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23. GENERIC WING, PYLON, AND MOVING FINNED STORE

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INTRODUCTION

Background

A Computational Fluid Dynamics (CFD) Program of the U. S. Air Force Research Laboratory (AFRL), formerly (AFATL), funded and supported this wind tunnel test. The data support the ongoing validation efforts for CFD codes. A review at AEDC, completed June 12, 1996, determined the data were unrestricted.

The test met the objectives of providing pressure data from geometrically simple wing and store shapes under mutual interference conditions with the store both at its carriage position and at selected points along a realistic store separation trajectory. AFRL chose AEDC's 4-Foot Transonic Aerodynamic Wind Tunnel (4T) for the test. AEDC's Captive Trajectory Support (CTS) system, a moving store-support mechanism, simulated the motion of the store. Dr. L. Liejewski, AFRL, Eglin AFB, FL 32542, designed and executed the test. E. Rolland Heim, Sverdrup Technology, MS 6001, Arnold AFB TN, 37388, an AEDC project engineer, conducted the experiment.

A generic finned-store shape and a clipped delta wing with a 45-degree leading edge sweep were the primary test articles. Store pressure data were acquired with a pressure model with orifices at radial locations in 36, 10-degree intervals around the store and at 8 span-wise locations from 10 to 80 percent span on both surfaces of each fin. Wing upper and lower surface orifices at locations inboard, outboard, and in the plane of the pylon also provided pressure data. The pylon had orifices as well. These data requirements in combination with store size constraints required testing at locations on both the left and right sides of the wing model. However, the resultant data are from a virtual, single store released from the pilot's right wing. Thus, the virtual configuration is asymmetric. A force model of the store provided force and moment data at carriage for comparison with the pressure model. The rig was positioned such that the store model at carriage nearly touched the left or right pylons, as required to initiate a trajectory, Fig 1, Appendix. The store fins were positioned at carriage in a rotated cruciform style and were numbered such that Fin 1 is positioned 45 degrees ccw of the pylon looking upstream. Fin 2 is 90 degrees ccw of Fin 1, and so on.

Summary of Data

The data set contains wind tunnel data for a generic wing/pylon/finned store configuration. Although the store and wing represent no full-scale system, AEDC uses full-scale and subscale terminology and references. In this case, the subscale test article is 5% of an imaginary full-scale wing/pylon/store. All files contain ASCII numeric data that were written out with the FORTRAN FORMAT statement (6(1PE12.5)). The dimensions in the data are full-scale feet. They are left unconverted, for it is a simple matter to perform the conversion to International Units while reading the files. The set contains the following files:

M12BODY.DAT	Store body surface pressures, Mach=1.2, Alpha=0.0
M12FIN.DAT	Store fin surface pressures, Mach=1.2, Alpha=0.0
M12WING.DAT	Wing/pylon surface pressures, Mach=1.2, Alpha=0.0
M12TRAJ.DAT	Entire trajectory data set (store position, forces, moments, velocities, and accelerations), Mach=1.2, Alpha=0.0
M12CAPLOAD.DAT	Store captive loads data, Mach=1.2, Alpha=0.0
M12FREESTR.DAT	Store free-stream data, Mach=1.2, Alpha=0.0
M95BODY.DAT	Store body surface pressures, Mach=0.95, Alpha=0.0
M95FIN.DAT	Store fin surface pressures, Mach=0.95, Alpha=0.0
M95WING.DAT	Wing/pylon surface pressures, Mach=0.95, Alpha=0.0
M95TRAJ.DAT	Entire trajectory data set (store position, forces, moments, velocities, and accelerations), Mach=0.95, Alpha=0.0
M95CAPLOAD.DAT	Store captive loads data, Mach=0.95, Alpha=0.0
M95FREESTR.DAT	Store free-stream data, Mach=0.95, Alpha=0.0

Surface pressure files (General)

The surface pressure files (M12BODY.DAT, M12FIN.DAT, M12WING.DAT, M95BODY.DAT, M95FIN.DAT, and M95WING.DAT) each contain five sets of pressure data corresponding to the store in its carriage position and at four selected points along a trajectory. An ID number indexes the information within the file. The correlation of ID number with store position is as follows:

ID	Mach	Store Position
1	.95	Carriage
7	.95	First point selected from the trajectory
8	.95	Second point selected from the trajectory
9	.95	Third point selected from the trajectory
10	.95	Fourth point selected from the trajectory
4	1.20	Carriage
11	1.20	First point selected from the trajectory
12	1.20	Second point selected from the trajectory
13	1.20	Third point selected from the trajectory
14	1.20	Fourth point selected from the trajectory

For each ID number, a Point Number, as described below, sequences the pressure data.

Wing/Pylon Pressure Data (M12WING.DAT and M95WING.DAT)

Obtaining store body pressure data in 10-degree increments around the body, and store fin pressure data on both sides of each fin, required a total of eight wind tunnel runs for a given ID number. Four runs were required with the store mounted on the left side of the wing and four more were needed with the store mounted on the right side of the wing. To position the body and fin taps at the appropriate locations, the store had to be rotated 90 degrees after each run. Data for the wing/pylon are ordered from Point Number 1 through Point Number 4 for each ID number, corresponding to the four runs made with the store mounted on the instrumented, or right, side of the wing.

Store Body Pressure Data (M12BODY.DAT and M95BODY.DAT)

For the store body, pressure data were collected in 10-degree increments around the store, beginning at an angular location of 5 degrees and ending at 355 degrees. The pylon is the roll reference or zero degree line. Therefore, for each ID number the data are ordered from Point Number 1 (corresponding to measurements at 5 degrees) through Point Number 36 (corresponding to measurements at 355 degrees). The angular position of any store body pressure measurement is denoted by the parameter PHIR.

Store Fin Pressure Data (M12FIN.DAT and M95FIN.DAT)

Similarly, the fin surface pressures are ordered from Point Number 1 through Point Number 32 corresponding to the eight pressure measurements taken at the four fin orientations for a given ID number. Point Numbers 1 through 8, 9 through 16, 17 through 24, and 25 through 32 correspond to fin orientations of 45, 135, 225, and 315 degrees, respectively. Fin orientation is specified in the parameter PHIF.

Trajectory data (M12TRAJ.DAT and M95TRAJ.DAT)

The files M12TRAJ.DAT and M95TRAJ.DAT contain the trajectory data for wind tunnel runs at Mach=1.2 and Mach=0.95, respectively. There is only one set of trajectory data at each Mach number so there is no ID number indexing, as was the case with the pressure data. These files contain the store position and its forces, moments, velocities, and accelerations as a function of time throughout the trajectory. Data were recorded every .01 seconds. In these files, the Point Number corresponds to a specific time during the trajectory. The store pressure information in files M12BODY.DAT and M95BODY.DAT corresponds directly to five selected times during the trajectory. For the trajectory at Mach 0.95, the store pressures in M95WING.DAT, M95FIN.DAT, and M95BODY.DAT correspond to trajectory points denoted by Point Numbers 4, 16, 23, 31, and 38 in the M95TRAJ.DAT file. Similarly, for the trajectory at Mach 1.2, the store pressures in M12WING.DAT, M12FIN.DAT, and M12BODY.DAT correspond to trajectory points denoted by Point Numbers 4, 16, 22, 33, and 43 in the M12TRAJ.DAT file.

At-carriage store force and moment data (M12CAPLOAD.DAT and M95CAPLOAD.DAT)

The files M12CAPLOAD.DAT and M95CAPLOAD.DAT contain the force and moment data from the force-model store in the carriage position at Mach numbers of 1.2 and 0.95, respectively. These data are included to provide a point of comparison with the forces and moments measured on the pressure-instrumented store in the carriage position during the trajectory run.

Free-stream store force and moment data (M12FREESTR.DAT and M95FREESTR.DAT)

The files M12FREESTR.DAT and M95FREESTR.DAT contain the force and moment data for the force-model store in the free stream. These data were collected to obtain the lateral and longitudinal characteristics of the store.

LIST OF SYMBOLS AND DEFINITIONS

ALPHA	Angle of attack of the wing model, deg
ALPHAS, ALPSRB	Angles of attack of the force and pressure models of the store, respectively, deg
BETA	Wing model angle of sideslip, deg
BETAS, BETSRB	Angles of sideslip of the force and pressure models of the store, respectively, deg
BL	Model Butt Line (spanwise location of an orifice row relative to the wing model centerline), cm.
C	Local chord length, cm.
CAT	Axial-force coefficient of the force model of the store, (axial force)/(Q)(S)
CBAR	Mean aerodynamic chord length, 21.59 cm.
CLL	Rolling-moment coefficient of the force model of the store (rolling moment)/(Q)(S)(d)
CLM	Pitching-moment coefficient of the force model of the store calculated about the store center of gravity located 7.09 cm aft of the store nose (pitching moment)/(Q)(S)(d)
CLMRB	Pitching-moment coefficient of the pressure model of the store calculated about a point 45.03 cms aft of the model nose
CLM1	Pitching-moment coefficient of the wing calculated about a point 18.75 cms aft of the leading edge of the wing centerline, (pitching moment)/(Q)(S1)(CBAR)
CLN	Yawing moment coefficient of the force model of the store calculated about the store center of gravity located 7.09 cms aft of the model nose, (yawing moment)/(Q)(S)(d)
CLNRB	Yawing moment coefficient of the pressure model of the store calculated about a point 47.22 cms aft of the model nose
CN	Normal-force coefficient of the force model of the store, (normal force)/(Q)(S)
CN1	Normal-force coefficient of the wing model, (normal force)/(Q)(S1)
CP	Pressure coefficient column heading on tabulated data
CPWXXX	Pressure coefficients (PWXXX – P)/Q
CY	Side-force coefficient of the force model of the store, (side force)/(Q)(S)
d	Diameter of the store centerbody, 2.54 cm.
DPHI, DPSI, DTHA	Identical to PSI, PHI, and THETA for present purposes.
ID	Sequential indexing number for referencing data
L	Store model length, 15.09 cm; chord length.
LP	Pylon model length, 11.43 cm.
M	Free-stream Mach number
P	Free-stream static pressure, psf; lower case addenda signify character: inf = free stream, etc.
P, Q, R	Angular velocities of store: roll, pitch, and yaw, radians/sec; see PHI, THETA, and. PSI
PHI	Roll angle of the store relative to the non-rolling body axes, deg. Zero at pylon position, deg.
PSI	Yaw angle of the store: Angle between the projection of the store longitudinal axis in the flight axis horizontal plane and the X-axis, deg.
PHIF	Radial location of a row of fin pressures, positive clockwise looking upstream, deg
PHIR	Radial location of a row of (store) pressures, positive clockwise looking upstream, deg
PWXXX	Model (wall) pressure at orifice xxx, psfa
PT	Free-stream total pressure, psfa
Q	Free-stream dynamic pressure, psf

Re	Free-stream unit Reynolds Number, $(10)^{-6}$/ft
RUN	Sequential indexing number for referencing on-line data
S	Store model cross-sectional area, 5.07 cm^2
S1	Wing model planform area, 1425.5 cm^2
T	Free-stream static temperature, deg R; Time, sec
TT	Total temperature, deg F
THETA	Pitch angle of the store: Angle between the store longitudinal axis and its projection in the flight axis horizontal plane, deg.
VX, VY, VZ	Velocity components of store cg in flight-axis system, as determined from the local wind velocity, ft/sec
X, Y, Z	Flight-axis system. Origin fixed in space. X is positive in direction of flight path, Y is positive to pilot's right, Z is positive downward. Not used in data presentation.
X	Model pressure orifice location measured from the store nose or the leading edge of the wing, pylon, or fin at the local chord, cm.
X/LW, X/LB, X/LF	X position non-dimensionalized by local chord length of Wing, Store Body, Store Fin, respectively.
XXX	Orifice Identification Number.
XP, YP, ZP	Pylon-axis system, full-scale ft. Origin is coincident with cg of store in carriage position. Used for description of store cg motion.
XP	Distance of the store cg from the pylon-axis system origin in the direction of the flight path.
YP	Distance of the store cg from the pylon-axis system origin parallel to X-Y plane, positive to pilot's right.
ZP	Distance of the store cg from the pylon-axis system origin perpendicular to X-Y plane, positive downward.

FORMULARY

1 General Description of model

1.1 Designation	Clipped generic delta wing with pylon and generic finned store positioned initially in its carriage position at pylon.
1.2 Type	Full 3-D model of wing, pylon, and finned store.
1.3 Derivation	Generic. For time-accurate CFD code validation purposes.
1.4 Relative motion control	Store is attached to sting that is moved with computer-controlled motors. An online 6-DOF computer program solves equations of motion which gives next position of store using sting-balance readings of forces and moments as initial conditions for each step. Steps are usually 0.0002 seconds in pseudo time (falling-store real time).
1.5 References	2, Section 4 in Appendix

2 Model Geometry

2.1 Wing planform	45-degree-leading-edge, clipped delta wing
2.2 Wing aspect ratio	1.73 (38.1 cm mid-wing chord; 66.04 cm full span)
2.3 Leading-edge sweep	45 degrees
2.4 Trailing-edge sweep	0.0 degrees
2.5 Taper ratio	0.133
2.6 Twist	None
2.7 Root chord	38.1 cm
2.8 Span of model	66.4 cm
2.9 Area of planform	1425.8 cm^2
2.10 Location of reference of profiles and definition of profiles	NACA 64A010 airfoil section over entire span
2.11 Lofting procedure between reference sections	Straight line
2.12 Form of wing-body, or wing-root junction	NACA 64A010 airfoil section; note references below
2.13 Form of wing tip	NACA 64A010 airfoil section
2.14 Wing centerbody	Ogive-cylinder: Tangent at trailing edge of wing. Nose 16.51 cm from wing leading edge. Maximum diameter of centerbody is 4.23 cm
2.15 Pylon elevation view	Rectangular blade: 11.43 cm long by 3.05 cm vertical distance from wing reference plane (plane through LE and TE of wing).
2.16 Pylon profile shape	Leading and trailing edge shapes are identical. Ogive tangent 1.47 cm back from leading and trailing edges. Blade is 0.75 cm thick.
2.17 Pylon locations	Centerline is 16.51 cm from wing centerline, both left and right. Pylon LE positioned 1.95 cm back from wing LE.
2.18 Store diameter	2.54 cm
2.19 Store fin leading-edge sweep	60 degrees
2.20 Store fin length	0.89 cm measured from maximum diameter of store
2.21 Store fin root chord	4.23 cm centerline projection
2.22 Form of store fins at body junctions	NACA 0008 airfoil section
2.23 Control surface details	None
2.24 Store model shape	Store shape is tangent-ogive forebody and afterbody. Tangent at point 4.23 cm back from radii intersections on centerline. Store model is 2.54 cm in diameter. Afterbody is truncated 2.39 cm aft of aft tangent point.
2.25 Full-scale store and ejector characteristics	
2.25.1 Weight	8896.4 N
2.25.2 Center of Gravity	XCG = 1.416 m aft of store nose
2.25.3 Roll Inertia	IXX = 27.12 kg-m^2
2.25.4 Pitch Inertia	IYY = 488.1 kg-m^2
2.25.5 Yaw Inertia	IZZ = 488.1 kg-m^2
2.25.6 Roll damping Coefficient	CLP = -4.0/rad
2.25.7 Pitch damping Coefficient	CMQ = -40.0/rad
2.25.8 Yaw Damping Coefficient	CNR = -40.0/rad
2.25.9 Forward Ejector Location	1.24 m aft of store nose
2.25.10 Forward Ejector Force	10675.7 N, constant (No forward-aft time differential)
2.25.11 Aft Ejector Location	1.75 m aft of store nose

2.25.12 Aft Ejector force	42702.9 N, constant (No forward-aft time differential)
2.25.13 Ejector Stroke Length	0.10 m
2.26 Model references	1, 3

3 Wind Tunnel

3.1 Designation	AEDC Aerodynamic 4T
3.2 Type of tunnel	Continuous, variable pressure
3.3 Test section dimensions	1.22 x 1.22 x 3.8 m
3.4 Type of roof and floor	Porous, adjustable
3.5 Type of side walls	Porous, adjustable
3.6 Ventilation geometry	Variable, 0.5 to 10.0 % open
3.7 Thickness of side wall boundary layer	Not recorded
3.8 Thickness of boundary layers at roof and floor	Not recorded
3.9 Method of measuring velocity	Total pressure, static pressure, and temperature in test section: Mach no. x sound speed
3.10 Flow angularity	Less than 0.1 degree in test section
3.11 Uniformity of velocity over test section	See Flow angularity
3.12 Sources and levels of noise or turbulence in empty tunnel	Compressor blade tips and edge tones from porous walls; level is typical; considered of secondary-tertiary importance
3.13 Tunnel resonances	None recorded; high frequency and of no concern
3.14 Additional remarks	Honeycomb addition has nearly eliminated free-stream turbulence
3.15 References on tunnel	AEDC www home page

4 Model motion

4.1 General description	CTS generated trajectories of store from pylon
4.2 Reference coordinate and definition of motion	Bottom of pylon is reference point. Move-pause motion. Quasi-steady.
4.3 Range of amplitude	Not applicable
4.4 Range of frequency	Not applicable
4.5 Method of applying motion	CTS rig
4.6 Time-wise purity of motion	Not time accurate; yaw, pitch, roll then pause
4.7 Natural frequencies and normal modes of model and support system	Not applicable
4.8 Actual mode of applied motion including any elastic deformation	Not applicable
4.9 Additional remarks	Trajectory is calculated on-line from equations of motion using measured forces and moments as input. Induced velocity is accounted for in algorithm (to account for changed wind vector from effect of dynamic store motion: considered as a secondary effect)
4.10 References on model motion	2

5 Test Conditions

5.1 Model planform area/tunnel area	0.098
5.2 Model span/tunnel width	0.54
5.3 Blockage	Not given
5.4 Position of model in tunnel	Inverted; store on tunnel centerline
5.5 Range of Mach number	0.95 and 1.2

5.6 Range of tunnel total pressure	5.75 N/m^2
5.7 Range of tunnel total temperature	300 K to 333 K
5.8 Range of model steady, or mean, incidence	0.0
5.9 Definition of model incidence	None
5.10 Position of transition, if free	Unknown
5.11 Position and type of trip, if transition fixed	No trips anywhere on test articles. Free transition.
5.12 Flow instabilities during tests	None
5.13 Changes to mean shape of model due to steady aerodynamic load	Not measured; very stiff model; store/CTS rig position corrected for deflection by aerodynamic forces.
5.14 Additional remarks	Concerns have been raised in subsequent tests in 4T regarding transition. There is evidence that transition has occurred far aft on some store models.
5.15 References describing tests	3-5

6 Measurements and Observations

6.1 Steady pressures for the mean conditions	Yes
6.2 Steady pressures for small changes from the mean conditions	No
6.3 Quasi-steady pressures	Yes
6.4 Unsteady pressures	Not applicable
6.5 Steady section forces for the mean conditions by integration of pressures	Balances only
6.6 Steady section forces for small changes from the mean conditions by integration	Balances only
6.7 Quasi-steady section forces by integration	Balances only
6.8 Unsteady section forces by integration	Not applicable
6.9 Measurement of actual motion at points of model	Yes, using CTS rig
6.10 Observation or measurement of boundary layer properties	None
6.11 Visualisation of surface flow	None
6.12 Visualisation of shock wave movements	None
6.13 Additional remarks	Store loads from strain-gauge balances only

7 Instrumentation

7.1 Steady pressure	
7.1.1 Position of orifices	On wing, there are 7 spanwise locations with 6-11 chordwise orifices each, with orifices both on top and bottom of wing. See Fig. 3 in Section 4 in Appendix. Store has 28 orifices arranged longitudinally at five azimuthal positions chosen so that swapping store across CL and rotating store 90 degrees 3 times at both locations gives 36 equally spaced orifice rows. See Section 2 of Appendix. There are two rows of fin orifices on one side of each fin; each is positioned at a different span location. Opposite side is taken when store is moved across CL. Using the swapping across CL and rotations of store, 8 effective rows of taps are on each side of each fin. There are two rows of four orifices each on each side of the pylon (inboard and outboard).
7.1.2 Type of measuring system	Electronically Scanned Pressure (ESP) module
7.2 Unsteady pressures	None
7.3 Model motion	CTS rig
7.3.1 Method of measuring motion	Touch point on pylon

	reference coordinate	
7.3.2	Method of determining next position of store	Error signal to motors. (Spatial mode of motion.)
7.3.3	Accuracy of measured motions	Uncertainty of trajectory position is recorded as ± 0.15 cm for model-scale position and ± 0.15 degs for attitude.
7.4	Processing of unsteady measurements	
7.4.1	Method of acquiring and processing measurements	Orifices, tubes, and transducers. Strain gauges. On-line computer. Off-line data reduction through Engineering Unit conversion FORTRAN codes
7.4.2	Type of analysis	Discretized equations of motion
7.4.3	Unsteady pressure quantities obtained and accuracy achieved	None
7.4.4	Method of integration to obtain forces	None
7.5	Additional remarks	None
7.6	References on techniques	3-5

8 Data presentation

8.1	Test cases for which data could be made available	Mach =0.95 and 1.2 at Re = 7.87 $\times 10^6$/m simulated store drops to equivalent real time of approximately 0.35 secs
8.2	Test cases for which data are included in this document	Same
8.3	Steady pressures	See files on CD-ROM
8.4	Quasi-steady or steady perturbation pressures	No
8.5	Unsteady pressures	No
8.6	Steady forces or moments	See files on CD-ROM
8.7	Quasi-steady or unsteady perturbation forces	No
8.8	Unsteady forces and moments	No
8.9	Other forms in which data could be made available	None
8.10	Reference giving other representations of data	3-5.

9 Comments on data

9.1	Accuracy	
9.1.1	Mach number	± 0.01 with 0.003 uncertainty
9.1.2	Steady incidence	0.15 degs uncertainty
9.1.3	Reduced frequency	Not given
9.1.4	Steady pressure coefficients	0.0069 uncertainty
9.1.5	Steady pressure derivatives	None
9.1.6	Unsteady pressure coefficients	None
9.2	Sensitivity to small changes of parameter	Not recorded
9.3	Non-linearities	Not recorded
9.4	Influence of tunnel total pressure	Not recorded
9.5	Effects on data of uncertainty, or variation, in mode of model motion	Not recorded
9.6	Wall interference corrections	CTS rig has no effect; subsequent CFD solutions confirm
9.7	Other relevant tests on same model	None
9.8	Relevant tests on other models of nominally the same shapes	None

9.9 Any remarks relevant to comparison between experiment and theory	References 3-5 present comparisons with CFD solutions. All the CFD solutions use the Euler equations. All CFD solutions show excellent agreement with the store's cg displacement. Good agreement was shown comparing pitch, yaw, and roll angles. Pitch angles compared least well. See Section 5 of Appendix.
9.10 Additional remarks	None
9.11 References on discussion of data	3-5

10 Personal contact for further information

Dr. L. Liejewski, AFRL, Eglin AFB, FL 32542

11 List of references

1. Abbott, Ira H., and von Doenhoff, Albert E., "Theory of Wing Sections." Dover Publications, New York, New York, 1959.
2. Carman, J. B., Hill, D., Christopher, J. P., "Store Separation Testing Techniques at the AEDC. Vols. I-II," AEDC TR-79-1, Arnold Engineering Development Center, Arnold AFB, TN 37389, 1980.
3. Liejewski, L. and Suhs, N. E. "Chimera-Eagle Store Separation." AIAA-92-4569, August 1992.
4. Jordan, J. K., Suhs, N. E., Thoms, R. E., Tramel, R. W., Fox, J. H., and Erickson, J. C. Jr., "Computational Time Accurate Body Movement: Methodology, Validation, and Application." AEDC-TR-94-15, October 1995.
5. Nichols, R. H., "Applications of a Highly Efficient Numerical Method for Overset-Mesh Moving Body Problems." AIAA-97-2255.

APPENDIX

1 Test Points

Mach Number	Equivalent Real Time of Trajectory	Data Recorded
0.95	0.01 second increments through complete trajectory	Position, Forces, Moments, Velocities, and Accelerations
1.20	0.01 second increments through complete trajectory	Position, Forces, Moments, Velocities, and Accelerations
Mach Number	**Position Points in Trajectory**	**Additional Data Recorded**
0.95	4	Wing, Store, and Pylon Pressures
	16	Wing, Store, and Pylon Pressures
	23	Wing, Store, and Pylon Pressures
	31	Wing, Store, and Pylon Pressures
	38	Wing, Store, and Pylon Pressures
1.20	4	Wing, Store, and Pylon Pressures
	16	Wing, Store, and Pylon Pressures
	22	Wing, Store, and Pylon Pressures
	33	Wing, Store, and Pylon Pressures
	43	Wing, Store, and Pylon Pressures

Table 1 Test Points

2 Identification of Orifices

Span Position	21.1 cm		19.5 cm		18.0 cm		16.5 cm		15.0 cm
Chord LW	17.0 cm		18.5 cm		20.1 cm		21.6 cm		23.1 cm
Orifice Number Bottom-Top	X/LW	Orifice Number Bottom-Top	X/LW	Orifice Number Bottom-Top	X/LW	Orifice Number Bottom-Top	X/LW	Orifice Number Bottom-Top	X/LW
102-302	0.1194	108-308	0.1096	115-315	0.1013	123-323	0.0941*	202-332	0.0879
103-303	0.2388	109-309	0.2192	116-316	0.2025	xxx-324	[0.1882]	203-333	0.1758
104-304	0.3582	110-310	0.3288	117-317	0.3038	xxx-325	[0.2824]	204-334	0.2637
105-305	0.4776	111-311	0.4384	118-318	0.4051	xxx-326	[0.3765]	205-335	0.3517
106-306	0.5970	112-312	0.5480	119-319	0.5063	xxx-327	[0.4706]	206-336	0.4396
107-307	0.7164	113-313	0.6575	120-320	0.6076	140-328	0.5647*	207-337	0.5275
		114-314	0.7671	121-321	0.7089	141-329	0.6588	208-338	0.6154
				122-322	0.8101	142-330	0.7529	209-339	0.7033
						143-331	0.8471	210-340	0.7912

Table 2 Wing Orifice Positions

Span Position	13.5 cm		11.9 cm		3.8 cm		-3.8 cm
Chord LW	24.6 cm		26.2 cm		34.3 cm		34.3 cm
Orifice Number Bottom-Top	X/LW	Orifice Number Bottom-Top	X/LW	Orifice Number Bottom-Top	X/LW	Orifice Number Bottom-Top	X/LW
211-402	0.0825	221-412	0.0777	232	(0.2259)	239	(0.2259)
221-403	0.1650	222-413	0.1553	233	(0.3000)	240	(0.3000)
213-404	0.2474	223-414	0.2330	234	(0.3741)	241	(0.3741)
214-405	0.3299	224-415	0.3107	235	(0.4482)	242	(0.4482)
215-406	0.4124	225-416	0.3884	236	(0.5222)	243	(0.5222)
216-407	0.4949	226-417	0.4660	237	(0.5963)	244	(0.5963)
217-408	0.5773	227-418	0.5437	238	(0.6704)	245	(0.6704)
218-409	0.6598	228-419	0.6214				
219-410	0.7423	229-420	0.6990				
220-411	0.8247	230-421	0.7767				
		231-422	0.8544				

* Orifices partially covered by pylon on bottom surface
[ ] Orifices unavailable on bottom surface
( ) Orifices with no counterpart on top surface
xxx Orifices 124 to 139 unavailable on bottom surfacc

Table 2 (continued) Wing Orifice Positions

Pylon Orifice Numbers and Positions

The Pylon pressure data is the last 16 CPWs in the Wing data set. There are two rows of four orifices each on each side of the pylon (inboard and outboard). The orifice numbers run from 124 through 139. Orifice numbers 126, 130, 134, 138 make the outboard row of taps closest to the store. Orifices 125, 129, 133, 137 make the outboard row closest to the Wing. Similarly, orifices 127, 131, 135, 139 make the inboard row closest to the store, and 124, 128, 132, 136 make the inboard row closest to the wing. Orifices 126 and 127, which correspond to outboard and inboard respectively, are on straight rows (call them Row 1OB and Row 1IB) positioned 0.25 cm inward from the edge attached to the store and parallel to it, and they are 2.1 cm aft of the leading edge of the pylon. Each orifice is equally spaced along the row by 2.03 cm. The rows closest to the wing (call them Row 2OB and Row 2IB) arc positioned 1.52 cm in from the edge attached to the store and parallel to Rows 1OB and IB with their orifices exactly aligned vertically with those in Rows 1OB and IB.

Store Body Orifice Rows

Row 1 is 45 degs ccw from pylon looking upstream. Row 1 is also coincident with Fin 1 footprint chord.

Row 2 is 30 degs ccw from Fin 1.

Row 3 is 20 degs cw from Fin 3, which is diametrically opposite Fin 1.

Row 4 is 80 degs ccw from Fin 3. Fin 4 is 10 degs ccw from Row 4, 90 degs ccw from Fin 3.

Row 5 is 40 degs cw from Fin 1.

Store Fin Orifice Rows

There are two rows of orifices on each fin. They are positioned differently on each fin.

Rows 1 and 5 are on Fin 4. Fin 4: Row 5 is 0.44 cm in from Fin tip and Row 1 is 0.80 cm in from Fin tip.

Rows 2 and 6 are on Fin 3. Fin 3: Row 6 is 0.35 cm in from Fin tip and Row 2 is 0.71 cm in from Fin tip.

Rows 3 and 7 are on Fin 2. Fin 2: Row 7 is 0.27 cm in from Fin tip and Row 3 is 0.62 cm in from Fin tip.

Rows 4 and 8 are on Fin 1. Fin 1: Row 8 is 0.18 cm in from Fin tip and Row 4 is 0.53 cm in from Fin tip.

	BODY ORIFICE ROWS					FIN ORIFICE ROWS							
	1	2	3	4	5	1	2	3	4	5	6	7	8
	ORIFICE IDENTIFICATION NUMBER												
Numbers increment aftward													
1	502	522	604	632	714	932	906	828	806	920	841	818	742
2	503	523	605	633	715	933	907	829	807	921	842	819	743
3	504	524	606	634	716	934	908	830	808	922	843	820	744
4	505	525	607	635	717	935	909	831	809	923	844	821	745
5	506	526	608	636	718	936	910	832	810	924	845	822	746
6	507	527	609	637	719	937	911	833	811	925	846	823	747
7	508	528	610	638	720	938	912	834	812	926	847	824	802
8	509	529	611	639	721	939	913	835	813	927	902	825	803
9	510	530	612	640	722	940	914	836	814	928	903	826	804
10	511	531	613	641	723	941	915	837	815	929	904	827	805
11	512	532	614	642	724	942	916	838	816	930	905		
12	513	533	615	643	725	943	917	839	817	931			
13	514	534	616	644	726	944	918	840					
14	515	535	617	645	727	945	919						
15	516	536	618	646	728								
16	517	537	619	647	729								
17	518	538	620	702	730								
18	519	539	621	703	731								
19	520	540	622	704	732								
20	521	541	623	705	733								
21	---	542	624	706	734								
22	---	543	625	707	735								
23	---	544	626	708	736								
24	---	545	627	709	737								
25	---	546	628	710	738								
26	---	547	629	711	739								
27	---	602	630	712	740								
28	---	603	631	713	741								

Table 3 Store Orifice Numbers

	BODY ORIFICE ROWS		FIN ORIFICE ROWS							
	1	2 – 5	1	2	3	4	5	6	7	8
	X/LB		X /LF							
1	0.0337	0.0337	0.0623	0.0647	0.0673	0.0702	0.0733	0.0767	0.0805	0.0846
2	0.0673	0.0673	0.1245	0.1294	0.1347	0.1404	0.1466	0.1535	0.1610	0.1692
3	0.1010	0.1010	0.1868	0.1942	0.2020	0.2107	0.2199	0.2302	0.2415	0.2538
4	0.1347	0.1347	0.2491	0.2589	0.2694	0.2809	0.2933	0.3070	0.3221	0.3384
5	0.1683	0.1683	0.3113	0.3236	0.3367	0.3511	0.3666	0.3837	0.4026	0.4280
6	0.2020	0.2020	0.3736	0.3883	0.4040	0.4213	0.4399	0.4605	0.4831	0.5076
7	0.2357	0.2357	0.4359	0.4531	0.4714	0.4916	0.5132	0.5372	0.5636	0.5922
8	0.2693	0.2693	0.4981	0.5178	0.5387	0.5618	0.5865	0.6140	0.6441	0.6768
9	0.3030	0.3030	0.5604	0.5825	0.6061	0.6320	0.6598	0.6907	0.7246	0.7614
10	0.3366	0.3366	0.6227	0.6472	0.6734	0.7022	0.7331	0.7675	0.8052	0.8460
11	0.3703	0.3703	0.6849	0.7120	0.7407	0.7725	0.8065	0.8442		
12	0.4040	0.4040	0.7472	0.7767	0.8081	0.8427	0.8798			
13	0.4376	0.4376	0.8095	0.8414	0.8754					
14	0.4713	0.4713	0.8717	0.9061						
15	0.5050	0.5050								
16	0.5386	0.5386	LF (cm)							
17	0.5723	0.5723	4.08	3.93	3.77	3.62	3.46	3.31	3.15	3.00
18	0.6060	0.6060								
19	0.6396	0.6396								
20	0.6733	0.6733								
21	-----	0.7071								
22	-----	0.7406								
23	-----	0.7743								
24	-----	0.8079								
25	-----	0.8416								
26	-----	0.8753								
27	-----	0.9089								
28	-----	0.9426								

LB = 15.1 cm

Table 4 Store Pressure Orifice Locations

3 Format of Data on CD-ROM

For files M12BODY.DAT and M95BODY.DAT, there are 55 items in each list. For example, below is the first list in file:

M12BODY.DAT FORMAT(6(1PE12.5))

9.12200E+03	4.00000E+00	1.00000E+00	1.00000E+00	1.15188E+03	9.40000E+01
2.04393E+03	1.20030E+00	4.78861E+02	4.74823E+02	2.43897E+00	4.29820E+02
-1.10000E-01	0.00000E+00	8.58740E-02	8.48428E-03	7.05405E+00	-6.80302E+00
2.10713E-02	1.42177E-02	1.41720E-02	2.41153E-02	8.37489E-03	7.29932E-02
5.00000E+00	5.07298E+00	6.92000E+02	8.63788E-01	6.74838E-01	5.24998E-01
4.01009E-01	3.07119E-01	2.80552E-01	3.82871E-01	5.73961E-01	3.01025E-01
7.88166E-02	-1.67391E-01	-3.31710E-01	-3.93508E-01	-3.58220E-01	-3.55254E-01
-3.15861E-0-	-2.76891E-01	-2.55959E-01	-2.53289E-00	-2.27156E-01	-1.52431E-01
-1.68920E-01	-2.24603E-01	-2.52846E-01	-3.29054E-01	-5.11267E-01	-6.51763E-01
-6.48532E-01					

Table 5 Data List, Store Body

Nomenclature Map of Above and M95BODY.DAT List:

Test number	ID number	Point	Configuration	PT	TT
Patm	M	Q	P	Re	T
ALPHA	BETA	ALPSRB	BETSRB	CLMRB	CLNRB
XP	YP	ZP	THETA	PSI	PHI
ROW	PHIR	RUN	CPW01	CPW02	CPW03
CPW04	CPW05	CPW06	CPW07	CPW08	CPW09
CPW10	CPW11	CPW12	CPW13	CPW14	CPW15
CPW16	CPW17	CPW18	CPW19	CPW20	CPW21
CPW22	CPW23	CPW24	CPW25	CPW26	CPW27
CPW28					

Table 6 Nomenclature Map, Store Body

The FORTRAN STATEMENTS to recover the data could be as follows for this dataset.

```
C     READ DATA

      REAL F(55)
      OPEN (UNIT = 5, FILE = 'c:\FTN\M95BODY.DAT')
      OPEN (UNIT = 8, FILE = 'c:\FTN\M95BODY.OUT')

      REWIND 8
      DO 105, K=1,99999
      READ (5,100,END=105)F
100   FORMAT(6(1PE12.5))

      Write (*,100)(F(I), I= 1,55)
C     Convert to MKS (International) units from Anglo-American
C     Psf to Pascals
      F(5) = F(5) * 47.8802
      F(7) = F(7) * 47.8802
      F(10)= F(10)* 47.8802
C     Farenheit to Kelvin
      F(6) = (F(6)+459.69) / 1.8
C     Rankine to Kelvin
      F(12)= F(12)/ 1.8
```

Table 7 FORTRAN Statements to Read Data, Store Body

```
C     Feet to Centimeters. Note these are full-scale. Multiply by
C     0.05 to recover subscale (tunnel scale) lengths.
         F(19) = F(19)*30.48
         F(20) = F(20)*30.48
         F(21) = F(21)*30.48
C     10**6 per foot to 10**6 per Meter
         F(11) = F(11)/.3048
         Write (8,101)(F(I), I= 1,18)
         Write (8,102)(F(I), I=19,39)
         Write (8,103)(F(I), I=40,55)
101 FORMAT(///,'  Test   =',F9.1,'  ID    =',F9.1,'  Point ='
   x ,F9.1,/,
   x '  Config =',F9.1,'  PT    =',F9.2,'  TT    ='
   x ,F9.4,/,
   x '  Patm   =',F9.2,'  M     =',F9.4,'  Q     ='
   x ,F9.4,/,
   x '  P      =',F9.2,'  Re    =',F9.4,'  T     ='
   x ,F9.4,/,
   x '  ALPHA  =',F9.4,'  BETA  =',F9.4,'  ALPSRB ='
   x ,F9.4,/,
   x '  BETSRB =',F9.4,'  CLMRB =',F9.4,'  CLNRB  ='
   x ,F9.4,/)
102 FORMAT('  XP    =',F9.4,'  YP    =',F9.4,'  ZP    ='
   x ,F9.4,/,
   x '  THETA =',F9.4,'  PSI   =',F9.4,'  PHI   ='
   x ,F9.4,/,
   x '  ROW   =',F9.4,'  PHIR  =',F9.4,'  RUN   ='
   x ,F9.2,//,
   x '  CPW01  =',F9.4,'  CPW02  =',F9.4,'  CPW03  ='
   x ,F9.4,/,
   x '  CPW04  =',F9.4,'  CPW05  =',F9.4,'  CPW06  ='
   x ,F9.4,/,
   x '  CPW07  =',F9.4,'  CPW08  =',F9.4,'  CPW09  ='
   x ,F9.4,/,
   x '  CPW10  =',F9.4,'  CPW11  =',F9.4,'  CPW12  ='
   x ,F9.4)
103 FORMAT('  CPW13 =',F9.4,'  CPW14 =',F9.4,'  CPW15 ='
   x ,F9.4,/,
   x '  CPW16  =',F9.4,'  CPW17  =',F9.4,'  CPW18  ='
   x ,F9.4,/,
   x '  CPW19  =',F9.4,'  CPW20  =',F9.4,'  CPW21  ='
   x ,F9.4,/,
   x'  CPW22  =',F9.4,'  CPW23  =',F9.4,'  CPW24  ='
   x ,F9.4,/,
   x '  CPW25  =',F9.4,'  CPW26  =',F9.4,'  CPW27  ='
   x ,F9.4,/,
   x'  CPW28  =',F9.4)
104 CONTINUE
105 CONTINUE
    END
```

Table 7 (continued) FORTRAN Statements to Read Data, Store Body

For a typical fin data list, there are 58 items, but the map is somewhat different.

NOMENCLATURE MAP OF M12FIN.DAT OR M95FIN.DAT

Test number	ID number	Point	Configuration	PT	TT
Patm	M	Q	P	Re	T
ALPHA	BETA	ALPSRB	BETSRB	CLMRB	CLNRB
XP	YP	ZP	THETA	PSI	PHI
ROW	PHIF	RUN	CPF01L	CPF02L	CPF03L
CPF04L	CPF05L	CPF06L	CPF07L	CPF08L	CPF09L
CPF10L	CPF11L	CPF12L	CPF13L	CPF14L	RUN
CPF01R	CPF02R	CPF03R	CPF04R	CPF05R	CPF06R
CPF07R	CPF08R	CPF09R	CPF10R	CPF11R	CPF12R
CPF13R	CPF14R				

Note that the suffix L and R indicate right and left looking upstream, with store virtually positioned on pilot's right wing.

Table 8. Nomenclature Map, Fin

For a typical wing data list, there are 171 items.

NOMENCLATURE MAP OF M12WING.DAT OR M95WING.DAT

Test number	ID number	Point	Configuration	PT	TT
Patm	M	Q	P	Re	T
ALPHA	BETA	ALPSRB	BETSRB	CN	CLM
XP	YP	ZP	THETA	PSI	PHI
RUN	CPW102	CPW103	ETCETERA	ETC.	CPW106
CPW107	ETC.	ETC.	ETC.	ETC.	CPW112
CPW113	ETC.	ETC.	ETC.	ETC.	CPW118
CPW119	ETC.	ETC.	ETC.	CPW123	CPW140
CPW141	CPW142	CPW143	CPW202	CPW203	CPW204
CPW205	ETC.	ETC.	ETC.	ETC.	CPW210
CPW211	ETC.	ETC.	ETC.	ETC.	CPW216
CPW217	ETC.	ETC.	ETC.	ETC.	CPW222
CPW223	ETC.	ETC.	ETC.	ETC.	CPW228
CPW229	ETC.	ETC.	ETC.	ETC.	CPW234
CPW235	ETC.	ETC.	ETC.	ETC.	CPW240
CPW241	CPW242	CPW243	CPW244	CPW245	CPW302
CPW303	ETC.	ETC.	ETC.	ETC.	CPW308
CPW309	ETC.	ETC.	ETC.	ETC.	CPW314
CPW315	ETC.	ETC.	ETC.	CPW319	CPW320
CPW321	CPW322	CPW323	CPW324	CPW325	CPW326
CPW327	ETC.	ETC.	ETC.	ETC.	CPW332
CPW333	ETC.	ETC.	ETC.	ETC.	CPW338
CPW339	CPW340	CPW402	CPW403	CPW404	CPW405
CPW406	ETC.	ETC.	ETC.	ETC.	CPW411
CPW412	ETC.	ETC.	ETC.	ETC.	CPW417
CPW418	ETC.	ETC.	ETC.	CPW422	CPW126
CPW130	CPW134	CPW138	CPW127	CPW131	CPW135
CPW139	CPW125	CPW129	CPW133	CPW137	CPW124
CPW128	CPW132	CPW136			

Table 9. Nomenclature Map, Wing

For a typical free-stream data list, there are 27 items.

NOMENCLATURE MAP OF M12FREESTR.DAT OR M95FREESTR.DAT

Test number	Run Point	Point	PT	TT	Patm
M	Q	P	Re	T	ALPHA
BETA	ALPHAS	BETAS	CAT	CY	CN
CLL	CLM	CLN	XP	YP	ZP
THETA	PSI	PHI			

Table 10. Nomenclature Map, Free Stream

For a typical carriage loads data list, there are 27 items. Nomenclature map is identical to that of free-stream data.

NOMENCLATURE MAP OF M12CAPLOAD.DAT OR M95CAPLOAD.DAT

Test number	Run Point	Point	PT	TT	Patm
M	Q	P	Re	T	ALPHA
BETA	ALPHAS	BETAS	CAT	CY	CN
CLL	CLM	CLN	XP	YP	ZP
THETA	PSI	PHI			

Table 11. Nomenclature Map, Carriage Loads

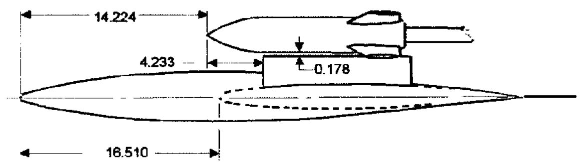
For a typical trajectory data list, there are 38 items.

NOMENCLATURE MAP OF M12TRAJ.DAT OR M95TRAJ.DAT

Test number	Run Point	Point	PT	TT	Patm
M	Q	P	Re	T	ALPHA
BETA	ALPHAS	BETAS	CAT	CY	CN
CLL	CLM	CLN	XP	YP	ZP
THETA	PSI	PHI	DPSI	DTHA	DPHI
VX	VY	VZ	P	Q	R
ETIME	T (Time)				

Table 12. Nomenclature Map, Trajectory

4 Drawings of Test Articles



Dimensions in Centimeters

Fig. 1 Store at Carriage

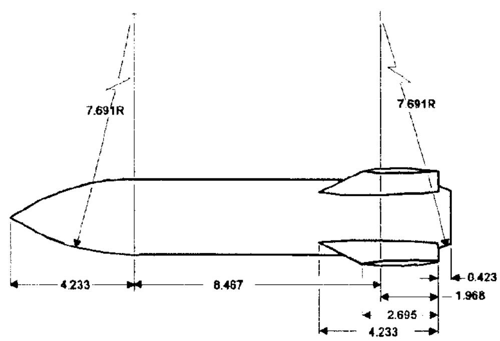


Fig. 2 Store Model

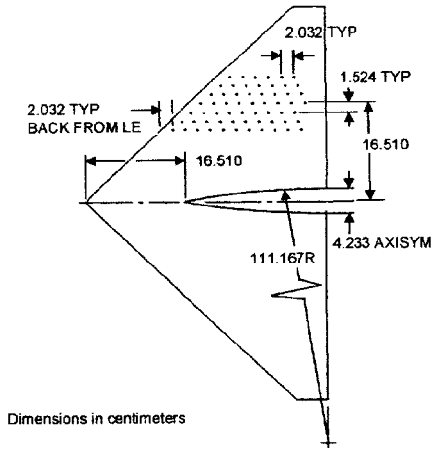


Fig. 3 Wing Upper Surface

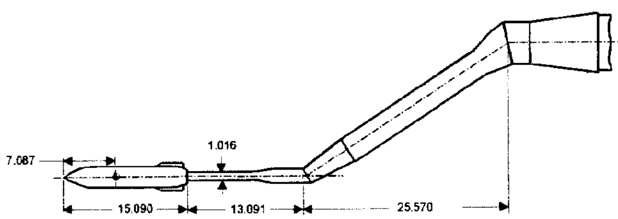


Fig. 4 Captive Trajectory Support Rig

5 Inviscid CFD Comparisons, Reference 5

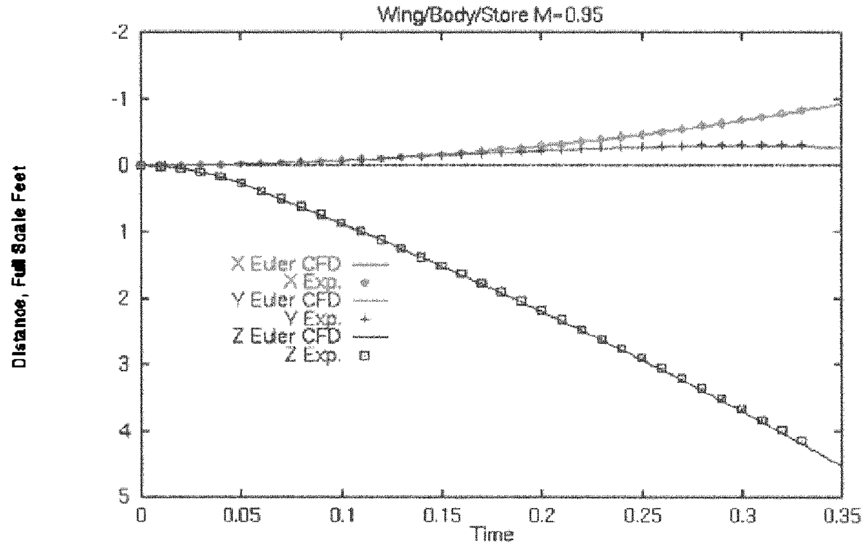


Fig. 5 Position vs Time

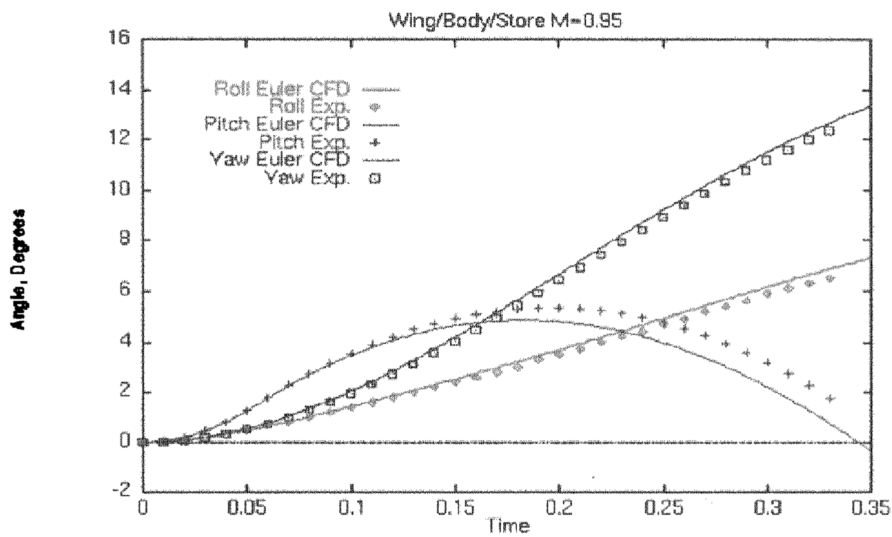


Fig. 6 Attitude vs Time