AEDC-TSR-81-P30

(2)

LEVEL II

AERODYNAMIC CHARACTERISTICS AND STORE LOADS OF A 1/24-SCALE F-111 AIRCRAFT MODEL WITH THREE EXTERNAL STORE LOADINGS

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Calspan Field Services, Inc.

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A

ARNOLD ENGINEERING DEVELOPMENT CENTER
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FOR THE COMMANDER

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The 1/24-scale F-111 aircraft model was tested in the Aerodynamic Wind Tunnel (4T) to obtain simultaneous measurements of the aircraft and store aerodynamic loads. Static stability and store loads data were obtained at 4 wing sweep angles for Mach numbers from 0.6 to 1.2. The angle of attack was varied from -2 to 24 deg and the angle of sideslip was varied from -10 to 10 deg.

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NOMENCLATURE

Aircraft aerodynamic coefficients are referenced to a body axis system of coordinates unless otherwise noted

A	Reference area, (F-111 0.911 ft^2; rack-mounted stores 0.0123 ft^2; pylon-mounted stores 0.0031 ft^2)
AB	Total nozzle plug base area, 0.0160 ft^2
ACAV	Cavity area, 0.0158 ft
AFA	Flow correction angle in pitch plane, deg
ALPHA	Model angle of attack, deg
B	Wing span, 31.5 in.
BETA	Model sideslip angle, deg
BL	Model butt line, in.
CA	Forebody axial-force coefficient, CAT-CAB
CAB	Base axial-force coefficient, FAB/QS
CAT	Total axial-force coefficient, total axial force/Q·A
CBAR	Wing mean aerodynamic cord, at 16 deg wing sweep angle, 4.5208 in.
CDB	Base drag coefficient (stability axis)
CDS	Forebody drag coefficient (stability axis)
CDTS	Total drag coefficient (stability axis)
CLL	Rolling-moment coefficient, rolling moment/Q·A·B
CLLS	Rolling-moment coefficient (stability axis)
CLMT	Total pitching-moment coefficient, pitching moment/Q·A·CBAR
CLMTS	Total pitching-moment coefficient (stability axis)
CLN	Yawing-moment coefficient, yawing moment/Q·A·B

CLNS	Yawing-moment coefficient (stability axis)
CLS	Lift coefficient (stability axis)
CLTS	Total lift coefficient (stability axis)
CL-A	Slope of CLS versus alpha curve, per deg.
CLLX	Store rolling moment coefficient, rolling moment/(Q·A·D), X = pylon number
CLMX	Store pitching moment coefficient, pitching moment/(Q·A·D), X = pylon number
CLNX	Store yawing moment coefficient, yawing moment/(Q·A·D), X = pylon number
CN	Normal-force coefficient, normal force/Q·A
CNX	Store normal force coefficient, normal force/(Q·A), X = pylon number
CON SET	Constant set used for data reduction
CONFIG NO	Model configuration identification no.
CY	Side-force coefficient, side force/Q·A
CYX	Store side force coefficient, side force/(Q·A), X = pylon number
CLM-A	Slope of CLMT versus alpha for $-2 \leq$ ALPHA ≤ 6, per deg
CYS	Side-force coefficient (stability axis)
D	Store reference diameter, 1.500 in. for rack-mounted stores and 0.750 in. for pylon mounted stores
DCLLS/DCY	Slope of CLLS versus CY for $-4 \leq$ BETA ≤ 4
DCLM/DCL	Slope of CLMTS versus CLS for $-2 \leq$ ALPHA ≤ 6
DCLNS/DCY	Slope of CLNS versus CY for $-4 \leq$ BETA ≤ 4
FAB	Base axial force, [P - (PB1 + PB2)/2]AB + [P - PCAV]ACAV
FS	Model fuselage station, in.
MACH,M	Freestream Mach number

MS	Model station, in.
NCP	Normal force center-of-pressure location in reference lengths from the model moment reference point, CLMT/CNT
P	Free-stream static pressure, psfa
PB1,2	Left and right nozzle plug base pressure, psfa
PCAV	Cavity pressure, psfa
PT	Total pressure measured in the tunnel stilling chamber, psfa
PTE1,2	Left and right nozzle exit total pressure, psfa
Q	Free-stream dynamic pressure, psf
REX10^{-6}	Free-stream unit Reynolds number, per foot
RUN	Run (data set) identification number
SPEED BRAKE	Speed brake deflection angle, deg, positive for extension
STABILATOR	Stabilator deflection angle, deg, positive trailing edge down
SWEEP	Wing sweep angle, deg
TP	Data point number
TT	Total temperature measured in the tunnel stilling chamber, ^{o}F
UM	Total Mach number uncertainty
UP	Total static pressure uncertainty, psf
UQ	Total dynamic pressure uncertainty, psf
WL	Model water line, in.
X_{MT}	Transfer distance along the pylon axis system X-axis, measured from the pylon moment reference center, in., positive upstream
XNP	Neutral point, -DCLMTS/DCLS, positive aft of moment reference center

X_{NT} Transfer distance along the pylon axis system X-axis, measured from the pylon moment reference center, in., positive upstream

Y_T Transfer distance along the pylon axis system Y-axis, measured from the pylon moment reference, in., positive to the right, looking upstream

Z_T Transfer distance along the pylon axis system Z-axis, measured from the pylon moment reference center, in., positive downward

Note: The store sign convention used for aerodynamic coefficients is the same as used for the aircraft aerodynamic coefficients, i.e., as viewed by the pilot; normal force coefficient, positive up; pitching-moment coefficient, positive nose up; axial force coefficient, positive aft; side force coefficient, positive to the right; yawing moment coefficient, positive nose to the right; and rolling moment coefficient, positive clockwise.

1.0 INTRODUCTION

The work reported herein was conducted by the Arnold Engineering Development Center (AEDC), Air Force Systems Command (AFSC), under Program Element 65807F, Control Number 9R02, at the request of AEDC/DOFA. The DOFA project manager was Mr. Alex Money and the Calspan project engineer was Mr. Dave Cahill. 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 Aerodynamic Wind Tunnel (4T) during the period from June 5 through June 10, 1981, under AEDC Project Number C015PB.

Aerodynamic forces and moments and store loads data were obtained with a 1/24-scale F-111 model with three different store loadings. This test was a continuation of the test program reported in Ref. 1. The purpose of this test was to obtain data on a store configuration not previously tested. Data were also obtained for two configurations at a wing sweep angle of 45 deg to fill in gaps in the data base used to develop the prediction program. Static stability and store loads data were obtained for three configurations over the Mach number range from 0.6 to 1.2 at angles of attack from -2 to 24 deg and angles of sideslip from -10 to 10 deg. The wing sweep angle was varied from 26 to 60 deg.

The purpose of this report is to document the test and to describe the test parameters. The report provides information to permit use of the data, but does not include any data analysis, which is beyond the scope of this report.

The final data package from this test has been retained at AEDC. Requests for these data should be addressed to AEDC/DOFA, Arnold AFS, Tennessee 37389. A copy of the final data is on file on microfilm at the AEDC.

2.0 APPARATUS

2.1 TEST FACILITY

The AEDC 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 1.96 by placing nozzle inserts over the permanent sonic nozzle. At all Mach numbers, the stagnation pressure can be varied from 300 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 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 sting attachment which has a pitch angle capability of -8 to 27 deg with respect to the tunnel centerline and a roll capability of -180 to 180 deg about the sting centerline. A more complete description of the tunnel may be found in Ref. 2.

2.2 TEST ARTICLES

The test articles were 1/24-scale models of the F-111 aircraft, MK-20 Rockeye, MK-82SE, SUU-30HB, GBU-8B and GBU-15CWW stores. The test installation in Tunnel 4T is shown in Fig. 1 while details and dimensions of the models are presented in Figs. 2 through 4. The F-111 model had Type II inlets (no splitter plates) containing fixed 10-deg inlet spikes. The inlets were connected to flow-through ducts which had fixed exhaust nozzle plugs. The aft fuselage and exhaust nozzles were modified to allow insertion of the balance and sting.

Pylons with five-component balances were installed at the pivot stations (3 through 6) for all testing. BRU-3A/A racks were installed for configurations using MK-20, MK-82SE, or SUU-30H/B stores. The store loadings for all configurations tested are presented in Table 1.

All testing was done with free boundary-layer transition on the F-111 model and stores.

2.3 TEST INSTRUMENTATION

Test instrumentation included a six-component main balance in the F-111 model and four five-component pylon balances. The pylon balances were an integral part of the pylons and measured the loads transmitted to the pylons by the store models. Because of space constraints, axial-force links could not be incorporated into the pylon balances and hence, the axial loads for the pylon mounted store and store-rack models were not measured. Five pressure transducers connected to orifices were used to measure sting cavity pressure, nozzle plug base pressures, and nozzle exit total pressures.

3.0 TEST DESCRIPTION

3.1 TEST CONDITIONS AND PROCEDURE

Measurements of aircraft and pylon-mounted store steady-state forces and moments were obtained at Mach numbers from 0.6 to 1.2. The nominal test conditions established during the test are given in Table 2. Tunnel conditions were held

constant while angle of attack or sideslip angle was varied. Data were recorded at selected angles using the pitch-pause technique. Data were obtained at angles of attack from -2 to 24 deg and sideslip angles from -10 to 10 deg.

All steady-state measurements were sequentially recorded by the facility online computer system and reduced to the desired final form. The data were then tabulated in the Tunnel 4T control room, recorded on magnetic tape, and transmitted to the AEDC central computer file. The data stored in the central computer file were generally available for plotting and analysis on the PWT Interactive Graphics System within 30 seconds after data acquisition. The immediate availability of the tabulated and plotted data permitted continual online monitoring of the test results. A typical data plot generated by the PWT Interactive Graphics System is shown in Fig. 5.

3.2 CORRECTIONS

The aircraft angles of attack and sideslip angles were corrected for sting deflections caused by aerodynamic loads. The flow angularity in the tunnel pitch plane was determined by testing the model upright and inverted. Flow angularities (see Table 2) thus determined ranged from 0.006 to -0.037 deg for Mach numbers from 0.6 to 1.2 and were applied to the data. Corrections for the components of model weight, normally termed static tares, were also applied to the data for both the aircraft and store models.

3.3 DATA REDUCTION

The force and moment data obtained on the F-111 aircraft model were reduced to coefficient form in the body and stability axes systems. Model base and cavity pressure measurements were made for the F-111 model and used to calculate base and forebody axial force and drag coefficients. The aircraft reference areas and lengths are noted in the Nomenclature and the moment reference point location is shown in Fig. 2.

The store loads data were reduced to coefficient form in the pylon axis system. The pylon longitudinal axis was parallel to the lower surface of the pylons and passed through the moment reference point shown in Fig. 3a. The reference area and length used to reduce the store loads data are noted in the Nomenclature. The moment reference point location for the store models was located at the pylon mid-lug point on the pylon balance centerline (see Fig. 3a). Since there were no axial-force gages on the pylon balances, the transferring of the store moments from the balance centerline to any other point in the pylon axis system requires

an estimated axial-force coefficient. Using an estimated axial-force coefficient, the moments can be transferred using the following equations:

$$\text{CLMX(TRANSFERRED)} = \text{CLMS(TABULATED)} - \frac{X_{MT}}{D}\,\text{CNX(TABULATED)} + \frac{Z_T}{D}\,\text{CAX(EST)}$$

$$\text{CLNX(TRANSFERRED)} = \text{CLNX(TABULATED)} - \frac{X_{NT}}{D}\,\text{CYX(TABULATED)} - \frac{Y_T}{D}\,\text{CAX(EST)}$$

$$\text{CLLX(TRANSFERRED)} = \text{CLLX(TABULATED)} + \frac{Y_T}{D}\,\text{CNX(TABULATED)} + \frac{Z_T}{D}\,\text{CYX(TABULATED)}$$

where X represents a wing pylon balance and where X_{MT}, X_{NT}, Y_T, and Z_T are transfer parameters defined in the Nomenclature. CAX(EST) is the estimated axial-force coefficient for the store loading (positive downstream). The sign convention used for the store aerodynamic coefficients is the same as that used for the aircraft aerodynamic coefficients.

3.4 UNCERTAINTY OF MEASUREMENTS

Uncertainties (combinations of system and random errors) of the basic tunnel parameters, shown in Fig. 6, were estimated from repeat calibrations of the instrumentation and from the repeatability and uniformity of the test section flow during tunnel calibration. Uncertainties in the instrumentation systems were estimated from repeat calibration of the systems against secondary standards whose uncertainties are traceable to the National Bureau of Standards calibration equipment. The tunnel parameter and instrument uncertainties, for a 95-percent confidence level, were combined using the Taylor series method of error propagation described in Ref. 3 to determine the uncertainties of the parameters shown in Tables 3 through 5. The estimated coefficient uncertainties of the parent aircraft data are given in Table 3 while representative coefficient uncertainties for rack-mounted stores and pylon mounted stores are given in Tables 4 and 5, respectively.

4.0 DATA PACKAGE PRESENTATION

The final data package contained 1) tabulated data summaries listing specific parameters, 2) digital magnetic computer tape containing summary data, 3) test article installation photographs, and 4) appropriate test logs for identification of test runs, test conditions, and test article configurations. An example of the tabulated summary data is shown in Table 6. All parameters on the data summaries are defined in the Nomenclature of this report. A summary of the test program listing run numbers for each test condition is presented in Table 7.

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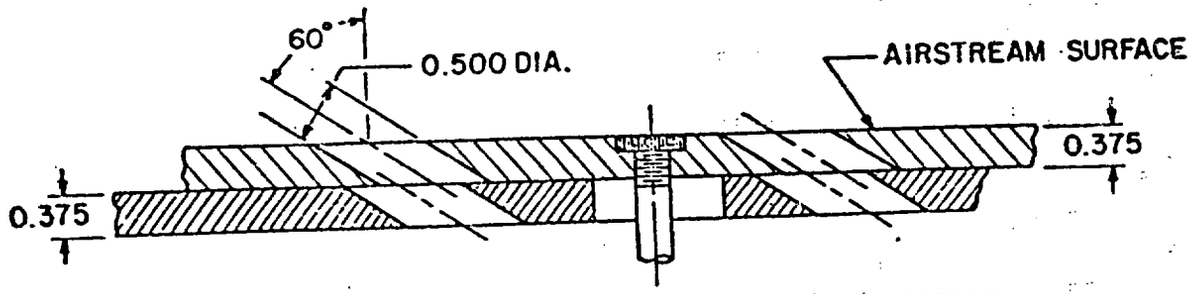
1. Anderson, C. F. "Wind Tunnel Tests to Determine the Aerodynamic Characteristics and Store Loads of the 1/24-Scale F-111 Aircraft Model with Several External Store Loadings." AEDC-TSR-79-P48, August 1979.

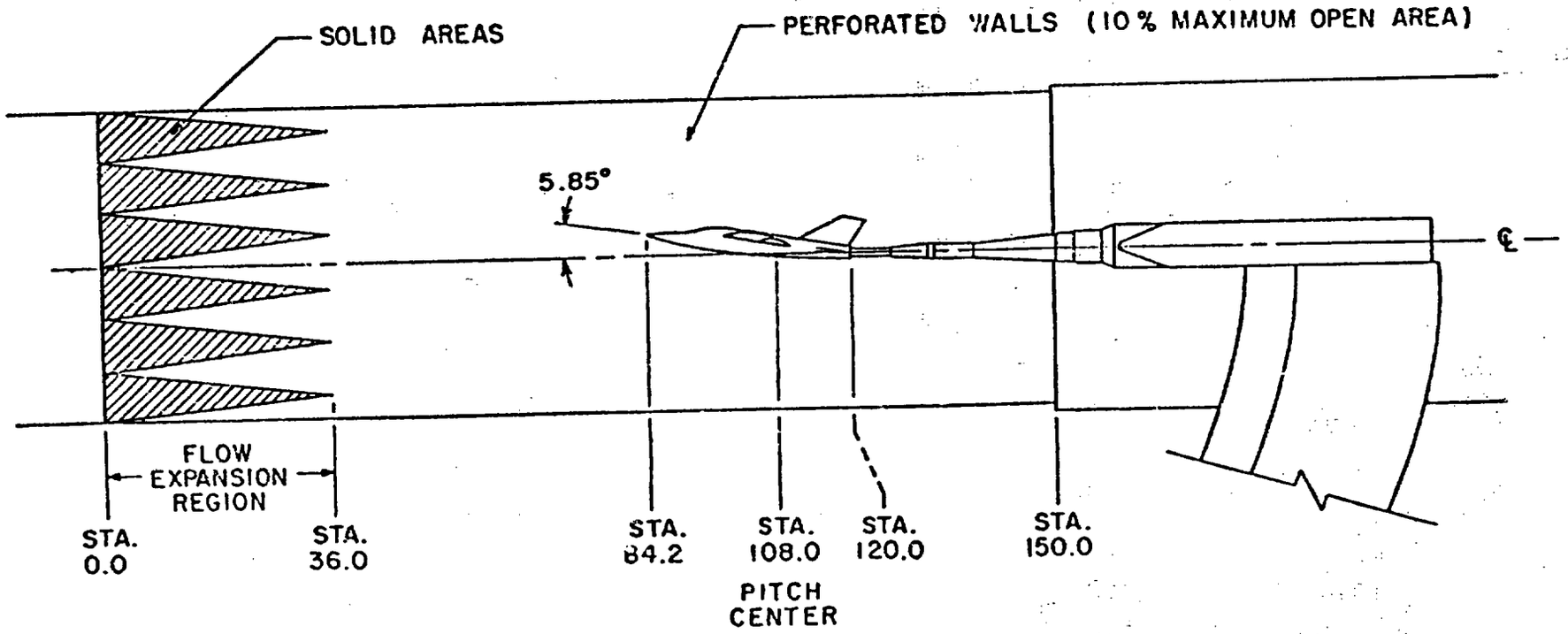
2. Test Facilities Handbook (Eleventh Edition). "Propulsion Wind Tunnel Facility, Vol. 4." Arnold Engineering Development Center, June 1979.

3. Abernethy, R. B. and Thompson, J. W., Jr., "Handbook - Uncertainty in Gas Turbine Measurements." AEDC-TR-73-5 (AD755356), February 1973.



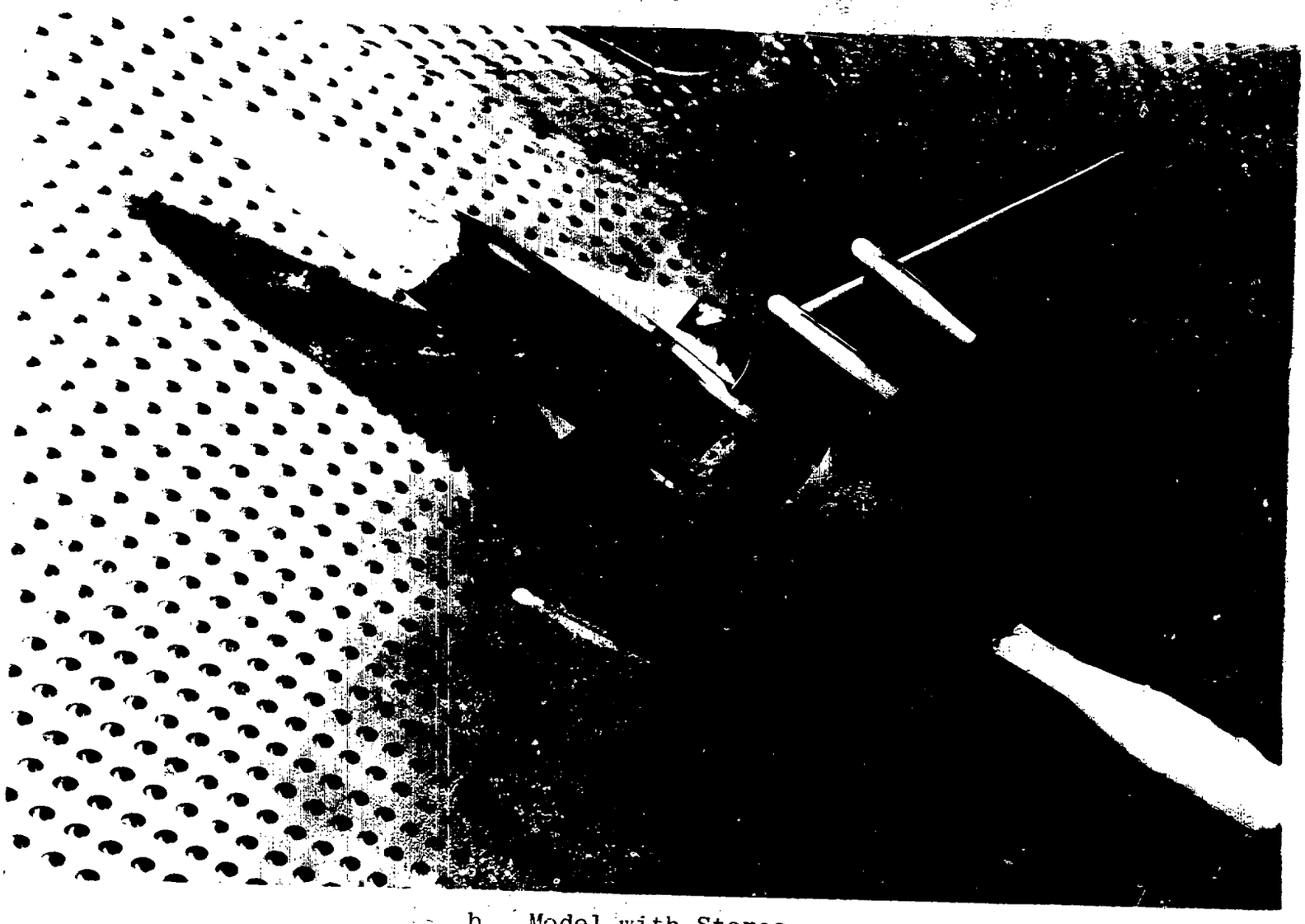
TYPICAL PERFORATED WALL CROSS SECTION

TUNNEL STATIONS AND DIMENSIONS ARE IN INCHES



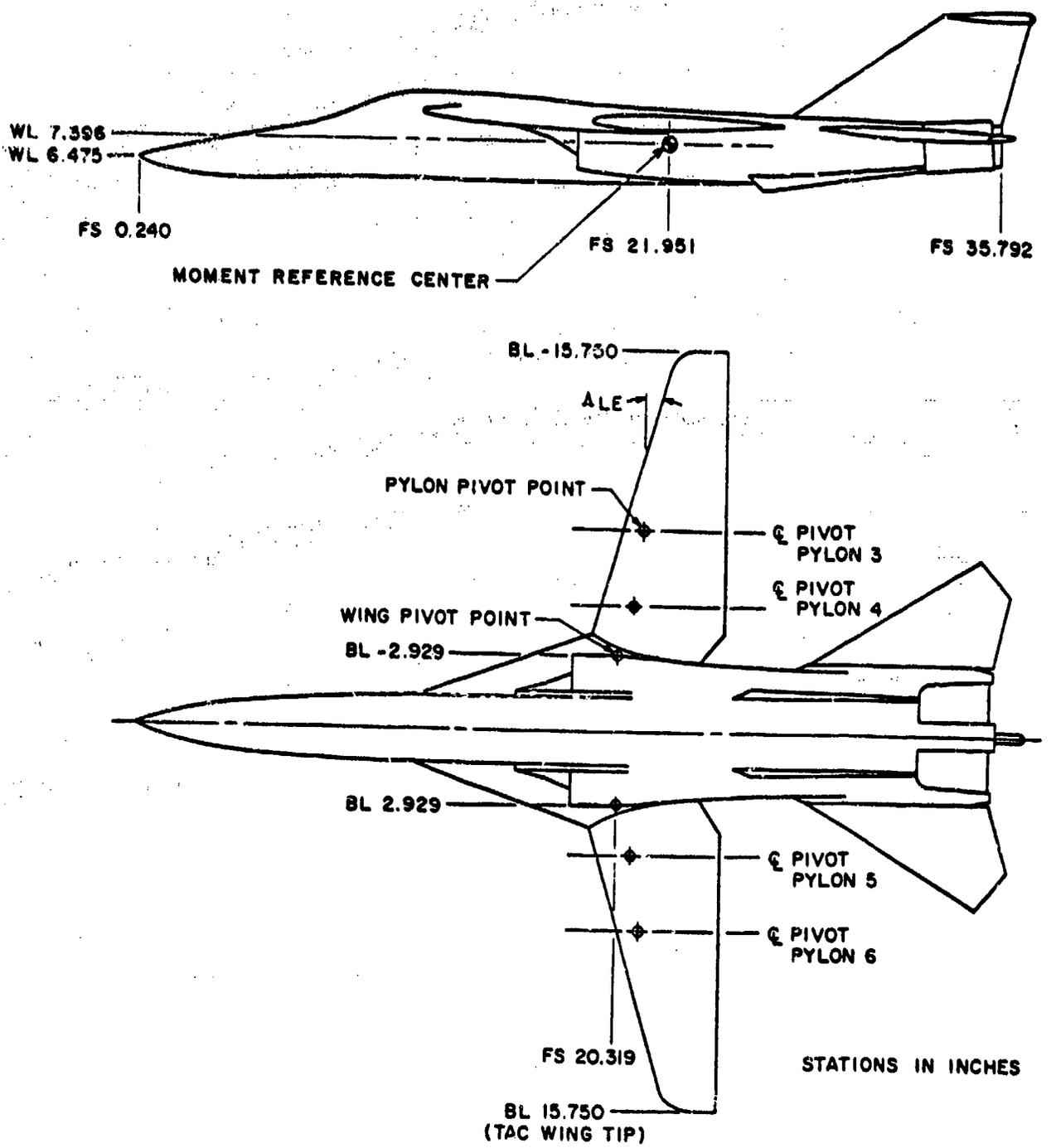
a. Test Article Location in Tunnel 4T

Figure 1. Tunnel Installation



b. Model with Stores

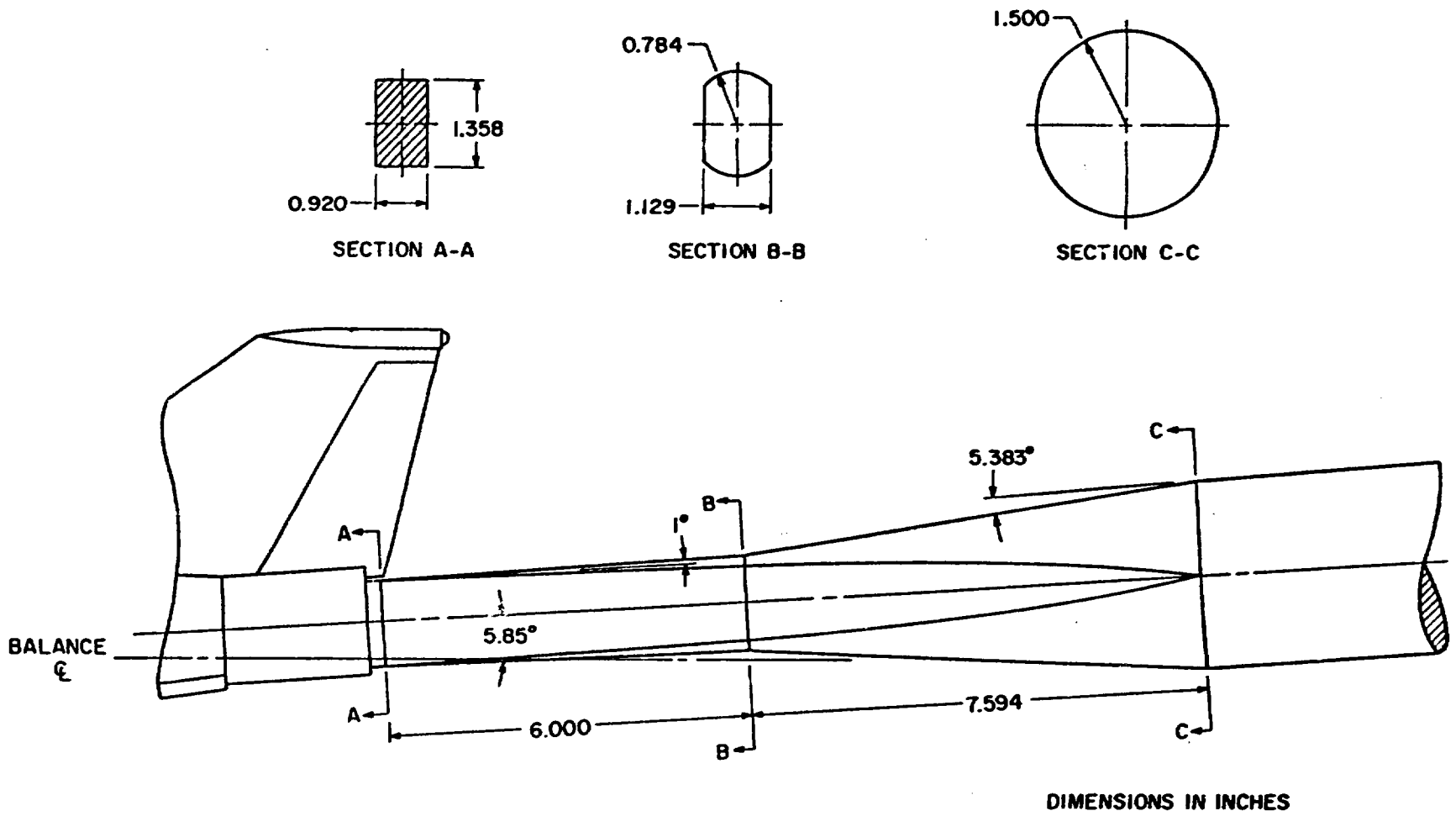
Figure 1. Concluded



Λ_{LE}	INBD PYLON POINT		OUTBD PYLON PIVOT POINT	
	FS	BL	FS	BL
16(Ref)	20.962	4.913	21.291	7.873
26	21.297	4.771	22.135	7.629
45	21.843	4.352	23.566	6.782
54	22.047	4.096	24.129	6.226
60	22.160	3.910	24.452	5.810
72.5	22.238	3.488	24.978	4.847

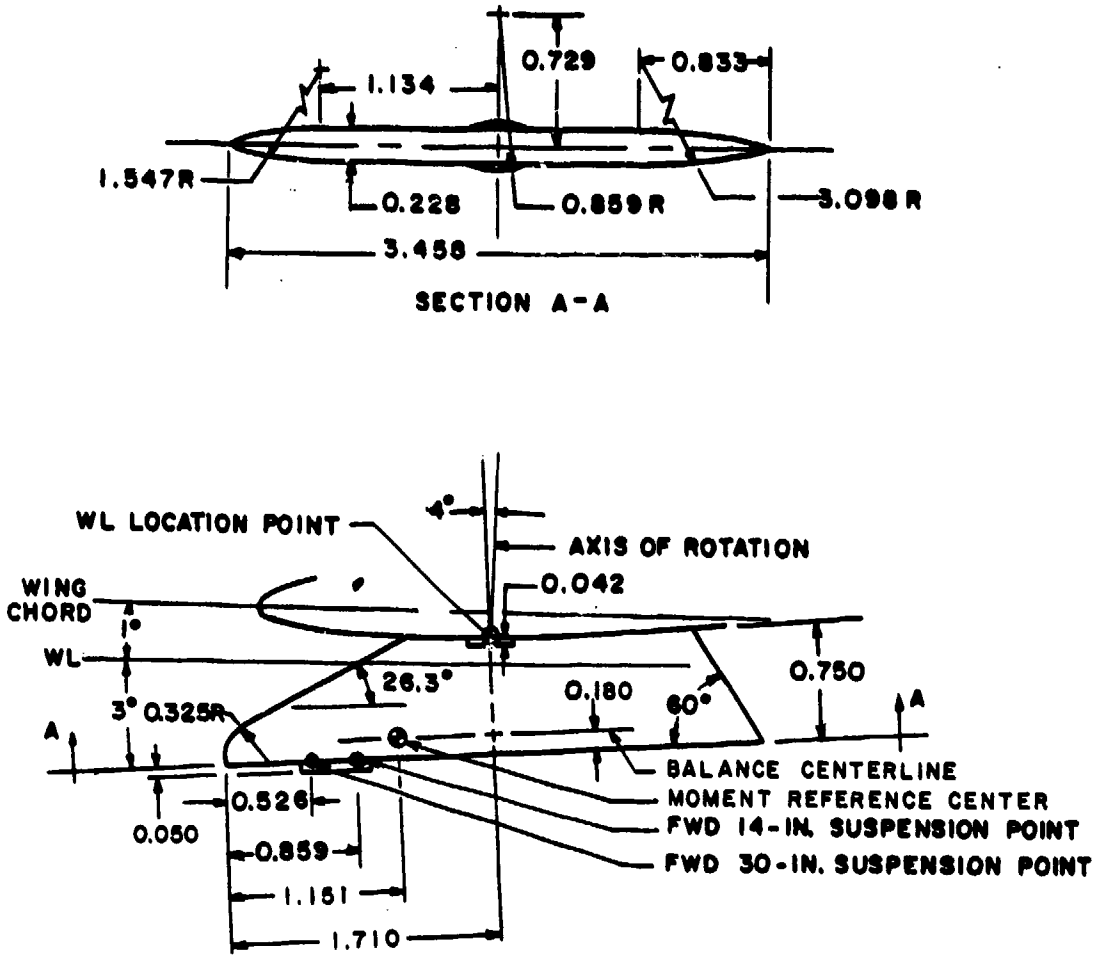
a. General Arrangement

Figure 2. F-111 Model



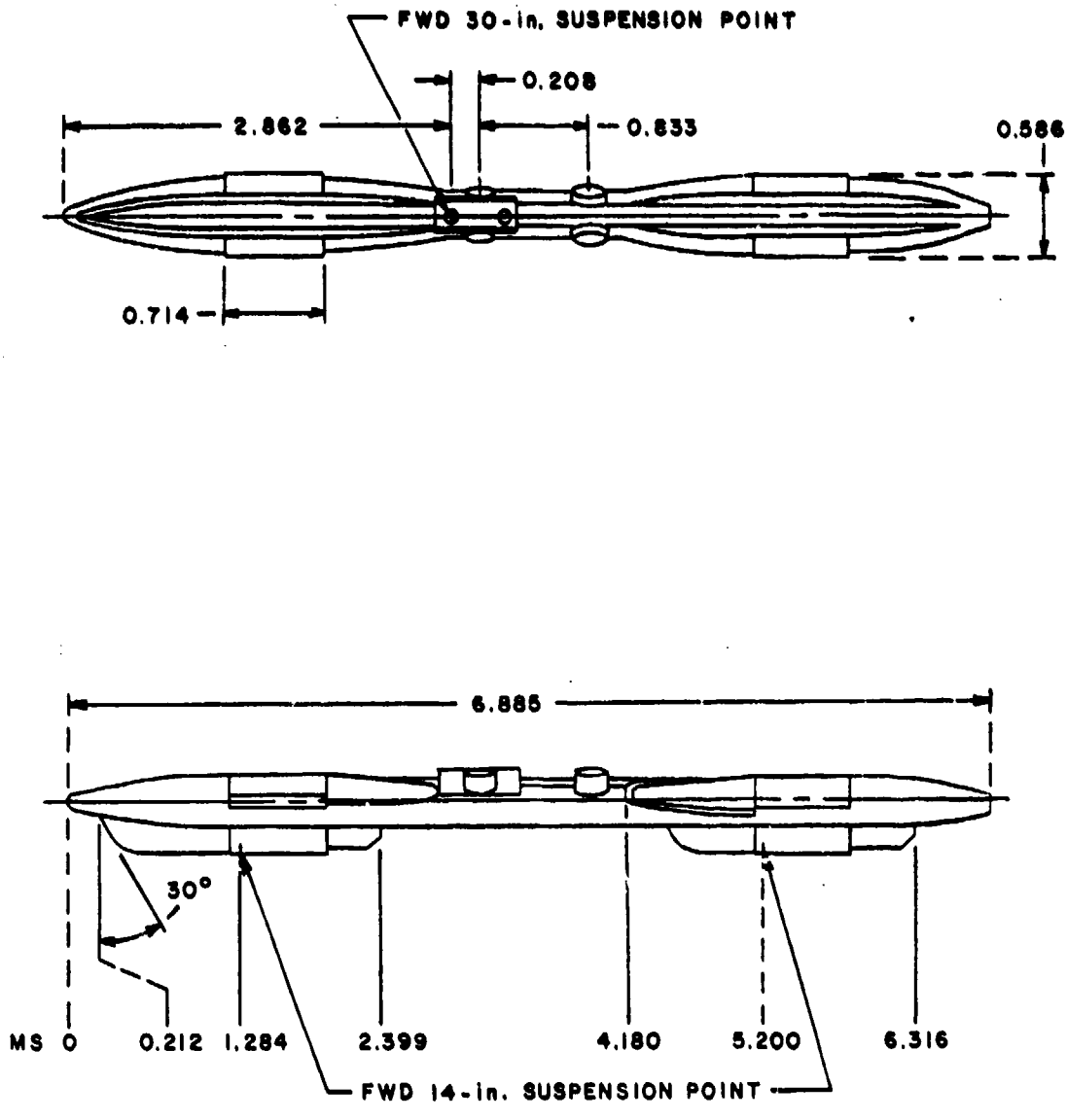
b. Sting and Model Base Details

Figure 2. Concluded



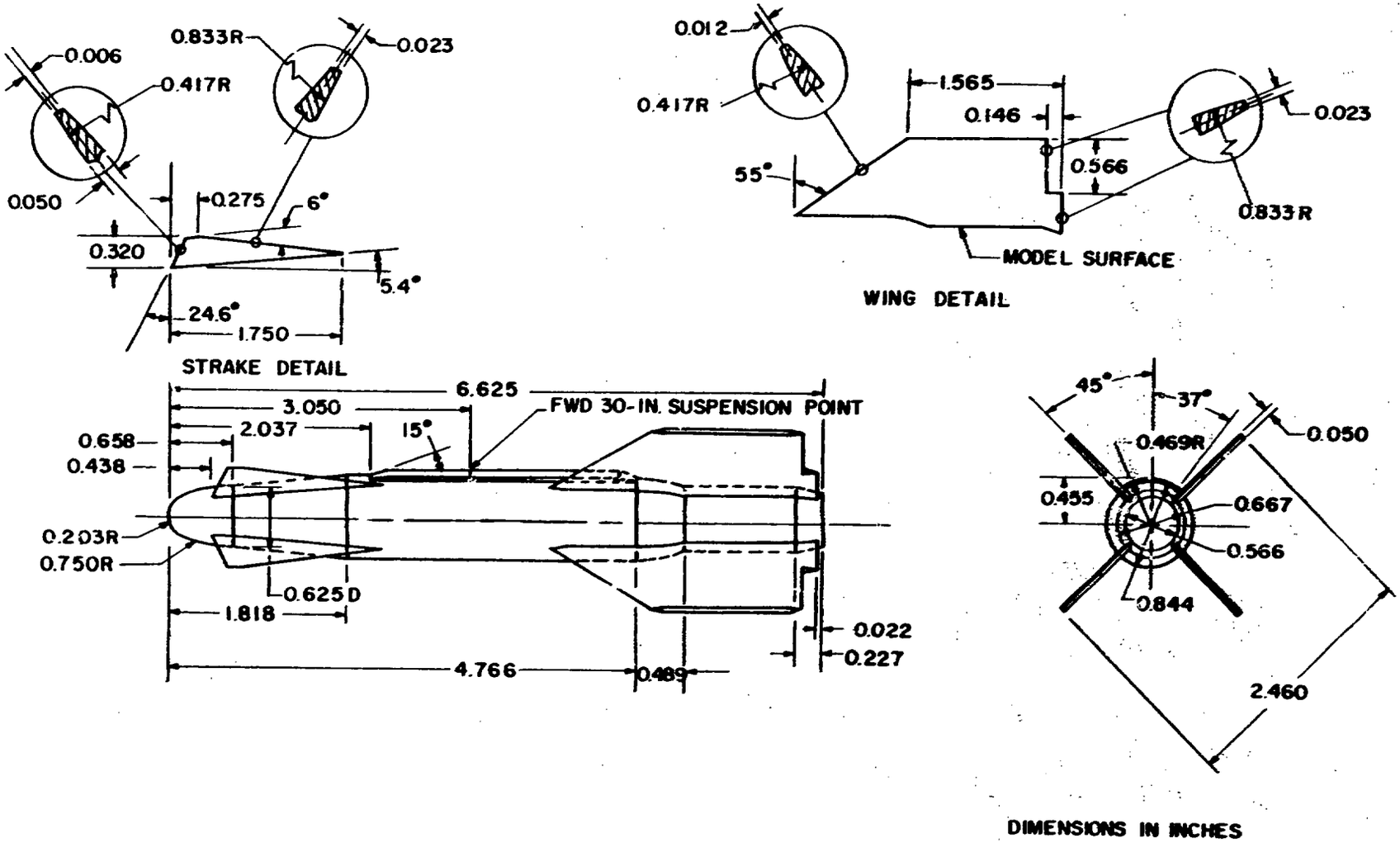
a. Pylon (Typical Stations 3, 4, 5, and 6)

Figure 3. External Store Suspension Equipment



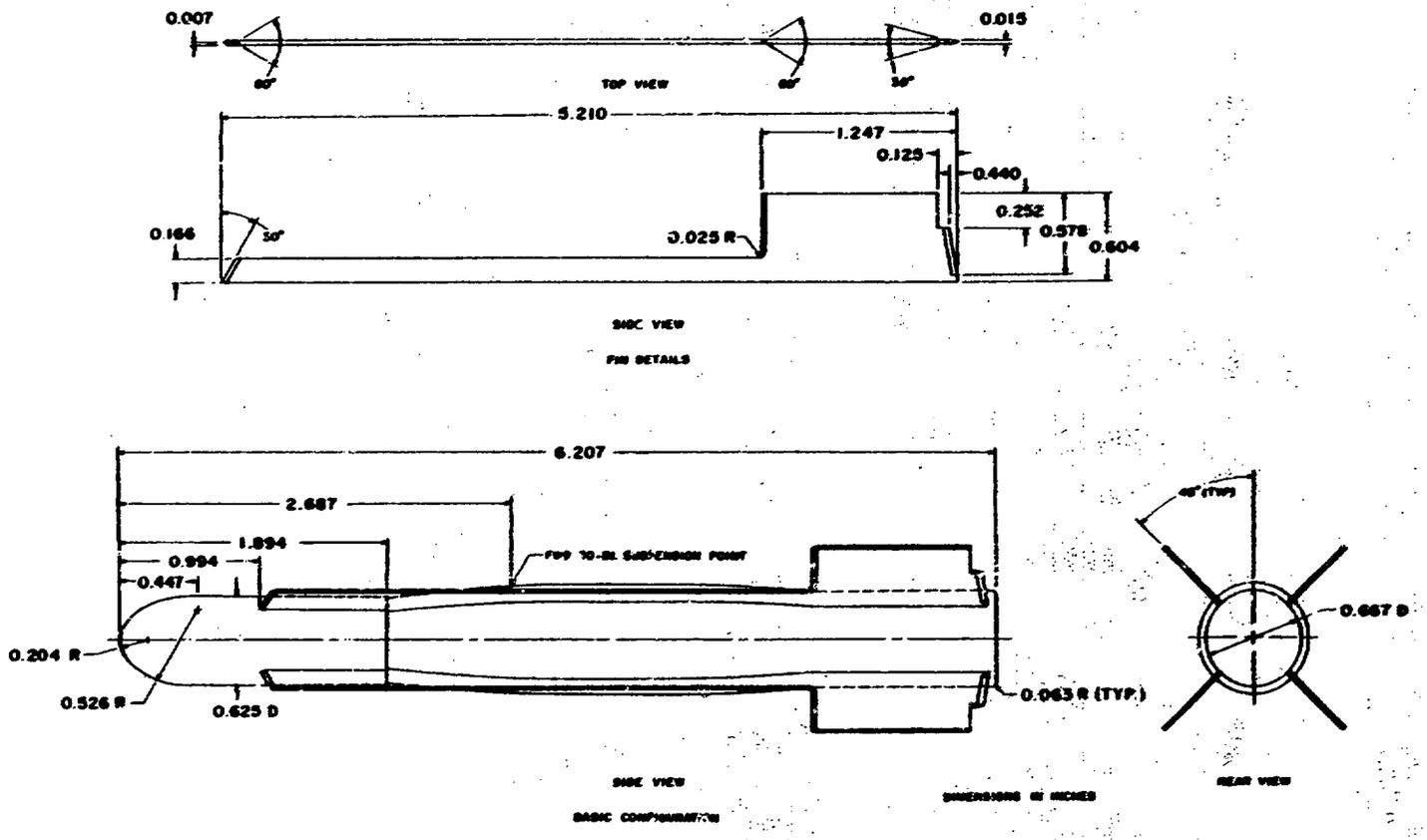
b. BRU-3A/A Rack

Figure 3. Concluded



a. GBU-15CWW

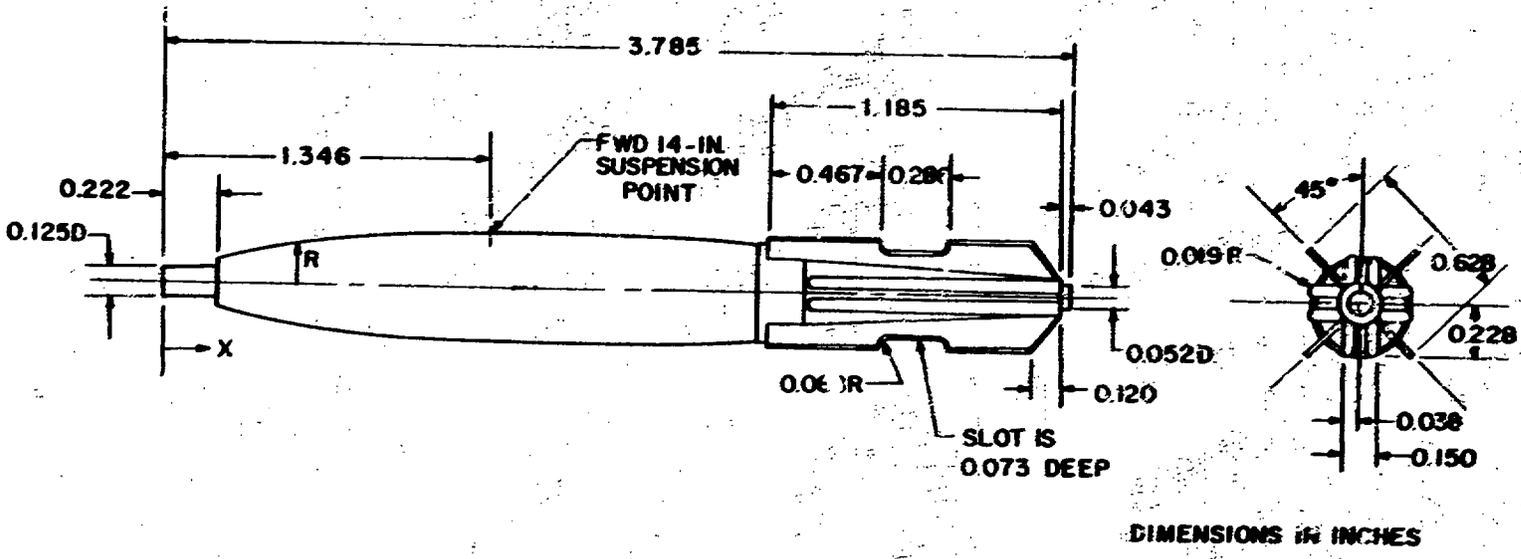
Figure 4. External Stores



b. GBU-8/B

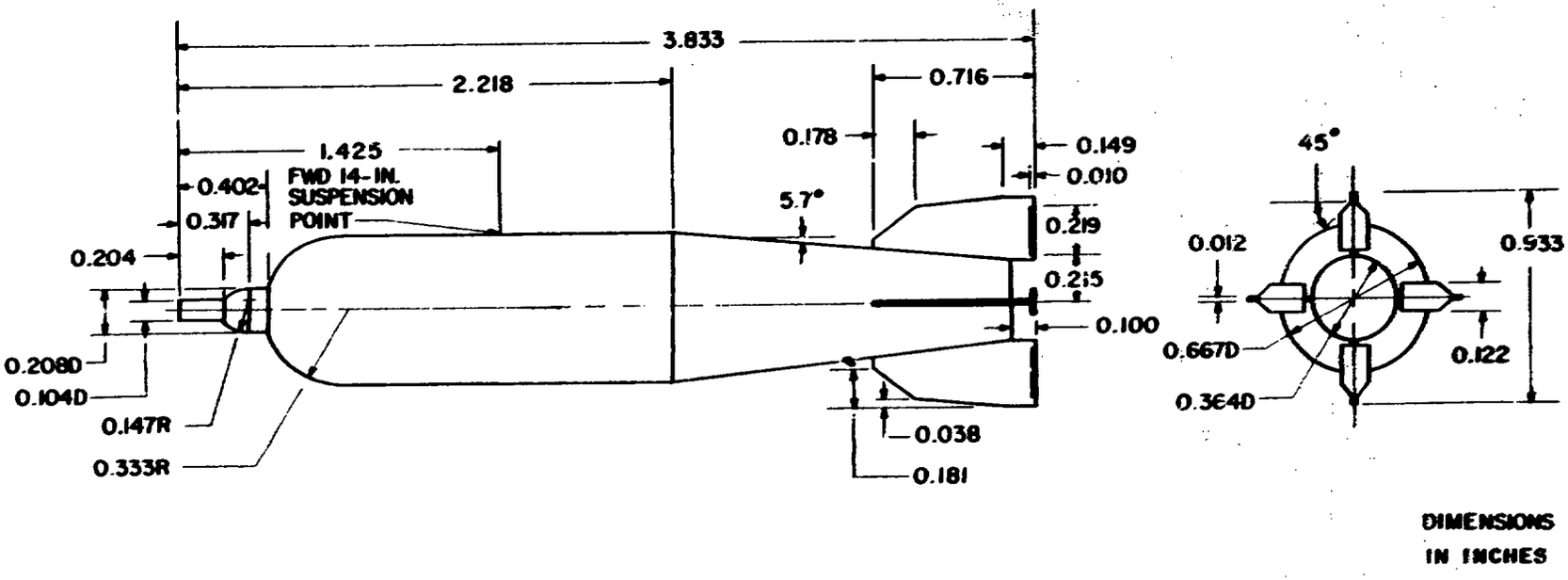
Figure 4. Continued

X, in.	R, in.
0.222	0.096
0.297	0.117
0.357	0.130
0.485	0.154
0.656	0.177
0.826	0.195
0.997	0.209
1.168	0.220
1.338	0.224
CONST DIAM	
1.893	0.224
2.063	0.222
2.234	0.216
2.404	0.206
2.479	0.201
2.479	0.209
CONST SLOPE	
2.675	0.210
CONST SLOPE	
3.440	0.068
CONST DIAM	
3.742	0.068



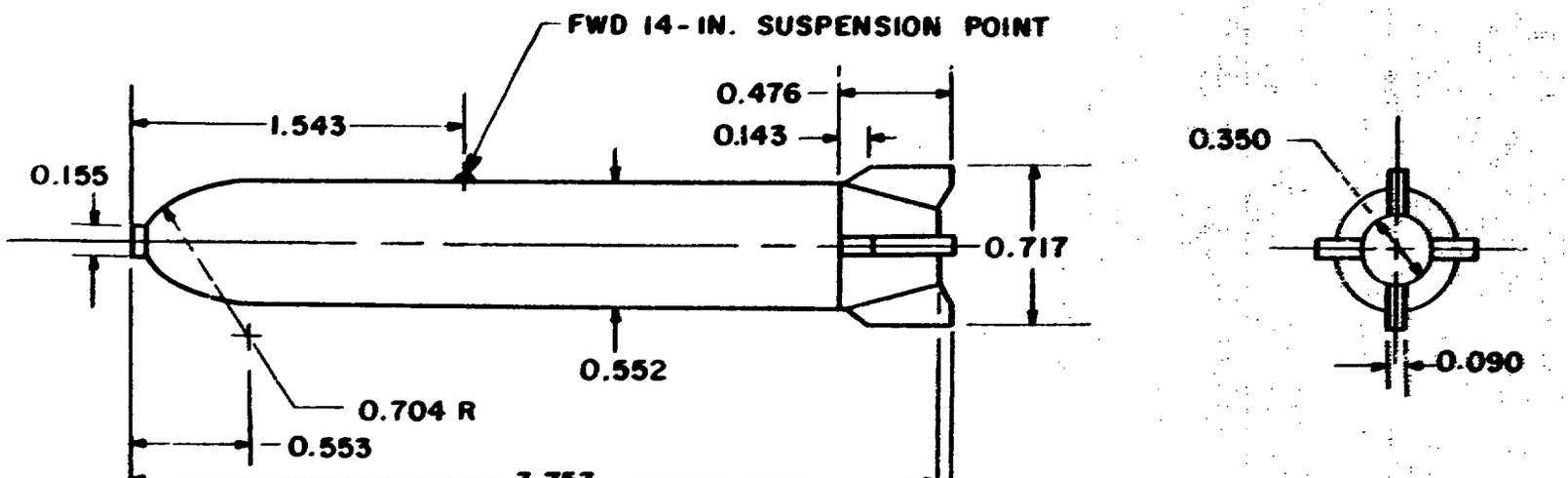
c. MK-82SE

Figure 4. Continued



d. SUU-30H/B

Figure 4. Continued



e. MK-20 Rockeye

Figure 4. Concluded

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PROJ-P41B-185 ARNOLD AFS,TN

** TC690 C.F. ANDERSON ** SWEEP CONFIG 23
RUN = 1103,1127,1203,1226

1 26 MACH 0.80
2 45
3 54
4 60

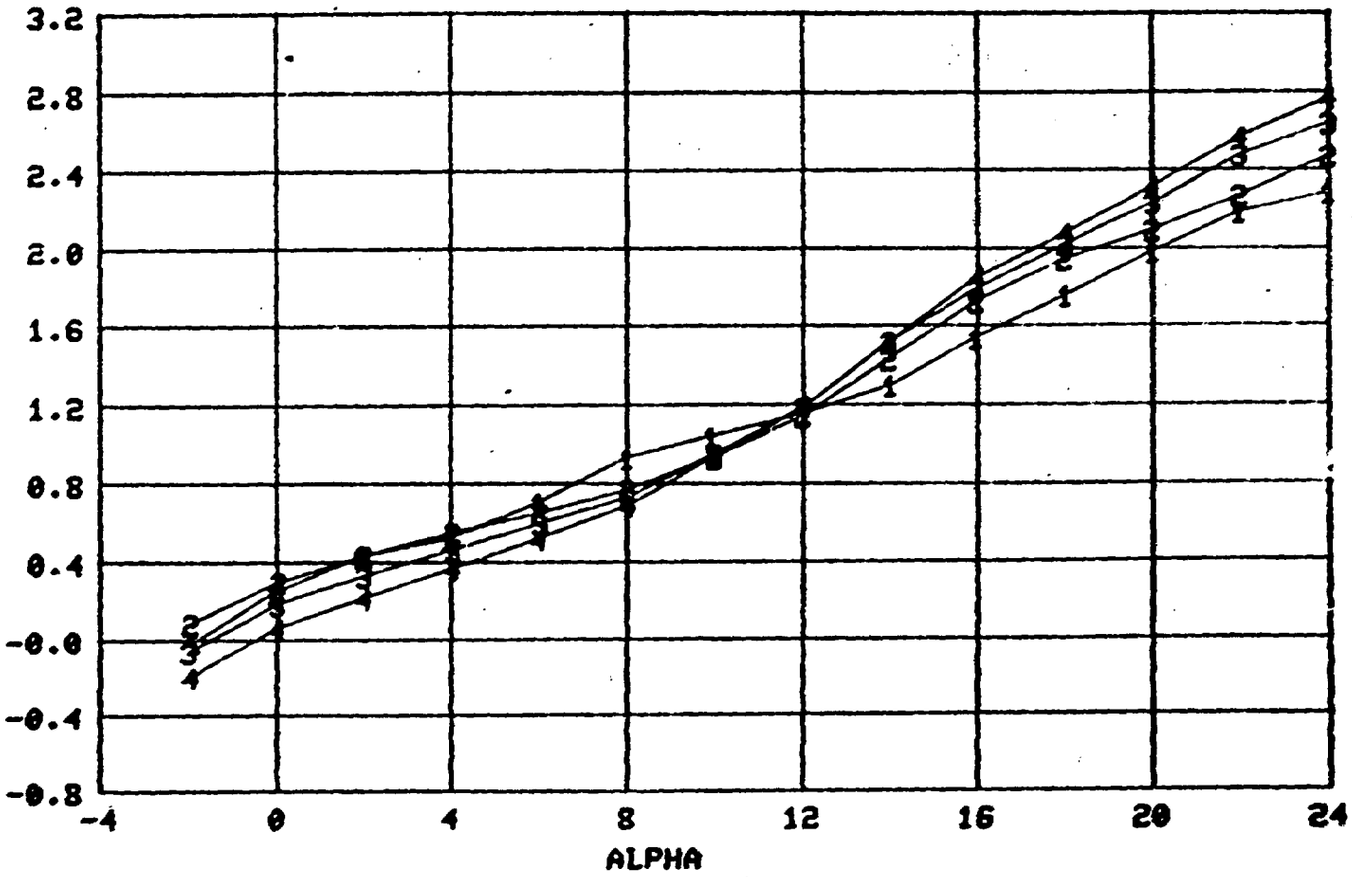

Figure 5. Typical Data Plot

DATE 07-16-81 CALSPAN FIELD SERVICES INC.
PROJ-P418-185 ARNOLD AFS, TN

** TC690 C.F. ANDERSON ** SWEEP CONFIG 23
RUN = 1103,1127,1203,1226

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2 45
3 54
4 60

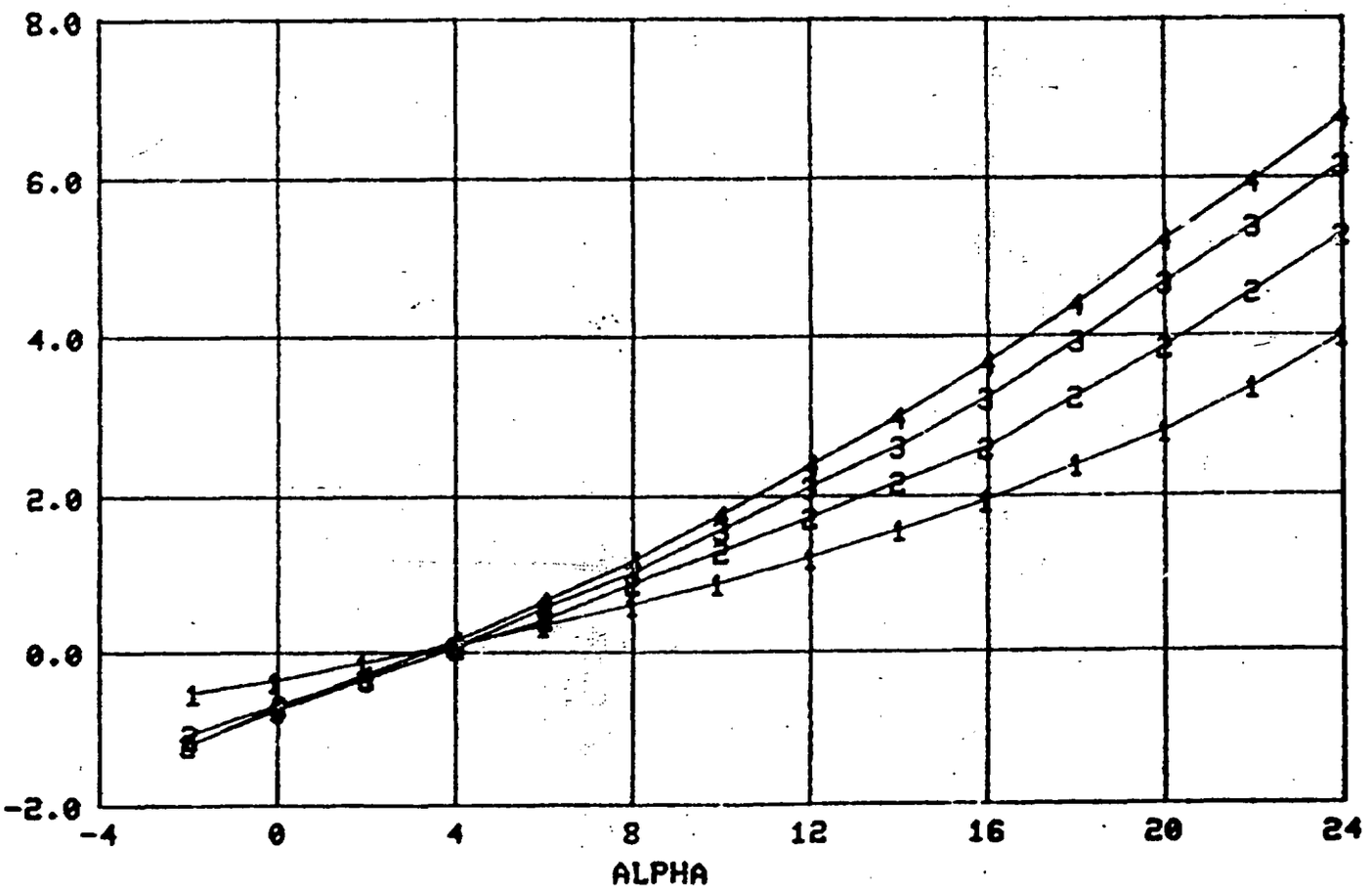

Figure 5. Continued

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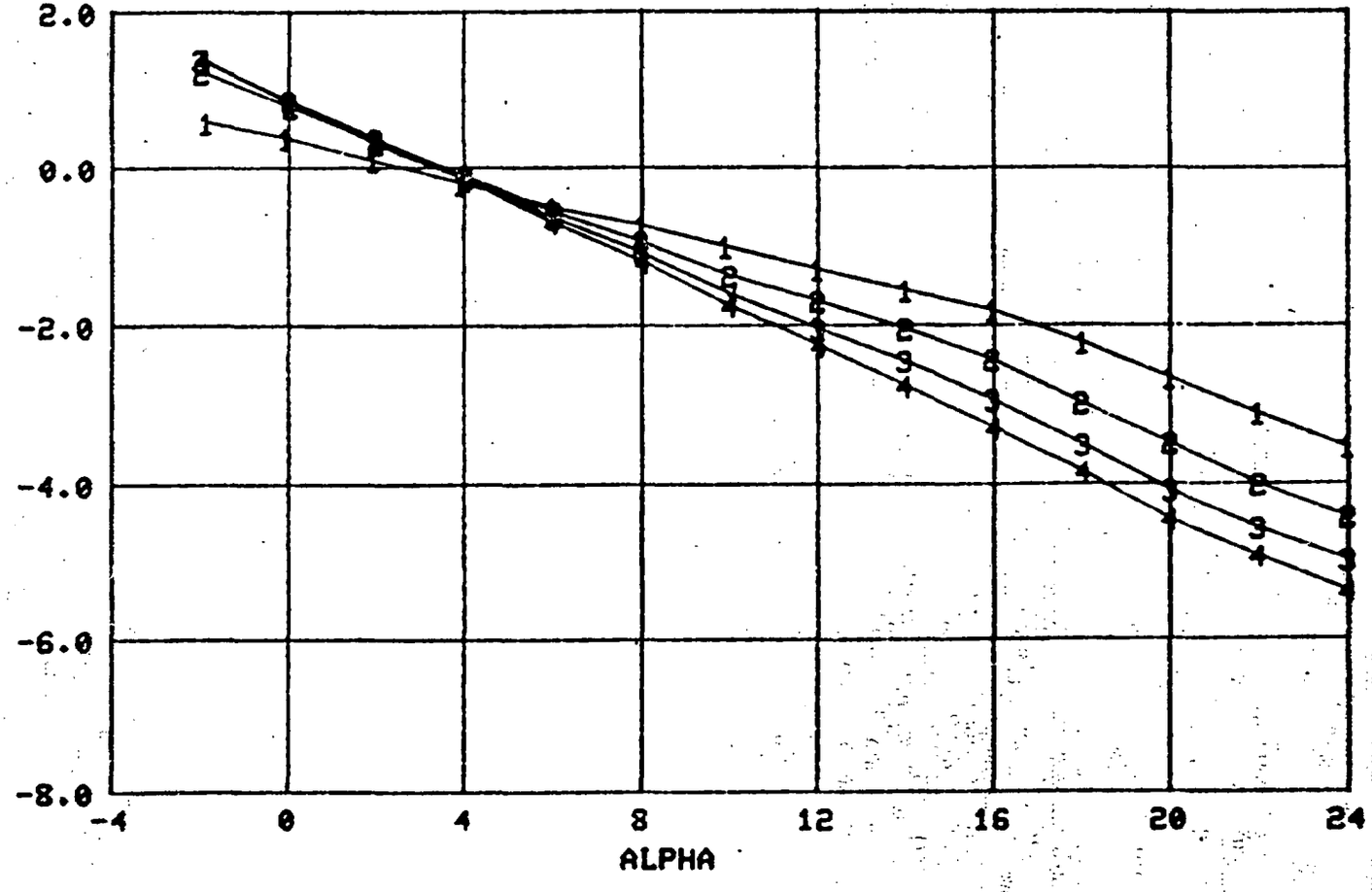

Figure 5. Continued

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PROJ-P418-185 ARNOLD AFS,TN

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3 54
4 60

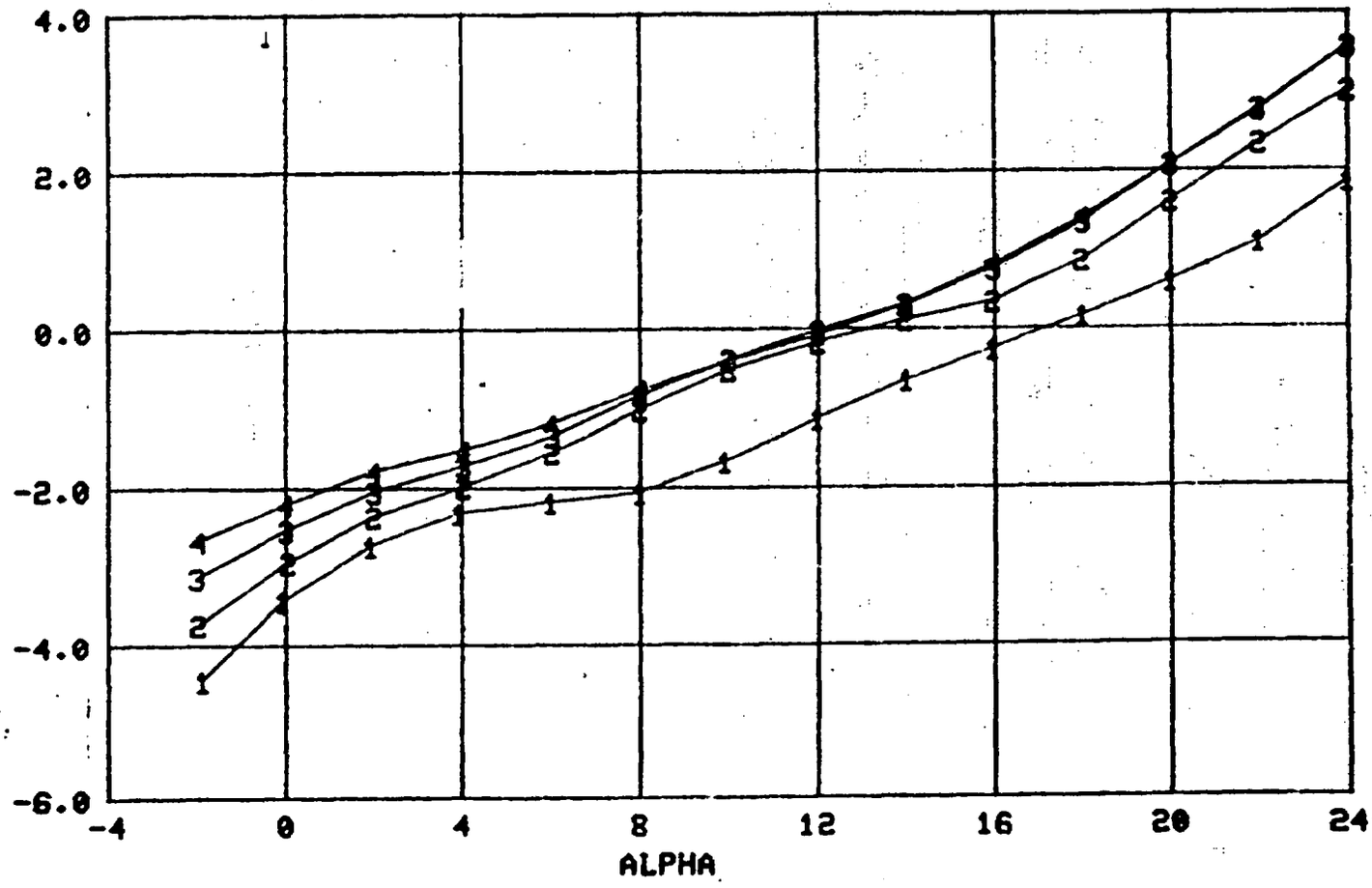

Figure 5. Continued

DATE 07-16-81 CALSPAN FIELD SERVICES INC.
PROJ-P418-125 ARNOLD AFS,TN

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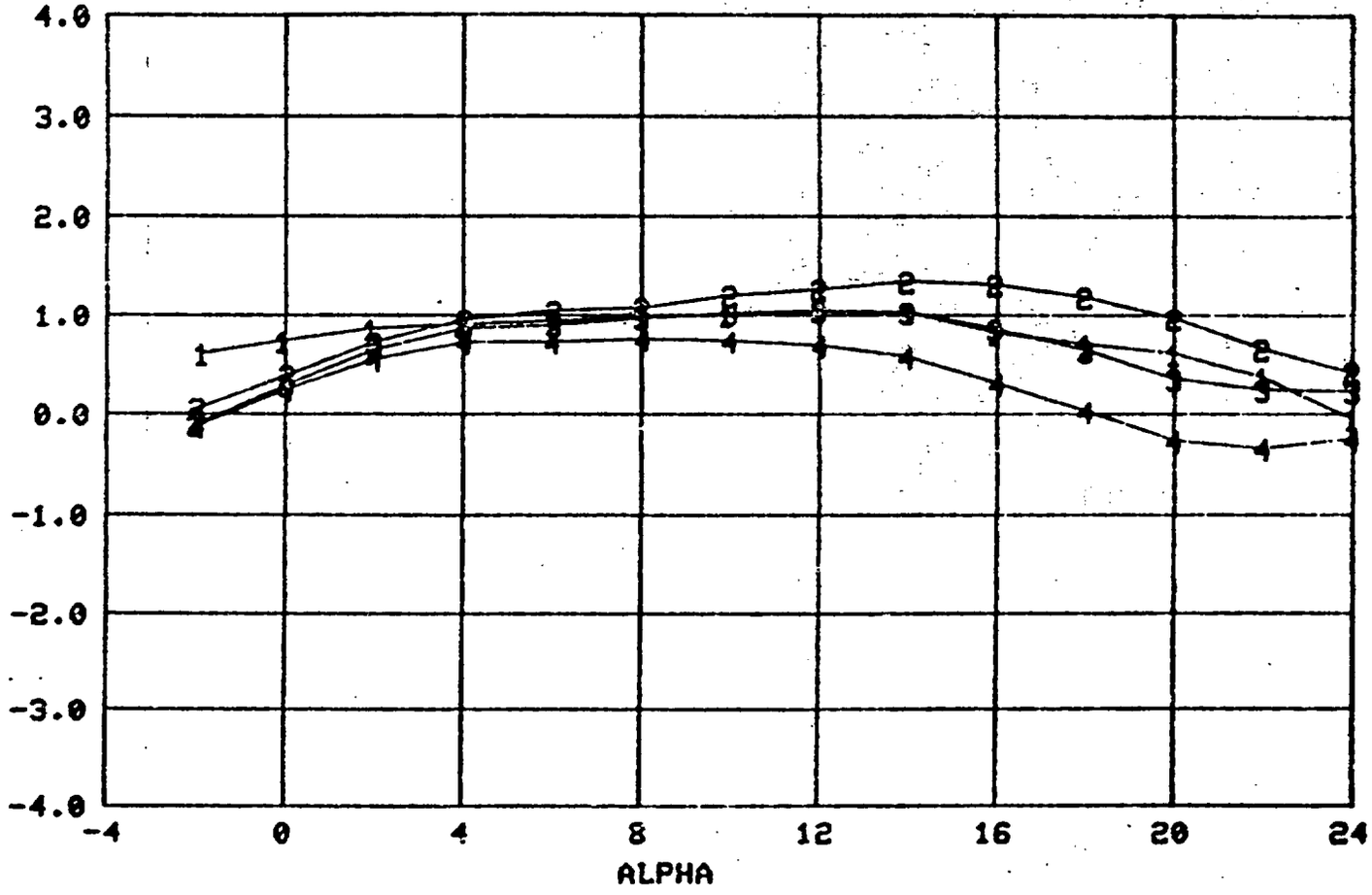
1 26 MACH 0.80
2 45
3 54
4 60



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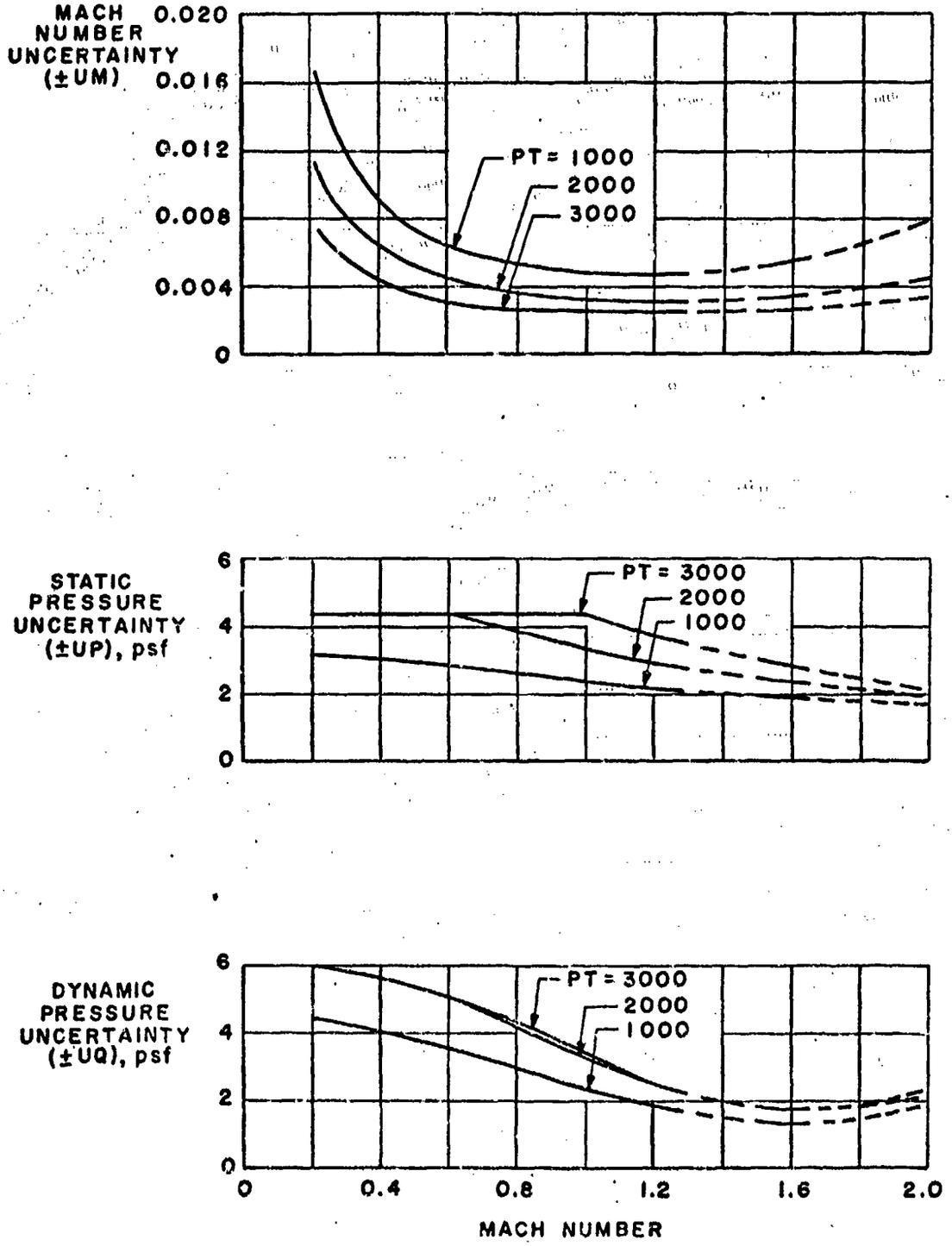
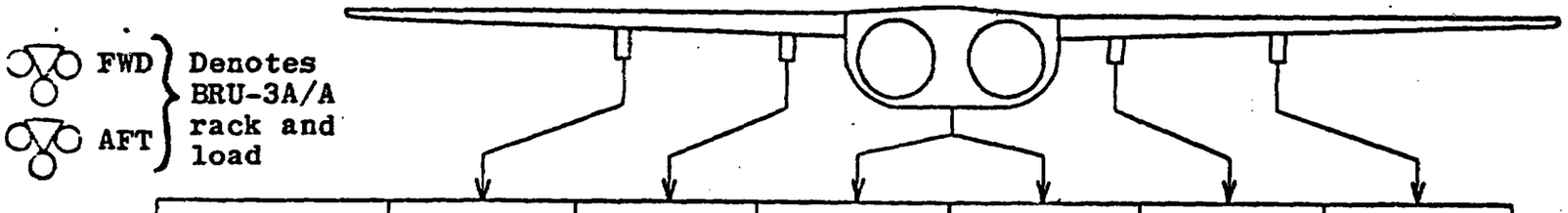


Figure 6. Estimated Uncertainties in 4T Tunnel Parameters

Table 1. Model Configuration Identification



CONFIG. NO.	PYLON 3	PYLON 4	FORWARD CENTERLINE	AFT CENTERLINE	PYLON 5	PYLON 6
16	BRU-3A/A 6 SUU-30	BRU-3A/A 4 SUU-30	Clean	Clean	BRU-3A/A 4 MK-20	BRU-3A/A 6 MK-20
18	BRU-3A/A 6 MK-82SE	Empty	Clean	Clean	Empty	GBU-15 CWW
23	GBU-8/B	GBU-8/B	Clean	Clean	Empty	GBU-8/B

Clean - Denotes Pylon Removed
Empty - Denotes No Store and/or Ejector Rack on Pylon

Table 2. Nominal Test Conditions

M	PT	P	Q	Re x 10^{-6}	AFA
0.60	1200	940	238	2.0	0.006
0.80	↓	790	352	2.3	-0.023
0.95	↓	670	425	2.5	-0.011
1.05	↓	598	460	↓	-0.015
1.20	↓	498	500	2.6	-0.037

Table 3. Aircraft Aerodynamic Coefficient Uncertainties

COEFFICIENT		MACH NUMBER				
		0.6	0.8	0.9	1.05	1.2
CLS	ALPHA = 0, BETA = 0	±0.015	±0.010	±0.008	±0.008	±0.007
	ALPHA = 10, BETA = 10	±0.020	±0.013	±0.010	±0.009	±0.008
CYS	ALPHA = 0, BETA = 0	±0.0070	±0.0046	±0.0039	±0.0036	±0.0033
	ALPHA = 10, BETA = 10	±0.0076	±0.0050	±0.0041	±0.0038	±0.0034
CDTS	ALPHA = 0, BETA = 0	±0.0037	±0.0025	±0.0022	±0.0020	±0.0018
	ALPHA = 10, BETA = 10	±0.0056	±0.0041	±0.0037	±0.0037	±0.0031
CLLS	ALPHA = 0, BETA = 0	±0.0004	±0.0003	±0.0002	±0.0002	±0.0002
	ALPHA = 10, BETA = 10	±0.0005	±0.0003	±0.0003	±0.0003	±0.0002
CLMTS	ALPHA = 0, BETA = 0	±0.0080	±0.0054	±0.0045	±0.0042	±0.0039
	ALPHA = 10, BETA = 10	±0.0080	±0.0054	±0.0045	±0.0044	±0.0041
CLNS	ALPHA = 0, BETA = 0	±0.0010	±0.0006	±0.0005	±0.0005	±0.0005
	ALPHA = 10, BETA = 10	±0.0010	±0.0007	±0.0005	±0.0005	±0.0005

Table 4. Typical Rack-Mounted Store Coefficient Uncertainties

COEFFICIENT	MACH NUMBER				
	0.60	0.80	0.95	1.05	1.20
CNX (CNX = 0)	±0.023	±0.016	±0.013	±0.012	±0.011
CNX (CNX = 1)	±0.029	±0.018	±0.015	±0.013	±0.012
CYX (CYX = 0)	±0.038	±0.026	±0.021	±0.020	±0.018
CYX (CYX = 1)	±0.041	±0.027	±0.022	±0.020	±0.019
CLLX (CLLX = 0)	±0.022	±0.015	±0.012	±0.011	±0.010
CLLX (CLLX = 1)	±0.028	±0.018	±0.014	±0.013	±0.011
CLMX (CLMX = 0)	±0.016	±0.011	±0.009	±0.008	±0.007
CLMX (CLMX = 1)	±0.023	±0.014	±0.011	±0.010	±0.008
CLNX (CLNX = 0)	±0.021	±0.014	±0.012	±0.011	±0.010
CLNX (CLNX = 1)	±0.027	±0.017	±0.013	±0.012	±0.011

Table 5. Typical Pylon-Mounted Store Coefficient Uncertainties

COEFFICIENT	MACH NUMBER				
	0.60	0.80	0.95	1.05	1.20
CNX (CNX = 0)	±0.094	±0.063	±0.052	±0.048	±0.044
CNX (CNX = 4)	±0.115	±0.074	±0.058	±0.053	±0.047
CYX (CYX = 0)	±0.154	±0.103	±0.085	±0.079	±0.073
CYX (CYX = 4)	±0.168	±0.109	±0.089	±0.082	±0.074
CLLX (CLLX = 0)	±0.178	±0.119	±0.099	±0.091	±0.084
CLLX (CLLX = 4)	±0.190	±0.125	±0.102	±0.094	±0.086
CLMX (CLMX = 0)	±0.125	±0.084	±0.070	±0.064	±0.059
CLMX (CLMX = 4)	±0.143	±0.092	±0.074	±0.068	±0.061
CLNX (CLNX = 0)	±0.171	±0.114	±0.095	±0.087	±0.081
CLNX (CLNX = 4)	±0.183	±0.120	±0.098	±0.090	±0.082

Table 6. Sample Tabulated Data Format

DATE. 7-16-81 PROJECT NO. P418-18
ARVIN/CALSPAN FIELD SERVICES, INC.
AEDC DIVISION
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 690 RUN 1115 AEDC F-111 AIRLOADS TEST

SUMMARY 1	STATION 3	STATION 4	FWD CL	AFT CL	STATION 5	STATION 6
DATE 07-16-81	G80-88	G80-88	CLEAN	CLEAN	PYLON	G80-88

RUN	MACH	Q	RX10-6	PT	P	TT	CONFIG NO.	SWEEP	SPEED BRAKE	STABILATOR	AFA	CONSET
1115	1.047	385.1	2.1003	1004.1	501.6	92.3	23.	26.0	0.	0.	-0.023	19

TP	ALPHA	BETA	CNT	CY	CAT	CLL	CLMT	CLN	CA	CAB	PCAV	PB1	PB2	PTE1	PTE2
5	-1.86	-0.03	-0.2643	-0.0031	0.1294	-0.0006	0.2017	0.0006	0.1703	-0.0410	958.60	949.90	412.60	1973.90	471.70
7	-0.05	-0.03	-0.0634	-0.0020	0.1272	-0.0011	0.1273	0.0007	0.1680	-0.0408	944.50	938.60	398.10	1973.40	464.10
9	1.94	-0.03	0.1576	-0.0009	0.1225	-0.0013	0.0434	0.0004	0.1632	-0.0407	934.50	928.80	396.60	1973.70	460.50
12	4.01	-0.03	0.3881	-0.0001	0.1159	-0.0016	-0.0537	0.0001	0.1561	-0.0402	932.30	922.10	396.20	1973.50	460.20
14	5.99	-0.04	0.6096	0.0010	0.1077	-0.0032	-0.1486	0.0001	0.1475	-0.0398	930.50	920.30	396.00	1973.10	460.30
15	7.93	-0.04	0.8269	0.0015	0.0989	-0.0028	-0.2331	0.0003	0.1386	-0.0398	931.20	925.90	404.10	1973.40	462.60
17	9.99	-0.04	1.0500	0.0014	0.0899	-0.0045	-0.3247	-0.0003	0.1302	-0.0403	937.20	930.20	411.60	1973.00	462.20
18	11.98	-0.04	1.2709	0.0025	0.0803	-0.0053	-0.4288	-0.0001	0.1205	-0.0402	934.90	929.20	410.90	1973.20	459.50
20	14.00	-0.05	1.4893	0.0049	0.0725	-0.0048	-0.5351	-0.0001	0.1126	-0.0401	924.50	921.20	416.70	1973.20	457.30
22	15.99	-0.05	1.6859	0.0061	0.0674	-0.0042	-0.6277	-0.0003	0.1078	-0.0403	918.90	915.40	423.70	1973.10	453.60
24	18.00	-0.05	1.8493	0.0085	0.0644	-0.0041	-0.6991	-0.0007	0.1050	-0.0406	924.90	916.40	421.90	1973.00	444.80
27	20.00	-0.04	1.9896	0.0127	0.0613	0.0016	-0.7491	-0.0015	0.1010	-0.0397	929.30	922.60	419.00	1973.20	436.50
30	22.00	-0.03	2.1157	0.0143	0.0617	0.0035	-0.8053	-0.0015	0.1004	-0.0387	914.60	904.60	409.90	1973.10	428.60
34	24.02	-0.04	2.2320	0.0129	0.0612	-0.0018	-0.8691	-0.0010	0.0987	-0.0375	903.20	890.10	402.30	1973.40	417.90

Table 6. Continued

DATE 7-16-81 PROJECT NO. P418-18
ARVIN/CALSPAN FIELD SERVICES, INC.
AEDC DIVISION
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 699 RUN 1115 AEDC F-111 AIRLOADS TEST

SUMMARY 2	STATION 3	STATION 4	FWD CL	AFT CL	STATION 5	STATION 6
DATE 07-16-81	GBU-8B	GBU-8B	CLEAN	CLEAN	PYLON	GBU-8B

RUN	MACH	Q	RX10-6	PT	P	TT	CONFIG NO.	SWEEP	SPEED BRAKE	STABILATOR	AFA	CONSET
1115	1.047	385.1	2.1003	1004.1	501.6	92.3	23.	26.0	0.	0.	-0.023	19

CL-A	CLM-A	DCLM/DCL	DCLNW/DCY	DCLLS/DCY
0.0	0.0	0.0	0.0	0.0

TP	ALPHA	BETA	CLS	CYS	CDTS	CLCS	CLMTS	CLNS	CDS	CDB	NCP
5	-1.86	-0.03	-0.2600	-0.0031	0.1379	-0.0006	0.2017	0.0006	0.1788	-0.0409	-0.7760
7	-0.05	-0.03	-0.0633	-0.0020	0.1272	-0.0011	0.1273	0.0007	0.1680	-0.0408	-2.0114
9	1.94	-0.03	0.1534	-0.0009	0.1278	-0.0013	0.0434	0.0005	0.1684	-0.0407	0.2830
12	4.01	-0.03	0.3791	-0.0001	0.1427	-0.0016	-0.0537	0.0003	0.1828	-0.0401	-0.1416
14	5.99	-0.04	0.5951	0.0010	0.1707	-0.0031	-0.1486	0.0005	0.2103	-0.0396	-0.2497
15	7.93	-0.04	0.8052	0.0015	0.2121	-0.0027	-0.2331	0.0006	0.2514	-0.0394	-0.2895
17	9.99	-0.04	1.0184	0.0014	0.2708	-0.0045	-0.3247	0.0005	0.3104	-0.0397	-0.3188
18	11.98	-0.04	1.2265	0.0025	0.3425	-0.0052	-0.4288	0.0010	0.3818	-0.0393	-0.3497
20	14.00	-0.05	1.4275	0.0049	0.4307	-0.0047	-0.5351	0.0011	0.4696	-0.0389	-0.3749
22	15.99	-0.05	1.6021	0.0061	0.5293	-0.0041	-0.6277	0.0008	0.5680	-0.0388	-0.3918
24	18.00	-0.05	1.7389	0.0085	0.6328	-0.0042	-0.6991	0.0006	0.6714	-0.0386	-0.4021
27	20.00	-0.04	1.8486	0.0127	0.7382	-0.0010	-0.7491	-0.0020	0.7755	-0.0373	-0.4052
30	22.00	-0.03	1.9386	0.0143	0.8497	0.0027	-0.8053	-0.0027	0.8856	-0.0359	-0.4154
34	24.02	-0.04	2.0138	0.0129	0.9644	-0.0021	-0.8691	-0.0002	0.9986	-0.0342	-0.4316

Table 6. Continued

DATE. 7-16-81 PROJECT NO. P418-18
ARVIN/CALSPAN FIELD SERVICES, INC.
AEDC DIVISION
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 690 RUN 1115 AEDC F-111 AIRLOADS TEST

SUMMARY 3	STATION 3	STATION 4	FWD CL	AFT CL	STATION 5	STATION 6
DATE 07-16-81	GBU-8B	GBU-8B	CLEAN	CLEAN	PYLON	GBU-8B

RUN	MACH	Q	RX10-6	PT	P	TT	CONFIG NO.	SWEEP	SPEED BRAKE	STABILATOR	AFA	CONSET
1115	1.047	385.1	2.1003	1004.1	501.6	92.3	23.	26.0	0.	0.	-0.023	19

TP	ALPHA	BETA	CN3	CY3	CLL3	CLM3	CLN3	CN4	CY4	CLL4	CLM4	CLN4
5	-1.86	-0.03	0.4360	0.7753	-0.8238	-6.9480	-3.4631	0.7231	1.8137	-1.8493	-7.2642	-4.0478
7	-0.05	-0.03	0.6391	0.6894	-0.6127	-6.4742	-3.1721	1.0133	1.5278	-1.5703	-7.0120	-3.6411
9	1.94	-0.03	0.7930	0.5701	-0.4307	-5.9553	-2.9064	1.2252	1.2524	-1.3044	-6.6320	-3.3807
12	4.01	-0.03	0.9295	0.4056	-0.2322	-5.4895	-2.7827	1.4334	0.9889	-1.0445	-6.3067	-3.1447
14	5.99	-0.04	1.0829	0.2002	-0.0369	-5.0207	-2.6099	1.5080	0.7684	-0.7893	-5.7484	-3.0381
15	7.93	-0.04	1.2492	-0.0634	0.1842	-4.5139	-2.3788	1.4076	0.4024	-0.4299	-4.5272	-2.4592
17	9.99	-0.04	1.2942	-0.4057	0.5179	-3.5125	-2.0937	1.3394	-0.1361	-0.0407	-3.3414	-1.5380
18	11.98	-0.04	1.2007	-0.7437	0.8400	-2.2565	-1.7371	1.3115	-0.3681	0.2263	-2.4606	-1.3721
20	14.00	-0.05	1.2192	-1.1760	1.2264	-1.2117	-1.2768	1.2561	-0.7574	0.6313	-1.4765	-1.3981
22	15.99	-0.05	1.3866	-1.5526	1.5097	-0.5619	-1.0515	1.3117	-1.1455	0.9835	-0.7308	-1.4773
24	18.00	-0.05	1.5660	-1.8770	1.7988	-0.1609	-0.8249	1.3878	-1.4918	1.3402	-0.3231	-1.5648
27	20.00	-0.04	1.7901	-2.2419	2.0826	0.3364	-0.6245	1.5513	-1.7740	1.6367	-0.1095	-1.6609
30	22.00	-0.03	1.9760	-2.6474	2.3964	0.7709	-0.4046	1.7593	-2.0696	1.9025	0.1813	-1.6915
34	24.02	-0.04	2.1101	-3.0820	2.6972	1.3117	-0.0804	1.8896	-2.3900	2.1458	0.8013	-1.4483

Table 6. Concluded

DATE. 7-16-81 PROJECT NO. P418-18
ARVIN/CALSPAN FIELD SERVICES, INC.
AEDC DIVISION
PROPULSION WIND TUNNEL
ARNOLD AIR FORCE STATION, TENNESSEE

TEST 690 RUN 1115 AEDC F-111 AIRLOADS TEST

SUMMARY 4	STATION 3	STATION 4	FWD CL	AFT CL	STATION 5	STATION 6
DATE 07-16-81	GBU-8B	GBU-8B	CLEAN	CLEAN	PYLON	GBU-8B

RUN	MACH	Q	RX10-6	PT	P	TT	CONFIG NO.	SWEEP	SPEED BRAKE	STABILATOR	AFA	CONSET
1115	1.047	385.1	2.1003	1004.1	501.6	92.3	23.	26.0	0.	0.	-0.023	19

TP	ALPHA	BETA	CN5	CY5	CLL5	CLM5	CLN5	CN6	CY6	CLL6	CLM6	CLN6
5	-1.86	-0.0317	0.0105	0.0189	0.1191	0.0773	-0.0182	0.5622	-1.1192	1.0609	-6.8963	3.9720
7	-0.05	-0.0334	-0.0100	0.0159	0.0645	0.0645	-0.0244	0.7332	-0.9883	0.8060	-6.3420	3.7707
9	1.94	-0.0330	-0.0474	-0.0036	0.0570	0.0507	-0.0127	0.8431	-0.8422	0.5593	-5.7347	3.6308
12	4.01	-0.0325	-0.0685	-0.0687	0.0567	0.0601	-0.0102	0.9880	-0.6420	0.3279	-5.4175	3.4446
14	5.99	-0.0372	-0.0547	-0.0118	0.0647	0.0386	-0.0036	1.1344	-0.4302	0.1327	-5.0492	3.3610
15	7.93	-0.0385	-0.0483	-0.0439	0.0987	0.0391	0.0283	1.2496	-0.1494	-0.1480	-4.3790	3.2255
17	9.99	-0.0360	-0.0382	-0.0447	0.1124	0.0483	0.0453	1.1123	0.5338	-0.7631	-2.8253	1.7346
18	11.98	-0.0401	-0.0404	-0.0416	0.1058	0.0512	0.0517	1.0411	1.0178	-1.1304	-1.7194	1.2472
20	14.00	-0.0529	-0.0253	-0.0363	0.0837	0.0411	0.0559	1.0753	1.4605	-1.4706	-0.7985	1.0430
22	15.99	-0.0512	-0.0223	-0.0438	0.0498	0.0331	0.0676	1.2635	1.8279	-1.7762	-0.2804	0.8737
24	18.00	-0.0532	-0.0190	-0.0415	0.0568	0.0334	0.0716	1.4225	2.2361	-2.1663	0.2413	0.7506
27	20.00	-0.0390	0.0006	-0.0432	0.0563	0.0262	0.0797	1.6047	2.6579	-2.5513	0.7124	0.6242
30	22.00	-0.0279	0.0134	-0.0474	0.0633	0.0189	0.0843	1.7573	3.1066	-2.9411	1.2427	0.3809
34	24.02	-0.0435	0.0134	-0.0387	0.0559	0.0189	0.0875	1.8512	3.6162	-3.2591	1.9072	-0.0184

Table 7. Summary of Test Program

CONFIG NO.	STORE LOADING	WING SWEEP	ALPHA	BETA	MACH NUMBER 0.60	0.80	0.95	1.05	1.2
16	Pylon 3 BRU-3,6 SUU-30	45	A1	0	1178	1181	1184	1189	1193
↓	Pylon 4 BRU-3,4 SUU-30	↓	6	B1	1179	1182	1187	1191	1194
↓	Pylon 5 BRU-3,4 MK-20	↓	10	B2	1180	1183	1188	1192	1195
↓	Pylon 6 BRU-3,6 MK-20								
18	Pylon 3 BRU-3,6 MK-82	45	A1	0	1145	1148,1152	1155	1158	1161
↓	Pylon 4 Empty	↓	6	B1	1146	1153	1156	1159	1162
↓	Pylon 5 Empty	↓	10	B2	1147	1154	1157	1160	1163
↓	Pylon 6 GBU-15CWW								
23	Pylon 3 GBU-15CWW	26	A2	0	1096,1097	1101,1102	1106,1108 1109	1113,1114	--
↓	Pylon 4 GBU-15CWW	↓	A1	0	1098	1103	1110	1115	--
↓	Pylon 5 Empty	↓	6	B1	1099	1104	1111	1118	--
↓	Pylon 6 GBU-15CWW	↓	10	B2	1100	1105	1112	1119	--
↓	↓	45	A2	0	--	--	--	--	1136,1137
↓	↓	↓	A1	0	1124	1127	1130	1133	1138
↓	↓	↓	6	B1	1125	1128	1131	1134	1139
↓	↓	↓	10	B2	1126	1129	1132	1135	1140
↓	↓	54	A1	0	1200	1203	1207	1213	1216
↓	↓	↓	6	B1	1201	1204	1209	1214	1217
↓	↓	↓	10	B2	1202	1205	1210	1215	1218
↓	↓	60	A1	0	1223	1226	1229	1232	1235
↓	↓	↓	6	B1	1224	1227	1230	1233	1236
↓	↓	↓	10	B2	1225	1228	1231	1234	1237

A1 $\alpha = -2 \rightarrow 24$ deg
A2 $\alpha = -2 \rightarrow 4$ deg at $\phi = 0$ and 180 deg
B1 $\beta = -8 \rightarrow 10$ deg
B2 $\beta = -10 \rightarrow 10$ deg