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GROUND PROXIMITY TESTS OF THE 0.03-SCALE MODEL (45-0) SPACE SHUTTLE ORBITER IN THE ROCKWELL INTERNATIONAL NAAL LOW SPEED WIND TUNNEL (OA250)

by

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Prepared under NASA Contract Number NAS9-13247

by

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Johnson Space Center
National Aeronautics and Space Administration
Houston, Texas

WIND TUNNEL TEST SPECIFICS:

Test Number:	NAAL 775
NASA Series Number:	OA250
Model Number:	45-0
Test Dates:	July 1 through 7, 1977
Occupancy Hours:	34

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

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ABSTRACT

Experimental aerodynamic investigations were conducted on a triple strut-mounted 0.03-scale representation of the 140A/B (modified) space shuttle orbiter configuration in the Rockwell International 7.75 x 11.00 foot low speed wind tunnel during the time period from July 1 to July 7, 1977. NASA designation for this test was OA250; facility number was NAAL 775.

The primary test objectives were to define orbiter lateral-directional stability characteristics in ground proximity and to investigate discrepancies in lateral-directional data obtained during previous NAAL tests. In order to accomplish the above objectives, the orbiter model was mounted at various heights (h/b) above the NAAL ground plane at a fixed angle of attack (10°) and sideslipped through an angle range of $-5° \leq \beta \leq 5°$. Model h/b heights consisted of 0.20, 0.178, 0.125, 0.10 and 0.075 at elevon deflections of 0° and $\pm 5°$. For this test period, a six-component Task internal strain-gaged balance (1.5" MK XIVA) was utilized to record all aerodynamic force data. No pressure data were recorded, and all data presented are uncorrected for base pressure effects.

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PLOTTED COEFFICIENTS SCHEDULE:

(A) C_Y, C_ℓ, C_n VERSUS β

NOMENCLATURE

SYMBOL	PLOT SYMBOL	DEFINITION
a		speed of sound; m/sec, ft/sec
C_A	CA	forebody axial-force coefficient
C_D	CD	drag coefficient
C_L	CL	lift coefficient; $\frac{\text{lift}}{qS}$
C_ℓ	CBL	rolling-moment coefficient; $\frac{\text{rolling moment}}{qSb}$
C_n	CYN	yawing-moment coefficient; $\frac{\text{yawing moment}}{qSb}$
C_N	CN	normal-force coefficient; $\frac{\text{normal force}}{qS}$
C_m	CLM	pitching-moment coefficient; $\frac{\text{pitching moment}}{qS\ell_{REF}}$
C_Y	CY	side-force coefficient; $\frac{\text{side force}}{qS}$
M	MACH	Mach number; V/a
p		pressure, psf
q	Q(PSF)	dynamic pressure, psf
RN/L	RN/L	unit Reynolds number; per m, per ft
T_t	TT	freestream total temperature °R
V		velocity, ft/sec
α	ALPHA	angle of attack, degrees
β	BETA	angle of sideslip, degrees
δ_{BF}	BDFLAP	body flap deflection
δ_a	AILRON	aileron deflection
δ_E	ELEVON	deflection of elevons

NOMENCLATURE (Concluded)

SYMBOL	PLOT SYMBOL	DEFINITION
	XCP/L	center of pressure location, percent of body length, XMRP/LB-(CLM)(LREF)/(CN)(LB)
δ_R	RUDDER	rudder deflection
δ_{sb}	SPDBRK	speedbrake deflection, degrees
		Reference and C. G. Definitions
b	BREF	wing span or reference span; m, ft
$\bar{c}$		aerodynamic chord; m, ft
ℓ_{REF}	LREF	reference length or wing mean
S	SREF	wing area or reference area, ft^2
	MRP	moment reference point
	XMRP	moment reference point on X axis
	YMRP	moment reference point on Y axis
	ZMRP	moment reference point on Z axis

- - - - - - - - - - - - -

SUBSCRIPTS

b	base
l	local
s	static conditions
t	total conditions
∞	freestream

- - - - - - - - - - - - -

h/b	H/B	orbiter height over ground plane to orbiter wing span ratio

CONFIGURATIONS INVESTIGATED

The model utilized for test period OA250 was a 0.03-scale representation of the 140A/B space shuttle orbiter configuration. The basic model was of the blended wing-body design utilizing a double delta wing ($75^{\circ}/45^{\circ}\Lambda_{LE}$), full span, dual panel elevons (unswept hingeline and 6" gaps), a centerline vertical tail with rudder and/or speed brake deflection capability, a canopy, a body flap, and an orbital maneuvering system (OMS pods) mounted on the aft fuselage sidewalls adjacent to the vertical tail. Landing gear simulation consisted of both nose and main landing gear with either full extended or full retracted capability.

The model was constructed primarily of fiberglass with wing panels of aluminum and consisted of both non-metric and metric sections. The model non-metric section was supported by a triple strut structure that was rigidly mounted to the test section floor. Each strut consisted of a threaded rod with a pinned clevis joint allowing variable h/bw settings to be obtained.

For this test period the following nomenclature was used to designate the various model components:

Component	Description
B_{26}	Orbiter fuselage per Rockwell International lines VL70-000140A/B
C_9	Orbiter canopy per Rockwell International lines VL70-000140A/B
E_{43}	Orbiter full-span, unswept hingeline, 6" gapped elevons per Rockwell International lines VL70-000200

Configurations Investigated (Concluded)

Component	Description
F_8	Orbiter body flap per Rockwell International lines VL70-000200
G_{15}	Orbiter landing gear per Rockwell International lines VL70-000140A/B
M_{16}	Orbiter OMS pods per Rockwell International lines VL70-000203A
N_{24}	Orbiter main propulsion system nozzles per Rockwell International lines VL70-000140A
N_{28}	Orbiter OMS nozzles per Rockwell International lines VL70-000140A
R_5	Orbiter rudder per Rockwell International lines VL70-000146A
TC_{19}	Orbiter tail cone fairing per Rockwell International lines BCD V70-30-330-02
V_8	Orbiter vertical tail per Rockwell lines VL70-000146A (Model Drawing SS-A01360)
W_{116}	Configuration 4, Rockwell International Drawing No. VL70-000140A, -000200

TEST FACILITY DESCRIPTION

North American Aerodynamics Laboratory (NAAL) 7.75 x 11-foot Wind Tunnel is a continuous flow, closed circuit, single return tunnel capable of speeds up to 200 miles per hour.

The test section is vented to atmospheric pressure and is 7.75 feet high, 11 feet wide, and 12 feet long. Power is supplied by a 1250-horsepower nacelle-mounted synchronous motor driving a 19-foot, seven-blade, laminated birch propeller. Airspeed is controlled by using a magnetic clutch to vary the degree of coupling between the motor and propeller. Turbulence is minimized by a damping screen and a honeycomb section in the settling chamber upstream from the contraction cone (ratio 7.53 to 1).

Tests may be conducted using a variety of mounting systems: single strut, double strut, sting strut, reflection plane, cable suspension, or two-dimensional wall. Aerodynamic data may be measured by a planar type external balance system or sting-mounted internal balances. An Astrodata Automatic Data Acquisition System collects, multiplexes, digitizes, and records on magnetic tape 50 channels of force or pressure data or both. Data are then reduced and plotted using automatic data processing equipment and an automatic digital plotter.

The NAAL Wind Tunnel has been operating since June 1943. Calibrations are available over a wide range of test conditions.

DATA REDUCTION

The aerodynamic force data presented in this report were measured by the Task Corporation 1.5 inch diameter MK XIVA internal strain gage balance. Corrections applied to the aforementioned data consisted of model tunnel blockage effects on test section dynamic pressure. No pressure measurements, other than tunnel parameters, were recorded and all data are uncorrected for base pressure effects.

REFERENCES

1. SD77-SH-0176, Rockwell Report, "Pretest Information for Ground Proximity Tests of the 0.03-Scale Space Shuttle Orbiter Vehicle in the Rockwell International NAAL Low Speed Wind Tunnel Test," by E. Chee, dated June 28, 1977.

2. IL, SAS/AERO/77-291, "Test Requirements for a New Test in Rockwell/NAAL in Verify Ground Effects on Lateral/Directional Stability," dated June 8, 1977.

3. IL, SAS/WTO/75-034, Addendum #8, "NAAL Ground Plane Tests of the SSV 45-0 Model," dated June 8, 1977.

4. SAS/AERO/77-402, Rockwell International letter, "Response to OV101 ALT Aero CDR RID 30-A, 'Directional Instability During Last Three Seconds of Flight'," by W. M. Zeman, dated July 13, 1977.

TABLE I.

TEST : OA250

DATE : 7/7/77

TEST CONDITIONS

MACH NUMBER	REYNOLDS NUMBER (per foot)	DYNAMIC PRESSURE (pounds/sq. inch)	STAGNATION TEMPERATURE (degrees Fahrenheit)
0.20	1.42×10^6/ft.	60#/ft.^{2}	$80^\circ \longrightarrow 120^\circ$F

BALANCE UTILIZED: 1.5" TASK MK XIV A

	CAPACITY:	ACCURACY:	COEFFICIENT TOLERANCE:
NF	130 lb/gage	0.25%	
SF	80 lb/gage	0.25%	
AF	40 lb/gage	0.25%	
PM			
RM	150 in-lb.	0.25%	
YM			

COMMENTS:

IMS 010

TABLE II.

TEST: OA250 NAAL 775

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 7/7/77

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	SCHD. β	PARAMETERS/VALUES δe	δa	δSB	δR	NO. OF RUNS	MACH NUMBERS (OR ALTERNATE INDEPENDENT VARIABLE) δBF	h/D		.20
RFQ001	(1) -	10°	A	+5	0	0	0	1	-11.7	.20		1
002	(1) - G15											2
003	(1)			+5								3
004				0								4
005				-5								5
006				0								6
007				0						.178		7
008				+5								8
009				-5								9
010				-5						.125		10
011				+5								11
012				+5								12
013				0								13
014				0								14
015				0						.178		15
016				0						.10		16
017				+5								17
018				-5								18

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

CL CD CLM CN XCP/L CA CY CYN CBL MACH BETA 9

COEFFICIENTS

α OR β SCHEDULES

β(A) = -5, -4, -2, -1, 0, 1, 2, 4, 5

IDVAR (1) IDVAR (2) NDV

(1) = B26C9G15M16F8W116E43V8R5TC19

(2) = B26C9G15M16N24N28F8W116E43V8R5

ORIGINAL PAGE IS OF POOR QUALITY

TABLE II. (Concluded)

TEST: OA250 NAAL 775

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 7/7/77

DATA SET IDENTIFIER	CONFIGURATION	SCHD. α	SCHD. β	PARAMETERS/VALUES de	da	dSB	dR	NO. OF RUNS	MACH NUMBERS (OR ALTERNATE INDEPENDENT VARIABLE) dBF	h/b		.20						
RFQ019	1	10	A	0	+5	0	0	1	-11.7	.10		19						
020	2			0	0							20						
021	1			0						.075		21						
022				+5								22						
023				-5								23						

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES

COEFFICIENTS

β(A) = -5, -4, -2, -1, 0, 1, 2, 4, 5

1 = B26C9G15M16F8W116E43V8R5TC19

IDVAR (1) IDVAR (2) NDV

TABLE III. MODEL DIMENSIONAL DATA

MODEL COMPONENT: BODY - B_{26}

GENERAL DESCRIPTION: Configuration 140A/B Orbiter fuselage. NOTE: B_{26} is identical to B_{24} except underside of fuselage has been refaired to accept W_{116}.

MODEL SCALE: 0.030 MODEL DRAWING: SS-A00147, Release 12

DRAWING NUMBER: VL70-000143B, -000200, -000205, -006089, -000145, VL70-000140A, -000140B

DIMENSIONS:	FULL SCALE	MODEL SCALE
Length (OML: Fwd. Sta. X_o = 235), In.	1293.3	38.799
Length (IML: Fwd. Sta. X_o = 238), In.	1290.3	38.709
Max Width (@ X_o = 1528.3), In.	264.0	7.920
Max Depth (@ X_o = 1564), In.	250.00	7.500
Fineness Ratio	0.264	0.264
Area - Ft^2		
Max. Cross-Sectional	340.88	0.3068

TABLE III. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: CANOPY - C_9

GENERAL DESCRIPTION: Configuration 3A. Canopy used with fuselage B_{26}.

MODEL SCALE: 0.030 MODEL DRAWING: SS-A00147. Release 12

DRAWING NUMBER:

DIMENSIONS:	FULL SCALE	MODEL SCALE
Length (X_o = 434.643 to 578), In.	143.357	4.301
Max Width (@X_o = 513.127), In.	152.412	4.572
Max Depth (@X_o = 485.0), In.	25.000	0.750

TABLE III. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: SLOTTED ELEVON (6-inch gap) - E_{43}

GENERAL DESCRIPTION: Configuration 140A/B orbiter elevon. NOTE: E_{43} is a slotted version of E_{26}. Data are for one side.

MODEL SCALE: 0.030

DRAWING NUMBER: VL70-000200, -006089, -006092

DIMENSIONS:	FULL SCALE	MODEL SCALE
Area, Ft^2	210.00	0.189
Span (equivalent), In.	349.2	10.476
Inb'd equivalent chord, In.	118.004	3.540
Outb'd equivalent chord, In.	55.192	1.656
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	0.2096	0.2096
At Outb'd equiv. chord	0.4004	0.4004
Sweep Back Angles, degrees		
Leading Edge	0.00	0.00
Trailing Edge	-10.056	-10.056
Hingeline	0.00	0.00
Area Moment (Product of Area & $\bar{c}$), Ft^3	1587.25	0.043
Mean Aerodynamic Chord, In.	90.7	2.721

TABLE III. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: BODY FLAP - F_8

GENERAL DESCRIPTION: Configuration 140A/B orbiter body flap.

Hingeline located at X_o = 1528.3, Z_o = 284.3

MODEL SCALE: 0.030 MODEL DRAWING: SS-A00147, Release 12

DRAWING NUMBER: VL70-000140A, -000145

DIMENSIONS:	FULL SCALE	MODEL SCALE
Length (X_o = 1520 to X_o = 1613), In.	93.00	2.79
Max Width, In.	262.00	7.86
Max Depth (@X = 1520), In.	23.00	0.69
Fineness Ratio		
Area - Ft^2		
Planform	150.525	0.406
Base	41.847	0.113

TABLE III. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: G_{15}

GENERAL DESCRIPTION: Main and nose landing gear door and struts.

MODEL SCALE: 0.03

DRAWING NUMBER: VL70-000140/SS-A00149

DIMENSIONS:	FULL SCALE	MODEL SCALE
NOSE GEAR:		
No. Wheels	2	2
Wheel axis:		
Fuselage Station, In.	374.741	11.242
Waterline, In.	221.506	6.645
Pivot axis:		
Fuselage Station	375.506	11.265
Waterline	298.000	8.940
Strut diameter, In.	7.716	0.231
Wheel diameter, In.	32.000	0.960
Wheel Width, In.	8.790	0.264
Wheel Centerline-to-centerline width, In.	22.000	0.660
Side door:		
Height (follows body contour), In.	18.518	0.556
Leading Edge location, F.S.	272.049	8.161
Trailing Edge location, F.S.	381.926	11.458
MAIN GEAR (Two Struts):		
No. of wheels (per strut)	2	2
Wheel axis:		
Fuselage Station, In.	1171.086	35.133
Waterline, In.	175.432	5.263
Pivot axis:		
Fuselage Station, In.	1180.000	35.400
Waterline, In.	283.012	8.490
Main Strut Diameter, In.	9.568	0.287
Wheel Diameter, In.	44.198	1.326
Wheel Width, In.	16.049	0.481
Wheel centerline-to-centerline width, In.	36.000	1.080
Side door:		
Length, In.	148.148	4.444
Width, In.	61.728	1.852

TABLE III. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: OMS POD - M_{16}

GENERAL DESCRIPTION: Configuration 140C orbiter OMS pod - short pod.

MODEL SCALE: 0.030

DRAWING NUMBER: VL70-008401, -008410

DIMENSIONS:	FULL SCALE	MODEL SCALE
Length (OMS Fwd. Sta. X_o = 1310.5), In.	258.50	7.755
Max Width (@X_o = 1511), In.	136.8	4.104
Max Depth (@X_o = 1511), In.	74.70	2.241
Fineness Ratio	2.484	2.484
Area - Ft^2		
Max Cross-Sectional	58.864	0.053

TABLE III. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: MPS NOZZLES - N_{24}

GENERAL DESCRIPTION: Configuration 140A/B orbiter MPS nozzles

MODEL SCALE: 0.030 MODEL DRAWING: SS-A00147, Release 12

DRAWING NUMBER: VL70-005030A, -000140A

DIMENSIONS:	FULL SCALE	MODEL SCALE
MACH NO.		
Length - In.		
Gimbal Point to Exit Plane	157.0	4.71
Throat to Exit Plane	99.2	2.976
Diameter - In.		
Exit	91.00	2.73
Area - Ft^2		
Exit	45.17	0.0407
Gimbal Point (Station) - In.		
Upper Nozzle		
X	1445.	43.35
Y	0	0
Z	443.00	13.29
Lower Nozzles		
X	1468.17	44.045
Y	+53.00	+1.59
Z	342.64	10.279
Null Position - Deg.		
Upper Nozzle		
Pitch	16	16
Yaw	0	0
Lower Nozzle		
Pitch	10	10
Yaw	3.5	3.5

TABLE III. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: OMS NOZZLES - N_{28}

GENERAL DESCRIPTION: Configuration 140A/B orbiter OMS nozzles.

MODEL SCALE: 0.030

DRAWING NUMBER: VL70-000140A (Location) SS-A00106, Release 5 (Contour)

DIMENSIONS:	FULL SCALE	MODEL SCALE
MACH NO.		
Gimbal Point (Station), In.		
Left Nozzles		
X_o	1518.0	45.54
Y_o	-88.0	-2.65
Z_o	492.0	14.76
Right Nozzles		
X_o	1518.0	45.54
Y_o	88.0	2.64
Z_o	492.0	14.76
Null Position - Deg.		
Left Nozzles		
Pitch	15°49'	15°49'
Yaw	12°17'	12°17'
Right Nozzles		
Pitch	15°49'	15°49'
Yaw	12°17'	12°17'

TABLE III. MODEL DIMENSIONAL DATA (Continued)

MODEL COMPONENT: RUDDER - R_5

GENERAL DESCRIPTION: Configuration 140C orbiter rudder (identical to Configuration 140A/B rudder)

MODEL SCALE: 0.030

DRAWING NUMBER: VL70-000146B, -000095

DIMENSIONS:	FULL SCALE	MODEL SCALE
Area, Ft^2	100.15	0.090
Span (equivalent), In.	201.00	6.030
Inb'd equivalent chord, In.	91.585	2.748
Outb'd equivalent chord, In.	50.833	1.525
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	0.400	0.400
At Outb'd equiv. chord	0.400	0.400
Sweep Back Angles, degrees		
Leading Edge	34.83	34.83
Trailing Edge	26.25	26.25
Hingeline	34.83	34.83
Area Moment (Product of area & $\bar{c}$), Ft^3	610.92	0.0165
Mean Aerodynamic Chord, In.	73.2	2.196

TABLE IIIa. - MODEL DIMENSIONAL DATA - Continued.

MODEL COMPONENT: Tailcone - TC19

GENERAL DESCRIPTION: Afterbody tailcone used with body B26 to simulate the orbiter ferry configuration.

SCALE MODEL = .03

DRAWING NUMBER: SS-A01681
VL70-30-330-02

DIMENSIONS:	FULL SCALE	MODEL SCALE
Length (TE @ X_o 1900), in.	459.3	13.779
Max. Width (X_o 1523), in.	303	9.090
Max. Depth (X_o 1466), in.	286	8.380
Area, ft^2		
Max. Cross-Sectional (X_o 1523)	504.6	.0454
Frontal	469.9	0.423

TABLE III. MODEL DIMENSIONAL DATA

MODEL COMPONENT: VERTICAL - V_8

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

MODEL SCALE: 0.030

DRAWING NUMBER: VL70-000140C, -000146B

DIMENSIONS:	FULL SCALE	MODEL SCALE
TOTAL DATA		
Area (Theo.), ft^2		
Planform	413.253	0.372
Span (Theo.), in.	315.72	9.472
Aspect Ratio	1.675	1.675
Rate of Taper	0.507	0.507
Taper Ratio	0.404	0.404
Sweep Back Angles, degrees		
Leading Edge	45.000	45.000
Trailing Edge	26.25	26.25
0.25 Element Line	41.13	41.13
Chords:		
Root (Theo.) WP	268.50	8.055
Tip (Theo.) WP	108.47	3.254
MAC	199.81	5.994
Fus. Sta. of .25 MAC	1463.35	43.901
W.P. of .25 MAC	635.52	19.066
B.L. of .25 MAC	0.0	0.0
Airfoil Section		
Leading Wedge Angle, deg.	10.00	10.00
Trailing Wedge Angle, deg.	14.92	14.92
Leading Edge Radius	3.00	0.060
Void Area	13.17	0.0019
Blanketed Area		

TABLE III. MODEL DIMENSIONAL DATA (Concluded)

MODEL COMPONENT: WING-W_{116}

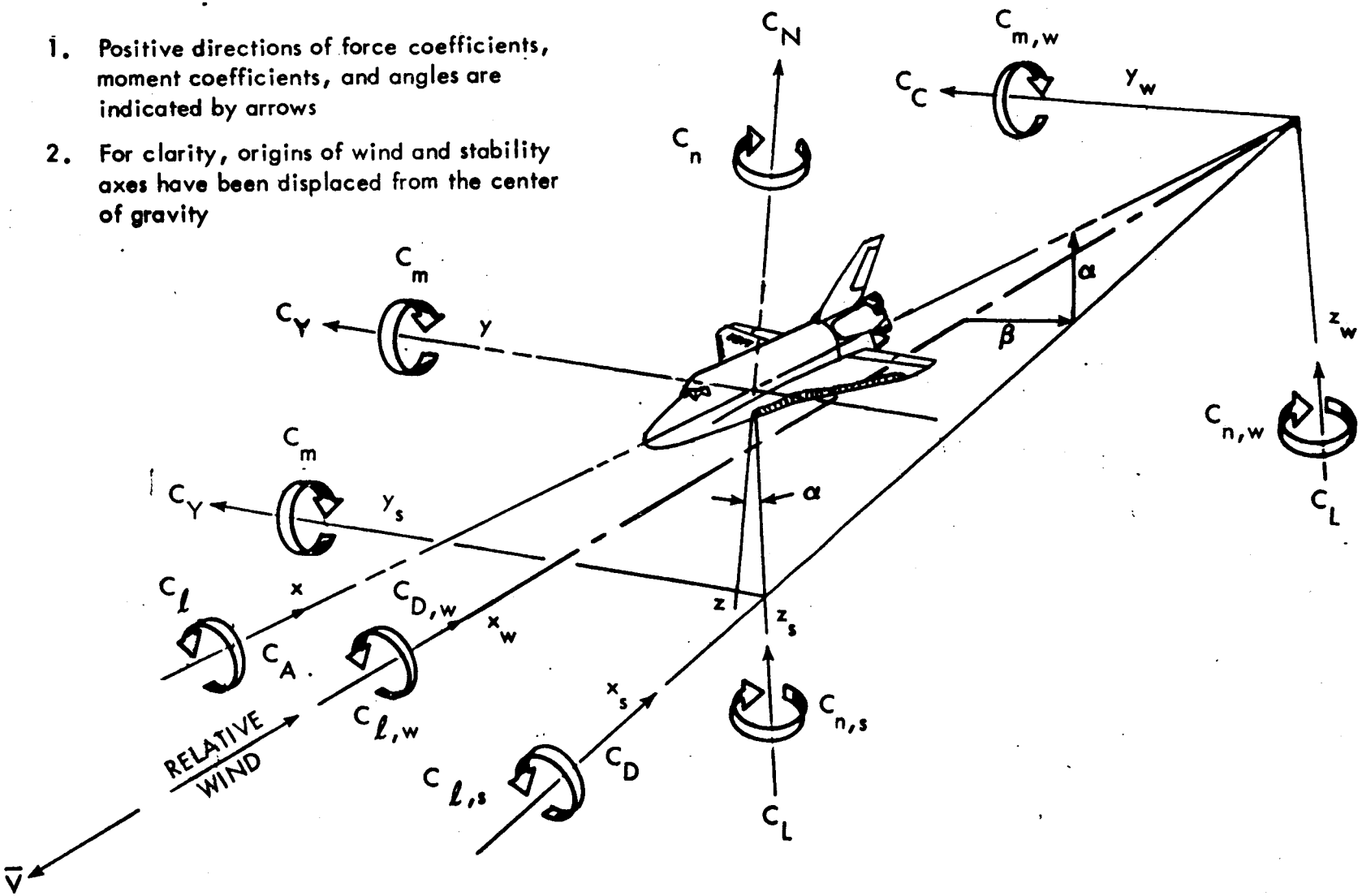
GENERAL DESCRIPTION: Configuration 4. NOTE: Identical to W_{114} except airfoil thickness. Dihedral angle is along trailing edge of wing.

MODEL SCALE: 0.030 DRAWING NO.: VL70-000140A, -000200

DIMENSIONS:	FULL SCALE	MODEL SCALE
TOTAL DATA		
Area (Theo.), ft^2		
Planform	2690.00	2.421
Span (Theo.), in.	936.68	28.10
Aspect Ratio	2.265	2.265
Rate of Taper	1.177	1.177
Taper Ratio	0.200	0.200
Dihedral Angle, degrees	3.500	3.500
Incidence Angle, degrees	0.500	0.500
Aerodynamic Twist, degrees	3.000	3.000
Sweep Back Angles, degrees		
Leading Edge	45.000	45.000
Trailing Edge	- 10.056	- 10.056
0.25 Element Line	35.209	35.209
Chords:		
Root (Theo.) B.P.0.0.	689.24	20.677
Tip, (Theo.) B.P.	137.85	4.136
MAC	474.81	14.244
Fus. Sta. of .25 MAC	1136.83	34.105
W.P. of .25 MAC	290.58	8.717
B.L. of .25 MAC	182.13	5.464
EXPOSED DATA		
Area (Theo.), ft^2	1751.50	1.576
Span, (Theo.), in. BP108	720.68	21.620
Aspect Ratio	2.059	2.059
Taper Ratio	0.245	0.245
Chords		
Root BP108	562.09	16.863
Tip 1.00 b/2	137.85	4.136
MAC	392.83	11.785
Fus. Sta. of .25 MAC	1185.98	35.579
W.P. of .25 MAC	294.30	8.829
B.L. of .25 MAC	251.77	7.553
Airfoil Section (Rockwell Mod NASA) XXXX-64		
Root b/2 =	0.113	0.113
Tip b/2 =	0.120	0.120
Data for (1) of (2) Sides		
Leading Edge Cuff		
Planform Area, ft^2	113.18	0.102
Leading Edge Intersects Fus M.L. @ Sta	500.00	15.00
Leading Edge Intersects Wing @ Sta	1024.00	30.72

Notes:

1. Positive directions of force coefficients, moment coefficients, and angles are indicated by arrows
2. For clarity, origins of wind and stability axes have been displaced from the center of gravity



a. Orbiter Axis Systems

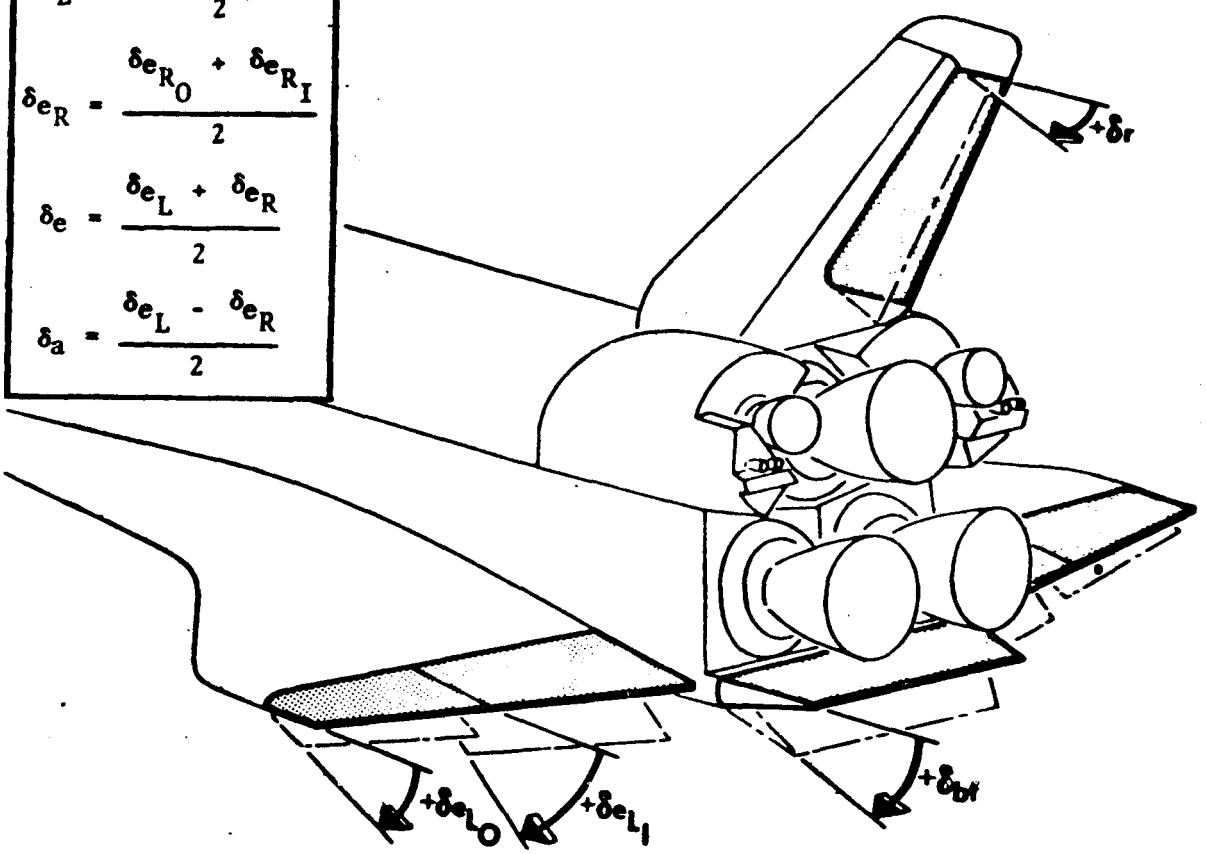
Figure 1. Axis systems and sign conventions.

$$\delta e_L = \frac{\delta e_{L_O} + \delta e_{L_I}}{2}$$

$$\delta e_R = \frac{\delta e_{R_O} + \delta e_{R_I}}{2}$$

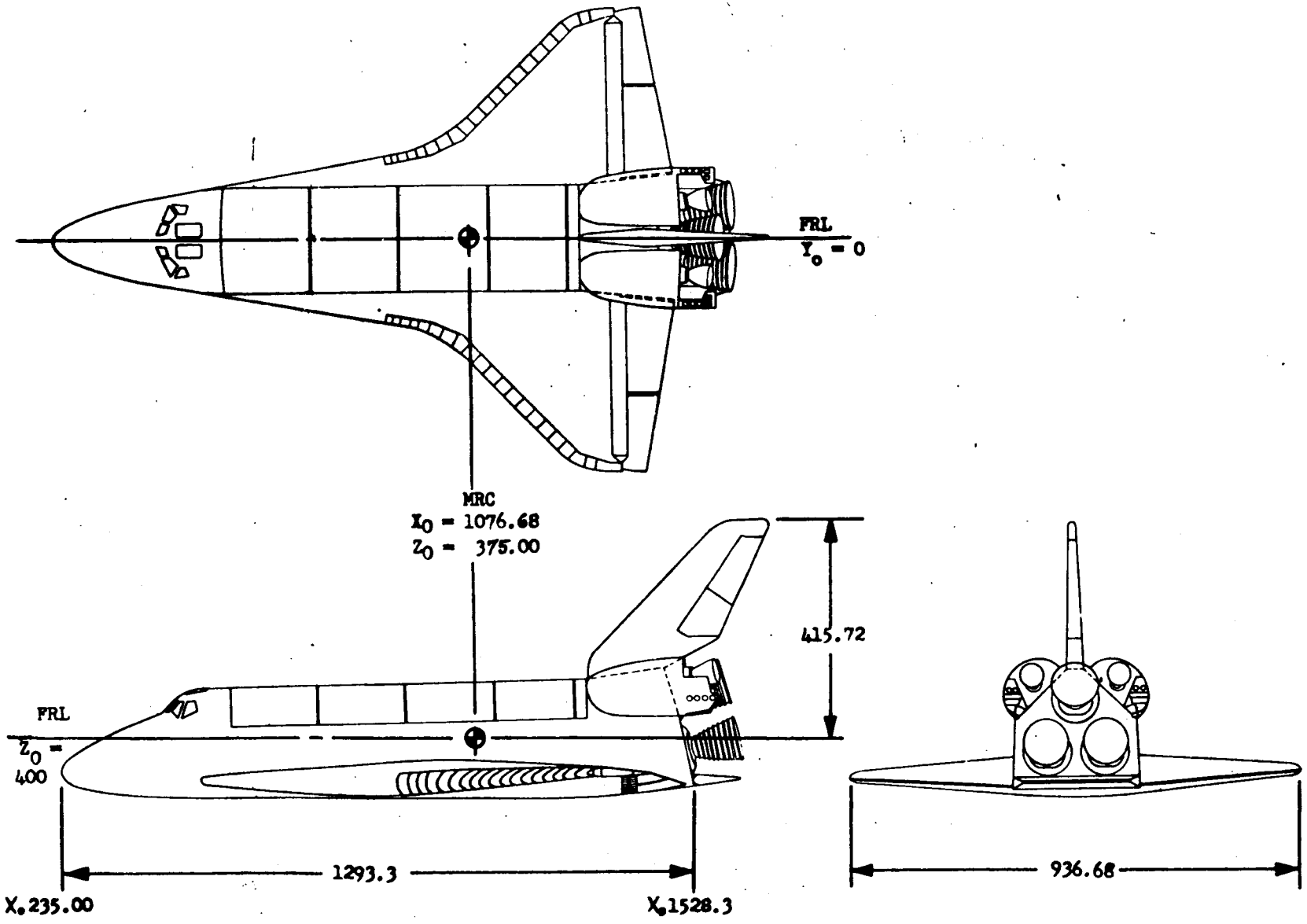
$$\delta e = \frac{\delta e_L + \delta e_R}{2}$$

$$\delta a = \frac{\delta e_L - \delta e_R}{2}$$

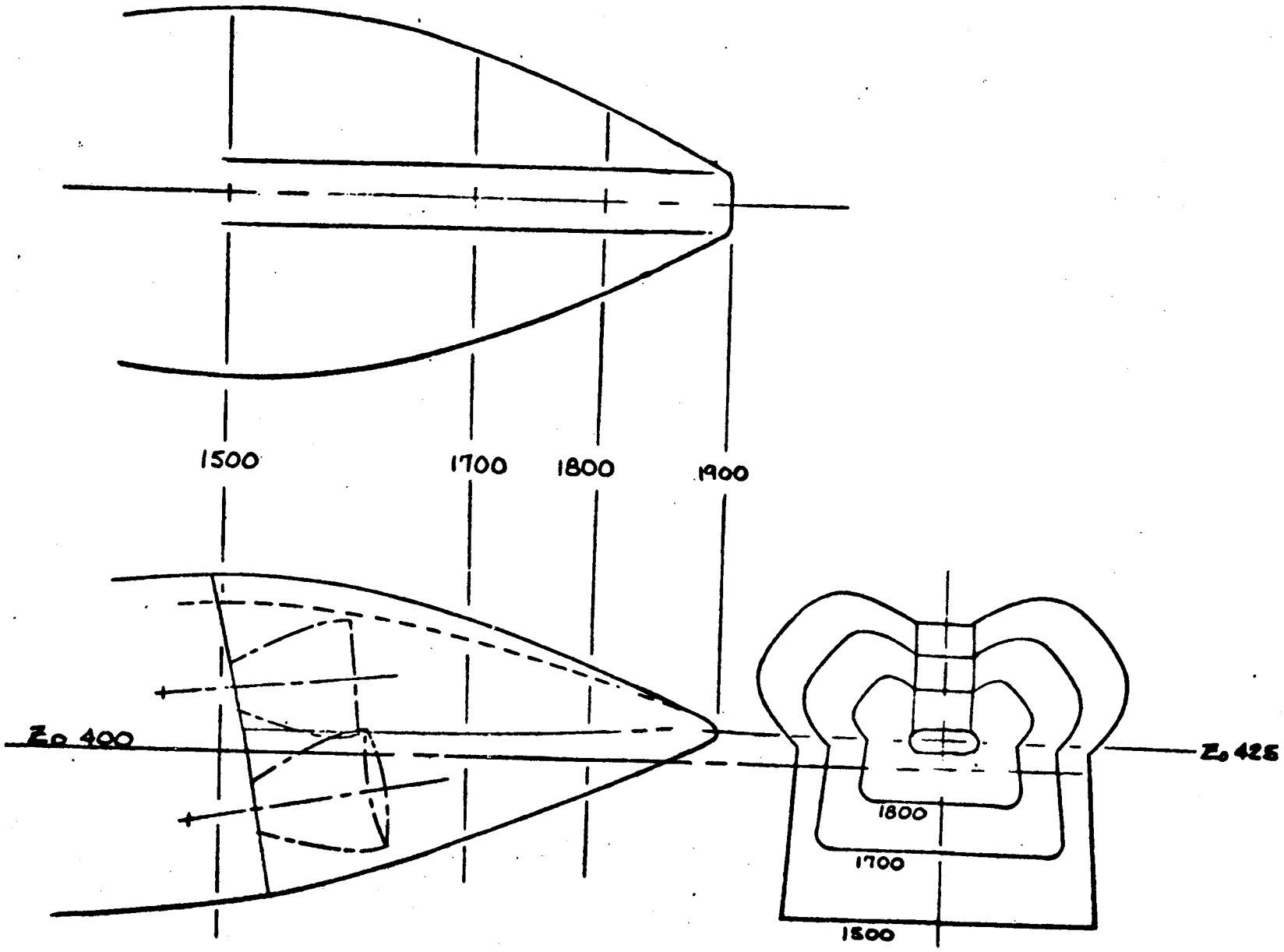


Positive Deflection of	Angle	Aero Forces and Moments	Hinge Moment
Rudder, δr	$+\beta$, $-\psi$	$+C_Y$, $-C_n$	$-C_{h_r}$
Elevon, δe	$-\alpha$, $-\theta$	$-C_m$	$-C_{h_e}$
Right, δe_R	$-\phi$	$-C_\ell$	$-C_{he_R}$
Left, δe_L	$+\phi$	$+C_\ell$	$-C_{he_L}$
Aileron, δa	$+\phi$	$+C_\ell$	
Body Flap, δbf	$-\alpha$, $-\theta$	$-C_m$	$-C_{hbf}$

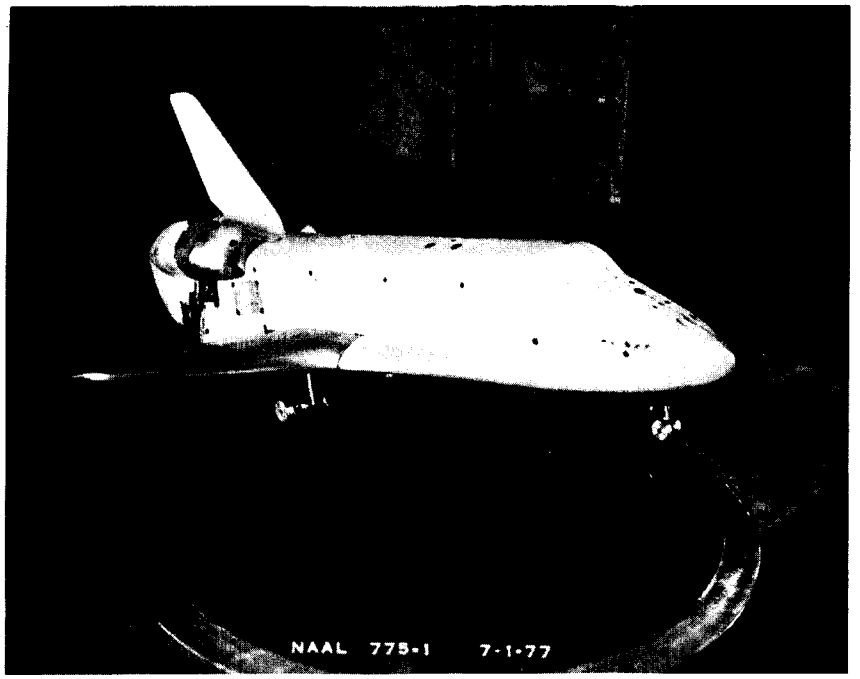
b. Control Surface Deflections
Figure 1. Concluded.



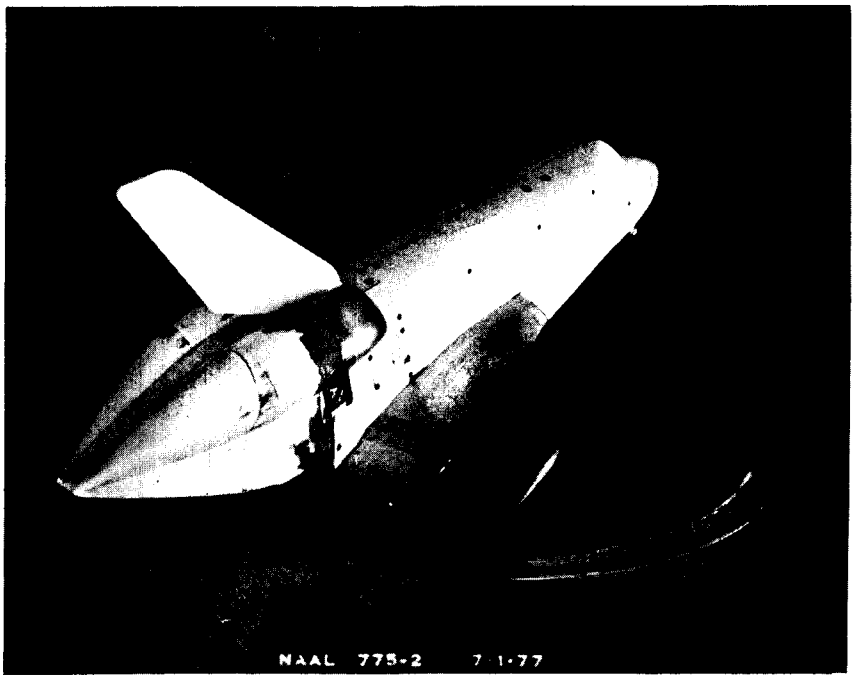
a. Three-View of 140A/B Modified Orbiter Configuration
Figure 2. Model sketches.



b. Tail Cone Configuration - TC_{19}
Figure 2. Concluded.



a. NAAL Installation, Three-Quarter Front View
Configuration B_{26} C_9 G_{15} M_{16} F_8 W_{116} E_{43} V_8 R_5 TC_{19}



b. NAAL Installation, Rear View Configuration
B_{26} C_9 G_{15} M_{16} F_8 W_{116} E_{43} V_8 R_5 TC_{19}

Figure 3. Model photographs.

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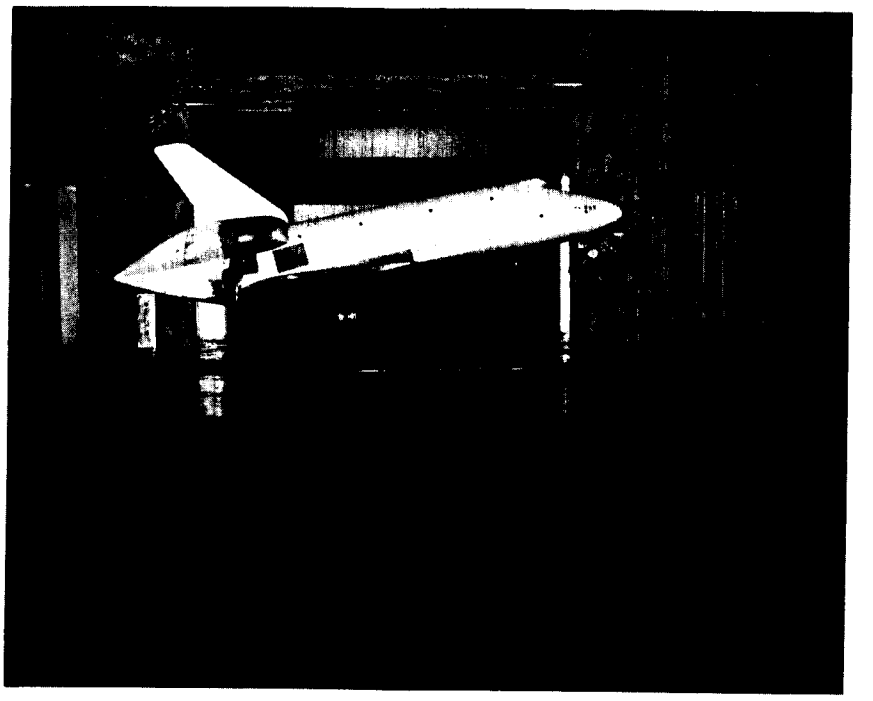
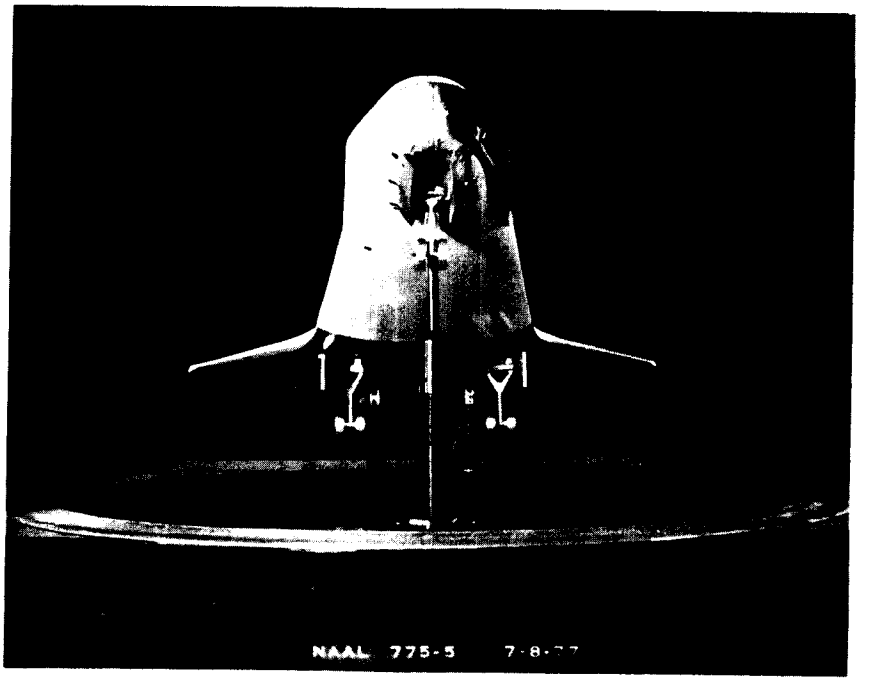


c. NAAL Installation, Side View Configuration
B_{26} C_9 G_{15} M_{16} F_8 W_{116} E_{43} V_8 R_5 TC_{19}



d. NAAL Installation, Front View Configuration
B_{26} C_9 G_{15} M_{16} F_8 W_{116} E_{43} V_8 R_5 TC_{19}

Figure 3. Concluded.

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DATA FIGURES

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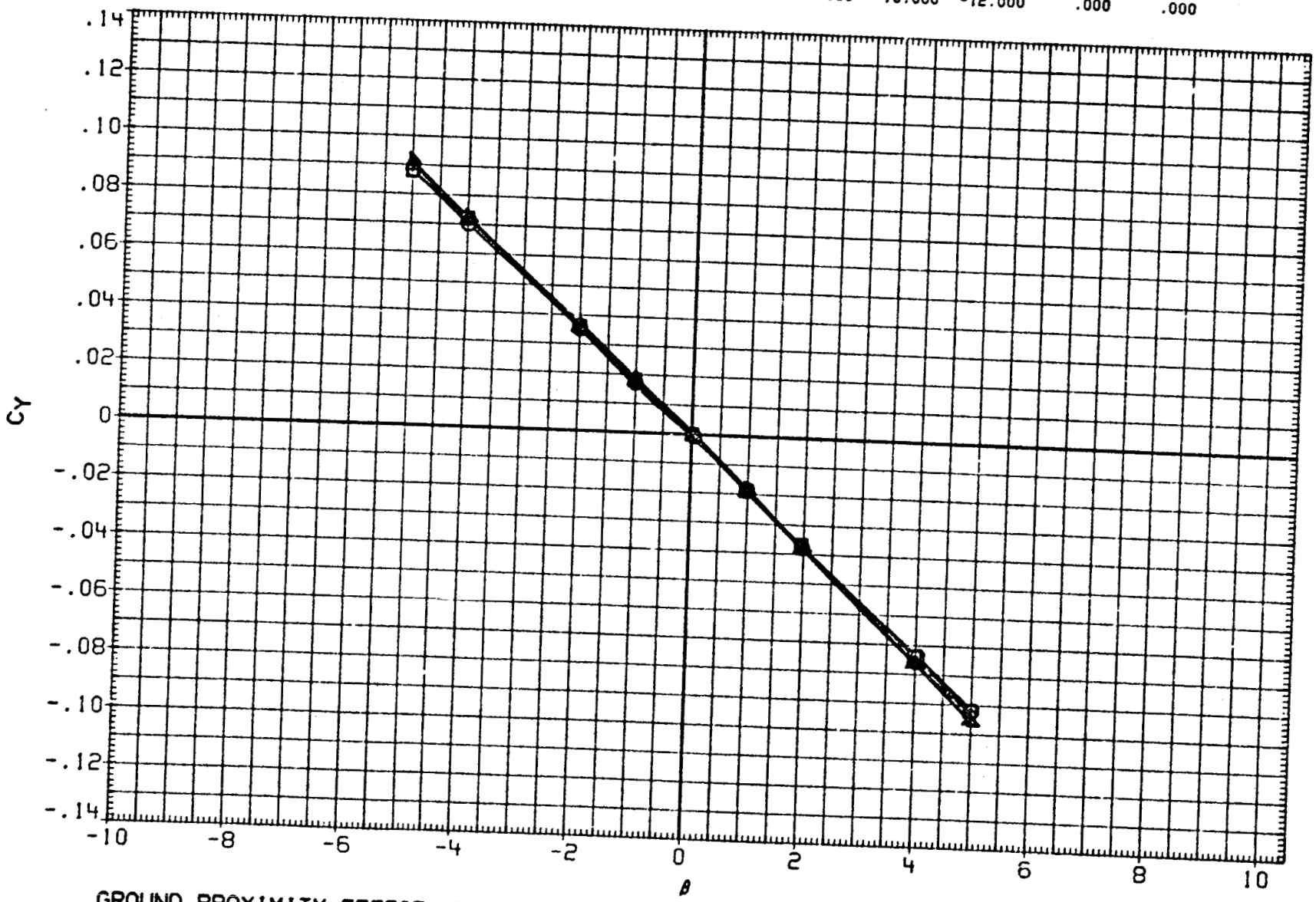
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RF0006	○	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.200	.000	10.000	-12.000	.000	.000
RF0007	□	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.178	.000	10.000	-12.000	.000	.000
RF0014	◇	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.125	.000	10.000	-12.000	.000	.000
RF0016	△	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.100	.000	10.000	-12.000	.000	.000
RF0021	◺	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.075	.000	10.000	-12.000	.000	.000



GROUND PROXIMITY EFFECT, ELEVON DEFLECTION = 0.0

(A)MACH = .20

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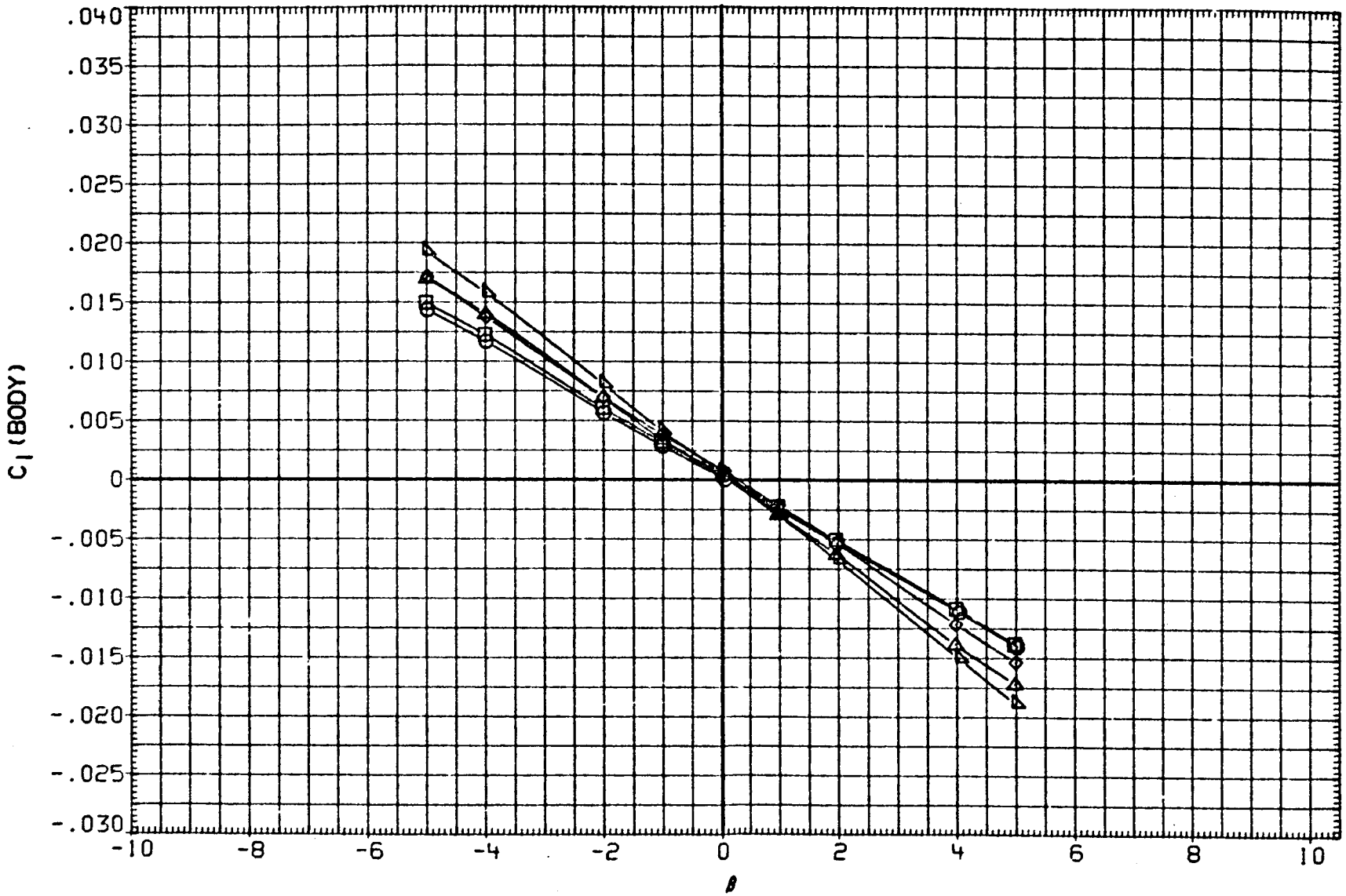
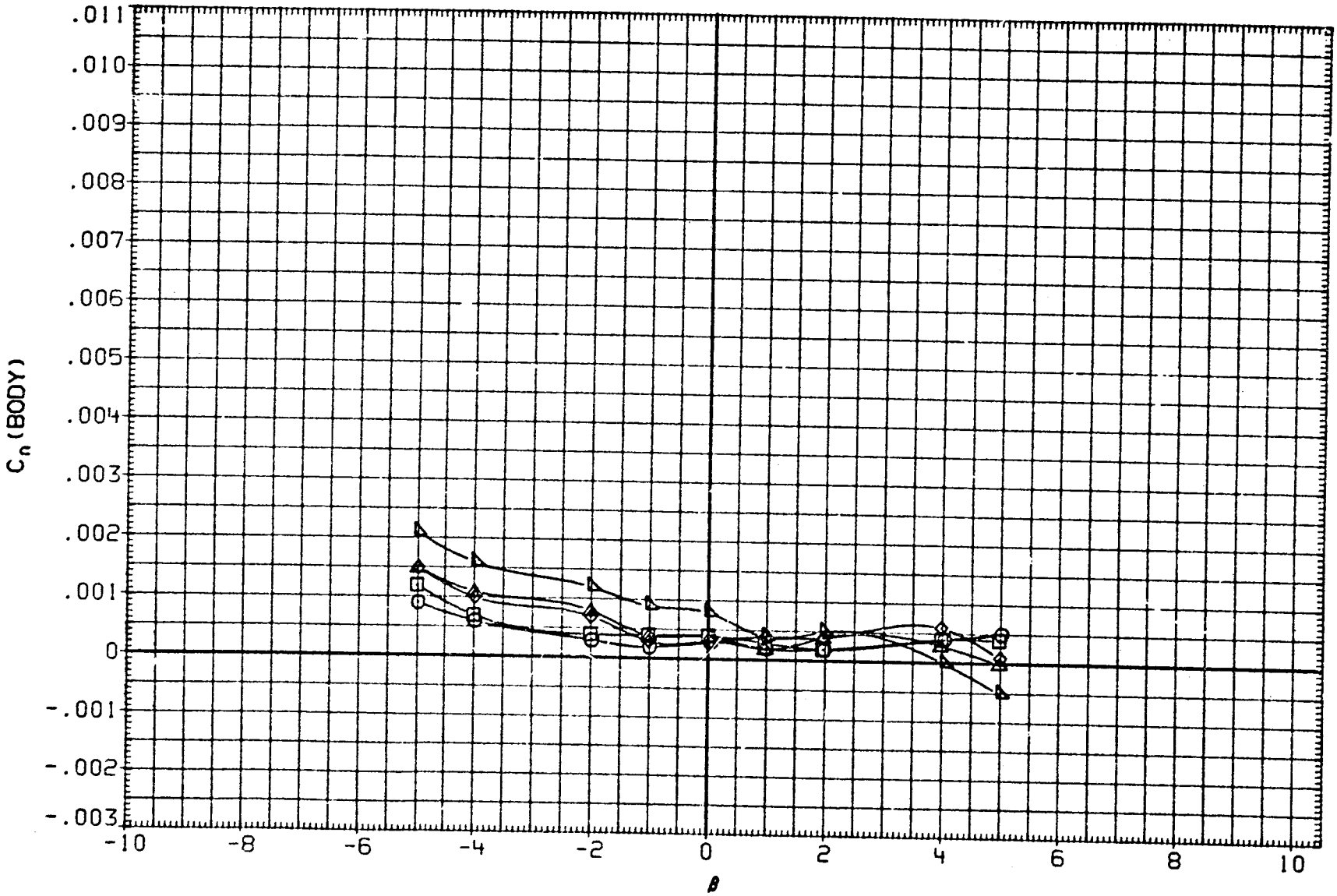
DATA SET	SYMBOL		CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ006	○	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.200	.000	10.000	-12.000	.000	.000
RFQ007	□	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.178	.000	10.000	-12.000	.000	.000
RFQ014	◇	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.125	.000	10.000	-12.000	.000	.000
RFQ016	△	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.100	.000	10.000	-12.000	.000	.000
RFQ021	◺	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.075	.000	10.000	-12.000	.000	.000



GROUND PROXIMITY EFFECT, ELEVON DEFLECTION = 0.0

(A)MACH = .20

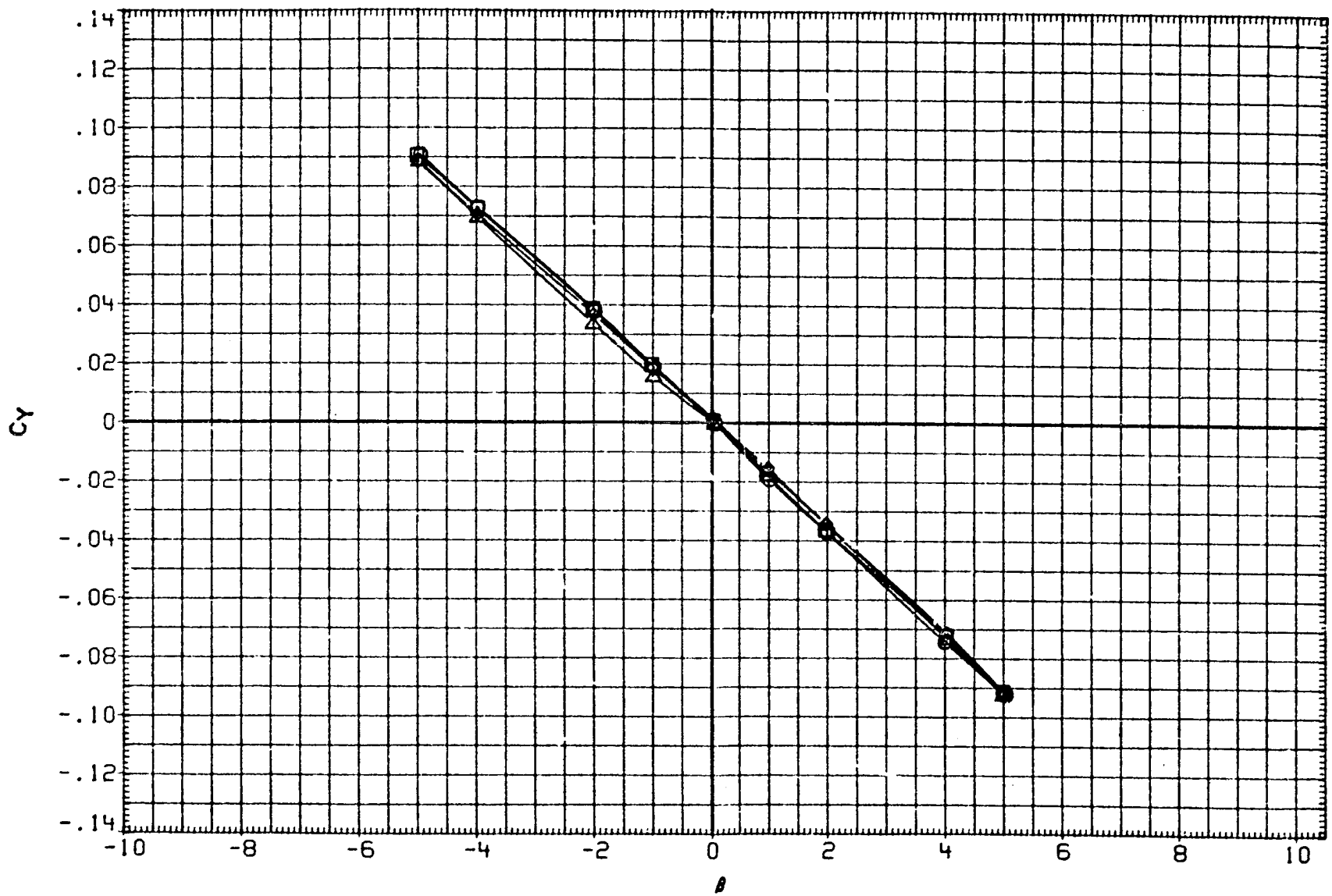
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ006	○	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.200	.000	10.000	-12.000	.000	.000
RFQ007	□	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.178	.000	10.000	-12.000	.000	.000
RFQ014	◇	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.125	.000	10.000	-12.000	.000	.000
RFQ016	△	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.100	.000	10.000	-12.000	.000	.000
RFQ021	◺	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.075	.000	10.000	-12.000	.000	.000



GROUND PROXIMITY EFFECT, ELEVON DEFLECTION = 0.0

(A)MACH = .20

DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ003	○	OA250 B26C9G15M16F8W116E43V8R5TC19	5.000	.200	.000	10.000	-12.000	.000	.000
RFQ008	□	OA250 B26C9G15M16F8W116E43V8R5TC19	5.000	.178	.000	10.000	-12.000	.000	.000
RFQ017	◇	OA250 B26C9G15M16F8W116E43V8R5TC19	5.000	.100	.000	10.000	-12.000	.000	.000
RFQ022	△	OA250 B26C9G15M16F8W116E43V8R5TC19	5.000	.075	.000	10.000	-12.000	.000	.000



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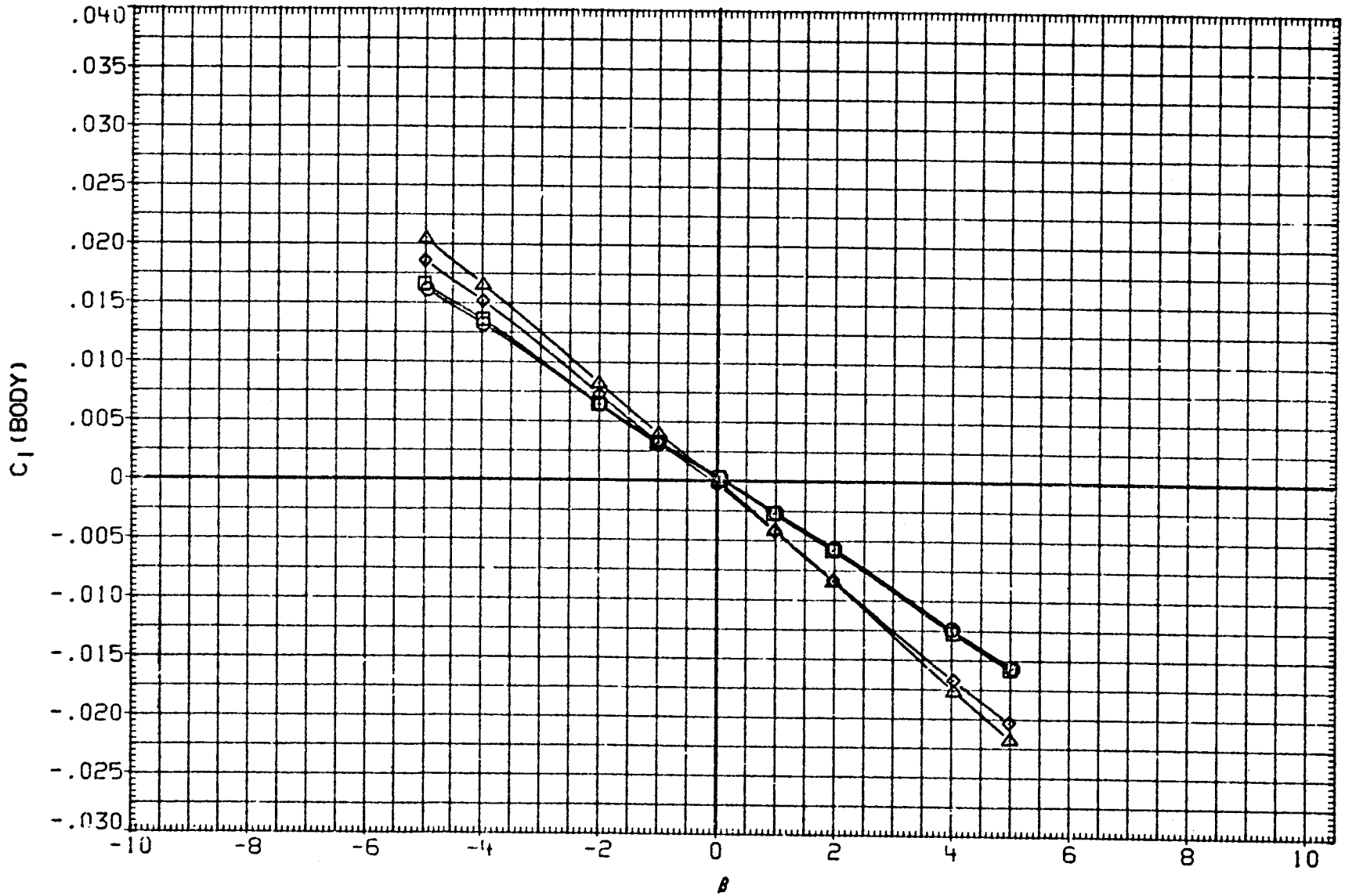
(A)MACH = .20

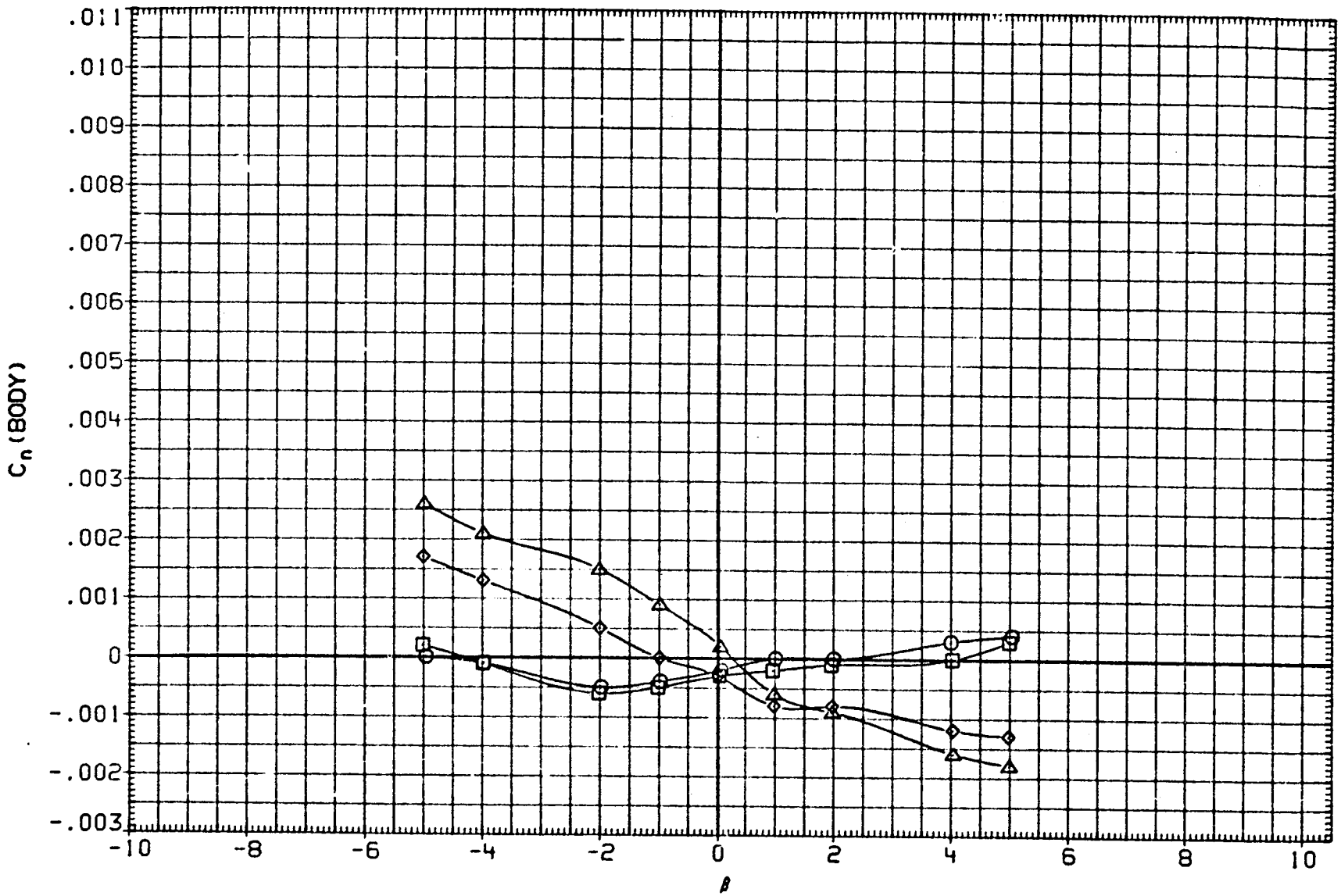
DATA SET	SYMBOL		CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ003	○	OA250	B26C9G15M16F8W116E43V8R5TC19	5.000	.200	.000	10.000	-12.000	.000	.000
RFQ008	□	OA250	B26C9G15M16F8W116E43V8R5TC19	5.000	.178	.000	10.000	-12.000	.000	.000
RFQ017	◇	OA250	B26C9G15M16F8W116E43V8R5TC19	5.000	.100	.000	10.000	-12.000	.000	.000
RFQ022	△	OA250	B26C9G15M16F8W116E43V8R5TC19	5.000	.075	.000	10.000	-12.000	.000	.000



GROUND PROXIMITY EFFECT, ELEVON DEFLECTION = 5.0

(A)MACH = .20

DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RF0003	○	0A250 B26C9G15M16F8W116E43V8R5TC19	5.000	.200	.000	10.000	-12.000	.000	.000
RF0008	□	0A250 B26C9G15M16F8W116E43V8R5TC19	5.000	.178	.000	10.000	-12.000	.000	.000
RF0017	◇	0A250 B26C9G15M16F8W116E43V8R5TC19	5.000	.100	.000	10.000	-12.000	.000	.000
RF0022	△	0A250 B26C9G15M16F8W116E43V8R5TC19	5.000	.075	.000	10.000	-12.000	.000	.000



GROUND PROXIMITY EFFECT, ELEVON DEFLECTION = 5.0

(A)MACH = .20

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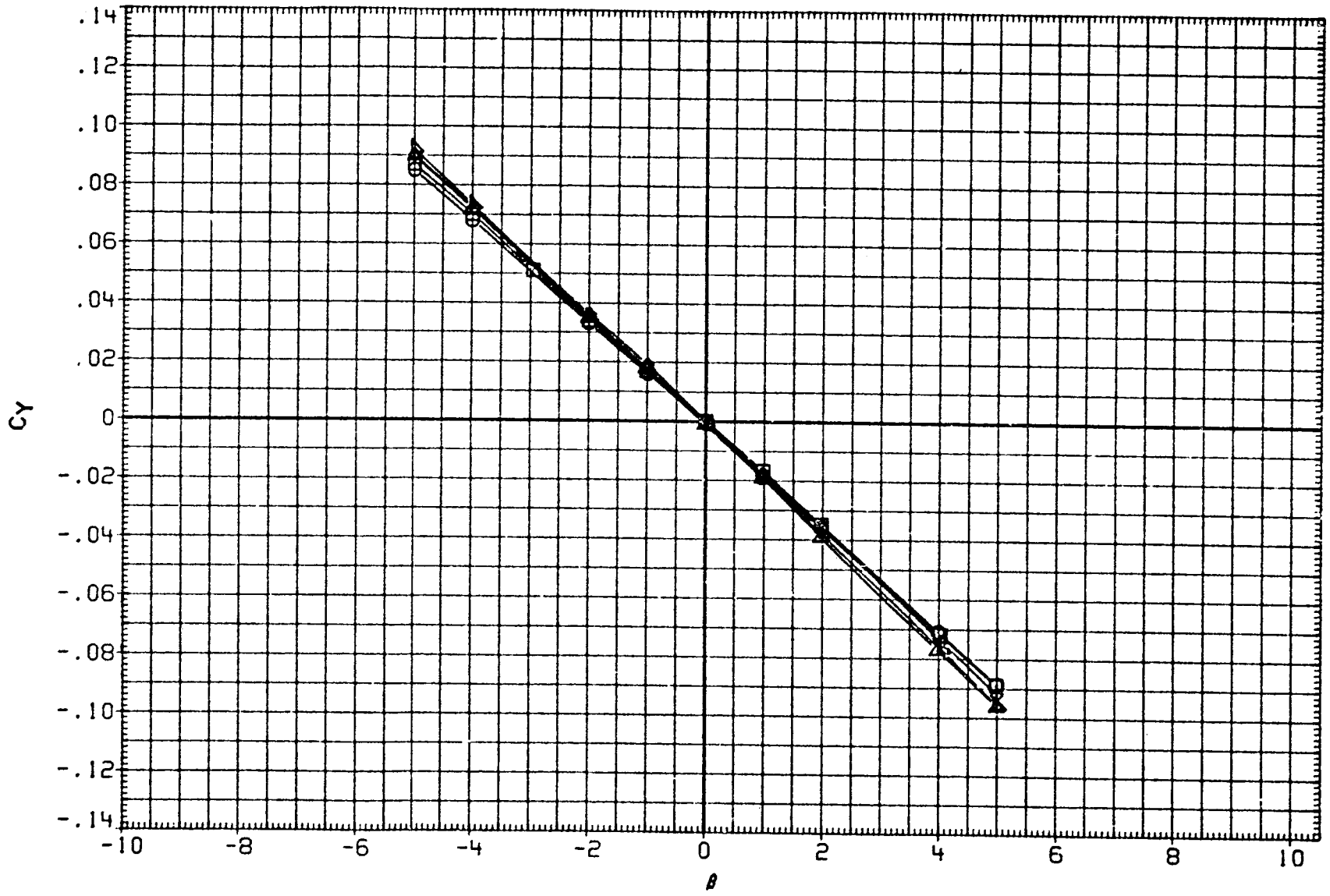
DATA SET	SYMBOL	CONFIGURATION		ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ005	○	OA250	B26C9G15M16F8W116E43V8R5...19	-5.000	.200	.000	10.000	-12.000	.000	.000
RFQ009	□	OA250	B26C9G15M16F8W116E43V8R5TC19	-5.000	.178	.000	10.000	-12.000	.000	.000
RFQ010	◇	OA250	B26C9G15M16F8W116E43V8R5TC19	-5.000	.125	.000	10.000	-12.000	.000	.000
RFQ018	△	OA250	B26C9G15M16F8W116E43V8R5TC19	-5.000	.100	.000	10.000	-12.000	.000	.000
RFQ023	▷	OA250	B26C9G15M16F8W116E43V8R5TC19	-5.000	.075	.000	10.000	-12.000	.000	.000



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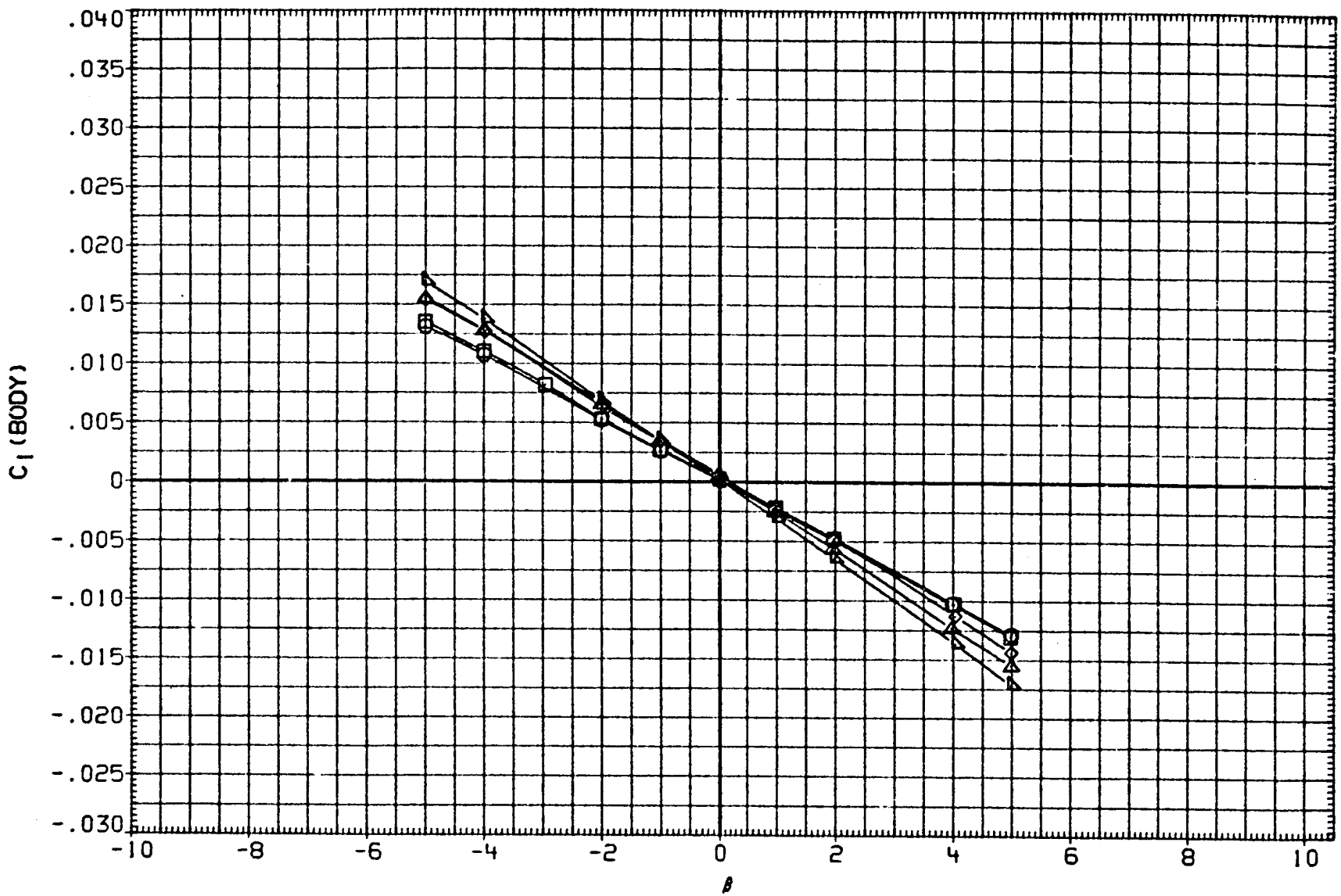
(A)MACH = .20

DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ005	○	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.200	.000	10.000	-12.000	.000	.000
RFQ009	□	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.178	.000	10.000	-12.000	.000	.000
RFQ010	◇	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.125	.000	10.000	-12.000	.000	.000
RFQ018	△	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.100	.000	10.000	-12.000	.000	.000
RFQ023	◺	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.075	.000	10.000	-12.000	.000	.000



GROUND PROXIMITY EFFECT, ELEVON DEFLECTION = -5.0

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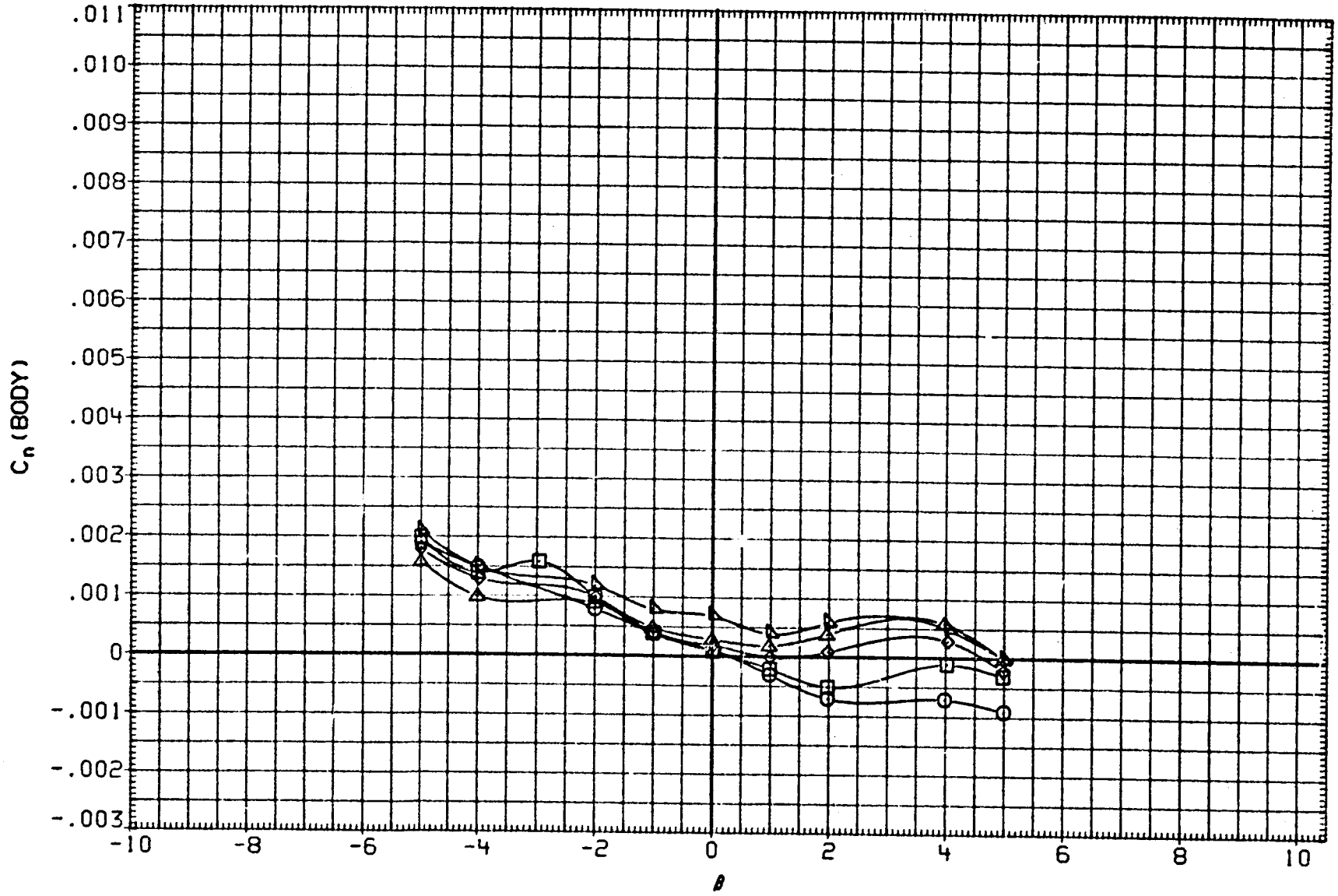
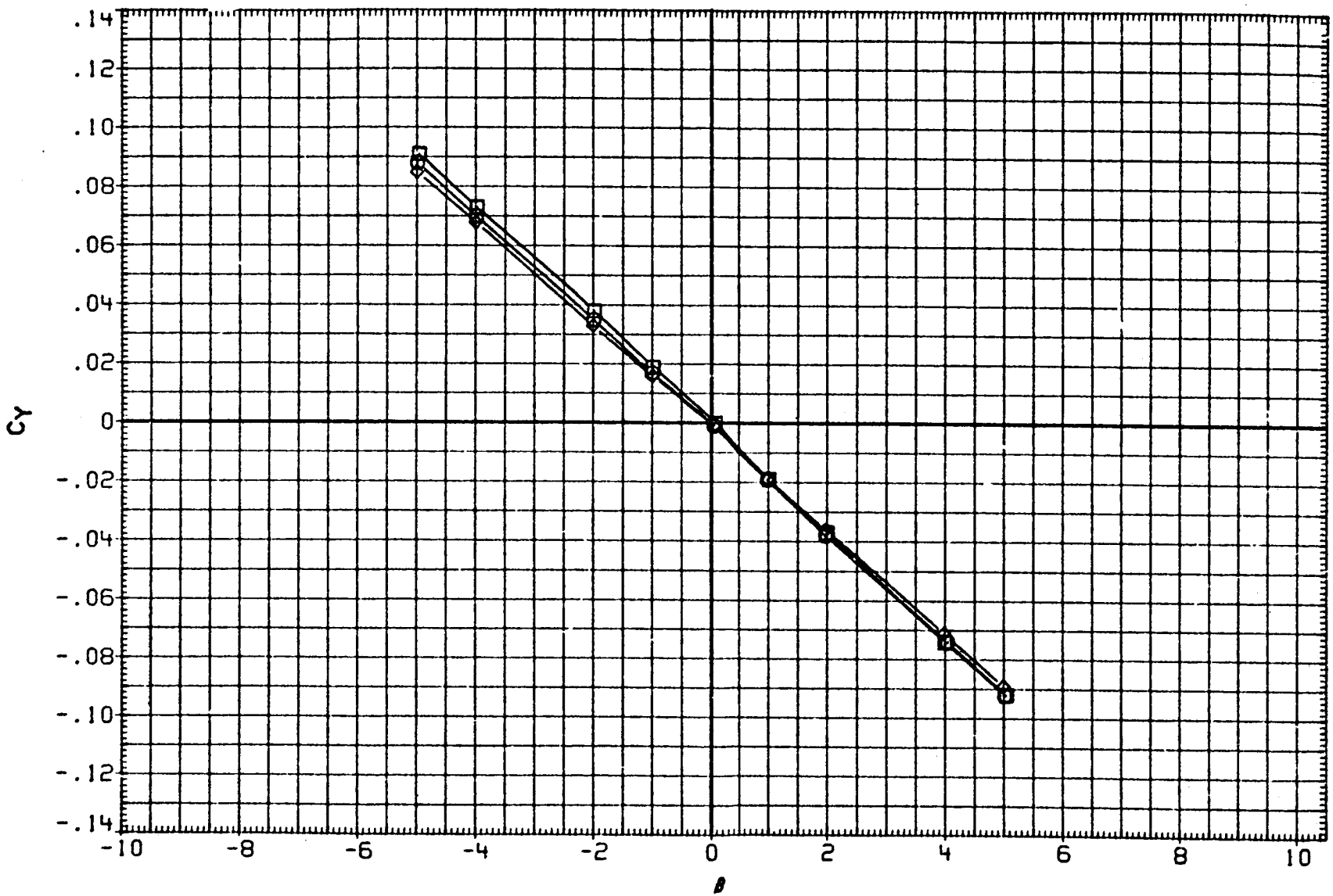
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ005	○	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.200	.000	10.000	-12.000	.000	.000
RFQ009	□	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.178	.000	10.000	-12.000	.000	.000
RFQ010	◇	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.125	.000	10.000	-12.000	.000	.000
RFQ018	△	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.100	.000	10.000	-12.000	.000	.000
RFQ023	◺	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.075	.000	10.000	-12.000	.000	.000



GROUND PROXIMITY EFFECT, ELEVON DEFLECTION = -5.0

(A)MACH = .20

DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ006	○	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.200	.000	10.000	-12.000	.000	.000
RFQ003	□	0A250 B26C9G15M16F8W116E43V8R5TC19	5.000	.200	.000	10.000	-12.000	.000	.000
RFQ005	◇	0A250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.200	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.20

(A)MACH = .20

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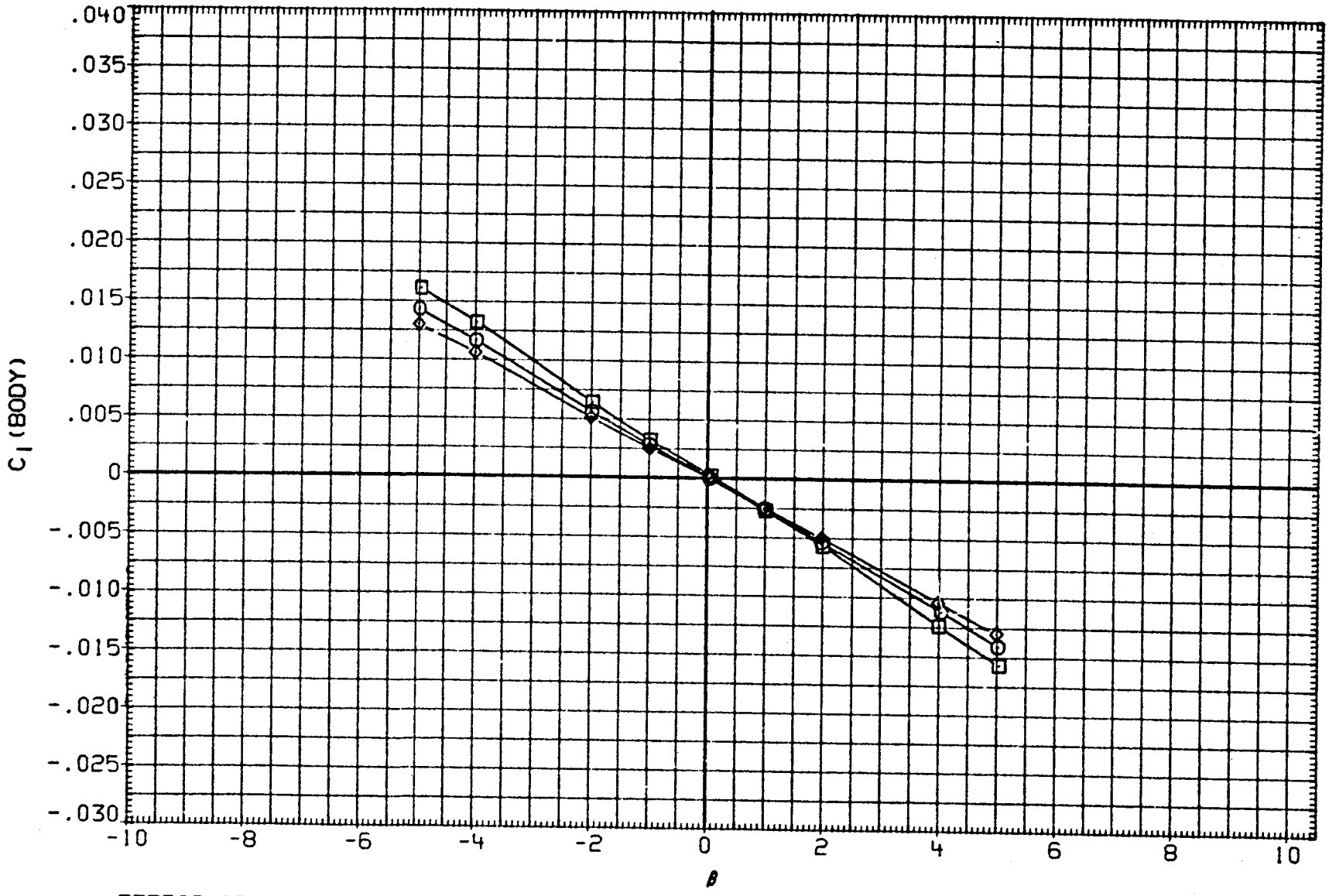
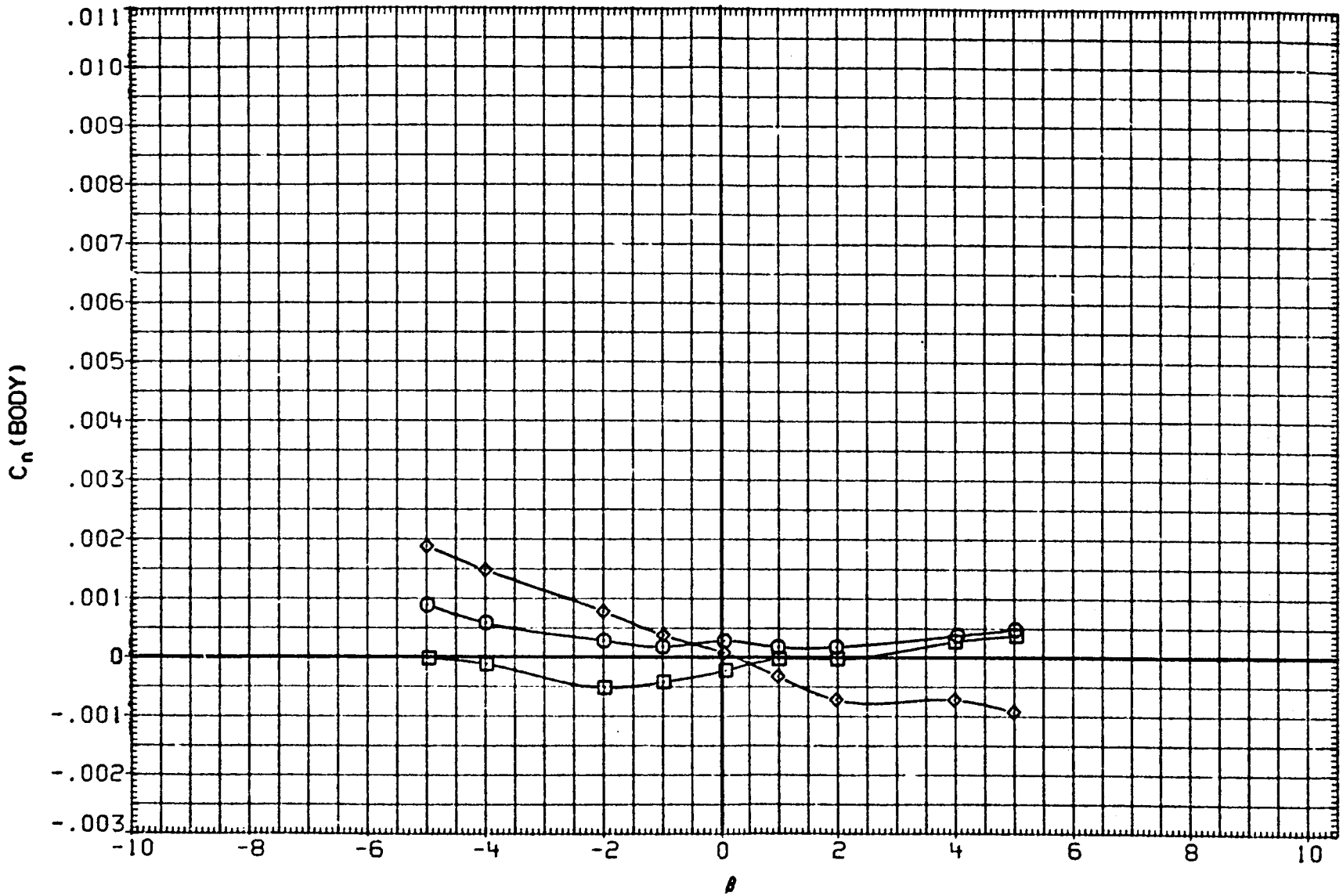
DATA SET	SYMBOL	CONFIGURATION		ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ006	○	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.200	.000	10.000	-12.000	.000	.000
RFQ003	□	OA250	B26C9G15M16F8W116E43V8R5TC19	5.000	.200	.000	10.000	-12.000	.000	.000
RFQ005	◇	OA250	B26C9G15M16F8W116E43V8R5TC19	-5.000	.200	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.20

(A) MACH = .20

DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ006	○	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.200	.000	10.000	-12.000	.000	.000
RFQ003	□	OA250 B26C9G15M16F8W116E43V8R5TC19	5.000	.200	.000	10.000	-12.000	.000	.000
RFQ005	◇	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.200	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.20

(A) MACH = .20

DATA SET	SYMBOL	CONFIGURATION
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RFQ008	□	0A250 B26C9G15M16F8W116E43V8R5TC19
RFQ009	◇	0A250 B26C9G15M16F8W116E43V8R5TC19

ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
.000	.178	.000	10.000	-12.000	.000	.000
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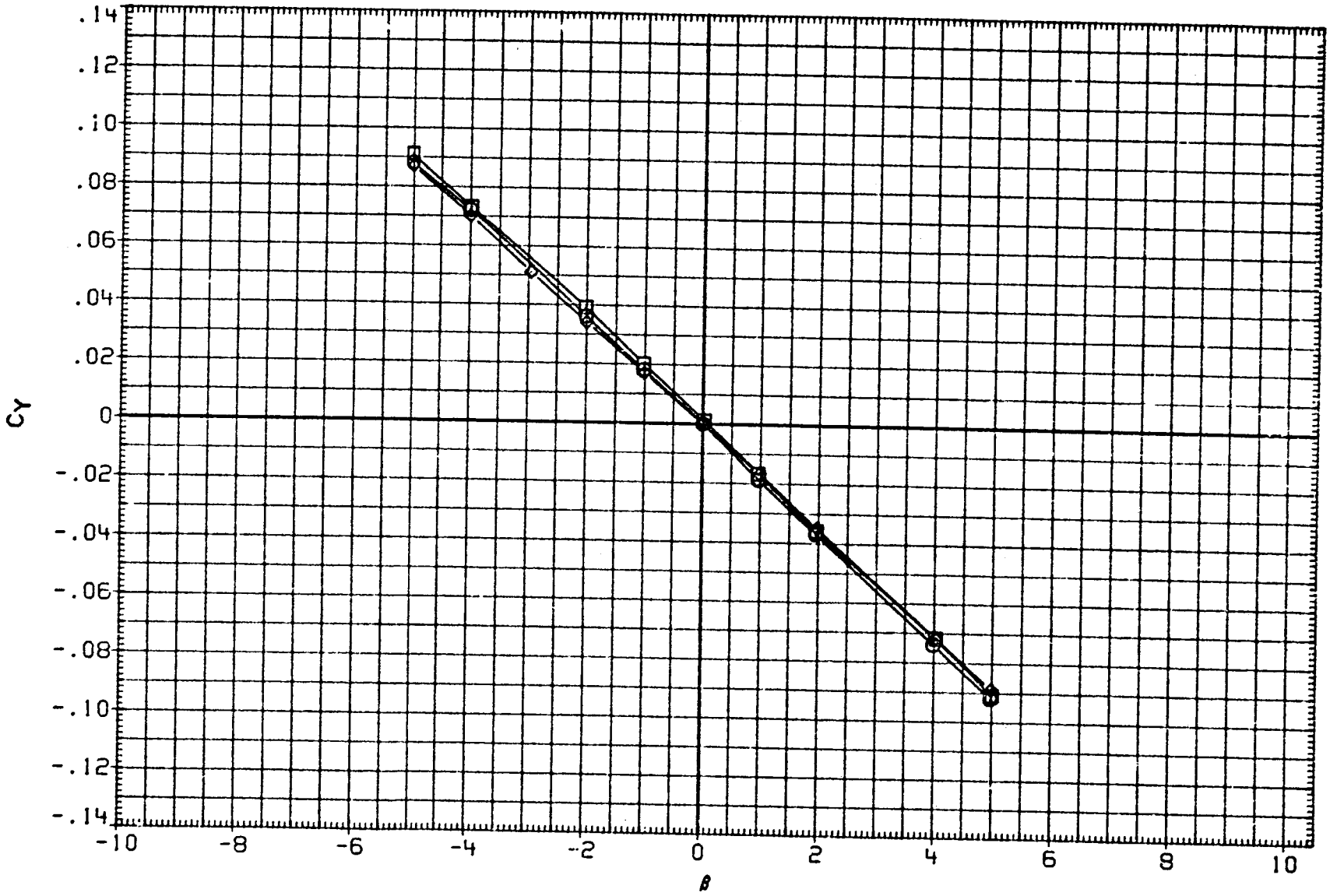
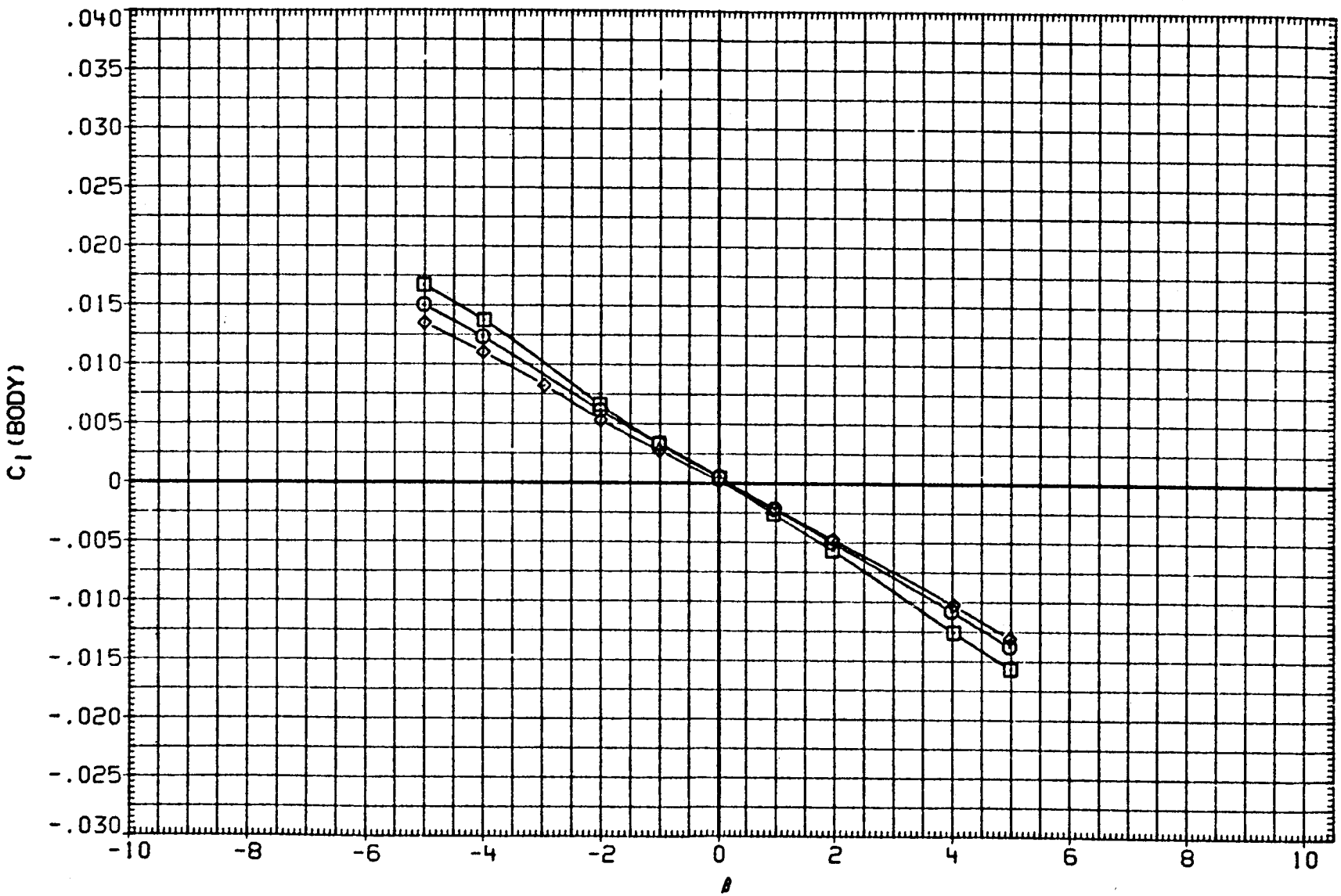
-5.000	.178	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.178

(A)MACH = .20

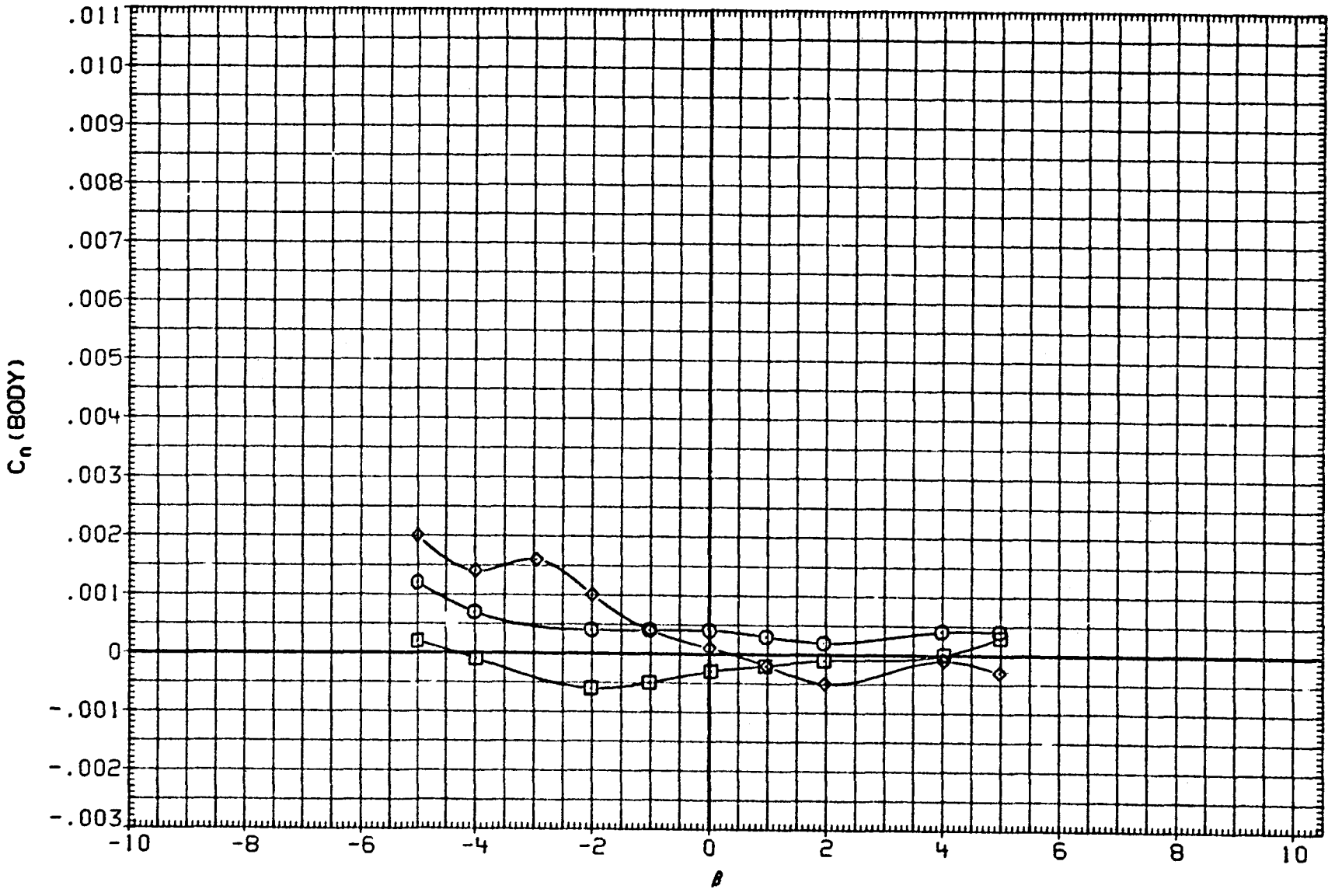
DATA SET	SYMBOL		CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ007	○	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.178	.000	10.000	-12.000	.000	.000
RFQ008	□	OA250	B26C9G15M16F8W116E43V8R5TC19	5.000	.178	.000	10.000	-12.000	.000	.000
RFQ009	◇	OA250	B26C9G15M16F8W116E43V8R5TC19	-5.000	.178	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.178

(A) MACH = .20

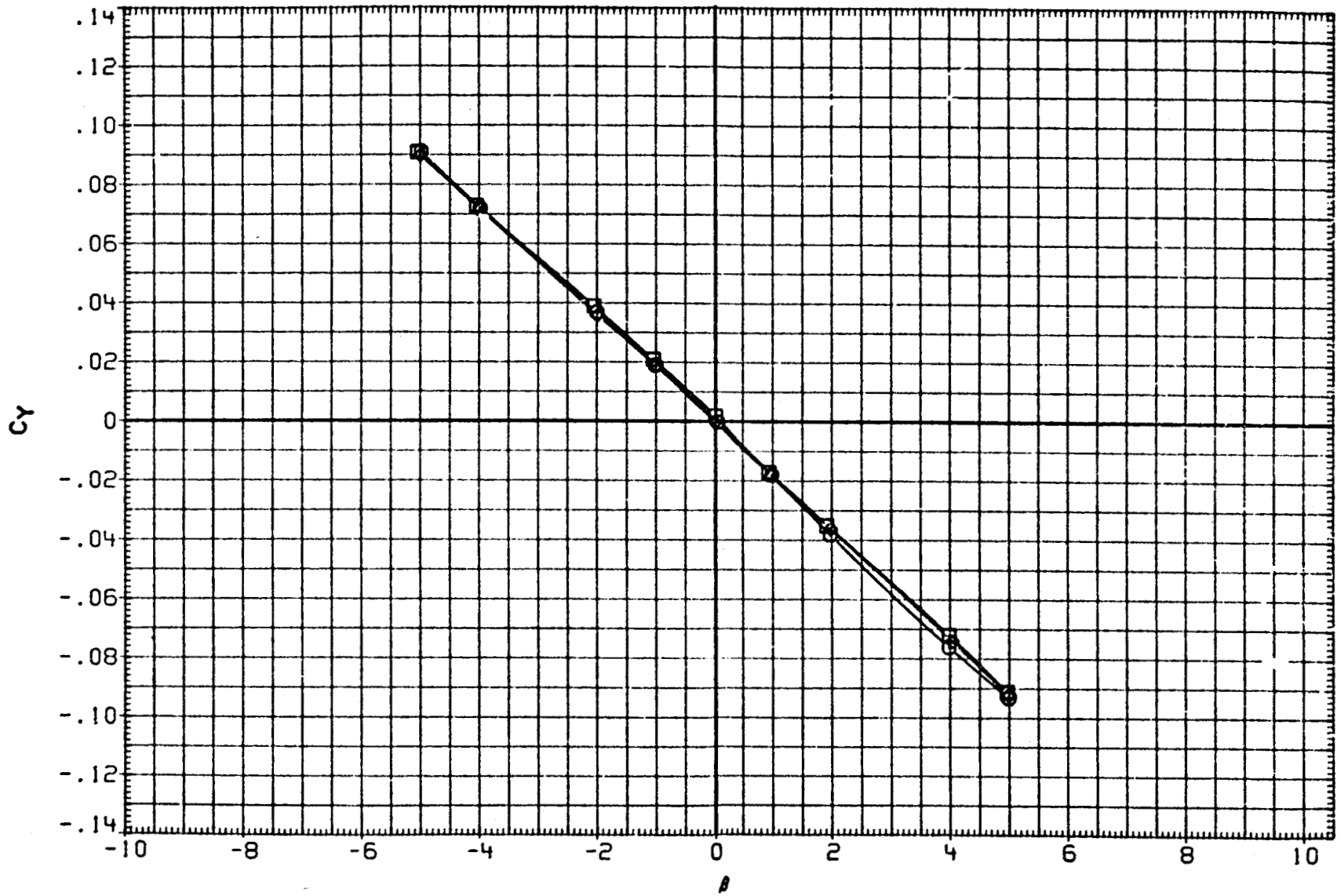
DATA SET	SYMBOL		CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RF0007	○	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.178	.000	10.000	-12.000	.000	.000
RF0008	□	OA250	B26C9G15M16F8W116E43V8R5TC19	5.000	.178	.000	10.000	-12.000	.000	.000
RF0009	◇	OA250	B26C9G15M16F8W116E43V8R5TC19	-5.000	.178	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.178

(A)MACH = .20

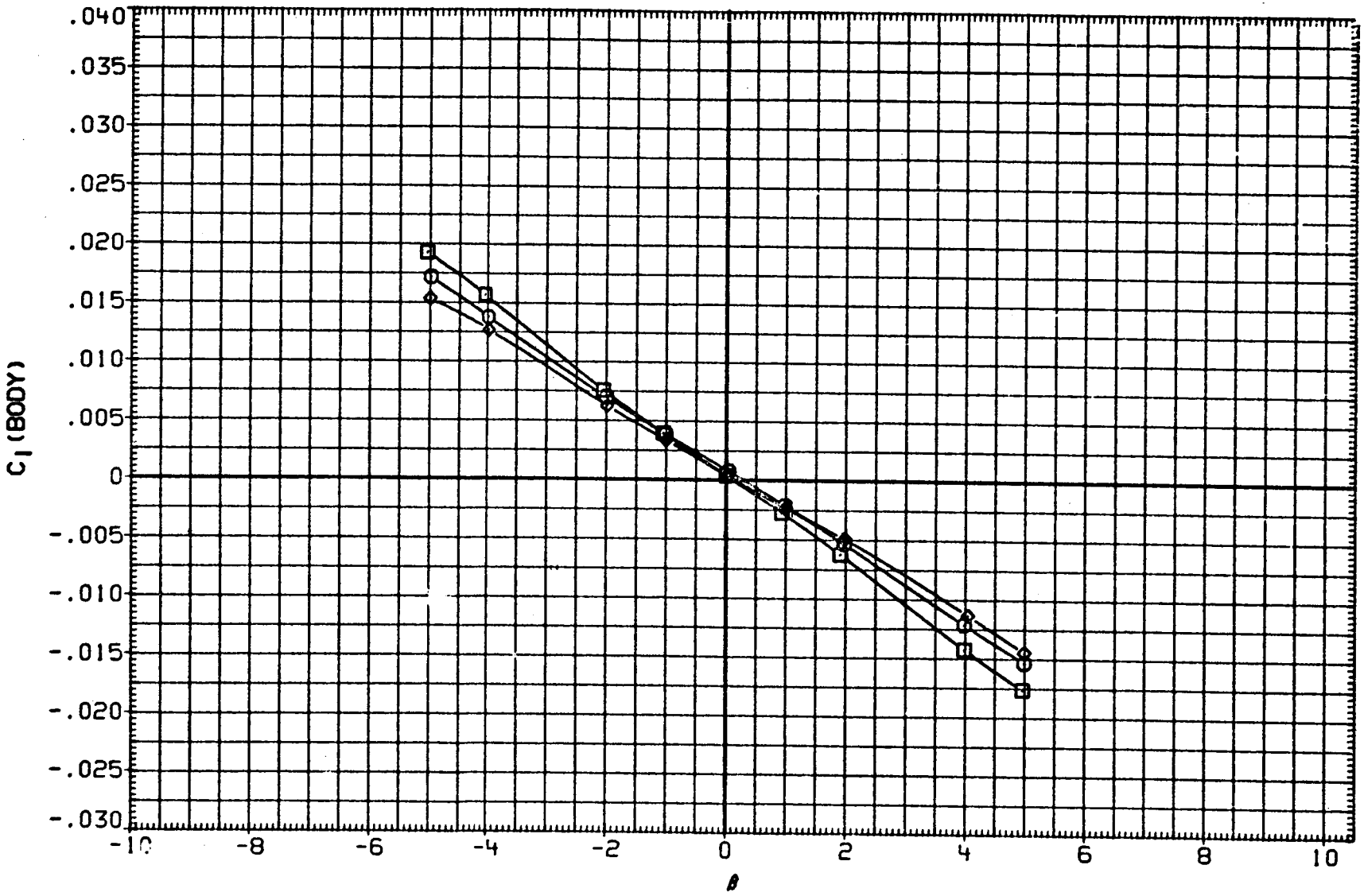
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BOFLAP	RUDDER	SPDBRK
RFQ014	○	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.125	.000	10.000	-12.000	.000	.000
RFQ011	□	OA250 B26C9G15M16F8W116E43V8R5TC19	5.000	.125	.000	10.000	-12.000	.000	.000
RFQ010	◇	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.125	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.125

(A)MACH = .20

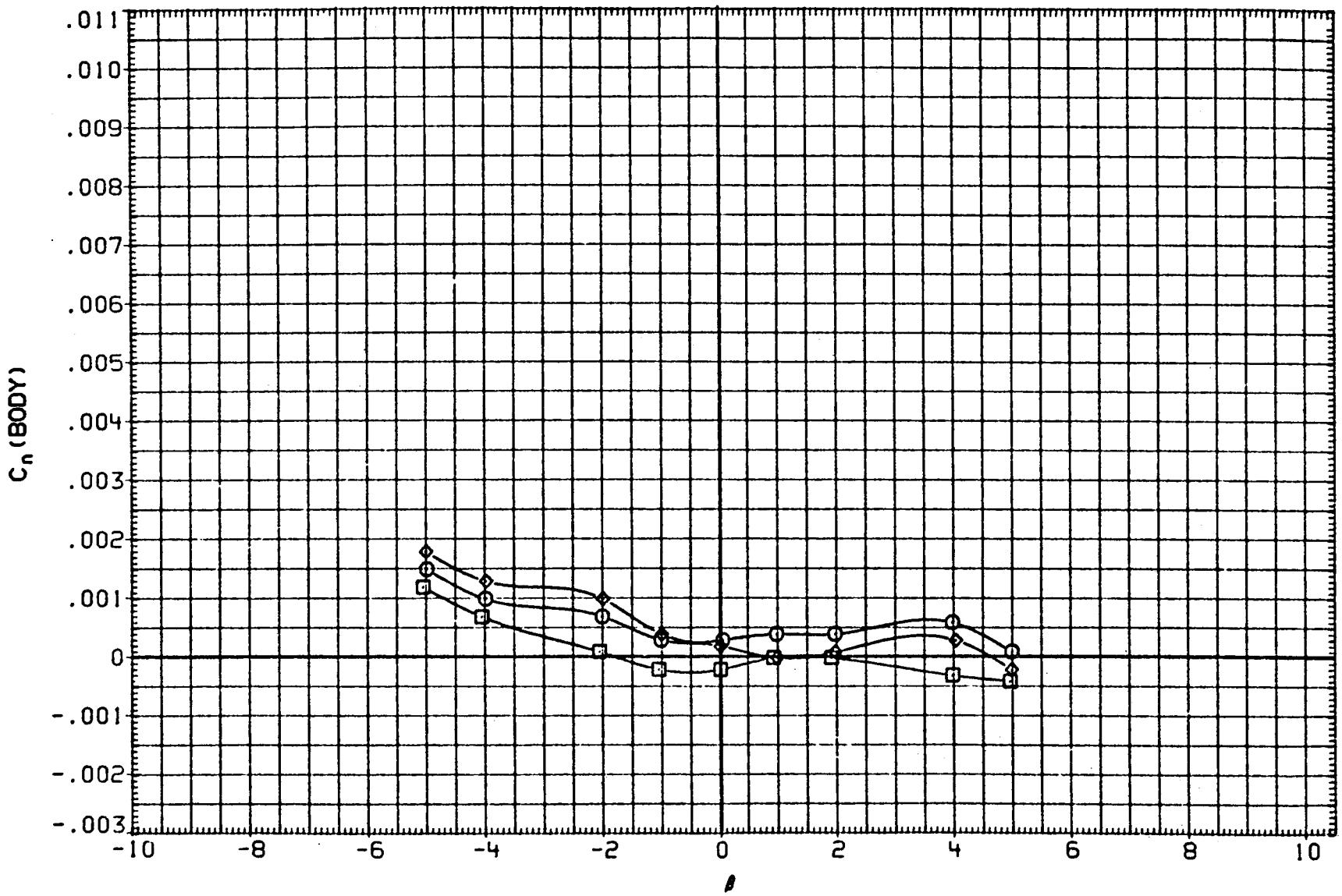
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BOFLAP	RUDDER	SPDBRK
RF0014	○	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.125	.000	10.000	-12.000	.000	.000
RF0011	□	0A250 B26C9G15M16F8W116E43V8R5TC19	5.000	.125	.000	10.000	-12.000	.000	.000
RF0010	◇	0A250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.125	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.125

(A)MACH = .20

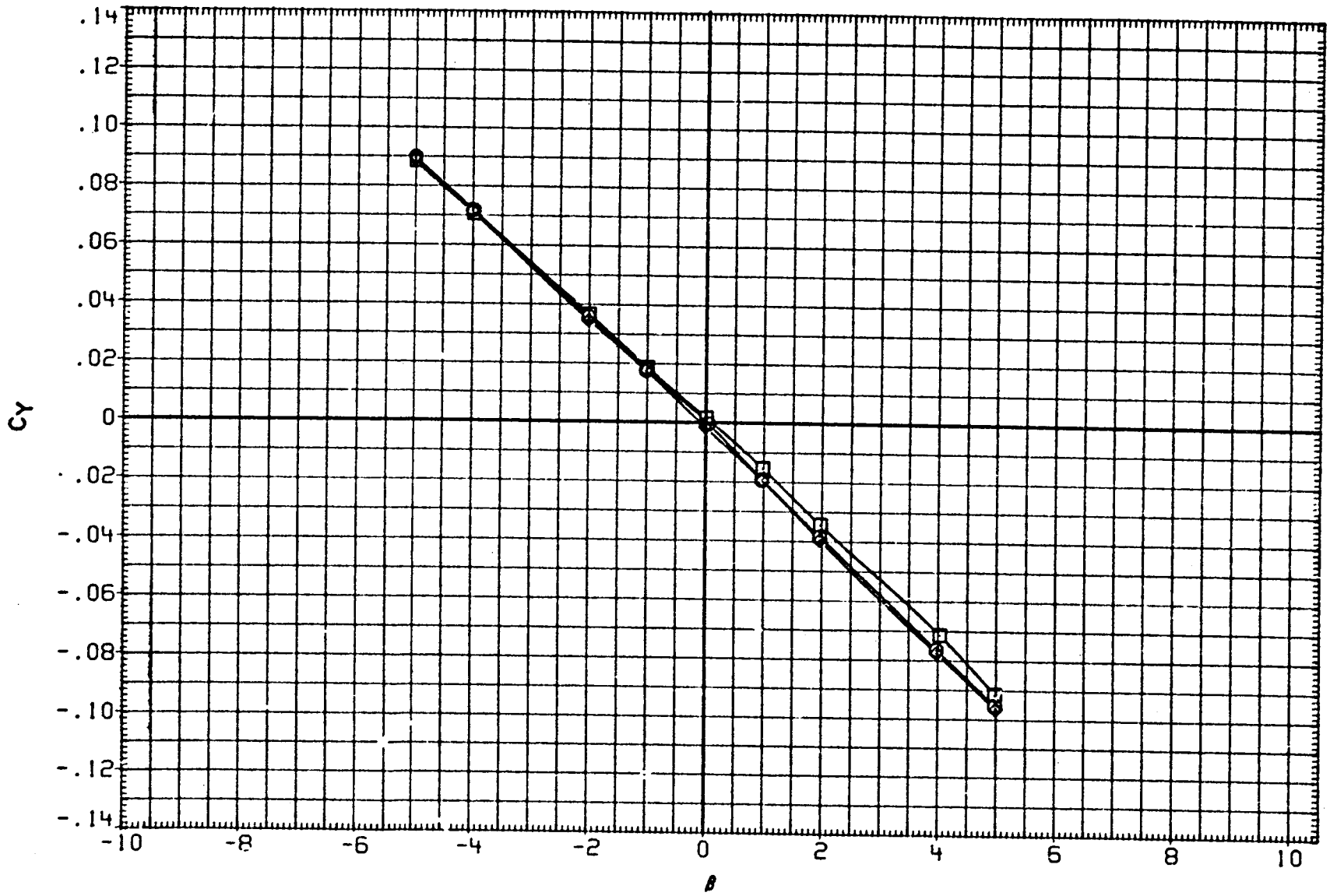
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ014	○	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.125	.000	10.000	-12.000	.000	.000
RFQ011	□	OA250 B26C9G15M16F8W116E43V8R5TC19	5.000	.125	.000	10.000	-12.000	.000	.000
RFQ010	◇	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.125	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.125

(A) MACH = .20

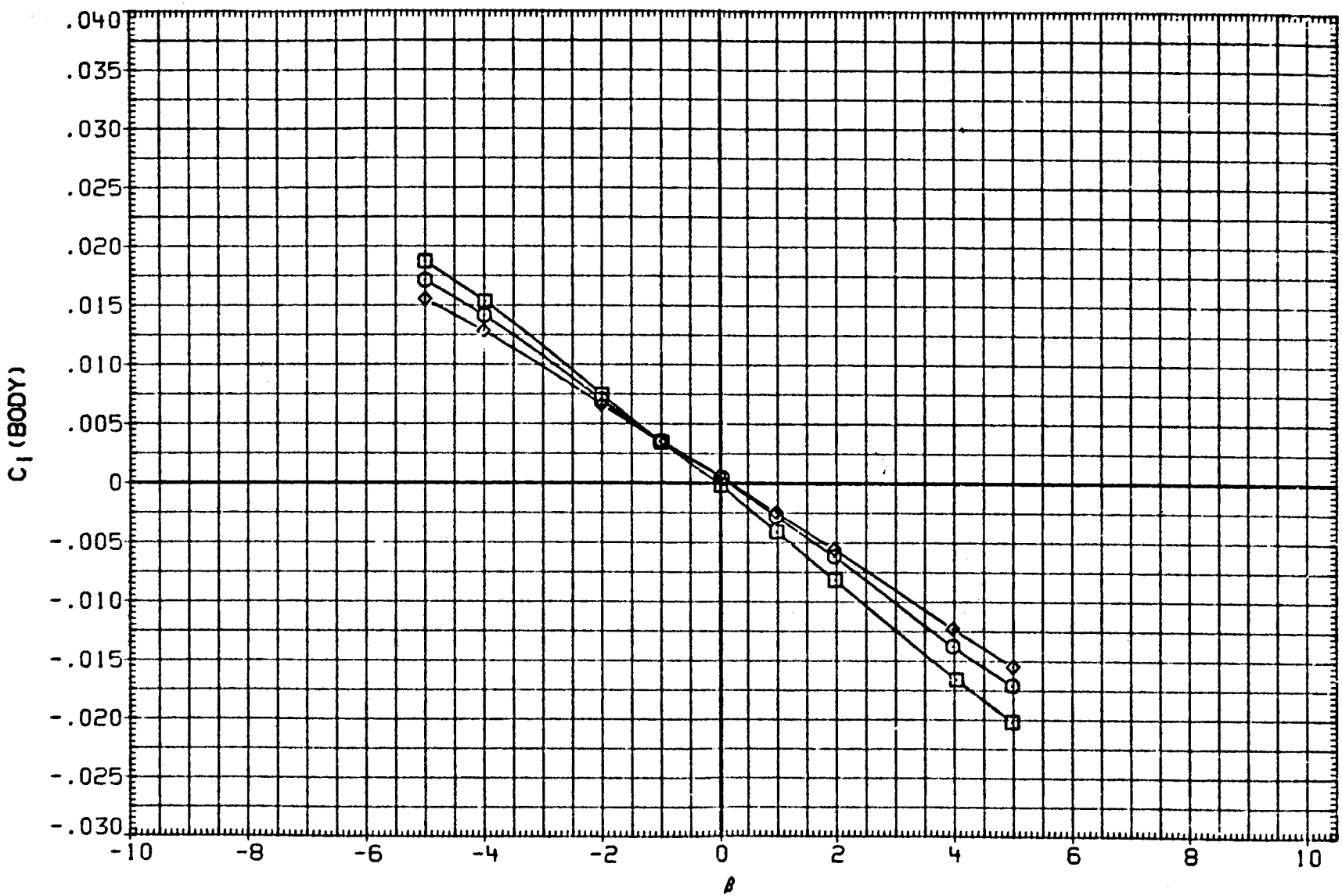
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ016	○	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.100	.000	10.000	-12.000	.000	.000
RFQ017	□	OA250 B26C9G15M16F8W116E43V8R5TC19	5.000	.100	.000	10.000	-12.000	.000	.000
RFQ018	◇	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.100	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.10

(A)MACH = .20

DATA SET	SYMBOL		CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ016	○	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.100	.000	10.000	-12.000	.000	.000
RFQ017	□	OA250	B26C9G15M16F8W116E43V8R5TC19	5.000	.100	.000	10.000	-12.000	.000	.000
RFQ018	◇	OA250	B26C9G15M16F8W116E43V8R5TC19	-5.000	.100	.000	10.000	-12.000	.000	.000

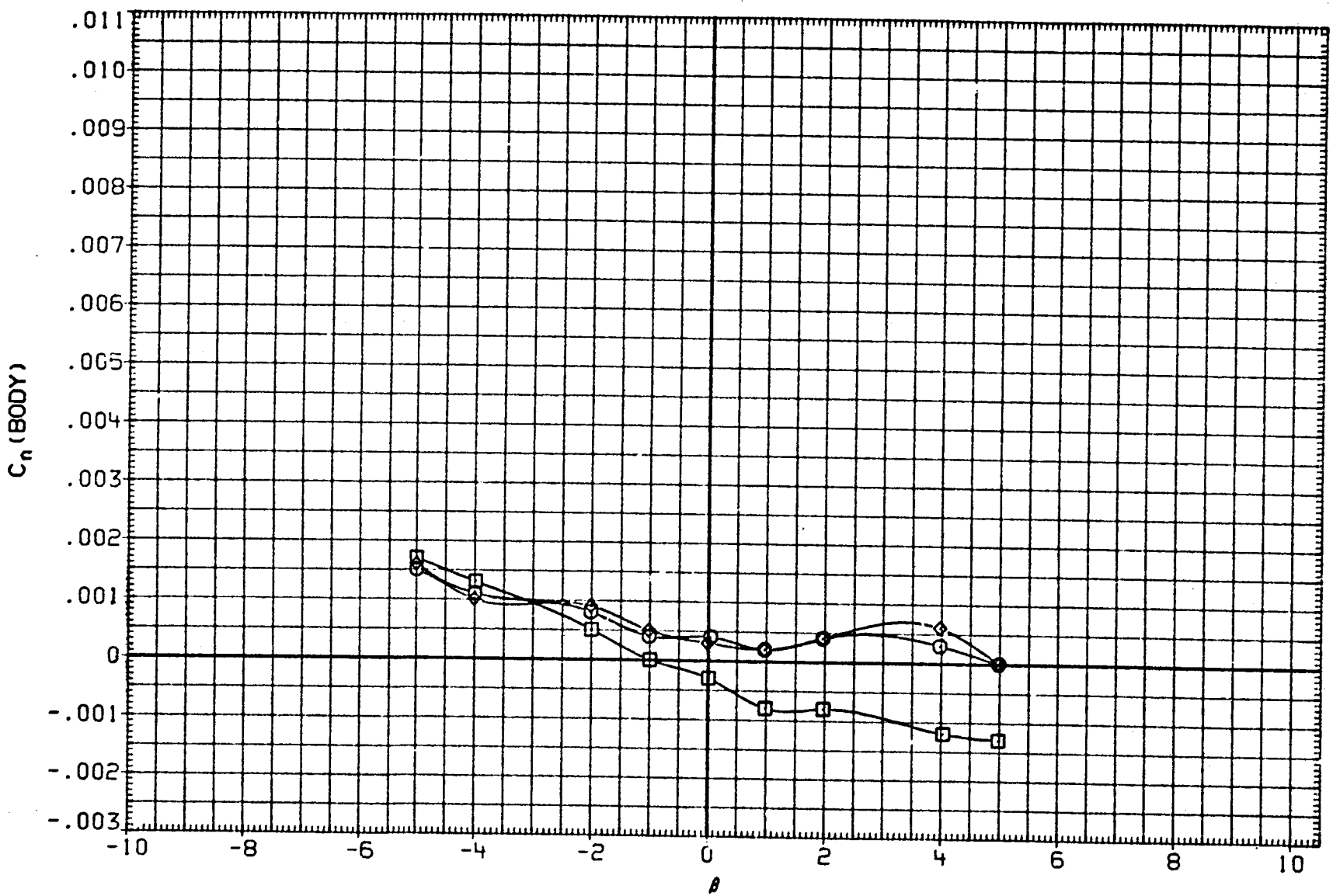


EFFECT OF ELEVON DEFLECTION, H/B = 0.10

(A)MACH = .20

DATA SET	SYMBOL	CONFIGURATION
RF0016	○	0A250 B26C9G15M16F8W116E43V8R5TC19
RF0017	□	0A250 B26C9G15M16F8W116E43V8R5TC19
RF0018	◇	0A250 B26C9G15M16F8W116E43V8R5TC19

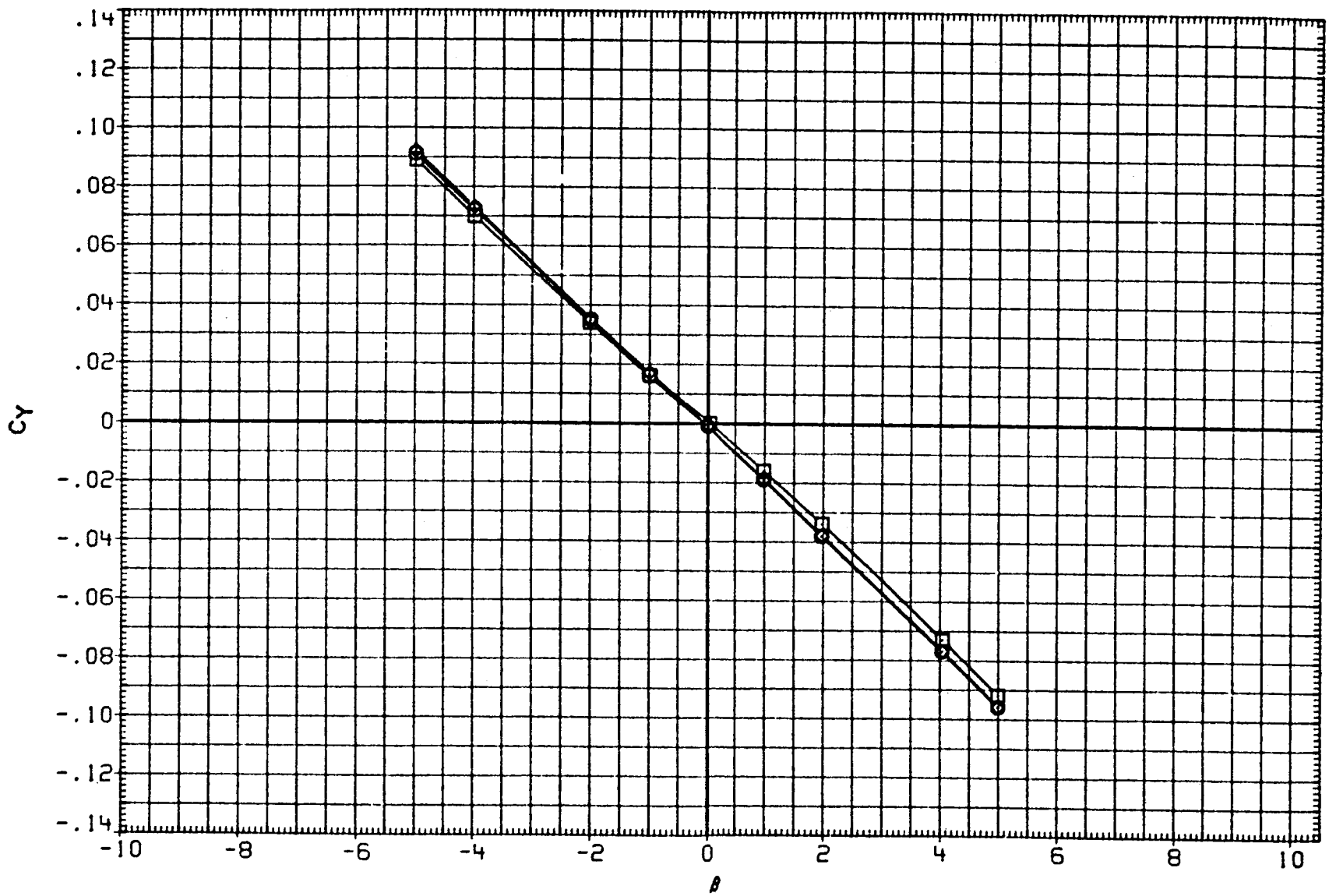
ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
.000	.100	.000	10.000	-12.000	.000	.000
5.000	.100	.000	10.000	-12.000	.000	.000
-5.000	.100	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.10

(A)MACH = .20

DATA SET	SYMBOL		CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ021	○	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.075	.000	10.000	-12.000	.000	.000
RFQ022	□	OA250	B26C9G15M16F8W116E43V8R5TC19	5.000	.075	.000	10.000	-12.000	.000	.000
RFQ023	◇	OA250	B26C9G15M16F8W116E43V8R5TC19	-5.000	.075	.000	10.000	-12.000	.000	.000

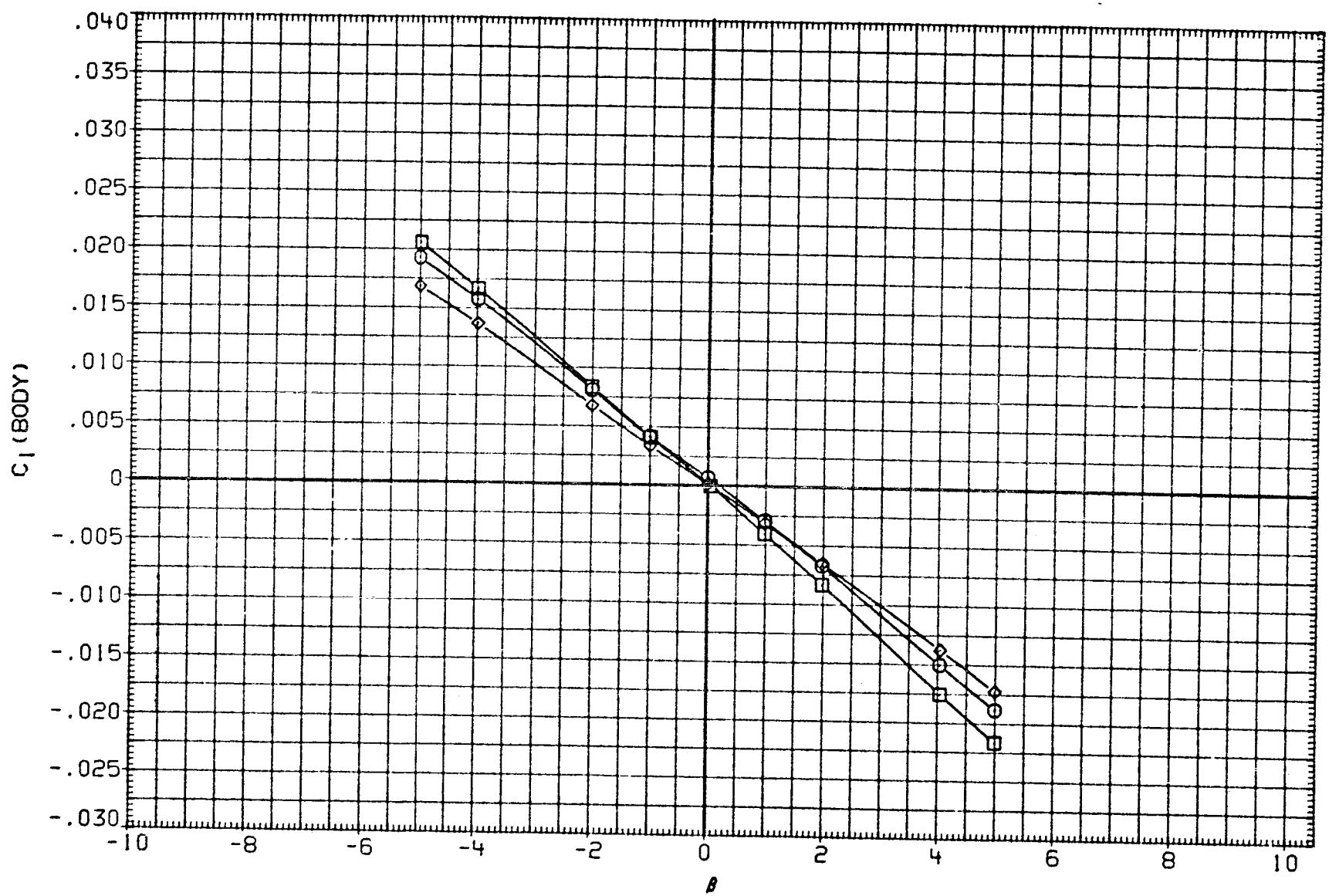


EFFECT OF ELEVON DEFLECTION, H/B = 0.075

(A)MACH = .20

DATA SET	SYMBOL	CONFIGURATION
RF0021	○	0A250 B26C9G15M16F8W116E43V8R5TC19
RF0022	□	0A250 B26C9G15M16F8W116E43V8R5TC19
RF0023	◇	0A250 B26C9G15M16F8W116E43V8R5TC19

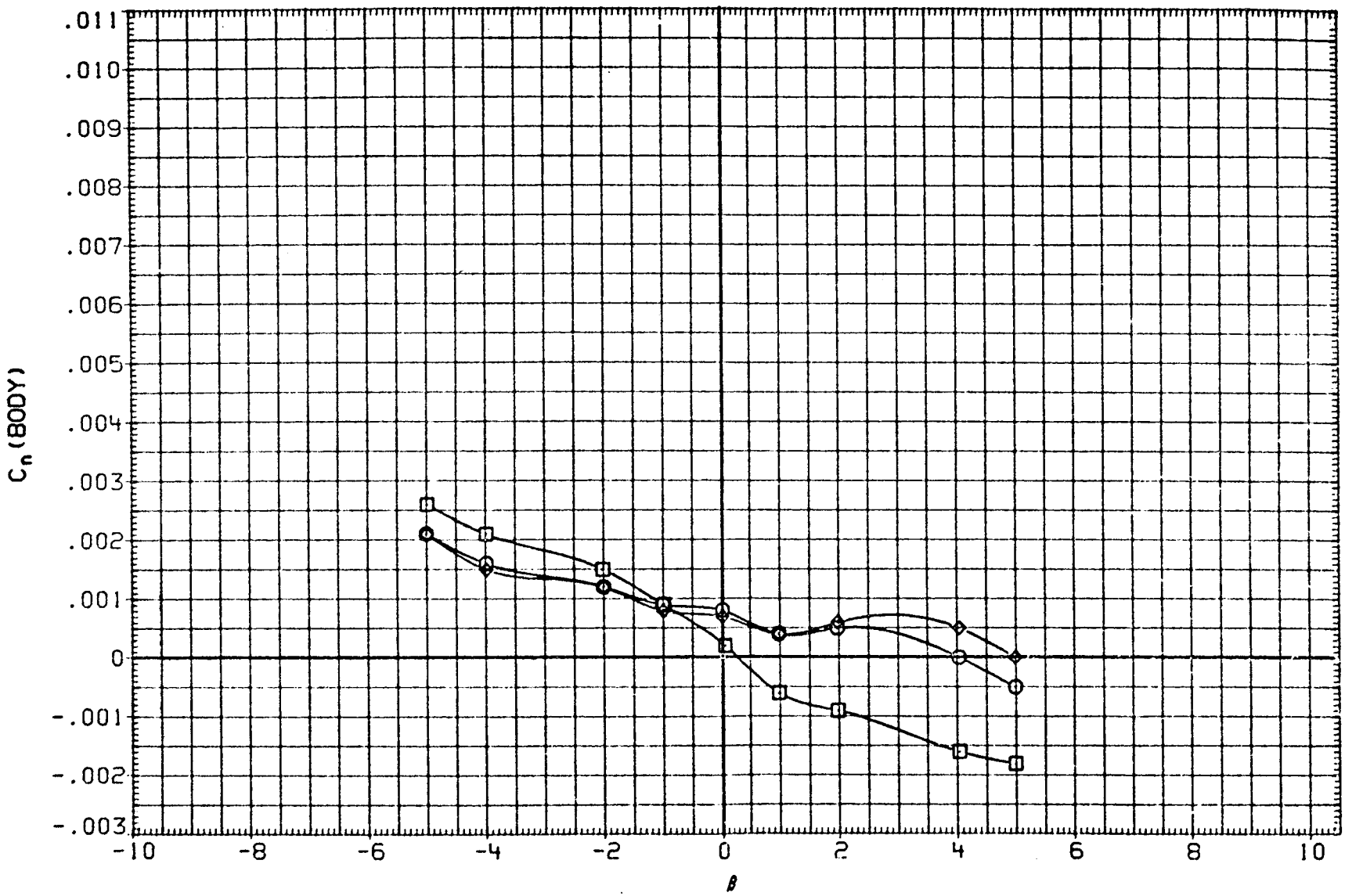
ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
.000	.075	.000	10.000	-12.000	.000	.000
5.000	.075	.000	10.000	-12.000	.000	.000
-5.000	.075	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.075

(A)MACH = .20

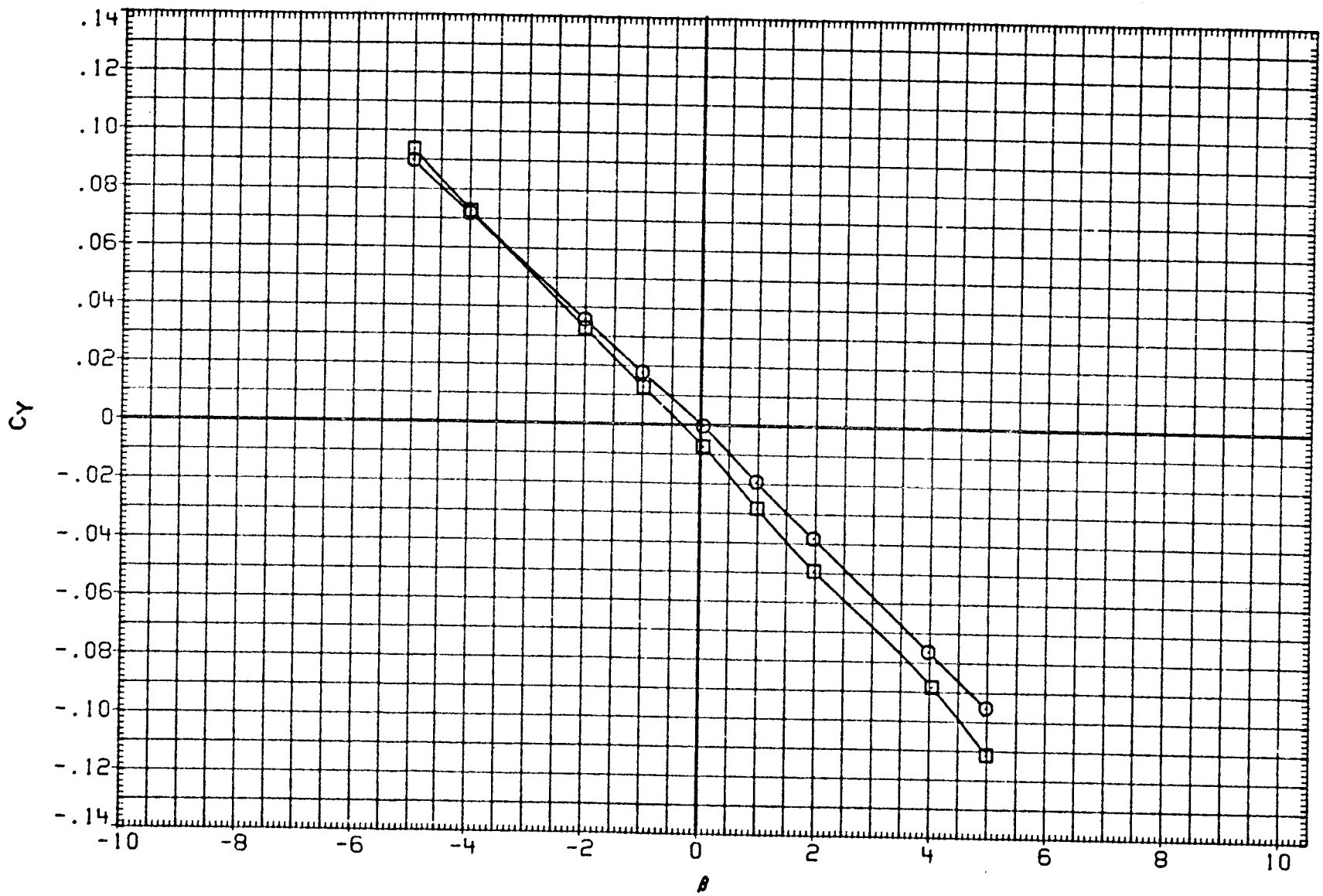
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ021	○	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.075	.000	10.000	-12.000	.000	.000
RFQ022	□	OA250 B26C9G15M16F8W116E43V8R5TC19	5.000	.075	.000	10.000	-12.000	.000	.000
RFQ023	◇	OA250 B26C9G15M16F8W116E43V8R5TC19	-5.000	.075	.000	10.000	-12.000	.000	.000



EFFECT OF ELEVON DEFLECTION, H/B = 0.075

(A) MACH = .20

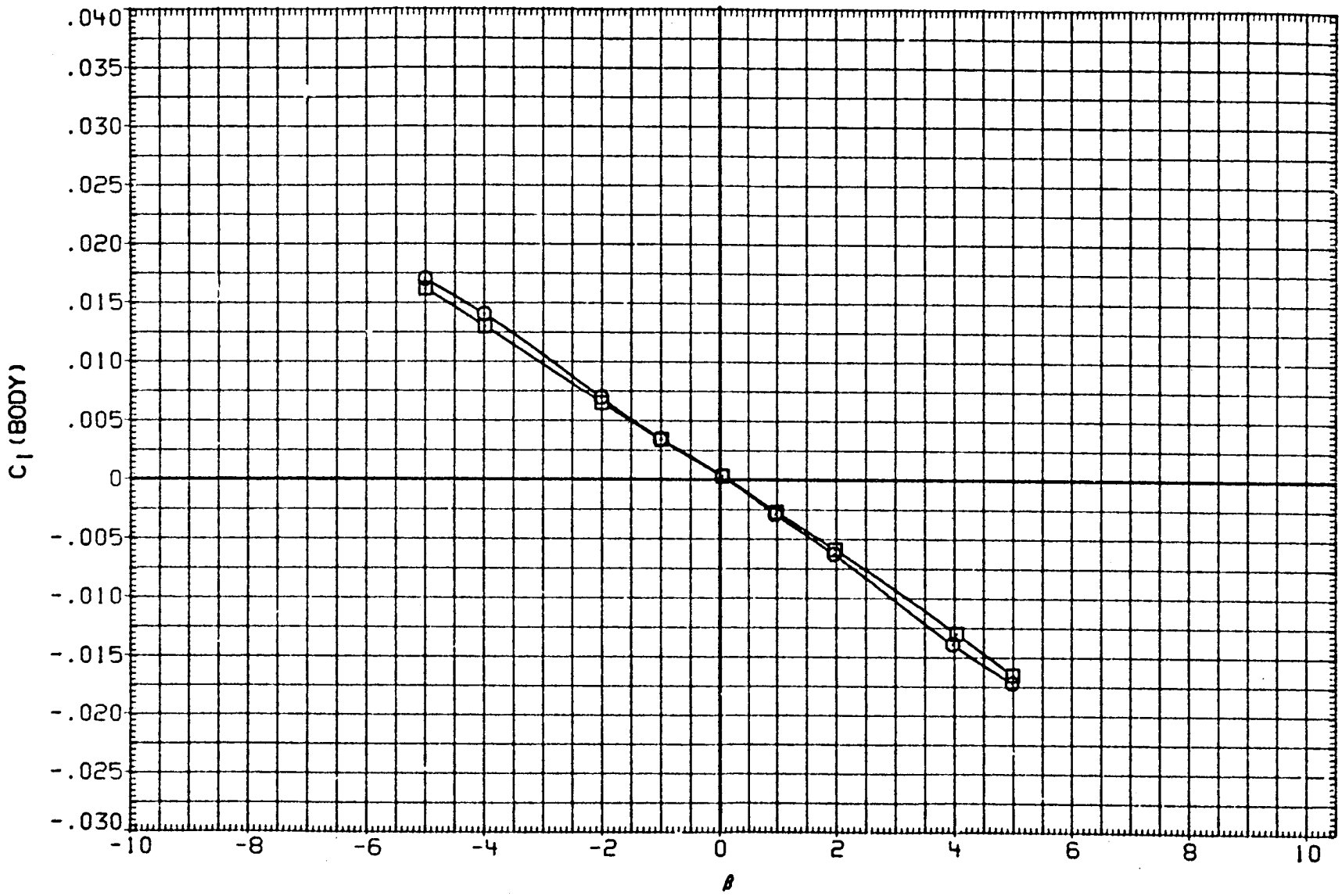
DATA SET	SYMBOL	CONFIGURATION		ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ016	○	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.100	.000	10.000	-12.000	.000	.000
RFQ020	□	OA250	B26C9G15M16N24N2BF8W116E43V8R5	.000	.100	.000	10.000	-12.000	.000	.000



EFFECT OF TAILCONE, H/B = 0.10

(A) MACH = .20

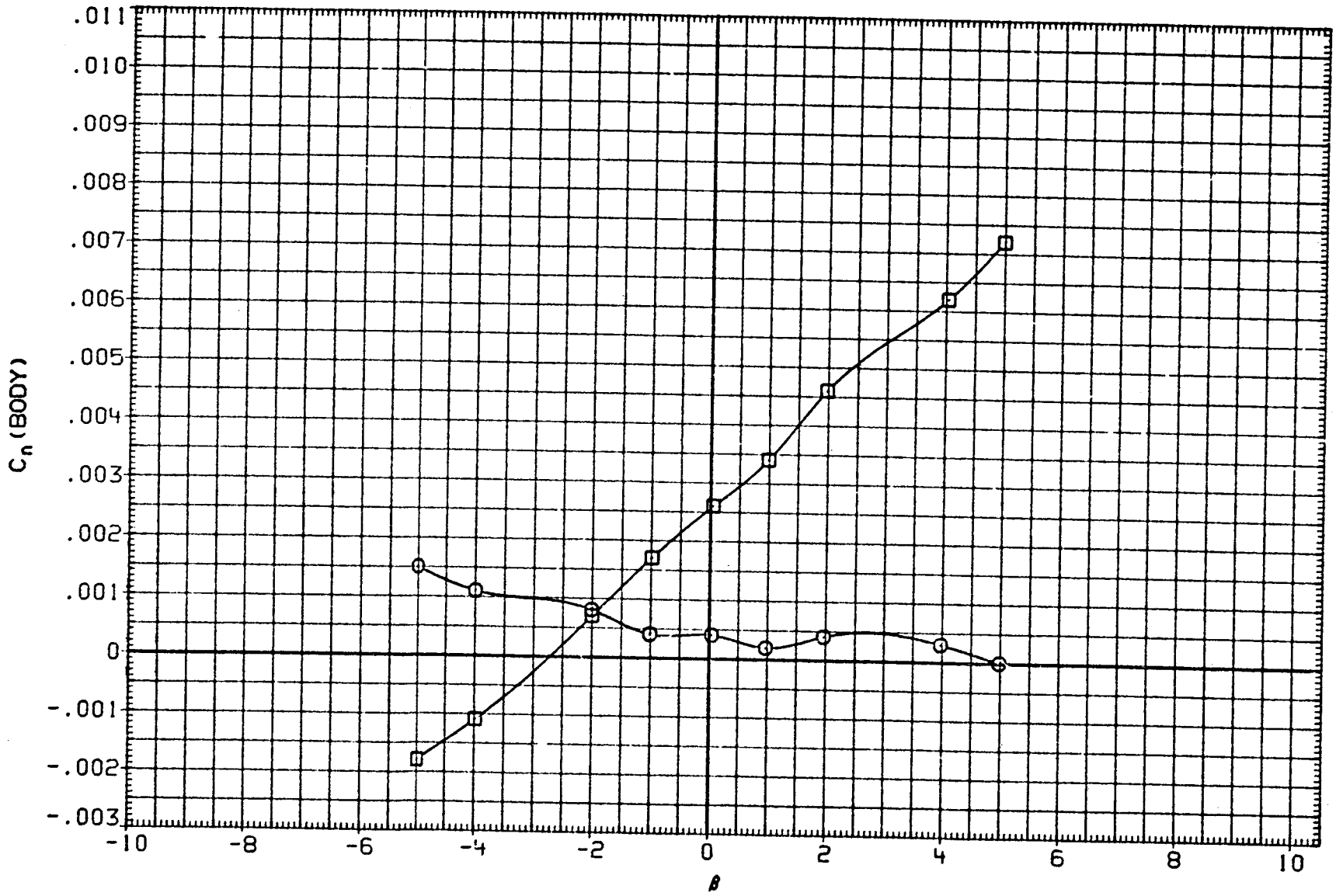
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ016	○	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.100	.000	10.000	-12.000	.000	.000
RFQ020	□	OA250 B26C9G15M16N24N28F8W116E43V8R5	.000	.100	.000	10.000	-12.000	.000	.000



EFFECT OF TAILCONE, H/B = 0.10

(A) MACH = .20

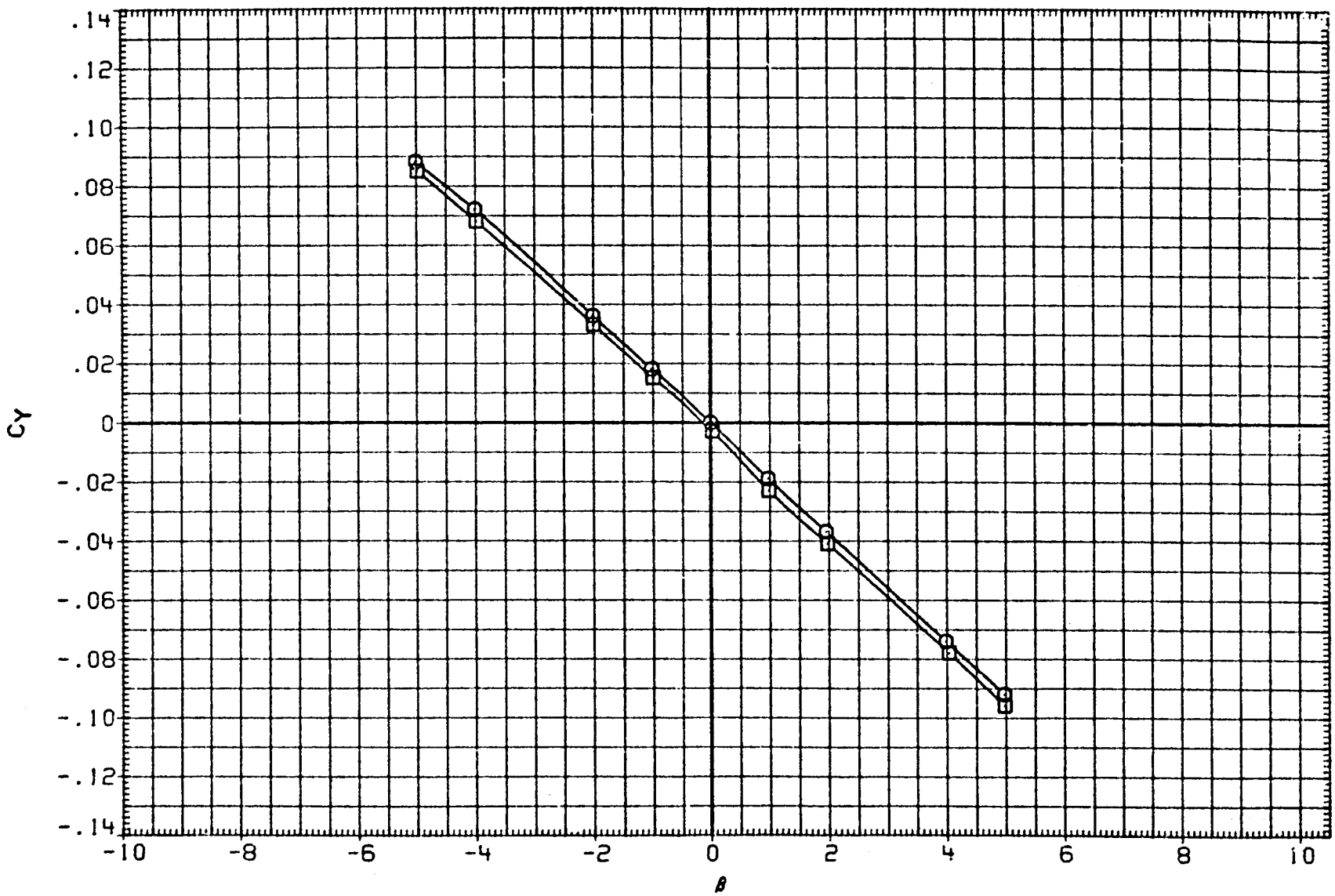
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RF0016	○	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.100	.000	10.000	-12.000	.000	.000
RF0020	□	0A250 B26C9G15M16N24N28F8W116E43V8R5	.000	.100	.000	10.000	-12.000	.000	.000



EFFECT OF TAILCONE, H/B = 0.10

(A)MACH = .20

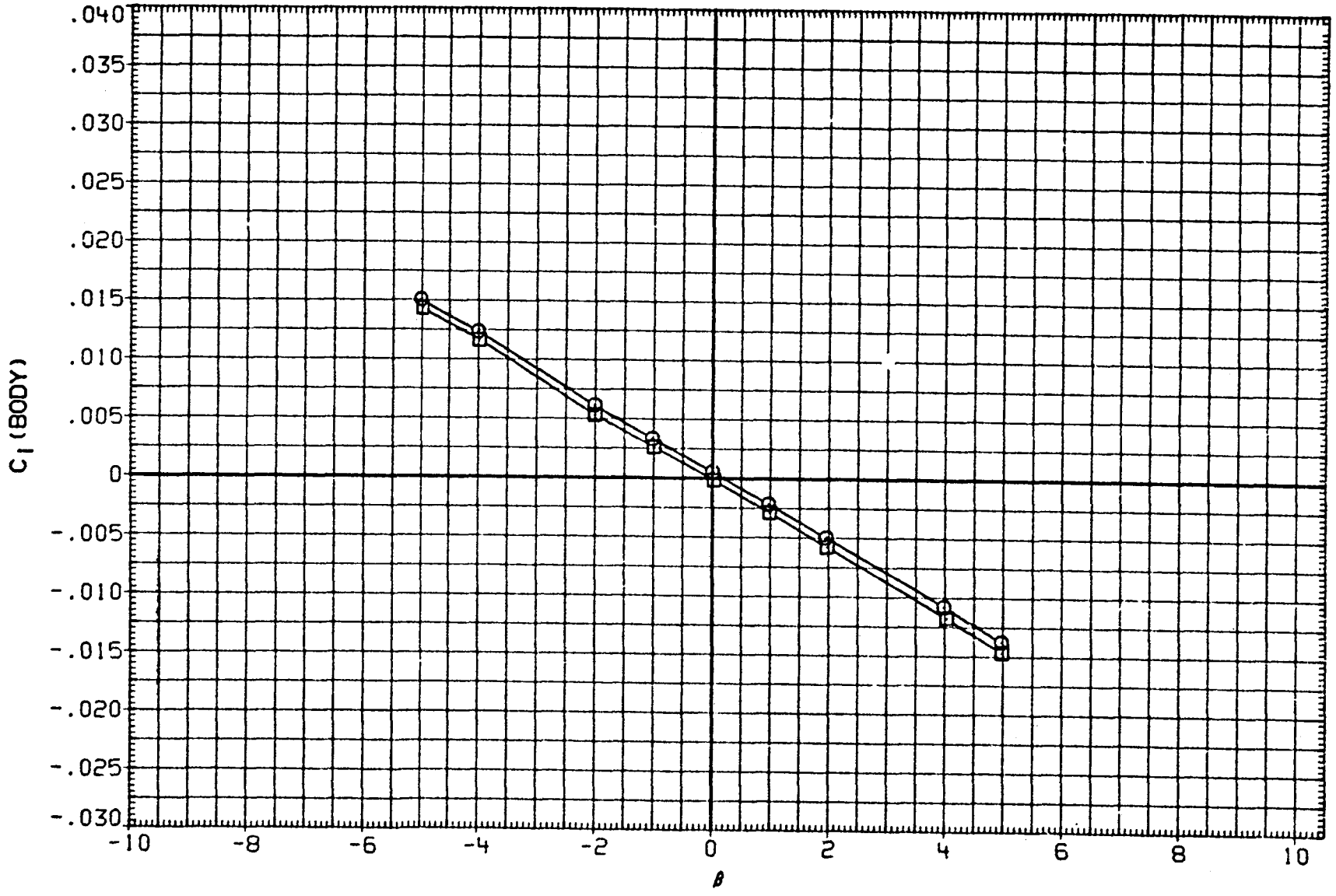
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RF0007	○	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.178	.000	10.000	-12.000	.000	.000
RF0015	□	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.178	.000	10.000	-12.000	.000	.000



DATA REPEATABILITY, H/B = 0.178

(A)MACH = .20

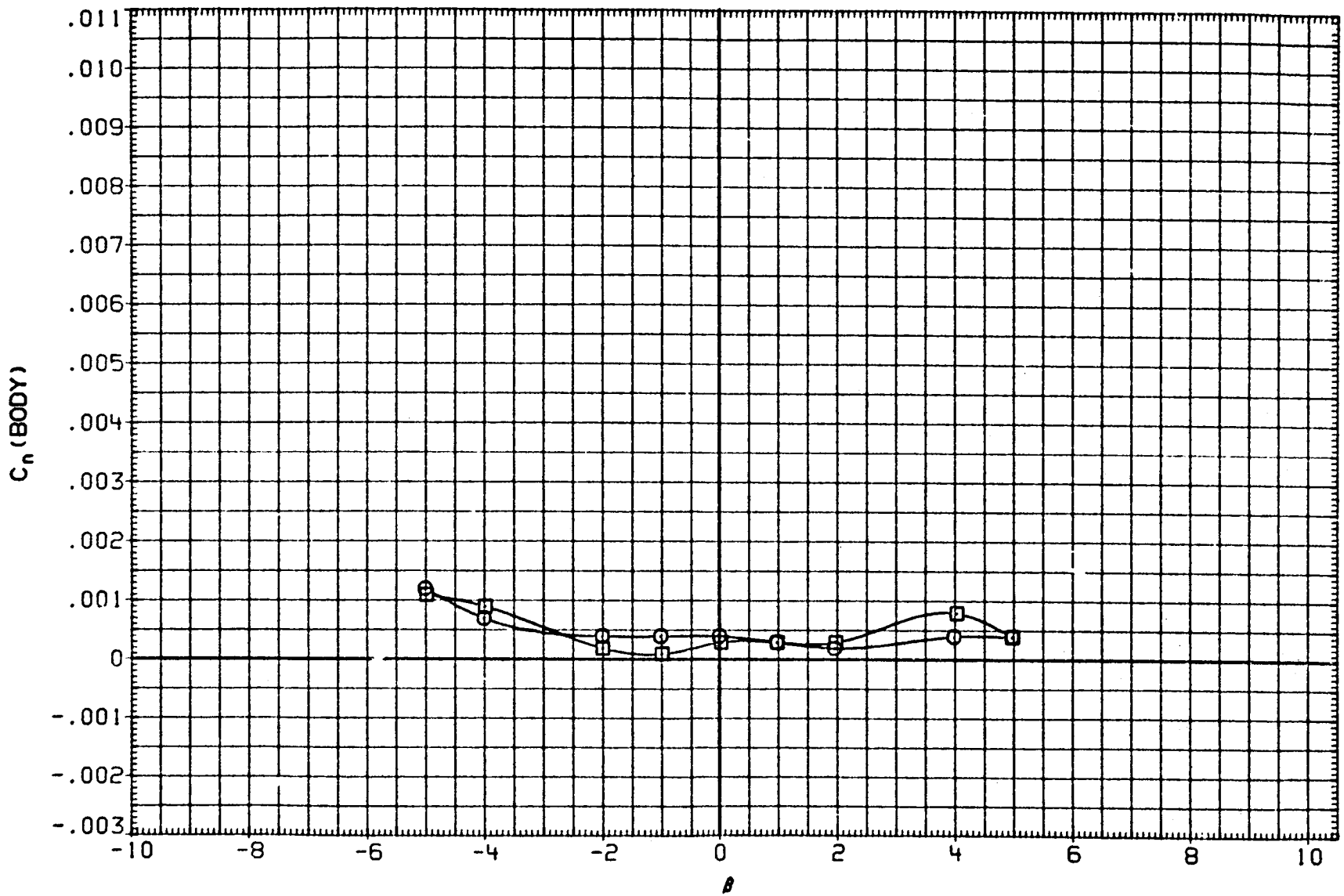
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ007	○	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.178	.000	10.000	-12.000	.000	.000
RFQ015	□	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.178	.000	10.000	-12.000	.000	.000



DATA REPEATABILITY, H/B = 0.178

(A)MACH = .20

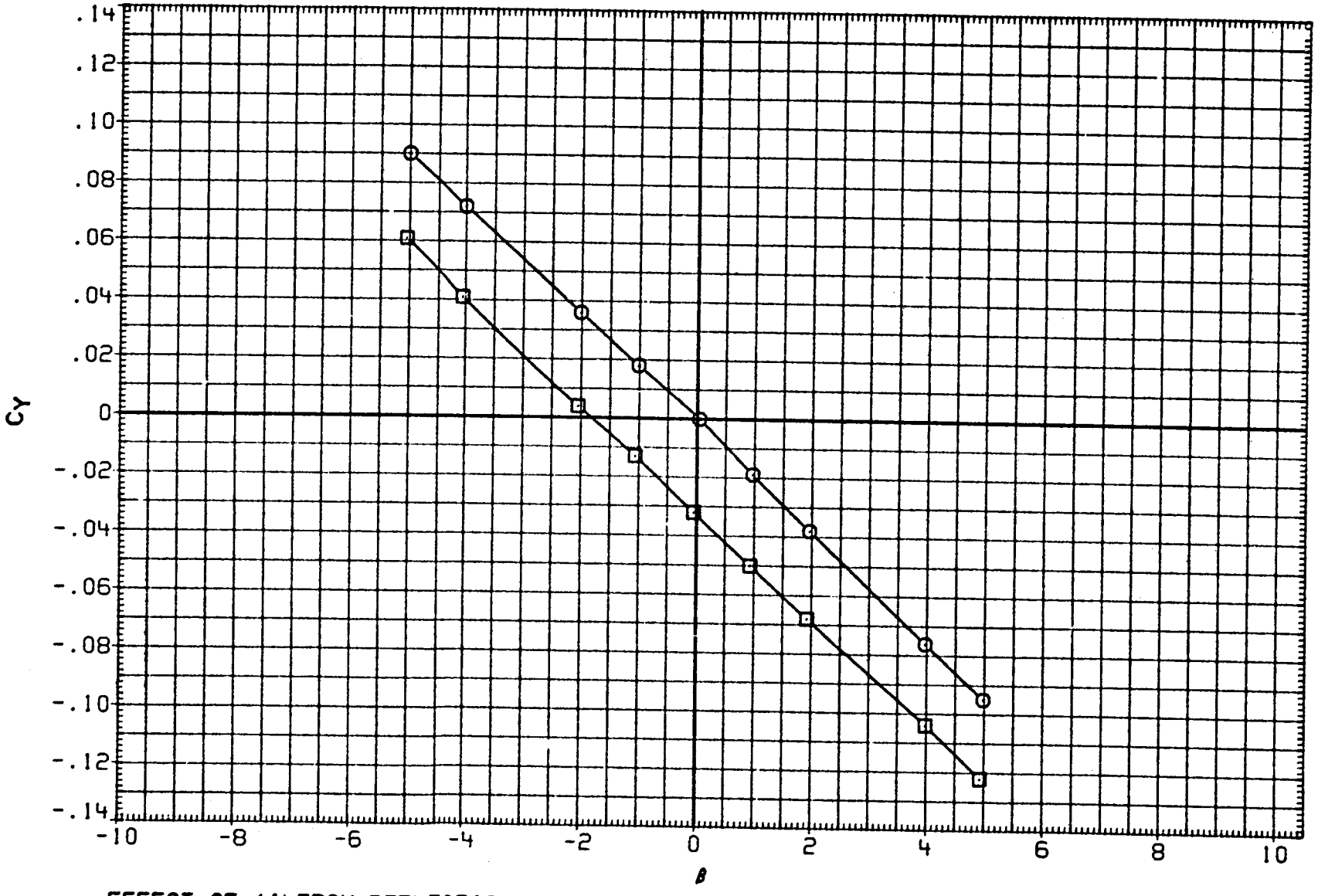
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RF0007	○	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.178	.000	10.000	-12.000	.000	.000
RF0015	□	0A250 B26C9G15M16F8W116E43V8R5TC19	.000	.178	.000	10.000	-12.000	.000	.000



DATA REPEATABILITY, H/B = 0.178

(A)MACH = .20

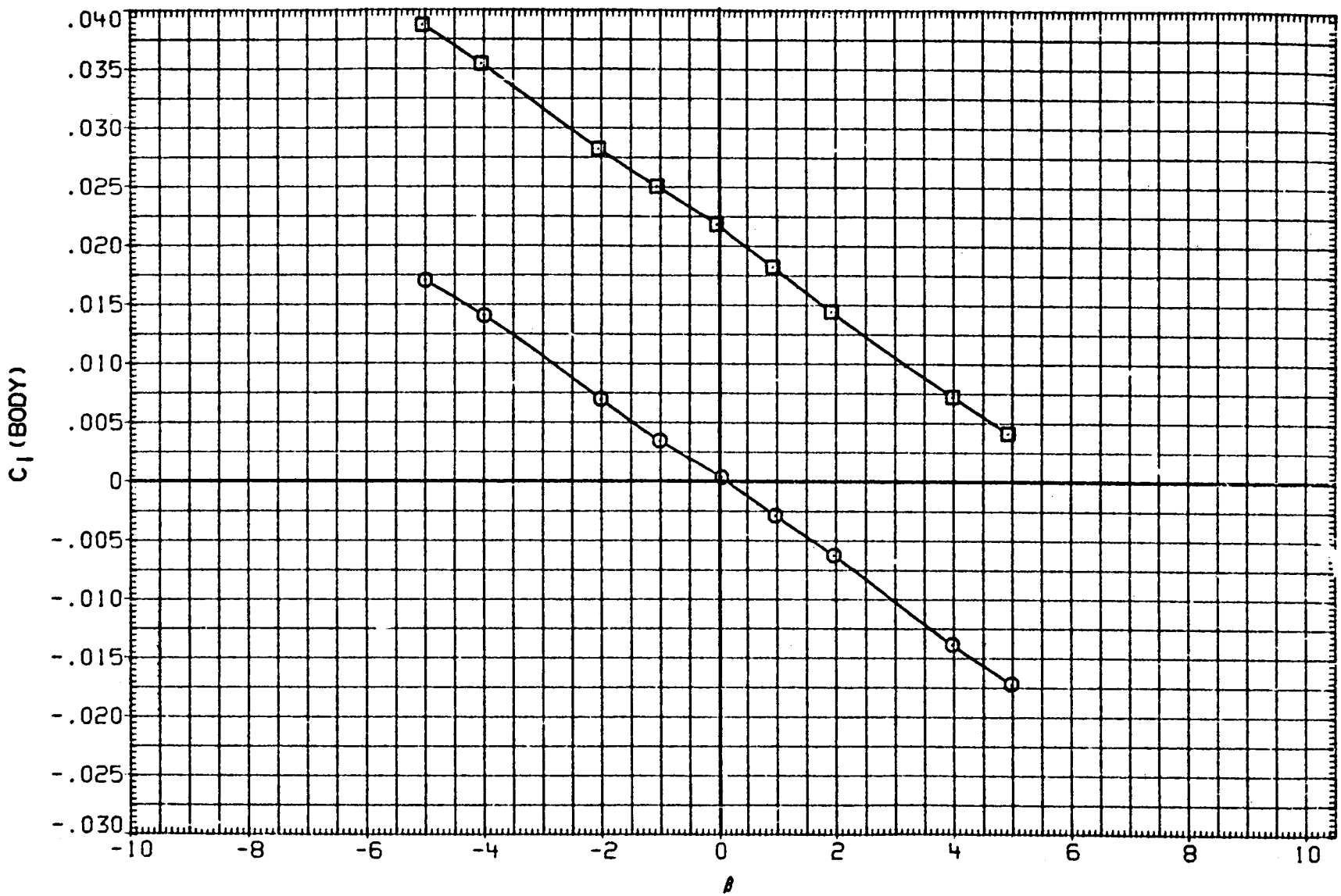
DATA SET	SYMBOL	CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ016	○	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.100	.000	10.000	-12.000	.000	.000
RFQ019	□	OA250 B26C9G15M16F8W116E43V8R5TC19	.000	.100	5.000	10.000	-12.000	.000	.000



EFFECT OF AILERON DEFLECTION, H/B = 0.10

(A) MACH = .20

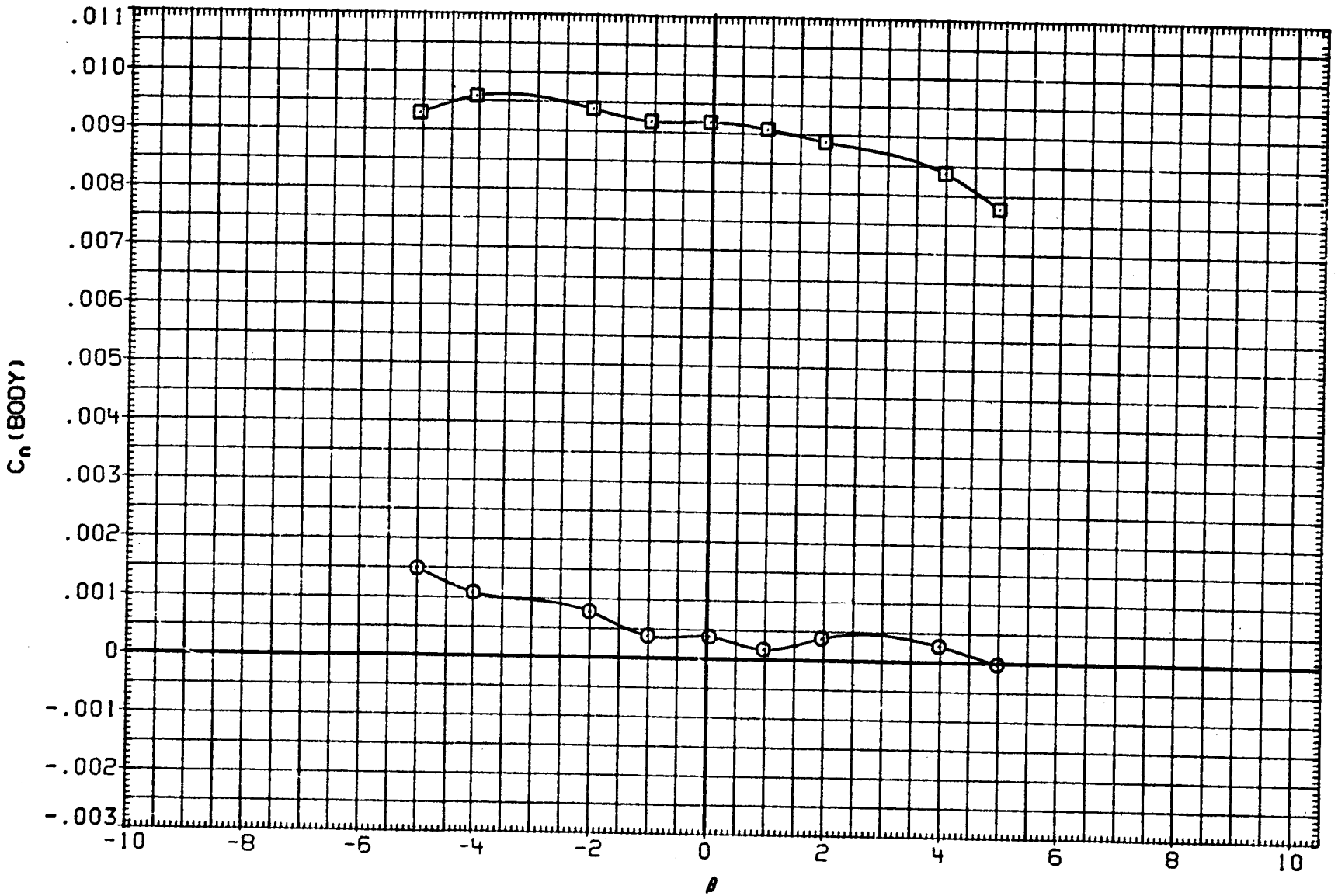
DATA SET	SYMBOL		CONFIGURATION	ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RFQ016	○	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.100	.000	10.000	-12.000	.000	.000
RFQ019	□	OA250	B26C9G15M16F8W116E43V8R5TC19	.000	.100	5.000	10.000	-12.000	.000	.000



EFFECT OF AILERON DEFLECTION, H/B = 0.10

(A)MACH = .20

DATA SET	SYMBOL	CONFIGURATION		ELEVON	H/B	AILRON	ALPHA	BDFLAP	RUDDER	SPDBRK
RF0016	○	0A250	B26C9G15M16F8W116E43V8R5TC19	.000	.100	.000	10.000	-12.000	.000	.000
RF0019	□	0A250	B26C9G15M16F8W116E43V8R5TC19	.000	.100	5.000	10.000	-12.000	.000	.000



EFFECT OF AILERON DEFLECTION, H/B = 0.10

(A)MACH = .20

APPENDIX

Tabulated Source Data

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

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ001) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = 5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .200

RUN NO. 1/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-4.990	.56790	.11410	-.04610	.57920	.67900	.01226	.16100	-.02020	.00670
.201	-3.980	.57890	.10880	-.04850	.58900	.68000	.00502	.13000	-.01650	.00570
.201	-2.000	.59710	.10390	-.05550	.60610	.68300	-.00304	.06400	-.00760	.00350
.201	-.990	.59970	.10320	-.05540	.60850	.68300	-.00416	.02900	-.00330	.00240
.201	.050	.60080	.10290	-.05570	.60950	.68300	-.00462	.00200	-.00090	.00060
.201	.990	.60130	.10260	-.05640	.61000	.68400	-.00501	-.01800	-.00050	-.00240
.201	1.980	.60290	.10220	-.05690	.61150	.68400	-.00574	-.03700	-.00020	-.00530
.201	4.040	.59390	.09820	-.05210	.60190	.68100	-.00802	-.07500	.00040	-.01230
.201	5.000	.59280	.09730	-.05210	.60070	.68100	-.00874	-.09400	.00050	-.01560
	GRADIENT	.00215	-.00142	-.00052	.00186	.00018	-.00178	-.02549	.00205	-.00224

OA250 B26C9 M16F8W116E43V8R5TC19 (RFQ002) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = 5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .200

RUN NO. 2/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-4.990	.58150	.07690	-.04610	.58600	.67800	-.02680	.07900	-.00080	.01650
.201	-3.950	.58350	.07760	-.04680	.58810	.67900	-.02645	.06500	-.00110	.01360
.201	-1.990	.58820	.07920	-.04980	.59300	.68000	-.02574	.03200	-.00070	.00690
.201	-1.000	.58950	.07950	-.05020	.59430	.68100	-.02566	.01600	-.00030	.00370
.201	.060	.58950	.07980	-.05020	.59430	.68100	-.02543	.00000	-.00010	.00050
.201	1.000	.59100	.07960	-.05060	.59580	.68100	-.02589	-.01600	.00010	-.00250
.201	1.990	.58890	.07910	-.05070	.59370	.68100	-.02599	-.03300	.00050	-.00600
.201	4.050	.58390	.07780	-.04700	.58840	.67900	-.02637	-.06500	.00110	-.01290
.201	5.000	.58280	.07720	-.04630	.58730	.67900	-.02673	-.08100	.00110	-.01610
	GRADIENT	.00012	.00002	-.00004	.00011	.00008	-.00000	-.01612	.00023	-.00327

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ003) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = 5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .200

RUN NO. 3/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-4.960	.59070	.09640	-.05220	.59840	.68200	-.00937	.09100	.00000	.01620
.201	-3.980	.59010	.09690	-.05130	.59790	.68100	-.00882	.07300	-.00010	.01330
.201	-1.980	.59750	.10050	-.05550	.60580	.68300	-.00647	.03800	-.00050	.00650
.201	-.980	.59860	.10150	-.05550	.60710	.68300	-.00566	.01900	-.00040	.00330
.201	.070	.59870	.10180	-.05550	.60730	.68300	-.00542	.00000	-.00020	.00030
.201	1.010	.59920	.10140	-.05610	.60770	.68300	-.00587	-.01900	.00000	-.00260
.201	2.000	.59830	.10060	-.05610	.60670	.68400	-.00652	-.03700	.00000	-.00560
.201	4.000	.59320	.09720	-.05210	.60100	.68100	-.00890	-.07400	.00030	-.01230
.201	5.040	.59030	.09620	-.05200	.59800	.68200	-.00942	-.09200	.00040	-.01560
	GRADIENT	.00014	.00000	-.00004	.00014	.00002	-.00001	-.01841	.00005	-.00317

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ004) (18 NOV 77)

REFFRENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = .000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .200

RUN NO. 4/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.030	.48600	.08100	.00000	.49270	.64900	-.00573	.08700	.00110	.01410
.201	-4.030	.48540	.08150	.00140	.49220	.64800	-.00514	.06900	.00080	.01160
.201	-2.030	.49100	.08510	-.00190	.49840	.65100	-.00259	.03400	.00050	.00560
.201	-1.030	.49060	.08580	-.00190	.49800	.65100	-.00182	.01600	.00040	.00280
.201	.010	.49150	.08620	-.00140	.49900	.65100	-.00161	-.00200	.00050	.00000
.201	.950	.49130	.08570	-.00190	.49870	.65100	-.00208	-.02000	.00030	-.00260
.201	1.940	.49200	.08540	-.00210	.49940	.65100	-.00248	-.03900	.00030	-.00520
.201	4.010	.48670	.08180	.00080	.49350	.64900	-.00511	-.07500	.00060	-.01090
.201	4.970	.48790	.08140	-.00040	.49460	.65000	-.00569	-.09400	.00050	-.01380
	GRADIENT	.00019	.00004	-.00005	.00019	.00010	.00000	-.01806	-.00005	-.00279

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ005) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = -5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .200

RUN NO. 5/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.000	.37210	.06940	.05660	.37850	.59400	.00296	.08500	.00190	.01310
.201	-4.000	.37100	.07010	.05890	.37760	.59200	.00385	.06800	.00150	.01070
.201	-2.000	.37370	.07330	.05640	.38070	.59500	.00650	.03300	.00080	.00520
.201	-.990	.37400	.07400	.05650	.38120	.59500	.00718	.01600	.00040	.00260
.201	.040	.37390	.07420	.05680	.38110	.59500	.00739	-.00100	.00010	.00010
.201	.980	.37360	.07380	.05630	.38070	.59500	.00702	-.01900	-.00030	-.00240
.201	1.970	.37410	.07350	.05660	.38120	.59500	.00669	-.03600	-.00070	-.00490
.201	3.980	.37120	.07010	.05910	.37770	.59200	.00386	-.07100	-.00070	-.01030
.201	4.990	.37230	.06950	.05680	.37880	.59400	.00303	-.08900	-.00090	-.01290
	GRADIENT	.00002	.00001	.00002	.00003	.00000	.00001	-.01742	-.00029	-.00261

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ006) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = .000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .200

RUN NO. 6/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-4.990	.48650	.08120	-.00050	.49320	.65000	-.00559	.08800	.00090	.01440
.201	-3.990	.48600	.08180	.00070	.49280	.64900	-.00498	.07000	.00060	.01170
.201	-1.990	.49240	.08530	-.00260	.49970	.65100	-.00260	.03500	.00030	.00570
.201	-1.000	.49170	.08600	-.00260	.49920	.65100	-.00178	.01700	.00020	.00290
.201	.050	.49330	.08660	-.00230	.50080	.65100	-.00155	-.00100	.00030	.00010
.201	.990	.49300	.08600	-.00320	.50050	.65200	-.00208	-.01900	.00020	-.00250
.201	1.980	.49420	.08580	-.00320	.50160	.65200	-.00248	-.03800	.00020	-.00530
.201	4.040	.48830	.08210	.00000	.49510	.64900	-.00505	-.07400	.00040	-.01110
.201	5.020	.48790	.08150	-.00100	.49460	.65000	-.00561	-.09200	.00050	-.01400
	GRADIENT	.00023	.00004	-.00008	.00023	.00003	-.00001	-.01800	-.00003	-.00283

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ007) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = .000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .178

RUN NO. 7/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.020	.48550	.08100	.00010	.49210	.64900	-.00567	.08800	.00120	.01500
.201	-4.010	.48640	.08170	.00160	.49320	.64800	-.00508	.07200	.00070	.01230
.201	-2.010	.49140	.08500	-.00150	.49870	.65100	-.00277	.03600	.00040	.00610
.201	-1.020	.49190	.08590	-.00170	.49940	.65100	-.00201	.01800	.00040	.00330
.201	.000	.49340	.08640	-.00150	.50090	.65100	-.00169	.00000	.00040	.00050
.201	.970	.49200	.08580	-.00190	.49940	.65100	-.00204	-.01900	.00030	-.00220
.201	1.950	.49420	.08570	-.00240	.50150	.65100	-.00259	-.03700	.00020	-.00500
.201	3.980	.48940	.08230	.00070	.49630	.64900	-.00507	-.07400	.00040	-.01080
.201	4.970	.48900	.08150	-.00050	.49570	.65000	-.00578	-.09200	.00040	-.01380
	GRADIENT	.00038	.00007	-.00009	.00039	.00010	-.00000	-.01815	-.00006	-.00288

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ008) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = 5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .178

RUN NO. 8/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.020	.58970	.09590	-.05110	.59740	.68100	-.00964	.09100	.00020	.01670
.201	-3.990	.58880	.09640	-.04990	.59660	.68000	-.00898	.07300	-.00010	.01370
.201	-2.020	.59670	.10000	-.05390	.60500	.68200	-.00684	.03900	-.00060	.00660
.201	-1.020	.59800	.10100	-.05410	.60650	.68200	-.00603	.02000	-.00050	.00330
.201	.030	.59890	.10160	-.05410	.60750	.68200	-.00561	.00100	-.00030	.00040
.201	.960	.59910	.10120	-.05460	.60750	.68300	-.00603	-.01700	-.00020	-.00260
.201	1.960	.59940	.10070	-.05510	.60780	.68300	-.00665	-.03600	-.00010	-.00570
.201	4.020	.59320	.09730	-.05140	.60110	.68100	-.00885	-.07200	.00000	-.01260
.201	4.990	.59260	.09650	-.05220	.60030	.68100	-.00960	-.09100	.00030	-.01570
	GRADIENT	.00042	.00009	-.00015	.00042	.00007	.00001	-.01822	.00002	-.00323

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ009) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = -5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .178

RUN NO. 9/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.010	.36860	.06920	.05890	.37500	.59200	.00356	.08700	.00200	.01350
.201	-4.000	.36690	.06970	.06140	.37340	.58900	.00434	.07000	.00140	.01100
.201	-2.960	.36720	.07130	.06110	.37400	.58900	.00580	.05100	.00160	.00820
.201	-2.000	.37030	.07390	.05930	.37730	.59200	.00695	.03400	.00100	.00530
.201	-1.010	.37060	.07390	.05920	.37780	.59200	.00775	.01700	.00040	.00270
.201	.000	.37100	.07410	.05940	.37820	.59200	.00793	.00000	.00010	.00020
.201	.980	.37130	.07370	.05920	.37840	.59200	.00751	-.01700	-.00020	-.00220
.201	1.970	.37200	.07350	.05880	.37910	.59200	.00715	-.03500	-.00050	-.00480
.201	4.020	.37080	.07040	.05970	.37750	.59100	.00434	-.07200	-.00010	-.01030
.201	4.980	.37120	.06980	.05740	.37770	.59400	.00363	-.08900	-.00030	-.01310
	GRADIENT	.00041	.00008	-.00020	.00043	.00025	.00001	-.01760	-.00024	-.00265

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ010) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = -5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .125

RUN NO. 10/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.000	.39140	.07140	.06750	.39780	.58700	.00162	.09000	.00180	.01540
.201	-3.980	.38780	.07150	.06990	.39430	.58400	.00240	.07200	.00130	.01270
.201	-1.990	.39270	.07500	.06830	.39980	.58700	.00498	.03600	.00100	.00630
.201	-1.000	.39360	.07570	.06710	.40080	.58800	.00548	.01900	.00040	.00340
.201	.000	.39520	.07640	.06700	.40240	.58800	.00586	.00000	.00020	.00050
.201	.990	.39600	.07630	.06680	.40330	.58800	.00565	-.01800	.00000	-.00230
.201	1.980	.39730	.07580	.06640	.40440	.58900	.00488	-.03600	.00010	-.00490
.201	4.040	.39840	.07340	.06600	.40520	.58900	.00239	-.07400	.00030	-.01130
.201	4.990	.40220	.07350	.06270	.40880	.59300	.00188	-.09200	-.00020	-.01440
	GRADIENT	.00117	.00022	-.00047	.00120	.00059	.00001	-.01821	-.00018	-.00297

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ011) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = 5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .125

RUN NO. 11/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.050	.61620	.09740	-.04660	.62370	.67700	-.01285	.09100	.00120	.01930
.201	-4.050	.61420	.09740	-.04540	.62180	.67600	-.01252	.07300	.00070	.01570
.201	-2.050	.62280	.10040	-.05030	.63070	.67900	-.01112	.03900	.00010	.00760
.201	-1.050	.62550	.10150	-.05130	.63360	.67900	-.01052	.02100	-.00020	.00400
.201	.000	.62600	.10250	-.05160	.63430	.67900	-.00960	.00200	-.00020	.00040
.201	.930	.62730	.10310	-.05200	.63570	.68000	-.00930	-.01700	.00000	-.00270
.201	1.910	.62680	.10350	-.05240	.63520	.68000	-.00878	-.03500	.00000	-.00620
.201	3.980	.62390	.10160	-.04980	.63210	.67900	-.01014	-.07200	-.00030	-.01420
.201	4.960	.62530	.10110	-.05130	.63330	.67900	-.01082	-.09100	-.00040	-.01760
	GRADIENT	.00102	.00047	-.00050	.00109	.00027	.00028	-.01820	-.00013	-.00368

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ012) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = 5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .125

RUN NO. 12/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.010	.61760	.09710	-.04830	.62510	.67800	-.01344	.09200	.00090	.01930
.201	-4.000	.61520	.09690	-.04680	.62270	.67700	-.01314	.07400	.00030	.01560
.201	-2.010	.62420	.09960	-.05150	.63200	.67900	-.01210	.03900	-.00010	.00740
.201	-1.020	.62610	.10060	-.05200	.63400	.68000	-.01153	.02100	-.00020	.00380
.201	-.010	.62570	.10110	-.05200	.63370	.68000	-.01095	.00200	-.00010	.00030
.201	.970	.62780	.10110	-.05280	.63580	.68000	-.01134	-.01700	.00000	-.00310
.201	1.960	.62700	.10000	-.05300	.63490	.68000	-.01224	-.03500	.00010	-.00660
.201	3.980	.62440	.09850	-.05100	.63200	.67900	-.01327	-.07200	.00000	-.01450
.201	4.980	.62550	.09830	-.05230	.63300	.68000	-.01368	-.09100	-.00020	-.01800
	GRADIENT	.00091	.00015	-.00044	.00092	.00022	-.00002	-.01836	-.00007	-.00372

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ013) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = .000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .125

RUN NO. 13/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-4.980	.49390	.08640	.00820	.50140	.64300	-.00186	.09500	.00000	.01320
.201	-3.990	.49340	.08670	.00910	.50090	.64300	-.00146	.07700	-.00050	.00970
.201	-1.990	.49780	.08980	.00740	.50590	.64400	.00079	.04100	-.00070	.00290
.201	-1.010	.49910	.09040	.00630	.50720	.64500	.00123	.02400	-.00140	-.00020
.201	.000	.49890	.09080	.00730	.50710	.64400	.00164	.00500	-.00150	-.00350
.201	.990	.50000	.09090	.00680	.50820	.64500	.00150	-.01400	-.00130	-.00640
.201	1.980	.50080	.09020	.00680	.50890	.64500	.00064	-.03300	-.00120	-.00930
.201	4.040	.50140	.08780	.00740	.50910	.64400	-.00175	-.07100	-.00110	-.01580
.201	4.990	.50480	.08780	.00490	.51240	.64600	-.00236	-.09000	-.00120	-.01870
	GRADIENT	.00102	.00014	-.00026	.00103	.00023	-.00004	-.01853	-.00010	-.00318

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ014) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = .000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .125

RUN NO. 14/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-4.990	.50900	.08270	.00660	.51560	.64500	-.00815	.09100	.00150	.01720
.201	-3.990	.50800	.08310	.00830	.51470	.64300	-.00756	.07200	.00100	.01380
.201	-2.000	.51450	.08620	.00530	.52160	.64600	-.00568	.03700	.00070	.00700
.201	-1.010	.51650	.08710	.00430	.52380	.64600	-.00519	.01900	.00030	.00390
.201	.040	.51730	.08760	.00400	.52460	.64700	-.00476	.00000	.00030	.00080
.201	.980	.51750	.08750	.00400	.52480	.64700	-.00491	-.01800	.00040	-.00210
.201	1.970	.51840	.08690	.00390	.52560	.64700	-.00573	-.03800	.00040	-.00530
.201	3.980	.51800	.08470	.00510	.52490	.64600	-.00784	-.07600	.00060	-.01210
.201	4.990	.51780	.08440	.00340	.52460	.64700	-.00803	-.09300	.00010	-.01530
	GRADIENT	.00101	.00018	-.00035	.00103	.00027	-.00000	-.01853	-.00010	-.00324

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ015) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = .000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .178

RUN NO. 15/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-4.990	.49460	.08250	.00410	.50140	.64600	-.00579	.08500	.00110	.01430
.201	-3.990	.49460	.08330	.00510	.50150	.64600	-.00498	.06800	.00090	.01160
.201	-2.000	.49740	.08630	.00170	.50480	.64800	-.00249	.03300	.00020	.00530
.201	-1.000	.49750	.08740	.00150	.50510	.64800	-.00148	.01500	.00010	.00260
.201	.030	.49660	.08770	.00180	.50430	.64800	-.00102	-.00300	.00030	-.00020
.201	.980	.49770	.08760	.00140	.50530	.64800	-.00132	-.02300	.00030	-.00290
.201	1.970	.49560	.08660	.00150	.50310	.64800	-.00196	-.04100	.00030	-.00580
.201	4.030	.49060	.08400	.00350	.49780	.64700	-.00363	-.07800	.00080	-.01180
.201	4.980	.49040	.08360	.00200	.49750	.64800	-.00393	-.09600	.00040	-.01470
	GRADIENT	-.00044	.00010	-.00019	-.00041	.00015	.00017	-.01824	-.00004	-.00290

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ016) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = .000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .100

RUN NO. 16/ 0 RN/L = 1 43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.010	.52400	.08220	.00730	.53030	.64400	-.01132	.09000	.00150	.01710
.201	-4.000	.52340	.08240	.00900	.52980	.64300	-.01100	.07200	.00110	.01410
.201	-2.010	.52820	.08490	.00660	.53490	.64500	-.00938	.03600	.00080	.00700
.201	-1.010	.52990	.08560	.00650	.53670	.64500	-.00906	.01800	.00040	.00350
.201	.040	.53040	.08590	.00610	.53730	.64500	-.00887	.00000	.00040	.00040
.201	.970	.53250	.08580	.00560	.53930	.64600	-.00929	-.01900	.00020	-.00280
.201	1.960	.53180	.08500	.00570	.53840	.64600	-.00999	-.03800	.00040	-.00620
.201	3.970	.53100	.08370	.00730	.53750	.64400	-.01113	-.07600	.00030	-.01380
.201	4.980	.53230	.08370	.00520	.53880	.64600	-.01138	-.09500	.00000	-.01710
	GRADIENT	.00089	.00014	-.00022	.00090	.00019	-.00002	-.01855	-.00013	-.00344

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ017) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = 5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .100

RUN NO. 17/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.010	.62850	.09610	-.04560	.63560	.67600	-.01632	.08900	.00170	.01870
.201	-3.990	.62740	.09620	-.04440	.63450	.67500	-.01611	.07100	.00130	.01530
.201	-2.000	.63570	.09850	-.04820	.64310	.67700	-.01526	.03700	.00050	.00740
.201	-1.000	.63650	.09880	-.04870	.64400	.67700	-.01517	.01900	.00000	.00340
.201	.010	.63900	.09980	-.04910	.64660	.67700	-.01469	.00200	-.00030	-.00020
.201	.980	.63790	.09910	-.04900	.64540	.67700	-.01505	-.01500	-.00080	-.00410
.201	1.970	.63740	.09850	-.04840	.64480	.67700	-.01558	-.03400	-.00080	-.00820
.201	4.030	.63520	.09770	-.04680	.64250	.67600	-.01597	-.07100	-.00120	-.01660
.201	4.980	.63670	.09770	-.04780	.64400	.67700	-.01623	-.09100	-.00130	-.02020
	GRADIENT	.00084	.00016	-.00023	.00086	.00010	.00001	-.01788	-.00031	-.00392

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ018) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = -5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .100

RUN NO. 18/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.010	.40020	.07120	.07030	.40650	.58600	-.00015	.09000	.00160	.01550
.201	-4.010	.39660	.07120	.07320	.40300	.58300	.00048	.07200	.00100	.01280
.201	-2.010	.39980	.07400	.07250	.40660	.58400	.00266	.03500	.00090	.00660
.201	-1.020	.40180	.07460	.07210	.40860	.58500	.00288	.01800	.00050	.00350
.201	-.010	.40350	.07520	.07160	.41040	.58500	.00325	-.00100	.00030	.00060
.201	.970	.40640	.07520	.07030	.41330	.58700	.00266	-.01900	.00020	-.00250
.201	1.960	.40810	.07470	.06970	.41490	.58800	.00194	-.03900	.00040	-.00560
.201	3.970	.40860	.07330	.06900	.41[illegible]10	.58800	.00043	-.07700	.00060	-.01230
.201	4.990	.41390	.07390	.06610	.42040	.59200	.00005	-.09600	.00000	-.01550
	GRADIENT	.00150	.00026	-.00049	.00152	.00065	-.00001	-.01863	-.00012	-.00311

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ019) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = .000
AILRON = 5.000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .100

RUN NO. 19/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.050	.51390	.08450	.01370	.52080	.64000	-.00731	.06100	.00930	.03880
.201	-4.050	.51230	.08470	.01500	.51920	.63900	-.00683	.04100	.00960	.03550
.201	-2.050	.51420	.08650	.01440	.52140	.63900	-.00534	.00400	.00940	.02830
.201	-1.060	.51590	.08730	.01370	.52320	.64000	-.00486	-.01300	.00920	.02510
.201	-.050	.51760	.08780	.01250	.52490	.64100	-.00468	-.03200	.00920	.02190
.201	.930	.51870	.08730	.01130	.52590	.64200	-.00538	-.05000	.00910	.01830
.201	1.920	.51890	.08660	.01180	.52610	.64100	-.00613	-.06800	.00890	.01450
.201	3.980	.51640	.08530	.01290	.52340	.64000	-.00696	-.10400	.00840	.00730
.201	4.930	.52150	.08580	.00990	.52840	.64300	-.00742	-.12200	.00780	.00420
	GRADIENT	.00072	.00010	-.00038	.00073	.00027	-.00003	-.01823	-.00015	-.00348

OA250 B26C9G15M16N24N28F8W116E43V8R5 (RFQ020) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = .000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .100

RUN NO. 20/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.000	.47470	.11330	.04050	.48730	.61900	.02808	.09400	-.00180	.01630
.201	-3.990	.47330	.11210	.04210	.48560	.61800	.02716	.07300	-.00110	.01310
.201	-2.000	.47460	.11380	.04330	.48720	.61700	.02864	.03300	.00070	.00660
.201	-.990	.47530	.11430	.04340	.48800	.61700	.02895	.01300	.00170	.00350
.201	.050	.47650	.11530	.04330	.48940	.61700	.02977	-.00700	.00260	.00040
.201	.990	.47760	.11480	.04300	.49040	.61700	.02908	-.02800	.00340	-.00260
.201	1.980	.47940	.11440	.04190	.49200	.61800	.02834	-.04900	.00460	-.00580
.201	4.040	.48040	.11380	.04120	.49300	.61[illegible]00	.02759	-.08800	.00620	-.01290
.201	4.990	.48310	.11550	.04010	.49590	.62000	.02872	-.11100	.00720	-.01640
	GRADIENT	.00089	.00021	-.00010	.00092	.00012	.00005	-.02037	.00091	-.00324

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ021) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = .000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .075

RUN NO. 21/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.010	.53090	.08130	.00830	.53700	.64400	-.01347	.09100	.00210	.01930
.201	-3.990	.53020	.08110	.00970	.53620	.64300	-.01359	.07200	.00160	.01580
.201	-2.000	.53720	.08290	.00630	.54340	.64500	-.01306	.03500	.00120	.00810
.201	-1.010	.53720	.08300	.00570	.54340	.64600	-.01298	.01600	.00090	.00420
.201	.000	.53890	.08410	.00590	.54530	.64500	-.01218	-.00100	.00080	.00070
.201	.980	.53970	.08360	.00520	.54600	.64600	-.01281	-.01900	.00040	-.00290
.201	1.970	.53900	.08270	.00530	.54510	.64600	-.01353	-.03800	.00050	-.00670
.201	4.030	.53570	.08160	.00760	.54170	.64400	-.01410	-.07700	.00000	-.01500
.201	4.990	.53790	.08220	.00610	.54400	.64500	-.01383	-.09600	-.00050	-.01880
	GRADIENT	.00068	.00007	-.00024	.00068	.00012	-.00005	-.01861	-.00023	-.00381

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ022) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = 5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .075

RUN NO. 22/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-4.990	.63550	.09480	-.04470	.64220	.67500	-.01895	.08900	.00260	.02060
.201	-3.990	.63460	.09470	-.04380	.64140	.67500	-.01831	.07000	.00210	.01670
.201	-2.010	.64170	.09630	-.04750	.64860	.67600	-.01860	.03400	.00150	.00840
.201	-.990	.64330	.09660	-.04820	.65030	.67700	-.01854	.01600	.00090	.00410
.201	.050	.64330	.09750	-.04830	.65040	.67700	-.01765	.00000	.00020	.00000
.201	.980	.64430	.09710	-.04830	.65140	.67700	-.01825	-.01600	-.00060	-.00400
.201	1.980	.64150	.09580	-.04770	.64830	.67700	-.01902	-.03400	-.00090	-.00830
.201	4.040	.63970	.09510	-.04640	.64640	.67600	-.01939	-.07300	-.00160	-.01750
.201	4.990	.64040	.09570	-.04700	.64720	.67600	-.01898	-.09200	-.00180	-.02160
	GRADIENT	.00049	.00006	-.00024	.00049	.00012	-.00003	-.01789	-.00047	-.00423

OA250 B26C9G15M16F8W116E43V8R5TC19 (RFQ023) (18 NOV 77)

REFERENCE DATA

SREF = 2690.0000 SQ.FT. XMRP = 1076.6800 INCHES
LREF = 474.8000 INCHES YMRP = .0000 INCHES
BREF = 936.6600 INCHES ZMRP = 375.0000 INCHES
SCALE = .0299 SCALE

PARAMETRIC DATA

ALPHA = 10.000 ELEVON = -5.000
AILRON = .000 RUDDER = .000
BDFLAP = -12.000 SPDBRK = .000
H/B = .075

RUN NO. 23/ 0 RN/L = 1.43 GRADIENT INTERVAL = -6.00/ 6.00

MACH	BETA	CL	CD	CLM	CN	XCP/L	CA	CY	CYN	CBL
.201	-5.000	.41200	.07150	.07050	.41820	.58700	-.00191	.09200	.00210	.01690
.201	-3.990	.40860	.07090	.07260	.41470	.58500	-.00193	.07300	.00150	.01370
.201	-2.000	.41430	.07310	.07010	.42070	.58800	-.00076	.03500	.00120	.00680
.201	-1.000	.41560	.07330	.06920	.42200	.58900	-.00076	.01700	.00080	.00340
.201	.000	.41600	.07390	.06970	.42250	.58900	-.00027	-.00100	.00070	.00020
.201	.990	.41830	.07370	.06830	.42480	.59000	-.00091	-.01900	.00040	-.00310
.201	1.980	.41880	.07310	.06840	.42510	.59000	-.00158	-.03800	.00060	-.00650
.201	4.040	.41670	.07180	.06980	.42280	.58900	-.00249	-.07700	.00050	-.01370
.201	4.990	.42110	.07280	.06730	.42730	.59100	-.00225	-.09600	.00000	-.01720
	GRADIENT	.00097	.00011	-.00034	.00097	.00044	-.00006	-.01871	-.00017	-.00340