

**ACSYNT AERODYNAMIC ESTIMATION - AN EXAMINATION AND
VALIDATION FOR USE IN CONCEPTUAL DESIGN**

by

Thomas K. Arledge

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APPROVED:



Dr. William H. Mason, Chairman



Dr. Sankar Jayaram



Dr. Wayne C. Durham

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**Committee Chairman: William H. Mason
Aerospace Engineering**

(ABSTRACT)

The aerodynamic prediction methodology available in ACSYNT is examined through comparison with aircraft data for a variety of classes of configurations. The predictions are a synthesis of the best empirical procedures currently available. The present work presents selected results obtained from the comparison, and shows how the basic capability can be enhanced by user supplied adjustments to represent changes in technology levels when considering advanced aircraft designs. The predictions and basis for adjustments are described for a supersonic cruise vehicle, a large subsonic transport, a typical fighter, an attack aircraft, and a typical business jet.

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List of Variables

Aerodynamic Variables

C_D	- Drag coefficient
C_{Di}	- Induced drag coefficient
C_{Dmin}	- Minimum drag coefficient
C_{D0}	- Drag coefficient at zero lift
C_L	- Lift coefficient
C_{Lmin}	- Lift coefficient at minimum drag
C_{L0}	- Lift coefficient at zero angle of attack
$C_{L\alpha}$	- Lift curve slope
C_L^2/C_{Di}	- Slope of the drag polar
C_{M0}	- Moment coefficient at zero lift
h	- Altitude
M	- Mach number
M_{DD}	- Drag rise Mach number
Re_{mac}	- Reynold's number referenced to the mean aerodynamic chord
T/C	- Thickness to chord ratio of airfoil surfaces
α	- Angle of attack
δ_t	- Deflection angle of wing tips (XB-70)

ACSYNT Variables

$CL0$	- Lift at zero angle of attack array
FCD	- Total drag sensitivity factor
$FCDF$	- Friction drag multiplying factor
$FCDL$	- Drag due to lift sensitivity factor for flaps in takeoff routine
$FCDRA$	- Minimum drag curve shape factor
$FCDW$	- Wave drag multiplying factor
$FCDWB$	- Wave drag multiplying factor for fuselage only
$FENG$	- Engine drag multiplying factor
$FINTF$	- Interference drag multiplying factor
$FLBCOR$	- Body base drag multiplying factor
$FLDM$	- Drag polar slope multiplying factor
$FLECOR$	- Engine-airframe interference drag multiplying factor

FMDR	- Drag rise Mach number multiplying factor
FRAB	- Fineness ratio of fuselage midsection
FRATIO	- Fineness ratio of total fuselage
FRN	- Fineness ratio of fuselage nose
FVCAM	- Lift curve slope multiplying factor
ITRIM	- Trimming indicator
	0 No trim drag calculated
	1 Trim drag calculated using flaps or horizontal tail
	2 Trim drag calculated using canard
IVCAM	- Induced drag matching indicator
	0 No induced drag matching
	1 Use FVCAM and FLDM in put values
SFFACT	- Wetted area multiplying factor for fuselage
SFWF	- Laminar/turbulent skin friction weighting factor
	0.0 All laminar
	1.0 All turbulent
SMN	- Array of reference Mach numbers for output
SMNSWP	- Array of reference Mach numbers for input
SWFACT	- Wetted area multiplying factor for airfoil surfaces and pods
VTNO	- Number of vertical tails on aircraft
YROOT	- Y location of specific geometry components from fuselage reference plane; expressed as a fraction of maximum radius of the fuselage
ZROOT	- Elevation of specific geometry components above fuselage reference plane; expressed as a fraction of maximum radius of the fuselage

Introduction

Conceptual aircraft designers frequently use aircraft sizing and optimization programs that necessarily employ relatively simple level technology representations for aerodynamics, weights, propulsion, stability and control, and economics. These programs are used to select the concept and determine the size to be used as the starting point in the preliminary design phase. Then, the design is analyzed and refined using more exact methodology in each discipline. However, at that stage the design concept has essentially already been selected, and only minor variations may be permitted based on the use of the advanced analysis methods in each discipline.

Each aircraft company and many government agencies have their own sizing programs. Recently, an effort to establish a standardized sizing methodology has been initiated by aircraft concept designers and evaluators at the NASA Ames Research Center. This effort is based on the NASA Ames originated aircraft sizing and optimization work¹ which resulted in the code known as ACSYNT (AirCRAFT SYNThesis).² The computational part of this code has been under constant development for twenty years. Since 1986, NASA Ames Research Center and the Virginia Tech CAD Laboratory have been working together on ACSYNT. During the late 1980's a modern interactive CAD interface was developed for ACSYNT from this collaboration.^{3,4} The focus for that effort was formalized in the formation of the ACSYNT Institute in 1990, which consists of members from government, industry and universities. This arrangement is effectively leveraging the research investment of each group in developing aircraft sizing methodology. This allows these organizations to concentrate their individual (proprietary) research on advanced vehicle concepts rather than basic aircraft sizing methodology. It also ensures companies that an evaluation of their concepts at government labs will be consistent with the results of their own sizing program estimates.

The aerodynamics methodology used in sizing programs is frequently obscured by the sheer size of these codes. Recently, efforts have been made to formulate sizing-program type methods in a manner that allows the aerodynamics models to be more highly visible.⁵ This approach has then been used to examine the integration of the design using optimization in a way that provides considerable insight into the relative effects of the technology.^{6,7} One result of these studies has been to identify the role that the accuracy, and hence sophistication, of the discipline representation, and its sensitivity to design variable changes, plays in determining the final configuration. Not surprisingly, the accuracy of the estimate for each discipline or technology, and its sensitivity to the effects in changes in the configuration, are important in obtaining an optimized configuration that properly captures the tradeoffs, for example, between aerodynamics, structures and propulsion.

One of the key considerations in the effectiveness of ACSYNT is the accuracy of the internal estimation of the aerodynamic characteristics. The goal of this thesis is to show how well ACSYNT estimates actual flight data and how input files can be adjusted to most closely match existing aircraft aerodynamic characteristics for a specified class of aircraft.

The thesis is structured around the development of five test cases. They are of a fighter, supersonic transport, subsonic transport, attack aircraft, and business jet. A comparison of lift and drag data between ACSYNT and actual flight data is given for each test case. Using the ACSYNT scaling factors, the input files are adjusted to match the flight data. The use of these ACSYNT scaling factors is explained in detail.

ACSYNT

ACSYNT² is an aircraft sizing and optimization program organized to operate in the COPEs environment.⁸ COPEs (COntrol Program for Engineering Synthesis) provides an extremely convenient shell for using engineering analysis codes for parametric and optimization-based design. The primary optimization capability is provided by CONMIN,⁹ which uses the method of feasible directions as described by Vanderplaats and Moses.¹⁰ In this environment, ACSYNT can be used as a mission analysis program, to perform parametric studies, or to do vehicle optimization. ACSYNT includes numerous technology modules. These include geometry, weights, propulsion, mission/performance (trajectory), aerodynamics, stability and control, sonic boom, takeoff, balance, and economics.

A key feature of ACSYNT is the use of a standards-based software approach using ISO standard PHIGS to allow the program to be graphics-device independent. This allows members of the ACSYNT Institute to run the program on a wide variety of workstations.

In addition to the technology analysis modules, ACSYNT is under continual development to provide an extremely general and flexible geometric representation of concepts while maintaining a user friendly interface. Recent developments in this capability have been described by Jayaram et al.¹¹ These enhancements also include adoption of a spreadsheet input style.^{12,13} Figure 1 contains an example of a typical ACSYNT screen with the geometry exploded to show some of the components available to the designer. Figure 2 provides an example of the spreadsheet screen used to define inputs to the analysis modules. ACSYNT provides “starter” templates of geometry and input data for various aircraft types: transport, fighter, general aviation and high speed civil transport (HSCT). This facilitates the development of a new aircraft concept. Although many variables are available to the user to employ various options, the default values from these setup files and/or similar aircraft’s input files are normally employed in initial analysis.

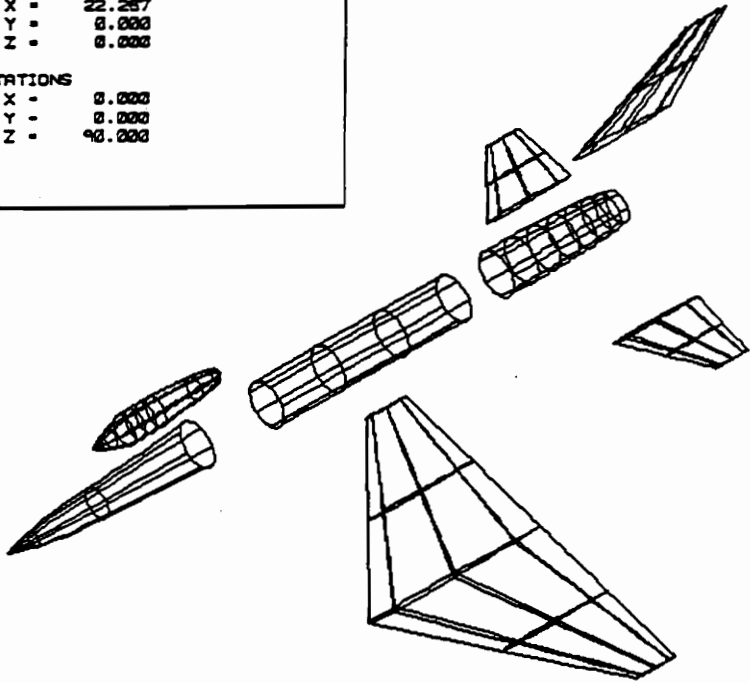

ACSYNT - V2.0.0		VPI & NASA-AMES			
<div>COMPONENT LOCATION</div> <div>COMPONENT NAME: WING</div> <div> TRANSLATIONS X = 22.257 Y = 0.000 Z = 0.000 </div> <div> ROTATIONS X = 0.000 Y = 0.000 Z = 90.000 </div>				COMP LOC	
RETURN AUTO UPDATE MANUAL UPDATE					
SELECT ITEM/ENTER X,Y,Z TRANSLATION VALUE				COLORS	
				COPY	
				HELP	
		EXIT			

Figure 1) Example ACSYNT screen

ACSYNT								
ACSYNT AERODYNAMICS INPUT							SPREADSHEET	
	A	B	C	D	E	F	G	
1	TITLE AERODYNAMICS INPUT FILE FMTD ST						RETURN JUMP MODIFY	
2	ABOSB 0.15 WACHAR RL	ALMAX 35.0 WACHAR RL	AMC 40.0 WACHAR RL	BONOSE 3.5 WACHAR RL	BTEF 0.0 WACHAR RL	MACHN 0.75 WACHAR RL		
3	RALDIT 0.0 WACHAR RL	RCLMAX 1.0 WACHAR RL	ROC 0.0 WACHAR RL	ROCAN 0.02 WACHAR RL	SFWF 1.0 WACHAR RL	SMNDR 0.88 WACHAR RL		SPANAC 0.0 WACHAR RL
4	SNPMIN 60.0 WACHAR RL	XDCD 0.6 WACHAR RL						
5	AJCAN 1 WACHAR IN	ALEJ 1 WACHAR IN	IDELTA 0 WACHAR IN	INORM 1 WACHAR IN	ISMNDR 0 WACHAR IN	ISUPCR 0 WACHAR IN		ITRAP 0 WACHAR IN
6	IXCD 1 WACHAR IN	ELLIPC .FALSE. WACHAR LO	ELLIPW .FALSE. WACHAR LO	ELLIPH .FALSE. WACHAR LO				
7	CSF 0.0 WAMULT RL	ESSF 1.0 WAMULT RL	FCD 1.0 WAMULT RL	FCDP 1.0 WAMULT RL	FCDL 1.0 WAMULT RL	FCDW 1.0 WAMULT RL		FCDWB 1.0 WAMULT RL
8	FENG 1.0 WAMULT RL	FINTF 1.0 WAMULT RL	FLBCOR 1.0 WAMULT RL	FLECOR 1.0 WAMULT RL	FMDR 1.0 WAMULT RL	FCDQ 1.0 WAMULT RL		FLD 1.0 WAMULT RL
9								
10	SNMSP(1) 0.2 WACHAR RL	CLO(1) 0.0 WACHAR RL	CLOC(1) 0.0 WACHAR RL	CLOW(1) 0.0 WACHAR RL	CMD(1) 0.0 WACHAR RL	YSMP(1) 0.0 WACHAR RL		FCDRA(1) 0.0 WACHAR RL
SELECT MENU ITEM SELECT MENU ITEM SPREADSHEET CONFIGURATION FILE READ SUCCESSFULLY SELECT HELP WINDOW TO REMOVE SELECT FROM SCREEN OR MOVE CELL POINTER								
0.88							HELP	
							COPY	
							COLORS	
							EXIT	

Figure 2) Example ACSYNT Spreadsheet Screen

Overview of ACSYNT Aerodynamic Estimation Methods

Many approximate aerodynamics methods have been assimilated into ACSYNT. The methodology is described in the User's Manual section by Moore and Samuels,¹⁴ which is the basis of the description given here. Some methods have a more rigorous theoretical basis than others. The aerodynamics estimation module reflects engineering experience developed throughout industry and government. Twist and camber effects are accounted for by a user supplied value of C_{Lo} . Following the traditional aerodynamics approach, the drag is taken to be the sum of the minimum drag and drag due to lift. Each of these is discussed separately.

Minimum Drag

The minimum drag is calculated using the procedure of component build-up. Minimum drag includes friction, wave, leading edge bluntness, external stores, weapons, bombs, engine cowl, engine boattail, and interference drags. Engine cowl drag and engine boattail drag can also be included as thrust loss in the propulsion module. The ACSYNT thrust-drag bookkeeping separates the propulsion and aerodynamics drag by establishing a reference condition. This reference condition is the point at which the engine inlet is operating at design mass flow with the nozzle wide open. Only reference condition boattail and cowl drags are included as part of the minimum drag. Any drag that is due to a throttle change (e.g. variable diameter afterburner/nozzle) is labeled as throttle dependent drag and is assigned to propulsion drag. For these comparisons, only the drag from the aerodynamics module is used. Throttle dependent drag is not used. The assumption was made that the test data used follows a similar thrust-drag bookkeeping scheme. This assumption leaves room for error in the comparisons.

Good prediction of the transonic drag rise is dependent upon the prediction of the critical Mach number and the drag divergence Mach number. These Mach numbers are

estimated from wing geometry (aspect ratio, thickness-to-chord ratio, sweep, and area) and angle of attack by using a data correlation scheme. The ACSYNT user also has the option of setting MDD . Supersonic wave drag is calculated using the momentum theory and linear formulas based on area ruling. The area ruling uses Sears-Haack bodies and, for wing-body combinations, uses oblique Mach planes to get the cross-sectional area. The momentum theory uses an overall momentum balance on a control volume surface.

The Sommer-Short T-prime method is used for compressible skin friction.¹⁵ The flow can be specified by SFWF anywhere from 0.0 (all laminar) to 1.0 (all turbulent). Thickness effects form factors are used to adjust wing, fuselage and cowl friction.¹⁶

The minimum drag is built up using the standard DATCOM type approach.¹⁷ To calculate the total minimum drag, first, the minimum drag for each component is calculated from its geometry using the skin friction, wave drag, reference cowl and boattail drags, etc. mentioned earlier. Then interference factors, based on the components' proximity to each other, are used to combine the components' drags. A store drag library is available to assist the user in specifying store drag. The effect of pod spacing on aircraft wave drag is incorporated using Nielsen's results for minimum wave drag interfering bodies.¹⁸

Drag due to Lift

For drag due to lift, the key aerodynamic estimation methodology is based on the AEROX program developed by John Axelson.^{19,20} AEROX estimates lift, induced drag, and pitching moment coefficients for wings and wing-body combinations. It does not predict low speed viscous stall. The code is based on compressible wing theory with potential and nonpotential flows extended to cover transonic and supersonic flows with shocks. For transonic speed and high angle of attack, the emphasis is on shocks on the airfoils, limiting Mach number (Laitone's criterion)²¹, and the nonpotential lift equation. The nonpotential lift equation is a nonlinear lift equation obtained from integration of downwash momentum. Trim effects are also computed.

The precise method used depends on Axelson's flow region classification. As shown in Figure 3, Axelson defines six zones, which include incompressible, compressible (shockless), leading edge Mach limit, surface Mach limit, attached shock, and detached shock zones. Zone 1 is for incompressible flow and is used for $M < 0.1$. The calculations in this zone use the potential flow theory of Kutta-Joukowski and the downwash momentum theory. Both theories are extended to three dimensions. Zone 2 is the compressible, shock-free region. It uses compressibility factors for blunt leading edge airfoils and when the flow surrounding the airfoil has local Mach numbers below the Laitone limit. Zone 3, the leading edge Mach limited region, is used when the Laitone limit Mach number is exceeded at the leading edge. For this zone and the rest of the zones, nonpotential flow theory and empirical equations are used. When the shock moves farther back on the upper surface, the calculations in zone 4 are used. Zone 5 is for sharp airfoils with attached shocks at the leading edge. Zone 6 is for blunt or sharp airfoils with detached shocks. The nonpotential equations in this zone are derived from diverted momentum and Newtonian impact theories. This separation into zones is primarily oriented toward calculating induced drag at transonic speeds and large angles of attack. The transonic case is the most important in most sizing and aircraft design work.

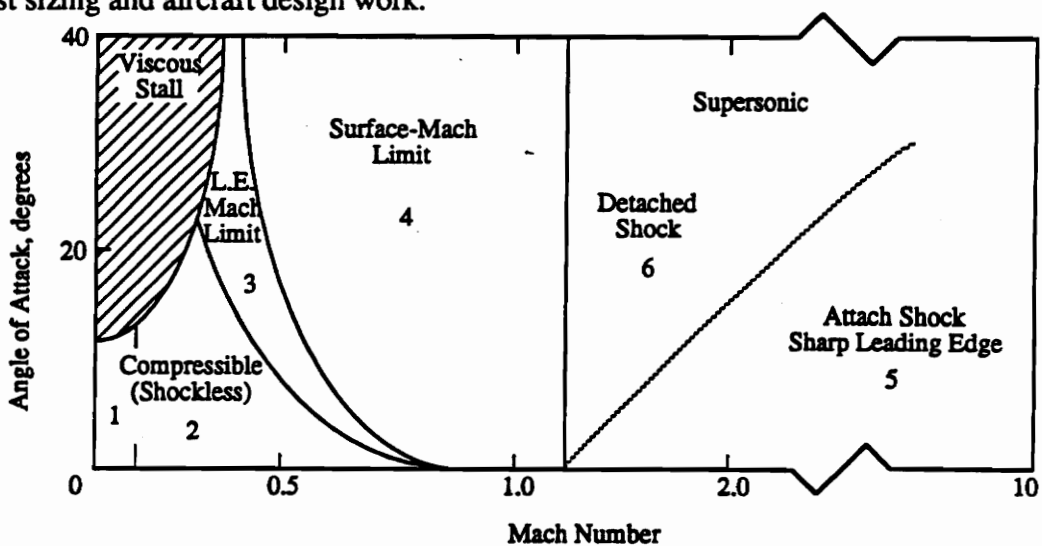


Figure 3) Illustration of Axelson's Six Flow Zones (ref. 19)

The AEROX portion of ACSYNT has been thoroughly evaluated previously. Reference 20 includes an entire volume with comparisons to wind tunnel and flight data for nine configurations. Subsequently, a complete comparison was carried out for some seventeen additional aircraft flight test data cases.²² The results were remarkably close to flight test data, and this report should be studied to understand how to get the best possible results from AEROX. Recently, AEROX has been extended to include estimates to 90° angle of attack and lateral directional capability under private sponsorship.²³

ACSYNT represents the state of the art in empirical and quasi-empirical estimation of aerodynamic performance of an aircraft. However, some configurations may not be modeled well. Provisions for user adjustment of the estimates are provided through inclusion of aerodynamic matching factors. Identifying these particular configurations and correcting the estimations for known aircraft will allow for future conceptual design work to recognize and adjust the analysis beforehand. The method used to apply these matching factors will be described in detail in a later section.

In addition to internal estimates, ACSYNT also provides the geometry interface required to obtain rapid estimates of the aerodynamic characteristics using external calculations. As an example, Reference 10 describes Vorview, which is an interactive, workstation-based analysis package which couples ACSYNT derived geometry with the subsonic and supersonic vortex lattice method VORLAX.²⁴ This approach provides the designer with refined aerodynamics estimates in minutes. The results obtained can then be used in ACSYNT.

The Evaluation Approach

Currently the ACSYNT user does not have a well-documented set of examples illustrating the use and accuracy of the aerodynamics estimation package, although AEROX has been completely documented. The scaling factors can be used to match data for a specific aircraft, but there is no general guide to matching data for a specific type of aircraft. To use ACSYNT efficiently, a guide illustrating the capabilities of the aerodynamics package was required.

The evaluation described herein should be valuable to current and potential ACSYNT users. First, ACSYNT aerodynamic predictions are compared to flight test data for a variety of existing aircraft. Second, it is demonstrated how the scaling factors, or multipliers, are used to produce good estimations for a particular type of vehicle. Finally, the results of this work provide a disciplined basis for identifying and prioritizing those portions of the methodology where further refinements are required.

In each case, several results were obtained. These include lift and drag predictions using the basic default settings for the scaling factors over a range of Mach numbers. Then, the same results are presented including the scaling factors. All of these predictions are for trimmed aircraft. Finally, the effects of scaling factors and recommendations for their use are presented.

For ACSYNT Institute purposes, this effort provides a baseline set of test case predictions. Whenever significant changes are made to the code, these test cases can be used to ensure that “improvements” and bug fixes do not adversely affect predictions over a wide range of conditions.

Due to the continual development of ACSYNT, the version used here was an intermediate version between 1.2.2 and the latest 2.0 release. It is designated as 2.0 α . There are some changes that are in the 2.0 release that are not included in these

comparisons. For example, there are now Mach number/altitude conditions reserved for takeoff and landing, geometry specifications such as afterbody upsweep, nose cant angle and wing twist included in analysis, and only the reference condition boattail and cowl drags are included in the zero lift drag. Due to these changes, ACSYNT 2.0 estimated total drag 10 to 20 counts lower than ACSYNT 2.0 α . The lift prediction was almost exactly the same. The methods used in calculating and applying the scaling factors is still valid for version 2.0 and future releases. The flight/wind tunnel data and the geometry definitions used in these comparisons are still applicable to the evaluation of future aerodynamics modules.

Test Cases

Five test cases were used in this work. They cover the entire range of vehicles of interest to ACSYNT Institute members and include a fighter, supersonic cruise aircraft, large subsonic aircraft, attack aircraft and business jet.

Fighter: The F-16A was chosen for this correlation. It has been examined by ACSYNT users at NASA Ames previously.²⁵ Figure 4 shows the actual F-16A geometry.

Supersonic transport for use in NASA HSCT analysis and design: The XB-70 has been selected for this comparison. This case is one of the best for ACSYNT evaluation because it was so well documented by NASA.^{26,27} After making the calculations it was understood why so much effort was expended by NASA in comparing flight and tunnel data. The comparisons produced are useful in NASA HSCT analysis and design. The XB-70 was designed to be a supersonic cruising strategic bomber. It has a delta shaped wing with wing tips that deflect down at Mach numbers above one to increase stability. The XB-70 is shown in Figure 5. It has a canard, two vertical tails, and two rectangular, variable geometry inlets which lead into the six turbojet engines. It is a rather complex aircraft to model, mostly due to its variable geometry inlets.

Subsonic Transport: This test case is used to establish results for a large subsonic

aircraft. This typical transport, pictured in Figure 6, is a high-wing/high-tail configuration with four engines mounted below the wings.

Attack Aircraft: The A-6 attack bomber was chosen for this test case. The A-6 is a twin-engine, midwing monoplane with moderately swept-back wings and a "tadpole" shaped fuselage. It also has a small strake at the wing/body junction. The actual A-6 geometry is in Figure 7.

Business Jet: The business jet is a low-wing/mid-height tail configuration with two fuselage mounted engines. Its actual geometry is shown in Figure 8.

Table 1 shows the ranges of the configuration variables used in analysis. The ranges were set to coincide as well as possible with the available test data. The test data conditions were the conditions used for input into ACSYNT. The test data obtained for the A-6 was for Mach numbers from .70 to 1.3. Since the A-6 is a subsonic fighter, the data from Reference 20 is probably adjusted wind tunnel data. The angles of attack for all of the aircraft tend to be on the high side. This was done to see how ACSYNT handled high angle of attack lift and drag.

Table 1 Aircraft Configurations for Analysis

Aircraft	Mach Number Range	Angle of Attack	Altitude (ft.)
F-16A	.40 - 1.6	0° - 14°	30,000
XB-70	.76 - 2.5	0° - 8°	25,720 - 61,630
Transport	.60 - .85	0° - 16°	10,000 - 45,000
A-6	.70 - 1.3	0° - 12°	30,000
BizJet	.10 - .70	0° - 11°	5,000 - 40,000

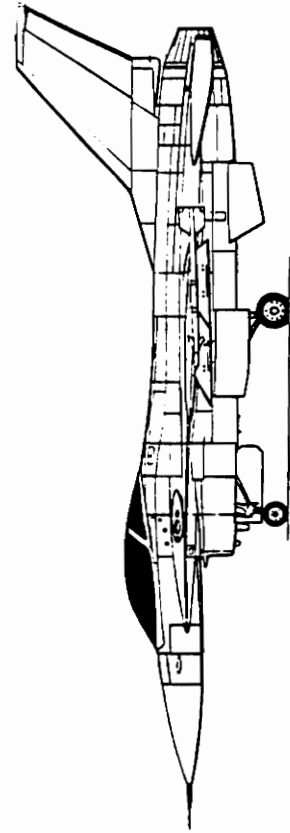
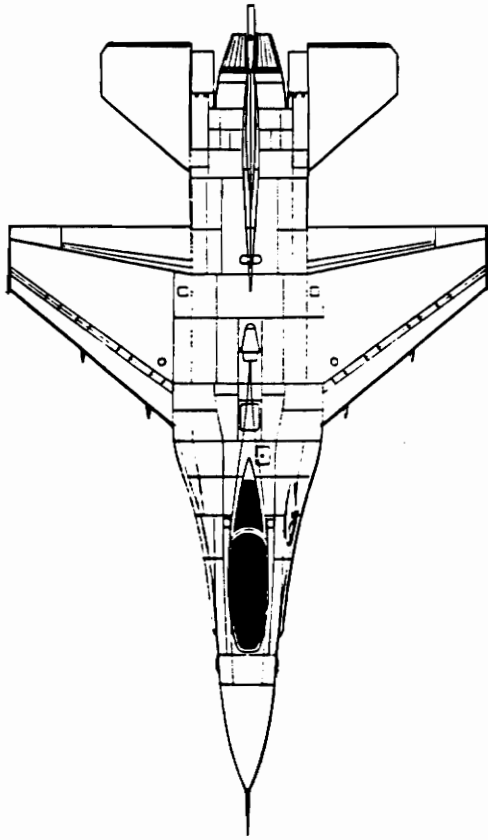


Figure 4) F-16A Geometry

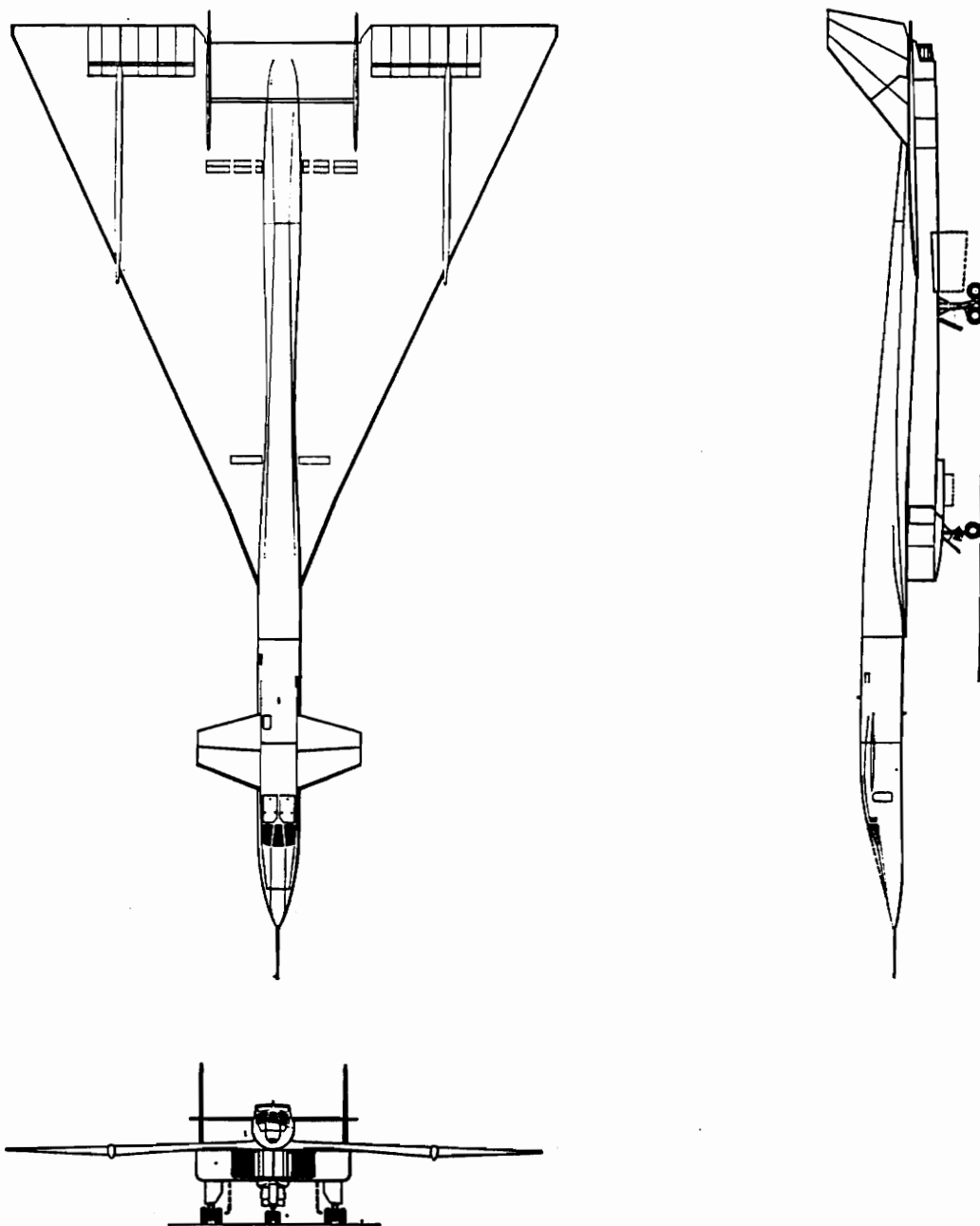


Figure 5) XB-70 Geometry (ref. 26)

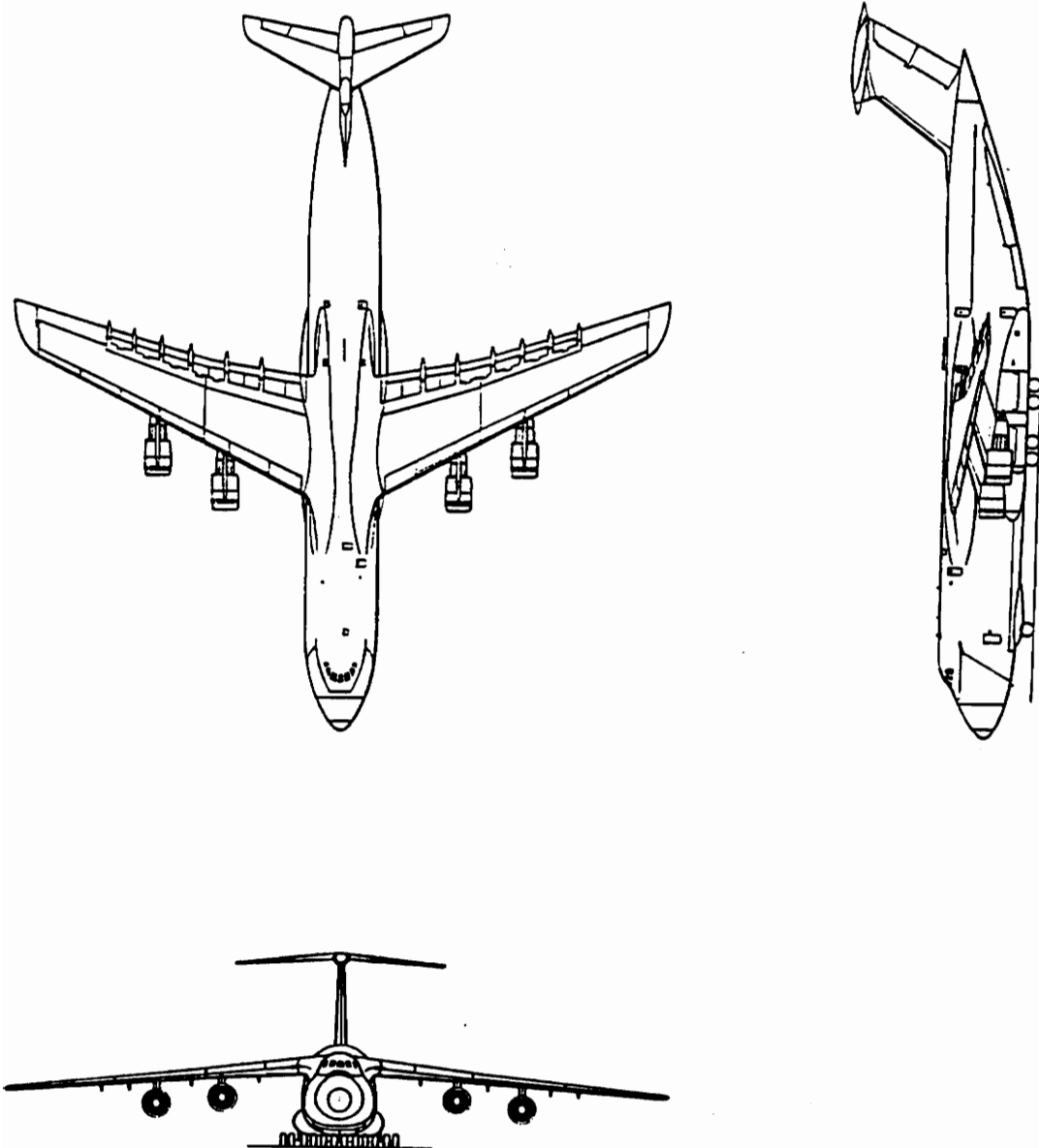


Figure 6) Subsonic Transport Geometry

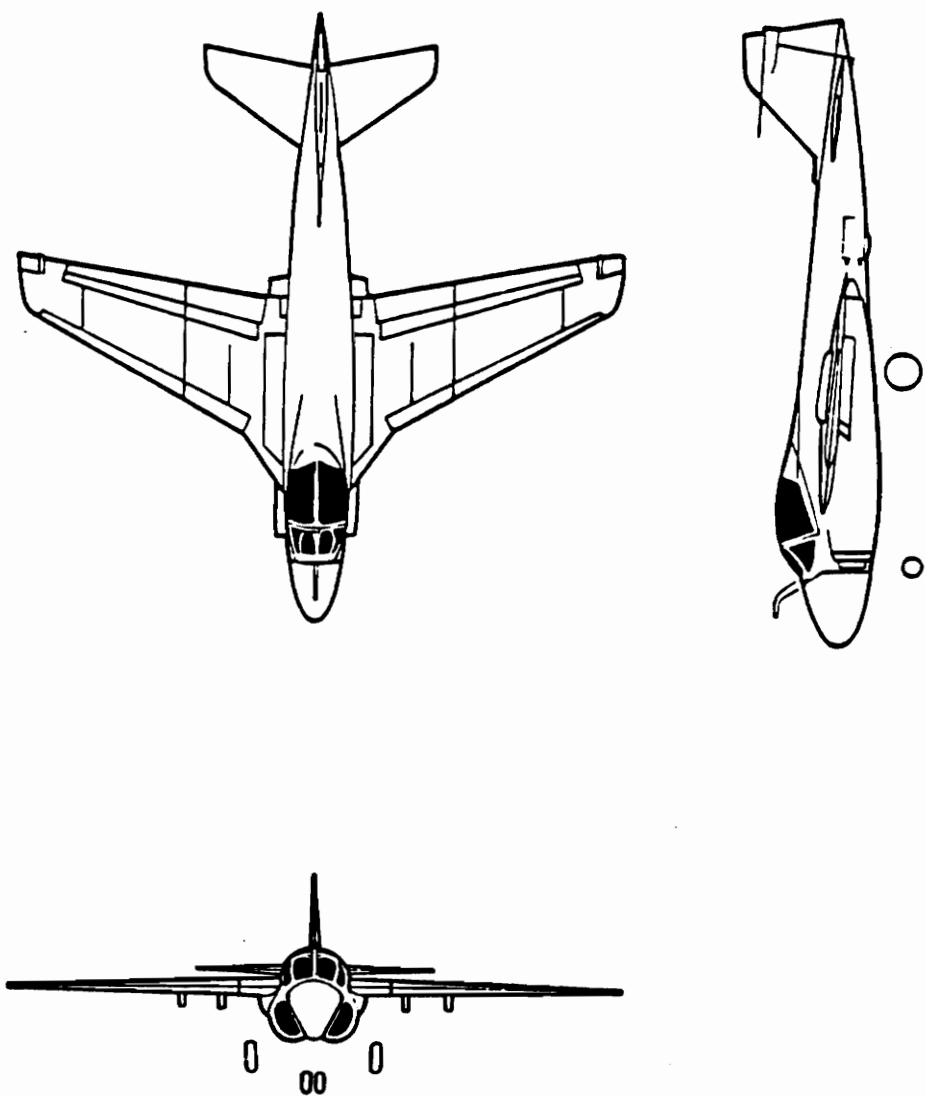


Figure 7) A-6 Geometry (ref. 22)

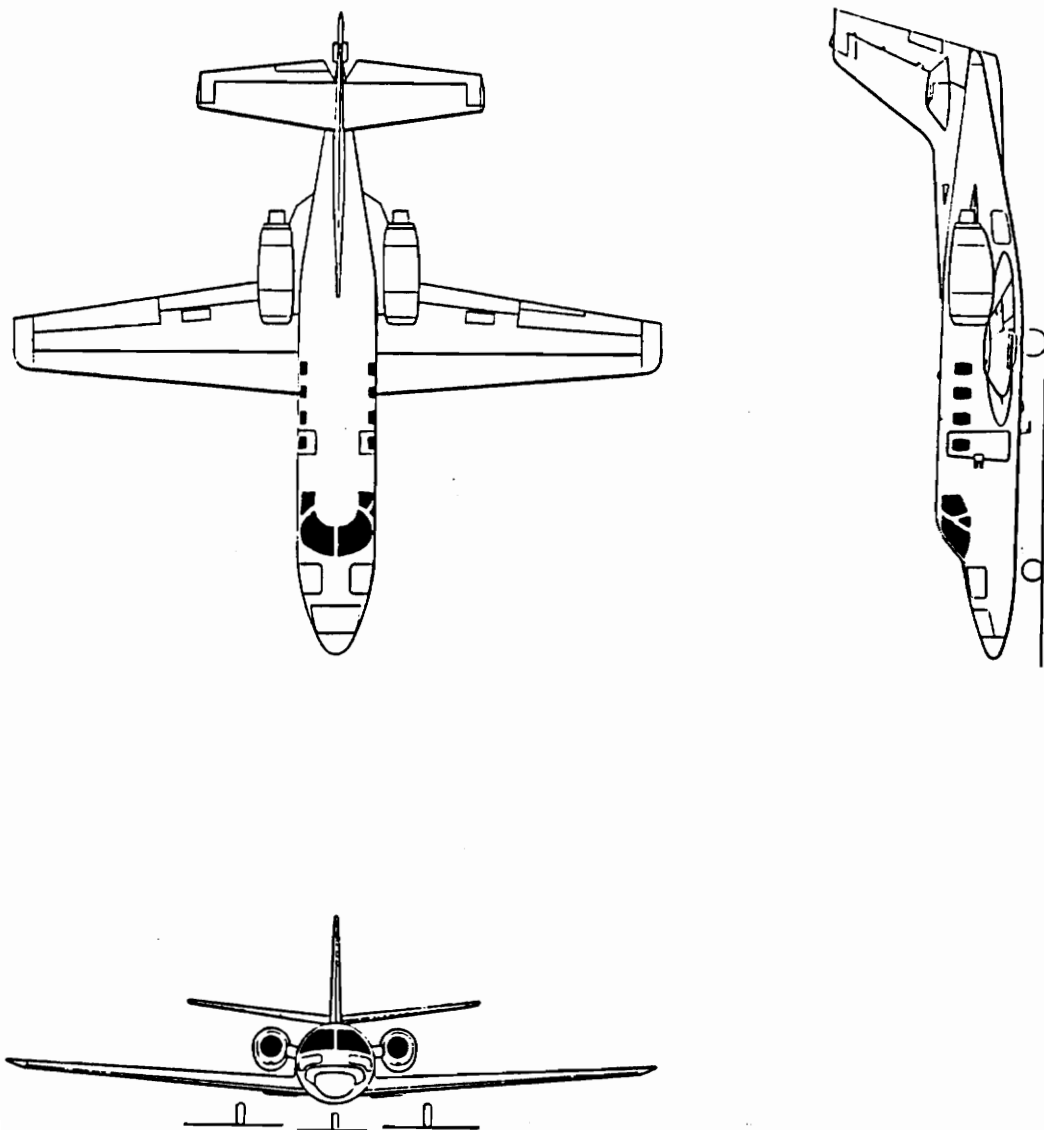


Figure 8) Business Jet Geometry

Model Development and Matching Procedure

The first step in creating an ACSYNT model is to create the geometry. Figure 1 illustrates the user environment for doing this. Creating the geometry consists of simply adding components and modifying their shape parameters. The basic ACSYNT components and their input parameters are listed in Table 2. ACSYNT cannot necessarily include all the geometric complexities in its analysis that the CAD portion is capable of creating. For example, canopies, afterbody upsweeps and nose cants can be created in the geometry but cannot be analyzed by ACSYNT. The best approach is to make the initial model as close to the real aircraft as possible, carry out an analysis, and examine the ACSYNT output geometry (i.e. post-analysis geometry) which shows the ACSYNT interpretation used for the analysis. The post-analysis geometry is the geometry ACSYNT develops from the input variables and its parameters are used by ACSYNT in its calculations. Examination of the post-analysis geometry will provide clues on how to adjust the geometry variables so that the model more closely represents the actual aircraft.

To follow this procedure, once the initial model geometry is defined, the ACSYNT input needs to be “set”. This extracts the CAD geometry data and places it into a template of

Table 2 Required Geometric Input

Component	Input Parameters
wing, canard, horizontal/vertical tail	aspect ratio, area, dihedral, sweep, taper ratio, thickness-to-chord ratio, location, twist, span, root chord
fuselage	length, diameter, fineness ratio(nose, afterbody, total), location
engines	length, diameter, location
inlets	length, cowl length, capture area, aspect ratio, location
generic pods	length, diameter, location referenced to fuselage

ACSYNT variables to be used for analysis. Default values of variables for the particular type of aircraft that is being modeled, not defined by the CAD model are used. It should be noted that only the geometry data is set and that the variables in the other modules still have default values. After the geometry input is set, it should be checked by executing an ACSYNT analysis and comparing the post-analysis geometry with the initial and actual geometries, as explained earlier. Usually, the post-analysis geometry will not be identical to the original CAD input geometry. The geometry may change due to optimization, sizing or analysis limitations. Since the models in this study are of existing aircraft and the aerodynamics is the main concern, there were no changes due to optimization or sizing. The one exception to this is the sizing of the engines. There are many variables used to define the propulsion system (geometry, efficiencies, pressure ratios, temperatures, inlet information, etc.). The engine may change size to accommodate all of the performance requirements set by these inputs and the mission requirements. ACSYNT uses what is known as a “rubber engine”. It starts with a known engine and alters it to meet performance requirements. The change in size of a fuselage mounted engine may affect the afterbody geometry. Since the engine information used in this study was for actual aircraft, the size change caused less than 10% increase in the afterbody exit diameter.

There are some limitations in the analysis that cause the geometry to change. The shape complexities that the CAD portion of ACSYNT creates cannot necessarily be analyzed. Therefore, to get an aerodynamic/geometric model as close to the actual aircraft geometry as possible, adjustments may be necessary in the geometry spreadsheet. The geometry spreadsheet is similar to the aerodynamics spreadsheet in Figure 2. In making these adjustments, the comparisons of the initial and post-analysis geometries are used. In particular, the component surface areas and location coordinates should be checked. Discrepancies in surface area may indicate location problems between the components by improper calculation of embedded area. For example, if a component that is partially

embedded in the fuselage moves with respect to the fuselage, its calculated surface area will change. This is because ACSYNT subtracts out the area of a component that is embedded in another component. Inaccurate surface areas may cause problems with aerodynamic results such as the drag due to skin friction. Since ACSYNT requires a straight fuselage, it tends to straighten out the fuselage during analysis (e.g. no cant angle for the nose); therefore, the fineness ratios (FRN, FRAB, FRATIO) should also be checked. The fineness ratio variables can be combined in various ways that determine what body length and diameter are used in the calculations. The details are listed in Reference 14. Some of the variables which locate components depend on the size and shape of the fuselage, e.g. ZROOT and YROOT. If the fuselage changes, the dependent components could be out of position relative to the fuselage. This could affect surface areas, interference drag, friction drag, etc. This procedure requires some trial and error, with the goal being a post-analysis geometry as close to the initial geometry as possible.

When the geometry module is complete, the next step is to assign values to the variables in the other modules (e.g., aerodynamics, propulsion, weights, and trajectory) to complete the ACSYNT aircraft modeling. These modules further define the aircraft model and mission. The aerodynamics module contains several different types of variables. Three of these are utilized here. First, there are variables that give the aerodynamic characteristics of the aircraft through geometry (e.g., thickness-to-chord ratios for airfoils, maximum fuselage diameter, and wing sweep angle). Trimming information is given here also. The center of gravity can be input as a fraction of the wing mean aerodynamic chord or it can be calculated using an input static margin factor. ITRIM is the trimming indicator. It can be set for no trim (ITRIM=0), trim using flaps or horizontal tail (ITRIM=1), or trim using the canard (ITRIM=2). For ITRIM=1, the horizontal tail is used unless the flap span and chord length are given. If information is given about the flaps, they are used to trim the aircraft. To trim with flaps, ACSYNT steps through flap angles until the calculated C_m is zero,

holding the tail fixed at zero deflection. The canard and horizontal tail trim uses the same method. The canard and tail are assumed to be all-moving. The second aerodynamics module variable type includes the variables which establish the flight conditions for the calculations (Mach numbers, angles of attack, altitudes). The third type is the scaling factors for lift and drag.

Three more modules are required to complete the models. The propulsion module is not an area of concentration, but is still necessary. The propulsion variables describe the engine/inlets used. The weights module is used simply to estimate the aircraft weights. The variables in the weights module assign initial values of weights for specific components and give component weight multiplying factors. Finally, the trajectory module defines a proper mission for the aircraft. Each of these modules can have an effect on the aerodynamic results. The mission assigned, the weights given and the propulsion system used affect the performance and, in turn, the aerodynamics.

ACSYNT is meant to be a conceptual design tool. During the conceptual design stage, there will not be firm data to input into ACSYNT. Therefore, default variables may have to be used. There are some places (aerodynamics specifically) where data can be input directly or calculated during analysis by ACSYNT. For example, in the aerodynamics module, values can be set for C_{Mo} , C_{Lo} and C_{Lmin} or these values can be calculated. For a new design, this data is not available initially. In conceptual design, unavailable data must be calculated by ACSYNT. In this study, an attempt was made to parallel this situation by having ACSYNT calculate as many parameters as possible. The results presented here represent the accuracy that can be expected by users early in a design cycle.

At this point, the geometry and ACSYNT analysis variables are set up and the model analysis should give reasonable results. Deciding what is reasonable depends on the experience of the designer. Comparisons of results with those found in this study is a good place to start. Once realistic results are obtained, the first step in matching is the comparison

of the wetted areas. ACSYNT calculates wetted areas by component (fuselage, wing, canard, vertical tail, horizontal tail) and subtracts out any embedded area. As explained earlier, ACSYNT is somewhat limited in its ability to model and analyze complex geometries (joined components, odd shapes, location problems, etc.). This can result in poor estimates for the calculated wetted areas. An example of this will be shown later. Poor wetted area estimation affects results such as friction drag. Therefore, wetted area factors (SWFACT, for the wing, and SFFACT, for the fuselage) are used to adjust the wetted areas for each component. These factors are simply multiplicative numbers to adjust the wetted areas that ACSYNT uses for calculations.

The next step is the aerodynamic matching. ACSYNT estimates the aerodynamic characteristics at user specified altitude/Mach number combinations. Results at other conditions are then found from interpolation. There are two different arrays in ACSYNT which contain the Mach numbers. The SMNSWP array is the array of Mach numbers at which the calculations are made. SMN contains the Mach numbers at which output is requested. Linear two-point interpolation is used to find values at SMN points that fall between the SMNSWP altitude/Mach number combinations. At each altitude/Mach number condition, ACSYNT steps through user input angles of attack. For each angle of attack, lift and drag coefficients are calculated as well as moment coefficients ($C_M = 0$ if aircraft is trimmed), lift-to-drag ratios, Oswald efficiencies, trim drags, trim control surface deflections, and the applicable flow zones as shown previously in Figure 3. Also output for each configuration are C_{Dmin} , $CL\alpha$ and a breakdown of the parasite drag. The parasite drag is broken down into friction drag, engine drag, interference drag (usually small), wave drag, external drag and camber drag. The friction drag, engine drag and external drag are further broken down by the specific aircraft components. Of this output data, C_{Dmin} , $CL\alpha$, CL , CD , angle of attack, interference drag, friction drag and wave drag are used in the matching procedure. Flight test data for the four aerodynamic coefficients and the

angles of attack are required for matching.

One goal of this study is to illustrate the exact usage of the five main aerodynamic scaling factors: FCDF, FCDW, FCDRA, FVCAM and FLDM. Generally, the scaling factors are defined to be the actual value divided by the ACSYNT value. The calculation of each of these factors is based on the methods used in Reference 25. FCDF is for friction drag and is one of the scaling factors used to match the subsonic minimum drag coefficient. It is calculated in two steps. First, a temporary FCDF (denoted as FCDF* for this discussion) is calculated for each condition (altitude, flap setting, Mach number, etc.) below the drag rise Mach number. These values are then averaged to get a final value to be input into ACSYNT as FCDF. FCDW, the wave drag scaling factor, is calculated using a similar two stage method, but for conditions above the drag rise Mach number (where there is wave drag). The final FCDF value should be established before calculating the FCDW values. This is so that the friction drag can be separated from the wave drag. The interference drag is separated from the minimum drag for both the FCDF and FCDW calculations so that these factors truly apply to only the friction and wave drags, respectively. Before averaging the FCDW* values, the first FCDW* value, which corresponds to the first Mach number that has wave drag, should be compared to the other FCDW* values. If the ACSYNT calculated wave drag here is small compared to those at the higher Mach numbers, this first FCDW* may be left out of the average taken to get the final FCDW value. This is to keep the supersonic wave drag calculation from being biased by the transonic wave drag. The procedure described above is given by the equations:

$$FCDF = \frac{\text{Actual } C_{D_{\min}} - \text{ACSYNT Interference}}{\text{ACSYNT Friction}} \quad (1)$$

$$FCDW = \frac{\text{Actual } C_{D_{\min}} - (FCDF \times \text{ACSYNT Friction}) - \text{ACSYNT Interference}}{\text{ACSYNT Wave}} \quad (2)$$

After executing ACSYNT analysis with the new FCDF and FCDW values, FCDRA (minimum drag curve scaling factor) is used to fine tune the C_{Dmin} values. It is a multiplicative value found by dividing the actual C_{Dmin} by the new ACSYNT value at each Mach number/altitude condition.

At this point, the data needs to be checked for excessive trim drag. To do this, the model is analyzed again with the aerodynamics untrimmed (ITRIM = 0) and trimmed (ITRIM = 1 or 2). Then the C_{Dtrim} values in the output are compared (trimmed vs. untrimmed). If the trim drag is excessive, the variables in namelist ATRIM can be used to change the aircraft geometry parameters that are used in trim drag calculations. The ATRIM namelist contains variables for the location of the center of gravity, flap chord length, horizontal tail incidence, static margin, etc. These variables should not require much additional adjustment unless the aircraft geometry is unusual. Adjusting these variables is part of the design process.

The next scaling factor to be adjusted is FVCAM. It is used to match the *slopes* of the C_L vs. α curves at each Mach number/altitude condition. FVCAM does not affect the C_{Lo} value. There are ten condition values set up for calculations. FVCAM is calculated by dividing the actual $C_{L\alpha}$ by the ACSYNT estimated $C_{L\alpha}$ for each condition. Note that to use FVCAM and FLDM, the variable IVCAM must be set equal to one. IVCAM is a flag to tell ACSYNT that matching is applied. As explained earlier, if aerodynamics results are requested between Mach numbers, a linear interpolation scheme is used. This also applies to the FVCAM array. Linear interpolation is used to find scaling factors between Mach numbers and then it is applied to the interpolated aerodynamic data. One consequence of this is that to get a desired scaling factor effect between Mach numbers, the scaling factors on either side will have to be adjusted.

Once the $C_{L\alpha}$'s are matched using FVCAM, the drag can be matched using FLDM. Similar to FVCAM, FLDM is an array of induced drag scaling factors used to adjust the

C_L^2/C_{Di} (drag curve slopes) at each condition. FLDM is the actual C_L^2/C_{Di} slope divided by the ACSYNT slope. Since the drag curve slopes are usually derived quantities, FLDM can be found by graphically matching the drag polar (C_L vs. C_D) at each configuration. Increasing FLDM increases the drag and vice versa. FLDM's effect on the drag polars also undergoes linear interpolation between Mach numbers and is, therefore, affected by FLDM values on either side.

Sample matching calculations for the subsonic transport can be found in Appendix A. Detailed equations for matching are also given there.

Additional Scaling Factors

The five scaling factors in the previous section are the main ones and cover the areas needed to complete matching. However, there are also several scaling factors available that were not used. FCD is a total drag sensitivity factor. Use of FCD is not recommended because it is too general; it simply scales the overall drag. FCDL is the drag due to lift sensitivity factor for the flaps and was not used because it is meant to be used for takeoff only. In this study, no takeoff conditions were analyzed and no actual takeoff data was obtained. FCDWB (wave drag for fuselage only), FENG (engine drag), FINTF (interference drag), FLBCOR (body base drag), and FLECOR (engine airframe interference drag) are additional scaling factors that would require more detailed knowledge of the components' drag. Obviously, flight test data for separate aircraft components is not readily available. Also, at the conceptual design stage, these scaling factors are too detailed to use. If this information is available, these factors could prove quite useful. One final scaling factor that was not used is FMDR, for the drag rise Mach number. It was not used because ACSYNT was already closely predicting M_{DD} .

Results

Each aircraft is accompanied by tables and figures that describe the geometry. The input and output files for each aircraft can be found in Appendix C.

F-16A

The F-16A had a simple geometry made up of a fuselage, wing, horizontal tail and vertical tail. The ACSYNT geometry is shown in Figure 9, and the post-analysis geometry is in Figure 10. The only difference between those two geometries is that the afterbody of the post-analysis is not tapered as much as it was. This is not a geometry limitation, but comes from the ACSYNT analysis. It is most likely from the propulsion analysis. The afterbody was expanded to make room for the increase in the size of the fuselage mounted engine which was sized to meet the performance requirements given in the propulsion and trajectory modules. Tables 3a and 3b list the parameters used for the F-16A geometry.

Table 3a F-16A Airfoil Surfaces

	wing	horizontal tail	vertical tail
aspect ratio	3.00	2.114	1.294
area (ft ²)	300.0	63.70	54.750
dihedral (deg.)	0	0	0
quarter chord sweep (deg.)	32.183°	32.271°	43.225°
taper ratio	.228	.390	.436
T/C root	.04	.06	.05
T/C tip	.04	.035	.03
x-location of 1/4 chord (ft.)*	22.527	46.343	38.412
y-location (ft.)	0	0	0
z-location (ft.)	0	0	1.899
twist (deg.)	0	0	0
span (ft.)	30	11.604	8.417
root chord (ft.)	16.293	7.898	9.063

* All locations measured from nose of aircraft, which is at (0,0,0)

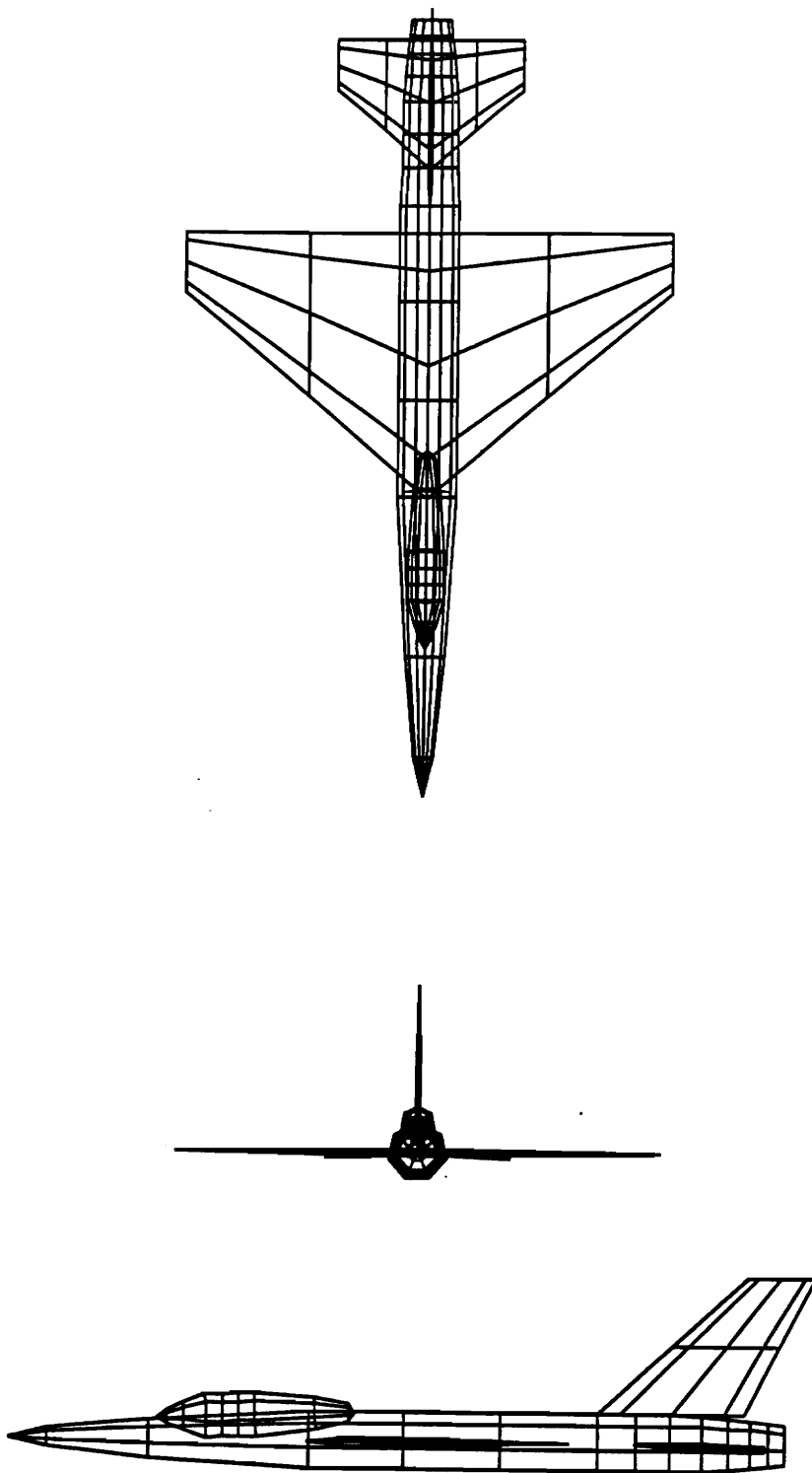


Figure 9) ACSYNT F-16A Geometry

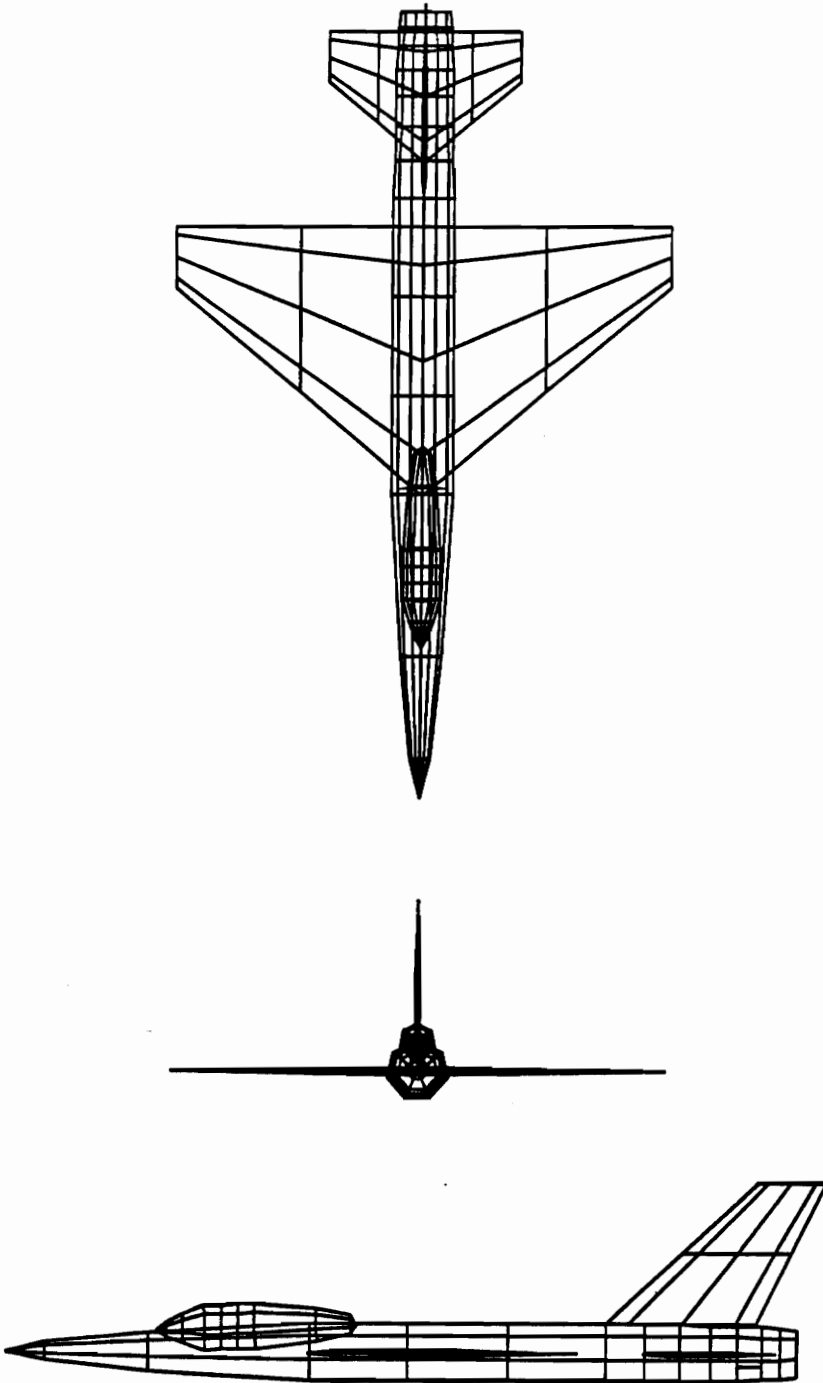


Figure 10) ACSYNT F-16A Post-analysis Geometry

Table 3b F-16A Geometry

fuselage	
length (ft.)	47.58
diameter (ft.)	3.8
fineness ratio-nose	4.8
fin. ratio-afterbody	3.0
fin. ratio-total	12.524

Since the F-16A has been examined before, there was information available on the matching.²⁵ The results were repeated here for completeness. All of the available configurations from Reference 25 were selected for use in the ACSYNT analysis and are listed in Table 4. Figure 11 shows that C_{D0} was underpredicted by about 30%. Friction drag and wave drag were about 50 counts low. The general shape of the curve was the same, however. The drag rise Mach number was predicted well. Figures 12 and 13 show the lift curves and drag polars, respectively. Both the lift curve and drag polar were very close to the actual data. The lift was predicted from 5% low to 5% high and the drag was

Table 4 F-16A Conditions Available/Selected for Comparison

M	h (ft.)
.40	30,000
.60	30,000
.80	30,000
.85	30,000
.90	30,000
.95	30,000
1.05	30,000
1.20	30,000
1.40	30,000
1.60	30,000

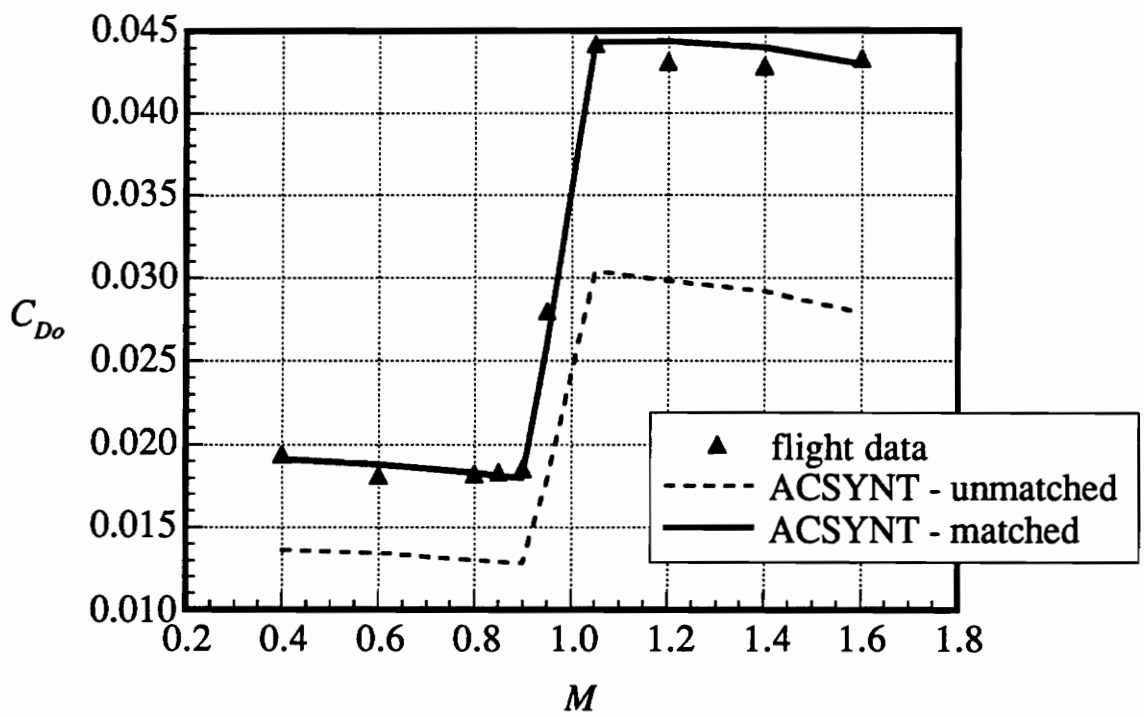


Figure 11) F-16A Zero Lift Drag Mach Dependence

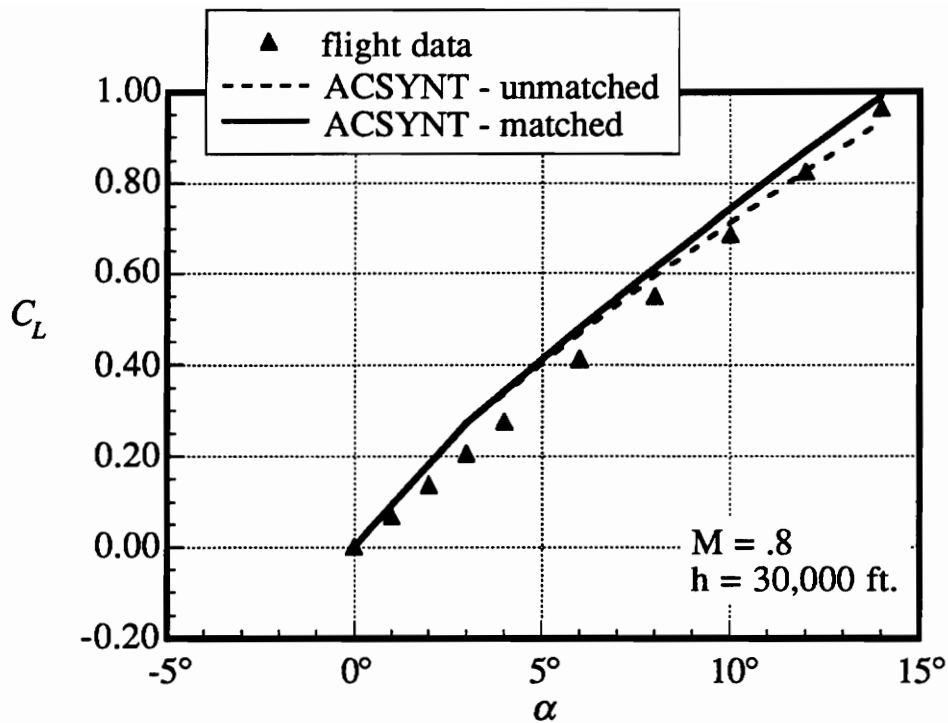


Figure 12) F-16A Lift Coefficient.

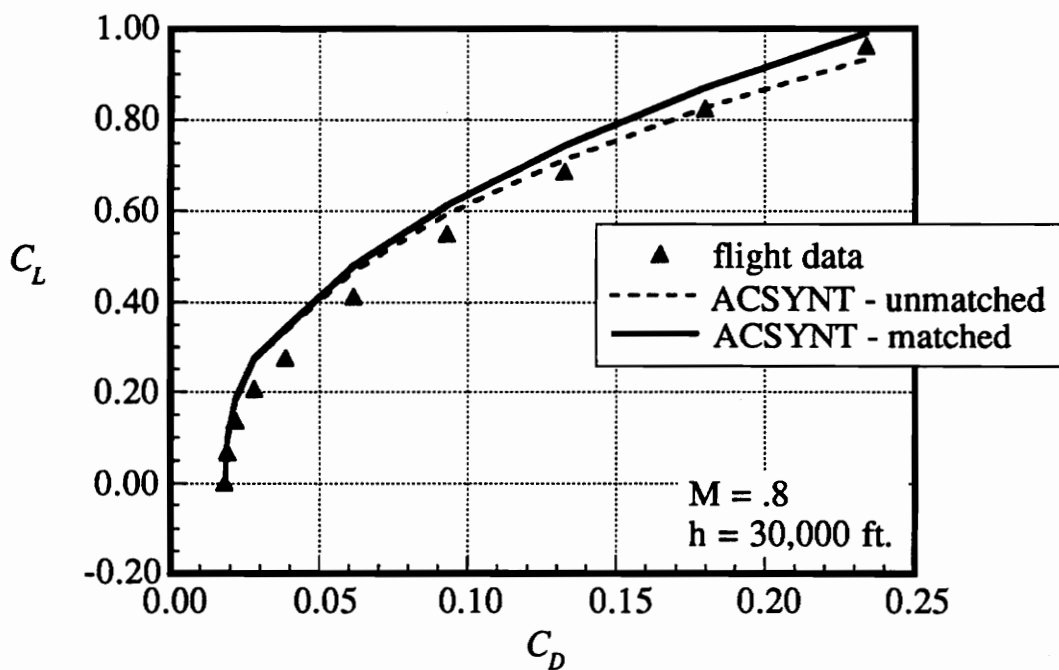


Figure 13) F-16A Drag Polar

predicted from 9% low to 5% high. The break in the lift curve at about $\alpha = 3^\circ$ is due to a change in the flow zone from (shockless) compressible to leading edge Mach limit.

Since the matching improves the ACSYNT calculated slopes, and not the actual lift and drag values, as explained earlier, matching results in poorer agreement with the flight data than the unmatched estimates here. FVCAM adjusts $C_L\alpha$, so the C_L vs. α curve is moved to match the slope of the data. Similarly, FLDM adjusts C_L^2/C_{Di} , the drag polar slope.

XB-70

The XB-70 ACSYNT geometry is shown in Figure 14, and the parameters are listed in Tables 5a and 5b. The ACSYNT model consists of ten components. The fuselage is split into three parts (nose, mid-section, afterbody). The nose has a downward cant angle and the afterbody is drastically tapered as it blends into the wing/inlets. Neither the downward canted nose, nor the downswept, tapered fuselage can be analyzed by ACSYNT. As a result, the fuselage is straightened out during analysis. The wing is modeled as a sharp, delta-shaped airfoil. As mentioned earlier, for $M > 1.0$, the XB-70 wing tips deflect down to improve stability. The tip deflections can be modeled by the ACSYNT geometry, but cannot be analyzed. The data used for comparison did contain the deflections and is, therefore, a source of discrepancy. The effect of the tip deflections could be modeled and analyzed by using a wing with the tips truncated. The XB-70 has two tails and a canard. The 2-D rectangular inlets are troublesome to model due to their dependencies in both the aerodynamics and propulsion modules. The canopy is included in the model, but cannot be analyzed. A fuselage storage pod is used to represent the bleed dump fairing.

Initially, the post-analysis geometry showed that, for the XB-70, the ZROOT and YROOT variables were incorrect. This could be due to the fact that ACSYNT cannot analyze a “bent” fuselage. Therefore, ACSYNT straightened out the fuselage. This threw off the positioning variables, ZROOT and YROOT, that were based on the fuselage. Specifically,

the canard, wing, canopy, engines and bleed dump fairing were out of position. Also, the real XB-70 fuselage cross section is not perfectly circular. The area of a component which is partially buried in the fuselage may be different than expected for a specific ZROOT value. This affects the position and thus the wetted area calculation. Table 6 shows the wetted areas and wetted area factors for the XB-70. The variables ZROOT and YROOT were adjusted until the post-analysis geometry had the components in the correct position. In post-analysis, the inlets were enlarged and the engines shrank. These changes are due to the analysis. The final post-analysis geometry is shown in Figure 15.

Table 5a XB-70 Airfoil Surfaces

	wing	canard	vertical tail (2)
aspect ratio	1.751	1.996	1.00
area (ft ²)	6296.4	414.777	223.960
dihedral (deg.)	0	0	0
quarter chord sweep (deg.)	58.804°	31.366°	45.0°
taper ratio	.019	.349	.300
T/C root	.02	.025	.02
T/C tip	.03	.02	.02
x-location of 1/4 chord (ft.)	96.0	39.0	167.0
y-location (ft.)	0	0	15.0
z-location (ft.)	.716	7.216	.716
twist (deg.)	0	0	0
span (ft.)	105.0	28.773	15.295
root chord (ft.)	112.695	21.371	23.531

Table 5b XB-70 Geometry

fuselage		engines (6)		inlets (2)	
length (ft.)	185.295	length (ft.)	19.75	length (ft.)	85.137
diameter (ft.)	8.80	diameter (ft.)	4.354	cowl length (ft.)	52.359
fineness ratio-nose	3.443	x-location (ft.)	164.25	capture area (ft ²)	39.15
fin. ratio-afterbody	16.705	y-location (ft.)	2.5,7.5,12.5	aspect ratio	.947
fin. ratio-total	21.056	z-location (ft.)	-3.0		

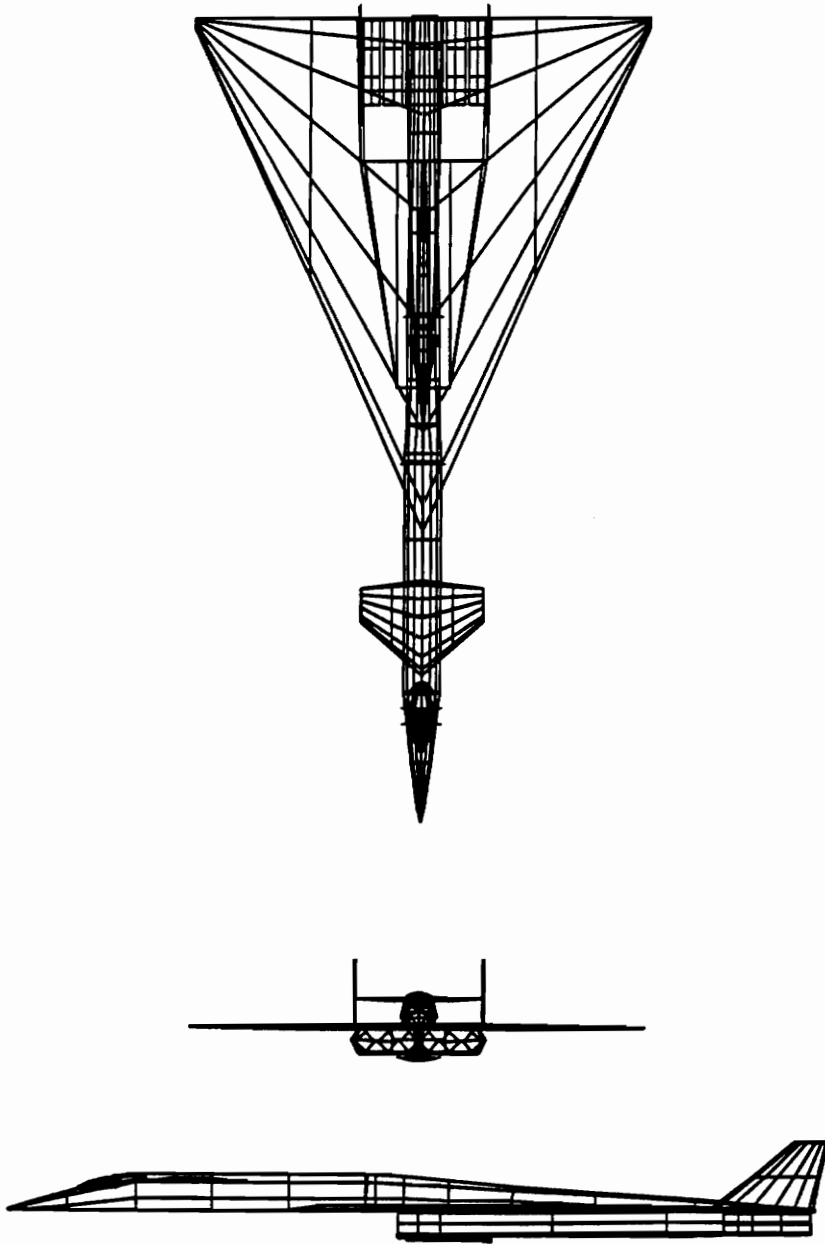


Figure 14) ACSYNT XB-70 Geometry

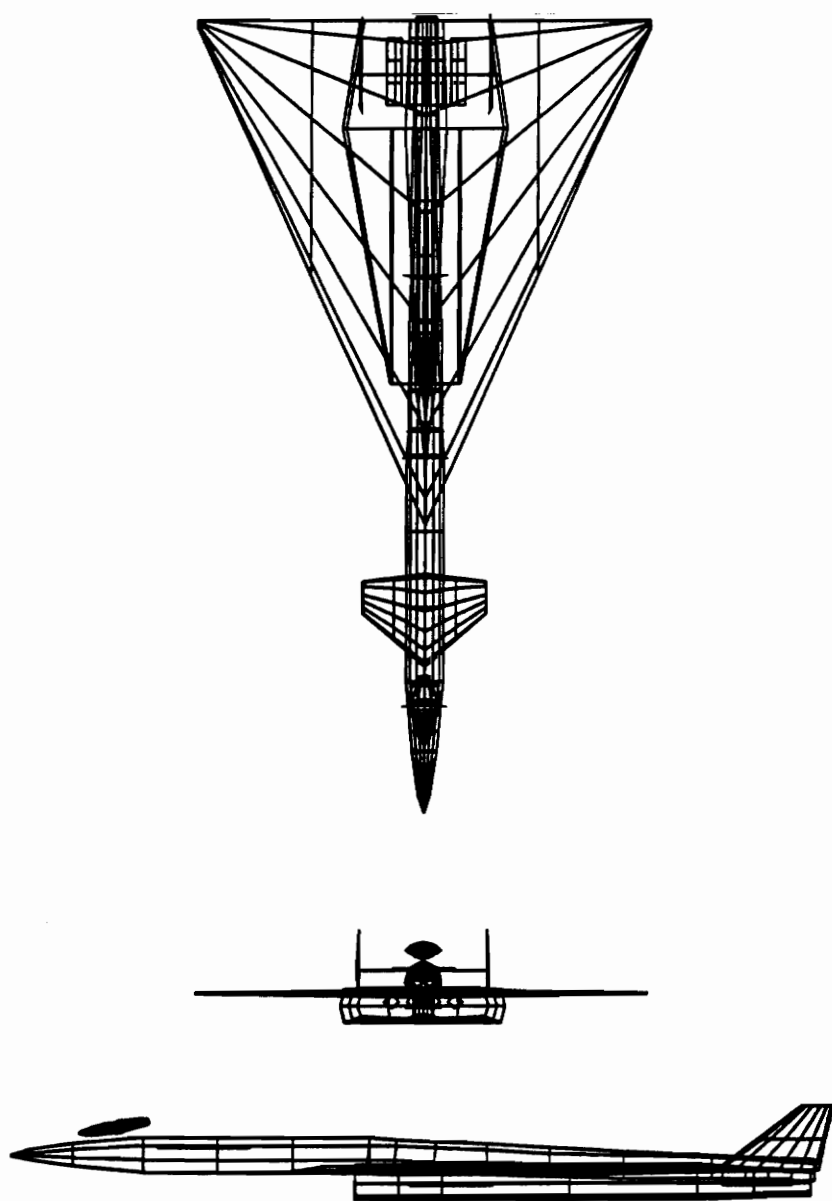


Figure 15) ACSYNT XB-70 Post-analysis Geometry

Table 6 XB-70 Wetted Areas (ft.²)

	XB-70 airplane (Reference 26)	Calculated Estimate	ACSYNT Model	SWFACT, SFFACT
Canard	532.6	530.5	540.2	.986
Wing	9307.7	9551.3	11,374.5	.818
Vertical Tail	937.7	935.8	700.6	1.338
Fuselage	2850.0	3281.8	4488.3	.635

The main discrepancy in wetted area was the vertical tail wetted area. The XB-70 tails are away from the fuselage ($Y_{ROOT} = 3.409$) and connected to the wing. In the ACSYNT calculation, Y_{ROOT} is not used. The tails are treated as being in the fuselage and thus having buried area. This explains the low estimation of the wetted area. Low wetted area will, in turn, cause low drag estimates, especially for skin friction. The variable VTNO (number of vertical tails) is used, but the area shown in the output is for one vertical tail only. Therefore, care must be taken when comparing the wetted areas.

The results for the XB-70 analysis are in Figures 16,17 and 18. References 26 and 27 contain test results from many flight conditions. Only seven of these conditions had complete lift and drag data, and were the only conditions that could be compared to ACSYNT. The conditions available and those selected are listed in Tables 7a and 7b, respectively. The base drag is included in the flight test data for C_{D0} . The base drag, given separately in Reference 27, was removed from the flight data for comparison to the ACSYNT C_{D0} , which does not include base drag. C_{D0} vs. *Mach number* is shown in Figure 16. The zero lift drag was predicted from 6% to 66% high. The unmatched prediction was not very good in the supersonic region, especially around $M = 1.0$. The experimental data was affected at the $M = 1.06$ condition by the small acceleration rate of the aircraft in flight and the large elevator deflections for trimming.²⁶ The low computational prediction of the wave drag was also found by Gary Hill of NASA -

Ames.²⁸ He suggested that the XB-70's surface is very rough from rivets, welds and other surface protrusions. This is a contribution to wave drag that does not show up in ACSYNT. ACSYNT also relies heavily on the fuselage shape to predict wave drag. For the actual aircraft, the trimming is done using both the canard and the elevons. The deflections of the relatively large elevons also contribute to the wave drag. In ACSYNT analysis, trimming can be done by the canard or flaps (elevons), but not both. The canard was used to trim here, so the influence of the elevons on drag was not captured. The XB-70 has a thin fuselage that tapers as it blends into the wing. This could be a problem in the approach used to calculate wave drag. To illustrate the large effect of miscellaneous drag, Figure 16 includes wind tunnel results prior to the many adjustments made to compare with flight data. Matching the C_{D0} vs. *Mach number* curve is a simple matter of directly multiplying the friction drag by FCDF and the wave drag by FCDW.

The lift curve (C_L vs. α) prediction produced mixed results. The lift prediction was from 15% low to 25% high. The prediction was good except around $M = 1.0$ and $M = 2.1$ to 2.5. ACSYNT underpredicts the lift for subsonic Mach numbers. This gets worse in the transonic region, specifically at $M = 1.06$. As the Mach numbers pass out of the transonic region and into the supersonic, ACSYNT lift predictions are too high. One reason for this is the inability of ACSYNT to analyze deflected wing tips. Deflected wing tips were modeled by truncating the wing tips to match the projected span. This captured the effect of the deflected tips on lift and drag. ACSYNT analysis was run again and the results were in very close agreement with the flight data. The results for $M = 2.5$ are shown in Figure 17g.

The drag polar prediction went from 8% low to 40% high. Drag prediction was good except just above $M = 1.0$. ACSYNT overpredicted drag, or underpredicted lift, at subsonic Mach numbers. The problems occurred mostly in the transonic region. For $M = 1.06$ and 1.18, the C_{D0} 's are off considerably and mislocate the drag polar. As shown in References 26 and 27, NASA had some difficulty matching flight and wind tunnel data. The slopes of

the transonic drag polars are also too small. The drag polars at $M = 1.65$ and 2.10 are slightly out of position, but their slopes are very close to that of the flight data. At $M=2.50$, the drag curve slope was overpredicted. Again, a model was run with the wing tips truncated. These unmatched results, shown in Figure 18g, fit the data almost perfectly.

Table 7a XB-70 Conditions Available for Comparison

M	h (ft.)	Re_{mac}(x10⁶)	δ_t (deg.)
.76	25,730	191.3	-.75°
.93	32,770	174.3	23.85°
1.06	27,140	242.0	24.00°
1.18	33,720	216.5	24.55°
1.15	34,121	208.7	23.15°
1.17	32,960	221.3	24.00°
1.61	38,570	269.1	61.85°
1.67	42,020	231.2	66.15°
2.10	48,600	216.5	62.30°
2.15	57,620	147.3	64.55°
2.53	62,950	133.0	63.00°
2.51	63,010	130.0	63.35°
2.56	63,070	134.5	63.10°
2.50	61,630	137.8	62.15°

Table 7b XB-70 Conditions Selected for Comparison

M	h (ft.)	Re_{mac}(x10⁶)	δ_t (deg.)
.76	25,730	191.3	-.75°
.93	32,770	174.3	23.85°
1.06	27,140	242.0	24.00°
1.18	33,720	216.5	24.55°
1.65	40,000	250.0	64.00°
2.10	48,600	216.5	62.30°
2.50	61,630	137.8	62.15°

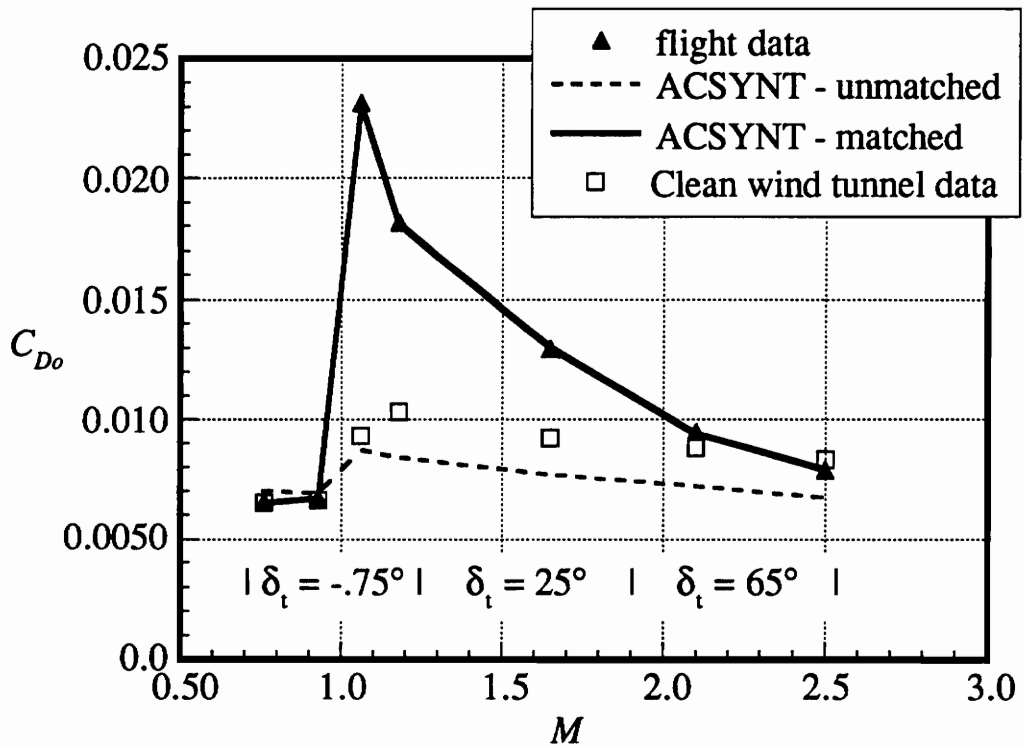


Figure 16) XB-70 Zero Lift Drag Mach Dependence

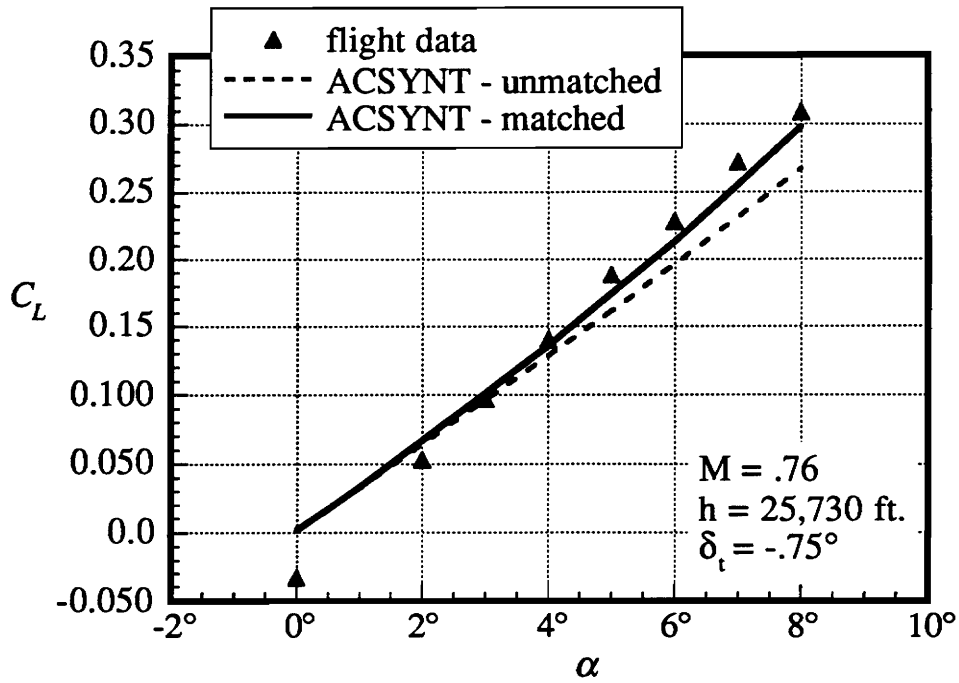


Figure 17a) XB-70 Lift Coefficient

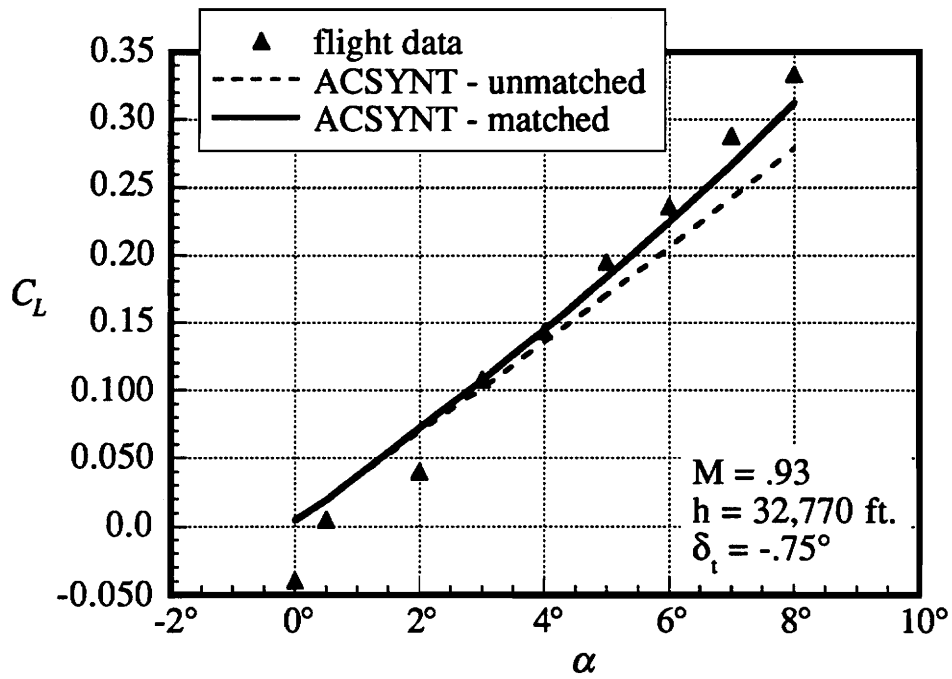


Figure 17b) XB-70 Lift Coefficient

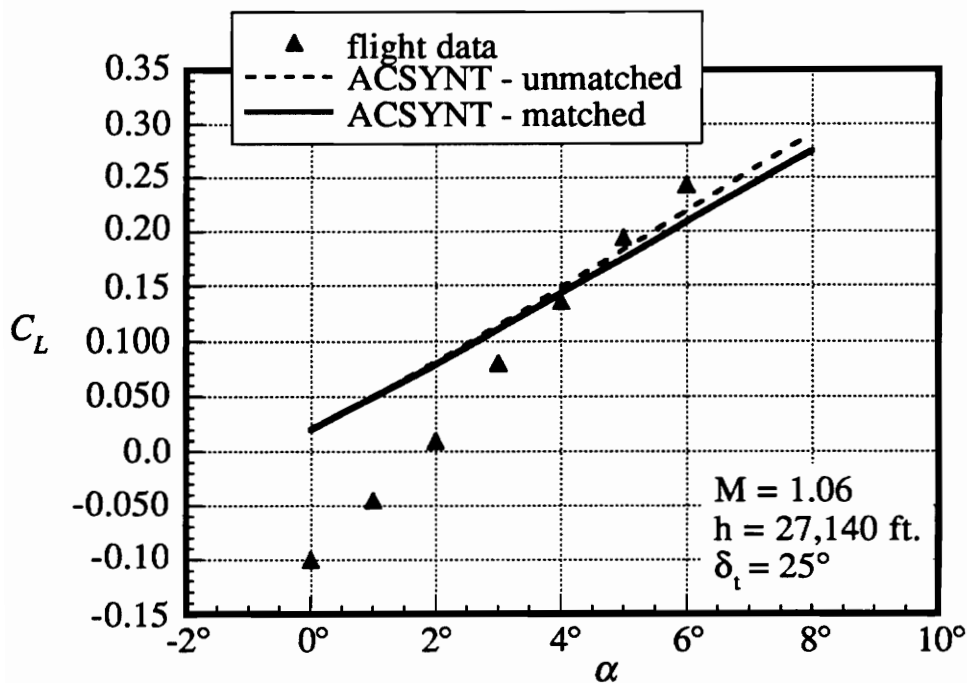


Figure 17c) XB-70 Lift Coefficient

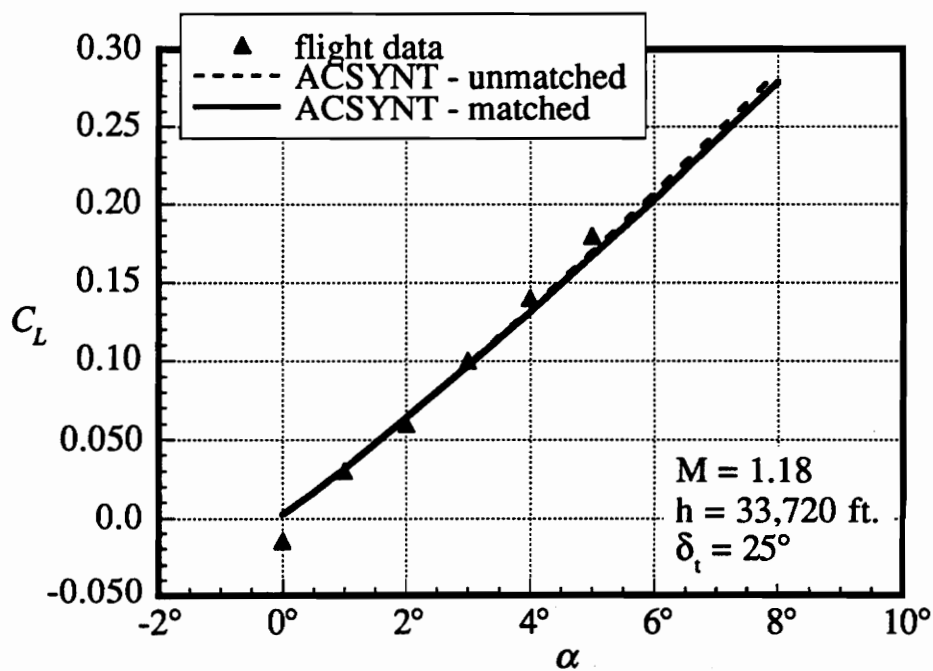


Figure 17d) XB-70 Lift Coefficient

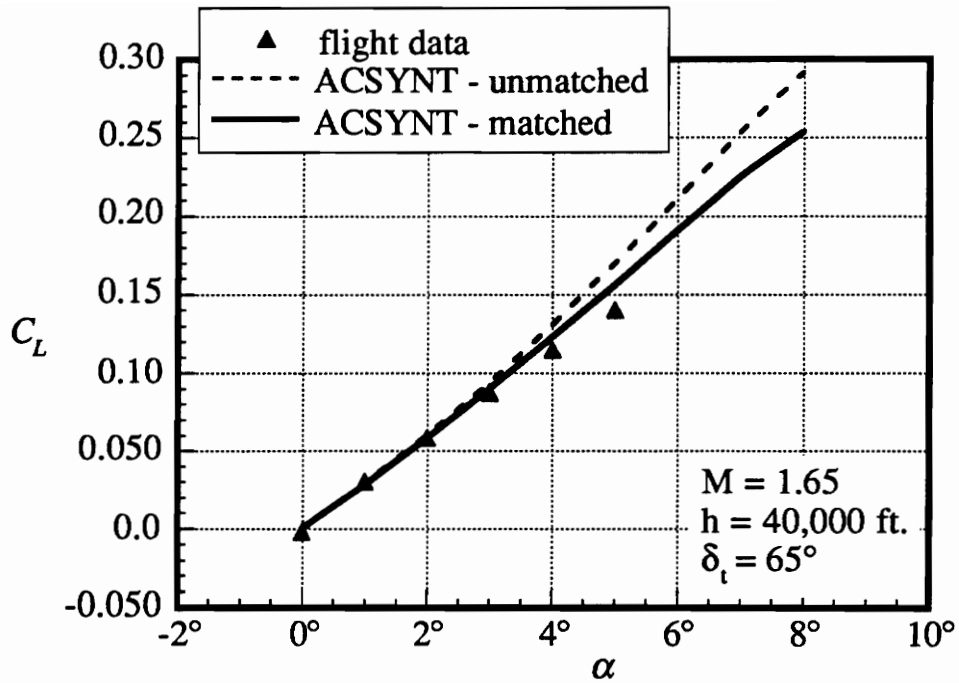


Figure 17e) XB-70 Lift Coefficient

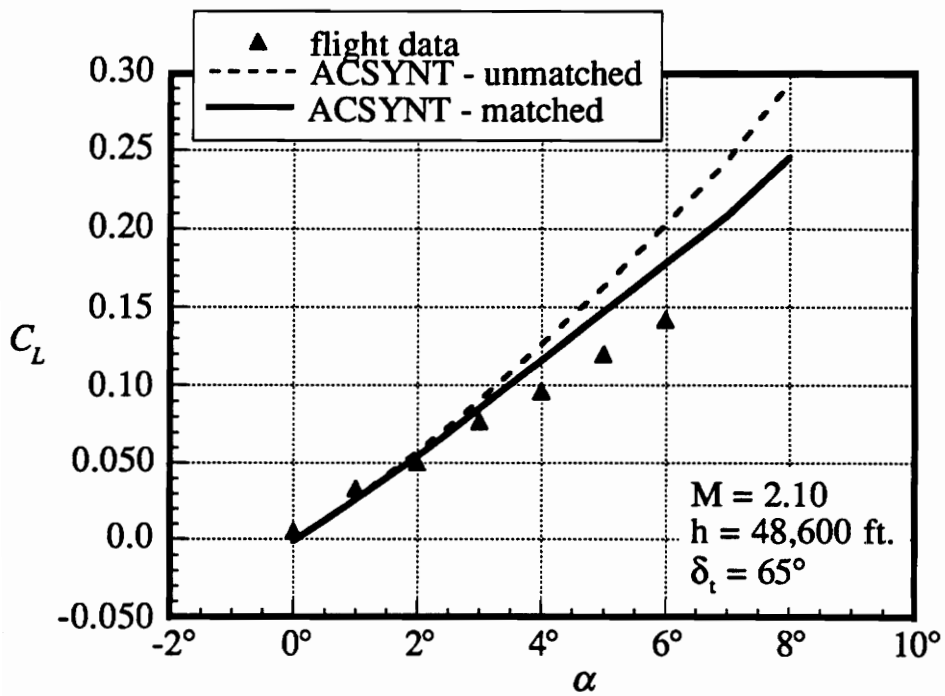


Figure 17f) XB-70 Lift Coefficient

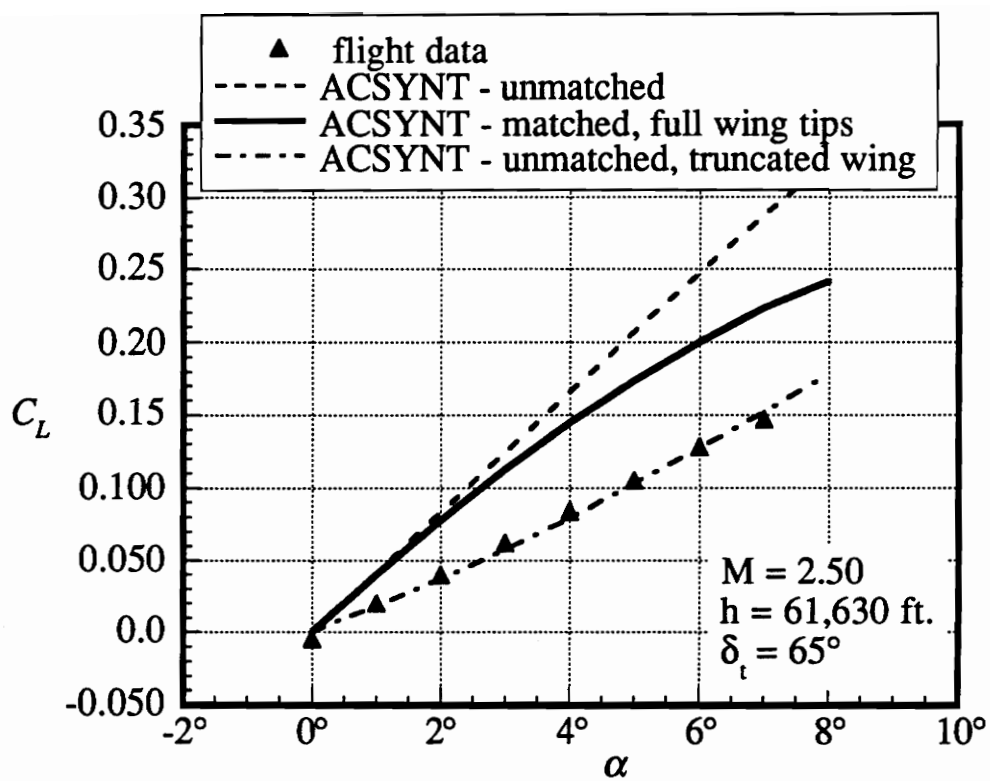


Figure 17g) XB-70 Lift Coefficient

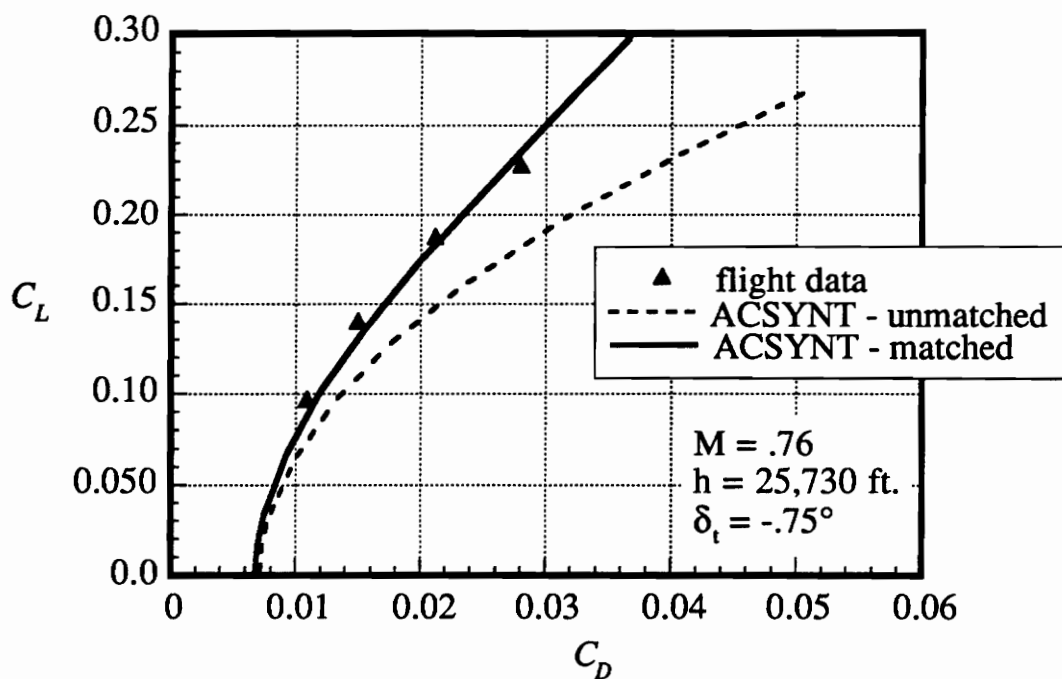


Figure 18a) XB-70 Drag Polar

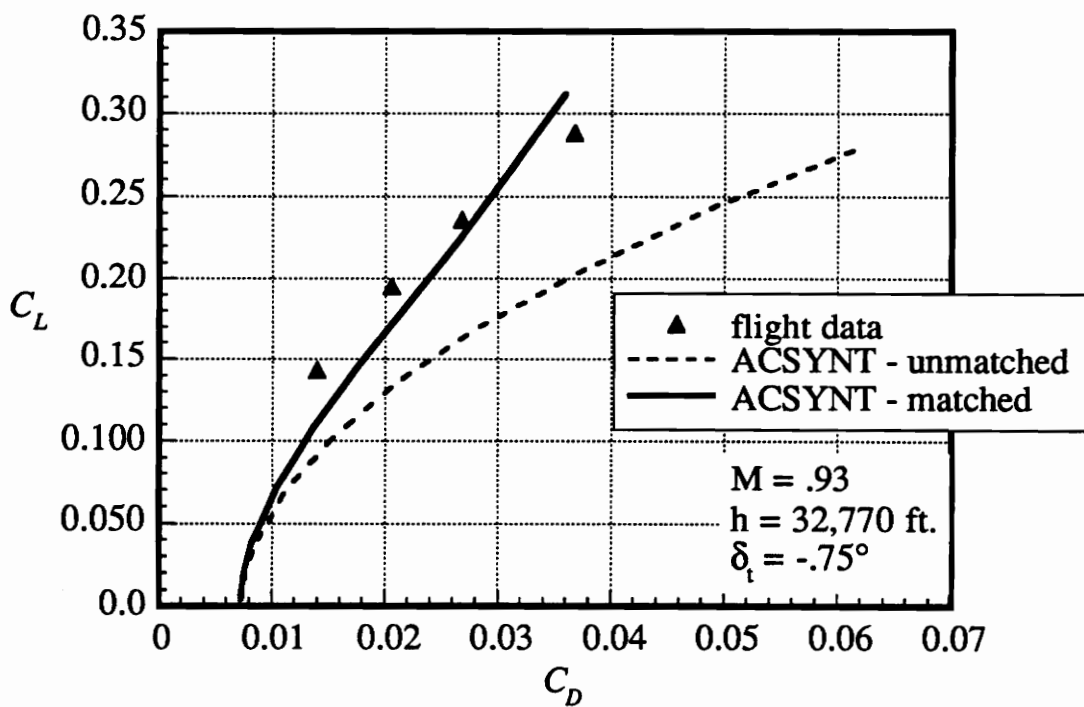


Figure 18b) XB-70 Drag Polar

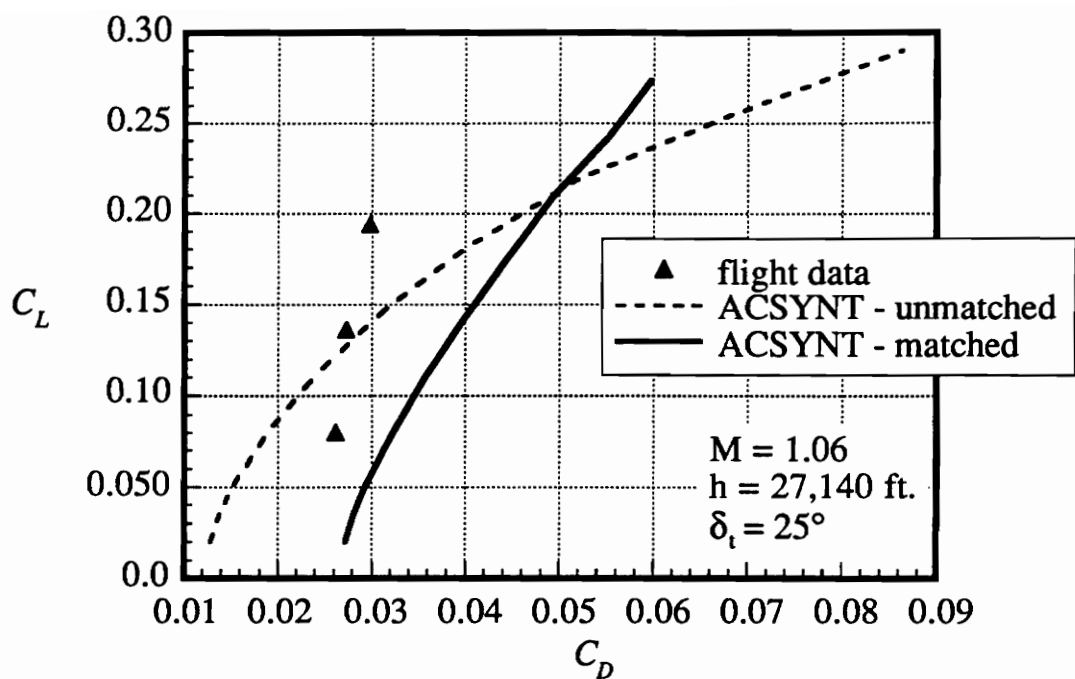


Figure 18c) XB-70 Drag Polar

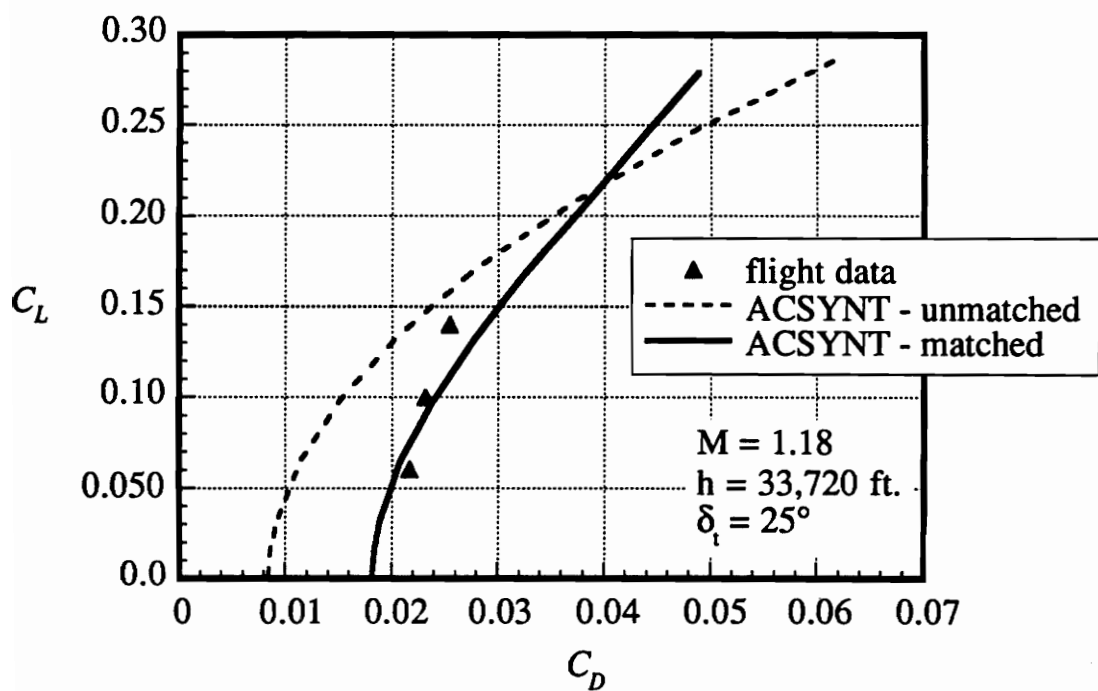


Figure 18d) XB-70 Drag Polar

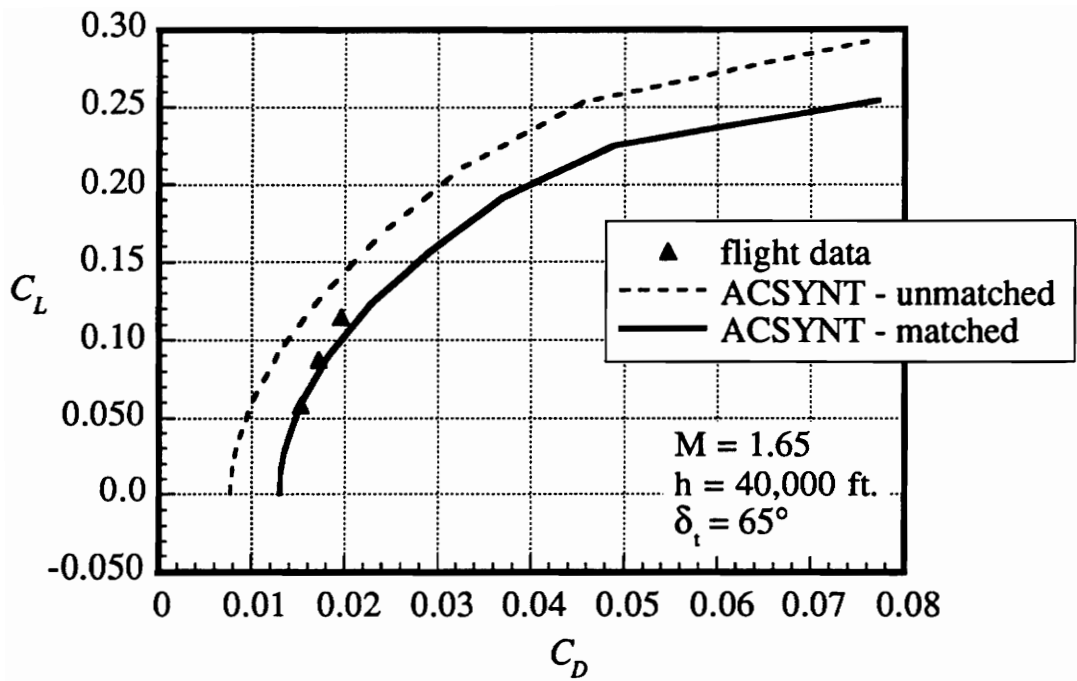


Figure 18e) XB-70 Drag Polar

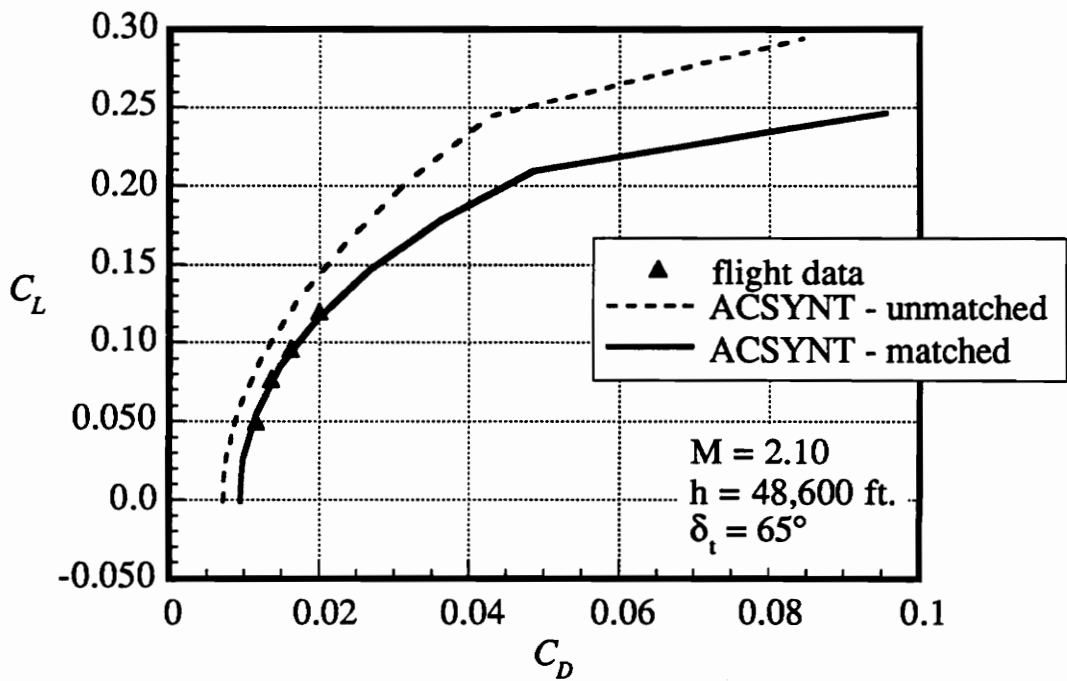


Figure 18f) XB-70 Drag Polar

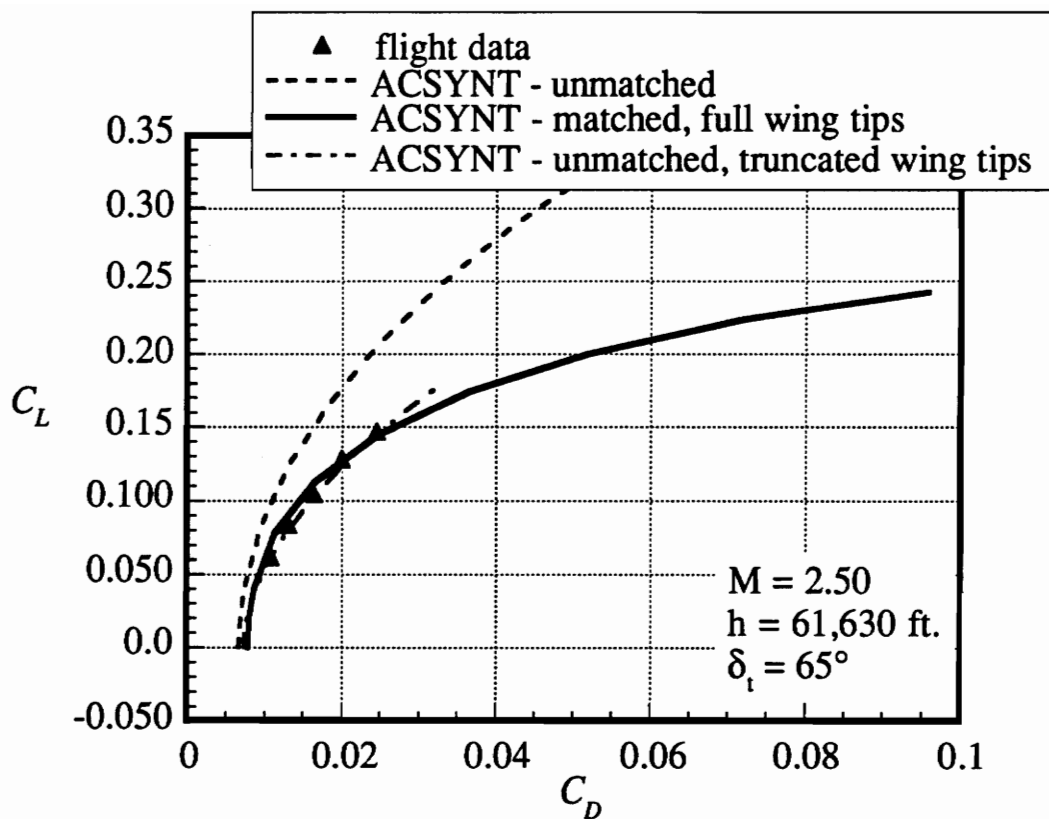


Figure 18g) XB-70 Drag Polar

Subsonic Transport

The ACSYNT model is relatively simple and is presented in Figure 19. The geometric parameters are in Tables 8a and 8b. The fuselage has a slight downward nose cant and the afterbody is upswept. Pods are attached to the sides of the fuselage to represent the landing gear housing. The wings are attached to the top of the fuselage and the tail is a T-tail. The four engines are located beneath the wings, and each engine is made up of two parts. The cylindrical engine pods are partially covered by a fuselage pod that represents the cowlings. The post-analysis geometry showed a straightened out fuselage and no dihedral angle due to ACSYNT geometry limitations. The changes to the fuselage included removal of the afterbody upsweep, nose cant angle, and nose roundness. These geometry changes required a couple of minor adjustments to position other components correctly. The horizontal tail had to be adjusted in the axial direction and the engines were adjusted in the z-direction. During the ACSYNT analysis, the engines are sized by the propulsion module to meet performance requirements set by the aircraft drag and weight. The engine pods' positions are dependent on the pod size; therefore, sizing of the engines contributes to the movement of the engines. All other components were positioned correctly. The final post-analysis geometry is in Figure 20.

In general, the analysis predicted well and the matching was mostly for fine tuning. The results for the subsonic transport are given in Figures 21, 22 and 23. The test conditions for the subsonic transport analysis are in Table 9. The first data compared was on the zero lift drag Mach dependence curve. The zero lift drag prediction ranged from 8% low to 25% high. For Mach numbers below .80, the prediction was low and for Mach numbers between .80 and .85, ACSYNT predicted high. There was a good prediction of when the supersonic drag began to have an effect (about $M = .8$). Since the original ACSYNT prediction was so close, the matching was done quite easily.

The lift curve slopes were very close to the data, although ACSYNT predictions were about 30% low. The slope of the ACSYNT curves decrease with larger angle of attack. This discrepancy is more pronounced at the higher Mach numbers. Matching improved the slopes, especially at the larger angles of attack; however, the actual data was not significantly shifted up to the test data. Setting values for the C_{Lo} would fix this.

Table 8a Subsonic Transport Airfoil Surfaces

	wing	horizontal tail	vertical tail
aspect ratio	8.0	4.888	1.50
area (ft ²)	6200.0	965.793	961.1
dihedral (deg.)	-5°	-5°	0
quarter chord sweep (deg.)	26.183°	26.250°	32.528°
taper ratio	.333	.420	.768
T/C root	.12	.11	.09
T/C tip	.11	.08	.09
x-location of 1/4 chord (ft.)	79.513	226.852	203.356
y-location (ft.)	0	0	0
z-location (ft.)	12.75	49.50	12.039
twist (deg.)	2°	0	0
span (ft.)	222.71	68.708	32.969
root chord (ft.)	41.768	19.797	28.634

Table 8b Subsonic Transport Geometry

fuselage		engines (4)		landing gear pods	
length (ft.)	230.72	length (ft.)	24.0	length (ft.)	72.5
diameter (ft.)	25.5	diameter (ft.)	8.160	diameter (ft.)	8.4
fineness ratio-nose	1.203	x-location (ft.)	75.0, 87.04	x-location (ft.)	74.07
fin. ratio-afterbody	3.413	y-location (ft.)	41.203, 64.8	y-location (ft.)	± 9
fin. ratio-total	9.048	z-location (ft.)	-1.389, -3.240	z-location (ft.)	-6

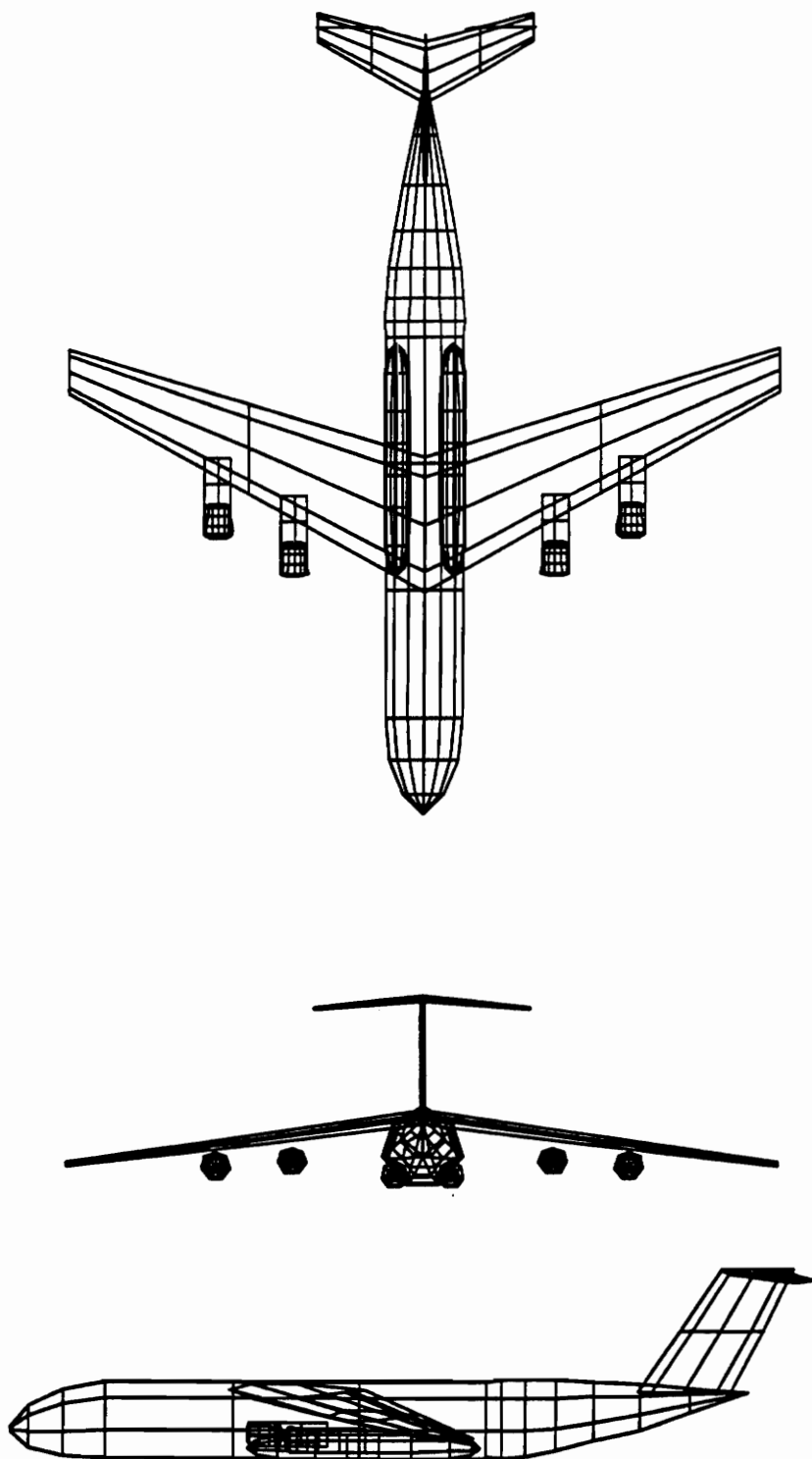


Figure 19) ACSYNT Subsonic Transport Geometry

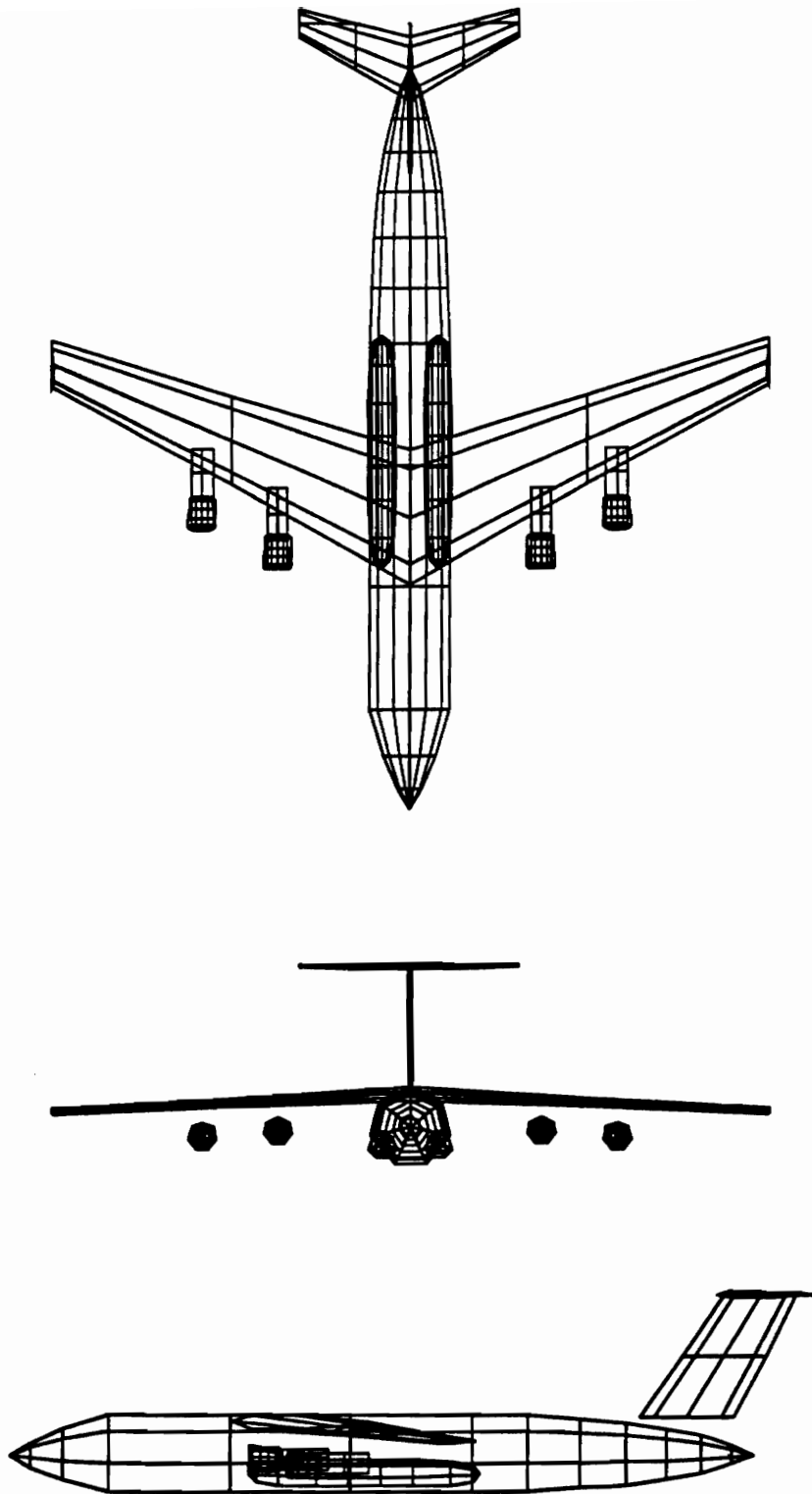


Figure 20) ACSYNT Subsonic Transport Post-analysis Geometry

Table 9 Subsonic Transport Conditions Selected for Comparison

M	h (ft.)
.60	10,000
.65	15,000
.70	20,000
.75	25,000
.77	27,000
.79	29,000
.80	30,000
.81	35,000
.825	40,000
.85	45,000

The drag polars were compared next. The drag prediction ranged from 8% low to 40% high. The point of minimum drag was in the right position until about $M = .825$. Generally, the upper part of the drag polar did not decrease in slope as rapidly as the test data. The upper part of the curve, for $M < .77$, was below the data. At $M = .77$ the curve intersected the data. For $M > .77$, the ACSYNT curve was above the test data. This problem is not likely to have been due to the error in prediction of C_L because the lift prediction was consistently low. It is most likely due to overprediction of drag. Matching of the drag polars helped with the slope and position of the upper portion of the curve; however, the error appears to get worse further along the curve due to troubles with matching the drag polar curvature. In other words, the drag polar slope can be matched, but there is no scaling factor to adjust the rate at which the slope changes.

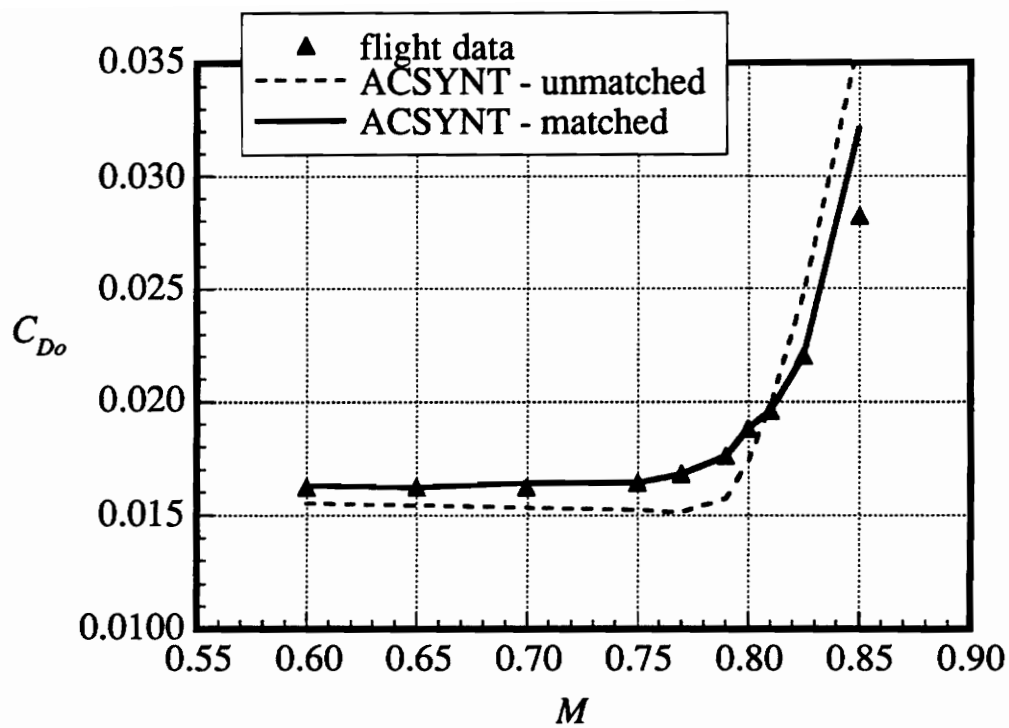


Figure 21) Subsonic Transport Zero Lift Drag Mach Dependence

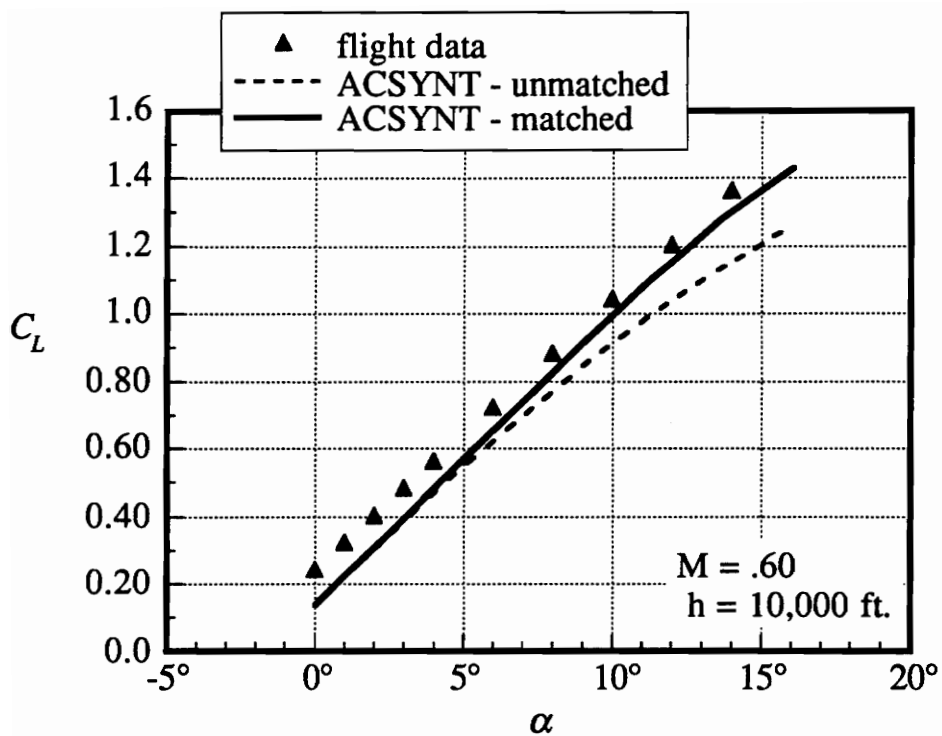


Figure 22a) Subsonic Transport Lift Coefficient

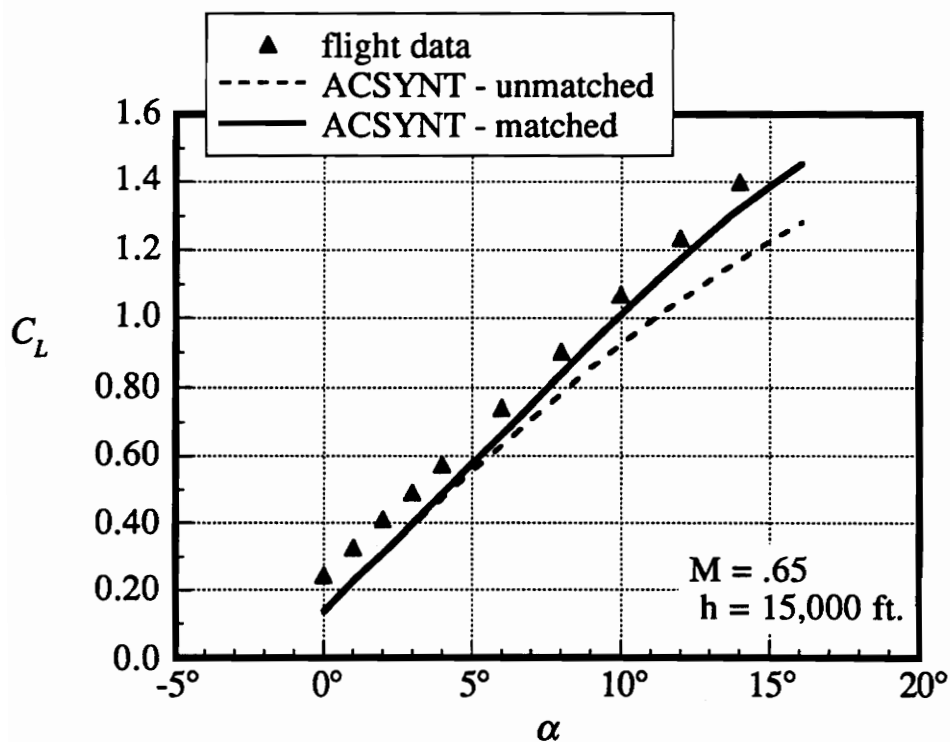


Figure 22b) Subsonic Transport Lift Coefficient

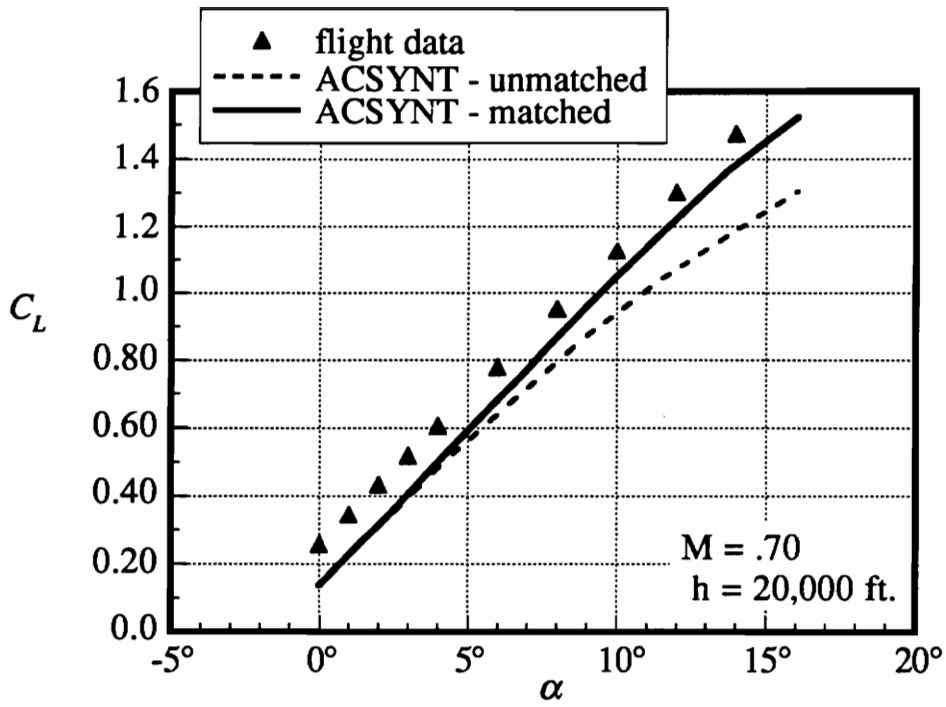


Figure 22c) Subsonic Transport Lift Coefficient

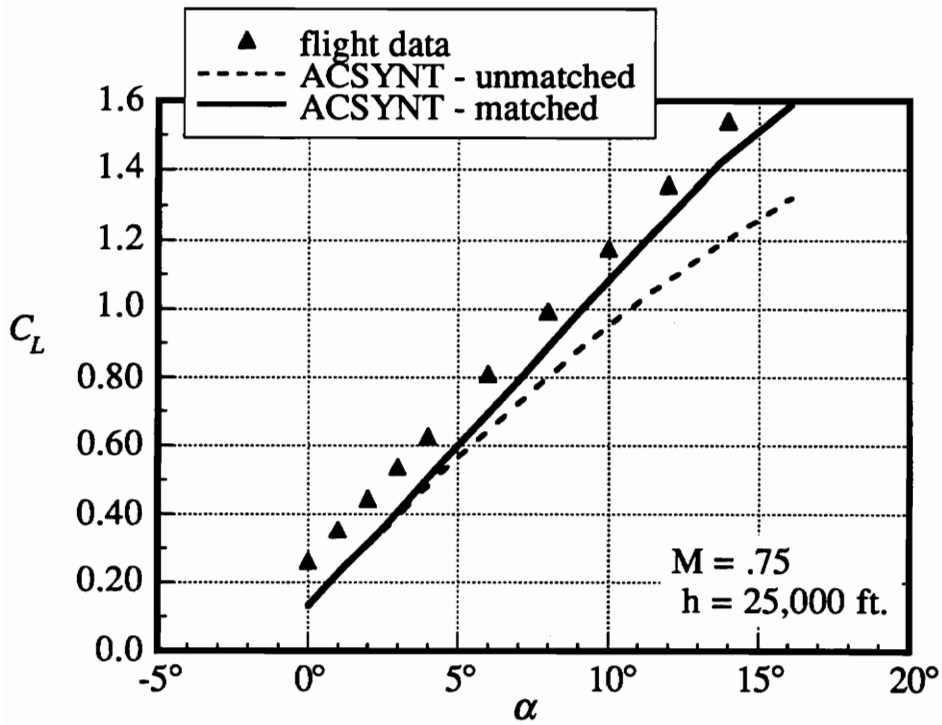


Figure 22d) Subsonic Transport Lift Coefficient

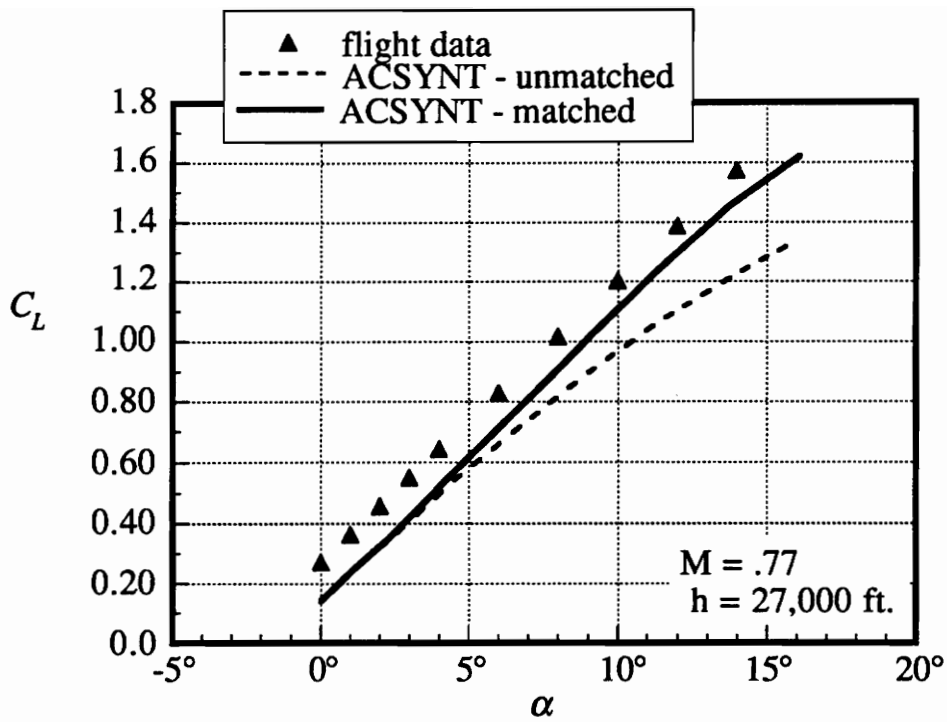


Figure 22e) Subsonic Transport Lift Coefficient

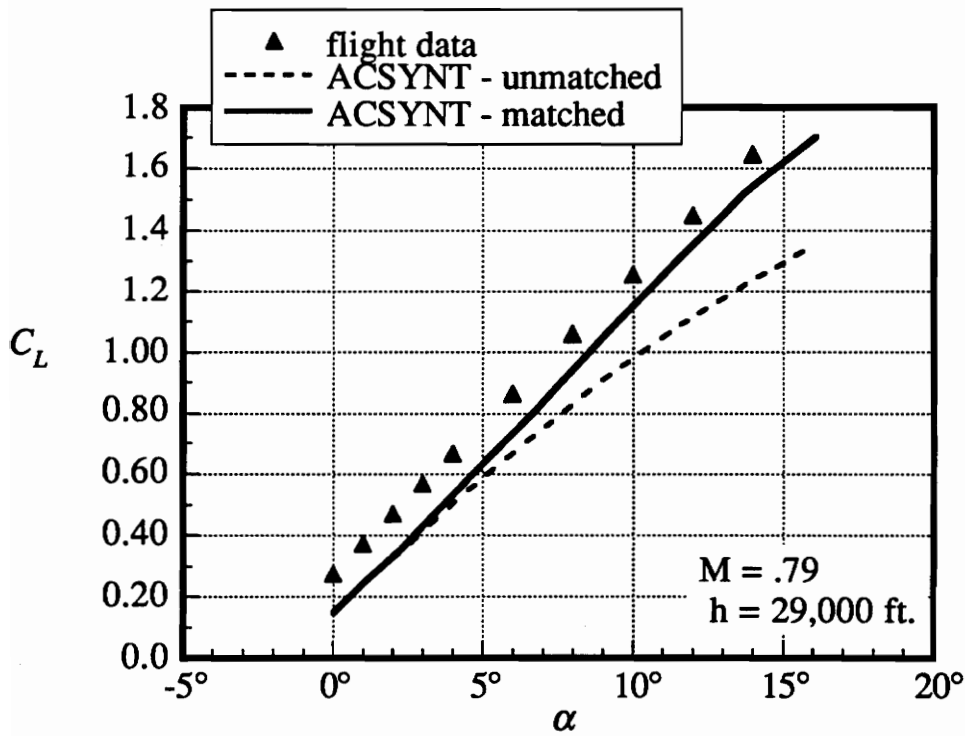


Figure 22f) Subsonic Transport Lift Coefficient

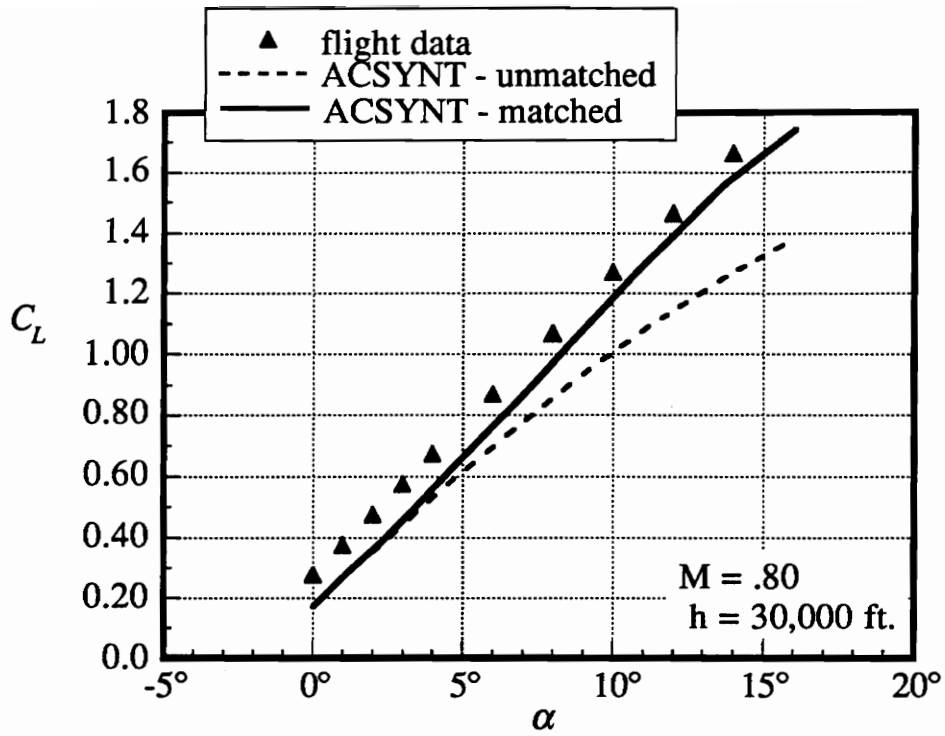


Figure 22g) Subsonic Transport Lift Coefficient

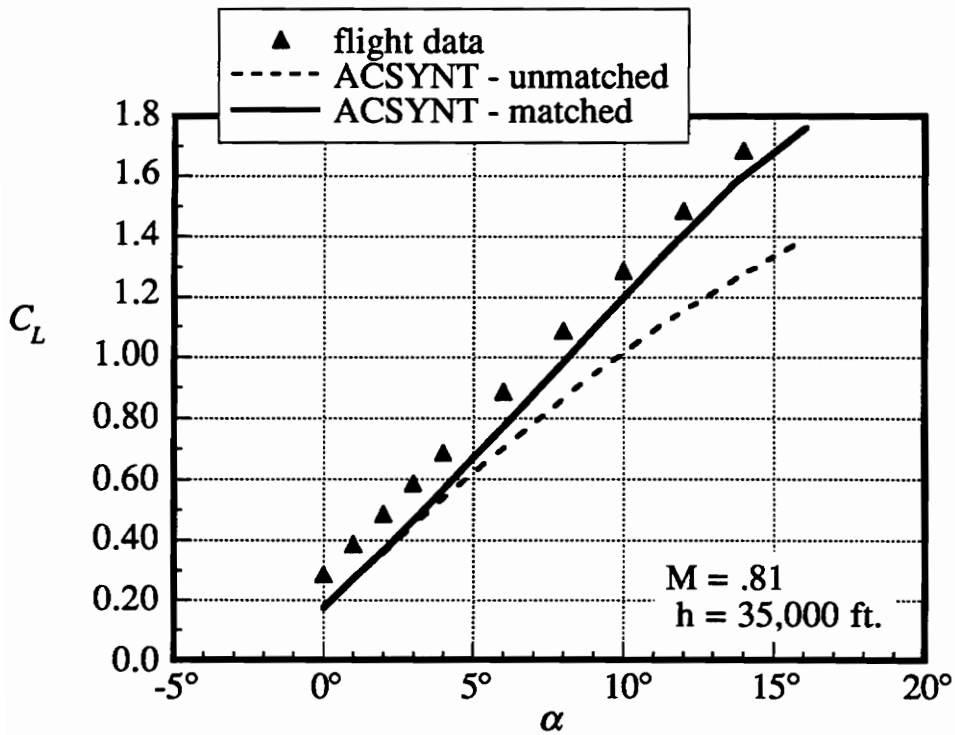


Figure 22h) Subsonic Transport Lift Coefficient

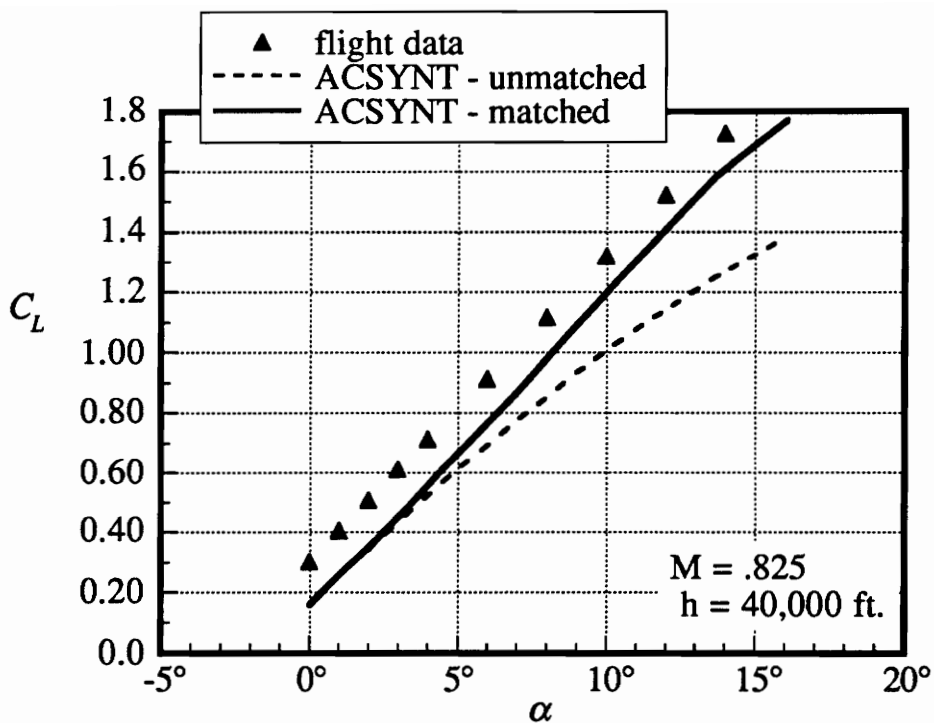


Figure 22i) Subsonic Transport Lift Coefficient

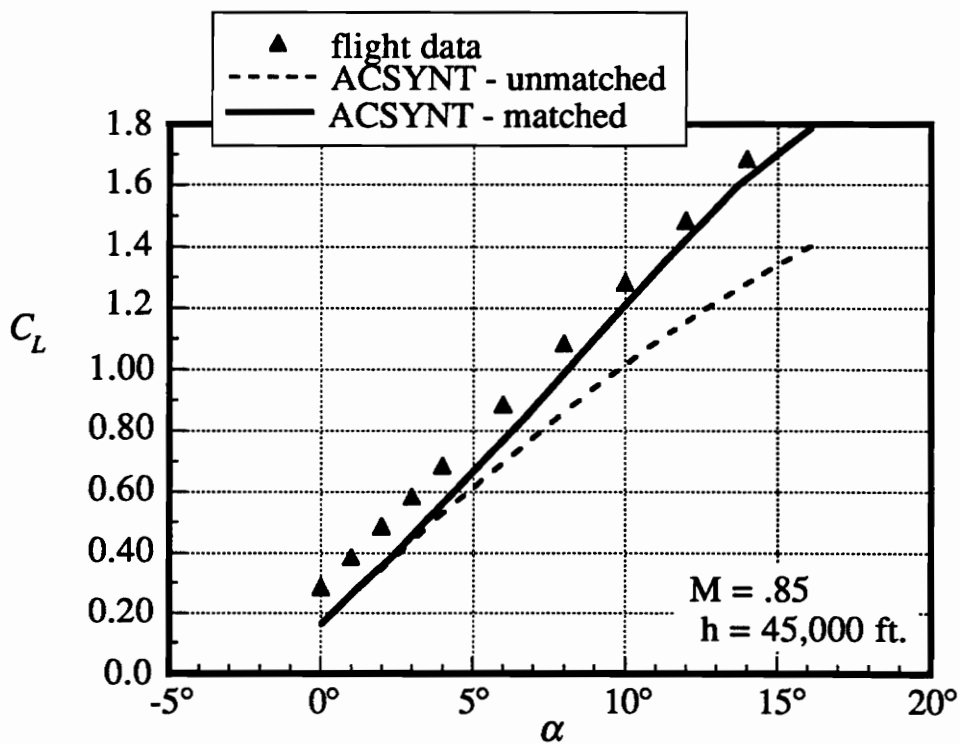


Figure 22j) Subsonic Transport Lift Coefficient

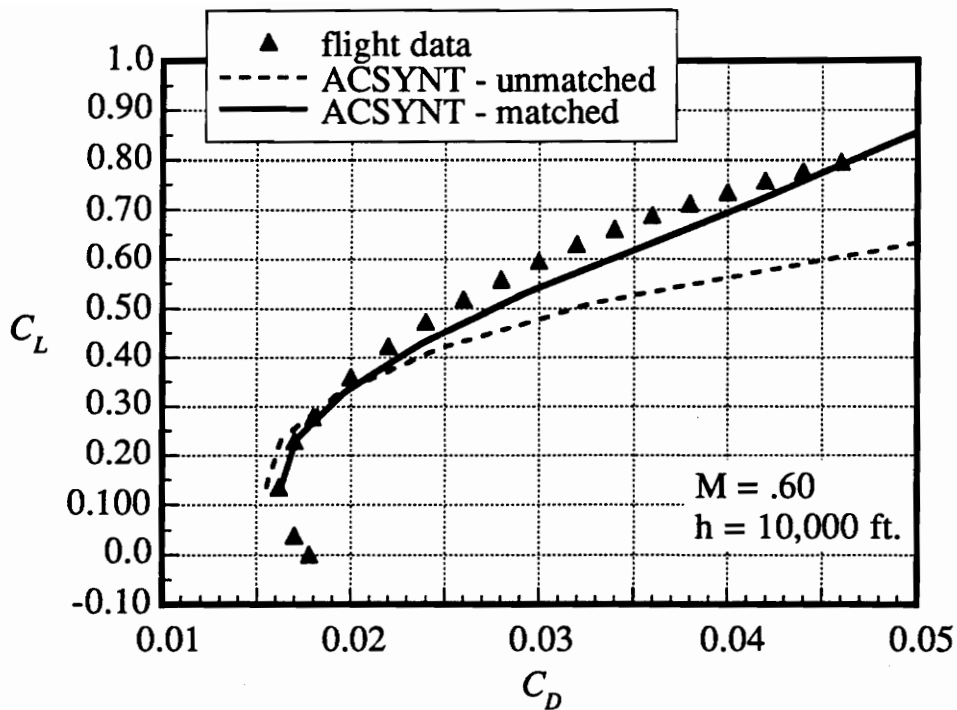


Figure 23a) Subsonic Transport Drag Polar

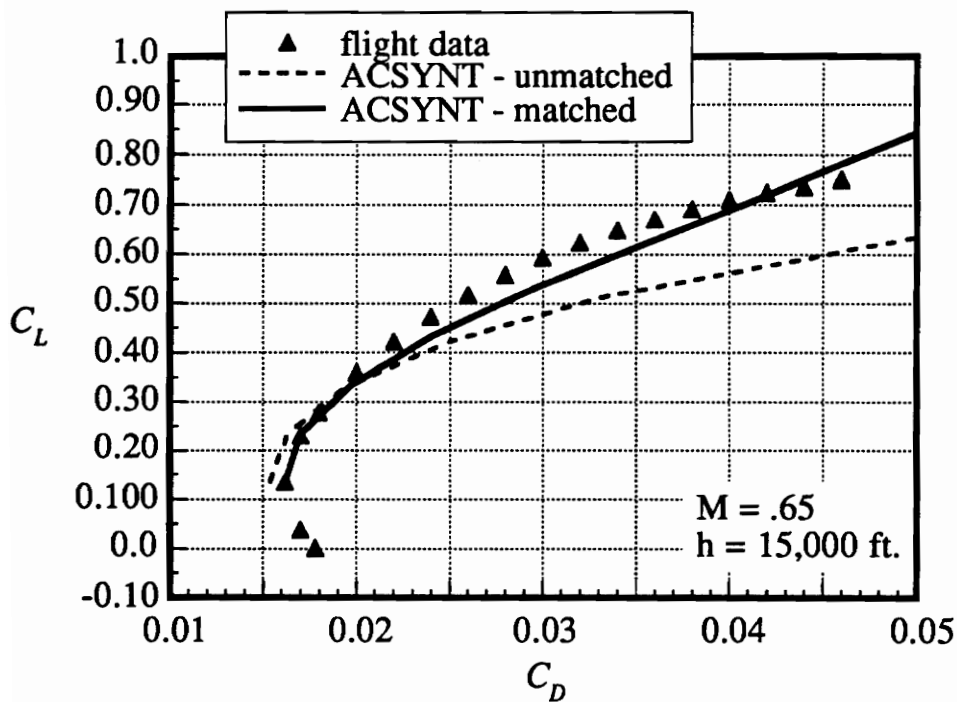


Figure 23b) Subsonic Transport Drag Polar

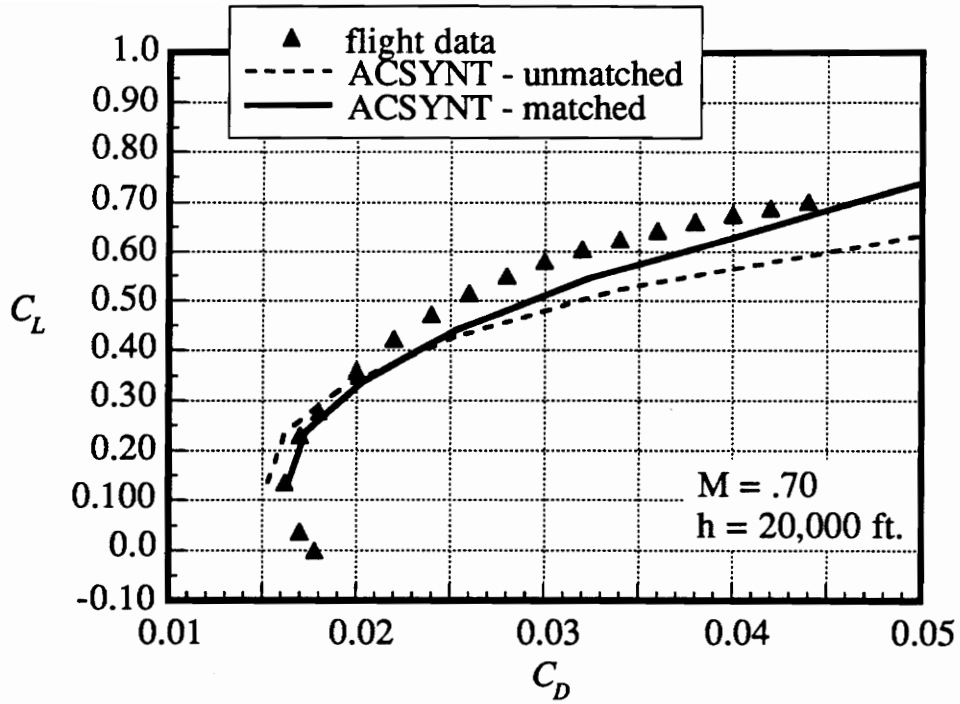


Figure 23c) Subsonic Transport Drag Polar

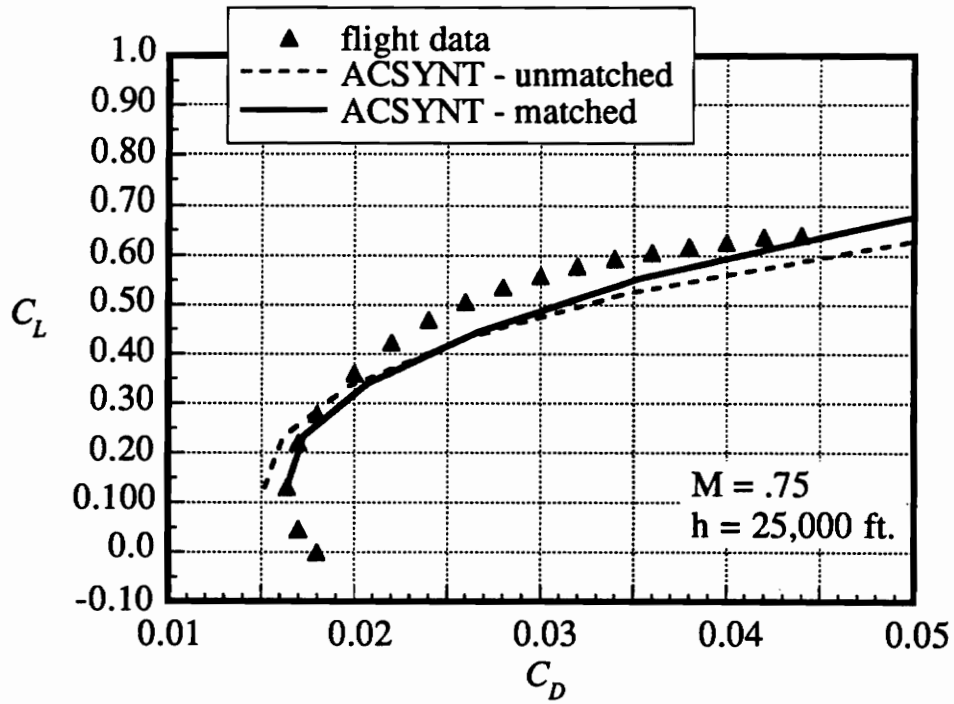


Figure 23d) Subsonic Transport Drag Polar

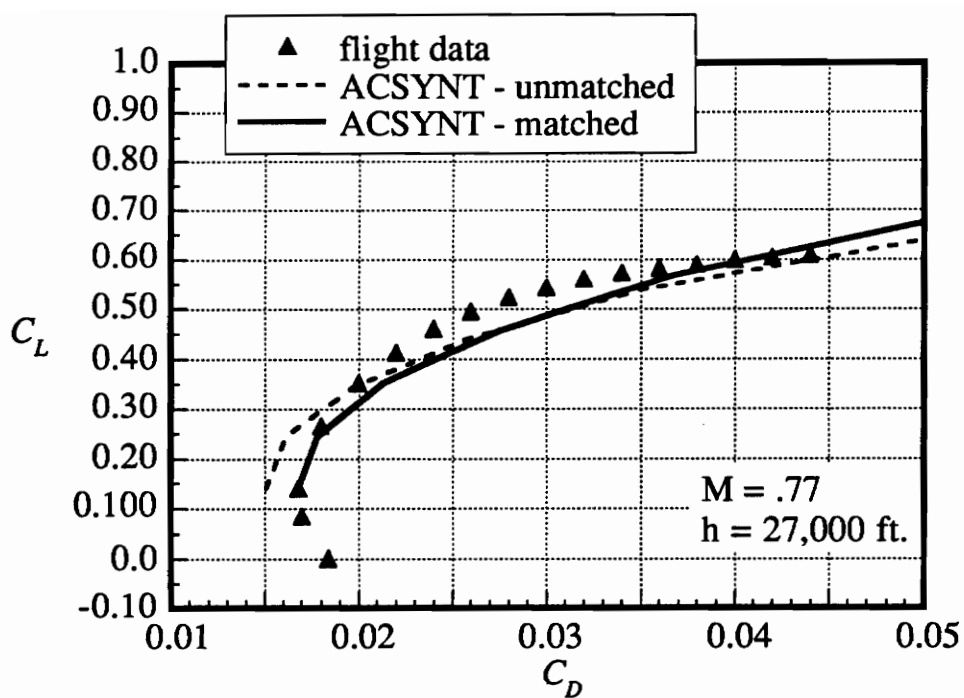


Figure 23e) Subsonic Transport Drag Polar

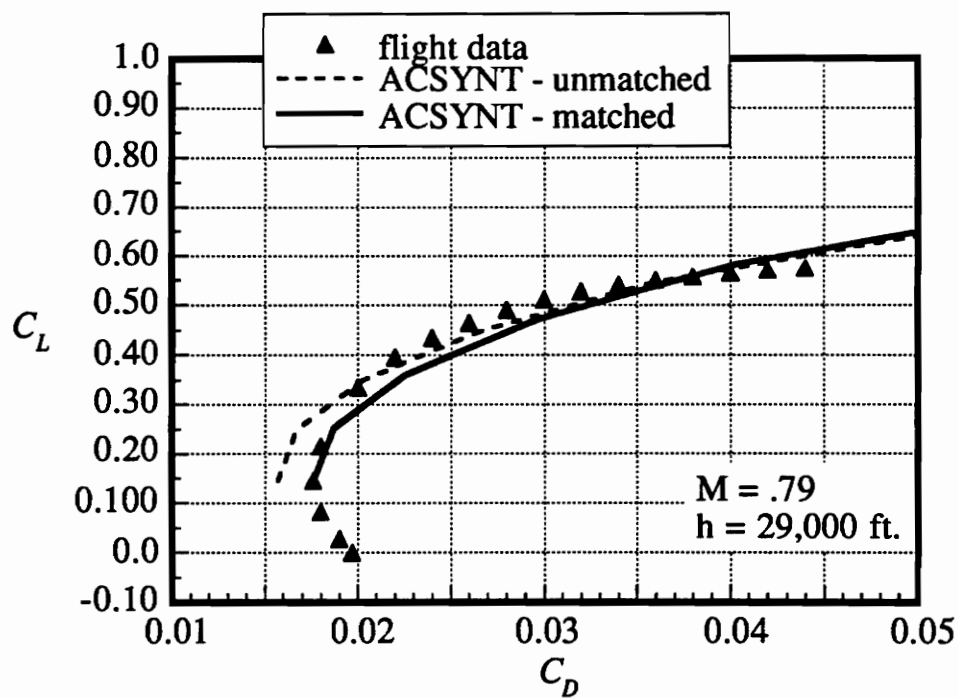


Figure 23f) Subsonic Transport Drag Polar

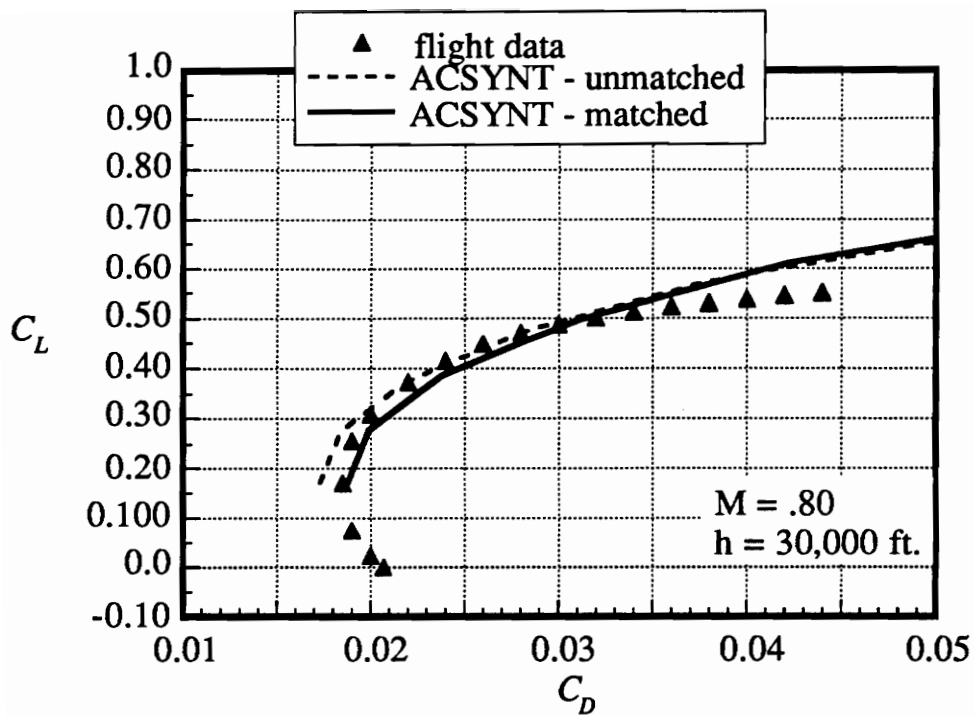


Figure 23g) Subsonic Transport Drag Polar

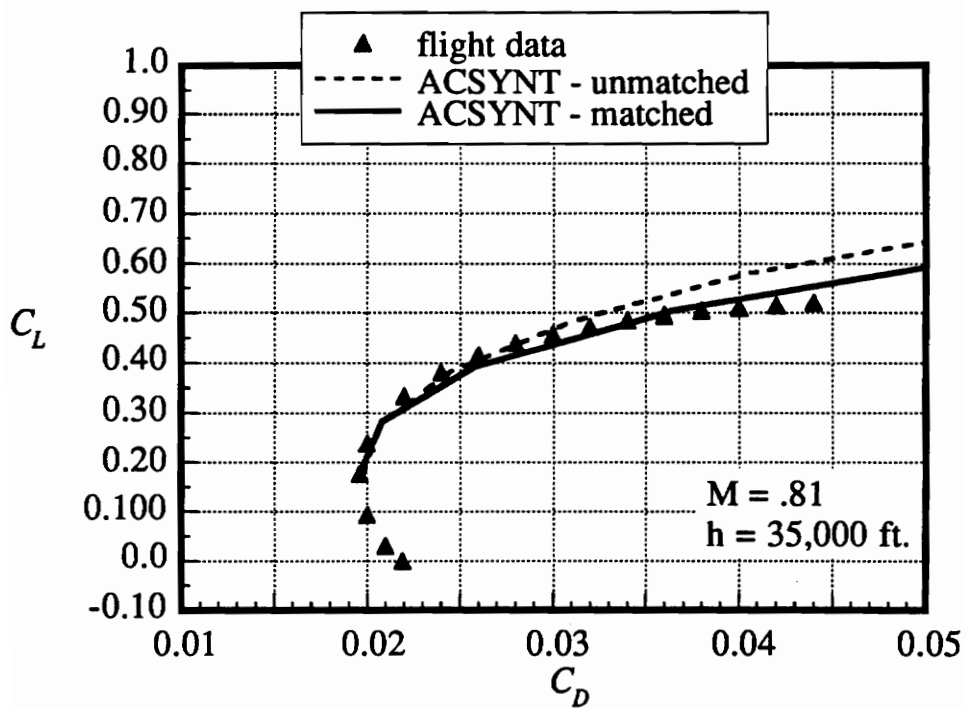


Figure 23h) Subsonic Transport Drag Polar

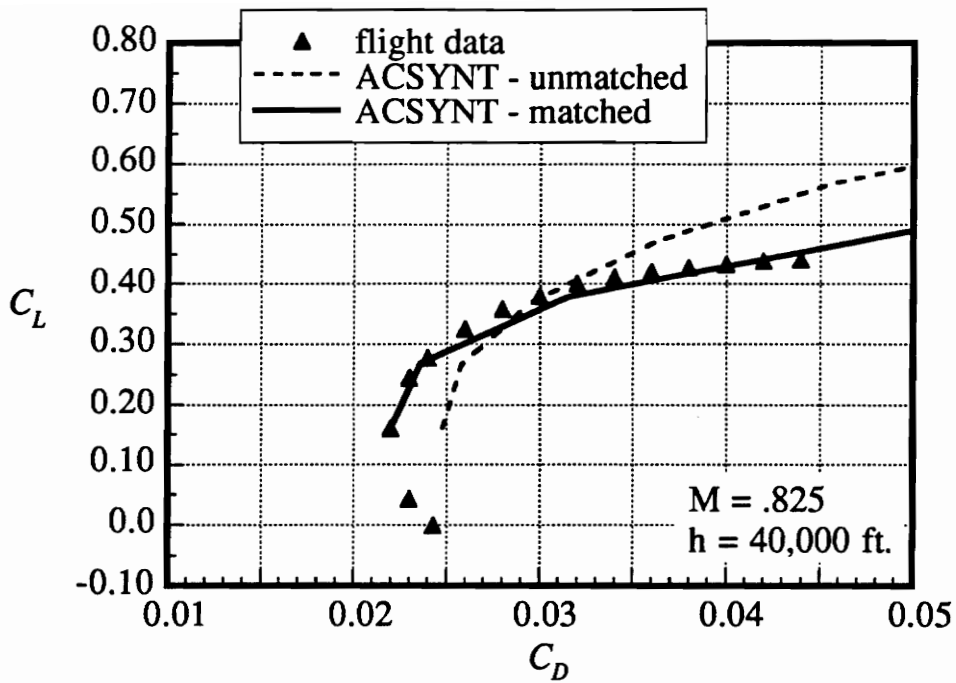


Figure 23i) Subsonic Transport Drag Polar

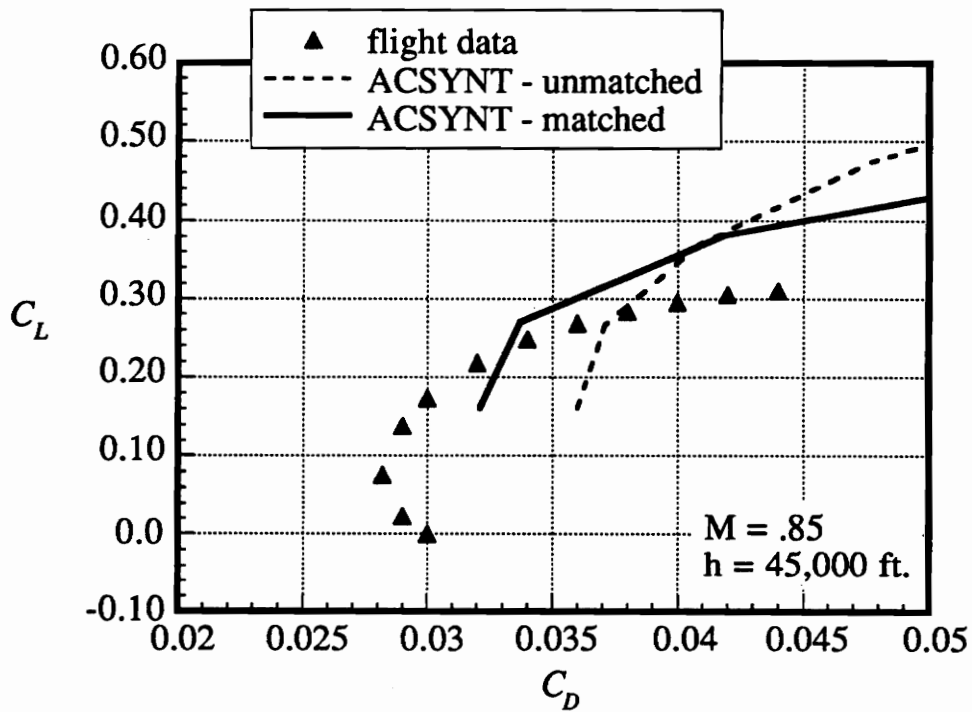


Figure 23j) Subsonic Transport Drag Polar

A-6

The ACSYNT model of the A-6 is shown in Figure 24. It includes the usual wing, fuselage and horizontal and vertical tails. The strake is also included. The canopy and fuel probe are included, but are not analyzed. The parameters are found in Tables 10a and 10b. The wing is moderately swept-back. The two engines are mounted on the lower side of the fuselage and are partially buried. The "tadpole" shape of the fuselage is difficult to model because ACSYNT requires the midsection to be straight.

The A-6 post-analysis geometry, seen in Figure 25, did not differ much from the input geometry; however, there were two minor changes. First, the engines increased in size to fulfill performance requirements. Since the engines were not completely inside the fuselage to begin with, the fuselage did not change size to accommodate the engines. The other change concerned the afterbody. It was not as uniformly tapered as in the original geometry. This is due to a geometry limitation in ACSYNT.

Table 10a A-6 Airfoil Surfaces

	wing	horizontal tail	vertical tail	strake
aspect ratio	5.19	3.829	.976	.759
area (ft ²)	529.0	125.21	65.0	196.31
dihedral (deg.)	0	0	0	0
Q.C. sweep (deg.)	24.0°	25.5°	31.998°	51.333°
taper ratio	.330	.384	.350	.551
T/C root	.06	.08	.10	.03
T/C tip	.06	.07	.06	.02
x-location Q.C. (ft.)	17.145	45.720	45.720	12.50
y-location (ft.)	0	0	0	0
z-location (ft.)	.8	.5	.8	.8
twist (deg.)	0	0	0	0
span (ft.)	52.397	21.898	7.968	12.214
root chord (ft.)	15.181	8.262	12.083	20.711

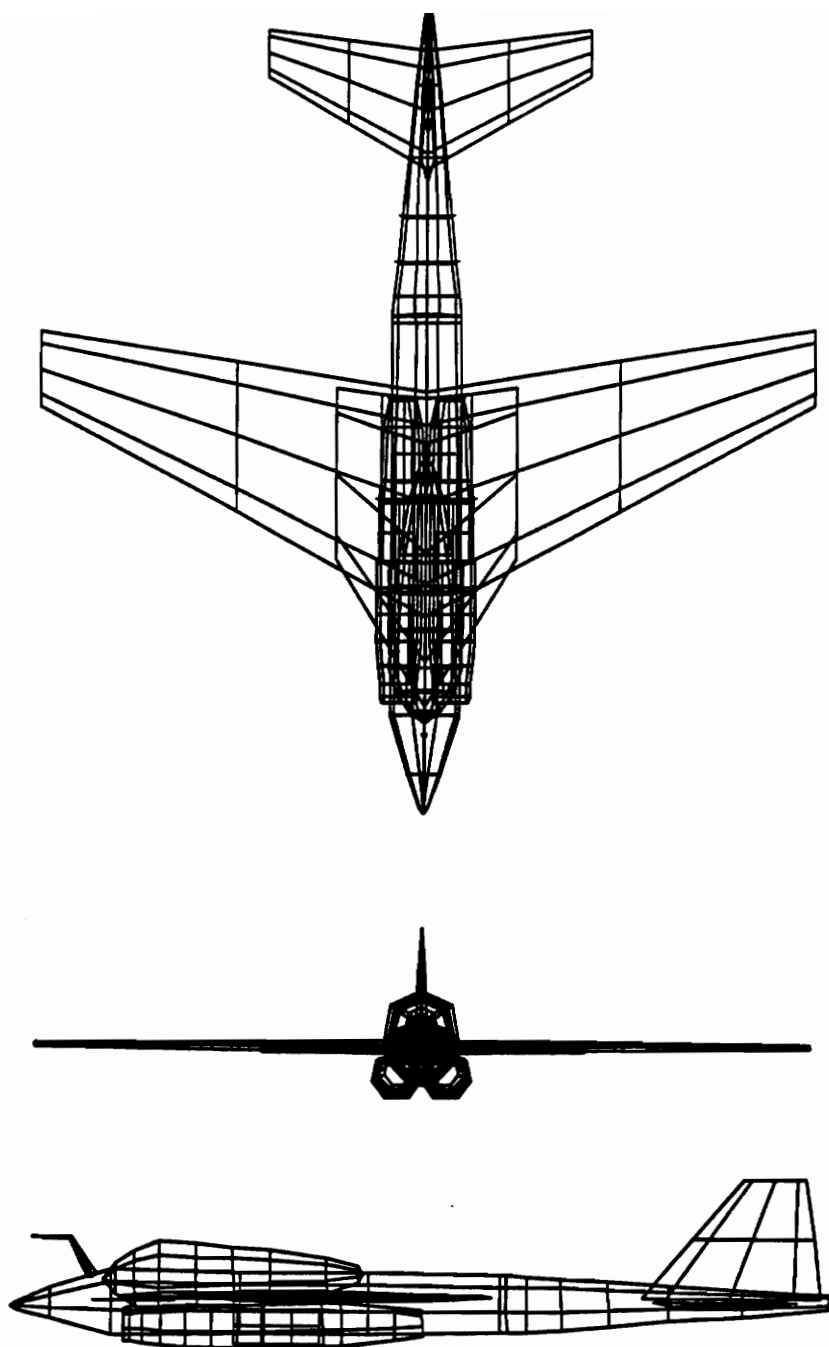


Figure 24) ACSYNT A-6 Geometry

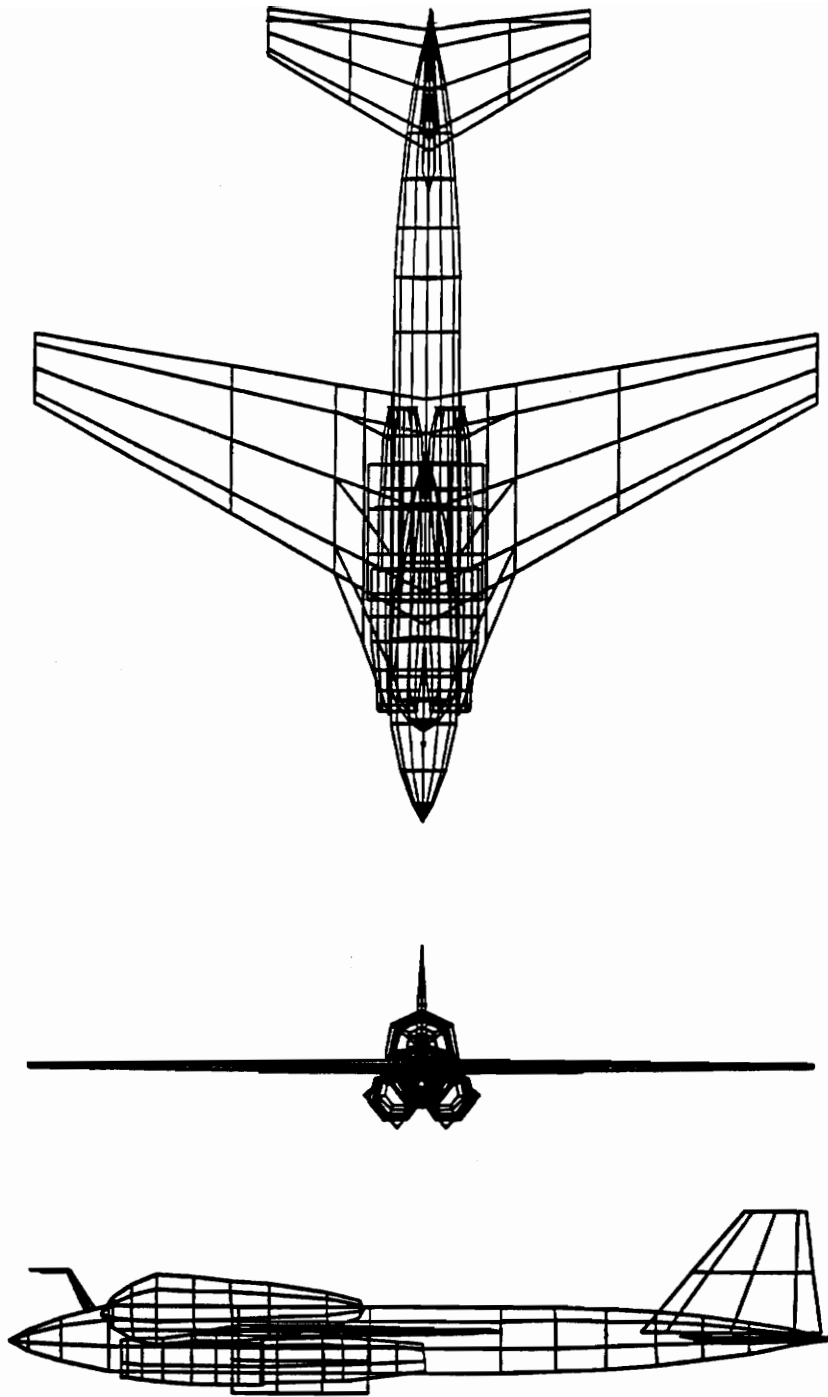


Figure 25) ACSYNT A-6 Post-analysis Geometry

Table 10b A-6 Geometry

fuselage		engines (2)	
length (ft.)	55.43	length (ft.)	6.0
diameter (ft.)	4.82	diameter (ft.)	2.4
fineness ratio-nose	1.384	x-location (ft.)	15.0
fin. ratio-afterbody	4.61	y-location (ft.)	± 1.85
fin. ratio-total	11.50	z-location (ft.)	-1.35

Five conditions were used for the comparison from Reference 20. They are listed in Table 11.

The zero lift drag Mach dependence is shown in Figure 26. Prediction ranged from 25% low to 40% low. The early part of the curve is close to the actual data, but the latter part predicts CD_0 low. This suggests that the friction drag is predicted well, but the wave drag is not. The drag rise Mach number is estimated to be about $M = .93$. The actual A-6 has $M_{DD} = .83$. The A-6 is the only case where the M_{DD} estimate is significantly off.

The lift curves are in Figures 27a-e. Lift prediction went from 6% low to 50% high. At $M = .7$ and $.8$, the ACSYNT lift prediction is very close to the flight data. In the transonic range, the lift is overpredicted. Figures 27c and d show how FVCAM changes the slope of the upper part of the lift curve so that a line from the first point to the last point is at the $CL\alpha$ of the flight data. At $M = 1.3$, the ACSYNT estimation of lift is a little high, but still quite close.

Table 11 A-6 Conditions Available/Selected for Comparison

M	h (ft.)
.70	30,000
.80	30,000
.90	30,000
1.10	30,000
1.30	30,000

The A-6 drag polars are shown in Figures 28a-e. Drag prediction ranged from 40% low to 45% high. At $M = .7$ and $.8$ the C_{D0} 's position the polars close to the correct spot. For $M = .7$, the curve starts out correctly, but then falls below the flight test data. The polar for $M = .8$ does the same thing, but is closer to the data. The rest of the drag polars ($M = .9$ to 1.3) are out of position due to the low estimation of the C_{D0} 's. On the other hand, their shapes would fit the test data if they were in the right position. Therefore, the polars with a matched C_{D0} fit the test data well.

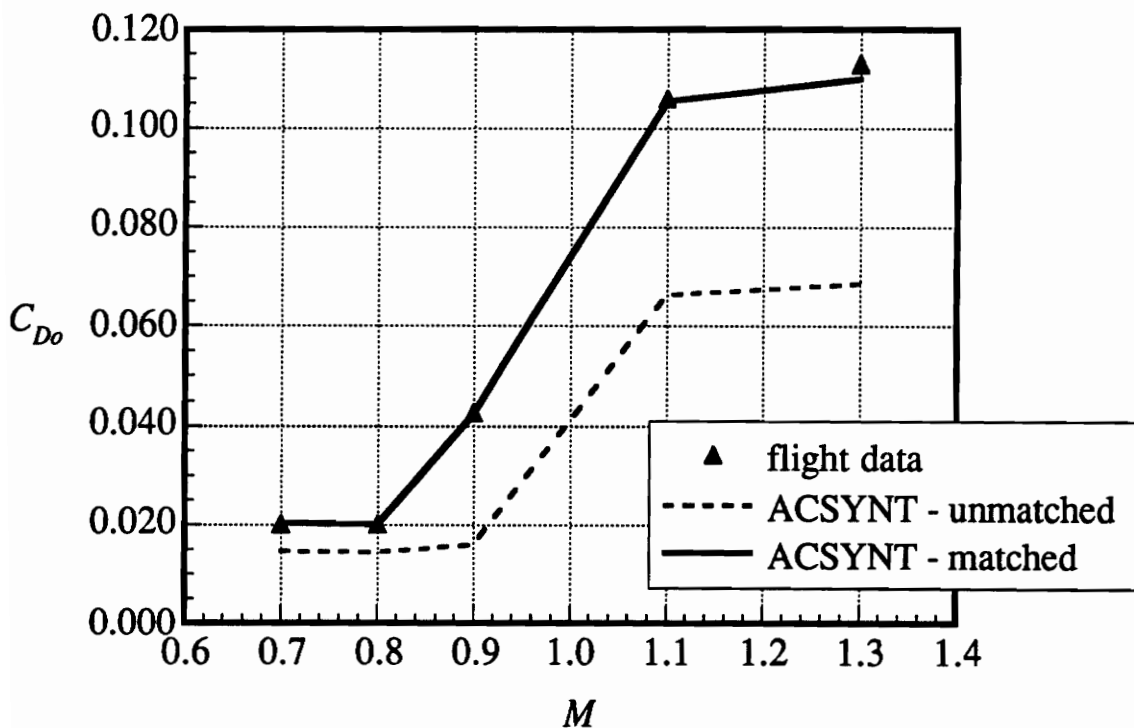


Figure 26) A-6 Zero Lift Drag Mach Dependence

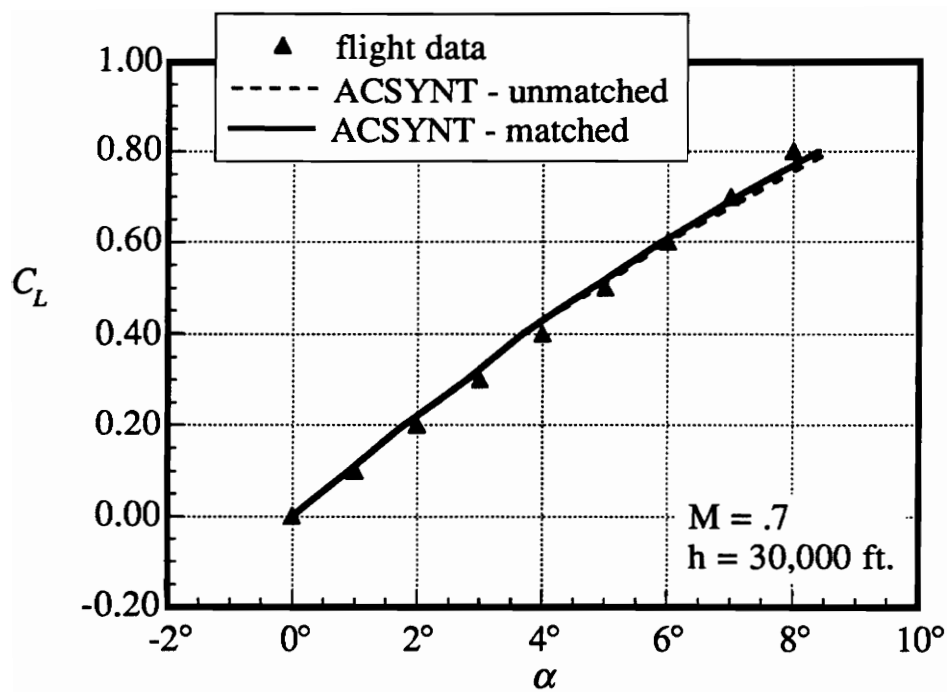


Figure 27a) A-6 Lift Coefficient.

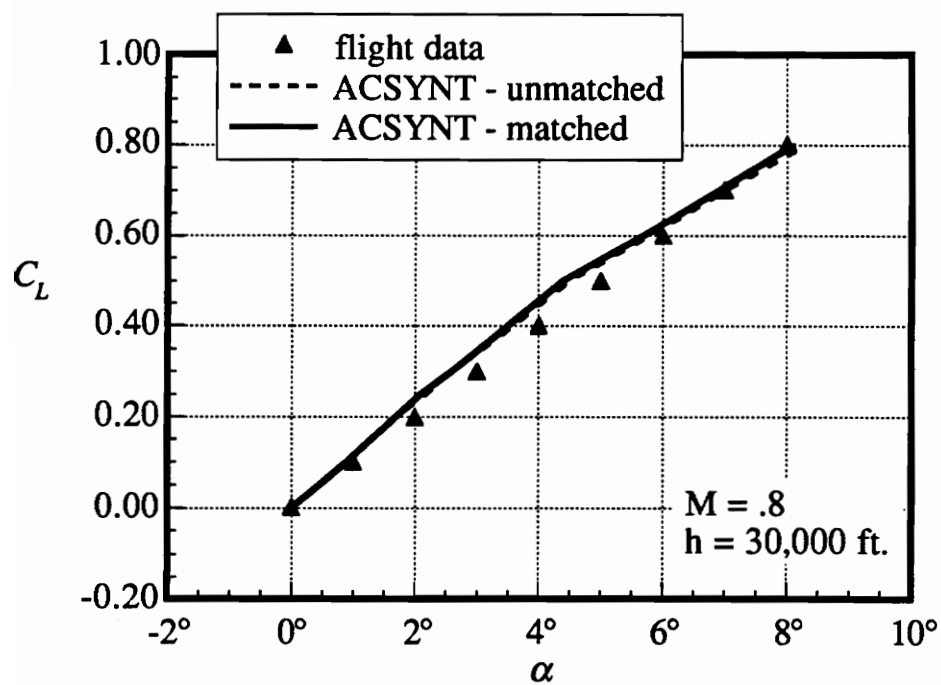


Figure 27b) A-6 Lift Coefficient.

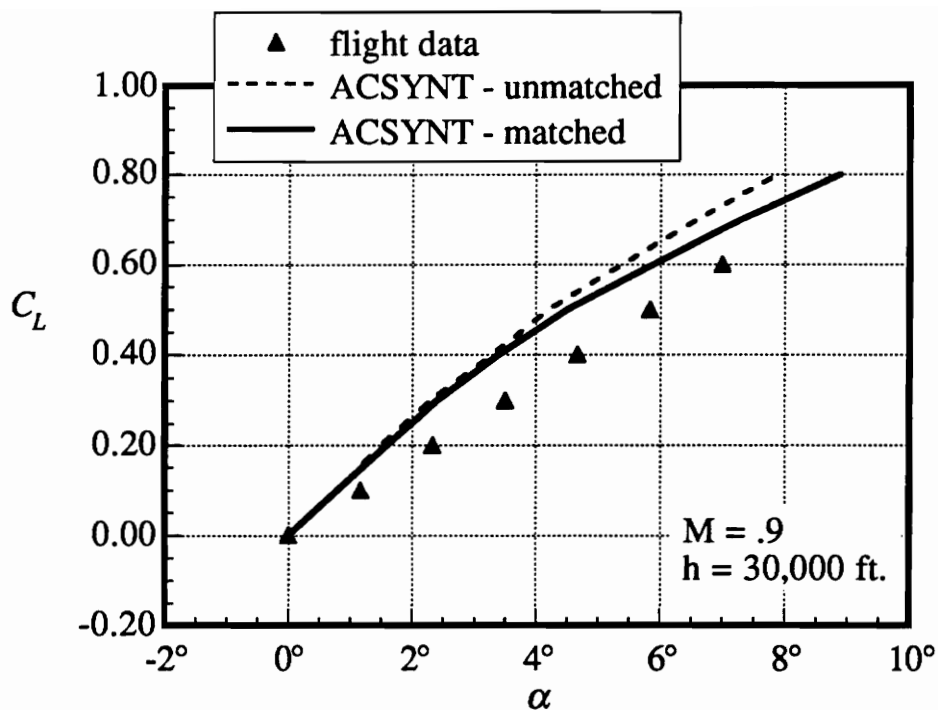


Figure 27c) A-6 Lift Coefficient.

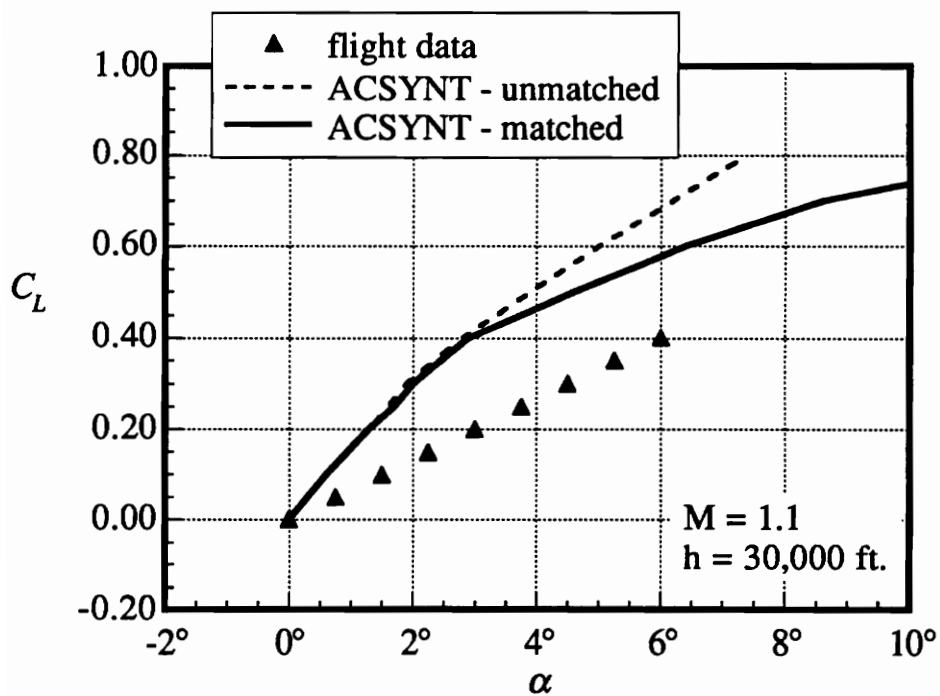


Figure 27d) A-6 Lift Coefficient.

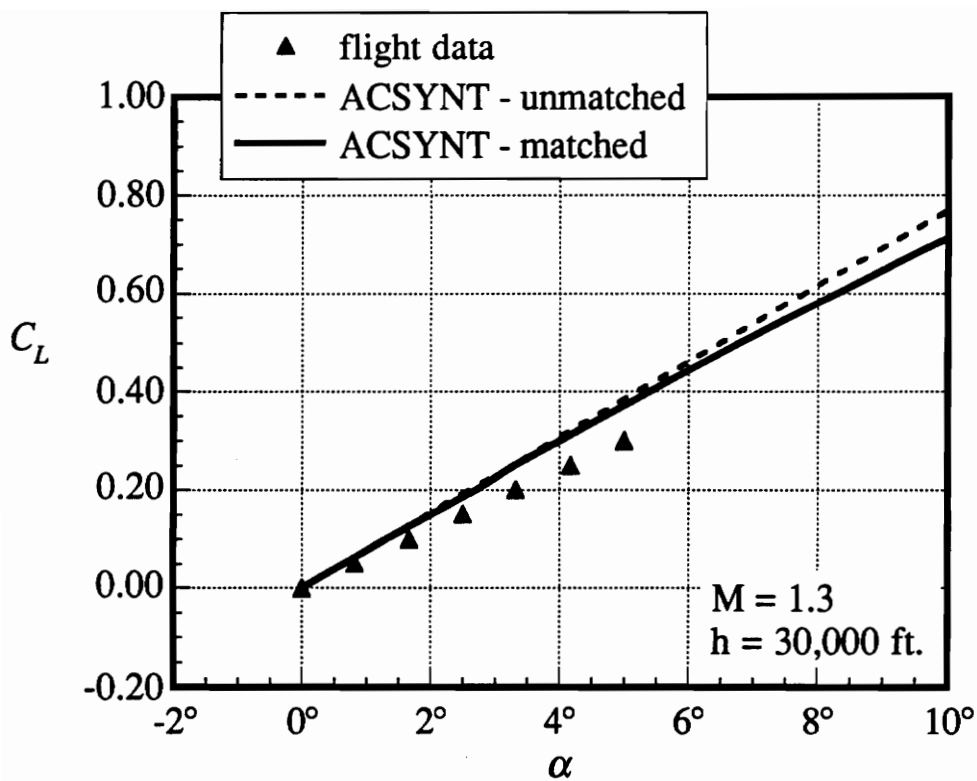


Figure 27e) A-6 Lift Coefficient.

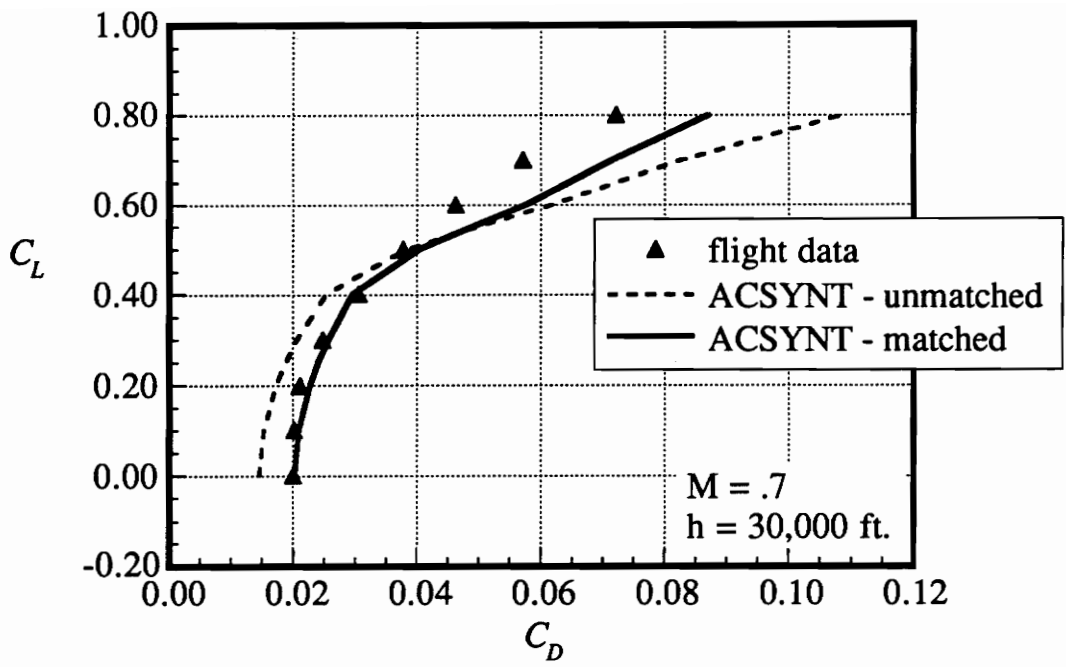


Figure 28a) A-6 Drag Polar

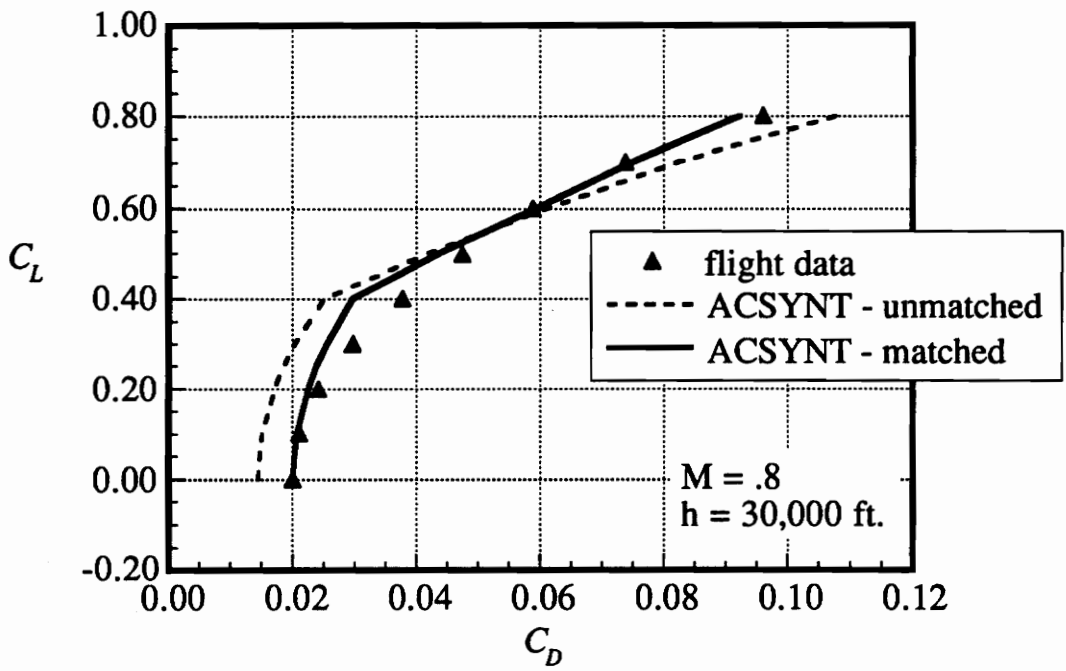


Figure 28b) A-6 Drag Polar

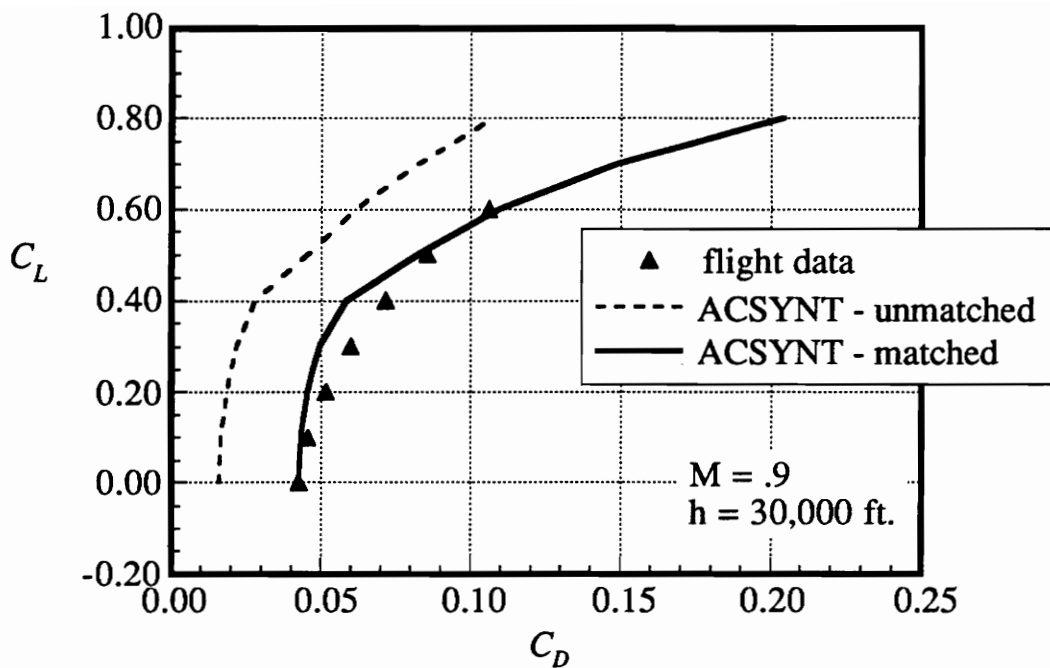


Figure 28c) A-6 Drag Polar

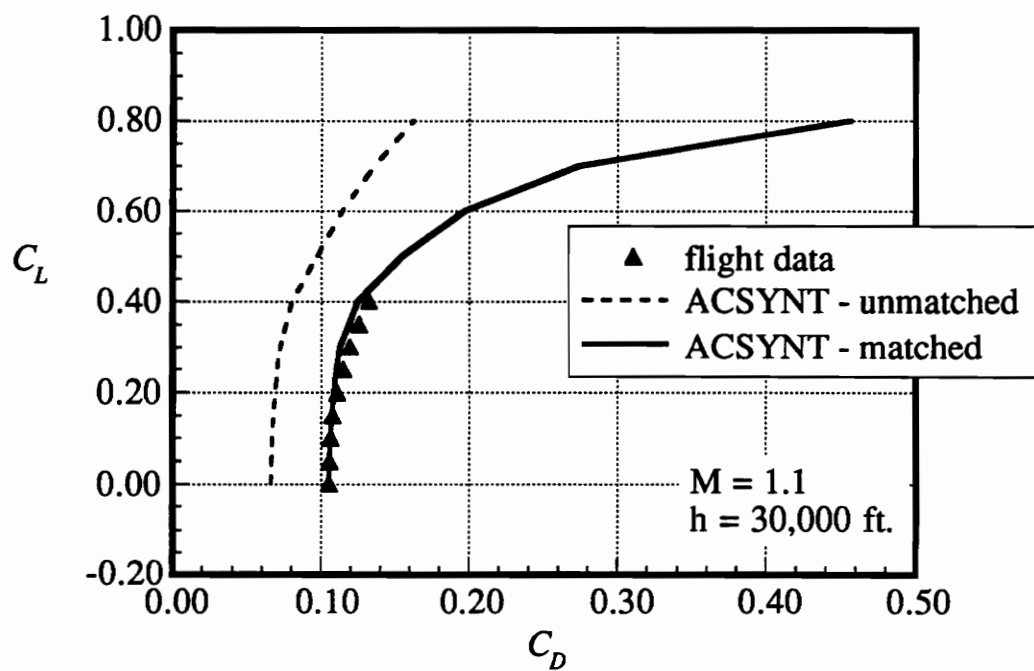


Figure 28d) A-6 Drag Polar

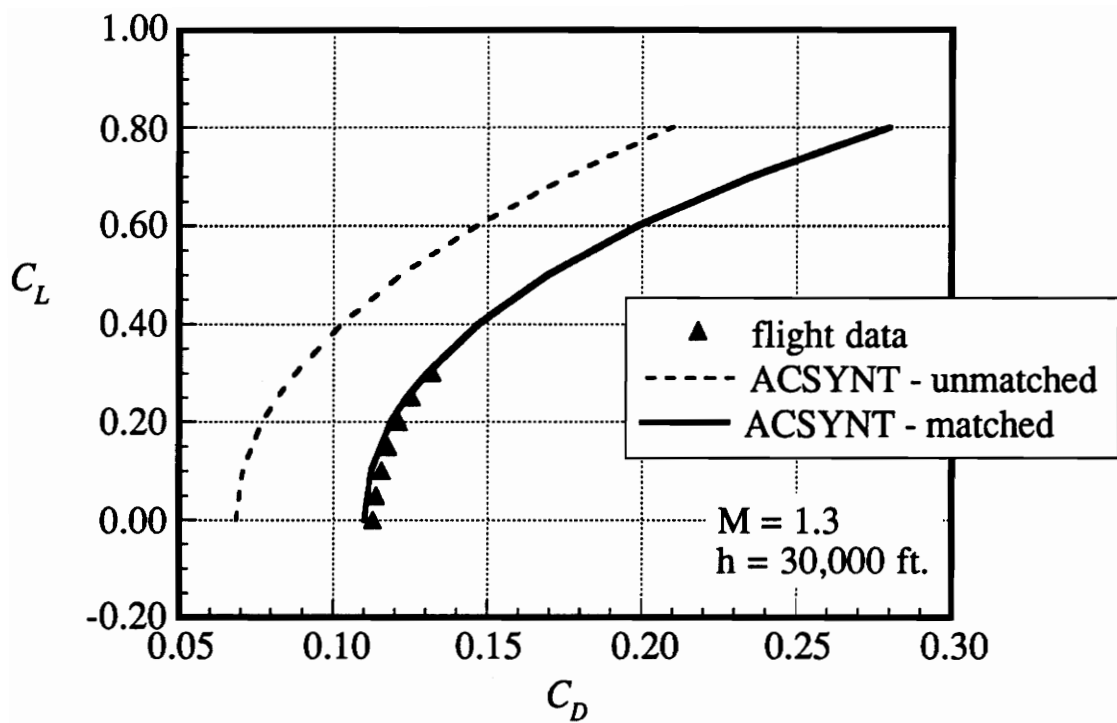


Figure 28e) A-6 Drag Polar

Business Jet

The ACSYNT model is shown in Figure 29. The geometry parameters are listed in Tables 12a and 12b. The wing and horizontal tail have small dihedral angles. The vertical tail is made big enough to stick out below the fuselage to model the vertical fin below the upswept tail section. The engines are mounted on the fuselage above and behind the wing. They are pitched up and yawed slightly outward relative to the fuselage. The nose has a downward cant and is not attached along the entire circumference of the midsection.

Table 12a Business Jet Airfoil Surfaces

	wing	horizontal tail	vertical tail
aspect ratio	7.85	4.96	1.59
area (ft ²)	279.058	69.76	66.27
dihedral (deg.)	4°	0	0
quarter chord sweep (deg.)	1.426°	5.37°	27.532°
taper ratio	.350	.500	.386
T/C root	.12	.10	.06
T/C tip	.10	.08	.06
x-location of 1/4 chord (ft.)	19.686	36.870	34.164
y-location (ft.)	0	0	0
z-location (ft.)	-.328	4.464	1.147
twist (ft.)	3°	0	0
span (ft.)	46.803	18.601	10.303
root chord (ft.)	8.833	5.00	9.350

In Figure 30, the post-analysis geometry shows a straightened fuselage (as with the other cases). The upsweep is taken out of the tail section and the base radius of the nose is enlarged to fit the midsection. The engines are straightened out (i.e. zero pitch, zero yaw). The dihedral angles are reduced to zero for the wing and horizontal tail. These are all geometry limitations of ACSYNT. Also, due to the straightening of the fuselage, some components are somewhat out of position because they are referenced to the fuselage. Minor adjustments of ZROOT / YROOT fixed the problem.

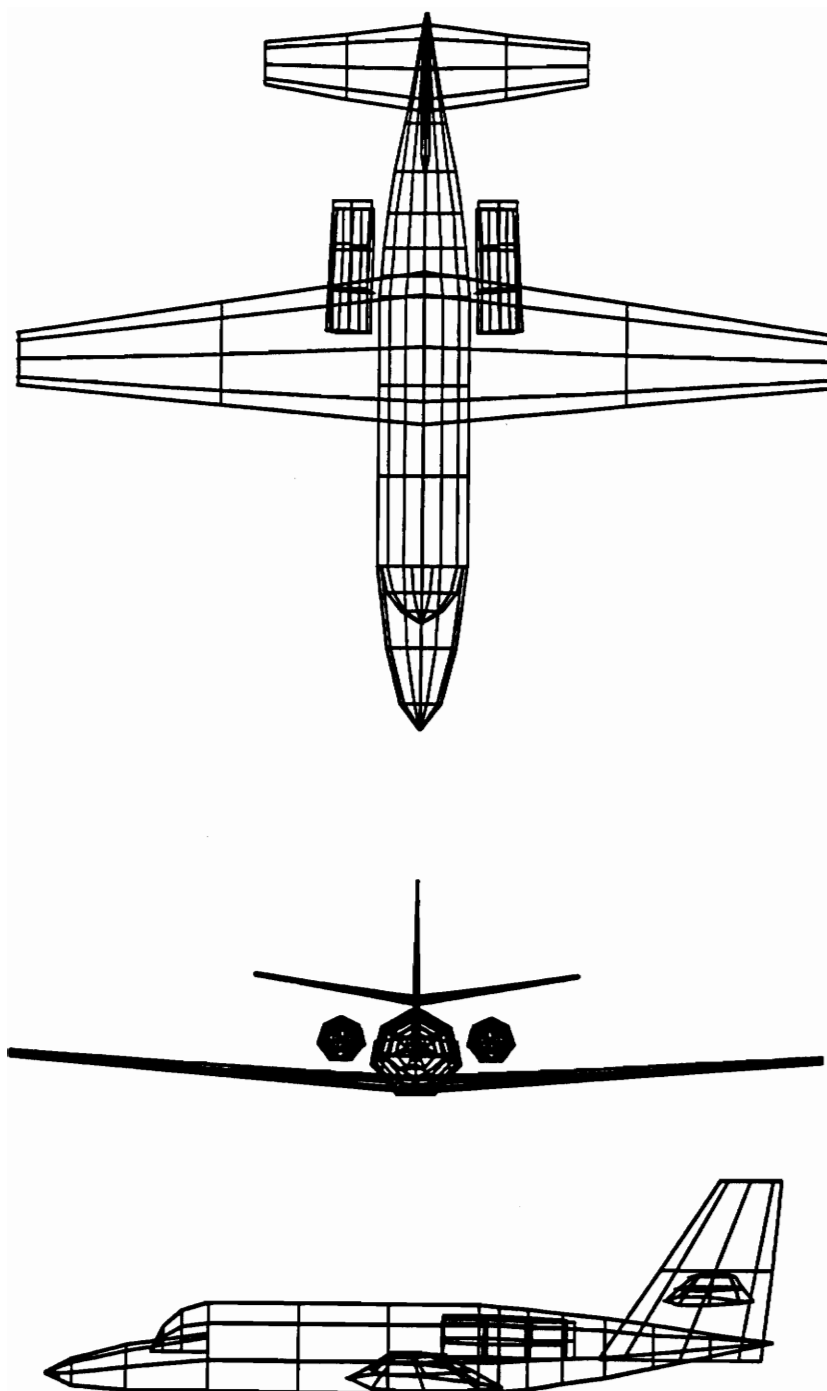


Figure 29) ACSYNT Business Jet Geometry

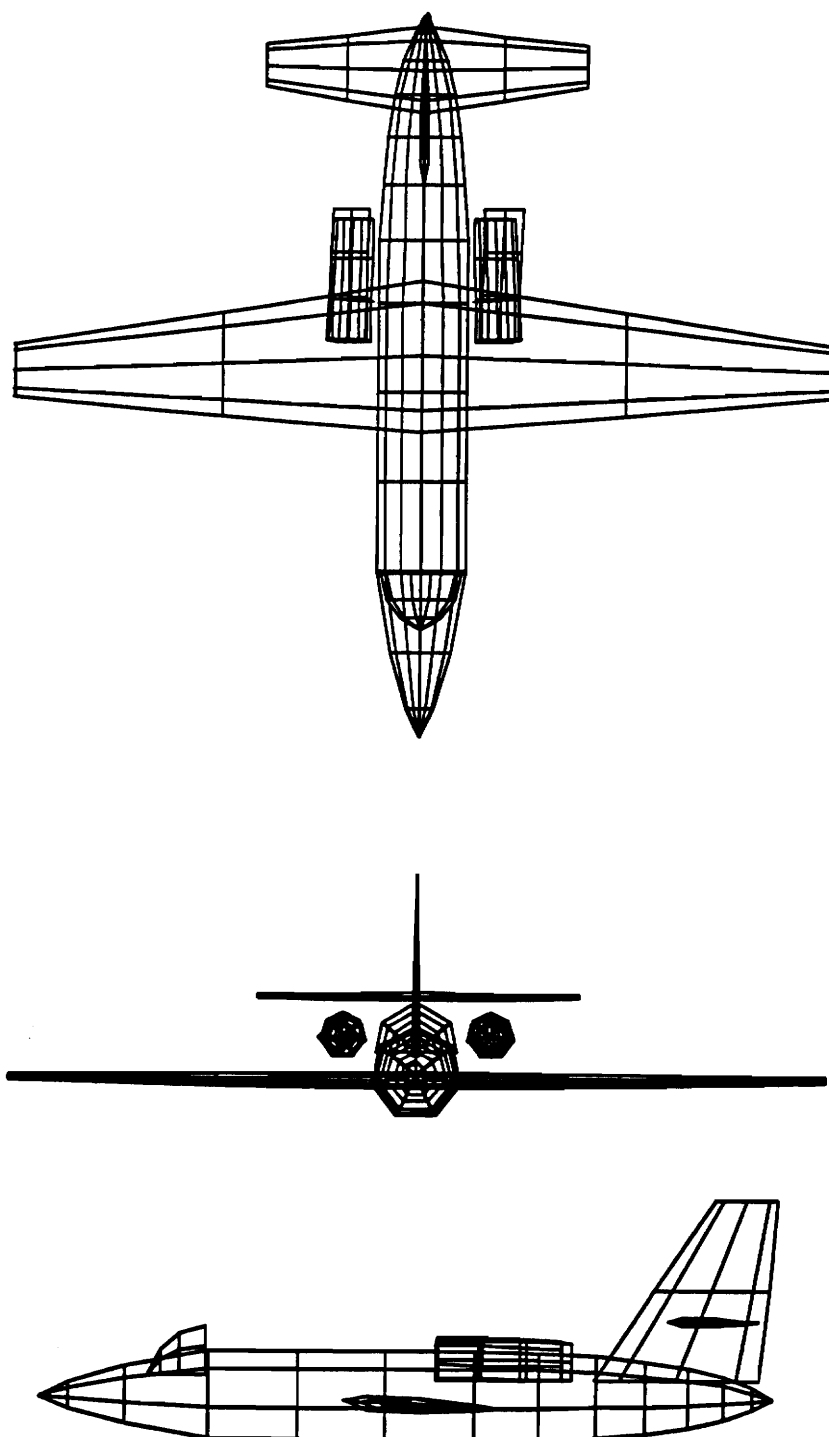


Figure 30) ACSYNT Business Jet Post-analysis Geometry

Table 12b Business Jet Geometry

fuselage		engines (2)	
length (ft.)	41.958	length (ft.)	7.594
diameter (ft.)	5.414	diameter (ft.)	2.126
fineness ratio-nose	1.751	x-location (ft.)	22.802
fin. ratio-afterbody	3.131	y-location (ft.)	± 4.420
fin. ratio-total	7.750	z-location (ft.)	2.295

The conditions used in the ACSYNT model of the business jet are listed in Table 13. However, the only test data that could be obtained was at $M = .2$ and $h = 10,000$ ft.

The zero lift drag Mach dependence for the business jet is in Figure 31. Prediction was about 29% low. The C_{D0} obtained for the flight data was labeled as “low speed”. It is therefore spread out from $M = .1$ to $M = .3$. The ACSYNT prediction C_{D0} is low and fairly constant. There is no wave drag to adjust; therefore, FCDF is the only scaling factor used.

The lift curve, in Figure 32, shows the good results produced by ACSYNT. The slope of the curve almost exactly fits the flight data. A C_{Lo} value is put into ACSYNT here to shift the curve up to the data. It is done to show the effect of the ACSYNT variable CLO which has not been used otherwise, due to a desire to see what ACSYNT predicts without giving it too much information.

Inputting a C_{Lo} value also helped position the drag polar, as shown in Figure 33. Drag prediction was about 30% high. The unmatched ACSYNT drag curve slope is a little small and the curve goes under the data. Using FLDM, the curve is easily shaped to fit the data.

Table 13 Business Jet Conditions Selected for Comparison

M	h (ft.)
.10	5,000
.20*	10,000
.25	12,000
.30	15,000
.40	20,000
.50	25,000
.55	28,000
.60	30,000
.65	35,000
.70	40,000

* Only conditions with available test data for matching

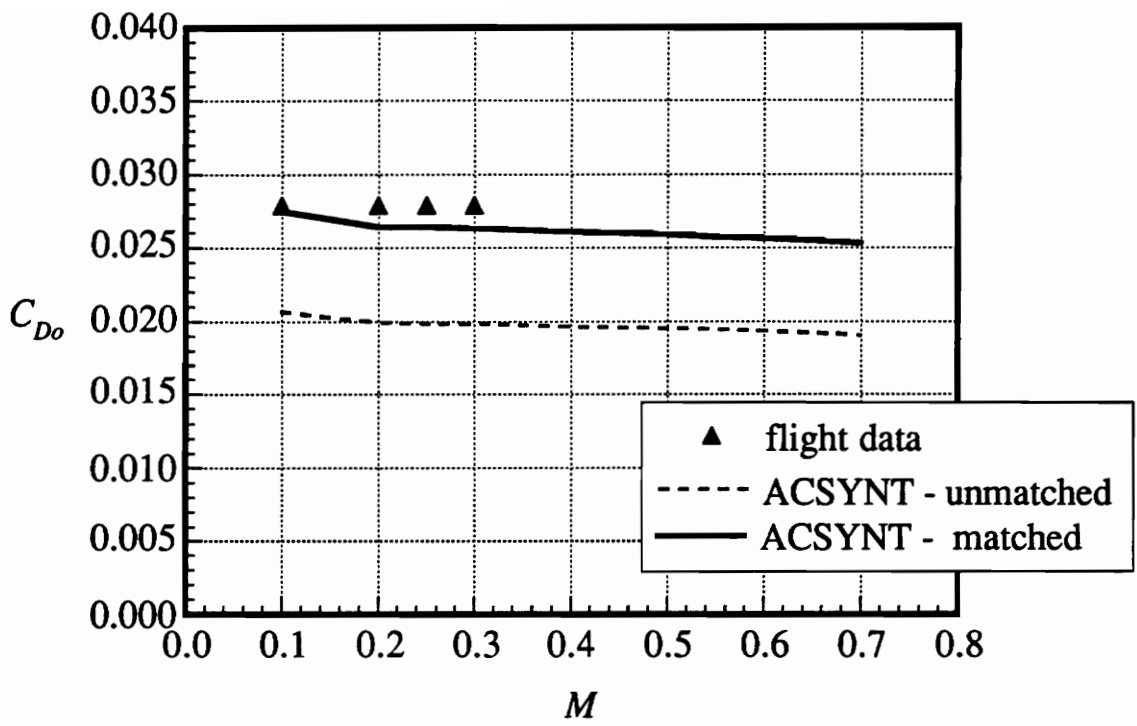


Figure 31) Business Jet Zero Lift Drag Mach Dependence

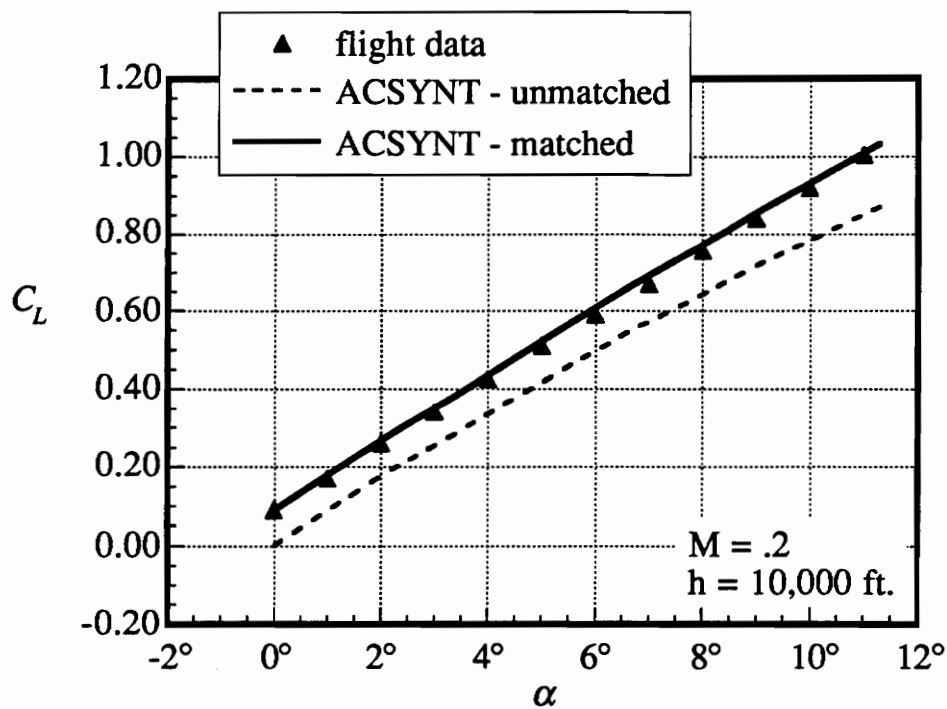


Figure 32) Business Jet Lift Coefficient.

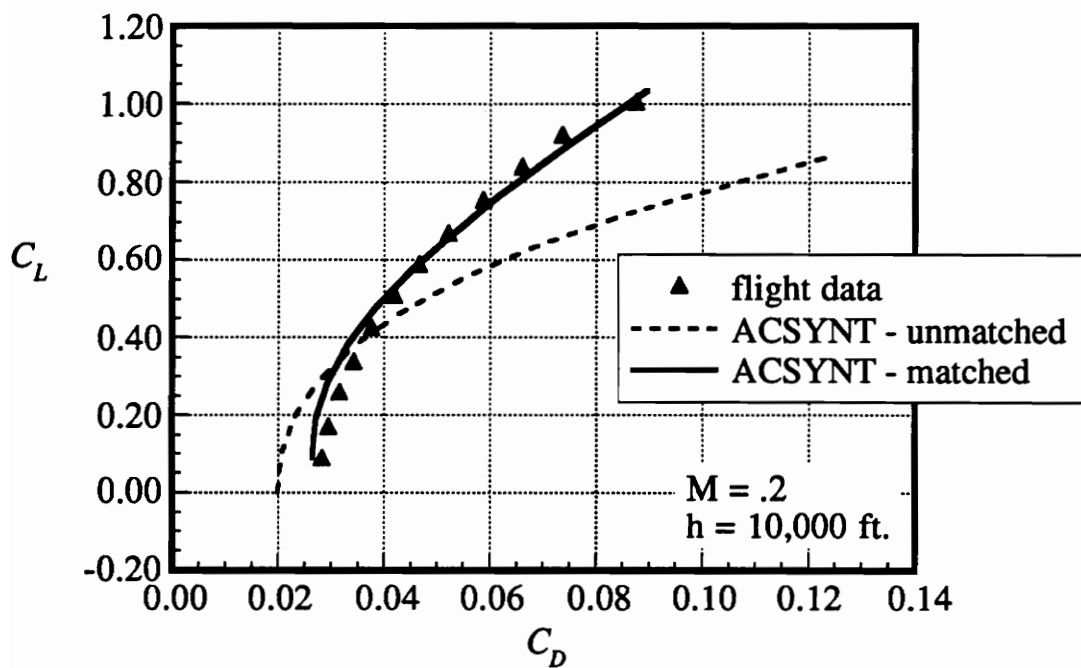


Figure 33) Business Jet Drag Polar

Scaling Factor Effects

Figure 34a shows the effects of FCDF and FCDW on the C_{D0} vs. M curve. The friction drag factor affects all values while the wave drag only affects those above M_{DD} . Figure 34b shows the effect of FVCAM. It adjusts the slope of the curve, but only seems to have an effect above the zone change at $\alpha = 3^\circ$. Figure 34c shows the effect of FLDM on the drag polar. Only the upper part of the polar is affected by FLDM.

As seen in Figures 34b and c, both FVCAM and FLDM tend to have more of an effect further up their respective curves. One explanation for this is that both FVCAM and FLDM are scaling factors for the curve *slopes*, not the actual lift and drag values. Therefore, the initial values on the C_L vs. α and C_L vs. C_D curves are not affected, but the curve continues in a direction coinciding with its adjusted slope, making the difference between unmatched and matched more significant. The ACSYNT values for the lift curve slope and the drag polar slope are calculated using only the last α , C_L and C_D for each condition. Therefore, on the C_L vs. α curve, the ACSYNT $C_{L\alpha}$ is taken from the line that goes from the first point to the last. FVCAM is geared toward moving the upper part of the curve so that the first and last points give the desired $C_{L\alpha}$. FLDM moves the upper part of the drag polar so the slope reaches a desired value.

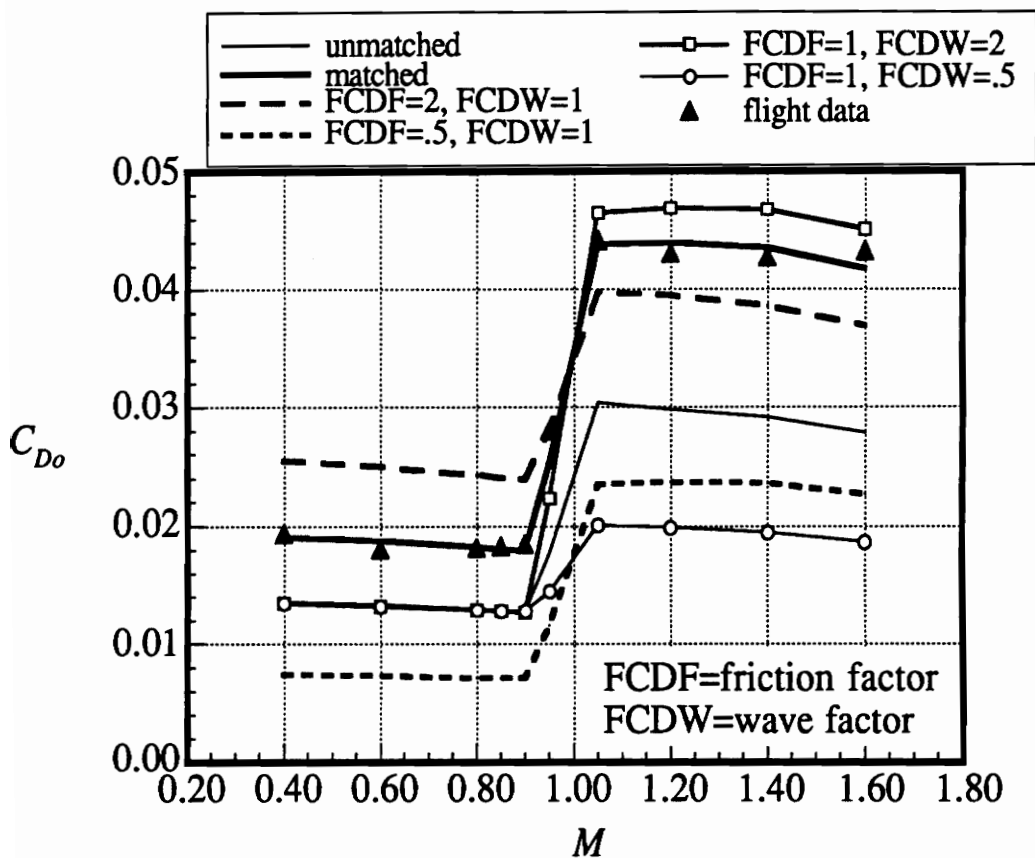


Figure 34a) F-16A Zero Lift Drag, Scaling Factor Effects

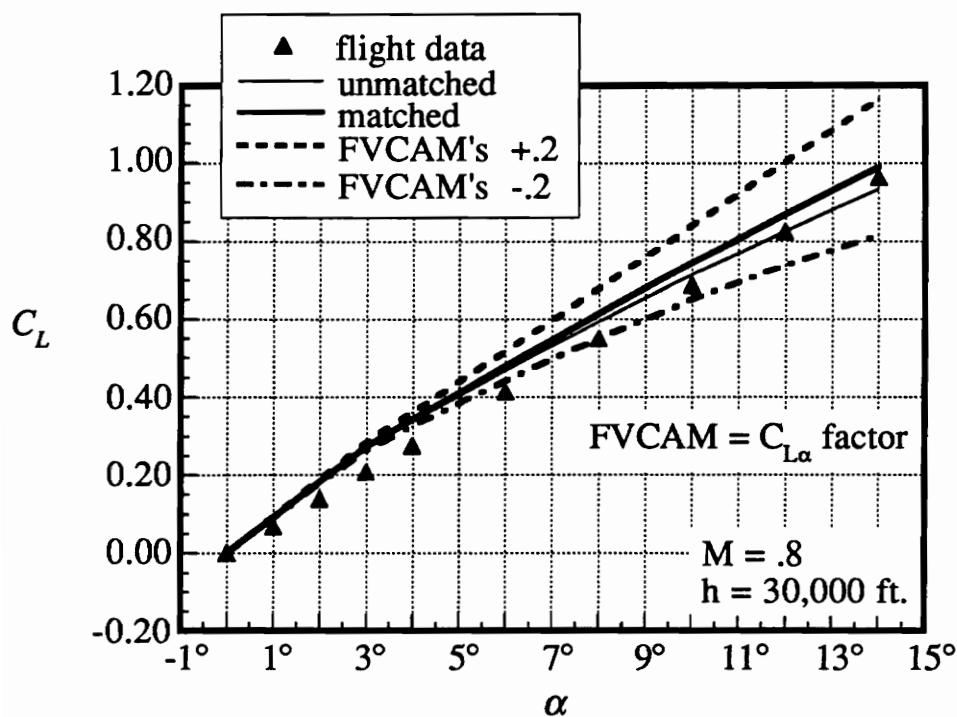


Figure 34b) F-16A Lift Coefficient, Scaling Factor Effects

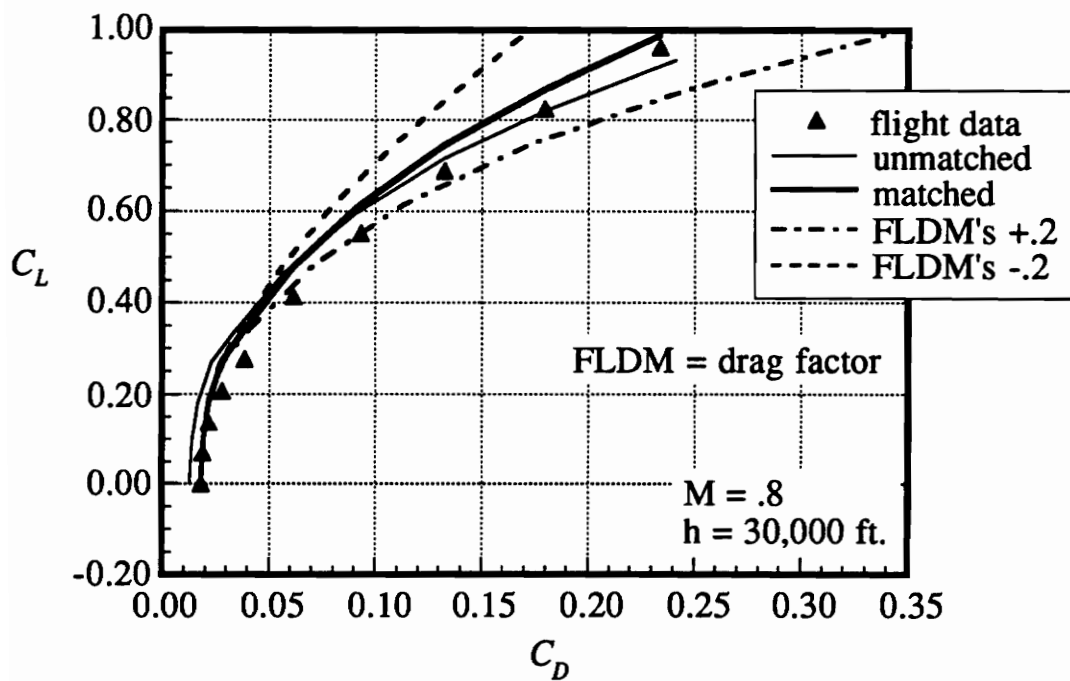


Figure 34c) F-16A Drag Polar, Scaling Factor Effects

Evaluation and Recommendations for Matching

From the five test cases run, it is seen that patterns begin to develop in the scaling factor values. These patterns give the user insight into how ACSYNT evaluates aircraft and how it treats different geometries.

The friction drag scaling factor, FCDF, found in Table 14, ranges from .94 to 1.458. The smaller sized aircraft (F-16, A-6, business jet) have values around 1.4. The larger aircraft (XB-70, subsonic transport) have values around 1.0. These results suggest a correlation between Reynold's number and FCDF values. The size of the aircraft is indirectly involved through the calculation of the Reynold's number using the mean aerodynamic chord (Re_{mac}). ACSYNT underpredicts for lower Reynold's numbers and is close for higher Reynold's numbers. This relationship is shown in Figure 35. Another possible relationship here could be "sleek vs. dirty" aircraft. The actual F-16, A-6 and business jet do not emphasize cruise performance as highly as the transports. They have surface protrusions that add to the friction drag. Also, component interference drag could be higher for the smaller aircraft because the components are closer together.

Table 14 Zero Lift Drag Scaling Factors

	FCDF	FCDW	FCDRA
F-16A	1.458	1.566	1.0
XB-70	.940	3.707	.6 - 1.5
Transport	1.081	1.077	.73 - 1.05
A-6	1.420	1.670	1.00 - 2.00
Business Jet	1.420	N/A	N/A

The wave drag was underpredicted in each test case. When comparing actual and ACSYNT wave drag, it is important to remember that real aircraft may not have been optimized for transonic/supersonic flight. This could explain the large wave drag for some aircraft. The wave drag scaling factor, FCDW, also found in Table 14, exhibits a Re_{mac} related pattern similar to FCDF; however, as explained earlier, there are some difficulties estimating the XB-70 wave drag. The problem is most likely the complex geometry of some supersonic aircraft that causes the gross underprediction of the wave drag. The inlets are a large contributor to the wave drag. The shocks that occur inside the inlet cannot be modeled in ACSYNT. Looking back at Figure 16, it is seen that if the ACSYNT XB-70 model were to be matched to the clean wind tunnel data, the FCDW value would be about 1.2. This is not nearly as drastic as the 3.707 used for matching the flight data. Again, extra drag could come from surface protrusions which ACSYNT's clean models do not have. When analyzing a supersonic aircraft with a complex geometry, the ACSYNT user should be aware of this miscellaneous drag problem. The FCDW value for the two fighters are both around 1.6 and the subsonic transport's FCDW is 1.077. The ACSYNT prediction for the wave drag is similar to the actual for the large transport.

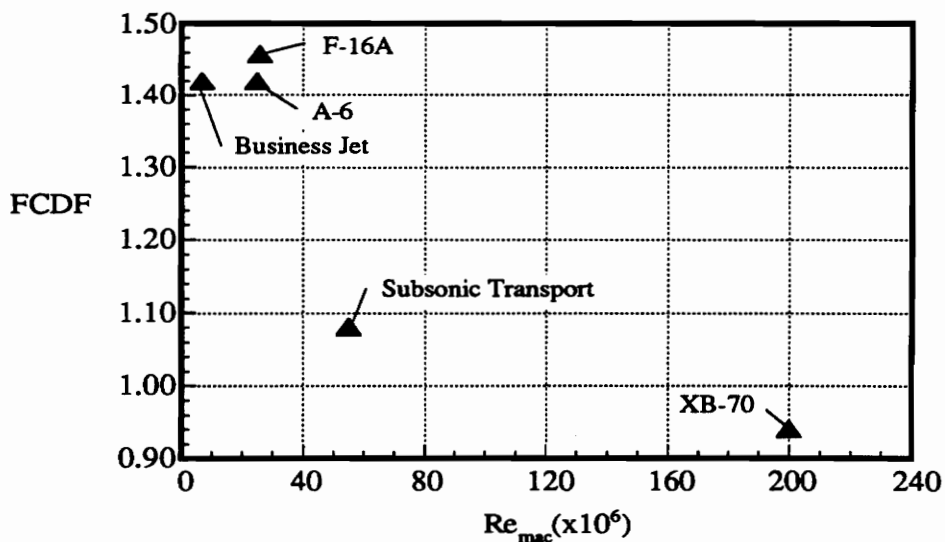


Figure 35) FCDF Relationship with Reynold's Number

The values for FVCAM, the lift curve slope factor, are in Table 15, with the corresponding aircraft and Mach number. At $M = .8$, the fighters have similar values. Somewhat close to these values, is the business jet value at $M = .2$. All of the low Mach number FVCAM values for the aircraft are around 1.1. The difference shows up as the Mach number increases on through drag divergence. The subsonic transport shows a steady increase through M_{DD} , but drops a little from $M = .825$ to $M = .85$. This shows that the lift curve slope is consistently underpredicted for the subsonic transport. For the supersonic transport, FVCAM increases through M_{DD} and then shows a general decrease as ACSYNT begins to overpredict $CL\alpha$. The A-6 decreases overall as it passes through M_{DD} , but the numbers are more sporadic. For both the XB-70 and the A-6, $CL\alpha$ is underpredicted below M_{DD} and overpredicted above M_{DD} . ACSYNT may not be accounting for the loss of lift above the M_{DD} . This problem may not show up for the subsonic transport because it does not go far enough into the transonic region. From these test cases, it seems that ACSYNT predicts the $CL\alpha$ best at low Mach numbers. The A-6 case also appears to be close just below M_{DD} .

Table 16 shows the values for FLDM, the drag polar shape factor. Again, the values for the F-16 at $M = .8$, A-6 at $M = .8$, and business jet at $M = .2$ are similar. The subsonic transport starts out with a very low value of FLDM at $M = .6$ and slowly increases through the M_{DD} with a jump from $M = .81$ to $M = .825$ and again to $M = .85$. The XB-70 and the A-6 change direction around their drag divergence Mach numbers. The XB-70's FLDM starts high and then drops to .35 at $M = .93$. It then undergoes a general increase to 1.65 at $M = 2.5$. The A-6 does just the opposite. It increases to M_{DD} and then decreases. From the XB-70, A-6, and subsonic transport cases, it seems that ACSYNT's best drag predictions are at Mach numbers just below M_{DD} and around $M = 2.0$ (for the XB-70).

Table 15 Lift Curve Slope Scaling Factor (FVCAM)*

Mach #	F-16A	XB-70	Transport	A-6	BizJet
.2	-	-	-	-	1.11
.6	-	-	1.144	-	-
.65	-	-	1.160	-	-
.7	-	-	1.202	1.079	-
.75	-	-	1.240	-	-
.76	-	1.156	-	-	-
.77	-	-	1.250	-	-
.79	-	-	1.307	-	-
.8	1.065	-	1.315	1.041	-
.81	-	-	1.323	-	-
.825	-	-	1.334	-	-
.85	-	-	1.3	-	-
.9	-	-	-	.841	-
.93	-	1.192	-	-	-
1.06	-	.923	-	-	-
1.1	-	-	-	.617	-
1.18	-	.958	-	-	-
1.3	-	-	-	.783	-
1.65	-	.764	-	-	-
2.1	-	.691	-	-	-
2.5	-	.552	-	-	-

* Double lines denote area of drag divergence for each aircraft

Table 16 Drag Polar Scaling Factor (FLDM)

Mach #	F-16A	XB-70	Transport	A-6	BizJet
.2	-	-	-	-	.7
.6	-	-	.21	-	-
.65	-	-	.41	-	-
.7	-	-	.721	.32	-
.75	-	-	.954	-	-
.76	-	1.95	-	-	-
.77	-	-	1.0	-	-
.79	-	-	1.18	-	-
.8	.8	-	1.22	.81	-
.81	-	-	1.8	-	-
.825	-	-	2.77	-	-
.85	-	-	5.0	-	-
.9	-	-	-	1.28	-
.93	-	.35	-	-	-
1.06	-	.1	-	-	-
1.1	-	-	-	1.25	-
1.18	-	.455	-	-	-
1.3	-	-	-	1.142	-
1.65	-	.954	-	-	-
2.1	-	1.1	-	-	-
2.5	-	1.65	-	-	-

Some general ideas about matching can be found by looking at the overall results. Table 17 lists the scaling factors for the various types of aircraft. (The F-16 and A-6 had similar values and were combined into the fighter type. The FCDW=1.2 value for the supersonic transport refers to the wind tunnel data and the 3.7 is for the flight data.) This table of values gives the ACSYNT user a good place to start matching. The designer should have some basic experience with the effects of geometry on friction drag, wave drag, lift, and induced drag. For example, changing wetted area affects skin friction, changing volume distribution affects wave drag, and changing the wing aspect ratio affects lift and induced drag. Using knowledge such as this and the scaling factor results presented here, the aircraft designer can compare a conceptual design geometry with these geometries and make an estimate of what the scaling factor values should be. For example, to begin matching the friction drag of a fighter aircraft, the designer should look at FCDF for the fighter in Table 17. Comparison of the Re_{mac} and FCDF in Figure 35 will give a starting point for FCDF. If the Re_{mac} is larger for this fighter than for the F-16 and A-6, ACSYNT will probably predict the friction drag more closely to the flight data. Therefore, the FCDF value will most likely be less than 1.43. Similar arguments can be developed for the other scaling factors.

Table 17 Scaling Factor Results

Aircraft Type	FCDF	FCDW	FVCAM*	FLDM*
Fighter	1.43	1.60	1.07	.80
Supersonic Transport	.94	1.20 (3.7)	.90	.60
Subsonic Transport	1.08	1.08	1.20	.85
Business Jet	1.42	N/A	1.11	.70

* At design Mach number

Conclusions

Previous experience with ACSYNT, and the results presented here demonstrate that the ACSYNT aerodynamic estimates are reasonably accurate, and that they can be improved for a specified class of aircraft by using technology scaling factors. The use and effect of these factors has been illustrated here.

ACSYNT is continually being refined, and this comparison set has identified areas where improvements can be made. First, the zero lift drag estimates are low. The main problem seems to be the low estimate of the miscellaneous wave drag. Second, lift prediction tends to be low for $M < 1.0$ and high for $M > 1.0$. Third, there needs to be some way to match the lower part of the lift curve. The problem here lies in the fact that ACSYNT calculates $C_{L\alpha}$ from only the first and last points on the C_L vs. α curve. Finally, the calculation of the wetted areas needs some improvement. NASA Ames is currently developing a new wetted area calculation algorithm for ACSYNT.

Work in this area demonstrates the continued importance of approximate and analytically based aerodynamics methods. With extremely sophisticated numerical methods now available to use for guidance, further work on approximate methods appears to be possible.

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Appendix A Sample Matching Calculations

Matching of the Subsonic Transport

Table A.1 Subsonic Transport Friction and Wave Drag Matching

Mach #	ACSYNT C _{Dmin}	Actual C _{Dmin}	ACSYNT Interference	ACSYNT Wave	ACSYNT Friction	FCDF*, FCDW*
.60	.0155	.0162	.0021	0	.0134	1.0522
.65	.0154	.0162	.0021	0	.0133	1.0602
.70	.0153	.0162	.0021	0	.0132	1.0682
.75	.0152	.0164	.0021	0	.0131	1.0916
.77	.0151	.0168	.0021	0	.0130	1.1308
.79	.0157	.0176	.0020	.0007	.0130	2.2174
.80	.0173	.0188	.0018	.0025	.0130	1.1809
.81	.0198	.0196	.0017	.0052	.0129	.7616
.825	.0248	.0220	.0015	.0104	.0129	.6307
.85	.036	.0282	.0012	.0220	.0129	.5936

FCDF is used below M_{DD} (zero wave drag) and FCDW is used when there is wave drag. The asterisk (*) shows that the variable is for a specific Mach number; the actual variables apply to a range of Mach numbers.

$$\begin{aligned}
 FCDF^* &= \frac{\text{Actual } C_{D\min} - \text{ACSYNT Interference}}{\text{ACSYNT Friction}} \\
 &= \frac{.0162 - .0021}{.0134} = 1.0522
 \end{aligned}$$

$$\begin{aligned}
 FCDF &= \frac{\sum FCDF^*}{\text{Number of Mach \#} < M_{DD}} \\
 &= \frac{1.0522 + 1.0602 + 1.0682 + 1.0916 + 1.1308}{5} = 1.0806
 \end{aligned}$$

$$FCDW^* = \frac{\text{Actual } C_{D \min} - (FCDF \times \text{ACSYNT Friction}) - \text{ACSYNT Interference}}{\text{ACSYNT Wave}}$$

$$= \frac{.0176 - (1.0806 \times .0130) - .0020}{.0007} = 2.2174$$

$$FCDW = \frac{\sum FCDW^*}{\text{Number of Mach \#} > M_{DD}}$$

$$= \frac{2.2174 + 1.1809 + .7616 + .6307 + .5936}{5} = 1.0769$$

After the model has been rerun with the new values of FCDF and FCDW, FCDRA can be used for fine tuning.

Table A.2 Subsonic Transport Zero Lift Drag Fine Tuning

Mach #	FCDRA
.60	.982
.65	.988
.70	1.006
.75	1.012
.77	1.043
.79	1.054
.80	1.016
.81	.925
.825	.830
.85	.729

$$FCDRA = \frac{\text{Actual } C_{D \min}}{\text{ACSYNT } C_{D \min}}$$

$$= \frac{.0162}{.0165} = .982$$

FVCAM can be used to match the $C_{L\alpha}$'s after FCDRA has been applied.

Table A.3 Subsonic Transport Lift Curve Matching

Mach #	Actual $C_{L\alpha}$	ACSYNT $C_{L\alpha}$	FVCAM
.60	.0800	.0699	1.144
.65	.0825	.0711	1.160
.70	.0870	.0724	1.202
.75	.0915	.0738	1.240
.77	.0930	.0744	1.250
.79	.0980	.0750	1.307
.80	.0990	.0753	1.315
.81	.1000	.0756	1.323
.825	.1015	.0761	1.334
.85	.1000	.0769	1.3000

$$\begin{aligned}
 FVCAM &= \frac{\text{Actual } C_{L\alpha}}{\text{ACSYNT } C_{L\alpha}} \\
 &= \frac{.0800}{.0699} = 1.144
 \end{aligned}$$

FLDM was matched visually by adjusting the value and plotting the drag polar for comparison with the test data.

Appendix B Flight and Wind Tunnel Data

Table B.1 F-16A Zero Lift Drag Flight Data

Mach #	C _{Do}
0.40000	0.019400
0.60000	0.018100
0.80000	0.018200
0.85000	0.018300
0.90000	0.018500
0.95000	0.028000
1.05000	0.044200
1.20000	0.043100
1.40000	0.042800
1.60000	0.043300

Table B.2 F-16A Lift and Drag Flight Data for M=.8

Alpha (deg.)	C _L	C _D
0.0000	0.000000	0.013000
1.0000	0.09200	0.013900
2.0000	0.18200	0.016500
3.0000	0.27200	0.022900
4.0000	0.34200	0.033800
6.0000	0.47900	0.057400
8.0000	0.61300	0.090300
10.0000	0.74400	0.132200
12.0000	0.86900	0.182700
14.0000	0.99000	0.241300

Table B.3 XB-70 Flight Conditions and Data

Mach Number	Altitude (ft.)	R _{mac} (x10 ⁶)	Wing Tip Deflection	C _{Do} actual	Mach # - wind tunnel	C _{Do} - wind tunnel, clean
0.7600	25730	191.30	-0.75000	0.0065000	0.75000	0.0065000
0.9300	32770	174.30	23.850	0.0066835	0.80000	0.0066000
1.0600	27140	242.00	24.000	0.023142	0.95000	0.0093000
1.1800	33720	216.50	24.550	0.018150	1.2000	0.010300
1.6500	40000	250.00	64.000	0.012944	1.6000	0.0092000
2.1000	48600	216.50	62.300	0.0094767	2.1000	0.0088000
2.5000	61630	137.80	62.150	0.0078800	2.5300	0.0083000

Table B.4 XB-70 Lift and Drag Flight Data

Alpha (deg.)	C _L (M=.76)	C _D (M=.76)	C _L (M=.93)	C _D (M=.93)	C _L (M=1.06)	C _D (M=1.06)
0.0000	-0.033300	-	-0.040000	-	-0.10000	-
0.50000	-	-	0.0050000	-	-	-
1.0000	-	-	-	-	-0.045000	-
2.0000	0.053000	-	0.040000	-	0.0100000	-
3.0000	0.097000	0.010900	0.10800	-	0.080000	0.026200
4.0000	0.14000	0.015000	0.14300	0.014000	0.13600	0.027300
5.0000	0.18800	0.021200	0.19500	0.020600	0.19400	0.029800
6.0000	0.22800	0.028000	0.23600	0.026800	0.24300	-
7.0000	0.27200	-	0.28800	0.036800	-	-
8.0000	0.30910	-	0.33300	-	-	-

Table B.4 XB-70 Lift and Drag Flight Data (cont'd)

C_L (M=1.18)	C_D (M=1.18)	C_L (M=1.65)	C_D (M=1.65)	C_L (M=2.10)	C_D (M=2.10)	C_L (M=2.50)	C_D (M=2.50)
-0.01500	-	-0.00250	-	0.005300	-	-0.00460	-
-	-	-	-	-	-	-	-
0.030000	-	0.030000	-	0.033000	-	0.020000	-
0.060000	0.021700	0.058000	0.015300	0.050000	0.011600	0.040000	-
0.10000	0.023200	0.087500	0.017200	0.077000	0.013600	0.062000	0.010800
0.14000	0.025500	0.11500	0.019600	0.096000	0.016200	0.084000	0.013100
0.18000	-	0.14000	-	0.12000	0.020000	0.10500	0.016400
-	-	-	-	0.14200	-	0.12800	0.020000
-	-	-	-	-	-	0.14700	0.024500

Table B.5 Subsonic Transport Zero Lift Drag Flight Data

Mach #	Altitude (ft.)	C_{Do}
0.60000	0.0000	0.016200
0.65000	10000	0.016200
0.70000	15000	0.016200
0.75000	20000	0.016400
0.77000	25000	0.016800
0.79000	30000	0.017600
0.80000	35000	0.018800
0.81000	40000	0.019600
0.82500	45000	0.022000
0.85000	50000	0.028200

Table B.6 Subsonic Transport Lift Flight Data

Alpha (deg.)	C_L (M=.6)	C_L (M=.65)	C_L (M=.7)	C_L (M=.75)	C_L (M=.77)
0.0000	0.24400	0.24400	0.25700	0.26100	0.27000
1.0000	0.32400	0.32650	0.34400	0.35250	0.36300
2.0000	0.40400	0.40900	0.43100	0.44400	0.45600
3.0000	0.48400	0.49150	0.51800	0.53550	0.54900
4.0000	0.56400	0.57400	0.60500	0.62700	0.64200
6.0000	0.72400	0.73900	0.77900	0.81000	0.82800
8.0000	0.88400	0.90400	0.95300	0.99300	1.0140
10.000	1.0440	1.0690	1.1270	1.1760	1.2000
12.000	1.2040	1.2340	1.3010	1.3590	1.3860
14.000	1.3640	1.3990	1.4750	1.5420	1.5720

Table B.6 Subsonic Transport Lift Flight Data (cont'd)

Alpha (deg.)	C_L (M=.79)	C_L (M=.8)	C_L (M=.81)	C_L (M=.825)	C_L (M=.85)
0.0000	0.27440	0.27700	0.28600	0.30500	0.28500
1.0000	0.37240	0.37600	0.38600	0.40650	0.38500
2.0000	0.47040	0.47500	0.48600	0.50800	0.48500
3.0000	0.56840	0.57400	0.58600	0.60950	0.58500
4.0000	0.66640	0.67300	0.68600	0.71100	0.68500
6.0000	0.86240	0.87100	0.88600	0.91400	0.88500
8.0000	1.0584	1.0690	1.0860	1.1170	1.0850
10.000	1.2544	1.2670	1.2860	1.3200	1.2850
12.000	1.4504	1.4650	1.4860	1.5230	1.4850
14.000	1.6464	1.6630	1.6860	1.7260	1.6850

Table B.7 Subsonic Transport Drag Polar Flight Data

C_L (M=.6)	C_D (M=.6)	C_L (M=.65)	C_D (M=.65)	C_L (M=.7)	C_D (M=.7)	C_L (M=.75)	C_D (M=.75)
0.0000	0.017800	0.0000	0.017800	0.0000	0.017800	0.045000	0.017000
0.037500	0.017000	0.037500	0.017000	0.037500	0.017000	0.0000	0.018000
0.13500	0.016200	0.13500	0.016200	0.13500	0.016200	0.13000	0.016400
0.23000	0.017000	0.23000	0.017000	0.23000	0.017000	0.22000	0.017000
0.27750	0.018000	0.27750	0.018000	0.27750	0.018000	0.27750	0.018000
0.36000	0.020000	0.36000	0.020000	0.36000	0.020000	0.36000	0.020000
0.42250	0.022000	0.42250	0.022000	0.42250	0.022000	0.42250	0.022000
0.47250	0.024000	0.47250	0.024000	0.47250	0.024000	0.46750	0.024000
0.51750	0.026000	0.51750	0.026000	0.51500	0.026000	0.50500	0.026000
0.55750	0.028000	0.55750	0.028000	0.55000	0.028000	0.53500	0.028000
0.59500	0.030000	0.59250	0.030000	0.58000	0.030000	0.55750	0.030000
0.63000	0.032000	0.62250	0.032000	0.60500	0.032000	0.57750	0.032000
0.66000	0.034000	0.64750	0.034000	0.62500	0.034000	0.59250	0.034000
0.68750	0.036000	0.67000	0.036000	0.64250	0.036000	0.60500	0.036000
0.71250	0.038000	0.69000	0.038000	0.66000	0.038000	0.61750	0.038000
0.73500	0.040000	0.71000	0.040000	0.67500	0.040000	0.62500	0.040000
0.75750	0.042000	0.72250	0.042000	0.68750	0.042000	0.63500	0.042000
0.77750	0.044000	0.73500	0.044000	0.70000	0.044000	0.64000	0.044000
0.79500	0.046000	0.75000	0.046000	-	-	-	-

Table B.7 Subsonic Transport Drag Polar Flight Data (cont'd)

C_L (M=.77)	C_D (M=.77)	C_L (M=.79)	C_D (M=.79)	C_L (M=.8)	C_D (M=.8)	C_L (M=.81)	C_D (M=.81)
0.0000	0.018400	0.0000	0.019700	0.0000	0.020700	0.0000	0.021900
0.085000	0.017000	0.027500	0.019000	0.022500	0.020000	0.030000	0.021000
0.14000	0.016800	0.082500	0.018000	0.075000	0.019000	0.092500	0.020000
0.26500	0.018000	0.14500	0.017600	0.17000	0.018500	0.17500	0.019600
0.35250	0.020000	0.21500	0.018000	0.25500	0.019000	0.23750	0.020000
0.41250	0.022000	0.33500	0.020000	0.30750	0.020000	0.33250	0.022000
0.46000	0.024000	0.39500	0.022000	0.37250	0.022000	0.38000	0.024000
0.49500	0.026000	0.43500	0.024000	0.41500	0.024000	0.41500	0.026000
0.52250	0.028000	0.46500	0.026000	0.44750	0.026000	0.44000	0.028000
0.54250	0.030000	0.49000	0.028000	0.47000	0.028000	0.45750	0.030000
0.56000	0.032000	0.51000	0.030000	0.48750	0.030000	0.47250	0.032000
0.57250	0.034000	0.52750	0.032000	0.50000	0.032000	0.48500	0.034000
0.58250	0.036000	0.54000	0.034000	0.51250	0.034000	0.49500	0.036000
0.59000	0.038000	0.55000	0.036000	0.52250	0.036000	0.50500	0.038000
0.60000	0.040000	0.55750	0.038000	0.53000	0.038000	0.51000	0.040000
0.60500	0.042000	0.56500	0.040000	0.53750	0.040000	0.51500	0.042000
0.61000	0.044000	0.57000	0.042000	0.54500	0.042000	0.52000	0.044000
-	-	0.57500	0.044000	0.55000	0.044000	-	-
-	-	-	-	-	-	-	-

Table B.7 Subsonic Transport Drag Polar Flight Data (cont'd)

C_L (M=.825)	C_D (M=.825)	C_L (M=.85)	C_D (M=.85)
0.0000	0.024300	0.0000	0.030000
0.042500	0.023000	0.022500	0.029000
0.16000	0.022000	0.075000	0.028200
0.24500	0.023000	0.13750	0.029000
0.27750	0.024000	0.17250	0.030000
0.32500	0.026000	0.21750	0.032000
0.35750	0.028000	0.24750	0.034000
0.38000	0.030000	0.26750	0.036000
0.40000	0.032000	0.28250	0.038000
0.41000	0.034000	0.29500	0.040000
0.42000	0.036000	0.30500	0.042000
0.42750	0.038000	0.31000	0.044000
0.43250	0.040000	-	-
0.43750	0.042000	-	-
0.44000	0.044000	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

Table B.8 A-6 Zero Lift Drag Flight Data

Mach #	C _{Do}
0.700000	0.020000
0.800000	0.020000
0.900000	0.042700
1.100000	0.106000
1.300000	0.113000

Table B.9 A-6 Lift and Drag Flight/Wind Tunnel Data

M = .7			M = .8		
Alpha (deg.)	C _L	C _D	Alpha (deg.)	C _L	C _D
0.000000	0.000000	0.020000	0.000000	0.000000	0.020000
1.000000	0.100000	0.020200	1.000000	0.100000	0.021100
2.000000	0.200000	0.021100	2.000000	0.200000	0.024200
3.000000	0.300000	0.024800	3.000000	0.300000	0.029800
4.000000	0.400000	0.030600	4.000000	0.400000	0.037800
5.000000	0.500000	0.037800	5.000000	0.500000	0.047500
6.000000	0.600000	0.046300	6.000000	0.600000	0.058900
7.000000	0.700000	0.057200	7.000000	0.700000	0.073900
8.000000	0.800000	0.072200	8.000000	0.800000	0.096100

Table B.9 A-6 Lift and Drag Flight/Wind Tunnel Data (cont'd)

M = .9			M = 1.1		
Alpha (deg.)	C _L	C _D	Alpha (deg.)	C _L	C _D
0.000000	0.000000	0.042700	0.000000	0.000000	0.105500
1.167000	0.100000	0.045600	0.750000	0.050000	0.106000
2.333000	0.200000	0.051700	1.500000	0.100000	0.106700
3.500000	0.300000	0.060000	2.250000	0.150000	0.108100
4.667000	0.400000	0.071700	3.000000	0.200000	0.111000
5.833000	0.500000	0.085600	3.750000	0.250000	0.115000
7.000000	0.600000	0.106100	4.500000	0.300000	0.119500
-	-	-	5.250000	0.350000	0.125600
-	-	-	6.000000	0.400000	0.132200

Table B.9 A-6 Lift and Drag Flight/Wind Tunnel Data (cont'd)

M = 1.3		
Alpha (deg.)	C _L	C _D
0.000000	0.000000	0.113000
0.833300	0.050000	0.114100
1.667000	0.100000	0.115700
2.500000	0.150000	0.117800
3.333000	0.200000	0.121400
4.167000	0.250000	0.125600
5.000000	0.300000	0.132200

Table B.10 Bizjet Zero Lift Drag Flight Data

Mach #	C_{Do}
0.10000	0.027900
0.20000	0.027900
0.25000	0.027900
0.30000	0.027900

Table B.11 Bizjet Lift and Drag Flight Data for $M=.2$

Alpha (deg.)	C_L	C_D
0.0000	0.090000	0.028300
1.0000	0.17000	0.029500
2.0000	0.26000	0.031600
3.0000	0.34000	0.034200
4.0000	0.42500	0.037700
5.0000	0.51000	0.042000
6.0000	0.59000	0.046700
7.0000	0.67000	0.052200
8.0000	0.75500	0.058800
9.0000	0.84000	0.066100
10.000	0.92000	0.073700
11.000	1.0050	0.087600

Appendix C ACSYNT Input and Output Files

```

$ DATA BLOCK A
***** GENERAL DYNAMICS F-16A FIGHTER - AIR SUPERIORITY MISSION *****
$ DATA BLOCK B
      1      0      0      0      0      0      0
$ DATA BLOCK V
END
FIGHTER
      5      4      4      570      585      1      0      1      2      1      7      0
      0.0001      0.80      60000.00      0.00      0.00      0.00
      1      2      3      4      6
      1      2      3      2
      2      3      4      1
***** GENERAL DYNAMICS F-16A BLOCK 15 GEOMETRY *****
$SWING
      AR      =      3.000, AREA      =      300.000, DIHED      =      0.000,
      FDENWVG      =      49.000, SWEEP      =      32.183, SWFACT      =      0.690,
      TAPER      =      0.228, TCROOT      =      0.040, TCTIP      =      0.040,
      WFFRAC      =      0.326, XWING      =      0.468, ZROOT      =      0.000,
      KSWEEP      =      1,
$SEND
$HTAIL
      AR      =      2.114, AREA      =      63.700, SWEEP      =      32.271,
      SWFACT      =      1.570, TAPER      =      0.390, TCROOT      =      0.060,
      TCTIP      =      0.035, XHTAIL      =      0.974, ZROOT      =      0.000,
      KSWEEP      =      1, SIZIT      =      .FALSE.,
$SEND
$VTAIL
      AR      =      1.294, AREA      =      54.750, SWEEP      =      43.225,
      SWFACT      =      1.067, TAPER      =      0.437, TCROOT      =      0.053,
      TCTIP      =      0.030, VTNO      =      1.000, XVTAIL      =      0.950,
      YROOT      =      0.000, ZROOT      =      1.000, KSWEEP      =      1,
      SIZIT      =      .FALSE.,
$SEND
$FUS
      BDMAX      =      3.799, BODL      =      47.580, DRADAR      =      2.600,
      FRAB      =      3.001, FRATIO      =      12.524, FRN      =      4.801,
      LRADAR      =      5.900, SFFACT      =      1.466, WFUEL      =      11876.000,
$SEND
$CREW
      NCREW      =      1,
$SEND
$FUEL
      DEN      =      49.000, FRAC      =      0.320, WFUEL      =      11876.000,
$SEND
$ENGINE
      N      =      1,
$SEND
$STRDATA
      CRMACH      =      1.500, DESLF      =      9.000, FRFURE      =      0.000,
      RANGE      =      2000.000, TIMTO1      =      0.000, TIMTO2      =      3.900,
      ULTLF      =      13.500, WFEXT      =      4810.000, WFTRAP      =      74.000,
      WFUEL      =      6972.000, IPLOT      =      2, IPSIZE      =      -2,
      MMPROP      =      0, NCODE      =      2, LENVEL      =      .FALSE.,
$SEND
10      0.0E+00

```


PHASE	MACH NO.		ALTITUDE		HORIZONTAL		NO. TURN	VIND 'G'S	WKFUEL	M	IP	IX	W	B	A	P
	START	END	START	END	DIST	TIME										
CLIMB	0.50	0.00	0	10000	0.0	0.0	0.0	330.0	1.0000	0	2	-1	0	0	0	0
CLIMB	0.60	0.00	-1	30000	0.0	0.0	0.0	315.0	1.0000	0	2	-1	0	0	0	0
CLIMB	0.87	0.00	-1	37600	0.0	0.0	0.0	0.0	1.0000	0	2	-1	0	0	0	0
CRUISE	0.87	0.87	-1	0	-1.0	0.0	0.0	0.0	1.0000	0	4	0	0	0	0	0
COMBAT	0.90	0.90	30000	30000	0.0	3.1	0.0	0.0	0.0000	0	1	0	0	0	0	0
ACCEL	0.90	1.60	30000	30000	0.0	0.0	0.0	0.0	1.0000	0	1	0	0	0	0	0
COMBAT	1.20	1.20	30000	30000	0.0	3.3	0.0	0.0	0.0000	0	1	0	1	0	0	0
CLIMB	0.87	0.00	20000	45250	0.0	0.0	0.0	0.0	1.0000	0	2	-1	0	0	0	0
CRUISE	0.87	0.87	-1	0	-1.0	0.0	0.0	0.0	1.0000	0	4	0	0	0	0	0
LOITER	0.43	0.43	0	0	0.0	20.0	0.0	0.0	1.0000	0	4	0	0	0	0	0

Unmatched Aerodynamics for F-16A

\$ACHAR

ABOSB	=	0.150,	ALMAX	=	30.000,	AMC	=	40.000,
BDNOSE	=	0.000,	BTEF	=	1.000,	MACHN	=	0.750,
RALOIT	=	0.000,	RCLMAX	=	1.000,	ROC	=	0.015,
ROCAN	=	0.020,	SFWF	=	1.000,	SMNDR	=	0.900,
SPANAC	=	0.000,	SWPMAX	=	60.000,	SWPMIN	=	0.000,
XCDC	=	0.600,	XCDW	=	0.600,	AJCAN	=	0,
ALELJ	=	3,	INORM	=	1,	ISMNDR	=	0,
ISUPCR	=	0,	ITRAP	=	0,	IXCD	=	1,
ELLIPC	=	FALSE.,	SMNSWP (1)	=	0.000,	SMNSWP (2)	=	0.200,
SMNSWP (3)	=	0.400,	SMNSWP (4)	=	0.600,	SMNSWP (5)	=	0.800,
SMNSWP (6)	=	1.000,	SMNSWP (7)	=	1.200,	SMNSWP (8)	=	1.400,
SMNSWP (9)	=	1.600,	SMNSWP (10)	=	1.800,	CLO (1)	=	0.000,
CLO (2)	=	0.000,	CLO (3)	=	0.000,	CLO (4)	=	0.000,
CLO (5)	=	0.000,	CLO (6)	=	0.000,	CLO (7)	=	0.000,
CLO (8)	=	0.000,	CLO (9)	=	0.000,	CLO (10)	=	0.000,
CLOC (1)	=	0.000,	CLOC (2)	=	0.000,	CLOC (3)	=	0.000,
CLOC (4)	=	0.000,	CLOC (5)	=	0.000,	CLOC (6)	=	0.000,
CLOC (7)	=	0.000,	CLOC (8)	=	0.000,	CLOC (9)	=	0.000,
CLOC (10)	=	0.000,	CLOW (1)	=	0.000,	CLOW (2)	=	0.000,
CLOW (3)	=	0.000,	CLOW (4)	=	0.000,	CLOW (5)	=	0.000,
CLOW (6)	=	0.000,	CLOW (7)	=	0.000,	CLOW (8)	=	0.000,
CLOW (9)	=	0.000,	CLOW (10)	=	0.000,	CMO (1)	=	0.000,
CMO (2)	=	0.000,	CMO (3)	=	0.000,	CMO (4)	=	0.000,
CMO (5)	=	0.000,	CMO (6)	=	0.000,	CMO (7)	=	0.000,
CMO (8)	=	0.000,	CMO (9)	=	0.000,	CMO (10)	=	0.000,
YSWP (1)	=	0.000,	YSWP (2)	=	0.000,	YSWP (3)	=	0.000,
YSWP (4)	=	0.000,	YSWP (5)	=	0.000,	YSWP (6)	=	0.000,
YSWP (7)	=	0.000,	YSWP (8)	=	0.000,	YSWP (9)	=	0.000,
YSWP (10)	=	0.000,						

\$END

\$AMULT

CSF	=	1.000,	ESSF	=	0.720,	FCD	=	1.000,
FCDF	=	1.000,	FCDL	=	1.000,	FCDW	=	1.000,
FCDWB	=	1.000,	FENG	=	1.000,	FINTE	=	1.000,
FLBCOR	=	1.000,	FLECOR	=	1.000,	FMDR	=	1.000,
FCDO	=	1.000,	FLD	=	1.000,	FCDRA (1)	=	1.000,
FCDRA (2)	=	1.000,	FCDRA (3)	=	1.000,	FCDRA (4)	=	1.000,
FCDRA (5)	=	1.000,	FCDRA (6)	=	1.000,	FCDRA (7)	=	1.000,
FCDRA (8)	=	1.000,	FCDRA (9)	=	1.000,	FCDRA (10)	=	1.000,

\$END

\$ATRIM

FLDM (1)	=	0.000,	FLDM (2)	=	0.000,	FLDM (3)	=	0.000,
FLDM (4)	=	0.000,	FLDM (5)	=	0.000,	FLDM (6)	=	0.000,
FLDM (7)	=	0.000,	FLDM (8)	=	0.000,	FLDM (9)	=	0.000,
FLDM (10)	=	0.000,	FVCAM (1)	=	0.000,	FVCAM (2)	=	0.000,
FVCAM (3)	=	0.000,	FVCAM (4)	=	0.000,	FVCAM (5)	=	0.000,

FVCAM(6)	=	0.000,	FVCAM(7)	=	0.000,	FVCAM(8)	=	0.000,
FVCAM(9)	=	0.000,	FVCAM(10)	=	0.000,	ITRIM(1)	=	0,
ITRIM(2)	=	0,	ITRIM(3)	=	0,	ITRIM(4)	=	0,
ITRIM(5)	=	0,	ITRIM(6)	=	0,	ITRIM(7)	=	0,
ITRIM(8)	=	0,	ITRIM(9)	=	0,	ITRIM(10)	=	0,
CAND	=	0.000,	CFLAP	=	0.000,	CGM	=	0.360,
IT	=	0.000,	SFLAP	=	0.000,	SM	=	0.000,
SPANF	=	0.000,	ZCG	=	0.000,	IVCAM	=	0,
\$END								
\$ADET								
IPLOT	=	1,	NALF	=	10,	NMDTL	=	10,
ICOD	=	1,	IALF	=	0,	IALP	=	2,
SMN(1)	=	0.400,	SMN(2)	=	0.600,	SMN(3)	=	0.800,
SMN(4)	=	0.850,	SMN(5)	=	0.900,	SMN(6)	=	0.950,
SMN(7)	=	1.050,	SMN(8)	=	1.200,	SMN(9)	=	1.400,
SMN(10)	=	1.600,	ALIN(1)	=	0.000,	ALIN(2)	=	1.000,
ALIN(3)	=	2.000,	ALIN(4)	=	3.000,	ALIN(5)	=	4.000,
ALIN(6)	=	6.000,	ALIN(7)	=	8.000,	ALIN(8)	=	10.000,
ALIN(9)	=	12.000,	ALIN(10)	=	14.000,	ALTV(1)	=	30000.000,
ALTV(2)	=	30000.000,	ALTV(3)	=	30000.000,	ALTV(4)	=	30000.000,
ALTV(5)	=	30000.000,	ALTV(6)	=	30000.000,	ALTV(7)	=	30000.000,
ALTV(8)	=	30000.000,	ALTV(9)	=	30000.000,	ALTV(10)	=	30000.000,
CLINPT(1)	=	0.000,	CLINPT(2)	=	0.000,	CLINPT(3)	=	0.000,
CLINPT(4)	=	0.000,	CLINPT(5)	=	0.000,	CLINPT(6)	=	0.000,
CLINPT(7)	=	0.000,	CLINPT(8)	=	0.000,	CLINPT(9)	=	0.000,
CLINPT(10)	=	0.000,	ITB(1)	=	0,	ITB(2)	=	0,
ITB(3)	=	0,	ITB(4)	=	0,	ITB(5)	=	0,
ITB(6)	=	0,	ITB(7)	=	0,	ITB(8)	=	0,
ITB(9)	=	0,	ITB(10)	=	0,	ITS(1)	=	0,
ITS(2)	=	0,	ITS(3)	=	0,	ITS(4)	=	0,
ITS(5)	=	0,	ITS(6)	=	0,	ITS(7)	=	0,
ITS(8)	=	0,	ITS(9)	=	0,	ITS(10)	=	0,
ISTRS(1)	=	0,	ISTRS(2)	=	0,	ISTRS(3)	=	0,
ISTRS(4)	=	0,	ISTRS(5)	=	0,	ISTRS(6)	=	0,
ISTRS(7)	=	0,	ISTRS(8)	=	0,	ISTRS(9)	=	0,
ISTRS(10)	=	0,						
\$END								
\$ADRAG								
ICDO	=	0,	SMNCDO(1)	=	0.000,	SMNCDO(2)	=	0.000,
SMNCDO(3)	=	0.000,	SMNCDO(4)	=	0.000,	SMNCDO(5)	=	0.000,
SMNCDO(6)	=	0.000,	SMNCDO(7)	=	0.000,	SMNCDO(8)	=	0.000,
SMNCDO(9)	=	0.000,	SMNCDO(10)	=	0.000,	CDONPT(1)	=	0.000,
CDONPT(2)	=	0.000,	CDONPT(3)	=	0.000,	CDONPT(4)	=	0.000,
CDONPT(5)	=	0.000,	CDONPT(6)	=	0.000,	CDONPT(7)	=	0.000,
CDONPT(8)	=	0.000,	CDONPT(9)	=	0.000,	CDONPT(10)	=	0.000,
SMNBMB(1)	=	0.000,	SMNBMB(2)	=	0.200,	SMNBMB(3)	=	0.400,
SMNBMB(4)	=	0.600,	SMNBMB(5)	=	0.800,	SMNBMB(6)	=	1.000,
SMNBMB(7)	=	1.200,	SMNBMB(8)	=	1.400,	SMNBMB(9)	=	1.600,
SMNBMB(10)	=	1.800,	CDBMB(1)	=	0.000,	CDBMB(2)	=	0.000,
CDBMB(3)	=	0.000,	CDBMB(4)	=	0.000,	CDBMB(5)	=	0.000,
CDBMB(6)	=	0.000,	CDBMB(7)	=	0.000,	CDBMB(8)	=	0.000,
CDBMB(9)	=	0.000,	CDBMB(10)	=	0.000,	SMSTRS(1)	=	0.000,
SMSTRS(2)	=	0.200,	SMSTRS(3)	=	0.400,	SMSTRS(4)	=	0.600,
SMSTRS(5)	=	0.800,	SMSTRS(6)	=	1.000,	SMSTRS(7)	=	1.200,
SMSTRS(8)	=	1.400,	SMSTRS(9)	=	1.600,	SMSTRS(10)	=	1.800,
CDSTR(1)	=	0.000,	CDSTR(2)	=	0.000,	CDSTR(3)	=	0.000,
CDSTR(4)	=	0.000,	CDSTR(5)	=	0.000,	CDSTR(6)	=	0.000,
CDSTR(7)	=	0.000,	CDSTR(8)	=	0.000,	CDSTR(9)	=	0.000,
CDSTR(10)	=	0.000,	SMTANK(1)	=	0.000,	SMTANK(2)	=	0.200,
SMTANK(3)	=	0.400,	SMTANK(4)	=	0.600,	SMTANK(5)	=	0.800,
SMTANK(6)	=	1.000,	SMTANK(7)	=	1.200,	SMTANK(8)	=	1.400,

SMTANK (9) =	1.600,	SMTANK (10) =	1.800,	CDTNK (1) =	0.000,
CDTNK (2) =	0.000,	CDTNK (3) =	0.000,	CDTNK (4) =	0.000,
CDTNK (5) =	0.000,	CDTNK (6) =	0.000,	CDTNK (7) =	0.000,
CDTNK (8) =	0.000,	CDTNK (9) =	0.000,	CDTNK (10) =	0.000,
SMEXTR (1) =	0.000,	SMEXTR (2) =	0.200,	SMEXTR (3) =	0.400,
SMEXTR (4) =	0.600,	SMEXTR (5) =	0.800,	SMEXTR (6) =	1.000,
SMEXTR (7) =	1.200,	SMEXTR (8) =	1.400,	SMEXTR (9) =	1.600,
SMEXTR (10) =	1.800,	CDEXTR (1) =	0.000,	CDEXTR (2) =	0.000,
CDEXTR (3) =	0.000,	CDEXTR (4) =	0.000,	CDEXTR (5) =	0.000,
CDEXTR (6) =	0.000,	CDEXTR (7) =	0.000,	CDEXTR (8) =	0.000,
CDEXTR (9) =	0.000,	CDEXTR (10) =	0.000,		
\$END					
\$ATAKE					
CLLAND =	-1.000,	CLTO =	-1.000,	DELFLD =	45.000,
DELFTO =	45.000,	DELLED =	30.000,	DELLTO =	30.000,
LDLAND =	-1.000,	LDTO =	-1.000,		
\$END					
\$APRINT					
ECHOIN =	1,	ECHOUT =	0,	INTM =	0,
IPBLNT =	0,	IPCAN =	0,	IPENG =	0,
IPEXT =	0,	IPFLAP =	0,	IPFRIC =	0,
IPINTF =	0,	IPLIFT =	0,	IPMIN =	0,
IPWAVE =	0,	KERROR =	0,		
\$END					
***** F100 CYCLE ANALYSIS *****					
2					
\$LEWIS					
BA =	0.630,	DIA1 =	3.875,	FRBT =	1.000,
RLENG =	1.500,	YREN =	76.000,	TWAB =	23294.000,
TWOAB =	12410.000,	TWTO =	1.000,	PRFD =	1.000,
P11P1 =	3.120,	P2P1 =	25.000,	SCPR =	1.280,
T3 =	2567.000,	R10A =	-1.000,	MACH2 =	1.100,
SFINSP =	1.000,	ALTI =	0.000,	AM =	0.000,
AUAENG =	0.005,	AWAENG =	0.260,	POSA =	29.920,
XMT =	1.000,	SFADP =	1.000,	SFADSP =	1.000,
ALTD (1) =	0.000,	ALTD (2) =	30000.000,	ALTD (3) =	30000.000,
ALTD (4) =	30000.000,	ALTD (5) =	30000.000,	ALTD (6) =	30000.000,
XMACH (1) =	0.000,	XMACH (2) =	0.800,	XMACH (3) =	1.000,
XMACH (4) =	1.200,	XMACH (5) =	1.400,	XMACH (6) =	1.600,
XMDES =	2.200,	EN =	1,	IPR =	-3,
KT5 =	2,	KT7 =	2,	IPRINT =	0,
NAB =	5,	NEWINL =	0,		
\$END					
FIGHTER					
GENERAL DYNAMICS F-16A BLOCK 15 WEIGHTS, A/G MISSION					
\$OPTS					
WGTO =	29805.000,	AFMACH =	2.200,	IDELT =	1,
KBODY =	2,				
\$END					
\$FIXW					
WBODY =	3422.000,	WHT =	498.000,	WLG =	988.000,
WNA =	655.000,	WVT =	330.000,	WAIRC =	267.000,
WCA =	312.000,	WELT =	1143.000,	WEP =	586.000,
WGEAR =	172.000,	WHDP =	311.000,	WINST =	107.000,
WSC =	716.000,	WE =	3452.000,	WFS =	375.000,
WCREW =	215.000,	WAMMUN =	287.000,	WARM =	598.000,
WBB1 =	339.000,	WBOMB =	0.000,	WMISS =	338.000,
WETANK =	1250.000,	WWING =	1936.000,		
\$END					

F-16A unmatched aerodynamics output

Mach = .40
Altitude = 30000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0122									
Body	.0061	.0	.000	.0136	.0	.000	.00	.0000	.0	2
Wing	.0034	1.0	.078	.0143	5.4	.003	.99	.0000	.0	2
Strakes	.0000	2.0	.154	.0162	9.5	.006	.99	.0000	.0	2
H. Tail	.0013	3.0	.229	.0192	11.9	.008	.99	.0000	.0	2
V. Tail	.0013	4.0	.302	.0235	12.9	.010	.98	.0000	.0	2
Canard	.0000	6.0	.447	.0393	11.4	.012	.83	.0000	.0	2
Pods	.0000	8.0	.564	.0804	7.0	.011	.51	.0000	.0	3
Engine	.0000	10.0	.677	.1169	5.8	.008	.47	.0000	.0	3
Cowl	.0000	12.0	.783	.1613	4.9	.003	.44	.0000	.0	3
Boattail	.0000	14.0	.883	.2131	4.1	-.003	.41	.0000	.0	3
Interference	.0014									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

				Slope Factors		
				ClAlpha		.0631
				Cdl^5Alpha		.0319
				Alpha Transition Zone 2-3		6.267

Cdmin .0136

Mach = .60
Altitude = 30000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0119									
Body	.0060	.0	.000	.0134	.0	.000	.00	.0000	.0	2
Wing	.0034	1.0	.082	.0141	5.8	.002	1.00	.0000	.0	2
Strakes	.0000	2.0	.163	.0162	10.1	.003	1.00	.0000	.0	2
H. Tail	.0013	3.0	.243	.0196	12.4	.004	.99	.0000	.0	2
V. Tail	.0013	4.0	.322	.0271	11.9	.004	.80	.0000	.0	2
Canard	.0000	6.0	.449	.0536	8.4	.003	.53	.0000	.0	3
Pods	.0000	8.0	.571	.0838	6.8	.000	.49	.0000	.0	3
Engine	.0000	10.0	.687	.1226	5.6	-.005	.46	.0000	.0	3
Cowl	.0000	12.0	.797	.1696	4.7	-.011	.43	.0000	.0	3
Boattail	.0000	14.0	.900	.2244	4.0	-.019	.41	.0000	.0	3
Interference	.0014									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

				Slope Factors		
				ClAlpha		.0643
				Cdl^5Alpha		.0328
				Alpha Transition Zone 2-3		4.151

Cdmin .0134

Mach = .80
Altitude = 30000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0116									
Body	.0058	.0	.000	.0130	.0	.000	.00	.0000	.0	2
Wing	.0033	1.0	.091	.0139	6.6	.000	1.01	.0000	.0	2
Strakes	.0000	2.0	.181	.0165	11.0	.000	1.01	.0000	.0	2
H. Tail	.0013	3.0	.269	.0229	11.7	.000	.77	.0000	.0	2
V. Tail	.0012	4.0	.336	.0338	9.9	-.002	.58	.0000	.0	3
Canard	.0000	6.0	.467	.0574	8.1	-.006	.52	.0000	.0	3
Pods	.0000	8.0	.593	.0903	6.6	-.011	.48	.0000	.0	3
Engine	.0000	10.0	.713	.1322	5.4	-.018	.45	.0000	.0	3
Cowl	.0000	12.0	.826	.1827	4.5	-.026	.43	.0000	.0	3
Boattail	.0000	14.0	.933	.2413	3.9	-.036	.40	.0000	.0	3
Interference	.0014									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

				Slope Factors		
				ClAlpha		.0666
				Cdl^5Alpha		.0341
				Alpha Transition Zone 2-3		3.021

Cdmin .0130

Mach = .85
Altitude = 30000.

Parasite Drag		Induced Drag									
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone	
Friction	.0115	.0	.000	.0129	.0	.000	.00	.0000	.0	2	
Body	.0058	.0	.000	.0129	.0	.000	.00	.0000	.0	2	
Wing	.0032	1.0	.095	.0139	6.8	.000	1.01	.0000	.0	2	
Strakes	.0000	2.0	.188	.0166	11.3	-.001	1.01	.0000	.0	2	
H. Tail	.0013	3.0	.278	.0245	11.3	-.001	.71	.0000	.0	3	
V. Tail	.0012	4.0	.342	.0345	9.9	-.003	.57	.0000	.0	3	
Canard	.0000	6.0	.474	.0588	8.1	-.008	.52	.0000	.0	3	
Pods	.0000	8.0	.601	.0925	6.5	-.014	.48	.0000	.0	3	
Engine	.0000	10.0	.722	.1353	5.3	-.022	.45	.0000	.0	3	
Cowl	.0000	12.0	.837	.1869	4.5	-.031	.43	.0000	.0	3	
Boattail	.0000	14.0	.944	.2467	3.8	-.041	.40	.0000	.0	3	
Interference	.0014										
Wave	.0000										
External	.0000										
Tanks	.0000										
Bombs	.0000										
Stores	.0000										
Extra	.0000										
Camber	.0000										
Cdmin											
				Slope Factors							
				ClAlpha .0674							
				Cdl^5Alpha .0345							
				Alpha Transition Zone 2-3 2.809							

Mach = .90
Altitude = 30000.

Parasite Drag		Induced Drag									
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone	
Friction	.0114	.0	.000	.0128	.0	.000	.00	.0000	.0	2	
Body	.0057	.0	.000	.0128	.0	.000	.00	.0000	.0	2	
Wing	.0032	1.0	.099	.0139	7.1	.000	1.01	.0000	.0	2	
Strakes	.0000	2.0	.196	.0169	11.6	-.001	1.01	.0000	.0	2	
H. Tail	.0013	3.0	.290	.0261	11.1	-.003	.68	.0000	.0	3	
V. Tail	.0012	4.0	.350	.0354	9.9	-.005	.57	.0000	.0	3	
Canard	.0000	6.0	.483	.0604	8.0	-.010	.52	.0000	.0	3	
Pods	.0000	8.0	.611	.0950	6.4	-.017	.48	.0000	.0	3	
Engine	.0000	10.0	.733	.1389	5.3	-.025	.45	.0000	.0	3	
Cowl	.0000	12.0	.848	.1916	4.4	-.035	.43	.0000	.0	3	
Boattail	.0000	14.0	.957	.2526	3.8	-.046	.40	.0000	.0	3	
Interference	.0015										
Wave	.0000										
External	.0000										
Tanks	.0000										
Bombs	.0000										
Stores	.0000										
Extra	.0000										
Camber	.0000										
Cdmin											
				Slope Factors							
				ClAlpha .0683							
				Cdl^5Alpha .0350							
				Alpha Transition Zone 2-3 2.615							

Mach = .95
Altitude = 30000.

Parasite Drag		Induced Drag									
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone	
Friction	.0113	.0	.000	.0177	.0	.000	.00	.0000	.0	2	
Body	.0056	.0	.000	.0177	.0	.000	.00	.0000	.0	2	
Wing	.0032	1.0	.105	.0188	5.6	-.001	1.02	.0000	.0	2	
Strakes	.0000	2.0	.208	.0223	9.3	-.002	.98	.0000	.0	2	
H. Tail	.0012	3.0	.290	.0322	9.0	-.004	.62	.0000	.0	3	
V. Tail	.0012	4.0	.359	.0415	8.7	-.007	.58	.0000	.0	3	
Canard	.0000	6.0	.494	.0674	7.3	-.013	.52	.0000	.0	3	
Pods	.0000	8.0	.623	.1030	6.0	-.020	.48	.0000	.0	3	
Engine	.0004	10.0	.746	.1480	5.0	-.029	.45	.0000	.0	3	
Cowl	.0000	12.0	.862	.2020	4.3	-.039	.43	.0000	.0	3	
Boattail	.0004	14.0	.971	.2644	3.7	-.050	.41	.0000	.0	3	
Interference	.0008										
Wave	.0052										
External	.0000										
Tanks	.0000										
Bombs	.0000										
Stores	.0000										
Extra	.0000										
Camber	.0000										
Cdmin											
				Slope Factors							
				ClAlpha .0694							
				Cdl^5Alpha .0355							
				Alpha Transition Zone 2-3 2.436							

Mach = 1.05
Altitude = 30000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0110									
Body	.0055	.0	.000	.0304	.0	.000	.00	.0000	.0	2
Wing	.0031	1.0	.114	.0317	3.6	-.008	1.03	.0000	.0	2
Strakes	.0000	2.0	.225	.0367	6.1	-.017	.85	.0000	.0	2
H. Tail	.0012	3.0	.281	.0445	6.3	-.024	.59	.0000	.0	3
V. Tail	.0012	4.0	.353	.0542	6.5	-.033	.55	.0000	.0	3
Canard	.0000	6.0	.493	.0813	6.1	-.052	.51	.0000	.0	3
Pods	.0000	8.0	.628	.1189	5.3	-.072	.47	.0000	.0	3
Engine	.0013	10.0	.756	.1664	4.5	-.095	.45	.0000	.0	3
Cowl	.0000	12.0	.878	.2235	3.9	-.120	.42	.0000	.0	3
Boattail	.0013	14.0	.992	.2892	3.4	-.147	.40	.0000	.0	3
Interference	.0005									
Wave	.0176									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Slope Factors				
ClAlpha				.0708
Cd1^5Alpha				.0363
Alpha Transition Zone 2-3				2.111

Cdmin .0304

Mach = 1.20
Altitude = 30000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0107									
Body	.0053	.0	.000	.0298	.0	.000	.00	.0000	.0	2
Wing	.0030	1.0	.117	.0312	3.7	-.011	1.03	.0000	.0	2
Strakes	.0000	2.0	.232	.0381	6.1	-.022	.69	.0000	.0	3
H. Tail	.0012	3.0	.306	.0471	6.5	-.032	.57	.0000	.0	3
V. Tail	.0011	4.0	.383	.0588	6.5	-.043	.54	.0000	.0	3
Canard	.0000	6.0	.536	.0912	5.9	-.066	.50	.0000	.0	3
Pods	.0000	8.0	.683	.1357	5.0	-.091	.47	.0000	.0	3
Engine	.0007	10.0	.825	.1919	4.3	-.119	.45	.0000	.0	3
Cowl	.0000	12.0	.959	.2589	3.7	-.148	.43	.0000	.0	3
Boattail	.0007	14.0	1.085	.3358	3.2	-.179	.41	.0000	.0	3
Interference	.0004									
Wave	.0180									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Slope Factors				
ClAlpha				.0775
Cd1^5Alpha				.0395
Alpha Transition Zone 2-3				1.673

Cdmin .0298

Mach = 1.40
Altitude = 30000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0101									
Body	.0051	.0	.000	.0292	.0	.000	.00	.0000	.0	6
Wing	.0029	1.0	.061	.0302	2.0	-.011	.37	.0000	.0	6
Strakes	.0000	2.0	.122	.0334	3.7	-.023	.37	.0000	.0	6
H. Tail	.0011	3.0	.185	.0388	4.8	-.034	.37	.0000	.0	6
V. Tail	.0011	4.0	.248	.0465	5.3	-.046	.38	.0000	.0	6
Canard	.0000	6.0	.375	.0685	5.5	-.070	.38	.0000	.0	6
Pods	.0000	8.0	.502	.0997	5.0	-.095	.38	.0000	.0	6
Engine	.0004	10.0	.628	.1399	4.5	-.121	.38	.0000	.0	6
Cowl	.0000	12.0	.752	.1890	4.0	-.147	.38	.0000	.0	6
Boattail	.0004	14.0	.874	.2470	3.5	-.172	.37	.0000	.0	6
Interference	.0004									
Wave	.0182									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Slope Factors				
ClAlpha				.0624
Cd1^5Alpha				.0333
Alpha Transition Zone 2-3				1.064

Cdmin .0292

Mach = 1.60
Altitude = 30000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0096									
Body	.0048	.0	.000	.0279	.0	.000	.00	.0000	.0	6
Wing	.0027	1.0	.054	.0288	1.9	-.010	.33	.0000	.0	6
Strakes	.0000	2.0	.110	.0317	3.5	-.021	.33	.0000	.0	6
H. Tail	.0011	3.0	.166	.0365	4.5	-.031	.34	.0000	.0	6
V. Tail	.0010	4.0	.222	.0434	5.1	-.042	.34	.0000	.0	6
Canard	.0000	6.0	.337	.0633	5.3	-.064	.34	.0000	.0	6
Pods	.0000	8.0	.452	.0914	4.9	-.086	.34	.0000	.0	6
Engine	.0003	10.0	.567	.1278	4.4	-.109	.34	.0000	.0	6
Cowl	.0000	12.0	.681	.1726	3.9	-.131	.34	.0000	.0	6
Boattail	.0003	14.0	.793	.2257	3.5	-.151	.34	.0000	.0	6
Interference	.0004									
Wave	.0176									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin	.0279									

Slope Factors			
CiAlpha			.0567
Cdl^5Alpha			.0318
Alpha Transition Zone 2-3			.500

1 SUMMARY --- ACSYNT OUTPUT --- NASA, AMES RESEARCH CENTER

***** GENERAL DYNAMICS F-16A FIGHTER - AIR SUPERIORITY MISSION *				ENGLISH UNITS - DISTANCES IN FEET WEIGHTS IN LBS.		
GENERAL		FUSELAGE		WING	HTAIL	VTAIL
WG	29805.	LENGTH	47.6	AREA	300.0	63.7
W/S	.0	DIAMETER	3.8	WETTED AREA	333.1	115.3
T/W	.78	VOLUME	470.0	SPAN	30.0	11.6
N(Z) ULT	13.5	WETTED AREA	755.8	L.E. SWEEP	40.0	40.0
CREW	1.	FINENESS RATIO	12.5	C/4 SWEEP	32.2	32.3
PASENGERS	0.			ASPECT RATIO	3.00	2.11
				TAPER RATIO	.23	.39
				T/C ROOT	.04	.06
				T/C TIP	.04	.04
				ROOT CHORD	16.3	7.9
				TIP CHORD	3.7	3.1
				M.A. CHORD	11.3	5.8
				LOC. OF L.E.	18.2	38.4
						36.1

ENGINE		WEIGHTS	
NUMBER	1.	W	WG
LENGTH	14.8	STRUCT.	8942. 30.0
DIAM.	4.3	PROPUL.	4113. 13.8
WEIGHT	4742.6	FIX. EQ.	4113. 13.8
TSLs	23294.	FUEL	11782. 39.5
SFCSLS	3.16	PAYLOAD	3547. 11.9

PHASE	MACH NO.		ALTITUDE		HORIZONTAL		NO. TURN	VIND 'G'S	WKFUEL	M	IP	IX	W	B	A	P
	START	END	START	END	DIST	TIME										
CLIMB	0.30	0.30	0	10000	0.0	0.0	0.0	300.0	1.0000	1	1	-1	0	0	0	0
CLIMB	0.00	0.00	10000	15000	0.0	0.0	0.0	350.0	1.0000	1	1	-1	0	0	0	0
CLIMB	0.00	0.00	15000	25000	0.0	0.0	0.0	370.0	1.0000	1	1	-1	0	0	0	0
CLIMB	0.00	0.00	25000	36000	0.0	0.0	0.0	480.0	1.0000	1	1	-1	0	0	0	0
CLIMB	0.00	0.00	36000	40000	0.0	0.0	0.0	480.0	1.0000	1	1	-1	0	0	0	0
CLIMB	0.00	0.00	40000	45000	0.0	0.0	0.0	475.0	1.0000	1	1	-1	0	0	0	0
CRUISE	2.40	0.00	45000	55000	1500.0	0.0	0.0	0.0	1.0000	1	4	0	0	0	0	0
CRUISE	2.40	0.00	-1	60000	1500.0	0.0	0.0	0.0	1.0000	1	4	0	0	0	0	0
CRUISE	2.40	0.00	-1	0	2500.0	0.0	0.0	0.0	1.0000	1	4	0	0	0	0	0
CRUISE	0.20	0.00	5000	0	5.0	0.0	0.0	140.0	1.0000	1	4	0	0	0	0	0

***** XB-70-1 UNMATCHED AERODYNAMICS *****

\$ACHAR

ABOSB	=	1.444,	ALMAX	=	9.000,	AMC	=	15.000,
BDNOSE	=	8.313,	BTEF	=	0.000,	MACHN	=	0.750,
RALOIT	=	0.000,	RCLMAX	=	1.000,	ROC	=	0.020,
ROCAN	=	0.020,	SFWF	=	1.000,	SMNDR	=	0.930,
SPANAC	=	0.000,	SWPMAX	=	60.000,	SWPMIN	=	0.000,
XCDC	=	0.600,	XCDW	=	0.600,	AJCAN	=	1,
ALELJ	=	1,	IDELTA	=	0,	INORM	=	1,
ISMNDR	=	0,	ISUPCR	=	0,	ITRAP	=	0,
IXCD	=	1,	ELLIPC	=	FALSE.,	ELLIPH	=	FALSE.,
ELLIPW	=	FALSE.,	SMNSWP (1)	=	0.760,	SMNSWP (2)	=	0.930,
SMNSWP (3)	=	1.060,	SMNSWP (4)	=	1.180,	SMNSWP (5)	=	1.650,
SMNSWP (6)	=	2.100,	SMNSWP (7)	=	2.500,	CLO (1)	=	0.000,
CLO (2)	=	0.000,	CLO (3)	=	0.000,	CLO (4)	=	0.000,
CLO (5)	=	0.000,	CLO (6)	=	0.000,	CLO (7)	=	0.000,
CLOC (1)	=	0.000,	CLOC (2)	=	0.000,	CLOC (3)	=	0.000,
CLOC (4)	=	0.000,	CLOC (5)	=	0.000,	CLOC (6)	=	0.000,
CLOC (7)	=	0.000,	CLOW (1)	=	-0.033,	CLOW (2)	=	-0.040,
CLOW (3)	=	-0.100,	CLOW (4)	=	-0.015,	CLOW (5)	=	-0.003,
CLOW (6)	=	0.005,	CLOW (7)	=	-0.005,	CMO (1)	=	0.000,
CMO (2)	=	0.000,	CMO (3)	=	0.000,	CMO (4)	=	0.000,
CMO (5)	=	0.000,	CMO (6)	=	0.000,	CMO (7)	=	0.000,
YSWP (1)	=	0.000,	YSWP (2)	=	0.000,	YSWP (3)	=	0.000,
YSWP (4)	=	0.000,	YSWP (5)	=	0.000,	YSWP (6)	=	0.000,
YSWP (7)	=	0.000,						

\$END

\$AMULT

CSF	=	0.000,	ESSF	=	1.000,	FCD	=	1.000,
FCDF	=	1.000,	FCDL	=	1.000,	FCDW	=	1.000,
FCDWB	=	1.000,	FENG	=	1.000,	FINTF	=	1.000,
FLBCOR	=	1.000,	FLECOR	=	1.000,	FMDR	=	1.000,
FCDO	=	1.000,	FLD	=	1.000,	FCDRA (1)	=	1.000,
FCDRA (2)	=	1.000,	FCDRA (3)	=	1.000,	FCDRA (4)	=	1.000,
FCDRA (5)	=	1.000,	FCDRA (6)	=	1.000,	FCDRA (7)	=	1.000,

\$END

\$ATRIM

FLDM (1)	=	1.000,	FLDM (2)	=	1.000,	FLDM (3)	=	1.000,
FLDM (4)	=	1.000,	FLDM (5)	=	1.000,	FLDM (6)	=	1.000,
FLDM (7)	=	1.000,	FVCAM (1)	=	1.000,	FVCAM (2)	=	1.000,
FVCAM (3)	=	1.000,	FVCAM (4)	=	1.000,	FVCAM (5)	=	1.000,
FVCAM (6)	=	1.000,	FVCAM (7)	=	1.000,	ITRIM (1)	=	2,
ITRIM (2)	=	2,	ITRIM (3)	=	2,	ITRIM (4)	=	2,
ITRIM (5)	=	2,	ITRIM (6)	=	2,	ITRIM (7)	=	2,
CAND	=	0.000,	CFLAP	=	9.000,	CGM	=	0.220,
IT	=	0.000,	SFLAP	=	395.400,	SM	=	0.100,
SPANF	=	40.250,	ZCG	=	0.000,	IVCAM	=	0,

\$END

\$ADET

IPLOT	=	1,	NALF	=	10,	NMDTL	=	7,
ICOD	=	1,	IALF	=	0,	IALP	=	2,
SMN(1)	=	0.760,	SMN(2)	=	0.930,	SMN(3)	=	1.060,
SMN(4)	=	1.180,	SMN(5)	=	1.650,	SMN(6)	=	2.100,
SMN(7)	=	2.500,	ALIN(1)	=	0.000,	ALIN(2)	=	0.500,
ALIN(3)	=	1.000,	ALIN(4)	=	2.000,	ALIN(5)	=	3.000,
ALIN(6)	=	4.000,	ALIN(7)	=	5.000,	ALIN(8)	=	6.000,
ALIN(9)	=	7.000,	ALIN(10)	=	8.000,	ALTV(1)	=	25730.000,
ALTV(2)	=	32770.000,	ALTV(3)	=	27140.000,	ALTV(4)	=	33720.000,
ALTV(5)	=	40000.000,	ALTV(6)	=	48600.000,	ALTV(7)	=	61630.000,
CLINPT(1)	=	0.000,	CLINPT(2)	=	0.000,	CLINPT(3)	=	0.000,
CLINPT(4)	=	0.000,	CLINPT(5)	=	0.000,	CLINPT(6)	=	0.000,
CLINPT(7)	=	0.000,	CLINPT(8)	=	0.000,	CLINPT(9)	=	0.000,
CLINPT(10)	=	0.000,	ITB(1)	=	0,	ITB(2)	=	0,
ITB(3)	=	0,	ITB(4)	=	0,	ITB(5)	=	0,
ITB(6)	=	0,	ITB(7)	=	0,	ITB(8)	=	0,
ITB(9)	=	0,	ITB(10)	=	0,	ITS(1)	=	0,
ITS(2)	=	0,	ITS(3)	=	0,	ITS(4)	=	0,
ITS(5)	=	0,	ITS(6)	=	0,	ITS(7)	=	0,
ITS(8)	=	0,	ITS(9)	=	0,	ITS(10)	=	0,
ISTRS(1)	=	0,	ISTRS(2)	=	0,	ISTRS(3)	=	0,
ISTRS(4)	=	0,	ISTRS(5)	=	0,	ISTRS(6)	=	0,
ISTRS(7)	=	0,	ISTRS(8)	=	0,	ISTRS(9)	=	0,
ISTRS(10)	=	0,						

\$END

\$ADRAG

ICDO	=	0,	SMNCDO(1)	=	0.000,	SMNCDO(2)	=	0.000,
SMNCDO(3)	=	0.000,	SMNCDO(4)	=	0.000,	SMNCDO(5)	=	0.000,
SMNCDO(6)	=	0.000,	SMNCDO(7)	=	0.000,	SMNCDO(8)	=	0.000,
SMNCDO(9)	=	0.000,	SMNCDO(10)	=	0.000,	CDONPT(1)	=	0.000,
CDONPT(2)	=	0.000,	CDONPT(3)	=	0.000,	CDONPT(4)	=	0.000,
CDONPT(5)	=	0.000,	CDONPT(6)	=	0.000,	CDONPT(7)	=	0.000,
CDONPT(8)	=	0.000,	CDONPT(9)	=	0.000,	CDONPT(10)	=	0.000,
SMNBMB(1)	=	0.000,	SMNBMB(2)	=	0.200,	SMNBMB(3)	=	0.400,
SMNBMB(4)	=	0.600,	SMNBMB(5)	=	0.800,	SMNBMB(6)	=	1.000,
SMNBMB(7)	=	1.200,	SMNBMB(8)	=	1.400,	SMNBMB(9)	=	1.600,
SMNBMB(10)	=	1.800,	CDBMB(1)	=	0.000,	CDBMB(2)	=	0.000,
CDBMB(3)	=	0.000,	CDBMB(4)	=	0.000,	CDBMB(5)	=	0.000,
CDBMB(6)	=	0.000,	CDBMB(7)	=	0.000,	CDBMB(8)	=	0.000,
CDBMB(9)	=	0.000,	CDBMB(10)	=	0.000,	SMSTRS(1)	=	0.000,
SMSTRS(2)	=	0.200,	SMSTRS(3)	=	0.400,	SMSTRS(4)	=	0.600,
SMSTRS(5)	=	0.800,	SMSTRS(6)	=	1.000,	SMSTRS(7)	=	1.200,
SMSTRS(8)	=	1.400,	SMSTRS(9)	=	1.600,	SMSTRS(10)	=	1.800,
CDSTR(1)	=	0.000,	CDSTR(2)	=	0.000,	CDSTR(3)	=	0.000,
CDSTR(4)	=	0.000,	CDSTR(5)	=	0.000,	CDSTR(6)	=	0.000,
CDSTR(7)	=	0.000,	CDSTR(8)	=	0.000,	CDSTR(9)	=	0.000,
CDSTR(10)	=	0.000,	SMTANK(1)	=	0.000,	SMTANK(2)	=	0.200,
SMTANK(3)	=	0.400,	SMTANK(4)	=	0.600,	SMTANK(5)	=	0.800,
SMTANK(6)	=	1.000,	SMTANK(7)	=	1.200,	SMTANK(8)	=	1.400,
SMTANK(9)	=	1.600,	SMTANK(10)	=	1.800,	CDTNK(1)	=	0.000,
CDTNK(2)	=	0.000,	CDTNK(3)	=	0.000,	CDTNK(4)	=	0.000,
CDTNK(5)	=	0.000,	CDTNK(6)	=	0.000,	CDTNK(7)	=	0.000,
CDTNK(8)	=	0.000,	CDTNK(9)	=	0.000,	CDTNK(10)	=	0.000,
SMEXTR(1)	=	0.000,	SMEXTR(2)	=	0.200,	SMEXTR(3)	=	0.400,
SMEXTR(4)	=	0.600,	SMEXTR(5)	=	0.800,	SMEXTR(6)	=	1.000,
SMEXTR(7)	=	1.200,	SMEXTR(8)	=	1.400,	SMEXTR(9)	=	1.600,
SMEXTR(10)	=	1.800,	CDEXTR(1)	=	0.000,	CDEXTR(2)	=	0.000,
CDEXTR(3)	=	0.000,	CDEXTR(4)	=	0.000,	CDEXTR(5)	=	0.000,
CDEXTR(6)	=	0.000,	CDEXTR(7)	=	0.000,	CDEXTR(8)	=	0.000,
CDEXTR(9)	=	0.000,	CDEXTR(10)	=	0.000,			

```

$SEND
$ATAKE
  CLLAND = 1.000, CLTO = 1.000, DELFLD = 45.000,
  DELFTO = 45.000, DELLED = 30.000, DELLTO = 30.000,
  LDLAND = 7.000, LDTO = 7.000,
$SEND
$APRINT
  ECHOIN = 1, ECHOUT = 0, INTM = 0,
  IPBLNT = 0, IPCAN = 0, IPENG = 0,
  IPEXT = 0, IPFLAP = 0, IPFRIC = 0,
  IPINTF = 0, IPLIFT = 0, IPMIN = 0,
  IPWAVE = 0, KERROR = 0,
$SEND
***** Estimated XB-70 Propulsion System (based on the J85) *****
1
$LEWIS
  AENWT = 7000.000,
  ATURB = 0.240, BA = 0.100,
  DIA1 = 4.345,
  FRBT = 0.800, FRPN = 6.928, HTR = 0.400,
  PCDFAC = 2.000, RDIAM = 1.000, RLENG = 1.000,
  SM1 = 0.900, SODG = 1.150, WCWA1 = 0.100,
  YREN = 64.000, ESF = 1.000, TWAB = 30000.000,
  TWOAB = 19000.000, TWTO = 6.000, EB1 = 0.910,
  ETAC1 = 0.900, ETAF1 = 0.900, ETAT1 = 0.885,
  P2P1 = 12.070, SPCR = 1.480, DELT57 = 200.000,
  T3 = 1250.000, T51 = 2000.000, R10A = -2.000,
  MACH1 = 1.300, MACH2 = 2.000, SFINSP = 1.000,
  ALTI = 30000.000, AM = 2.000, AUAENG = 0.000,
  AWAENG = 1.000, POSA = 20.000, XMT = 2.000,
  XMPRI (1) = 0.302, XMPRI (2) = 0.930, XMPRI (3) = 1.200,
  XMPRI (4) = 2.000, XMPRI (5) = 2.100, XMPRI (6) = 3.000,
  XPRI (1) = 0.986, XPRI (2) = 0.990, XPRI (3) = 0.986,
  XPRI (4) = 0.937, XPRI (5) = 0.600, XPRI (6) = 0.400,
  SFSFC1 = 1.000, SFSFC2 = 1.000, SFSFC3 = 1.000,
  DEPWCC = 10.000, ALTD (1) = 25730.000, ALTD (2) = 32770.000,
  ALTD (3) = 27140.000, ALTD (4) = 33720.000, ALTD (5) = 40000.000,
  ALTD (6) = 48600.000, XMACH (1) = 0.760, XMACH (2) = 0.930,
  XMACH (3) = 1.060, XMACH (4) = 1.180, XMACH (5) = 1.650,
  XMACH (6) = 2.100, XMDES = 3.000, SWING = 6297.800,
  TOSA = 518.000, EN = 6, IPR = 1,
  KODE = 0, KTS = 2, IPLOT = 0,
  IPRINT = 0, MINPR = 1, MODPRT = 1,
  NAB = 0, NDTAIL = 6, NSUMM = 6,
  NEWINL = 1,
$SEND
$INLET
  AR = 0.947, LIPRAT = 0.010, LM = 85.137,
  PSI = 0.000, YCOYM = 0.437, THETA = 8.000,
  SFSPLP = 1.000, SFWAVP = 1.000, SFPRFP = 1.000,
  SFINLP = 1.000, ETA = 17.559, INTYPE = 4,
  NINL = 2,
$SEND
BOMBER
***** WEIGHTS *****
$OPTS
  WGTO = 500000.000, AFMACH = 3.000, IDELT = 1,
  KBODY = 2,
$SEND
$FIXW
$SEND

```

XB-70-1 AIRPLANE - unmatched aerodynamics output

Mach = .76
Altitude = 25730.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0052									
Body	.0009	-.1	.002	.0072	.3	.000	.00	.0003	2.3	3
Wing	.0032	.4	.017	.0074	2.2	.000	.10	.0004	2.2	3
Strakes	.0000	.9	.032	.0079	4.0	.000	.19	.0006	2.2	3
H. Tail	.0000	2.0	.064	.0100	6.4	.000	.25	.0012	2.2	3
V. Tail	.0008	3.0	.096	.0132	7.3	.000	.27	.0020	2.3	3
Canard	.0002	4.0	.128	.0177	7.2	.000	.28	.0031	2.8	3
Pods	.0002	5.0	.161	.0237	6.8	.000	.28	.0046	3.3	3
Engine	.0000	6.0	.196	.0311	6.3	.000	.29	.0064	3.9	3
Cowl	.0000	7.0	.231	.0400	5.8	.000	.29	.0084	4.5	3
Boattail	.0000	8.0	.267	.0505	5.3	.000	.30	.0108	5.2	3
Interference	.0018									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
		Slope Factors								
		ClAlpha								
		Cdl^5Alpha								
		Alpha Transition Zone 2-3								

Cdmin .0070

Mach = .93
Altitude = 32770.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0050									
Body	.0008	-.1	.004	.0074	.5	.000	.00	.0005	3.2	3
Wing	.0031	.4	.019	.0077	2.5	.000	.08	.0008	3.4	3
Strakes	.0000	.9	.036	.0085	4.2	.000	.15	.0012	3.8	3
H. Tail	.0000	2.0	.069	.0112	6.2	.000	.20	.0025	4.7	3
V. Tail	.0008	3.0	.101	.0153	6.6	.000	.22	.0043	5.6	3
Canard	.0002	4.0	.135	.0210	6.4	.000	.23	.0066	6.8	3
Pods	.0001	5.0	.170	.0284	6.0	.000	.24	.0095	7.8	3
Engine	.0000	6.0	.205	.0375	5.5	.000	.25	.0129	9.0	3
Cowl	.0000	7.0	.242	.0486	5.0	.000	.25	.0172	10.4	3
Boattail	.0000	8.0	.279	.0620	4.5	.000	.26	.0226	12.3	3
Interference	.0018									
Wave	.0001									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
		Slope Factors								
		ClAlpha								
		Cdl^5Alpha								
		Alpha Transition Zone 2-3								

Cdmin .0069

Mach = 1.06
Altitude = 27140.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0049									
Body	.0008	.0	.020	.0128	1.6	.000	.02	.0041	9.1	3
Wing	.0030	.5	.035	.0138	2.5	.000	.04	.0050	9.5	3
Strakes	.0000	1.0	.050	.0152	3.3	.000	.07	.0060	10.7	3
H. Tail	.0000	2.0	.081	.0191	4.3	.000	.11	.0086	11.5	3
V. Tail	.0008	3.0	.114	.0245	4.6	.000	.15	.0117	12.0	3
Canard	.0002	4.0	.148	.0316	4.7	.000	.17	.0154	12.8	3
Pods	.0001	5.0	.183	.0407	4.5	.000	.19	.0199	14.2	3
Engine	.0000	6.0	.218	.0518	4.2	.000	.20	.0253	15.9	3
Cowl	.0000	7.0	.255	.0684	3.7	.000	.20	.0328	18.9	3
Boattail	.0000	8.0	.290	.0864	3.4	*****	.20	.0423	22.9	3
Interference	.0011									
Wave	.0026									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
		Slope Factors								
		ClAlpha								
		Cdl^5Alpha								
		Alpha Transition Zone 2-3								

Cdmin .0087

Mach = 1.18
Altitude = 33720.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0048	.0	.002	.0084	1.2	.000	.01	.0001	1.0	3
Body	.0008	.4	.016	.0086	1.8	.000	.17	.0002	1.2	3
Wing	.0029	.9	.031	.0092	3.4	.000	.22	.0004	1.4	3
Strakes	.0000	2.0	.064	.0114	5.7	.000	.25	.0012	2.0	3
H. Tail	.0000	3.0	.098	.0151	6.5	.000	.26	.0025	2.8	3
V. Tail	.0007	4.0	.133	.0205	6.5	.000	.27	.0045	3.9	3
Canard	.0002	5.0	.170	.0278	6.1	.000	.27	.0072	5.4	3
Pods	.0001	6.0	.207	.0371	5.6	.000	.27	.0107	7.1	3
Engine	.0000	7.0	.246	.0483	5.1	.000	.28	.0147	8.6	3
Cowl	.0000	8.0	.286	.0617	4.6	.000	.28	.0197	10.3	3
Boattail	.0000									
Interference	.0010									
Wave	.0026									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin	.0084									

Slope Factors		
ClAlpha		.0353
Cdl*.5Alpha		.0277
Alpha Transition Zone 2-3		.000

Mach = 1.65
Altitude = 40000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0042	.0	.000	.0077	1.1	.000	.01	.0000	.2	3
Body	.0007	.5	.014	.0079	1.8	.000	.27	.0000	.2	3
Wing	.0026	1.0	.029	.0083	3.5	.000	.28	.0001	.3	3
Strakes	.0000	2.0	.060	.0100	6.0	.000	.29	.0005	.6	3
H. Tail	.0000	3.0	.094	.0131	7.2	.000	.30	.0013	1.0	3
V. Tail	.0006	4.0	.131	.0179	7.4	.000	.31	.0025	1.6	3
Canard	.0002	5.0	.170	.0243	7.0	.000	.32	.0041	2.4	3
Pods	.0001	6.0	.211	.0327	6.4	.000	.32	.0064	3.4	3
Engine	.0000	7.0	.253	.0456	5.6	.000	.31	.0118	7.9	3
Cowl	.0000	8.0	.292	.0760	3.8	.000	.23	.0124	7.2	4
Boattail	.0000									
Interference	.0009									
Wave	.0026									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin	.0077									

Slope Factors		
ClAlpha		.0364
Cdl*.5Alpha		.0324
Alpha Transition Zone 2-3		.000

Mach = 2.10
Altitude = 48600.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0037	.0	-.001	.0072	-.1	.000	.01	.0000	-.4	3
Body	.0006	.5	.012	.0073	1.7	.000	.25	.0000	-.2	3
Wing	.0022	1.0	.026	.0076	3.5	.000	.27	.0001	.1	3
Strakes	.0000	2.0	.057	.0092	6.1	.000	.28	.0004	.7	3
H. Tail	.0000	3.0	.090	.0123	7.3	.000	.28	.0012	1.6	3
V. Tail	.0006	4.0	.126	.0170	7.4	.000	.29	.0024	2.7	3
Canard	.0002	5.0	.163	.0235	7.0	.000	.30	.0042	4.0	3
Pods	.0001	6.0	.203	.0320	6.3	.000	.30	.0068	5.6	3
Engine	.0000	7.0	.244	.0429	5.7	.000	.30	.0104	7.6	3
Cowl	.0000	8.0	.294	.0845	3.5	.000	.20	.0389	28.3	4
Boattail	.0000									
Interference	.0009									
Wave	.0026									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin	.0072									

Slope Factors		
ClAlpha		.0369
Cdl*.5Alpha		.0335
Alpha Transition Zone 2-3		.000

Mach = 2.50
Altitude = 61630.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0033									
Body	.0005	.0	.000	.0067	.0	.000	.00	.0000	.0	5
Wing	.0020	.5	.021	.0069	3.0	.000	.43	.0000	-30.0	5
Strakes	.0000	1.0	.041	.0075	5.5	.000	.43	.0000	-30.0	5
H. Tail	.0000	2.0	.083	.0096	8.6	.000	.43	.0000	30.0	5
V. Tail	.0005	3.0	.124	.0132	9.4	.000	.43	.0000	30.0	5
Canard	.0001	4.0	.166	.0184	9.0	.000	.43	.0000	-30.0	5
Pods	.0001	5.0	.207	.0249	8.3	.000	.43	.0000	-30.0	5
Engine	.0000	6.0	.247	.0328	7.5	.000	.43	.0000	-30.0	5
Cowl	.0000	7.0	.287	.0421	6.8	.000	.42	.0000	30.0	5
Boattail	.0000	8.0	.325	.0526	6.2	.000	.42	.0000	30.0	5
Interference	.0009									
Wave	.0025									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha .0406						
				Cdl*.5Alpha .0268						
				Alpha Transition Zone 2-3 .000						
Cdmn		.0067								

Output for Module # 11

1 SUMMARY --- ACSYNT OUTPUT --- NASA, AMES RESEARCH CENTER

XB-70-1 AIRPLANE

GENERAL		FUSELAGE		WING			CANARD	VTAIL	ENGLISH UNITS - DISTANCES IN FEET WEIGHTS IN LBS. FORCES IN LBS. PRESSURES IN LBS/FT**2
WG	500000.	LENGTH	185.3	AREA	6296.4	414.8	234.0		
W/S	.0	DIAMETER	8.8	WETTED AREA	9303.7	524.6	937.7		
T/W	6.00	VOLUME	9176.6	SPAN	105.0	28.8	15.3		
N(2) ULT	3.8	WETTED AREA	2864.3	L.E. SWEEP	65.6	40.4	51.8		
CREW	0.	FINENESS RATIO	21.1	C/4 SWEEP	58.8	31.4	45.0		
PASENGERS	0.			ASPECT RATIO	1.75	2.00	1.00		
				TAPER RATIO	.02	.35	.30		
				T/C ROOT	.02	.03	.02		
				T/C TIP	.03	.02	.02		
ENGINE		WEIGHTS		ROOT CHORD	117.7	21.4	23.5		
NUMBER	4.	W	WG	TIP CHORD	2.2	7.5	7.1		
LENGTH	9.2	STRUCT.	130000.	M.A. CHORD	78.5	15.5	16.8		
DIAM.	4.3	PROPUL.	70000.	LOC. OF L.E.	66.6	33.7	162.7		
WEIGHT	608.0	FIX. EQ.	60000.						
TSLs	2050.	FUEL	918530.						
SFCSLS	.96	PAYLOAD	45000.						

PHASE	MACH NO.		ALTITUDE		HORIZONTAL		NO. TURN	VIND 'G'S	WKFUEL	M	IP	IX	W	B	A	P
	START	END	START	END	DIST	TIME										
CLIMB	0.30	0.30	0	10000	0.0	0.0	0.0	300.0	1.0000	1	1	-1	0	0	0	0
CLIMB	0.00	0.00	10000	15000	0.0	0.0	0.0	350.0	1.0000	1	1	-1	0	0	0	0
CLIMB	0.00	0.00	15000	25000	0.0	0.0	0.0	370.0	1.0000	1	1	-1	0	0	0	0
CLIMB	0.00	0.00	25000	36000	0.0	0.0	0.0	480.0	1.0000	1	1	-1	0	0	0	0
CLIMB	0.00	0.00	36000	40000	0.0	0.0	0.0	480.0	1.0000	1	1	-1	0	0	0	0
CLIMB	0.00	0.00	40000	45000	0.0	0.0	0.0	475.0	1.0000	1	1	-1	0	0	0	0
CRUISE	2.40	0.00	45000	55000	1500.0	0.0	0.0	0.0	1.0000	1	4	0	0	0	0	0
CRUISE	2.40	0.00	-1	60000	1500.0	0.0	0.0	0.0	1.0000	1	4	0	0	0	0	0
CRUISE	2.40	0.00	-1	0	2500.0	0.0	0.0	0.0	1.0000	1	4	0	0	0	0	0
CRUISE	0.20	0.00	5000	0	5.0	0.0	0.0	140.0	1.0000	1	4	0	0	0	0	0

***** XB-70-1 MATCHED AERODYNAMICS *****

\$ACHAR

ABOSB	=	1.444,	ALMAX	=	9.000,	AMC	=	15.000,
BDNOSE	=	8.313,	BTEF	=	0.000,	MACHN	=	0.750,
RALOIT	=	0.000,	RCLMAX	=	1.000,	ROC	=	0.020,
ROCAN	=	0.020,	SFWF	=	1.000,	SMNDR	=	0.930,
SPANAC	=	0.000,	SWPMAX	=	60.000,	SWPMIN	=	0.000,
XCDC	=	0.600,	XCDW	=	0.600,	AJCAN	=	1,
ALELJ	=	1,	IDELTA	=	0,	INORM	=	1,
ISMNDR	=	0,	ISUPCR	=	0,	ITRAP	=	0,
IXCD	=	1,	ELLIPC	=	.FALSE.,	ELLIPH	=	.FALSE.,
ELLIPW	=	.FALSE.,	SMNSWP (1)	=	0.760,	SMNSWP (2)	=	0.930,
SMNSWP (3)	=	1.060,	SMNSWP (4)	=	1.180,	SMNSWP (5)	=	1.650,
SMNSWP (6)	=	2.100,	SMNSWP (7)	=	2.500,	CLO (1)	=	0.000,
CLO (2)	=	0.000,	CLO (3)	=	0.000,	CLO (4)	=	0.000,
CLO (5)	=	0.000,	CLO (6)	=	0.000,	CLO (7)	=	0.000,
CLOC (1)	=	0.000,	CLOC (2)	=	0.000,	CLOC (3)	=	0.000,
CLOC (4)	=	0.000,	CLOC (5)	=	0.000,	CLOC (6)	=	0.000,
CLOC (7)	=	0.000,	CLOW (1)	=	-0.033,	CLOW (2)	=	-0.040,
CLOW (3)	=	-0.100,	CLOW (4)	=	-0.015,	CLOW (5)	=	-0.003,
CLOW (6)	=	0.005,	CLOW (7)	=	-0.005,	CMO (1)	=	0.000,
CMO (2)	=	0.000,	CMO (3)	=	0.000,	CMO (4)	=	0.000,
CMO (5)	=	0.000,	CMO (6)	=	0.000,	CMO (7)	=	0.000,
YSWP (1)	=	0.000,	YSWP (2)	=	0.000,	YSWP (3)	=	0.000,
YSWP (4)	=	0.000,	YSWP (5)	=	0.000,	YSWP (6)	=	0.000,
YSWP (7)	=	0.000,						

\$END

\$AMULT

CSF	=	0.000,	ESSF	=	1.000,	FCD	=	1.000,
FCDF	=	.9403,	FCDL	=	1.000,	FCDW	=	3.707,
FCDWB	=	1.000,	FENG	=	1.000,	FINTE	=	1.000,
FLBCOR	=	1.000,	FLECOR	=	1.000,	FMDR	=	1.000,
FCDO	=	1.000,	FLD	=	1.000,	FCDRA (1)	=	0.970,
FCDRA (2)	=	0.983,	FCDRA (3)	=	1.493,	FCDRA (4)	=	1.194,
FCDRA (5)	=	0.892,	FCDRA (6)	=	0.677,	FCDRA (7)	=	1.000,
FCDRA (8)	=	1.000,	FCDRA (9)	=	0.588,	FCDRA (10)	=	0.588,

\$END

\$ATRIM

FLDM (1)	=	1.950,	FLDM (2)	=	0.350,	FLDM (3)	=	0.100,
FLDM (4)	=	0.455,	FLDM (5)	=	0.945,	FLDM (6)	=	1.100,
FLDM (7)	=	1.650,	FLDM (8)	=	1.650,	FLDM (9)	=	1.650,
FLDM (10)	=	1.650,	FVCAM (1)	=	1.156,	FVCAM (2)	=	1.192,
FVCAM (3)	=	0.923,	FVCAM (4)	=	0.958,	FVCAM (5)	=	0.764,
FVCAM (6)	=	0.691,	FVCAM (7)	=	0.522,	FVCAM (8)	=	0.522,
FVCAM (9)	=	0.522,	FVCAM (10)	=	0.522,	ITRIM (1)	=	2,
ITRIM (2)	=	2,	ITRIM (3)	=	2,	ITRIM (4)	=	2,
ITRIM (5)	=	2,	ITRIM (6)	=	2,	ITRIM (7)	=	2,
CAND	=	0.000,	CFLAP	=	9.000,	CGM	=	0.220,

IT	=	0.000,	SFLAP	=	395.400,	SM	=	0.100,
SPANF	=	40.250,	ZCG	=	0.000,	IVCAM	=	1,
\$END								
\$ADET								
IPLOT	=	1,	NALF	=	10,	NMDTL	=	7,
ICOD	=	1,	IALF	=	0,	IALP	=	2,
SMN (1)	=	0.760,	SMN (2)	=	0.930,	SMN (3)	=	1.060,
SMN (4)	=	1.180,	SMN (5)	=	1.650,	SMN (6)	=	2.100,
SMN (7)	=	2.500,	ALIN (1)	=	0.000,	ALIN (2)	=	0.500,
ALIN (3)	=	1.000,	ALIN (4)	=	2.000,	ALIN (5)	=	3.000,
ALIN (6)	=	4.000,	ALIN (7)	=	5.000,	ALIN (8)	=	6.000,
ALIN (9)	=	7.000,	ALIN (10)	=	8.000,	ALTV (1)	=	25730.000,
ALTV (2)	=	32770.000,	ALTV (3)	=	27140.000,	ALTV (4)	=	33720.000,
ALTV (5)	=	40000.000,	ALTV (6)	=	48600.000,	ALTV (7)	=	61630.000,
CLINPT (1)	=	0.000,	CLINPT (2)	=	0.000,	CLINPT (3)	=	0.000,
CLINPT (4)	=	0.000,	CLINPT (5)	=	0.000,	CLINPT (6)	=	0.000,
CLINPT (7)	=	0.000,	CLINPT (8)	=	0.000,	CLINPT (9)	=	0.000,
CLINPT (10)	=	0.000,	ITB (1)	=	0,	ITB (2)	=	0,
ITB (3)	=	0,	ITB (4)	=	0,	ITB (5)	=	0,
ITB (6)	=	0,	ITB (7)	=	0,	ITB (8)	=	0,
ITB (9)	=	0,	ITB (10)	=	0,	ITS (1)	=	0,
ITS (2)	=	0,	ITS (3)	=	0,	ITS (4)	=	0,
ITS (5)	=	0,	ITS (6)	=	0,	ITS (7)	=	0,
ITS (8)	=	0,	ITS (9)	=	0,	ITS (10)	=	0,
ISTRS (1)	=	0,	ISTRS (2)	=	0,	ISTRS (3)	=	0,
ISTRS (4)	=	0,	ISTRS (5)	=	0,	ISTRS (6)	=	0,
ISTRS (7)	=	0,	ISTRS (8)	=	0,	ISTRS (9)	=	0,
ISTRS (10)	=	0,						
\$END								
\$ADRAG								
ICDO	=	0,	SMNCDO (1)	=	0.000,	SMNCDO (2)	=	0.000,
SMNCDO (3)	=	0.000,	SMNCDO (4)	=	0.000,	SMNCDO (5)	=	0.000,
SMNCDO (6)	=	0.000,	SMNCDO (7)	=	0.000,	SMNCDO (8)	=	0.000,
SMNCDO (9)	=	0.000,	SMNCDO (10)	=	0.000,	CDONPT (1)	=	0.000,
CDONPT (2)	=	0.000,	CDONPT (3)	=	0.000,	CDONPT (4)	=	0.000,
CDONPT (5)	=	0.000,	CDONPT (6)	=	0.000,	CDONPT (7)	=	0.000,
CDONPT (8)	=	0.000,	CDONPT (9)	=	0.000,	CDONPT (10)	=	0.000,
SMNBMB (1)	=	0.000,	SMNBMB (2)	=	0.200,	SMNBMB (3)	=	0.400,
SMNBMB (4)	=	0.600,	SMNBMB (5)	=	0.800,	SMNBMB (6)	=	1.000,
SMNBMB (7)	=	1.200,	SMNBMB (8)	=	1.400,	SMNBMB (9)	=	1.600,
SMNBMB (10)	=	1.800,	CDBMB (1)	=	0.000,	CDBMB (2)	=	0.000,
CDBMB (3)	=	0.000,	CDBMB (4)	=	0.000,	CDBMB (5)	=	0.000,
CDBMB (6)	=	0.000,	CDBMB (7)	=	0.000,	CDBMB (8)	=	0.000,
CDBMB (9)	=	0.000,	CDBMB (10)	=	0.000,	SMSTRS (1)	=	0.000,
SMSTRS (2)	=	0.200,	SMSTRS (3)	=	0.400,	SMSTRS (4)	=	0.600,
SMSTRS (5)	=	0.800,	SMSTRS (6)	=	1.000,	SMSTRS (7)	=	1.200,
SMSTRS (8)	=	1.400,	SMSTRS (9)	=	1.600,	SMSTRS (10)	=	1.800,
CDSTR (1)	=	0.000,	CDSTR (2)	=	0.000,	CDSTR (3)	=	0.000,
CDSTR (4)	=	0.000,	CDSTR (5)	=	0.000,	CDSTR (6)	=	0.000,
CDSTR (7)	=	0.000,	CDSTR (8)	=	0.000,	CDSTR (9)	=	0.000,
CDSTR (10)	=	0.000,	SMTANK (1)	=	0.000,	SMTANK (2)	=	0.200,
SMTANK (3)	=	0.400,	SMTANK (4)	=	0.600,	SMTANK (5)	=	0.800,
SMTANK (6)	=	1.000,	SMTANK (7)	=	1.200,	SMTANK (8)	=	1.400,
SMTANK (9)	=	1.600,	SMTANK (10)	=	1.800,	CDTNK (1)	=	0.000,
CDTNK (2)	=	0.000,	CDTNK (3)	=	0.000,	CDTNK (4)	=	0.000,
CDTNK (5)	=	0.000,	CDTNK (6)	=	0.000,	CDTNK (7)	=	0.000,
CDTNK (8)	=	0.000,	CDTNK (9)	=	0.000,	CDTNK (10)	=	0.000,
SMEXTR (1)	=	0.000,	SMEXTR (2)	=	0.200,	SMEXTR (3)	=	0.400,
SMEXTR (4)	=	0.600,	SMEXTR (5)	=	0.800,	SMEXTR (6)	=	1.000,
SMEXTR (7)	=	1.200,	SMEXTR (8)	=	1.400,	SMEXTR (9)	=	1.600,
SMEXTR (10)	=	1.800,	CDEXTR (1)	=	0.000,	CDEXTR (2)	=	0.000,

CDEXTR(3) = 0.000, CDEXTR(4) = 0.000, CDEXTR(5) = 0.000,
 CDEXTR(6) = 0.000, CDEXTR(7) = 0.000, CDEXTR(8) = 0.000,
 CDEXTR(9) = 0.000, CDEXTR(10) = 0.000,
 \$END
 \$ATAKE
 CLLAND = 1.000, CLTO = 1.000, DELFLD = 45.000,
 DELFTO = 45.000, DELLED = 30.000, DELLTO = 30.000,
 LDLAND = 7.000, LDTO = 7.000,
 \$END
 \$APRINT
 ECHOIN = 1, ECHOUT = 0, INTM = 0,
 IPBLNT = 0, IPCAN = 0, IPENG = 0,
 IPEXT = 0, IPFLAP = 0, IPFRIC = 0,
 IPINTF = 0, IPLIFT = 0, IPMIN = 0,
 IPWAVE = 0, KERROR = 0,
 \$END

***** Estimated XB-70 Propulsion System (based on the J85) *****

\$LEWIS
 AENWT = 7000.000,
 ATURB = 0.240, BA = 0.100,
 DIA1 = 4.345,
 FRBT = 0.800, FRPN = 6.928, HTR = 0.400,
 PCDFAC = 2.000, RDIAM = 1.000, RLENG = 1.000,
 SM1 = 0.900, SODG = 1.150, WCWA1 = 0.100,
 YREN = 64.000, ESF = 1.000, TWAB = 30000.000,
 TWOAB = 19000.000, TWTO = 6.000, EB1 = 0.910,
 ETAC1 = 0.900, ETAF1 = 0.900, ETAT1 = 0.885,
 P2P1 = 12.070, SCPR = 1.480, DELT57 = 200.000,
 T3 = 1250.000, T51 = 2000.000, R10A = -2.000,
 MACH1 = 1.300, MACH2 = 2.000, SFINSP = 1.000,
 ALTI = 30000.000, AM = 2.000, AUAENG = 0.000,
 AWAENG = 1.000, POSA = 20.000, XMT = 2.000,
 XMPRI(1) = 0.302, XMPRI(2) = 0.930, XMPRI(3) = 1.200,
 XMPRI(4) = 2.000, XMPRI(5) = 2.100, XMPRI(6) = 3.000,
 XPRI(1) = 0.986, XPRI(2) = 0.990, XPRI(3) = 0.986,
 XPRI(4) = 0.937, XPRI(5) = 0.600, XPRI(6) = 0.400,
 SFSFC1 = 1.000, SFSFC2 = 1.000, SFSFC3 = 1.000,
 DEPWCC = 10.000, ALTD(1) = 25730.000, ALTD(2) = 32770.000,
 ALTD(3) = 27140.000, ALTD(4) = 33720.000, ALTD(5) = 40000.000,
 ALTD(6) = 48600.000, XMACH(1) = 0.760, XMACH(2) = 0.930,
 XMACH(3) = 1.060, XMACH(4) = 1.180, XMACH(5) = 1.650,
 XMACH(6) = 2.100, XMDES = 3.000, SWING = 6297.800,
 TOSA = 518.000, EN = 6, IPR = 1,
 KODE = 0, KT5 = 2, IPLOT = 0,
 IPRINT = 0, MINPR = 1, MODPRT = 1,
 NAB = 0, NDTAIL = 6, NSUMM = 6,
 NEWINL = 1,
 \$END

\$INLET
 AR = 0.947, LIPRAT = 0.010, LM = 85.137,
 PSI = 0.000, YCOYM = 0.437, THETA = 8.000,
 SFSPLP = 1.000, SFWAVP = 1.000, SFPRFP = 1.000,
 SFINLP = 1.000, ETA = 17.559, INTYPE = 4,
 NINL = 2,
 \$END

BOMBER

***** WEIGHTS *****

\$OPTS
 WGTO = 500000.000, AFMACH = 3.000, IDELT = 1,
 KBODY = 2,
 \$END

XB-70-1 AIRPLANE

MATCHED aerodynamics output

Mach = .76
Altitude = 25730.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0047	-.1	.002	.0068	.3	.000	.00	.0003	2.3	3
Body	.0008	.4	.017	.0070	2.4	.000	.11	.0004	2.2	3
Wing	.0029	.9	.033	.0075	4.4	.000	.20	.0006	2.2	3
Strakes	.0000	2.0	.067	.0093	7.2	.000	.29	.0012	2.2	3
H. Tail	.0000	3.0	.101	.0120	8.4	.000	.33	.0020	2.3	3
V. Tail	.0007	4.0	.136	.0156	8.7	.000	.37	.0031	2.8	3
Canard	.0002	5.0	.174	.0200	8.7	.000	.41	.0046	3.3	3
Pods	.0001	6.0	.213	.0251	8.5	.000	.44	.0064	3.9	3
Engine	.0000	7.0	.255	.0307	8.3	.000	.49	.0084	4.5	3
Cowl	.0000	8.0	.298	.0367	8.1	.000	.53	.0108	5.2	3
Boattail	.0000									
Interference	.0017									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Slope Factors
ClAlpha .0364
Cdl^1.5Alpha .0193
Alpha Transition Zone 2-3 .000

Cdmin .0065

Mach = .93
Altitude = 32770.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0047	-.1	.004	.0072	.5	.000	.00	.0005	3.2	3
Body	.0008	.4	.019	.0075	2.6	.000	.08	.0008	3.4	3
Wing	.0028	.9	.037	.0082	4.5	.000	.16	.0012	3.8	3
Strakes	.0000	2.0	.072	.0105	6.8	.000	.25	.0025	4.7	3
H. Tail	.0000	3.0	.107	.0136	7.8	.000	.30	.0043	5.6	3
V. Tail	.0007	4.0	.144	.0175	8.2	.000	.35	.0066	6.8	3
Canard	.0002	5.0	.183	.0219	8.4	.000	.40	.0095	7.8	3
Pods	.0001	6.0	.224	.0266	8.4	.000	.46	.0129	9.0	3
Engine	.0000	7.0	.267	.0313	8.5	.000	.53	.0172	10.4	3
Cowl	.0000	8.0	.312	.0360	8.7	.000	.60	.0226	12.3	3
Boattail	.0000									
Interference	.0017									
Wave	.0003									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Slope Factors
ClAlpha .0378
Cdl^1.5Alpha .0184
Alpha Transition Zone 2-3 .000

Cdmin .0067

Mach = 1.06
Altitude = 27140.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0069	.0	.020	.0272	.7	.000	.02	.0041	9.1	3
Body	.0011	.5	.035	.0281	1.2	.000	.04	.0050	9.5	3
Wing	.0042	1.0	.049	.0292	1.7	.000	.07	.0060	10.7	3
Strakes	.0000	2.0	.079	.0322	2.5	.000	.13	.0086	11.5	3
H. Tail	.0000	3.0	.111	.0358	3.1	.000	.17	.0117	12.0	3
V. Tail	.0011	4.0	.143	.0400	3.6	.000	.22	.0154	12.8	3
Canard	.0003	5.0	.175	.0445	3.9	.000	.26	.0199	14.2	3
Pods	.0002	6.0	.208	.0491	4.2	.000	.30	.0253	15.9	3
Engine	.0000	7.0	.242	.0552	4.4	.000	.33	.0328	18.9	3
Cowl	.0000	8.0	.274	.0598	4.6	*****	.37	.0423	22.9	3
Boattail	.0000									
Interference	.0017									
Wave	.0097									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Slope Factors
ClAlpha .0318
Cdl^1.5Alpha .0160
Alpha Transition Zone 2-3 .000

Cdmin .0231

Mach = 1.18
Altitude = 33720.

Parasite Drag		Induced Drag							Zone
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	
Friction	.0054	.0	.002	.0182	1.1	.000	.01	.0001	3
Body	.0009	.4	.016	.0184	.9	.000	.17	.0002	3
Wing	.0033	.9	.031	.0189	1.6	.000	.23	.0004	3
Strakes	.0000	2.0	.064	.0208	3.1	.000	.28	.0012	3
H. Tail	.0000	3.0	.097	.0238	4.1	.000	.30	.0025	3
V. Tail	.0008	4.0	.131	.0277	4.8	.000	.33	.0045	3
Canard	.0002	5.0	.167	.0324	5.2	.000	.35	.0072	3
Pods	.0000	6.0	.203	.0378	5.4	.000	.38	.0107	3
Engine	.0000	7.0	.241	.0433	5.6	.000	.42	.0147	3
Cowl	.0000	8.0	.279	.0489	5.7	.000	.46	.0197	3
Boattail	.0000								
Interference	.0012								
Wave	.0097								
External	.0000								
Tanks	.0000								
Bombs	.0000								
Stores	.0000								
Extra	.0000								
Camber	.0000								
Cdmin	.0181								

Slope Factors
ClAlpha .0344
Cdl^5Alpha .0208
Alpha Transition Zone 2-3 .000

Mach = 1.65
Altitude = 40000.

Parasite Drag		Induced Drag							Zone
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	
Friction	.0035	.0	.000	.0130	1.0	.000	.01	.0000	3
Body	.0006	.5	.014	.0131	1.1	.000	.26	.0000	3
Wing	.0021	1.0	.028	.0135	2.1	.000	.27	.0001	3
Strakes	.0000	2.0	.058	.0152	3.8	.000	.28	.0005	3
H. Tail	.0000	3.0	.090	.0183	4.9	.000	.28	.0013	3
V. Tail	.0005	4.0	.123	.0228	5.4	.000	.28	.0025	3
Canard	.0002	5.0	.156	.0290	5.4	.000	.28	.0041	3
Pods	.0001	6.0	.191	.0369	5.2	.000	.28	.0064	3
Engine	.0000	7.0	.225	.0489	4.6	.000	.26	.0118	3
Cowl	.0000	8.0	.254	.0773	3.3	.000	.18	.0124	4
Boattail	.0000								
Interference	.0008								
Wave	.0097								
External	.0000								
Tanks	.0000								
Bombs	.0000								
Stores	.0000								
Extra	.0000								
Camber	.0000								
Cdmin	.0130								

Slope Factors
ClAlpha .0317
Cdl^5Alpha .0315
Alpha Transition Zone 2-3 .000

Mach = 2.10
Altitude = 48600.

Parasite Drag		Induced Drag							Zone
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	
Friction	.0023	.0	-.001	.0095	-.1	.000	.01	.0000	3
Body	.0004	.5	.012	.0096	1.3	.000	.25	.0000	3
Wing	.0014	1.0	.026	.0099	2.6	.000	.26	.0001	3
Strakes	.0000	2.0	.054	.0116	4.7	.000	.25	.0004	3
H. Tail	.0000	3.0	.085	.0148	5.7	.000	.24	.0012	3
V. Tail	.0004	4.0	.116	.0199	5.8	.000	.23	.0024	3
Canard	.0001	5.0	.147	.0269	5.5	.000	.22	.0042	3
Pods	.0001	6.0	.178	.0364	4.9	.000	.21	.0068	3
Engine	.0000	7.0	.209	.0487	4.3	.000	.20	.0104	3
Cowl	.0000	8.0	.246	.0955	2.6	.000	.13	.0389	4
Boattail	.0000								
Interference	.0006								
Wave	.0096								
External	.0000								
Tanks	.0000								
Bombs	.0000								
Stores	.0000								
Extra	.0000								
Camber	.0000								
Cdmin	.0094								

Slope Factors
ClAlpha .0309
Cdl^5Alpha .0354
Alpha Transition Zone 2-3 .000

Mach = 2.50
Altitude = 61630.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0031	.0	.000	.0079	.0	.000	.00	.0000	.0	5
Body	.0005	.5	.020	.0081	2.5	.000	.40	.0000	-30.0	5
Wing	.0019	1.0	.040	.0087	4.6	.000	.37	.0000	-30.0	5
Strakes	.0000	2.0	.078	.0114	6.8	.000	.31	.0000	30.0	5
H. Tail	.0000	3.0	.113	.0166	6.8	.000	.26	.0000	30.0	5
V. Tail	.0005	4.0	.145	.0248	5.8	.000	.23	.0000	-30.0	5
Canard	.0001	5.0	.174	.0366	4.8	.000	.19	.0000	-30.0	5
Pods	.0001	6.0	.200	.0520	3.8	.000	.16	.0000	-30.0	5
Engine	.0000	7.0	.223	.0716	3.1	.000	.14	.0000	30.0	5
Cowl	.0000	8.0	.242	.0959	2.5	.000	.12	.0000	30.0	5
Boattail	.0000									
Interference	.0009									
Wave	.0094									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin	.0079									

Slope Factors	
ClAlpha	.0303
Cdl*.5Alpha	.0371
Alpha Transition Zone 2-3	.000

Output for Module # 11

1 SUMMARY --- ACSYNT OUTPUT --- NASA, AMES RESEARCH CENTER

XB-70-1 AIRPLANE

ENGLISH UNITS -
DISTANCES IN FEET
WEIGHTS IN LBS.
FORCES IN LBS.
PRESSURES IN LBS/FT**2

GENERAL		FUSELAGE		WING		CANARD	VTAIL
WG	500000.	LENGTH	185.3	AREA	6296.4	414.8	234.0
W/S	.0	DIAMETER	8.8	WETTED AREA	9303.7	524.6	937.7
T/W	6.00	VOLUME	9176.6	SPAN	105.0	28.8	15.3
N(Z) ULT	3.8	WETTED AREA	2864.3	L.E. SWEEP	65.6	40.4	51.8
CREW	0.	FINENESS RATIO	21.1	C/4 SWEEP	58.8	31.4	45.0
PASENGERS	0.			ASPECT RATIO	1.75	2.00	1.00
				TAPER RATIO	.02	.35	.30
				T/C ROOT	.02	.03	.02
				T/C TIP	.03	.02	.02
ENGINE		WEIGHTS		ROOT CHORD	117.7	21.4	23.5
NUMBER	4.	W	WG	TIP CHORD	2.2	7.5	7.1
LENGTH	9.2	STRUCT.	130000.	M.A. CHORD	78.5	15.5	16.8
DIAM.	4.3	PROPUL.	70000.	LOC. OF L.E.	66.6	33.7	162.7
WEIGHT	608.0	FIX. EQ.	60000.				
TSLs	2050.	FUEL	1131865.226.4				
SFCSLs	.96	PAYLOAD	45000.				

[illegible]

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IPL0T      =          2, IPSIZE      =          -3, IPRINT      =          0,
IPST01     =          3, IPST02     =          2, KERROR       =          0,
MMPROP      =          1, NCRUSE      =          2, NLEGCL       =          0,
NLEGLO      =          0, NLEGCR      =          0, NMIS5        =          1,
LENVEL      =.FALSE.,
$END

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10 2.0E+05
PHASE      MACH NO.  ALTITUDE  HORIZONTAL  NO.  VIND
          START END   START  END    DIST  TIME   TURN  'G'S  WKFUEL M IP IX W B A P
-----
CLIMB      0.00 0.00      0  7500    0.0  0.0    0.0 300.0  1.0000 1 2 -1 0 0 0 0
CLIMB      0.00 0.00     -1 10000    0.0  0.0    0.0 300.0  1.0000 1 2 -1 0 0 0 0
CLIMB      0.00 0.00     -1 14000    0.0  0.0    0.0 300.0  1.0000 1 2 -1 0 0 0 0
CRUISE     0.00 0.00     -1 14000  2000.0  0.0    0.0  0.0  1.0000 1 3  0 0 0 0 0
CLIMB      0.00 0.00     -1 21000    0.0  0.0    0.0 300.0  1.0000 1 2 -1 0 0 0 0
CLIMB      0.00 0.00     -1 25000    0.0  0.0    0.0 300.0  1.0000 1 2 -1 0 0 0 0
CLIMB      0.00 0.00     -1 30000    0.0  0.0    0.0 300.0  1.0000 1 2 -1 0 0 0 0
CRUISE     0.60 0.75  30000 30000  2000.0  0.0    0.0  0.0  1.0000 1 3  0 0 0 0 0
CLIMB      0.00 0.00  30000 40000    0.0  0.0    0.0 350.0  1.0000 1 3 -1 0 0 0 0
CRUISE     0.75 0.85  40000 40000  2000.0  0.0    0.0  0.0  1.0000 1 3  0 0 0 0 0

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** Subsonic Transport AERODYNAMICS MODULE *****

\$ACHAR

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ABOSB      =          0.020, ALMAX      =          20.000, AMC      =          35.000,
BDNOSE     =          25.500, BTEF      =          1.000, MACHN     =          0.750,
RALOIT     =          0.000, RCLMAX     =          1.000, ROC      =          0.015,
ROCAN      =          0.020, SFWF      =          1.000, SMNDR     =          0.860,
SPANAC     =          0.000, SWPMAx     =          60.000, SWPMIN    =          0.000,
XCDC       =          0.600, XCDW      =          0.600, AJCAN     =          0,
ALELJ      =          1, INORM        =          1, ISMNRD     =          0,
ISUPCR     =          0, ITRAP        =          0, IXCD        =          1,
ELLIPC     =.FALSE., ELLIPW     =.FALSE., SMNSWP (1) =          0.600,
SMNSWP (2) =          0.650, SMNSWP (3) =          0.700, SMNSWP (4) =          0.750,
SMNSWP (5) =          0.770, SMNSWP (6) =          0.790, SMNSWP (7) =          0.800,
SMNSWP (8) =          0.810, SMNSWP (9) =          0.825, SMNSWP (10) =          0.850,
CLO (1)    =          0.135, CLO (2)    =          0.135, CLO (3)    =          0.135,
CLO (4)    =          0.130, CLO (5)    =          0.140, CLO (6)    =          0.145,
CLO (7)    =          0.170, CLO (8)    =          0.175, CLO (9)    =          0.160,
CLO (10)   =          0.075, CLOC (1)   =          0.000, CLOC (2)   =          0.000,
CLOC (3)   =          0.000, CLOC (4)   =          0.000, CLOC (5)   =          0.000,
CLOC (6)   =          0.000, CLOC (7)   =          0.000, CLOC (8)   =          0.000,
CLOC (9)   =          0.000, CLOC (10)  =          0.000, CLOW (1)   =          0.000,
CLOW (2)   =          0.000, CLOW (3)   =          0.000, CLOW (4)   =          0.000,
CLOW (5)   =          0.000, CLOW (6)   =          0.000, CLOW (7)   =          0.000,
CLOW (8)   =          0.000, CLOW (9)   =          0.000, CLOW (10)  =          0.000,
CMO (1)    =          0.000, CMO (2)    =          0.000, CMO (3)    =          0.000,
CMO (4)    =          0.000, CMO (5)    =          0.000, CMO (6)    =          0.000,
CMO (7)    =          0.000, CMO (8)    =          0.000, CMO (9)    =          0.000,
CMO (10)   =          0.000, YSWP (1)   =          0.000, YSWP (2)   =          0.000,
YSWP (3)   =          0.000, YSWP (4)   =          0.000, YSWP (5)   =          0.000,
YSWP (6)   =          0.000, YSWP (7)   =          0.000, YSWP (8)   =          0.000,
YSWP (9)   =          0.000, YSWP (10)  =          0.000,
$END

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\$AMULT

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CSF        =          1.000, ESSF      =          1.000, FCD      =          1.000,
FCDF       =          1.000, FCDL      =          1.000, FCDW     =          1.000,
FCDWB      =          1.000, FENG      =          1.000, FINTF     =          1.000,
FLBCOR     =          1.000, FLECOR    =          1.000, FMDR      =          1.000,
FCDO       =          1.000, FLD       =          1.000, FCDRA (1) =          1.000,
FCDRA (2)  =          1.000, FCDRA (3) =          1.000, FCDRA (4) =          1.000,
FCDRA (5)  =          1.000, FCDRA (6) =          1.000, FCDRA (7) =          1.000,
FCDRA (8)  =          1.000, FCDRA (9) =          1.000, FCDRA (10) =          1.000,

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$END
$ATRIM
FLDM(1) = 1.000, FLDM(2) = 1.000, FLDM(3) = 1.000,
FLDM(4) = 1.000, FLDM(5) = 1.000, FLDM(6) = 1.000,
FLDM(7) = 1.000, FLDM(8) = 1.000, FLDM(9) = 1.000,
FLDM(10) = 1.000, FVCAM(1) = 1.000, FVCAM(2) = 1.000,
FVCAM(3) = 1.000, FVCAM(4) = 1.000, FVCAM(5) = 1.000,
FVCAM(6) = 1.000, FVCAM(7) = 1.000, FVCAM(8) = 1.000,
FVCAM(9) = 1.000, FVCAM(10) = 1.000, ITRIM(1) = 1,
ITRIM(2) = 1, ITRIM(3) = 1, ITRIM(4) = 1,
ITRIM(5) = 1, ITRIM(6) = 1, ITRIM(7) = 1,
ITRIM(8) = 1, ITRIM(9) = 1, ITRIM(10) = 1,
CAND = 0.000, CFLAP = 0.000, CGM = 0.250,
IT = 0.000, SFLAP = 0.000, SM = 0.000,
SPANF = 0.000, ZCG = 0.000, IVCAM = 0,
$END
$ADET
IPLOT = 1, NALF = 10, NMDTL = 10,
ICOD = 1, IALF = 0, IALP = 2,
SMN(1) = 0.600, SMN(2) = 0.650, SMN(3) = 0.700,
SMN(4) = 0.750, SMN(5) = 0.770, SMN(6) = 0.790,
SMN(7) = 0.800, SMN(8) = 0.810, SMN(9) = 0.825,
SMN(10) = 0.850, ALIN(1) = 0.000, ALIN(2) = 1.000,
ALIN(3) = 2.000, ALIN(4) = 3.000, ALIN(5) = 4.000,
ALIN(6) = 6.000, ALIN(7) = 8.000, ALIN(8) = 10.000,
ALIN(9) = 12.000, ALIN(10) = 14.000, ALTV(1) = 10000.000,
ALTV(2) = 15000.000, ALTV(3) = 20000.000, ALTV(4) = 25000.000,
ALTV(5) = 27000.000, ALTV(6) = 29000.000, ALTV(7) = 30000.000,
ALTV(8) = 35000.000, ALTV(9) = 40000.000, ALTV(10) = 45000.000,
CLINPT(1) = 0.000, CLINPT(2) = 0.000, CLINPT(3) = 0.000,
CLINPT(4) = 0.000, CLINPT(5) = 0.000, CLINPT(6) = 0.000,
CLINPT(7) = 0.000, CLINPT(8) = 0.000, CLINPT(9) = 0.000,
CLINPT(10) = 0.000, ITB(1) = 0, ITB(2) = 0,
ITB(3) = 0, ITB(4) = 0, ITB(5) = 0,
ITB(6) = 0, ITB(7) = 0, ITB(8) = 0,
ITB(9) = 0, ITB(10) = 0, ITS(1) = 0,
ITS(2) = 0, ITS(3) = 0, ITS(4) = 0,
ITS(5) = 0, ITS(6) = 0, ITS(7) = 0,
ITS(8) = 0, ITS(9) = 0, ITS(10) = 0,
ISTRS(1) = 1, ISTRS(2) = 1, ISTRS(3) = 1,
ISTRS(4) = 1, ISTRS(5) = 1, ISTRS(6) = 1,
ISTRS(7) = 1, ISTRS(8) = 1, ISTRS(9) = 1,
ISTRS(10) = 1,
$END
$ADRAG
ICDO = 0, SMNCDO(1) = 0.000, SMNCDO(2) = 0.000,
SMNCDO(3) = 0.000, SMNCDO(4) = 0.000, SMNCDO(5) = 0.000,
SMNCDO(6) = 0.000, SMNCDO(7) = 0.000, SMNCDO(8) = 0.000,
SMNCDO(9) = 0.000, SMNCDO(10) = 0.000, CDONPT(1) = 0.000,
CDONPT(2) = 0.000, CDONPT(3) = 0.000, CDONPT(4) = 0.000,
CDONPT(5) = 0.000, CDONPT(6) = 0.000, CDONPT(7) = 0.000,
CDONPT(8) = 0.000, CDONPT(9) = 0.000, CDONPT(10) = 0.000,
SMNBMB(1) = 0.000, SMNBMB(2) = 0.800, SMNBMB(3) = 0.900,
SMNBMB(4) = 0.930, SMNBMB(5) = 0.950, SMNBMB(6) = 0.980,
SMNBMB(7) = 1.000, SMNBMB(8) = 1.100, SMNBMB(9) = 1.400,
SMNBMB(10) = 1.600, CDBMB(1) = 0.000, CDBMB(2) = 0.000,
CDBMB(3) = 0.000, CDBMB(4) = 0.000, CDBMB(5) = 0.000,
CDBMB(6) = 0.000, CDBMB(7) = 0.000, CDBMB(8) = 0.000,
CDBMB(9) = 0.000, CDBMB(10) = 0.000, SMSTRS(1) = 0.600,
SMSTRS(2) = 0.650, SMSTRS(3) = 0.700, SMSTRS(4) = 0.750,
SMSTRS(5) = 0.770, SMSTRS(6) = 0.790, SMSTRS(7) = 0.800,

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SMSTRS(8) = 0.810, SMSTRS(9) = 0.825, SMSTRS(10) = 0.850,
CDSTR(1) = 0.000, CDSTR(2) = 0.000, CDSTR(3) = 0.000,
CDSTR(4) = 0.000, CDSTR(5) = 0.000, CDSTR(6) = 0.000,
CDSTR(7) = 0.000, CDSTR(8) = 0.000, CDSTR(9) = 0.000,
CDSTR(10) = 0.000, SMTANK(1) = 0.000, SMTANK(2) = 0.000,
SMTANK(3) = 0.000, SMTANK(4) = 0.000, SMTANK(5) = 0.000,
SMTANK(6) = 0.000, SMTANK(7) = 0.000, SMTANK(8) = 0.000,
SMTANK(9) = 0.000, SMTANK(10) = 0.000, CDTNK(1) = 0.000,
CDTNK(2) = 0.000, CDTNK(3) = 0.000, CDTNK(4) = 0.000,
CDTNK(5) = 0.000, CDTNK(6) = 0.000, CDTNK(7) = 0.000,
CDTNK(8) = 0.000, CDTNK(9) = 0.000, CDTNK(10) = 0.000,
SMEXTR(1) = 0.000, SMEXTR(2) = 0.800, SMEXTR(3) = 0.900,
SMEXTR(4) = 0.930, SMEXTR(5) = 0.950, SMEXTR(6) = 0.980,
SMEXTR(7) = 1.000, SMEXTR(8) = 1.100, SMEXTR(9) = 1.400,
SMEXTR(10) = 1.600, CDEXTR(1) = 0.000, CDEXTR(2) = 0.000,
CDEXTR(3) = 0.000, CDEXTR(4) = 0.000, CDEXTR(5) = 0.000,
CDEXTR(6) = 0.000, CDEXTR(7) = 0.000, CDEXTR(8) = 0.000,
CDEXTR(9) = 0.000, CDEXTR(10) = 0.000,
$END
$ATAKE
CLLAND = -1.000, CLTO = -1.000, DELFLD = 45.000,
DELFTO = 25.000, DELLED = 30.000, DELLTO = 10.000,
LDLAND = -1.000, LDTO = -1.000,
$END
$APRINT
ECHOIN = 1, ECHOUT = 0, INTM = 0,
IPBLNT = 0, IPCAN = 0, IPENG = 0,
IPEXT = 0, IPFLAP = 0, IPFRIC = 0,
IPINTF = 0, IPLIFT = 0, IPMIN = 0,
IPWAVE = 0, KERROR = 0,
$END
**** Subsonic Transport PROPULSION MODULE - USING CF6 ENGINE (CYCLE ANALYSIS) **
5
$LEWIS
AENDIA = 8.200, AENLE = 24.000, AENWT = 9000.000,
BA = 7.000, DIA1 = 8.200, FRPN = 1.250,
RDIAM = 1.000, RLENG = 1.000, SM1 = 0.800,
SODG = 2.720, WCWA1 = 0.030, YREN = 80.000,
TWOAB = 43000.000, ETAF1 = 0.900, SCPR = 1.350,
SFADP = 1.400, SFADSP = 1.400, SFBPP = 1.400,
ALTD(1) = 0.000, ALTD(2) = 10000.000, ALTD(3) = 20000.000,
ALTD(4) = 30000.000, ALTD(5) = 35000.000, ALTD(6) = 40000.000,
XMACH(1) = 0.600, XMACH(2) = 0.650, XMACH(3) = 0.700,
XMACH(4) = 0.750, XMACH(5) = 0.800, XMACH(6) = 0.850,
XMDES = 0.800, EN = 4, IPR = 1,
KODE = 2, KT5 = 0, KT7 = 0,
MINPR = 1, NAB = 6, NDTAIL = 5,
$END

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Subsonic Transport - unmatched aerodynamics output

Mach = .60
Altitude = 10000.

Parasite Drag	Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0134	Alpha	Cl						
Body	.0052	.0	.135	.0155	8.7	.000	.00	.0000	.0
Wing	.0054	1.1	.231	.0163	14.1	.000	2.43	.0000	-1.1
Strakes	.0000	2.3	.325	.0193	16.8	.000	1.09	.0002	-2.1
H. Tail	.0010	3.4	.418	.0248	16.9	.000	.75	.0006	-3.1
V. Tail	.0008	4.5	.508	.0327	15.5	.000	.59	.0011	-4.2
Canard	.0000	6.8	.681	.0566	12.0	.000	.45	.0028	-6.1
Pods	.0009	9.0	.844	.0913	9.2	.000	.37	.0053	-8.1
Engine	.0000	11.3	.996	.1366	7.3	.000	.33	.0089	-10.1
Cowl	.0000	13.7	1.136	.1924	5.9	.000	.29	.0136	-12.1
Boattail	.0000	16.1	1.263	.2581	4.9	.000	.26	.0198	-14.3
Interference	.0021								
Wave	.0000								
External	.0000			Slope Factors					
Tanks	.0000			CdAlpha					
Bombs	.0000			CdI^5Alpha					
Stores	.0000			Alpha Transition Zone 2-3					
Extra	.0000								
Camber	.0000								
			</						

Mach = .75
Altitude = 25000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0131									
Body	.0051	.0	.130	.0152	8.6	.000	.00	.0000	.0	3
Wing	.0053	1.1	.232	.0162	14.3	.000	2.13	.0001	-1.1	3
Strakes	.0000	2.3	.331	.0196	16.9	.000	.98	.0003	-2.3	3
H. Tail	.0010	3.4	.429	.0258	16.6	.000	.69	.0008	-3.3	3
V. Tail	.0008	4.5	.524	.0348	15.1	.000	.56	.0015	-4.4	3
Canard	.0000	6.8	.707	.0616	11.5	.000	.43	.0036	-6.5	3
Pods	.0009	9.0	.879	.1002	8.8	.000	.36	.0068	-8.6	3
Engine	.0000	11.3	1.040	.1505	6.9	.000	.32	.0111	-10.7	3
Cowl	.0000	13.7	1.187	.2118	5.6	.000	.29	.0168	-12.8	3
Boattail	.0000	16.1	1.322	.2839	4.7	.000	.26	.0239	-15.1	3
Interference	.0021									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha					.0741	
				Cdl^5Alpha					.0322	
				Alpha Transition Zone 2-3					.000	
Cdmin		.0152								

Mach = .77
Altitude = 27000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0130									
Body	.0051	.0	.140	.0151	9.3	.000	.00	.0000	.0	3
Wing	.0053	1.1	.243	.0161	15.0	.000	2.29	.0001	-1.1	3
Strakes	.0000	2.3	.343	.0197	17.5	.000	1.03	.0003	-2.3	3
H. Tail	.0010	3.4	.441	.0259	17.0	.000	.72	.0008	-3.4	3
V. Tail	.0008	4.5	.538	.0351	15.3	.000	.58	.0016	-4.4	3
Canard	.0000	6.8	.722	.0624	11.6	.000	.44	.0038	-6.6	3
Pods	.0009	9.0	.895	.1016	8.8	.000	.37	.0071	-8.6	3
Engine	.0000	11.3	1.057	.1525	6.9	.000	.32	.0115	-10.8	3
Cowl	.0000	13.7	1.206	.2148	5.6	.000	.29	.0172	-12.9	3
Boattail	.0000	16.1	1.341	.2877	4.7	.000	.26	.0245	-15.2	3
Interference	.0021									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha					.0747	
				Cdl^5Alpha					.0325	
				Alpha Transition Zone 2-3					.000	
Cdmin		.0151								

Mach = .79
Altitude = 29000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0130									
Body	.0051	.0	.145	.0157	9.3	.000	.00	.0000	.0	3
Wing	.0053	1.1	.248	.0167	14.9	.000	2.37	.0001	-1.2	3
Strakes	.0000	2.3	.350	.0203	17.3	.000	1.06	.0003	-2.3	3
H. Tail	.0010	3.4	.449	.0267	16.8	.000	.73	.0008	-3.4	3
V. Tail	.0008	4.5	.546	.0360	15.2	.000	.58	.0016	-4.5	3
Canard	.0000	6.8	.732	.0637	11.5	.000	.44	.0039	-6.6	3
Pods	.0009	9.0	.907	.1036	8.8	.000	.37	.0073	-8.7	3
Engine	.0000	11.3	1.069	.1553	6.9	.000	.33	.0118	-10.8	3
Cowl	.0000	13.7	1.219	.2184	5.6	.000	.29	.0177	-13.0	3
Boattail	.0000	16.1	1.356	.2923	4.6	.000	.26	.0252	-15.4	3
Interference	.0020									
Wave	.0007									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha					.0753	
				Cdl^5Alpha					.0327	
				Alpha Transition Zone 2-3					.000	
Cdmin		.0157								

Mach = .80
Altitude = 30000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0130									
Body	.0051	.0	.170	.0173	9.8	.000	.00	.0000	.0	3
Wing	.0053	1.1	.274	.0184	14.9	.000	2.85	.0001	-1.2	3
Strakes	.0000	2.3	.376	.0220	17.1	.000	1.21	.0003	-2.3	3
H. Tail	.0010	3.4	.475	.0284	16.7	.000	.81	.0008	-3.4	3
V. Tail	.0008	4.5	.572	.0379	15.1	.000	.63	.0017	-4.5	3
Canard	.0000	6.8	.759	.0658	11.5	.000	.47	.0040	-6.6	3
Pods	.0009	9.0	.935	.1060	8.8	.000	.39	.0074	-8.8	3
Engine	.0000	11.3	1.098	.1581	6.9	.000	.34	.0120	-10.9	3
Cowl	.0000	13.7	1.248	.2216	5.6	.000	.30	.0180	-13.1	3
Boattail	.0000	16.1	1.385	.2961	4.7	.000	.27	.0255	-15.4	3
Interference	.0018									
Wave	.0025									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Cdmin = .0173

Mach = .81
Altitude = 35000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0129									
Body	.0051	.0	.175	.0198	8.8	.000	.00	.0000	.0	3
Wing	.0053	1.1	.279	.0208	13.4	.000	2.94	.0001	-1.2	3
Strakes	.0000	2.3	.382	.0245	15.6	.000	1.24	.0003	-2.3	3
H. Tail	.0010	3.4	.482	.0310	15.6	.000	.83	.0008	-3.4	3
V. Tail	.0008	4.5	.579	.0405	14.3	.000	.64	.0017	-4.5	3
Canard	.0000	6.8	.767	.0687	11.2	.000	.48	.0041	-6.7	3
Pods	.0009	9.0	.943	.1092	8.6	.000	.40	.0075	-8.8	3
Engine	.0000	11.3	1.107	.1617	6.8	.000	.34	.0122	-10.9	3
Cowl	.0000	13.7	1.258	.2257	5.6	.000	.31	.0182	-13.2	3
Boattail	.0000	16.1	1.395	.3006	4.6	.000	.28	.0258	-15.5	3
Interference	.0017									
Wave	.0052									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Cdmin = .0198

Mach = .82
Altitude = 40000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0129									
Body	.0051	.0	.160	.0248	6.5	.000	.00	.0000	.0	3
Wing	.0052	1.1	.265	.0258	10.3	.000	2.61	.0001	-1.2	3
Strakes	.0000	2.3	.368	.0295	12.5	.000	1.14	.0003	-2.3	3
H. Tail	.0010	3.4	.469	.0361	13.0	.000	.77	.0008	-3.4	3
V. Tail	.0008	4.5	.567	.0457	12.4	.000	.61	.0017	-4.5	3
Canard	.0000	6.8	.756	.0744	10.2	.000	.46	.0042	-6.7	3
Pods	.0009	9.0	.933	.1153	8.1	.000	.38	.0077	-8.8	3
Engine	.0000	11.3	1.098	.1684	6.5	.000	.33	.0125	-11.0	3
Cowl	.0000	13.7	1.250	.2331	5.4	.000	.30	.0186	-13.2	3
Boattail	.0000	16.1	1.388	.3088	4.5	.000	.27	.0263	-15.6	3
Interference	.0015									
Wave	.0104									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Cdmin = .0248

Mach = .85
Altitude = 45000.

Parasite Drag		Induced Drag									
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone	
Friction	.0129										
Body	.0050	.0	.160	.0360	4.4	.000	.00	.0000	.0	3	
Wing	.0052	1.1	.266	.0371	7.2	.000	2.58	.0001	-1.2	3	
Strakes	.0000	2.3	.370	.0409	9.1	.000	1.13	.0003	-2.4	3	
H. Tail	.0010	3.4	.472	.0476	9.9	.000	.77	.0008	-3.5	3	
V. Tail	.0008	4.5	.571	.0574	10.0	.000	.61	.0017	-4.6	3	
Canard	.0000	6.8	.762	.0867	8.8	.000	.46	.0043	-6.8	3	
Pods	.0009	9.0	.941	.1286	7.3	.000	.38	.0080	-8.9	3	
Engine	.0000	11.3	1.108	.1827	6.1	.000	.33	.0130	-11.1	3	
Cowl	.0000	13.7	1.262	.2486	5.1	.000	.30	.0193	-13.4	3	
Boattail	.0000	16.1	1.402	.3256	4.3	.000	.27	.0272	-15.7	3	
Interference	.0012										
Wave	.0220										
External	.0000										
Tanks	.0000										
Bombs	.0000										
Stores	.0000										
Extra	.0000										
Camber	.0000										
Cdmin	.0360										

Slope Factors		
ClAlpha		.0772
Cd1^5Alpha		.0335
Alpha Transition Zone 2-3		.000

10 2.0E+05																
PHASE	MACH NO.		ALTITUDE		HORIZONTAL		NO. TURN	VIND 'G'S	WKFUEL	M	IP	IX	W	B	A	P
	START	END	START	END	DIST	TIME										
CLIMB	0.00	0.00	0	7500	0.0	0.0	0.0	300.0	1.00000	1	2	-1	0	0	0	0
CLIMB	0.00	0.00	-1	10000	0.0	0.0	0.0	300.0	1.00000	1	2	-1	0	0	0	0
CLIMB	0.00	0.00	-1	14000	0.0	0.0	0.0	300.0	1.00000	1	2	-1	0	0	0	0
CRUISE	0.00	0.00	-1	14000	2000.0	0.0	0.0	0.0	1.00000	1	3	0	0	0	0	0
CLIMB	0.00	0.00	-1	21000	0.0	0.0	0.0	300.0	1.00000	1	2	-1	0	0	0	0
CLIMB	0.00	0.00	-1	25000	0.0	0.0	0.0	300.0	1.00000	1	2	-1	0	0	0	0
CLIMB	0.00	0.00	-1	30000	0.0	0.0	0.0	300.0	1.00000	1	2	-1	0	0	0	0
CRUISE	0.60	0.75	30000	30000	2000.0	0.0	0.0	0.0	1.00000	1	3	0	0	0	0	0
CLIMB	0.00	0.00	30000	40000	0.0	0.0	0.0	350.0	1.00000	1	3	-1	0	0	0	0
CRUISE	0.75	0.85	40000	40000	2000.0	0.0	0.0	0.0	1.00000	1	3	0	0	0	0	0

** Subsonic Transport AERODYNAMICS MODULE *****

\$ACHAR

ABOSB	=	0.020,	ALMAX	=	20.000,	AMC	=	35.000,
BDNOSE	=	25.500,	BTEF	=	1.000,	MACHN	=	0.750,
RALOIT	=	0.000,	RCLMAX	=	1.000,	ROC	=	0.015,
ROCAN	=	0.020,	SFWF	=	1.000,	SMNDR	=	0.860,
SPANAC	=	0.000,	SWPMAX	=	60.000,	SWPMIN	=	0.000,
XCDC	=	0.600,	XCDW	=	0.600,	AJCAN	=	0,
ALELJ	=	1,	INORM	=	1,	ISMNDR	=	0,
ISUPCR	=	0,	ITRAP	=	0,	IXCD	=	1,
ELLIPC	=	.FALSE.,	ELLIPW	=	.FALSE.,	SMNSWP (1)	=	0.600,
SMNSWP (2)	=	0.650,	SMNSWP (3)	=	0.700,	SMNSWP (4)	=	0.750,
SMNSWP (5)	=	0.770,	SMNSWP (6)	=	0.790,	SMNSWP (7)	=	0.800,
SMNSWP (8)	=	0.810,	SMNSWP (9)	=	0.825,	SMNSWP (10)	=	0.850,
CLO (1)	=	0.135,	CLO (2)	=	0.135,	CLO (3)	=	0.135,
CLO (4)	=	0.130,	CLO (5)	=	0.140,	CLO (6)	=	0.145,
CLO (7)	=	0.170,	CLO (8)	=	0.175,	CLO (9)	=	0.160,
CLO (10)	=	0.075,	CLOC (1)	=	0.000,	CLOC (2)	=	0.000,
CLOC (3)	=	0.000,	CLOC (4)	=	0.000,	CLOC (5)	=	0.000,
CLOC (6)	=	0.000,	CLOC (7)	=	0.000,	CLOC (8)	=	0.000,
CLOC (9)	=	0.000,	CLOC (10)	=	0.000,	CLOW (1)	=	0.000,
CLOW (2)	=	0.000,	CLOW (3)	=	0.000,	CLOW (4)	=	0.000,
CLOW (5)	=	0.000,	CLOW (6)	=	0.000,	CLOW (7)	=	0.000,
CLOW (8)	=	0.000,	CLOW (9)	=	0.000,	CLOW (10)	=	0.000,
CMO (1)	=	0.000,	CMO (2)	=	0.000,	CMO (3)	=	0.000,
CMO (4)	=	0.000,	CMO (5)	=	0.000,	CMO (6)	=	0.000,
CMO (7)	=	0.000,	CMO (8)	=	0.000,	CMO (9)	=	0.000,
CMO (10)	=	0.000,	YSWP (1)	=	0.000,	YSWP (2)	=	0.000,
YSWP (3)	=	0.000,	YSWP (4)	=	0.000,	YSWP (5)	=	0.000,
YSWP (6)	=	0.000,	YSWP (7)	=	0.000,	YSWP (8)	=	0.000,
YSWP (9)	=	0.000,	YSWP (10)	=	0.000,			

\$END

\$AMULT

CSF	=	1.000,	ESSF	=	1.000,	FCD	=	1.000,
FCDF	=	1.081,	FCDL	=	1.000,	FCDW	=	1.077,
FCDWB	=	1.000,	FENG	=	1.000,	FINTF	=	1.000,
FLBCOR	=	1.000,	FLECOR	=	1.000,	FMDR	=	1.000,
FCDO	=	1.000,	FLD	=	1.000,	FCDRA (1)	=	0.982,
FCDRA (2)	=	0.988,	FCDRA (3)	=	1.006,	FCDRA (4)	=	1.012,
FCDRA (5)	=	1.043,	FCDRA (6)	=	1.054,	FCDRA (7)	=	1.016,
FCDRA (8)	=	0.925,	FCDRA (9)	=	0.830,	FCDRA (10)	=	0.729,

\$END

\$ATRIM

FLDM (1)	=	0.210,	FLDM (2)	=	0.410,	FLDM (3)	=	0.721,
FLDM (4)	=	0.954,	FLDM (5)	=	1.000,	FLDM (6)	=	1.180,
FLDM (7)	=	1.220,	FLDM (8)	=	1.800,	FLDM (9)	=	2.770,
FLDM (10)	=	5.000,	FVCAM (1)	=	1.144,	FVCAM (2)	=	1.160,
FVCAM (3)	=	1.202,	FVCAM (4)	=	1.240,	FVCAM (5)	=	1.250,
FVCAM (6)	=	1.307,	FVCAM (7)	=	1.315,	FVCAM (8)	=	1.323,
FVCAM (9)	=	1.334,	FVCAM (10)	=	1.300,	ITRIM (1)	=	1,

ITRIM(2)	=	1,	ITRIM(3)	=	1,	ITRIM(4)	=	1,
ITRIM(5)	=	1,	ITRIM(6)	=	1,	ITRIM(7)	=	1,
ITRIM(8)	=	1,	ITRIM(9)	=	1,	ITRIM(10)	=	1,
CAND	=	0.000,	CFLAP	=	0.000,	CGM	=	0.250,
IT	=	0.000,	SFLAP	=	0.000,	SM	=	0.000,
SPANF	=	0.000,	ZCG	=	0.000,	IVCAM	=	1,
\$END								
\$ADET								
IPLOT	=	1,	NALF	=	10,	NMDTL	=	10,
ICOD	=	1,	IALF	=	0,	IALP	=	2,
SMN(1)	=	0.600,	SMN(2)	=	0.650,	SMN(3)	=	0.700,
SMN(4)	=	0.750,	SMN(5)	=	0.770,	SMN(6)	=	0.790,
SMN(7)	=	0.800,	SMN(8)	=	0.810,	SMN(9)	=	0.825,
SMN(10)	=	0.850,	ALIN(1)	=	0.000,	ALIN(2)	=	1.000,
ALIN(3)	=	2.000,	ALIN(4)	=	3.000,	ALIN(5)	=	4.000,
ALIN(6)	=	6.000,	ALIN(7)	=	8.000,	ALIN(8)	=	10.000,
ALIN(9)	=	12.000,	ALIN(10)	=	14.000,	ALTV(1)	=	10000.000,
ALTV(2)	=	15000.000,	ALTV(3)	=	20000.000,	ALTV(4)	=	25000.000,
ALTV(5)	=	27000.000,	ALTV(6)	=	29000.000,	ALTV(7)	=	30000.000,
ALTV(8)	=	35000.000,	ALTV(9)	=	40000.000,	ALTV(10)	=	45000.000,
CLINPT(1)	=	0.000,	CLINPT(2)	=	0.000,	CLINPT(3)	=	0.000,
CLINPT(4)	=	0.000,	CLINPT(5)	=	0.000,	CLINPT(6)	=	0.000,
CLINPT(7)	=	0.000,	CLINPT(8)	=	0.000,	CLINPT(9)	=	0.000,
CLINPT(10)	=	0.000,	ITB(1)	=	0,	ITB(2)	=	0,
ITB(3)	=	0,	ITB(4)	=	0,	ITB(5)	=	0,
ITB(6)	=	0,	ITB(7)	=	0,	ITB(8)	=	0,
ITB(9)	=	0,	ITB(10)	=	0,	ITS(1)	=	0,
ITS(2)	=	0,	ITS(3)	=	0,	ITS(4)	=	0,
ITS(5)	=	0,	ITS(6)	=	0,	ITS(7)	=	0,
ITS(8)	=	0,	ITS(9)	=	0,	ITS(10)	=	0,
ISTRS(1)	=	1,	ISTRS(2)	=	1,	ISTRS(3)	=	1,
ISTRS(4)	=	1,	ISTRS(5)	=	1,	ISTRS(6)	=	1,
ISTRS(7)	=	1,	ISTRS(8)	=	1,	ISTRS(9)	=	1,
ISTRS(10)	=	1,						
\$END								
\$ADRAG								
ICDO	=	0,	SMNCDO(1)	=	0.000,	SMNCDO(2)	=	0.000,
SMNCDO(3)	=	0.000,	SMNCDO(4)	=	0.000,	SMNCDO(5)	=	0.000,
SMNCDO(6)	=	0.000,	SMNCDO(7)	=	0.000,	SMNCDO(8)	=	0.000,
SMNCDO(9)	=	0.000,	SMNCDO(10)	=	0.000,	CDONPT(1)	=	0.000,
CDONPT(2)	=	0.000,	CDONPT(3)	=	0.000,	CDONPT(4)	=	0.000,
CDONPT(5)	=	0.000,	CDONPT(6)	=	0.000,	CDONPT(7)	=	0.000,
CDONPT(8)	=	0.000,	CDONPT(9)	=	0.000,	CDONPT(10)	=	0.000,
SMNBMB(1)	=	0.000,	SMNBMB(2)	=	0.800,	SMNBMB(3)	=	0.900,
SMNBMB(4)	=	0.930,	SMNBMB(5)	=	0.950,	SMNBMB(6)	=	0.980,
SMNBMB(7)	=	1.000,	SMNBMB(8)	=	1.100,	SMNBMB(9)	=	1.400,
SMNBMB(10)	=	1.600,	CDBMB(1)	=	0.000,	CDBMB(2)	=	0.000,
CDBMB(3)	=	0.000,	CDBMB(4)	=	0.000,	CDBMB(5)	=	0.000,
CDBMB(6)	=	0.000,	CDBMB(7)	=	0.000,	CDBMB(8)	=	0.000,
CDBMB(9)	=	0.000,	CDBMB(10)	=	0.000,	SMSTRS(1)	=	0.600,
SMSTRS(2)	=	0.650,	SMSTRS(3)	=	0.700,	SMSTRS(4)	=	0.750,
SMSTRS(5)	=	0.770,	SMSTRS(6)	=	0.790,	SMSTRS(7)	=	0.800,
SMSTRS(8)	=	0.810,	SMSTRS(9)	=	0.825,	SMSTRS(10)	=	0.850,
CDSTR(1)	=	0.000,	CDSTR(2)	=	0.000,	CDSTR(3)	=	0.000,
CDSTR(4)	=	0.000,	CDSTR(5)	=	0.000,	CDSTR(6)	=	0.000,
CDSTR(7)	=	0.000,	CDSTR(8)	=	0.000,	CDSTR(9)	=	0.000,
CDSTR(10)	=	0.000,	SMTANK(1)	=	0.000,	SMTANK(2)	=	0.000,
SMTANK(3)	=	0.000,	SMTANK(4)	=	0.000,	SMTANK(5)	=	0.000,
SMTANK(6)	=	0.000,	SMTANK(7)	=	0.000,	SMTANK(8)	=	0.000,
SMTANK(9)	=	0.000,	SMTANK(10)	=	0.000,	CDTNK(1)	=	0.000,
CDTNK(2)	=	0.000,	CDTNK(3)	=	0.000,	CDTNK(4)	=	0.000,
CDTNK(5)	=	0.000,	CDTNK(6)	=	0.000,	CDTNK(7)	=	0.000,
CDTNK(8)	=	0.000,	CDTNK(9)	=	0.000,	CDTNK(10)	=	0.000,
SMEXTR(1)	=	0.000,	SMEXTR(2)	=	0.800,	SMEXTR(3)	=	0.900,


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SMEXTR(4) = 0.930, SMEXTR(5) = 0.950, SMEXTR(6) = 0.980,
SMEXTR(7) = 1.000, SMEXTR(8) = 1.100, SMEXTR(9) = 1.400,
SMEXTR(10) = 1.600, CDEXTR(1) = 0.000, CDEXTR(2) = 0.000,
CDEXTR(3) = 0.000, CDEXTR(4) = 0.000, CDEXTR(5) = 0.000,
CDEXTR(6) = 0.000, CDEXTR(7) = 0.000, CDEXTR(8) = 0.000,
CDEXTR(9) = 0.000, CDEXTR(10) = 0.000,
$END
$ATAKE
CLLAND = -1.000, CLTO = -1.000, DELFLD = 45.000,
DELFTO = 25.000, DELLED = 30.000, DELLTO = 10.000,
LDLAND = -1.000, LDTO = -1.000,
$END
$APRINT
ECHOIN = 1, ECHOUT = 0, INTM = 0,
IPBLNT = 0, IPCAN = 0, IPENG = 0,
IPEXT = 0, IPFLAP = 0, IPFRIC = 0,
IPINTF = 0, IPLIFT = 0, IPMIN = 0,
IPWAVE = 0, KERROR = 0,
$END
**** Subsonic Transport PROPULSION MODULE - USING CF6 ENGINE (CYCLE ANALYSIS) ***
5
$LEWIS
AENDIA = 8.200, AENLE = 24.000, AENWT = 9000.000,
BA = 7.000, DIA1 = 8.200, FRPN = 1.250,
RDIAM = 1.000, RLENG = 1.000, SM1 = 0.800,
SODG = 2.720, WCWA1 = 0.030, YREN = 80.000,
TWOAB = 43000.000, ETAF1 = 0.900, SCPR = 1.350,
SFADP = 1.400, SFADSP = 1.400, SFBPP = 1.400,
ALTD(1) = 0.000, ALTD(2) = 10000.000, ALTD(3) = 20000.000,
ALTD(4) = 30000.000, ALTD(5) = 35000.000, ALTD(6) = 40000.000,
XMACH(1) = 0.600, XMACH(2) = 0.650, XMACH(3) = 0.700,
XMACH(4) = 0.750, XMACH(5) = 0.800, XMACH(6) = 0.850,
XMDES = 0.800, EN = 4, IPR = 1,
KODE = 2, KT5 = 0, KT7 = 0,
MINPR = 1, NAB = 6, NDTAIL = 5,
$END

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Subsonic Transport - matched aerodynamics output

Mach = .60
Altitude = 10000.

Parasite Drag		Induced Drag								
Friction	.0141	Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Body	.0056	.0	.135	.0163	8.3	.000	.00	.0000	.0	3
Wing	.0058	1.1	.232	.0171	13.6	.000	2.62	.0000	-1.1	3
Strakes	.0000	2.3	.330	.0197	16.8	.000	1.28	.0002	-2.1	3
H. Tail	.0011	3.4	.428	.0238	18.0	.000	.97	.0006	-3.1	3
V. Tail	.0008	4.5	.526	.0291	18.0	.000	.85	.0011	-4.2	3
Canard	.0000	6.8	.720	.0417	17.3	.000	.81	.0028	-6.1	3
Pods	.0009	9.0	.912	.0535	17.1	.000	.89	.0053	-8.1	3
Engine	.0000	11.3	1.099	.0600	18.3	.000	1.10	.0089	-10.1	3
Cowl	.0000	13.7	1.281	.0569	22.5	.000	1.61	.0136	-12.1	3
Boattail	.0000	16.1	1.430	.0678	21.1	.000	1.58	.0198	-14.3	3
Interference	.0021									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Cdmin = .0163

Mach = .65
Altitude = 15000.

Parasite Drag		Induced Drag								
Friction	.0141	Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Body	.0056	.0	.135	.0162	8.3	.000	.00	.0000	.0	3
Wing	.0058	1.1	.234	.0170	13.7	.000	2.54	.0001	-1.1	3
Strakes	.0000	2.3	.333	.0197	16.9	.000	1.25	.0003	-2.2	3
H. Tail	.0011	3.4	.433	.0241	18.0	.000	.95	.0006	-3.2	3
V. Tail	.0008	4.5	.533	.0297	18.0	.000	.84	.0012	-4.2	3
Canard	.0000	6.8	.731	.0429	17.0	.000	.80	.0030	-6.3	3
Pods	.0009	9.0	.926	.0554	16.7	.000	.87	.0058	-8.3	3
Engine	.0000	11.3	1.117	.0627	17.8	.000	1.07	.0096	-10.3	3
Cowl	.0000	13.7	1.302	.0603	21.6	.000	1.53	.0146	-12.4	3
Boattail	.0000	16.1	1.454	.0724	20.1	.000	1.50	.0211	-14.6	3
Interference	.0021									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Cdmin = .0162

Mach = .70
Altitude = 20000.

Parasite Drag		Induced Drag								
Friction	.0143	Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Body	.0056	.0	.135	.0164	8.2	.000	.00	.0000	.0	3
Wing	.0058	1.1	.236	.0173	13.7	.000	2.40	.0001	-1.1	3
Strakes	.0000	2.3	.338	.0203	16.7	.000	1.16	.0003	-2.2	3
H. Tail	.0011	3.4	.442	.0254	17.4	.000	.86	.0007	-3.3	3
V. Tail	.0008	4.5	.545	.0324	16.8	.000	.74	.0014	-4.3	3
Canard	.0000	6.8	.753	.0513	14.7	.000	.65	.0033	-6.4	3
Pods	.0009	9.0	.959	.0744	12.9	.000	.63	.0063	-8.4	3
Engine	.0000	11.3	1.163	.0993	11.7	.000	.65	.0103	-10.5	3
Cowl	.0000	13.7	1.363	.1229	11.1	.000	.69	.0156	-12.6	3
Boattail	.0000	16.1	1.524	.1596	9.5	.000	.65	.0224	-14.8	3
Interference	.0021									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Cdmin = .0164

Mach = .75
Altitude = 25000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0142									
Body	.0056	.0	.130	.0164	8.0	.000	.00	.0000	.0	3
Wing	.0058	1.1	.234	.0173	13.5	.000	2.18	.0001	-1.1	3
Strakes	.0000	2.3	.339	.0207	16.3	.000	1.04	.0003	-2.3	3
H. Tail	.0011	3.4	.445	.0267	16.6	.000	.76	.0008	-3.3	3
V. Tail	.0008	4.5	.553	.0354	15.6	.000	.64	.0015	-4.4	3
Canard	.0000	6.8	.770	.0609	12.6	.000	.53	.0036	-6.5	3
Pods	.0009	9.0	.988	.0968	10.2	.000	.48	.0068	-8.6	3
Engine	.0000	11.3	1.205	.1424	8.5	.000	.46	.0111	-10.7	3
Cowl	.0000	13.7	1.419	.1969	7.2	.000	.44	.0168	-12.8	3
Boattail	.0000	16.1	1.588	.2625	6.1	.000	.41	.0239	-15.1	3
Interference	.0021									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin		.0164								

		Slope Factors				
		ClAlpha				.0907
		Cd1^.5Alpha				.0308
		Alpha Transition Zone 2-3				.000

Mach = .77
Altitude = 27000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0146									
Body	.0058	.0	.140	.0168	8.3	.000	.00	.0000	.0	3
Wing	.0060	1.1	.244	.0178	13.7	.000	2.33	.0001	-1.1	3
Strakes	.0000	2.3	.351	.0213	16.4	.000	1.08	.0003	-2.3	3
H. Tail	.0011	3.4	.458	.0276	16.6	.000	.77	.0008	-3.4	3
V. Tail	.0009	4.5	.567	.0368	15.4	.000	.64	.0016	-4.4	3
Canard	.0000	6.8	.788	.0641	12.3	.000	.52	.0038	-6.6	3
Pods	.0009	9.0	1.009	.1033	9.8	.000	.47	.0071	-8.6	3
Engine	.0000	11.3	1.230	.1542	8.0	.000	.44	.0115	-10.8	3
Cowl	.0000	13.7	1.449	.2165	6.7	.000	.42	.0172	-12.9	3
Boattail	.0000	16.1	1.621	.2894	5.6	.000	.38	.0245	-15.2	3
Interference	.0022									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin		.0168								

		Slope Factors				
		ClAlpha				.0921
		Cd1^.5Alpha				.0325
		Alpha Transition Zone 2-3				.000

Mach = .79
Altitude = 29000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0147									
Body	.0058	.0	.145	.0176	8.2	.000	.00	.0000	.0	3
Wing	.0060	1.1	.251	.0187	13.4	.000	2.34	.0001	-1.2	3
Strakes	.0000	2.3	.359	.0225	16.0	.000	1.05	.0003	-2.3	3
H. Tail	.0011	3.4	.470	.0296	15.9	.000	.73	.0008	-3.4	3
V. Tail	.0009	4.5	.583	.0404	14.4	.000	.59	.0016	-4.5	3
Canard	.0000	6.8	.813	.0742	11.0	.000	.46	.0039	-6.6	3
Pods	.0009	9.0	1.048	.1263	8.3	.000	.40	.0073	-8.7	3
Engine	.0000	11.3	1.284	.1987	6.5	.000	.36	.0118	-10.8	3
Cowl	.0000	13.7	1.520	.2929	5.2	.000	.33	.0177	-13.0	3
Boattail	.0000	16.1	1.702	.3955	4.3	.000	.31	.0252	-15.4	3
Interference	.0021									
Wave	.0008									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin		.0176								

		Slope Factors				
		ClAlpha				.0968
		Cd1^.5Alpha				.0382
		Alpha Transition Zone 2-3				.000

Mach = .80
Altitude = 30000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0142									
Body	.0056	.0	.170	.0188	9.0	.000	.00	.0000	.0	3
Wing	.0058	1.1	.276	.0199	13.9	.000	2.80	.0001	-1.2	3
Strakes	.0000	2.3	.385	.0238	16.2	.000	1.19	.0003	-2.3	3
H. Tail	.0011	3.4	.497	.0311	16.0	.000	.80	.0008	-3.4	3
V. Tail	.0008	4.5	.611	.0424	14.4	.000	.63	.0017	-4.5	3
Canard	.0000	6.8	.843	.0780	10.8	.000	.48	.0040	-6.6	3
Pods	.0009	9.0	1.080	.1336	8.1	.000	.40	.0074	-8.8	3
Engine	.0000	11.3	1.319	.2115	6.2	.000	.36	.0120	-10.9	3
Cowl	.0000	13.7	1.558	.3141	5.0	.000	.33	.0180	-13.1	3
Boattail	.0000	16.1	1.742	.4245	4.1	.000	.30	.0255	-15.4	3
Interference	.0018									
Wave	.0027									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
<hr/> Cdm				.0188						

Mach = .81		Altitude = 35000.								
				Slope Factors						
				ClAlpha .0977						
				Cdl^5Alpha .0396						
				Alpha Transition Zone 2-3 .000						

Mach = .81
Altitude = 35000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0129									
Body	.0051	.0	.175	.0196	8.9	.000	.00	.0000	.0	3
Wing	.0053	1.1	.282	.0208	13.5	.000	2.56	.0001	-1.2	3
Strakes	.0000	2.3	.392	.0258	15.2	.000	.98	.0003	-2.3	3
H. Tail	.0010	3.4	.504	.0364	13.8	.000	.60	.0008	-3.4	3
V. Tail	.0008	4.5	.618	.0542	11.4	.000	.44	.0017	-4.5	3
Canard	.0000	6.8	.853	.1180	7.2	.000	.29	.0041	-6.7	3
Pods	.0008	9.0	1.092	.2297	4.8	.000	.23	.0075	-8.8	3
Engine	.0000	11.3	1.334	.4019	3.3	.000	.19	.0122	-10.9	3
Cowl	.0000	13.7	1.577	.6462	2.4	.000	.16	.0182	-13.2	3
Boattail	.0000	16.1	1.762	.8871	2.0	.000	.14	.0258	-15.5	3
Interference	.0016									
Wave	.0055									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
<hr/> Cdm				.0196						

Mach = .82		Altitude = 40000.								
				Slope Factors						
				ClAlpha .0987						
				Cdl^5Alpha .0579						
				Alpha Transition Zone 2-3 .000						

Mach = .82
Altitude = 40000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0115									
Body	.0045	.0	.160	.0220	7.3	.000	.00	.0000	.0	3
Wing	.0047	1.1	.268	.0236	11.3	.000	1.77	.0001	-1.2	3
Strakes	.0000	2.3	.378	.0315	12.0	.000	.60	.0003	-2.3	3
H. Tail	.0009	3.4	.492	.0504	9.8	.000	.34	.0008	-3.4	3
V. Tail	.0007	4.5	.608	.0850	7.1	.000	.23	.0017	-4.5	3
Canard	.0000	6.8	.845	.2210	3.8	.000	.14	.0042	-6.7	3
Pods	.0007	9.0	1.089	.4770	2.3	.000	.10	.0077	-8.8	3
Engine	.0000	11.3	1.335	.8906	1.5	.000	.08	.0125	-11.0	3
Cowl	.0000	13.7	1.582	1.4987	1.1	.000	.07	.0186	-13.2	3
Boattail	.0000	16.1	1.771	2.0738	.9	.000	.06	.0263	-15.6	3
Interference	.0012									
Wave	.0112									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
<hr/> Cdm				.0220						

Mach = .82		Altitude = 40000.								
				Slope Factors						
				ClAlpha .1002						
				Cdl^5Alpha .0891						
				Alpha Transition Zone 2-3 .000						

Mach = .85
Altitude = 45000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0101									
Body	.0040	.0	.160	.0321	5.0	.000	.00	.0000	.0	3
Wing	.0041	1.1	.269	.0337	8.0	.000	1.74	.0001	-1.2	3
Strakes	.0000	2.3	.381	.0419	9.1	.000	.59	.0003	-2.4	3
H. Tail	.0008	3.4	.496	.0613	8.1	.000	.33	.0008	-3.5	3
V. Tail	.0006	4.5	.613	.0971	6.3	.000	.23	.0017	-4.6	3
Canard	.0000	6.8	.853	.2381	3.6	.000	.14	.0043	-6.8	3
Pods	.0006	9.0	1.099	.5034	2.2	.000	.10	.0080	-8.9	3
Engine	.0000	11.3	1.348	.9317	1.4	.000	.08	.0130	-11.1	3
Cowl	.0000	13.7	1.597	1.5609	1.0	.000	.07	.0193	-13.4	3
Boattail	.0000	16.1	1.788	2.1551	.8	.000	.06	.0272	-15.7	3
Interference	.0009									
Wave	.0237									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin	.0321									

Slope Factors	
ClAlpha	.1012
Cdl^5Alpha	.0906
Alpha Transition Zone 2-3	.000

SUMMARY --- ACSYNT OUTPUT --- NASA, AMES RESEARCH CENTER

**** Subsonic Transport ****

ENGLISH UNITS -
DISTANCES IN FEET
WEIGHTS IN LBS.
FORCES IN LBS.
PRESSURES IN LBS/FT**2

GENERAL		FUSELAGE		WING		HTAIL	VTAIL
WG	279945.	LENGTH	230.7	AREA	6200.0	965.8	961.1
W/S	45.2	DIAMETER	25.5	WETTED AREA	11352.0	1940.3	1691.2
T/W	.61	VOLUME	97303.6	SPAN	222.7	68.7	38.0
N(Z) ULT	9.0	WETTED AREA	16505.1	L.E. SWEEP	29.0	30.0	34.3
CREW	0.	FINENESS RATIO	9.0	C/4 SWEEP	26.2	26.3	32.6
PASSENGERS	0.			ASPECT RATIO	8.00	4.89	1.50
				TAPER RATIO	.33	.42	.77
				T/C ROOT	.12	.11	.09
				T/C TIP	.11	.08	.09
				ROOT CHORD	41.8	19.8	28.6
				TIP CHORD	13.9	8.3	22.0
				M.A. CHORD	30.2	14.8	25.5
				LOC. OF L.E.	69.2	220.3	196.1

ENGINE		WEIGHTS	
NUMBER	4.	W	WG
LENGTH	24.0	STRUCT.	200571. 71.6
DIAM.	6.5	PROPUL.	46440. 16.6
WEIGHT	9000.0	FIX. EQ.	24572. 8.8
TSLs	43000.	FUEL	6837. 2.4
SFCSLS	.30	PAYLOAD	0. .0


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WFEXT      =      0.000, WETRAP      =    100.000, WFUEL      = 25000.000,
XDESC      =    30.000, IBREG        =      0, IPLOT        =      2,
IPSIZE     =     -2, IPRINT         =      0, IPSTO1        =      5,
IPSTO2     =      1, KERROR         =      0, MMPROP        =      1,
NCRUSE     =      1, NLEGCL         =      0, NLEGLO        =      0,
NLEGCR     =      0, NMISS          =      1, LENVEL        = -.FALSE.,
$END

      6      0.0E+00
PHASE      MACH NO.  ALTITUDE  HORIZONTAL  NO.  VIND
START END   START END   DIST  TIME   TURN  'G'S  WKFUEL M IP IX W B A P
-----
CLIMB      0.00 0.00      0 8000      0.0  0.0    0.0  0.0  1.0000 0 2 -1 0 0 0 0
CLIMB      0.00 0.00     -1 28000     0.0  0.0    0.0  0.0  1.0000 0 3 -1 0 0 0 0
CRUISE     -1 0.75     -1 35000  1000.0  0.0    0.0  0.0  1.0000 0 4  0 0 0 0 0
COMBAT     0.75 0.75  15000 15000     0.0  3.0    0.0  0.0  1.0000 0 2 -1 1 0 0 0
CLIMB     -1 0.00     -1 30000     0.0  0.0    0.0  0.0  1.0000 0 3 -1 0 0 0 0
CRUISE     -1 0.75     -1 35000  1000.0  0.0    0.0  0.0  1.0000 0 4  0 0 0 0 0
**** A-6E AERODYNAMICS DATA ***
$ACHAR
ABOSB      =      0.150, ALMAX        =    30.000, AMC        =    40.000,
BDNOSE     =      4.820, BTEF         =      0.000, SFWF        =      1.000,
SMNSWP (1) =      0.700, SMNSWP (2) =      0.800, SMNSWP (3) =      0.900,
SMNSWP (4) =      1.100, SMNSWP (5) =      1.300, SMNSWP (6) =      0.000,
SMNSWP (7) =      0.000, SMNSWP (8) =      0.000, SMNSWP (9) =      0.000,
SMNSWP (10) =      0.000,
XCDW       =      0.600, ALELJ        =      3, ISMNRD       =      0,
ISUPCR     =      0, ITRAP          =      0, IXCD          =      1,
$END
$AMULT
CSF         =      1.000, ESSF        =      1.000,
$END
$ATRIM
ITRIM (1)  =      1, ITRIM (2)  =      1, ITRIM (3)  =      1,
ITRIM (4)  =      1, ITRIM (5)  =      1, ITRIM (6)  =      1,
ITRIM (7)  =      1, ITRIM (8)  =      1, ITRIM (9)  =      1,
ITRIM (10) =      1, CFLAP       =    3.500, CGM         =      0.250,
IT          =      0.000, SFLAP      =   60.000, SM          =      0.120,
SPANF      =    25.000, IVCAM       =      0,
$END
$ADET
IPLOT       =      1, NALF          =    10, NMDTL         =      5,
ICOD        =      7, IALF          =      0, IALP          =      2,
SMN (1)     =      0.700, SMN (2)   =      0.800, SMN (3)   =      0.900,
SMN (4)     =      1.100, SMN (5)   =      1.300, SMN (6)   =      0.000,
SMN (7)     =      0.000, SMN (8)   =      0.000, SMN (9)   =      0.000,
SMN (10)    =      0.000, ALIN (1)  =      0.000, ALIN (2)  =      1.000,
ALIN (3)    =      2.000, ALIN (4)  =      3.000, ALIN (5)  =      4.000,
ALIN (6)    =      5.000, ALIN (7)  =      6.000, ALIN (8)  =      8.000,
ALIN (9)    =    10.000, ALIN (10) =    12.000, ALTV (1)   = 30000.000,
ALTV (2)    = 30000.000, ALTV (3)   = 30000.000, ALTV (4)   = 30000.000,
ALTV (5)    = 30000.000, ALTV (6)   = 30000.000, ALTV (7)   = 30000.000,
ALTV (8)    = 30000.000, ALTV (9)   = 30000.000, ALTV (10)  = 30000.000,
CLINPT (1)  =      0.000, CLINPT (2) =      0.100, CLINPT (3) =      0.200,
CLINPT (4)  =      0.250, CLINPT (5) =      0.300, CLINPT (6) =      0.400,
CLINPT (7)  =      0.500, CLINPT (8) =      0.600, CLINPT (9) =      0.700,
CLINPT (10) =      0.800, ITB (1)   =      1, ITB (2)   =      1,
ITB (3)     =      1, ITB (4)     =      1, ITB (5)     =      1,
ITB (6)     =      1, ITB (7)     =      1, ITB (8)     =      1,
ITB (9)     =      1, ITB (10)    =      1, ITS (1)     =      1,
ITS (2)     =      1, ITS (3)     =      1, ITS (4)     =      1,
ITS (5)     =      1, ITS (6)     =      1, ITS (7)     =      1,

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ITS(8)      =      1, ITS(9)      =      1, ITS(10)     =      1,
ISTRS(1)    =      1, ISTRS(2)    =      1, ISTRS(3)    =      1,
ISTRS(4)    =      1, ISTRS(5)    =      1, ISTRS(6)    =      1,
ISTRS(7)    =      1, ISTRS(8)    =      1, ISTRS(9)    =      1,
ISTRS(10)   =      1,
$END
$ADRAG
ICDO        =      0,
$END
$ATAKE
CLLAND      =     -1.000, CLTO      =     -1.000, DELFLD      =     35.000,
DELFTO      =     30.000, DELLED    =     25.000, DELLTO      =     20.000,
LDLAND      =     -1.000, LDTO      =     -1.000,
$END
$APRINT
ECHOIN      =      0, KERROR      =      2,
$END
**** A-6E INTRUDER PROPULSION - TWO P&W J52-P8A (9300 LB ST)
2
$LEWIS
YREN        =     70.000, TWOAB     =    9300.000, EB1        =     0.950,
P11P1       =     4.300, R32       =     0.960, SCPR        =     1.210,
T3          =    2115.000, MACH1    =     1.500, AM          =     0.800,
SFSFC1      =     0.680, ALTD(1)   =     0.000, ALTD(2)     =    5000.000,
ALTD(3)     =   10000.000, ALTD(4)   =   20000.000, ALTD(5)     =   30000.000,
ALTD(6)     =   45000.000, XMACH(1)  =     0.000, XMACH(2)     =     0.500,
XMACH(3)    =     0.600, XMACH(4)   =     0.700, XMACH(5)     =     0.800,
XMACH(6)    =     0.900, XMDES     =     0.820, EN          =      2,
KODE        =      0, KT5         =      0, KT7          =      0,
NEWINL      =      1,
$END
$INLET
LM          =     9.525, YCOYM      =     0.750, SFWAVP      =     0.000,
SFPRFP      =     0.000, ETA       =    11.000, INTYPE       =      2,
NINL        =      2,
$END

```


**** GRUMMAN A-6E INTRUDER unmatched output file
Detailed Aerodynamics Output

Mach = .70
Altitude = 30000.

Parasite Drag		Induced Drag		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0133			.0	.000	.0146	.0	.000	.00	.0000	.0	2
Body	.0029			.9	.100	.0153	6.5	.000	.90	.0000	-.4	2
Wing	.0055			1.8	.200	.0173	11.6	.000	.90	.0002	-.7	2
Strakes	.0002			2.3	.250	.0188	13.3	.000	.90	.0003	-.9	2
H. Tail	.0010			2.8	.300	.0206	14.5	.000	.90	.0004	-1.1	2
V. Tail	.0004			3.7	.400	.0254	15.8	.000	.89	.0008	-1.5	2
Canard	.0000			4.9	.500	.0384	13.0	.000	.63	-.0004	-2.0	3
Pods	.0034			6.0	.600	.0619	9.7	.000	.46	-.0004	-2.5	3
Engine	.0000			7.3	.700	.0830	8.4	.000	.43	-.0004	-3.1	3
Cowl	.0000			8.6	.800	.1089	7.3	.000	.41	-.0003	-3.8	3
Boattail	.0000											
Interference	.0013											
Wave	.0000											
External	.0000											
Tanks	.0000											
Bombs	.0000											
Stores	.0000											
Extra	.0000											
Camber	.0000											

Cdmin .0146

Mach = .80
Altitude = 30000.

Parasite Drag		Induced Drag		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0131			.0	.000	.0144	.0	.000	.00	.0000	.0	2
Body	.0028			.9	.100	.0151	6.6	.000	.90	.0001	-.4	2
Wing	.0054			1.7	.200	.0171	11.7	.000	.90	.0002	-.8	2
Strakes	.0002			2.2	.250	.0186	13.5	.000	.90	.0003	-.9	2
H. Tail	.0010			2.6	.300	.0204	14.7	.000	.90	.0005	-1.1	2
V. Tail	.0004			3.6	.400	.0252	15.9	.000	.89	.0009	-1.6	2
Canard	.0000			4.5	.500	.0420	11.9	.000	.54	-.0002	-2.0	3
Pods	.0033			5.8	.600	.0614	9.8	.000	.46	-.0002	-2.6	3
Engine	.0000			7.0	.700	.0824	8.5	.000	.43	-.0002	-3.2	3
Cowl	.0000			8.3	.800	.1081	7.4	.000	.41	.0001	-3.9	3
Boattail	.0000											
Interference	.0013											
Wave	.0000											
External	.0000											
Tanks	.0000											
Bombs	.0000											
Stores	.0000											
Extra	.0000											
Camber	.0000											

Cdmin .0144

Detailed Aerodynamics Output

Mach = .90
Altitude = 30000.

Parasite Drag		Induced Drag		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0129			.0	.000	.0160	.0	.000	.00	.0000	.0	2
Body	.0028			.8	.100	.0166	6.0	.000	.91	.0001	-.4	2
Wing	.0053			1.5	.200	.0186	10.7	.000	.91	.0002	-.8	2
Strakes	.0002			1.9	.250	.0201	12.4	.000	.91	.0003	-1.0	2
H. Tail	.0010			2.3	.300	.0219	13.7	.000	.91	.0005	-1.1	2
V. Tail	.0004			3.3	.400	.0280	14.3	.000	.80	.0009	-1.6	2
Canard	.0000			4.2	.500	.0456	11.0	.000	.51	-.0001	-2.1	3
Pods	.0032			5.4	.600	.0618	9.7	.000	.47	-.0000	-2.7	3
Engine	.0000			6.6	.700	.0825	8.5	.000	.44	.0001	-3.3	3
Cowl	.0000			7.9	.800	.1077	7.4	.000	.42	.0004	-4.0	3
Boattail	.0000											
Interference	.0011											
Wave	.0020											
External	.0000											
Tanks	.0000											
Bombs	.0000											
Stores	.0000											
Extra	.0000											
Camber	.0000											

Cdmin .0160

Mach = 1.10
Altitude = 30000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0124									
Body	.0027	.0	.000	.0663	.0	.000	.00	.0000	.0	2
Wing	.0051	.6	.100	.0670	1.5	.000	.88	.0001	-.6	2
Strakes	.0002	1.3	.200	.0690	2.9	.000	.88	.0004	-1.3	2
H. Tail	.0009	1.6	.250	.0706	3.5	.000	.88	.0006	-1.6	2
V. Tail	.0004	1.9	.300	.0725	4.1	.000	.88	.0008	-2.0	2
Canard	.0000	2.8	.400	.0805	5.0	.000	.68	.0015	-2.7	2
Pods	.0031	3.9	.500	.0973	5.1	.000	.48	.0015	-3.7	3
Engine	.0000	5.0	.600	.1145	5.2	.000	.45	.0026	-4.7	3
Cowl	.0000	6.2	.700	.1362	5.1	.000	.42	.0042	-5.8	3
Boattail	.0000	7.4	.800	.1626	4.9	.000	.40	.0063	-6.9	3
Interference	.0003									
Wave	.0536									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

				Slope Factors						
				ClAlpha			.1082			
				Cd1^5Alpha			.0420			
				Alpha Transition Zone 2-3			2.415			

Cdmin .0663

Detailed Aerodynamics Output

Mach = 1.30
Altitude = 30000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0118									
Body	.0026	.0	.000	.0686	.0	.000	.00	.0000	.0	6
Wing	.0048	1.3	.100	.0707	1.4	.000	.28	.0001	-1.1	6
Strakes	.0002	2.6	.200	.0772	2.6	.000	.28	.0006	-2.1	6
H. Tail	.0009	3.3	.250	.0820	3.0	.000	.28	.0010	-2.6	6
V. Tail	.0004	3.9	.300	.0879	3.4	.000	.28	.0015	-3.1	6
Canard	.0000	5.2	.400	.1029	3.9	.000	.28	.0029	-4.2	6
Pods	.0030	6.5	.500	.1225	4.1	.000	.28	.0049	-5.3	6
Engine	.0000	7.8	.600	.1469	4.1	.000	.28	.0075	-6.5	6
Cowl	.0000	9.1	.700	.1759	4.0	.000	.27	.0108	-7.7	6
Boattail	.0000	10.4	.800	.2100	3.8	.000	.27	.0150	-9.0	6
Interference	.0003									
Wave	.0565									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

				Slope Factors						
				ClAlpha			.0766			
				Cd1^5Alpha			.0360			
				Alpha Transition Zone 2-3			1.662			

Cdmin .0686

1 SUMMARY --- ACSYNT OUTPUT --- NASA, AMES RESEARCH CENTER

**** GRUMMAN A-6E INTRUDER INPUT FILE

ENGLISH UNITS -
DISTANCES IN FEET
WEIGHTS IN LBS.
FORCES IN LBS.
PRESSURES IN LBS/FT**2

GENERAL		FUSELAGE		WING			HTAIL	VTAIL
WG	77076.	LENGTH	55.4	AREA	637.5	125.2	65.0	
W/S	120.9	DIAMETER	4.8	WETTED AREA	1129.0	178.2	80.4	
T/W	.50	VOLUME	934.1	SPAN	58.2	21.9	8.0	
N(2) ULT	10.0	WETTED AREA	800.2	L.E. SWEEP	29.5	30.7	41.1	
CREW	2.	FINENESS RATIO	11.5	C/4 SWEEP	25.0	25.5	32.0	
PASENGERS	0.			ASPECT RATIO	5.31	3.83	.98	
				TAPER RATIO	.31	.38	.35	
				T/C ROOT	.05	.08	.10	
				T/C TIP	.06	.07	.05	
ENGINE		WEIGHTS		ROOT CHORD	16.7	8.3	12.1	
NUMBER	4.	W	WG	TIP CHORD	5.2	3.2	4.2	
LENGTH	15.2	STRUCT.	16207.	M.A. CHORD	12.0	6.1	8.8	
DIAM.	3.8	PROPUL.	13870.	LOC. OF L.E.	12.9	45.7	42.7	
WEIGHT	3790.0	FIX. EQ.	5500.					
TSLS	9423.	FUEL	31650.					
SFCSLS	.71	PAYLOAD	9950.					


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WFEXT      =      0.000, WFTRAP      =      100.000, WFUEL      =      25000.000,
XDESC      =      30.000, IBREG      =      0, IPLOT      =      2,
IPSIZE     =      -2, IPRINT      =      0, IPSTO1     =      5,
IPSTO2     =      1, KERROR      =      0, MMPROP      =      1,
NCRUSE     =      1, NLEGCL      =      0, NLEGLO      =      0,
NLEGCR     =      0, NMISS      =      1, LENVEL      =      .FALSE.,
SEND

      6      0.0E+00
PHASE      MACH NO. ALTITUDE HORIZONTAL NO. VIND
START END START END DIST TIME TURN 'G'S WKFUEL M IP IX W B A P
-----
CLIMB      0.00 0.00      0 8000      0.0 0.0      0.0 0.0      1.0000 0 2 -1 0 0 0 0
CLIMB      0.00 0.00     -1 28000      0.0 0.0      0.0 0.0      1.0000 0 3 -1 0 0 0 0
CRUISE     -1 0.75     -1 35000 1000.0 0.0      0.0 0.0      1.0000 0 4 0 0 0 0 0
COMBAT     0.75 0.75 15000 15000      0.0 3.0      0.0 0.0      1.0000 0 2 -1 1 0 0 0
CLIMB     -1 0.00     -1 30000      0.0 0.0      0.0 0.0      1.0000 0 3 -1 0 0 0 0
CRUISE     -1 0.75     -1 35000 1000.0 0.0      0.0 0.0      1.0000 0 4 0 0 0 0 0
**** A-6E AERODYNAMICS DATA ***
$ACHAR
ABOSB      =      0.150, ALMAX      =      30.000, AMC      =      40.000,
BDNOSE     =      4.820, BTEF      =      0.000, SFWF      =      1.000,
SMNSWP (1) =      0.700, SMNSWP (2) =      0.800, SMNSWP (3) =      0.900,
SMNSWP (4) =      1.100, SMNSWP (5) =      1.300, SMNSWP (6) =      1.300,
XCDW       =      0.600, ALELJ     =      3, ISMNRD      =      0,
ISUPCR     =      0, ITRAP      =      0, IXCD      =      1,
SEND
$AMULT
CSF         =      1.000, ESSF      =      1.000, FCDF      =      1.417,
FCDW       =      1.667, FCDRA (1) =      1.064, FCDRA (2) =      1.081,
FCDRA (3)  =      1.995, FCDRA (4) =      0.996, FCDRA (5) =      1.027,
SEND
$ATRIM
ITRIM (1)  =      1, ITRIM (2)  =      1, ITRIM (3)  =      1,
ITRIM (4)  =      1, ITRIM (5)  =      1,
CFLAP      =      3.500, CGM      =      0.250,
IT         =      0.000, SFLAP     =      60.000, SM      =      0.120,
SPANF      =      25.000, IVCAM     =      1, FVCAM (1) =      1.079,
FVCAM (2)  =      1.041, FVCAM (3) =      0.841, FVCAM (4) =      0.617,
FVCAM (5)  =      0.783, FVCAM (6) =      0.783, FVCAM (7) =      .7800,
FLDM (1)   =      0.320, FLDM (2)  =      0.810, FLDM (3)  =      1.281,
FLDM (4)   =      1.250, FLDM (5)  =      1.142, FLDM (6)  =      1.000,
SEND
$ADET
IPLOT      =      1, NALF      =      10, NMDTL      =      5,
ICOD       =      7, IALF      =      0, IALP      =      2,
SMN (1)    =      0.700, SMN (2)  =      0.800, SMN (3)  =      0.900,
SMN (4)    =      1.100, SMN (5)  =      1.300, SMN (6)  =      1.300,
ALIN (1)   =      0.000, ALIN (2)  =      1.000,
ALIN (3)   =      2.000, ALIN (4)  =      3.000, ALIN (5)  =      4.000,
ALIN (6)   =      5.000, ALIN (7)  =      6.000, ALIN (8)  =      8.000,
ALIN (9)   =      10.000, ALIN (10) =      12.000, ALTV (1) =      30000.000,
ALTV (2)   =      30000.000, ALTV (3) =      30000.000, ALTV (4) =      30000.000,
ALTV (5)   =      30000.000,
CLINPT (1) =      0.000, CLINPT (2) =      0.100, CLINPT (3) =      0.200,
CLINPT (4) =      0.250, CLINPT (5) =      0.300, CLINPT (6) =      0.400,
CLINPT (7) =      0.500, CLINPT (8) =      0.600, CLINPT (9) =      0.700,
CLINPT (10) =      0.800, ITB (1)  =      1, ITB (2)  =      1,
ITB (3)    =      1, ITB (4)    =      1, ITB (5)    =      1,
ITB (6)    =      1, ITB (7)    =      1, ITB (8)    =      1,
ITB (9)    =      1, ITB (10)   =      1, ITS (1)    =      1,
ITS (2)    =      1, ITS (3)    =      1, ITS (4)    =      1,

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ITS (5)      =      1, ITS (6)      =      1, ITS (7)      =      1,
ITS (8)      =      1, ITS (9)      =      1, ITS (10)     =      1,
ISTRS (1)    =      1, ISTRS (2)    =      1, ISTRS (3)    =      1,
ISTRS (4)    =      1, ISTRS (5)    =      1, ISTRS (6)    =      1,
ISTRS (7)    =      1, ISTRS (8)    =      1, ISTRS (9)    =      1,
ISTRS (10)   =      1,
$END
$ADRAG
ICDO         =      0,
$END
$ATAKE
CLLAND       =     -1.000, CLTO       =     -1.000, DELFLD     =     35.000,
DELFTO       =     30.000, DELLED     =     25.000, DELLTO     =     20.000,
LDLAND       =     -1.000, LDTO       =     -1.000,
$END
$APRINT
ECHOIN       =      0, KERROR       =      2,
$END
**** A-6E INTRUDER PROPULSION - TWO P&W J52-P8A (9300 LB ST)
2
$LEWIS
YREN         =     70.000, TWOAB      =    9300.000, EB1        =      0.950,
P11P1        =      4.300, R32        =      0.960, SCPR        =      1.210,
T3           =    2115.000, MACH1      =      1.500, AM          =      0.800,
SFSFC1       =      0.680, ALTD (1)   =      0.000, ALTD (2)   =    5000.000,
ALTD (3)     =   10000.000, ALTD (4)   =   20000.000, ALTD (5)   =   30000.000,
ALTD (6)     =   45000.000, XMACH (1)  =      0.000, XMACH (2)  =      0.500,
XMACH (3)    =      0.600, XMACH (4)  =      0.700, XMACH (5)  =      0.800,
XMACH (6)    =      0.900, XMDES      =      0.820, EN          =      2,
KODE         =      0, KT5           =      0, KT7           =      0,
NEWINL       =      1,
$END
$INLET
LM           =      9.525, YCOYM       =      0.750, SFWAVP     =      0.000,
SFPRFP       =      0.000, ETA        =     11.000, INTYPE      =      2,
NINL         =      2,
$END

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**** GRUMMAN A-6E INTRUDER matched output file

Mach = .70
Altitude = 30000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0186	.0	.000	.0203	.0	.000	.00	.0000	.0	2
Body	.0044	.0	.000	.0203	.0	.000	.00	.0000	.0	2
Wing	.0082	.9	.100	.0209	4.8	.000	.93	.0000	-.4	2
Strakes	.0004	1.8	.200	.0228	8.8	.000	.96	.0002	-.7	2
H. Tail	.0015	2.3	.250	.0241	10.4	.000	.97	.0003	-.9	2
V. Tail	.0006	2.8	.300	.0257	11.7	.000	.99	.0004	-1.1	2
Canard	.0000	3.7	.400	.0296	13.5	.000	1.03	.0008	-1.5	2
Pods	.0036	4.8	.500	.0404	12.4	.000	.75	.0013	-1.9	2
Engine	.0000	5.9	.600	.0577	10.4	.000	.58	-.0004	-2.4	3
Cowl	.0000	7.1	.700	.0716	9.8	.000	.57	-.0004	-3.0	3
Boattail	.0000	8.4	.800	.0871	9.2	.000	.57	-.0003	-3.6	3
Interference	.0014									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Slope Factors
ClAlpha .0957
Cdl^5Alpha .0309
Alpha Transition Zone 2-3 4.456

Cdmin .0203

Mach = .80
Altitude = 30000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0186	.0	.000	.0200	.0	.000	.00	.0000	.0	2
Body	.0044	.0	.000	.0200	.0	.000	.00	.0000	.0	2
Wing	.0082	.9	.100	.0207	4.8	.000	.93	.0001	-.4	2
Strakes	.0004	1.7	.200	.0225	8.9	.000	.95	.0002	-.7	2
H. Tail	.0015	2.1	.250	.0239	10.5	.000	.96	.0003	-.9	2
V. Tail	.0006	2.6	.300	.0256	11.7	.000	.97	.0005	-1.1	2
Canard	.0000	3.5	.400	.0297	13.5	.000	.99	.0008	-1.5	2
Pods	.0036	4.4	.500	.0437	11.5	.000	.63	-.0002	-2.0	3
Engine	.0000	5.7	.600	.0594	10.1	.000	.55	-.0002	-2.6	3
Cowl	.0000	6.9	.700	.0748	9.4	.000	.54	-.0002	-3.2	3
Boattail	.0000	8.1	.800	.0924	8.7	.000	.53	.0000	-3.8	3
Interference	.0014									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Slope Factors
ClAlpha .0988
Cdl^5Alpha .0332
Alpha Transition Zone 2-3 3.806

Cdmin .0200

Detailed Aerodynamics Output

Mach = .90
Altitude = 30000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0338	.0	.000	.0426	.0	.000	.00	.0000	.0	2
Body	.0079	.0	.000	.0426	.0	.000	.00	.0000	.0	2
Wing	.0149	.8	.100	.0433	2.3	.000	.87	.0001	-.4	2
Strakes	.0007	1.6	.200	.0455	4.4	.000	.82	.0002	-.8	2
H. Tail	.0027	2.0	.250	.0473	5.3	.000	.80	.0003	-1.0	2
V. Tail	.0011	2.4	.300	.0495	6.1	.000	.78	.0005	-1.2	2
Canard	.0000	3.4	.400	.0585	6.8	.000	.61	.0010	-1.7	2
Pods	.0065	4.5	.500	.0822	6.1	.000	.38	-.0001	-2.2	3
Engine	.0000	5.9	.600	.1095	5.5	.000	.32	.0000	-2.9	3
Cowl	.0000	7.3	.700	.1488	4.7	.000	.28	.0003	-3.7	3
Boattail	.0000	8.9	.800	.2044	3.9	.000	.24	.0009	-4.7	3
Interference	.0021									
Wave	.0034									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Slope Factors
ClAlpha .0894
Cdl^5Alpha .0449
Alpha Transition Zone 2-3 3.274

Cdmin .0426

Mach = 1.10
Altitude = 30000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0162	.0	.000	.1055	.0	.000	.00	.0000	.0	2
Body	.0038	.6	.100	.1062	.9	.000	.83	.0001	-.7	2
Wing	.0071	1.3	.200	.1086	1.8	.000	.78	.0004	-1.3	2
Strakes	.0003	1.7	.250	.1104	2.3	.000	.76	.0006	-1.7	2
H. Tail	.0013	2.0	.300	.1128	2.7	.000	.74	.0009	-2.1	2
V. Tail	.0005	2.9	.400	.1250	3.2	.000	.49	.0009	-2.9	3
Canard	.0000	4.6	.500	.1548	3.2	.000	.30	.0022	-4.4	3
Pods	.0031	6.4	.600	.1972	3.0	.000	.24	.0045	-6.0	3
Engine	.0000	8.6	.700	.2737	2.6	.000	.17	.0091	-8.2	3
Cowl	.0000	12.2	.800	.4562	1.8	.000	.11	.0215	-12.0	3
Boattail	.0000									
Interference	.0003									
Wave	.0894									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha .0655						
				Cdl^5Alpha .0485						
				Alpha Transition Zone 2-3 2.415						
Cdmin .1055										

Detailed Aerodynamics Output

Mach = 1.30
Altitude = 30000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0159	.0	.000	.1100	.0	.000	.00	.0000	.0	6
Body	.0037	1.3	.100	.1122	.9	.000	.28	.0001	-1.1	6
Wing	.0070	2.7	.200	.1189	1.7	.000	.27	.0007	-2.1	6
Strakes	.0003	3.3	.250	.1240	2.0	.000	.27	.0011	-2.7	6
H. Tail	.0013	4.0	.300	.1305	2.3	.000	.26	.0016	-3.2	6
V. Tail	.0005	5.4	.400	.1473	2.7	.000	.26	.0032	-4.4	6
Canard	.0000	6.8	.500	.1697	2.9	.000	.25	.0055	-5.6	6
Pods	.0030	8.3	.600	.1987	3.0	.000	.24	.0086	-6.9	6
Engine	.0000	9.8	.700	.2349	3.0	.000	.24	.0129	-8.4	6
Cowl	.0000	11.4	.800	.2799	2.9	.000	.23	.0188	-10.0	6
Boattail	.0000									
Interference	.0003									
Wave	.0942									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha .0699						
				Cdl^5Alpha .0360						
				Alpha Transition Zone 2-3 1.662						
Cdmin .1100										

SUMMARY --- ACSYNT OUTPUT --- NASA, AMES RESEARCH CENTER

**** GRUMMAN A-6E INTRUDER INPUT FILE

ENGLISH UNITS -
DISTANCES IN FEET
WEIGHTS IN LBS.
FORCES IN LBS.
PRESSURES IN LBS/FT**2

GENERAL		FUSELAGE		WING		HTAIL	VTAIL
WG	98290.	LENGTH	55.4	AREA	637.5	125.2	65.0
W/S	154.2	DIAMETER	4.8	WETTED AREA	1129.0	178.2	80.4
T/W	.50	VOLUME	934.1	SPAN	58.2	21.9	8.0
N(2) ULT	10.0	WETTED AREA	800.2	L.E. SWEEP	29.5	30.7	41.1
CREW	2.	FINENESS RATIO	11.5	C/4 SWEEP	25.0	25.5	32.0
PASENGERS	0.			ASPECT RATIO	5.31	3.83	.98
				TAPER RATIO	.31	.38	.35
				T/C ROOT	.05	.08	.10
				T/C TIP	.06	.07	.05
ENGINE		WEIGHTS		ROOT CHORD	16.7	8.3	12.1
NUMBER	6.	W	WG	TIP CHORD	5.2	3.2	4.2
LENGTH	15.2	STRUCT.	17230.	M.A. CHORD	12.0	6.1	8.8
DIAM.	3.8	PROPUL.	20804.	LOC. OF L.E.	12.9	45.7	42.7
WEIGHT	3790.0	FIX. EQ.	5500.				
TSLs	9423.	FUEL	44906.				
SFCSLS	.71	PAYLOAD	9950.				


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LENVEL      =.FALSE.,
$END

      7      0.0E+00
      MACH NO.      ALTITUDE      HORIZONTAL      NO.      VIND
PHASE      START END      START END      DIST TIME      TURN 'G'S      WKFUEL M IP IX W B A P
-----
CLIMB      0.00 0.70      0 5000      0.0 0.0      0.0 0.0      1.0000 1 2 -1 0 0 0 0
CLIMB      0.00 0.70      5000 10000      0.0 0.0      0.0 0.0      1.0000 1 2 -1 0 0 0 0
CLIMB      0.00 0.70      10000 20000      0.0 0.0      0.0 0.0      1.0000 1 2 -1 0 0 0 0
CRUISE      0.30 0.40      20000 20000      4300.0 0.0      0.0 0.0      1.0000 1 4 1 0 0 0 0
CLIMB      0.40 0.50      20000 30000      0.0 0.0      0.0 0.0      1.0000 1 2 -1 0 0 0 0
CLIMB      0.50 0.70      30000 40000      0.0 0.0      0.0 0.0      1.0000 1 2 -1 0 0 0 0
CRUISE      0.70 0.70      40000 40000      3230.0 0.0      0.0 0.0      1.0000 1 4 1 0 0 0 0
**** BzJet AERODYNAMICS ****

$ACHAR
ABOSB      =      0.150, ALMAX      =      25.000, AMC      =      40.000,
BDNOSE      =      5.118, BTEF      =      1.000, MACHN      =      0.700,
RCLMAX      =      1.000, ROC      =      0.020, ROCAN      =      0.000,
SFWF      =      1.000, SMNDR      =      0.900, XCDC      =      0.000,
XCDW      =      0.600, AJCAN      =      0, ALELJ      =      1,
INORM      =      1, ISMNR      =      0, ISUPCR      =      0,
ITRAP      =      0, IXCD      =      1, SMNSWP (1)      =      0.100,
SMNSWP (2)      =      0.200, SMNSWP (3)      =      0.250, SMNSWP (4)      =      0.300,
SMNSWP (5)      =      0.400, SMNSWP (6)      =      0.500, SMNSWP (7)      =      0.550,
SMNSWP (8)      =      0.600, SMNSWP (9)      =      0.650, SMNSWP (10)      =      0.700,
CLO (1)      =      0.000, CLO (2)      =      0.000, CLO (3)      =      0.000,
CLO (4)      =      0.000, CLO (5)      =      0.000, CLO (6)      =      0.000,
CLO (7)      =      0.000, CLO (8)      =      0.000, CLO (9)      =      0.000,
CLO (10)      =      0.000, CLOW (1)      =      0.000, CLOW (2)      =      0.000,
CLOW (3)      =      0.000, CLOW (4)      =      0.000, CLOW (5)      =      0.000,
CLOW (6)      =      0.000, CLOW (7)      =      0.000, CLOW (8)      =      0.000,
CLOW (9)      =      0.000, CLOW (10)      =      0.000, CMO (1)      =      0.000,
CMO (2)      =      0.000, CMO (3)      =      0.000, CMO (4)      =      0.000,
CMO (5)      =      0.000, CMO (6)      =      0.000, CMO (7)      =      0.000,
CMO (8)      =      0.000, CMO (9)      =      0.000, CMO (10)      =      0.000,
$END

$AMULT
CSF      =      1.000,
$END

$ATRIM
CFLAP      =      1.708, CGM      =      0.250, SFLAP      =      32.720,
SM      =      0.000, SPANF      =      29.000, ZCG      =      0.000,
$END

$ADET
IPLOT      =      1, NALF      =      10, NMDTL      =      10,
ICOD      =      1, IALF      =      2, IALP      =      2,
SMN (1)      =      0.100, SMN (2)      =      0.200, SMN (3)      =      0.250,
SMN (4)      =      0.300, SMN (5)      =      0.400, SMN (6)      =      0.500,
SMN (7)      =      0.550, SMN (8)      =      0.600, SMN (9)      =      0.650,
SMN (10)      =      0.700, ALIN (1)      =      0.000, ALIN (2)      =      1.000,
ALIN (3)      =      2.000, ALIN (4)      =      3.000, ALIN (5)      =      4.000,
ALIN (6)      =      5.000, ALIN (7)      =      6.000, ALIN (8)      =      7.000,
ALIN (9)      =      8.000, ALIN (10)      =      10.000, ALTV (1)      =      5000.000,
ALTV (2)      =      10000.000, ALTV (3)      =      12000.000, ALTV (4)      =      15000.000,
ALTV (5)      =      20000.000, ALTV (6)      =      25000.000, ALTV (7)      =      28000.000,
ALTV (8)      =      30000.000, ALTV (9)      =      35000.000, ALTV (10)      =      40000.000,
ITB (1)      =      0, ITB (2)      =      0, ITB (3)      =      0,
ITB (4)      =      0, ITB (5)      =      0, ITB (6)      =      0,
ITB (7)      =      0, ITB (8)      =      0, ITB (9)      =      0,
ITB (10)      =      0, ITS (1)      =      0, ITS (2)      =      0,
ITS (3)      =      0, ITS (4)      =      0, ITS (5)      =      0,

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ITS (6)      =      0, ITS (7)      =      0, ITS (8)      =      0,
ITS (9)      =      0, ITS (10)     =      0, ISTRS (1)     =      1,
ISTRS (2)    =      1, ISTRS (3)    =      1, ISTRS (4)     =      1,
ISTRS (5)    =      1, ISTRS (6)    =      1, ISTRS (7)     =      1,
ISTRS (8)    =      1, ISTRS (9)    =      1, ISTRS (10)    =      1,
$END
$ADRAG
ICDO         =      0, SMNCDO (1)    =      0.100, SMNCDO (2)    =      0.200,
SMNCDO (3)   =      0.250, SMNCDO (4) =      0.300, SMNCDO (5)    =      0.400,
SMNCDO (6)   =      0.500, SMNCDO (7) =      0.550, SMNCDO (8)    =      0.600,
SMNCDO (9)   =      0.650, SMNCDO (10) =      0.700, CDONPT (1)    =      0.000,
CDONPT (2)   =      0.000, CDONPT (3) =      0.000, CDONPT (4)    =      0.000,
CDONPT (5)   =      0.000, CDONPT (6) =      0.000, CDONPT (7)    =      0.000,
CDONPT (8)   =      0.000, CDONPT (9) =      0.000, CDONPT (10)   =      0.000,
$END
$ATAKE
DELFLD      =      45.000, DELFTO    =      15.000, DELLED     =      0.000,
DELLTO      =      0.000,
$END
$APRINT
ECHOIN      =      1, ECHOUT       =      0, INTM          =      0,
IPBLNT      =      0, IPCAN        =      0, IPENG          =      0,
IPEXT       =      0, IPFLAP      =      0, IPFRIC         =      0,
IPINTF      =      0, IPLIFT      =      0, IPMIN          =      0,
IPWAVE      =      0, KERROR       =      0,
$END
**** CYCLE ANALYSIS ****
1
$LEWIS
AENDIA      =      2.126, AENLE      =      7.594, AENWT       =      513.000,
BA          =      4.500, HVF        =      22000.000, RDIAM      =      1.740,
RLENG       =      1.000, SODG       =      3.935, YREN        =      68.000,
TWOAB       =      2200.000, TWTO     =      0.500, PRFD        =      1.000,
P11P1       =      1.000, P2P1      =      7.000, SCPR         =      1.270,
T3          =      2160.000, R10A     =      -1.000, MACH1       =      0.900,
SFINSF      =      1.000, SFSFC1    =      0.450, ALTD (1)     =      0.000,
ALTD (2)    =      5000.000, ALTD (3) =      10000.000, ALTD (4)    =      20000.000,
ALTD (5)    =      30000.000, ALTD (6) =      40000.000, XMACH (1)   =      0.100,
XMACH (2)   =      0.300, XMACH (3) =      0.400, XMACH (4)    =      0.500,
XMACH (5)   =      0.600, XMACH (6) =      0.700, XMDES       =      0.700,
EN          =      2, IPR          =      3, KT5           =      0,
KT7         =      0, NOZZ         =      0, IPRINT        =      0,
NAB         =      6,
$END
FIGHTER
**** WEIGHTS ****
$OPTS
WGTO        =      11500.000, KBODY   =      1,
$END
$FIXW
$END

```

***** Business Jet unmatched output*****

Mach = .10
Altitude = 5000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0176	Alpha	Cl							
Body	.0058	.0	.000	.0206	.0	.000	.00	.0000	.0	1
Wing	.0070	1.1	.102	.0213	4.8	.000	.59	-.0001	-.6	1
Strakes	.0000	2.2	.203	.0239	8.5	.000	.51	-.0002	-1.2	1
H. Tail	.0022	3.4	.304	.0286	10.6	.000	.47	-.0004	-1.8	1
V. Tail	.0012	4.5	.404	.0357	11.3	.000	.44	-.0006	-2.4	1
Canard	.0000	5.6	.502	.0454	11.0	.000	.41	-.0008	-3.0	1
Pods	.0014	6.7	.598	.0578	10.3	.000	.39	-.0008	-3.6	1
Engine	.0000	7.9	.692	.0730	9.5	.000	.37	-.0008	-4.2	1
Cowl	.0000	9.0	.784	.0910	8.6	.000	.35	-.0007	-4.8	1
Boattail	.0000	11.3	.962	.1360	7.1	.000	.32	.0001	-6.1	1
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha .0849						
				Cdl^5Alpha .0300						
				Alpha Transition Zone 2-3 .000						
Cdmin .0206										

Mach = .20
Altitude = 10000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0168	Alpha	Cl							
Body	.0056	.0	.000	.0199	.0	.000	.00	.0000	.0	3
Wing	.0067	1.1	.097	.0206	4.7	.000	.54	-.0001	-.7	3
Strakes	.0000	2.3	.192	.0230	8.3	.000	.47	-.0002	-1.3	3
H. Tail	.0021	3.4	.285	.0275	10.4	.000	.43	-.0003	-1.9	3
V. Tail	.0012	4.5	.376	.0342	11.0	.000	.40	-.0005	-2.5	3
Canard	.0000	5.7	.465	.0433	10.7	.000	.37	-.0006	-3.1	3
Pods	.0013	6.8	.551	.0547	10.1	.000	.35	-.0006	-3.7	3
Engine	.0000	8.0	.635	.0687	9.3	.000	.34	-.0005	-4.3	3
Cowl	.0000	9.1	.717	.0851	8.4	.000	.32	-.0004	-4.9	3
Boattail	.0000	11.5	.871	.1254	6.9	.000	.29	.0004	-6.0	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha .0759						
				Cdl^5Alpha .0283						
				Alpha Transition Zone 2-3 .000						
Cdmin .0199										

Detailed Aerodynamics Output

Mach = .25
Altitude = 12000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0168	Alpha	Cl							
Body	.0056	.0	.000	.0198	.0	.000	.00	.0000	.0	3
Wing	.0067	1.1	.098	.0205	4.8	.000	.54	-.0001	-.7	3
Strakes	.0000	2.3	.194	.0231	8.4	.000	.47	-.0002	-1.3	3
H. Tail	.0021	3.4	.288	.0277	10.4	.000	.42	-.0003	-2.0	3
V. Tail	.0012	4.6	.380	.0347	11.0	.000	.39	-.0004	-2.6	3
Canard	.0000	5.7	.470	.0440	10.7	.000	.37	-.0005	-3.2	3
Pods	.0013	6.8	.557	.0558	10.0	.000	.35	-.0004	-3.8	3
Engine	.0000	8.0	.642	.0702	9.2	.000	.33	-.0003	-4.4	3
Cowl	.0000	9.1	.724	.0870	8.3	.000	.32	-.0001	-5.0	3
Boattail	.0000	11.5	.880	.1284	6.9	.000	.29	.0009	-6.1	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha .0767						
				Cdl^5Alpha .0287						
				Alpha Transition Zone 2-3 .000						
Cdmin .0198										

Mach = .30
Altitude = 15000.

Parasite Drag		Induced Drag								
Friction	.0167	Alpha	C1	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Body	.0055	.0	.000	.0198	.0	.000	.00	.0000	.0	3
Wing	.0067	1.1	.099	.0205	4.8	.000	.53	-.0001	-.7	3
Strakes	.0000	2.3	.196	.0232	8.5	.000	.46	-.0002	-1.3	3
H. Tail	.0021	3.4	.291	.0280	10.4	.000	.42	-.0003	-2.0	3
V. Tail	.0011	4.6	.385	.0352	10.9	.000	.39	-.0003	-2.6	3
Canard	.0000	5.7	.475	.0448	10.6	.000	.37	-.0003	-3.2	3
Pods	.0013	6.8	.564	.0570	9.9	.000	.35	-.0003	-3.9	3
Engine	.0000	8.0	.650	.0718	9.1	.000	.33	-.0001	-4.5	3
Cowl	.0000	9.1	.733	.0892	8.2	.000	.31	.0002	-5.1	3
Boattail	.0000	11.5	.891	.1317	6.8	.000	.29	.0014	-6.3	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Cdmin = .0198

Detailed Aerodynamics Output

Mach = .40
Altitude = 20000.

Parasite Drag		Induced Drag								
Friction	.0166	Alpha	C1	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Body	.0055	.0	.000	.0196	.0	.000	.00	.0000	.0	3
Wing	.0066	1.1	.102	.0205	5.0	.000	.51	.0000	-.7	3
Strakes	.0000	2.3	.202	.0233	8.6	.000	.45	-.0001	-1.4	3
H. Tail	.0021	3.4	.299	.0285	10.5	.000	.41	-.0002	-2.1	3
V. Tail	.0011	4.6	.395	.0363	10.9	.000	.38	-.0002	-2.7	3
Canard	.0000	5.7	.488	.0466	10.5	.000	.36	-.0001	-3.4	3
Pods	.0013	6.9	.579	.0597	9.7	.000	.34	.0001	-4.0	3
Engine	.0000	8.0	.667	.0755	8.8	.000	.32	.0005	-4.6	3
Cowl	.0000	9.2	.753	.0940	8.0	.000	.31	.0009	-5.3	3
Boattail	.0000	11.5	.915	.1392	6.6	.000	.28	.0024	-6.5	3
Interference	.0030									
Wave	.0000									
External	.0000			Slope Factors						
Tanks	.0000			C1Alpha						
Bombs	.0000			Cd1^5Alpha						
Stores	.0000			Alpha Transition Zone 2-3						
Extra	.0000								.000	
Camber	.0000									

Cdmin = .0196

Mach = .50
Altitude = 25000.

Parasite Drag		Induced Drag									
Friction	.0164	Alpha	C1	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone	
Body	.0054	.0	.000	.0195	.0	.000	.00	.0000	.0	3	
Wing	.0065	1.1	.105	.0204	5.2	.000	.50	.0000	-.7	3	
Strakes	.0000	2.3	.208	.0235	8.9	.000	.44	-.0001	-1.5	3	
H. Tail	.0020	3.4	.309	.0292	10.6	.000	.40	.0000	-2.2	3	
V. Tail	.0011	4.6	.408	.0376	10.9	.000	.37	.0001	-2.9	3	
Canard	.0000	5.7	.504	.0488	10.3	.000	.35	.0003	-3.5	3	
Pods	.0013	6.9	.598	.0628	9.5	.000	.33	.0006	-4.2	3	
Engine	.0000	8.0	.689	.0798	8.6	.000	.32	.0011	-4.8	3	
Cowl	.0000	9.2	.777	.0996	7.8	.000	.31	.0018	-5.5	3	
Boattail	.0000	11.5	.944	.1479	6.4	.000	.28	.0037	-6.8	3	
Interference	.0030										
Wave	.0000										
External	.0000										
Tanks	.0000										
Bombs	.0000										
Stores	.0000										
Extra	.0000										
Camber	.0000										
				Slope Factors							
				C1Alpha					.0819		
				Cd1^5Alpha					.0311		
				Alpha Transition Zone 2-3					.000		

Cdmin = .0195

Detailed Aerodynamics Output

Mach = .55
Altitude = 28000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0163	Alpha	C1							
Body	.0054	.0	.000	.0194	.0	.000	.00	.0000	.0	3
Wing	.0065	1.1	.107	.0203	5.3	.000	.49	.0000	-.8	3
Strakes	.0000	2.3	.212	.0236	9.0	.000	.43	.0000	-1.5	3
H. Tail	.0020	3.4	.315	.0295	10.6	.000	.39	.0000	-2.2	3
V. Tail	.0011	4.6	.415	.0383	10.8	.000	.37	.0002	-2.9	3
Canard	.0000	5.7	.513	.0500	10.3	.000	.35	.0005	-3.6	3
Pods	.0013	6.9	.608	.0646	9.4	.000	.33	.0009	-4.3	3
Engine	.0000	8.0	.701	.0822	8.5	.000	.32	.0015	-5.0	3
Cowl	.0000	9.2	.790	.1028	7.7	.000	.30	.0023	-5.6	3
Boattail	.0000	11.5	.960	.1528	6.3	.000	.28	.0045	-7.0	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Cdmin .0194

Mach = .60
Altitude = 30000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0162	Alpha	C1							
Body	.0054	.0	.000	.0193	.0	.000	.00	.0000	.0	3
Wing	.0065	1.1	.109	.0203	5.4	.000	.48	.0000	-.8	3
Strakes	.0000	2.3	.216	.0237	9.1	.000	.42	.0000	-1.5	3
H. Tail	.0020	3.4	.321	.0299	10.7	.000	.39	.0001	-2.3	3
V. Tail	.0011	4.6	.423	.0391	10.8	.000	.37	.0003	-3.0	3
Canard	.0000	5.7	.523	.0513	10.2	.000	.35	.0007	-3.7	3
Pods	.0013	6.9	.620	.0665	9.3	.000	.33	.0012	-4.4	3
Engine	.0000	8.0	.714	.0849	8.4	.000	.32	.0019	-5.1	3
Cowl	.0000	9.2	.805	.1063	7.6	.000	.30	.0028	-5.8	3
Boattail	.0000	11.6	.978	.1582	6.2	.000	.28	.0053	-7.1	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Cdmin .0193

Detailed Aerodynamics Output

Mach = .65
Altitude = 35000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0161	Alpha	C1							
Body	.0053	.0	.000	.0192	.0	.000	.00	.0000	.0	3
Wing	.0064	1.1	.111	.0202	5.5	.000	.47	.0000	-.8	3
Strakes	.0000	2.3	.220	.0239	9.2	.000	.42	.0000	-1.6	3
H. Tail	.0020	3.4	.327	.0304	10.8	.000	.39	.0002	-2.3	3
V. Tail	.0011	4.6	.431	.0400	10.8	.000	.36	.0005	-3.1	3
Canard	.0000	5.7	.533	.0527	10.1	.000	.34	.0009	-3.8	3
Pods	.0013	6.9	.632	.0687	9.2	.000	.33	.0015	-4.5	3
Engine	.0000	8.0	.728	.0878	8.3	.000	.31	.0023	-5.2	3
Cowl	.0000	9.2	.821	.1101	7.5	.000	.30	.0034	-5.9	3
Boattail	.0000	11.6	.998	.1640	6.1	.000	.28	.0062	-7.3	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									

Cdmin .0192

Parasite Drag	Induced Drag		Slope Factors						
	Alpha	C _l	C _d	L/D	C _m	e	C _{dtrim}	Deltrim	Zone
Friction	.0160								3
Body	.0053	.0	.0000	.0190	.0	.0000	.0000	.0	3
Wing	.0064	1.1	.114	.0202	5.6	.000	.47	.0000	-8
Strakes	.0000	2.3	.225	.0240	9.4	.000	.41	.0001	-1.6
H. Tail	.0020	3.4	.334	.0309	10.8	.000	.38	.0003	-2.4
V. Tail	.0011	4.6	.441	.0410	10.8	.000	.36	.0006	-3.2
Canard	.0000	5.7	.545	.0543	10.0	.000	.34	.0012	-3.9
Pods	.0013	6.9	.646	.0710	9.1	.000	.33	.0019	-4.6
Engine	.0000	8.0	.744	.0909	8.2	.000	.31	.0028	-5.4
Cowl	.0000	9.2	.839	.1141	7.3	.000	.30	.0040	-6.1
Boattail	.0000	11.6	1.019	.1702	6.0	.000	.28	.0071	-7.5
Interference	.0030								
Wave	.0000								
External	.0000								
Tanks	.0000								
Bombs	.0000								
Stores	.0000								
Extra	.0000								
Camber	.0000								
C _{dmin}	.0190								

***** Business Jet *****

ENGLISH UNITS -
DISTANCES IN FEET
WEIGHTS IN LBS.
FORCES IN LBS.
PRESSURES IN LBS/FT**2

GENERAL		FUSELAGE		WING	HTAIL	VTAIL	
WG	40870.	LENGTH	42.0	AREA	279.1	69.8	66.8
W/S	146.5	DIAMETER	5.4	WETTED AREA	469.5	140.1	91.2
T/W	.18	VOLUME	715.8	SPAN	46.8	18.6	10.3
N(2) ULT	4.0	WETTED AREA	592.3	L.E. SWEEP	4.9	9.2	33.4
CREW	2.	FINENESS RATIO	7.7	C/4 SWEEP	1.4	5.4	27.5
PASSENGERS	8.			ASPECT RATIO	7.85	4.96	1.59
				TAPER RATIO	.35	.50	.39
				T/C ROOT	.12	.10	.06
				T/C TIP	.10	.08	.06
				ROOT CHORD	8.8	5.0	9.4
				TIP CHORD	3.1	2.5	3.6
				M.A. CHORD	6.4	3.9	6.9
				LOC. OF L.E.	17.5	36.1	31.8
ENGINE		WEIGHTS					
NUMBER	2.	W	WG				
LENGTH	7.6	STRUCT.	5739.	14.0			
DIAM.	1.2	PROPUL.	1404.	3.4			
WEIGHT	513.0	FIX. EQ.	4302.	10.5			
TSLs	2200.	FUEL	29019.	71.0			
SFCSLs	.37	PAYLOAD	480.	1.2			


```

LENVEL      =.FALSE.,
$END

      7      0.0E+00
      MACH NO.  ALTITUDE  HORIZONTAL  NO.  VIND
PHASE  START END  START END  DIST  TIME  TURN  'G'S  WKFUEL M IP IX W B A P
-----
CLIMB  0.00 0.70      0 5000      0.0  0.0      0.0  0.0  1.0000 1 2 -1 0 0 0 0
CLIMB  0.00 0.70    5000 10000      0.0  0.0      0.0  0.0  1.0000 1 2 -1 0 0 0 0
CLIMB  0.00 0.70   10000 20000      0.0  0.0      0.0  0.0  1.0000 1 2 -1 0 0 0 0
CRUISE 0.30 0.40   20000 20000  4300.0  0.0      0.0  0.0  1.0000 1 4  1 0 0 0 0
CLIMB  0.40 0.50   20000 30000      0.0  0.0      0.0  0.0  1.0000 1 2 -1 0 0 0 0
CLIMB  0.50 0.70   30000 40000      0.0  0.0      0.0  0.0  1.0000 1 2 -1 0 0 0 0
CRUISE 0.70 0.70   40000 40000  3230.0  0.0      0.0  0.0  1.0000 1 4  1 0 0 0 0
**** BzJet AERODYNAMICS ****
$SACHAR
ABOSB    =      0.150, ALMAX    =      25.000, AMC      =      40.000,
BDNOSE   =      5.118, BTEF     =      1.000, MACHN     =      0.700,
RCLMAX   =      1.000, ROC      =      0.020, ROCAN     =      0.000,
SFWF     =      1.000, SMNDR    =      0.900, XCDC      =      0.000,
XCDW     =      0.600, AJCAN    =      0, ALELJ       =      1,
INORM    =      1, ISMNR      =      0, ISUPCR      =      0,
ITRAP    =      0, IXCD      =      1, SMNSWP (1) =      0.100,
SMNSWP (2) =      0.200, SMNSWP (3) =      0.250, SMNSWP (4) =      0.300,
SMNSWP (5) =      0.400, SMNSWP (6) =      0.500, SMNSWP (7) =      0.550,
SMNSWP (8) =      0.600, SMNSWP (9) =      0.650, SMNSWP (10) =      0.700,
CLO (1)  =      0.090, CLO (2)  =      0.090, CLO (3)  =      0.000,
CLO (4)  =      0.000, CLO (5)  =      0.000, CLO (6)  =      0.000,
CLO (7)  =      0.000, CLO (8)  =      0.000, CLO (9)  =      0.000,
CLO (10) =      0.000, CLOW (1) =      0.000, CLOW (2) =      0.000,
CLOW (3) =      0.000, CLOW (4) =      0.000, CLOW (5) =      0.000,
CLOW (6) =      0.000, CLOW (7) =      0.000, CLOW (8) =      0.000,
CLOW (9) =      0.000, CLOW (10) =      0.000, CMO (1) =      0.000,
CMO (2)  =      0.000, CMO (3)  =      0.000, CMO (4)  =      0.000,
CMO (5)  =      0.000, CMO (6)  =      0.000, CMO (7)  =      0.000,
CMO (8)  =      0.000, CMO (9)  =      0.000, CMO (10) =      0.000,
$END
$AMULT
CSF      =      1.000, FCDF     =      1.423,
$END
$ATRIM
CFLAP    =      1.708, CGM      =      0.250, SFLAP     =      32.720,
SM        =      0.000, SPANF    =      29.000, ZCG      =      0.000,
FVCAM (1) =      1.000, FVCAM (2) =      1.110, FVCAM (3) =      1.000,
FVCAM (4) =      1.000, FVCAM (5) =      1.000, FVCAM (6) =      1.000,
FVCAM (7) =      1.000, FVCAM (8) =      1.000, FVCAM (9) =      1.000,
FVCAM (10) =      1.000, IVCAM  =      1, FLDM (1) =      1.000,
FLDM (2)  =      0.690, FLDM (3) =      0.700, FLDM (4) =      1.000,
FLDM (5)  =      1.000, FLDM (6) =      1.000, FLDM (7) =      1.000,
FLDM (8)  =      1.000, FLDM (9) =      1.000, FLDM (10) =      1.000,
$END
$ADET
IPLT     =      1, NALF      =      10, NMDTL      =      10,
ICOD     =      1, IALF     =      2, IALP      =      2,
SMN (1)  =      0.100, SMN (2) =      0.200, SMN (3) =      0.250,
SMN (4)  =      0.300, SMN (5) =      0.400, SMN (6) =      0.500,
SMN (7)  =      0.550, SMN (8) =      0.600, SMN (9) =      0.650,
SMN (10) =      0.700, ALIN (1) =      0.000, ALIN (2) =      1.000,
ALIN (3) =      2.000, ALIN (4) =      3.000, ALIN (5) =      4.000,
ALIN (6) =      5.000, ALIN (7) =      6.000, ALIN (8) =      7.000,
ALIN (9) =      8.000, ALIN (10) =      10.000, ALTV (1) =      5000.000,
ALTV (2) =      10000.000, ALTV (3) =      12000.000, ALTV (4) =      15000.000,

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ALTV (5)	=	20000.000,	ALTV (6)	=	25000.000,	ALTV (7)	=	28000.000,
ALTV (8)	=	30000.000,	ALTV (9)	=	35000.000,	ALTV (10)	=	40000.000,
ITB (1)	=	0,	ITB (2)	=	0,	ITB (3)	=	0,
ITB (4)	=	0,	ITB (5)	=	0,	ITB (6)	=	0,
ITB (7)	=	0,	ITB (8)	=	0,	ITB (9)	=	0,
ITB (10)	=	0,	ITS (1)	=	0,	ITS (2)	=	0,
ITS (3)	=	0,	ITS (4)	=	0,	ITS (5)	=	0,
ITS (6)	=	0,	ITS (7)	=	0,	ITS (8)	=	0,
ITS (9)	=	0,	ITS (10)	=	0,	ISTRS (1)	=	1,
ISTRS (2)	=	1,	ISTRS (3)	=	1,	ISTRS (4)	=	1,
ISTRS (5)	=	1,	ISTRS (6)	=	1,	ISTRS (7)	=	1,
ISTRS (8)	=	1,	ISTRS (9)	=	1,	ISTRS (10)	=	1,
SEND								
\$ADRAG								
ICDO	=	0,	SMNCDO (1)	=	0.100,	SMNCDO (2)	=	0.200,
SMNCDO (3)	=	0.250,	SMNCDO (4)	=	0.300,	SMNCDO (5)	=	0.400,
SMNCDO (6)	=	0.500,	SMNCDO (7)	=	0.550,	SMNCDO (8)	=	0.600,
SMNCDO (9)	=	0.650,	SMNCDO (10)	=	0.700,	CDONPT (1)	=	0.000,
CDONPT (2)	=	0.000,	CDONPT (3)	=	0.000,	CDONPT (4)	=	0.000,
CDONPT (5)	=	0.000,	CDONPT (6)	=	0.000,	CDONPT (7)	=	0.000,
CDONPT (8)	=	0.000,	CDONPT (9)	=	0.000,	CDONPT (10)	=	0.000,
SEND								
\$ATAKE								
DELFID	=	45.000,	DELFTO	=	15.000,	DELLED	=	0.000,
DELLTO	=	0.000,						
SEND								
\$APRINT								
ECHOIN	=	1,	ECHOUT	=	0,	INTM	=	0,
IPBLNT	=	0,	IPCAN	=	0,	IPENG	=	0,
IPEXT	=	0,	IPFLAP	=	0,	IPFRIC	=	0,
IPINTF	=	0,	IPLIFT	=	0,	IPMIN	=	0,
IPWAVE	=	0,	KERROR	=	0,			
SEND								
**** CYCLE ANALYSIS ****								
1								
\$LEWIS								
AENDIA	=	2.126,	AENLE	=	7.594,	AENWT	=	513.000,
BA	=	4.500,	HVF	=	22000.000,	RDIAM	=	1.740,
RLENG	=	1.000,	SODG	=	3.935,	YREN	=	68.000,
TWOAB	=	2200.000,	TWTO	=	0.500,	PRFD	=	1.000,
P11P1	=	1.000,	P2P1	=	7.000,	SCPR	=	1.270,
T3	=	2160.000,	R10A	=	-1.000,	MACH1	=	0.900,
SFINSP	=	1.000,	SFSFC1	=	0.450,	ALTD (1)	=	0.000,
ALTD (2)	=	5000.000,	ALTD (3)	=	10000.000,	ALTD (4)	=	20000.000,
ALTD (5)	=	30000.000,	ALTD (6)	=	40000.000,	XMACH (1)	=	0.100,
XMACH (2)	=	0.300,	XMACH (3)	=	0.400,	XMACH (4)	=	0.500,
XMACH (5)	=	0.600,	XMACH (6)	=	0.700,	XMDES	=	0.700,
EN	=	2,	IPR	=	3,	KT5	=	0,
KT7	=	0,	NOZZ	=	0,	IPRINT	=	0,
NAB	=	6,						
SEND								
FIGHTER								
**** WEIGHTS ****								
\$OPTS								
WGTO	=	11500.000,	KBODY	=	1,			
SEND								
\$FIXW								
SEND								

***** Business Jet Matched Output M=.2 *****
Detailed Aerodynamics Output

Mach = .10
Altitude = 5000.

Parasite Drag		Induced Drag							Deltrim	Zone
		Alpha	C1	Cd	L/D	Cm	e	Cdtrim		
Friction	.0244	.0	.090	.0275	3.3	.000	.00	.0000	.0	1
Body	.0082	1.1	.192	.0282	6.8	.000	2.13	-.0001	-.6	1
Wing	.0100	2.2	.295	.0306	9.6	.000	1.12	-.0002	-1.2	1
Strakes	.0000	3.4	.397	.0350	11.4	.000	.85	-.0004	-1.8	1
H. Tail	.0031	4.5	.499	.0414	12.1	.000	.72	-.0006	-2.4	1
V. Tail	.0017	5.6	.600	.0499	12.0	.000	.65	-.0008	-3.0	1
Canard	.0000	6.7	.700	.0604	11.6	.000	.60	-.0008	-3.6	1
Pods	.0014	7.9	.799	.0728	11.0	.000	.57	-.0008	-4.2	1
Engine	.0000	9.0	.896	.0870	10.3	.000	.55	-.0007	-4.8	1
Cowl	.0000	11.3	1.086	.1205	9.0	.000	.51	.0001	-6.1	1
Boattail	.0000									
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin		.0275								

Slope Factors
ClAlpha .0879
Cdl*.5Alpha .0269
Alpha Transition Zone 2-3 .000

Mach = .20
Altitude = 10000.

Parasite Drag		Induced Drag							Deltrim	Zone
		Alpha	C1	Cd	L/D	Cm	e	Cdtrim		
Friction	.0234	.0	.090	.0264	3.4	.000	.00	.0000	.0	3
Body	.0079	1.1	.188	.0271	6.9	.000	2.13	-.0001	-.7	3
Wing	.0095	2.3	.285	.0293	9.7	.000	1.14	-.0002	-1.3	3
Strakes	.0000	3.4	.382	.0332	11.5	.000	.88	-.0003	-1.9	3
H. Tail	.0030	4.5	.478	.0385	12.4	.000	.77	-.0005	-2.5	3
V. Tail	.0016	5.7	.574	.0452	12.7	.000	.71	-.0006	-3.1	3
Canard	.0000	6.8	.668	.0530	12.6	.000	.68	-.0006	-3.7	3
Pods	.0013	8.0	.762	.0616	12.4	.000	.67	-.0005	-4.3	3
Engine	.0000	9.1	.854	.0708	12.1	.000	.67	-.0004	-4.9	3
Cowl	.0000	11.5	1.033	.0897	11.5	.000	.68	.0004	-6.0	3
Boattail	.0000									
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin		.0264								

Slope Factors
ClAlpha .0822
Cdl*.5Alpha .0219
Alpha Transition Zone 2-3 .000

Detailed Aerodynamics Output

Mach = .25
Altitude = 12000.

Parasite Drag		Induced Drag							Deltrim	Zone
		Alpha	C1	Cd	L/D	Cm	e	Cdtrim		
Friction	.0233	.0	.000	.0264	.0	.000	.00	.0000	.0	3
Body	.0079	1.1	.098	.0271	3.6	.000	.56	-.0001	-.7	3
Wing	.0095	2.3	.194	.0294	6.6	.000	.51	-.0002	-1.3	3
Strakes	.0000	3.4	.288	.0334	8.6	.000	.48	-.0003	-2.0	3
H. Tail	.0030	4.6	.380	.0389	9.8	.000	.47	-.0004	-2.6	3
V. Tail	.0016	5.7	.470	.0459	10.2	.000	.46	-.0005	-3.2	3
Canard	.0000	6.8	.557	.0540	10.3	.000	.46	-.0004	-3.8	3
Pods	.0013	8.0	.642	.0630	10.2	.000	.46	-.0003	-4.4	3
Engine	.0000	9.1	.724	.0727	10.0	.000	.46	-.0001	-5.0	3
Cowl	.0000	11.5	.880	.0926	9.5	.000	.47	.0009	-6.1	3
Boattail	.0000									
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Cdmin		.0264								

Slope Factors
ClAlpha .0767
Cdl*.5Alpha .0224
Alpha Transition Zone 2-3 .000

Mach = .30
Altitude = 15000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0233									
Body	.0079	.0	.000	.0263	.0	.000	.00	.0000	.0	3
Wing	.0095	1.1	.099	.0271	3.7	.000	.53	-.0001	-.7	3
Strakes	.0000	2.3	.196	.0297	6.6	.000	.46	-.0002	-1.3	3
H. Tail	.0030	3.4	.291	.0345	8.4	.000	.42	-.0003	-2.0	3
V. Tail	.0016	4.6	.385	.0417	9.2	.000	.39	-.0003	-2.6	3
Canard	.0000	5.7	.475	.0513	9.3	.000	.37	-.0003	-3.2	3
Pods	.0013	6.8	.564	.0635	8.9	.000	.35	-.0003	-3.9	3
Engine	.0000	8.0	.650	.0783	8.3	.000	.33	-.0001	-4.5	3
Cowl	.0000	9.1	.733	.0957	7.7	.000	.31	.0002	-5.1	3
Boattail	.0000	11.5	.891	.1382	6.4	.000	.29	.0014	-6.3	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha				.0775		
				Cd1^5Alpha				.0291		
				Alpha Transition Zone 2-3				.000		
Cadmin		.0263								

Detailed Aerodynamics Output

Mach = .40
Altitude = 20000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0231									
Body	.0078	.0	.000	.0261	.0	.000	.00	.0000	.0	3
Wing	.0094	1.1	.102	.0269	3.8	.000	.51	.0000	-.7	3
Strakes	.0000	2.3	.202	.0298	6.8	.000	.45	-.0001	-1.4	3
H. Tail	.0029	3.4	.299	.0350	8.6	.000	.41	-.0002	-2.1	3
V. Tail	.0016	4.6	.395	.0427	9.2	.000	.38	-.0002	-2.7	3
Canard	.0000	5.7	.488	.0531	9.2	.000	.36	-.0001	-3.4	3
Pods	.0013	6.9	.579	.0662	8.8	.000	.34	.0001	-4.0	3
Engine	.0000	8.0	.667	.0819	8.1	.000	.32	.0005	-4.6	3
Cowl	.0000	9.2	.753	.1005	7.5	.000	.31	.0009	-5.3	3
Boattail	.0000	11.5	.915	.1457	6.3	.000	.28	.0024	-6.5	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha				.0795		
				Cd1^5Alpha				.0300		
				Alpha Transition Zone 2-3				.000		
Cadmin		.0261								

Mach = .50
Altitude = 25000.

Parasite Drag		Induced Drag								
		Alpha	Cl	Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
Friction	.0229									
Body	.0077	.0	.000	.0259	.0	.000	.00	.0000	.0	3
Wing	.0093	1.1	.105	.0268	3.9	.000	.50	.0000	-.7	3
Strakes	.0000	2.3	.208	.0299	7.0	.000	.44	-.0001	-1.5	3
H. Tail	.0029	3.4	.309	.0356	8.7	.000	.40	.0000	-2.2	3
V. Tail	.0016	4.6	.408	.0440	9.3	.000	.37	.0001	-2.9	3
Canard	.0000	5.7	.504	.0552	9.1	.000	.35	.0003	-3.5	3
Pods	.0013	6.9	.598	.0692	8.6	.000	.33	.0006	-4.2	3
Engine	.0000	8.0	.689	.0862	8.0	.000	.32	.0011	-4.8	3
Cowl	.0000	9.2	.777	.1060	7.3	.000	.31	.0018	-5.5	3
Boattail	.0000	11.5	.944	.1543	6.1	.000	.28	.0037	-6.8	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
				Slope Factors						
				ClAlpha				.0819		
				Cd1^5Alpha				.0311		
				Alpha Transition Zone 2-3				.000		
Cadmin		.0259								

Detailed Aerodynamics Output

Mach = .55
Altitude = 28000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0227									
Body	.0077	.0	.000	.0257	.0	.000	.00	.0000	.0	3
Wing	.0093	1.1	.107	.0267	4.0	.000	.49	.0000	-.8	3
Strakes	.0000	2.3	.212	.0300	7.1	.000	.43	.0000	-1.5	3
H. Tail	.0029	3.4	.315	.0359	8.8	.000	.39	.0000	-2.2	3
V. Tail	.0016	4.6	.415	.0447	9.3	.000	.37	.0002	-2.9	3
Canard	.0000	5.7	.513	.0563	9.1	.000	.35	.0005	-3.6	3
Pods	.0013	6.9	.608	.0710	8.6	.000	.33	.0009	-4.3	3
Engine	.0000	8.0	.701	.0886	7.9	.000	.32	.0015	-5.0	3
Cowl	.0000	9.2	.790	.1092	7.2	.000	.30	.0023	-5.6	3
Boattail	.0000	11.5	.960	.1592	6.0	.000	.28	.0045	-7.0	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Slope Factors										
									ClAlpha	.0832
									Cdl*.5Alpha	.0317
									Alpha Transition Zone 2-3	.000
Cadmin .0257										

Mach = .60
Altitude = 30000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0226									
Body	.0076	.0	.000	.0256	.0	.000	.00	.0000	.0	3
Wing	.0092	1.1	.109	.0266	4.1	.000	.48	.0000	-.8	3
Strakes	.0000	2.3	.216	.0301	7.2	.000	.42	.0000	-1.5	3
H. Tail	.0029	3.4	.321	.0363	8.8	.000	.39	.0001	-2.3	3
V. Tail	.0016	4.6	.423	.0454	9.3	.000	.37	.0003	-3.0	3
Canard	.0000	5.7	.523	.0576	9.1	.000	.35	.0007	-3.7	3
Pods	.0013	6.9	.620	.0729	8.5	.000	.33	.0012	-4.4	3
Engine	.0000	8.0	.714	.0912	7.8	.000	.32	.0019	-5.1	3
Cowl	.0000	9.2	.805	.1126	7.2	.000	.30	.0028	-5.8	3
Boattail	.0000	11.6	.978	.1645	5.9	.000	.28	.0053	-7.1	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Slope Factors										
									ClAlpha	.0847
									Cdl*.5Alpha	.0323
									Alpha Transition Zone 2-3	.000
Cadmin .0256										

Detailed Aerodynamics Output

Mach = .65
Altitude = 35000.

Parasite Drag		Induced Drag		Cd	L/D	Cm	e	Cdtrim	Deltrim	Zone
		Alpha	Cl							
Friction	.0224									
Body	.0076	.0	.000	.0255	.0	.000	.00	.0000	.0	3
Wing	.0091	1.1	.111	.0265	4.2	.000	.47	.0000	-.8	3
Strakes	.0000	2.3	.220	.0301	7.3	.000	.42	.0000	-1.6	3
H. Tail	.0029	3.4	.327	.0367	8.9	.000	.39	.0002	-2.3	3
V. Tail	.0016	4.6	.431	.0463	9.3	.000	.36	.0005	-3.1	3
Canard	.0000	5.7	.533	.0590	9.0	.000	.34	.0009	-3.8	3
Pods	.0013	6.9	.632	.0749	8.4	.000	.33	.0015	-4.5	3
Engine	.0000	8.0	.728	.0941	7.7	.000	.31	.0023	-5.2	3
Cowl	.0000	9.2	.821	.1163	7.1	.000	.30	.0034	-5.9	3
Boattail	.0000	11.6	.998	.1702	5.9	.000	.28	.0062	-7.3	3
Interference	.0030									
Wave	.0000									
External	.0000									
Tanks	.0000									
Bombs	.0000									
Stores	.0000									
Extra	.0000									
Camber	.0000									
Slope Factors										
									ClAlpha	.0863
									Cdl*.5Alpha	.0329
									Alpha Transition Zone 2-3	.000
Cadmin .0255										

Vita

Thomas K. Arledge was born on September 23, 1967 in Bellefontaine, Ohio. His parents were a big influence on him, early in his academic career. From them, he learned to pay close attention to detail and developed a desire for practical knowledge about how things work. These traits surfaced in high school in the areas of math and science. After graduating as valedictorian from high school, Thomas attended Ohio Northern University in the Mechanical Engineering Department. Still desiring practical experience, he entered the cooperative education program. During his undergraduate years, he developed an interest in fluid mechanics and thermodynamics. So, upon graduating with high distinction from Ohio Northern with a Bachelor of Science in Mechanical Engineering in May of 1991, he entered the Aerospace Engineering program at Virginia Polytechnic Institute and State University to pursue the Master of Science degree. Thomas intends to work in the areas of applied fluid dynamics and propulsion.

A handwritten signature in black ink that reads "Thomas K. Arledge". The script is cursive and fluid, with the first letter of each word being capitalized and prominent.

Thomas K. Arledge