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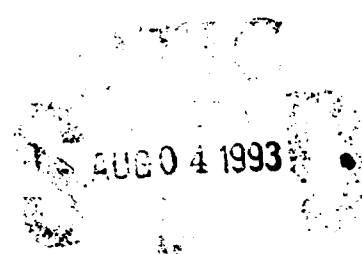
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MISSILE DATCOM

USER'S MANUAL - REVISION 6/93



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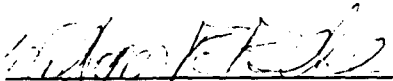
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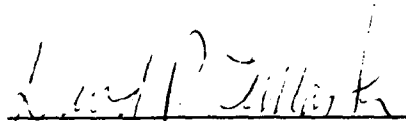
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PREFACE

This report was prepared for the Flight Dynamics Directorate of the Wright Laboratory and the Foreign Aerospace Science and Technology Center, Wright-Patterson AFB, Ohio under Contract F33657-89-D-2198. It documents Missile Datcom Revision 6/93. The work was performed by the McDonnell Douglas Aerospace, St Louis, Missouri, a division of the McDonnell Douglas Corporation. The period of performance was August 1992 to January 1993. Joseph W. Herrmann and William B. Blake served as the Air Force project engineers. This report supersedes WL TR-91-3039, produced under Contract F33615-87-C-3604, which documents Missile Datcom Rev 4/91.

A list of the Missile Datcom principal investigators and individuals who made significant contributions to the development of this program is provided below.

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The Flight Dynamics Directorate is committed to the continuing development of Missile Datcom. The development is dependent to a large extent on users' feedback. Questions about the program or suggestions for future improvements to the program should be directed to Mr. William Blake, WL/FIGC, 2210 Eighth St Ste 21, Wright-Patterson Air Force Base, OH 45433-7531, phone (513) 255-6764.

BACKGROUND TO MISSILE DATCOM

Missile Datcom Revision 6/93 is the sixth in a series of releases.

In the late 1970's, the Tri-Service committee on Missile and Projectile Aerodynamics defined the need for a Missile Datcom type prediction tool. The Air Force was chosen as the lead service for the effort. A contract was subsequently awarded to the McDonnell Douglas Astronautics Company (F33615-80-C-3605) to recommend specific methods for inclusion into a potential computer program and identify areas where further work was needed. The final report from this effort, "Development Feasibility of Missile Datcom," (AFWAL-TR-81-3130) was published in October 1981.

In September 1981, The Missile Datcom Development Contract, (F33615-81-C-3617) was awarded to the McDonnell Douglas Astronautics Company. It subdivided the effort into four distinct phases. The initial release of the program in August 1984 presented the "Phase I" interim capability. Cases run using this version were limited to axisymmetric bodies with no more than eight fins total (two sets with up to four fins each).

The second release of the program (Rev 11/85) represented the "Phase IV" capability. This was the final version generated under contract F33615-81-C-3617. It added capability for elliptic bodies, inlets at supersonic speeds, dynamic derivatives, experimental data substitution, and configuration incrementing. It also increased the permissible number of fins to 32 (4 sets with up to 8 fins each). Two volumes of documentation (User's Manual and Program Implementation Guide), dated November 1985, were printed.

The third release (Rev/ 12/88) coincided with the publishing of AFWAL TR-86-3091. This version expanded the experimental data substitution option and dynamic derivative capability. Error from the 11/85 version were also corrected. Volume I of TR-86-3091 (Final Report) discusses the methods selected for incorporation into Missile Datcom. Volume II (User's Manual) is an updated version of the November 1985 manual. These reports are available from DTIC as ADA-211086 and ADA-210128 respectively.

The fourth release (Rev 7/89) added little new capability; its primary purpose was to correct coding errors, expand the body-alone dynamic derivative capability, and modify the equivalent angle-of-attack formulation. No new documentation was published.

The fifth release (Rev 4/91) followed contracted efforts with Nielsen Engineering and Research (F33615-86-C-3626) and the McDonnell Douglas Missile Systems Company (F33615-87-C-3604). This version expanded the inlet capability to subsonic speeds, added methods for inlet additive drag, base plume effects, and body protuberances.

Many other methods were improved and coding errors were corrected. The User's Manual for the 4/91 revision, WL-TR-91-3039, reflected these changes and is available from DTIC as ADA-237817.

The 6/93 version of the program is the end product an effort to further extend the capability of the code and expand the user's manual. This work was performed by McDonnell Douglas Aerospace under contract F33657-89-D-2198. The major changes to the program and associated reference material are listed below:

- (a) The program was modified to be compatible with Unix based workstations.
- (b) A method for trailing edge flap effectiveness has been added. The method is valid at subsonic (ref. 1) and supersonic (ref. 2) speeds. A cubic fairing between these results is used in the transonic region ($0.8 < \text{Mach} < 1.4$).
- (c) The fin-body carryover interference calculation has been expanded to include the effect of fin dihedral (ref. 3).
- (d) The inlet method has been expanded to treat semi-submerged shapes.
- (e) The base drag calculation for boattails and flares has been modified.
- (f) Coding errors have been corrected.
- (g) The information in the original Program Implementation Guide (printed November 1985) has been updated and included as part of this User's Manual.

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1.0 INTRODUCTION

In missile preliminary design it is necessary to quickly and economically estimate the aerodynamics of a wide variety of missile configuration designs. Since the ultimate shape and aerodynamic performance are so dependent upon the subsystems utilized, such as payload size, propulsion system selection and launch mechanism, the designer must be capable of predicting a wide variety of configurations accurately. The fundamental purpose of Missile Datcom is to provide an aerodynamic design tool which has the predictive accuracy suitable for preliminary design, and the capability for the user to easily substitute methods to fit specific applications.

2.0 PROGRAM CAPABILITIES

The computer code is capable of addressing a wide variety of conventional missile designs. For the purposes of this document, a conventional missile is one which is comprised of the following:

- An axisymmetric or elliptically-shaped body
- One to four fin sets located along the body between the nose and base. Each fin set can be comprised of one to eight identical panels attached around the body at a common longitudinal position
- An airbreathing propulsion system.

To minimize the quantity of input data required, commonly used values for many inputs are assumed as defaults. However, all program defaults can be overridden by the user in order to more accurately model the configuration of interest.

The following paragraphs detail the configurations that can be analyzed. Later paragraphs describe the range of aerodynamic coefficients that can be predicted. Finally, the program constraints are discussed.

2.1 ADDRESSABLE CONFIGURATIONS

The following configurations can be analyzed:

- Circular or elliptically-shaped cross section bodies, with or without airbreathing inlets
- Fin alone (1 to 8 panels attached at the root)
- Body and up to 4 fin sets (1 to 8 panels in each fin set)
- The body and fin set configurations with deflected fins

Certain restrictions exist due to method limitations and are summarized in the following paragraphs.

2.1.1 Axisymmetric or Elliptical Bodies

Methodology is incorporated that permits analysis of the configuration components summarized in Table 1. Due to the types of methods selected restrictions also apply to the manner in which these components are joined to form a complete configuration:

- Subsonic/transonic speeds - The aerodynamic methods assume that the body is, as a minimum, composed of a nose-cylinder combination. The afterbody (boattail or flare) is optional, but if used, it must be attached to a cylindrical center body whose length is at least four body diameters; this restriction minimizes nose flow field coupling over the afterbody. If an afterbody is specified it must not be cylindrical, e.g., the base diameter must be different than the centerbody diameter. Table 2 summarizes the other restrictions on the configurations.
- Supersonic speeds - The aerodynamic methods used are not restricted to nose-cylinder combinations. Any arbitrary radii distribution can be defined since theoretical techniques are employed at Mach numbers above 1.2. Care should be taken to avoid introducing unexpected corners into the contour. If the contour has any concaved regions the marching may fail due to shock impingement on the body as it starts to curve out.

2.1.2 Panels

The program will accept inputs to describe most airfoil sections or planforms. Certain assumptions and limitations are made and summarized in the following paragraphs.

2.1.2.1 Airfoil Section - The program will accept virtually any symmetrical airfoil section or NASA subsonic cambered section. The airfoil section can be defined using a NACA designation or by supplying the coordinates of the section. Circular arc, hexagonal, or diamond shaped sections can also be specified. A symmetric hexagonal cross-section is the default; its shape is computed using the planform inputs. Hence, explicit definition of the airfoil section is optional. Although cambered airfoil sections can be input, their use in the code is currently limited to subsonic applications.

2.1.2.2 Planform - Each set of fins may be comprised of up to eight separate panels. It is assumed that each panel is geometrically identical. Although planforms may be described by up to 10 separate pieces or sections, an equivalent straight-tapered panel is computed and used at all speeds. There is no capability to specify a panel with outboard dihedral.

2.1.3 Airbreathing Inlets

Both axisymmetric and two-dimensional airbreathing inlet/diverter combinations can be defined. Up to 20 identical inlets can be positioned around the body at arbitrary angles. Vehicles with inlets can be analyzed at all speeds.

2.2 TYPES OF DATA COMPUTED

2.2.1 Aerodynamics

The program computes the following aerodynamic parameters as a function of angle of attack for each configuration:

C_N	Normal Force Coefficient
C_L	Lift Coefficient
C_m	Pitching Moment Coefficient
X_{cp}	Center of Pressure in calibers from the moment reference center
C_A	Axial Force Coefficient
C_D	Drag Coefficient
C_Y	Side Force Coefficient
C_n	Yawing Moment Coefficient
C_l	Rolling Moment Coefficient
$C_{N\alpha}$	Normal force coefficient derivative with angle of attack
$C_{m\alpha}$	Pitching moment coefficient derivative with angle of attack
$C_{Y\beta}$	Side force coefficient derivative with sideslip angle
$C_{n\beta}$	Yawing moment coefficient derivative with sideslip angle
$C_{l\beta}$	Rolling moment coefficient derivative with sideslip angle

The derivative output can be in degrees or radians. Partial output results, which detail the components used in the calculations, are also optionally available.

It should be noted that the drag force (and drag coefficient) is different between the wind and stability axes systems if the missile body is at a sideslip angle (β) to the wind. However, wind axis drag and stability axis drag are the same at zero sideslip. In Missile Datcom, drag force methods are assumed to be in the stability axes system and axial force methods are assumed to be in the body axes system unless otherwise noted.

The program has the capability to perform a static trim of the configuration, using any fin set for control with fixed incidence on the other sets. The two types of aerodynamic output available from the trim option are as follows:

- Untrimmed data - Each of the aerodynamic force and moment coefficients are printed in a matrix, which is a function of angle of attack and panel deflection angle. This output is optional.
- Trimmed data - The trimmed aerodynamic coefficients, and trim deflection angle, are output as a function of angle of attack.

2.2.2 Geometry

All components of the configuration have their physical properties calculated and output for reference if requested. All data is supplied in the user selected system of units.

2.2.3 Other

The reference area and reference length are user defined. The user may optionally select to print the calculated body or fin pressure coefficient distributions at supersonic speeds. Outputs of the partial aerodynamic results and a summary of method extrapolations are also optionally available.

2.3 OPERATIONAL CONSIDERATIONS

The code has been written to conform to the coding standards for the American National Standards Institute (ANSI) Standard FORTRAN X3.9-1978, often referred to as FORTRAN V or FORTRAN 77.

There are only four exceptions to the ANSI standards used in the code:

- Transfer on end-of-file - The FORTRAN IV statement `IF(EOF(UNIT).NE.0)` is used in the standard CDC compatible code. The FORTRAN V statement `END=label` in the

FORTTRAN READ statements is incorporated in the code, but is inactive in the CDC code.

- NAMELIST - The use of namelist for input and output (I/O) is used. Although this appears to be a violation of FORTRAN IV, it is really not since a namelist emulator has been written for the Missile Datcom code using FORTRAN IV.
- Mathematical functions - A few mathematical functions are not considered "standard," such as the trigonometric tangent. Standard FORTRAN equivalents for these functions are available on request.
- PROGRAM card - The code was developed on the Control Data Corporation CYBER computers. This system requires that the first card of the main routine be a PROGRAM statement. An IBM or VAX compatible version of the code is also maintained which has a different format for the program card.

3.0 INPUT DEFINITION

Inputs to the program are grouped by "case". A "case" consists of a set of input cards which define the flight conditions and geometry to be run. Provisions are made to allow multiple cases to be run. The successive cases can either incorporate the data of the previous case (using the input card SAVE) or be a completely new configuration design. The SAVE feature, for example, permits the user to define a body and wing (or canard) configuration in the first case and vary the tail design for subsequent cases.

The scheme used to input data to the computer program is a mixture of namelist and control cards. This combination permits the following:

- Inputs are column independent and can be input in any order.
- All numeric inputs are related to mnemonic (variable) names.
- Program input "flags" are greatly reduced. Required "flags" are identified by a unique alphabetic name which corresponds to the option selected.

The program includes an error checking routine which scans all inputs and identifies all errors. This process is a single-pass error checking routine; all errors are identified in a single "run". In addition, the program checks for necessary valid inputs, such as a non-zero Reynolds number. In some cases, the code will take corrective action. The type of corrective action taken is summarized later in this section.

Flexibility has been maintained for all user inputs and outputs. The following summarize the program generality available:

- The units system can be feet, inches, meters or centimeters. The default is feet.
- Derivatives can be expressed in degree or radian measure. Degree measure is the default.
- The body geometry can be defined either by shape type or by surface coordinates.
- The airfoil can be user defined, NACA, or supersonic shaped sections. The NACA sections are defined using the NACA

designation. A hexagonally shaped supersonic section is the default.

- The configuration can be run at a fixed sideslip angle and varying body angle of attack, or a fixed aerodynamic roll angle and varying total angle of attack.
- The flight conditions can be user defined, or set using a Standard Atmosphere model. The capability to define wind tunnel test conditions as the flight conditions is also available. The default flight condition is zero altitude.

3.1 NAMELIST INPUTS

The required program inputs use FORTRAN namelists. Missile Datcom is similar to other codes which use the namelist input technique, but differ as follows:

- Namelist inputs are column independent, and can begin in any column including the first. If a namelist is continued to a second card, the continued card must leave column 1 blank. Also, the card before the continued card must end with a comma. The last usable column is number 79 if column 1 is used, and column 80 if column 1 is blank.
- The same namelist can be input multiple times for the same input case. The total number of namelists read, including repeat occurrences of the same namelist name, must not exceed 300.

The three namelist inputs

```
$REFQ      SREF=1.,$  
$REFQ      LREF=2.,$  
$REFQ      ROUGH=0.001,$
```

are equivalent to

```
$REFQ      SREF=1.,LREF=2.,ROUGH=0.001,$
```

- The last occurrence of a namelist variable in a case is the value used for the calculations.

The three namelist inputs

```
$REFQ      SREF=1.,$  
$FLTCON    NMACH=2.,MACH=1.0,2.0,$  
$REFQ      SREF=2.,$
```

are equivalent to

```
$REFQ      SREF=2.,$  
$FLTCON    NMACH=2., MACH=1.0, 2.0,$
```

- The namelists can be input in any order.
- Only those namelists required to execute the case need be entered.
- Certain hollerith constants are permitted. They are summarized in Table 3. Note that any variable can be initialized by using the constant UNUSED; for example, LREF=UNUSED sets the reference length to its initialized value.

All Missile Datcom namelist inputs are either real numbers or logical constants. Integer constants will produce a nonfatal error message from the error checking routine and should be avoided.

The namelist names have been selected to be mnemonically related to their physical meaning. The ten namelists available are as follows:

<u>Namelist</u>	<u>Inputs</u>
\$FLTCON	Flight Conditions (Angles of attack, Mach numbers, etc.)
\$REFQ	Reference quantities (Reference area, length, etc.)
\$AXIBOD	Axisymmetric body definition
\$ELLBOD	Elliptical body definition
\$PROTUB	Protuberance information and geometry
\$FINSETn	Fin descriptions by fin set (n is the fin set number; 1, 2, 3 or 4)
\$DEFLCT	Panel incidence (deflection) values
\$TRIM	Trimming information
\$INLET	Inlet geometry
\$EXPR	Experimental data

Each component of the configuration requires a separate namelist input. Hence, an input case of a body-wing-tail configuration requires at least one of each of the following namelist inputs, since not all variables have default values assigned:

\$FLTCON	to define the flight conditions
\$AXIBOD or \$ELLBOD	to define the body
\$FINSET1	to define the most forward fin set
\$FINSET2	to define the first following fin set
\$FINSET3	to define the second following fin set
\$FINSET4	to define the third following fin set

The following namelists are optional since defaults exist for all inputs:

\$REFQ	to define the reference quantities
\$PROTUB	to define protuberance option inputs
\$DEFLCT	to define the panel incidence (deflection angles)
\$TRIM	to define a trim case
\$INLET	to define inlet geometry
\$EXPR	to define experimental input data

Defaults for all namelists should be checked to verify the configuration being modeled does not include an unexpected characteristic introduced by a default.

The following sections describe each of the namelist inputs. Each section is accompanied by a figure which summarizes the input variables, their definitions, and units. Since the system of units can be optionally selected, the column "Units" specifies the generic system of units as follows:

L	Units of length; feet, inches, centimeters or meters
F	Units of force; pounds or Newtons
deg	Units of degrees; if angular, in angular degrees; if temperature, either degrees Rankine or degrees Kelvin
sec	Units of time in seconds

Exponents are added to modify the above. For example, L^2 means units of length squared, or area. Combinations of the above are also used to specify other units. For example, F/L^2 means force divided by area, which is a pressure.

Since it is difficult to discern the difference between the number zero "0" and the alphabetic letter "O", it should be noted that none of the namelist

or namelist variable names contain the number zero in them. In general, the number zero and the letter "O" are not interchangeable unless so stated.

The program ascertains the configuration being modeled by the presence of each component namelist, even if no data is entered. The following rules for namelist input apply:

- Do not include a namelist unless it is required. Once read, the presence of a namelist (and, hence, a configuration component) can only be removed using the DELETE control card in a subsequent case. Simply setting all variables to their initialized values will not remove the configuration component.
- Do not include a variable within a namelist unless it is required. Program actions are often determined from the number and types of input provided.
- Do not over-specify the geometry. User inputs will take precedence over program calculations. Inputs that define a shape that is physically impossible will be used as specified. The program does not "fix-up" inconsistent or contradictory inputs.

3.1.1 Namelist FLTCON - Flight Conditions

This namelist defines the flight conditions to be run for the case. The program is limited to no more than 20 angles of attack and 20 Mach numbers per case at a fixed sideslip angle, aerodynamic roll angle, altitude, and panel deflection angle. Therefore, a "case" is defined as a fixed geometry with variable Mach number and angles of attack.

The inputs are given in Figure 1. There are two ways in which the aerodynamic pitch and yaw angles can be defined:

- Input ALPHA and BETA. If BETA is input and PHI is not, it is assumed that the body axis angles of attack (α) and sideslip angles (β) are defined.
- Input ALPHA and PHI. If PHI is input and non-zero, it is assumed that ALPHA is the total angle of attack (α) and PHI is the aerodynamic roll angle (ϕ).
- Input ALPHA, BETA and PHI. The value for BETA is ignored if PHI is non-zero.

As a minimum the following variables must be defined:

NALPHA	number of angles of attack to run (NALPHA $\geq$ 2)
ALPHA	angle of attack schedule (matching NALPHA)
NMACH	number of Mach numbers or speeds (NMACH $\geq$ 1)
MACH or VINF	Mach number or speed schedule (matching NMACH)

The REN, TINF and PINF data must correspond to the MACH or VINF inputs. The ALPHA and MACH dependent data can be input in any order; the code will sort the data into ascending order.

Reynolds number is always required. Three types of inputs are permitted to satisfy the Reynolds number requirement:

- Specify Reynolds number per unit length using REN
- Specify the altitude using ALT, and the speed using MACH or VINF (Reynolds number is computed using the Standard Atmosphere model)
- Specify pressure and temperature using PINF and TINF, and the speed using MACH or VINF (typical of data available from a wind tunnel test)

User supplied data will take precedence over program calculations. Hence, the user can override any default or Standard Atmosphere calculation. The default condition is sea-level altitude (ALT=0.) if the wrong combination of inputs are provided and the Reynolds number cannot be calculated.

3.1.2 Namelist REFQ - Reference Quantities

Inputs for this namelist are optional and are defined in Figure 2. A vehicle scale factor (SCALE) permits the user to input a geometry that is scaled to the size desired. This scale factor is used as a multiplier to the user defined geometry inputs; it is not applied to the user input reference quantities (SREF, LREF, LATREF). If no reference quantities are input, they are computed based upon the scaled geometry. XCG is input relative to the origin (X=0) and is scaled using SCALE.

In lieu of specifying the surface roughness height ROUGH, the surface Roughness Height Rating (RHR) can be specified. The RHR represents the arithmetic average roughness height variation in millionths of an inch. Typical values of ROUGH and RHR are given in Table 4.

3.1.3 Namelist AXIBOD - Axisymmetric Body Geometry

An axisymmetric body is defined using this namelist. The namelist input variables are given in Figures 3a and 3b and a sketch of the geometric inputs are given in Figure 4. The body can be specified in one of two ways:

OPTION 1: The geometry is divided into nose, centerbody, and aft body sections. The shape, overall length, and base diameter for each section are specified. Note that not all three body sections need to exist on a configuration; for example, a nose-cylinder configuration does not require definition of an aft body.

OPTION 2: The longitudinal stations and corresponding body radii are defined, from nose to tail. This option should only be selected if the Mach number is greater than 1.2.

If Option 2 is selected, the program generates a body contour based on the user specified values of X, R, and DISCON. Many additional points in between the user specified input coordinates will be generated. The resulting contour can contain more than 1000 points. If the PRINT GEOM BODY control card is used, this contour will be written to tape unit 3.

The program uses the input value for NX to determine which option is being used. If NX is not input then Option 1 inputs are assumed. If both shapes and body coordinates (Options 1 and 2) are used, the body coordinate information will take precedence. NX can be set to its initialized value (to simulate the variable as not input) by specifying "NX=UNUSED".

It is highly recommended that Option 1 be used when possible. The program automatically calculates the body contour based upon the segment shapes using geometry generators. Hence, more accurate calculations are possible. Even when Option 2 is used, appropriate Option 1 inputs should be included. This identifies where the code should insert break points in the contour. If these parameters are not input, they are selected as follows:

LNOSE	Length of the body segment to where the radius first reaches a maximum
DNOSE	The diameter at the first radius maximum
LCENTR	Length of the body segment where the radius is constant
DCENTR	Diameter of the constant radius segment
LAFT	The remaining body length
DAFT	Diameter at the base
DEXIT	Not defined (implies that base drag is not to be included in the axial force calculations)

If DEXIT is not input, or set to UNUSED, the base drag computed for the body geometry will not be included in the final computed axial force calculations. To include a "full" base drag increment, a zero exit diameter must be specified (DEXIT=0.).

If body coordinates are input using the variables NX, X, R, and DISCON, and the nose is spherically blunted, the geometry must be additionally defined using the following:

- BNOSE must be specified (even if zero)
- TRUNC must be set to .FALSE.
- The first five (5) points in the X and R arrays must lie on the spherical nose cap [i.e., X(1), X(2), X(3), X(4), X(5), R(1), R(2), R(3), R(4), and R(5) are spherical cap coordinates]

The following summarizes the input generality available:

- X(1) does not have to be 0.0; an arbitrary origin can be selected.
- Five shapes can be specified by name:

CONICAL (CONE) - cone or cone frustrum (default for boattails and flares)

OGIVE - tangent ogive (default for noses)

POWER - power law*

HAACK - L-V Haack (length-volume constrained)*

KARMAN - von Karman (L-D Haack; length-diameter constrained)*

- If DAFT<DCENTR the afterbody is a boattail.**
- If DAFT>DCENTR the afterbody is a flare.**
- If LAFT is not input, aft body (boattail or flare) does not exist.

* applies to noses only

** DAFT must not be equal to DCENTR

The inputs for base-jet plume interaction effects are defined using Option 1. Incremental forces and moments due to jet induced boattail separation and separation locations on aft fins are calculated if these inputs are used.

- This option should only be run for supersonic cases (i.e. $M_{\infty} \geq 1.2$)
- The calculations will be done for three types of aft bodies conical boattail, ogival boattail, or cylindrical (i.e. no boattail). Error messages will be printed to the output file and the calculations skipped if any other aft body is defined.
- If BASE=.FALSE. or is not input the calculations will be skipped.
- DEXIT must not equal zero if this option is used.
- The jet Mach number (JMACH), jet to freestream static pressure ratio (PRAT), and jet to freestream stagnation temperature ratio (TRAT) must be specified for each freestream Mach number or velocity input in the namelist FLTCN. For subsonic or transonic freestream Mach numbers or velocities, dummy values must be input for JMACH, PRAT, and TRAT. The user must be careful to match these inputs with the proper freestream conditions.
- If a portion of the fins in a fin set are located on the boattail or base, the boattail separation locations will be calculated and output at each fin roll angle. However, if the fins do not extend to the boattail the separation locations will be skipped.
- Results may be inaccurate if excessive extrapolation is required. If extrapolation occurs, a warning message will be printed to the output file. To avoid extrapolation and minimize inaccuracy, the input parameters should be kept within the ranges shown in Figure 5.

3.1.4 Namelist ELLBOD - Elliptical Body Geometry

Elliptically-shaped cross section bodies are defined using this namelist. The inputs are similar to those for the axisymmetric body geometry (AXIBOD), and are shown in Figures 6a and 6b. The types of shapes available, and the limitations, are the same as those given for axisymmetric bodies. However, the base-jet plume interaction input options in namelist AXIBOD are not available in namelist ELLBOD. Please read Section 3.1.3 for limitations.

Note that the body cross section ellipticity can vary along the body longitudinal axis. Sections which are taller-than-wide and wider-than-tall can

be mixed to produce "shaped" designs. The shape of the sections is controlled by the variables ENOSE, ECENTR, and EAFT or ELLIP, H and W.

3.1.5 Namelist PROTUB - Protuberance Geometry

Missile protuberances can be input using this namelist. Axial force coefficient is calculated for the protuberances and added to the body axial force coefficient. Figure 7 shows the inputs required. Figure 8 shows the different protuberance shapes available. The following defines the inputs required for protuberance calculations:

- NPROT is the number of protuberance sets. A protuberance set is made up of protuberances at the same axial location with the same size and shape. Therefore, it is only necessary to describe the geometry of one individual protuberance per set. The maximum number of protuberance sets is 20.
- NLOC is the number of protuberances in each protuberance set. NLOC accounts for the number of identical protuberances located around the missile body at a given axial location.
- The following equation helps to clarify the relationship between NLOC and NPROT:

$$NLOC(1)+NLOC(2)+NLOC(3)+\dots+NLOC(NPROT) = (\text{Total number of protuberances on the missile})$$

- The axial location of a protuberance (XPROT) should be input at the protuberance geometric centroid. An approximation of the centroid will be adequate for the analysis. The location is used to calculate the average boundary layer thickness over the protuberance length.
- VCYL, HCYL, BLOCK, and FAIRING type protuberances have 1 member. LUG types have 4 members and SHOE types have 3 members. (Refer to Figure 8)
- All inputs for LPROT, WPROT, HPROT, and OPROT are in sequential order based upon the members specified with the protuberance type (PTYPE) input.
- The FAIRING type protuberance should always have a zero offset. The code will assume a zero offset even if a non-zero offset is input.

More complex protuberance shapes can be analyzed by a component build-up method. Each member is treated as a separate protuberance. Combinations of vertical cylinders, horizontal cylinders, and flat plates or blocks can be input at specified offsets from the missile body. If a FAIRING type protuberance is used in a component build-up, the offset should be zero. The user must manually add axial force of the individual members of the component build-up if the total protuberance axial force is desired.

Figure 9 shows an example input file for a missile with several protuberances.

3.1.6 Namelist FINSETn - Define Fin Set n

Figure 10a describes the variables needed to be input for fin set planform geometry descriptions. Optional fin cross-section inputs are described in Figure 10b. Special user specified fin cross-sections can be input using the variables in Figure 10c. The user may specify up to four non-overlapping fin sets. The variable "n" in the namelist specifies the fin set number. Fin sets must be numbered sequentially from the front to the back of the missile beginning with fin set one. An input error will occur if "n" is zero or omitted. The code allows for between 1 and 8 geometrically identical panels to be input per fin set. The panels may be arbitrarily rolled about the body and can be given dihedral.

Four types of airfoil sections are permitted--hexagonal (HEX), circular arc (ARC), NACA airfoils (NACA), and user defined (USER). Only one type of airfoil section can be specified per fin set, and this type is used for all chord wise cross sections from root to tip. Diamond-shaped sections are considered a special case of the HEX type; hence, hexagonal and diamond sections can coexist on the same panel. The airfoil proportions can be varied from span station to span station.

The user selects "break points" on the panel (Figure 11a). A "break point" specifies a change in leading or trailing edge sweep angle. Also a break point may specify a change in airfoil section, but the section must be of the same type (i.e., a change in section type cannot go from a NACA to an ARC) only the proportions can change. The location of each "break point" is defined by specifying its semi-span station (SSPAN) from the vehicle centerline and distance from the first body station to the chord leading edge (XLE). The "break point" chord leading edge array (XLE) can be defined by simply specifying the root chord leading edge [XLE(1)] and the sweep angles of each successive panel segment if the semi-span stations are input. Note that only those variables that uniquely define the fin need to be entered. Redundant inputs can lead to numerical inconsistencies and subsequent computational errors.

The panel sweep angle (SWEEP) can be specified at any span station for each segment of the panels. If STA=0., the sweep angle input is measured at the segment leading edge; if STA=1., the sweep angle input is measured at the segment trailing edge. Note that some aerodynamic methods are very sensitive to panel sweep angle. For small span fins, small errors in the planform inputs can create large sweep angle calculation errors. It is recommended that exact sweep angles be specified wherever possible; for example, if the panel trailing edge is unswept, specifying SWEEP=0. and STA=1. will minimize calculation error. Then the leading edge sweep will be computed by the code internally using the SSPAN and CHORD inputs.

Plain trailing edge devices may be modelled in Missile Datcom. This is accomplished via the CFOC array which is the flap chord to fin chord ratio, c_f/c . Trailing edge devices can be either full span or partial span subject to certain limits specified below. The trailing edge devices can not have a taper ratio greater than 1.0, and the hinge line must be straight regardless of the number of segments comprising the trailing edge device. A partial span trailing edge device is specified by setting CFOC=0 for those chord/span stations that are not part of the trailing edge device. Examples of acceptable and unacceptable geometries are shown in Figure 11b as well as the corresponding input values for the variable arrays CFOC, CHORD and SSPAN. A special case where the trailing edge device extends to the tip of a fin with a taper ratio of zero is also shown in Figure 11b. While any value of CFOC will result in the correct flap chord at the tip (since the tip chord is zero), the user must specify a CFOC=1.0 since a value of CFOC=0 would indicate the trailing edge device does not exist at this chord/span station. the user should also be aware of the following:

- All trailing edge deflection angles are measured with respect to the freestream and not relative to the hinge line. This becomes an important distinction as the hinge line sweep angle is increased.
- The variable SKEW does not apply to trailing edge devices.
- The hinge moments for trailing edge devices are not calculated.
- The increase in profile drag due to trailing edge deflection is not calculated.

Since all panels are assumed to be planar (i.e., no tip dihedral), all inputs must be "true view". Once the planform of a single panel is defined, all fins of the set are assumed to be identical. The number of panels present is defined using the variable NPANEL. Each panel may be rolled to an arbitrary position around the body using the variable PHIF. PHIF is measured clockwise from top vertical center (looking forward from behind the missile) as shown in Figure 12. Each panel may also contain a constant dihedral. A panel has zero dihedral when it is aligned along a radial ray from the centerline (see Figure 12). The variable used to specify dihedral is GAM. GAM is positive if the panel tip chord is rotated clockwise.

Different aerodynamics will be computed depending upon whether the FLTCON namelist variable PHI, or the FINSETn namelist variable PHIF, is used to roll the geometry. Figure 13 depicts the usage of the roll options. The variable "PHI" means that the body axes system is to be rolled with the missile body, whereas PHIF keeps the aerodynamics in a non-rolled body axis, but rather locates the fin positions around the body. PHIF must be input for each panel, while PHI rolls the whole configuration.

It is the user's responsibility to assure that the fins are (1) on the body surface, and (2) do not lie internal to the body mold line. The program does not check for these peculiarities. If SSPAN(1)=0 is input, the program will assume that the panel semi-span data relative to its root chord are supplied. The code will automatically interpolate the body geometry to place the panel on the body surface with the root chord parallel to the body centerline. See Section 3.4 for modeling fins on body segments of varying radii.

When defining more than one fin set, the fin sets must never have their planforms overlap one another. There must be sufficient space between the forward fin trailing edge and aft fin leading edge to avoid violating the assumptions made by the aerodynamic computations. It is assumed by the aerodynamic model that the vortices are fully rolled up when they pass the control points of the next downstream set of fins. In reality the vortex sheet does not fully roll up until it is at least four semispans downstream. If two fin sets are closer than this the results may be in error since the use of a vortex filament model may introduce too much vorticity. The closer the spacing the larger the error may be. No algorithm error will result from too close a fin set spacing.

Panels with cut-out portions can be modeled by using one of the ten available fin segments as a transition segment. This is accomplished by giving the segment a small span, such as 0.0001, and specifying the segment root and tip chords to transition into the cut-out portion of the fin.

3.1.7 Namelist DEFLCT - Panel Deflection Angles

This namelist permits the user to fix the incidence angle for each panel in each fin set. The variables are given in Figure 14. Note that the panel numbering scheme is assumed to be that shown in Figure 12. The array element of each deflection array corresponds to the panel number.

The scheme for specifying deflection angles is unique, yet concise. The scheme used is based upon the body axis rolling moment:

"In Missile Datcom a positive panel deflection is one which will produce a negative (counterclockwise when viewed from the

rear) roll moment increment at zero angle of attack and sideslip."

3.1.8 Namelist TRIM - Trim Aerodynamics

This namelist instructs the program to statically trim the vehicle longitudinally ($C_m=0$). The inputs are given in Figure 15. Note that only one fin set can be used for trimming. The user only specifies the range of deflection angles desired using DELMIN and DELMAX; the code will try to trim the vehicle for each angle of attack specified using the allowable fin deflections. This option will not trim the vehicle at a specific angle of attack if the deflection required is outside the range set by the values of DELMIN and DELMAX.

The deflection sign convention used is that described in Section 3.1.7; hence, DELMIN and DELMAX are input as if deflecting the panel to the maximum will produce a negative rolling moment from the panels resulting normal force increment. DELMIN must always be less than DELMAX.

A logical variable, ASYM, has been included to permit reverse panel deflections. For example, deflecting all panels in one sense results in a rolling moment and no pitching moment. The ASYM flag will permit analysis of an elevator (or pitch deflection) effect, by deflecting panels on one side of the vehicle only, with opposite panels mirroring those deflections. Since a maximum of eight panels are allowed in a fin set, only four panels of the fin set can be deflected in the reverse direction using the ASYM flag. Both trimmed and untrimmed results are available for output.

3.1.9 Namelist INLET - Axisymmetric and 2-Dimensional Inlet Geometry

This namelist is used to model the inlet and diverter geometry. Axisymmetric, two-dimensional side mounted, and two-dimensional top mounted inlets can be described. The inlets may be covered or uncovered and oriented in any position about the missile body. Inlet normal force, pitching moment, side force, yawing moment, and axial force are calculated. The methods are valid for subsonic, transonic, and supersonic speeds. Figure 16 shows the INLET namelist inputs, and Figures 17a, 17b, 17c and 17d show the inlet/diverter geometry for each type of inlet. The inlets may have a boundary layer diverter, be conformal (diverter height HDIV=0), or be semi-submerged (diverter height HDIV<0). The methods used for the inlets are the same regardless of whether the inlet has a diverter or is semi-submerged, and they are not applicable to chin inlets. The variable HDIV is used to determine whether a diverter exist. Figure 17d shows examples of two-dimensional and axisymmetric inlets that are conformal or semi-submerged.

- Inlet roll orientation uses the same convention as the fin panel roll orientation.
- Inlet height and width or inlet diameter is input at five axial locations described in Figures 17a, 17b, and 17c:
 - 1) leading edge or tip
 - 2) cowl lip leading edge
 - 3) midbody start
 - 4) boattail start
 - 5) boattail end
- If the inlet is covered (COVER=.TRUE.), no flow is allowed into the inlet. The inlet is plugged between stations 1 and 2, flush with the inlet face.

Inlet additive drag or spillage drag can be calculated for external compression inlets operating at off-design conditions ($M_\infty < M_{design}$) for Mach numbers greater than 1. Whenever flow spillage occurs, the mass flow ratio is less than one, and additive forces are generated on the deflected streamtube captured by the inlet. If the inlet operates on-design, the ramp shock lies on the inlet face and on the cowl lip. In these cases, the maximum mass flow ratio is one (zero spillage) and the minimum additive forces are zero.

- If the inlet is covered (COVER=.TRUE.), the additive drag calculations will be skipped.
- If ADD=.FALSE., or is not input the additive drag calculations will be skipped.
- Mass flow ratio (MFR) must be specified for each freestream Mach number or velocity given in namelist FLTCON. For Mach numbers less than 1, dummy values must be input for MFR. The user must be careful to match these inputs with the proper freestream conditions.
- The additive drag is calculated at zero angle of attack and assumed to remain constant for all angles of attack.

3.1.10 Namelist EXPR - Experimental Data Substitution

This namelist is used to substitute experimental data for the theoretical data generated by the program. The variables to be input are shown in Figure 18. Use of namelist EXPR does not stop the program from calculating theoretical data, but rather the experimental data is used in configuration synthesis, and it is the experimental data that is used for the component aerodynamics for which it is input.

Experimental data may be substituted for any configuration component or partial configuration. Experimental data is input at a specific Mach number. When using namelist EXPR, the case must be run at the Mach number for which you are substituting experimental data. However, the experimental data being input may have different reference quantities and a different center of gravity location than the case being run.

Experimental data input for a fin alone is input as panel data, not as total fin set data. The user should note that experimental data for fin alone $C_{m\alpha}$ is not used in the configuration synthesis process. Instead fin alone $C_{N\alpha}$ (the experimental value if input) is used to determine the fin contribution to $C_{m\alpha}$ during configuration synthesis. If body alone experimental data and body-fin experimental data are input for the same case the body data is ignored in configuration synthesis. If experimental $C_{m\alpha}$ data is input for a body + 1 fin set for a multi-fin set configuration, the calculated contributions to $C_{m\alpha}$ of the other fin sets are added to the experimental data.

Since the experimental namelist forms the basis for configuration incrementing, the lateral directional coefficients are included to allow for sideslip cases. These coefficients are input the same as the longitudinal coefficients. However, if the lateral directional coefficients are input, the lateral directional beta derivatives will not be computed our output.

The following rules apply to the use of namelist EXPR.

- It is assumed that the coefficients in EXPR are for the same sideslip and/or aerodynamic roll as the case being run.
- Separate namelist EXPR must be specified for each Mach number.
- Each namelist EXPR must end with a \$END card.
- Separate namelist EXPR must be specified for each partial configuration for which experimental data is to be input, (i.e., body, body + 1 fin set, etc)
- Separate namelist EXPR must be specified for each reference quantity change.

Example:

The user has experimental data available for a body + 2 fin set configurations and is interested in the effects of adding a booster containing a third fin set. he would then use namelist EXPR to input the experimental data. When the

configuration is synthesized, it would use the experimental data for body + 2 fin sets and theoretical data for fin set three.

3.2 CONTROL CARD INPUTS

Control cards are one line commands which select program options. Although they are not required inputs, they permit user control over program execution and the types of output desired. Control cards enable the following:

- Printing internal data array results for diagnostic purposes (DUMP)
- Outputting intermediate calculations (PART, BUILD, PRESSURES, PRINT AERO, PRINT EXTRAP, PRINT GEOM, PLOT, NAMELIST, WRITE, FORMAT)
- Selecting the system of units to be used (DIM, DERIV)
- Defining multiple cases, permitting the reuse of previously input namelist data or deleting namelists of a prior case (SAVE, DELETE, NEXT CASE)
- Adding case titles or comments to the input file and output pages (*, CASEID)
- Limits the calculations to longitudinal aerodynamics (NO LAT)

3.2.1 Control Card - General Remarks

A total of 42 different control cards are available. There is no limit to the number of control cards that can be present in a case. If two or more control cards contradict each other, the last control card input will take precedence. All control cards must be input as shown, including any blanks. Control cards can start in any column but they cannot be continued to a second card. Misspelled cards are ignored. Control cards can be located anywhere within a case.

Once input, the following control cards remain in effect for all subsequent cases:

DIM FT	DIM IN	DIM CM	DIM M	FORMAT
HYPER	INCREMENT	NOGO	NO LAT	PLOT
SOSE	WRITE			

The following control cards are effective only for the case in which they appear:

BUILD	CASEID	DAMP	DELETE
DUMP CASE	DUMP NAME	NAMelist	PART
PRESSURES	PRINT AERO	PRINT EXTRAP	
PRINT GEOM	SAVE	SPIN	TRIM

These control cards can be changed from case to case:

DERIV DEG	DERIV RAD	NACA
-----------	-----------	------

The only control card that can be optionally saved, from case-to-case, is the NACA card.

3.2.2 Control Card Definition

Available control cards are summarized as follows:

BUILD

This control card instructs the program to print the results of a configuration build-up. All configurations which can be built from the components defined will be synthesized and output, including isolated data (e.g., body alone, fin alone, etc.). Component build-up data is not provided if the TRIM option is selected.

CASEID

A user supplied title to be printed on each output page is specified. Up to 72 characters can be specified (card columns 8 to 80).

DAMP

When DAMP control card is input longitudinal dynamic derivatives are computed and the results output for the configuration. Dynamic derivatives for configuration components or partial configurations may be output using the PART or BUILD control cards respectively.

DELETE name1,name2

This control card instructs the program to ignore a previous case namelist input that was retained using the SAVE control card. All previously saved namelists with the names specified will be purged from the input file.

Any new inputs of the same namelist will be retained. At least one name (name1) must be specified.

DIM IN, DIM FT, DIM CM, or DIM M

This control card sets the system of units for the user inputs and program outputs. The four options are inches (DIM IN), feet (DIM FT), centimeters (DIM CM), and meters (DIM M). The default system of units is feet. Once the system of units has been set, it remains set for all subsequent cases of the "run".

DERIV DEG or DERIV RAD

All output derivatives are set to either degree (DERIV DEG) or radian (DERIV RAD) measure. The default setting is degree. The derivative units can be changed more than once during the run by inputting multiple DERIV cards.

DUMP CASE

Internal data blocks, used in the computation of the case, are written on Tape 6. This control card automatically selects partial output (PART).

DUMP name1,name2

This permits the user to write selected internal data blocks or common blocks on Tape 6. At least one name (name1) must be specified. The arrays will be dumped in units of feet, pounds, degrees or degrees Rankine. Table 5 shows the common block dump names and Tables 8 through 62 provide a definition of each common block.

FORMAT (format)

This control card is used in conjunction with the WRITE control card. It specifies the format of the data to be printed to tape unit 3. The format is input starting with a left parenthesis, the format and a right parenthesis. This is exactly the same as a FORTRAN FORMAT statement. Because of the code structure, alphanumeric data must not be printed. For example:

FORMAT ((8(2X,F10.4))	is legal
FORMAT (2HX=,F10.4)	is illegal

The default format is 8F10.4, and will be used if the FORMAT control card is not present. Multiple formats can be used. The last FORMAT read will be used for all successive WRITE statements until another FORMAT is encountered. Hence, the FORMAT must precede the applicable WRITE.

HYPER

This control card causes the program to select the Newtonian flow method for bodies at any Mach number above 1.4. HYPER should normally be selected at Mach numbers greater than 6.

INCRMT

This card is used to set the configuration incrementing flag. Configuration incrementing uses the first case of a run to determine correction factors for the longitudinal and lateral aerodynamic coefficients. These correction factors are computed by comparing theoretical and experimental values for each coefficient for which data is input. The experimental values are input using namelist EXPR. During subsequent cases of the run, the correction factors are applied to coefficients for which experimental data was input in the first case. This provides the user with a method to evaluate changes in a configuration.

The INCRMT card must be input in the first case of a run. The first case must be run at the same Mach number as the experimental data which is input. Once the increment flag is set it cannot be deleted during that run.

The following restrictions apply:

- All cases of a run must have the same number of fin sets.
- All cases of a run must have the same sideslip or aerodynamic roll angle as the first case (BETA or PHI as specified in namelist FLTCON).
- The first case must be run at exactly the same angles of attack as the experimental data being input.
- All cases must be run within the same Mach regime (subsonic, transonic, or supersonic) as the experimental data.
- Experimental data can only be input in the first case and only for the complete configuration. No additional data can be substituted.
- To increment $C_{Y\beta}$ and $C_{N\alpha}$ experimental data must be input for C_Y and C_N .

Use of configuration incrementing may or may not increase the accuracy of the results. The following guidelines will produce better results when using configuration incrementing:

- The user may run different angles of attack in each case. However, no angle of attack should exceed the upper or lower limit of the angles of attack for which experimental data was input in the first case.
- Experimental data should be input at as many angles of attack as possible.
- The user should remember that the effect of a change in Mach number from case to case is not corrected by inputting experimental data at one Mach number as is required.

NACA

This card defines the NACA airfoil section designation (or supersonic airfoil definition). Note that if airfoil coordinates and the NACA card are specified for the same aerodynamic surface, the airfoil coordinate specification will be used. Therefore, if coordinates have been specified in a previous case and the SAVE option is in effect, the saved namelist must be deleted or the namelist variable SECTYP must be changed for the NACA card to be recognized for that aerodynamic surface. The airfoil designated with this card will be used for all segments and panels of the fin set.

The form of this control card and the required parameters are as follows:

<u>Card Column(s)</u>	<u>Input(s)</u>	<u>Purpose</u>
1 thru 4	NACA	The unique letters NACA designate that an airfoil is to be defined
5	Any delimiter	
6	1,2,3, or 4	Fin set number for which the airfoil designation applies
7	Any delimiter	
8	1,4,5,6,S	Type of NACA airfoil section; 1-series (1), 4-digit (4), 5-digit (5), 6-series (6), or supersonic (S)
9	Any delimiter	
10 thru 80	Designation	Input designation (see Table 6); columns are free-field (blanks are ignored)

Only fifteen (15) characters are accepted in the airfoil designation. The vocabulary consists of the following characters:

0 1 2 3 4 5 6 7 8 9 A , = . -

Any characters input that are not in the vocabulary list will be interpreted as the number zero (0). Table 6 details the restrictions on the NACA designation.

NAMelist

This control card instructs the program to print all namelist data. This is useful when multiple inputs of the same variable or namelist are used.

NEXT CASE

This card indicates termination of the case input data and instructs the program to begin case execution. It is required for multiple case "runs". This card must be the last card input for the case.

NOGO

This control card permits the program to cycle through all of the input cases without computing configuration aerodynamics. It can be present anywhere in the input stream and only needs to appear once. This option is useful for performing error checking to insure all cases have been correctly set up.

NO LAT

This control card inhibits the calculation of the lateral-directional derivatives due to sideslip angle. Savings in computation time can be realized by using this option. This option is automatically selected when using TRIM.

PART

This control card permits printing of partial aerodynamic output, such as a summary of the normal force and axial force contributors. Partial output of the configuration synthesis methods is only provided if the TRIM option is not selected. Use of this card is equivalent to inputting all PRINT AERO and PRINT GEOM control cards.

PLOT

A data file for use with a post-processing plotting program is provided when this control card is used. A formatted file is written to unit 3. Appendix B shows the format of this data file.

PRESSURES

This control card instructs the program to print the body and fin alone pressure coefficient distributions at supersonic speeds. Only pressure data to 15 degrees angle of attack for bodies and at zero angle of attack for fins are printed.

PRINT AERO name

This control card instructs the program to print the incremental aerodynamics for "name", which can be one of the following:

BODY	for body aerodynamics
FIN1	for FINSET1 aerodynamics
FIN2	for FINSET2 aerodynamics
FIN3	for FINSET3 aerodynamics
FIN4	for FINSET4 aerodynamics
SYNTHS	for configuration synthesis aerodynamics
TRIM	for trim/untrimmed aerodynamics
BEND	for panel bending moments
HINGE	for panel hinge moments
INLET	for inlet aerodynamics

All options are automatically selected when the control card PART is used. Details of the output obtained with these options are presented in Section 4.2.

PRINT EXTRAP

This control card enables the printing of method extrapolation messages produced during execution of the case. Extrapolation messages are not normally provided.

PRINT GEOM name

This control card instructs the program to print the geometric characteristics of the configuration component "name", which can be one of the following:

BODY	for body geometry
FIN1	for FINSET1 geometry
FIN2	for FINSET2 geometry
FIN3	for FINSET3 geometry
FIN4	for FINSET4 geometry
INLET	for inlet geometry

If PRINT GEOM BODY is selected and the Mach number is greater than 1.2, the body contour coordinates (X,R) used by the program are written to tape unit 3. This contour will contain many additional points in between the user specified input coordinates.

All options are automatically selected when the control card PART is used.

SAVE

The SAVE card saves namelist inputs from one case to the following case but not for the entire run. This permits the user to build-up or change a complex configuration, case-to-case, by adding new namelist cards without having to re-input namelist cards of the previous case. When changing a namelist that has been saved, the namelist must first be deleted using the delete control card.

The only control card that can be optionally saved, case-to-case, is the NACA card.

SOSE

The presence of this control card selects the Second-Order Shock Expansion Method for axisymmetric bodies at supersonic speeds. SOSE should be selected if any Mach number is higher than 2.0.

SPIN

When the SPIN control card is input, spin and magnus derivatives are computed for body alone. If the configuration being run is a body + fin sets, the spin derivatives are still computed for body alone. A PART or BUILD card must be input for body alone derivatives to be printed out.

TRIM

This control card causes the program to perform a trim calculation. Component buildup data cannot be dumped if TRIM is selected. The use of this control card is the same as if the namelist TRIM was included except that the defaults for namelist TRIM are used.

WRITE name, start, end

This control card causes the common block "name" to be printed to tape unit 3 using the most recent FORMAT control card. Locations from "start" to "end" are dumped (see Table 5 for common block write names). A complete definition of each common block is provided in Tables 8 through 62. Multiple WRITE statements may be input, and there is no limit to the number which may be present. The presence of a WRITE will cause the block "name" to be printed for all cases of the run. The output will be in units of feet, pounds, degrees, or degrees Rankine. If the PLOT option is also selected, this output will be "mixed" with the PLOT file output on tape unit 3.

*
—

Any card with an asterisk (*) in Column 1 will be interpreted as a comment card. This permits detailed documentation of case inputs.

3.3 TYPICAL CASE SET-UP

Figure 19 schematically shows how Missile Datcom inputs are structured. This example illustrates a multiple case job in which case 2 uses part of the case 1 inputs. This is accomplished through use of the SAVE control card. Case 1 is a body-wing-tail configuration; partial output, component buildup data, and a plot file are created. Case 2 uses the body and tail data of case 1 (the wing is deleted using DELETE), specifies panel deflection angles and sets the data required to trim.

There is no limit to the number of cases that can be "stacked" in a single run, provided that no more than 300 namelist inputs are "saved" between cases. If a SAVE control card is not present in a case, all previous case inputs are deleted.

3.3.1 Configuration Incrementing Case Set-up

A "configuration incrementing" case set-up is shown in Figure 20. This figure shows the inputs for a three case set-up fin parametric analysis. The first case is the calibration case with the remaining cases being used for the parametric analysis. Therefore, the first case must contain both the INCRMT control card and EXPR namelist. These should only appear in the first case.

3.4 SPECIAL USAGE OF INPUT PARAMETERS

It is possible to manipulate the input geometry, such that unique configurations can be modeled. This section defines those capabilities.

3.4.1 Locating Panels on Varying Body Radii Segments

The fin panels can be located anywhere on the geometry. If they are to be positioned on a varying radii segment, select the root chord span station [SSPAN(1)] such that the center of the exposed root chord is on the surface mold line. Physically this places part of the panel within the body and part offset from the body.

If SSPAN(1) is input precisely as zero, the code will assume that panel semi-span stations relative to the root chord are defined. It will then interpolate the body geometry at the root chord center and add the body radius at this point to the user defined values in the SSPAN array.

Table 1 Body Addressable Configurations

CONFIGURATION	SUBSONIC $M \leq 0.6$	TRANSONIC $0.6 < M \leq 1.2$	SUPERSONIC $M > 1.2$
1. Nose Shape			
Conical			
Sharp	x	x	x
Blunted	x	x	x
Truncated	x	x	x
Tangent Ogive			
Sharp	x	x	x
Blunted	x	x	x
Truncated	x	x	x
Other		x	x
2. Centerbody Shape			
Cylinder	x	x	x
Elliptically Variable	x	x	x
3. Afterbody Shape			
Boattails			
Conical	x	x	x
Tangent Ogive	x	x	x
Other			x
Flares			
Conical	x	x	x
Ogive			x
Other			x

Table 2 Subsonic/Transonic Method Limitations

METHOD	RANGE PERMITTED	ACTION TAKEN IF EXCEEDED
Nose Bluntness (C _N , C _m)	Sharp Only	Uses Sharp Method
Conical Nose Slope	0 to 25 Degrees	Uses 25 Degrees
Boattail Shape	Cone or Ogive	Uses Cone
Conical Boattail Slope	0 to 16 Degrees	Extrapolates
Ogive Boattail Slope	0 to 28 Degrees	Extrapolates
Flare Shape	Cone	Uses Cone
Flare Slope	0 to 10 Degrees	Extrapolates
Airfoil t/c	0 to 12%	Continues, if Possible

Table 3 Namelist Alphanumeric Constants

NAMELIST	PERMITTED ALPHANUMERIC CONSTANTS	CONVERTED VALUE
(ALL) REFQ	UNUSED	1.0E-30 (Initialized Value)
AXIBOD or ELLBOD	TURB	0.
	NATURAL	1.
	CONICAL	0.
	CONE	0.
	OGIVE	1.
PROTUB	POWER	2.
	HAACK	3.
	KARMAN	4.
	VCYL	1.
	HCYL	2.
FINSETn	BLOCK	5.
	FAIRING	6.
	LUG	3.
	SHOE	4.
	HEX	0.
INLET	NACA	1.
	ARC	2.
	USER	3.
	AXI	3.
	2DTOP	1.
EXPR	2DSIDE	2.
	BODY	1.
	F1	2.
	F2	3.
	F3	4.
	F4	5.
	BF1	6.
	BF12	7.
	BF123	8.
	BF1234	9.

Table 4 Equivalent Sand Roughness

TYPE OF SURFACE	EQUIVALENT SAND ROUGHNESS k (INCHES)	RHR
Aerodynamically Smooth	0.0	0.0
Polished Metal or Wood	0.02 E-3 to 0.08 E-3	6 to 26
Natural Sheet Metal	0.16 E-3	53
Smooth Matte Paint, Carefully Applied	0.25 E-3	83
Standard Camouflage Paint, Average Application	0.40 E-3	133
Camouflage Paint, Mass-Production Spray	1.20 E-3	400
Dip Galvanized Metal Surface	6.0 E-3	2000
Natural Surface of Cast Iron	10.0 E-3	3333

PREFERRED RHR VALUES

APPLICATION	RHR
Steel Structural Parts	250
Aluminum and Titanium Structural Parts	125
Close Tolerance Surfaces	63
Seals	32

NAMELIST FLTCON

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
NALPHA	-	NUMBER OF ANGLES OF ATTACK (AT LEAST 2)	-	-
ALPHA	20	ANGLE OF ATTACK OR TOTAL ANGLE OF ATTACK	DEG	-
BETA	-	SIDESLIP ANGLE	DEG	0.
PHI	-	AERODYNAMIC ROLL ANGLE	DEG	0.
NMACH	-	NUMBER OF MACH NUMBERS (AT LEAST 1)	-	-
MACH	20	MACH NUMBERS	-	-
REN	20	REYNOLDS NUMBER PER UNIT LENGTH	1/L ^②	-
ALT	-	GEOMETRIC ALTITUDE	L ^③	0.
VINF	20	FREESTREAM SPEED	L/SEC ^④	-
TINF	20	FREESTREAM STATIC TEMPERATURE	DEG	-
PINF	20	FREESTREAM STATIC PRESSURE	F/(L*L) ^⑤	-

① THE FOLLOWING COMBINATIONS SATISFY THE REYNOLDS NUMBER AND MACH NUMBER INPUT REQUIREMENTS

USER INPUT	PROGRAM COMPUTES
1. MACH, REN	(NONE)
2. MACH, ALT	PINF, TINF, REN
3. VINF, ALT	PINF, TINF, MACH, REN
4. VINF, TINF, PINF	MACH, REN
5. MACH, TINF, PINF	VINF, REN

② INPUT AS 1/FT FOR ENGLISH UNITS AND 1/M FOR METRIC UNITS

③ INPUT AS FT FOR ENGLISH UNITS AND M FOR METRIC UNITS

④ INPUT AS FT/SEC FOR ENGLISH UNITS AND M/SEC FOR METRIC UNITS

⑤ INPUT AS LB/FT² FOR ENGLISH UNITS AND N/M² FOR METRIC UNITS

Figure 1 Flight Conditions Inputs

NAMELIST REFQ

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
SREF	-	REFERENCE AREA	L*L	②
LREF	-	REFERENCE LENGTH (LONGITUDINAL)	L	③
LATREF	-	REFERENCE LENGTH (LATERAL-DIRECTIONAL)	L	LREF
ROUGH	①	SURFACE ROUGHNESS HEIGHT	L ④	0.
RHR		ROUGHNESS HEIGHT RATING	-	0.
XCG		LONGITUDINAL POSITION OF C.G. (+AFT)	L	0.
ZCG		VERTICAL POSITION OF C.G. (+UP)	L	0.
SCALE	-	VEHICLE SCALE FACTOR (MULTIPLIER TO GEOMETRY)	-	1.
BLAYER	-	BOUNDARY LAYER TYPE: TURB FOR FULLY TURBULENT, NATURAL FOR NATURAL TRANSITION	-	TURB

① EITHER CAN BE USED

② DEFAULT IS BODY MAXIMUM CROSS-SECTIONAL AREA. IF NO BODY IS INPUT, MAXIMUM FIN PANEL AREA IS USED.

③ DEFAULT IS BODY MAXIMUM DIAMETER. IF NO BODY IS INPUT, MAXIMUM FIN PANEL MEAN GEOMETRIC CHORD IS USED.

④ INPUT AS INCHES FOR ENGLISH UNITS AND CENTIMETERS FOR METRIC UNITS.

Figure 2 Reference Quantity Inputs

NAMelist AXIBOD
OPTION 1 INPUTS

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
XO OR X0	-	LONGITUDINAL COORDINATE AT NOSE TIP	L	0.
TNOSE	-	NOSE SHAPE NAME: CONICAL, CONE, OGIVE, POWER, HAACK, OR KARMAN	-	OGIVE
POWER	-	EXPONENT, n , FOR POWER SERIES SHAPES, $(r/R) = (x/L)^n$	-	0.
LNOSE	-	NOSE LENGTH	L	-
DNOSE	-	NOSE SECTION BASE DIAMETER	L	1.0
BNOSE	-	NOSE BLUNTNESS RADIUS OR TRUNCATED NOSE RADIUS	L	0.
TRUNC	-	TRUNCATION FLAG (.TRUE. IF NOSE IS TRUNCATED)	-	.FALSE.
LCENTR	-	CENTERBODY LENGTH	L	0.
DCENTR	-	CENTERBODY BASE DIAMETER	L	DNOSE
TAFT	-	AFTERBODY SHAPE NAME: CONICAL, CONE, OR OGIVE	-	CONICAL
LAFT	① -	AFTERBODY LENGTH	L	0.
DAFT④	-	AFTERBODY BASE DIAMETER	L	-
DEXIT	-	DIAMETER OF NOZZLE EXIT	L	-
BASE	-	BASE-JET PLUME INTERACTION FLAG (.TRUE. IF CALCULATIONS DESIRED)	-	.FALSE.
BETAN	② -	NOZZLE EXIT ANGLE	DEG	-
JMACH	20	JET MACH NUMBER AT NOZZLE EXIT	-	-
PRAT	20	JET TO FREESTREAM STATIC PRESSURE RATIO	-	-
TRAT	20	JET TO FREESTREAM STAGNATION TEMPERATURE RATIO	-	-

- ① AFT BODY MUST NOT BE CYLINDRICAL (i.e. **DAFT** NOT EQUAL TO **DCENTR**)
- ② ONLY REQUIRED IF BASE-JET PLUME INTERACTION CALCULATIONS DESIRED. (**DEXIT** MUST NOT EQUAL ZERO)
- ③ **JMACH**, **PRAT**, AND **TRAT** ARE SPECIFIED FOR EACH FREESTREAM MACH NUMBER OR VELOCITY INPUT IN NAMelist \$FLTCON
- ④ **DAFT** MUST BE NON-ZERO

Figure 3a Axisymmetric Body Geometry Inputs - Option 1

NAMelist AXIBOD
OPTION 2 INPUTS (USE ONLY IF MACH > 1.2)

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
XO OR X0	-	LONGITUDINAL COORDINATE AT NOSE TIP	L	0.
BNOSE	-	NOSE BLUNTNESs RADIUS OR TRUNCATED NOSE RADIUS	L	0.
TRUNC	-	TRUNCATION FLAG (.TRUE. IF NOSE IS TRUNCATED)	-	.FALSE.
DEXIT	-	DIAMETER OF NOZZLE EXIT	L	-
NX	-	NUMBER OF INPUT STATIONS	-	-
X ①	50	LONGITUDINAL COORDINATES	L	-
R	50	RADIUS AT EACH X STATION	L	-
DISCON	20	INDICES OF X STATIONS WHERE THE SURFACE SLOPE IS DISCONTINUOUS	-	-

① X(NX) MUST BE END OF BODY

Figure 3b Axisymmetric Body Geometry Inputs - Option 2

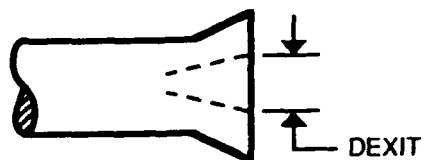
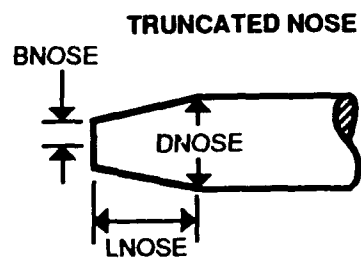
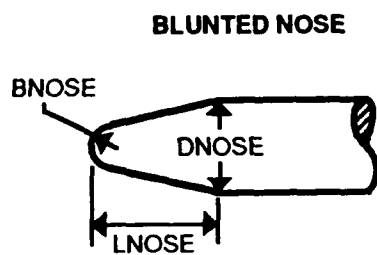
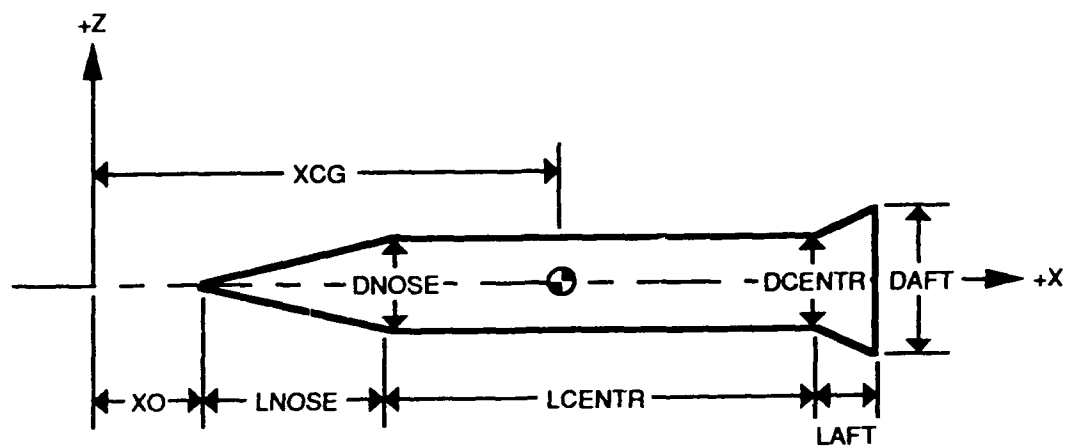
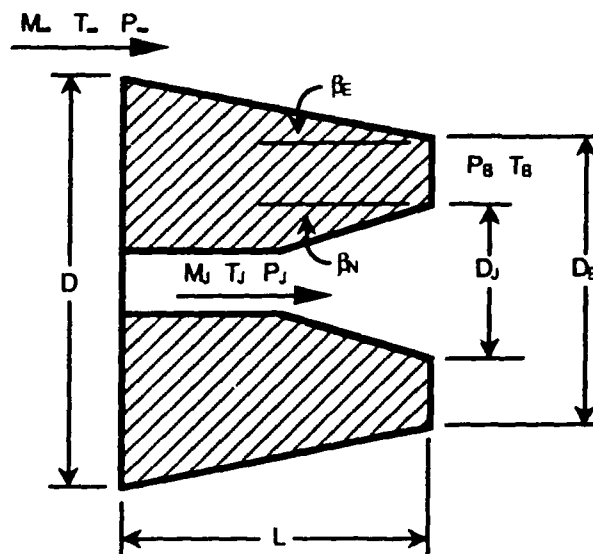


Figure 4 Body Geometry Inputs



Input Parameter	Symbol	Min. Value	Max. Value
Boattail shape	--	Cylinder, Cone, Ogive	
Boattail fineness ratio	L/D	0	2
Boattail terminal angle	β_E	0°	12°
Jet pressure ratio	P_J/P_∞	0	10
Freestream Mach number	M_∞	2	5
Angle of Attack	α	0°	8°
Jet Mach number	M_J	$M_\infty - 1$	$M_\infty + 1$
Nozzle terminal angle	β_N	5°	25°
Jet diameter ratio	D_J/D_B	0.80	0.95
Jet temperature ratio	$T_{tj}/T_{t\infty}$	4	10

Note: If input parameter is not between minimum and maximum value the code will extrapolate

Figure 5 Base-Jet Plume Interaction Parameters

NAMelist ELLBOD
OPTION 1 INPUTS

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
XO OR X0	-	LONGITUDINAL COORDINATE AT NOSE TIP	L	0.
TNOSE	-	NOSE SHAPE NAME: CONICAL, CONE, OGIVE, POWER, HAACK, OR KARMAN	-	OGIVE
POWER	-	EXPONENT, n , FOR POWER SERIES SHAPES, $(r/R) = (x/L)^n$	-	0.
LNOSE	-	NOSE LENGTH	L	-
WNOSE	-	NOSE SECTION BASE WIDTH	L	1.0
BNOSE	-	NOSE BLUNTNESS RADIUS OR TRUNCATED NOSE RADIUS	L	0.
TRUNC	-	TRUNCATION FLAG (.TRUE. IF NOSE IS TRUNCATED)	-	.FALSE.
ENOSE	-	ELLIPTICITY AT NOSE BASE (H/W)	-	1.0
LCENTR	-	CENTERBODY LENGTH	L	0.
WCENTR	-	CENTERBODY BASE WIDTH	L	WNOSE
ECENTR	-	ELLIPTICITY AT CENTERBODY BASE (H/W)	-	1.0
TAFT	-	AFTERBODY SHAPE NAME: CONICAL, CONE, OR OGIVE	-	CONICAL
LAFT	①	AFTERBODY LENGTH	L	0.
WAFT		AFTERBODY BASE WIDTH	L	-
EAFT		ELLIPTICITY AT AFT BODY BASE (H/W)	-	1.0
DEXIT		DIAMETER OF NOZZLE EXIT	L	-

① AFT BODY MUST NOT BE CYLINDRICAL (i.e. **WAFT** NOT EQUAL TO **WCENTR**)

Figure 6a Elliptical Body Geometry Inputs - Option 1

NAMelist ELLBOD
OPTION 2 INPUTS (USE ONLY IF MACH > 1.2)

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
XO OR X0	-	LONGITUDINAL COORDINATE AT NOSE TIP	L	0.
BNOSE	-	NOSE BLUNTNESS RADIUS OR TRUNCATED NOSE RADIUS	L	0.
TRUNC	-	TRUNCATION FLAG (.TRUE. IF NOSE IS TRUNCATED)	-	.FALSE.
DEXIT	-	DIAMETER OF NOZZLE EXIT	L	-
NX	-	NUMBER OF INPUT STATIONS	-	-
X ①	50	LONGITUDINAL COORDINATES	L	-
W ②	50	BODY HALF-WIDTH AT EACH X STATION	L	-
DISCON	20	INDICES OF X STATIONS WHERE THE SURFACE SLOPE IS DISCONTINUOUS	-	-
H ②	50	BODY HALF-HEIGHT AT EACH X STATION	L	-
ELLIP ②	50	BODY HEIGHT TO WIDTH RATIO AT EACH X STATION	-	1.0

① X(NX) MUST BE END OF BODY

② ONE OF THE FOLLOWING COMBINATIONS IS REQUIRED:
W AND H, W AND ELLIP, OR H AND ELLIP

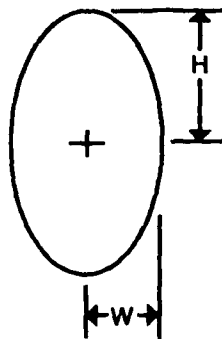


Figure 6b Elliptical Body Geometry Inputs - Option 2

NAMELIST PROTUB

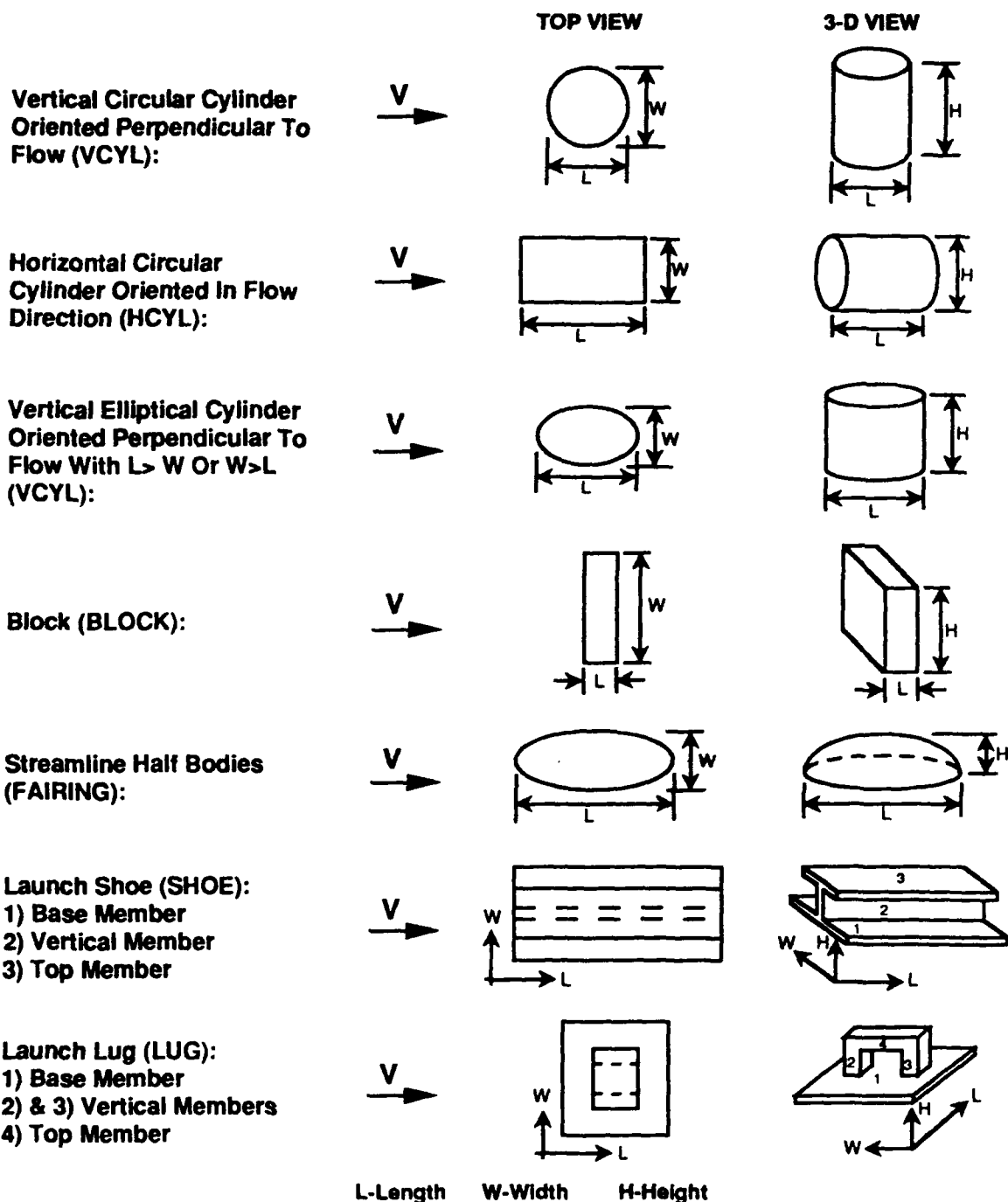
VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
NPROT	-	NUMBER OF PROTUBERANCE SETS (20 MAXIMUM)	-	0.
PTYPE	20	PROTUBERANCE SET TYPE: VCYL, HCYL, BLOCK, FAIRING, LUG, OR SHOE ②	-	-
XPROT	20	LONGITUDINAL DISTANCE FROM MISSILE NOSE TO PROTUBERANCE SET	L	-
NLOC ①	20	NUMBER OF PROTUBERANCES IN EACH PROTUBERANCE SET	-	0.
LPROT	100	LENGTH OF EACH MEMBER OR PROTUBERANCE	L	-
WPROT	100	WIDTH OF EACH MEMBER OR PROTUBERANCE	L	-
HPROT	100	HEIGHT OF EACH MEMBER OR PROTUBERANCE	L	-
OPROT	100	VERTICAL OFFSET OF EACH MEMBER OR PROTUBERANCE	L	0.

① **NLOC** ACCOUNTS FOR IDENTICAL PROTUBERANCES (SAME SIZE AND SHAPE) LOCATED AROUND THE BODY AT THE SAME AXIAL LOCATION.

② **LUG** TYPE HAS 4 MEMBERS. **SHOE** TYPE HAS 3 MEMBERS. **LPROT**, **WPROT**, **HPROT**, AND **OPROT** MUST BE SPECIFIED FOR EACH MEMBER.

③ INPUT FOR EACH PROTUBERANCE (VCYL, HCYL, BLOCK, OR FAIRING TYPE) OR EACH PROTUBERANCE MEMBER (LUG AND SHOE TYPE)

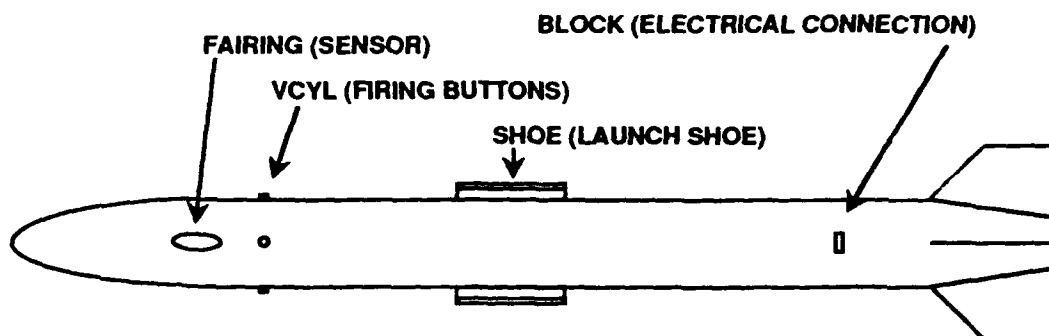
Figure 7 Protuberance Inputs



Note; Length, width, height, and offset must be input for each member of launch lug and launch shoe types

Note; Offset is the perpendicular distance from the missile mold line to the bottom of the protuberance or protuberance member

Figure 8 Protuberance Shapes Available



```

CASEID PROTUBERANCE EXAMPLE CASE
DIM IN
NO LAT
$REFQ XCG=39.0,$
$FLTCON NMACH=3.,MACH=0.4,0.8,2.0,
        REN=3.E06,3.E06,3.E06,ALT=0.0,
        NALPHA=5.,ALPHA=-8.,-4.,0.,4.,8.,$
$AXIBOD TNOSE=OGIVE,LNOSE=12.0,DNOSE=12.0,
        LCENTR=54.0,DCENTR=12.0,
        TAFT=CONE,LAFT=12.0,DAFT=6.0,DEXIT=5.0,$
$PROTUB NPROT=4.,
        PTYPE=FAIRING,VCYL,SHOE,BLOCK,
        XPROT=14.,22.,39.,56.,
        NLOC=2.,4.,2.,1.,
        LPROT=5.,1.,10.,10.,10.,0.5,
        WPROT=2.,1.,4.,0.25,1.,1.,
        HPROT=2.,0.5,0.1,0.75,0.25,0.25,
        OPROT=0.,0.,0.,0.1,0.85,0.,$
$FINSET1 SSPAN=0.0,9.0,CHORD=14.0,8.0,
        XLE=64.0,SWEEP=0.0,STA=1.0,NPANEL=4.,
        PHIF=45.,135.,225.,315.,$
PRINT GEOM BODY
PRINT AERO BODY
SAVE
NEXT CASE

```

NOTE; Length, Width, and Height is input for each member of the launch shoe

Figure 9 Protuberance Example Input File

**NAMELIST FINSETn
NOMINAL INPUTS**

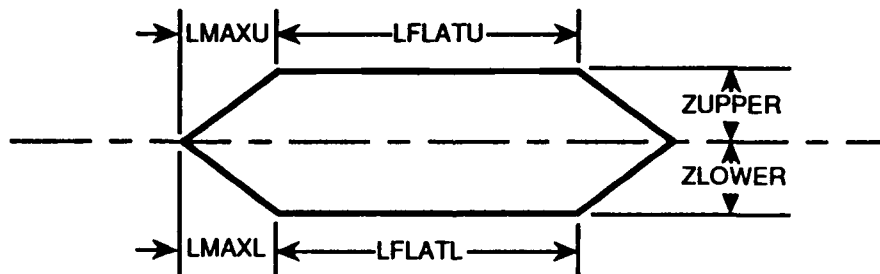
VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
SECTYP	-	TYPE OF SECTION TO BE DEFINED: HEX, NACA, ARC, OR USER	-	HEX
SSPAN ①	10	SEMI-SPAN	L	-
CHORD	10	PANEL CHORD LENGTH AT EACH SSPAN	L	-
XLE	10	DISTANCE FROM NOSE TIP TO CHORD LEADING EDGE AT EACH SSPAN	L	0.0
SWEEP ②	10	SWEEPBACK ANGLE AT EACH SSPAN	DEG	0.0
STA	10	CHORD STATION USED IN MEASURING SWEEP AT EACH SSPAN (0.0=LEADING EDGE, 1.0=TRAILING EDGE)	-	1.0
LER ③	10	PANEL LEADING EDGE RADIUS AT EACH SPAN STATION	L	0.0
NPANEL	-	NUMBER OF PANELS IN SET (1-8)	-	4
PHIF	8	ROLL ANGLE OF EACH FIN MEASURED CLOCKWISE FROM TOP VERTICAL CENTER LOOKING FORWARD	DEG	④
GAM	8	DIHEDRAL OF EACH FIN (POSITIVE WHEN PHIF IS INCREASED, SEE FIG. 12)	DEG	0.0
SKEW	-	ANGLE BETWEEN THE Y AXIS AND THE FIN HINGE LINE (POSITIVE SWEEP BACK)	DEG	0.0
CFOC	10	FLAP CHORD TO FIN CHORD RATIO	-	1.0

- ① IF SSPAN(1)=0.0, INPUTS ARE RELATIVE TO ROOT CHORD NOT BODY CENTERLINE
 ② IF USING SWEEP, SPECIFY ONLY XLE(1); IF USING XLE DO NOT SPECIFY SWEEP
 ③ NOT REQUIRED FOR NACA AIRFOILS, REQUIRED FOR USER AIRFOILS
 ④ IF PHIF NOT INPUT THE NUMBER OF PANELS ARE EVENLY SPACED ABOUT THE BODY.

Figure 10a Fin Geometry Inputs - Nominal

**NAMelist FINSETn
OPTIONAL INPUTS**

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
ZUPPER	10	MAXIMUM THICKNESS TO CHORD RATIO OF UPPER SURFACE	-	0.025
ZLOWER	10	MAXIMUM THICKNESS TO CHORD RATIO OF LOWER SURFACE	-	ZUPPER
LMAXU	10	FRACTION OF CHORD FROM SECTION LEADING EDGE TO MAXIMUM THICKNESS OF UPPER SURFACE	-	0.5
LMAXL	10	FRACTION OF CHORD FROM SECTION LEADING EDGE TO MAXIMUM THICKNESS OF LOWER SURFACE	-	LMAXU
LFLATU	10	FRACTION OF CHORD OF CONSTANT THICKNESS SECTION ON UPPER SURFACE	-	0.0
LFLATL	10	FRACTION OF CHORD OF CONSTANT THICKNESS SECTION ON LOWER SURFACE	-	LFLATU



NOTE; THESE PARAMETERS MUST BE INPUT AT EACH SPAN STATION

Figure 10b Fin Geometry Inputs - Optional

**NAMelist FINSETn
INPUTS FOR "USER" SECTIONS**

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
XCORD	50	CHORD STATION, FRACTION OF CHORD FROM LEADING EDGE	-	-
MEAN ①	50	DISTANCE BETWEEN THE MEAN LINE AND CHORD LINE AT EACH XCORD, FRACTION OF CHORD	-	-
THICK ①	50	THICKNESS TO CHORD RATIO AT EACH XCORD	-	-
YUPPER ①	50	UPPER SURFACE COORDINATES, FRACTION OF CHORD, AT EACH XCORD	-	-
YLOWER ①	50	LOWER SURFACE COORDINATES, FRACTION OF CHORD, AT EACH XCORD	-	-

NOTE: ALL VARIABLES ARE EXPRESSED AS FRACTIONS OF CHORD
LEADING EDGE RADIUS (VARIABLE LER) MUST BE DEFINED

- ① EITHER MEAN AND THICK OR YUPPER AND YLOWER ARE REQUIRED
- ② THE AIRFOIL SECTION MUST BE CLOSED. THIS MEANS THE FINAL CHORD STATION INPUT MUST HAVE EITHER THICK=0.0 OR YUPPER=YLOWER.

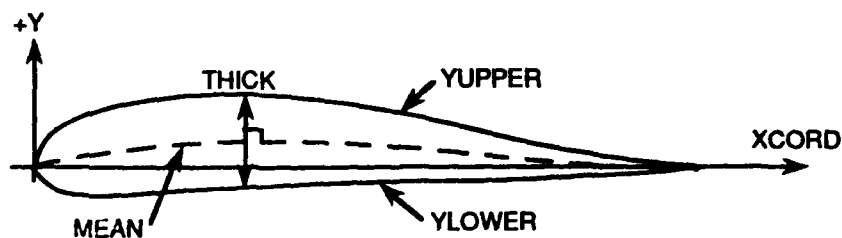
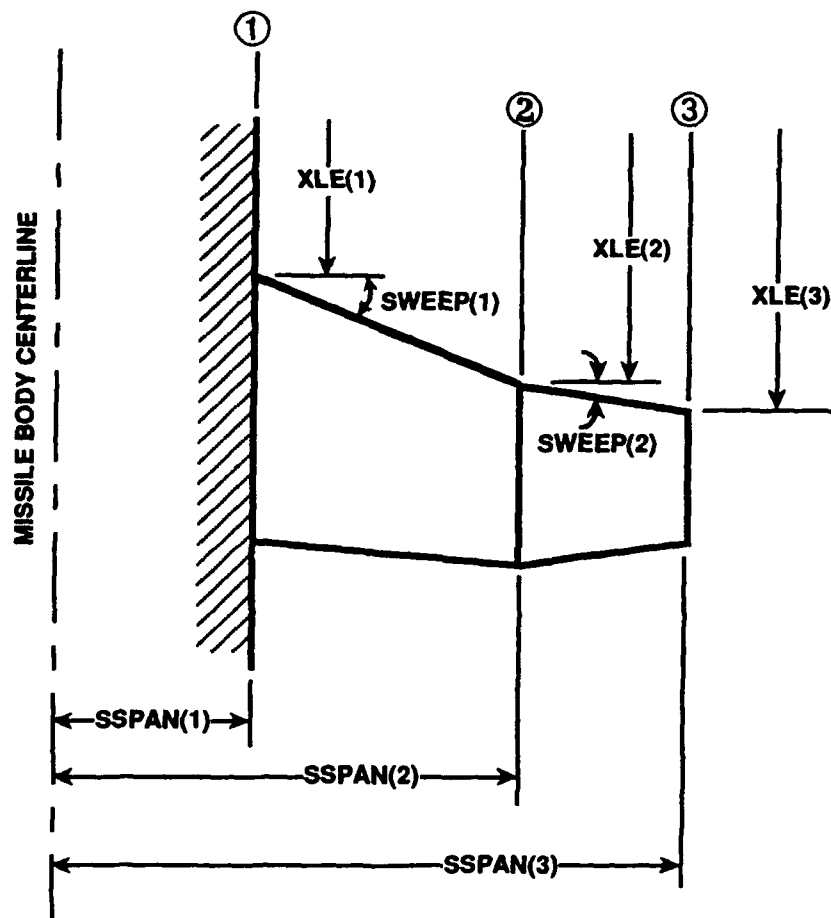


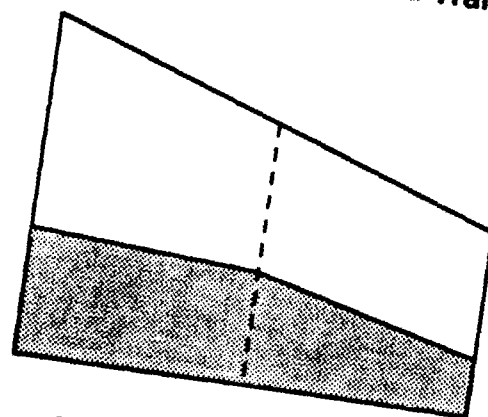
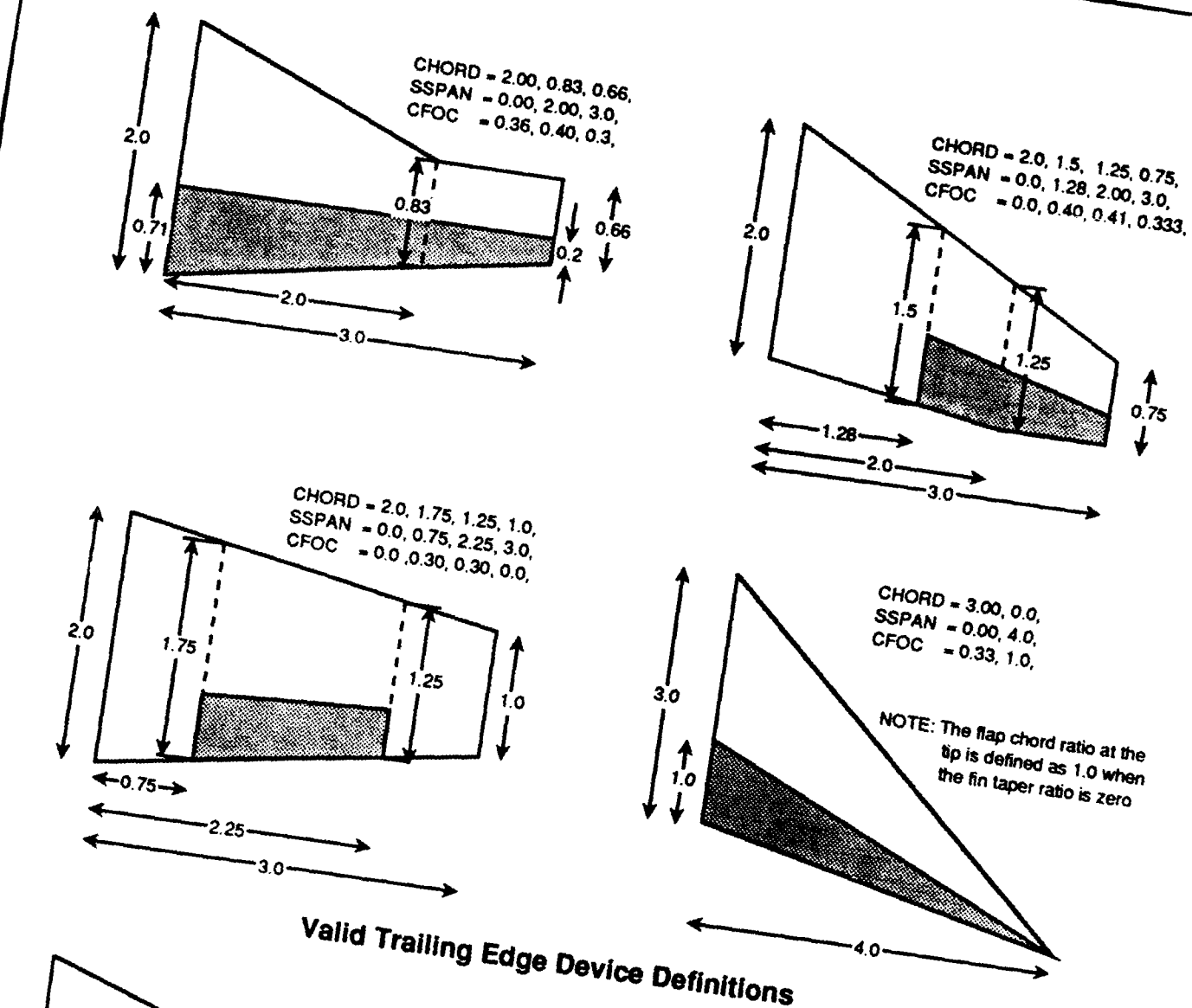
Figure 10c Fin Geometry Inputs - User Airfoils



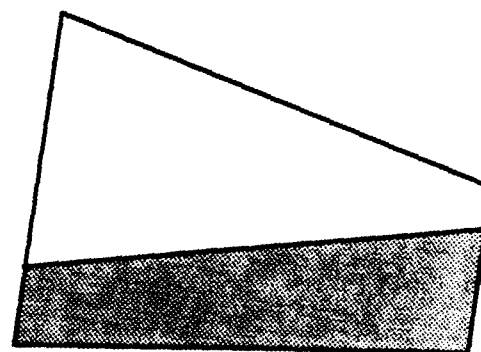
NOTE; XLE IS MEASURED FROM NOSE TIP

IF SSPAN(1) IS INPUT AS ZERO, SSPAN INPUTS
ARE RELATIVE TO BODY SURFACE MOLD LINE

Figure 11a Selecting Panel Break Points



• Cranked Hinge Line Is Invalid



• Trailing Edge Device With Taper Ratio Greater Than One Is Invalid

Invalid Trailing Edge Device Definitions

Figure 11b Definition Of Plain Trailing Edge Devices

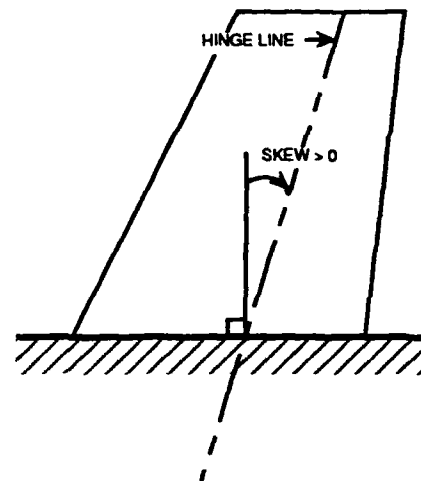
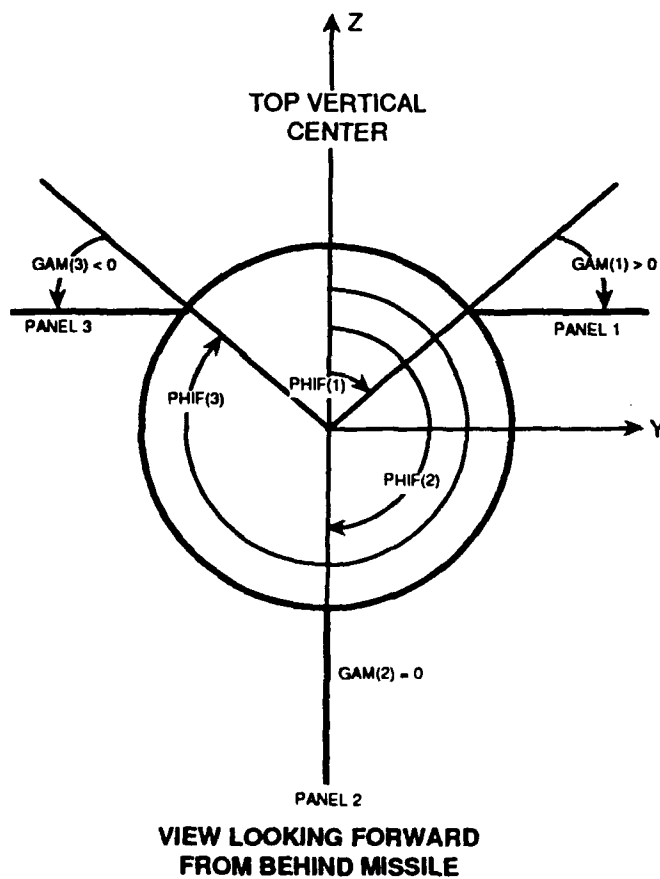
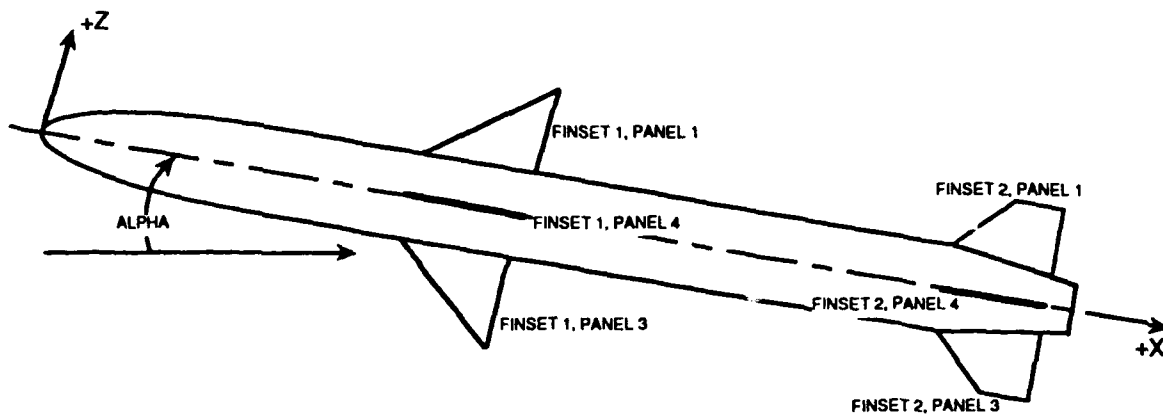
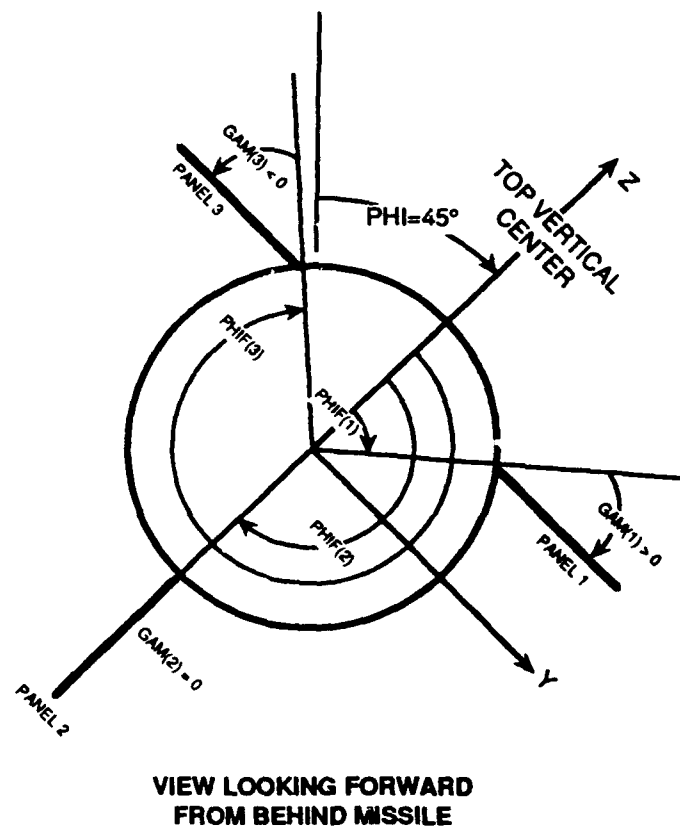


Figure 12 Fin Numbering and Orientation



PHI IS THE BODY ROLL ANGLE
PHIF IS THE FIN PANEL ROLL ANGLE

Figure 13 Roll Attitude vs Fin Orientation

NAMELIST DEFLCT

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
DELTA1 ①	8	DEFLECTION ANGLES FOR EACH PANEL IN FIN SET 1 (SUBSCRIPT IS FIN NUMBER)	DEG	0.
DELTA2 ①	8	DEFLECTION ANGLES FOR EACH PANEL IN FIN SET 2 (SUBSCRIPT IS FIN NUMBER)	DEG	0.
DELTA3 ①	8	DEFLECTION ANGLES FOR EACH PANEL IN FIN SET 3 (SUBSCRIPT IS FIN NUMBER)	DEG	0.
DELTA4 ①	8	DEFLECTION ANGLES FOR EACH PANEL IN FIN SET 4 (SUBSCRIPT IS FIN NUMBER)	DEG	0.
XHINGE	4	DISTANCE FROM COORDINANT SYSTEM ORIGIN TO PANEL HINGE LINE FOR EACH FIN SET	L	$XO + XLE + CR/2$ ②
SKEW	4	SWEEPBACK OF HINGE LINE FOR EACH FIN SET	DEG	0.

① PANEL NUMBERING IS SHOWN IN FIGURE 12

② DEFAULT IS AT ONE-HALF THE EXPOSED ROOT CHORD, AS MEASURED FROM THE COORDINANT SYSTEM ORIGIN.

NOTE: A POSITIVE DEFLECTION ANGLE PRODUCES A NEGATIVE BODY AXIS
ROLLING MOMENT AT ZERO ANGLE OF ATTACK

Figure 14 Panel Deflection Inputs

NAMELIST TRIM

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
SET	-	FIN SET TO BE USED FOR TRIM	-	1.
PANL1	-	.TRUE. IF PANEL TO BE USED	-	.FALSE.
PANL2	-	.TRUE. IF PANEL TO BE USED	-	.FALSE.
PANL3	-	.TRUE. IF PANEL TO BE USED	-	.FALSE.
PANL4	-	.TRUE. IF PANEL TO BE USED	-	.FALSE.
PANL5	-	.TRUE. IF PANEL TO BE USED	-	.FALSE.
PANL6	-	.TRUE. IF PANEL TO BE USED	-	.FALSE.
PANL7	-	.TRUE. IF PANEL TO BE USED	-	.FALSE.
PANL8	-	.TRUE. IF PANEL TO BE USED	-	.FALSE.
DELMIN	-	MINIMUM NEGATIVE DEFLECTION	DEG	-25.
DELMAX	-	MAXIMUM POSITIVE DEFLECTION	DEG	+20.
ASYM	8	.TRUE. IF PANEL WITH SUBSCRIPT IS TO BE DEFLECTED OPPOSITE TO NORMAL SIGN CONVENTION (ASYMMETRIC DEFLECTIONS)	-	.FALSE.

① DEFAULTS APPLY ONLY IF ALL PANL# DATA ARE NOT INPUT OR .FALSE.

② BOTH DELMIN AND DELMAX MUST BE SPECIFIED

Figure 15 Trim Inputs

NAMELIST INLET

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
NIN	-	NUMBER OF INLETS (MAXIMUM=20)	-	-
INTYPE	-	TYPE OF INLET: 2D TOP , 2D SIDE , OR AXI ①	-	-
XINLT	-	LONGITUDINAL DISTANCE FROM NOSE TIP TO INLET LEADING EDGE	L	-
XDIV	-	LONGITUDINAL DISTANCE FROM INLET LEADING EDGE TO DIVERTER LEADING EDGE	L	-
HDIV	-	HEIGHT OF DIVERTER LEADING EDGE	L	-
LDIV	-	LENGTH OF DIVERTER	L	-
PHI ②	20	INLET ROLL ORIENTATIONS	DEG	-
X	5	INLET LONGITUDINAL POSITIONS RELATIVE TO INLET LEADING EDGE	L	-
H ④	5	INLET HEIGHTS AT THE LONGITUDINAL POSITIONS	L	-
W ⑤				
COVER	-	IF COVER=.TRUE. INLETS ARE COVERED	-	.FALSE.
RAMP	-	EXTERNAL COMPRESSION RAMP ANGLE	DEG	-
ADD	-	IF ADD=.TRUE. INLET ADDITIVE DRAG IS CALCULATED	-	.FALSE.
MFR ⑥	20	MASS FLOW RATIO FOR EACH MACH NUMBER ($0 \leq \text{MFR} \leq 1.0$)	-	-

① 2D**TOP**: TWO DIMENSIONAL TOP MOUNTED, 2D**SIDE**: TWO DIMENSIONAL SIDE MOUNTED, **AXI**: AXISYMMETRIC

② ROLL POSITIONS FROM TCP VERTICAL CENTER. SAME CONVENTION AS FIN ROLL POSITIONS.

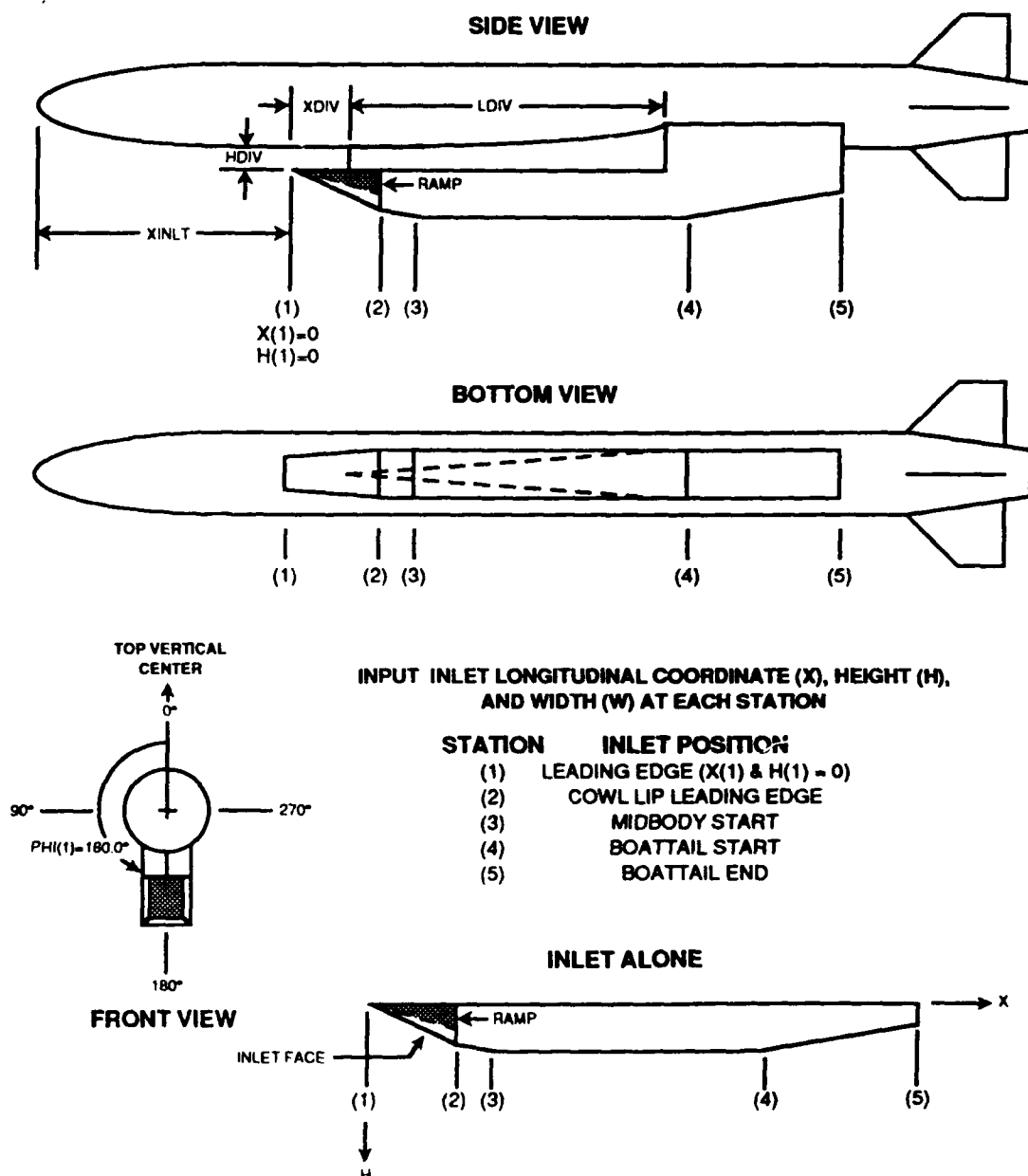
③ SPECIFY X, H, AND W AT FIVE INLET LOCATIONS: 1) LEADING EDGE, 2) COWL LIP LEADING EDGE, 3) MIDBODY START, 4) START OF BOATTAIL, 5) END OF BOATTAIL

④ NOT REQUIRED IF INTYPE=**AXI**

⑤ IF INTYPE=**AXI**, W=DIAMETER

⑥ SPECIFY MASS FLOW RATIO, **MFR**, FOR EACH FREE STREAM MACH NUMBER OR VELOCITY GIVEN IN \$FLTCON (ONLY REQUIRED IF **ADD** = .TRUE.)

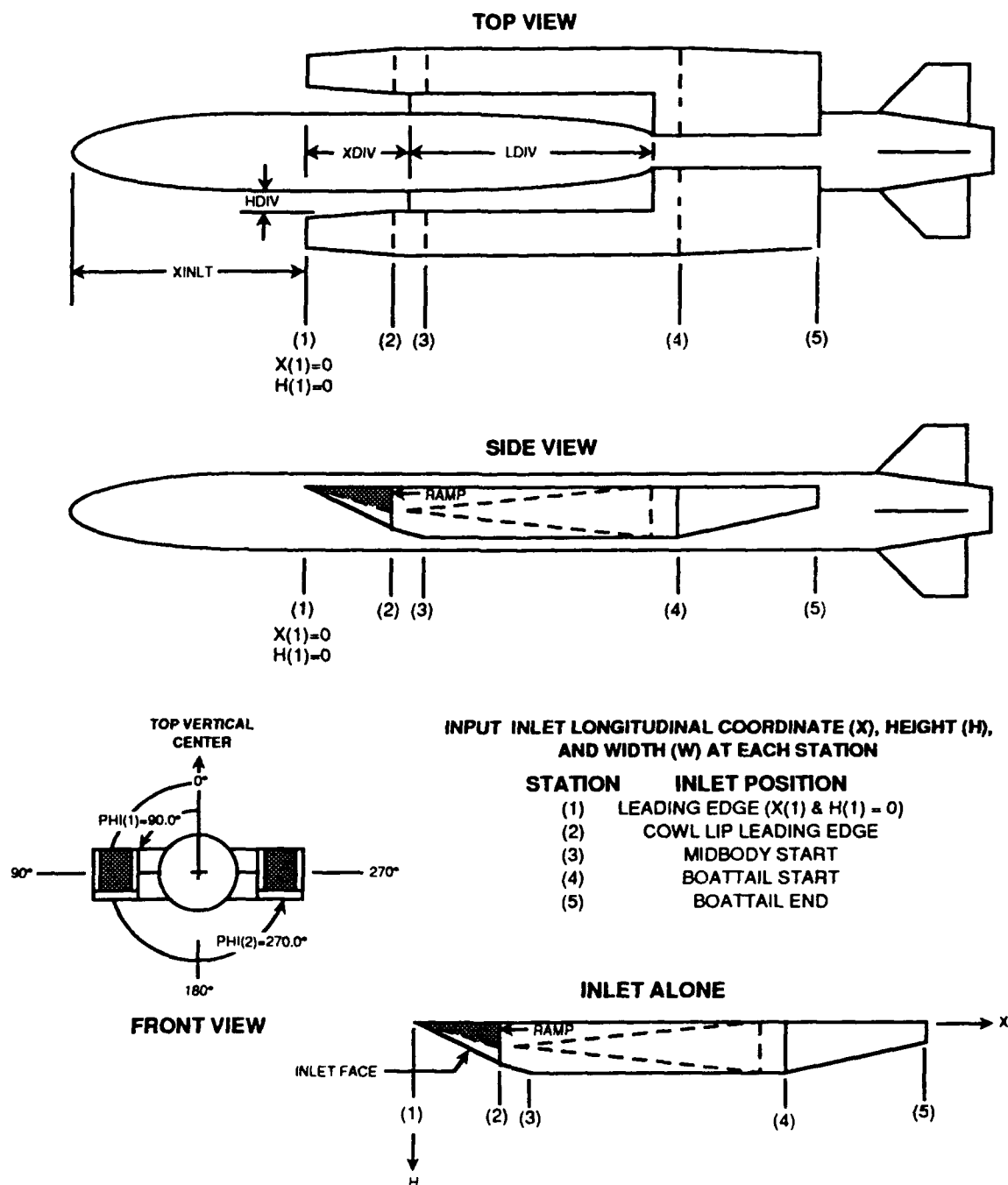
Figure 16 Inlet Geometry Inputs



NOTES:

- INLET ROLL ORIENTATION IS SAME CONVENTION AS FIN ROLL ORIENTATION.
- RAMP IS THE EXTERNAL COMPRESSION RAMP ANGLE (SHOWN SHADED IN THE SIDE VIEW)
- HEIGHT OF THE DIVERTER IS SPECIFIED AT THE DIVERTER LEADING EDGE
- THE DIVERTER WIDTH IS EQUAL TO THE INLET WIDTH AT LDIV
- IF INLET IS COVERED (COVER=.TRUE.) A PLUG IS PLACED BETWEEN STATIONS 1 AND 2 FLUSH WITH THE INLET FACE

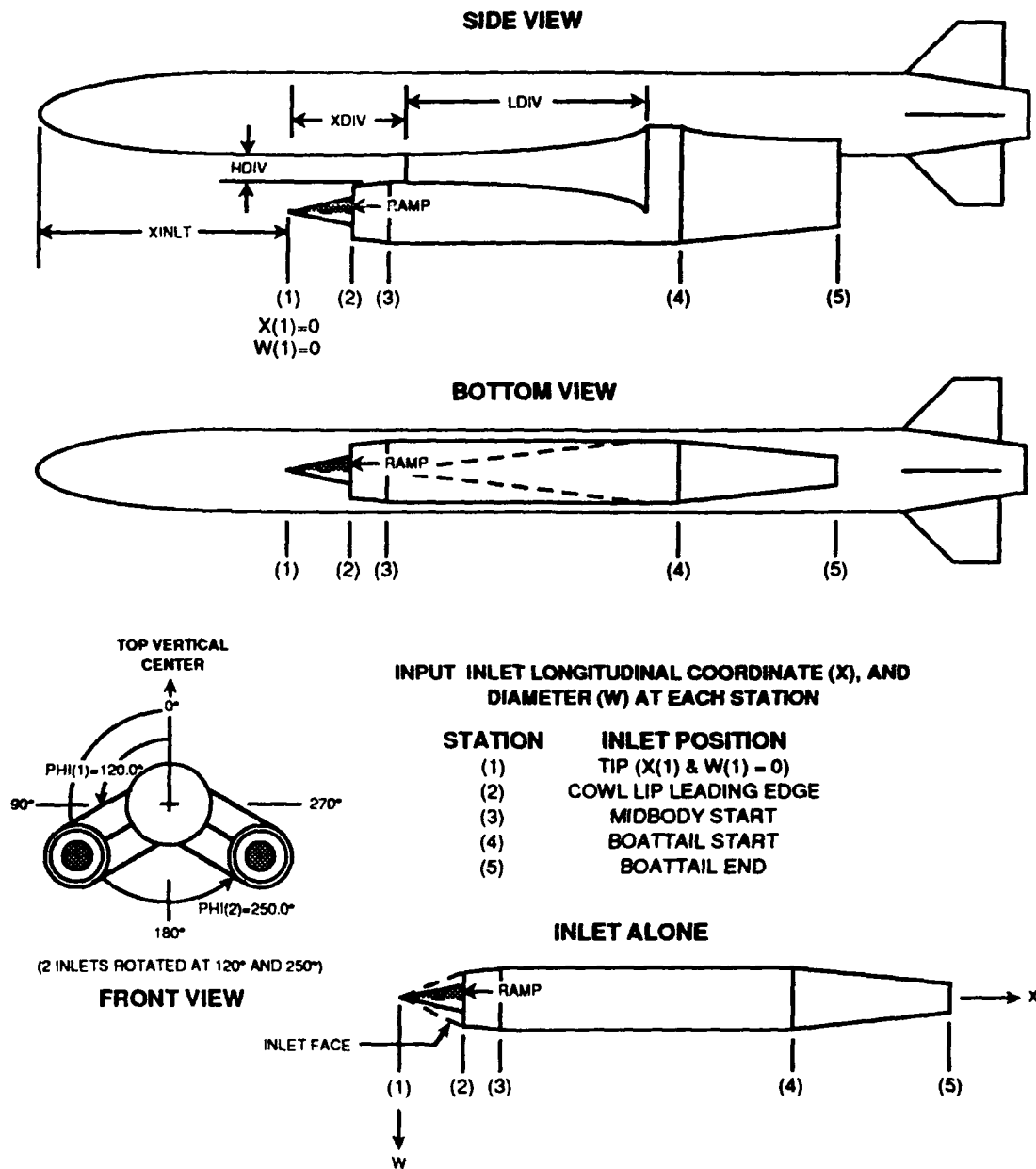
Figure 17a Top-Mounted 2-D Inlet/Diverter Geometry



NOTES:

- INLET ROLL ORIENTATION IS SAME CONVENTION AS FIN ROLL ORIENTATION.
- RAMP IS THE EXTERNAL COMPRESSION RAMP ANGLE (SHOWN SHADED IN THE SIDE VIEW)
- HEIGHT OF THE DIVERTER IS SPECIFIED AT THE DIVERTER LEADING EDGE
- THE DIVERTER WIDTH IS EQUAL TO THE INLET WIDTH AT LDIV
- IF INLET IS COVERED (COVER=.TRUE.) A PLUG IS PLACED BETWEEN STATIONS 1 AND 2 FLUSH WITH THE INLET FACE

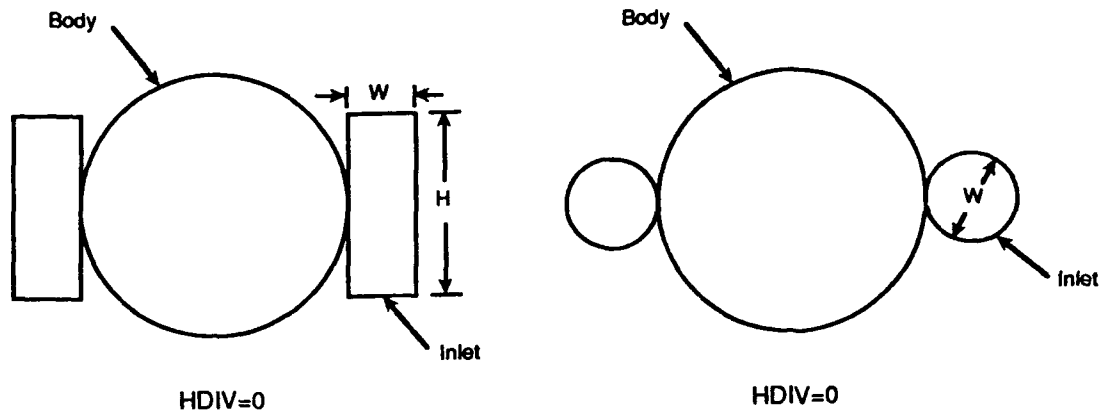
Figure 17b Side-Mounted 2-D Inlet/Diverter Geometry



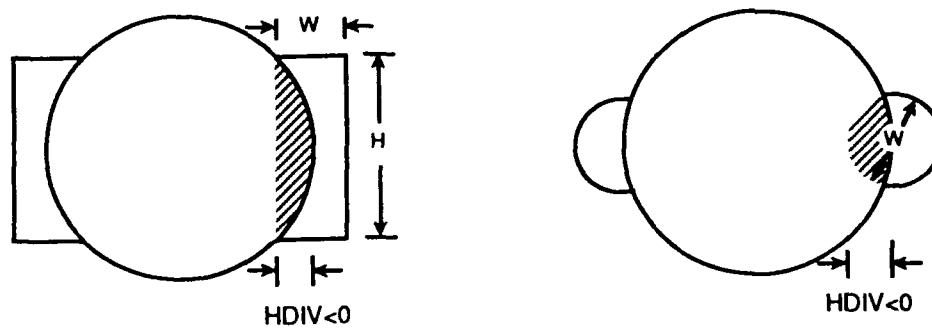
NOTES:

- INLET ROLL ORIENTATION IS SAME CONVENTION AS FIN ROLL ORIENTATION.
- RAMP IS THE EXTERNAL COMPRESSION CONE HALF-ANGLE (SHOWN SHADED IN THE SIDE VIEW)
- HEIGHT OF THE DIVERTER IS SPECIFIED AT THE DIVERTER LEADING EDGE
- THE DIVERTER WIDTH IS EQUAL TO THE INLET DIAMETER AT LDIV
- IF INLET IS COVERED (COVER=.TRUE.) A PLUG IS PLACED BETWEEN STATIONS 1 AND 2 FLUSH WITH THE INLET FACE

Figure 17c Axisymmetric Inlet/Diverter Geometry



Conformal Inlets



Semi-Submerged Inlets

Figure 17d Geometry Definition For Conformal And Semi-Submerged Inlets

NAMELIST EXPR

VARIABLE NAME	ARRAY DIMENSION	DEFINITION	UNITS	DEFAULT
MACH	-	MACH NUMBER	-	-
NALPHA	-	NUMBER OF ANGLES OF ATTACK (2-20)	-	-
ALPHA	20	ANGLES OF ATTACK FOR DATA	DEG	-
SREF	-	REFERENCE AREA FOR DATA	L*L	①
LREF	-	LONGITUDINAL REFERENCE LENGTH FOR DATA	L	②
LATREF	-	LATERAL REFERENCE LENGTH FOR DATA	L	LREF
XCG	-	LONGITUDINAL C.G. FOR DATA	L	0.
ZCG	-	VERTICAL C.G. FOR DATA	L	0.
CONF	-	CONFIGURATION FOR DATA SELECT ONE OF THE FOLLOWING BODY - BODY F1 - WING F2 - TAIL F3 - THIRD FIN SET F4 - FOURTH FIN SET BF1 - BODY-WING BF12 - BODY-2 FIN SETS BF123 - BODY-3 FIN SETS BF1234 - BODY-4 FIN SETS	-	-
CN	20	C _N DATA VS ALPHA	-	-
CM	20	C _M DATA VS ALPHA	-	-
CA	20	C _A DATA VS ALPHA	-	-
CY	20	C _Y DATA VS ALPHA	-	-
CSN	20	C _N DATA VS ALPHA	-	-
CSL	20	C _L DATA VS ALPHA	-	-

① DEFAULT IS BODY MAXIMUM CROSS-SECTIONAL AREA. IF NO BODY IS INPUT, MAXIMUM FIN PANEL AREA IS USED.

② DEFAULT IS BODY MAXIMUM DIAMETER. IF NO BODY IS INPUT, MAXIMUM FIN PANEL MEAN GEOMETRIC CHORD IS USED.

Figure 18 Experimental Data Inputs

Table 5 Common Block DUMP and WRITE Names

COMMON BLOCK	DUMP NAME	WRITE NAME
ABODIN	BDIN	ABODIN or EBODIN
BDWORK	BDWK	BDWORK
CASEID		CASEID
CONST		CONST
DBODY	DBOD	DBODY
DB1	DB1	DB1
DB12	DB12	DB12
DB123	DB13	DB123
DB1234	DB14	DB1234
DESIG		DESIG
DDFIN1	DF1	DFIN1
DDFIN2	DF2	DFIN2
DDFIN3	DF3	DFIN3
DDFIN4	DF4	DFIN4
DFLAGS		DFLAGS
DUMPF		DUMPF
FLC	FLT	FLC
FSET1	F1IN	FSET1
FSET2	F2IN	FSET2
FSET3	F3IN	FSET3
FSET4	F4IN	FSET4
F1WORK	F1WK	F1WORK
F2WORK	F2WK	F2WORK
F3WORK	F3WK	F3WORK
F4WORK	F4WK	F4WORK
GEOBOD	GEOB	GEOBOD
GEOFS1	F1GM	GEOFS1
GEOFS2	F2GM	GEOFS2
GEOFS3	F3GM	GEOFS3
GEOFS4	F4GM	GEOFS4
INCID		INCID
INLETN	INLI	INLETN
INLTD	INLD	INLTD
INPCON		INPCON
LOGIC		LOGIC
PAERO		PAERO
REFQN	REFQ	REFQN
SBODY	SBOD	SBODY
SB1	SB1	SB1
SB12	SB12	SB12
SB123	SB13	SB123
SB1234	SB14	SB1234
SFIN1	SF1	SFIN1
SFIN2	SF2	SFIN2
SFIN3	SF3	SFIN3
SFIN4	SF4	SFIN4
THERY		THERY
TOTALC	FLCT	TOTALC
TRACE		TRACE
TRIMD		TRIMD
TRIMIN		TRIMIN
UTRIMD		UTRIMD

Table 6 Airfoil Designation Using the NACA Control Card

INPUT NACA DESIGNATION	NACA SERIES AIRFOIL	RESTRICTIONS
0012.25	4-Digit	None. Fractional thickness may be specified.
23118.50	5-Digit	None. Fractional thickness may be specified.
2406-32	4-Digit modified	Sixth digit specifies position of maximum thickness, (%chord/10), and must be a 2, 3, 4, 5, or 6.
43006-65	5-Digit modified	Seventh digit specifies position of maximum thickness, (%chord/10), and must be a 2, 3, 4, 5, or 6.
16-212.25	1-Series	Second digit specifies location of minimum pressure, (%chord/10), and must be a 6, 8, or 9. Fractional thickness may be specified.
64-005 64-205 A=0.6 63A005 652A215 A=0.8 65,2A215 A=0.8	6-Series	Second digit specifies location of minimum pressure, (%chord/10), and must be a 3, 4, 5, or 6. The mean line parameter (A=xx) must be a decimal between 0.1 and 1.0 (Default is 1.0). See Note 1.
3-30.0-2.5-40.1 A B C D	Supersonic	See Note 2. A - Section type: 1=Double Wedge 2=Circular Arc 3=Hexagonal B - Distance from leading edge to position of maximum thickness, % of chord. C - Maximum thickness, % of chord. D - For hexagonal sections, length of surface of constant thickness, % of chord.

Note 1. The program does not distinguish between a 64,2-220 and a 64-220 specification. The difference in coordinates between the two is negligible.

Note 2. All parameters can be expressed to 0.1%. The delimiter "-" must be used.

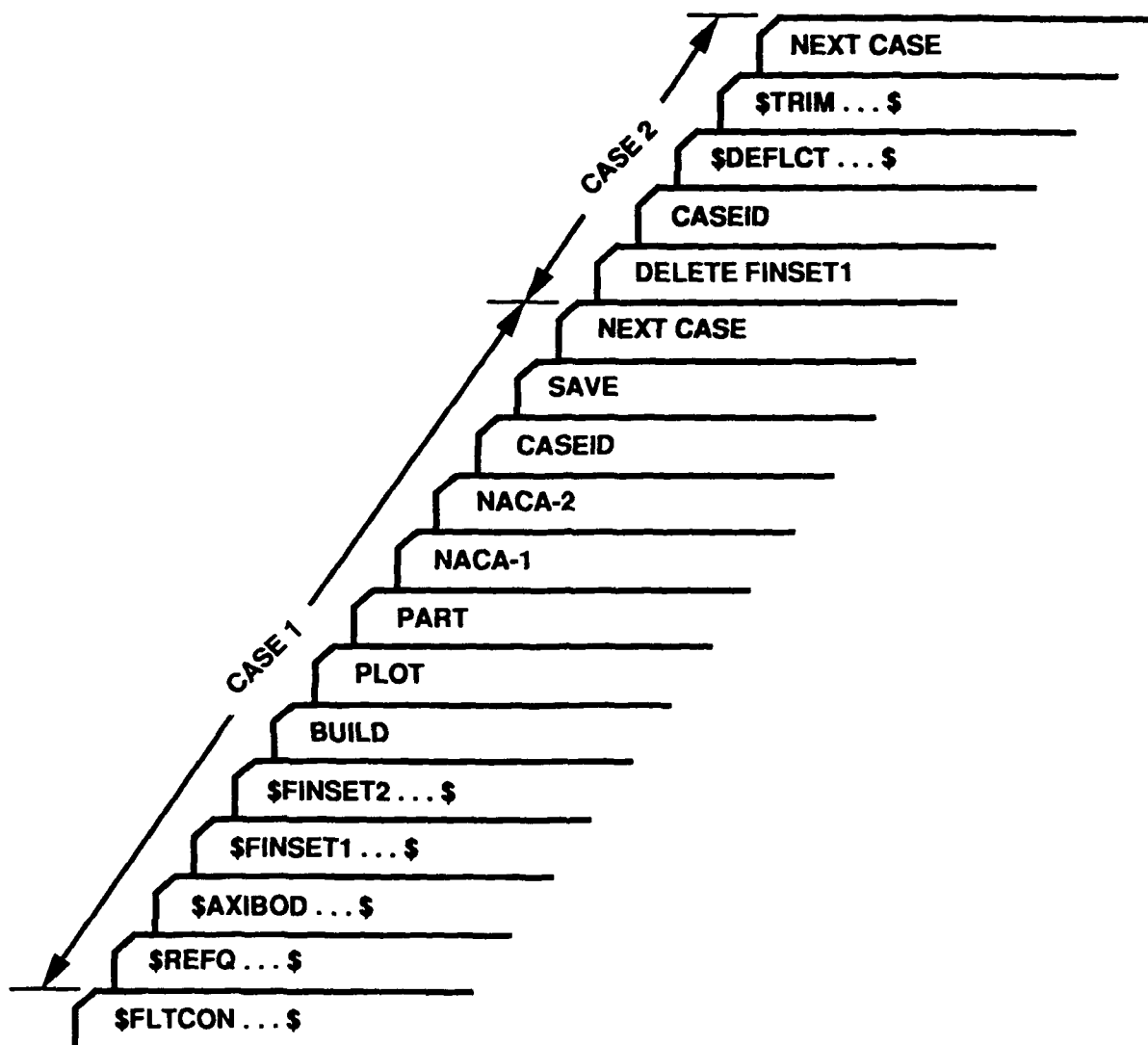


Figure 19 Typical "Stacked" Case Set-up

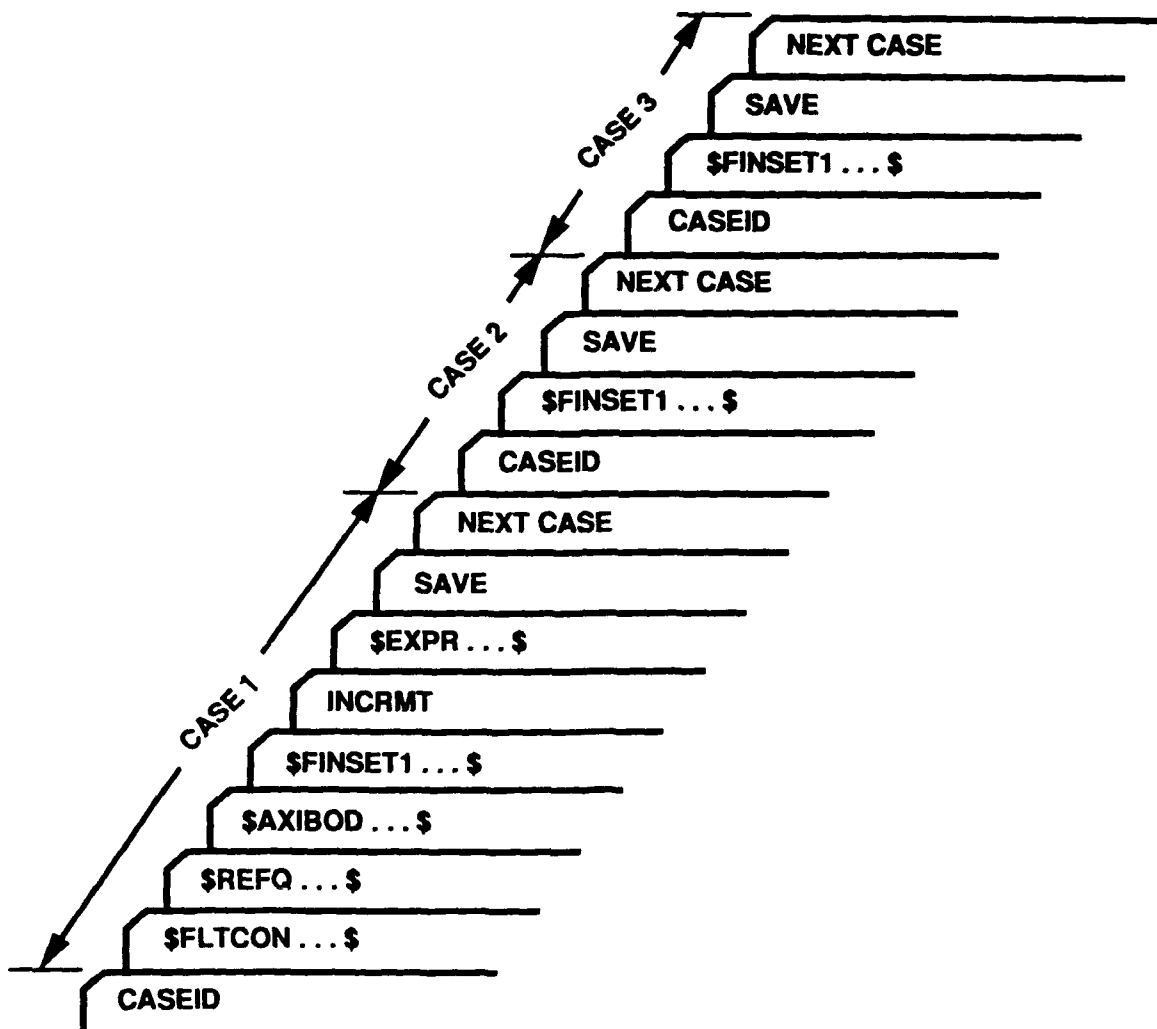


Figure 20 "Configuration Incrementing" Case Set-up

4.0 OUTPUT DESCRIPTION

This section describes the types of output available from the code. In most cases the available output is user selectable, that is, it is not normally provided and must be specifically requested using a specialized control card. This feature permits the user to tailor the code output to fit his particular application without extensive reprogramming. This allows him to find the output that he is interested in without having to wade through output that does not interest him.

The following four types of output are available from the code:

- Nominal output - This output is always provided by the code and consists of output from the input error checking module (CONERR), a listing of the inputs for each case, and the final aerodynamic results for the configuration.
- Partial output - This output details the configuration geometry and the intermediate aerodynamic calculations. Special control cards are available so that the user can select the quantity and types of output desired.
- External data files - This output permits the user to create external data files which can be used in post-processing programs, such as plotting or trajectory programs. Both fixed and user defined format data files can be created with the addition of simple control cards.
- Array dumps and extrapolation messages - This output permits the user to print internal data arrays (DUMP) or to investigate design chart extrapolations during the course of the case execution (PRINT EXTRAP).

The remainder of the section describes each of these output data. Examples of each output page are also included and were created from the example problems, described in Appendix A, which can be used as a model for setting up another, similar configuration or be used as a means to check the proper operation of the code.

4.1 NOMINAL OUTPUT

Without the use of any program options the code will provide three types of output. First, an analysis by the input error checking routine is provided. It lists all input cards provided by the user and identifies any input

errors detected. Second, a listing of all input cards, grouped by case, are provided; included in this output is an error analysis from the major input error routine MAJERR. Finally, the total configuration aerodynamics are provided in summary form; one page of aerodynamic output is supplied for each Mach number specified. The MAJERR results and the total configuration aerodynamics results are listed in succession for each case.

4.1.1 Input Error Checking

The purpose of the input error checking module is to provide single pass error checking of all inputs. If an error is detected, it is identified and an appropriate error message provided. The error messages are designed to be self-explanatory. In some cases, errors are automatically corrected by the routine, although the routine was not designed to be a comprehensive error correction utility.

The following errors are automatically corrected by the code:

- No terminating comma on a namelist input card
- No terminating "\$" or "\$END" on a namelist input ("&" on IBM systems)
- No terminating NEXT CASE for the case inputs for single case or last case inputs.

Errors detected by the error checking routine are considered either "FATAL" or "NON-FATAL". A "FATAL" error is one which will cause the code to terminate execution abnormally; examples of "FATAL" errors include incorrect spelling of any namelist name, incorrect spelling of any variable name, and any drastic input error in a namelist input, such as leaving out an equals sign in a constant definition. All "FATAL" errors are clearly identified on the output. A "NON-FATAL" error is one which will not cause the program to terminate execution; an example of a "NON-FATAL" error is leaving off the decimal point on numeric constants all Missile Datcom inputs are either REAL or LOGICAL regardless of the variable name assigned. "NON-FATAL" errors will not cause the code to stop execution, whereas, "FATAL" errors will cause the code to stop execution after input error checking has been completed.

An example output from CONERR is shown in Figure 21. This figure illustrates the array of input errors checked by CONERR. Several additional features of the output are as follows:

- All user defined input cards are assigned a sequential "line number". This serves to identify user inputs from the code

generated inputs (all code-created input cards are not identified with a "line number"). This scheme also permits the user to quickly identify those input cards in error so that efficient correction of input errors can be performed.

- All input cards are listed as input by the user. To the right of each input card is a listing of any errors encountered in processing that card. If no such error message appears then the input was interpreted as being correct.
- In many cases alphanumeric constants are available (see Table 3). Hence the user does not need to memorize a numeric scheme of "flags". Since some computers do not recognize alphanumeric constants as namelist constants, they are automatically converted by the code to their numeric equivalent. A message is printed to identify the substitutions performed. The example input in Figure 21 shows replacements for CONE and OGIVE.

In order to permit column independent inputs the code will automatically adjust some of the input cards to begin in columns 1 or 2. All control cards will be automatically shifted to start in column 1; all namelists which begin in column 1 will be shifted to column 2. If any input card cannot be shifted to conform to this scheme, an error message will be produced. As a general rule, column 80 of namelist inputs should be left blank so that the code can shift the card image, if necessary.

4.1.2 Listing of Case Input Data

Figure 22 shows the first page of outputs for a case without CONERR detected errors. Then Figure 23 shows the next page of output which lists all input cards for the case (down to the NEXT CASE control card). If the input for a case is from a previous case (through use of the SAVE control card) only the new case inputs are listed. All saved inputs are not repeated in subsequent case input summaries.

After the case data have been read, the data set-up for the case is analyzed by the case major error checking module (MAJERR). The purpose of this second error checking is to insure that the data input, although syntax error free, properly defines a case to be run. Examples of errors detected in MAJERR include valid flight condition inputs, valid reference condition inputs, and that geometry has been defined. In most cases errors detected by MAJERR are corrected with assumed defaults. If any MAJERR error message is produced, the user should verify the "fix-up" taken by the code. In some cases a "fix-up" is not possible; an appropriate error message and a suggestion

for correcting the error is provided. If a "fix-up" is not possible the case will not run.

4.1.3 Case Total Configuration Aerodynamic Output Summary

As shown in Figure 24, the total configuration aerodynamics are provided in compact form for easy review. The aerodynamics are summarized as a function of angle of attack (ALPHA) in the user specified system of units. the nomenclature is as follows:

CN	- Normal force coefficient
CM	- Pitching moment coefficient
CA	- Axial force coefficient
CY	- Side force coefficient
CLN	- Yawing moment coefficient
CLL	- Rolling moment coefficient
CNA	- Normal force coefficient derivative with ALPHA
CMA	- Pitching moment coefficient derivative with ALPHA
CYB	- Side force coefficient derivative with BETA
CLNB	- Yawing moment coefficient derivative with BETA
CLLB	- Rolling moment coefficient derivative with BETA
CL	- Lift coefficient
CD	- Drag coefficient
CL/CD	- Lift to drag ratio
XCP	- Center of pressure from the moment reference center divided by reference length

All coefficients are based upon the reference areas and lengths specified at the top of the output page. The derivatives CNA and CMA are computed by numeric differentiation of the CN and CM curves, respectively; precise derivatives are only obtained when the angle of attack range specified is narrow. The derivatives CYB, CLNB and CLLB are determined by perturbing the sideslip angle by one degree, recalculating the configuration forces and moments, and then differencing with the user specified orientation. Hence, the longitudinal and lateral derivatives will probably not be numerically identical for those conditions which should produce identical results if they were both calculated by the same method.

A significant decrease in computational time is realized when the calculation of lateral-directional derivatives are suppressed using the control card NO LAT. For these cases, the CYB, CLNB, and CLLB data fields are filled with blanks.

When selecting TRIM, the output is provided in a form similar to Figure 25. When running a trim case the derivatives due to ALPHA and

BETA are not available. The panels which were deflected to trim the configuration are indicated by the "VARIED" citation next to them.

The format for the values of the numbers in the printed output has been assumed based on typical magnitudes for missile aerodynamic coefficients. In some cases, a user specified reference area and/or length will cause the results to underflow or overflow the format selected. For these cases the user should adjust his reference quantities by powers of ten to get the data to fit the format specified.

4.2 PARTIAL OUTPUT

Partial output consists of geometry calculation details, intermediate aerodynamic results, or auxiliary data, such as pressure distributions. Each of these output types are printed through the addition of control cards input for each case. In all cases, partial output requested for one case is not automatically selected for subsequent cases, and the control cards must be re-input. This permits the user to be selective on the amount and types of output desired.

A special control card PART permits the user to request all geometric and aerodynamic partial output. Due to the amount of output produced, this option should be used sparingly or when details of the calculations are desired.

The following paragraphs describe the output received when partial output is requested.

4.2.1 Geometric Partial Output

Details of the geometry are provided when the PART or PRINT GEOM control cards are included in the case inputs. Figure 26 shows the output created when the PRINT GEOM BODY control card is used. Detailed are the results of the geometric calculations for the body. Included are such items as planform area, surface (wetted) area, and the mold line contour.

If fins are present on the configuration, two types of fin geometry data are produced when PRINT GEOM FIN1 or PART is requested. As shown in Figure 27, the description of the panel airfoil section is provided. Following that, shown in Figure 28, is a summary of the major geometric characteristics of such planform; note that fin planform geometry data is given for one panel of each fin set, since it is assumed that each fin of a fin set is identical. If a panel is made up of multiple segments, the geometric data is provided by panel segment (each segment is assigned a number starting at the root). Total panel set of characteristics is also provided. This total panel data represents an

equivalent straight-tapered panel, which is used for most of the aerodynamic calculations. The thickness-to-chord ratio shown for each segment is that value at the segment root; for the total panel, it is an "effective" value.

If an airbreathing inlet is specified the output is similar to that in Figure 29. This output reflects the user input definition for the inlet design specified. It is provided if the PRINT GEOM INLET or PART control cards are included in the input case.

4.2.2 Aerodynamic Partial Output

The output on the configuration aerodynamics is most extensive when PRINT AERO or PART is specified. Output is created for the body and each fin set on the configuration. In addition, for any subsonic/transonic Mach number (less than 1.4) an analysis by the Airfoil Section Module is made, which involves a potential flow analysis of the airfoil section using conformal mapping. If a configuration has inlets additional partial output is included to summarize the inlet external aerodynamics.

If base-jet plume interaction calculations are specified (BASE=.TRUE. in namelist AXIBOD), then there will be one or two separate pages of output. Figure 30 shows an example of the first page of output. This page will always be printed if BASE=.TRUE. The base pressure coefficient, axial force coefficient, and freestream pressure and temperature ratios are shown versus angle of attack. Also, the incremental forces and moments due to separation are shown versus angle of attack. If extrapolation of the base pressures and separation conditions database occurs, a warning message is printed explaining what input variable required extrapolation. A second page of output containing the boattail separation parameters will be printed if there are any fins on the missile boattail. The separation location aft of the nose and the Mach cone angle are shown versus angle of attack for each panel on the fin set. Figure 31 shows an example of this page. This output is provided if the PRINT AERO BODY or PART control card is input.

The protuberance partial output is printed if PRINT AERO BODY or PART is used. This output will only be shown if the namelist PROTUB is present in the input file. Figure 32 is an example of the protuberance output. Protuberance type, location, number, and axial force coefficient are listed for each protuberance set. The total axial force coefficient or zero lift drag coefficient is printed at the bottom of the page.

As shown in Figure 33, the body alone partial aerodynamic output for normal force lists the axial force contributors, potential normal force (CN-POTENTIAL), viscous normal forces (CN-VISCOUS), potential pitching moment (CM-POTENTIAL), viscous pitching moment (CM-VISCOUS), and the crossflow drag coefficient (CDC). The cross-flow drag proportionality factor

at subsonic and transonic speeds is also given for reference. These data are similar to that obtained for elliptical bodies.

Figure 34 details the fin normal force calculations by fin set. Each panel's contribution to the configuration normal force is described. The column titled CN-POTENTIAL is the potential contribution and the column titled CN-VISCOUS is the viscous contribution. Their sum is given in the column titled CN-TOTAL. CNAA is the nonlinear variation of normal force due to angle of attack and ALPHA EQUIV is the panel angle of attack due to its roll position on the body. Figure 35 illustrates the fin axial force contributors and Figure 36 presents an example of the fin pitching moment contributors.

The analysis by the Airfoil Section Module is provided in a format similar to Figure 37. If any Mach number specified produces supersonic flow on the airfoil surface, the message "CREST CRITICAL MACH NUMBER EXCEEDED" will be printed; approximation of the airfoil section data is then assumed. These fin aerodynamic increments are repeated for each fin set on the configuration. Note that the Airfoil Section Module assumes that the panels have sharp trailing edges. Any panel input with a non-sharp trailing edge will have its aerodynamic characteristics set as though the airfoil was "ideal". This assumption is approximate for preliminary design.

Figure 38 shows the aerodynamic output available when inlets are specified on the configuration. It is provided when PRINT AERO INLET or PART is specified in the case inputs. The aerodynamics summarized for inlets can include additive drag results if the user input the additive drag calculation flag. The maximum mass flow ratio is printed at the bottom of the page if the additive drag is calculated. If additive drag cannot be calculated, a warning message is printed.

After the aerodynamic details for each component of the configuration are output, the aerodynamic calculations for the synthesis of the complete configuration follows. For the example case, fin set 1 results would be followed by fin set 2 results for each of the following outputs:

- "FIN SET PRESENCE OF THE BODY" - This summarizes the aerodynamic incrementals of the most forward set of fins with the influence of the body. Figure 39 presents the example of this output. The left-most six columns include the effect of body-on-fin component interference. The right-most columns represent the contribution to each panel to configuration aerodynamics, and include the effect of body-on-fin interference, these values are, in effect, individual panel loads. The panel characteristic values included are "AEQn" (the panel equivalent (local) angle of attack) and

"CNn" (the panel normal force coefficient). The sign convention is as follows: a positive panel normal force, hence, equivalent angle of attack, produces a negative roll moment. Therefore, panels on the right side of the configuration will produce loads and angles of attack opposite in sign to those on the left side of the configuration even though they produce the same physical force loading.

- "BODY-FIN SET" - Aerodynamics for the body plus most forward set of fins configuration. It is produced through addition of the body alone and wing in presence of the body incrementals, described above. The results shown in Figure 40, include the component carryover factors K-W(B) (wing in presence of the body carryover due to angle of attack), K-B(W) (body in presence of the wing carryover due to angle of attack), KK-B(W) (body in presence of the wing carryover due to panel deflection), XCP-W(B) (wing in presence of the body carryover center of pressure), and XCP-B(W) (body in presence of the wing carryover center of pressure). This output is repeated for the body plus each additional aft fin set, if one exists on the configuration. This example includes two fin sets so the next page of partial output would look like Figure 41. If additional fin sets are present on the configuration additional pages are output with each one successively included.
- "CARRYOVER INTERFERENCE FACTORS" - This page of partial output summarizes the carryover factors listed in the paragraph above. These were included in the body plus fin set calculations. An example of this output is presented in Figure 42.
- "COMPLETE CONFIGURATION" - Complete configuration aerodynamics. This output was illustrated in Figure 24. The values are obtained by summing the body-wing and tail in the presence of the wing flow field data.

In addition to the output described above, more data is presented when the BUILD control card is used. Static aerodynamics are output for each configuration component. Body alone aerodynamics are shown in Figure 43. Fin alone aerodynamics are shown for each fin set present. Figure 44 shows the output for the first fin set. Static aerodynamics for a configuration with body plus most forward set of fins is given next. Figure 45 shows an example of this output. This output is repeated for configurations including the body plus each additional fin set present.

If the PRINT AERO BEND or PART control card is used, the code will compute and print panel bending moment coefficients for each fin set on a separate page. One page is shown in Figure 46. The sign convention is that assumed for the individual panel loads and equivalent angles of attack, noted above. The bending moment coefficients are based upon the reference area and longitudinal length given at the top of the page. The moments are referenced about the fin-body structure specified by the root chord span station.

Figure 47 illustrates the panel hinge moments coefficients computed when the control cards PRINT AERO HINGE or PART are used. The reference area and longitudinal reference length given at the top of the page are used. All moments are computed about the hinge line, which is defined using namelist DEFLCT.

If TRIM is specified, the user can selectively print the six untrimmed static aerodynamic tables used in the trim process. An example is shown in Figure 48. The code computes the six-component aerodynamics at ten deflection angles for each specified angle of attack, then interpolates for $C_m=0$. Note that this trim process can be used to create control authority data, effectively giving the user 10 deflection angles, 20 angles of attack, and 20 Mach numbers per input case.

4.2.3 Pressure Distribution Data

If the Mach number is supersonic ($M \geq 1.2$), the user has the option to print the surface pressure distributions over the body and fins. This option is selected only through the addition of the control card PRESSURES. Since three body alone supersonic methods are available (Van Dyke Hybrid, Second-Order Shock Expansion (SOSE), and Newtonian flow) the capability exists to output the pressure distribution data from any one of these methods. The method to be used in the calculation of the pressure data is controlled with the control cards SOSE and HYPER; if neither control card is input, the Van Dyke Hybrid method is selected. Because of the nature of the calculations, body alone pressures are printed for angles of attack less than or equal to 15 degrees when using the Hybrid or SOSE techniques.

The capability also exists for the user to output the pressure distribution data over fins at any Mach number greater than 1.05. This option is also controlled by the PRESSURES control card. Due to the nature of the method, only pressure distribution data at zero angle of attack is presently output.

Figures 49, 50, and 51 illustrate typical output produced when PRESSURES is specified. The format of Figure 49 is only available when SOSE is specified; all other body alone pressure methods produce output similar to

Figure 50 for bodies. Figure 51 is representative of fin pressure distribution output. Note that calculation of pressures is a time-consuming process; much higher computational times will be required.

All body pressure distribution data is based on a configuration that has body diameter of unity; that is, the configuration is expressed in calibers (or body diameters). The longitudinal stations at which pressure coefficient data is desired cannot be user specified; however, sufficient data is provided to permit accurate interpolation for most applications.

4.3 DYNAMIC DERIVATIVES

As shown in Figure 52, the total configuration dynamic derivatives are provided in compact form for easy interpretation. The dynamic derivatives are summarized as a function of angle of attack in the user specified units. The coefficients provided are as follows:

CNQ	Normal force coefficient due to pitch rate
CNAD	Normal force coefficient due to rate of change of angle of attack (α)
CMQ	Pitching moment coefficient due to pitch rate
CMAD	Pitching moment coefficient due to rate of change of angle of attack (α)

Note: For body alone and body + fin set data CMQ and CMAD are presented as the sum CMQ+CMAD.

The dynamic derivatives are printed after all static coefficients and partial static aerodynamics are printed. If a BUILD or PART card is input, additional dynamic derivatives for partial configurations and/or configuration components are printed.

4.4 EXTERNAL DATA FILES

The code has the capability to be used in conjunction with other missile design tools, such as post-processing plotting programs or trajectory programs. Fixed format aerodynamic data is output as an external data file with the addition of the PLOT control card. Included in this data file are the six component forces and moments based upon the user specified reference quantities. In order to print component buildup data to the plot file the BUILD and PLOT control cards must be present in the case.

An option to create a user specified format data file is also available. The control cards WRITE and FORMAT have been designed for easy access to this capability.

Both the PLOT output and output generated via the WRITE control are written to unit 3. Thus, if both PLOT and WRITE are used in the same run, the external data file will have both output formats in the same file.

4.5 EXTRAPOLATION MESSAGES AND ARRAY DUMPS

As shown in Figure 53, the extrapolation messages are summarized for all design charts which have been extrapolated during the execution of the case. Since many of the aerodynamic methods do not include design charts, but are either closed-form equations or complete theoretical methods, this option is most useful in the subsonic and transonic Mach regimes. Extrapolation messages are only provided if the control card PRINT EXTRAP appears in the case inputs. The data titled "ROUTINE TRACE-BACK" lists the subroutines called when the look-up was performed; "X" represents the independent variable and "Y" represents the dependent variable in the extrapolation.

When it is necessary to examine the values stored in internal data arrays the DUMP control card can be used. This control card causes the contents of the named data arrays to be printed in a form similar to Figure 54. Array dumps are provided for each Mach number of the input case, and represent the data block contents at aerodynamic calculation completion.

Note that all data arrays are initialized to a constant named "UNUSED", which is preset to a value of 1×10^{-30} . Hence, any array element which contains this constant was not changed during execution of the case (since it is highly unlikely that this constant will result from any calculation). This scheme permits rapid "tracking" of program calculation sequences while in "debug" mode.

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AEROYNAMIC METHODS FOR MISSILE CONFIGURATIONS
CONERR - INPUT ERROR CHECKING

ERROR CODES - N* DENOTES THE NUMBER OF OCCURRENCES OF EACH ERROR

A - UNKNOWN VARIABLE NAME

B - MISSING EQUAL SIGN FOLLOWING VARIABLE NAME

C - NON-ARRAY VARIABLE HAS AN ARRAY ELEMENT DESIGNATION - (N)

D - NON-ARRAY VARIABLE HAS MULTIPLE VALUES ASSIGNED

E - ASSIGNED VALUES EXCEED ARRAY DIMENSION

F - SYNTAX ERROR

***** INPUT DATA CARDS *****

```

1 *
2 * INPUT ERROR CHECKING TEST CASES
3 *
4 CASEID CONERR ERROR CHECKING TEST CASE
5
6 $FLTCOM NACHE=1, $
7 $REFQ REF 1., $
8 $REFQ ROUGH (2)=0., $
9 $REFQ LATREF=1.,1., $
10 $FLTCOM MACH (21)=0.6,
11 $END
12 $FLTCOM NACHE=1, $
13 $FLTCOM
14 $AXINOD THOSE=COME, $
15 $AXINOD LNOSE=1., $
16 $AXINOD THOSE=COME, TAFT=OGIVE, $
17 DUMP $$$
18 $
19 NEXT CASE

```

FATAL ERROR ENCOUNTERED IN CONERR. EXECUTION TERMINATED.

```

** BLANK CARD - IGNORED
** ERROR ** 1*A 0*B 0*C 0*D 0*E 0*F
** FATAL ERROR **
** ERROR ** 0*A 1*B 0*C 0*D 0*E 0*F
** FATAL ERROR **
** ERROR ** 0*A 0*B 1*C 0*D 0*E 0*F
** FATAL ERROR **
** ERROR ** 0*A 0*B 0*C 1*D 0*E 0*F
** FATAL ERROR **
** ERROR ** 0*A 0*B 0*C 0*D 1*E 0*F
** FATAL ERROR **
** ERROR ** 0*A 0*B 0*C 0*D 0*E 1*F
** ERROR ** UNKNOWN CONTROL CARD - IGNORED
** SUBSTITUTING NUMERIC FOR NAME COME
** ERROR ** UNKNOWN NAMELIST NAME
** SUBSTITUTING NUMERIC FOR NAME COME
** SUBSTITUTING NUMERIC FOR NAME OGIVE
** ERROR ** 1 INCORRECT ARRAY NAMES
** ERROR ** UNKNOWN NAMELIST NAME

```

Figure 21 Input Error Checking Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
CONERR - INPUT ERROR CHECKING

ERROR CODES - * DENOTES THE NUMBER OF OCCURRENCES OF EACH ERROR

A - UNKNOWN VARIABLE NAME

B - MISSING EQUAL SIGN FOLLOWING VARIABLE NAME

C - NON-ARRAY VARIABLE HAS AN ARRAY ELEMENT DESIGNATION - (N)

D - NON-ARRAY VARIABLE HAS MULTIPLE VALUES ASSIGNED

E - ASSIGNED VALUES EXCEED ARRAY DIMENSION

F - SYNTAX ERROR

***** INPUT DATA CARDS *****

```

1 CASEID PLAMER WING, CRUCIFORM PLUS TAIL CONFIGURATION
2 S08E
3 DIM IN
4 NO LAT
5 $FLATCON MACH=1.,MACH=2.36,RE=3.E6,
6     KALPHA=8.,ALPHA=0.,4.,8.,12.,16.,20.,24.,28.,$
7 $REFQ KCG=18.75,$
8 $AXIBOD LMOSE=11.25,DH0SE=3.75,LCENTD=26.25,$
9 $FINSET1 CHORD=6.96,0.,SSPAN=1.875,5.355,XLS=15.42,
10     SWEEP=0.,STA=1.,SUPPER=2*0.02238,NPANEL=4.,
11     IMAXU=0.288,LER=2*0.015,LFLATU=0.428,PHIF=0.,$
12 $FINSET2 CHORD=5.585,2.792,SSPAN=1.875,6.260,XLS=31.915,
13     SWEEP=0.,STA=1.,SUPPER=2*0.02238,NPANEL=4.,
14     IMAXU=0.288,LER=2*0.015,LFLATU=0.428,PHIF=0.,$
15 PART
16 BUILD
17 SAVE
18 NEXT CASE

```

Figure 22 Case Input Listing

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
CASE INPUTS

FOLLOWING ARE THE CARDS INPUT FOR THIS CASE

CASEID PLANAR WING, CRUCIFORM FINS TAIL CONFIGURATION
SORE
DIM IN
NO LAY
\$PLTCOM NMACH=1.0, MACH=2.36, REM=3.16,
\$REFQ XCC=18.75,
\$ALPHA=8.0, ALPHA=0.0, 4.0, 8.0, 12.0, 16.0, 20.0, 24.0, 28.0,
\$XCC=18.75,
\$XINBO LMOSE=11.25, DMOS=3.75, LCENTR=26.25, 4
\$FINSET1 CHORD=6.96, 0.0, SSPAN=1.875, 5.355, XLE=15.42,
SWEEP=0.0, STAB=1.0, SUPPER=2*0.02238, WPAVEL=4.0,
LWATU=0.288, LEB=2*0.015, LPLATU=0.428, PHIP=0.0, 4
\$FINSET2 CHORD=5.585, 2.792, SSPAN=1.875, 6.260, XLE=31.915,
SWEEP=0.0, STAB=1.0, SUPPER=2*0.02238, WPAVEL=4.0,
LWATU=0.288, LEB=2*0.015, LPLATU=0.428, PHIP=0.0, 4
PART
BUILD
SAVE
NEXT CASE

* WARNING * THE REFERENCE AREA IS UNSPECIFIED, DEFAULT VALUE ASSUMED

* WARNING * THE REFERENCE LENGTH IS UNSPECIFIED, DEFAULT VALUE ASSUMED

* WARNING * A CENTER SECTION IS DEFINED BUT THE BASE DIAMETER IS NOT INPUT. CYLINDRICAL SECTION ASSUMED.

THE BOUNDARY LAYER IS ASSUMED TO BE TURBULENT OVER ALL COMPONENTS OF THE CONFIGURATION

THE INPUT UNITS ARE IN INCHES, THE SCALE FACTOR IS 1.0000

Figure 23 Example of Default Substitutions
for Incomplete Case Inputs

FLIGHT CONDITIONS										REFERENCE DIMENSIONS									
MACH NUMBER	ALTITUDE FT	VELOCITY FT/SEC	PRESSURE LB/IN**2	TEMPERATURE DEG R	REYNOLDS NUMBER 1/FT	SIDESLIP ANGLE DEG	ROLL ANGLE DEG	REF. AREA IN**2	REF. LENGTH IN	MOMENT REF. CENTER LONG. IN	VERTICAL IN	REF. AREA IN**2	REF. LENGTH IN	MOMENT REF. CENTER LONG. IN	VERTICAL IN	REF. AREA IN**2	REF. LENGTH IN	MOMENT REF. CENTER LONG. IN	VERTICAL IN
2.36					3.000E+06	0.00	0.00	11.045	3.750	18.750	0.000								

LONGITUDINAL										LATERAL DIRECTIONAL									
ALPHA	CN	CM	CA	CY	CL	CLL	CLM	CLN	CMA	CMB	CML	CMLL	CMLM	CMLN	CMA	CMB	CML	CMLL	CMLM
0.00	0.000	0.000	0.368	0.000	0.000	0.000	0.000	0.000	2.586E-01	-3.424E-01									
4.00	1.124	-1.472	0.368	0.000	0.000	0.000	0.000	0.000	3.032E-01	-3.934E-01									
8.00	2.427	-3.149	0.368	0.000	0.000	0.000	0.000	0.000	3.715E-01	-4.803E-01									
12.00	4.102	-5.327	0.369	0.000	0.000	0.000	0.000	0.000	4.316E-01	-5.783E-01									
16.00	5.880	-7.779	0.369	0.000	0.000	0.000	0.000	0.000	4.413E-01	-6.214E-01									
20.00	7.632	-10.298	0.370	0.000	0.000	0.000	0.000	0.000	4.193E-01	-6.175E-01									
24.00	9.235	-12.719	0.371	0.000	0.000	0.000	0.000	0.000	4.034E-01	-5.909E-01									
28.00	10.859	-15.026	0.373	0.000	0.000	0.000	0.000	0.000	4.084E-01	-5.624E-01									

DERIVATIVES (PER DEGREE)										LATERAL DIRECTIONAL									
ALPHA	CL	CLL	CLM	CLN	CL	CLL	CLM	CLN	X-C.P.	CL	CLL	CLM	CLN	CL	CLL	CLM	CLN	CL	CLL
0.00	0.000	0.000	0.368	0.000	0.000	0.000	0.000	0.000	-1.324										
4.00	1.095	0.445	2.460	0.000	0.000	0.000	0.000	0.000	-1.310										
8.00	2.352	0.702	3.349	0.000	0.000	0.000	0.000	0.000	-1.298										
12.00	3.935	1.213	3.244	0.000	0.000	0.000	0.000	0.000	-1.299										
16.00	5.550	1.976	2.809	0.000	0.000	0.000	0.000	0.000	-1.323										
20.00	7.045	2.958	2.382	0.000	0.000	0.000	0.000	0.000	-1.349										
24.00	8.286	4.095	2.023	0.000	0.000	0.000	0.000	0.000	-1.377										
28.00	9.413	5.427	1.734	0.000	0.000	0.000	0.000	0.000	-1.384										

LINEAR DATA FOR BODY ALONE WAS GENERATED USING THE SECOND-ORDER SHOCK EXPANSION METHOD

Figure 24 Total Configuration Aerodynamic Output Summary

FLIGHT CONDITIONS										REFERENCE DIMENSIONS					
MACH	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS	SIDESLIP	ROLL	REF.	REF.	REF.	REF.	REF.	REF.	MOMENT	REF. CENTER
NUMBER	FT	FT/SEC	LB/IN**2	DEG R	1/FT	ANGLE	ANGLE	AREA	LONG.	LAT.	IN	IN	IN	IN	VERTICAL
0.60						0.00	0.00	11.045	3.750	3.750	18.750	0.000			
	ALPHA	DELTA	CL	CD	CA	CH	CA	CY	CLM	CLL					
	0.00	0.0000	0.0000	0.2682	0.0000	0.2682	0.0000	0.0000	0.0000	0.0000					
	8.00	16.9428	3.8491	1.5803	4.0316	1.0292	0.0000	0.0000	0.0000	0.0000					
	16.00	*NT*	*NT*	*NT*	*NT*	*NT*	*NT*	*NT*	*NT*	*NT*					

PANELS FROM FIN SET 1 WERE DEFLECTED OVER THE RANGE -25.0000 TO 20.0000 DEG.
PANEL 1 WAS FIXED
PANEL 2 WAS VARIED
PANEL 3 WAS FIXED
PANEL 4 WAS VARIED

NOTE - *NT* PRINTED WHEN NO TRIM POINT COULD BE FOUND

Figure 25 Trimmed Output Summary

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
ASYMMETRIC BODY DEFINITION

	----- NOSE -----	----- CENTERBODY -----	----- AFT BODY -----	----- TOTAL -----
SHAPE	OGIVE	CYLINDER		
LENGTH	11.2500	26.2500	0.0000	37.5000 IN
FINENESS RATIO	3.0000	7.0000	0.0000	10.0000
PLANFORM AREA	28.2799	98.4376	0.0000	126.7175 IN**2
AREA CENTROID	7.0157	24.3750	0.0000	20.5008 IN FROM NOSE TIP
WETTED AREA	89.8180	309.2506	0.0000	399.0687 IN**2
VOLUME	66.7887	289.9221	0.0000	356.7109 IN**3
VOLUME CENTROID	7.7135	24.3750	0.0000	21.2554 IN FROM NOSE TIP

MOLD LINE CONTOUR

LONGITUDINAL STATIONS	0.0000	1.1250	2.2500	3.3750	4.5000	5.6250	6.7500	7.8750	9.0000	10.1250
	11.2500	13.8750	16.5000	19.1250	21.7500	24.3750	27.0000	29.6250	32.2500	34.8750
	37.5000*									
BODY RADII	0.0000	0.3644	0.6871	0.9693	1.2119	1.4159	1.5819	1.7104	1.8020	1.8568
	1.8750	1.8750	1.8750	1.8750	1.8750	1.8750	1.8750	1.8750	1.8750	1.8750
	1.8750*									

NOTE - * INDICATES SLOPE DISCONTINUOUS POINTS

Figure 26 Body Geometry Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
FIN SET NUMBER 1 AIRFOIL SECTION

NACA S-3-35.9-04.5-28.5

UPPER ABCISSA	UPPER ORDINATE	LOWER ABCISSA	LOWER ORDINATE	X-FRACTION CHORD	MEAN LINE	THICKNESS
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00100	0.00006	0.00100	-0.00006	0.00100	0.00000	0.00013
0.00200	0.00013	0.00200	-0.00013	0.00200	0.00000	0.00025
0.00300	0.00019	0.00300	-0.00019	0.00300	0.00000	0.00038
0.00400	0.00025	0.00400	-0.00025	0.00400	0.00000	0.00050
0.00500	0.00031	0.00500	-0.00031	0.00500	0.00000	0.00063
0.00600	0.00038	0.00600	-0.00038	0.00600	0.00000	0.00075
0.00800	0.00050	0.00800	-0.00050	0.00800	0.00000	0.00100
0.01000	0.00063	0.01000	-0.00063	0.01000	0.00000	0.00125
0.02000	0.00125	0.02000	-0.00125	0.02000	0.00000	0.00251
0.03000	0.00188	0.03000	-0.00188	0.03000	0.00000	0.00376
0.04000	0.00251	0.04000	-0.00251	0.04000	0.00000	0.00501
0.05000	0.00313	0.05000	-0.00313	0.05000	0.00000	0.00627
0.06000	0.00376	0.06000	-0.00376	0.06000	0.00000	0.00752
0.08000	0.00501	0.08000	-0.00501	0.08000	0.00000	0.01003
0.10000	0.00627	0.10000	-0.00627	0.10000	0.00000	0.01253
0.12000	0.00752	0.12000	-0.00752	0.12000	0.00000	0.01504
0.14000	0.00877	0.14000	-0.00877	0.14000	0.00000	0.01755
0.16000	0.01003	0.16000	-0.01003	0.16000	0.00000	0.02006
0.18000	0.01128	0.18000	-0.01128	0.18000	0.00000	0.02256
0.20000	0.01253	0.20000	-0.01253	0.20000	0.00000	0.02507
0.40000	0.02250	0.40000	-0.02250	0.40000	0.00000	0.04500
0.42000	0.02250	0.42000	-0.02250	0.42000	0.00000	0.04500
0.45000	0.02250	0.45000	-0.02250	0.45000	0.00000	0.04500
0.50000	0.02250	0.50000	-0.02250	0.50000	0.00000	0.04500
0.55000	0.02250	0.55000	-0.02250	0.55000	0.00000	0.04500
0.60000	0.02250	0.60000	-0.02250	0.60000	0.00000	0.04500
0.65000	0.02212	0.65000	-0.02212	0.65000	0.00000	0.04424
0.70000	0.01896	0.70000	-0.01896	0.70000	0.00000	0.03792
0.75000	0.01580	0.75000	-0.01580	0.75000	0.00000	0.03160
0.80000	0.01264	0.80000	-0.01264	0.80000	0.00000	0.02528
0.82000	0.01138	0.82000	-0.01138	0.82000	0.00000	0.02275
0.84000	0.01011	0.84000	-0.01011	0.84000	0.00000	0.02022
0.86000	0.00885	0.86000	-0.00885	0.86000	0.00000	0.01770
0.88000	0.00758	0.88000	-0.00758	0.88000	0.00000	0.01517
0.90000	0.00632	0.90000	-0.00632	0.90000	0.00000	0.01264
0.92000	0.00506	0.92000	-0.00506	0.92000	0.00000	0.01011
0.94000	0.00379	0.94000	-0.00379	0.94000	0.00000	0.00758
0.96000	0.00253	0.96000	-0.00253	0.96000	0.00000	0.00506
0.98000	0.00126	0.98000	-0.00126	0.98000	0.00000	0.00253
1.00000	0.00000	1.00000	0.00000	1.00000	0.00000	0.00000

Figure 27 Airfoil Geometry Output

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THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
GEOMETRIC RESULTS FOR FIN SETS

FIN SET NUMBER 1 (DATA FOR ONE PANEL ONLY)									
SEGMENT NUMBER	PLANFORM AREA	TAPER RATIO	ASPECT RATIO	LEADING EDGE SWEEP DEG	TRAILING EDGE SWEEP DEG	MEAN AEROYNAMIC CHORD IN	LEADING M.A.C. POSITION IN	LATERAL M.A.C. POSITION IN	THICKNESS TO CHORD RATIO
1	IN**2 12.11040	0.0000	1.00000	63.43495	0.00000	4.6400	2.3200	3.0350	0.04500
TOTAL	12.11040	0.0000	1.00000	63.43495	0.00000	4.6400	2.3200	3.0350	0.04500

FIN SET NUMBER 2 (DATA FOR ONE PANEL ONLY)									
SEGMENT NUMBER	PLANFORM AREA	TAPER RATIO	ASPECT RATIO	LEADING EDGE SWEEP DEG	TRAILING EDGE SWEEP DEG	MEAN AEROYNAMIC CHORD IN	LEADING M.A.C. POSITION IN	LATERAL M.A.C. POSITION IN	THICKNESS TO CHORD RATIO
1	IN**2 18.36658	0.4999	1.04691	32.49486	0.00000	4.3437	1.2413	3.8238	0.04500
TOTAL	18.36658	0.4999	1.04691	32.49486	0.00000	4.3437	1.2413	3.8238	0.04500

Figure 28 Fin Geometry Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
2D SIDE INLET PHI=90, 270
INLET GEOMETRY

INLET IS A SIDE MOUNTED TWO-DIMENSIONAL TYPE

THE INLETS ARE OPEN

EXTERNAL COMPRESSION RAMP ANGLE (DEG) = 12.22

NUMBER OF INLETS = 2

INLET ANGULAR ROLL POSITIONS FROM TOP VERTICAL CENTER (DEG)
(SAME CONVENTION AS FIN ROLL POSITIONS)

90.0 270.0

LONGITUDINAL DISTANCE FROM MISSILE NOSE TIP TO
INLET LEADING EDGE = 35.69

INLET POSITIONS RELATIVE TO THE LEADING EDGE			
POSITION	LONGITUDINAL	WIDTH	HEIGHT
TOP LIP LEADING EDGE	0.000	3.600	0.000
CONFL LIP LEADING EDGE	8.694	4.064	4.073
MID BODY START	13.335	4.064	4.844
BOATTAIL START	56.071	4.064	4.064
BOATTAIL END	70.993	2.286	2.286

LONGITUDINAL DISTANCE FROM INLET LEADING EDGE TO
DIVERTER LEADING EDGE = 7.75

DIVERTER LENGTH = 12.45

HEIGHT OF DIVERTER LEADING EDGE = 0.25

Figure 29 Inlet Geometry Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
 AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
 TEST CASE FOR BASEPIS IMPLEMENTATION
 BASE-JET PLUME INTERACTION FLOW PARAMETERS

CASE 1
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FLIGHT CONDITIONS				REFERENCE DIMENSIONS									
MACH NUMBER	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS NUMBER	SIDSLIP ANGLE	ROLL ANGLE	REF. AREA	REF. LENGTH	MOMENT REF. CENTER	REF. LONG.	REF. LAT.	REF. VERTICAL
	FT	FT/SEC	LB/IN**2	DEG R	1/FT	DEG	DEG	IN**2	IN	IN	IN	IN	IN
2.00	0.00	2232.43	1.470E+01	5186.70	1.414E+07	0.00	0.00	19.635	5.000	5.000	15.000	0.000	0.000

WARNING EXTRAPOLATION WILL BE REQUIRED FOR THE FOLLOWING CONDITIONS:
 * ANGLE OF ATTACK LESS THAN 0.0

BASE FLOW PARAMETERS				INCREMENTAL FORCE AND MOMENT DATA			
ALPHA	CP-BASE	CA-BASE	TRASE/TINT	PRASE/PINT	DELTA CM	DELTA CN	DELTA CA
-2.00	0.0926	-0.0073	4.0996	1.2592	-0.0023	0.0035	-0.0218
0.00	0.0926	-0.0073	4.0996	1.2592	0.0000	0.0000	-0.0218
2.00	0.0926	-0.0073	4.0996	1.2592	0.0023	-0.0035	-0.0218

Figure 30 Base-Jet Plume Interaction Output - Page 1

		FLIGHT CONDITIONS				REFERENCE DIMENSIONS			
MACH NUMBER	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS NUMBER	SIDESLIP ANGLE	ROLL ANGLE	REF. AREA	MOMENT REF. CENTER
	FT	FT/SEC	LB/IN**2	DEG R	1/FT	DEG	DEG	IN**2	LONG. LAT. VERTICAL
2.00	0.00	2232.53	1.470E+01	5186.70	1.414E+07	0.00	0.00	19.635	5.000 5.000 15.000 0.000
----- BOATTAIL SEPARATION PARAMETERS -----									
PANEL 1 PHI= 45.0 PANEL 2 PHI=135.0 PANEL 3 PHI=225.0 PANEL 4 PHI=315.0									
ALPHA	X-SEP (FT)	MACH CONE ANGLE	X-SEP (FT)	MACH CONE ANGLE	X-SEP (FT)	MACH CONE ANGLE	X-SEP (FT)	MACH CONE ANGLE	
-2.00	1.881	28.586	1.857	31.414	1.857	31.414	1.881	28.586	
0.00	1.867	30.000	1.867	30.000	1.867	30.000	1.867	30.000	
2.00	1.854	31.414	1.877	28.565	1.877	28.586	1.854	31.414	

Figure 31 Base-Jet Plume Interaction Output - Page 2

FLIGHT CONDITIONS						REFERENCE DIMENSIONS					
MACH NUMBER	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS NUMBER	SIDESLIP ANGLE	ROLL ANGLE	REF. AREA	REF. LENGTH	MOMENT	REF. CENTER
	FT	FT/SEC	LB/IN**2	DEG R	1/FT	DEG	DEG	IN**2	IN	IN	IN
0.40	0.00				3.000E+06	0.00	0.00	113.097	12.000	39.000	0.000

PROTUBERANCE AXIAL FORCE COEFFICIENT IS CALCULATED AT ZERO ANGLE OF ATTACK AND ASSUMED TO REMAIN CONSTANT OVER ALL ANGLES OF ATTACK. PROTUBERANCES ARE CONSIDERED TO BE PART OF THE BODY WHEN CALCULATING TOTAL BODY AXIAL FORCE. THEREFORE, PROTUBERANCE AXIAL FORCE INCREMENT IS INCLUDED IN THE TOTAL CONFIGURATION AERODYNAMICS SECTION.

----- PROTUBERANCE CALCULATIONS -----					
NUMBER	TYPE	LONGITUDINAL LOCATION (IN)	NUMBER AT LOCATION	INDIVIDUAL CA	TOTAL CA
1	FAIRING	14.000	2	0.0027	0.0053
2	VERTICAL CYLINDER	22.000	4	0.0018	0.0073
3	LAUNCH SHOE	39.000	2	0.0034	0.0068
4	FLAT PLATE OR BLOCK	56.000	1	0.0012	0.0012
TOTAL CA DUE TO PROTUBERANCES =					0.0206

Figure 32 Protuberance Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
BODY ALONE PARTIAL OUTPUT

FLIGHT CONDITIONS				REFERENCE DIMENSIONS							
MACH NUMBER	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS NUMBER	SIDESLIP ANGLE	ROLL ANGLE	REF. AREA	REF. LENGTH	MOMENT	REF. CENTER
	FT	FT/SEC	LB/IN**2	DEG R	1/FT	DEG	DEG	IN**2	IN	IN	VERTICAL
2.36					3.000E+06	0.00	0.00	11.045	3.750	18.750	0.000
CA-FRICTION				CA-PRESSURE/WAVE				CA-ALPHA			
ALPHA											
0.000				0.10301		0.12540		0.00000			
4.000				0.08459		0.12540		0.00000			
8.000				0.08493		0.12540		0.00000			
12.000				0.08551		0.12540		0.00000			
16.000				0.08633		0.12540		0.00000			
20.000				0.08740		0.12540		0.00000			
24.000				0.08871		0.12540		0.00000			
28.000				0.09028		0.12540		0.00000			

NOTE - THE BASE DRAG INCREMENT IS NOT INCLUDED IN THE AXIAL FORCE CALCULATIONS

CROSS FLOW DRAG PROPORTIONALITY FACTOR = 1.00000

CM-POTENTIAL				CM-VISCOUS				CM-POTENTIAL				CM-VISCOUS				CDC			
ALPHA																			
0.000				0.0000		0.0000		0.0000		0.0000		0.0000		0.0000		0.2800		0.4446	
4.000				0.2213		0.0248		0.5822		-0.0116		-0.0845		-0.0845		0.8140		1.3264	
8.000				0.4375		0.1809		1.1510		-0.3071		-0.6105		-0.6105		1.5000		1.4935	
12.000				0.6436		0.6578		1.6932		-1.2177		-1.5547		-1.5547		1.3741		1.3168	
16.000				0.8350		1.3075		2.1965											
20.000				1.0072		2.0045		3.0427											
24.000				1.1566		2.6081		3.3671											
28.000				1.2800		3.3299													

Figure 33 Body Alone Aerodynamic Partial Output

MACH NUMBER	FLIGHT CONDITIONS				REFERENCE DIMENSIONS									
	ALTITUDE FT	VELOCITY FT/SEC	PRESSURE LB/IN**2	TEMPERATURE DEG R	REYNOLDS NUMBER	SIDESLIP ANGLE DEG	ROLL ANGLE DEG	REF. AREA IN**2	REF. LENGTH IN	REF. LENGTH IN	LONG. IN	LAT. IN	MOMENT REF. IN	CENTRIF. VERTICAL IN
2.36					3.000E+06	0.00	0.00	11.045	3.750	3.750	18.750			0.000
POTENTIAL NORMAL FORCE SLOPE AT ALPHA ZERO (1 PANEL), CMA = 0.03186/DEG														
PANEL NO.	ALPHA TOTAL DEG	FIN PHI DEG	ALPHA EQUIV DEG	CMA	POTENTIAL CM	CM VISCOUS	CM TOTAL							
1	0.000	0.000	0.000	1.75439	0.00000	0.00000	0.00000							
2	0.000	90.000	0.000	1.75439	0.00000	0.00000	0.00000							
3	0.000	180.000	0.000	1.75439	0.00000	0.00000	0.00000							
4	0.000	270.000	0.000	1.75439	0.00000	0.00000	0.00000							
SET					0.00000	0.00000	0.00000							
1	4.000	0.000	0.000	1.75439	0.00000	0.00000	0.00000							
2	4.000	90.000	4.000	1.56610	0.12703	0.00762	0.13465							
3	4.000	180.000	0.000	1.75439	0.00000	0.00000	0.00000							
4	4.000	270.000	4.000	1.56610	0.12703	0.00762	0.13465							
SET					0.25406	0.01524	0.26930							
1	8.000	0.000	0.000	1.75439	0.00000	0.00000	0.00000							
2	8.000	90.000	8.000	1.38431	0.25159	0.02681	0.27840							
3	8.000	180.000	0.000	1.75439	0.00000	0.00000	0.00000							
4	8.000	270.000	8.000	1.38431	0.25159	0.02681	0.27840							
SET					0.50318	0.05363	0.55680							
1	12.000	0.000	0.000	1.75439	0.00000	0.00000	0.00000							
2	12.000	90.000	12.000	1.21073	0.37125	0.05234	0.42359							
3	12.000	180.000	0.000	1.75439	0.00000	0.00000	0.00000							
4	12.000	270.000	12.000	1.21073	0.37125	0.05234	0.42359							
SET					0.74250	0.10467	0.84717							

Figure 34 Fin Normal Force Partial Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
 AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
 PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
 FIN SET 1 CA PARTIAL OUTPUT

CASE 1
 PAGE 8

FLIGHT CONDITIONS					REFERENCE DIMENSIONS						
MACH NUMBER	ALTITUDE FT	VELOCITY FT/SEC	PRESSURE LB/IN**2	TEMPERATURE DEG R	REYNOLDS NUMBER 1/FT	SIDESLIP ANGLE DEG	ROLL ANGLE DEG	REF. AREA IN**2	REF. LENGTH LONG. IN	MOMENT REF. LONG. IN	CENTER VERTICAL IN
2.36					3.000E+06	0.00	0.00	11.045	3.750	18.750	0.000

SINGLE FIN PANEL ZERO-LIFT AXIAL FORCE COMPONENTS

SKIN FRICTION	0.00755
SUBSONIC PRESSURE	0.00000
TRANSONIC WAVE	0.00000
SUPERSONIC WAVE	0.00598
LEADING EDGE	0.00108
TRAILING EDGE	0.00000
TOTAL CAO	0.01461

FIN AXIAL FORCE DUE TO ANGLE OF ATTACK

ALPHA DEG	CA DUE TO ALPHA	CA-TOTAL (4 FINS)
0.000	0.00000	0.05845
4.000	0.00000	0.05845
8.000	0.00000	0.05845
12.000	0.00000	0.05845
16.000	0.00000	0.05845
20.000	0.00000	0.05845
24.000	0.00000	0.05845
28.000	0.00000	0.05845

Figure 35 Fin Axial Force Partial Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
 AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
 FLAMAR WING, CRUCIFORM FINS TAIL CONFIGURATION
 FIN SET 1 CM PARTIAL OUTPUT

CASE 1
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FLIGHT CONDITIONS										REFERENCE DIMENSIONS										
MACH	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS	SIDESLIP	ROLL	REF.	REF.	REF.	LENGTH	MOMENT	REF.	CENTER						
NUMBER	FT	FT/SEC	LB/IN**2	DEG R	1/FT	ANGLE	ANGLE	AREA	LONG.	LONG.	IN	IN	IN	IN	IN					
2.36					3.000E+06	0.00	0.00	11.045	3.750	3.750	18.750	0.000								
CENTER OF PRESSURE FOR LINEAR CM = -0.35552 (CALIBERS FROM C.G.)																				
CENTER OF PRESSURE FOR NON-LINEAR CM = -0.34933 (CALIBERS FROM C.G.)																				
ALPHA		CM		CM		CM		CM		CM		CM		CM						
DEG.		LINEAR		NON-LINEAR		NON-LINEAR		NON-LINEAR		NON-LINEAR		NON-LINEAR		NON-LINEAR						
0.00000		0.00000		0.00000		0.00000		0.00000		0.00000		0.00000		0.00000						
4.00000		-0.09032		-0.00532		-0.09565		-0.09565		-0.09565		-0.09565		-0.09565						
8.00000		-0.17869		-0.01873		-0.19762		-0.19762		-0.19762		-0.19762		-0.19762						
12.00000		-0.26397		-0.03657		-0.30054		-0.30054		-0.30054		-0.30054		-0.30054						
16.00000		-0.34392		-0.05663		-0.40055		-0.40055		-0.40055		-0.40055		-0.40055						
20.00000		-0.41717		-0.07651		-0.49368		-0.49368		-0.49368		-0.49368		-0.49368						
24.00000		-0.48230		-0.09492		-0.57722		-0.57722		-0.57722		-0.57722		-0.57722						
28.00000		-0.53805		-0.11338		-0.65142		-0.65142		-0.65142		-0.65142		-0.65142						

Figure 36 Fin Pitching Moment Partial Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
FIN SET 1 SECTION AERODYNAMICS

IDEAL ANGLE OF ATTACK = 0.00000 DEG.

ZERO LIFT ANGLE OF ATTACK = 0.00000 DEG.

IDEAL LIFT COEFFICIENT = 0.00000

ZERO LIFT PITCHING MOMENT COEFFICIENT = 0.00000

MACH ZERO LIFT-CURVE-SLOPE = 0.09275 /DEG.

LEADING EDGE RADIUS = 0.00323 FRACTION CHORD

MAXIMUM AIRFOIL THICKNESS = 0.04500 FRACTION CHORD

DELTA-I = 0.36664 PERCENT CHORD

MACH= 0.6000 LIFT-CURVE-SLOPE = 0.11536 /DEG. XAC = 0.28302 MAX. LIFT = 0.73826

Figure 37 Airfoil Section Aerodynamic Partial Output

CASE 1
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THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
2D SIDE INLET PHI=90,270
INLET AERODYNAMIC INCREMENTALS

FLIGHT CONDITIONS				REFERENCE DIMENSIONS						
MACH	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS	SIDESLIP	ROLL	REF. AREA	REF. LENGTH	MOMENT REF. CENTER
NUMBER		M/SEC	WT/CM**2	DEG K	1/ M	ANGLE	DEG	CM**2	CM	LONG. LAT. VERTICAL
2.50	0.00	850.81	4.758E-02	2881.50	5.798E+07	0.00	0.00	45.604	7.620	53.340 0.000
INLET AERODYNAMIC INCREMENTALS										
CA-ADD										
ALPHA		CM-INLET	CM-INLET	CM-INLET	CM-INLET	CM-INLET	CM-INLET	CM-INLET	CM-INLET	CM-INLET
-4.00		-1.0229	-0.9977	-0.9977	0.0796	0.0796	0.0655	0.0000	0.0000	0.0000
0.00		0.0000	0.0000	0.0000	0.0796	0.0796	0.0655	0.0000	0.0000	0.0000
4.00		1.0229	0.9977	0.9977	0.0796	0.0796	0.0655	0.0000	0.0000	0.0000
8.00		2.2836	1.3925	1.3925	0.0796	0.0796	0.0655	0.0000	0.0000	0.0000

NOTE; CA-ADD IS INLET ADDITIVE DRAG COEFFICIENT FOR AN INLET MASS FLOW RATIO OF 0.75

NOTE; THE MAXIMUM MASS FLOW RATIO FOR THIS INLET AT THESE FLIGHT CONDITIONS IS 0.77

Figure 38 Inlet Aerodynamic Partial Output

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AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
FLAMAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
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FLIGHT CONDITIONS										REFERENCE DIMENSIONS				
MACH NUMBER	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS NUMBER	SIDESLIP	ROLL	REF. AREA	MOMENT	REF. CENTER				
	FT	FT/SEC	LB/IN**2	DEG R	1/FT	ANGLE DEG	ANGLE DEG	IN**2	IN	LONG. IN	VERTICAL IN			
2.36					3.000E+06	0.00	0.00	11.045	3.750	18.750	0.000			
FIN SET 1 IN PRESENCE OF THE BODY														
ANGLE OF ATTACK, DEG.		CN	CM	CA	CY	CLM	CLL	PANEL CHARACTERISTICS						
								PANEL NUMBER	ARQ (IN PANEL AXIS SYS.) DEG.	CM				
0.0000		0.0000	0.0000	0.0584	0.0000	0.0000	0.0000	1	0.0000	0.0000	0.0000			
								2	0.0000	0.0000	0.0000			
								3	0.0000	0.0000	0.0000			
4.0000		0.3541	-0.1259	0.0584	0.0000	0.0000	0.0000	4	0.0000	0.0000	0.0000			
								1	0.0000	0.0000	0.0000			
								2	5.1963	0.1770	0.1770			
								3	0.0000	0.0000	0.0000			
8.0000		0.7285	-0.2590	0.0584	0.0000	0.0000	0.0000	4	-5.1963	-0.1770	-0.1770			
								1	0.0000	0.0000	0.0000			
								2	10.3582	0.3642	0.3642			
								3	0.0000	0.0000	0.0000			
12.0000		1.0919	-0.3882	0.0584	0.0000	0.0000	0.0000	4	-10.3582	-0.3642	-0.3642			
								1	0.0000	0.0000	0.0000			
								2	15.4529	0.5459	0.5459			
								3	0.0000	0.0000	0.0000			
16.0000		1.3782	-0.4900	0.0584	0.0000	0.0000	0.0000	4	-15.4529	-0.5459	-0.5459			
								1	0.0000	0.0000	0.0000			
								2	19.7740	0.6891	0.6891			
								3	0.0000	0.0000	0.0000			
20.0000		1.6192	-0.5756	0.0584	0.0000	0.0000	0.0000	4	-19.7740	-0.6891	-0.6891			
								1	0.0000	0.0000	0.0000			
								2	23.8356	0.8096	0.8096			
								3	0.0000	0.0000	0.0000			
24.0000		1.8547	-0.6594	0.0584	0.0000	0.0000	0.0000	4	-23.8356	-0.8096	-0.8096			
								1	0.0000	0.0000	0.0000			
								2	28.3397	0.9274	0.9274			
								3	0.0000	0.0000	0.0000			
28.0000		2.0750	-0.7377	0.0584	0.0000	0.0000	0.0000	4	-28.3397	-0.9274	-0.9274			
								1	0.0000	0.0000	0.0000			
								2	32.7188	1.0375	1.0375			
								3	0.0000	0.0000	0.0000			
								4	-32.7188	-1.0375	-1.0375			

Figure 39 Fin Set in Presence of the Body Partial Output

FLIGHT CONDITIONS										REFERENCE DIMENSIONS									
MACH NUMBER	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS NUMBER	SIDESLIP ANGLE	ROLL ANGLE	REF. AREA	REF. LENGTH	MOMENT	REF. CENTER								
FT	FT/SEC	LB/IN**2	DEG R	1/FT	DEG	DEG	IN	IN**2	IN	IN	IN								
2.36					3.000E+06	0.00	0.00	11.045	3.750	18.750	0.000								

SYNTHESIS AERODYNAMICS FOR BODY-FIN SET 1									
ANGLE OF ATTACK, DEG.	CM	CM	CA	CY	CLM	CLL			
0.0000	0.0000	0.0000	0.2459	0.0000	0.0000	0.0000			
4.0000	0.7170	0.3174	0.2460	0.0000	0.0000	0.0000			
8.0000	1.5871	0.5457	0.2463	0.0000	0.0000	0.0000			
12.0000	2.7534	0.6054	0.2468	0.0000	0.0000	0.0000			
16.0000	3.9751	0.6007	0.2475	0.0000	0.0000	0.0000			
20.0000	5.1647	0.5562	0.2484	0.0000	0.0000	0.0000			
24.0000	6.2309	0.4989	0.2495	0.0000	0.0000	0.0000			
28.0000	7.3689	0.3289	0.2509	0.0000	0.0000	0.0000			

Figure 40 Body Plus Fin Set Partial Output

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AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
FLANGAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
AERODYNAMIC FORCE AND MOMENT SYNTHESIS

FLIGHT CONDITIONS										REFERENCE DIMENSIONS					
MACH NUMBER	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS NUMBER	SIDESLIP ANGLE	ROLL ANGLE	REF. AREA	REF. LENGTH	MOMENT REF.	CENTER VERTICAL				
FT	FT/SEC	LB/IN**2	DEG R	DEG	1/FT	DEG	DEG	IN**2	IN	IN	IN				
2.36					3.000E+06	0.00	0.00	11.045	3.750	3.750	18.750				
											0.000				

SYNTHESIS AERODYNAMICS FOR BODY-FIN SET 1 AND 2										
ANGLE OF ATTACK, DEG.	CM	CM	CA	CY	CLM	CLL				
0.0000	0.0000	0.0000	0.3676	0.0000	0.0000	0.0000				
4.0000	1.1236	-1.4716	0.3677	0.0000	0.0000	0.0000				
8.0000	2.4267	-3.1490	0.3680	0.0000	0.0000	0.0000				
12.0000	4.1015	-5.3266	0.3685	0.0000	0.0000	0.0000				
16.0000	5.8796	-7.7793	0.3692	0.0000	0.0000	0.0000				
20.0000	7.6316	-10.2981	0.3701	0.0000	0.0000	0.0000				
24.0000	9.2350	-12.7195	0.3712	0.0000	0.0000	0.0000				
28.0000	10.8586	-15.0261	0.3726	0.0000	0.0000	0.0000				

Figure 41 Body Plus Two Fin Sets Partial Output

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AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
AERODYNAMIC FORCE AND MOMENT SYNTHESIS

FLIGHT CONDITIONS										REFERENCE DIMENSIONS									
MACH	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS	SIDELIP	ROLL	REF.	REF. LENGTH	MOMENT	REF. CENTER								
NUMBER	FT	FT/SEC	LB/IN**2	DEG R	1/FT	ANGLE	DEG	AREA	LONG.	IN	LONG.	IN	IN	IN	IN	IN	IN	IN	IN
2.36					3.000E+06	0.00	0.00	11.045	3.750	3.750	18.750	0.000							
CARRYOVER INTERFERENCE FACTORS																			
FIN SET	K-W (B)	K-B (W)	EX-W (B)	EX-B (W)	XCP-W (B)	XCP-B (W)													
1	1.300543E+00	4.287630E-01	9.347357E-01	3.658075E-01	3.555199E-01	1.090305E+00													
2	1.252313E+00	1.126451E-01	9.358542E-01	3.164592E-01	4.390780E+00	4.503570E+00													
PANEL CENTERS OF PRESSURE																			
FIN SET	X-CP	Y-CP	X-CP	Y-CP	X-CP	Y-CP													
1	3.5552E-01	3.2301E-01																	
2	4.3908E+00	4.1973E-01																	

Figure 42 Carryover Interference Factors Partial Output

THE DRAF AUTOMATED MISSILE DATCOM * REV 4/91 *
 AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
 PLANAR WING, CRUCIFORM PLUG TAIL CONFIGURATION
 BODY ALONE STATIC AERODYNAMIC CHARACTERISTICS

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FLIGHT CONDITIONS										REFERENCE DIMENSIONS									
MACH NUMBER	ALTITUDE FT	VELOCITY FT/SEC	PRESSURE LB/IN**2	TEMPERATURE DEG R	REYNOLDS NUMBER 1/FT	SIDESLIP ANGLE DEG	ROLL ANGLE DEG	REF. AREA IN**2	REF. LENGTH IN	LONG. IN	LAT. IN	MOMENT IN	REF. CENTER IN	VERTICAL IN					
2.36					3.000E+06	0.00	0.00	11.045	3.750	18.750				0.000					
LONGITUDINAL										DERIVATIVES (PER DEGREE)									
ALPHA	CM	CN	CA	LATERAL DIRECTIONAL			CLL	CMA	CSA	LATERAL DIRECTIONAL			CLL	CLM	CLN	CLY	CLZ		
				CY	CLM	CLN				CYB	CLMB	CLNB							
0.00	0.000	0.000	0.187	0.000	0.000	0.000	0.000	4.579E-02	1.520E-01	-4.972E-02	-1.497E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
4.00	0.246	0.571	0.188	0.000	0.000	0.000	0.000	7.728E-02	1.333E-01	-6.189E-02	-1.421E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
8.00	0.618	1.066	0.188	0.000	0.000	0.000	0.000	1.317E-01	1.019E-01	-7.721E-02	-1.322E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
12.00	1.301	1.386	0.188	0.000	0.000	0.000	0.000	1.904E-01	6.493E-02	-1.071E-01	-1.136E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
16.00	2.143	1.586	0.189	0.000	0.000	0.000	0.000	2.138E-01	4.097E-02	-1.305E-01	-9.644E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
20.00	3.012	1.714	0.190	0.000	0.000	0.000	0.000	2.027E-01	2.987E-02	-1.405E-01	-8.213E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
24.00	3.765	1.825	0.191	0.000	0.000	0.000	0.000	1.997E-01	1.232E-02	-1.476E-01	-7.150E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
28.00	4.610	1.812	0.192	0.000	0.000	0.000	0.000	2.228E-01	-1.862E-02	-1.513E-01	-5.946E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
X-C.P.																			
ALPHA	CL	CD	CL/CD	CL	CD	CL/CD	CL	CD	CL/CD	CL	CD	CL/CD	CL	CD	CL/CD	CL	CD	CL/CD	CL
0.00	0.000	0.000	0.187	0.000	0.000	0.187	0.000	0.000	0.187	0.000	0.187	0.000	0.000	0.187	0.000	0.000	0.187	0.000	0.187
4.00	0.232	0.204	1.138	0.232	0.204	1.138	0.232	0.204	1.138	0.232	0.204	1.138	0.232	0.204	1.138	0.232	0.204	1.138	0.232
8.00	0.586	0.272	2.154	0.586	0.272	2.154	0.586	0.272	2.154	0.586	0.272	2.154	0.586	0.272	2.154	0.586	0.272	2.154	0.586
12.00	1.234	0.455	2.713	1.234	0.455	2.713	1.234	0.455	2.713	1.234	0.455	2.713	1.234	0.455	2.713	1.234	0.455	2.713	1.234
16.00	2.007	0.772	2.599	2.007	0.772	2.599	2.007	0.772	2.599	2.007	0.772	2.599	2.007	0.772	2.599	2.007	0.772	2.599	2.007
20.00	2.765	1.209	2.288	2.765	1.209	2.288	2.765	1.209	2.288	2.765	1.209	2.288	2.765	1.209	2.288	2.765	1.209	2.288	2.765
24.00	3.362	1.706	1.971	3.362	1.706	1.971	3.362	1.706	1.971	3.362	1.706	1.971	3.362	1.706	1.971	3.362	1.706	1.971	3.362
28.00	3.980	2.334	1.705	3.980	2.334	1.705	3.980	2.334	1.705	3.980	2.334	1.705	3.980	2.334	1.705	3.980	2.334	1.705	3.980

LINEAR DATA FOR BODY ALONE WAS GENERATED USING THE SECOND-ORDER SHOCK EXPANSION METHOD

Figure 43 Body Alone Static Aerodynamic Partial Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
FIN 1 ALONE STATIC AERODYNAMIC CHARACTERISTICS

FLIGHT CONDITIONS				REFERENCE DIMENSIONS			
MACH NUMBER	ALTITUDE FT	VELOCITY FT/SEC	PRESSURE LB/IN**2	TEMPERATURE DEG R	REYNOLDS NUMBER 1/FT	ROLL ANGLE DEG	SIDESLIP ANGLE DEG
2.36					3.000E+06	0.00	0.00
LONGITUDINAL				DERIVATIVES (PER DEGREE)			
ALPHA	CN	CM	CA	LONGITUDINAL CMA	LATERAL DIRECTIONAL CYB	MOMENT REF. CENTER IN	VERTICAL IN
0.00	0.000	0.000	0.058	6.505E-02	-2.312E-02	11.045	0.000
4.00	0.269	-0.096	0.058	6.960E-02	-2.470E-02	3.750	18.750
8.00	0.557	-0.198	0.058	7.223E-02	-2.561E-02		
12.00	0.847	-0.301	0.058	7.159E-02	-2.537E-02		
16.00	1.129	-0.401	0.058	6.816E-02	-2.414E-02		
20.00	1.392	-0.494	0.058	6.235E-02	-2.208E-02		
24.00	1.628	-0.577	0.058	5.569E-02	-1.972E-02		
28.00	1.838	-0.651	0.058	4.913E-02	-1.738E-02		
LATERAL DIRECTIONAL				X-C.P.			
ALPHA	CL	CD	CL/CD	CL/CD	X-C.P.		
0.00	0.000	0.058	0.000	0.000	-0.355		
4.00	0.265	0.077	3.432	3.432	-0.355		
8.00	0.543	0.135	4.013	4.013	-0.355		
12.00	0.817	0.233	3.500	3.500	-0.355		
16.00	1.070	0.368	2.910	2.910	-0.355		
20.00	1.288	0.531	2.426	2.426	-0.355		
24.00	1.464	0.716	2.045	2.045	-0.354		
28.00	1.595	0.914	1.745	1.745	-0.354		

Figure 44 Fin Alone Static Aerodynamic Partial Output

FLIGHT CONDITIONS										REFERENCE DIMENSIONS									
MOCH NUMBER	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS	SIDESLIP	ROLL	ANGLE	ANGLE	REF. AREA	REF. LENGTH	MOMENT	REF. CENTER						
	FT	FT/SEC	LB/IN**2	DEG R	1/FT	DEG	DEG	DEG	DEG	IN**2	IN	IN	IN	IN	IN	IN	IN	IN	IN
2.36					3.000E+06	0.00	0.00	0.00	0.00	11.045	3.750	3.750	18.750	0.000					
LATERAL DIRECTIONAL										DERIVATIVES (PER DEGREE)									
LONGITUDINAL					CY					LONGITUDINAL					LATERAL DIRECTIONAL				
ALPHA	CM	CA	CM	CA	CL	CLM	CLL	CL	CL	CMA	CMA	CMA	CMA	CMA	CYB	CLB	CLB	CLB	CLB
0.00	0.000	0.000	0.000	0.246	0.000	0.000	0.000	0.000	0.000	1.602E-01	9.052E-02	1.602E-01	9.052E-02	1.602E-01	9.052E-02	1.602E-01	9.052E-02	1.602E-01	9.052E-02
4.00	0.717	0.317	0.317	0.246	0.000	0.000	0.000	0.000	0.000	1.983E-01	6.820E-02	1.983E-01	6.820E-02	1.983E-01	6.820E-02	1.983E-01	6.820E-02	1.983E-01	6.820E-02
8.00	1.587	0.546	0.546	0.246	0.000	0.000	0.000	0.000	0.000	2.542E-01	3.598E-02	2.542E-01	3.598E-02	2.542E-01	3.598E-02	2.542E-01	3.598E-02	2.542E-01	3.598E-02
12.00	2.753	0.605	0.605	0.247	0.000	0.000	0.000	0.000	0.000	2.985E-01	6.878E-03	2.985E-01	6.878E-03	2.985E-01	6.878E-03	2.985E-01	6.878E-03	2.985E-01	6.878E-03
16.00	3.975	0.601	0.601	0.247	0.000	0.000	0.000	0.000	0.000	3.014E-01	-6.152E-03	3.014E-01	-6.152E-03	3.014E-01	-6.152E-03	3.014E-01	-6.152E-03	3.014E-01	-6.152E-03
20.00	5.165	0.556	0.556	0.248	0.000	0.000	0.000	0.000	0.000	2.819E-01	-1.272E-02	2.819E-01	-1.272E-02	2.819E-01	-1.272E-02	2.819E-01	-1.272E-02	2.819E-01	-1.272E-02
24.00	6.231	0.499	0.499	0.250	0.000	0.000	0.000	0.000	0.000	2.755E-01	-2.841E-02	2.755E-01	-2.841E-02	2.755E-01	-2.841E-02	2.755E-01	-2.841E-02	2.755E-01	-2.841E-02
28.00	7.369	0.329	0.329	0.251	0.000	0.000	0.000	0.000	0.000	2.935E-01	-5.662E-02	2.935E-01	-5.662E-02	2.935E-01	-5.662E-02	2.935E-01	-5.662E-02	2.935E-01	-5.662E-02
ALPHA										CL/CD X-C.P.									
0.00	0.000	0.000	0.000	0.246	0.000	0.000	0.000	0.000	0.000	0.000	0.565	0.000	0.565	0.000	0.565	0.000	0.565	0.000	0.565
4.00	0.698	0.295	0.295	0.443	0.000	0.000	0.000	0.000	0.000	2.363	0.344	2.363	0.344	2.363	0.344	2.363	0.344	2.363	0.344
8.00	1.537	0.465	0.465	0.344	0.000	0.000	0.000	0.000	0.000	3.308	0.220	3.308	0.220	3.308	0.220	3.308	0.220	3.308	0.220
12.00	2.642	0.814	0.814	0.151	0.000	0.000	0.000	0.000	0.000	3.246	0.151	3.246	0.151	3.246	0.151	3.246	0.151	3.246	0.151
16.00	3.753	1.334	1.334	0.108	0.000	0.000	0.000	0.000	0.000	2.814	0.108	2.814	0.108	2.814	0.108	2.814	0.108	2.814	0.108
20.00	4.768	2.000	2.000	0.080	0.000	0.000	0.000	0.000	0.000	2.384	0.080	2.384	0.080	2.384	0.080	2.384	0.080	2.384	0.080
24.00	5.591	2.762	2.762	0.045	0.000	0.000	0.000	0.000	0.000	2.024	0.045	2.024	0.045	2.024	0.045	2.024	0.045	2.024	0.045
28.00	6.389	3.681	3.681	0.045	0.000	0.000	0.000	0.000	0.000	1.736	0.045	1.736	0.045	1.736	0.045	1.736	0.045	1.736	0.045
PANEL DEFLECTION ANGLES (DEGREES)																			
FIN SET	FIN 1	FIN 2	FIN 3	FIN 4															
1	0.00	0.00	0.00	0.00															

LINEAR DATA FOR BODY ALONE WAS GENERATED USING THE SECOND-ORDER SHOCK EXPANSION METHOD

Figure 45 Body Plus Fin Static Aerodynamic Partial Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
FLANGER WING, CRUCIFORM PLUS TAIL CONFIGURATION
FIN SET 1 PANEL BENDING MOMENTS (ABOUT EXPOSED ROOT CHORD)

MACH NUMBER	ALTITUDE FT	VELOCITY FT/SEC	FLIGHT CONDITIONS				REFERENCE DIMENSIONS			
			PRESSURE LB/IN**2	TEMPERATURE DEG R	REYNOLDS NUMBER 1/FT	SIDESLIP ANGLE DEG	ROLL ANGLE DEG	REF. AREA IN**2	REF. LENGTH LONG. IN	MOMENT REF. CENTER LONG. IN LAT. IN VERTICAL IN
2.36					3.000E+06	0.00	0.00	11.045	3.750	18.750
ANGLE OF ATTACK,										
DEG.										
			PANEL 1	PANEL 2	PANEL 3	PANEL 4				
0.0000			0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00				
4.0000			0.00000E+00	5.30687E-02	8.07681E-09	-5.30687E-02				
8.0000			0.00000E+00	1.09182E-01	1.70681E-08	-1.09182E-01				
12.0000			0.00000E+00	1.63648E-01	2.70648E-08	-1.63648E-01				
16.0000			-1.49415E-08	2.06561E-01	2.32314E-08	-2.06561E-01				
20.0000			-2.83057E-08	2.42673E-01	5.05213E-08	-2.42673E-01				
24.0000			-3.36869E-08	2.77978E-01	9.79532E-08	-2.77978E-01				
28.0000			-6.00104E-08	3.10986E-01	1.19611E-07	-3.10986E-01				

Figure 46 Panel Bending Moment Partial Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
FIN SET 1 PANEL HINGE MOMENTS (ABOUT HINGE LINE)

FLIGHT CONDITIONS							REFERENCE DIMENSIONS					
MACH NUMBER	ALTITUDE	VELOCITY	PRESSURE	TEMPERATURE	REYNOLDS NUMBER	SIDESLIP	ROLL	REF. AREA	REF. LENGTH	MOMENT	REF. CENTER	
	FT	FT/SEC	LB/IN**2	DEG R	1/FT	ANGLE	ANGLE	IN**2	IN	IN	VERTICAL	
2.36					3.000E+06	0.00	0.00	11.045	3.750	18.750	0.000	
ANGLE OF ATTACK, DEG.												
						PANEL 3		PANEL 4				
						0.00000E+00		0.00000E+00				
0.0000						-8.50186E-09		5.58607E-02				
4.0000						-1.79661E-08		1.14926E-01				
8.0000						-2.84883E-08		1.72258E-01				
12.0000						-5.31793E-08		2.55441E-01				
16.0000						-1.03107E-07		2.92603E-01				
20.0000						-1.25904E-07		3.27347E-01				
24.0000												
28.0000												

Figure 47 Panel Hinge Moment Partial Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
UNTRIMMED STATIC AERODYNAMIC COEFFICIENTS

MACH NUMBER	FLIGHT CONDITIONS				REFERENCE DIMENSIONS							
	ALTITUDE FT	VELOCITY FT/SEC	PRESSURE LB/IN**2	TEMPERATURE DEG R	REYNOLDS NUMBER	SIDESLIP ANGLE DEG	ROLL ANGLE DEG	REF. AREA IN**2	REF. LENGTH IN	REF. LONG. IN	MOMENT REF. IN	CENTER VERTICAL IN
0.60					1.000E+06	0.00	0.00	11.045	3.750	3.750	18.750	0.000
TABLE OF UNTRIMMED NORMAL FORCE COEFFICIENTS												
PANEL DEFLECTION ANGLE, DEG.												
ALPHA	-25.0000	-20.0000	-15.0000	-10.0000	-5.0000	0.0000	0.0000	5.0000	10.0000	15.0000	20.0000	
0.00	-1.0150	-0.9025	-0.7207	-0.4950	-0.2471	0.0000	0.0000	0.2471	0.4950	0.7207	0.9025	
8.00	1.9098	2.3005	2.6479	2.9346	3.1942	3.4112	3.6550	3.8627	4.0093	4.0666	4.0666	
16.00	4.6103	5.1425	5.7523	6.3950	7.0090	7.5348	7.9105	8.0954	8.0628	7.7300	7.7300	
NOMINAL DEFLECTION ANGLES (DEGREES)												
	FIN SET	FIN 1	FIN 2	FIN 3	FIN 4							
	1	0.00	0.00	0.00	0.00							
	2	0.00	0.00	0.00	0.00							

PANELS IN FIN SET 1 HAVE BEEN DEFLECTED

Figure 48 Untrimmed Partial Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
BODY ALONE PRESSURE OUTPUT

CASE 1
PAGE 6

MACH = 2.36 ANGLE OF ATTACK = 0.00 DEG.

PRESSURE COEFFICIENTS

X/DW/LX	CP	M-LOCAL
0.000000	0.284442	1.867502
0.050000	0.276666	1.876899
0.100000	0.268558	1.886836
0.150000	0.260664	1.896649
0.200000	0.252793	1.906577
0.250000	0.244998	1.916553
0.300000	0.237277	1.926579
0.350000	0.229629	1.936659
0.400000	0.222055	1.946791
0.450000	0.214555	1.956977
0.500000	0.207422	1.966809
0.550000	0.200348	1.976703
0.600000	0.193339	1.986654
.	.	.
.	.	.
.	.	.
9.000000	-0.001058	2.348805
9.050000	-0.001027	2.348726
9.100000	-0.000996	2.348649
9.150001	-0.000966	2.348574
9.200000	-0.000937	2.348501
9.250000	-0.000909	2.348431
9.300000	-0.000881	2.348362
9.350000	-0.000855	2.348296
9.400001	-0.000829	2.348232
9.450000	-0.000804	2.348170
9.500000	-0.000780	2.348109
9.550000	-0.000757	2.348050
9.600000	-0.000734	2.347993
9.650001	-0.000712	2.347938
9.700000	-0.000691	2.347885
9.750000	-0.000670	2.347833
9.800000	-0.000650	2.347783
9.850000	-0.000630	2.347734
9.900001	-0.000611	2.347687
9.950000	-0.000593	2.347641
10.000000	-0.000575	2.347596

Figure 49 Body Pressure Distribution from SOSE, AOA=0°

THE USAF AUTOMATED MISSILE DATCOM - REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
BODY ALONE PRESSURE OUTPUT

MACH = 2.36 ANGLE OF ATTACK = 4.00 DEG.

PRESSURE COEFFICIENTS

X/DNAX	PHI=0	PHI=30	PHI=60	PHI=90	PHI=120	PHI=150	PHI=180
0.00000	0.205017	0.213251	0.238086	0.277548	0.323402	0.361022	0.375649
0.05000	0.198498	0.206561	0.230935	0.269780	0.315035	0.352226	0.366698
0.10000	0.191601	0.199509	0.223454	0.261705	0.306353	0.343094	0.357399
0.15000	0.184943	0.192688	0.216191	0.253836	0.297876	0.334171	0.348313
0.20000	0.178321	0.185902	0.208957	0.245988	0.289413	0.325258	0.339235
0.25000	0.171782	0.179199	0.201802	0.238216	0.281024	0.316416	0.330227
0.30000	0.165323	0.172574	0.194724	0.230518	0.272706	0.307643	0.321287
0.35000	0.158942	0.166027	0.187721	0.222893	0.264458	0.298938	0.312415
0.40000	0.152640	0.159557	0.180795	0.215342	0.256280	0.290301	0.303610
0.45000	0.146416	0.153166	0.173945	0.207864	0.248173	0.281733	0.294873
0.50000	0.140327	0.147113	0.167444	0.200751	0.240449	0.273562	0.286538
0.55000	0.134699	0.141121	0.161004	0.193699	0.232784	0.265447	0.278259
0.60000	0.128937	0.135194	0.154629	0.186710	0.225180	0.257393	0.270039
0.65000	0.123244	0.129338	0.148323	0.179790	0.217643	0.249402	0.261882
0.70000	0.117622	0.123551	0.142088	0.172938	0.210172	0.241476	0.253789
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
9.250000	0.006124	0.002622	-0.004344	-0.007705	-0.003958	0.003291	0.006897
9.300000	0.006164	0.002660	-0.004312	-0.007678	-0.003937	0.003309	0.006913
9.350000	0.006203	0.002696	-0.004280	-0.007653	-0.003916	0.003326	0.006930
9.400001	0.006240	0.002732	-0.004249	-0.007628	-0.003897	0.003343	0.006946
9.450000	0.006277	0.002767	-0.004219	-0.007604	-0.003877	0.003359	0.006961
9.500000	0.006312	0.002800	-0.004191	-0.007581	-0.003859	0.003375	0.006976
9.550000	0.006347	0.002833	-0.004163	-0.007558	-0.003841	0.003390	0.006990
9.600000	0.006380	0.002865	-0.004135	-0.007536	-0.003823	0.003405	0.007004
9.650001	0.006412	0.002895	-0.004109	-0.007515	-0.003806	0.003420	0.007018
9.700000	0.006443	0.002925	-0.004083	-0.007495	-0.003790	0.003434	0.007031
9.750000	0.006474	0.002954	-0.004059	-0.007474	-0.003774	0.003447	0.007044
9.800000	0.006503	0.002982	-0.004035	-0.007455	-0.003758	0.003460	0.007057
9.850000	0.006532	0.003009	-0.004011	-0.007436	-0.003743	0.003473	0.007068
9.900001	0.006560	0.003035	-0.003989	-0.007418	-0.003729	0.003485	0.007080
9.950000	0.006587	0.003061	-0.003967	-0.007400	-0.003714	0.003497	0.007091
10.000000	0.006613	0.003085	-0.003945	-0.007383	-0.003701	0.003509	0.007102

NOTE - PHI= 0 IS TOP VERTICAL CENTER (LEEWARD)
PHI=180 IS BOTTOM VERTICAL CENTER (WINDWARD)

Figure 50 Body Pressure Distribution at Angle of Attack

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
PRESSURE COEFFICIENTS ON FIN SET 1 AT MACH = 2.360

FOR ALPHA = 0.0

LOCAL CHORD = 0.5798 FT

Y/(B/2)	Y/C	CP
0.0003	0.0000	0.3413
0.0003	0.0000	0.3310
0.0003	0.0001	0.3013
0.0003	0.0003	0.2559
0.0003	0.0005	0.2003
0.0003	0.0008	0.1410
0.0003	0.0011	0.0853
0.0003	0.0014	0.0399
0.0003	0.0023	0.0229
0.0003	0.0025	0.0200
0.0003	0.0026	0.0173
0.0003	0.0028	0.0148
0.0003	0.0029	0.0124
0.0003	0.0031	0.0103
0.0003	0.0032	0.0052
0.0003	0.0034	-0.0052
.	.	.
.	.	.
.	.	.
0.0003	0.5020	-0.0049
0.0003	0.5326	-0.0049
0.0003	0.5631	-0.0049
0.0003	0.5937	-0.0049
0.0003	0.6243	-0.0049
0.0003	0.6549	-0.0049
0.0003	0.6854	-0.0049
0.0003	0.7160	-0.0814
0.0003	0.7160	-0.0814
0.0003	0.7444	-0.0682
0.0003	0.7728	-0.0682
0.0003	0.8012	-0.0682
0.0003	0.8296	-0.0682
0.0003	0.8580	-0.0682
0.0003	0.8864	-0.0682
0.0003	0.9148	-0.0682
0.0003	0.9432	-0.0682
0.0003	0.9716	-0.0682
0.0003	1.0000	0.0055

Figure 51 Fin Pressure Distribution Output

THE USAF AUTOMATED MISSILE DATCOM * REV 4/91 *
 AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
 PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
 BODY + 2 FIN SETS DYNAMIC DERIVATIVES

CASE 1
 PAGE 3

FLIGHT CONDITIONS										REFERENCE DIMENSIONS				
MACH NUMBER	ALTITUDE FT	VELOCITY FT/SEC	PRESSURE LB/IN**2	TEMPERATURE DEG R	REYNOLDS NUMBER 1/FT	SIDSLIP ANGLE DEG	ROLL ANGLE DEG	REF. AREA IN**2	REF. LENGTH IN	REF. LONG. IN	MOMENT IN	REF. CENTER LONG. IN	REF. CENTER LAT. IN	REF. CENTER VERTICAL IN
2.36					3.000E+06	0.00	0.00	11.045	3.750	3.750	18.750			0.000
DYNAMIC DERIVATIVES (PER DEGREE)														
ALPHA					CMQ					CMQ+3RAD				
0.0					6.984E-01					3.641E-01				-3.83418E+00
4.0					8.745E-01					6.338E-01				-4.53844E+00
8.0					1.168E+00					1.101E+00				-5.62797E+00
12.0					1.492E+00					1.606E+00				-6.77794E+00
16.0					1.727E+00					1.946E+00				-7.59595E+00

Figure 52 Dynamic Derivative Output

THE USAF AUTOMATED MISSILE DATCOM - REV 4/91 -
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
PLANAR WING, CRUCIFORM PLUS TAIL CONFIGURATION
EXTRAPOLATION SUMMARY FOR INPUT MACH 1

ROUTINE TRACE-BACK -----										UPPER BOUNDS		FINAL RESULT	
MISDAT	AERO	ASPECT	MAXCL	MYLOOK	LNTRP	LOWER BOUNDS				X=	Y=	X=	Y=
MISDAT	AERO	ASPECT	MAXCL	MYLOOK	LNTRP	X= 3.0000000E+06 Y= -3.2997910E-02				X= 2.5000000E+07 Y= 4.3997213E-02		X= 1.1600000E+06 Y= -5.3236630E-02	
MISDAT	AERO	ASPECT	MAXCL	MYLOOK	LNTRP	X= 3.0000000E+06 Y= -3.1011123E-02				X= 2.5000000E+07 Y= 4.1348159E-02		X= 1.0859260E+06 Y= -5.0796986E-02	
MISDAT	AERO	BODY	BODYA	STBODY	BODYCM	BOCMAN	MYLOOK	LNTRP		X= 1.0000000E+00 Y= 5.9000001E+00		X= 1.1000000E+00 Y= 5.5000005E+00	
MISDAT	AERO	BODY	BODYA	STBODY	BODYCM	BOCMAN	MYLOOK	LNTRP		X= 1.0000000E+00 Y= 8.0500002E+00		X= 1.1000000E+00 Y= 7.7500010E+00	
MISDAT	AERO	BODY	BODYA	STBODY	BODYCM	BOCMAN	MYLOOK	LNTRP		X= 1.0000000E+00 Y= 1.0600000E+01		X= 1.1000000E+00 Y= 1.0400002E+01	
MISDAT	AERO	BODY	BODYA	STBODY	BODYCM	BOCMAN	MYLOOK	LNTRP		X= 1.0000000E+00 Y= 4.9499998E+00		X= 1.1000000E+00 Y= 3.5499992E+00	
MISDAT	AERO	BODY	BODYA	STBODY	BODYCM	BOCMAN	MYLOOK	LNTRP		X= 1.0000000E+00 Y= 7.9000001E+00		X= 1.1000000E+00 Y= 6.0999999E+00	
MISDAT	AERO	BODY	BODYA	STBODY	BODYCM	BOCMAN	MYLOOK	LNTRP		X= 1.0000000E+00 Y= 1.1500000E+01		X= 1.1000000E+00 Y= 1.0900000E+01	
MISDAT	AERO	FINS	FINCEN	FCMAA	FCMAAT	FCMAAS	FCMAAS	MYLOOK	LNTRP	X= 6.0000000E+01 Y= 1.3000000E+00		X= 6.3434952E+01 Y= 1.3343494E+00	
MISDAT	AERO	FINS	FINCEN	FCMAA	FCMAAT	FCMAAS	FCMAAS	MYLOOK	LNTRP	X= 6.0000000E+01 Y= 1.1900000E+00		X= 6.3434952E+01 Y= 1.2174797E+00	
MISDAT	AERO	FINS	FINCEN	FCMAA	FCMAAT	FCMAAS	FCMAAS	MYLOOK	LNTRP	X= 6.0000000E+01 Y= 1.0300000E+00		X= 6.3434952E+01 Y= 1.0437398E+00	
MISDAT	AERO	FINS	FINCEN	FCMAA	FCMAAT	FCMAAS	FCMAAS	MYLOOK	LNTRP	X= 6.0000000E+01 Y= 8.7000000E-01		X= 6.3434952E+01 Y= 8.6656505E-01	
MISDAT	AERO	FINS	FINCEN	FCMAA	FCMAAT	FCMAAS	FCMAAS	MYLOOK	LNTRP	X= 6.0000000E+01 Y= 7.3000002E-01		X= 6.3434952E+01 Y= 7.1282330E-01	
MISDAT	AERO	FINS	FINCEN	FCMAA	FCMAAT	FCMAAS	FCMAAS	MYLOOK	LNTRP	X= 6.0000000E+01 Y= 5.8999997E-01		X= 6.3434952E+01 Y= 5.4678056E-01	

Figure 53 Extrapolation Message Output

DUMP OF INTERNAL DATA ARRAYS IN FOOT-POUND-RANKINE UNITS

```

FLT( 1)= 5.00000E+00    FLT( 2)= 0.00000E+00    FLT( 3)= 4.00000E+00    FLT( 4)= 8.00000E+00    FLT( 5)= 1.20000E+01
FLT( 6)= 1.60000E+01    FLT( 7)= 1.00000E-30    FLT( 8)= 1.00000E-30    FLT( 9)= 1.00000E-30    FLT(10)= 1.00000E-30
FLT(11)= 1.00000E-30    FLT(12)= 1.00000E-30    FLT(13)= 1.00000E-30    FLT(14)= 1.00000E-30    FLT(15)= 1.00000E-30
FLT(16)= 1.00000E-30    FLT(17)= 1.00000E-30    FLT(18)= 1.00000E-30    FLT(19)= 1.00000E-30    FLT(20)= 1.00000E-30
FLT(21)= 1.00000E-30    FLT(22)= 0.00000E+00    FLT(23)= 0.00000E+00    FLT(24)= 1.00000E+00    FLT(25)= 2.36000E+00
FLT(26)= 1.00000E-30    FLT(27)= 1.00000E-30    FLT(28)= 1.00000E-30    FLT(29)= 1.00000E-30    FLT(30)= 1.00000E-30
FLT(31)= 1.00000E-30    FLT(32)= 1.00000E-30    FLT(33)= 1.00000E-30    FLT(34)= 1.00000E-30    FLT(35)= 1.00000E-30
FLT(36)= 1.00000E-30    FLT(37)= 1.00000E-30    FLT(38)= 1.00000E-30    FLT(39)= 1.00000E-30    FLT(40)= 1.00000E-30
FLT(41)= 1.00000E-30    FLT(42)= 1.00000E-30    FLT(43)= 1.00000E-30    FLT(44)= 1.00000E-30    FLT(45)= 1.00000E-30
FLT(46)= 3.00000E+06    FLT(47)= 1.00000E-30    FLT(48)= 1.00000E-30    FLT(49)= 1.00000E-30    FLT(50)= 1.00000E-30
FLT(51)= 1.00000E-30    FLT(52)= 1.00000E-30    FLT(53)= 1.00000E-30    FLT(54)= 1.00000E-30    FLT(55)= 1.00000E-30
FLT(56)= 1.00000E-30    FLT(57)= 1.00000E-30    FLT(58)= 1.00000E-30    FLT(59)= 1.00000E-30    FLT(60)= 1.00000E-30
FLT(61)= 1.00000E-30    FLT(62)= 1.00000E-30    FLT(63)= 1.00000E-30    FLT(64)= 1.00000E-30    FLT(65)= 1.00000E-30
FLT(66)= 1.00000E-30    FLT(67)= 1.00000E-30    FLT(68)= 1.00000E-30    FLT(69)= 1.00000E-30    FLT(70)= 1.00000E-30
FLT(71)= 1.00000E-30    FLT(72)= 1.00000E-30    FLT(73)= 1.00000E-30    FLT(74)= 1.00000E-30    FLT(75)= 1.00000E-30
FLT(76)= 1.00000E-30    FLT(77)= 1.00000E-30    FLT(78)= 1.00000E-30    FLT(79)= 1.00000E-30    FLT(80)= 1.00000E-30
FLT(81)= 1.00000E-30    FLT(82)= 1.00000E-30    FLT(83)= 1.00000E-30    FLT(84)= 1.00000E-30    FLT(85)= 1.00000E-30
FLT(86)= 1.00000E-30    FLT(87)= 1.00000E-30    FLT(88)= 1.00000E-30    FLT(89)= 1.00000E-30    FLT(90)= 1.00000E-30
FLT(91)= 1.00000E-30    FLT(92)= 1.00000E-30    FLT(93)= 1.00000E-30    FLT(94)= 1.00000E-30    FLT(95)= 1.00000E-30
FLT(96)= 1.00000E-30    FLT(97)= 1.00000E-30    FLT(98)= 1.00000E-30    FLT(99)= 1.00000E-30    FLT(100)= 1.00000E-30
FLT(101)= 1.00000E-30    FLT(102)= 1.00000E-30    FLT(103)= 1.00000E-30    FLT(104)= 1.00000E-30    FLT(105)= 1.00000E-30
FLT(106)= 1.00000E-30    FLT(107)= 1.00000E-30    FLT(108)= 1.00000E-30    FLT(109)= 1.00000E-30    FLT(110)= 1.00000E-30
FLT(111)= 1.00000E-30    FLT(112)= 1.00000E-30    FLT(113)= 1.00000E-30    FLT(114)= 1.00000E-30    FLT(115)= 1.00000E-30
FLT(116)= 1.00000E-30    FLT(117)= 1.00000E-30    FLT(118)= 1.00000E-30    FLT(119)= 1.00000E-30    FLT(120)= 1.00000E-30
FLT(121)= 1.00000E-30    FLT(122)= 1.00000E-30    FLT(123)= 1.00000E-30    FLT(124)= 1.00000E-30    FLT(125)= 1.00000E-30

REFQ( 1)= 7.66990E-02    REFQ( 2)= 3.12500E-01    REFQ( 3)= 3.12500E-01    REFQ( 4)= 0.00000E+00    REFQ( 5)= 1.56250E+00
REFQ( 6)= 0.00000E+00    REFQ( 7)= 1.00000E+00    REFQ( 8)= 0.00000E+00    REFQ( 9)= 1.00000E-30

```

Figure 54 Internal Array Dump Output

5.0 IMPLEMENTATION GUIDE

This section details the steps necessary to make the code operational on the user's computer system. In addition this section contains cross reference tables for all the subroutines and common blocks used in the computer program. It also contains a description of the variables in the common blocks that can be written out using the WRITE or DUMP cards in the input deck.

5.1 INSTALLATION ON COMPUTER SYSTEMS

This section details the steps necessary to make the computer code functional on the user's computer system. Although conversion of the program can be easily accomplished by someone with a good understanding of the FORTRAN V language, it is highly recommended that someone familiar with the computer operating system be consulted.

5.1.1 Requirements

In order for the Missile Datcom code to be successfully implemented on the user's computer system, there are three requirements which must be met, as follows:

- Language - As received, the CDC code is compatible with FORTRAN IV, except as noted below. The program can be easily converted to FORTRAN V and the changes required are described later in this section. The VAX compatible code is maintained as a FORTRAN V version.
- Namelist - The code has been designed with an internal FORTRAN NAMELIST emulator to allow the input and output (I/O) to be handled by namelist variables. This is an exception to Standard FORTRAN but with the emulator as part of the code the program will run under Standard FORTRAN. The code is not easily converted to fixed field, rather than namelist input.
- I/O Scratch Files - The code uses the following logical file units: 1, 2, 3, 4, 5, 6 and 7. All file units are accessed using formatted reads and writes. File units 1, 2, 4 and 7 are used internally; file units 3, 5 and 6 transfer data between the user and the code.

5.1.2 Coding Changes

In order for the code to made operational on other computer systems, several minor coding changes may be required.

- **Namelist Delimiter** - The namelist delimiter used on the computer system is set in the routine BLOCK DATA. It is preset to the "\$" character for VAX computers in the DATA statement defining the variable KAND. It must be changed for other computers, which employ the "&" character for the namelist delimiter.
- **Defining UNUSED** - The variable UNUSED is defined in routine BLOCK DATA. It is preset to "1.E-30" and should be acceptable for most computers. If this number is too small for the computer being used, it may be changed to a small, non-zero, positive number which is no larger than 1×10^{-10} . This constant is used to initialize all program data arrays. If a new value is assigned it must also be incorporated in NMLIST, variable JUNSD.

5.1.3 Input/Output

Seven file units are used by the program. They are the logical units 1, 2, 3, 4, 5, 6 and 7 which are used as follows:

<u>Unit</u>	<u>Usage</u>
1	All input cards read from unit 5 are written to unit 1 by CONERR after they have been checked for errors
2	Namelists for the input "case" are read from unit 1 and written to unit 2 by READIN. The namelists for the "case" are read from unit 2.
3	Data dumped at user request (using PLOT or WRITE control cards) are written to unit 3 by PLOT3, PLTTRM, and/or SAVEF. The PLOT file format is given in Appendix B.
4	Method extrapolation messages are printed in compact form on unit 4 by MESSG and read by EXTRAP.
5	User inputs are read from unit 5 by CONERR.
6	Program output is written to unit 6.
7	The FORMAT and WRITE control cards are written to unit 7 by CONTRL and read by SAVEF.

The method extrapolation messages are written to unit 4 as they are generated if a PRINT EXTRAP control card is present. When the

aerodynamic calculations are completed for each Mach number, the line END MACH is written to signify the end of messages for that Mach number. For each extrapolation two lines are written to unit 4 as follows:

<u>Line</u>	<u>Contents</u>
1	The names of the routines called to get to this part of the code. The last name is the routine currently being executed.
2	The seven (7) parameters defining the extrapolation: First Value: Value for the independent variable Second Value: Final Result Third Value: Lower independent value Fourth Value: Upper independent value Fifth Value: Lower dependent value Sixth Value: Upper dependent value Seventh Value: Order of extrapolation

The data is automatically read and formatted for output by the program in the standard output file. Hence, this file need not be retained or printed by the user at the end of code execution.

5.2 PROGRAM CROSS REFERENCES

This section summarizes the cross references of subroutines and common blocks within the code. The tables given can be used to verify the proper location of common blocks within the code, identify the subroutines called by each of the methods and, if program revisions are made, facilitates subroutine modification. The cross references are given by subroutine name and by common block name.

5.2.1 Subroutine Cross Reference By Name

Figures 55 and 56 summarizes the subroutine cross references for the program. Figure 55 lists each subroutine and gives the subroutines that call it. Figure 56 list each subroutine and gives the subroutines which it calls. For convenience, the subroutines are listed in alphabetical order.

5.2.2 Common Block Cross Reference By Name

Figures 57 and 58 summarize the common blocks used by the program. Seven types of common blocks are used by the program: (1) Internal data management, (2) Input data, (3) Aerodynamic work, (4) Geometry, (5) Static aerodynamic, (6) Dynamic aerodynamic, and (7) Trim blocks. These common blocks are shown in Figure 59 for each type of data. For each block type, the data is subdivided by task or configuration, as appropriate.

Internal Data Management : These eight common blocks contain the data to control program execution.

CASEID - Contains the case title (from the CASEID control card), the case number and flag to print extrapolation messages and the flag to suppress calculation of the lateral-directional derivatives.

THERY - Contains the flags necessary to select the correct supersonic body theory.

CONST - Contains the program constants.

TRACE - Contains the position in the code being executed.

LOGIC - Contains the configuration and program option flags.

DUMPF - Contains the logic flags to delete namelist inputs using the DELETE control card.

INPCON - Contains the data required to validate namelist name inputs.

Input Common Blocks: Except for namelist EXPR, each input namelist is assigned a separate common block for data storage. The values read in from EXPR are stored in the common blocks in which the coefficients of the partial configurations for which the experimental data is provided are stored. The theoretical values are over written by the experimental data.

<u>Common Block</u>	<u>Namelist</u>
FLC	FLTCON
REFQN	REFQ
ABODIN	AXIBOD
ABODIN	ELLBOD
FSET1	FINSET1
FSET2	FINSET2
FSET3	FINSET3
FSET4	FINSET4
DESIG	FINSET1 - FINSET4(NACA control card)
INCID	DEFLCT
TRIMIN	TRIM

Aerodynamic Work Arrays: These common blocks contain most of the intermediate aerodynamic calculations, particularly those needed for other methods.

<u>Common Block</u>	<u>Configuration Component</u>
BDWORK	Body
F1WORK	Fin Set 1
F2WORK	Fin Set 2
F3WORK	Fin Set 3
F4WORK	Fin Set 4

Geometry Common Blocks: These common blocks hold the results of the geometric calculations for each component of the configuration.

<u>Common Block</u>	<u>Configuration Component</u>
GEOBOD	Body
GEOFS1	Fin Set 1
GEOFS2	Fin Set 2
GEOFS3	Fin Set 3
GEOFS4	Fin Set 4

Static Aerodynamic Results: The final static aerodynamic results are stored by configuration or configuration component. These arrays form the Ideal Output Matrix (I.O.M.), where the data is stored in a fixed format, regardless of configuration component. These data are exactly that which is printed as the normal aerodynamic output. Twenty array elements are reserved for each aerodynamic parameter, which corresponds to the 20 angles of attack. Eleven aerodynamic coefficients are defined. this pattern is used for both the static (SBODY, SFIN1, SFIN2, SFIN3, SFIN4, SB1, SB12, SB123, SB1234) and dynamic (DBODY, DFIN1, DFIN2, DFIN3, DFIN4, DB1, DB12, DB123, DB1234) aerodynamic results. Since a maximum of four sets of fins are permitted, SB1 (and DB1) refers to the body plus the most forward fin set, SB12 (and DB12) refers to the body plus the first and second most forward fin sets, SB123 (and DB123) refers to the body plus the three most forward fin sets, Finally, SB1234 (and DB1234) refers to the body plus all four fin sets.

Trim Results: The code uses ten deflection angles, as a function of angle of attack, in order to interpolate for the longitudinal trim points. The untrimmed aerodynamic results obtained are stored in the common blocks UTRIMD as a function of angle of attack and deflection

angle. the aerodynamic coefficients retained are C_N , C_m , C_A , C_Y , C_n , and C_l . The trimmed results are stored in the common block TRIMD, and are the trimmed values for C_N , C_A , C_Y , C_n , and C_l .

Experimental Data Substitution: Experimental substitution allows the user to input experimental data for any part of the configuration or any partial configuration. For example the user may input body alone experimental data, fin alone experimental data and/or body + one (1) fin set experimental data for a configuration having a body + two (2) sets of fins. The experimental is substituted into the appropriate common block and replaces the computed theoretical coefficients. The substituted coefficients are then used in the configuration synthesis process in subroutine SYNTHS.

Configuration Incrementing: Configuration incrementing requires all cases of an incrementing run to have the same configuration components (i.e. if the first case is a body + one (1) fin set then all the cases that follow must be for a body + one (1) fin set). Configuration incrementing runs must be thought of as a sequence of case runs rather than individual cases. When the first case is executed, the experimental data is substituted for the configuration being run. The experimental data is then compared with the theoretical coefficients. The correction factors that are computed are stored in the INC common block. When the subsequent cases are run, the correction factors are applied to the theoretical coefficients in SYNTHS. These corrections are made prior to printing out the aerodynamic results.

Module	Calls Module(s):				Module	Called Module(s):			
AEBO	ADDECG	ASBCT	BETADR	BODY	CAINC	CHINC			
	CNINC	CSINC	CSNINC	CYINC	DAMP	DUMPRT			
	ETRACE	FINS	FLAPS	FLTCDS	ILTARO	INZICH			
	POLINT	PRINT	STRACE	SUBEXP	TRINIT				
AFTCAP	CP3DM								
AIRFOL	COORD1	COORD4	COORD5	COORD6	CORD4H	CORD5H			
	CORDSP	DECODE	ETRACE	HEADER	LNTRP	STRACE			
	SUPXY								
ALPBET									
ALPEQ	CLVR	DINED	ETRACE	SPLINE	STRACE				
ANGDET									
ARCCA	CP3DM	SINPM							
ARCOR	TABLOK								
ARSECH									
ASECT	CLMAX	ETRACE	STRACE	THEORY					
ASOSL	AX2U								
ATMOS									
AXBNDY	ARSECH								
AXINWT									
AX2U									
BASPRS	BOTCA	BOTCHH	CKDAT	ETRACE	STRACE	TABLOK			
BDRMP	BCHAD	BOOVAR	BODER	BSUB	ETRACE	HYPER			
	LMSC	SPIN83	STRACE						
BDCAB	ETRACE	LNTRP	STRACE						
BDCALP									
BDCAP1	ETRACE	MYLOOK	STRACE						
BDCAP2	ETRACE	MYLOOK	STRACE						
BDCAPR									
BDCANC	ETRACE	LNTRP	STRACE						
BDCAMF	ETRACE	MYLOOK	STRACE						
BDCAMN	ETRACE	INTER4	STRACE						
BDCDRV	BDCAP1	BDCAP2	ETRACE	STRACE					
BDCNP									
BDCNV									
BDCNAB	ETRACE	LNTRP	STRACE						
BDCNAF	ETRACE	LNTRP	STRACE						
BDCNAH	ETRACE	LNTRP	MYLOOK	STRACE					
BDCNP									
BDCNV									
BDPART	HEADER	PRIFLC							
BDXCPB									
BDXCEN	ETRACT	LNTRP	MYLOOK	STRACE					
BETADR	AL	BLKLOD	ETRACE	STRACE	SYNTHS				
BETAU									
BITSS	ELLIP1	ELLIP2	ETRACE	LNTRP	STRACE				
BLUNT	LOOP								
BLUNTN									
BODCFD	ILTCDC								
BODNWT									
BODVAR									
BODY	BODYA	BODYE	ETRACE	STRACE					
BODYA	ALPBET	BDPART	ETRACE	POLINT	STRACE				
	SUPBOD								
BODYCA	BDCAB	BDCALP	BDCAPR	BDCAMF	BDCAMN	BDCDRV			
	CAFRIC	CDPRES	CDPROT	ETRACE	HEADER	LNTRP			
	MDIV	PRIFLC	STRACE						
BODYCH	BDCMP	BDCNV	BDXCPB	BDXCPF	BDXCPN	ETRACE			
	STRACE								

Figure 55 Subroutine Cross Reference (Listed by Calling Routine)

Module	Calls Module(s):										Module	Calls Module(s):									
BODYCH	BDCNAB	BDCNAB	BDCNAB	ETRAZE	GETETA	STRACE	BDCNAB	BDCNAB	BDCNAB	CDGS	CNPAXI										
BOOYE	ALPAST	BOPART	POLINT	STRACE	STRACE	STRACE	BODYA	ETRAZE	GETCNO	LWTRP	CNPFTWO										
BOTCA	ETRAZE	STRACE	STRACE	STRACE	STRACE	STRACE	TABLOK				CNSBT										
BOTCHM	BDCNAB	ETRAZE	ETRAZE	ETRAZE	ETRAZE	ETRAZE	STRACE				CONEP										
BSUB											CONERR	CCARD	HEADER	INSBLK	NHLIST	NHTEST	PACK				
BUILD	CIRC	CYL				FLAT					CONIC	DSPLAN	DSMET	DVOL	DXCENP	DXCENV	SPHERE				
CAPRIC	SKINF										CONTRL	DELNMS	NHTEST								
CAINC	CALIB	ETRAZE	ETRAZE	ETRAZE	ETRAZE	ETRAZE	LWTRP	STRACE			CONVRT										
CALIB	ETRAZE	ETRAZE	ETRAZE	ETRAZE	ETRAZE	ETRAZE	STRACE				COORD1	SLEQ									
CARRYO	CARRYS	ETRAZE	ETRAZE	ETRAZE	ETRAZE	ETRAZE	FALCF	FWDMAC	STRACE		COORD4										
CARRYS											COORD5										
CCARD	DELNMS	NHTEST									COORD6	SLEQ									
CDGS	ETRAZE	LWTRP					MYLOOK	STRACE			CORD4M	SLEQ									
CDPRES	EVAL	PRCOR					SPLIN2				CORD5M	SLEQ									
CDPROT	BUILD	CIRC				CONVRT	CONVRT	CYL	FLAT	LUGSHO	CORDSP										
	STREAM										CP3DM										
CHEEND											CPCAL	SRATIO									
CIRC	CROSS	CUBIC									CPDIST										
CLMAX	ETRAZE	LWTRP					MYLOOK	STRACE			CROSS	TABLOK									
CLOCD											CSLINC	CALIB	ETRAZE	LWTRP	STRACE						
CLVR	ETRAZE	LWTRP					STRACE	SVRINT			CSWINC	CALIB	ETRAZE	LWTRP	POLINT	STRACE					
CHINC	CALIB	ETRAZE	ETRAZE	ETRAZE	ETRAZE	ETRAZE	LWTRP	STRACE			CUBIC										
CHENT											CYRBOD	CONVRT									
CHINC	CALIB	ETRAZE	ETRAZE	ETRAZE	ETRAZE	ETRAZE	LWTRP	STRACE			CYRFIN	CONVRT									
CHMENT	ETRAZE	LWTRP					STRACE				CVREFLT	CONVRT									
											CVREF	CONVRT									

Figure 55 Subroutine Cross Reference (Listed by Calling Routine) - Continued

Module	Calla_Modules(al):										Module	Calla_Modules(al):									
CVRFTT	CVRBOD	CVRFIN	CVRFLT	CVRREF							ELLIP2										
CVRTUS	CVRBOD	CVRFIN	CVRFLT	CVRREF							ELLKWB										
CYINC	CALIB	ETRACE	LNTRP	POLINT	STRACE						EQH44										
CYL	ARCOR	CROSS	CUBIC								EXPAND										
CYPAXI											EXTRAP	HEADER									
DAMP	BDAMP	DDSYN	ETRACE	FDAMP	IN2DYN	STRACE					FIGEOM	ASPECT YMG	FINCEN	FINMGC	FINPLN	SWEEN	TCEFTT				
DDSYN	POLINT										F2GEOM	ASPECT YMG	FINCEN	FINMGC	FINPLN	SWEEN	TCEFTT				
DELIMS	INTTEST										F3GEOM	ASPECT YMG	FINCEN	FINMGC	FINPLN	SWEEN	TCEFTT				
DELV	AXBNDY	DISC2	JAS26								F4GEOM	ASPECT YMG	FINCEN	FINMGC	FINPLN	SWEEN	TCEFTT				
DISC2	INTERP										F4GEOM	ASPECT YMG	FINCEN	FINMGC	FINPLN	SWEEN	TCEFTT				
DIVCFD	ILTDCD										FALCP	ETRACE	MVLOOK	STRACE							
DIVVMT											FAPART	HEADER	PRIFLC								
DMPARY											FCALC										
DREAD	RARBOD	RAXIS	RDEFL	RELLB	RFIN1	RFLT					FCALP	ETRACE	LNTRP	STRACE							
DSPLAN	RINLET	RREFQ	RTRIM								FCAMPF	AFTCAP SIMPW	ARCCA	ASOSL	HEADER	HEXCA	HSOSL				
DSWET											FCAMS										
DSWETE	DXCENP	ELLIP2									FCANT	ETRACE	MVLOOK	STRACE							
DUMPRT	DMPARY										FCMSB	ETRACE	LNTRP	MVLOOK	STRACE						
DVOL											FCMISH	ETRACE	MVLOOK	STRACE							
DVOLE											FCNA	ETRACE	FCNASB	FCNATR	STRACE						
DWRITE	HEADER	PRIFLC									FCNAH	ETRACE	FCNAH	FCNAAT	STRACE						
DXCENP											FCNAH	ETRACE	FIG60B	FSDETA	LNTRP	MVLOOK	STRACE				
DXCENV											FCNAAS	ETRACE	FCMSB	FCMISH	LNTRP	MVLOOK	STRACE				
DXCNVE											FCNAAT	ETRACE	FCNAH	FCNASB	FCNASP	STRACE					
ELLIP1											FCNASB										

Figure 55 Subroutine Cross Reference (Listed by Calling Routine) - Continued

Module	Calls Module(s):										Module	Called Module(s):									
FCMASP	ETRACE	LNTRP	LUCERO									FOIL	ETRACE	LNTRP	STRACE	TOHOLL					
FCNATR	ETRACE	LOOK3	STRACE									FORINT									
FDAMP	BITSS	ETRACE	FINVAR									FORLOG									
	SFCNQ	SFCNAD	SFCNQ									FORREA									
	SUBDER	TRANS																			
FDP5	FDS											FSEDTA	ANGDET								
FGEOM	AIRPOL	ETRACE	F1GEOM									FMDXAC	ETRACE	MVLOOK	STRACE						
	FOIL	LNTRP	STRACE																		
FIG60B	ETRACE	LNTRP	MVLOOK									GEO									
FINCA	ETRACE	FINXCA	STRACE									GEOAXI	CONIC	CVRTFT	CVRTUS	ETRACE	HAACK	OGIVE			
FINCAB	ETRACE	LNTRP	STRACE										POWR	PRIAXI	STRACE	USERS					
FINCAP												GEOELL	CONIC	CVRTFT	CVRTUS	DSPLAN	DSWET	DSWETZ			
													DVOL	DVOLE	DXCNVE	ETRACE	HAACK	LNTRP			
													OGIVE	POWR	PRIELL	STRACE	USEREL				
FINCEN	ASPECT											GEOFIN	ETRACE	FGEOM	PRIFIN	STRACE					
FINCN	ETRACE	FALCP	FNPART									GEOINL	BODNWT	DIVNWT	ILTANG	ILTRF	ILTNWT	ILTVIN			
FINCN	ETRACE	FCNA	FCNAA										INLETG								
	STRACE											GEOM	CVRTUS	ETRACE	GEOAXI	GEOELL	GEOFIN	GEOINL			
FINDVN													LNTRP	STRACE	STRACE						
FINFIN	BETAU	ETRACE	SPLINE									GETCNO	CHNWT	CNSBT	ETRACE	LNTRP	QUAD1	STRACE			
FIN5	ETRACE	FINCA	FINCH									GETETA	ETRACE	LNTRP	STRACE						
	STRACE											GETNLN									
FINVAR	POLINT											HAACK	DSPLAN	DSWET	DVOL	DXCENP	DXCENV	SPHERE			
FINXCA	ETRACE	FNPART	FCAL2									HEADER									
	FCAMT	FINCAB	FINCAP									HEXCA	CF3DW	MDIV	SINEM						
													HEADER	PRIIFLC							
PTT												HINGEM	HX2U								
PLAPS	CUBIC											HOSL	HX2U								
PLAT	CROSS	CUBIC	PLATE									HX2U									
PLICDS	ALPBET	ATHOS										HYBG1	FDP5	INTERP	LOOP						
PNPART	HEADER	PRIIFLC										HYBG2	BLUNT	FDP5	INTERP						
PNPART	HEADER	PRIIFLC																			

Figure 55 Subroutine Cross Reference (Listed by Calling Routine) - Continued

Module	Calls Module(s):										Module	Calls Module(s):									
HYBRID	HYBG1	HYBG2			HYBSET		VANDYK				LINKCP										
HYBSET	FDP5	LOOP									LMSC	CHENT	LNSTAR	LOOK	STAMR						
HYPER											LNSTAR										
HYPER8	ETRACE	HEADER			NEWTON		QUAD1	SPLINE	STRACE		LNTRP	ETRACE	MESSG	STRACE							
IAD2D	WVLOOK										LOADF										
IADAXI	WVLOOK										LOOK1	INDEXS									
IDBAL	ETRACE	LNTRP			POLINT		STRACE				LOOK2	INDEXS	LOOK1								
ILTABO	BDCAPR	CAPRIC			CDPRES		DVOL	IAD2D	IADAXI		LOOK3	INDEXS	LOOK2								
	ILTRVX	ILTSMT			ILTVIS		INLETA	LINFOR	LINKCP		LUCERO										
	MDIV	MONFOR			POTAR1		POTAR2	POTAR3	SKINF		LUGSHO	FLAT									
ILTCDC											LVALUE	WNTST									
ILTCFD	AXINWT	ILTCDC									MAJERR	SORT									
ILTNMT											MATCHX										
ILTRVX											NDIV										
ILTSMT											MESSG										
ILTVIN											MISDAT	AERO	BLOCKD	CONERR	EXTRAP	GEOM	INITZ				
ILTVIS	BDCCFD	DIVCFD			ILTCFD		INZFLC	INZFLG	INZLOM	INZREF		READIN	STRACE								
INITZ	INZBOD	INZFIN			INZFLC						MONFOR										
	INZTRM																				
INLETA	HEADER	PRIFLC									WVLOOK	ETRACE	LNTRP	STRACE							
INLETG	CVRTFT	CVRTUS			HEADER						NAMEH	EXTRST	FINDCH	FINDVN	READCD	REPTCT	SKIPBL				
INTER4	ETRACE	LNTRP			STRACE						NAMEH	SUBINT	SUBLOG	SUBREA	TODEC	TOINT	TOLOG				
INTERP	INTERS											FORINT	FORLOG	FORREA							
JAS26	ARSECH										NEWNT										
KRBALP	ETRACE	LNTRP			STRACE						NEWTON										
LAN025	BITSS	ETRACE			SBLAMO		SFCNAD	SFCNQ	SFCNAD		NMLIST	CHKEND	SUBNAM	SUBNM2	TESTOR						
	SFCNQ	STRACE									NMTEST										
LINFOR											OGIVE	DSPLAN	DSWET	DVOL	DXCENP	DXCENY	SPHERE				

Figure 55 Subroutine Cross Reference (Listed by Calling Routine) - Continued

Module	Calls Module(s):					Module	Called Module(s):				
PANLCH	ALPQ	STRACE			YCP	READCD					
PLATE	TABLOK					READIN	CONTRL	GETLM	HEADER	MAJERR	READNL
PLOT3	CVRTFT	CVRTUS				READNL	DREAD	RARBOD	RAXIS	RDEFL	WRITNL
PLTRM	CVRTFT	CVRTUS					RFLT	RINLET	RREFQ	RTRIM	RFLNS
POLINT						RELLB	NAMER				
POTAR1	CNPTWO	CYPTDIV				REPTCT	EXTRST	FINDCH	TOINT		
POTAR2	CNPTWO	CYPTDIV				REXPR	NAMER				
POTAR3	CNPAKI	CYPTDIV				RFIN1	NAMER				
PQWR	DSPLAN	DSNET				RFIN2	NAMER				
PRIAX1	HEADER					RFIN3	NAMER				
PRIELL	HEADER					RFIN4	NAMER				
PRIF1						RFIN5	RFIN1	RFIN2	RFIN3	RFIN4	
PRIF2						RFLT	NAMER				
PRIF3						RINLET	NAMER				
PRIF4						RREFQ	NAMER				
PRIFIN	CVRTFT	CVRTUS				RTRIM	NAMER				
	PRIF4					SAVFF	DDECOD				
PRIFLC	CVRTFT	CVRTUS				SBLAKO	ELLIP2	ETRACE	LNTRP	STRACE	
PRIIOM	CLOCD	PLOT3				SETGEO	BLUNTN	PARAB			
PRINT	DWRITE	PRINTS				SFCMAD					
PRINTS	HEADER	PRIOH				SFCMQ					
PRITRM	CLOCD	HEADER				SFCNAD					
PRIUNT	HEADER	PRIFLC				SFCNQ					
QUAD1						SPWRM	ETRACE	FIT	HVLOOK	STRACE	
RARBOD	NAMER					SHOCK					
RAXIS	NAMER					SIMP	INTERP				
RDEFL	NAMER										

Figure 55 Subroutine Cross Reference (Listed by Calling Routine) - Continued

Module	Calla_Module(s):	Module	Calla_Module(s):
WEDGE			
WELLB	NAMEW		
WINLET	NAMEW		
WRAXIS	NAMEW		
WRDEFL	NAMEW		
WRFIN1	NAMEW		
WRFIN2	NAMEW		
WRFIN3	NAMEW		
WRFIN4	NAMEW		
WRFLT	NAMEW		
WRFINL	WRBOD WRFIN2	WRAXIS WRFLT	WRDEFL WRREFQ WRFIN1 WRTRIM
WRREFQ	NAMEW		
WRTRIM	NAMEW		
YBAR	ETRACE	MYLOOK	STRACE
YCP	ETRACE	STRACE	YBAR
YMGC	FINNGC		

Figure 55 Subroutine Cross Reference (Listed by Calling Routine) - Continued

Module	Called by Module(s):										Module	Called by Module(s):									
ADDECG	AERO	SYNTHS									BDCAMF	BODYCA									
AERO	HISDAT										BDCAWN	BODYCA									
AFTCAP	FCAMPF										BDCDRV	BODYCA									
AIRINFOL	FGZOM										BDCMP	BODYCM	SUPBOD								
ALPBET	BETADR	BOOYA	BOOYE	FLTCDS							BDCNV	BODYCH	SUPBOD								
ALPEO	PANLCH										BDCNAB	BODYCN	BOTCNM								
ANGDET	FSDETA										BDCNAF	BODYCN									
ARCCA	FCAMPF										BDCNAM	BODYCN									
ANCOR	CTL										BDCNP	BODYCN	SUPBOD								
ARSECH	AXBNDY	JAS26	SUNPOT	VANDYK							BDCNV	BODYCN	SUPBOD								
ASECT	AERO										BDPART	BODYA	BODYE								
ASOSL	FCAMPF										BDXCPB	BODYCH									
ASPECT	FIGEOM	F2GEOM	F3GEOM	F4GEOM	FINCEN	SWEEP					BDXCPF	BODYCH									
ATWOS	FLTCDS										BDXCPN	BODYCH									
AXBNDY	DELV										BETADR	AERO									
AXINWT	ILTCFD										BETAU	FINFIN									
AXZU	ASOSL										BITSS	FDAMP	LAM025	TRANS							
BASPRS	SUPBOD										BLKIDD	BETADR	TRIMIT								
BCHAD	BDMF										BLOCKD	HISDAT									
BDMF	DAMP										BLUNT	HYBG2									
BDCAB	BODYCA	SUPBOD									BLUNTN	SETGEO									
BDCALP	BODYCA										BODCFD	ILTVIS									
BDCAP1	BDCDRV										BODNWT	GEOTNL									
BDCAP2	BDCDRV										BODVAR	BDMF									
BDCAPR	BODYCA	ILTARO									BODY	AERO									
BDCANC											BODYA	BODY	BODYE								

Figure 56 Subroutine Cross Reference (Listed by Routine that is Called)

Module Called by Module(s):		Module Called by Module(s):	
BODYCA	STBODY	CHINC	AERO SYNTHS
BODYCH	STBODY	CHNEWT	GETCNO
BODYCH	STBODY	CNPAXI	POTAR3
BODYE	BODY	CNPTWO	POTAR1 POTAR2
BOTCA	BASPRS	CNSBT	GETCNO
BOTCHN	BASPRS	CONEP	SOSE
BODER	BDAMP	CONERR	MISDAT
BSUB	BDAMP	CONIC	GEOAXI GEOELL USEREL USERS
BUILD	CDPROT	CONTRL	READIN
CAPRIC	BODYCA	CONVRT	CDPROT CVRBOD CVREFL CVRREF SUBEXP
CAINC	AERO	COORD1	AIRFOL
CALIB	CAINC	COORD4	AIRFOL
CARRYO	SYNTHS	COORD5	AIRFOL
CARRYS	CARRYO	COORD6	AIRFOL
CCARD	CONERR	CORD4M	AIRFOL
CDCS	BODYCH	CORD5M	AIRFOL
CDPRES	BODYCA	CORDSP	AIRFOL
CDPROT	BODYCA	CP3DM	AFTCAP ARCCA HEXCA
CHREND	NHLIST	CPCAL	
CIRC	BUILD	CPDIST	SOSE
CHDAT	BASPRS	CROSS	CIRC CYL FLAT STREAM
CLMAX	ASECT	CSLINC	AERO SYNTHS
CLOCD	PRITRM	CSNINC	AERO SYNTHS
CLVR	ALPQ	CUBIC	CIRC CYL FLAT FLAPS STREAM
CHINC	AERO	CVRBOD	CVRTFT CVRTUS
CHNEWT	LASC	CVREFIN	CVRTFT CVRTUS

Figure 56 Subroutine Cross Reference (Listed by Routine that is Called) - Continued

Module		Called by Module(s):		Module		Called by Module(s):	
CVRFLT	CVRFTT	CVRTUS		DUMPRT	AERO	TRIMIT	
CVRREF	CVRFTT	CVRTUS		DVOL	CONIC USERS	GEOELL	HAACK ILTARO OGIVE POWR
CVRFTT	GEOAXI PRIFLC	GEOELL	INLETG	DVOLE	GEOELL	USEREL	
				DWRITE	PRINT		
CVRTUS	GEOAXI PRIFIN	GEOELL	GEOM	DXCENP	CONIC USERS	DSWETE	HAACK OGIVE POWR USEREL
CYINC	AERO	SYNTHS					
CYL	BUILD	CDPROT		DXCENV	CONIC	HAACK	OGIVE POWR USERS
CYPAXI	POTAR3			DXCNEV	GEOELL	USEREL	
CYPDIV	POTAR1	POTAR2	POTAR3	ELLIP1	BITSS		
CYPTWO	POTAR1	POTAR2		ELLIP2	BITSS	DSWETE	SBLAMO
DAMP	AERO			ELLIRWB	SYNTHS		
DDECOD	SAVEF			PQH44	SOSE		
DDSYN	DAMP			ETRACE	AERO	ATRFOL	ALPEQ
DDECODE	ATRFOL				BDCAB	BDCAP1	BDCAP2
DELINS	CCARD	CONTRL			BDCDRV	BDCNAB	BDCNAB
DELV	VANDYK				BITSS	BODY	BODYA
					BODYE	BOTCA	BOTCNH
DIHED	ALPEQ	SYNTHS			CDCS	CLMAX	CLVR
DISC2	DELV	SUMPOT			CSLINC	CSNINC	CYINC
DIUCTD	ILTVIS				FCNMT	FCLMSB	FCLASH
DIYVMT	GEOINL				FCNMT	FCNAT	FCNASH
DMPARY	DUMPRT				FIG60B	FINCA	FCNAB
DREAD	READNL				FINS	FINXCA	FOIL
DSPLAN	CONIC USERS	GEOELL	HAACK		GEOFIN	GEOM	GETCNO
					INTER4	KWBALP	LAH025
DSWET	CONIC USERS	GEOELL	HAACK		SBLAMO	SFRW	SLOPE
					STBODY	SUBDER	SUBEXP
DSWETE	GEOELL	USEREL			TABLOK	THEORY	TRANS
					YBAR	YCP	
				EXVAL	CDPRES		
				EXPAND	SOSE		
				EXTRAP	MISDAT		
				EXTRST	NAMER	REPTCT	
				FIGEOM	FGEOM		

Figure 56 Subroutine Cross Reference (Listed by Routine that is Called) - Continued

Module	Called by Module(s)	Module	Called by Module(s)
F2GEOM	FGEOM	FINCAB	FINXCA
F3GEOM	FGEOM	FINCAP	FINXCA
F4GEOM	FGEOM	FINCEN	F1GEOM F2GEOM F3GEOM F4GEOM
FALCP	CARRYO FINCH	FINCH	FINS
FAFART	FINXCA	FINCN	FINS
FCALC	FINXCA	FINDCH	NAMER REPTCT TOINT
FCALP	FINXCA	FINDVN	NAMER
FCAMPF	FINXCA	FINFIN	PANLCH
FCAMS	FINXCA	FINHGC	F1GEOM F2GEOM F3GEOM F4GEOM YHGC
FCAMT	FINXCA	FINPLN	F1GEOM F2GEOM F3GEOM F4GEOM
FCLMSB	FCNAAS	FINS	AERO
FCLMSH	FCNAAS	FINVAR	FDAMP
FCNA	FINCN	FINXCA	FINCA
FCNA	FINCN	FIT	SPWRM
FCNAH	FCNA	FLAPS	AERO
FCNAAS	FCNA	FLAT	BUILD CDPROT LUGSHO
FCNAAT	FCNA	FLTCD	AERO
FCNASB	FCNA	FNPART	FINCH
FCNASP	FCNA	FNPART	FINCH FINS
FCNATR	FCNA	FOIL	FGEOM
FDS	FDS	FORINT	NAMEN
FDAMP	DAMP	FORLOG	NAMEN
FDS	HYBG1 HYBG2 HYBSET	FORREA	NAMEN
FGEOM	GEOPIN	FRCOR	CDPRES
F1G60B	FCNAH	PSDETA	FCNAH
FINCA	FINS	FWDAC	CARRYO FINCH

Figure 56 Subroutine Cross Reference (Listed by Routine that is Called) - Continued

Module	Called by Module(s):	Module	Called by Module(s):
GEO	SOSE	IDEAL	THEORY
GEOAXI	GEOM	ILTANG	GEOINL
GEOELL	GEOM	ILTARO	AERO
GEOFIN	GEOM	ILTCDC	BODCFD DIVCFD ILTCFD
GEOINL	GEOM	ILTCFD	ILTVIS
GEOM	MISDAT	ILTR	GEOINL
GETCHO	BOOTE	ILTNWT	GEOINL
GETETA	BODYCN	ILTRVX	ILTARO
GETNLN	READIN	ILTSWT	ILTARO
HAACK	GEOAXI GEOELL	ILTVIN	GEOINL
HEADER	ATROL BOPART FCAMPF FNPART INLETA INLETC PRIPTH PRIUNT THEORY VANDYK	ILTVIS	ILTARO
HEXCA	FCAMPF	INDEXS	LOOK1 LOOK2 LOOK3
HINGEN	SYNTHS	INITZ	MISDAT
HSOSL	FCAMPF	INLETA	ILTARO
HXZU	HSOSL	INLETC	GEOINL
HYBG1	HYBRID	INSBLK	CONERR
HYBG2	HYBRID	INTER4	BDCAWN
HYB1N2	HYBRID	INTER5	INTERP
HYBRID	SUPPOT	INTERP	DISC2 HYBG1 HYBG2 SIMP
HYBSET	HYBRID	INEBOD	INITZ
HYPER	BDAMP	INSDYN	DAMP
HYPERAS	SUPPOT	INEFIN	INITZ
IAD2D	ILTARO	INEFLC	INITZ
IADAXI	ILTARO	INEFLG	INITZ
		INEIOM	AERO INITZ
		INEREF	INITZ

Figure 56 Subroutine Cross Reference (Listed by Routine that is Called) - Continued

Module		Called by Module(s):		Module		Called by Module(s):	
PWR	GEOMX	GEOMX	GROELL	RFIN2	RFINS		
PRIAXI	GEOMX			RFIN3	RFINS		
PRIELL	GROELL			RFIN4	RFINS		
PRIF1	PRIFIN			RFINS	READNL		
PRIF2	PRIFIN			RFLT	DREAD	READNL	
PRIF3	PRIFIN			RINLET	DREAD	READNL	
PRIF4	PRIFIN			RREFQ	DREAD	READNL	
PRIFIN	GEOMX			RTRIM	DREAD	READNL	
PRIFLC	BDPART	BODYCA	DWRITE	RVALUE	TESTOR		
	HINGEN	INLETA	PRION	SAVEF	PRINT		
	SYNPAR			SBLANO	FDAMP	LAH025	TRANS
PRION	PRINTS			SETGEO	SOSE		
PRINT	AERO			SFCMAD	FDAMP	LAH025	TRANS
PRINTS	PRINT			SFCMQ	FDAMP	LAH025	TRANS
PRITM	TRINIT			SFCNAD	FDAMP	LAH025	TRANS
PRUIT	TRIMIT			SFCNQ	FDAMP	LAH025	TRANS
QUAD1	GETCHO	HYPERS	SOSE	SFWRW	SYNTHS		
RABOD	DREAD	READNL		SHOCK	SOSE		
RAXIS	DREAD	READNL		SIMP	WAVE		
RDEF1	DREAD	READNL		SIMPM	ARCCA	FCAMPF	HEXCA
READCD	NAMER			SKINF	CAFRIC	FINKCA	ILTARO
READIN	MISDAT			SKIPBL	NAMER	TOLOG	
READNL	READIN			SLEQ	COORD1	COORD6	CORD4M
RELLS	DREAD	READNL		SLOPE	THEORY		
REPTCT	NAMER			SORT	MAJERR		
REXP	SUBEXP			SOSE	SUPPOT		
RFIN1	DREAD	RFINS					

Figure 56 Subroutine Cross Reference (Listed by Routine that is Called) - Continued

Called by Module(s):				Module				Called by Module(s):			
SPHERE	COMIC	HACK	OGIVE	POWR				SUBNM2	NMLIST		
SPIN#3	BOAMP							SUBREA	NAMER		
SPLIN2	CDPRS							SUMPOT	VANDYK		
SPLIN2	ALPEQ	FINFIN	HYPERS	PANLCH	SYNTHS			SUPBOD	BODYA		
SPLIN2	FINCH							SUPPOT	SUPBOD		
SRATIO	CPCAL							SUPXY	AIRFOL		
SSADER	FDAMP	TRANS						SVRINT	CLVR		
SSCHQ	SSODER							SVTRAK	SYNTHS		
SSODER	FDAMP	TRANS						SWEZPN	F1GEOM	F2GEOM	F3GEOM
STAIR	LMSC							SWRITE	PRIFLC	PR10M	PR1TRM
STBODY	BODYA							SYNPAR	SYNTHS		
STRACE	AERO	AIRFOL	ALPEQ	ASBCT	BASPRS	BDCAMN	BDCAMP	SYNTHS	BETADR	TRINIT	
	BDCAP1	BDCAP2	BDCAPF	BDCAMN	BDCAMN	BDCAMN	BDCAMN	TABLOK	ARCOR	BASPRS	BOTCA
	BDCAPV	BDCAPF	BDCAPF	BDCAMN	BDCAMN	BDCAMN	BDCAMN	TCEFFT	F1GEOM	F2GEOM	F3GEOM
	BITS	BODY	BODYA	BODYC	CALIB	CARRYO	CARRYO	TESTOR	NMLIST		
	BODYE	BOTCA	BOTCM	CAINC	CNINC	CNMENT	CNMENT	THEORY	ASECT		
	CDCS	CLMAX	CLVR	DAMP	FALCP	FCALP	FCALP	TODEC	NAMER	TOINT	
	CSLINC	CSLINC	CYINC	DAMP	FCNA	FCNAH	FCNAH	TOHOLL	FOIL		
	FCANT	FCIASB	FCIASH	FCNA	FCNAH	FCNAH	FCNAH	TOINT	NAMER	REPTCT	
	FCMAAS	FCMAAT	FCMAAT	FCNATR	FDAMP	FDAMP	FDAMP	TOLOG	NAMER		
	FIG60B	FINCA	FINCAB	FINCH	FINCH	FINCH	FINCH	TRANS	FDAMP		
	FINS	FINCA	FOIL	FINCH	FINCH	FINCH	FINCH	TRINIT	AERO		
	GEQFIN	GEOM	GETCNO	FINCH	FINCH	FINCH	FINCH	USEFOL	FGEOM		
	INTER4	KWBALP	LAN025	FINCH	FINCH	FINCH	FINCH	USEREL	GEOELL		
	PANLCH	SBLAWO	SFRW	FINCH	FINCH	FINCH	FINCH	USERS	GEOAXI		
	SSADER	STBODY	SUBDER	FINCH	FINCH	FINCH	FINCH	VANDYK	HYBRID		
	SYNTHS	TABLOK	THEORY	FINCH	FINCH	FINCH	FINCH				
	USERS	YEAR	YCP	FINCH	FINCH	FINCH	FINCH				
STREAM	CDPROT										
SUBDER	FDAMP	TRANS									
SUBEXP	AERO	SYNTHS									
SUBINT	NAMER										
SUBLOG	NAMER										
SUBNAM	NMLIST										

Figure 56 Subroutine Cross Reference (Listed by Routine that is Called) - Continued

Module	Called by Module(s)	Module	Called by Module(s)
VNAME	TESTOR		
VRINTS	SYNTHS		
WARBOD	WRITNL		
WAVE	VANDYK		
WEDGE	SOSE		
WELLB	WRITNL		
WINLST	WRITNL		
WRAXIS	WRITNL		
WRDEFL	WRITNL		
WRFIN1	WRITNL		
WRFIN2	WRITNL		
WRFIN3	WRITNL		
WRFIN4	WRITNL		
WRFLT	WRITNL		
WRITNL	READIN		
WRREFQ	WRITNL		
WRTRIN	WRITNL		
YBAR	YCP		
YCP	PANLCH		
YMSC	F1GEOM	F2GEOM	F3GEOM
			F4GEOM

Figure 56 Subroutine Cross Reference (Listed by Routine that is Called) - Continued

Common Block	Used by Module(s):										Common Block	Used by Module(s):									
DFIN4	SAVEF											INZFIN	MAJERR	MISDAT	PRI2	PRIOM	PRINTS				
DFLAGS	CONTRL	DELIMS		INZFLG	MISDAT	READLN	SAVEF					PRI1RM	WRFIN2	READLN	SAVEF	SUPBOD	SYNTHS				
DIWVSC	AXINMT	BODCFD	BODNMT	BODNMT	CNPAXI	CNP2WO	CYPAXI		FSET3	AERO	ASECT	FGEOM	FINCA	CVRFIN	DAMP	DUMPRT	F3GEOM				
	CYPDIV	CYP2WO	DIVCFD	DIVCFD	GEONLN	GEONLN	ILTANG			FGEOM	FINCA			FINCH	FINS	GEOFIN	GEOM				
	ILTAO	ILTCDC	ILTCDC	ILTCDC	ILTSWT	ILTSWT	ILTVIN			MAJERR	MAJERR	MISDAT	PRI2	MISDAT	PRI2	PRIOM	PRINTS				
	ILTSWT	ILTVIN	ILTVIN	ILTVIS	LINFOR	LINXCP	MONFOR			PRI1RM	PRI1RM	PRI1RM	SAVEF	READLN	SAVEF	SUPBOD	SYNTHS				
	POTAR1	POTAR2	POTAR3	POTAR3						TRINIT	WRFIN3	TRINIT									
DUMPF	CONTRL	DUMPRT		INZFLG	MISDAT	SAVEF			FSET4	AERO	ASECT	FGEOM	FINCA	CVRFIN	DAMP	DUMPRT	F4GEOM				
F1WORK	AERO	ASECT	DAMP	DAMP	DUMPRT	FGEOM	FINCA			FGEOM	FINCA			FINCH	FINS	GEOFIN	GEOM				
	FINCH	FINCH	FINS	FINS	INZFIN	MISDAT	SAVEF			INZFIN	MAJERR	MISDAT	PRI2	MISDAT	PRI2	PRIOM	PRINTS				
	SUBEXP	SYNTHS								TRINIT	WRFIN4	TRINIT		READLN	SAVEF	SUPBOD	SYNTHS				
F2WORK	AERO	ASECT	DAMP	DAMP	DUMPRT	FGEOM	FINCA		GEOBOD	AERO	BODCFD	BODYCA	BODYCH	BODYCA	BODYCH	BODYC	BODYE				
	FINCH	FINCH	FINS	FINS	INZFIN	MISDAT	SAVEF			CVRBOD	DAMP	DUMPRT	GEAXI	DUMPRT	GEAXI	GEODLN	GEONLN				
	SUBEXP	SYNTHS								ILTSWT	ILTSWT	INZBOD	LINFOR	INZBOD	LINFOR	MISDAT	PRIAXI				
F3WORK	AERO	ASECT	DAMP	DAMP	DUMPRT	FGEOM	FINCA			PRIELL	SAVEF	SUPBOD	SUPPOT	SUPBOD	SUPPOT	SYNTHS	USEREL				
	FINCH	FINCH	FINS	FINS	INZFIN	MISDAT	SAVEF			USERS											
	SUBEXP	SYNTHS							GEOF2	FINCH	FINCH	FINS	MISDAT	FINS	MISDAT						
F4WORK	AERO	ASECT	DAMP	DAMP	DUMPRT	FGEOM	FINCA		GEOF31	AERO	ASECT	FGEOM	FINCA	CVRFIN	DAMP	DUMPRT	F1GEOM				
	FINCH	FINCH	FINS	FINS	INZFIN	MISDAT	SAVEF			FGEOM	FINCA	MISDAT	PRI1	FINCH	FINS	GEOFIN	INZFIN				
	SUBEXP	SYNTHS												SAVEF	SYNTHS						
FFINDL	AERO	MISDAT	PRINTS	PRINTS	SYNTHS	TRINIT			GEOF32	AERO	ASECT	FGEOM	FINCA	CVRFIN	DAMP	DUMPRT	F2GEOM				
														FINCH	FINS	GEOFIN	INZFIN				
FLC	AERO	ASECT	AXINMT	AXINMT	BODPART	BETADR	BODCFD			FGEOM	FINCA	MISDAT	PRI2	FINCH	SAVEF						
	BODNMT	BODYA	BODYCA	BODYCA	BODYCH	BODYCH	BODYE														
	CALNC	CHINC	CNP2WO	CNP2WO	CNPAXI	CNP2WO	CSLINC		GEOF33	AERO	ASECT	FGEOM	FINCA	CVRFIN	DAMP	DUMPRT	F3GEOM				
	CSNINC	C/REFLT	CYINC	CYINC	CYPDIV	CYP2WO	CYP2WO			FGEOM	FINCA	MISDAT	PRI2	FINCH	FINS	GEOFIN	INZFIN				
	DAMP	DDSYN	DIVCFD	DIVCFD	DIVNMT	DWRITE	FLTCDS			MISDAT	PRI2			SAVEF	SYNTHS						
	FAPART	FINCH	FINCH	FINCH	FINCA	FLTCDS	FLTCDS														
	GEONLN	HINGEM	ILTANG	ILTANG	ILTAO	ILTCDC	ILTCDC		GEOF34	AERO	ASECT	FGEOM	FINCA	CVRFIN	DAMP	DUMPRT	F4GEOM				
	ILTSWT	ILTSWT	ILTSWT	ILTSWT	ILTSWT	ILTVIN	ILTVIS			FGEOM	FINCA	MISDAT	PRI2	FINCH	FINS	GEOFIN	INZFIN				
	INLETA	INZFLC	LINFOR	LINFOR	LINXCP	MAJERR	MISDAT			MISDAT	PRI2			SAVEF	SYNTHS						
	MONFOR	PLOT3	PL1TRM	PL1TRM	POTAR1	POTAR2	POTAR3														
	PRIELC	PRIOM	PRINTS	PRINTS	PRI1RM	PRINTS	READLN														
	SAVEF	SUBEXP	SUPBOD	SUPBOD	SUPPOT	SYNTHS	TRINIT														
	WRFLT																				
FSET1	AERO	ASECT	CVRFIN	CVRFIN	DAMP	DUMPRT	FGEOM		ILTGE0	AXINMT	BODCFD	BODNMT	CNPAXI	BODNMT	CNPAXI	CNP2WO	CYPAXI				
	FGEOM	FINCA	FINCH	FINCH	FINCH	GEOFIN	GEOM			CYPDIV	CYP2WO	DIVCFD	DIVNMT	DIVCFD	DIVNMT	GEONLN	ILTANG				
	INZFIN	MAJERR	MISDAT	MISDAT	MAJERR	PRIOM	PRINTS			ILTSWT	ILTSWT	ILTCDC	ILTSWT	ILTCDC	ILTSWT	ILTSWT	ILTANG				
	PRI1RM	PRI1RM	READLN	READLN	POTAR1	POTAR2	SYNTHS			ILTSWT	ILTVIN	ILTVIS	LINFOR	LINXCP	LINXCP	MONFOR	MONFOR				
	TRINIT	WRFIN1								POTAR1	POTAR2	POTAR3									

Figure 57 Common Block/Subroutine Cross Reference (Listed by Common Block) - Continued

Common Block	Used by Module(s):										Common Block	Used by Module(s):									
INC	ASRO	CAINC	CMINC	CMINC	CMINC	CMINC	CMINC	CMINC	CMINC	POTENT	AXINMT	BODCFD	BODNMT	CNPXAI	CNPXAI	CNPXAI	CNPXAI	CNPXAI	CNPXAI	CNPXAI	CNPXAI
INCID	CYINC	INZFLC	INZFLG	INZFLG	INZFLG	INZFLG	INZFLG	INZFLG	INZFLG	POTAR1	CYPDIV	CYPXAI	DIVCFD	DIVNMT	DIVNMT	DIVNMT	DIVNMT	DIVNMT	DIVNMT	DIVNMT	DIVNMT
INLETM	INLETM	INLETM	INLETM	INLETM	INLETM	INLETM	INLETM	INLETM	INLETM	REFON	INLETM	INLETM	INLETM	INLETM	INLETM	INLETM	INLETM	INLETM	INLETM	INLETM	INLETM
INLTD	INLTD	INLTD	INLTD	INLTD	INLTD	INLTD	INLTD	INLTD	INLTD	SB1	INLTD	INLTD	INLTD	INLTD	INLTD	INLTD	INLTD	INLTD	INLTD	INLTD	INLTD
INPCON	INPCON	INPCON	INPCON	INPCON	INPCON	INPCON	INPCON	INPCON	INPCON	SB12	INPCON	INPCON	INPCON	INPCON	INPCON	INPCON	INPCON	INPCON	INPCON	INPCON	INPCON
INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	SB123	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP	INTZAPP
LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	SB1234	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	SBODY	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC	LOGIC
MONEN	MONEN	MONEN	MONEN	MONEN	MONEN	MONEN	MONEN	MONEN	MONEN	SECVAR	MONEN	MONEN	MONEN	MONEN	MONEN	MONEN	MONEN	MONEN	MONEN	MONEN	MONEN
PAERO	PAERO	PAERO	PAERO	PAERO	PAERO	PAERO	PAERO	PAERO	PAERO	SFIN1	PAERO	PAERO	PAERO	PAERO	PAERO	PAERO	PAERO	PAERO	PAERO	PAERO	PAERO
PARTF	PARTF	PARTF	PARTF	PARTF	PARTF	PARTF	PARTF	PARTF	PARTF	SFIN2	PARTF	PARTF	PARTF	PARTF	PARTF	PARTF	PARTF	PARTF	PARTF	PARTF	PARTF
										SFIN3											
										SFIN4											

Figure 57 Common Block/Subroutine Cross Reference (Listed by Common Block) - Continued

Common Block	Used By Module(s):				Common Block	Used By Module(s):			
THEORY	CONTRL SAVEF	FINMCA SUPPOT	INZFLG USEREL	LMSC USERS	MISDAT	PRINTS			
TOTALC	BODYE INZFLC	AERO DUMPT MISDAT	BODYA FINCM SAVEF	BODYCA FINCM SUPBOD	BODYCH FINS	BODYCH FLTCDS			
TRACE	BLOCKD	ETRACE	MESSG	SAVEF	STRACE				
TRIND	IN2TRM	MISDAT	PL1TRM	SAVEF	TRINIT				
TRININ	IN2TRM	MISDAT	READML	SAVEF	TRINIT	WRTRIM			
UDATA	PRI1OM								
UTRIND	IN2TRM	MISDAT	PL1TRM	PRIUNT	SAVEF	TRINIT			
VANVAR	DISC2	HYBIN2	MISDAT	VANDYK					
VARNAM	BLOCKD	CONERR	NMLIST						
VDARY	AXBNDY HYBIN2 WAVE	BLUNT MISDAT	DELV NEMT	DISC2 SIMP	HYBG1 SUMPOT	HYBG2 VANDYK			
XRBLNT	BODYCA	GEOAXI	GEODEL	USEREL	USERS				

Figure 57 Common Block/Subroutine Cross Reference (Listed by Common Block) - Continued

Module	Common Blocks Used:				Module	Common Blocks Used:			
CORDSP	CONST				DECODE	SB1 SF12	SB123 SF13	SB1234	SF121
CP3DW	CAFD	CONST			DELHNS	DFLAGS			
CPCAL					DELV	VDARY			
CPDIST	CONST				DINED				
CROSS					DISC2	CONST	VARVAR	VDARY	
CSLINC	CONST	FLC	INC		DIVCFD	BODVSC ILTVSC	CFFLOW INLETN	CONST LINEAR	FLC POTENT REFQ
CSWINC	CONST	FLC	INC		DIVNWT	BODVSC ILTVSC	CFFLOW INLETN	CONST LINEAR	FLC POTENT REFQ
CUBIC					DMPARY				
CVRBOO	ABODIN	GEOBOD	INLETN		DREAD				
CVRFIN	FSET1 GEOS3	FSET2 GEOS4	FSET3 INCID	GEOS2	DSPLAN	CONST			
CVRFLT	CONST	FLC	LOGIC		DSMET	CONST			
CVRREF	REFQ				DSMETE	CONST			
CVRUS					DUMPR	ABODIN DB1234 DUMPF FSET1 GEOS2 REFQ SF12 SF13	BDWORK DBODY F1WORK FSET2 GEOS3 INLETN SB1 SF12 SF13	CONST DDFIN1 F1WORK FSET3 GEOS4 INLETN SB123 SF14	DB123 DDFIN4 FLC F4WORK GEOS1 INLETN LOGIC SBODY TOTALC
CYINC	CONST	FLC	INC		DVOL	CONST			
CYL					DVOLT	CONST			
CYRAXI	BODVSC ILTVSC	CFFLOW INLETN	CONST LINEAR	FLC POTENT REFQ	DWRITE	DB1 DDFIN2	DB12 DDFIN3	DB1234 FLC	DDFIN1 LOGIC
CYRDI	BODVSC ILTVSC	CFFLOW INLETN	CONST LINEAR	FLC POTENT REFQ	DXCENP	CONST			
CYRTO	BODVSC ILTVSC	CFFLOW INLETN	CONST LINEAR	FLC POTENT REFQ	DXCENV	CONST			
DAMP	ABODIN FLC	CONST FSET1 GEOS1	F1WORK FSET2 GEOS2	F4WORK FSET3 LOGIC SBODY	DXCENV	CONST			
DDECOO					DXCENV	CONST			
DDSYN	CONST DDFIN1	DB1 DDFIN2	DB12 DDFIN3	DB1234 FLC	ELLIP1				

Figure 58 Common Block/Subroutine Cross Reference (Listed by Subroutine) - Continued

Common Blocks Used:				Common Blocks Used:				Module	Common Blocks Used:			
Module	CONST	FLC	LOGIC	PARTF	REFQ	THRY		Module	CONST	FLC	LOGIC	PARTF
FINVAR								GETNIN	CONST		LOGIC	
FINXCA	CONST							HAACK	CONST			
FIT								HEADER	CASEID			
FLAPS	CONST							HEXCA	CAFD			
FLAT								HINGEM	CONST	FLC		PARTF
FLTCDS	CONST	FLC	TOTALC					HSOSL	CAFD	CONST		PARTF
FNPART								HXZU	CONST			
FNPART	CONST							HYBGI	PARTF	VDARY		
FOIL	CONST							HYBG2	VDARY			
FORINT								HYBIN2	CONST	VARVAR	VDARY	
FORLOG								HYBRID				
FOREZA								HYBSET	ABODIN	CONST		
PRCOR								HYPER				
FSDETA	CONST							HYPERS	CONST			
FWDZAC	CONST							IAD2D	CONST			
GEO								IADAXI	CONST			
GEOAXI	ABODIN XBBLNT	CONST	GEOBOD	LOGIC	PARTF	REFQ		IDEAL	ASHVAR	CONST		
GEOELL	ABODIN XBBLNT	CONST	GEOBOD	LOGIC	PARTF	REFQ		ILTANG	BODVSC ILTVSC	CFFLOW INLETN	CONST LINEAR	DIVVSC MOMEN
GEOFIN	CONST GEOFS2 GEOFS3	FSET1 GEOFS4	FSET2 GEOFS4	FSET3 INCID	FSET4 LOGIC	GEOFS1 REFQ		ILTARO	ABODIN PARTF	BODVSC POTENT	CFFLOW INLETN	CONST REFQ
GEOINL	BODVSC ILTVSC POTENT	CFFLOW ILTVSC REFQ	CONST INLETN	DIVVSC LINEAR	FLC MOMEN	GEOBOD PARTF		ILTCDC	BODVSC ILTVSC	CFFLOW INLETN	CONST LINEAR	DIVVSC MOMEN
GEOM	ABODIN LOGIC	CONST REFQ	FSET1	FSET2	FSET3	FSET4		ILTCFD	BODVSC ILTVSC	CFFLOW INLETN	CONST LINEAR	DIVVSC MOMEN
GETCHO	CONST	REFQ						ILTR	BODVSC ILTVSC	CFFLOW ILTVSC	CONST INLETN	DIVVSC LINEAR
GETZTA												

Figure 58 Common Block/Subroutine Cross Reference (Listed by Subroutine) - Continued

Common Blocks Used:										Common Blocks Used:									
Module	BOOVSC	CFLOW	CONST	LINEAR	CONST	DIWVSC	FLC	ILTGeo	REFQ	Module	ABODIN	BIT3	CONST	DESIG	FLC	INC	TOTALC	DUMPF	INC
ILTRMT	BOOVSC	CFLOW	CONST	LINEAR	CONST	DIWVSC	FLC	ILTGeo	REFQ	INZTRM	CONST	INCID	TRIMD	TRIMIN	UTRIMD				
ILTRVX	BOOVSC	CFLOW	CONST	LINEAR	CONST	DIWVSC	FLC	ILTGeo	REFQ	JAS26									
ILTSMT	BOOVSC	CFLOW	CONST	LINEAR	CONST	DIWVSC	FLC	ILTGeo	REFQ	RWBALP									
ILTVIN	BOOVSC	CFLOW	CONST	LINEAR	CONST	DIWVSC	FLC	ILTGeo	REFQ	LAN025									
ILTVIS	BOOVSC	CFLOW	CONST	LINEAR	CONST	DIWVSC	FLC	ILTGeo	REFQ	LINFOR	BOOVSC	CFLOW	CONST	DIWVSC	FLC	GEOBOD	POTENT		
INDEXS	BOOVSC	CFLOW	CONST	LINEAR	CONST	DIWVSC	FLC	ILTGeo	REFQ		ILTGeo	REFQ							
INITE	BOOVSC	CFLOW	CONST	LINEAR	CONST	DIWVSC	FLC	ILTGeo	REFQ	LINXCP	BOOVSC	CFLOW	CONST	DIWVSC	FLC	ILTGeo	REFQ		
INLETA	FLC	INLETN	INLTD							LIPCOR									
INLETG	INLETN									LASC	CONST	DERIV	THERY						
INSLBK										LNSTAR	DERIV								
INTER4										LNTRP									
INTER5										LOADF									
INTERP										LOOK									
INZBOD	ABODIN	CONST	GEOBOD	INLETN	INLTD	PAERO				LOOK1									
INZDYN	BIT3	CONST	DERIV							LOOK2									
INZFIN	CONST	DESIG	F1WORK	F2WORK	F3WORK	F4WORK	F5WORK	F6WORK	F7WORK	LOOK3									
INZFLC	CONST	FLC	INC	TOTALC	DUMPF	INC				LOOP									
INZFLG	CASEID	CONST	LOGIC	THERY						LUCERO									
INZION	BOMOR	DDOY	DDOY1	DDOY2	DDOY3	DDOY4	DDOY5	DDOY6	DDOY7	LUGSHO									
INZREF	CONST	REFQ								LVALUE	CONST								
										MAJERR	ABODIN	FSET4	CONST	FLC	LOGIC	FSET1	FSET2	FSET3	
										MATCHX									
										MDIV									
										MESG	CASEID	TRACE							
										MISDAT	ABODIN	DDOY1	DDOY2	DDOY3	DDOY4	DDOY5	DDOY6	DDOY7	DDOY8

Figure 58 Common Block/Subroutine Cross Reference (Listed by Subroutine) - Continued

Common Blocks Used:		Common Blocks Used:	
Module		Module	
SUBM2	PARTF	USEFOL	CONST
SUBREA		USEREL	ABODIN CONST GEOBOD THERY XRBUNT
SUPROT	VDARY	USERS	ABODIN CONST GEOBOD THERY XRBUNT
SUPBOD	ABODIN BDMRK CONST FLC FSET1 FSET2 FSET3 FSET4 GEOBOD PARTF REFOQ SBODY	VANDYK	CONST PARTF VANVAR VDARY
TOTALC		VNAME	
SUPPOT	ABODIN CONST FLC GEOBOD LOGIC REFOQ THERY	VRINTS	CONST
SUPXY		WARBOD	ABODIN CONST
SVRINT		WAVE	CONST VDARY
SVTRAK	CONST	WEDGE	CONST
SWEEPW	CONST	WELLB	ABODIN CONST
SWRITE	CONST	WINLET	CONST INLETN
SYNPAR	PAERO	WRAXIS	ABODIN CONST
SYNTHS	ABODIN BDMRK CASEID CONST F1WORK F2WORK F3WORK F4WORK F5SET1 F5SET2 F5SET3 F5SET4 GEODS1 GEODS2 GEODS3 GEODS4 INC INCID PAERO PARTF REFOQ SBI SB12 SB123 SB1234 SBODY	WRDEFI	CONST INCID
TABLOK		WRFIN1	CONST FSET1
TCEFFT		WRFIN2	CONST FSET2
TESTOR	CONST PARTF	WRFIN3	CONST FSET3
THEORY	ASHVAR CONST PARTF	WRFIN4	CONST FSET4
TODEC		WRFLT	CONST FLC
TOHOLL		WRITNL	LOGIC
TOINT		WRREFQ	CONST REFOQ
TOLOG		WRTRIM	CONST TRIMIN
TRANS		YBAR	
TRINIT	CASEID CONST CONST PFINDL FLC FSET1 FSET2 FSET3 FSET4 FSET4 INCID LOGIC SBI SB12 SB123 SB1234 TRIND TRIMIN UTRIND	YCP	
		YMC	

Figure 58 Common Block/Subroutine Cross Reference (Listed by Subroutine) - Continued

Internal Common Management Blocks

- CASEID
- CONST
- DUMPF
- DFLAGS
- LOGIC
- PARTF
- INPCON
- TRACE
- THERY

Input Common Blocks

- ABODIN
- DESIG
- DIVERN
- FLC
- FSET1
- FSET2
- FSET3
- FSET4
- INCID
- INLETN
- REFQN
- TOTALC
- TRIMIN

Internal Aerodynamic Work Arrays

- BDWORK
- F1WORK
- F2WORK
- F3WORK
- F4WORK
- INC
- PAERO

Geometry Arrays

- GEOBOD
- GEOP51
- GEOP52
- GEOP53
- GEOP54

Static Aerodynamic Results (I.O.M.)

- INLTD
- SBODY
- SB1
- SB12
- SB123
- SB1234
- SFIN1
- SFIN2
- SFIN3
- SFIN4

Dynamic Aerodynamic Results (I.O.M.)

- DBODY
- DB1
- DB12
- DB123
- DB1234
- DDFIN1
- DDFIN2
- DDFIN3
- DDFIN4

Aerodynamic Trim Results

- UTRIMD
- TRIMD

Figure 59 Program Common Blocks By Data Type

5.3 AERODYNAMIC METHODOLOGY

This section briefly summarizes the method routines incorporated in the Missile Datcom code. Also covered in this section is the means to update or replace a method.

5.3.1 Methods Incorporated

The methods incorporated are summarized in Table 7. Each method is coded into its own subroutine so that revision or replacement is easily accomplished. Detailed documentation within the code using "comment cards" further describes the methods as well as their limitations.

5.3.2 Changing a Method

Replacing a component buildup method is easily done. Since each method is coded in an individual subroutine, simply replacing the method subroutine will implement the new technique. A few of the methods are complex and require several subroutines; these are called method modules. Method modules substitution is more complex but can still be easily accomplished. The program development philosophy, described below, will aid in method revision.

Code Structure: The code was developed using top-down design. This development scheme was implemented by coding at the top-most control logic downward to integration of the individual method subroutines. Hence, the upper levels of the code structure contain the basic logic to implement the component buildup methods. The lower levels are the implemented methods. In most cases the control logic requires no changes.

Method Coding Style: Most Methods are implemented in a single subroutine. Their inputs and outputs are passed through the subroutine calling sequence. Any method routine can be extracted and used in another code without modification. In some cases utility routines, such as table look-ups, are used; they must also be extracted if the method is to be used in another code.

Each subroutine includes a brief description of the inputs and outputs, the reference documentation, and any limitations or assumptions.

When any routine contains data tables, two subroutines calls are inserted so that the program execution sequence can be "tracked". The call to STRACE at the start of the subroutine places the name of the

routine being executed (parameter IROUT) into the common block TRACE. The subroutine name is removed from the TRACE common block using the call to ETRACE at the end of the subroutine. These routines do not have any impact on other calculations of the program and the subroutine calls may be removed if the code is used in another program.

Execution Sequence: Subroutines BODY and FINS control the calculation sequence for body alone and fin alone, respectively. These two routines are called by the master aerodynamic calculation subroutine AERO; this is where the Mach number and the flight conditions are defined for the user input case. the full configuration component build-up is done in subroutine SYNTHS.

The aerodynamics are calculated in the following sequence: 1) Normal force, 2) Axial force, 3) Pitching Moment, 4) Side Force, 5) Yawing Moment, 6) Rolling Moment, and 7) the derivatives of the above with respect to angle of attack and sideslip angle. In some cases, the calling sequence must not be changed since subsequent results are dependant upon other coefficients. For example, drag-to-lift is dependant upon normal force. Extreme caution must be exercised when revising the method execution sequence. It is recommended that the same example case be run with both the "old" and "new" versions of the code and any differences be reconciled.

Special options of the code such as experimental data substitution and configuration incrementing depend on the methods by which the aerodynamic coefficients are calculated. Both of these Options are executed in the subroutine SYNTHS. An example of these options dependence on the computation methods is the separation of C_N into C_{N0} , C_{Np} and C_{Nv} . Incrementing factors are applied to each of these components separately. Therefore, a change in the decomposition of C_N would effect the configuration incrementing option. Therefore any change in the method of computing an aerodynamic coefficient should be checked for synthesis ramifications.

Changing a Method Subroutine: Revising a method which is coded into a single subroutine is as simple as writing a routine with the same name and substituting it into the program. Any changes to the variables passed through the routine calling sequence must also be changed in those routines that call it. Data required which are not available in the calling sequence may be optionally added by inserting the appropriate common block (see Section 5.4). Care must be taken when using data from a common block to make sure that it has been computed prior to its attempted use.

Changing a Method Module: Four methods are too complex to be included as a single subroutine. They are the Airfoil Section Module, the Hybrid Theory Module, the Second Order Shock Expansion Module and the Supersonic Wing Potential Flow Module. These techniques are neither short nor easily changed. To replace each module with another technique, the following is recommended.

- Airfoil Section Module - this module starts with subroutine THEORY. To use another set of airfoil section calculations requires the revision of this subroutine.
- Hybrid Theory Module - The second-order potential flow solution of Van Dyke (Hybrid Theory) begins with subroutine HYBRID. Replacement of this method requires changes to subroutine SUPPOT.
- Second-Order Shock Expansion Theory Module - The Second-Order Shock Expansion method is implemented beginning with SOSE. Replacement of this method requires changes to subroutine SUPPOT.
- Supersonic Wing Potential Flow Module - The potential flow method for supersonic wave drag is implemented in subroutine FCAWPF. Replacement of this method is done in FINXCA.

Format of PLOT File: When the PLOT control card is used, a formatted data file is written to unit 3 which can be used in a separate plotting program. The file format can be seen in Appendix B.

Table 7 Summary of Methods Implemented in Missile Datcom

Coeff	ROUTINE	DESCRIPTION	REFERENCES
α_{EQ}	ALPEQ	COMPUTES EQUIVALENT ANGLE OF ATTACK OF FIN PANEL	J OF SPACECRAFT & ROCKETS, JULY-AUGUST 1983
δ^*	ANGDET	WEDGE TURN ANGLE FOR WHICH SHOCK WILL BECOME DETACHED	NACA 1135 EQNS. 138 & 168
C_{Ab}	BDCAB	COMPUTES BASE DRAG FOR BODIES AT ALL SPEEDS	NASA TR R-100 NSWC TR-81-156 (NSWC AERO CODE)
$C_{A(\alpha)}$	BDCALP	COMPUTES DRAG DUE TO LIFT FOR AXISYMMETRIC BODIES	AMCP 706-280
C_{Ap}	BDCAPR	COMPUTES SUBSONIC PRESSURE DRAG FOR BODIES	ALLEN AND PERKINS (NACA 1048)
$(C_{Ap})_{BT}$	BDCAP1	SUBSONIC-TRANSONIC PRESSURE DRAG COEFFICIENT (NO FRICTION) OF AXISYMMETRIC CONICAL BODIES	DATCOM SECTION 4.2.3.1
$(C_{Ap})_{BT}$	BDCAP2	SUBSONIC-TRANSONIC PRESSURE DRAG COEFFICIENT (NO FRICTION) OF AXISYMMETRIC OGIVAL BODIES	PAYNE-DTNSRDC/ASED-80/10 MAY, 1980. PP. 33-38
$C_{Ap,w}$	BDCAWC	CALCULATES PRESSURE/WAVE DRAG INCREMENT OF CONICAL NOSE CYLINDER AT TRANSONIC SPEEDS	MOORE, NSWC-TR-80-346, P. 28
C_{Aw}	BDCAWF	SUBSONIC-TRANSONIC WAVE DRAG COEFFICIENT OF AXISYMMETRIC CONICAL BODIES WITH FLARE	AMCP 706-280, FIGURE 8-33A TO 8-33D, P.8-49
C_{Aw}	BDCAWN	COMPUTES NOSE WAVE DRAG AT TRANSONIC SPEEDS USING CHAUSSEE, UNSTEADY EULER SOLUTION	NSWC TR-80-346, P.28
C_{mp}	BDCMP	COMPUTES POTENTIAL PITCHING MOMENT FOR BODIES	ALLEN AND PERKINS (NACA 1048)
C_{mv}	BDCMV	COMPUTES VISCOUS PITCHING MOMENT FOR BODIES ABOUT USER SPECIFIED CENTER OF GRAVITY	ALLEN AND PERKINS (NACA 1048)
$(C_{N\alpha})_{BT}$	BDCNAB	COMPUTES INCREMENTAL NORMAL FORCE SLOPE DUE TO CONICAL BOATTAIL ON AXISYMMETRIC BODIES	NSWC-TR-81-156, P.110
$(C_{N\alpha})_{FL}$	BDCNAF	COMPUTE INCREMENTAL NORMAL FORCE SLOPE DUE TO FLARE AT SUBSONIC/TRANSONIC SPEEDS	AMCP 706-280, JULY 1968
$C_{N\alpha}$	BDCNAN	INTERPOLATE NORMAL FORCE COEFFICIENT SLOPE FOR CONE-CYLINDER AND OGIVE-CYLINDER AT TRANSONIC SPEEDS	MBB TN, WE2-97/69 MBB TN, WE12-88/70
C_{Np}	BDCNP	COMPUTES POTENTIAL NORMAL FORCE FOR BODIES	ALLEN AND PERKINS (NACA 1048)
C_{Nv}	BDCNV	COMPUTES VISCOUS NORMAL FORCE FOR BODIES	ALLEN AND PERKINS (NACA 1048)
$(x_{cp})_{BT}$	BDXCPB	LOCATE AFT BODY CENTER OF PRESSURE (SLENDER BODY THEORY)	NSWC-TR-80-316, P.41
$(x_{cp})_{FL}$	BDXCPF	COMPUTES SUBSONIC/TRANSONIC FLARE CENTER OF PRESSURE	AMCP 706-280, JULY 1968
x_{cp}	BDXCPN	INTERPOLATE LONGITUDINAL CENTER OF PRESSURE FOR CONE-CYLINDER AND OGIVE-CYLINDER AT TRANSONIC SPEEDS	MBB TN, WE2-97/69 MBB TN, WE12-88/70
β_u	BETAU	DETERMINES THE REGION OF INFLUENCE OF PANEL IN PROXIMITY TO ANOTHER	ONR-CR215-226-4F, APPENDIX D
C_A	BODYCA	LINEARLY REDUCE PRESSURE DRAG IN MACH RANGE 1.0 - 1.2	DATCOM SECTION 4.1.5.1

Table 7 Summary of Methods Implemented in Missile Datcom (Continued)

Coeff	ROUTINE	DESCRIPTION	REFERENCES
C_{Af}	CAFRIC	COMPUTE FRICTION COMPONENT OF AXIAL FORCE AT ANGLE OF ATTACK	MDAC-WEST AERODYNAMIC HANDBOOK (M 8.080-CD) DATCOM SECTION 4.1.5.1 FLUID DYNAMIC DRAG (HOERNER)
	CARRYO	COMPUTE FIN-BODY AND BODY-FIN CARRY-OVER FACTORS DUE TO ANGLE OF ATTACK AND INCIDENCE	NACA 1307 J. AIRCRAFT, OCTOBER 1975
	CARRYS	SUPERSONIC FIN-BODY CARRY OVER WITH FINITE AFTERBODIES	AIAA JOURNAL: VOL.19,NO.5,MAY 1981,P.661 VOL.20,NO.6,JUN 1982,P.855 VOL.20,NO.8,AUG 1982,P.1144
C_{dc}	CDCS	COMPUTE CROSS FLOW DRAG COEFFICIENT (JORGENSEN) DATA FAIRING GUIDE (BAKER)	NASA TN D-6996, FIGS.1,2,3 AEDC-TR-75-124
$(\delta DEG)_v$	CLVR	COMPUTE PANEL LIFT INCREMENT DUE TO BODY VORTICES AS A FRACTION OF THE THEORETICAL PANEL LIFT	NWC TP-5761
C_p	CONEP	COMPUTE CONE PRESSURE AT ZERO ANGLE OF ATTACK (RASMUSSEN)	AIAA JOURNAL, AUG 1967, P.1495
$C_p(\alpha, \theta)$	CPDIST	COMPUTE PRESSURES AROUND BODY (DEJARNETTE EQNS.28)	AIAA JOURNAL OF SPACECRAFT, NOV-DEC 1980 P.529
M_2	EQN44	COMPUTE MACH NUMBER (FROM EQUATION 44)	NACA 1135
X_{Cp}	FALCP	CALCULATE FIN ALONE AERODYNAMIC CENTER FOR AFT SWEPT WINGS	DATCOM SECTION 4.1.4.2, FIGURES 26(A) - 26(F)
C_{ALE}	FCALE	COMPUTE DRAG INCREMENT DUE TO LEADING EDGE BLUNTNESS	DATCOM SECTION 4.1.5.1
$C_{A(\alpha)}$	FALPF	COMPUTE DRAG DUE TO LIFT FOR FINS ALONE	DATCOM SECTION 4.1.5.2
C_{Aw}	FCAWPF	COMPUTE FIN ALONE WAVE DRAG AT SUPERSONIC SPEEDS	NSWC TR-80-346
C_{Aw}	FCAWS	SUPERSONIC FIN WAVE DRAG INCREMENT TO AXIAL FORCE	DATCOM SECTION 4.1.5.1
$C_{Ap,w}$	FCAWT	COMPUTE FIN ALONE TRANSONIC WAVE DRAG INCREMENT	DATCOM SECTION 4.1.5.1
α_{CLMAX} C_{LMAX}	FCLMSB	COMPUTE SUBSONIC MAXIMUM LIFT AND ANGLE OF ATTACK FOR MAXIMUM LIFT FOR LOW ASPECT RATIO WINGS	DATCOM SECTION 4.1.3.4 METHOD 3
α_{CLMAX} C_{LMAX}	FCLMSH	COMPUTE SUBSONIC MAXIMUM LIFT AND ANGLE OF ATTACK FOR MAXIMUM LIFT FOR HIGH ASPECT RATIO WINGS	DATCOM SECTION 4.1.3.4 METHOD 2
$C_{N\alpha}$	FCNA	COMPUTES FIN ALONE LINEAR NORMAL FORCE CURVE SLOPE, PER DEGREE	DATCOM SECTION 4.1.3.2 RAS DATA SHEETS
$C_{N\alpha\alpha}$	FCNAAH	COMPUTES SUPERSONIC NON-LINEAR NORMAL FORCE PER $\sin^2\alpha$	DATCOM SECTION 4.1.3.3
$C_{N\alpha\alpha}$	FCNAAS	COMPUTES SUBSONIC NON-LINEAR NORMAL FORCE PER $\sin^2\alpha$	DATCOM SECTION 4.1.3.3
$C_{N\alpha\alpha}$	FCNAAT	COMPUTES TRANSONIC NON-LINEAR NORMAL FORCE PER $\sin^2\alpha$	DATCOM SECTION 4.1.3.3
$C_{N\alpha}$	FCNASB	COMPUTES FIN-ALONE LIFT CURVE SLOPE FOR TWO (2) PANELS CONNECTED AT THE ROOT CHORD (LOWRY-POLHAMUS)	DATCOM FIGURE 4.1.3.2
$C_{N\alpha}$	FCNASP	COMPUTES SUPERSONIC LIFTING SURFACE C_N PER ALPHA	DATCOM FIGURE 4.1.3.2-56 DATCOM FIGURE 4.1.3.2-60 DAC SM 13110
$C_{N\alpha}$	FCNATR	COMPUTES FIN ALONE TRANSONIC LIFT CURVE SLOPE FOR TWO(2) PANELS (EXPOSED PLANFORM)	BRITISH DATA SHEETS: S.01.03.06, S.01.03.05 S.01.03.04, S.01.03.03 S.08.01.02

Table 7 Summary of Methods Implemented in Missile Datcom (Continued)

Coeff	ROUTINE	DESCRIPTION	REFERENCES
$C_{N_{\alpha}}$	FIG60B	INTERPOLATE FOP FIN CNAA (DATCOM FIGURE 4.1.3.3-60B)	DATCOM SECTION 4.1.3.3
C_{AB}	FINCAB	COMPUTE BASE DRAG OF FIN TRAILING EDGE	NWC TR-2796 EMPIRICAL $0.0 < M < 3.1$ 3D $0.0 < M < 1.2$ 2D $1.2 < M < 3.1$ $1/M^2$ $M > 4.0$
C_{AP}	FINCAP	FIN ALONE SUBSONIC PRESSURE DRAG	FLUID DYNAMIC DRAG (HOERNER)
$(\Delta \text{DEG})_s$	FINFIN	DETERMINE DELTA-ALPHA-EQUIVALENT OF DEFLECTED FIN IN PRESENCE OF ADJACENT CRUCIFORM FINS	NEAR TR 125
θ^*	FSDETA	CALCULATE SHOCK DETACHMENT ANGLE-OF-ATTACK ON FINS	DATCOM SECTION 4.1.3.3, PAGE 4.1.3.3-33 STEP 2B NACA 1135 EQN 138 & 168
X_{cp}	FWDXAC	CALCULATE FIN ALONE AERODYNAMIC CENTER FOR FORWARD SWEPT FINS	AFWAL TR-84-3084
η	GETETA	COMPUTE SUBSONIC CROSS FLOW DRAG PROPORTIONALITY FACTOR	AEDC-TR-75-124
	HYPER	COMPUTES PRESSURES BY MODIFIED NEWTONIAN THEORY	NASA TND-176
	KWBALP	DETERMINE RATIO K-W(B)/K-W(B) SBT DUE TO ANGLE OF ATTACK	EMPIRICAL CORRELATION OF TEST DATA (TEMPORARILY SET TO 1.0)
	LOADF	PRESSURE LOADING FUNCTIONS (DEJARNETTE)	AIAA JOURNAL OF SPACECRAFT, NOV-DEC 1980 P.529
$C_{N'}$	PANLCN	COMPUTES TOTAL FIN NORMAL FORCE OF A CRUCIFORM FIN SET USING THE CONCEPT OF EQUIVALENT ANGLE OF ATTACK	AIAA PAPER 77-1153 (NIELSON)
$F-R$ $S-R$	SFWRW	COMPUTES SURFACE VORTEX LATERAL POSITION FOR LIFTING SURFACE/BODY VORTEX INTERFERENCE	NACA TR-1307 (PITTS, NIELSON, KAATARI)
θ_s	SHOCK	GET SHOCK SHAPE ANGLE FROM EQN.42 OF DEJARNETTE	AIAA JOURNAL OF SPACECRAFT, NOV-DEC 1980 P.529
C_F	SKINF	COMPUTES SKIN FRICTION DRAG USING VAN DRIEST METHOD II FOR TURBULENT FLOW AND BLAIUS FOR LAMINAR FLOW. EMPIRICAL CORRELATIONS ARE USED FOR TRANSITION AND SURFACE ROUGHNESS CALCULATIONS	MDAC-WEST AERODYNAMIC HANDBOOK (M 8.080-CD) DATCOM SECTION 4.1.5.1 FLUID DYNAMIC DRAG (HOERNER)
	SLOPE	COMPUTES SUBSONIC AIRFOIL SECTION LIFT CURVE SLOPE, AERODYNAMIC CENTER, AND CRITICAL MACH NUMBER	AFFDL-TR-71-87
	SOSE	PRESSURES BY MODIFIED NEWTONIAN AND IMPROVED 2ND ORDER SHOCK EXPANSION OF DEJARNETTE	AIAA JOURNAL OF SPACECRAFT, NOV-DEC 1980 P.529 (NSWC AERO CODE)
I_v	SURINT	COMPUTES INTERFERENCE FACTOR FOR VORTEX INTERACTION WITH LIFTING SURFACE	NACA TR-1307, APPENDIX B (PITTS, NIELSON, KAATARI)
	SVTRAK	COMPUTES WING VORTEX HORIZONTAL AND VERTICAL LOCATION AT CENTER OF PRESSURE	NACA TR-1307 (PITTS, NIELSON, KAATARI)
	VANDYK	COMPUTES SECOND ORDER AXIAL AND FIRST ORDER CROSS FLOW PERTURBATION VELOCITY COMPONENTS	NSWC AERO CODE
I_v	VRINTS	COMPUTES INTERFERENCE FACTOR FOR VORTEX INTERACTION WITH LIFTING SURFACE	NACA TR-1307, APPENDIX B (PITTS, NIELSON, KAATARI)
Y_{cp}	YCP	SUBROUTINE TO COMPUTE LATERAL CENTER OF PRESSURE	AIAA PAPER 91-0708

5.4 COMMON BLOCK DEFINITIONS

This section summarizes the contents of each major common block within the program. If the block of data is input using namelist, the namelist name is noted. If the array can be dumped using the DUMP control card or written using the WRITE control card, the name is shown in the proper blank.

All data is stored in the foot-pound-second-degree-Rankine system of units regardless of the dimensional units set by the user. A data element is determined "unused" when the value of the number is equal to 1×10^{-30} . (See section 5.1.2 for a complete definition of UNUSED)

The blocks of data are listed alphabetically in this section according to their COMMON BLOCK names.

Table 8 AXIBOD Namelist Inputs (Common Block ABODIN)

DEFINITION OF COMMON BLOCK <i>ABODIN</i> (DUMP NAME <i>BDIN</i> , WRITE NAME <i>ABODIN</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	NX		Number of body stations	-
2	X0	X_0	Body apex station	ft
3-52	X	X	Longitudinal stations	ft
53-102	R	r	Radii	ft
103	TNOSE		Nose shape type 0. = Conical or Cone 1. = Tangent ogive 2. = Power series 3. = Haack 4. = Von Karam	-
104	LNOSE	L	Actual nose length	ft
105	DNOSE	D	Nose base diameter	ft
106	BNOSE	b	Nose bluntness radius	ft
107	TRUNC		.TRUE. if truncated	-
108	LCENTR	L	Centerbody length	ft
109	DCENTR	D	Centerbody base diameter	ft
110	TAFT		Afterbody shape type 0. = Conical or Cone 1. = Ogive	-
111	LAFT	L	Afterbody length	ft
112	DAFT	D	Afterbody base diameter	ft
113	POWER	n	Exponent for power series nose	-
114-133	DISCON		Indices of X stations where surface slope is discontinuous	-
134-183	ELLIP	e	Ellipticity of body at each X station	-
184-233	H	h	Height of body at each X station	ft
234	ENOSE	e_N	Nose base ellipticity	-
235	ECENTR	e_C	Centerbody base ellipticity	-
236	EAFT	e_a	Afterbody base ellipticity	-
237	DEXIT	d_{exit}	Nozzle exit diameter at base	ft

NOTE: Table continues on next page.

Table 8 AXIBOD Namelist Inputs (Common Block ABODIN) - Continued

DEFINITION OF COMMON BLOCK <i>ABODIN</i> (DUMP NAME <i>BDIN</i> , WRITE NAME <i>ABODIN</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
238	BASE		.TRUE. if jet interaction calculated	-
239	BETAN		Nozzle exit angle	deg
240-259	JMACH		Jet Mach number at nozzle exit	-
260-279	PRAT		Jet to freestream static pressure ratio	-
280-299	TRAT		Jet to freestream stagnation temperature ratio	-
300	PROTUB		.TRUE. if protuberance drag is calculated	-
301	NPROT		Number of protuberance sets	-
302-321	PTYPE		Protuberance set type: 1. = Vertical cylinder 2. = Horizontal cylinder 3. = Launch lug 4. = Launch shoe 5. = Block 6. = Fairing 7. = Component build (Not Used)	-
322-341	XPROT		Longitudinal distance from missile nose to protuberance set	ft
342-361	NLOC		Number of protuberances in each protuberance set	-
362-381	BLDMEM		Number of protuberance types in component build-up	-
382-481	BLDTYP		Types of protuberances in component build-up	-
482-581	LPROT		Length of each member or protuberance	ft
582-681	WPROT		Width of each member or protuberance	ft
682-781	HPROT		Height of each member or protuberance	ft
782-881	OPROT		Vertical offset of each member of protuberance	ft

Table 9 ELLBOD Namelist Inputs (Common Block ABODIN)

DEFINITION OF COMMON BLOCK <i>ABODIN</i> (DUMP NAME <i>BDIN</i> , WRITE NAME <i>ABODIN</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	NX		Number of body stations	-
2	X0	X ₀	Body apex station	ft
3-52	X	X	Longitudinal stations	ft
53-102	R	r	Radii	ft
103	TNOSE		Nose shape type 0. = Conical or Cone 1. = Tangent ogive 2. = Power series 3. = Haack 4. = Von Karm	-
104	LNOSE	L	Actual nose length	ft
105	DNOSE	D	Nose base diameter	ft
106	BNOSE	b	Nose bluntness radius	ft
107	TRUNC		.TRUE. if truncated	-
108	LCENTR	L	Centerbody length	ft
109	DCENTR	D	Centerbody base diameter	ft
110	TAFT		Afterbody shape type 0. = Conical or Cone 1. = Ogive	-
111	LAFT	L	Afterbody length	ft
112	DAFT	D	Afterbody base diameter	ft
113	POWER	n	Exponent for power series nose	-
114-133	DISCON		Indices of X stations where surface slope is discontinuous	-
134-183	ELLIP	e	Ellipticity of body at each X station	-
184-233	H	h	Height of body at each X station	ft
234	ENOSE	e _N	Nose base ellipticity	-
235	ECENTR	e _C	Centerbody base ellipticity	-
236	EAFT	e _a	Afterbody base ellipticity	-
237	DEXIT	d _{exit}	Nozzle exit diameter at base	ft

NOTE: Table continues on next page.

Table 9 ELLBOD Namelist Inputs (Common Block ABODIN) - Continued

DEFINITION OF COMMON BLOCK ABODIN (DUMP NAME BDIN , WRITE NAME ABODIN)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
238	BASE		.TRUE. if jet interaction calculated	-
239	BETAN		Nozzle exit angle	deg
240-259	JMACH		Jet Mach number at nozzle exit	-
260-279	PRAT		Jet to freestream static pressure ratio	-
280-299	TRAT		Jet to freestream stagnation temperature ratio	-
300	PROTUB		.TRUE. if protuberance drag is calculated	-
301	NPROT		Number of protuberance sets	-
302-321	PTYPE		Protuberance set type: 1. = Vertical cylinder 2. = Horizontal cylinder 3. = Launch lug 4. = Launch shoe 5. = Block 6. = Fairing 7. = Component build (Not Used)	-
322-341	XPROT		Longitudinal distance from missile nose to protuberance set	ft
342-361	NLOC		Number of protuberances in each protuberance set	-
362-381	BLDMEM		Number of protuberance types in component build-up	-
382-481	BLDTYP		Types of protuberances in component build-up	-
482-581	LPROT		Length of each member or protuberance	ft
582-681	WPROT		Width of each member or protuberance	ft
682-781	HPROT		Height of each member or protuberance	ft
782-881	OPROT		Vertical offset of each member of protuberance	ft

Table 10 Body Aerodynamic Work Array (Common Block BDWORK)

DEFINITION OF COMMON BLOCK <i>BDWORK</i> (DUMP NAME <i>BDWK</i> , WRITE NAME <i>BDWORK</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	CNP	C_{Np}	Potential normal force vs. α	-
21-40	CMP	C_{mp}	Potential pitching moment vs. α	-
41-60	CNVIS	C_{Nv}	Viscous normal force vs. α	-
61-80	CMVIS	C_{mv}	Viscous pitching moment vs. α	-
81-100	CAPR	$C_{AP,W}$	Pressure/wave axial force vs. α	-
101-120	CAF	C_{Af}	Friction axial force vs. α	-
121-140	CABASE	C_{Ab}	Base axial force vs. α	-
141	ETA	η	Cross-flow proportionality factor	-
142-161	CDC	C_{dc}	Cross-flow drag coefficient vs. α	-
162-181	CAPROT		Protuberance axial force coefficient	-
182-201	BOTDCA		Boattail incremental axial force due to separation	-
202-221	BOTDCN		Boattail incremental normal force due to separation	-
222-241	BOTDCM		Boattail incremental pitching moment due to separation	-

Table 11 Case Identification (Common Block CASEID)

DEFINITION OF COMMON BLOCK CASEID (DUMP NAME , WRITE NAME CASEID)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-74	IDCASE		Case I.D., one character per element	-
75	KOUNT		Number of saved namelists	-
76-175	NAMSV		Saved namelist order (packed 3 per element)	-
176	CASE		Case number	-
177	NOEXTR		.TRUE. if, no extrapolation messages	-
178	NOLAT		. TRUE . if no lat-dir derivatives to be computed	-
179	IR		Run number for plot file	-
180	IPAGE		Page number of output	-

Table 12 Program Constants (Common Block CONST)

DEFINITION OF COMMON BLOCK <i>CONST</i> (DUMP NAME , WRITE NAME <i>CONST</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	PI	π	Value for π	-
2	RAD		Value for $180/\pi$	-
3	UNUSED		Value for unused (1×10^{-30})	-
4	KAND		Namelist delimineter (\$)	-

Table 13 Dynamic Derivatives for Body and Finset 1 (Common Block DB1)

DEFINITION OF COMMON BLOCK DB1 (DUMP NAME DB1 , WRITE NAME DB1)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	T1CNQ	C_{Nq}	Normal force due to pitch vs. α	1/rad
21-40	T1CNAD	$C_{N\dot{\alpha}}$	Normal force due to time rate of change of angle of attack vs. α	1/rad
41-60	TIPTCH	$C_{m\dot{\theta}}$	Total damping in pitch vs. α	1/rad

Table 14 Dynamic Derivatives for Body and Finset 1,2 (Common Block DB12)

DEFINITION OF COMMON BLOCK <i>DB12</i> (DUMP NAME <i>DB12</i> , WRITE NAME <i>DB12</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	T2CNQ	C_{Nq}	Normal force due to pitch vs. α	1/rad
21-40	T2CNAD	$C_{N\dot{\alpha}}$	Normal force due to time rate of change of angle of attack vs. α	1/rad
41-60	T2PTCH	$C_{m\dot{\theta}}$	Total damping in pitch vs. α	1/rad

Table 15 Dynamic Derivatives for Body and Finset 1,2,3 (Common Block DB123)

DEFINITION OF COMMON BLOCK DB123 (DUMP NAME DB13 , WRITE NAME DB123)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	T3CNQ	C_{Nq}	Normal force due to pitch vs. α	1/rad
21-40	T3CNAD	$C_{N\dot{\alpha}}$	Normal force due to time rate of change of angle of attack vs. α	1/rad
41-60	T3PTCH	$C_{m\dot{\theta}}$	Total damping in pitch vs. α	1/rad

Table 16 Dynamic Derivatives for Body and Finset 1,2,3,4 (Common. Block DB1234)

DEFINITION OF COMMON BLOCK <i>DB1234</i> (DUMP NAME <i>DB14</i> , WRITE NAME <i>DB1234</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	T4CNQ	C_{Nq}	Normal force due to pitch vs. α	1/rad
21-40	T4CNAD	$C_{N\dot{\alpha}}$	Normal force due to time rate of change of angle of attack vs. α	1/rad
41-60	T4PTCH	$C_{m\dot{\theta}}$	Total damping in pitch vs. α	1/rad

Table 17 Body Dynamic Derivatives (Common Block DBODY)

DEFINITION OF COMMON BLOCK <i>DBODY</i> (DUMP NAME <i>DBOD</i> , WRITE NAME <i>DBODY</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	BCNQ	C_{Nq}	Normal force due to pitch vs. α	1/rad
21-40	BCNAD	$C_{N\dot{\alpha}}$	Normal force due to time rate of change of angle of attack vs. α	1/rad
41-60	BPTCH	$C_{m\dot{\theta}}$	Total damping in pitch vs. α	1/rad
61	CLLP	C_{lp}	Rolling moment due to roll rate	1/rad
62	CYP	C_{Yp}	Side force due to roll rate	1/rad
63	CNP1		1 st order yawing moment (magnus) coefficient	1/sin(α)
64	CNP3		3 rd order yawing moment (magnus) coefficient	1/sin ³ (α)
65	CNP5		5 th order yawing moment (magnus) coefficient	1/sin ⁵ (α)
66	CNPY5		5 degree secant slope of magnus moment coefficient (@ 5 degrees yaw)	1/sin(α)

Table 18 Finset 1 Dynamic Derivatives (Common Block DDFIN1)

DEFINITION OF COMMON BLOCK <i>DDFIN1</i> (DUMP NAME <i>DFI</i> , WRITE NAME <i>DFINI</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	F1CNQ	C_{Nq}	Normal force due to pitch vs. α	1/rad
21-40	F1CNAD	$C_{N\dot{\alpha}}$	Normal force due to time rate of change of angle of attack vs. α	1/rad
41-60	F1CMQ	C_{mq}	Pitching moment due to pitch rate vs. α	1/rad
61-80	F1CMAD	$C_{m\dot{\alpha}}$	Pitching moment due to time rate of change of angle of attack vs. α	1/rad

Table 19 Finset 2 Dynamic Derivatives (Common Block DDFIN2)

DEFINITION OF COMMON BLOCK <i>DDFIN2</i> (DUMP NAME <i>DF2</i> , WRITE NAME <i>DFIN2</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	F2CNQ	C_{N_q}	Normal force due to pitch vs. α	1/rad
21-40	F2CNAD	$C_{N_{\dot{\alpha}}}$	Normal force due to time rate of change of angle of attack vs. α	1/rad
41-60	F2CMQ	C_{m_q}	Pitching moment due to pitch rate vs. α	1/rad
61-80	F2CMAD	$C_{m_{\dot{\alpha}}}$	Pitching moment due to time rate of change of angle of attack vs. α	1/rad

Table 20 Finset 3 Dynamic Derivatives (Common Block DDFIN3)

DEFINITION OF COMMON BLOCK <i>DDFIN3</i> (DUMP NAME <i>DF3</i> , WRITE NAME <i>DFIN3</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	F2CNQ	C_{Nq}	Normal force due to pitch vs. α	1/rad
21-40	F2CNAD	$C_{N\dot{\alpha}}$	Normal force due to time rate of change of angle of attack vs. α	1/rad
41-60	F2CMQ	C_{mq}	Pitching moment due to pitch rate vs. α	1/rad
61-80	F2CMAD	$C_{m\dot{\alpha}}$	Pitching moment due to time rate of change of angle of attack vs. α	1/rad

Table 21 Finset 4 Dynamic Derivatives (Common Block DDFIN4)

DEFINITION OF COMMON BLOCK <i>DDFIN4</i> (DUMP NAME <i>DF4</i> , WRITE NAME <i>DFIN4</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	F4CNQ	C_{Nq}	Normal force due to pitch vs. α	1/rad
21-40	F4CNAD	$C_{N\dot{\alpha}}$	Normal force due to time rate of change of angle of attack vs. α	1/rad
41-60	F4CMQ	C_{mq}	Pitching moment due to pitch rate vs. α	1/rad
61-80	F4CMAD	$C_{m\dot{\alpha}}$	Pitching moment due to time rate of change of angle of attack vs. α	1/rad

Table 22 NACA Designation (Common Block DESIG)

DEFINITION OF COMMON BLOCK <i>DESIG</i> (DUMP NAME , WRITE NAME <i>DESIG</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-320	NNACA		NACA designation by fin set (80 each)	-

Table 23 Delete Flags for Input NAMELISTs (Common Block DFLAGS)

DEFINITION OF COMMON BLOCK <i>DFLAGS</i> (DUMP NAME , WRITE NAME <i>DFLAGS</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	DFLT		Delete prior \$FLTCON flag	-
2	DREF		Delete prior \$REFQ flag	-
3	DAXI		Delete prior \$AXIBOD flag	-
4	DFIN1		Delete prior \$FINSET1 flag	-
5	DFIN2		Delete prior \$FINSET2 flag	-
6	DFIN3		Delete prior \$FINSET3 flag	-
7	DFIN4		Delete prior \$FINSET4 flag	-
8	DDEFL		Delete prior \$DEFLCT flag	-
9	DTRIM		Delete prior \$TRIM flag	-
10	DELLB		Delete prior \$ELLBOD flag	-
11	DINLET		Delete prior \$INLET flag	-
12	DARBOD		Delete prior \$ARBOD flag	-

Table 24 Dump Array Flags (Common Block DUMPF)

DEFINITION OF COMMON BLOCK <i>DUMPF</i> (DUMP NAME , WRITE NAME <i>DUMPF</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	LGEOB		Flag to dump GEOBOD	-
2	LF1GM		Flag to dump GEOFS1	-
3	LF2GM		Flag to dump GEOFS2	-
4	LF3GM		Flag to dump GEOFS3	-
5	LF4GM		Flag to dump GEOFS4	-
6	LATMP		Flag to dump FLC and TOTALC	-
7	LBDWK		Flag to dump BDWORK	-
8	LFLCT		Flag to dump FLC	-
9	LINLD		Flag to dump INLTD	-
10	LINPT		Flag to dump input data	-
11	LFLTC		Flag to dump FLCT	-
12	LREFQN		Flag to dump REFQN	-
13	LBDIN		Flag to dump ABODIN or EBODIN	-
14	LF1IN		Flag to dump FSET1	-
15	LF2IN		Flag to dump FSET2	-
16	LF3IN		Flag to dump FSET3	-
17	LF4IN		Flag to dump FSET4	-
18	LINLEN		Flag to dump INLETN	-
19	LIOM		Flag to dump the I.O.M.	-
20	LSBOD		Flag to dump SBODY	-
21	LSF1		Flag to dump SFIN1	-
22	LSF2		Flag to dump SFIN2	-
23	LSF3		Flag to dump SFIN3	-
24	LSF4		Flag to dump SFIN4	-
25	LSB1		Flag to dump SB1	-
26	LSB12		Flag to dump SB12	-
27	LSB123		Flag to dump SB123	-
28	LS1234		Flag to dump SB1234	-
29	LBOD		Flag to dump DBODY	-
30	LDF1		Flag to dump DFIN1	-
31	LDF2		Flag to dump DFIN2	-
32	LDF3		Flag to dump DFIN3	-
33	LDF4		Flag to dump DFIN4	-
34	LDB1		Flag to dump DB1	-
35	LDB12		Flag to dump DB12	-
36	LDB123		Flag to dump DB123	-
37	LD1234		Flag to dump DB1234	-

Table 25 Finset 1 Aerodynamic Work Array (Common Block FIWORK)

DEFINITION OF COMMON BLOCK <i>FIWORK</i> (DUMP NAME <i>FIWK</i> , WRITE NAME <i>FIWORK</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	RHO1	P_{LE}	Panel effective L.E. radius	ft
2	TMAX1	$(t/c)_{MAX}$	Panel effective maximum t/c	-
3	KSHAR1	k	Wave drag parameter for section	-
4-23	CCLA1	$C_{l\alpha}$	Section $C_{l\alpha}$ vs. Mach	1/deg
24-43	XAC1	X_{ac}	Section X_{ac} vs. Mach	-
44-63	CMC041	$C_{m_{c/4}}$	Section C_m about $c/4$	-
64	CNALF1	$C_{N\alpha}$	Single panel $C_{N\alpha}$	1/deg
65-84	CNAAF1	$C_{N_{\alpha\alpha}}$	Single panel $C_{N_{\alpha\alpha}}$ vs. α	1/rad ²
85-104	CNLF1	C_{N_L}	Fin set linear C_N	-
105-124	CNNLF1	$C_{N_{NL}}$	Fin set non-linear C_N	-
125-144	CNF1AT	C_N	Fin set total C_N	-
145	XCPL1	X_{CPL}	Single panel linear C.P.	ft
146	XCPNL1	X_{CPNL}	Single panel non-linear C.P.	ft
147-166	CMFL1	C_{m_L}	Fin set linear C_m	-
167-186	CMFNL1	$C_{m_{NL}}$	Fin set non-linear C_m	-
187-206	CMF1AT	C_m	Fin set total C_m	-
207	CA0F1	C_{A_0}	Single panel C_{A_0}	-
208-227	CANLF1	C_{ANL}	Single panel $(C_A - C_{A_0})$ vs α	-
228-247	ALPTF1	α_j	Interpolated α for panel char.	deg
248-267	CNFIT1	C_{N_j}	Interpolated C_N for panel char.	-
268	AI1	α_{ideal}	Ideal α for section	deg
269	AL01	α_{OL}	Zero lift α for section	deg
270	CLI1	CL_{ideal}	Ideal CL for section	-
271-290	CLM1	CL_{max}	Maximum airfoil section C_L	-

Table 26 Finset 2 Aerodynamic Work Array (Common Block F2WORK)

DEFINITION OF COMMON BLOCK <i>F2WORK</i> (DUMP NAME <i>F2WK</i> , WRITE NAME <i>F2WORK</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	RHO2	P_{LE}	Panel effective L.E. radius	ft
2	TMAX2	$(t/c)_{MAX}$	Panel effective maximum t/c	-
3	KSHAR2	k	Wave drag parameter for section	-
4-23	CCLA2	$C_{l\alpha}$	Section $C_{l\alpha}$ vs. Mach	1/deg
24-43	XAC2	X_{ac}	Section X_{ac} vs. Mach	-
44-63	CMC042	$C_{m_{c/4}}$	Section C_m about $c/4$	-
64	CNALF2	$C_{N\alpha}$	Single panel $C_{N\alpha}$	1/deg
65-84	CNAAF2	$C_{N\alpha\alpha}$	Single panel $C_{N\alpha\alpha}$ vs. α	1/rad ²
85-104	CNLF2	C_{NL}	Fin set linear C_N	-
105-124	CNNLF2	$C_{N_{NL}}$	Fin set non-linear C_N	-
125-144	CNF2AT	C_N	Fin set total C_N	-
145	XCPL2	X_{CPL}	Single panel linear C.P.	ft
146	XCPNL2	X_{CPNL}	Single panel non-linear C.P.	ft
147-166	CMFL2	C_{mL}	Fin set linear C_m	-
167-186	CMFNL2	$C_{m_{NL}}$	Fin set non-linear C_m	-
187-206	CMF2AT	C_m	Fin set total C_m	-
207	CA0F2	C_{A0}	Single panel C_{A0}	-
208-227	CANLF2	C_{ANL}	Single panel $(C_A - C_{A0})$ vs α	-
228-247	ALPTF2	α_j	Interpolated α for panel char.	deg
248-267	CNFIT2	C_{N_j}	Interpolated C_N for panel char.	-
268	AI2	α_{ideal}	Ideal α for section	deg
269	AL02	α_{OL}	Zero lift α for section	deg
270	CLI2	CL_{ideal}	Ideal CL for section	-
271-290	CLM2	$C_{L_{max}}$	Maximum airfoil section C_L	-

Table 27 Finset 3 Aerodynamic Work Array (Common Block F3WORK)

DEFINITION OF COMMON BLOCK F3WORK (DUMP NAME F3WK , WRITE NAME F3WORK)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	RHO3	P_{LE}	Panel effective L.E. radius	ft
2	TMAX3	$(t/c)_{MAX}$	Panel effective maximum t/c	-
3	KSHAR3	k	Wave drag parameter for section	-
4-23	CCLA3	$C_{l\alpha}$	Section $C_{l\alpha}$ vs. Mach	1/deg
24-43	XAC3	X_{ac}	Section X_{ac} vs. Mach	-
44-63	CMC043	$C_{m_{c/4}}$	Section C_m about c/4	-
64	CNALF3	$C_{N\alpha}$	Single panel $C_{N\alpha}$	1/deg
65-84	CNAAF3	$C_{N\alpha\alpha}$	Single panel $C_{N\alpha\alpha}$ vs. α	1/rad ²
85-104	CNLF3	C_{NL}	Fin set linear C_N	-
105-124	CNNLF3	C_{NNL}	Fin set non-linear C_N	-
125-144	CNF3AT	C_N	Fin set total C_N	-
145	XCPL3	X_{CPL}	Single panel linear C.P.	ft
146	XCPNL3	X_{CPNL}	Single panel non-linear C.P.	ft
147-166	CMFL3	C_{mL}	Fin set linear C_m	-
167-186	CMFNL3	C_{mNL}	Fin set non-linear C_m	-
187-206	CMF3AT	C_m	Fin set total C_m	-
207	CA0F3	C_{A0}	Single panel C_{A0}	-
208-227	CANLF3	C_{ANL}	Single panel $(C_A - C_{A0})$ vs α	-
228-247	ALPTF3	α_j	Interpolated α for panel char.	deg
248-267	CNFTT3	C_{Nj}	Interpolated C_N for panel char.	-
268	AI3	α_{ideal}	Ideal α for section	deg
269	AL03	α_{OL}	Zero lift α for section	deg
270	CLI3	CL_{ideal}	Ideal CL for section	-
271-290	CLM3	$C_{L_{max}}$	Maximum airfoil section C_L	-

Table 28 Finset 4 Aerodynamic Work Array (Common Block F4WORK)

DEFINITION OF COMMON BLOCK <i>F4WORK</i> (DUMP NAME <i>F4WK</i> , WRITE NAME <i>F4WORK</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	RHO4	$\rho L E$	Panel effective L.E. radius	ft
2	TMAX4	$(t/c)_{MAX}$	Panel effective maximum t/c	-
3	KSHAR4	k	Wave drag parameter for section	-
4-23	CCLA4	$C_{l\alpha}$	Section $C_{l\alpha}$ vs. Mach	1/deg
24-43	XAC4	X_{ac}	Section X_{ac} vs. Mach	-
44-63	CMC044	$C_{m_{c/4}}$	Section C_m about $c/4$	-
64	CNALF4	$C_{N\alpha}$	Single panel $C_{N\alpha}$	1/deg
65-84	CNAAF4	$C_{N\alpha\alpha}$	Single panel $C_{N\alpha\alpha}$ vs. α	1/rad ²
85-104	CNLF4	C_{NL}	Fin set linear C_N	-
105-124	CNNLF4	C_{NNL}	Fin set non-linear C_N	-
125-144	CNF4AT	C_N	Fin set total C_N	-
145	XCPL4	X_{CPL}	Single panel linear C.P.	ft
146	XCPNL4	X_{CPNL}	Single panel non-linear C.P.	ft
147-166	CMFL4	C_{mL}	Fin set linear C_m	-
167-186	CMFNL4	C_{mNL}	Fin set non-linear C_m	-
187-206	CMF4AT	C_m	Fin set total C_m	-
207	CA0F4	C_{A0}	Single panel C_{A0}	-
208-227	CANLF4	C_{ANL}	Single panel $(C_A - C_{A0})$ vs α	-
228-247	ALPTF4	α_j	Interpolated α for panel char.	deg
248-267	CNFIT4	C_{Nj}	Interpolated C_N for panel char.	-
268	AI3	α_{ideal}	Ideal α for section	deg
269	AL04	α_{OL}	Zero lift α for section	deg
270	CLI4	CL_{ideal}	Ideal CL for section	-
271-290	CLM4	CL_{max}	Maximum airfoil section C_L	-

Table 29 FLTCON Namelist Inputs (Common Block FLC)

DEFINITION OF COMMON BLOCK <i>FLC</i> (DUMP NAME <i>FLT</i> , WRITE NAME <i>FLC</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	NALPHA		Number of angles of attack	-
2-21	ALPHA	α	Angles of attack	deg
22	BETA	β	Sideslip angle	deg
23	PHI	ϕ	Roll angle	deg
24	NMACH		Number of Mach numbers	
25-44	MACH	M	Mach numbers	-
45	ALT	h	Geometric altitude	ft
46-65	REN	Re	Reynolds number	1/ft
66-85	VINF	V_{∞}	Free-stream velocity	ft/sec
86-105	TINF	T_{∞}	Free-stream temperature	$^{\circ}R$
106-125	PINF	P_{∞}	Free-stream pressure	lb/ft ²

Table 30 FINSET1 Namelist Inputs (Common Block FSET1)

DEFINITION OF COMMON BLOCK <i>FSET1</i> (DUMP NAME <i>FIIN</i> , WRITE NAME <i>FSET1</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	SECTYP		Type of airfoil section 1. = NACA 0. = Hexagonal/diamond 2. = Circular arc 3. = User defined	-
2-11	SSPAN	$b/2$	Semi-span stations	ft
12-21	LMAXU	$(t/c)_{\max u}$	L.E. to max t/c , upper surface	-
22-31	LFLATU	l_u	Length of constant t/c , upper surface	-
31-41	LMAXL	$(t/c)_{\max l}$	L.E. to max, t/c , lower surface	-
42-51	LFLATL	l_l	Length of constant t/c , lower surface	-
52-61	CHORD	c	Chord length	ft
62-71	THICKU	$(t/c)_u$	t/c of upper section	-
72-81	THICKL	$(t/c)_l$	t/c of lower section	-
82-91	SWEEP	Λ	Sweep-back angle	deg
92-101	STA	η	Station for measuring sweep	-
102-111	XLE	X_{LE}	Station for L.E. of chord	ft
112	NPANEL		Number of panels	-
113-162	XCORD	X/c	X/c of section	-
163-212	MEAN	Y_m/c	Y/c of section (mean line)	-
213-262	THICK	t/c	t/c of section (thickness distribution)	-
263-312	YUPPER	Y_u	Y/c of upper surface	-
313-362	YLOWER	Y_l	Y/c of lower surface	-
363	FINPHI	ϕ	Roll angle of fins	deg
364-373	LER	r_{LE}	Fin L.E. radius	ft
374-381	GAM	Γ	Fin dihedral angle	deg
382-389	PHIF	ϕ_F	Fin ϕ from top vertical center	deg
390-399	CFOC	c/c	Flap chord to total chord ratio	-

Table 31 FINSET2 Namelist Inputs (Common Block FSET2)

DEFINITION OF COMMON BLOCK <i>FSET2</i> (DUMP NAME <i>F2IN</i> , WRITE NAME <i>FSET2</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	SECTYP		Type of airfoil section 1. = NACA 0. = Hexagonal/diamond 2. = Circular arc 3. = User defined	-
2-11	SSPAN	b/2	Semi-span stations	ft
12-21	LMAXU	(t/c) _{maxu}	L.E. to max t/c, upper surface	-
22-31	LFLATU	l _u	Length of constant t/c, upper surface	-
31-41	LMAXL	(t/c) _{maxl}	L.E. to max, t/c, lower surface	-
42-51	LFLATL	l _l	Length of constant t/c, lower surface	-
52-61	CHORD	c	Chord length	ft
62-71	THICKU	(t/c) _u	t/c of upper section	-
72-81	THICKL	(t/c) _l	t/c of lower section	-
82-91	SWEEP	Λ	Sweep-back angle	deg
92-101	STA	η	Station for measuring sweep	-
102-111	XLE	X _{LE}	Station for L.E. of chord	ft
112	NPANEL		Number of panels	-
113-162	XCORD	X/c	X/c of section	-
163-212	MEAN	Y _m /c	Y/c of section (mean line)	-
213-262	THICK	t/c	t/c of section (thickness distribution)	-
263-312	YUPPER	Y _u	Y/c of upper surface	-
313-362	YLOWER	Y _l	Y/c of lower surface	-
363	FINPHI	φ	Roll angle of fins	deg
364-373	LER	r _{LE}	Fin L.E. radius	ft
374-381	GAM	Γ	Fin dihedral angle	deg
382-389	PHIF	φ _F	Fin φ from top vertical center	deg
390-399	CFOC	c _{fc}	Flap chord to total chord ratio	-

Table 32 FINSET3 Namelist Inputs (Common Block FSET3)

DEFINITION OF COMMON BLOCK FSET3 (DUMP NAME F3IN , WRITE NAME FSET3)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	SECTYP		Type of airfoil section 1. = NACA 0. = Hexagonal/diamond 2. = Circular arc 3. = User defined	-
2-11	SSPAN	b/2	Semi-span stations	ft
12-21	LMAXU	$(t/c)_{\max u}$	L.E. to max t/c, upper surface	-
22-31	LFLATU	l_u	Length of constant t/c, upper surface	-
31-41	LMAXL	$(t/c)_{\max l}$	L.E. to max, t/c, lower surface	-
42-51	LFLATL	l_l	Length of constant t/c, lower surface	-
52-61	CHORD	c	Chord length	ft
62-71	THICKU	$(t/c)_u$	t/c of upper section	-
72-81	THICKL	$(t/c)_l$	t/c of lower section	-
82-91	SWEEP	Λ	Sweep-back angle	deg
92-101	STA	η	Station for measuring sweep	-
102-111	XLE	X_{LE}	Station for L.E. of chord	ft
112	NPANEL		Number of panels	-
113-162	XCORD	X/c	X/c of section	-
163-212	MEAN	Y_m/c	Y/c of section (mean line)	-
213-262	THICK	t/c	t/c of section (thickness distribution)	-
263-312	YUPPER	Y_u	Y/c of upper surface	-
313-362	YLOWER	Y_l	Y/c or lower surface	-
363	FINPHI	ϕ	Roll angle of fins	deg
364-373	LER	r_{LE}	Fin L.E. radius	ft
374-381	GAM	Γ	Fin dihedral angle	deg
382-389	PHIF	ϕ_F	Fin ϕ from top vertical center	deg
390-399	CFOC	c_{fc}	Flap chord to total chord ratio	-

Table 33 FINSET4 Namelist Inputs (Common Block FSET4)

DEFINITION OF COMMON BLOCK FSET4 (DUMP NAME F4IN , WRITE NAME FSET4)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	SECTYP		Type of airfoil section 1. = NACA 0. = Hexagonal/diamond 2. = Circular arc 3. = User defined	-
2-11	SSPAN	$b/2$	Semi-span stations	ft
12-21	LMAXU	$(t/c)_{max_u}$	L.E. to max t/c, upper surface	-
22-31	LFLATU	l_u	Length of constant t/c, upper surface	-
31-41	LMAXL	$(t/c)_{max_l}$	L.E. to max, t/c, lower surface	-
42-51	LFLATL	l_l	Length of constant t/c, lower surface	-
52-61	CHORD	c	Chord length	ft
62-71	THICKU	$(t/c)_u$	t/c of upper section	-
72-81	THICKL	$(t/c)_l$	t/c of lower section	-
82-91	SWEEP	Λ	Sweep-back angle	deg
92-101	STA	η	Station for measuring sweep	-
102-111	XLE	X_{LE}	Station for L.E. of chord	ft
112	NPANEL		Number of panels	-
113-162	XCORD	X/c	X/c of section	-
163-212	MEAN	Y_m/c	Y/c of section (mean line)	-
213-262	THICK	t/c	t/c of section (thickness distribution)	-
263-312	YUPPER	Y_u	Y/c of upper surface	-
313-362	YLOWER	Y_l	Y/c of lower surface	-
363	FINPHI	ϕ	Roll angle of fins	deg
364-373	LER	r_{LE}	Fin L.E. radius	ft
374-381	GAM	Γ	Fin dihedral angle	deg
382-389	PHIF	ϕ_F	Fin ϕ from top vertical center	deg
390-399	CFOC	c_{fc}	Flap chord to total chord ratio	-

Table 34 Body Geometry Data (Common Block GEOBOD)

DEFINITION OF COMMON BLOCK <i>GEOBOD</i> (DUMP NAME <i>GEOB</i> , WRITE NAME <i>GEOBOD</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	SPNOSE	$(S_p)_N$	Nose section planform area	ft ²
2	SWNOSE	$(S_w)_N$	Nose section wetted area	ft ²
3	VOLNOS	V_N	Nose section volume	ft ³
4	XCVNOS	$(X_{C.V.})_N$	Nose section volume centroid	ft
5	XCPNOS	$(X_{C.P.})_N$	Nose section planform centroid	ft
6	FRNOSE	$(FR)_N$	Nose Section fineness ratio	-
7	THEOLN	l_N^*	Nose section theoretical length	ft
8	THEOFN	FR_N^*	Nose section theoretical fineness ratio	-
9-16			Repeat of 1- 8 for centerbody	-
17-24			Repeat of 1-8 for aft body	-
25	SPLAN	S_p	Total planform area	ft ²
26	SWET	S_w	Total wetted area	ft ²
27	VOL	V	Total volume	ft ³
28	XCENTV	$X_{C.V.}$	Total volume centroid	ft
29	XCENTP	$X_{C.P.}$	Total planform centroid	ft
30	FR	FR	Total fineness ratio	-
31	DBASE	d_b	Base diameter	ft
32	SBASE	S_b	Base area	ft ²
33	DMAX	d_{max}	Maximum diameter	ft
34	SMAX	S_{max}	Maximum cross-section area	ft ²
35	LTOTAL	l_T	Total body length	ft
36	BPNOSE	$(S_{p_v})_N$	Vertical planform area of nose	ft ²
37	BCPNOS	$(X_{C.P.v})_N$	Vertical planform centroid of nose	ft
38	BPCENT	$(S_{p_v})_C$	Vertical planform area of center body	ft ²
39	BCPCEN	$(X_{C.P.v})_C$	Vertical planform centroid of center body	ft
40	BPAFT	$(S_{p_v})_A$	Vertical planform area of aft body	ft ²
41	BCPAFT	$(X_{C.P.v})_A$	Vertical planform centroid of aft body	ft
42	BPLAN	S_{p_v}	Total vertical planform area	ft ²
43	BCENTP	$X_{C.P.v}$	Total vertical planform centroid	ft
44	ECSPN	$(S_{peqv})_N$	Equivalent circular nose planform area	ft ²
45	ECSPC	$(S_{peqv})_C$	Equivalent circular centerbody planform area	ft ²
46	ECSPA	$(S_{peqv})_A$	Equivalent circular aftbody planform area	ft ²
47	ECSPT	S_{peqv}	Total equivalent circular planform area	ft ²

Table 35 Finset 1 Geometry Data (Common Block GEOFS1)

DEFINITION OF COMMON BLOCK GEOFS1 (DUMP NAME FIGM , WRITE NAME GEOFS1)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-10	SPLANF	S_{pi}	Planform area of segment	ft ²
11-20	CBAR	$\bar{C}_i$	Mean geometric chord of segment	ft
21-30	SWEPL	$\Lambda_{L.E.i}$	Sweep angle at L . E . of segment	deg
31-40	SWEP25	$\Lambda_{.25c_i}$	Sweep angle at c/4 of segment	deg
41-50	SWEP50	$\Lambda_{.50c_i}$	Sweep angle at c/2 of segment	deg
51-60	SWEP75	$\Lambda_{.75c_i}$	Sweep angle at 3c/4 of segment	deg
61-70	SWEPT	$\Lambda_{T.E.i}$	Sweep angle at T. E. of segment	deg
71-80	XMGCLE	$\bar{X}_{LE_i}$	Distance from c_T L.E. to M.G.C. of segment	ft
81-90	XMGC25	$\bar{X}_{.25c_i}$	Distance from c_T L.E. to .25 M.G.C. of segment	ft
91-100	XMGC50	$\bar{X}_{.50c_i}$	Distance from c_T L.E. to .50 M.G.C. of segment	ft
101-110	XMGC75	$\bar{X}_{.75c_i}$	Distance from c_T L.E. to .75 M.G.C. of segment	ft
111-120	XMGCTE	$\bar{X}_{TE_i}$	Distance from c_T L.E. to T.E. M.G.C. of segment	ft
121-130	YMEANC	$\bar{Y}_i$	Semi-span location of M.G.C. of segment	ft
131-140	ASPCT	AR_i	Aspect ratio of segment	-
141-150	TAPER	λ_i	Taper ratio of segment	-
151-160	TOVERC	t/c_i	Thickness to chord ratio of segment	-
161-170	XCENT	X_{c_i}	Planform area centroid station of segment	-
171	FINAR	AR	Panel aspect ratio (overall)	-
172	FINTPR	λ	Panel taper ratio (overall)	-
173	FINSPN	$b/2$	Panel exposed semi-span (overall)	ft
174	FINSF	S_p	Panel planform area (overall)	ft ²
175	FINWET	S_w	Panel wetted area (overall)	ft ²
176	TCEFF	$(t/c)_{eff}$	Panel effective t/c (overall)	-
177	FINXCG	X_{MGC}	Panel M.G.C. L.E. from root chord L.E.	ft
178	FINYCG	Y_{MGC}	Panel lateral M.G.C. position from C.L.	ft
179	SWAVLE	$\Lambda_{L.E.}$	Panel leading edge sweep, effective	deg
180	SWAV25	$\Lambda_{.25c}$	Panel c/4 sweep, effective	deg
181	SWAV50	$\Lambda_{.50c}$	Panel c/2 sweep, effective	deg
182	SWAV75	$\Lambda_{.75c}$	Panel 3c/4 sweep, effective	deg
183	SWAVTE	$\Lambda_{T.E.}$	Panel T.E. sweep, effective	deg
184	FINCBR	$\bar{C}$	Mean geometric chord	ft
185	DELTAY	Δy	Datcom parameter DY	-
186	DELTAD	δ_{LE}	Panel leading edge wedge angle	deg
187	XCENF	X_c	Panel area centroid from root chord L.E.	ft
188	XOVC	X/c	Axial position of section max thickness	-

Table 36 Finset 2 Geometry Data (Common Block GEOFS2)

DEFINITION OF COMMON BLOCK GEOFS2 (DUMP NAME F2GM , WRITE NAME GEOFS2)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-10	SPLANF	S_{pi}	Planform area of segment	ft ²
11-20	CBAR	$\bar{c}$	Mean geometric chord of segment	ft
21-30	SWEPL	$\Lambda_{L.E.i}$	Sweep angle at L . E . of segment	deg
31-40	SWEP25	$\Lambda_{.25c_i}$	Sweep angle at c/4 of segment	deg
41-50	SWEP50	$\Lambda_{.50c_i}$	Sweep angle at c/2 of segment	deg
51-60	SWEP75	$\Lambda_{.75c_i}$	Sweep angle at 3c/4 of segment	deg
61-70	SWEPTE	$\Lambda_{T.E.i}$	Sweep angle at T. E. of segment	deg
71-80	XMGCLE	$\bar{X}_{LE_i}$	Distance from c_r L.E. to M.G.C. of segment	ft
81-90	XMGC25	$\bar{X}_{.25c_i}$	Distance from c_r L.E. to .25 M.G.C. of segment	ft
91-100	XMGC50	$\bar{X}_{.50c_i}$	Distance from c_r L.E. to .50 M.G.C. of segment	ft
101-110	XMGC75	$\bar{X}_{.75c_i}$	Distance from c_r L.E. to .75 M.G.C. of segment	ft
111-120	XMGCTE	$\bar{X}_{TE_i}$	Distance from c_r L.E. to T.E. M.G.C. of segment	ft
121-130	YMEANC	$\bar{Y}_i$	Semi-span location of M.G.C. of segment	ft
131-140	ASPCT	AR_i	Aspect ratio of segment	-
141-150	TAPER	λ_i	Taper ratio of segment	-
151-160	TOVERC	t/c_i	Thickness to chord ratio of segment	-
161-170	XCENT	X_{c_i}	Planform area centroid station of segment	-
171	FINAR	AR	Panel aspect ratio (overall)	-
172	FINTPR	λ	Panel taper ratio (overall)	-
173	FINSPN	$b/2$	Panel exposed semi-span (overall)	ft
174	FINSF	S_p	Panel planform area (overall)	ft ²
175	FINWET	S_w	Panel wetted area (overall)	ft ²
176	TCEFF	$(t/c)_{eff}$	Panel effective t/c (overall)	-
177	FINXCG	X_{MGC}	Panel M.G.C. L.E. from root chord L.E.	ft
178	FINYCG	Y_{MGC}	Panel lateral M.G.C. position from C.L.	ft
179	SWAVLE	$\Lambda_{L.E.}$	Panel leading edge sweep, effective	deg
180	SWAV25	$\Lambda_{.25c}$	Panel c/4 sweep, effective	deg
181	SWAV50	$\Lambda_{.50c}$	Panel c/2 sweep, effective	deg
182	SWAV75	$\Lambda_{.75c}$	Panel 3c/4 sweep, effective	deg
183	SWAVTE	$\Lambda_{T.E.}$	Panel T.E. sweep, effective	deg
184	FINCBR	$\bar{c}$	Mean geometric chord	ft
185	DELTAY	Δy	Datcom parameter DY	-
186	DELTAD	δ_{LE}	Panel leading edge wedge angle	deg
187	XCENF	X_c	Panel area centroid from root chord L.E.	ft
188	XOVC	X/c	Axial position of section max thickness	-

Table 37 Finset 3 Geometry Data (Common Block GEOFS3)

DEFINITION OF COMMON BLOCK GEOFS3 (DUMP NAME F3GM , WRITE NAME GEOFS3)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-10	SPLANF	S_{pi}	Planform area of segment	ft ²
11-20	CBAR	$\bar{G}$	Mean geometric chord of segment	ft
21-30	SWEPL	$\Lambda_{L.E.i}$	Sweep angle at L . E . of segment	deg
31-40	SWEP25	$\Lambda_{.25c_i}$	Sweep angle at c/4 of segment	deg
41-50	SWEP50	$\Lambda_{.50c_i}$	Sweep angle at c/2 of segment	deg
51-60	SWEP75	$\Lambda_{.75c_i}$	Sweep angle at 3c/4 of segment	deg
61-70	SWEPTE	$\Lambda_{T.E.i}$	Sweep angle at T. E. of segment	deg
71-80	XMGCLE	$\bar{X}_{LE_i}$	Distance from c_r L.E. to M.G.C. of segment	ft
81-90	XMGC25	$\bar{X}_{.25c_i}$	Distance from c_r L.E. to .25 M.G.C. of segment	ft
91-100	XMGC50	$\bar{X}_{.50c_i}$	Distance from c_r L.E. to .50 M.G.C. of segment	ft
101-110	XMGC75	$\bar{X}_{.75c_i}$	Distance from c_r L.E. to .75 M.G.C. of segment	ft
111-120	XMGCTE	$\bar{X}_{TE_i}$	Distance from c_r L.E. to T.E. M.G.C. of segment	ft
121-130	YMEANC	$\bar{Y}_i$	Semi-span location of M.G.C. of segment	ft
131-140	ASPCT	AR_i	Aspect ratio of segment	-
141-150	TAPER	λ_i	Taper ratio of segment	-
151-160	TOVERC	t/c_i	Thickness to chord ratio of segment	-
161-170	XCENT	X_{c_i}	Planform area centroid station of segment	-
171	FINAR	AR	Panel aspect ratio (overall)	-
172	FINTPR	λ	Panel taper ratio (overall)	-
173	FINSPN	$b/2$	Panel exposed semi-span (overall)	ft
174	FINSP	S_p	Panel planform area (overall)	ft ²
175	FINWET	S_w	Panel wetted area (overall)	ft ²
176	TCEFF	$(t/c)_{eff}$	Panel effective t/c (overall)	-
177	FINXCG	X_{MGC}	Panel M.G.C. L.E. from root chord L.E.	ft
178	FINYCG	Y_{MGC}	Panel lateral M.G.C. position from C.L.	ft
179	SWAVLE	$\Lambda_{L.E.}$	Panel leading edge sweep, effective	deg
180	SWAV25	$\Lambda_{.25c}$	Panel c/4 sweep, effective	deg
181	SWAV50	$\Lambda_{.50c}$	Panel c/2 sweep, effective	deg
182	SWAV75	$\Lambda_{.75c}$	Panel 3c/4 sweep, effective	deg
183	SWAVTE	$\Lambda_{T.E.}$	Panel T.E. sweep, effective	deg
184	FINCBR	$\bar{C}$	Mean geometric chord	ft
185	DELTAY	Δy	Datcom parameter DY	-
186	DELTAD	δ_{LE}	Panel leading edge wedge angle	deg
187	XCENF	X_c	Panel area centroid from root chord L.E.	ft
188	XOVC	X/c	Axial position of section max thickness	-

Table 38 F.inset 4 Geometry Data (Common Block GEOFS4)

DEFINITION OF COMMON BLOCK GEOFS4 (DUMP NAME F4GM , WRITE NAME GEOFS4)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-10	SPLANF	S_{pi}	Planform area of segment	ft ²
11-20	CBAR	$\bar{C}$	Mean geometric chord of segment	ft
21-30	SWEPL	$\Lambda_{L.E.i}$	Sweep angle at L . E . of segment	deg
31-40	SWEP25	$\Lambda_{.25c_i}$	Sweep angle at c/4 of segment	deg
41-50	SWEP50	$\Lambda_{.50c_i}$	Sweep angle at c/2 of segment	deg
51-60	SWEP75	$\Lambda_{.75c_i}$	Sweep angle at 3c/4 of segment	deg
61-70	SWEPTE	$\Lambda_{T.E.i}$	Sweep angle at T. E. of segment	deg
71-80	XMGCLE	$\bar{X}_{LE_i}$	Distance from c_r L.E. to M.G.C. of segment	ft
81-90	XMGC25	$\bar{X}_{.25c_i}$	Distance from c_r L.E. to .25 M.G.C. of segment	ft
91-100	XMGC50	$\bar{X}_{.50c_i}$	Distance from c_r L.E. to .50 M.G.C. of segment	ft
101-110	XMGC75	$\bar{X}_{.75c_i}$	Distance from c_r L.E. to .75 M.G.C. of segment	ft
111-120	XMGCTE	$\bar{X}_{TE_i}$	Distance from c_r L.E. to T.E. M.G.C. of segment	ft
121-130	YMEANC	$\bar{Y}_i$	Semi-span location of M.G.C. of segment	ft
131-140	ASPCT	AR_i	Aspect ratio of segment	-
141-150	TAPER	λ_i	Taper ratio of segment	-
151-160	TOVERC	t/c_i	Thickness to chord ratio of segment	-
161-170	XCENT	X_{c_i}	Planform area centroid station of segment	-
171	FINAR	AR	Panel aspect ratio (overall)	-
172	FINTPR	λ	Panel taper ratio (overall)	-
173	FINSNP	$b/2$	Panel exposed semi-span (overall)	ft
174	FINSP	S_p	Panel planform area (overall)	ft ²
175	FINWET	S_w	Panel wetted area (overall)	ft ²
176	TCEFF	$(t/c)_{eff}$	Panel effective t/c (overall)	-
177	FINXCG	X_{MGC}	Panel M.G.C. L.E. from root chord L.E.	ft
178	FINYCG	Y_{MGC}	Panel lateral M.G.C. position from C.L.	ft
179	SWAVLE	$\Lambda_{L.E.}$	Panel leading edge sweep, effective	deg
180	SWAV25	$\Lambda_{.25c}$	Panel c/4 sweep, effective	deg
181	SWAV50	$\Lambda_{.50c}$	Panel c/2 sweep, effective	deg
182	SWAV75	$\Lambda_{.75c}$	Panel 3c/4 sweep, effective	deg
183	SWAVTE	$\Lambda_{T.E.}$	Panel T.E. sweep, effective	deg
184	FINCBR	$\bar{C}$	Mean geometric chord	ft
185	DELTAY	Δy	Datcom parameter DY	-
186	DELTAD	δ_{LE}	Panel leading edge wedge angle	deg
187	XCENF	X_c	Panel area centroid from root chord L.E.	ft
188	XOVC	X/c	Axial position of section max thickness	-

Table 39 Panel Incidence Data (Common Block INCID)

DEFINITION OF COMMON BLOCK <i>INCID</i> (DUMP NAME , WRITE NAME <i>INCID</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-8	DELTA1	δ_1	Panel deflections for fin set 1	deg
9-16	DELTA2	δ_2	Panel deflections for fin set 2	deg
17-24	DELTA3	δ_3	Panel deflections for fin set 3	deg
25-32	DELTA4	δ_4	Panel deflections for fin set 4	deg
33-36	XHINGE	X _{HL}	Station of panel hinge line for fin sets 1-4	ft
37-40	SKEW	Δ_{HL}	Hinge line skew for each panel, +aft	deg

Table 40 INLET Namelist Inputs (Common Block INLETN)

DEFINITION OF COMMON BLOCK INLETN (DUMP NAME INLI, WRITE NAME INLETN)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	NIN	ϕ	Number of inlets	-
2	INTYPE		Type of inlet 0 = 2 dimensional top mounted 1 = 2 dimensional side mounted 2 = axisymmetric	-
3	XINLT		Longitudinal distance from nose tip to inlet leading edge	ft
4	XDIV		Longitudinal distance from inlet leading edge to diverter leading edge	ft
5	HDIV		Height of diverter leading edge	ft
6	LDIV		Length of diverter	ft
7-26	PHI		Inlet roll orientations	deg
27-31	XI		Inlet longitudinal positions relative to inlet leading edge	ft
32-36	HI		Inlet heights at the longitudinal positions	ft
37-41	WI		Inlet widths at the longitudinal positions	ft
42	ICOVER		if .TRUE. Inlets are covered	-
43	RAMANG		External compression ramp angle	deg
44	IAD		if .TRUE. Inlet additive drag is calculated	-
45-64	MFR		Mass flow ratio for each Mach number	-

Table 41 Inlet Incremental Aerodynamics (Common Block INLTD)

DEFINITION OF COMMON BLOCK <i>INLTD</i> (DUMP NAME <i>INLD</i> , WRITE NAME <i>INLTD</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	CNINLT	C_{N_I}	Inlet increment for normal force coefficient	-
21-40	CMINLT	C_{m_I}	Inlet increment for pitching moment coefficient	-
41-60	CAINLT	C_{A_I}	Inlet increment for axial force coefficient	-
61-80	CYINLT	C_{Y_I}	Inlet increment for side force coefficient	-
81-100	CLNILT	C_{n_I}	Inlet increment for yawing moment coefficient	-

Table 42 Namelist Inputs Names (Common Block INPCON)

DEFINITION OF COMMON BLOCK <i>INPCON</i> (DUMP NAME , WRITE NAME <i>INPCON</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-11	LOC		Position of first letter for each name	-
12-22	LEN		Number of characters in each name	-
23-78	NLNAME		Namelist names valid as input	-

Table 43 Program Execution Logic Flags (Common Block LOGIC)

DEFINITION OF COMMON BLOCK LOGIC (DUMP NAME , WRITE NAME LOGIC)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	LDMPCS		Dump case flag	-
2	LDAMP		Dynamic derivatives flag	-
3	LBUILD		Configuration buildup flag	-
4	LNACA		NACA airfoil designation flag	-
5	LDERDG		Degree measure flag	-
6	LDERRD		Radian measure flag	-
7	LPART		Partial output flag	-
8	LNAME		Namelist print flag	-
9	LLOT		Plot flag	-
10	LFLT		\$FLTCON input flag	-
11	LREFQ		\$REFQ input flag	-
12	LAXIS		\$AXIBOD input flag	-
13	LFIN1		\$FINSET1 input flag	-
14	LFIN2		\$FINSET2 input flag	-
15	LFIN3		\$FINSET3 input flag	-
16	LFIN4		\$FINSET4 input flag	-
17	LDEFL		\$DEFLCT input flag	-
18	LTRIM		\$TRIM input flag	-
19	LDIMIN		Inches units flag	-
20	LDIMFT		Feet units flag	-
21	LDIMCM		Centimeters units flag	-
22	LDIMM		Meters units flag	-
23	LELLB		\$ELLBOD input flag	-
24	LINLET		\$INLET input flag	-
25	LEXPR		Experimental data input flag	-
26	LICRMT		Configuration incrementing flag	-
27	LSPIN		Body magnus coefficient flag	-
28	LARBOD		\$ARBOD input flag	-

NOTE: All flags are initially false. The flag is set if the array element is true.

Table 44 Partial Aerodynamic Coefficients (Common Block PAERO)

DEFINITION OF COMMON BLOCK PAERO (DUMP NAME , WRITE NAME PAERO)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-4	AKBW	$K_{B(W)}$	Wing carryover on body	-
5-8	AKWB	$K_{W(B)}$	Body carryover on wing	-
9-12	AKKBW	$k_{B(W)}$	Wing incidence carryover on body	-
13-16	AKKWB	$k_{W(B)}$	Body incidence carryover on wing	-
17-20	XCPBW	$X_{cpB(W)}$	Body c.p. in presence of wing	-
21-24	XCPWB	$X_{cpW(B)}$	Wing c.p. in presence of body	-
25-664	DAQ	$\Delta\alpha_{EQ}$	Change in equivalent angle of attack	rad
665-1304	WAQ	α_{EQ}	Equivalent angle of attack	rad
1305-1944	CNW	C_{N_W}	Wing along normal for coefficient	-
1945-2584	CLW	C_{l_W}	Wing alone rolling moment	-
2585-2664	CNWB	$C_{N_{W(B)}}$	Wing (body) normal force coefficient	-
2665-2744	CMWB	$C_{m_{W(B)}}$	Wing (body) pitching moment coefficient	-
2745-2824	CAWB	$C_{A_{W(B)}}$	Wing (body) axial force coefficient	-
2825-2904	CYWB	$C_{Y_{W(B)}}$	Wing (body) side force coefficient	-
2905-2984	CSNWB	$C_{n_{W(B)}}$	Wing (body) yawing moment coefficient	-
2985-3064	CSLWB	$C_{l_{W(B)}}$	Wing (body) rolling moment coefficient	-
3065-3144	CNBW	$C_{N_{B(W)}}$	Body (wing) normal force coefficient	-
3145-3224	CMBW	$C_{m_{B(W)}}$	Body (wing) pitching moment coefficient	-
3225-3304	CABW	$C_{A_{B(W)}}$	Body (wing) axial force coefficient	-
3305-3384	CYBW	$C_{Y_{B(W)}}$	Body (wing) side force coefficient	-
3385-3464	CSNBW	$C_{n_{B(W)}}$	Body (wing) yawing moment coefficient	-
3465-3544	CSLBW	$C_{l_{B(W)}}$	Body (wing) rolling moment coefficient	-
3545-3624	CN	C_N	Total normal force coefficient	-
3625-3704	CM	C_m	Total pitching moment coefficient	-
3705-3784	CA	C_A	Total axial force coefficient	-
3785-3864	CY	C_Y	Total side force coefficient	-
3865-3944	CSN	C_n	Total yawing moment coefficient	-
3945-4024	CSL	C_l	Total rolling moment coefficient	-

Table 45 REFQ Namelist Inputs (Common Block REFQN)

DEFINITION OF COMMON BLOCK <i>REFQN</i> (DUMP NAME <i>REFQ</i> , WRITE NAME <i>REFQN</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	SREF	S_{ref}	Reference area	ft ²
2	LREF	$(L_{ref})_{lon}$	Longitudinal reference length	ft
3	LATREF	$(L_{ref})_{lat}$	Lateral reference length	ft
4	ROUGH	h^*	Surface roughness height	in
5	XCG	$X_{C.G.}$	Longitudinal center of gravity	ft
6	ZCG	$Z_{C.G.}$	Vertical center of gravity	ft
7	SCALE		Vehicle scale factor	-
8	BLAYER		Boundary layer type 0. = turbulent 1. = natural transition	-
9	RHR		Surface roughness height rating [ROUGH = 3×10^{-6} (RHR)]	-

Table 46 Body and Finset 1 Ideal Output Matrix (I.O.M.) (Common Block SB1)

DEFINITION OF COMMON BLOCK SB1 (DUMP NAME SB1 , WRITE NAME SB1)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	CN1	C_N	Normal force vs. α	-
21-40	CM1	C_m	Pitching moment vs. α	-
41-60	CA1	C_A	Axial force vs. α	-
61-80	CY1	C_Y	Side force vs. α	-
81-100	CSN1	C_n	Yawing moment vs. α	-
101-120	CSL1	C_l	Rolling moment vs. α	-
121-140	CNA1	$C_{N\alpha}$	$C_{N\alpha}$ vs. α	1/deg
141-160	CMA1	$C_{m\alpha}$	$C_{m\alpha}$ vs. α	1/deg
161-180	CYB1	$C_{Y\beta}$	$C_{Y\beta}$ vs. α	1/deg
181-200	CLNB1	$C_{n\beta}$	$C_{n\beta}$ vs. α	1/deg
201-220	CLLB1	$C_{l\beta}$	$C_{l\beta}$ vs. α	1/deg

Table 47 Body and Finset 1,2 I.O.M. (Common Block SB12)

DEFINITION OF COMMON BLOCK SB12 (DUMP NAME SB12 , WRITE NAME SB12)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	CN12	C_N	Normal force vs. α	-
21-40	CM12	C_m	Pitching moment vs. α	-
41-60	CA12	C_A	Axial force vs. α	-
61-80	CY12	C_Y	Side force vs. α	-
81-100	CSN12	C_n	Yawing moment vs. α	-
101-120	CSL12	C_l	Rolling moment vs. α	-
121-140	CNA12	$C_{N\alpha}$	$C_{N\alpha}$ vs. α	1/deg
141-160	CMA12	$C_{m\alpha}$	$C_{m\alpha}$ vs. α	1/deg
161-180	CYB12	$C_{Y\beta}$	$C_{Y\beta}$ vs. α	1/deg
181-200	CLNB12	$C_{n\beta}$	$C_{n\beta}$ vs. α	1/deg
201-220	CLLB12	$C_{l\beta}$	$C_{l\beta}$ vs. α	1/deg

Table 48 Body and Finset 1,2,3 I.O.M. (Common Block SB123)

DEFINITION OF COMMON BLOCK SB123 (DUMP NAME SB13 , WRITE NAME SB123)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	CN13	C_N	Normal force vs. α	-
21-40	CM13	C_m	Pitching moment vs. α	-
41-60	CA13	C_A	Axial force vs. α	-
61-80	CY13	C_Y	Side force vs. α	-
81-100	CSN13	C_n	Yawing moment vs. α	-
101-120	CSL13	C_l	Rolling moment vs. α	-
121-140	CNA13	$C_{N\alpha}$	$C_{N\alpha}$ vs. α	1/deg
141-160	CMA13	$C_{m\alpha}$	$C_{m\alpha}$ vs. α	1/deg
161-180	CYB13	$C_{Y\beta}$	$C_{Y\beta}$ vs. α	1/deg
181-200	CLNB13	$C_{n\beta}$	$C_{n\beta}$ vs. α	1/deg
201-220	CLLB13	$C_{l\beta}$	$C_{l\beta}$ vs. α	1/deg

Table 49 Body and Finset 1,2,3,4 I.O.M. (Common Block SB1234)

DEFINITION OF COMMON BLOCK <i>SB1234</i> (DUMP NAME <i>SB14</i> , WRITE NAME <i>SB1234</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	CN14	C_N	Normal force vs. α	-
21-40	CM14	C_m	Pitching moment vs. α	-
41-60	CA14	C_A	Axial force vs. α	-
61-80	CY14	C_Y	Side force vs. α	-
81-100	CSN14	C_n	Yawing moment vs. α	-
101-120	CSL14	C_l	Rolling moment vs. α	-
121-140	CNA14	$C_{N\alpha}$	$C_{N\alpha}$ vs. α	1/deg
141-160	CMA14	$C_{m\alpha}$	$C_{m\alpha}$ vs. α	1/deg
161-180	CYB14	$C_{Y\beta}$	$C_{Y\beta}$ vs. α	1/deg
181-200	CLNB14	$C_{n\beta}$	$C_{n\beta}$ vs. α	1/deg
201-220	CLLB14	$C_{l\beta}$	$C_{l\beta}$ vs. α	1/deg

Table 50 Body I.O.M. (Common Block SBODY)

DEFINITION OF COMMON BLOCK <i>SBODY</i> (DUMP NAME <i>SBOD</i> , WRITE NAME <i>SBODY</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	CN	C_N	Normal force vs. α	-
21-40	CM	C_m	Pitching moment vs. α	-
41-60	CA	C_A	Axial force vs. α	-
61-80	CY	C_Y	Side force vs. α	-
81-100	CLN	C_n	Yawing moment vs. α	-
101-120	CLL	C_l	Rolling moment vs. α	-
121-140	CNA	$C_{N\alpha}$	$C_{N\alpha}$ vs. α	1/deg
141-160	CMA	$C_{m\alpha}$	$C_{m\alpha}$ vs. α	1/deg
161-180	CYB	$C_{Y\beta}$	$C_{Y\beta}$ vs. α	1/deg
181-200	CLNB	$C_{n\beta}$	$C_{n\beta}$ vs. α	1/deg
201-220	CLLB	$C_{l\beta}$	$C_{l\beta}$ vs. α	1/deg

Table 51 Finset 1 I.O.M. (Common Block SFIN1)

DEFINITION OF COMMON BLOCK <i>SFIN1</i> (DUMP NAME <i>SF1</i> , WRITE NAME <i>SFIN1</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	F1CN	C_N	Normal force vs. α	-
21-40	F1CM	C_m	Pitching moment vs. α	-
41-60	F1CA	C_A	Axial force vs. α	-
61-80	F1CY	C_Y	Side force vs. α	-
81-100	F1CLN	C_n	Yawing moment vs. α	-
101-120	F1CLL	C_l	Rolling moment vs. α	-
121-140	F1CNA	$C_{N\alpha}$	$C_{N\alpha}$ vs. α	1/deg
141-160	F1CMA	$C_{m\alpha}$	$C_{m\alpha}$ vs. α	1/deg
161-180	F1CYB	$C_{Y\beta}$	$C_{Y\beta}$ vs. α	1/deg
181-200	F1CLNB	$C_{n\beta}$	$C_{n\beta}$ vs. α	1/deg
201-220	F1CLLB	$C_{l\beta}$	$C_{l\beta}$ vs. α	1/deg

Table 52 Finset 2 I.O.M. (Common Block SFIN2)

DEFINITION OF COMMON BLOCK SFIN2 (DUMP NAME SF2 , WRITE NAME SFIN2)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	F2CN	C_N	Normal force vs. α	-
21-40	F2CM	C_m	Pitching moment vs. α	-
41-60	F2CA	C_A	Axial force vs. α	-
61-80	F2CY	C_Y	Side force vs. α	-
81-100	F2CLN	C_n	Yawing moment vs. α	-
101-120	F2CLL	C_l	Rolling moment vs. α	-
121-140	F2CNA	$C_{N\alpha}$	$C_{N\alpha}$ vs. α	1/deg
141-160	F2CMA	$C_{m\alpha}$	$C_{m\alpha}$ vs. α	1/deg
161-180	F2CYB	$C_{Y\beta}$	$C_{Y\beta}$ vs. α	1/deg
181-200	F2CLNB	$C_{n\beta}$	$C_{n\beta}$ vs. α	1/deg
201-220	F2CLLB	$C_{l\beta}$	$C_{l\beta}$ vs. α	1/deg

Table 53 Finset 3 I.O.M. (Common Block SFIN3)

DEFINITION OF COMMON BLOCK SFIN3 (DUMP NAME SF3 , WRITE NAME SFIN3)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	F3CN	C_N	Normal force vs. α	-
21-40	F3CM	C_m	Pitching moment vs. α	-
41-60	F3CA	C_A	Axial force vs. α	-
61-80	F3CY	C_Y	Side force vs. α	-
81-100	F3CLN	C_n	Yawing moment vs. α	-
101-120	F3CLL	C_l	Rolling moment vs. α	-
121-140	F3CNA	$C_{N\alpha}$	$C_{N\alpha}$ vs. α	1/deg
141-160	F3CMA	$C_{m\alpha}$	$C_{m\alpha}$ vs. α	1/deg
161-180	F3CYB	$C_{Y\beta}$	$C_{Y\beta}$ vs. α	1/deg
181-200	F3CLNB	$C_{n\beta}$	$C_{n\beta}$ vs. α	1/deg
201-220	F3CLLB	$C_{l\beta}$	$C_{l\beta}$ vs. α	1/deg

Table 54 Finset 4 I.O.M. (Common Block SFIN4)

DEFINITION OF COMMON BLOCK SFIN4 (DUMP NAME SF4 , WRITE NAME SFIN4)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	F4CN	C_N	Normal force vs. α	-
21-40	F4CM	C_m	Pitching moment vs. α	-
41-60	F4CA	C_A	Axial force vs. α	-
61-80	F4CY	C_Y	Side force vs. α	-
81-100	F4CLN	C_n	Yawing moment vs. α	-
101-120	F4CLL	C_l	Rolling moment vs. α	-
121-140	F4CNA	$C_{N\alpha}$	$C_{N\alpha}$ vs. α	1/deg
141-160	F4CMA	$C_{m\alpha}$	$C_{m\alpha}$ vs. α	1/deg
161-180	F4CYB	$C_{Y\beta}$	$C_{Y\beta}$ vs. α	1/deg
181-200	F4CLNB	$C_{n\beta}$	$C_{n\beta}$ vs. α	1/deg
201-220	F4CLLB	$C_{l\beta}$	$C_{l\beta}$ vs. α	1/deg

Table 55 Methodology Flags (Common Block THERY)

DEFINITION OF COMMON BLOCK <i>THERY</i> (DUMP NAME , WRITE NAME <i>THERY</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	LSOSE		.TRUE. if SOSE to be used	-
2	PRESUR		.TRUE. if pressure data to be output	-
3	LHYBRD		.TRUE. if Hybrid method to be used	-
4	LHYPER		.TRUE. if Newtonian theory to be used	-

Table 56 Configuration Total Attitude (Common Block TOTALC)

DEFINITION OF COMMON BLOCK <i>TOTALC</i> (DUMP NAME <i>FLCT</i> , WRITE NAME <i>TOTALC</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	BALPHA	α	Body axis angle of attack	deg
21-40	BBETA	β	Body axis sideslip angle	deg
41-60	BPHI	ϕ	Roll angle	deg
61-80	ALPTOT	α'	Total angle of attack	deg

Table 57 TRACE Subroutine Variables (Common Block TRACE)

DEFINITION OF COMMON BLOCK <i>TRACE</i> (DUMP NAME , WRITE NAME <i>TRACE</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1 2-21	LEVEL IROUTN		Program level Routine names by level (2 locations per name, 10 levels)	- -

Table 58 Trimmed Aerodynamic Data Arrays (Common Block TRIMD)

DEFINITION OF COMMON BLOCK <i>TRIMD</i> (DUMP NAME , WRITE NAME <i>TRIMD</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	DELTRM	δ_{TRIM}	δ_{TRIM} vs. α	deg
21-40	CNTRM	C_{NTRIM}	C_{NTRIM} vs. α	-
41-60	CATRM	C_{ATRM}	C_{ATRM} vs. α	-
61-80	CYTRM	C_{YTRIM}	C_{YTRIM} vs. α	-
81-100	CLNTRM	C_{nTRIM}	C_{nTRIM} vs. α	-
101-120	CLLTRM	C_{lTRIM}	C_{lTRIM} vs. α	-

Table 59 Trim Inputs (Common Block TRIMIN)

DEFINITION OF COMMON BLOCK <i>TRIMIN</i> (DUMP NAME , WRITE NAME <i>TRIMIN</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1	SET		Fin set for trimming	-
2	PANL1		.TRUE. if used for trim	-
3	PANL2		.TRUE. if used for trim	-
4	PANL3		.TRUE. if used for trim	-
5	PANL4		.TRUE. if used for trim	-
6	PANL5		.TRUE. if used for trim	-
7	PANL6		.TRUE. if used for trim	-
8	PANL7		.TRUE. if used for trim	-
9	PANL8		.TRUE. if used for trim	-
10	DELMIN	$\delta_{\min}$	Minimum deflection angle	deg
11	DELMAX	$\delta_{\max}$	Maximum deflection angle	deg
12-19	ASYM		.TRUE. if panel is deflected asymmetric (reverses sign convention)	-

Table 60 Untrimmed Aerodynamic Data Arrays (Common Block UTRIMD)

DEFINITION OF COMMON BLOCK <i>UTRIMD</i> (DUMP NAME , WRITE NAME <i>UTRIMD</i>)				
LOCATION	VARIABLE NAME	ENGINEERING SYMBOL	DEFINITION	UNITS
1-20	CN	C _N	C _N vs. α for δ_1	-
21-40			C _N vs. α for δ_2	-
41-60			C _N vs. α for δ_3	-
61-80			C _N vs. α for δ_4	-
81-100			C _N vs. α for δ_5	-
101-120			C _N vs. α for δ_6	-
121-140			C _N vs. α for δ_7	-
141-160			C _N vs. α for δ_8	-
161-180			C _N vs. α for δ_9	-
181-200			C _N vs. α for δ_{10}	-
201-400	CM	C _m	C _m vs. α, δ (see C _N pattern)	-
401-600	CA	C _A	C _A vs. α, δ (see C _N pattern)	-
601-800	CY	C _y	C _y vs. α, δ (see C _N pattern)	-
801-1000	CLN	C _n	C _n vs. α, δ (see C _N pattern)	-
1001-1200	CLL	C _l	C _l vs. α, δ (see C _N pattern)	-

A. EXAMPLE PROBLEMS

This appendix presents two example missile configurations that have been synthesized as Missile Datcom input files. These examples may be used as a model for the setup of inputs of similar configurations.

The first example is a simple tangent ogive nose-cylinder circular body. It has a planar wing (two panels) and a cruciform set of tails orientated in the "plus" configuration. There are two input cases for this problem. The first generates output consistent with the inclusion of the PART control card. The second creates trimmed output (note that trim partial output has been requested with the PRINT AERO TRIM control card).

The second problem is a body-tail-inlet configuration. Three Mach numbers are requested, one subsonic, one transonic, and one supersonic. Although all three Mach numbers could be run in a single case, they have been divided into three separate cases to illustrate the "SAVE" feature as well as selecting particular output for illustration.

A.1 EXAMPLE PROBLEM 1

The first example problem is shown in Figure A-1. It is comprised of a 3-caliber tangent ogive nose attached to a cylindrical body; a triangular monoplane set of wings; and a cruciform set of tails orientated in the "plus" position. The first case is a simple angle of attack sweep; component buildup data and partial output are requested. The second case is a trim of the configuration using the two horizontal tail surfaces. The inputs are shown in Figure A-2.

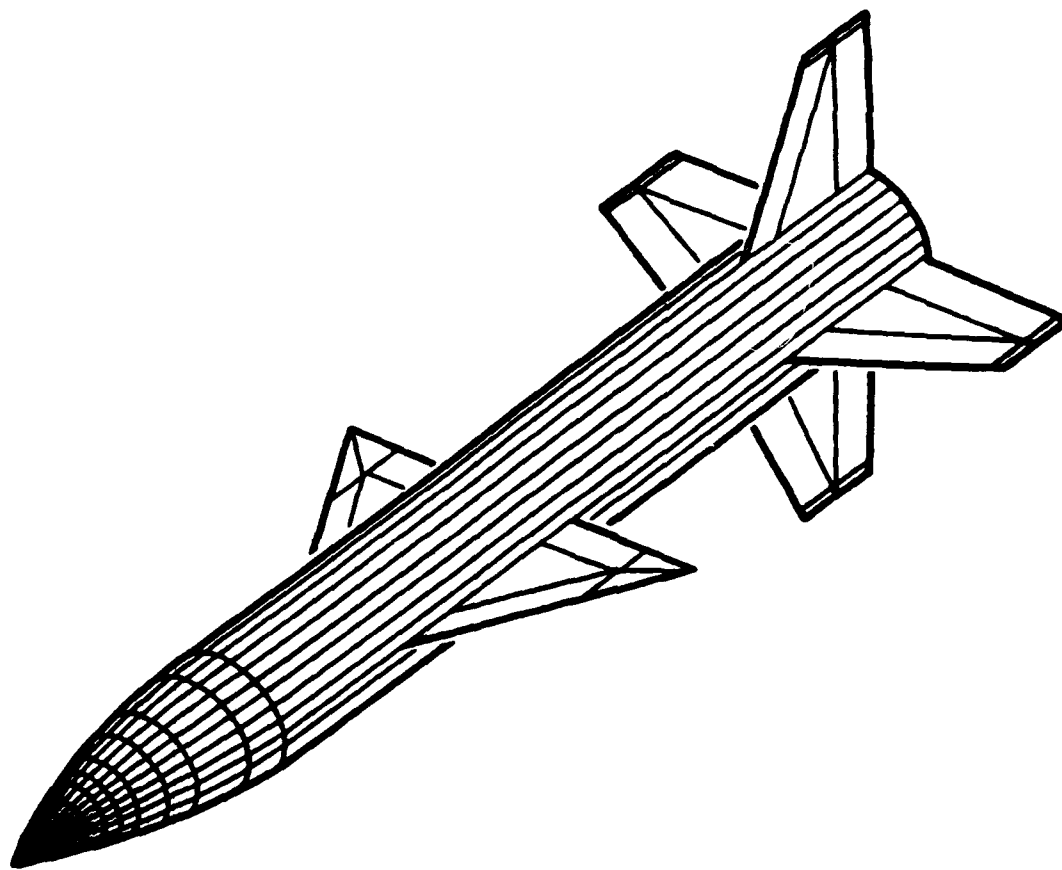


Figure A-1 Example Problem 1 Configuration

THE GRAY AUTOMATED MISSILE DATCOM * REV 4/91 *
AERODYNAMIC METHODS FOR MISSILE CONFIGURATIONS
CONTRL - INPUT ERROR CHECKING

ERROR CODES - N* DENOTES THE NUMBER OF OCCURRENCES OF EACH ERROR

- A - UNKNOWN VARIABLE NAME
- B - MISSING EQUAL SIGN FOLLOWING VARIABLE NAME
- C - NON-ARRAY VARIABLE HAS AN ARRAY ELEMENT DESIGNATION - (N)
- D - NON-ARRAY VARIABLE HAS MULTIPLE VALUES ASSIGNED
- E - ASSIGNED VALUES EXCEED ARRAY DIMENSION
- F - SYNTAX ERROR

***** INPUT DATA CARDS *****

```

1 CARBID PLANAAR WING, CRUCIFORM FUSEE TAIL CONFIGURATION
2 DIM IN
3 NO LAT
4 NOE
5 0FLTCOM WACCH=1., WACH=2.36, WED=3.026,
6 0FLTCOM WAFED=0., ALPED=0., 6., 8., 12., 16., 20., 24., 28., 0
7 0HEVQ XCG=18.75, 0
8 0AXICOD LCOB=11.25, DCOB=3.75, LCHST=26.25, 0
9 0TIMEST1 CROD=6.96, 0., 889AM=1.875, 5.355, XLB=15.42,
10 0HEVQ XCG=18.75, 0
11 0FLTCOM WACCH=1., WACH=2.36, WED=3.026,
12 0FLTCOM WAFED=0., ALPED=0., 6., 8., 12., 16., 20., 24., 28., 0
13 0TIMEST2 CROD=6.96, 0., 889AM=1.875, 5.355, XLB=15.42,
14 0HEVQ XCG=18.75, 0
15 0FLTCOM WACCH=1., WACH=2.36, WED=3.026,
16 0FLTCOM WAFED=0., ALPED=0., 6., 8., 12., 16., 20., 24., 28., 0
17 0HEVQ XCG=18.75, 0
18 0FLTCOM WACCH=1., WACH=2.36, WED=3.026,
19 0FLTCOM WAFED=0., ALPED=0., 6., 8., 12., 16., 20., 24., 28., 0
20 NEXT CASE
21 CARBID TAIL OF CASE NUMBER 1
22 0FLTCOM WACCH=1., WACH=2.36, WED=3.026,
23 0FLTCOM WAFED=0., ALPED=0., 6., 8., 12., 16., 20., 24., 28., 0
24 NEXT CASE

```

Figure A-2 Example Problem 1 Input

A.2 EXAMPLE PROBLEM 2

The configuration for this example is sketched in Figures A-3 and A-4. The figure is a modified copy of the wind tunnel model drawings from NASA Technical Memorandum 84557. The model definition in these figures is representative of the detail normally found on design drawings.

This example has been divided into subsonic, transonic, and supersonic cases. Each case is run for one Mach number. Although all three Mach numbers could have been run in one case they were run separately to demonstrate the SAVE capability.

This example provides a check case for the inlet option. It can be used by the user to make sure that he understands the inputs. Figure A-5 shows the inputs required to run this example.

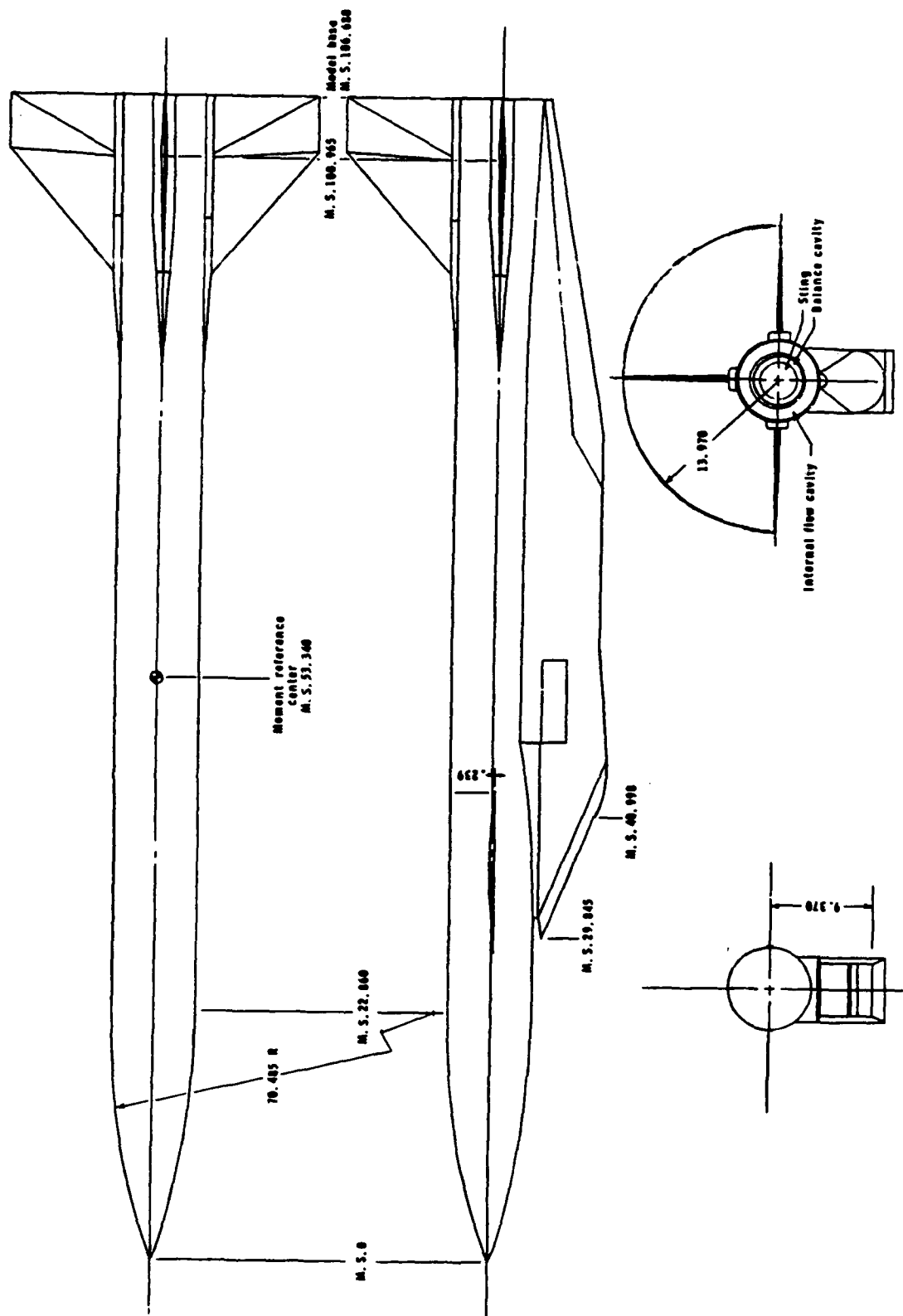
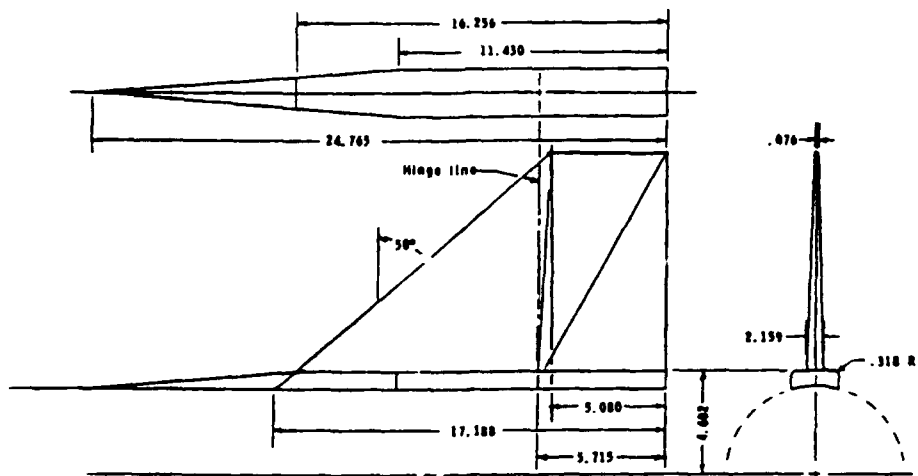
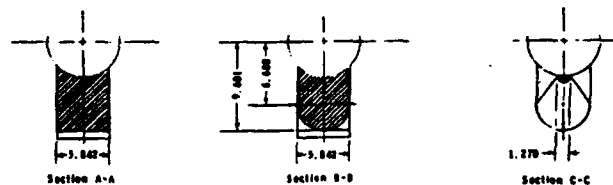
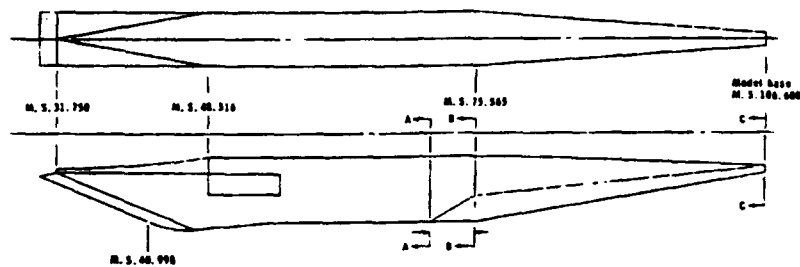


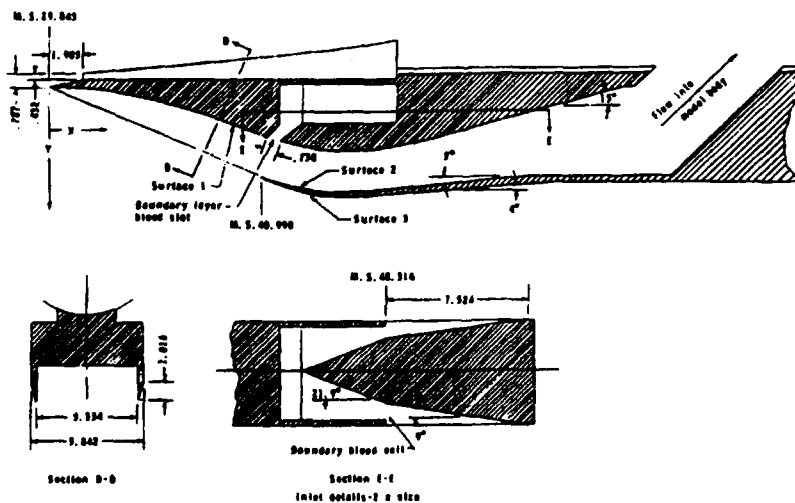
Figure A-3 Example Problem 2 Configuration



TAIL SURFACE DETAILS



INLET-FAIRING DETAILS



INLET DETAILS - 2X SIZE

Figure A-4 Example Problem 2 Tail/Inlet Details

♦♦ PARTICIPATING MEMBERS FOR NAME KEY

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22 * DEFINE INLET GEOMETRY
23 *
24 *
25 $INLET HIN=1.,XWTP2=2DTOP,XINLE=29.845,
26 XDIV=1.905,XDIV=16.566,MDIV=0.432,
27 PRI=180.,
28 X=0.,11.153,14.812,45.72,76.835,
29 W=5.334,5.842,5.842,5.842,5.842,
30 B=0.,5.128,5.359,5.359,0.635,
31 COVER=.FALSE.,RAMP=15.0,$
32 *
33 * OPTIONS
34 *
35 CASEID MISSILE DATCOM EXAMPLE PROBLEM - SUBSONIC
36 SOLE
37 DIM CN
38 PART
39 SAVE
40 NEXT CASE
41 *
42 * CASE TWO - TRANSONIC
43 *
44 DELETE FLTCOM
45 $FLTCOM MACH=1.,MACH=1.0,REP=6.5626,
46 RALPHA=5.,ALPHA=0.,5.,10.,20.,25.,$
47 *
48 * OPTIONS
49 *
50 CASEID MISSILE DATCOM EXAMPLE PROBLEM - TRANSONIC
51 PRINT AERO HINGE
52 PRINT AERO BEND
53 SAVE
54 NEXT CASE
55 *
56 * CASE THREE - SUPERSONIC
57 *
58 DELETE FLTCOM
59 $FLTCOM MACH=1.,MACH=3.95,REP=6.5626,
60 RALPHA=5.,ALPHA=0.,5.,10.,20.,25.,$
61 *
62 * OPTIONS
63 *
64 CASEID MISSILE DATCOM EXAMPLE PROBLEM - SUPERSONIC
65 PRESSURE
66 NEXT CASE

```

** SUBSTITUTING STANDARD FOR NAME 2DTOP

Figure A-5 Example Problem 2 Input (Continued)

B. PLOT FILE FORMAT

When the PLOT control card is used, a formatted data file is written to unit 3. The first line in the file will be the word MISDAT. Lines with the following format will be repeated for each run:

LINE	COLUMN	CONTENT
1	1-4	Word RUN
	5-7	For each case, a sequential run number beginning with one (1) and incrementing by one (1)
	8-10	Number of angles of attack
	11-14	word CASE
	15-17	A sequential run number beginning with one (1) and incrementing by one (1)
2	1-10	Mach Number
	11-22	Reynolds Number
	23-32	Aerodynamic roll angle, phi
	33-34	Units system: I-inches, F-feet, C-centimeters, M-meters
	35-41	I.D. Code (see below)
3	1-10	Reference Area
	11-20	Longitudinal Reference Length
	21-30	Longitudinal C.G. Location (X_{cg})
	31-40	Lateral Reference Length
	41-50	Vertical C.G. Location (Z_{cg})
4 (Repeated for each angle of attack)	1-10	Angle of Attack
	11-20	C_N or α TRIM
	21-30	C_m or C_N TRIM
	31-40	C_A or C_A TRIM
	41-50	C_Y or C_Y TRIM
	1-60	C_n or C_n TRIM
	1-70	C_l or C_l TRIM
LAST	1	Character R (denotes end of data for set)

The I.D. field identifies the configuration for which the data is applicable.

<u>I.D. Code</u>	<u>Configuration/Condition</u>
B	Body Alone
F1	Most forward fin set or fin set #1
F2	Second most forward fin set or fin set #2
F3	Third most forward fin set or fin set #3
F4	Fourth most forward fin set or fin set #4
BF1	Body plus most forward fin set
BF12	Body plus two most forward fin sets
BF13	Body plus three most forward fin sets
BF14	Body plus four most forward fin sets
TRIMMED	Trimmed results

Component buildup data is written to the file if the BUILD control card is used. If the TRIM control card is used, both the trimmed and untrimmed results are output. Otherwise, only the final configuration data is output. It is important to note that output via WRITE control cards is also written to unit 3.