0.05080
0.100	0.01710	0.01040	0.00240	-0.00690	-0.01690	-0.03630	-0.04030
0.200	0.02080	0.01550	0.00750	-0.00050	-0.00590	-0.01520	-0.01920
0.300	0.02590	0.02190	0.01920	0.01650	0.01650	0.00990	0.00990
0.500	0.00930	0.00930	0.00800	0.00400	0.00400	0.00400	0.00400
1.000	0.00400	0.00400	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER: [illegible]
DATE: 4-14-77
REVISED:

Figure 4.1.1.3-153
GROUND EFFECT



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

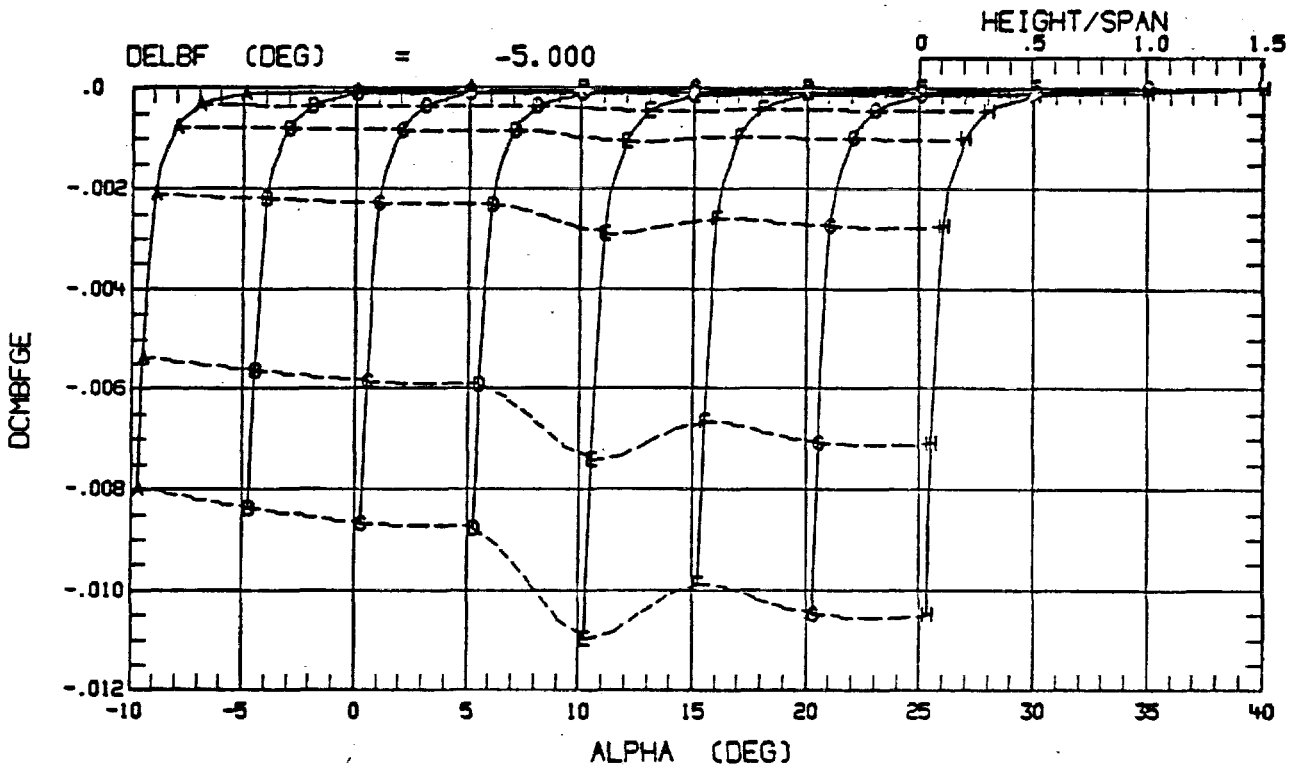
	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF P.M. COEF. INCR							
0.025	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.050	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____

DATE_____

FIGURE 4.1.1.3-154

GROUND EFFECT BODY FLAP PITCHING MOMENT COEF. INCR.

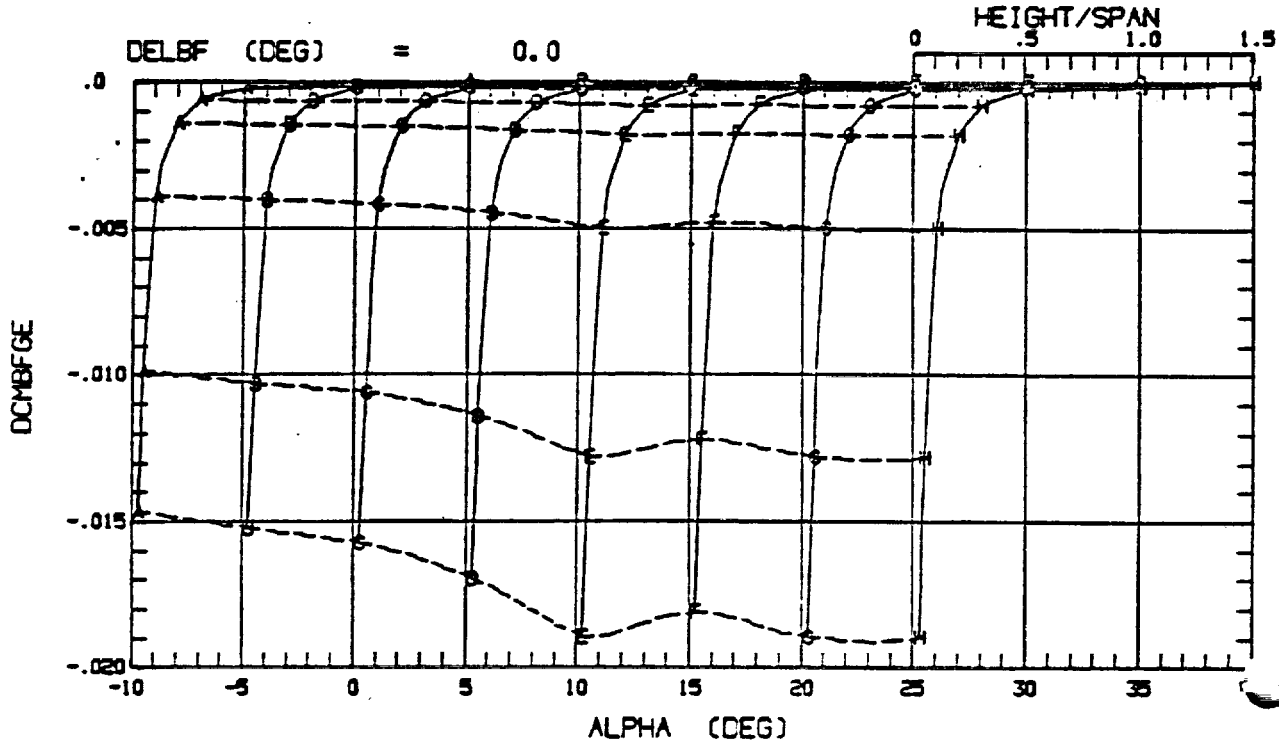


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
HEIGHT/SPAN	GROUND EFFECT BF P.M. COEF. INCR							
0.025	-0.00800	-0.00840	-0.00870	-0.00880	-0.01100	-0.00990	-0.01050	-0.01050
0.050	-0.00540	-0.00567	-0.00587	-0.00594	-0.00743	-0.00668	-0.00709	-0.00709
0.100	-0.00212	-0.00223	-0.00231	-0.00233	-0.00292	-0.00252	-0.00278	-0.00278
0.200	-0.00078	-0.00081	-0.00084	-0.00085	-0.00107	-0.00096	-0.00102	-0.00102
0.300	-0.00034	-0.00036	-0.00037	-0.00038	-0.00047	-0.00043	-0.00045	-0.00045
0.500	-0.00011	-0.00012	-0.00012	-0.00012	-0.00015	-0.00014	-0.00015	-0.00015
1.000	-0.00007	-0.00008	-0.00008	-0.00008	-0.00010	-0.00009	-0.00009	-0.00009
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-155
GROUND EFFECT BODY FLAP PITCHING MOMENT COEF. INCR.



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

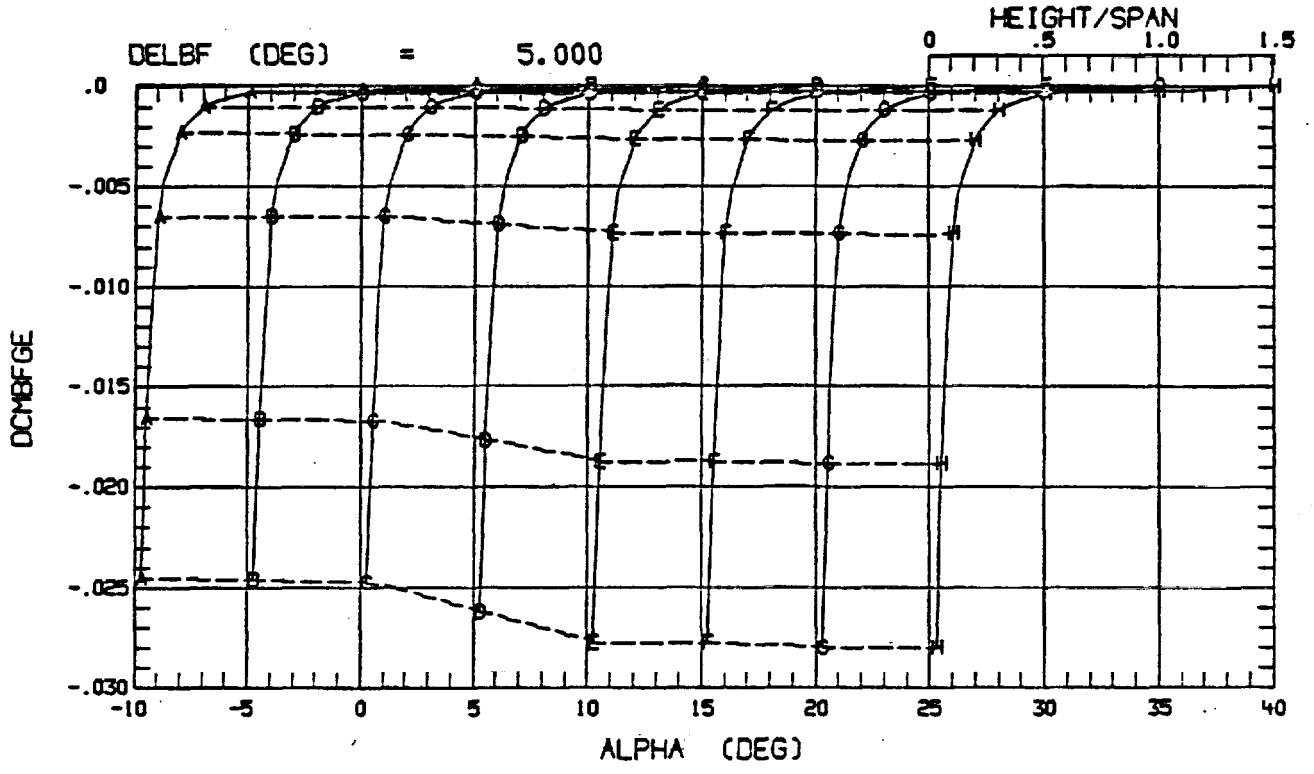
	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
HEIGHT/SPAN	GROUND EFFECT BF P.M. COEF. INCR							
0.025	-0.01470	-0.01530	-0.01580	-0.01700	-0.01900	-0.01810	-0.01900	-0.01900
0.050	-0.00992	-0.01033	-0.01067	-0.01148	-0.01283	-0.01222	-0.01283	-0.01283
0.100	-0.00390	-0.00405	-0.00419	-0.00451	-0.00504	-0.00480	-0.00504	-0.00504
0.200	-0.00143	-0.00148	-0.00153	-0.00165	-0.00184	-0.00176	-0.00184	-0.00184
0.300	-0.00063	-0.00066	-0.00068	-0.00073	-0.00082	-0.00078	-0.00082	-0.00082
0.500	-0.00021	-0.00021	-0.00022	-0.00024	-0.00027	-0.00025	-0.00027	-0.00027
1.000	-0.00013	-0.00014	-0.00014	-0.00015	-0.00017	-0.00016	-0.00017	-0.00017
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____

DATE_____

FIGURE 4.1.1.3-156

GROUND EFFECT BODY FLAP PITCHING MOMENT COEF. INCR.

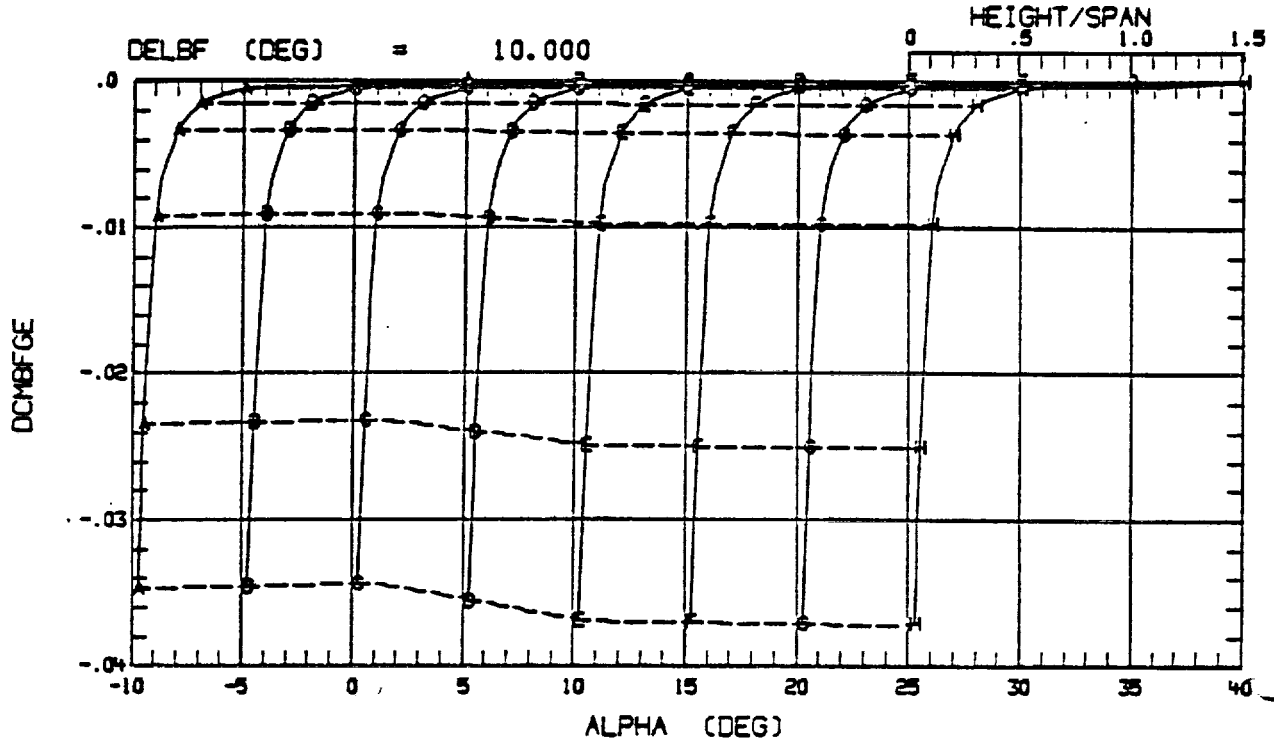


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF P.M. COEF. INCR							
0.025	-0.02460	-0.02470	-0.02480	-0.02624	-0.02780	-0.02780	-0.02800	-0.02800
0.050	-0.01661	-0.01667	-0.01674	-0.01771	-0.01877	-0.01877	-0.01890	-0.01890
0.100	-0.00652	-0.00655	-0.00657	-0.00695	-0.00737	-0.00737	-0.00742	-0.00742
0.200	-0.00239	-0.00240	-0.00241	-0.00255	-0.00270	-0.00270	-0.00272	-0.00272
0.300	-0.00106	-0.00106	-0.00107	-0.00113	-0.00120	-0.00120	-0.00120	-0.00120
0.500	-0.00034	-0.00035	-0.00035	-0.00037	-0.00039	-0.00039	-0.00039	-0.00039
1.000	-0.00022	-0.00022	-0.00022	-0.00024	-0.00025	-0.00025	-0.00025	-0.00025
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-157
GROUND EFFECT BODY FLAP PITCHING MOMENT COEF. INCR.

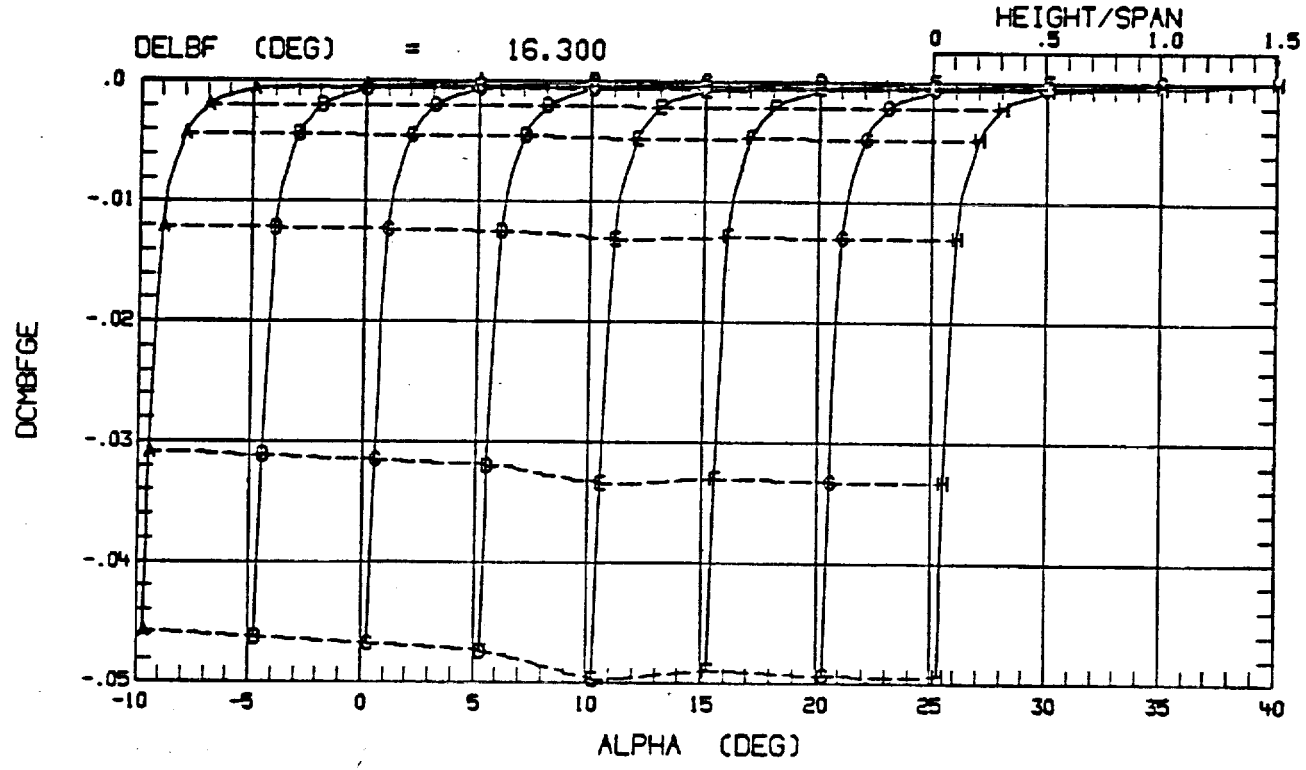


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
HEIGHT/SPAN	GROUND EFFECT BF P.M. COEF. INCR							
0.025	-0.03470	-0.03460	-0.03440	-0.03560	-0.03700	-0.03710	-0.03720	-0.03720
0.050	-0.02342	-0.02336	-0.02322	-0.02403	-0.02498	-0.02504	-0.02511	-0.02511
0.100	-0.00920	-0.00917	-0.00912	-0.00943	-0.00981	-0.00983	-0.00986	-0.00986
0.200	-0.00337	-0.00336	-0.00334	-0.00345	-0.00359	-0.00360	-0.00361	-0.00361
0.300	-0.00149	-0.00149	-0.00148	-0.00153	-0.00159	-0.00160	-0.00160	-0.00160
0.500	-0.00049	-0.00048	-0.00048	-0.00050	-0.00052	-0.00052	-0.00052	-0.00052
1.000	-0.00031	-0.00031	-0.00031	-0.00032	-0.00033	-0.00033	-0.00033	-0.00033
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-158
GROUND EFFECT BODY FLAP PITCHING MOMENT COEF. INCR.



CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

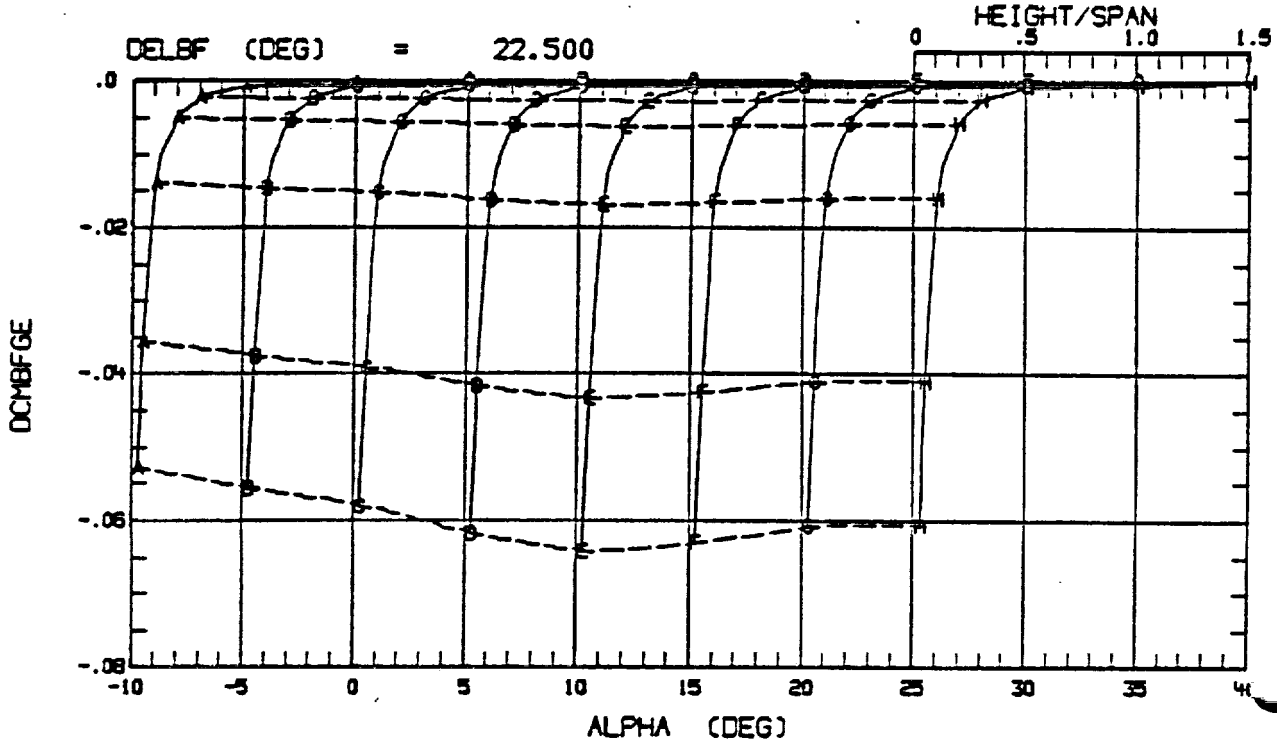
	ALPHA (DEG)							
	-10.000 A	-5.000 B	0.0 C	5.000 D	10.000 E	15.000 F	20.000 G	25.000 H
HEIGHT/SPAN	GROUND EFFECT BF P.M. COEF. INCR							
0.025	-0.04580	-0.04630	-0.04680	-0.04750	-0.04970	-0.04900	-0.04940	-0.04940
0.050	-0.03092	-0.03125	-0.03159	-0.03206	-0.03355	-0.03308	-0.03335	-0.03335
0.100	-0.01214	-0.01227	-0.01240	-0.01259	-0.01317	-0.01299	-0.01309	-0.01309
0.200	-0.00444	-0.00449	-0.00454	-0.00461	-0.00482	-0.00475	-0.00479	-0.00479
0.300	-0.00197	-0.00199	-0.00201	-0.00204	-0.00214	-0.00211	-0.00212	-0.00212
0.500	-0.00064	-0.00065	-0.00066	-0.00067	-0.00070	-0.00069	-0.00069	-0.00069
1.000	-0.00041	-0.00042	-0.00042	-0.00043	-0.00045	-0.00044	-0.00044	-0.00044
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____

DATE_____

FIGURE 4.1.1.3-159

GROUND EFFECT BODY FLAP PITCHING MOMENT COEF. INCR.

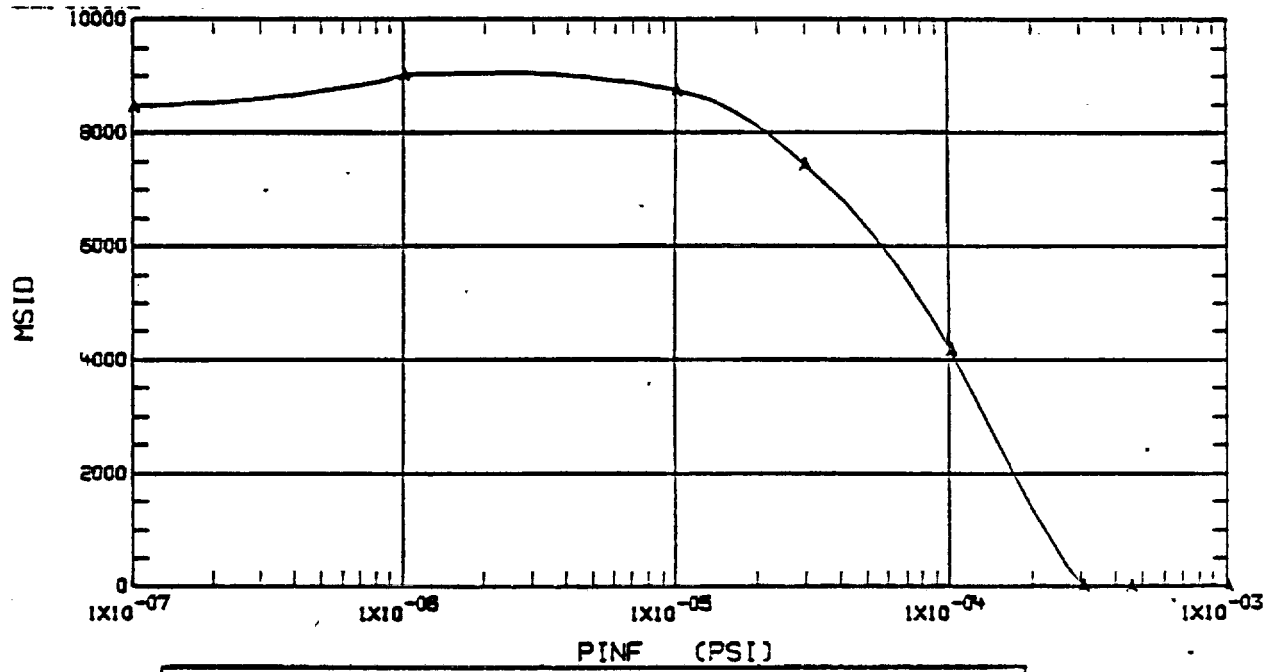


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.056 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

	ALPHA (DEG)							
	-10.000	-5.000	0.0	5.000	10.000	15.000	20.000	25.000
	A	B	C	D	E	F	G	H
HEIGHT/SPAN	GROUND EFFECT BF P.M. COEF. INCR							
0.025	-0.05300	-0.05580	-0.05820	-0.06200	-0.06430	-0.06310	-0.06100	-0.06100
0.050	-0.03578	-0.03767	-0.03929	-0.04185	-0.04340	-0.04259	-0.04118	-0.04118
0.100	-0.01405	-0.01479	-0.01542	-0.01643	-0.01704	-0.01672	-0.01617	-0.01617
0.200	-0.00514	-0.00541	-0.00565	-0.00601	-0.00624	-0.00612	-0.00592	-0.00592
0.300	-0.00229	-0.00240	-0.00250	-0.00267	-0.00276	-0.00271	-0.00262	-0.00262
0.500	-0.00074	-0.00078	-0.00081	-0.00087	-0.00090	-0.00088	-0.00085	-0.00085
1.000	-0.00048	-0.00050	-0.00052	-0.00056	-0.00058	-0.00057	-0.00055	-0.00055
1.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-160
GROUND EFFECT BODY FLAP PITCHING MOMENT COEF. INCR.

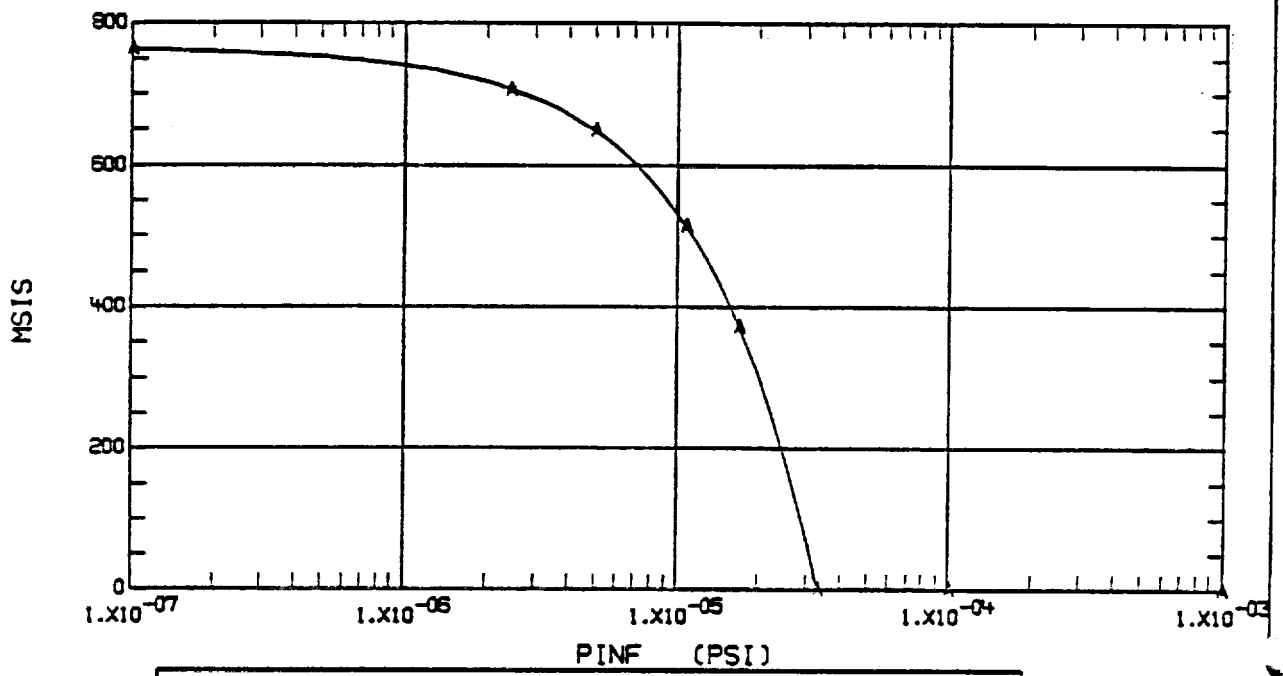


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.058 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.560 FT.
		BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	$M_{SURF\ IMP}$ ft-lb/r PITCHING M
1.000E-07	8469.000
1.000E-06	9015.000
1.000E-05	6742.500
3.000E-05	7430.801
1.000E-04	4152.802
3.000E-04	0.0
4.500E-04	0.0
1.000E-03	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-161
PITCHING MOMENT SURFACE IMPINGEMENT.DOWN-FIRING

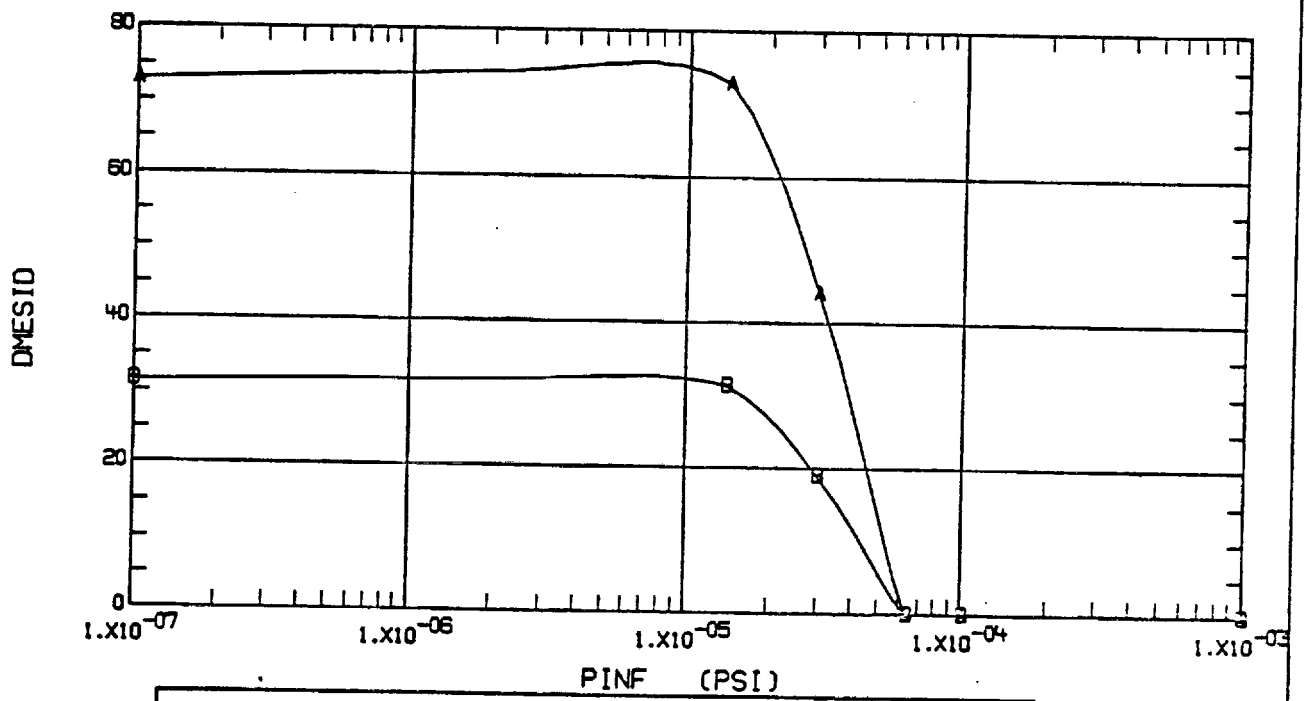


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2590.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

PINF (PSI)	$M_{SURF\ IMP}$ ft-lb/m PITCHING M
1.000E-07	762.400
2.410E-06	706.000
4.970E-06	647.000
1.070E-05	513.000
1.580E-05	371.000
3.290E-05	0.0
1.000E-04	0.0
1.000E-03	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-162
PITCHING MOMENT SURFACE IMPINGEMENT, SIDE-FIRING

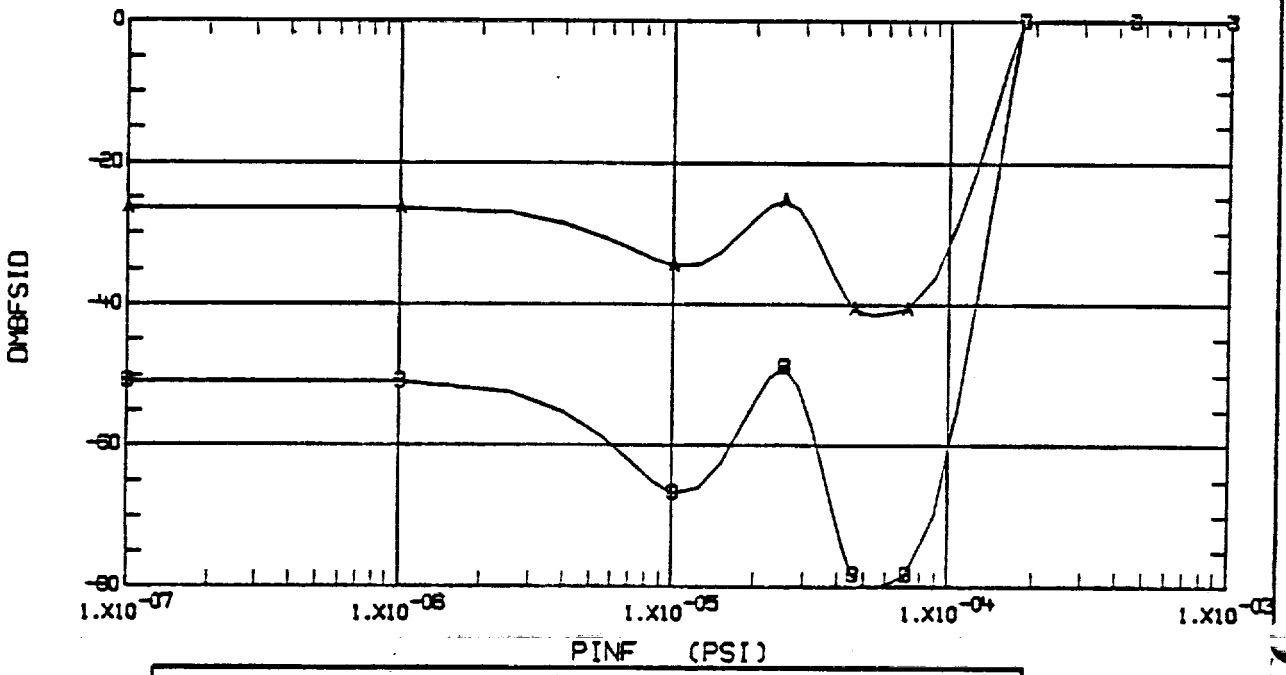


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	$\partial M/\partial \delta_e \sim \frac{ft\ lb}{rad}$	
	$\delta < 0$	$\delta > 0$
PINF (PSI)	DE PITCHING MOMENT SI	
1.000E-07	72.730	31.200
1.400E-05	72.730	31.200
3.000E-05	44.020	18.890
6.300E-05	0.0	0.0
1.000E-04	0.0	0.0
1.000E-03	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-163
ELEVON PITCHING MOMENT SURFACE IMPINGEMENT.DOWN-FIR

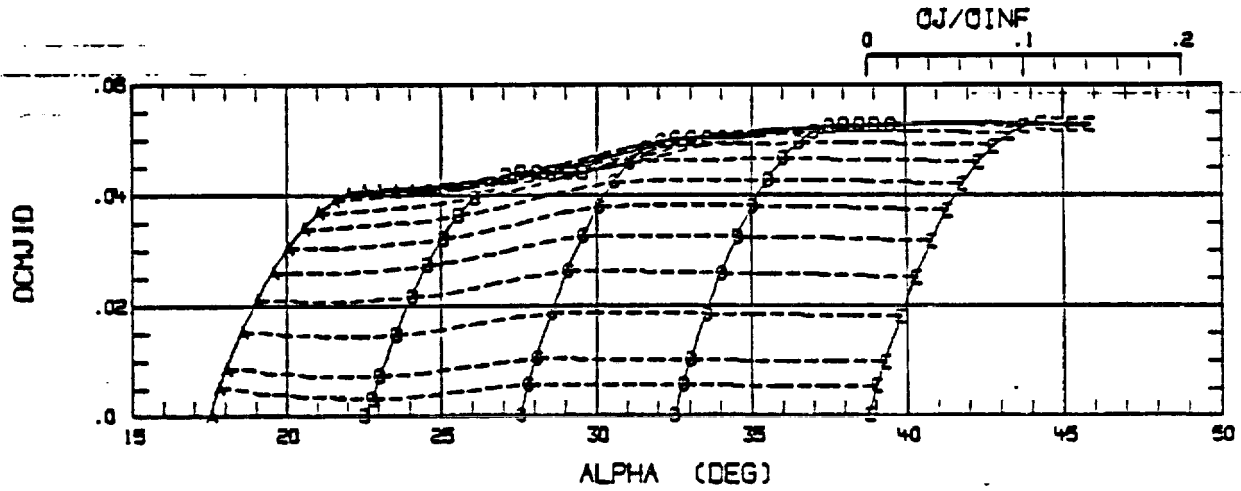


CONFIGURATION			
BASELINE ORBITER VEHICLE		REFERENCE DIMENSIONS	
CENTER OF GRAVITY	XO = FS 1076.7 IN.	WING AREA	SW = 2690.00 SQ.FT.
OR	YO = BL 0.0 IN.	WING SPAN	BW = 78.057 FT.
MOMENT REFERENCE	ZO = WL 375.0 IN.	M.A.C.	CW = 39.568 FT.
		BODY LENGTH	LB = 1290.3 IN.

	$-\partial M/\partial \delta_{BF} \sim \frac{ft\ lb}{ft\text{-}deg}$	
	$\delta_{BF} < 0$	$\delta_{BF} > 0$
PINF (PSI)	OBF PITCHING MOMENT S	
1.000E-07	-25.500	-51.080
1.000E-06	-25.500	-51.080
1.000E-05	-34.630	-66.740
2.500E-05	-25.440	-49.040
4.500E-05	-40.630	-78.320
7.000E-05	-40.630	-78.320
1.800E-04	0.0	0.0
4.500E-04	0.0	0.0
1.000E-03	0.0	0.0

ENGINEER_____
DATE_____

FIGURE 4.1.1.3-164
BODYFLAP PITCHING MOMENT SURFACE IMPINGEMENT.DN-FIR



QJ/QINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	PITCHING MOMENT [illegible]				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.00495	0.00300	0.00563	0.00544	0.00518
0.0100	0.00652	0.00709	0.01021	0.00986	0.00945
0.0200	0.01509	0.01462	0.01863	0.01830	0.01766
0.0300	0.02091	0.02130	0.02606	0.02574	0.02494
0.0400	0.02599	0.02712	0.03249	0.03228	0.03138
0.0500	0.03032	0.03207	0.03792	0.03790	0.03697
0.0600	0.03391	0.03618	0.04237	0.04258	0.04174
0.0700	0.03675	0.03942	0.04582	0.04642	0.04558
0.0800	0.03885	0.04180	0.04827	0.04932	0.04874
0.0900	0.04020	0.04333	0.04973	0.05150	0.05099
0.1000	0.04080	0.04400	0.05020	0.05240	0.05240
0.1100	0.04080	0.04400	0.05020	0.05260	0.05297
0.1200	0.04080	0.04400	0.05020	0.05260	0.05370
0.1300	0.04080	0.04400	0.05020	0.05260	0.05270
0.1400	0.04080	0.04400	0.05020	0.05260	0.05270

$$\frac{\phi_j}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

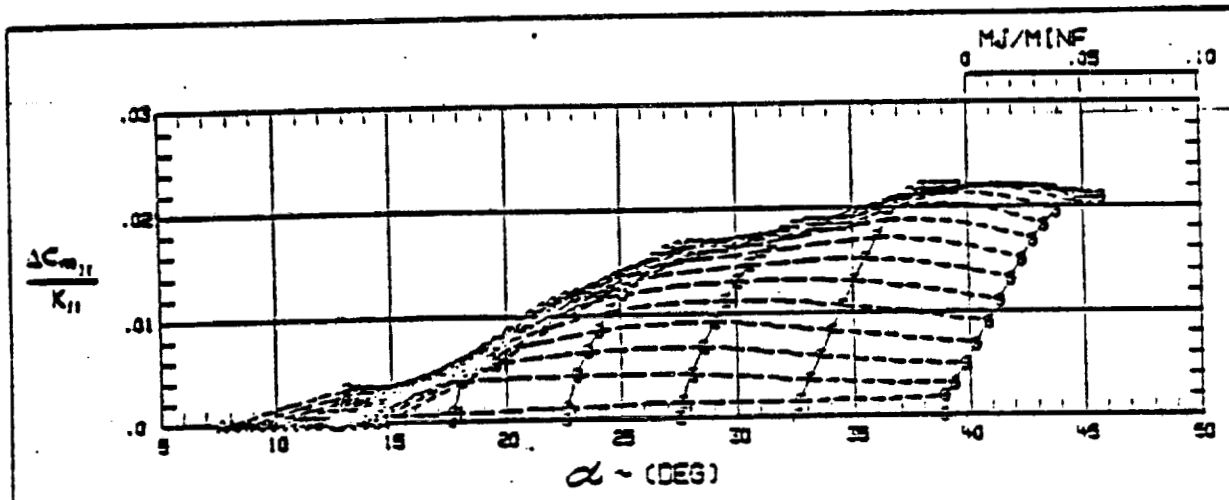
$$\Delta C_{m_{JI}} = A_0 + A_1\left(\frac{\phi_j}{\phi_\infty}\right) - A_2\left(\frac{\phi_j}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_j}{\phi_\infty}\right)^3$$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_j/\phi_\infty)_{MIN}$	$(\phi_j/\phi_\infty)_{MAX}$
	PITCHING MOMENT [illegible]					
17.500	0.0012	0.7690	-3.7200	0.0	0.0050	0.1000
22.500	-0.0013	0.8620	-4.2500	0.0	0.0050	0.1000
27.500	0.0008	0.9910	-4.9700	0.0	0.0050	0.1000
32.500	0.0007	0.9710	-4.8400	0.0	0.0050	0.1050
38.750	0.0005	0.9370	-4.1900	0.0	0.0050	0.1200

ENGINEER [illegible]
DATE [illegible]

FIGURE 4.1.1.3-165
PITCHING MOMENT JET INTERACTION.DOWN-FIRING



MJ/MINF A	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	PITCHING MOMENT JI,SF						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	0.0	0.00063	0.00078	0.00110	0.00150	0.00150	0.00190
0.005	0.0	0.00314	0.00379	0.00420	0.00415	0.00343	0.00310
0.010	0.0	0.00256	0.00508	0.00547	0.00675	0.00571	0.00484
0.015	0.0	0.00295	0.00625	0.00851	0.00903	0.00908	0.00878
0.020	0.0	0.00294	0.00734	0.01032	0.01116	0.01046	0.00873
0.025	0.0	0.00299	0.00831	0.01189	0.01257	0.01279	0.01085
0.030	0.0	0.00303	0.00917	0.01323	0.01452	0.01500	0.01299
0.035	0.0	0.00324	0.00993	0.01433	0.01591	0.01701	0.01484
0.040	0.0	0.00353	0.01058	0.01520	0.01634	0.01878	0.01862
0.045	0.0	0.00390	0.01113	0.01594	0.01781	0.02018	0.01817
0.050	0.0	0.00435	0.01158	0.01625	0.01813	0.02119	0.01942
0.055	0.0	0.00487	0.01191	0.01642	0.01837	0.02173	0.02031
0.060	0.0	0.00548	0.01214	0.01638	0.01837	0.02173	0.02077
0.065	0.0	0.00548	0.01214	0.01638	0.01837	0.02173	0.02077
0.070	0.0	0.00548	0.01214	0.01638	0.01837	0.02173	0.02077

$$\frac{\dot{m}_1}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_1}{\phi_\infty}\right)\left(\frac{v_\infty}{v_1}\right)\left(\sin\theta_1\right)^{1/2} = 8.296 \times 10^{-4}\left(\frac{v_\infty}{q_\infty}\right)$$

v_1 = exit velocity — fps
v_∞ = freestream velocity — fps
θ_1 = nozzle half angle at exit

$$\frac{\Delta C_{m_{JI}}}{K_{JI}} = A_0 + A_1\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	ADDS.MIN.MAX A_0	A_1	A_2	A_3	$(\dot{m}_1/\dot{m}_\infty)_{MIN}$	$(\dot{m}_1/\dot{m}_\infty)_{MAX}$
	PITCHING MOMENT JI,SF					
7.500	0.0	0.0	0.0	0.0	0.00500	0.06000
12.500	0.00340	-0.05940	1.55690	0.0	0.00500	0.06000
17.500	0.00240	0.28900	-2.11000	0.0	0.00500	0.06000
22.500	0.00170	0.52400	-4.66000	0.0	0.00500	0.06000
27.500	0.00130	0.59700	-5.21000	0.0	0.00500	0.05500
32.500	0.00130	0.40500	4.52000	-93.30000	0.00500	0.05500
38.750	0.00160	0.27100	5.22000	-90.20000	0.00500	0.05000

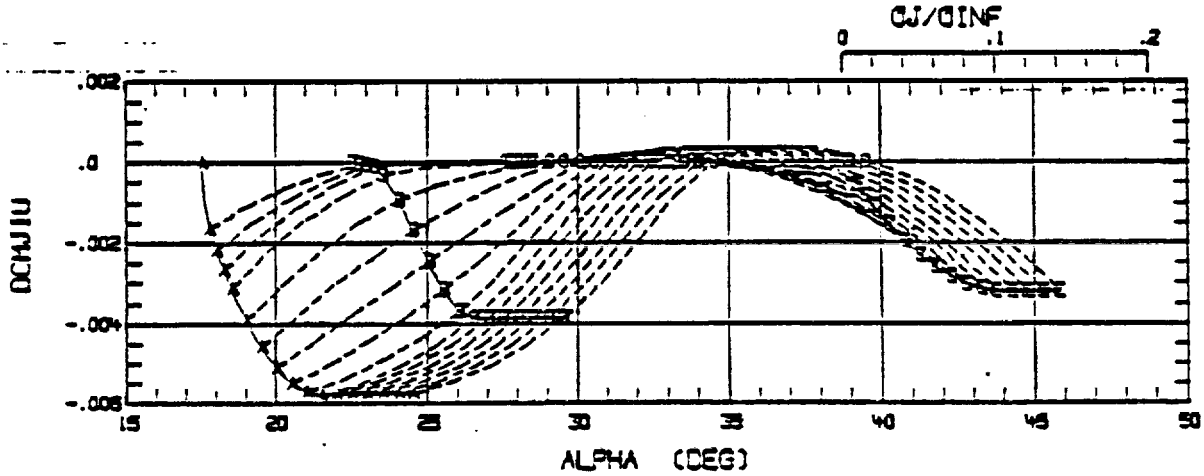
$K_{JI} = 1.0$

Interpolate for α's not shown *after* calculation. of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

ENGINEER HP
DATE [illegible]

FIGURE 4.1.1.3- 166
PITCHING MOMENT JET INTERACTION.SIDE-FIRING



CJ/CINF	ALPHA (DEG) 17.500	22.500	27.500	32.500	38.750
	PITCHING MOMENT VALUE				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00188	-0.00004	0.0	0.0	-0.00030
0.0100	-0.00219	-0.00008	0.0	0.0	-0.00045
0.0150	-0.00288	-0.00012	0.0	0.0	-0.00068
0.0200	-0.00313	-0.00034	0.0	0.0	-0.00110
0.0300	-0.00394	-0.00098	0.0	0.0	-0.00157
0.0400	-0.00460	-0.00171	0.0	0.0	-0.00198
0.0500	-0.00511	-0.00249	0.0	0.0	-0.00233
0.0600	-0.00549	-0.00319	0.0	0.0	-0.00265
0.0700	-0.00572	-0.00370	0.0	0.0	-0.00295
0.0800	-0.00591	-0.00398	0.0	0.0	-0.00304
0.0900	-0.00576	-0.00398	0.0	0.0	-0.00316
0.1000	-0.00576	-0.00398	0.0	0.0	-0.00301
0.1100	-0.00576	-0.00398	0.0	0.0	-0.00301
0.1200	-0.00576	-0.00398	0.0	0.0	-0.00301
0.1300	-0.00576	-0.00398	0.0	0.0	-0.00301
0.1500	-0.00576	-0.00398	0.0	0.0	-0.00301

$$\frac{\Phi_j}{\Phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2590\ ft^2$

$$\Delta C_{m_{jj}} = A_0 + A_1\left(\frac{\Phi_j}{\Phi_\infty}\right) + A_2\left(\frac{\Phi_j}{\Phi_\infty}\right)^2 + A_3\left(\frac{\Phi_j}{\Phi_\infty}\right)^3$$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\Phi_j/\Phi_\infty)_{MIN}$	$(\Phi_j/\Phi_\infty)_{MAX}$
	PITCHING MOMENT VALUE					
17.500	-0.0011	-0.1160	0.1140	0.0	0.0000	0.1000
22.500	0.0	0.0244	-0.4400	19.1000	0.0140	0.1000
27.500	0.0	0.0	0.0	0.0	0.0000	0.1200
32.500	0.0	0.0	0.0	0.0	0.0000	0.1200
38.750	0.0	-0.3810	0.2860	0.0	0.0000	0.1000

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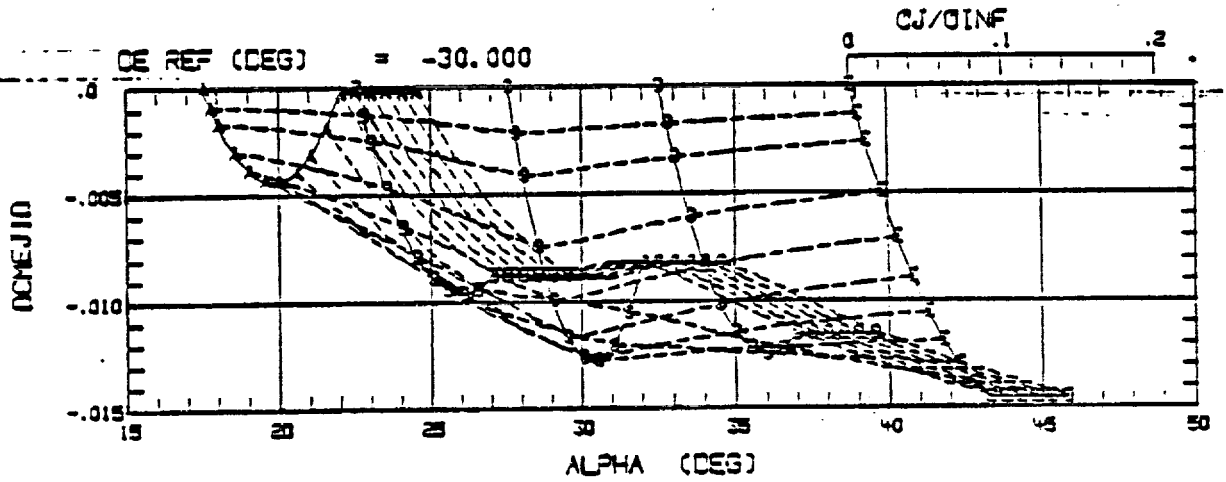
FIGURE 4.1.1.3-167
PITCHING MOMENT JET INTERACTION-UP-FIRING



CJ/CINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	ΔE PITCHING MOMENT [illegible]				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	-0.00091	-0.00134	-0.00215	-0.00172	-0.00133
0.0100	-0.00172	-0.00259	-0.00413	-0.00331	-0.00261
0.0200	-0.00302	-0.00476	-0.00746	-0.00611	-0.00498
0.0300	-0.00369	-0.00654	-0.00998	-0.00840	-0.00707
0.0400	-0.00434	-0.00792	-0.01170	-0.01019	-0.00894
0.0500	-0.00437	-0.00890	-0.01263	-0.01148	-0.01055
0.0600	-0.00397	-0.00948	-0.01274	-0.01225	-0.01192
0.0700	-0.00315	-0.00968	-0.01205	-0.01232	-0.01303
0.0800	-0.00190	-0.00944	-0.01059	-0.01229	-0.01390
0.0900	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453
0.1000	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453
0.1100	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453
0.1200	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453
0.1300	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453
0.1400	-0.00023	-0.00882	-0.00829	-0.01155	-0.01453

$$\frac{\dot{\phi}_1}{\phi_{\infty}} = \left(\frac{\dot{m}_j v_j}{\bar{q}_{\infty} A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right) n = 0.1543\left(\frac{n}{\bar{q}_{\infty}}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$(\Delta C_m)_{\delta_{e_{REF}} = -30^\circ} = A_0 + A_1\left(\frac{\dot{\phi}_1}{\phi_{\infty}}\right) + A_2\left(\frac{\dot{\phi}_1}{\phi_{\infty}}\right)^2 + A_3\left(\frac{\dot{\phi}_1}{\phi_{\infty}}\right)^3$$

Interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\dot{\phi}_1/\phi_{\infty})_{MIN}$	$(\dot{\phi}_1/\phi_{\infty})_{MAX}$
	ΔE PITCHING MOMENT [illegible]					
17.500	0.0	-0.1934	2.1200	0.0	0.0050	0.0900
22.500	0.0	-0.2780	2.0000	0.0	0.0050	0.0900
27.500	0.0	-0.4530	4.0100	0.0	0.0050	0.0900
32.500	0.0	-0.3550	2.5300	0.0	0.0050	0.0900
38.750	0.0	-0.2730	1.2400	0.0	0.0050	0.0900

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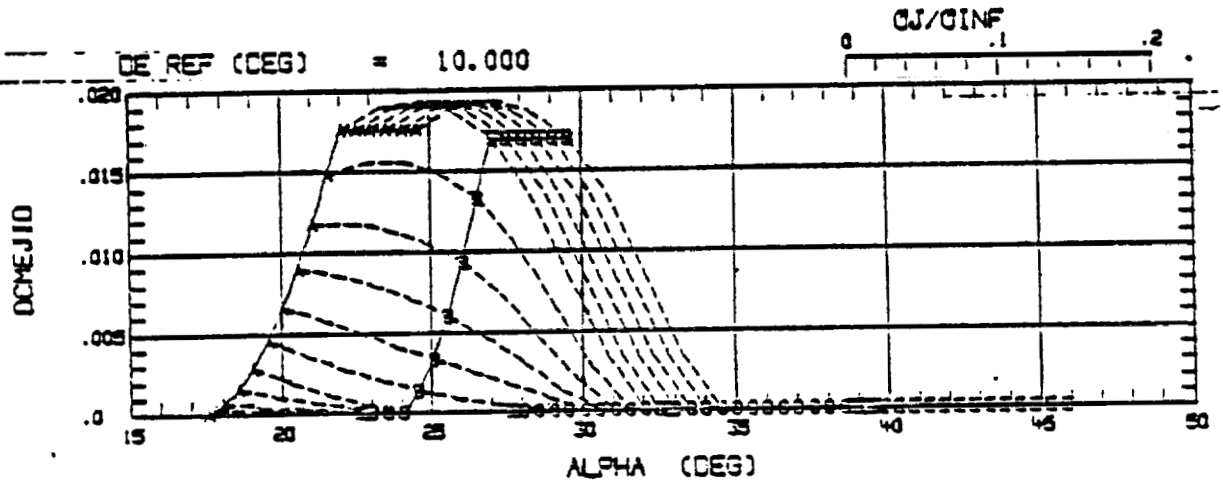
FIGURE 4.1.1.3-168
ELEVON PITCHING MOMENT JET INTERACTION, DOWN-FIRING



CJ/CINF	ALPHA (DEG) 17.500 A	22.500 B	27.500 C	32.500 D	38.750 E
	DE PITCHING MOMENT JET				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.00025	0.0	0.0	0.0	0.0
0.0100	0.00059	0.0	0.0	0.0	0.0
0.0200	0.00154	0.0	0.0	0.0	0.0
0.0300	0.00295	0.0	0.0	0.0	0.0
0.0400	0.00452	0.00129	0.0	0.0	0.0
0.0500	0.00855	0.00327	0.0	0.0	0.0
0.0600	0.00894	0.00593	0.0	0.0	0.0
0.0700	0.01169	0.00925	0.0	0.0	0.0
0.0800	0.01460	0.01323	0.0	0.0	0.0
0.0900	0.01755	0.01690	0.0	0.0	0.0
0.1000	0.01755	0.01690	0.0	0.0	0.0
0.1100	0.01755	0.01690	0.0	0.0	0.0
0.1200	0.01755	0.01690	0.0	0.0	0.0
0.1300	0.01755	0.01690	0.0	0.0	0.0
0.1400	0.01755	0.01690	0.0	0.0	0.0

$$\frac{\phi_1}{\phi_\infty} = \left(\frac{\dot{m}_j v_j}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2 S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_j$ = mass flow rate
v_j = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2690\ ft^2$

$$\left(\Delta C_m\right)_{\delta_{e_{REF}} = +10^\circ} = A_0 + A_1\left(\frac{\phi_1}{\phi_\infty}\right) + A_2\left(\frac{\phi_1}{\phi_\infty}\right)^2 + A_3\left(\frac{\phi_1}{\phi_\infty}\right)^3$$

Interpolate for α's not shown [illegible] calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\phi_1/\phi_\infty)_{MIN}$	$(\phi_1/\phi_\infty)_{MAX}$
	DE PITCHING MOMENT JET					
17.500	0.0	0.0410	1.2000	0.0	0.0050	0.0880
22.500	0.0	-0.1010	3.3300	0.0	0.0300	0.0880
27.500	0.0	0.0	0.0	0.0	0.0050	0.1000
32.500	0.0	0.0	0.0	0.0	0.0050	0.1000
38.750	0.0	0.0	0.0	0.0	0.0050	0.1000

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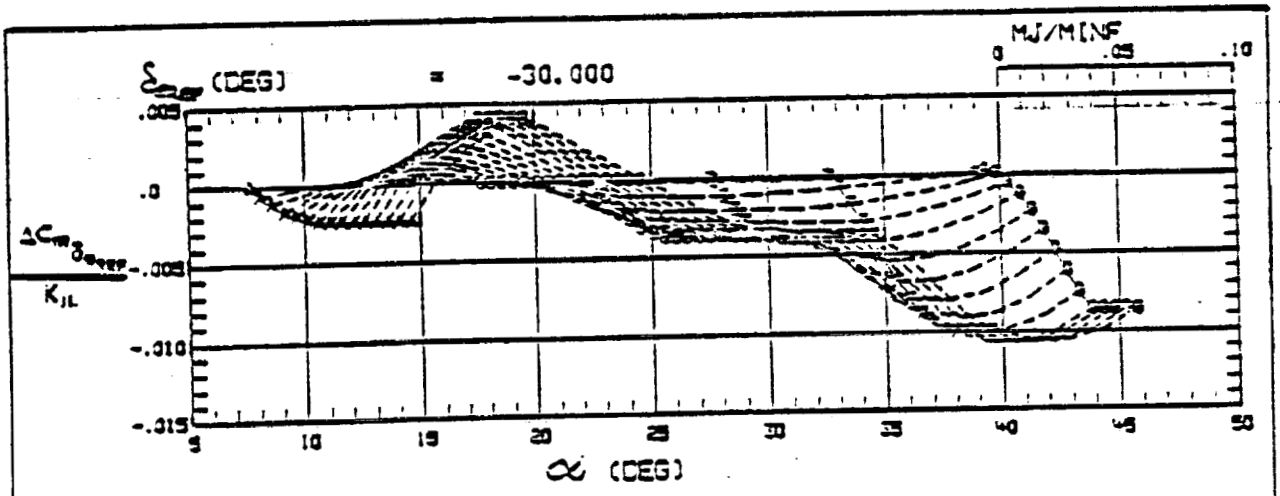
FIGURE 4.1.1.3- 169
ELEVON PITCHING MOMENT JET INTERACTION.DOWN-FIRING



MJ/MINF	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	38.750 G
	DE PITCHING MOMENT JET						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	-0.00013	0.00005	0.0	-0.00020	-0.00023	-0.00015	0.00005
0.005	-0.00058	0.00027	0.0	-0.00101	-0.00114	-0.00078	0.00025
0.010	-0.00121	0.00057	0.0	-0.00188	-0.00209	-0.00177	0.00003
0.015	-0.00165	0.00090	0.0	-0.00255	-0.00294	-0.00294	-0.00044
0.020	-0.00200	0.00125	0.0	-0.00309	-0.00339	-0.00421	-0.00127
0.025	-0.00223	0.00165	0.0	-0.00346	-0.00375	-0.00552	-0.00233
0.030	-0.00235	0.00207	0.0	-0.00368	-0.00391	-0.00678	-0.00355
0.035	-0.00237	0.00252	0.0	-0.00374	-0.00392	-0.00793	-0.00467
0.040	-0.00237	0.00301	0.0	-0.00374	-0.00392	-0.00891	-0.00521
0.045	-0.00237	0.00352	0.0	-0.00374	-0.00392	-0.00963	-0.00751
0.050	-0.00237	0.00406	0.0	-0.00374	-0.00392	-0.01004	-0.00870
0.055	-0.00237	0.00406	0.0	-0.00374	-0.00392	-0.01004	-0.00870
0.060	-0.00237	0.00406	0.0	-0.00374	-0.00392	-0.01004	-0.00870
0.065	-0.00237	0.00406	0.0	-0.00374	-0.00392	-0.01004	-0.00870
0.070	-0.00237	0.00406	0.0	-0.00374	-0.00392	-0.01004	-0.00870

$$\frac{\dot{m}_1}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\phi_1}{\phi_\infty}\right)\left(\frac{v_\infty}{v_1}\right)\left(\sin\theta_1\right)^{1/2} = 8.296 \times 10^{-4}\left(\frac{v_\infty}{\theta_\infty}\right)$$

v_1 = exit velocity — fps
v_∞ = freestream velocity — fps
θ_1 = nozzle half angle at exit

$$\frac{\Delta C_{m_{\delta_{elev}}}}{K_{JL}} = A_0 + A_1\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_1}{\dot{m}_\infty}\right)^3$$

ALPHA (DEG)	A0	A1	A2	A3	$(\dot{m}_1/\dot{m}_\infty)_{MIN}$	$(\dot{m}_1/\dot{m}_\infty)_{MAX}$
	DE PITCHING MOMENT JET					
7.500	0.0	-0.14650	2.14620	0.0	0.00500	0.03530
12.500	0.0	0.05090	0.50590	0.0	0.00500	0.05000
17.500	0.0	0.0	0.0	0.0	0.00500	0.05000
22.500	0.0	-0.21600	3.18000	0.0	0.00500	0.03420
27.500	0.0	-0.24800	3.92000	0.0	0.00500	0.03160
32.500	0.0	-0.12400	-8.20000	83.30000	0.00500	0.05000
38.750	0.0	0.10000	-9.99000	90.20000	0.00500	0.05000

$K_{JL} = 1.0$

Interpolate for α's not shown after calculation of given α's only

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

FIGURE 4.1.1.3-170
ELEVON PITCHING MOMENT JET INTERACTION, SIDE-FIRING

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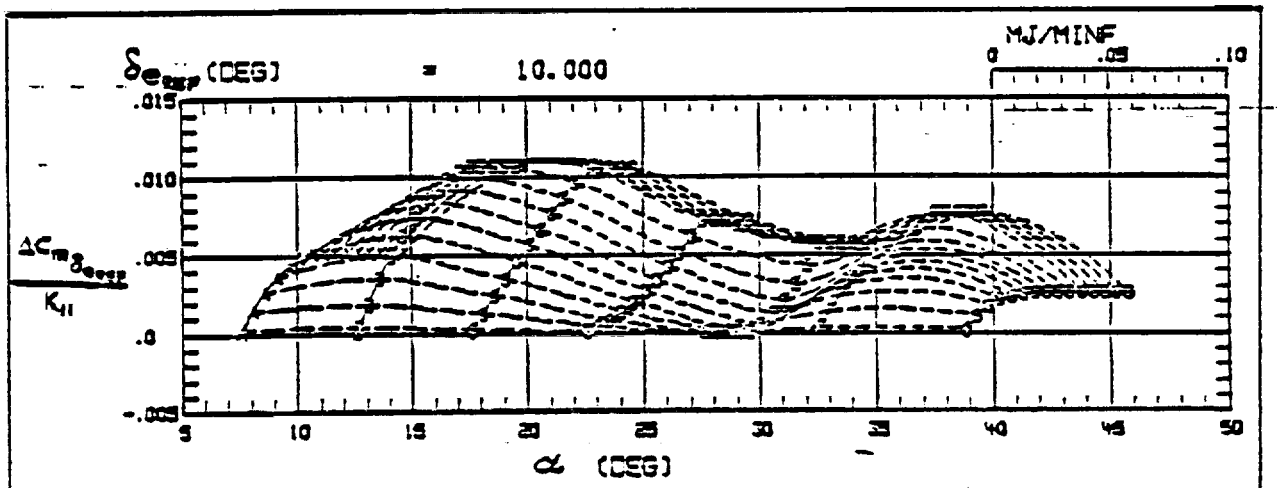

MJ/MINF	α (DEG) 7.500 A	12.500 B	17.500 C	22.500 D	27.500 E	32.500 F	37.750 G
	$\Delta C_{m_{\delta_{exp}}}/K_{11}$ PITCHING MOMENT JET						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	0.00028	0.00036	0.00023	0.00007	0.0	0.00027	0.00015
0.005	0.00142	0.00160	0.00116	0.00034	0.0	0.00137	0.00095
0.010	0.00280	0.00344	0.00229	0.00077	0.00001	0.00242	0.00159
0.015	0.00385	0.00491	0.00340	0.00127	0.00001	0.00322	0.00201
0.020	0.00428	0.00621	0.00449	0.00166	0.00002	0.00383	0.00225
0.025	0.00477	0.00725	0.00558	0.00254	0.00049	0.00433	0.00240
0.030	0.00503	0.00833	0.00658	0.00329	0.00115	0.00479	0.00252
0.035	0.00507	0.00914	0.00780	0.00413	0.00199	0.00528	0.00252
0.040	0.00507	0.00979	0.00858	0.00508	0.00302	0.00587	0.00252
0.045	0.00507	0.01027	0.00928	0.00508	0.00424	0.00662	0.00252
0.050	0.00507	0.01059	0.01049	0.00715	0.00554	0.00781	0.00252
0.055	0.00507	0.01059	0.01049	0.00715	0.00554	0.00781	0.00252
0.060	0.00507	0.01059	0.01049	0.00715	0.00554	0.00781	0.00252
0.065	0.00507	0.01059	0.01049	0.00715	0.00554	0.00781	0.00252
0.070	0.00507	0.01059	0.01049	0.00715	0.00554	0.00781	0.00252

$$\frac{\dot{m}_j}{\dot{m}_\infty} = \left(\frac{1}{n}\right)\left(\frac{\Phi_j}{\Phi_\infty}\right)\left(\frac{v_\infty}{v_j}\right)\left(\sin\delta_j\right)^{1/2} = 8.296\times10^{-4}\left(\frac{v_\infty}{\dot{q}_\infty}\right)$$

v_j = exit velocity ~ fps

v_∞ = freestream velocity ~ fps

δ_j = nozzle half angle at exit

$$\frac{\Delta C_{m_{\delta_{exp}}}}{K_{11}} = A_0 + A_1\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right) + A_2\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^2 + A_3\left(\frac{\dot{m}_j}{\dot{m}_\infty}\right)^3$$

$K_{11} = 1.0$

Interpolate for α's not shown after calculation of given α's only

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\dot{m}_j/\dot{q}_\infty)_{MIN}$	$(\dot{m}_j/\dot{q}_\infty)_{MAX}$
	AC23,MIN,MAX $\Delta C_{m_{\delta_{exp}}}/K_{11}$ PITCHING MOMENT JET					
7.500	0.0	0.30640	-4.52700	0.0	0.00500	0.03310
12.500	0.0	0.37660	-3.25520	0.0	0.00500	0.05000
17.500	0.0	0.23400	-3.46500	0.0	0.00500	0.05000
22.500	0.0	0.06000	1.65000	0.0	0.00500	0.05000
27.500	0.0	-0.07360	3.73000	0.0	0.02000	0.05000
32.500	0.0	0.31100	-7.24000	93.30000	0.00500	0.05000
37.750	0.0	0.23400	-7.3[illegible]000	90.30000	0.00500	0.03000

CAUTION: Polynomial curve-fit is valid ONLY for the mass flow ratio range given in the above table.

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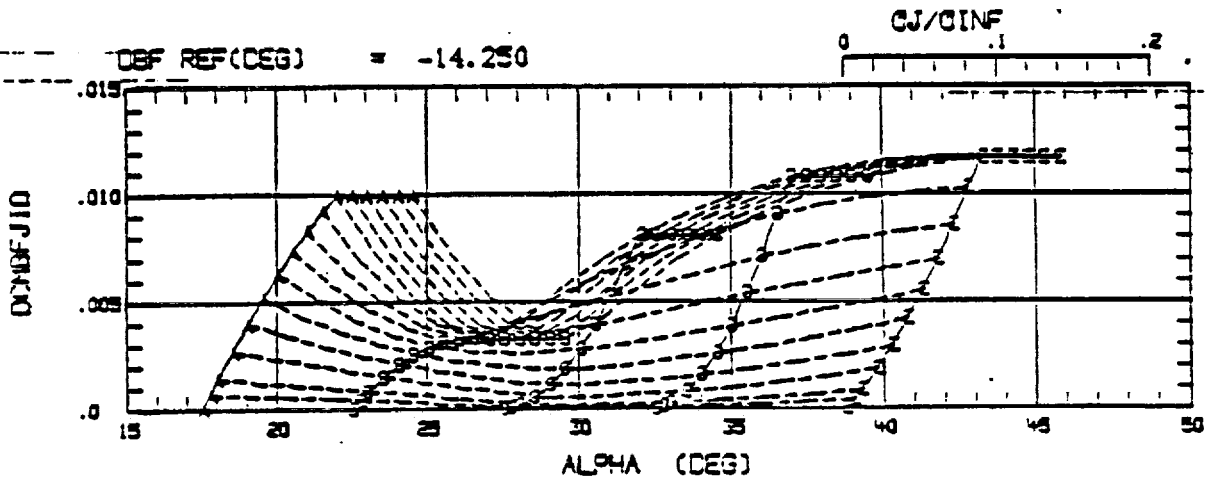
FIGURE 4.1.1.3-171
ELEVON PITCHING MOMENT JET INTERACTION, SIDE-FIRING



CJ/CINF	ALPHA (DEG) 17.500	22.500	27.500	32.500	37.500
	A	B	C	D	E
	BODYFLAP PITCHING MOMENT				
0.0	0.0	0.0	0.0	0.0	0.0
0.0050	0.00058	0.00040	0.00008	0.00011	0.00042
0.0100	0.00150	0.00078	0.00019	0.00029	0.00088
0.0200	0.00308	0.00146	0.00054	0.00089	0.00194
0.0300	0.00390	0.00203	0.00110	0.00178	0.00294
0.0400	0.00468	0.00263	0.00184	0.00280	0.00416
0.0500	0.00520	0.00298	0.00277	0.00394	0.00546
0.0600	0.00585	0.00311	0.00350	0.00494	0.00667
0.0700	0.00625	0.00325	0.00431	0.00566	0.00787
0.0800	0.00650	0.00331	0.00511	0.00603	0.01017
0.0900	0.00691	0.00347	0.00600	0.01078	0.01117
0.1000	0.00691	0.00347	0.00600	0.01078	0.01117
0.1100	0.00691	0.00347	0.00600	0.01078	0.01117
0.1200	0.00691	0.00347	0.00605	0.01078	0.01117
0.1300	0.00691	0.00347	0.00605	0.01078	0.01117
0.1400	0.00691	0.00347	0.00605	0.01078	0.01117

$$\frac{\Phi_1}{\Phi_\infty} = \left(\frac{\dot{m}_1 v_1}{\bar{q}_\infty A_{ref}}\right)\left(\frac{A_{ref}}{2S_{ref}}\right)n = 0.1543\left(\frac{n}{\bar{q}_\infty}\right)$$

$\dot{m}_1$ = mass flow rate
v_1 = exit velocity
n = number of thrusters

$A_{ref} = 1\ ft^2$
$S_{ref} = 2590\ ft^2$

$$\Delta C_{m_{\delta_{BF_{REF}}=-14.25°}} = A_0 + A_1\left(\frac{\Phi_1}{\Phi_\infty}\right) + A_2\left(\frac{\Phi_1}{\Phi_\infty}\right)^2 + A_3\left(\frac{\Phi_1}{\Phi_\infty}\right)^3$$

interpolate for α's not shown after calculation of given α's only.

ALPHA (DEG)	A_0	A_1	A_2	A_3	$(\Phi_1/\Phi_\infty)_{MIN}$	$(\Phi_1/\Phi_\infty)_{MAX}$
	BODYFLAP PITCHING MOMENT					
17.500	0.0	0.1232	-1.2500	0.0	0.0050	0.1000
22.500	0.0	0.0804	-1.2470	0.0	0.0050	0.1000
27.500	0.0	0.0081	0.9470	0.0	0.0050	0.1000
32.500	0.0	0.3169	1.2000	0.0	0.0050	0.1000
37.500	0.0	0.2903	1.2000	0.0	0.0050	0.1000

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FIGURE 4.1.1.3- 172
BODYFLAP PITCHING MOMENT JET INTERACTION.DOWN-FIRING

4.1.1.4 TRIM AND STABILITY. This section presents the trim and stability characteristics of the Orbiter Vehicle (OV102) in a manner considered useful for determining the longitudinal trim and stability limits.

Trim and stability limits are presented for the speed brake and body flap control schedules given on Figure 4.1.1.4-1 (b & c) for both forward (0.65 L_e) and aft (0.675 L_e) design centers-of-gravity. The control schedules presented on this figure are for determining maximum obtainable trim limits and do not reflect actual flight control system schedules. A reserve for maneuvering, trimming spanwise center of gravity offset (ΔY_{CG}), manufacturing misalignments, and aerodynamic uncertainties has been applied to the limits of the elevon effectiveness data to establish the limits shown on Figures 4.1.1.4-2 through 4.1.1.4-11.

For a positive elevon deflection, the aforementioned reserve is equivalent to five-degrees of elevon. Therefore, aft center of gravity trim limits are based on a positive elevon deflection of 15-degrees for Mach numbers less than or equal to 10. A positive elevon deflection of 10-degrees was used for Mach numbers greater than 10 due to thermal protection system design limits during maximum heating conditions. Forward center-of-gravity trim limits are based on an incremental pitching moment coefficient reserve of 0.015 for Mach numbers less than or equal to 10 and 0.020 for Mach numbers greater than 10. The longitudinal trim limits are presented as functions of angle of attack. For a summary of these trim limits see Section 2.2. This summary has been presented for the TPS design trajectory (14414.1) angle of attack schedule shown on Figure 4.1.1.4-1(a).

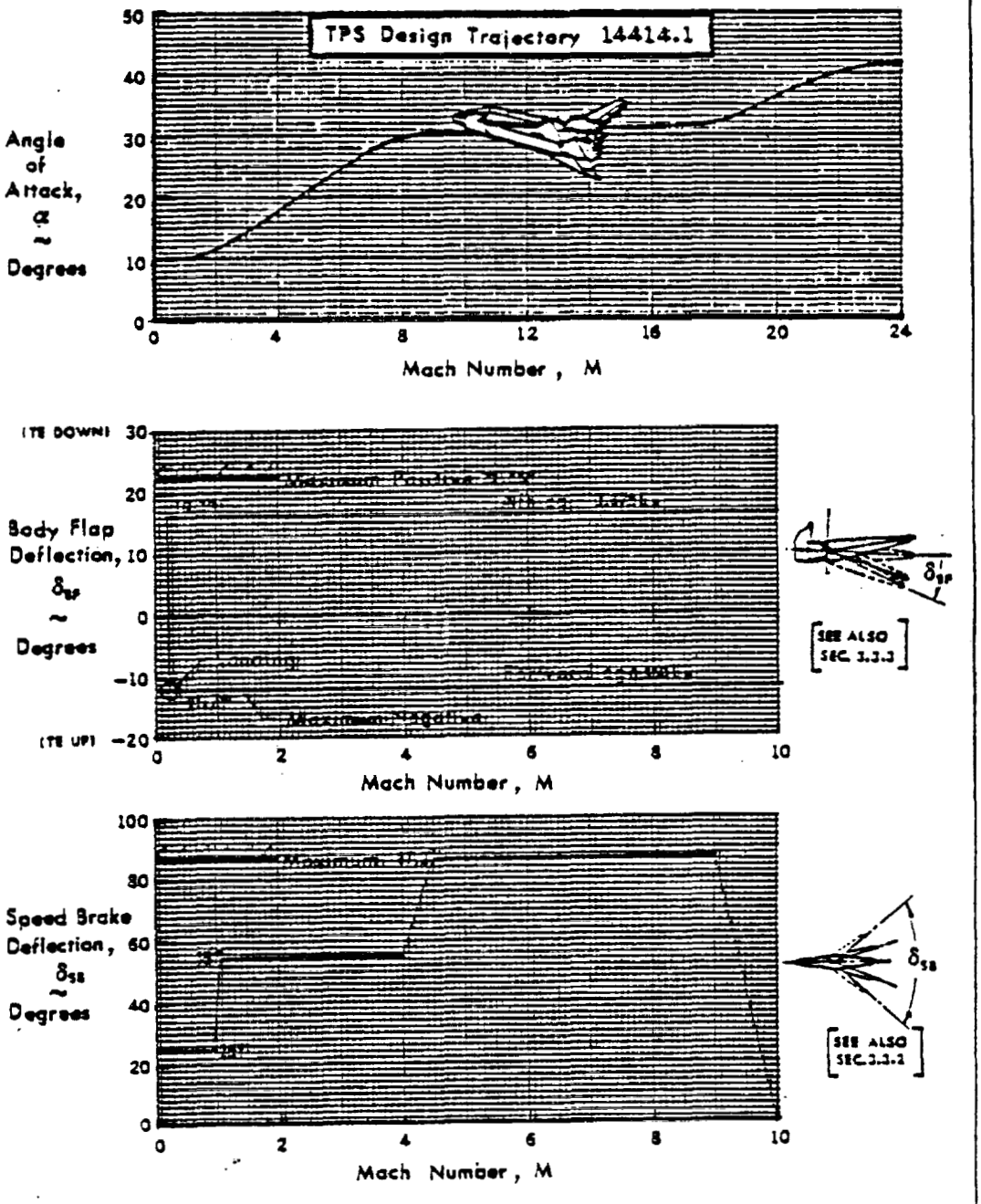

Figure 4.1.1.4-1
CONTROL SCHEDULES

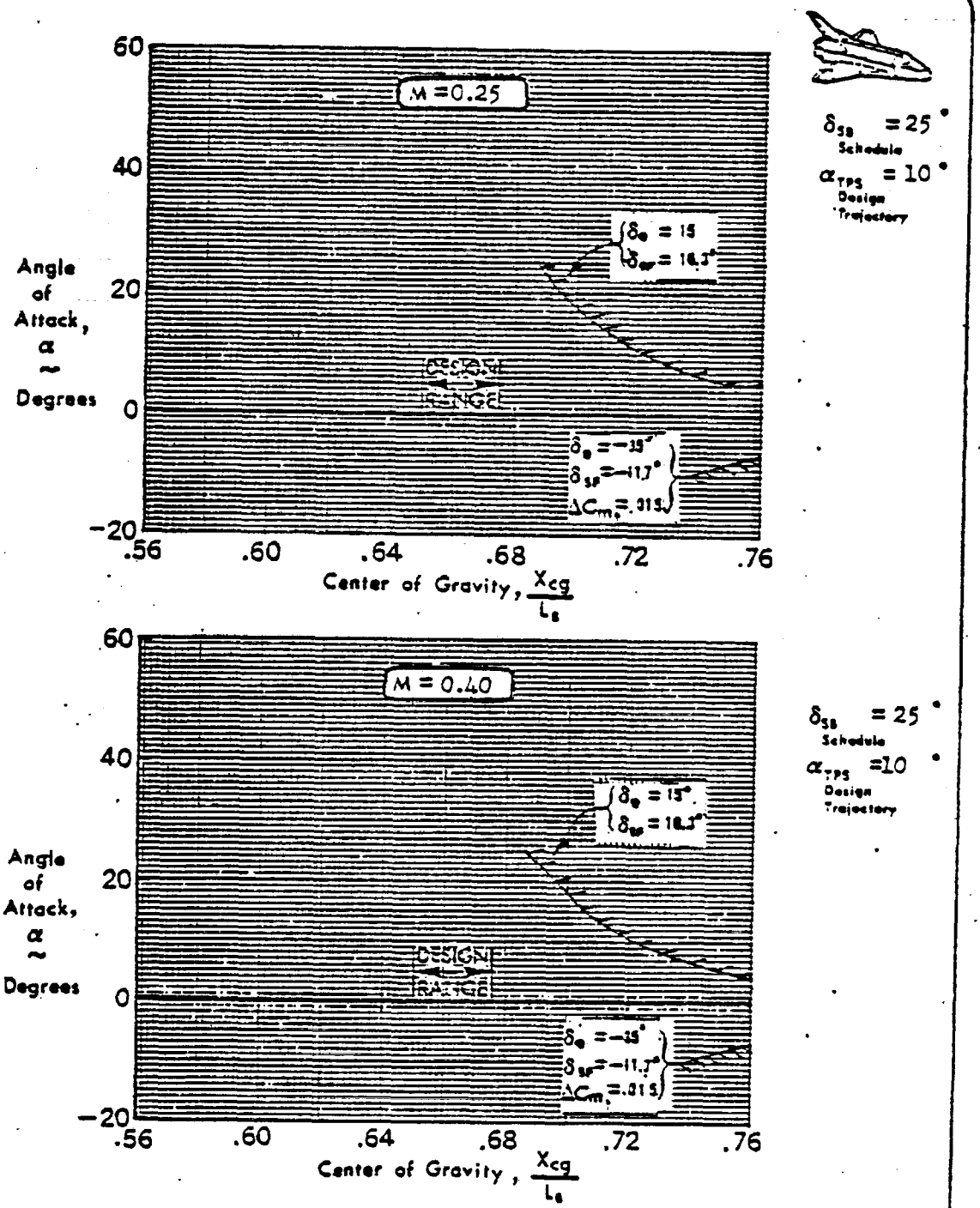

Figure 4.1.1.4-2
STATIC TRIM CAPABILITY

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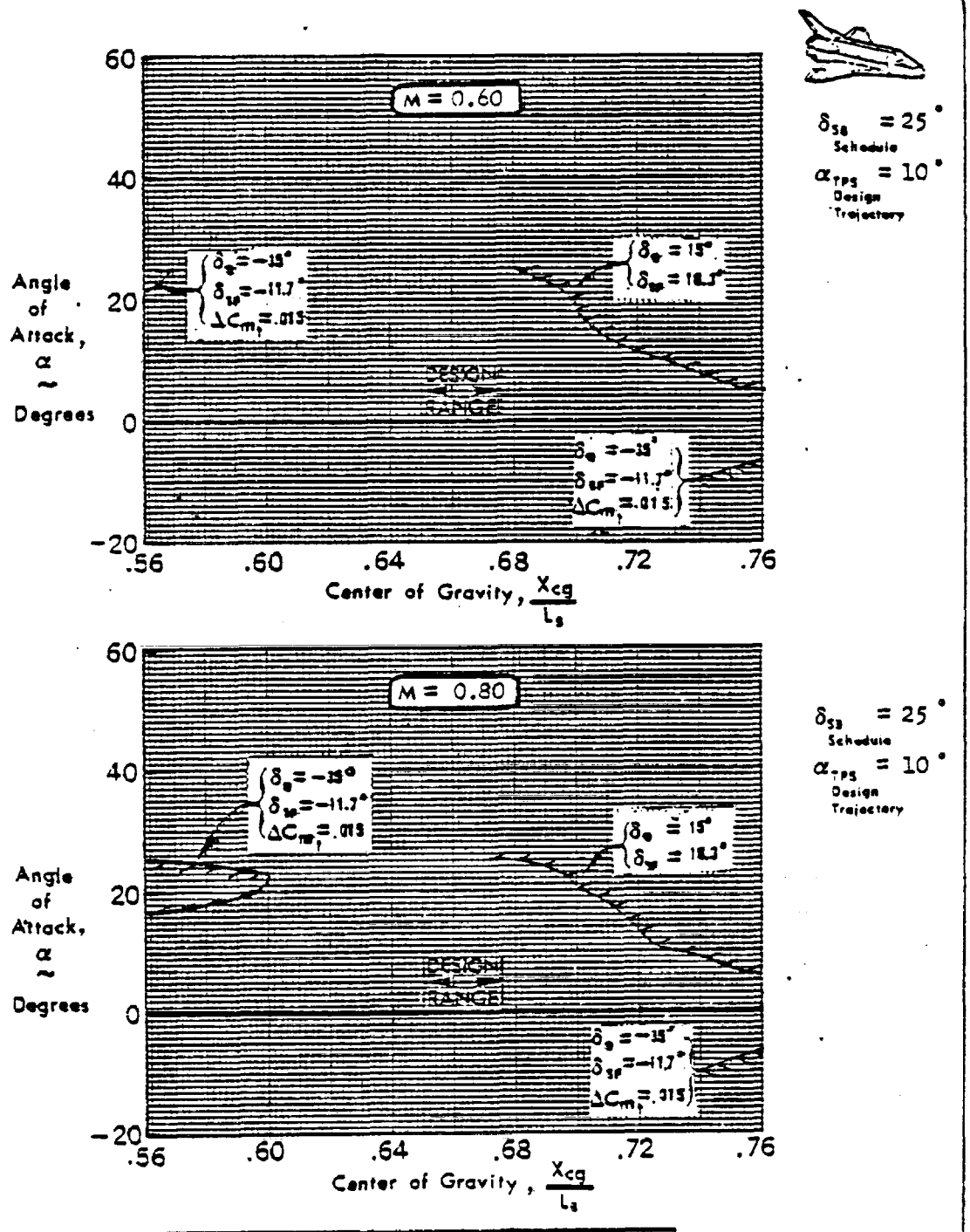

Figure 4.1.1.4-3
STATIC TRIM CAPABILITY

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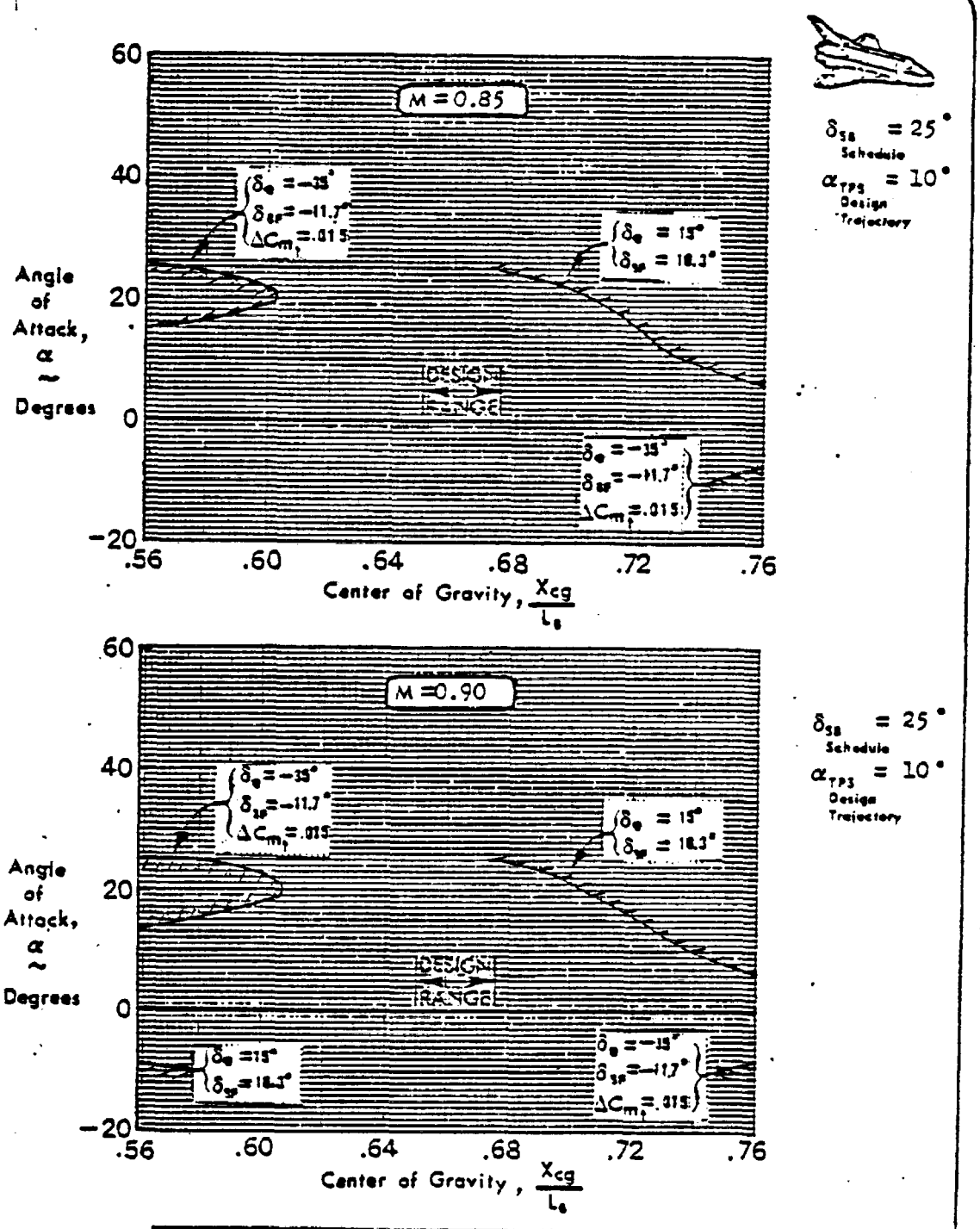

Figure 4.1.1.4-4
STATIC TRIM CAPABILITY

DSD 6-6-79

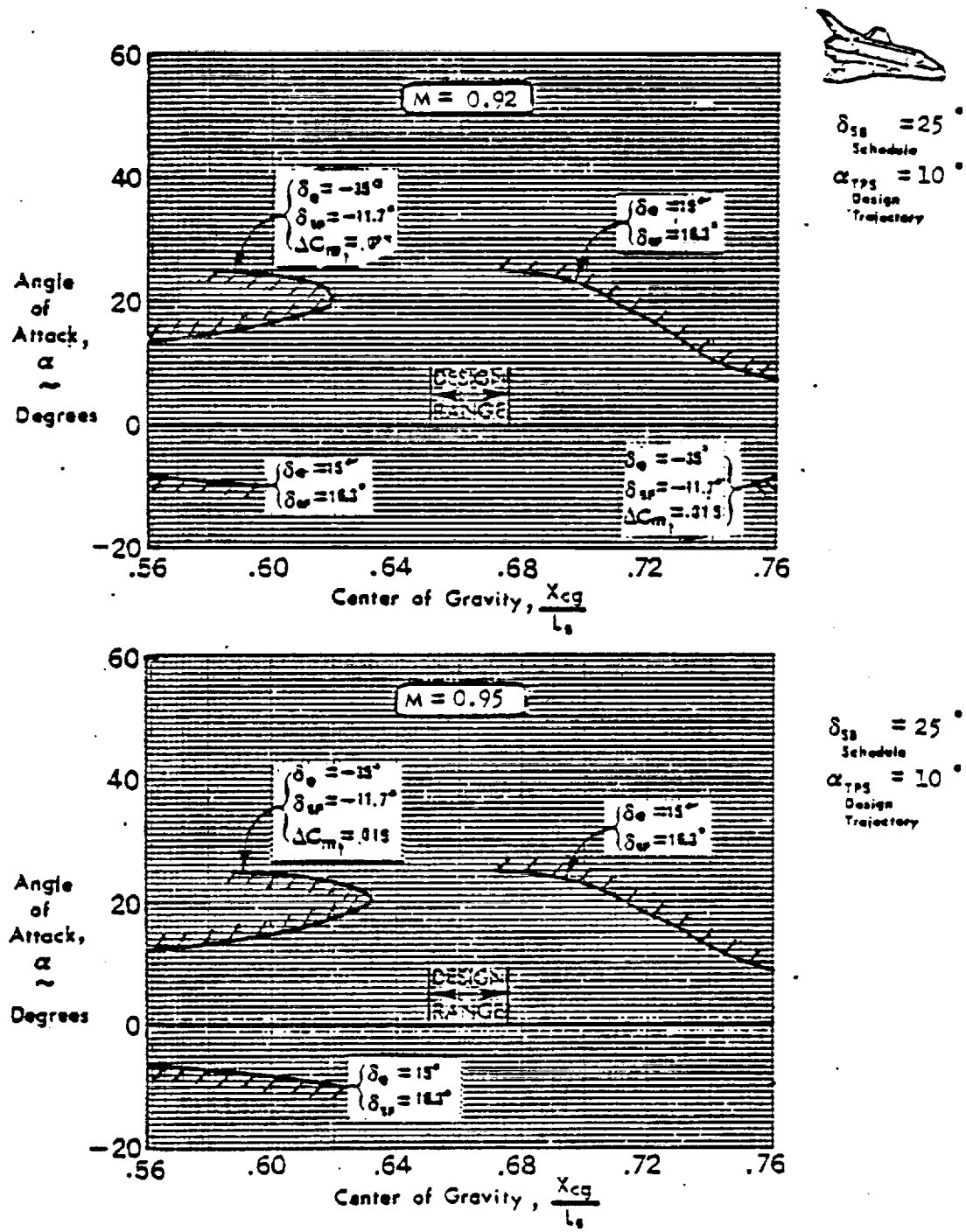

Figure 4.1.1.4-5

STATIC TRIM CAPABILITY

DGD 5-6-79

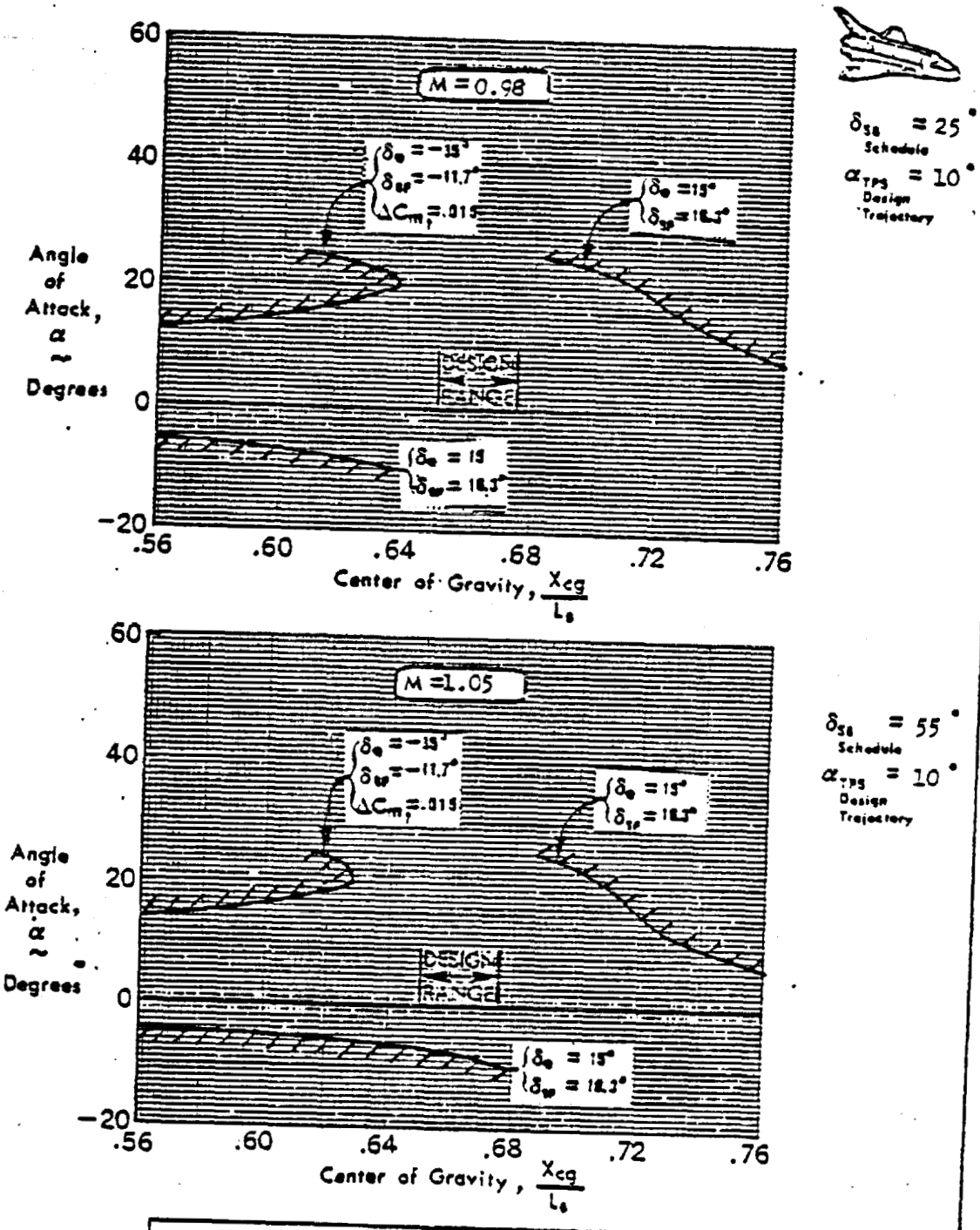

Figure 4.1.1.4-6
STATIC TRIM CAPABILITY

DD 6-6-79

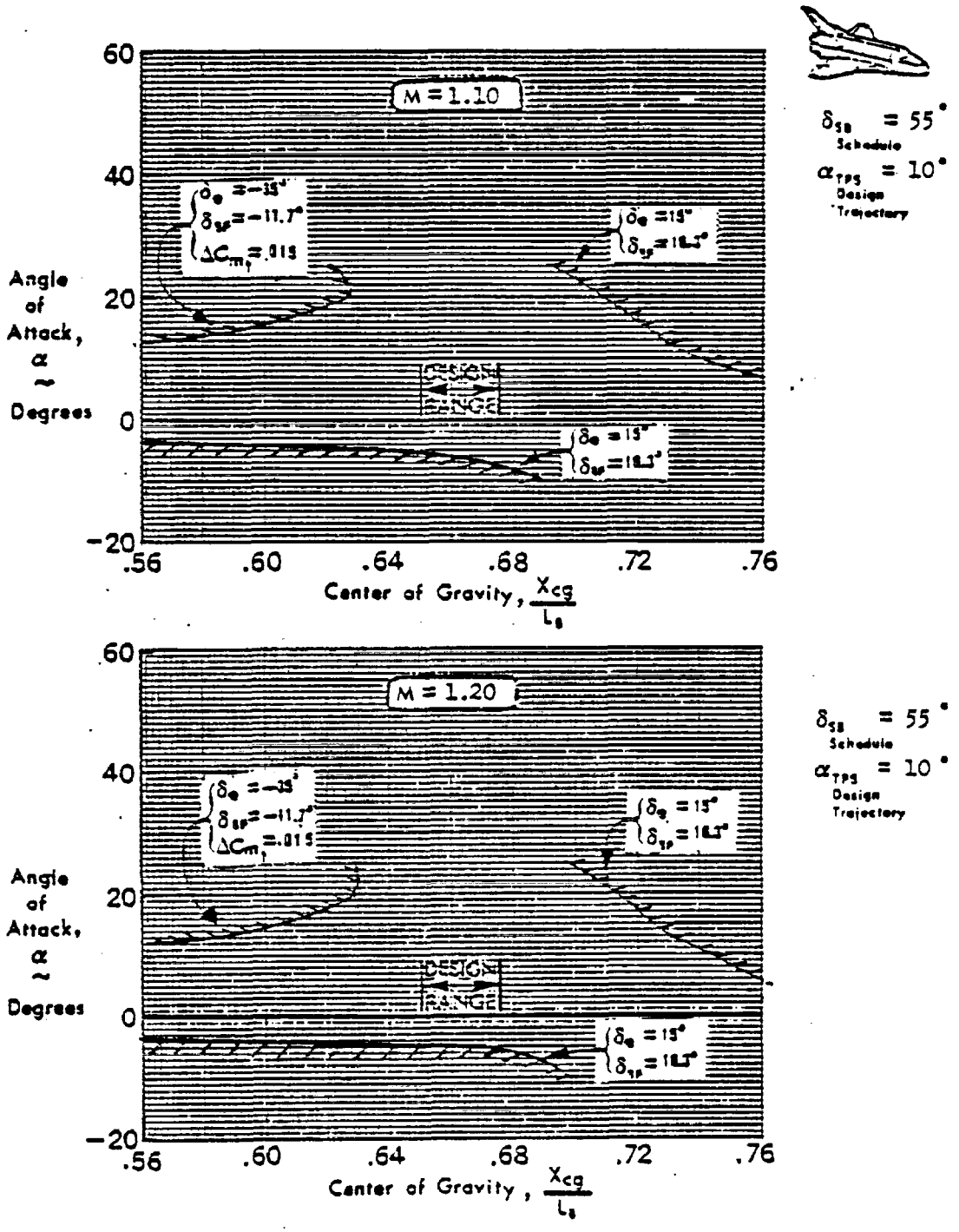

Figure 4.1.1.4-7
STATIC TRIM CAPABILITY

DJD 6-6-79

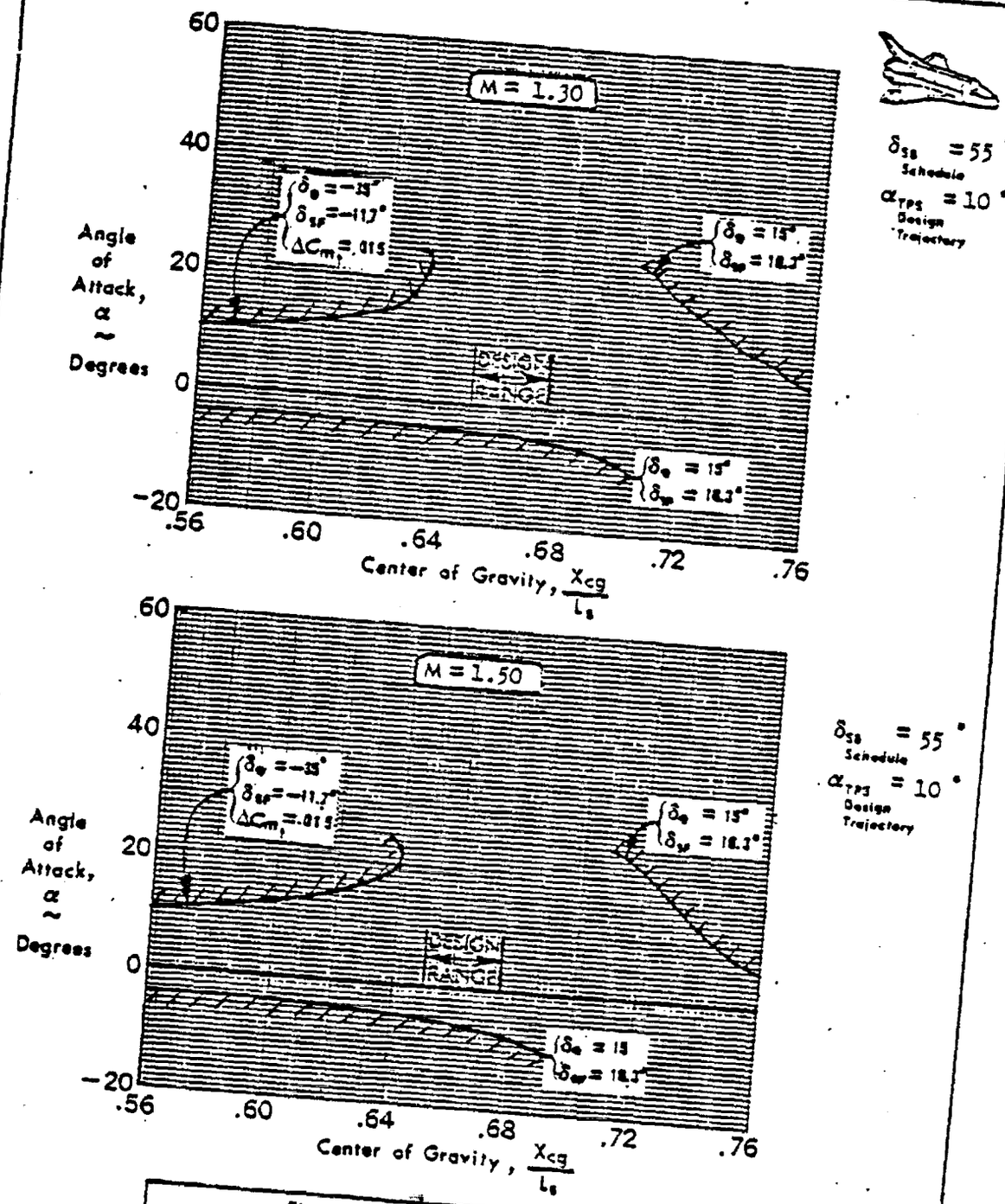

Figure 4.1.1.4-3
STATIC TRIM CAPABILITY

DGD 6-6-79

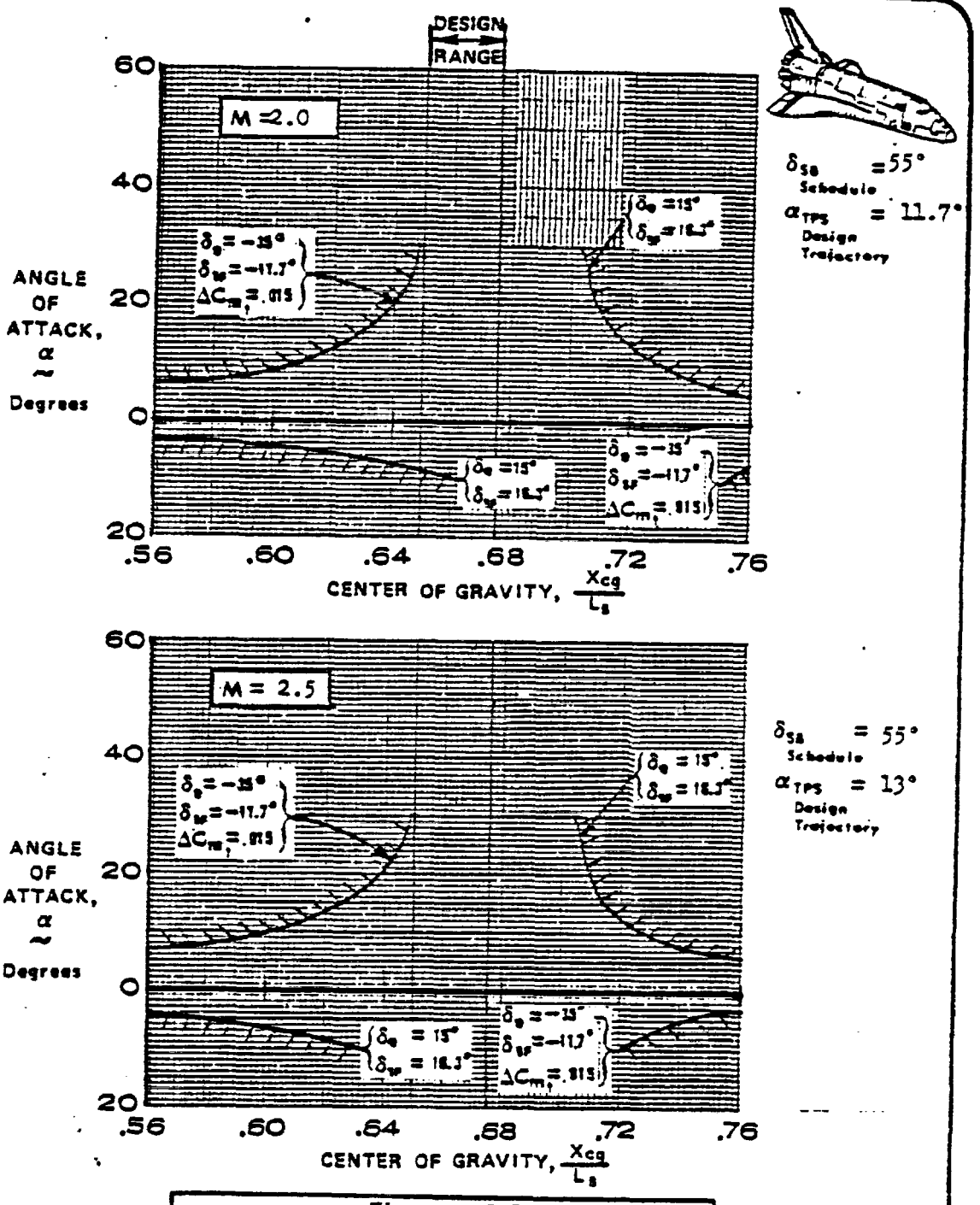

Figure 4.1.1.4-9
STATIC TRIM CAPABILITY

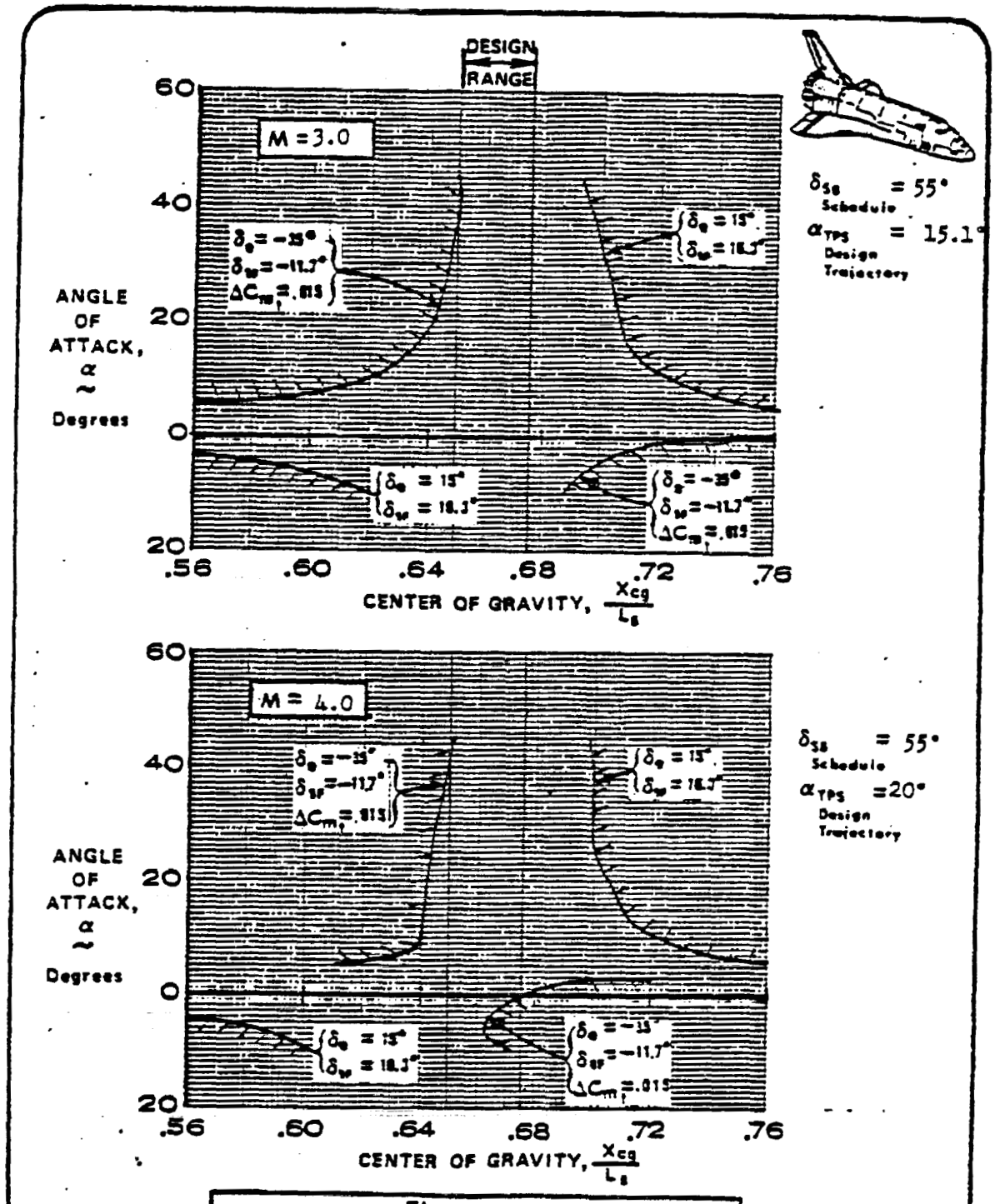

Figure 4.1.1.4-10
STATIC TRIM CAPABILITY

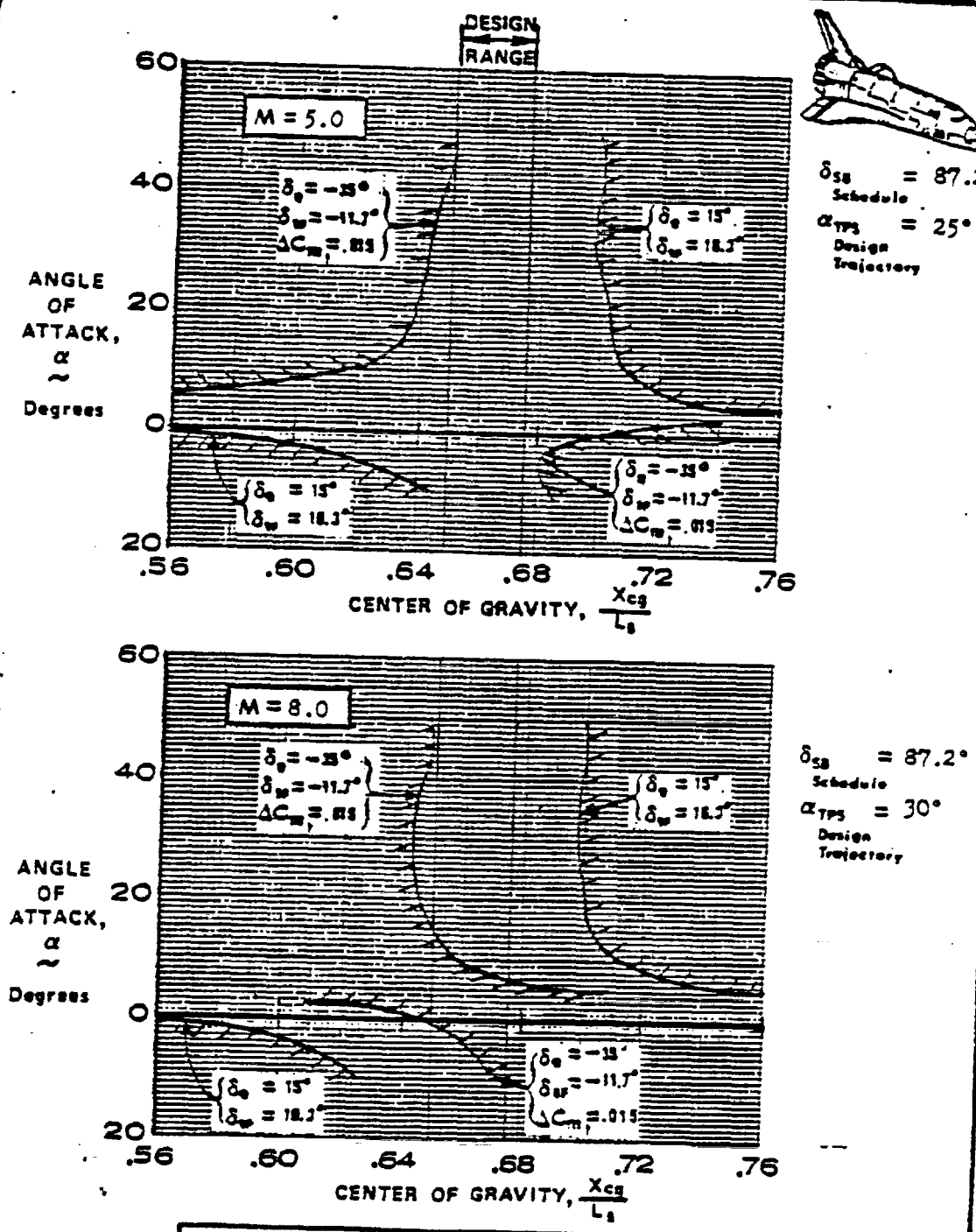

Figure 4.1.1.4-11
STATIC TRIM CAPABILITY

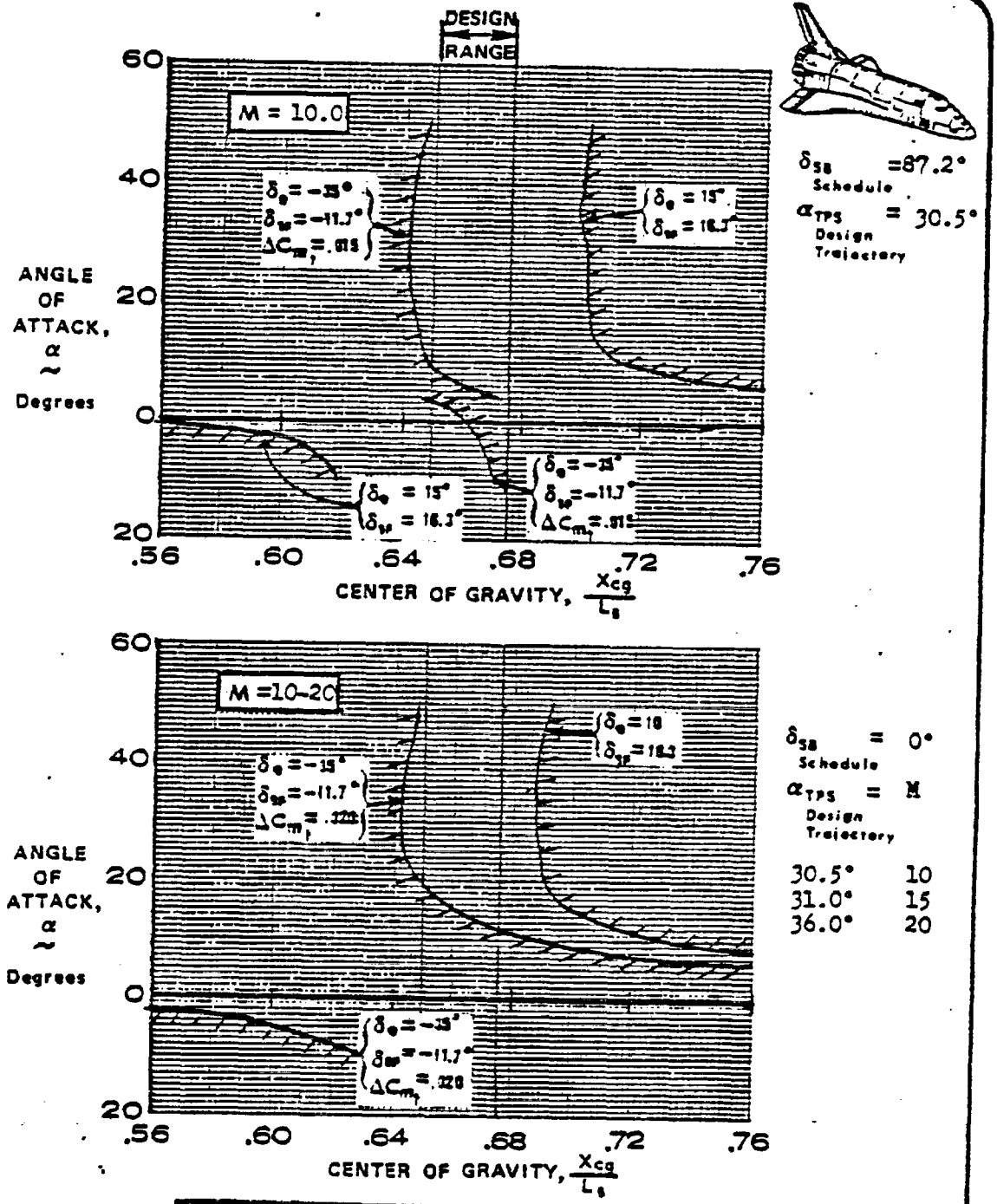

Figure 4.1.1.4-12
STATIC TRIM CAPABILITY