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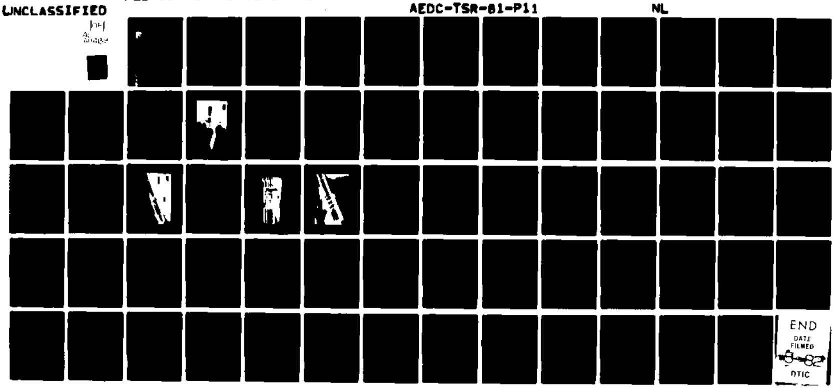

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DYNAMIC STABILITY TESTS OF THE STANDARD DYNAMICS MODEL UTILIZING THE NEW 1,500-LB BALANCE MECHANISMS

S. M. Coulter and E. J. Marquart

Calspan Field Services, Inc.

February 1981

Final Report for Period December 8, 1980 - February 26, 1981

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ARNOLD ENGINEERING DEVELOPMENT CENTER
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AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE

APPROVAL STATEMENT

This report has been reviewed and approved.

ALEXANDER F. MONEY
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Aerospace Flight Dynamics Testing
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
An investigation was conducted to verify the performance of the new 1,500-lb (normal force) pitch/yaw and roll force oscillation balance systems. These systems are capable of measuring direct, cross, and cross-coupling derivatives. Symmetrical and asymmetrical configurations of the Standard Dynamics Model were tested. Data were obtained at Mach Numbers 0.3 to 1.3 and at angles of attack ranging from -4 to 24 deg. In general, static and direct dynamic coefficients agreed closely with previous data. Cross and cross-coupling coefficients were measured for both configurations.

CONTENTS

		Page
	NOMENCLATURE	2
1.0	INTRODUCTION	6
2.0	APPARATUS	
	2.1 Test Facility	6
	2.2 Test Article	7
	2.3 Test Mechanism	7
	2.4 Test Instrumentation	8
3.0	TEST DESCRIPTION	
	3.1 Test Conditions and Procedures	
	3.1.1 General	8
	3.1.2 Data Acquisition	9
	3.2 Data Reduction	9
	3.3 Uncertainty of Measurements	9
4.0	DATA PACKAGE PRESENTATION	10
	REFERENCES	11

APPENDIXES

I. ILLUSTRATIONS

Figure		
1.	General Installation Arrangement	13
2.	Standard Dynamics Model (SDM) Dimensions	16
3.	Standard Dynamics Model (SDM) Details	17
4.	1,500-lb Pitch/Yaw Dynamic Balance	25
5.	1,500-lb 5 -Component Can Balance	27
6.	Pitch/Yaw Can Balance Assembly	29
7.	1,500-lb Roll Dynamic Balance Details	30
8.	Data Comparisons	31

II. TABLES

1.	Standard Dynamics Model Configuration Designations	35
2.	Test Summary	37
3.	Estimated Uncertainties	38

III. SAMPLE OF TABULATED AND PLOTTED DATA

1.	Pitch Tabulated Data	46
2.	Yaw Tabulated Data	49
3.	Roll Tabulated Data	52
4.	Pitch Plotted Data	54
5.	Yaw Plotted Data	58
6.	Roll Plotted Data	62

NOMENCLATURE

AD	Rate of change of angle at attack, rad/sec
ALPHA	Model angle of attack, deg
B	Wing span, 1.65 ft
BD	Rate of change of angle of sideslip, rad/sec
BETA	Sideslip angle in the stability axis system, deg
CBAR	Wing mean aerodynamic chord, 0.62233 ft
CLL	$M_{\ell}/(Q \cdot S \cdot B)$
CLL-A	$\partial CLL/\partial ALPHA$, rad^{-1}
CLL-AD	$\partial CLL/\partial(Q \cdot CBAR/2V) + \partial CLL/\partial(AD \cdot CBAR/2V)$, rad^{-1}
CLL-B	$[\partial CLL/\partial BETA]$ cos ALPHA for yaw test phase (measured by can balance) or $[\partial CLL/\partial BETA]$ sin ALPHA for roll test phase, rad^{-1}
CLL-BD	$\partial CLL/\partial(RB/2V) - [\partial CLL/\partial(BD \cdot B/2V)]$ cos ALPHA, rad^{-1}
CLL-PBD	$\partial CLL/\partial(P \cdot B/2V) + [\partial CLL/\partial(BD \cdot B/2V)]$ sin ALPHA, rad^{-1}
CLM	$M_m/Q \cdot S \cdot CBAR$
CLM-A	$\partial CLM/\partial ALPHA$, measured by can balance, rad^{-1}
CLM-AD	$\partial CLM/\partial(Q \cdot CBAR/2V) + \partial CLM/\partial(AD \cdot CBAR/2V)$, measured by can balance, rad^{-1}
CLM-B	$[\partial CLM/\partial BETA]$ cos ALPHA, rad^{-1}
CLM-BD	$\partial CLM/\partial(R \cdot B/2V) - [\partial CLM/\partial(BD \cdot B/2V)]$ cos ALPHA, rad^{-1}
CLN	$M_n/Q \cdot S \cdot B$
CLN-A	$\partial CLN/\partial ALPHA$, rad^{-1}
CLN-AD	$\partial CLN/\partial(Q \cdot CBAR/2V) + \partial CLN/\partial(AD \cdot CBAR/2V)$, rad^{-1}
CLN-B	$[\partial CLN/\partial BETA]$ cos ALPHA, measured by can balance, rad^{-1}

CLN-BD	$\partial CLN/\partial(R \cdot B/2V) - [\partial CLN/\partial(BD \cdot B/2V)] \cos ALPHA$, measured by can balance, rad^{-1}
CLN-PBD	$\partial CLN/\partial(P \cdot B/2V) + [\partial CLN/\partial(BD \cdot B/2V)] \sin ALPHA$, rad^{-1}
CN	$F_N/Q \cdot S$
CN-A	$\partial CN/\partial ALPHA$, rad^{-1}
CN-AD	$\partial CN/\partial(Q \cdot CBAR/2V) + \partial CN/\partial(AD \cdot CBAR/2V)$, rad^{-1}
CY	$F_Y/Q \cdot S$
CY-B	$[\partial CY/\partial BETA] \cos ALPHA$
CY-BD	$\partial CY/\partial(R \cdot B/2V) - [\partial CY/\partial(BD \cdot B/2V)] \cos ALPHA$, rad^{-1}
CYPBD	$\partial CY/\partial(P \cdot B/2V) + [\partial CY/\partial(BD \cdot B/2V] \sin ALPHA$, rad^{-1}
CONFIG	Model configuration
E	Amplitude of excitation voltage, volts
F.S.	Fuselage Station, inches
F_N	Normal force, lb
F_Y	Side force, lb
M	Free-stream Mach number
M_ℓ	Rolling moment, ft-lb
M_m	Pitching moment, ft-lb
M_n	Yawing moment, ft-lb
MAC	Model mean aerodynamic chord, 0.62233 ft
MΘF	Balance restoring spring constant, in-lb/deg
NCP	Center of pressure location, in the normal plane, expressed in terms of the model reference length from the model moment reference point

OMEGA	Wind-on angular frequency, rad/sec
P	Free-stream static pressure, psfa or rolling velocity, rad/sec
POC	Program option code, Pitch = 1 Yaw = 5 Roll = 8
POS	Model oscillation amplitude, deg
PT	Tunnel stilling chamber pressure, psfa
P/Y CLM	M_m/Q•S•CBAR, measured by pitch/yaw balance
P/Y CLM-A	∂CLM/∂ALPHA, measured by pitch/yaw balance, rad^{-1}
P/Y CLM-AD	∂CLM/∂(Q•CBAR/2V) + ∂CLM/∂(AD•CBAR/2V), measured by pitch/yaw balance, rad^{-1}
P/Y CLN	M_n/Q•S•B, measured by pitch/yaw balance
P/Y CLN-B	[∂CLN/∂BETA] cos ALPHA, measured by pitch/yaw balance, rad^{-1}
P/Y CLN-BD	∂CLN/∂(R•B/2V) - [∂CLN/∂(BD•B/2V)] cos ALPHA, measured by pitch/yaw balance, rad^{-1}
Q	Free-stream dynamic pressure, psfa or pitching velocity, rad/sec
R	Yawing velocity, rad/sec
RE	Free-stream Reynolds number, ft^{-1}
RFP	Reduced frequency parameter (OMEGA•CBAR/2V) for pitch phase, (OMEGA•B/2V) for yaw and roll phases
S	Reference model wing area, 0.907 ft^2
TP	Data point number
TT	Tunnel stilling chamber temperature, degrees F or R

W.L.	Water line, inches
V	Free stream velocity, ft/sec
YCP	Center of pressure location, in the side plane, in terms of the model reference length from the model moment reference point
ϕ_B	Roll angle of balance-sting assembly; ϕ_B = 90 deg for yaw oscillation of balance
θ	Total deflection of cross-flexure, deg
$\bar{\theta}_T$	Static deflection of cross-flexure, deg

1.0 INTRODUCTION

The work reported herein was sponsored by the Arnold Engineering Development Center (AEDC), Air Force Systems Command (AFSC), Arnold Air Force Station, Tennessee, under Program Element 65807F, and Control Number 9T02. The results were obtained by Calspan Field Services, Inc./AEDC Division, operating contractor for the Aerospace Flight Dynamics testing effort at the AEDC, AFSC, Arnold Air Force Station, Tennessee. The tests were conducted in the Propulsion Wind Tunnel Facility (PWT) Aerodynamic Wind Tunnel (4T) under AEDC Project Number C005-PB, December 8 through December 13, 1980. This test was a subtask of the 4T Facility Improvement Program. The project sponsor was Major R. L. Bruce, DOFA, AEDC.

This test was part of a continuing effort to design, fabricate, and verify the performance of forced oscillation dynamic balance systems capable of measuring direct, cross, and cross-coupling derivatives at high angles of attack. The 1,500-lb (normal force) Pitch/Yaw and Roll balance systems were utilized. The objectives of the test were to:

(1) verify the controllability of the oscillating model over the operating range of the tunnel,

(2) verify the quantitative measurements of the balance systems by comparing to previous data, and

(3) further investigate the capabilities and problems associated with measuring cross and cross-coupling derivatives.

Forced oscillation data about the pitch, yaw, and roll axis were obtained on the Standard Dynamics Model (SDM) at angles of attack of -4 to 24 deg at Mach numbers 0.3 to 1.3. The unit Reynolds number ranged from 1.0×10^6 to 2.5×10^6. The reduced frequency parameter varied from 0.012 to 0.04 for pitch oscillation, from 0.017 to 0.058 for yaw oscillation, and from 0.034 to 0.13 for roll oscillation. The nominal frequencies were 7.35 Hz, 3.65 Hz, and 8.5 Hz for pitch, yaw, and roll, respectively. The model was oscillated at amplitudes of 0.5, 1.0, and 1.5 deg.

A microfilm copy of the final data has been retained in the PWT at AEDC. Inquiries to obtain copies of the test data should be addressed to AEDC/DOS, Arnold Air Force Station, Tennessee 37389.

2.0 APPARATUS

2.1 TEST FACILITY

The Aerodynamic Wind Tunnel (4T) is a closed-loop, continuous flow, variable-density tunnel in which the Mach number can be varied from 0.1 to 1.3 and can be set at discrete Mach numbers of 1.6 and 2.0 by placing nozzle inserts over the permanent sonic nozzle. At all Mach numbers, the stagnation pressure can be varied from 400 to 3,400 psfa. The test section is 4-ft square and 12.5 ft long with perforated, variable porosity (0.5- to 10-percent open) walls. It is completely enclosed in a plenum chamber from which the air can be evacuated, allowing part of the tunnel airflow to be removed through the perforated walls of the test section. The model support system consists of a sector and boom attachment which has a pitch angle capability of -5 to 24 deg with respect to the tunnel centerline. Guy rod stiffeners were used to strengthen the boom in the yaw plane. The general arrangement of the test section with the test article installed is shown in Fig. 1. A more complete description of the tunnel may be found in Ref. 1.

2.2 TEST ARTICLE

The Standard Dynamics Model (SDM) represents a 1/18-scale fighter type aircraft. Dimensions of the SDM are shown in Fig. 2, and details are shown in Fig. 3. The model has a 19.8 in. wing span and double-taper leading and trailing edges on the wing, stabilators, and vertical tail. The stabilators may be deflected in increments of ±5 deg. For this test, the stabilator was deflected -5 deg. All external components, that is wings, stabilators, inlet, ventral fins, canopy, etc., may be removed for buildup tests as desired. Table 1 lists the Configuration codes for the test reported herein. The balance pivot center, model center, model center of gravity, and model moment reference point were located at 35 percent MAC. The two configurations tested were (see Table 1)

-B1C1W1V1T05S1F1I1 - full symmetrical aircraft

-B1C1W1V1T05S0F1I1 - full aircraft with left-hand (looking upstream) forebody strake removed.

The heavy wing tips (W2) were installed for the roll phase.

2.3 TEST MECHANISM

The pitch/yaw balance and its external 5-component can balance are shown in Figs. 4 and 5, respectively. A photograph of this arrangement is shown in Fig. 6. For the roll case, the cross-derivative balance was designed as an integral part of the balance system as shown in Fig. 7. These systems were designed, fabricated, and bench checked under various technology and development programs at AEDC.

The P/Y and roll balances use the same principle of operation and control. Each balance consists of a cross-flexure pivot connected to a hydraulic cylinder through a force measuring flexure. The hydraulic cylinder is operated with a servo valve to obtain sinusoidal oscillation motion at a constant oscillation amplitude, up to ±2 deg, and constant frequency from 2 to about 10 Hz. The cross flexure is instrumented to measure angular displacement and supports the model loads (up to 1,500 lb normal force and 600 lb axial force) and provides the restoring moment to cancel the inertia moment when the system is operating at the natural frequency of the model/balance assembly. The P/Y balance has provisions for changing the restoring moment by installing leaf springs on the sides of the balance; leaf springs were used for these tests. The restoring moment was 348 in-lb/deg for the P/Y balance and 43 in-lb/deg for the roll balance. The P/Y balance was oriented at 0 deg with respect to the model for the pitch tests and at 90 deg for the yaw tests.

The can balance and its load limits are shown in Fig. 5. The balance has five components of load measuring elements: pitching moment and normal force, yawing moment and side force, and rolling moment. Each element is instrumented to resolve the static, in-phase, and out-of-phase (with respect to the model position vector) component of the load as discussed later. The balance is capable, therefore, of measuring the same derivatives as the pitch-yaw balance, as well as the cross and cross-coupling derivatives.

2.4 TEST INSTRUMENTATION

The Forced Oscillation Balance Control and Readout System (FOBCARS) is used for setting the oscillation frequency and amplitude and for nulling the static torque. An electronic position feedback loop is used to maintain a constant oscillation amplitude and frequency under aerodynamic loads and permits testing both dynamically stable and unstable configurations. Data are normally obtained at the natural frequency of the model/flexure spring-mass system. Limit circuits are set prior to the test to provide overload protection for the balance. These limit circuits automatically shut the system down when they are exceeded. The torque-nulling system centers the hydraulic-driven piston so the force-measuring flexure (termed "torque beam") is not subjected to the model static aerodynamic moment. This allows the use of a torque beam suitable to the particular model for increased sensitivity.

Each load measuring element of each balance is instrumented with three sets of strain gages. Two sets of these strain gages are used with the system for each dynamic measurement. A two-phase oscillator provides $E \sin\omega t$ (AC) excitation to one set of strain gages to resolve the in-phase (with respect to a reference signal) component of the dynamic signal while $E \cos\omega t$ (AC) excitation is used to excite the second set of strain gages to resolve the out-of-phase (quadrature) component (where ω is the oscillation rate of the model). The third set of gages is DC excited to provide readings of static deflections, forces, and moments. A LSI-11 minicomputer and filter-amplifier chassis are used to provide analog-to-digital conversion and signal conditioning. The gage signals first pass through a 2-Hz passive filter, then through a 0.2-Hz active filter. A digital filter routine is performed in the minicomputer. The digital filter parameters can be changed easily depending on the noise of the data. The 32 channels of data are then sent to the facility computer for online data reduction.

3.0 TEST DESCRIPTION

3.1 TEST CONDITIONS AND PROCEDURES

3.1.1 General

A summary of the nominal test conditions at each Mach number is listed below.

M	PT, psf	TT, °F	Q, psf	P, psf	RE x 10^{-6}	V ft/sec
0.3	2,870	105	170	2,700	2.5	350
0.6	1,480	68	290	1,160	2.5	655
0.6	585	63	115	460	1.0	650
0.95	1,160	70	410	650	2.5	985
0.95	800	65	280	450	1.7	980
1.05	1,130	67	435	560	2.5	1,071
1.05	890	63	341	445	2.0	1,065
1.3	1,100	67	475	400	2.5	1,265

Definition of the configuration code is given in Table 1. The Test Summary is given in Table 2.

3.1.2 Data Acquisition

After establishing tunnel conditions and model attitude, the model was unlocked and brought to a constant oscillation amplitude by using the FOBCARS. The system was allowed to stabilize at the system resonant frequency before data were recorded. At each angle of attack, generally 3 data points were taken.

3.2 DATA REDUCTION

The digital readouts of the data acquisition instrumentation from the FOBCARS were input to the facility computer for reducing the data to coefficients. The direct damping coefficients were obtained using data reduction equations and procedures given in Ref. 2. The pitch and yaw damping results were corrected for sting motion, as discussed in Ref. 3. The cross and cross-coupling data were reduced using equations derived by methods as discussed in Ref. 4.

3.3 UNCERTAINTY OF MEASUREMENTS

In general, instrumentation calibrations and data uncertainty estimates were made using methods recognized by the National Bureau of Standards (NBS) (Ref. 5). Measurement uncertainty is a combination of bias and precision errors defined as:

$$U = \pm (B + t_{95}S)$$

where B is the bias limit, S is the sample standard deviation, and t_{95} is the 95th percentile point for the two-tailed Student's "t" distribution, which for degrees of freedom greater than 30 equals 2.

Estimates of the measured data uncertainties for this test are given in Table 3a, b, and c. The balance data uncertainties were determined from in-place static and dynamic calibrations through the data recording system and data reduction program. Static load hangings on the balances simulate the range of loads and center-of-pressure locations anticipated during the test, and measurement errors are based on differences between applied loads and corresponding values calculated from the balance equations used in the data reduction. Load hangings to verify the balance calibrations are made in-place on the assembled model. Static and dynamic calibrations of the dynamic stability balance system allowed the measurement uncertainty to be that which is due to the amount of nonrepeatability of the calibration constants. The sting and parts of the balance not dynamically calibrated were calibrated by static load hangings over the range of anticipated loads. Uncertainties in the measurements of sting effects were included in the error analysis. Structural damping values were obtained near vacuum conditions before the tunnel flow was started to evaluate the still-air damping contribution.

Propagation of the bias and precision errors of measured data through the calculated data was made in accordance with Ref. 5, and the results are given in Table 3d. The uncertainties are for steady-state conditions. Occasionally vibration and noise of the wind tunnel environment caused the scatter in the data to exceed the estimated uncertainty.

4.0 DATA PACKAGE PRESENTATION

The Data Package includes tabulated data, plotted data, and a test summary. Tabulated data includes summary data, point-by-point data, wind-off tare data, zeros data, a listing of constants, and miscellanous data, such as check loads, etc. Plotted data includes all static, direct dynamic, cross and cross-coupling data as a function of angle of attack, and comparison plots which depict configuration effects. A sample of the tabulated and plotted data is presented in Appendix 3. The data package is comprised of seven volumes, arranged as follows:

Volume No.	Run Nos.	Description
1	22-61	Pitch phase summary and plotted data
2	76-94	Yaw phase summary and plotted data
3	113-124	Roll phase summary and plotted data
4	22-61	Pitch phase point-by-point data
5	76-94	Yaw phase point-by-point data
6	113-124	Roll phase point-by-point data
7		Zeros, tares, constants, miscellanous

Plots of some of the coefficient data are shown in Fig. 8. The direct derivatives, P/Y CLM-A, P/Y CLM-AD, P/Y CLN-B, P/Y CLN-BD and P/Y CLM compared favorably with previous SDM data (Refs. 6 and 7).

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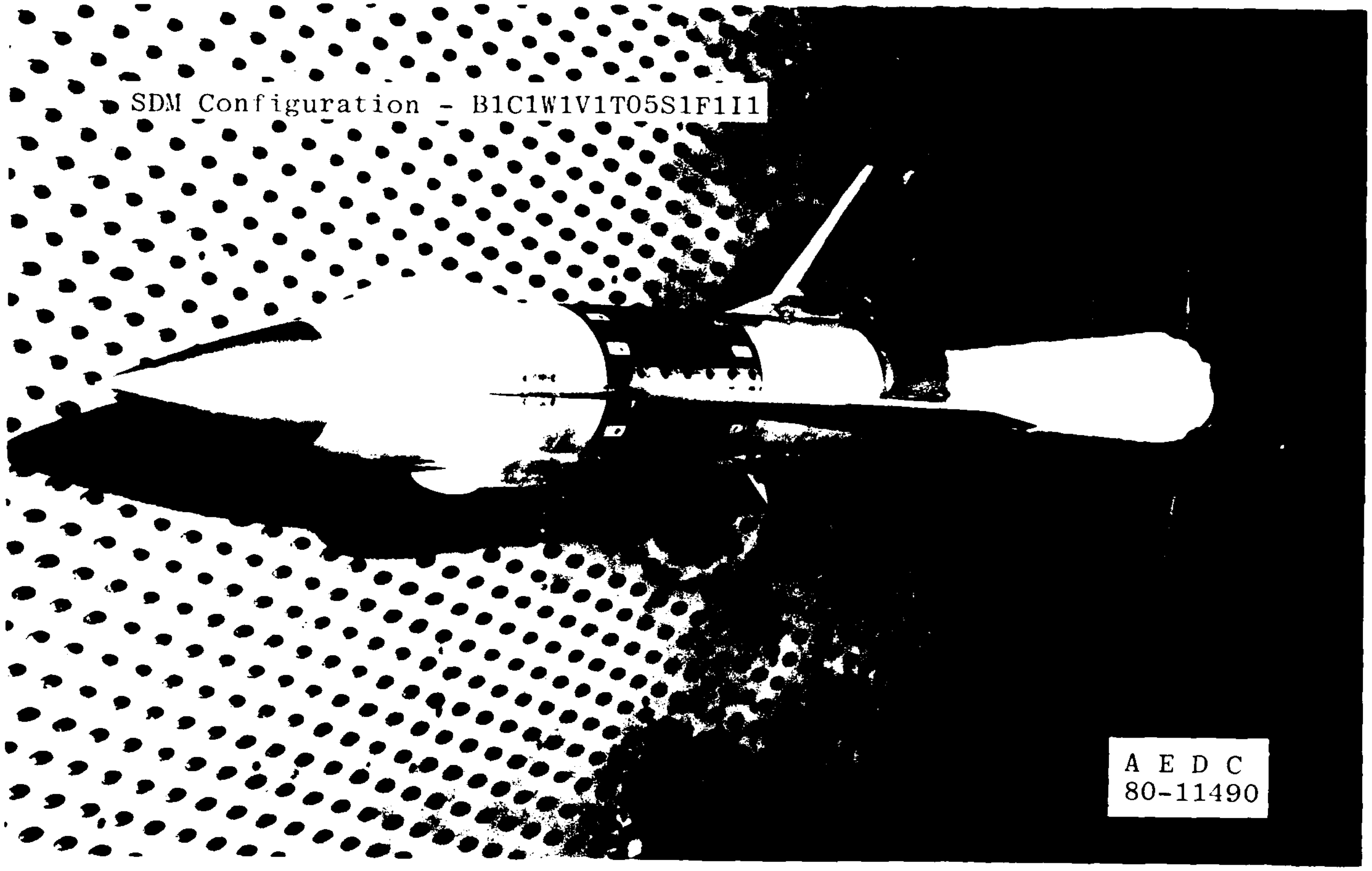
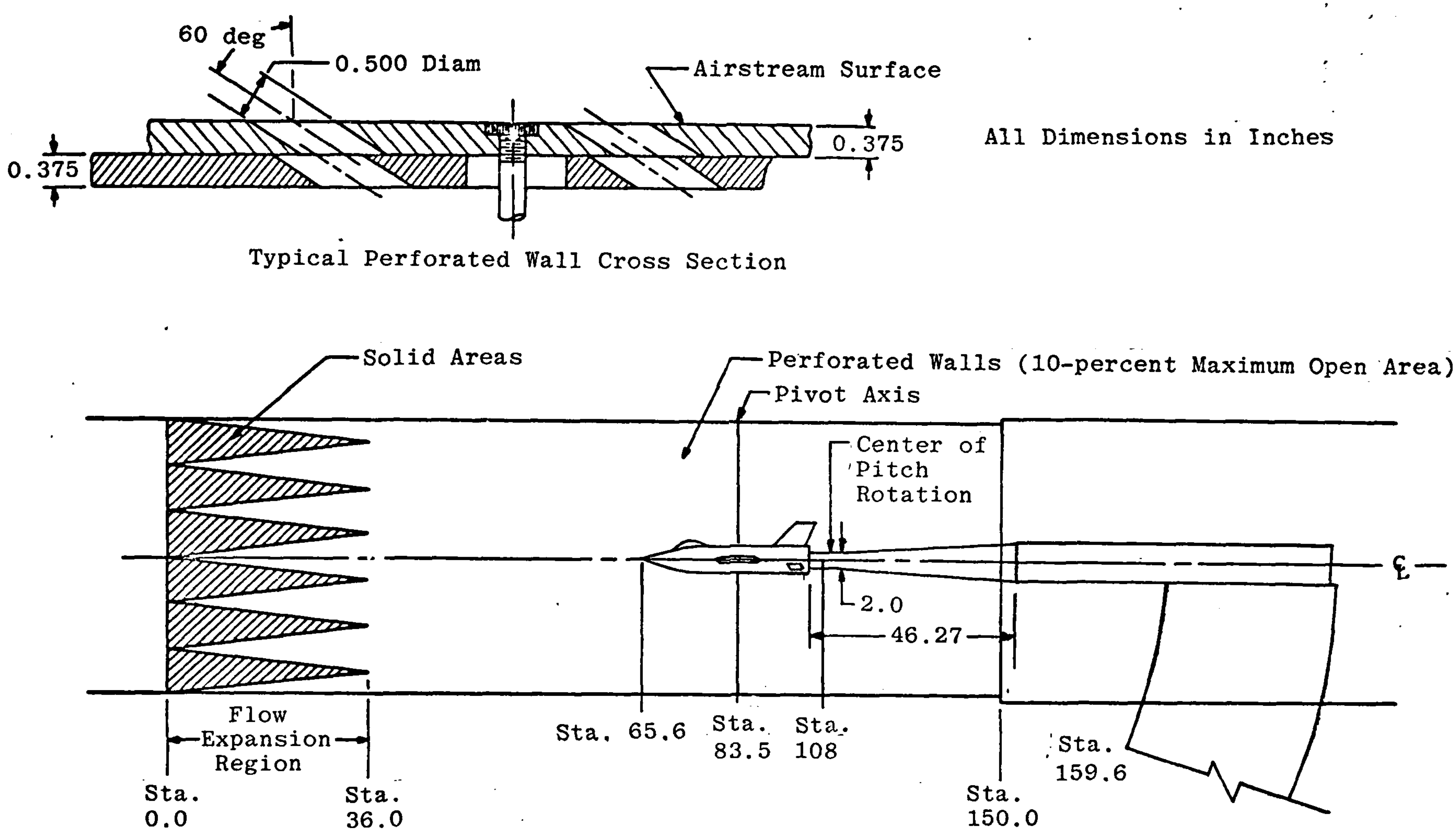
APPENDIX I

ILLUSTRATIONS



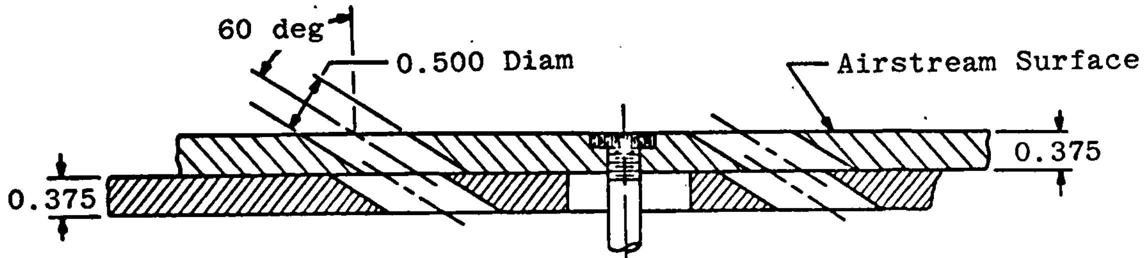
a. Installation Photograph

Fig. 1. General Installation Arangement



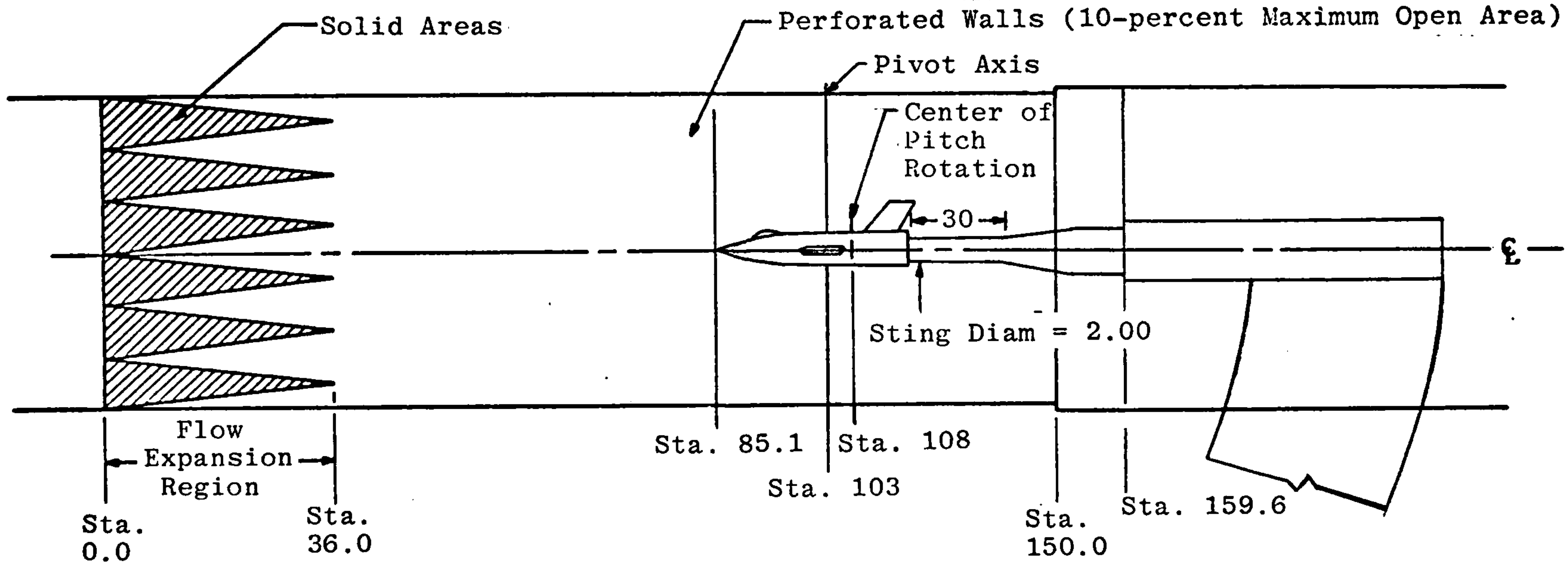
b. Installation Sketch - Pitch/Yaw Balance

Fig. 1. Continued



All Dimensions in Inches

Typical Perforated Wall Cross Section



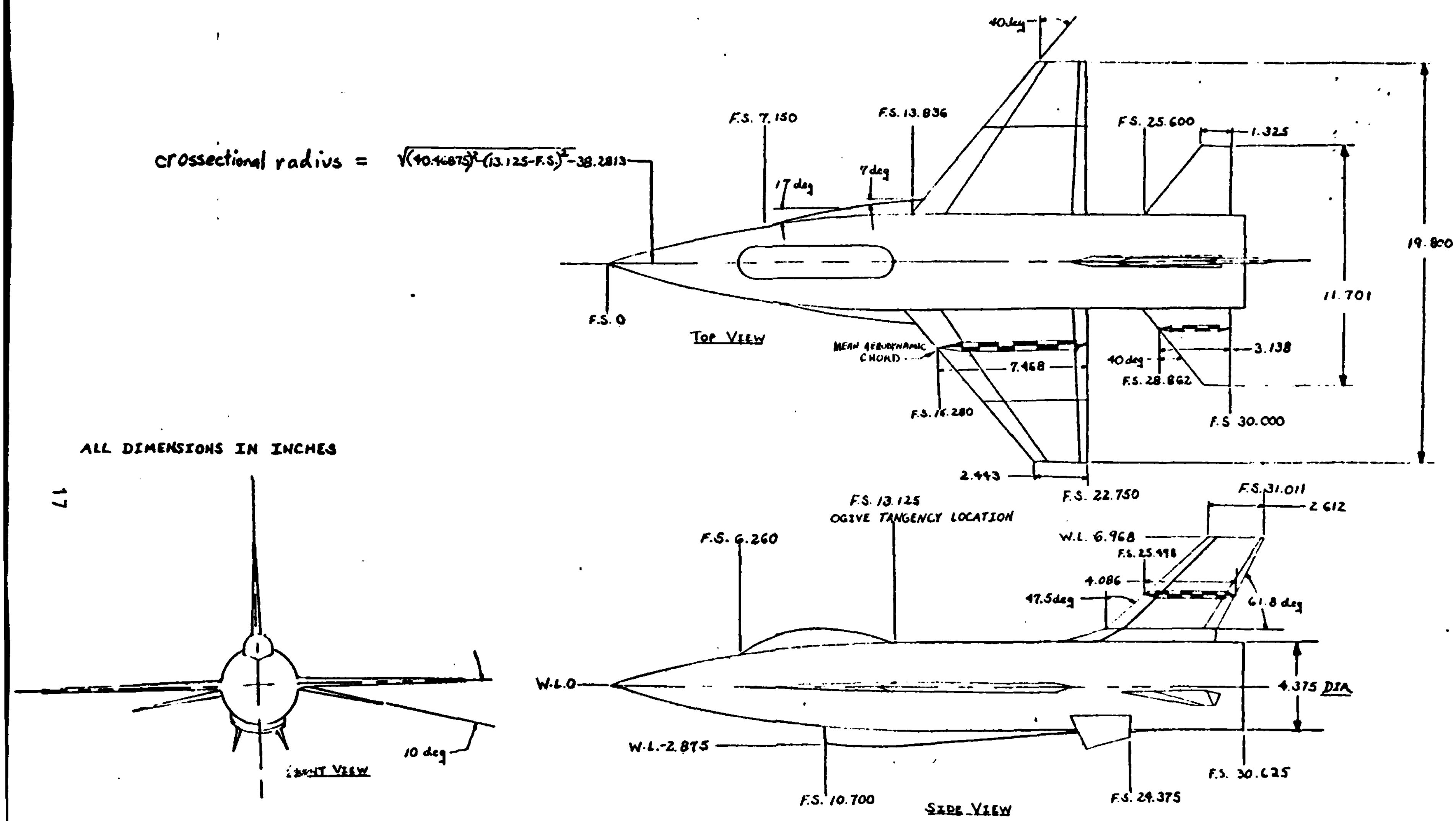
Schematic of 4T

c. Installation Sketch - Roll Balance

Fig. 1. Concluded

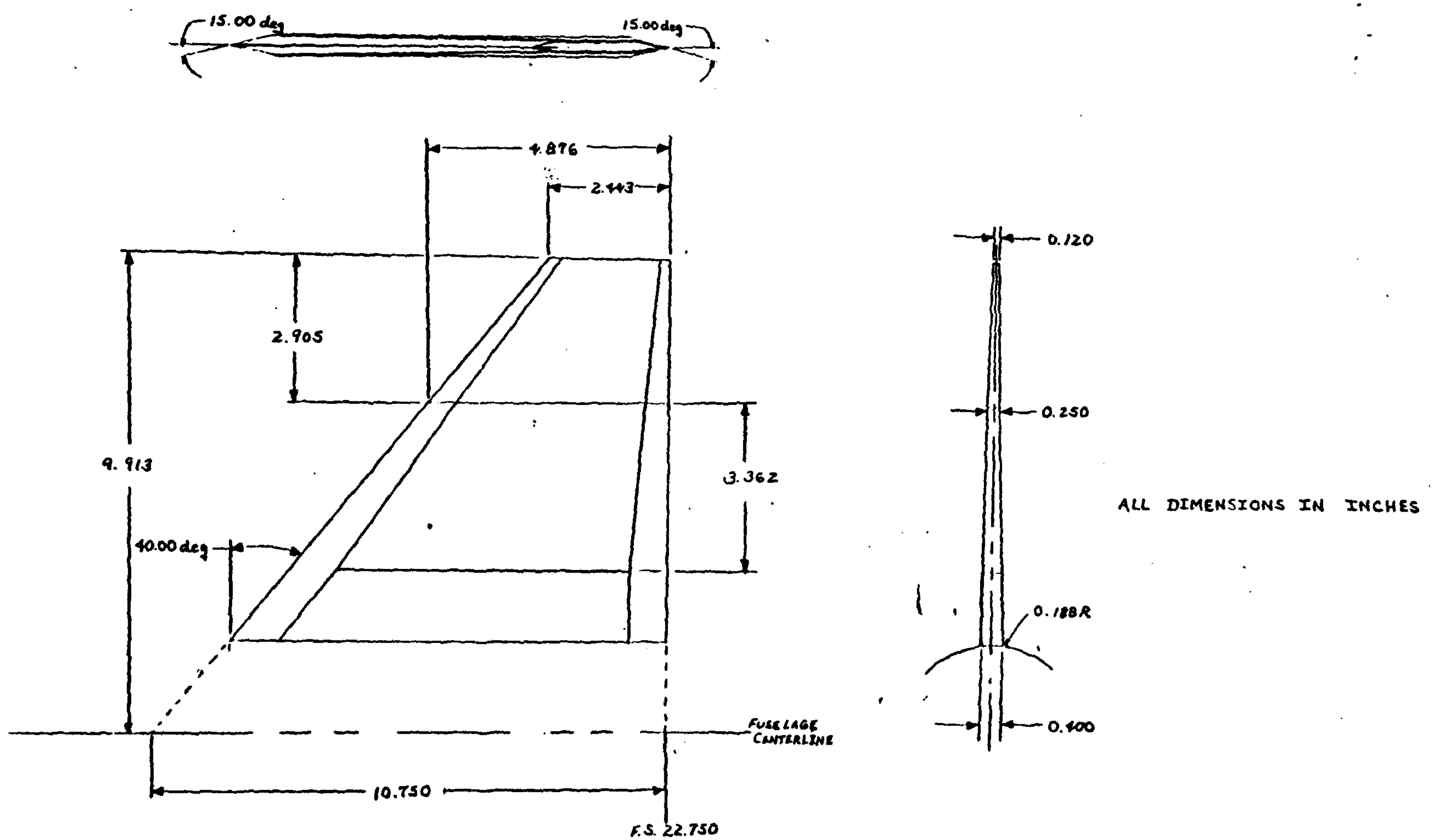
WING	
Area	0.90702 ft^2
Span	1.6500 ft
MAC	0.62233 ft
Aspect Ratio	3.0
L.E. Sweep	40 deg
Dihedral	0
Incidence	0
Airfoil	Double Wedge 4.5 percent thickness at root.
L.E. Angle	15 (half angle)
T.E. Angle	15 (half angle)
HORIZONTAL TAIL	
Area	0.30707 ft^2
Aspect Ratio	3.0
Taper Ratio	0.213
L.E. Sweep	40 deg
Dihedral	-10 deg
Airfoil	Double Wedge 6.4 percent thickness at root.
L.E. Angle	14 deg (half angle)
T.E. Angle	15 deg (half angle)
VERTICAL TAIL	
Area	0.30846 ft^2
Aspect Ratio	1.093
Taper Ratio	0.362
L.E. Sweep	
Tip	47.5 deg
Root	15.0 deg
Airfoil	Double Wedge 5.6 percent thickness at root.
L.E. Angle	15 deg (half angle)
T.E. Angle	15 deg (half angle)
VENTRAL FIN (Each)	
Area	0.0263 ft^2
Span	0.150 ft
Aspect Ratio	0.86
Taper Ratio	0.70
L.E. Sweep	26.5 deg
Dihedral (cant)	25.2 deg (outboard)
Airfoil	
At Root	Modified Wedge 3.8 percent thick at root.
At Tip	Constant 0.003 r
FUSELAGE	
Length	2.55208 ft
Diameter	0.36458 ft
Center of Gravity	1.49125 ft from Nose @ 35% MAC 9
	1.36667 ft from Nose @ 15% MAC

Fig. 2. Standard Dynamics Model (SDM) Dimensions



a. Overall Details

Fig. 3. Standard Dynamics Model (SDM) Details



b. Wing and Wing Tip Details

Fig. 3. Continued

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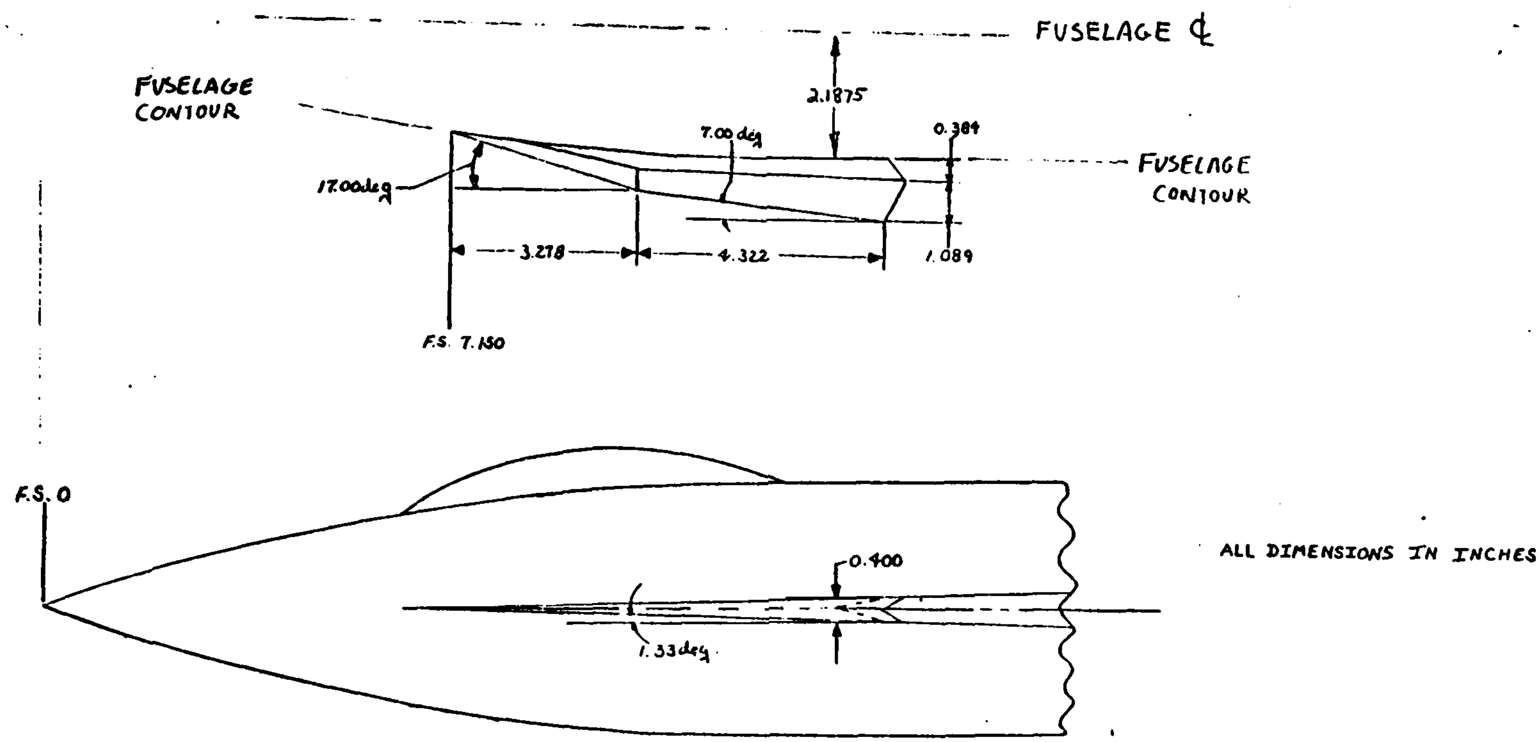
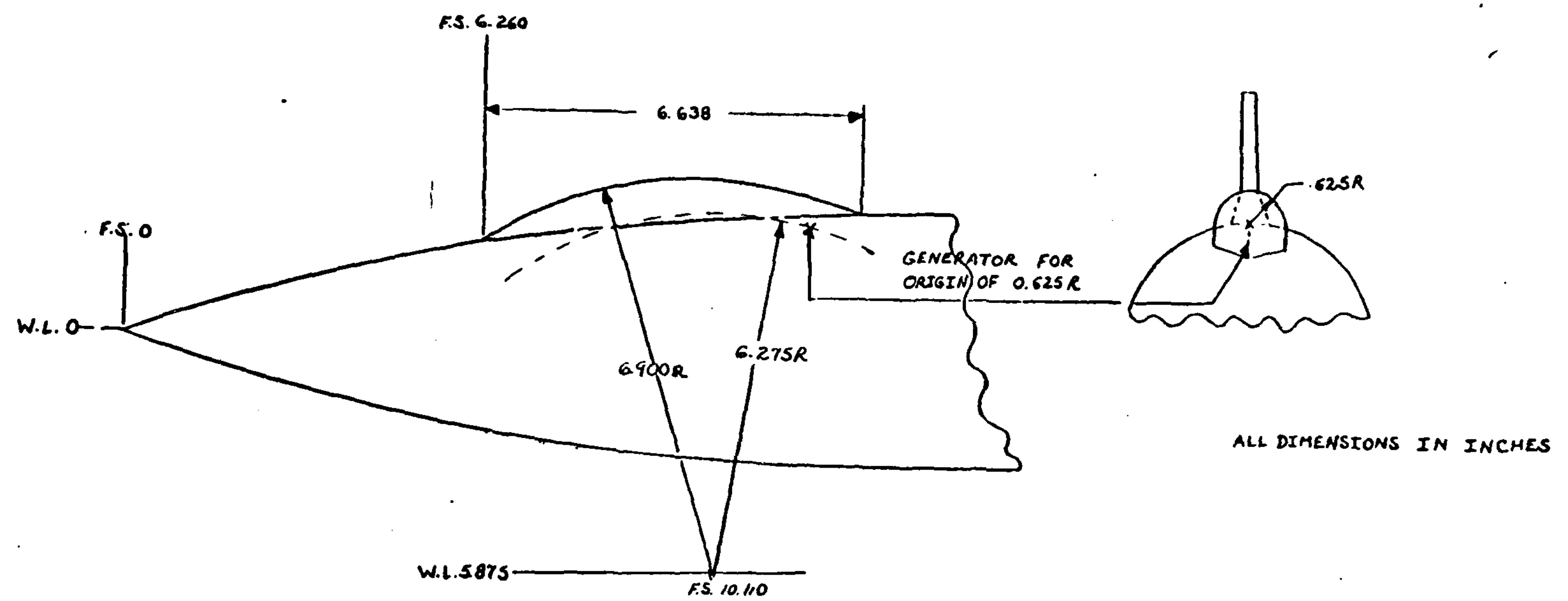


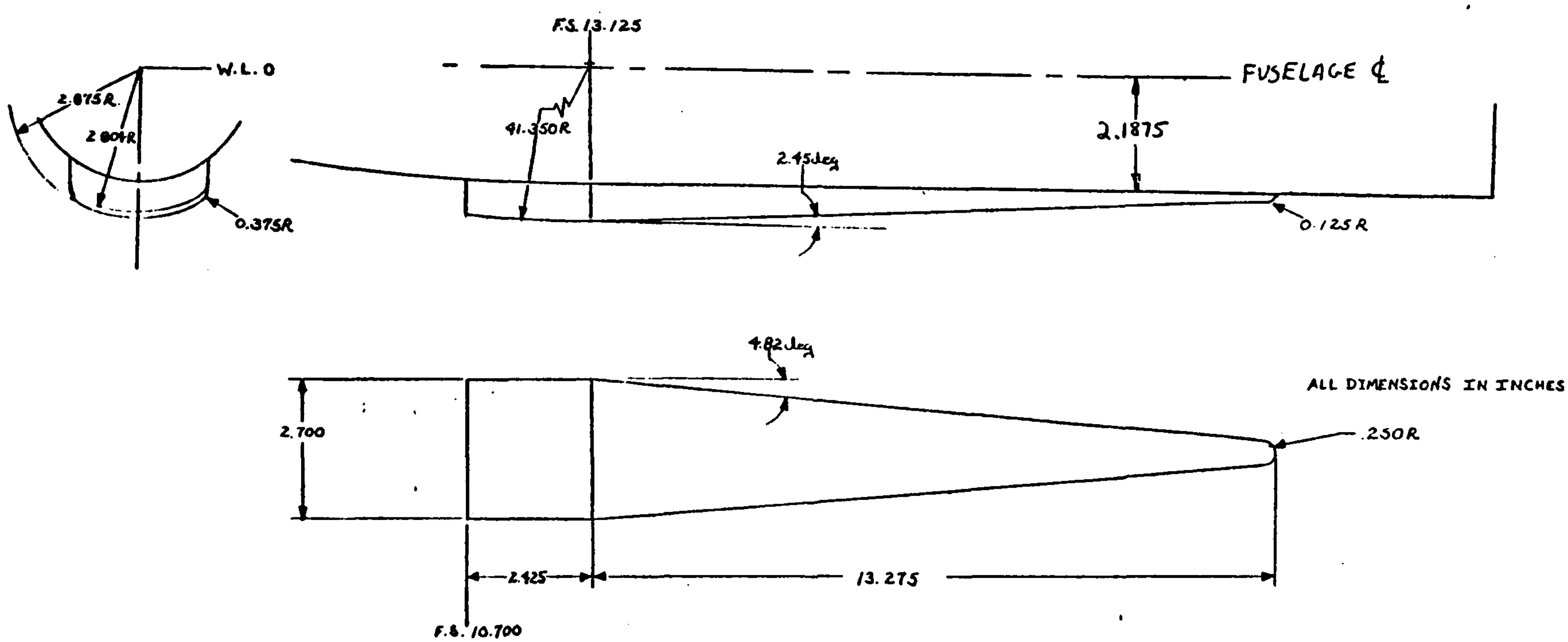
c. Strake Details

Fig. 3. Continued

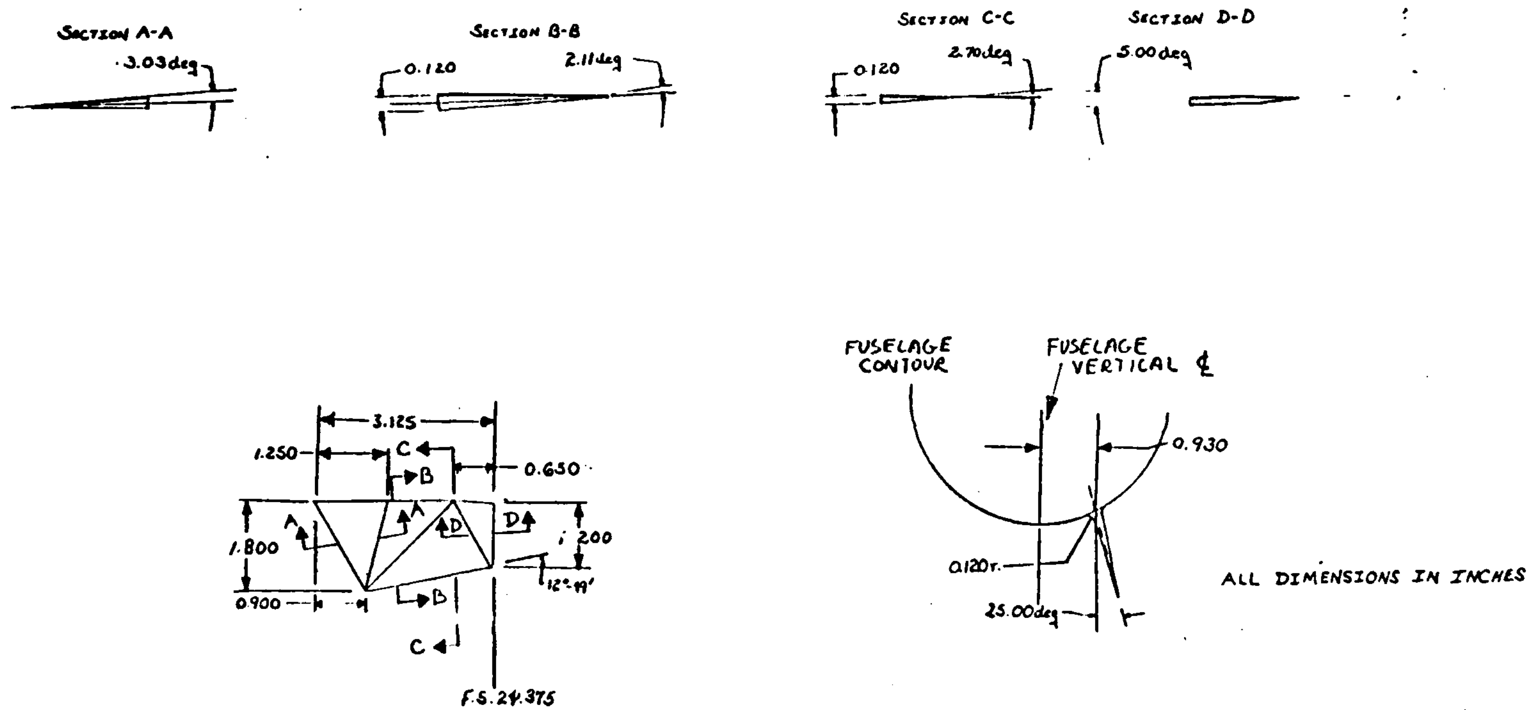


d. Canopy Details

Fig. 3. Continued

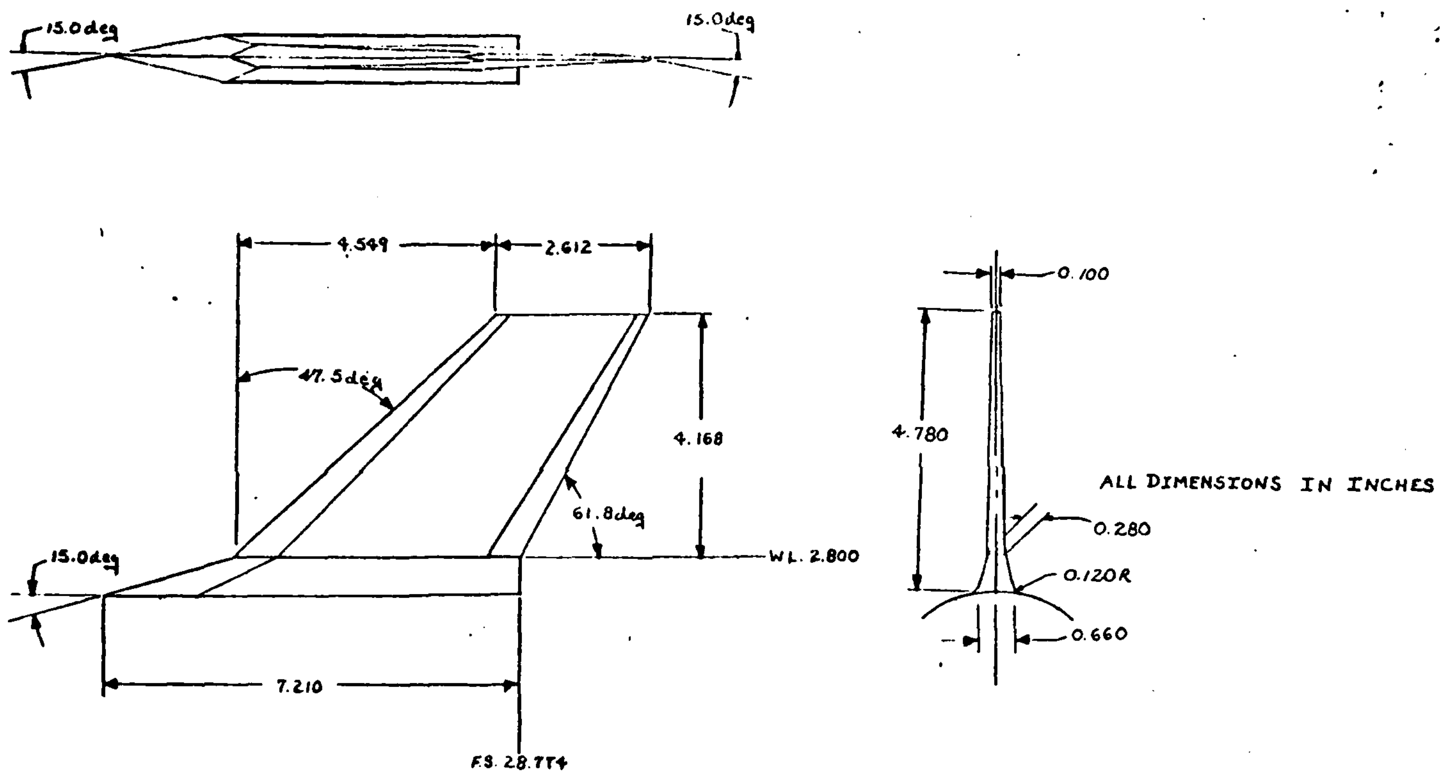


e. Inlet Details
Fig. 3. Continued

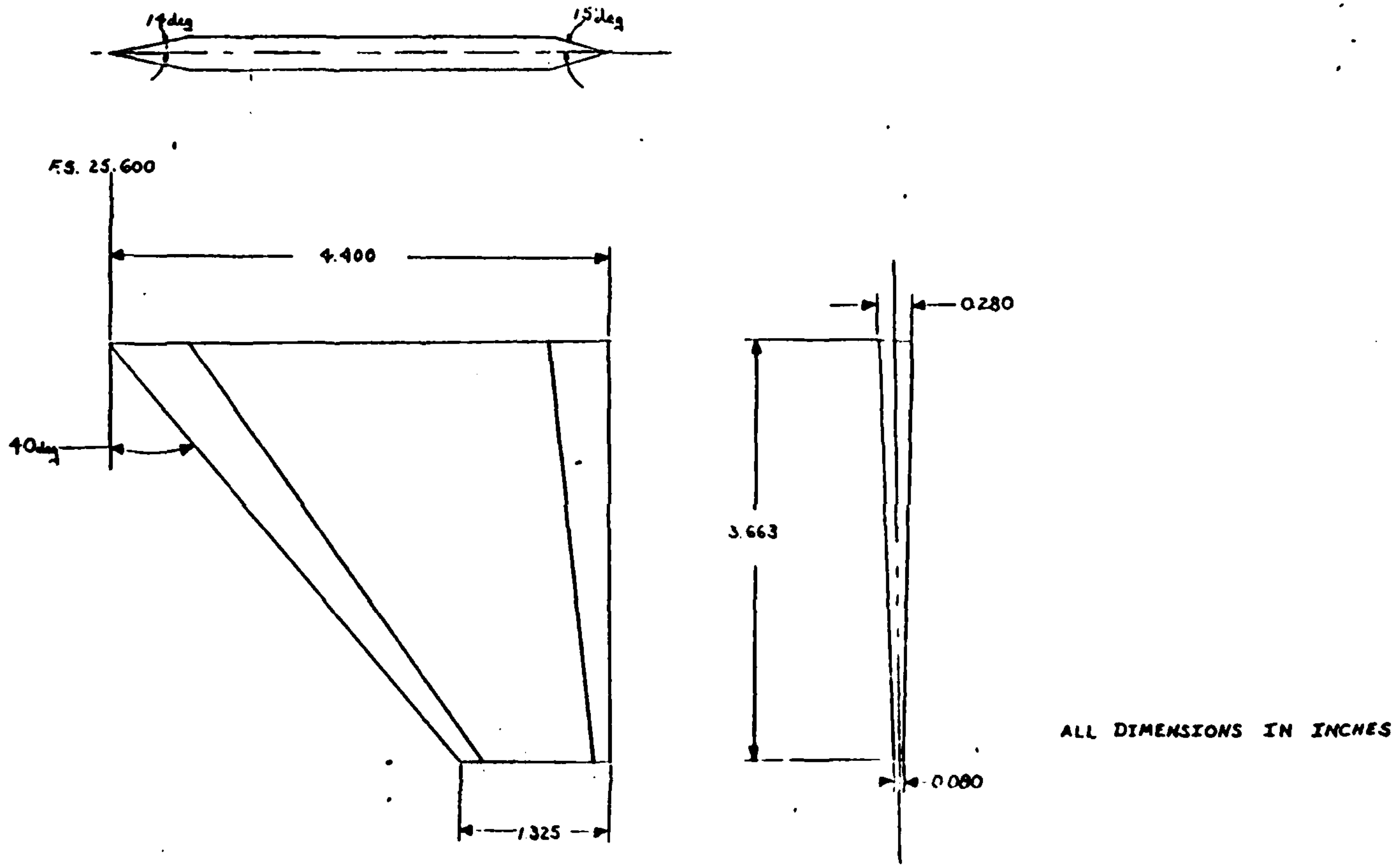


f. Ventral Fin Details

Fig. 3. Continued



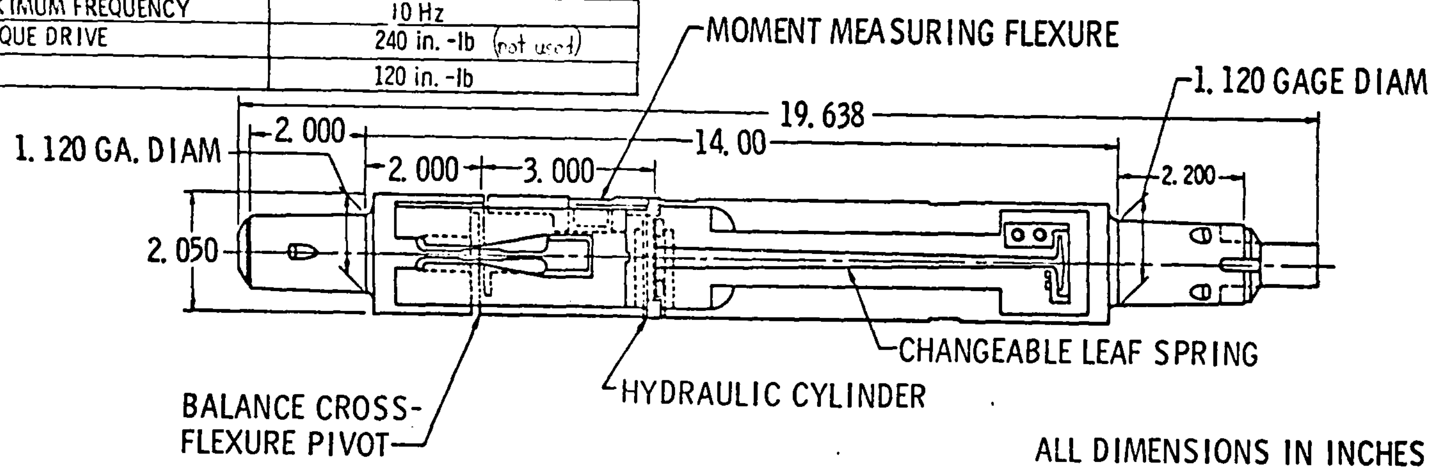
g. Vertical Stabilizer Details
Fig. 3. Continued



h. Horizontal Stabilizer Details

Fig. 3. Concluded

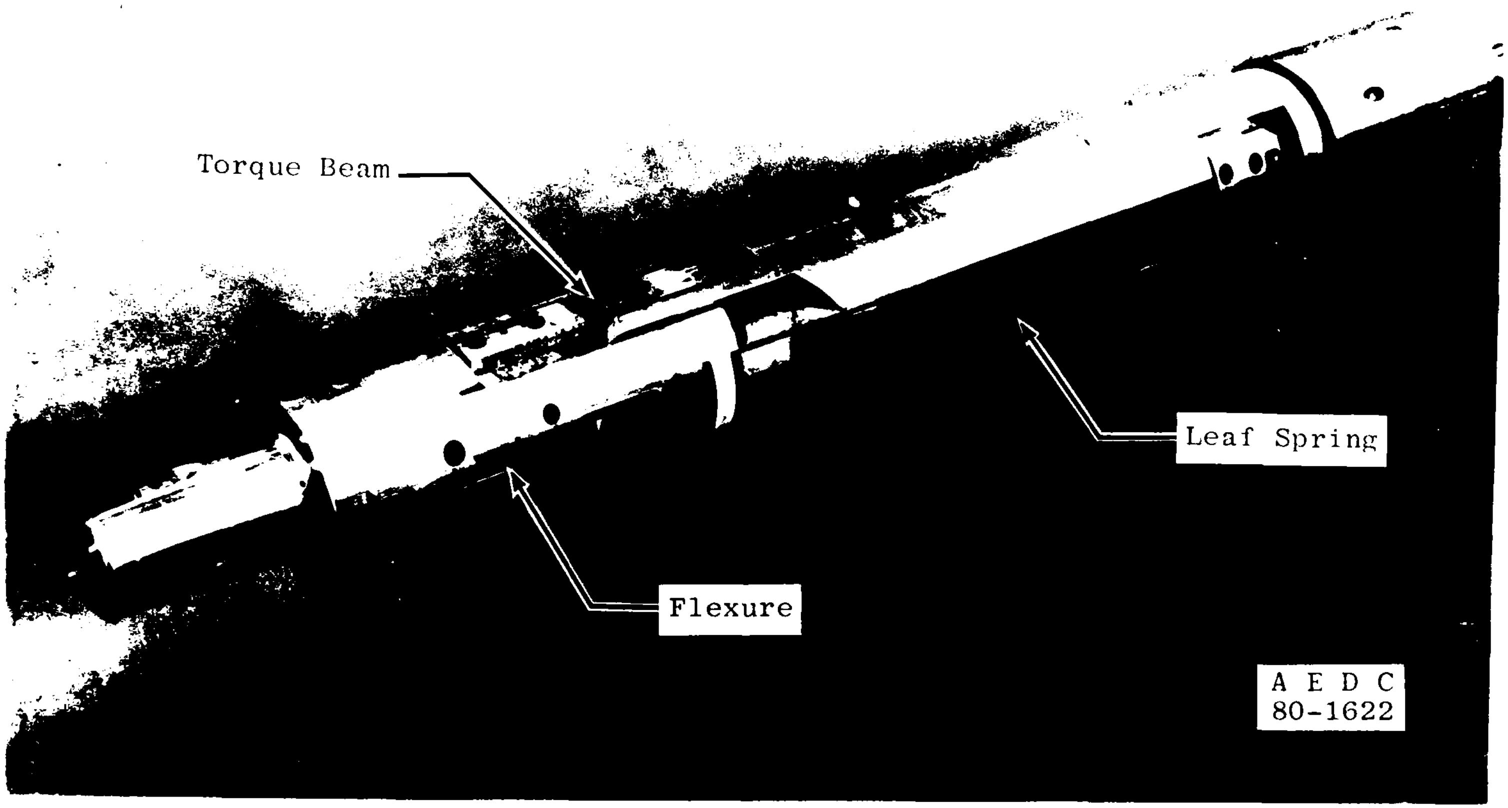
BALANCE LIMITS		
PARAMETER	PITCH DERIVATIVE ϕ_B-0°	YAW DERIVATIVE ϕ_B-90°
NORMAL FORCE	1500 lb	1500 lb
PITCHING MOMENT	θT X MθF	1500 in. -lb
SIDE FORCE	150 lb	150 lb
YAWING MOMENT	150 in. -lb	θT X MθF
AXIAL FORCE	600 lb	
ROLLING MOMENT	150 in. -lb	
CROSS-FLEXURE STIFFNESS	87 in. -lb/deg	
CROSS-FLEXURE AND LEAF-SPRING STIFFNESS	600 in-lb/deg or 350 in-lb/deg	
TOTAL OSCILLATING ANGLE	3 deg	1 deg
MAXIMUM FREQUENCY	10 Hz	
TORQUE DRIVE	240 in. -lb (not used)	
	120 in. -lb	



P7986
C811

a. Balance Details

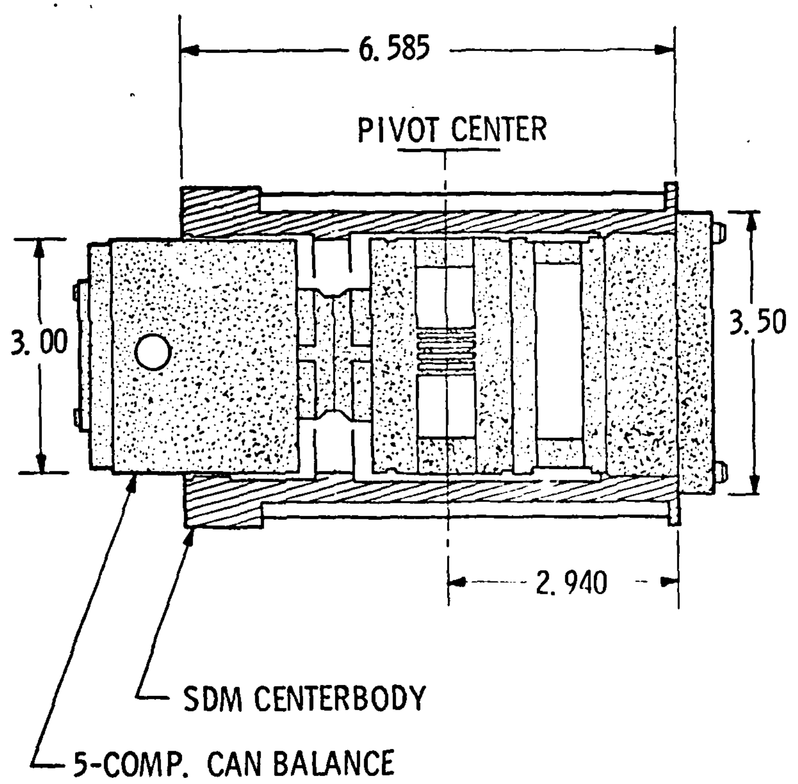
Figure 4. 1500 lb Pitch/Yaw Dynamic Balance



b. Balance Photograph

Figure 4. Concluded

ALL DIMENSIONS IN INCHES

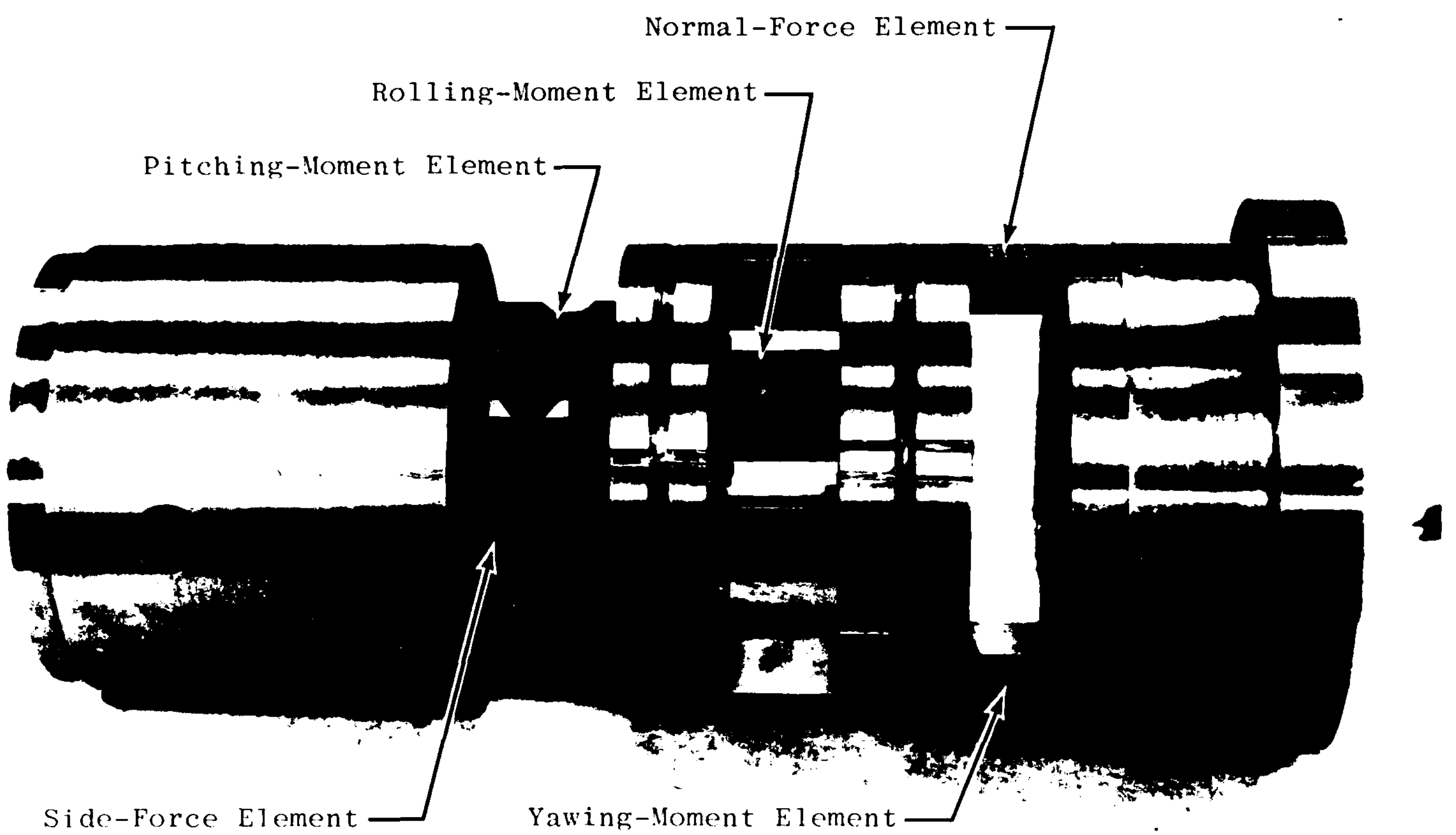


LOAD	BALANCE LIMITS
F_N	1500 LB
F_Y	150 LB
M_m	1050 IN. -LB
M_n	525 IN. -LB
M_ℓ	150 IN. -LB

C811

a. Balance Details

Figure 5. 1500 lb 5-Component Can Balance



A E D C
80-1623

b. Balance Photograph

Figure 5. Concluded

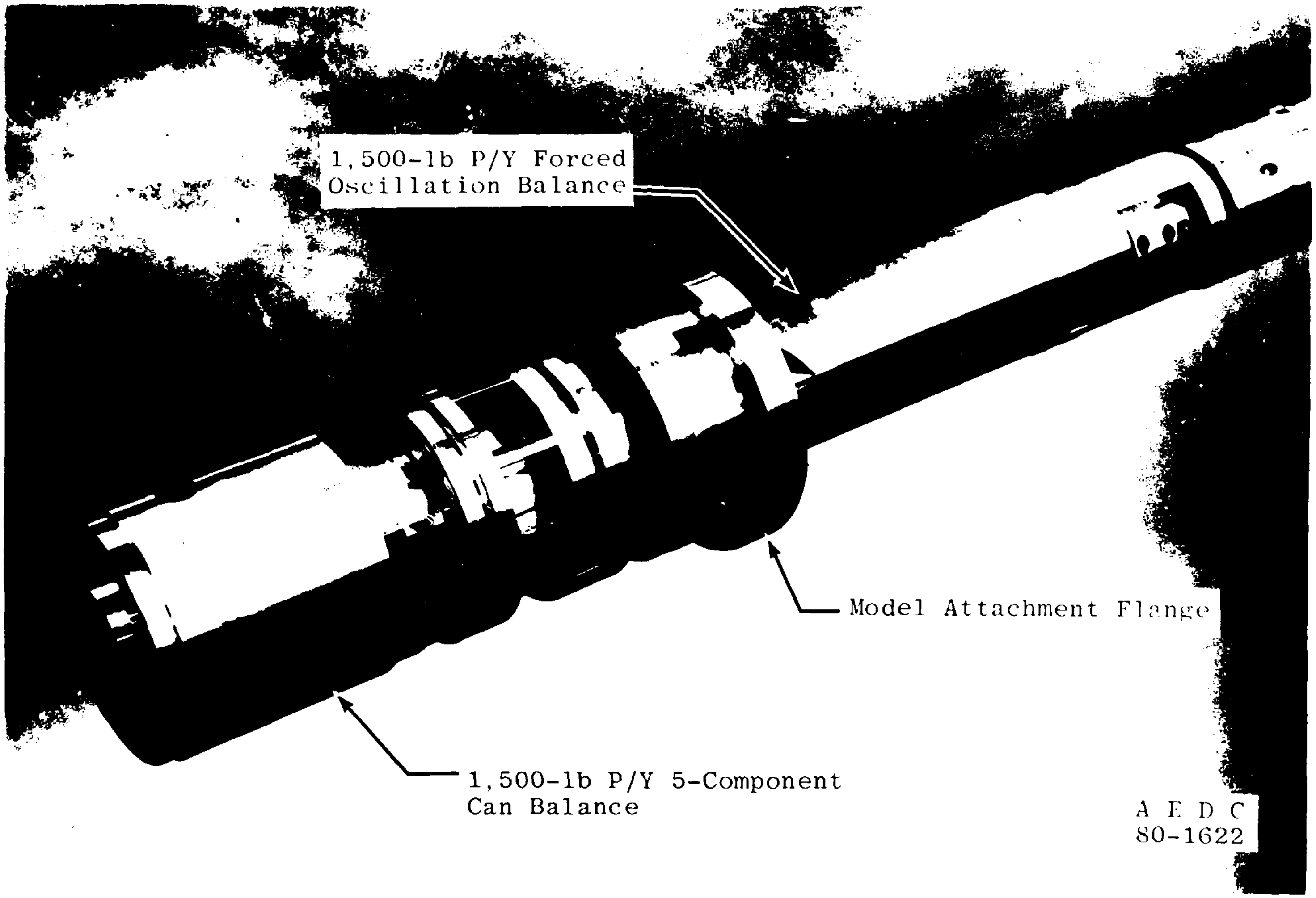
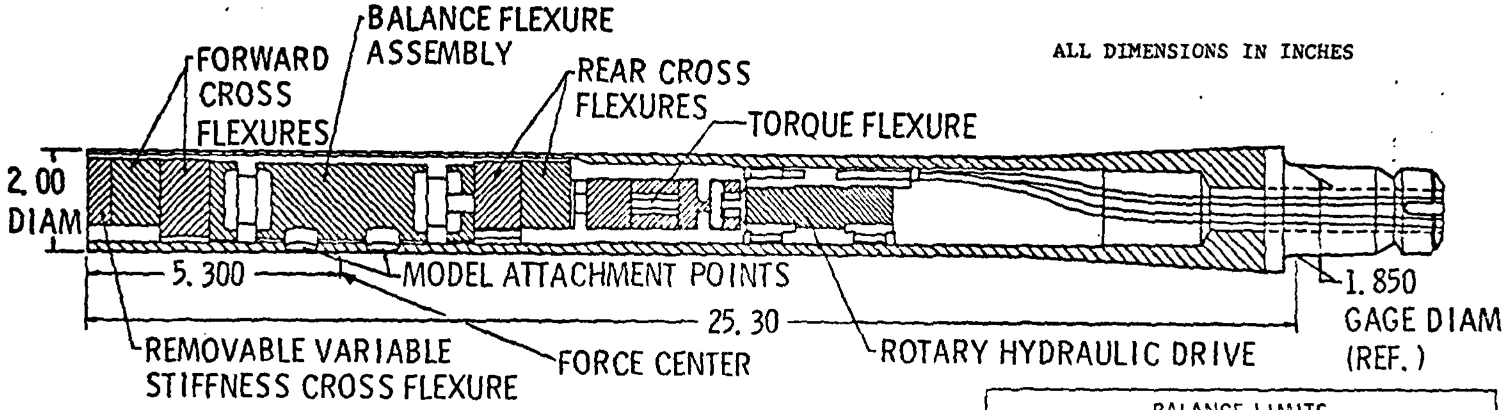


Figure 6. Pitch/Yaw - Can Balance Assembly

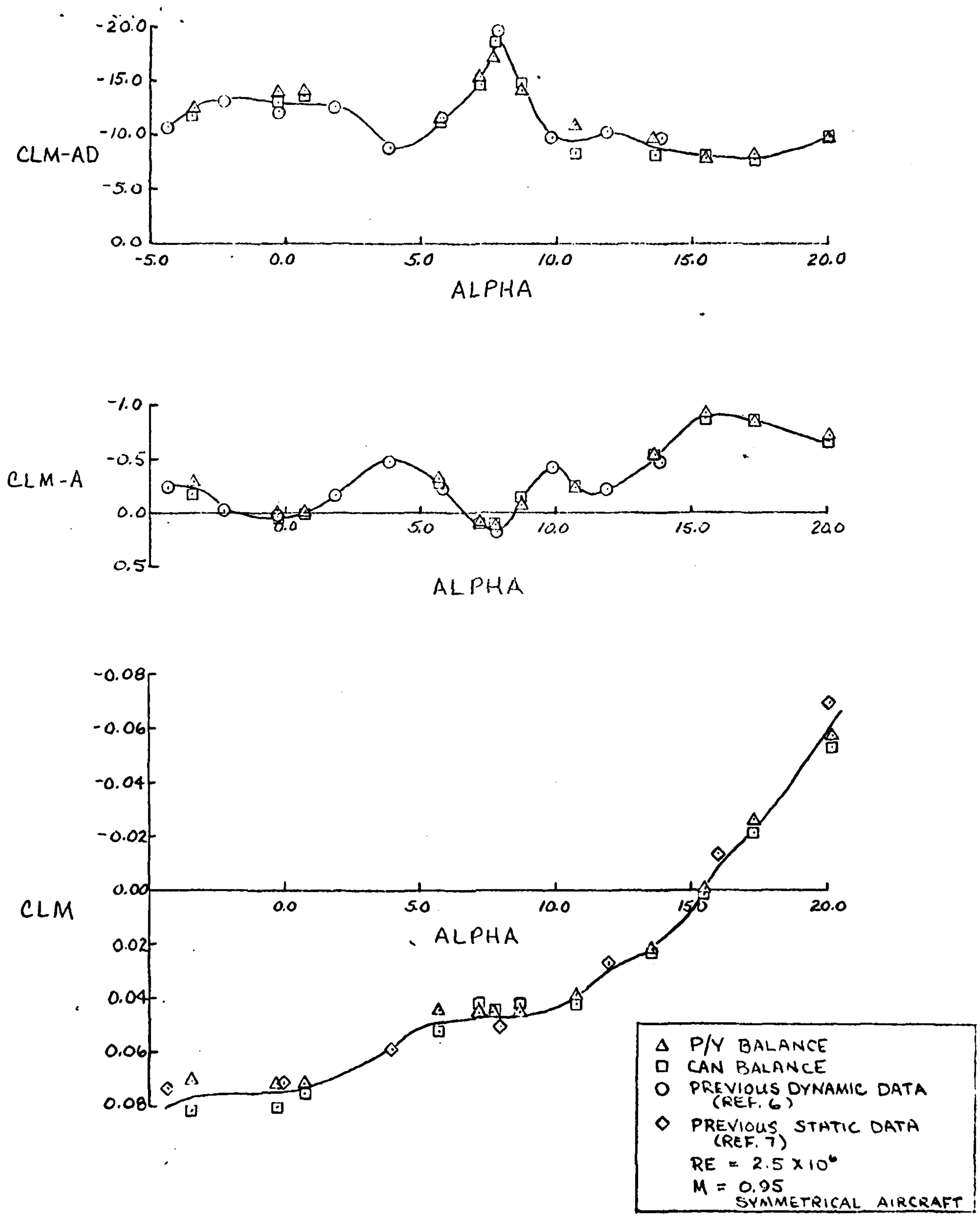


BALANCE LIMITS	
PARAMETER	ROLL DERIVATIVE
NORMAL FORCE	1500 LB
PITCHING MOMENT	3000 IN.-LB
SIDE FORCE	200 LB
YAWING MOMENT	400 IN.-LB
AXIAL FORCE	600 LB
ROLLING MOMENT	$\bar{\theta}_T$ x MθF
CROSS-FLEXURE STIFFNESS	43 IN.-LB/DEG
VARIABLE AND CROSS-FLEXURE STIFFNESS	62 IN.-LB/DEG
TOTAL OSCILLATING ANGLE	$\pm$3 DEG
MAXIMUM FREQUENCY	10 Hz
TORQUE DRIVE	60 IN.-LB 120 IN.-LB

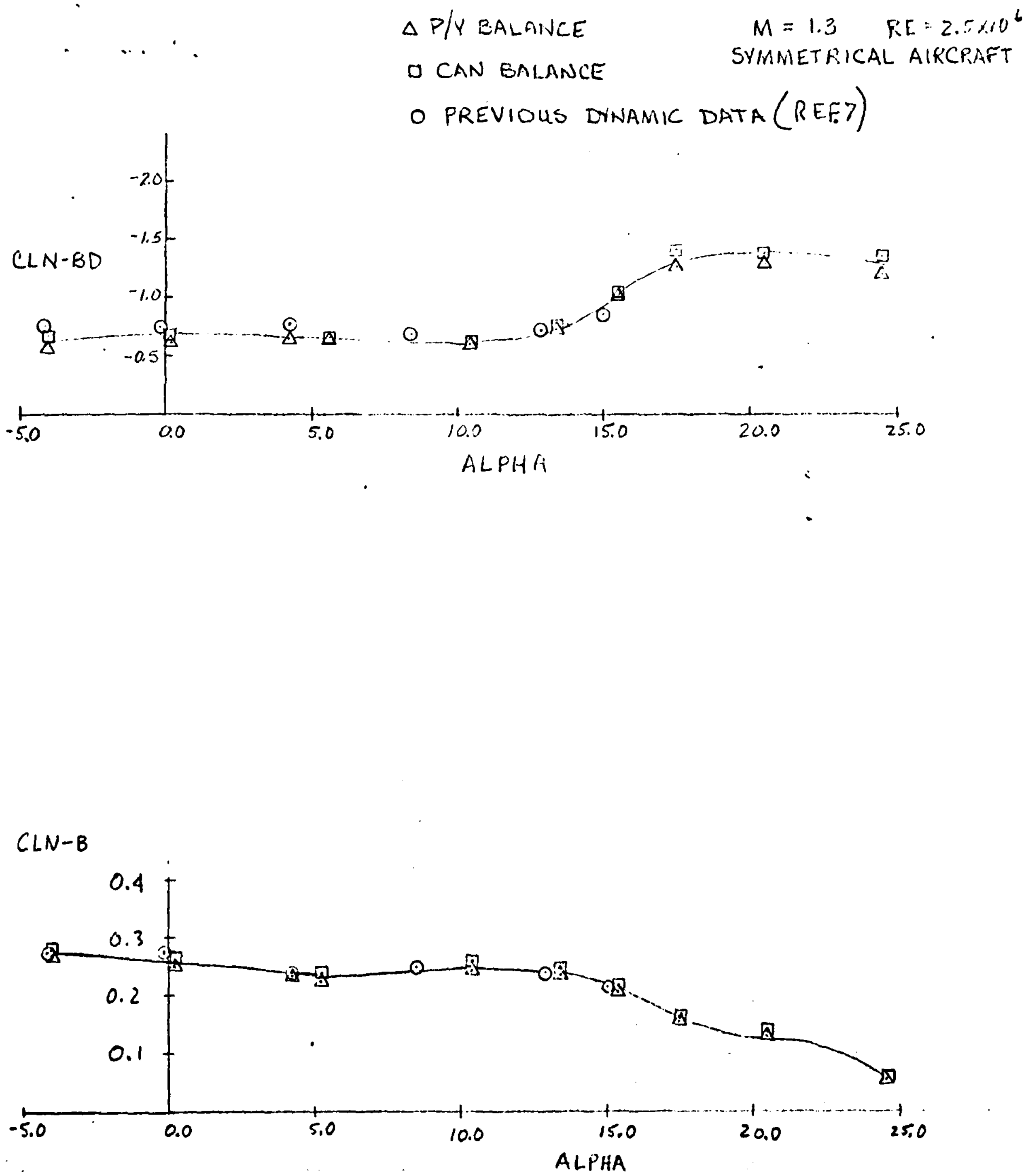
$\bar{\theta}_T = \theta$ - (OSCILLATION AMPLITUDE)

Figure 7. 1500 lb Roll Dynamic Balance Details

C811

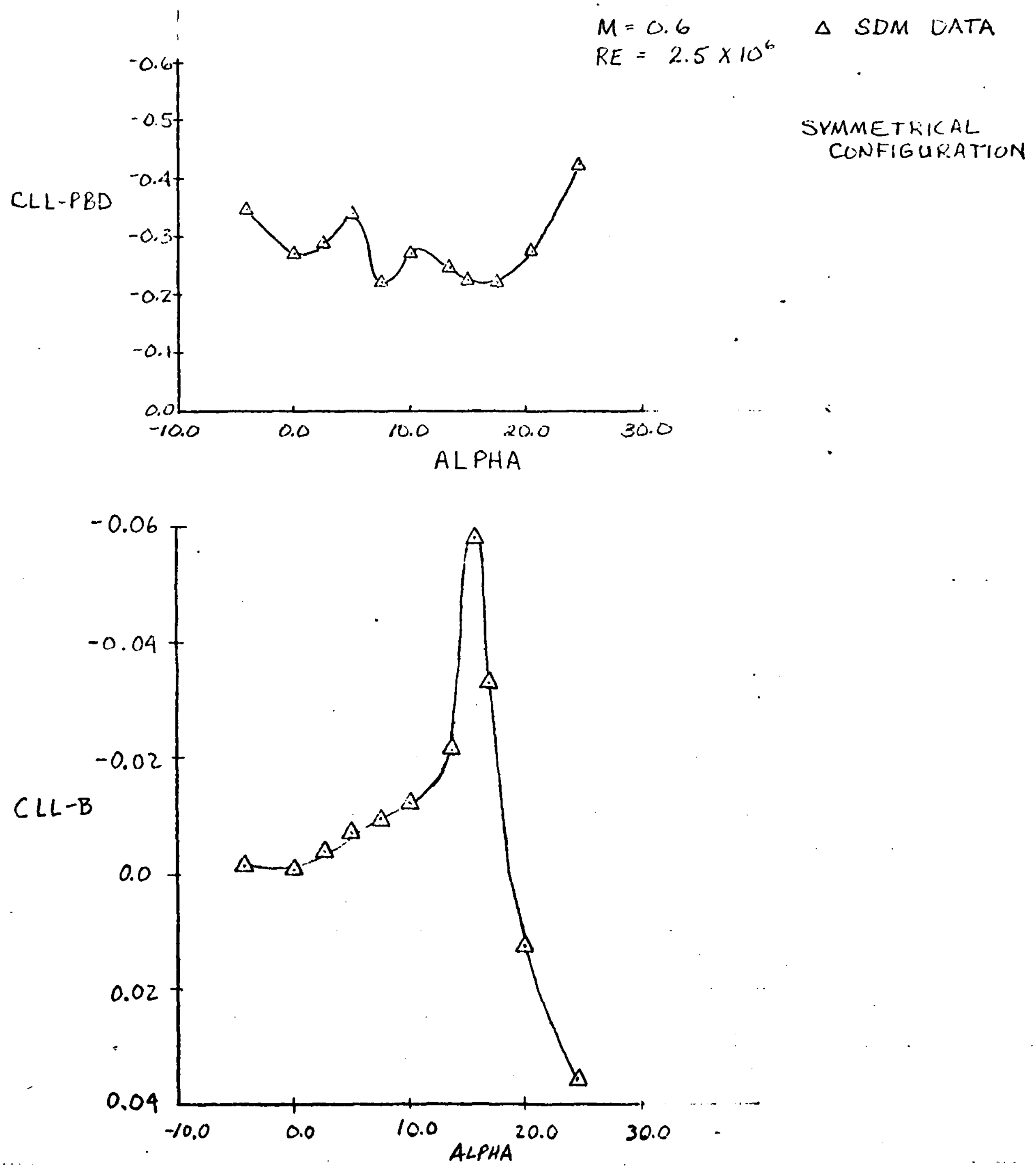


a. Pitch Phase Data
Figure 8. Data Comparisons



b. Yaw Phase Data

Figure 8. Continued



c. Roll Phase Data

Figure 8. Concluded

APPENDIX II

TABLES

Table 1

STANDARD DYNAMICS MODEL
CONFIGURATION DESIGNATIONS

EXAMPLE	CONFIGURATION DETAIL
B1C0W0V0T99	BASIC FUSELAGE BODY (CG at 35% MAC)
B1C1W0V0T99	BODY + CANOPY
B1C1W1V0T99	BODY + CANOPY + WINGS
B1C2W1V1T99	BODY + CANOPY + WINGS + VERTICAL TAIL
±B1C1W1V1TXX	BODY + CANOPY + WINGS + VERTICAL TAIL + HORIZONTAL STABILIZERS
±B1C1W1V1TXXS1	BODY + CANOPY + WINGS + VERTICAL TAIL + HORIZONTAL STABILIZERS + STRAKES
±B1C1W1V1TXXS1F1	BODY + CANOPY + WINGS + VERTICAL TAIL + HORIZONTAL STABILIZERS + STRAKES + VENTRAL FINS
±B1C1W1V1TXXS1F1I1	BODY + CANOPY + WINGS + VERTICAL TAIL + HORIZONTAL STABILIZERS + STRAKES + VENTRAL FINS + INLET
±B1C1W1V1TXXS0F1I1	BODY + CANOPY + WINGS + VERTICAL TAIL + HORIZONTAL STABILIZER + VENTRAL FINS + INLET (NO STRAKES)

SEE KEY (TYP.)

± B___ - C___ - W___ - V___ - T XX S___ - F___ - I___

XX: STABILATOR DEFLECTION (DELE) Angle, deg.

±: Stabilizer angle direction. Positive Trailing edge down.

NON-ZERO INDICATES COMPONENT ON EXCEPT FOR
TAIL WHERE 99 WILL SIGNIFY TAIL OFF

Table 1.-Continued

Standard Configuration Key

KEY		MODEL PART
1	B	BASIC FUSELAGE BODY CG @ 35% MAC
2	B	BASIC FUSELAGE BODY CG @ 15% MAC
1	C	CANOPY
1	W	WINGS - LIGHT TIPS
2	W	- HEAVY TIPS
1	V	VERTICAL TAIL
±XX deg	T	HORIZONTAL STABILIZERS - DEFLECTION 99 signifies tail off
1	S	STRAKES
1	F	VENTRAL FINS
1	I	INLET

TABLE 2. Test Summary

RUN	CONFIGURATION	M	RE x 10^6	PT	POS	RFP	ALPHA RANGE	TEST PHASE
22	-B1C1W1V1T05S1F1I1	0.3	2.5	2900	0.5,1.0,1.5	.04	0	Pitch
23							10	
28					1.5		0	
29					1.0,1.5		10	
30							20	
31					1.0		0	
32		0.95		1160	1.0,1.5	.014	0	
34							17-20	
35							15	
36							13	
37							10	
38							5	
39							-4	
40							-1	
41			1.75	800		.015	20-24	
45		1.3	2.5	1110	1.0	.012	-4-20	
*46		0.95		1160		.014	6.5-8	
47		0.6		1480		.021	-4-24	
48		1.05		1130	0.5,1.0	.013	-4-24	
54	-B1C1W1V1T05S0F1I1	0.6		1480	1.0	.021	-4-13	
55		0.6	1.0	585		.022	0-20	
56		0.95	1.75	800		.015	-4-17	
57		1.05	2.0	890		.013	-4-0	
60							0-12	
61		1.3	2.5	1110	0.5,1.0	.012	-4-20	
76	-B1C1W1V1T05S1F1I1	0.3		2700	0.5,1.0	.058	-4-24	Yaw
77		0.95		1160	1.0	.022	0	
78							-4-20	
79		1.3		1110		.017	-4-24	
80		1.05		1130		.02	-4-17	
80.22		1.05	2.0	900			17	
85	-B1C1W1V1T05S0F1I1	0.3	2.5	2760		.058	-4-24	
86		0.95	1.75	800		.02	-4-17	
87		1.3	2.5	1100		.017	-4-10	
93							0-20	
94		1.05	2.0	885		.02	-4-15	
114	-B1C1W2V1T05S1F1I1	0.3	2.5	2730	0.5,1.0,1.5	.13	0-20	Roll
115		0.6	2.5	1500	1.0,1.5	.067	-4-24	
119		0.95	1.7	800	1.5	.044	0-24	
120		1.30	2.5	1100		.034	0-24	
123	-B1C1W2V1T05S0F1I1	0.6	1.0	600		.067	0-15	
124		0.95	1.75	810		.044	0-15	

*Run 46 is additional M = 0.95 data and should be included with Runs 32 $\longrightarrow$ 41

TABLE 3. ESTIMATED UNCERTAINTIES

a. Basic Measurements

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT*							Range	Type of Measuring Device	Type of Recording Device	Method of System Calibration
	Precision Index (S)			Bias (B)		Uncertainty $\pm(B + t_{95}S)$					
	Percent of Reading	Unit of Measurement	Degree of Freedom	Percent of Reading	Unit of Measurement	Percent of Reading	Unit of Measurement				
PT, psfa	±(0.04% + 0.15)	±0.7	30 30	±(0.11% + 1)	±2.9	±(0.2% + 1.3)	±4.3	0 to 1500 1500 to 4000	Datametrics Barocel Model 538AX-93 0.4000 PSFA	Datametrics Electronic Manometer C-1018	In-place calibration with a precision pressure standard
TT, deg R		±0.1	6		±0.55		±0.77	410 to 610	Dual Chromel® Alumel® Thermocouples	Newport Model 2600KF Digital Thermometer	Voltage standard substitution using a stirred ice bath thermocouple reference
ALPHA, deg	±(0.014% + 0.004)		7		±0.029	±(0.03% + 0.038)		-8 to 27	Clifton Precision products Model CG-10-AS-1 SYNCHRO Transmitter	Theta Model C-5280 Digital Indicator	In-place calibration by comparison to an inclinometer
FREQUENCY, Hz	0.002		2		0	0.0086		0 to 10	Eldorado Freq. Converter Model 1602	FOBCARS	Compared with a Frequency Standard

*Thompson, J. W. and Abernethy, R. B. et al. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973

TABLE 3. Continued

b. Basic Dynamic Measurements - Pitch/Yaw Balance Assembly

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT* Precision Index (S) Percent of Reading	Precision Index (S) Unit of Measurement	Precision Index (S) Degree of Freedom	Bias (B) Percent of Reading	Bias (B) Unit of Measurement	Uncertainty $\pm(B + t_{95}S)$ Percent of Reading	Uncertainty $\pm(B + t_{95}S)$ Unit of Measurement	Range	Type of Measuring Device	Type of Recording Device	Method of System Calibration
POS, deg		1.06×10^{-2}	>30		2.50×10^{-3}		2.37×10^{-2}	$0.4\rightarrow1.5$	Bonded Strain Gage	Forced Oscillation Control and Readout System (FOBCARS)	Static Loading
In-Phase Torque, ft-lb		3.00×10^{-3}	>30		1.00×10^{-3}		7.00×10^{-3}	$0\rightarrow0.1$			
Out-of-Phase Torque, ft-lb		7.00×10^{-3}	>30		3.00×10^{-3}		1.70×10^{-2}	$0\rightarrow1.5$			
In-Phase Sting Moment, ft-lb		1.89	>30		0		3.78	$0\rightarrow120$			
Out-of-Phase Sting Moment, ft-lb		1.89	>30		0		3.78	$0\rightarrow5$			
Normal Force, lb (Static) (Dynamic)		5.10×10^{-1}	>30		-1.08×10^{-1}		9.12×10^{-1}	$0\rightarrow600$ $0\rightarrow30$			
Side Force, lb (Static) (Dynamic)		2.30×10^{-1}	>30		-6.30×10^{-2}		3.97×10^{-1}	$0\rightarrow10$ $0\rightarrow15$			
Rolling Moment, ft-lb (Static) (Dynamic)		1.92-02	>30		-5.50-03		4.40-02	$0\rightarrow5$ $0\rightarrow3$			
Pitching Moment, ft-lb (Static) (Dynamic)		1.06×10^{-1}	>30		1.375-02		1.98×10^{-1}	$0\rightarrow50$ $0\rightarrow44$			
Yawing Moment, ft-lb (Static) (Dynamic)		4.23-02	>30		-2.83-03		8.18-02	$0\rightarrow0.5$ $0\rightarrow8$			

*Thompson, J. W. and Abernethy, R. B. et al. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

TABLE 3. Continued

c. Basic Dynamic Measurements - Roll Balance

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT*							Range	Type of Measuring Device	Type of Recording Device	Method of System Calibration
	Precision Index (S)			Bias (B)		Uncertainty $\pm(B + t_{95}S)$					
	Percent of Reading	Unit of Measurement	Degree of Freedom	Percent of Reading	Unit of Measurement	Percent of Reading	Unit of Measurement				
POS, deg		0.009	>30		0.002		0.020	0.5→2.0	Bonded Strain Gages	FOBCARS	Static Loading
In Phase Torque, ft-lb	0.04	3.4×10^{-4}	>30 >30	0.02	1.7×10^{-3}	0.1	2.3×10^{-3}	0→2.3 2.3→5.0			
Out-of-Phase Torque, ft-lb	0.04	3.4×10^{-4}	>30 >30	0.02	1.7×10^{-3}	0.1	2.3×10^{-3}	0→2.3 2.3→5.0			
Dynamic and Static Forward Normal Force, lb	0.08	7.0×10^{-2}	>30 >30	0.022	0.35	0.18	0.5	0→300 300→1500			
Dynamic and Static Aft Normal Force, lb	0.08	7.0×10^{-2}	>30 >30	0.022	0.35	0.18	0.5	0→300 300→1500			
Dynamic and Static Forward Side Force, lb	0.14	1.1×10^{-2}	>30 >30	0.01	5.5×10^{-2}	0.28	0.08	0→28 28→200			
Dynamic and Static Aft Side Force, lb	0.14	1.1×10^{-2}	>30 >30	0.01	5.5×10^{-2}	0.28	0.08	0→28 28→200			

*Thompson, J. W. and Abernethy, R. B. et al. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

TABLE 3. Continued

d. Calculated Parameters

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT[a]							Parameter	M	RE $\times 10^{-6}$
	Precision Index (S)			Bias (B)		Uncertainty $\pm(B + t_{95}S)$				
	Percent of Reading	Unit of Measurement	Degree of Freedom	Percent of Reading	Unit of Measurement	Percent of Reading	Unit of Measurement			
P, psf		0.71			2.9		4.3	2722	0.3	2.5
		0.71			2.9		4.3	2594	0.3	2.5
		0.63			2.3		3.5	1162	0 6	2.5
		0.36			1.5		2.2	460	0 6	1.0
		0.43			1.7		2 6	647	0.95	2.5
		0.36			1.5		2.2	450	0.95	1.8
		0.40			1.6		2.4	563	1.05	2.5
		0.36			1.5		2.2	443	1.05	2.0
		0.34			1.5		2.1	400	1.30	2.5
M		0.0009			0.004		0.005	0.3		2.5
		0.0009			0.004		0.006	0.3		2.5
		0.0009			0.003		0.005	0.6		2.5
		0.0013			0.006		0.008	0.6		1.0
		0.0008			0.003		0.004	0.95		2.5
		0.0009			0.004		0.005	0.95		1.8
		0.0007			0.003		0.004	1.05		2.5
		0.0008			0.003		0.005	1.05		2.0
		0.0007			0.003		0.005	1.30		2.5
V, ft/sec		0.98			4.04		6.01	348	0.3	2.5
		1.01			4.15		6.17	340	0.3	2.5
		0.96			3.45		5.36	652	0.6	2.5
		1.32			5.60		8.24	649	0.6	1.0
		0.67			2.63		3.97	984	0.95	2.5
		0.77			3.22		4.76	980	0.95	1.8
		0.62			2.50		3.74	1069	1.05	2.5
		0.69			2.85		4.23	1066	1.05	2.0
		0.55			2.31		3.41	1265	1.30	2.5
RE $\times 10^{-6}$, ft^{-1}		0.007			0.028		0.042	2.5	0.3	
		0.007			0.030		0.044	2.5	0.3	
		0.003			0.012		0.019	2.5	0.6	
		0.002			0.008		0.012	1.0	0.6	
		0.002			0.006		0.009	2.5	0.95	
		0.001			0.005		0.008	1.8	0.95	
		0.001			0.005		0.008	2.5	1.05	
		0.001			0.005		0.007	2.0	1.05	
		0.001			0.005		0.008	2.5	1.30	

[a] Abernethy, R. B. et al. and Thompson, J. W. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

TABLE 3. Continued

d. Calculated Parameters

Parameter Designation	Precision Index (S): Percent of Reading	Precision Index (S): Unit of Measurement	Precision Index (S): Degree of Freedom	Bias (B): Percent of Reading	Bias (B): Unit of Measurement	Uncertainty ±(B + t_{95}S): Percent of Reading	Uncertainty ±(B + t_{95}S): Unit of Measurement	Parameter	M	RE $\times 10^{-6}$
Q,psf		0.96			3.92		5.83	172	0.3	2.5
		0.96			3.92		5.83	163	0.3	2.5
		0.81			2.90		4.52	293	0.6	2.5
		0.44			1.86		2.74	116	0.6	1.0
		0.47			1.77		2.71	409	0.95	2.5
		0.37			1.49		2.23	284	0.95	1.8
		0.41			1.55		2.36	435	1.05	2.5
		0.35			1.38		2.07	342	1.05	2.0
		0.29			1.10		1.68	473	1.30	2.5
P/Y CLM-A		0.054			0.045		0.153	0.400	0.3	2.5
		0.023			0.018		0.064	-0.236	0.95	
		0.020			-0.016		0.024	-0.751	1.30	
P/Y CLM-AD		0.098			-0.097		0.099	-5.794	0.3	
		0.157			-0.068		0.246	-10.108	0.95	
		0.149			-0.072		0.226	-7.855	1.30	
P/Y CLM		0.003			0		0.006	0.099	0.3	
		1.200-03			0		2.400-03	0.039	0.95	
		1.100-03			0		2.200-03	-0.075	1.3	
CN-A		0.850			0		1.700	3.457	0.3	
		0.347			0		0.693	4.318	0.95	
		0.299			0		0.599	5.262	1.3	
CN-AD		20.340			0		40.680	9.977	0.3	
		22.221			0		44.442	-10.745	0.95	
		26.477			0		52.954	-55.559	1.3	
CLM-A		0.08			0.04		0.2	0.257	0.3	
		0.060			0.032		0.152	-0.251	0.95	
		0.050			0.03		0.13	-0.838	1.3	
CLM-AD		2.737			-2.700		2.770	-2.847	0.3	
		3.820			-3.66		3.980	-5.138	0.95	
		1.416			0.037		2.87	-4.507	1.3	
CLN-A		4.327-03			9.347-03		0.018	0.027	0.3	
		3.976-03			1.752-03		9.704-03	0.015	0.95	
		3.227-03			1.458-03		7.912-03	8.119-03	1.3	
CLN-AD		0.225			0.106		0.556	-0.027	0.3	
		0.255			0.119		0.629	0.059	0.95	
		0.263			0.123		0.649	-0.190	1.3	

[a] Abernethy, R. B. et al. and Thompson, J. W. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

TABLE 3. Continued

d. Calculated Parameters

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT* Precision Index (S) Percent of Reading	Precision Index (S) Unit of Measure-ment	Degree of Freedom	Bias (B) Percent of Reading	Bias (B) Unit of Measure-ment	Uncertainty ±($B + t_{95}S$) Percent of Reading	Uncertainty ±($B + t_{95}S$) Unit of Measure-ment	Parameter	M	RE $\times 10^{-4}$
CLL-A		4.561-03			1.586-03		1.070-02	0.026	0,3	2.5
		2.286-03			6.163-04		5.188-03	0.016	0.95	
		1.463-03			4.977-04		3.424-03	3.673-03	1.3	
CLL-AD		0.112			0.036		0.260	-0.089	0.3	
		0.127			0.041		0.295	-0.352	0.95	
		0.131			0.042		0.304	-0.046	1.3	
P/Y CLN-B		5.825-03			5.042-03		0.017	0.105	0.3	
		2.686-03			1.876-03		7.248-03	0.163	0.95	
		2.768-03			1.602-03		7.138-03	0.243	1.3	
P/Y CLN-BD		1.446-02			-7.695-03		0.021	-0.418	0.3	
		1.634-02			-5.731-03		0.027	-0.669	0.95	
		1.680-02			-5.957-03		0.027	-0.604	1.3	
P/Y CLN		2.800-04			0		5.600-04	-6.644-04	0.3	
		1.141-04					2.281-04	2.643-04	0.95	
		9.847-04			0		1.969-04	-4.488-04	1.3	
CY-B		0.080			0		0.160	-0.959	0.3	
		0.031			0		0.062	-1.251	0.95	
		0.027			0		0.054	-1.43	1.3	
CY-BD		2.320			0		4.630	-1.181	0.3	
		2.669			0		5.339	-1.146	0.95	
		2.957			0		5.913	-1.391	1.3	
CLN-B		0.031			0.022		0.084	0.101	0.3	
		0.012			4.536-03		0.029	0.176	0.95	
		9.349-03			8.441-03		0.27	0.253	1.3	
CLN-BD		0.134			0.125		0.393	-0.554	0.3	
		0.100			0.076		0.276	-0.802	0.95	
		0.067			0.042		0.176	-0.633	1.3	
CLM-B		0.145			0.057		0.347	-0.036	0.3	
		0.057			0.011		0.125	0.046	0.95	
		0.050			0.019		0.119	0.022	1.3	

*Abernethy, R. B. et al. and Thompson, J. W. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

TABLE 3. Concluded
b. Calculated Parameters

Parameter Designation	STEADY-STATE ESTIMATED MEASUREMENT[a] Precision Index (S) Percent of Reading	Precision Index (S) Unit of Measurement	Precision Index (S) Degree of Freedom	Bias (B) Percent of Reading	Bias (B) Unit of Measurement	Uncertainty $\pm(B + t_{95}S)$ Percent of Reading	Uncertainty $\pm(B + t_{95}S)$ Unit of Measurement	Parameter	M	RE $\times 10^{-6}$
CLN-BD		2.539	30		0.990		6.070	0.321	0.3	2.5
		2.680			0.195		5.555	-0.341	0.95	
		2.813			1.097		6.723	2.423	1.3	
CLL-B (YAW)		8.272-03			2.774-03		0.019	-0.063	0.3	
		5.623-03			9.240-04		0.012	-0.162	0.95	
		2.076-03			6.738-04		0.005	-0.119	1.3	
CLL-BD		0.227			0.073		0.531	0.299	0.3	
		0.0913			0.029		0.211	0.319	0.95	
		0.253			0.081		0.587	0.109	1.3	
CLL-B (ROLL)		3.1×10^{-3}			3.0×10^{-3}		9.2×10^{-3}	-3.212×10^{-3}	0.3	2.5
		1.8×10^{-3}			1.7×10^{-3}		5.3×10^{-3}	-0.015	0.95	1.7
		1.1×10^{-3}			1.0×10^{-3}		3.2×10^{-3}	-1.503×10^{-2}	1.3	2.5
CLL-PBD		4.6×10^{-3}			6.7×10^{-2}		1.6×10^{-2}	-2.590×10^{-1}	0.3	2.5
		7.4×10^{-3}			1.1×10^{-2}		2.7×10^{-2}	-3.382×10^{-1}	0.95	1.7
		6.3×10^{-3}			8.9×10^{-3}		2.1×10^{-2}	-3.347×10^{-1}	1.3	2.5
CLN-PBD		7.0×10^{-3}			7.1×10^{-2}		9.0×10^{-2}	-2.4×10^{-2}	0.3	2.5
		1.2×10^{-2}			0.12		0.14	5.176×10^{-2}	0.95	1.7
		9.7×10^{-3}			9.0×10^{-2}		0.11	4.126×10^{-2}	1.3	2.5
CY PBD		0.02			0.28		0.32	2.658×10^{-1}	0.3	2.5
		2.1×10^{-2}			0.24		0.26	-5.025×10^{-2}	0.95	1.7
		2.2×10^{-2}			0.17		0.21	-1.464×10^{-1}	1.3	2.5
CN							0.022	0.600	0.3	
							6.221-03	0.758	0.95	
							3.915-03	0.656	1.3	
CY		-			-		0.029	4.14-04	0.3	
							1.219-03	5.850-04	0.95	
							1.053-03	2.847-03	1.3	
CLL		-			-		9.760-04	-4.650-04	0.3	
							4.100-04	-1.200-05	0.95	
							3.540-04	6.370-04	1.3	
CLM		-			-		6.000-03	0.100	0.3	
							2.100-03	0.047	0.95	
							1.814-03	-0.082	1.3	
CLN		-			-		4.140-04	5.600-05	0.3	
							1.740-04	1.430-04	0.95	
							1.500-04	-6.550-04	1.3	

[a] Abernethy, R. B. et al. and Thompson, J. W. "Handbook Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD 755356), February 1973.

APPENDIX III

SAMPLE OF TABULATED AND PLOTTED DATA

ARO, INC.
[redacted]ECC[redacted]IC
A SVERDRUP CORPORATION COMPANY
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 69A RUN 57 AEDC DYNAMIC STABILITY
SUMMARY 1 TRANSONIC 4T

CONFIG PAC
9 1

TP	M	REX10-6	ALPHA	CN	CLM	CY	CLN	CLL	NCP	YCP	P/Y CLM
1	1.053	2.00	0.51	-3.4708E-02	5.6105E-02	-2.5832E-03	7.1899E-04	1.1805E-04	-1.6165E+00	-2.7833E-01	5.3110E-02
2	1.053	2.00	0.51	-3.4401E-02	5.6233E-02	-2.5860E-03	7.1911E-04	1.2352E-04	-1.6346E+00	-2.7808E-01	5.3107E-02
3	1.049	2.00	0.51	-3.4733E-02	5.5985E-02	-2.6260E-03	7.0726E-04	1.1519E-04	-1.6119E+00	-2.6923E-01	5.3078E-02
5	[illegible]	2.00	-3.35	-3.9724E-01	9.7711E-02	-2.2097E-03	9.1527E-04	-5.6201E-04	-2.5187E-01	-4.1420E-01	9.2286E-02
6	1.048	2.00	-3.35	-3.8914E-01	9.7616E-02	-2.3501E-03	9.5016E-04	-5.5445E-04	-2.5085E-01	-4.0431E-01	9.2636E-02
7	1.049	2.00	-3.35	-3.8706E-01	9.7503E-02	-2.2055E-03	9.2812E-04	-5.5707E-04	-2.5190E-01	-4.2082E-01	9.2426E-02

a. Static Data

Sample 1. Pitch Tabulated Data

DATE 10-PE--R0 PROJECT NO 741C-V1

ARC

AEDC L SION

A SVERDRUP CORPORATION COMPANY

PROPULSION WIND TUNNEL

ARNOLD AIR FORCE STATION, TENNESSEE

TEST 494 RUN 52 AEDC DYNAMIC STABILITY

SUMMARY 2 TRANSONIC 4T

CONFIG PAC

9 1

TP	M	REX10-6	ALPHA	POS	OMEGA	RFP	CN-A	CN-AD	CLM-A	CLM-AD	CLN-A	CLN-AD	P/Y CLM-A	P/Y CLM-AD
1	1.053	2.00	0.51	0.995	47.18	0.0138	1.7081E+00	-7.2433E+02	-6.3102E-01	-6.6965E+00	1.2046E-02	6.7109E-02	-6.6036E-01	-8.2029E+00
2	1.052	2.00	0.51	0.994	47.18	0.0138	6.9083E-01	-7.3358E+02	-6.1466E-01	-5.6223E+00	1.3590E-02	-8.7996E-03	-6.7753E-01	-8.4142E+00
3	1.049	2.00	0.51	0.995	47.19	0.0138	4.6521E-01	-7.3426E+02	-6.2682E-01	-6.0883E+00	1.3397E-02	-2.3586E-02	-6.8213E-01	-8.3726E+00
5	1.048	2.00	-3.35	0.980	46.69	0.0137	6.2071E-02	-6.6297E+02	-3.7216E-01	-1.3421E+01	6.3311E-03	6.5525E-02	-4.7734E-01	-1.6635E+01
6	1.048	2.00	-3.35	0.980	46.70	0.0137	1.2928E-01	-6.6147E+02	-3.7637E-01	-1.5122E+01	5.6093E-03	2.0475E-01	-4.7635E-01	-1.6511E+01
7	1.049	2.00	-3.35	0.979	46.69	0.0136	1.1180E-01	-6.6114E+02	-3.6682E-01	-1.4624E+01	4.9555E-03	1.2313E-01	-4.7428E-01	-1.6837E+01

b. Dynamic Data

Sample 1. Continued

DATE 20-SEP-80 PROJECT NO P41C-X1
ARO, INC.
AEDC DIVISION
A SVERDRUP CORPORATION COMPANY
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 494 RUN 57 AEDC DYNAMIC STABILITY
SUMMARY 3 TRANSONIC 4T

CONFIG PAC
9 1

TP	M	REX10-6	ALPHA	POS	OMEGA	REP	CLL-A	CLL-AD	CLN-A	CLN-AD
1	1.050	2.00	0.51	0.995	47.18	0.0138	2.7149E-02	-1.4452E-01	1.2046E-02	6.7109E-02
2	1.050	2.00	0.51	0.994	47.18	0.0138	2.7314E-02	-1.4528E-01	1.3590E-02	-8.7996E-03
3	1.049	2.00	0.51	0.995	47.19	0.0138	2.6854E-02	-1.4036E-01	1.3397E-02	-2.3586E-02
5	1.048	2.00	-3.35	0.980	46.69	0.0137	-3.0585E-03	-7.9749E-02	6.3311E-03	6.5525E-02
6	1.048	2.00	-3.35	0.980	46.70	0.0137	-2.9096E-03	-9.1333E-02	5.6093E-03	2.0475E-01
7	1.049	2.00	-3.35	0.979	46.69	0.0136	-2.9037E-03	-1.1424E-01	4.9555E-03	1.7313E-01

c. Cross-Coupling Data

Sample 1. Concluded

DATE 11-DEC-80 PROJECT NO P41C-X1
ARO, INC.
AEDC DIVISION
A SVERDRUP CORPORATION COMPANY
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 494 RUN 94 AEDC DYNAMIC STABILITY
SUMMARY 1 TRANSONIC 4T

CONFIG 9 PAC 5

TP	M	REX10-6	ALPHA	CN	CLM	CY	CLN	CLL	NCP	YCP	P/Y CLN
1	1.052	2.01	0.14	-7.2467E-02	6.7385E-02	-2.6599E-03	8.9387E-04	-5.2893E-05	-9.2986E-01	-3.3607E-01	2.8188E-04
2	1.052	2.01	0.14	-7.2368E-02	6.7224E-02	-2.7014E-03	9.0374E-04	-5.0385E-05	-9.2892E-01	-3.3455E-01	2.8644E-04
3	1.052	2.01	0.14	-7.2662E-02	6.7166E-02	-2.5656E-03	8.9323E-04	-5.0187E-05	-9.2436E-01	-3.4816E-01	2.9138E-04
4	1.049	2.00	-3.97	-4.3480E-01	1.0898E-01	-1.9836E-03	8.5981E-04	-5.0600E-04	-2.5065E-01	-4.3343E-01	2.1680E-04
5	1.049	1.99	-3.98	-4.4936E-01	1.0724E-01	-2.0520E-03	8.7073E-04	-5.2219E-04	-2.3865E-01	-4.2433E-01	2.1988E-04
6	1.047	1.99	-3.98	-4.5265E-01	1.0602E-01	-2.1282E-03	8.7798E-04	-5.2562E-04	-2.3421E-01	-4.1254E-01	2.1002E-04
23	1.049	2.01	5.27	3.7648E-01	1.7814E-02	-3.9883E-03	4.4483E-04	1.3719E-03	4.7319E-02	-1.1153E-01	-1.4129E-04
24	1.049	1.98	5.28	3.9320E-01	1.9571E-02	-4.2409E-03	4.7241E-04	1.4025E-03	4.9774E-02	-1.1139E-01	-1.4832E-04
25	1.051	1.99	5.28	3.9239E-01	1.7677E-02	-4.1776E-03	4.5881E-04	1.3891E-03	4.5049E-02	-1.0984E-01	-1.6211E-04
26	1.049	2.01	13.37	8.1303E-01	-5.0613E-02	-1.0991E-02	-4.5379E-04	2.3663E-03	-6.2252E-02	4.1286E-02	-1.0528E-03
27	1.049	2.00	13.37	8.1581E-01	-5.2647E-02	-1.0966E-02	-4.9124E-04	2.3848E-03	-6.4533E-02	4.4798E-02	-1.0947E-03
28	1.051	2.01	13.37	8.1319E-01	-5.3677E-02	-1.1223E-02	-5.0660E-04	2.3876E-03	-6.6008E-02	4.5145E-02	-1.1086E-03
29	1.047	2.00	13.37	9.9082E-01	-1.1586E-01	-1.2546E-02	-5.2337E-04	-5.9167E-03	-1.1693E-01	4.1717E-02	-1.1202E-03
30	1.052	2.00	13.38	9.9650E-01	-1.0334E-01	-1.2626E-02	-4.8313E-04	-6.2891E-03	-1.0370E-01	3.8258E-02	-1.1073E-03
31	1.049	1.99	13.38	9.9966E-01	-9.8235E-02	-1.2966E-02	-4.6831E-04	-6.4136E-03	-9.8269E-02	3.6123E-02	-1.1038E-03
32	1.049	1.99	15.43	1.2254E+00	-1.1976E-01	-1.3574E-02	2.1783E-03	-7.6376E-03	-9.6931E-02	-1.6047E-01	1.6152E-03
33	1.049	1.99	15.40	1.1629E+00	-1.3136E-01	-1.3836E-02	2.3704E-03	-7.8417E-03	-1.1296E-01	-1.7130E-01	1.7533E-03
34	1.051	1.99	15.39	1.1367E+00	-1.3690E-01	-1.3713E-02	2.3856E-03	-7.8351E-03	-1.2044E-01	-1.7397E-01	1.7827E-03
35	1.052	2.00	14.39	1.0701E+00	-1.1814E-01	-1.3091E-02	8.3069E-04	-7.4662E-03	-1.1040E-01	-6.3454E-02	2.6162E-04
36	1.052	2.00	14.39	1.0708E+00	-1.1554E-01	-1.3406E-02	7.5613E-04	-7.4324E-03	-1.0790E-01	-5.6401E-02	1.7651E-04
37	1.052	2.00	14.39	1.0677E+00	-1.1681E-01	-1.3436E-02	7.5920E-04	-7.4267E-03	-1.0941E-01	-5.6505E-02	1.4916E-04

a. Static Data

Sample 2. Yaw Tabulated Data

DATE 11-DEC-80 PROJECT NO P41C-X1

ARO, INC.

AEDC DIVISION

A SVERDRUP CORPORATION COMPANY

PROPULSION WIND TUNNEL

ARNOLD AIR FORCE STATION, TENNESSEE

TEST 494 RUN 94 AEDC DYNAMIC STABILITY

SUMMARY 2 TRANSONIC 4T

CONFIG 9 PoC 5

TP	M	REX10-6	ALPHA	POS	OMEGA	RFP	CY-B	CY-BD	CLN-B	CLN-BD	CLM-B	CLM-BD	P/Y CLN-B	P/Y CLN-B
1	1.052	2.01	0.14	0.940	26.21	0.0202	-9.1623E-01	-1.1338E+00	1.7816E-01	-6.4282E-01	8.2062E-03	-2.0062E-01	2.4928E-01	-5.1126E-01
2	1.052	2.01	0.14	0.981	26.21	0.0202	-9.0953E-01	-1.3861E+00	2.4529E-01	-7.2417E-01	1.0724E-02	-5.7479E-01	2.4914E-01	-5.1942E-01
3	1.052	2.01	0.14	0.998	26.21	0.0202	-8.9757E-01	-1.1933E+00	2.6563E-01	-6.7510E-01	4.5344E-03	-4.8159E-01	2.4894E-01	-5.0601E-01
4	1.049	2.00	-3.97	0.997	27.32	0.0211	-9.7253E-01	-1.3300E+00	3.6109E-01	-5.3217E-01	-3.0799E-03	-3.1329E-01	3.3923E-01	-3.9754E-01
5	1.049	1.99	-3.98	0.996	27.32	0.0211	-9.7642E-01	-1.2485E+00	3.5858E-01	-5.0505E-01	-1.6406E-03	-3.8480E-01	3.4195E-01	-4.0422E-01
6	1.047	1.99	-3.98	0.997	27.32	0.0212	-9.7293E-01	-1.2087E+00	3.5628E-01	-4.8855E-01	1.4371E-03	-5.6581E-01	3.4378E-01	-4.2167E-01
23	1.049	2.01	5.27	1.004	25.60	0.0198	-8.6084E-01	-1.3688E+00	2.1640E-01	-8.1173E-01	3.0057E-02	2.9720E-01	2.0435E-01	-6.2006E-01
24	1.049	1.98	5.28	1.002	25.53	0.0198	-8.6562E-01	-1.3475E+00	2.1659E-01	-8.2836E-01	2.8708E-02	-5.4219E-02	2.0188E-01	-6.3453E-01
25	1.051	1.99	5.28	0.999	25.53	0.0197	-8.6340E-01	-1.5397E+00	2.1679E-01	-7.5977E-01	3.2899E-02	2.3489E-01	1.9736E-01	-6.1561E-01
26	1.049	2.01	10.37	0.997	25.95	0.0201	-8.9707E-01	-1.0911E+00	2.4308E-01	-6.5379E-01	3.9399E-02	2.1827E-01	2.3182E-01	-4.7654E-01
27	1.049	2.00	10.37	0.993	25.95	0.0201	-8.9892E-01	-1.0668E+00	2.4312E-01	-6.9550E-01	3.0701E-02	-1.8669E-01	2.3179E-01	-4.6230E-01
28	1.051	2.01	10.37	0.998	25.95	0.0200	-8.9925E-01	-1.0873E+00	2.4910E-01	-6.4711E-01	2.5653E-02	-1.9927E-01	2.2806E-01	-4.3501E-01
29	1.047	2.00	13.37	0.966	25.63	0.0199	-8.3207E-01	-1.4297E+00	2.1817E-01	-8.8363E-01	8.1616E-02	-2.3317E-01	2.0757E-01	-5.4674E-01
30	1.052	2.00	13.38	0.986	25.63	0.0198	-8.3170E-01	-1.2097E+00	2.1554E-01	-9.2626E-01	8.1969E-02	-3.1873E-01	2.0891E-01	-5.7463E-01
31	1.049	1.99	13.38	0.986	25.63	0.0198	-8.3291E-01	-1.3554E+00	2.1393E-01	-9.2207E-01	8.6120E-02	-3.1046E-01	2.0855E-01	-5.5638E-01
32	1.049	1.99	15.43	0.981	25.17	0.0195	-8.1534E-01	-1.6672E+00	1.8358E-01	-1.0969E+00	7.4296E-02	-1.5162E-01	1.7114E-01	-7.6867E-01
33	1.049	1.99	15.40	0.985	25.17	0.0195	-8.0504E-01	-1.8325E+00	1.8296E-01	-1.0379E+00	7.6792E-02	7.1990E-02	1.7082E-01	-7.5811E-01
34	1.051	1.99	15.39	0.983	25.17	0.0195	-8.0841E-01	-1.8965E+00	1.8258E-01	-1.1410E+00	8.1526E-02	5.7890E-02	1.7087E-01	-8.0655E-01
35	1.052	2.00	14.39	0.993	25.29	0.0195	-7.9283E-01	-1.6991E+00	1.8985E-01	-1.0415E+00	9.9445E-02	-2.4934E-01	1.8130E-01	-6.7961E-01
36	1.052	2.00	14.39	0.994	25.29	0.0195	-7.9080E-01	-1.6296E+00	1.8952E-01	-9.5612E-01	9.2148E-02	-1.5981E-02	1.8089E-01	-6.8499E-01
37	1.052	2.00	14.39	0.993	25.29	0.0195	-7.9143E-01	-1.5760E+00	1.8716E-01	-9.4322E-01	9.0685E-02	-7.8425E-02	1.8115E-01	-7.0433E-01

b. Dynamic Data

Sample 2. Continued

DATE 11-DEC-80 PROJECT NO P41C-X1
ARO, INC.
AEDC DIVISION
A SVERDRUP CORPORATION COMPANY
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 624 RUN 94 AEDC DYNAMIC STABILITY
SUMMARY 3 TRANSONIC 4T

CONFIG PAC
9 5

TP	M	REX10-6	ALPHA	POS	OMEGA	RFP	CLL-B	CLL-BD	CLM-B	CLM-BD
1	1.052	2.01	0.14	0.940	26.21	0.0202	-4.2121E-02	1.1437E-01	8.2062E-03	-2.0062E-01
2	1.052	2.01	0.14	0.981	26.21	0.0202	-4.1255E-02	1.0794E-01	1.0724E-02	-5.7479E-01
3	1.052	2.01	0.14	0.998	26.21	0.0202	-4.0721E-02	1.0575E-01	4.5344E-03	-4.8159E-01
4	1.049	2.00	-3.97	0.997	27.32	0.0211	-3.8901E-02	1.1004E-01	-3.0799E-03	-3.1329E-01
5	1.048	1.99	-3.98	0.996	27.32	0.0211	-4.0314E-02	1.1319E-01	-1.6406E-03	-3.8480E-01
6	1.047	1.99	-3.98	0.997	27.32	0.0212	-4.0143E-02	1.1442E-01	1.4371E-03	-5.6581E-01
23	1.049	2.01	5.27	1.004	25.60	0.0198	-1.0723E-01	1.0954E-01	3.0057E-02	2.9720E-01
24	1.048	1.98	5.28	1.002	25.53	0.0198	-1.0991E-01	8.0139E-02	2.8708E-02	-5.4219E-02
25	1.051	1.99	5.28	0.999	25.53	0.0197	-1.0913E-01	7.4852E-02	3.2899E-02	2.3489E-01
26	1.048	2.01	10.37	0.997	25.95	0.0201	-1.6092E-01	4.7255E-02	3.9399E-02	2.1827E-01
27	1.049	2.00	10.37	0.993	25.95	0.0201	-1.6524E-01	4.8406E-02	3.0701E-02	-1.8669E-01
28	1.051	2.01	10.37	0.998	25.95	0.0200	-1.6495E-01	4.2379E-02	2.3653E-02	-1.9927E-01
29	1.047	2.00	13.37	0.986	25.63	0.0199	-2.3191E-01	-1.7849E-02	8.1616E-02	-2.3317E-01
30	1.05	2.00	13.38	0.986	25.63	0.0198	-2.3965E-01	-2.9087E-02	8.1969E-02	-3.1873E-01
31	1.047	1.99	13.38	0.986	25.63	0.0198	-2.4365E-01	-6.7700E-02	8.6120E-02	-3.1046E-01
32	1.049	1.99	15.43	0.981	25.17	0.0195	-2.0712E-01	1.4823E-01	7.4296E-02	-1.5162E-01
33	1.049	1.99	15.40	0.985	25.17	0.0195	-2.1165E-01	1.5795E-01	7.6792E-02	7.1990E-02
34	1.051	1.99	15.39	0.983	25.17	0.0195	-2.1406E-01	1.6827E-01	8.1528E-02	5.7890E-02
35	1.052	2.00	14.39	0.993	25.29	0.0195	-2.3409E-01	4.6500E-02	9.9445E-02	-2.4934E-01
36	1.052	2.00	14.39	0.994	25.29	0.0195	-2.3649E-01	2.9534E-02	9.2148E-02	-1.5981E-02
37	1.052	2.00	14.39	0.993	25.29	0.0195	-2.3698E-01	-3.4507E-03	9.0685E-02	-7.8425E-02

c. Cross and Cross-Coupling Data

Sample 2. Concluded

DATE 16-DEC-80 PROJECT NO P41C-X1
ARO, INC.
AEDC DIVISION
A SVERDRUP CORPORATION COMPANY
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 694 RUN 123 AEDC DYNAMIC STABILITY
SUMMARY 1 TRANSONIC 4T

CONFIG
-B1C1W2V1T05S0F1T1

TP	M	REX10-6	ALPHA	CN	CLM	CY	CLN	CLL	XCP	YCP
1	0.600	1.02	-0.07	-6.5991E-02	6.5294E-02	-3.4062E-03	1.6037E-04	2.7639E-04	-9.8944E-01	-4.7081E-02
2	0.601	1.02	-0.07	-6.6316E-02	6.5785E-02	-3.6842E-03	1.7565E-04	2.8131E-04	-9.9200E-01	-4.7675E-02
3	0.602	1.02	5.01	2.5805E-01	6.7720E-02	-8.3536E-03	-4.1446E-04	-7.0969E-05	2.6243E-01	4.9615E-02
4	0.599	1.02	5.02	2.6475E-01	6.8907E-02	-8.9468E-03	-4.3436E-04	-7.1528E-05	2.6027E-01	4.6519E-02
5	0.601	1.02	10.07	5.6425E-01	8.2069E-02	-1.5204E-02	-1.8621E-03	-2.5447E-03	1.4545E-01	1.2247E-01
6	0.598	1.02	10.07	5.7709E-01	8.4434E-02	-1.5388E-02	-1.8528E-03	-2.6404E-03	1.4631E-01	1.2010E-01
7	0.601	1.02	15.10	8.2290E-01	8.1454E-02	-3.7823E-02	5.0599E-03	-1.5175E-02	9.8984E-02	-1.3378E-01
8	0.598	1.02	15.10	8.3137E-01	8.1998E-02	-3.8543E-02	5.1541E-03	-1.5209E-02	9.8630E-02	-1.3372E-01
9	0.601	1.03	7.54	4.5230E-01	7.2142E-02	-1.7390E-02	-1.1572E-03	-2.5170E-04	1.5948E-01	6.6514E-02
10	0.598	1.02	7.55	4.6128E-01	7.2990E-02	-1.6453E-02	-1.2190E-03	-2.5107E-04	1.5823E-01	7.4090E-02
11	0.600	1.02	5.02	2.8023E-01	6.8230E-02	-1.2542E-02	-4.3817E-04	-5.9440E-05	2.4348E-01	3.4936E-02
12	0.601	1.03	5.02	2.7036E-01	6.8645E-02	-1.2070E-02	-4.4148E-04	-5.9269E-05	2.5390E-01	3.6577E-02
13	0.601	1.03	2.48	9.1558E-02	7.2979E-02	-9.6505E-03	-1.6238E-04	-3.6494E-05	7.7178E-01	1.6826E-02
14	0.599	1.02	2.47	8.3907E-02	7.2820E-02	-9.1774E-03	-1.9772E-04	-4.1696E-05	8.6889E-01	2.0862E-02
15	0.599	1.02	4.00	1.6260E-01	7.5130E-02	-9.8352E-03	-3.7644E-04	1.9400E-04	4.1145E-01	3.8275E-02
16	0.600	1.03	4.00	1.8416E-01	7.3764E-02	-9.3437E-03	-2.7029E-04	2.1381E-04	4.0055E-01	2.8928E-02
17	0.600	1.02	6.03	3.3112E-01	6.9054E-02	-1.0067E-02	-5.7019E-04	2.9740E-06	2.0855E-01	5.6638E-02
18	0.601	1.03	6.03	3.4925E-01	6.5802E-02	-1.1162E-02	-6.5831E-04	-8.8767E-06	1.8841E-01	5.8977E-02
19	0.601	1.03	15.10	8.2955E-01	8.2326E-02	-3.6280E-02	5.1073E-03	-1.5174E-02	9.9247E-02	-1.4077E-01
20	0.601	1.03	15.10	8.3157E-01	8.2540E-02	-3.6905E-02	5.1080E-03	-1.5190E-02	9.9259E-02	-1.3841E-01
21	0.599	1.02	15.10	8.3129E-01	8.4042E-02	-3.6984E-02	5.2155E-03	-1.5307E-02	1.0110E-01	-1.4102E-01
22	0.601	1.03	15.10	8.2911E-01	8.3527E-02	-3.7527E-02	5.1034E-03	-1.5220E-02	1.0074E-01	-1.3599E-01

a. Static Data

Sample 3. Roll Tabulated Data

DATE 16-DEC-80 PROJECT NO P41C-X1
ARO, INC.
AEDC DIVISION
A SVERDRUP CORPORATION COMPANY
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 694 RUN 123 AEDC DYNAMIC STABILITY
SUMMARY 2 TRANSONIC 4T

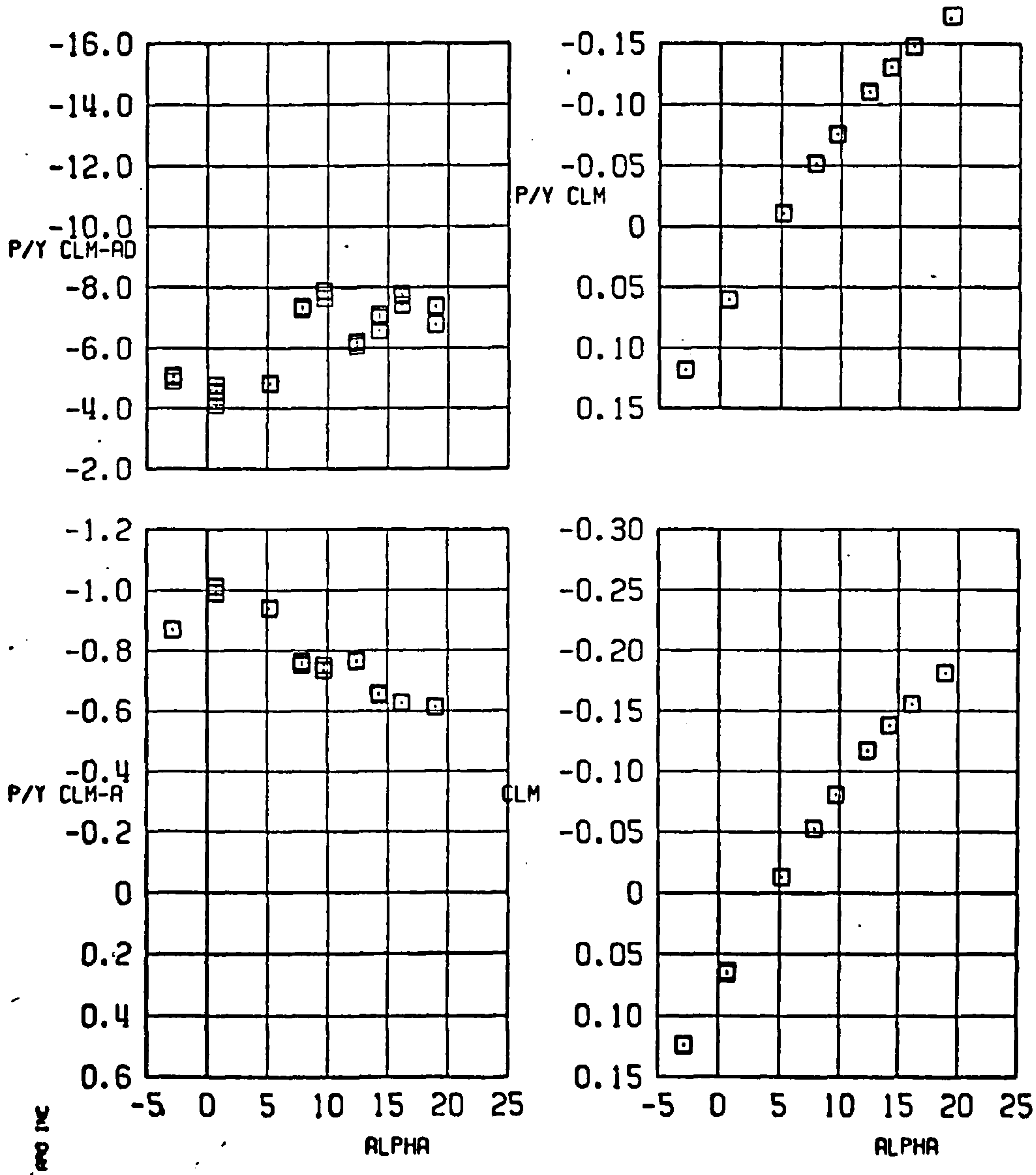
CONFIG
-B1C1W2V1T05S0F1T1

TP	M	REX10-6	ALPHA	POS	OMEGA	RFP	CLL-B	CLL-PBD	CLN-PBD	CYPBD
1	0.600	1.02	-0.07	1.503	53.20	0.0674	-1.7743E-03	-2.8233E-01	-9.0095E-02	5.0799E-01
2	0.601	1.02	-0.07	1.504	53.20	0.0673	-1.9197E-03	-2.8609E-01	-3.0416E-02	3.4995E-01
3	0.602	1.02	5.01	1.504	53.38	0.0675	-7.0850E-03	-4.8433E-01	6.0698E-02	-1.5461E-01
4	0.599	1.02	5.02	1.504	53.38	0.0678	-6.8349E-03	-4.8493E-01	7.5550E-02	4.7792E-0[illegible]
5	0.601	1.02	10.07	1.495	53.45	0.0677	-9.1308E-03	-2.0176E-01	-1.5082E-02	6.2289E-01
6	0.598	1.02	10.07	1.494	53.45	0.0680	-9.1244E-03	-2.0057E-01	2.4265E-05	1.7521E-01
7	0.601	1.02	15.10	1.491	53.85	0.0682	-2.6386E-02	-2.2387E-01	1.0450E-01	-4.0099E-01
8	0.598	1.02	15.10	1.492	53.84	0.0665	-2.4974E-02	-2.1175E-01	3.0005E-02	-1.6896E-01
9	0.601	1.03	7.54	1.498	53.29	0.0676	-5.9554E-03	-2.0410E-01	-2.8202E-02	1.6523E-01
10	0.598	1.02	7.55	1.499	53.29	0.0679	-6.2522E-03	-1.3916E-01	-5.7325E-02	1.5345E-01
11	0.600	1.02	5.02	1.502	53.29	0.0677	-7.7847E-03	-4.7043E-01	-5.5436E-02	-2.0630E-01
12	0.601	1.03	5.02	1.502	53.29	0.0676	-7.6266E-03	-4.8332E-01	-8.6100E-02	1.3850E-01
13	0.601	1.03	2.48	1.507	53.29	0.0676	-4.8167E-03	-3.0052E-01	-8.7461E-02	5.0818E-01
14	0.599	1.02	2.47	1.508	53.29	0.0678	-3.7678E-03	-2.9660E-01	-1.5060E-02	4.4933E-01
15	0.599	1.02	4.00	1.502	53.29	0.0678	-6.3467E-03	-3.4853E-01	-8.7971E-02	3.2730E-01
16	0.600	1.03	4.00	1.501	53.29	0.0677	-6.7516E-03	-3.4545E-01	-2.8131E-02	-5.9221E-03
17	0.606	1.02	6.03	1.506	53.36	0.0678	-7.2537E-03	-3.3414E-01	-4.1743E-02	2.5900E-01
18	0.601	1.03	6.03	1.506	53.36	0.0677	-7.2651E-03	-3.2629E-01	-8.4818E-02	1.5076E-01
19	0.601	1.03	15.10	1.491	53.78	0.0682	-2.6198E-02	-1.9303E-01	1.5026E-02	2.7682E-01
20	0.601	1.03	15.10	1.486	53.78	0.0682	-2.5647E-02	-2.1173E-01	1.5810E-02	1.0574E-01
21	0.599	1.02	15.10	1.490	53.78	0.0684	-2.6422E-02	-2.0746E-01	3.0333E-02	1.9876E-01
22	0.601	1.03	15.10	1.487	53.79	0.0682	-2.8242E-02	-2.0268E-01	-1.3137E-02	9.1185E-02

b. Dynamic Data

Sample 3. Concluded

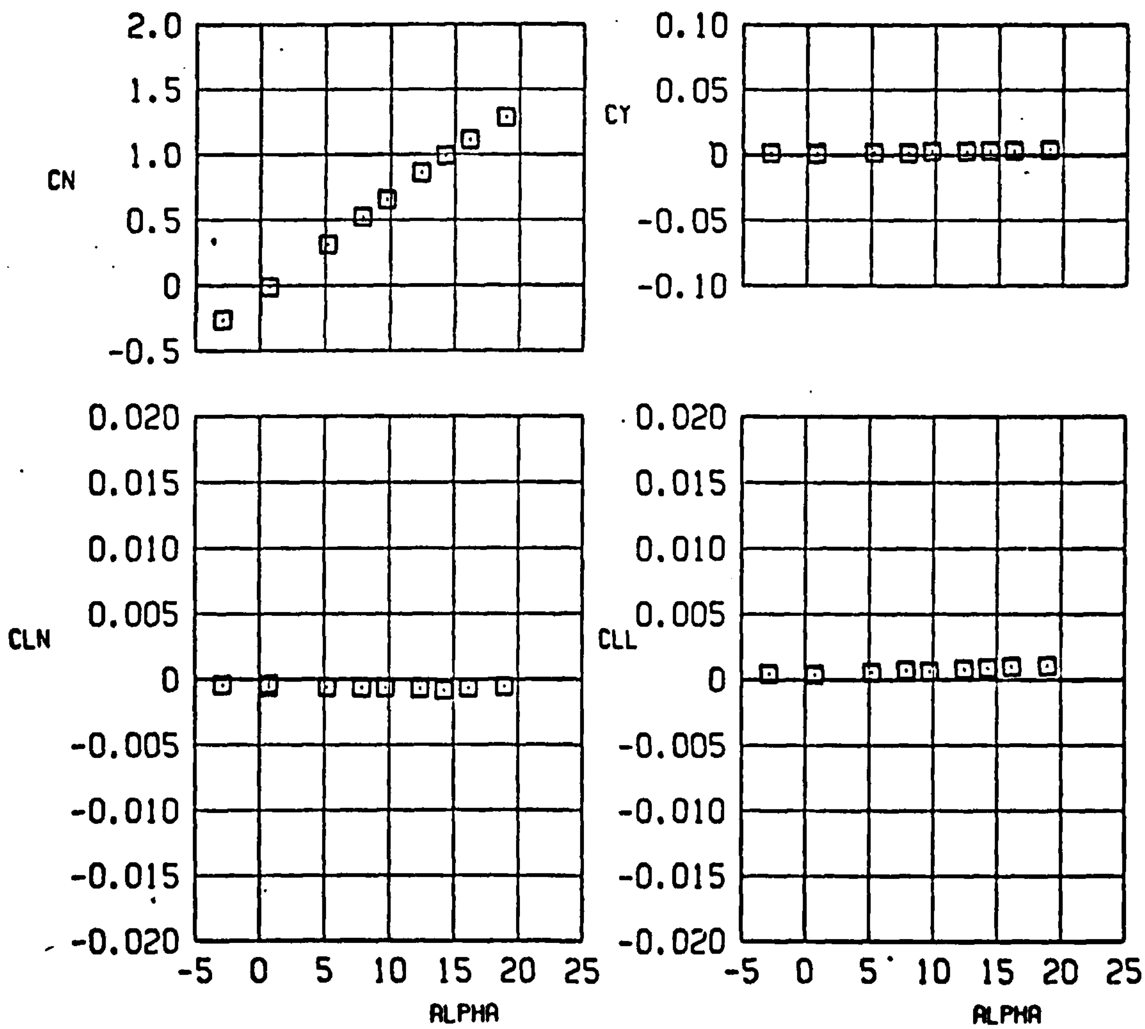
SYM	CONFIGURATION	M	REX10^-6	AFP	RUN
⊡	-B1C1W1V1T05S1F111	1.30	2.50	0.01	45



DATE 02-06-81 PROJ-P568-251 ARO INC

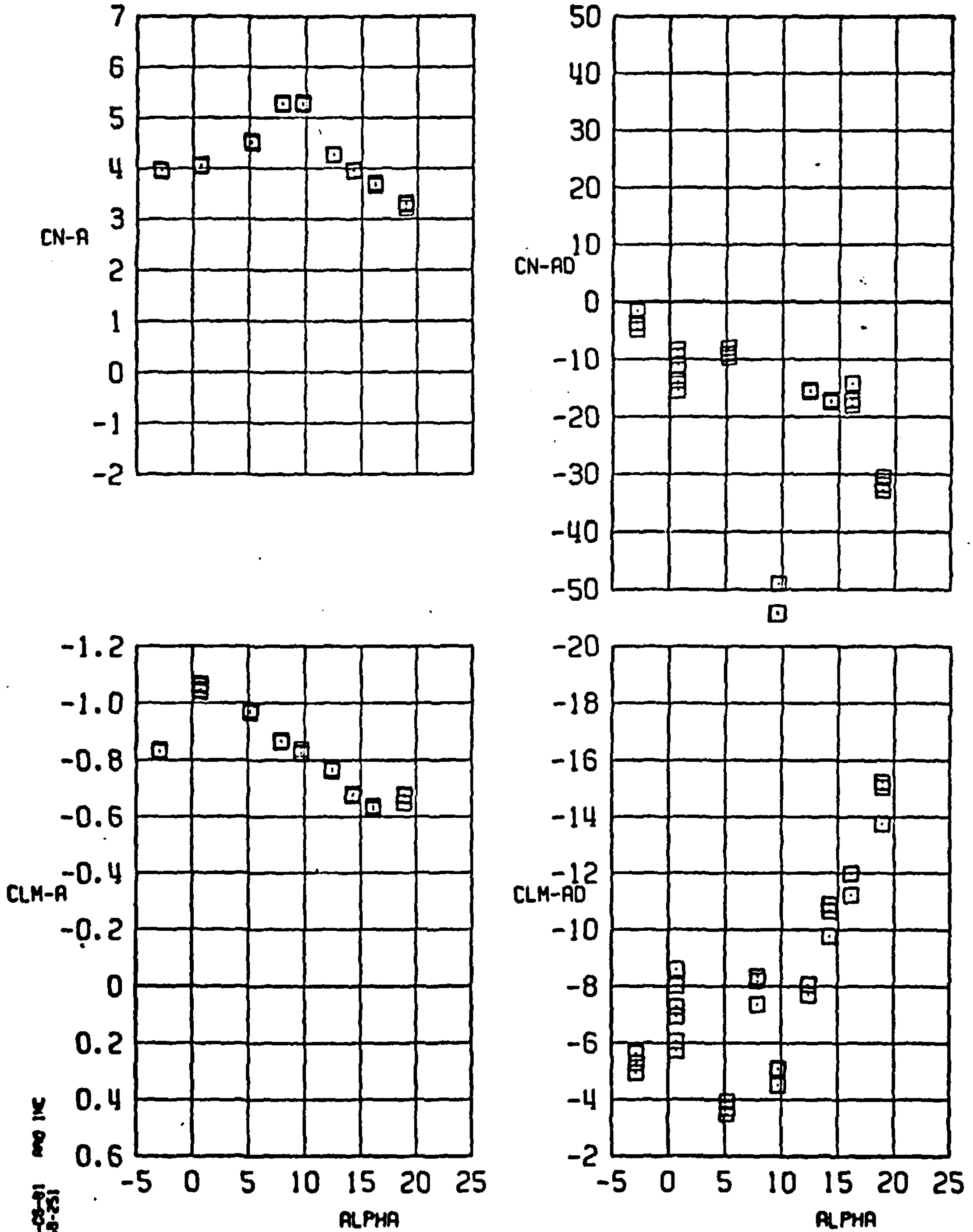
Sample 4. Pitch Plotted Data

SYM	CONFIGURATION	M	$REX10^{-6}$	AFP	RUN
⊡	-B1C1W1V1T05S1F111	1.30	2.50	0.01	45



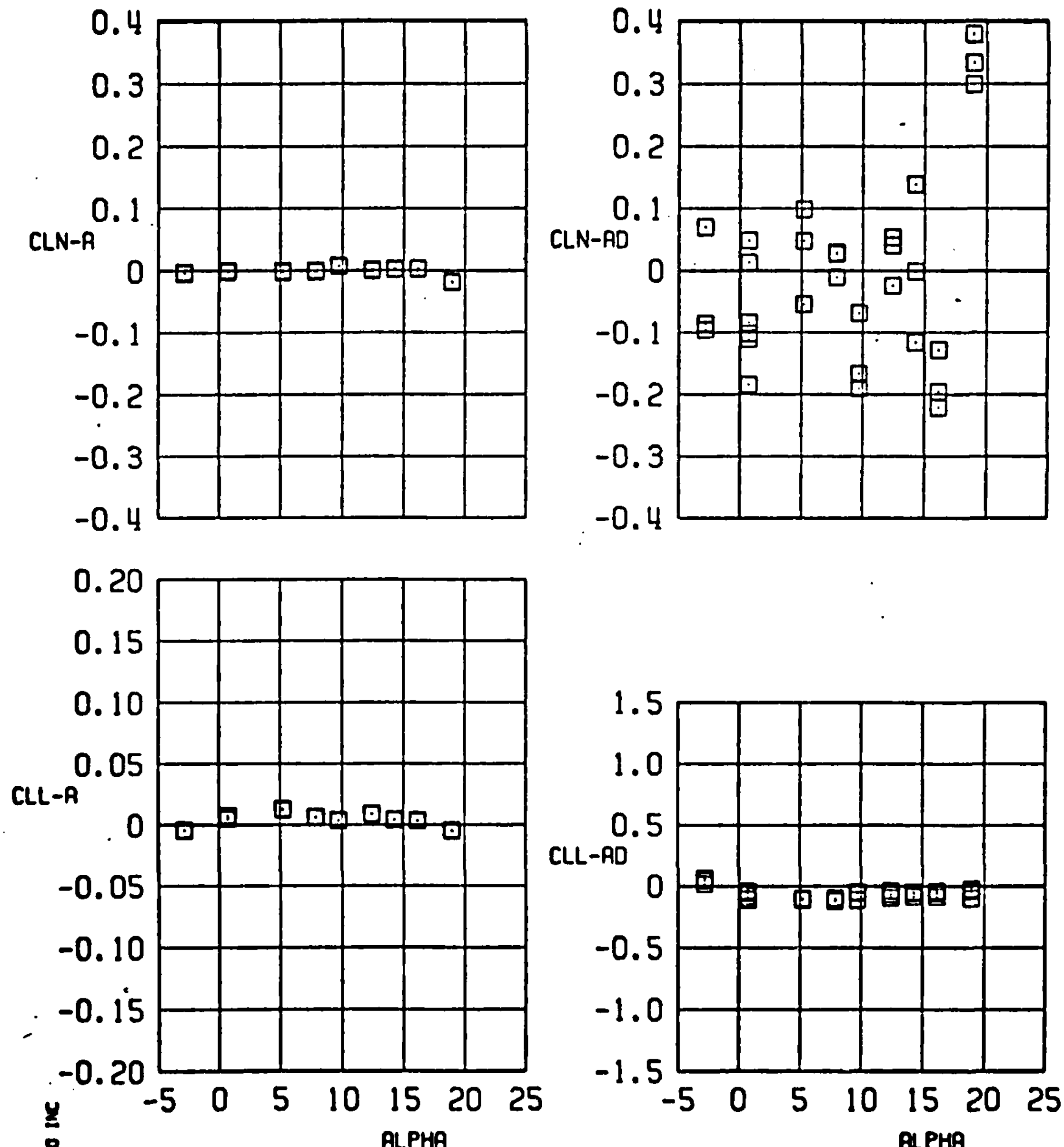
Sample 4. Continued

SYM	CONFIGURATION	M	$REX10^{-6}$	RFP	RUN
⊡	-B1C1W1V1T05S1F111	1.30	2.50	0.01	45



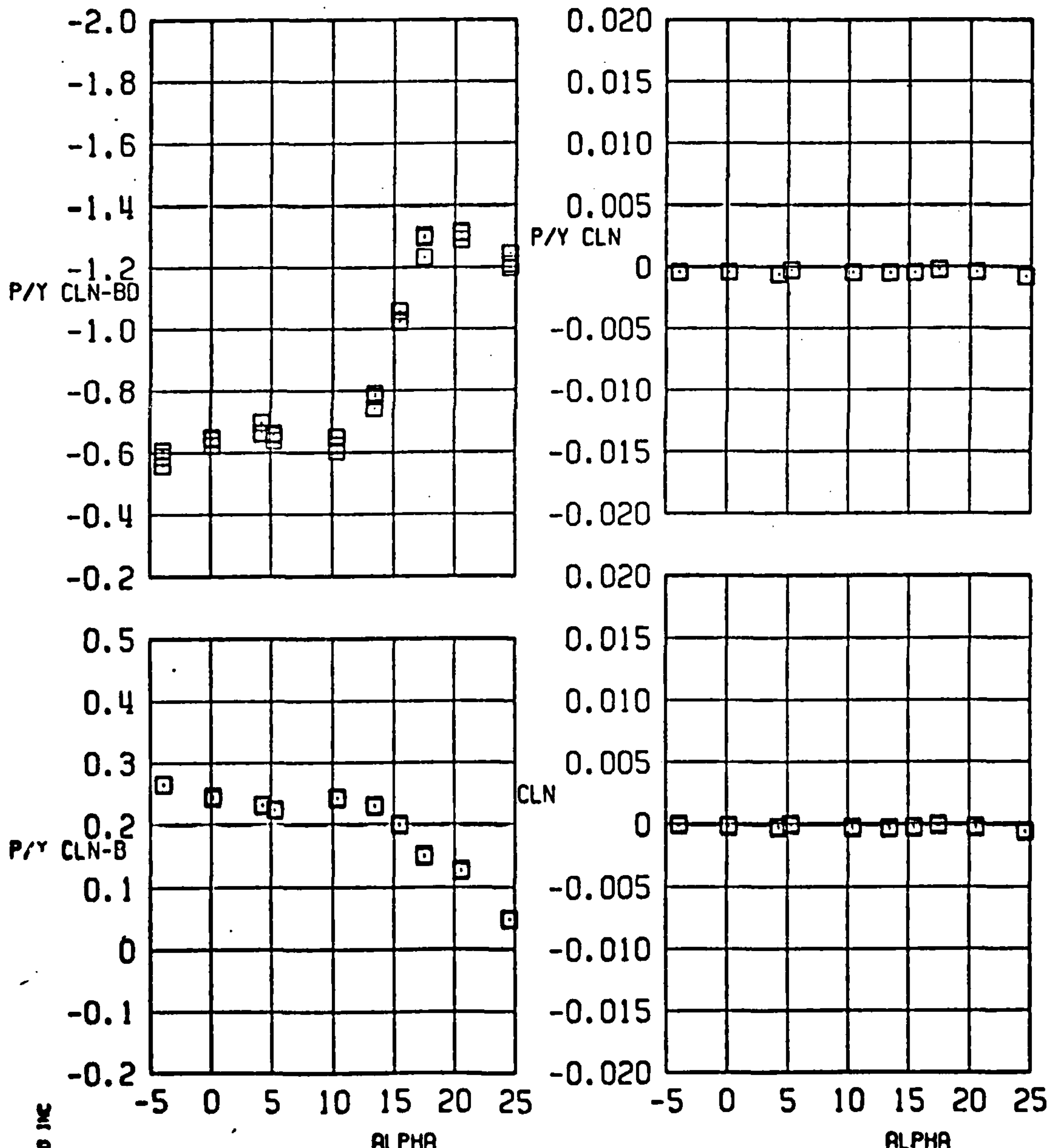
Sample 4. Continued

SYM	CONFIGURATION	M	REX10^-6	AFP	RUN
⊡	B1C1W1V1T05S1F111	1.30	2.50	0.01	45



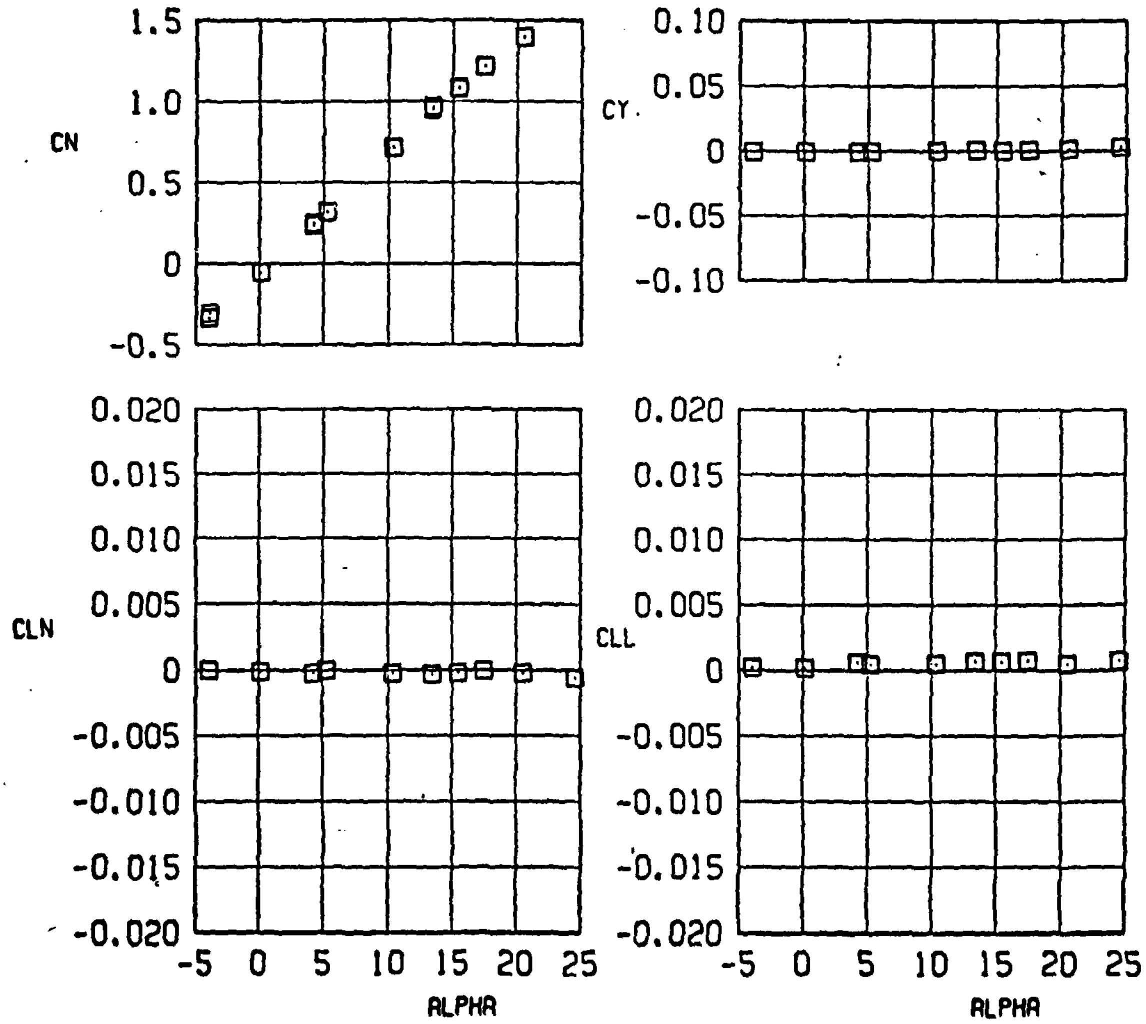
Sample 4. Concluded

SYM	CONFIGURATION	M	$REX10^{-6}$	RFP	RUN
⊡	-B1C1W1V1T05S1F111	1.30	2.50	0.02	79



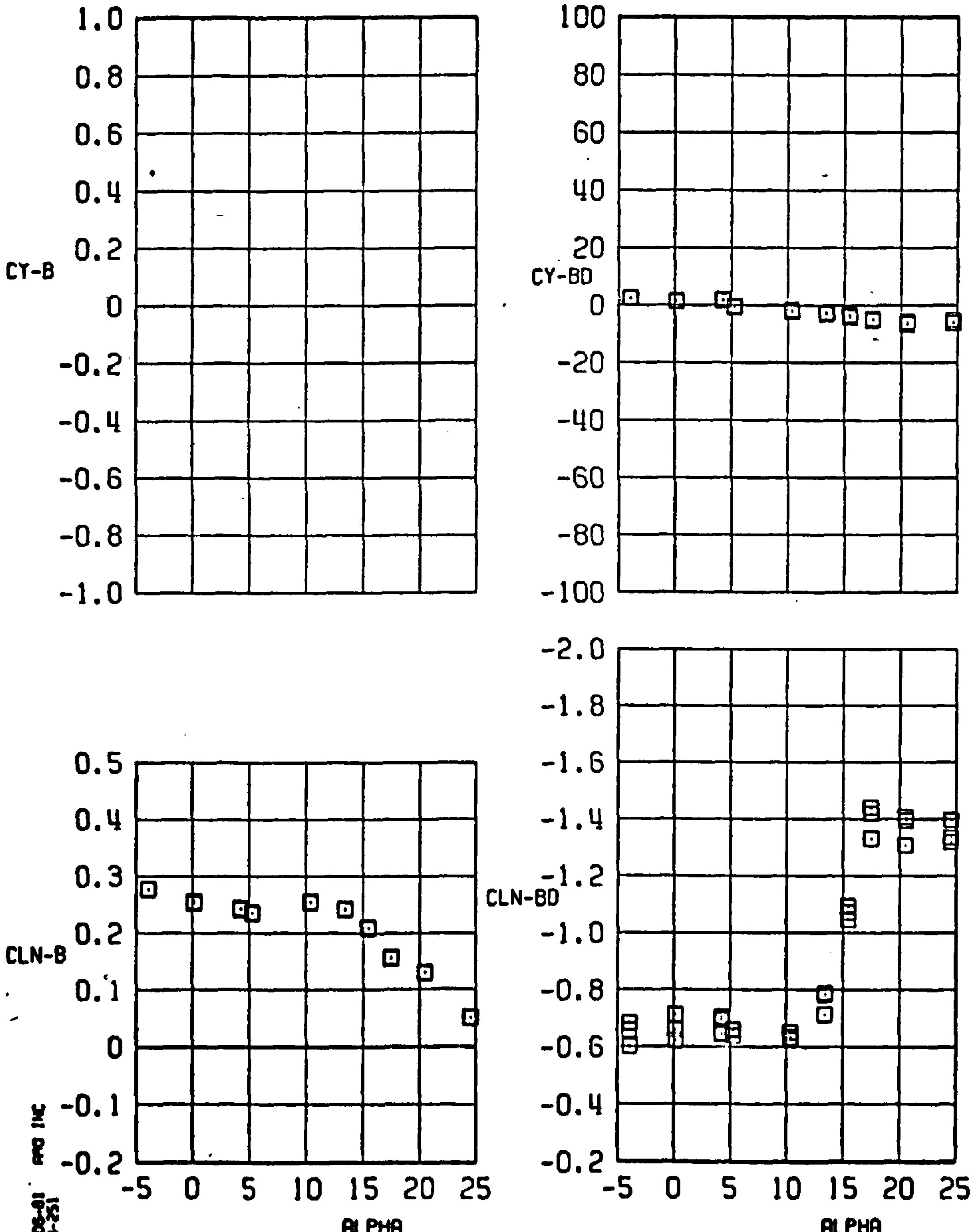
Sample 5. Yaw Plotted Data

SYM	CONFIGURATION	M	REX10^{-6}	RFP	RUN
⊡	-B1C1W1V1T05S1F1I1	1.30	2.50	0.02	79



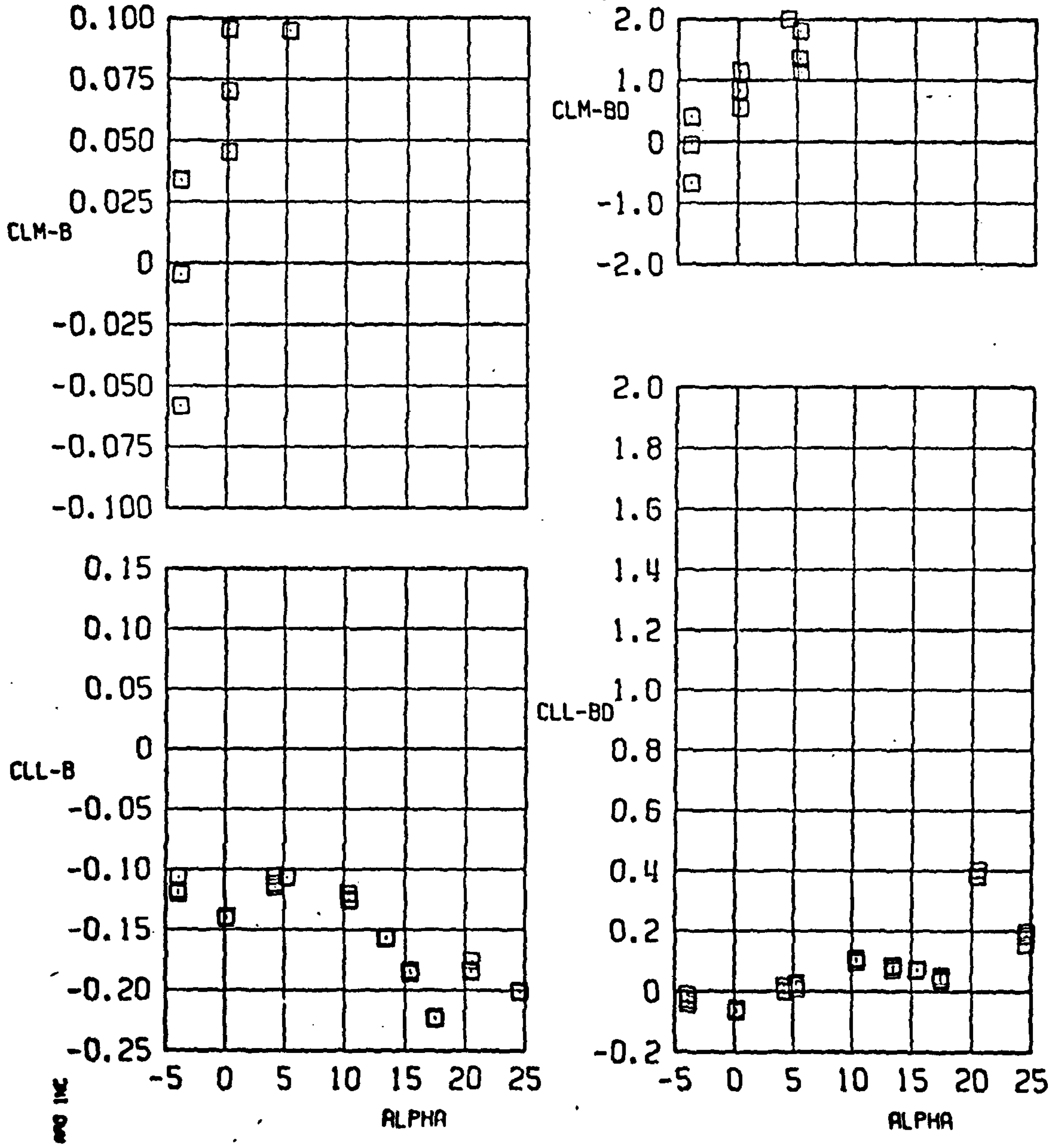
Sample 5. Continued

SYM	CONFIGURATION	M	REX10^{-6}	RFP	RUN
⊡	-B1C1W1V1T05S1F111	1.30	2.50	0.02	79



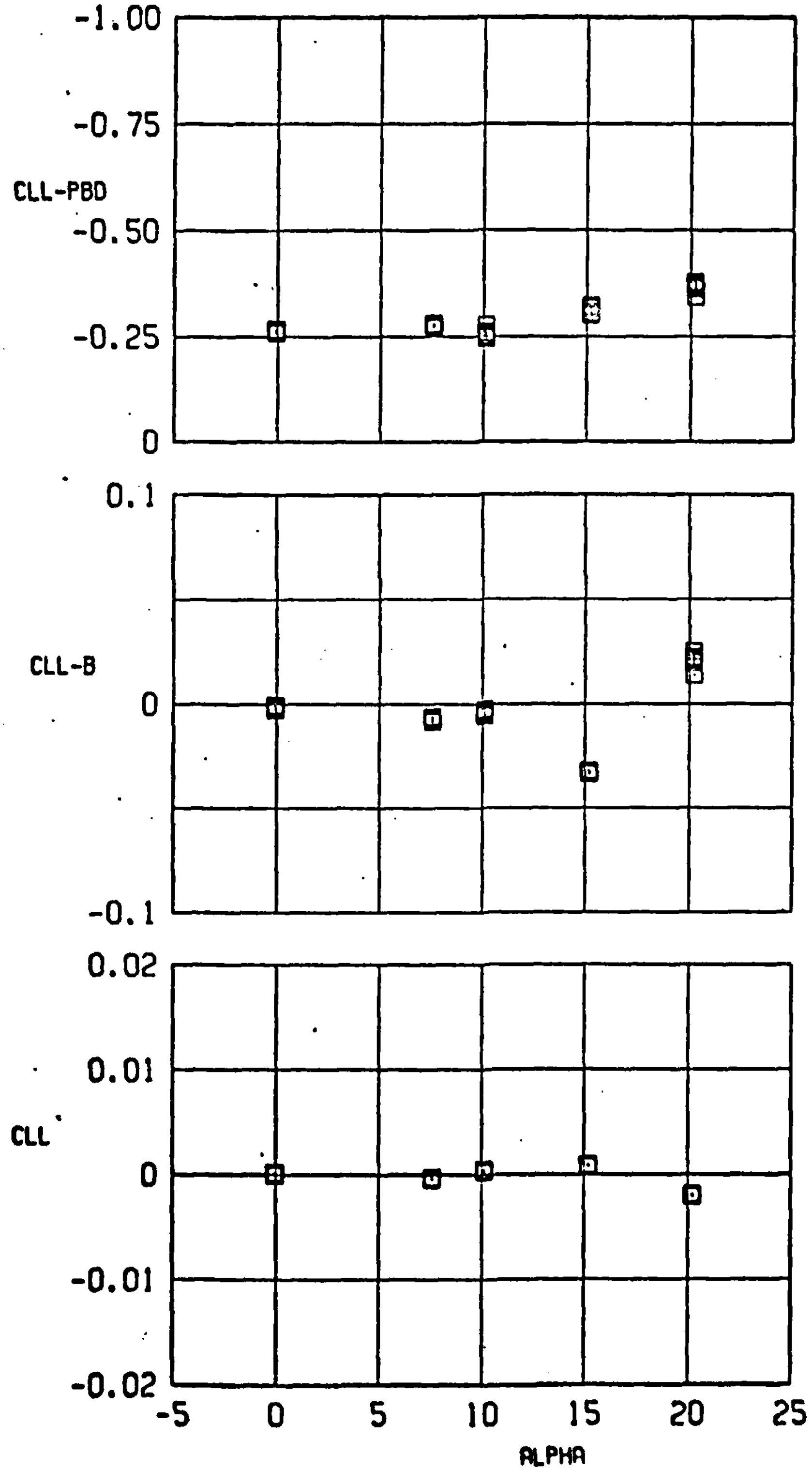
Sample 5. Continued

SYM	CONFIGURATION	M	$REX10^{-6}$	RFP	RUN
⊡	-B1C1W1V1T0S51F1I1	1.30	2.50	0.02	79



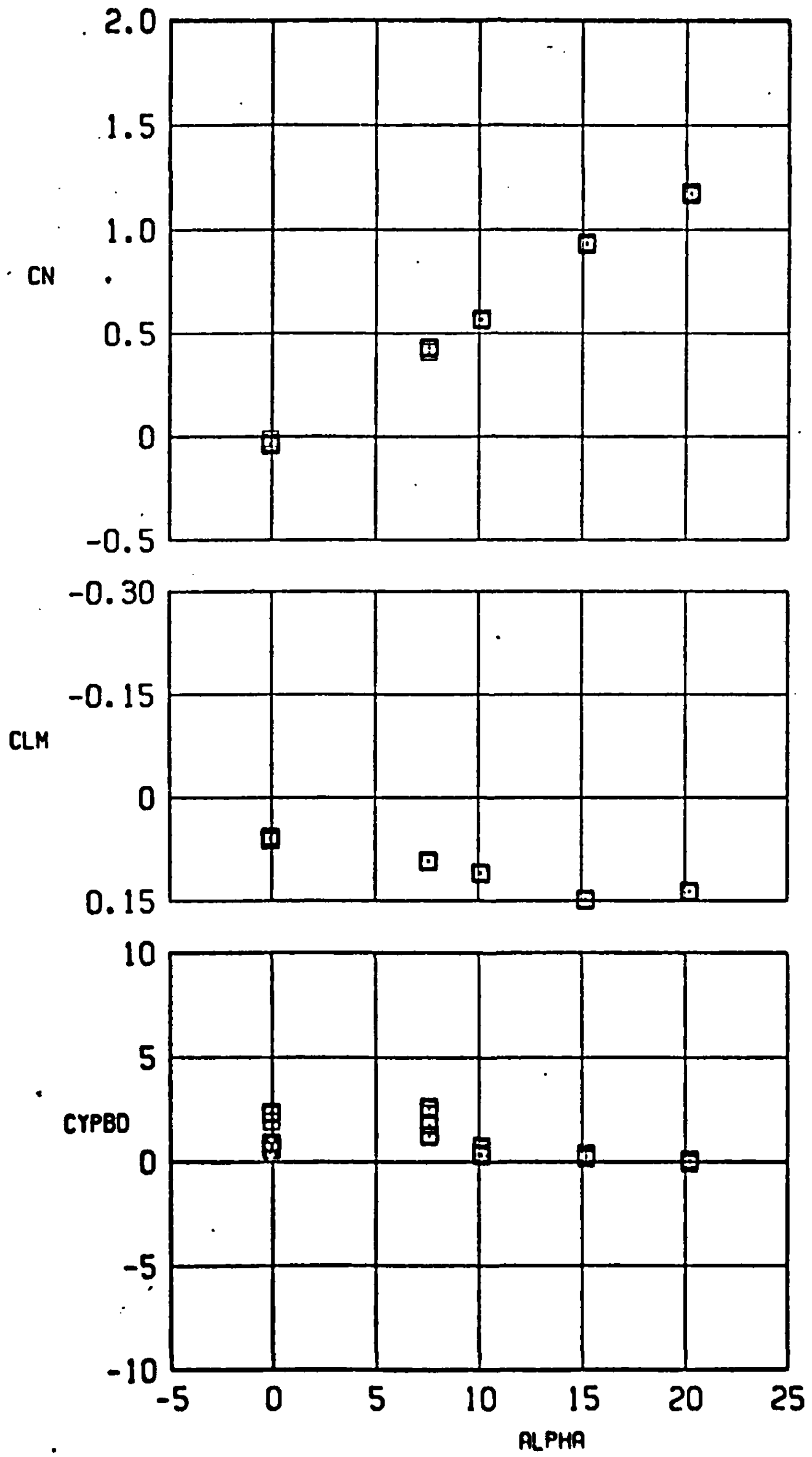
Sample 5. Concluded

SYM	CONFIGURATION	M	REX10^{-6}	RFP	RUN
⊡	-B1C1W2V1T05S1F111	0.30	2.49	0.13	114



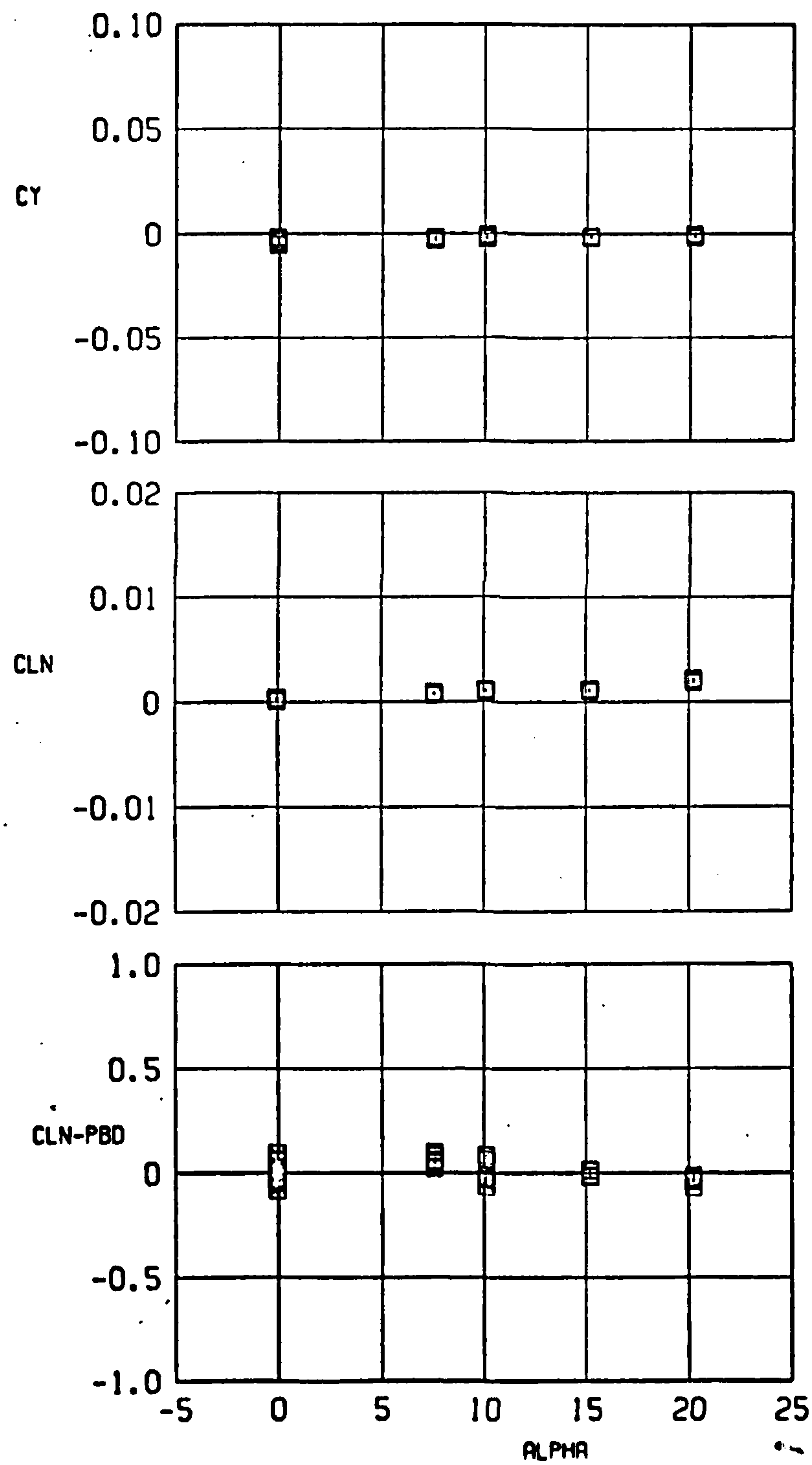
Sample 6. Roll Plotted Data

SYM	CONFIGURATION	M	REX10[-6]	AFP	RUN
⊡	-B1C1W2V1T05S1F111	0.30	2.49	0.13	114



Sample 6. Continued

SYM	CONFIGURATION	M	REX10^{-6}	RFP	RUN
⊡	-B1C1W2V1T05S1F1I1	0.30	2.49	0.13	114



Sample 6. Concluded