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DEVELOPMENT OF AN EMPIRICALLY BASED COMPUTER PROGRAM TO PREDICT THE AERODYNAMIC CHARACTERISTICS OF AIRCRAFT VOLUME II. PROGRAM USER GUIDE

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General Dynamics

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13. ABSTRACT
This report (Volume II, Program User Guide) describes the computer program developed for the evaluation of the aerodynamic characteristics of large aircraft (bombers, tankers, and transports). The program calculates lift, moment, and drag characteristics of aircraft through the subsonic, transonic, and supersonic speed regimes, and includes the capability of calculating the effect of high-lift systems in both free air and in ground effect for landing and takeoff. The input to the computer program requires the configuration geometry and the aerodynamic conditions for which solutions are desired. The program includes the capability of analyzing both fixed-wing and variable-sweep-wing configurations as well as the aerodynamic characteristics of supercritical wing designs. Details of the methods, equations, and substantiating data for this program are contained in Volume I, Empirical Methods. Although this program was developed to handle the bomber, tanker, transport class of aircraft, it is also applicable to fighter type aircraft without maneuver devices.

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Volume II Program User Guide

R. T. SCHEMENSKY

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This report was prepared by the Convair Aerospace Division of General Dynamics Corporation, Fort Worth, Texas, for the Air Force Flight Dynamics Laboratory under Contract F33615-73-C-3043, Project 147601. The work reported here was performed in the period December 1972 through October 1973. This report was submitted by the author in October 1973.

The results of this work are documented in two volumes. Volume I presents the methodology developed in this study; Volume II contains the users manual for a computer program which automates these methods.

The work was accomplished under the direction of Mr. J. Kenneth Johnson of the Air Force Flight Dynamics Laboratory (FXM). The author wishes to acknowledge the valuable assistance of Mr. Eugene L. Crosthwait, Convair Aerospace Division, in the development of the empirical methods for the wing lift and wave drag characteristics.

This technical report has been reviewed and is approved.

Philip P. Antonatos
Chief, Flight Mechanics Division
Air Force Flight Dynamics Laboratory

TABLE OF CONTENTS

		Page
1.	COMPUTER PROGRAM DESCRIPTION	1
2.	PROGRAM INPUT	5
3.	SAMPLE PROBLEMS	32
4.	PROGRAM AND SUBROUTINE DESCRIPTIONS	57
5.	PROGRAM LISTING	89

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1. COMPUTER PROGRAM DESCRIPTION

The Large Aircraft Aerodynamic Prediction Program has been coded in Fortran Extended Version 3.0 to operate on the CDC 6600 computer facility at W-PAFB. This program is also operational on the General Dynamics CDC 6600 computer (procedure code R1T).

The main program controls the calling of three primary overlay programs XINPT, GEOM, and SURVEY. In turn, XINPT calls two secondary overlay programs INPT and NINPT; while SURVEY calls four secondary overlay programs VGEOM, MCRIT, AERO, and LSHL. These programs bring the desired subroutines into the core and direct the calling of the subroutines to make the necessary computations. Figure 1 shows the overlay structure and the subroutines called from these programs.

Card input occurs on file name TAPE5 and data output occurs on file name TAPE6.

The deck structure for a run consists of a job card, system control cards, end-of-record card, binary object decks, end-of-record card, problem data deck, end-of-file card. The structure of the binary object decks and overlay control cards are listed in Table I. The problem data deck is described in the Program Input Section.

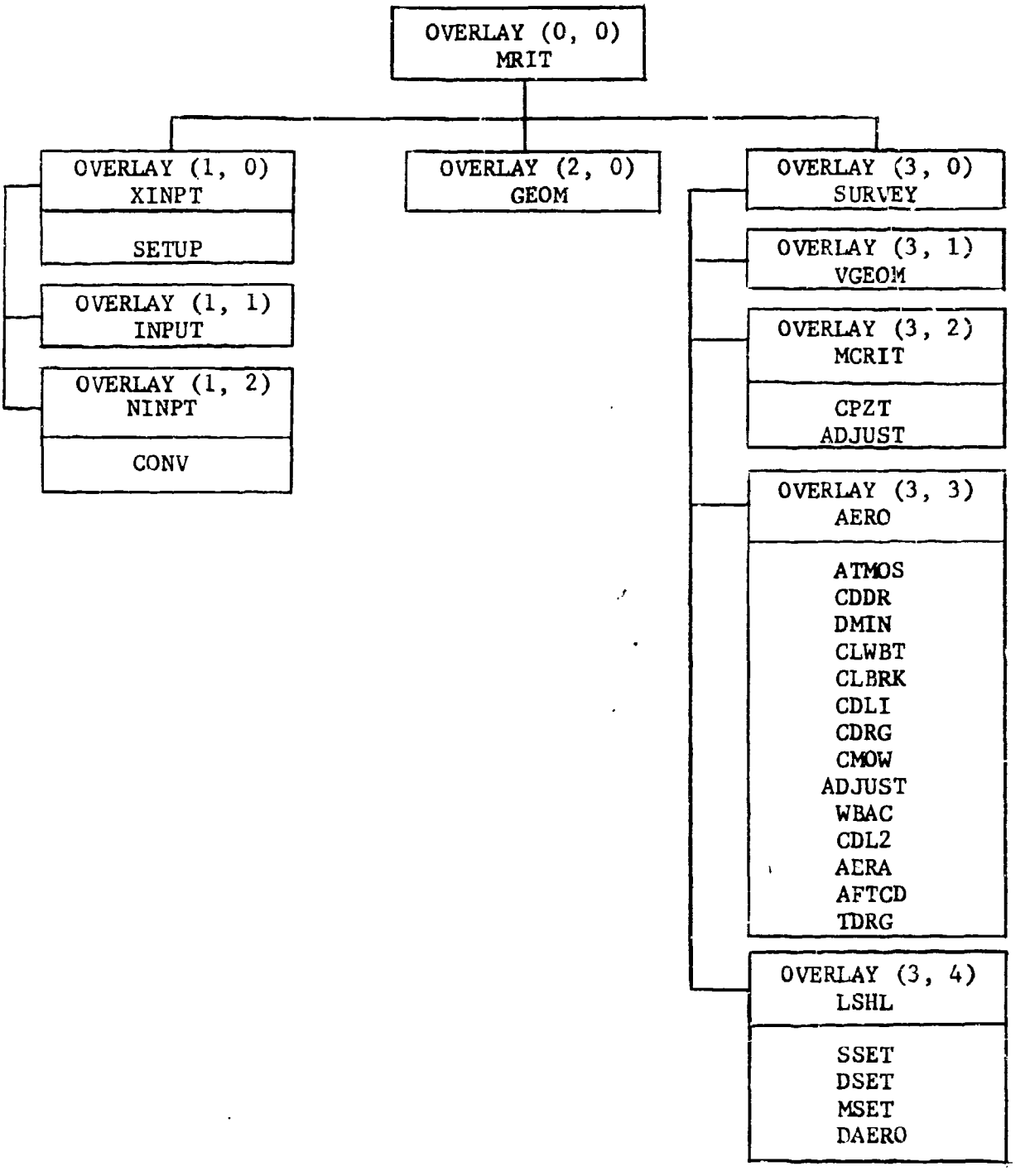


Figure 1 PROGRAM OVERLAY STRUCTURE

Table 1
DECK STRUCTURE FOR OVERLAYS

```
OVERLAY (OULY, 0, 0)
    PROGRAM MRIT
        SUBROUTINE LNTP
        FUNCTION DLNT
        SUBROUTINE TLNT

OVERLAY (1, 0)
    PROGRAM XINPT
        SUBROUTINE SETUP

OVERLAY (1, 1)
    PROGRAM INPT
OVERLAY (1, 2)
    PROGRAM NINPT
        SUBROUTINE CONV

OVERLAY (2, 0)
    PROGRAM GEOM

OVERLAY (3, 0)
    PROGRAM SURVEY
        SUBROUTINE ADJUST
        BLOCK DATA

OVERLAY (3, 1)
    PROGRAM VGEOM

OVERLAY (3, 2)
    PROGRAM MCRIT
        SUBROUTINE CPZT
                   SECT
                   CPUOV

OVERLAY (3, 3)
    PROGRAM AERO
        SUBROUTINE CDDR
                   CLWBT
                   AER2
                   TAIL
                   AALO
                   CLBRK
                   CDL1
                   ADCL
                   KGIN
```

Table 1 (Cont'd)

```
        SUBROUTINE CDL2
                   AERA
                   AFTCD
                   TDRG
                   DMIN
                   FDRG
                   CFEQ
                   FFACT
                   IFACT
                   WDRG
                   CDWN
                   CDWT
                   CDRG
                   BDRG
                   CMOW
                   WBAC
                   ACCR
                   ATMOS
                   PLSQ
                   MTXEQ

OVERLAY (3, 4)
    PROGRAM LSHL
        SUBROUTINE SSET
                   DSET
                   MSET
                   DAERO
```

2. PROGRAM INPUT

The input to this program is described in the following section. Three data types are specified in the card descriptions. Type A indicates that alphabetic or numeric characters should be entered. Type I indicates integers which should be right-adjusted within the specified columns with no decimal point. Type F indicates a real number and may be tabulated anywhere within the specified columns and should include a decimal point. The program input is illustrated by the sample cases in the Sample Problem Section.

Card 1 - Title - Enter any alphanumeric characters to identify each problem. This data is printed out at the top of each aerodynamic survey problem. Columns 1-66.

Card 2 KPRINT(I), Printout Option Indicators - Setting a given KPRINT indicator to 1 causes the program to print out certain types of data. Columns 1-27. KPRINT(11) through (27) are used for diagnostic purposes to dump data generated in various subroutines and are not intended to be used for normal computer runs.

KRPINT and Column No.	Print Out
1	Airfoil ordinates and pressure distribution
2 - 10	Not used
11	Dump Subroutine AER2
12	. GEOM
13	. AALO
14	. CDL2
15	BDRG
16	CLBRK
17	AERA
18	WBAC
19	CFEQ
20	CDWW
21	TAIL
22	CDL1
23	CDDR
24	ADJUST
25	CMOW
26	CPZT
27	Dump Subroutine SSET

Card 3 - Input Control Card - Write "FORMAT" or "NAMELIST" beginning in Column 1 if format or namelist input option is desired.

Cards 4, 5, ..., 27 - Configuration Definition Cards, Format Input Option (For NAMELIST input option go to card 43)

The aircraft geometry is represented as a series of bodies for the fuselage, canopy, and stores; open-nosed bodies for the nacelles; and a series of airfoil surfaces for the wing, tail surfaces, pylon and ventral fins. For cranked or complex wing planforms, the wing is represented as a series of surface panels. Figures 2 through 7 illustrate many of the geometric parameters which are used to define an aircraft configuration. In the

input to the program, those parameters that are marked with an asterisk (*) indicate that if zero or blank is entered the program will calculate that parameter using the available geometric data; otherwise the input value will be used.

Card 4 (Required, all Type I)

Column	Symbol	Definition
4-5	NBODYS	Total number of body types used to represent the configuration
9-10	NNACS	Total number of nacelle types used to represent the configuration
14-15	NSURFS	Total number of airfoil surfaces used to represent the configuration
20	NHT	Enter 1 if a horizontal tail is present
25	NVT	Enter 1 if a single vertical tail is present, 2 for a twin vertical tail
30	ISWP	Variable sweep indicator 0 fixed wing geometry 1 variable sweep wing
34-35	NPNLS	Number of wing panels used to represent the wing surface (≤ 10)
40	IHLS	Enter 1 or 2 if geometry for the high-lift system is to be input. Enter 1 for single high-lift system, enter 2 if the high-lift system is defined by two segments (see Figure 6)
45	IREF	Angle of attack reference indicator 0 referenced to wing root chord plane 1 referenced to fuselage centerline

Card 5 (Required, all Type F)

Column	Symbol	Definition
1-10	SREF	Reference area (ft^2)
11-20	*CMAC	Wing mean aerodynamic chord (in.)
21-30	*XCG	Fuselage station for moment reference point (in.). If zero is input the program will use the quarter-chord of the wing MAC.
31-40	ZCG	Height of moment reference point relative to wing root chord plane
41-50	ROUGHK	Surface roughness height for friction drag (in.)
51-60	FMISC	Miscellaneous drag factor as a percentage of total friction and form drag

Card 6 (Required if NBODYS > 0, all Type F)

1-10	BLEN(I)	Body length (in.)
11-20	BWID(I)	Body width (in.)
21-30	BHGT(I)	Body height (in.)
31-40	*BAWET(I)	Body wetted area (ft^2)
41-50	BQ(I)	Interference factor
51-60	BNO(I)	Number of bodies of this type

Card 7 (Required if NBODYS > 0, all Type F)

1-10	*BAMX(I)	Body maximum cross-sectional area (in^2)
11-20	BABS(I)	Body base area (in^2)
21-30	BLNS(I)	Nose length (in.)
31-40	BLBT(I)	Boattail length (in.)

Card 7 (Continued)

Column	Symbol	Definition
41-50	BASE(I)	Base drag area (in^2)
51-60	BFUS	Aft fuselage upsweep angle (deg.)
61-66	AB	Ratio of aft fuselage width to height in the upswept region

Repeat cards 6 and 7 for I=1 to NBODYS. Note the BFUS and AB are only entered for I=1 which corresponds to the fuselage input.

Card 8 (Required if NNACS > 0, all Type F)

1-10	ELEN(I)	Nacelle length (in.)
11-20	EWID(I)	Nacelle width (in.)
21-30	EHGT(I)	Nacelle height (in.)
31-40	*EAWET(I)	Total wetted area (ft^2)
41-50	EQF(I)	Interference factor
51-60	ENO(I)	Number of nacelles of this type

Card 9 (Required if NNACS > 0, all Type F)

1-10	*EAMX(I)	Nacelle maximum cross-sectional area (in^2)
11-20	EIN(I)	Nacelle inlet area (in^2)
21-30	EXIT(I)	Nacelle exit area (in^2)
31-40	ELNS(I)	Nose length (in.)
41-50	ELBT(I)	Boattail length (in.)

Repeat cards 8 and 9 for I=1 to NNACS.

Card 10 (Required only if NPNLS=1, otherwise go to card 13, all Type F)

Column	Symbol	Definition
1-10	AR	Aspect ratio
11-20	TAPR	Taper ratio
21-30	SWPLE	Leading-edge sweep (deg.)
31-40	SPLAN	Wing planform area (ft^2)
41-50	TWIST	Wing twist (deg.) negative for washout
51-60	WINC	Wing incidence (deg.) relative to fuselage centerline

Card 11 (NPNLS=1, all Type F except as noted)

1-10	TW (Type A)	Type wing section (begin in Col. 1) 64-210 (example 6-series) 00XX-64 (example 4-digit) SUPERCRIT (example supercritical) BICONVEX (example biconvex)
11-20	CAM(1)	Wing camber design C_L (decimal value)
21-30	TOC(1)	Wing thickness (decimal value)
31-40	XLEW	X-position of point on wing leading edge (in.)
41-50	YWW	Y-position of point on wing leading edge (in.)
51-60	YB	Y-distance of intersection of wing with fuselage (in.)

Card 12 (NPNLS=1, all Type F)

1-10	SWMT	Maximum thickness sweep (deg.)
11-20	*CBAR(1)	Exposed wing mean aerodynamic chord (in.)

Card 12 (Continued)

Column	Symbol	Definition
21-30	*AWET(1)	Wetted area (ft^2)
31-40	CONCL	Wing conical camber design C_L

Skip to card 17 after card 12.

Card 13 (NPNLS > 1, all Type F)

1-10	SPLAN	Planform area (ft^2). For fixed wing configurations if zero is input the program will calculate the theoretical planform area by extending the wing panel geometry that is input to the fuselage centerline. For variable sweep configurations the planform area of the movable panel extended to the centerline must be input. For wings with a highly swept inboard strake, the value of the theoretical planform area of the wing, ignoring the strake, should be input.
11-20	TAPR	Taper ratio of wing planform (required input for variable sweep)
21-30	SWPLE	Leading-edge sweep (deg.) of wing planform. (Required input for variable sweep)

Card 14 (NPNLS > 1, all Type F except as noted)

1-10	TW (Type A)	Type wing section
11-20	TWIST	Wing twist (deg.) negative for washout
21-30	WINC	Wing incidence (deg.)
31-40	SWMT	Average maximum thickness sweep for the entire wing planform (deg.)
41-50	CONCL	Wing conical camber design C_L

Card 15 (NPNLS > 1, all Type F)

Column	Symbol	Definition
1-10	CAM(I)	Panel camber design C_L
11-20	TOC(I)	Panel thickness ratio
21-30	XLE(I)	Inboard X-position of panel leading edge (in.)
31-40	YW(I)	Inboard Y-position of panel leading edge (in.)
41-50	CRW(I)	Inboard chord length of panel (in.)
51-60	*CBAR(I)	Panel mean aerodynamic chord length (in.)
61-66	*AWET(I)	Panel wetted area (ft^2)

Repeat card 15 for I=1 to NPNLS

Card 16 (NPNLS > 1, all Type F)

1-10	XLE(NPNLS+1)	Outboard X-position of last panel's leading edge (in.)
11-20	YW(NPNLS+1)	Outboard Y-position of last panel's leading edge (in.)
21-30	CRW(NPNLS+1)	Outboard chord length of panel (in.)

Card 17 (TW = "SUPERCRIT", all Type F)

1-10	XMU	x/c position of maximum thickness on upper surface
11-20	ZMU	upper surface thickness (Zu/c)
21-30	XML	x/c position of maximum thickness on lower surface
31-40	ZML	Lower surface thickness (must be input as a negative value)

Card 17 (Continued)

Column	Symbol	Definition
41-50	ZPTE	Trailing edge slope (deg.)
51-60	ZTHICK	Thickness at trailing edge

Card 18 (ISWP=1, all Type F)

1-10	XPIVOT	X-location of wing pivot (in.)
11-20	YPIVOT	Y-location of wing pivot (in.)
21-30	XAPEX	X-location of centerline apex of movable panel (in.)
31-40	AFTSW	Maximum aft sweep (deg.)
41-50	*AFTCB	Mean aerodynamic chord of movable panel in aft sweep position (in.)
51-60	*AFTOC	Thickness ratio of movable panel in aft sweep position
61-66	*AFTAW	Wetted area of movable panel in aft sweep position

Card 19 (NSURFS $\geq$ 2, all Type F except as noted) Enter horizontal tail geometry first, then vertical tail followed by any additional airfoil surfaces.

1-10	TS(I) (Type A)	Type airfoil surface
11-20	SCAM(I)	Surface camber design C_L
21-30	STOC(I)	Thickness ratio
31-40	SMTSW(I)	Maximum thickness sweep (deg.)
41-50	SHF(I)	Hinge factor or interference factor

Card 20 (NSURFS $\geq$ 2, all Type F)

1-10	SWL(I)	Surface leading-edge sweep (deg.)
11-20	SWT(I)	Trailing-edge sweep (deg.)

Card 20 (Continued)

Column	Symbol	Definition
21-30	STAPR(I)	Taper ratio
31-40	SCR(I)	Exposed root chord (in.)
41-50	*SBAR(I)	Exposed mean aerodynamic chord (in.)
51-60	*SAWET(I)	Wetted area (ft^2)

Card 21 (NSURFS $\geq$ 2, NHT=1, all Type F)

1-10	HTLE	X-location of horizontal tail exposed root chord (in.)
11-20	HTY	Y-location of exposed root chord (in.)
21-30	HTZ	Z-location relative to wing chord plane of horizontal tail (in.)
31-40	HTINC	Incidence of horizontal tail (deg.)

Repeat cards 19 and 20 for I=2 to NSURFS.

Card 22 (NPNLS $\geq$ 3, all Type F) Since the aerodynamic center calculation is restricted to one or two panel wings, an equivalent two-panel wing must be defined for moment calculation whenever 3 or more panels are used to define the main wing.

1-10	CLE(1)	X-location of leading edge at inboard span station of inboard panel (in.)
11-20	YC(1)	Y-location of leading edge at inboard span station of inboard panel (in.)
21-30	CCR(1)	Chord length of inboard panel at inboard span station (in.)
31-40	CLE(2)	X-location of leading edge at inboard span station of outboard panel (in.)
41-50	YC(2)	Y-location of leading edge at inboard span station of outboard panel (in.)
51-60	CCR(2)	Chord length of outboard panel at inboard span station (in.)

Card 23 (NPNLS $\geq$ 3, all Type F)

Column	Symbol	Definition
1-10	CLE(3)	X-location of leading edge at outboard span station of outboard panel (in.)
11-20	YC(3)	Y-location of leading edge at outboard span station of outboard panel (in.)
21-30	CCR(3)	Chord length of outboard panel at outboard span station (in.)

Card 24 (Required if IHLS > 0, otherwise go to card 30)

1-20	FLAP (Type A)	Type flap (begin in Col. 1) PLAIN FLAP S.S. FLAP (single slotted) D.S. FLAP (double slotted) T.S. FLAP (triple slotted) INPUT (user defined)
21-40	SLAT (Type A)	Type slat (begin in Col. 21) L.E. FLAP KRUGER SLAT SLAT (slotted type) INPUT
41-45	NF (Type I)	If flap type was "INPUT" indicate number of flap sectional data points to be entered, NF $\leq$ 5.
46-50	NS (Type I)	If slat type was "INPUT" indicate number of slat sectional data points to be entered, NS $\leq$ 5.

Card 25 (IHLS > 0, all Type F)

1-10	BF1I	Inboard span station of first flap segment
11-20	BF1O	Outboard span station of first flap segment
21-30	CF1(1)	Flap chord to wing chord ratio of first flap segment

Card 25 (Continued)

Column	Symbol	Definition
31-40	BS1I	Inboard span station of first slat segment
41-50	BS1O	Outboard span station of first slat segment
51-60	CS1	Slat chord to wing chord ratio of first slat segment

Card 26 (IHLS=2, all Type F)

1-10	BF2I	Inboard span station of second flap segment
11-20	BF2O	Outboard span station of second flap segment
21-30	CF2(1)	Flap chord ratio of second flap segment
31-40	BS2I	Inboard span station of second slat segment
41-50	BS2O	Outboard span station of second slat segment
51-60	CS2	Slat chord ratio

Card 27 (FLAP = "D.S." or "T.S.", all Type F) For double-slotted flaps (or triple-slotted) the additional flap chord ratios are then read in.

1-10	CF1(2)	Second flap chord of first flap segment for double- or triple-slotted flap
11-20	CF1(3)	Third flap chord of first flap segment for triple-slotted flap
21-30	CF2(2)	Second flap chord of second flap segment for double- or triple-slotted flap
31-40	CF2(3)	Third flap chord of second flap segment for triple-slotted flap

Card 28 (Required if "INPUT" was used for flap type on card 29, all Type F)

Flap Section Data

Column	Symbol	Definition
1-10	DF(I)	Flap deflection (deg.)
11-20	CFOC(I)	Wing chord to wing chord ratio in extended position
21-30	DCLOF(I)	Change in lift at zero angle of attack due to flap deflection
31-40	DCLMF(I)	Change in maximum lift due to flap deflection
41-50	DCDF(I)	Change in profile drag due to flap deflection
51-60	DCMOF	Change in moment at zero angle of attack due to flap deflection

Repeat card 28 for I=1 to NF.

Card 29 (Required if "INPUT" was used for slat type on card 29, all Type F)

1-10	DS(I)	Slat deflection (deg.)
11-20	CSOC(I)	Wing chord to wing chord ratio in extended position
21-30	DCLOS(I)	Change in lift at zero angle of attack due to slat deflection
31-40	DCLMS(I)	Change in maximum lift due to slat deflection
41-50	DCDS(I)	Change in profile drag due to slat deflection
51-60	DCMOS(I)	Change in moment at zero angle of attack due to slat deflection

Repeat card 29 for I=1 to NS.

Cards 30, 31, 32, and 33 - Problem Control Cards

Card 30 (Required, all Type I)

Column	Symbol	Definition
4-5	NSURV	Number of high speed lift, drag, moment surveys to be run (NSURV $\leq$ 20)
10	NHLSV	Number of low speed, high lift survey conditions to be run (NHLSV $\leq$ 5)
14-15	NCLAS	Number of evenly spaced C_L values in the high speed survey
21	IT(1)	Transition location indicator, 1st survey
22	IT(2)	Transition location indicator, 2nd survey
⋮	⋮	⋮
40	IT(20)	Transition location indicator, 20th survey

For the ith survey condition, set IT=0 or blank if the flow is to be fully turbulent on all aircraft components, otherwise, set IT equal to the transition pattern number defined by the card 32 input.

41	ITRM(1)	Trim indicator, 1st survey
42	ITRM(2)	Trim indicator, 2nd survey
⋮	⋮	⋮
60	ITRM(20)	Trim indicator, 20th survey

For the ith survey condition, set ITRM=0 or blank if the horizontal tail is fixed, set ITRM=1 if the horizontal tail will vary to trim out the moment.

Card 31 (NSURV > 0, all Type F)

Column	Symbol	Definition
1-10	FMSURV(I)	Mach number for the survey condition
11-20	ALT(I)	Altitude for the survey condition. Reynolds number can be input here instead of altitude by inputing a negative value of RN/ft multiplied by 10^6
21-30	DHSV(I)	Horizontal tail setting (If ITRM(I)=1, the program will calculate the tail setting)
31-40	SWPV(I)	Leading-edge sweep angle (deg.) (Required input only for variable-sweep configurations)
41-50	CLLO(I)	Low C_L value for the survey condition
51-60	CLHI(I)	High C_L value for the survey condition

Repeat card 31 for each survey condition, I=1, NSURV.

Card 32 (IT≠0, 6F10.0 Format)

Each survey has a transition indicator assigned to it. If IT≠0 for any survey, a boundary-layer transition pattern must be defined for each component of the aircraft. Up to five different transition patterns can be used in the surveys. Each transition pattern is numbered sequentially by the order it is input beginning with J=1 for the first transition pattern.

Transition location on a component is indicated by inputing the fraction of the component length where transition occurs.

TRB(J,K1)	Transition location on body K1 (K1 = 1, NBODYS)
TRN(J,K2)	Transition location on nacelle K2 (K2 = 1, NNACS)

Card 32 (Continued)

Column	Symbol	Definition
	TRU(J,K3)	Transition location on upper surface of panel K3 (K3 = 1, NPNLS)
	TRL(J,K3)	Transition location on lower surface of panel K3
	TRS(J,K4)	Transition location on upper and lower surface of airfoil surface K4 (K4 = 2, NSURFS)

For each transition pattern J, first input the body transition location followed in turn by all the nacelle, wing panel, and airfoil surface transition locations. Repeat Card 32 input for each transition pattern J=1, to J_{MAX} where J_{MAX} = maximum value of IT(I=1, 20).

Card 33 (NHLSV > 0, all Type F)

1-10	DFI(1,I)	Flap deflection (deg.) of first flap element
11-20	CPF(I)	Wing chord with flap extended to wing chord with flap retracted ratio
21-30	DSI(I)	Slat deflection (deg.)
31-40	CPS(I)	Wing chord with slat extended to clean wing chord ratio
41-50	DELCD(I)	Landing gear drag
51-60	H(I)	Height of wing $\bar{c}/4$ above ground (ft.)

"PLAIN", "S.S.", or "INPUT" trailing-edge-flap types are single-element flaps. If FLAP = "D.S." or "T.S.", the deflection of each flap element must be input beginning with DFI(1,I) in Columns 1-10, DFI(2,I) in Columns 11-20 and for "T.S." flaps DFI(3,I) in Columns 21-30. The data for CPF(I), CPS(I), etc. are then shifted to the right on the card.

Repeat card 33 for I=1, to NHLSV.

Card 34 - Format Input Control Card - Write "ADJUST" beginning in Column 1 to indicate if adjustment factors are to be applied to some of the aerodynamic parameters predicted by the program. If no adjustment factors are to be read in, write "END OF INPUT" beginning in Column 1 to indicate that all Configuration Definition and Problem Control Cards have been read in and go to card 41.

Cards 35 through 39 - Adjustment Option Cards - The adjustment option allows certain predicted items in the computer procedure to be adjusted to match a desired value. Thus, the predictions can be adjusted to match wind tunnel data, for instance, so that perturbations in geometry for trade studies can be predicted from a firm baseline. An aerodynamic parameter of interest (A_{PRED}) can be adjusted to match an experimental value (A_{EXP}) by the equation

$$A_{EXP} = (A_{PRED}) \cdot YM + YA$$

where YM and YA are input correlation multiplier and adder that are a function of Mach number or lift coefficient.

Card 35 (Type I) Set a given IVAL indicator equal to a non-zero value to identify it as being an aerodynamic parameter to be adjusted. Begin with IVAL=1 for the first parameter to be identified, IVAL=2 for the second parameter, etc.

Column	Symbol	Definition
1	IVAL(1)	Adjust C_{M_O} as a function of Mach number
2	IVAL(2)	Adjust $C_{D_{MISC}}$ as a function of Mach number
3	IVAL(3)	Adjust α_{LO} as a function of Mach number
4	IVAL(4)	Adjust M_{CR} as a function of lift coefficient
24-25	NXVAR	Number of Mach values in the table of Mach function adjust factors (≤ 15)
29-30	NADJ	Number of parameters to be adjusted as a function of Mach number
34-35	NXCL	Number of C_L values in the table of lift function adjust factors (≤ 15)
39-40	NADJ2	Set equal to 1 if M_{CR} is to be adjusted

Card 36 (NXVAR > 0, all Type F)

Column	Symbol	Definition
1-10	X(1)	Mach numbers for the table of Mach function adjust factors
11-20	X(2)	
21-30	X(3)	
31-40	X(4)	
41-50	X(5)	
51-60	X(6)	

Repeat card 36 until NXVAR values of X are read in.

Card 37 (NXVAR > 0, all Type F)

1-10	YM(J=1,I=1)	Multiplier factor
11-20	YA(J=1,I=1)	Adder factor
21-30	YM(J=2,I=1)	
31-40	YA(J=2,I=1)	
41-50	YM(J=3,I=1)	
51-60	YA(J=3,I=1)	

Repeat card 37 until NXVAR values are read in (J=NXVAR) for each aerodynamic parameter to be adjusted (I=1 to NADJ).

Card 38 (NXCL > 0, all Type F)

1-10	XCL(1)	C_L values for the table of lift function adjust factors
11-20	XCL(2)	
21-30	XCL(3)	
31-40	XCL(4)	
41-50	XCL(5)	
51-60	XCL(6)	

Repeat card 38 until NXCL values of XCL are read in.

Card 39 (NXCL > 0, all Type F)

Column	Symbol	Definition
1-10	YM(J=1,I=NXVAR+1)	Multiplier factor
11-20	YA(J=1,I=NXVAR+1)	Adder factor
21-30	YM(J=2,I=NXVAR+1)	
31-40	YA(J=2,I=NXVAR+1)	
41-50	YM(J=3,I=NXVAR+1)	
51-60	YA(J=3,I=NXVAR+1)	

Repeat card 39 until NXCL values are read in (J=NXCL).

Card 40 - Format Input Control Card - Write "END OF INPUT" beginning in Column 1 to indicate that all Configuration Definition, Problem Control and Adjust Cards have been read in.

Card 41 - Repeat Problem Control Card - Write "END" to terminate a problem. This clears the input common blocks and reads card 1 as the next card. Write "SAVE" to repeat a problem with only small changes to the geometry or conditions to be run. Additional values will be read in on cards 42 through 50 which will update the previous problem; values not read in will remain unchanged.

Card 42 - New Title - Enter any alphanumeric characters to identify each problem. Columns 1-66.

Card 43 (Required, all Type I)

1	L(1)	BODYS Namelist data to be read in
2	L(2)	NACEL Namelist data to be read in
3	L(3)	WING Namelist data to be read in
4	L(4)	SURFS Namelist data to be read in
5	L(5)	SURV Namelist data to be read in
6	L(6)	STOL Namelist data to be read in
7	L(7)	ADJUST Namelist data to be read in

Set L(1), L(2), ... L(7) equal to 1 if that particular set of Namelist data is to be read in. Only the values that are read in will change the values in storage from the previous problem.

Use of NAMELIST in Input Data

Input data must be in a special form in order to read using a NAMELIST list. The first character (column 1) in each card to be read must be blank. The second character in the first card of a group of data cards must be an $ (dollar sign), immediately followed by the NAMELIST name. The NAMELIST name must be followed by two blanks and must not contain any embedded blanks. This name is followed by data items separated by commas. (A comma after the last item is optional.) The end of a data group is signaled by $. The form of the data items in an input card may be

(1) Variable name = constant

The variable name may be a subscripted array name or a single variable name. The constant may be integer, real, literal, complex, or logical.

(2) Array name = set of constants (separated by commas)

The array name is not subscripted. The set of constants consist of constants of the type integer, real, literal, complex, or logical. The number of constants must be less than or equal to the number of elements in the array. Successive occurrences of the same constant can be represented in the form K * constant.

The variable names and array names specified in the input data set must appear in the NAMELIST list, but the order is not significant.

Each data card must begin with a complete variable or array name or constant. Embedded blanks are not permitted in names or constants. Trailing blanks after integers or exponents are treated as zeros.

NOTE: All data items on a card are entered in Columns 9-66.

Card 44 - BODYS NAMELIST - Namelist input variables

NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS, SREF, CMAC, IREF, ROUGHK, XCG, ZCG, CONCL, BLEN(I), BWID(I), BHGT(I), BAWET(I), BQ(I), BNO(I), BAMX(I), BABS(I), BLNS(I), BLBT(I), BASE(I), BFUS, AB, FMISC

Card 45 - NACEL NAMELIST

NNACS, SREF, ELEN(I), EWID(I), EHGT(I), EAWET(I), EQF(I), ENO(I), EAMX(I), EIN(I), EXIT(I), ELNS(I), ELBT(I)

Card 46 - WING NAMELIST **

NSURFS, ISWP, NPNLS, AR, TAPR, SWPLE, SPLAN, TWIST, WING, TW, CAM(I), TOC(I), XLE(I), YW(I), CRW(I), CBAR(I), AWET(I), SWMT, XPIVOT, YPIVOT, XAPEX, AFTSW, AFTCB, AFTOC, AFTAW, SREF, CMAC, CLE(I), YC(I), CCR(I), XLEW, YWW, YB, XCG, CONCL

Card 47 - SURFS NAMELIST **

NSURFS, NHT, NVT, SREF, SBAR(I), TS(I), SCAM(I), STOC(I), SAWET(I), SMTSW(I), SHF(I), SWL(I), SWT(I), STAPR(I), SCR(I), HTLE, HTY, HTZ, HTINC

Card 48 - SURV NAMELIST

NSURV, NHLSV, NCLAS, IT(I), ITRM(I), FMSURV(I), ALT(I), DHSV(I), SWPV(I), CLLO(I), CLHI(I), DFI(I), CPF(I), DSI(I), CPS(I), DELCD(I), H(I), KPRINT(I), TRB(I), TRN(I), TRU(I), TRL(I), TRS(I), DFI2(I), CPF2(I), DSI2(I), CPS2(I)

Card 49 - STOL NAMELIST ***

IHLS, NF, NS, FLAP, SLAT, DF(I), CFDC(I), DCLOF(I), DCLMF(I), DCDF(I), DCMOF(I), DS(I), CSOC(I), DCLOS(I), DCLMS(I), DCOS(I), DCMOS(I), BF1I, BF1O, CF1, BF2I, BF2O, CF2, BS1I, BS1O, CS1, BS2I

Card 50 - ADJUST NAMELIST

IVAL(I), NXVAR, NXCL, X(I), XCL(I), YM(J,I), YA(J,I)

** TW and TS indicate type of airfoil section; the following code is used for NAMELIST input.

CODE	AIRFOIL TYPE	CODE	AIRFOIL TYPE
1	63-0XX	10	00XX-62
2	64-0XX	11	00XX-63
3	65-0XX	12	00XX-64
4	66-0XX	13	00XX-65
5	63A0XX	14	00XX-66
6	64A0XX	15	00XX-33
7	65A0XX	16	00XX-34
8	Supercritical	17	00XX-35
9	Biconvex	18	00XX-93
		19	00XX-94
		20	00XX-95

*** FLAT and SLAT indicate type of high lift system; the following code is used for NAMELIST input.

CODE	FLAP TYPE	CODE	SLAT TYPE
0	No flap	0	No slat
1	Plain flaps	1	Leading-edge flap
2	Single-slotted flap	2	Slotted slat
3	Double-slotted flap	3	Kruger slat
4	Triple-slotted flap	4	Input section data
5	Input section data		

After all the NAMELIST data is read in, card 41 is the next card to be read in.

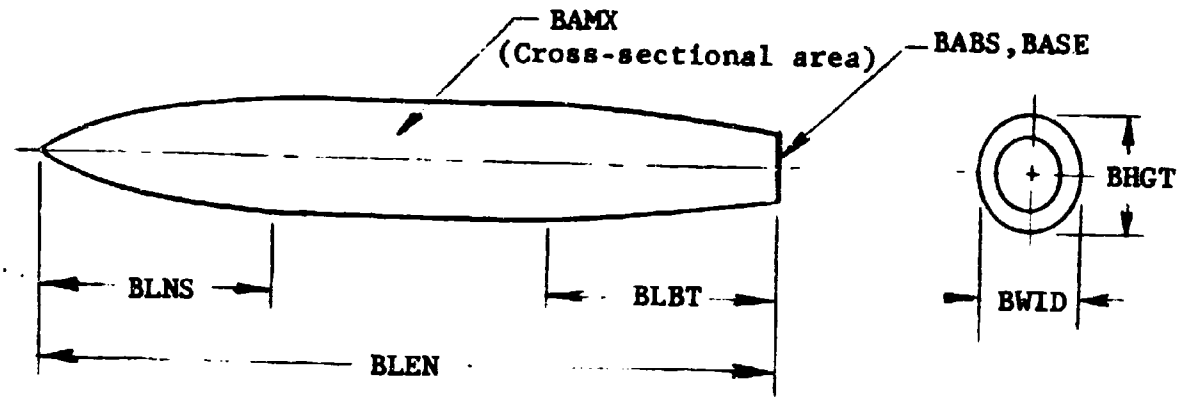


Figure 2 BODIES

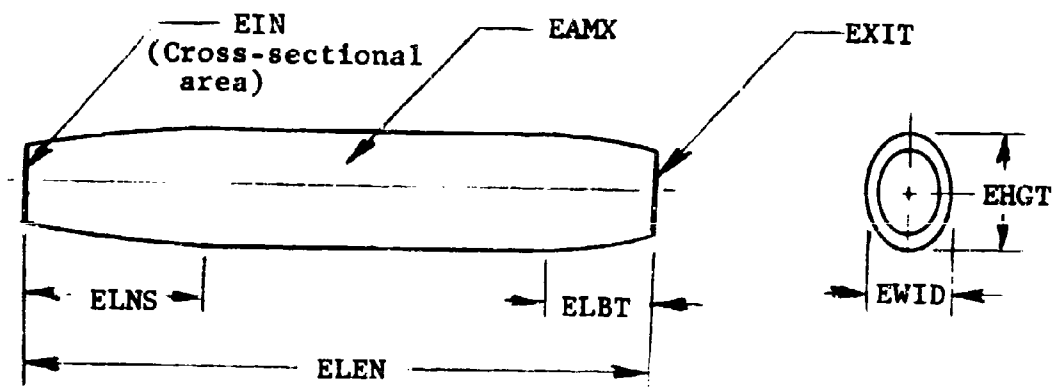


Figure 3 NACELLES

STAPR = SCT/SCR

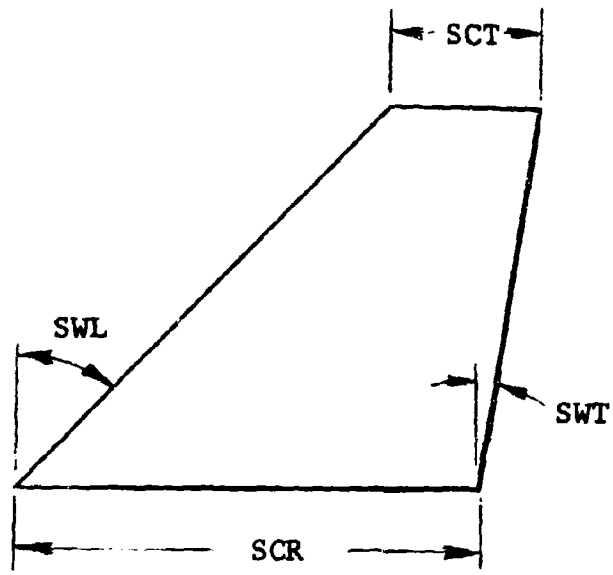


Figure 4 AIRFOIL SURFACE GEOMETRY
(OTHER THAN MAIN WING)

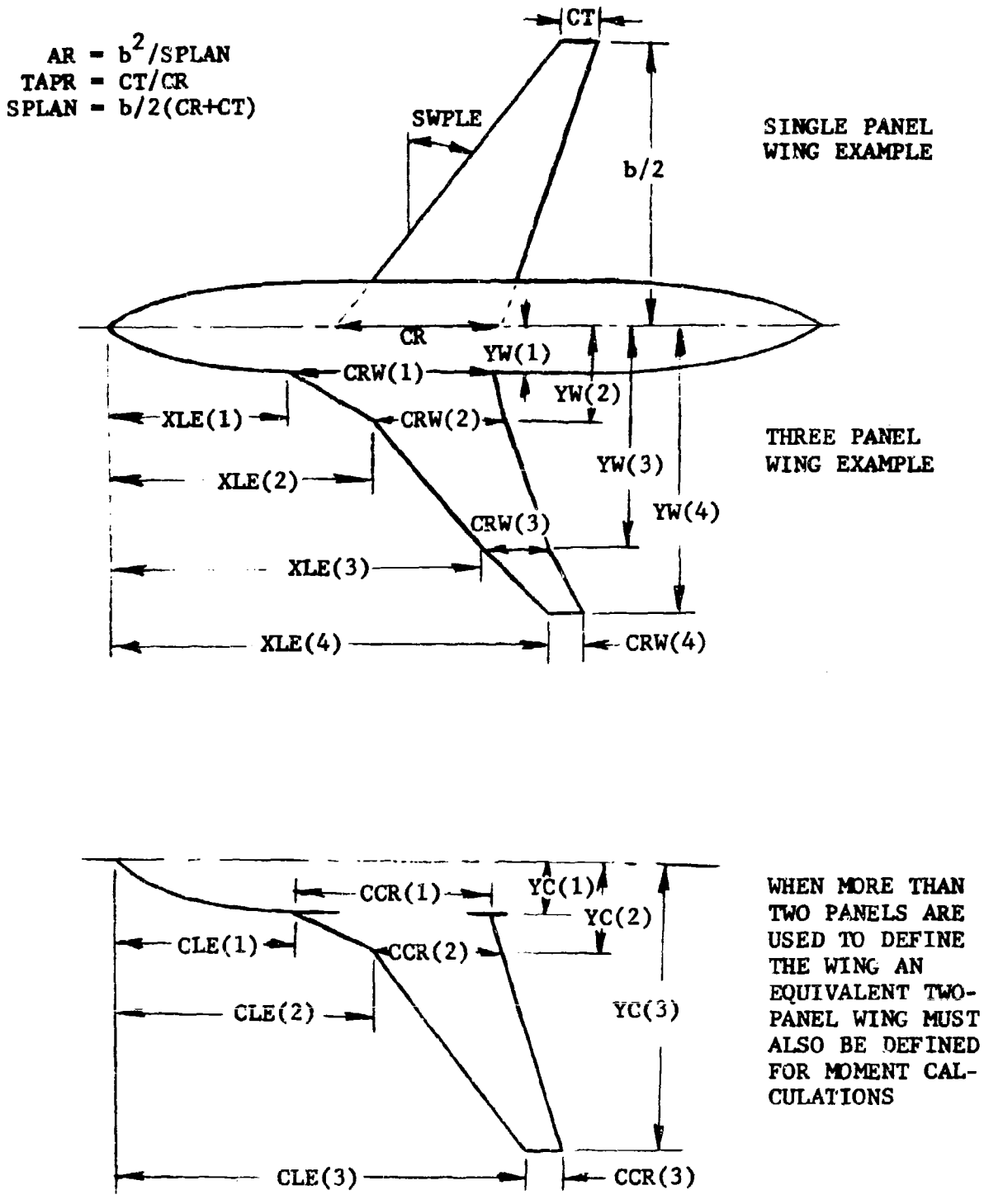


Figure 5 WING SURFACE GEOMETRY

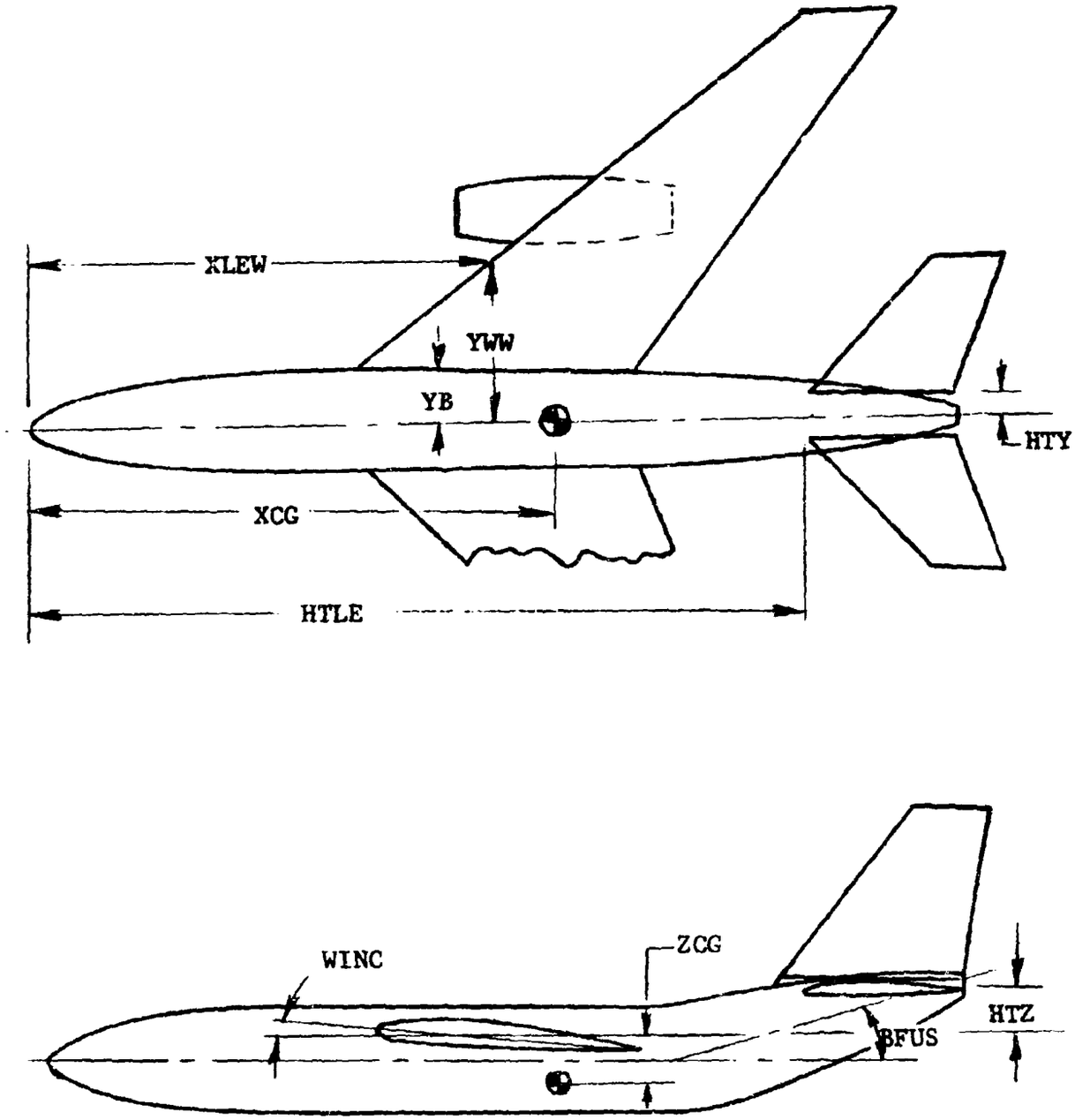
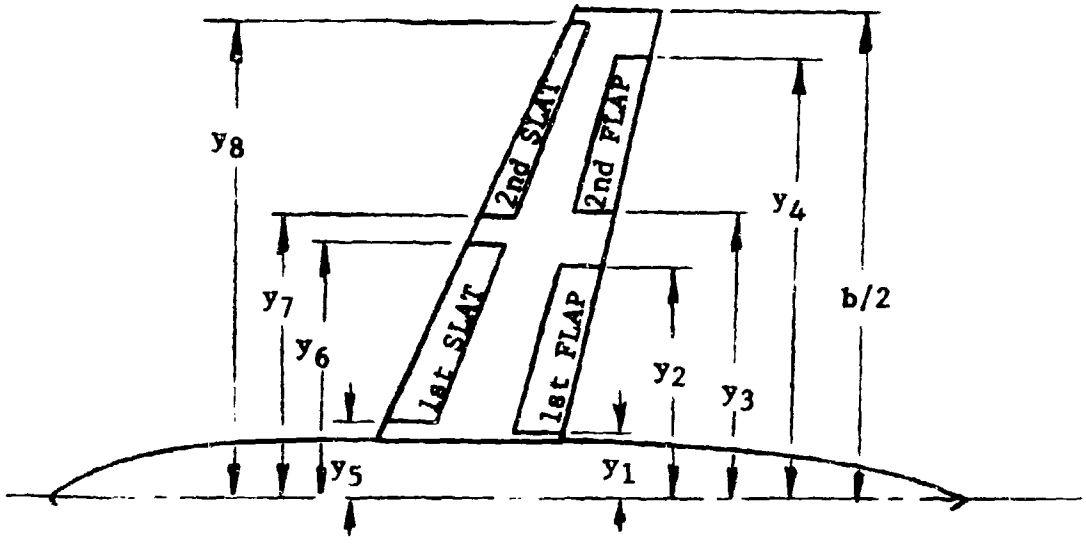


Figure 6 AIRCRAFT GEOMETRY REPRESENTATION

BF1I = $y_1/b/2$
BF1O = $y_2/b/2$
BS1I = $y_5/b/2$
BS1O = $y_6/b/2$
CF1 = C_f/C
CFOC = C'/C



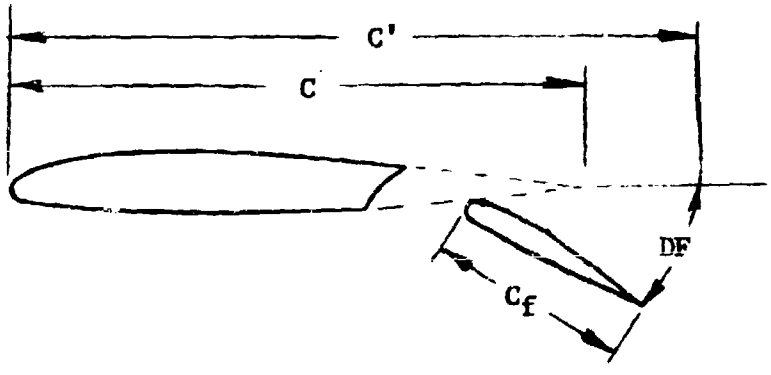


Figure 7 HIGH LIFT SYSTEM GEOMETRY

3. SAMPLE PROBLEMS

Three configurations are analyzed to illustrate the Large Aircraft input techniques and output formats. Problem 1 considers a transport configuration and demonstrates the Format input option and the high-speed lift and drag calculations. Problem 2 demonstrates the input to define the high-lift system for a transport configuration, some dump options and the high-lift system calculations in both free air and in ground effect. Problem 2 also demonstrates the use of the Repeat Problem Control Card to rerun the problem changing the defined configuration from a full-span flap to a partial-span flap high-lift system. Problem 3 demonstrates the Namelist input option for a wing-body configuration.

An abbreviated sample-problem output listing for Problem 1 is presented in pages 35 through 42 corresponding to the configuration defined by the input data in Table 2. The first page of output prints the problem title and the printout option indicators that were set. The next set of output is a listing of some of the input data which occurs when the FORMAT input option is used. The next set of output is a dump of the geometry calculated in Program GEOM which occurs when KPRINT(12) is set equal to 1. A summary of the configuration geometry used in friction drag calculations follows along with a table of the prediction for the critical Mach number versus lift and fuselage aft-end upsweep drag versus wing angle of attack. The last set of data consist of either a tabulation of the predicted drag, moment and angle of attack versus lift for a fixed horizontal tail setting, or a tabulation of drag, tail setting, and angle of attack versus lift for a trimmed (C_M=0) condition.

Several columns of drag versus lift are shown tabulated in the last set of data so that a breakdown of the items contributing to the total drag buildup can be seen. Basic drag due to lift of the wing-body combination is shown in one column, transonic-rise-plus-fuselage aft-end upsweep drag (if any) is shown in another column, while the lift and drag for a zero-horizontal-tail setting are shown in the last two columns on the page. A listing of the items contributing to minimum drag is also shown in the output, along with values of the lift-curve slope, zero-lift angle of attack, polar shape factors, tail-off zero-lift moment, tail-off moment curve slope, separation lift coefficient and maximum lift coefficient.

The input data for sample-problem 2 is shown in Table 3. The sample-problem output listing for problem 2 is presented in pages 44 through 51. Problem 2 set many of the printout option indicators to dump data generated in various subroutines. The dumped data is useful for checking out the program or evaluating the output in detail. The definition of the parameters that are dumped can be determined from the listing of the subroutine. For the high-lift survey problems the final output consists of a table of alpha, C_L, C_D, C_M for both free-air and in-ground effect up to the maximum lift coefficient.

Namelist input data for sample-problem 3 is shown in Table 4 and the output listing is presented in pages 53 through 56.

Table 2 SAMPLE PROBLEM 1

```
C-141A FLIGHT TEST ANALYSIS   NASA CR - 1558                                P010001
          1                                                                 P010002
FORMAT INPUT                                                                P010003
    3    1    5    1    1    0    2    0    1                               P010004
3228.0    266.47    732.88    0.0       0.0       5.00                      P010005
1590.0    170.0     170.0     4347.52                                       P010006
22600.0   0.0       204.0     610.0     0.0       7.0       1.0             P010007
404.0     70.14     70.14     822.0     1.2       2.0                       P010008
3860.0    0.0       202.0     202.0     0.0                                 P010009
299.84    43.8      43.8      136.8     1.3       1.0                       P010010
1508.3    0.0       150.0     145.0     0.0                                 P010011
199.22    66.0      66.0      1045.96   1.3       4.0                       P010012
3421.2    1800.0    1344.96   99.0      100.0                               P010013
3228.0    0.373                                                             P010014
0011-63   -5.58     4.89      25.0                                          P010015
0.4       0.1195    450.0     48.0      380.04    310.3     3134.2          P010016
0.4       0.11      641.6     404.6     240.7     186.3     2932.2          P010017
928.03    959.7     131.89                                                  P010018
64A010.5  0.0       0.105     25.0      1.1                                 P010019
29.0      11.4      0.35      171.15    115.5     893.74                    P010020
1512.0    0.0       276.0     0.0                                           P010021
64A013    0.0       0.13      35.0      1.1                                 P010022
38.5      22.5      0.60863   273.17    219.7     819.4                     P010023
64A010    0.0       0.1       73.0      1.3                                 P010024
73.0      72.0      0.99      200.0     200.0     223.24                    P010025
64A010    0.0       0.1       73.0      1.3                                 P010026
73.0      72.0      0.99      200.0     200.0     214.88                    P010027
   12    0   21                         000000111111                         P010028
0.6       -2.47683  0.0       28.0      0.0       1.0                       P010029
0.7       -2.47683  0.0       28.0      0.0       1.0                       P010030
0.75      -2.47683  0.0       28.0      0.0       1.0                       P010031
0.775     -2.47683  0.0       28.0      0.0       1.0                       P010032
0.8       -2.47683  0.0       28.0      0.0       1.0                       P010033
0.81      -2.47683  0.0       28.0      0.0       1.0                       P010034
0.6       -2.47683            28.0      0.0       1.0                       P010035
0.7       -2.47683            28.0      0.0       1.0                       P010036
0.75      -2.47683            28.0      0.0       1.0                       P010037
0.775     -2.47683            28.0      0.0       1.0                       P010038
0.        -2.47683            28.0      0.0       1.0                       P010039
0.81      -2.47683            28.0      0.0       1.0                       P010040
END OF INPUT                                                                P010041
END                                                                         P010042
```

EMPIRICALLY BASED COMPUTER PROGRAM

TO PREDICT THE AERODYNAMIC CHARACTERISTICS

OF LARGE AIRCRAFT

C-141A FLIGHT TEST ANALYSIS NASA CR - 1558

KFRINT(12) = 1

GENERAL DYNAMICS
6600 PROCEDURE 51T

CONVAIR AEROSPACE DIVISION
PROBLEM 185829-01

FORT WORTH OPERATION
01/10/74 PAGE 0002

PROBLEM INPUT PARAMETERS

NBODYS = 7 NMACS = 1 NSURFS = 5 NHT = 1 NVT = 1 ISWP = 0 NPNLS = 2

SREF = 3228.000 SQ.FT. CMAC = 266.470 IN. FUS. STA. C.G. = 732.880 IN. ZCG = .000 IN.

NO.	BLEN	BWID	BHGT	BAWET	BAMX	BABS	BLNS	BLBT	BASE	BQ	BNO
1	1590.000	170.000	170.000	4347.520	22600.000	0.000	204.000	610.000	0.000	1.000	1.000
2	404.000	70.140	70.140	822.000	3861.000	0.000	202.000	202.000	0.000	1.200	2.000
3	299.840	43.800	43.800	136.800	1508.300	0.000	150.000	145.000	0.000	1.300	1.000

NO.	ELEN	EWID	EHGT	EAWET	EAMX	E1N	EXIT	ELNS	ELBT	EQF	ENO
1	199.220	66.000	66.000	1045.960	3421.200	1800.000	1344.960	99.000	100.000	1.300	4.000

AIRFOIL TYPE = 0011-63 TWIST = -5.580 DEG. INCIDENCE = 4.890 DEG. MAX. THICKNESS SWP. = 25.000 DEG.

WING PANEL GEOMETRY

NO.	CAMBER	T/C	XLE	YW	CRW	CBAR	AWET
1	.400	.119	450.000	48.000	380.040	310.300	3134.200
2	.400	.119	641.600	404.600	240.700	186.300	2932.200
			928.030	959.700	131.890		

GEOMETRY FOR ADDITIONAL AIRFOIL SURFACES

AIRFOIL	CAMBER	T/C	SMTSW	SHF	L.E.SWP	T.E.SWP	TAPER	CR	SBAR	SAWET
64A010.	0.000	.105	25.000	1.100	29.000	11.400	.350	171.150	115.500	893.740
64A013	0.000	.130	35.000	1.100	38.500	22.500	.609	273.170	219.700	819.400
64A010	0.000	.110	73.000	1.300	73.000	72.000	.990	200.000	200.000	223.240
64A010	0.000	.110	73.000	1.300	73.000	72.000	.990	200.000	200.000	214.880

12 DRAG POLARS TO BE GENERATED AT THE FOLLOWING CONDITIONS

MACH NO.	ALTITUDE	TAIL SETTING	L.E.SWEEP	FROM CL	TO CL
.6000	-2.477	0.000	28.000	0.000	1.000
.7000	-2.477	0.000	28.000	0.000	1.000
.7500	-2.477	0.000	28.000	0.000	1.000
.7750	-2.477	0.000	28.000	0.000	1.000
.8000	-2.477	0.000	28.000	0.000	1.000
.8100	-2.477	0.000	28.000	0.000	1.000
.6000	-2.477	TRIMMED	28.000	0.000	1.000
.7000	-2.477	TRIMMED	28.000	0.000	1.000
.7500	-2.477	TRIMMED	28.000	0.000	1.000
.7750	-2.477	TRIMMED	28.000	0.000	1.000
.8000	-2.477	TRIMMED	28.000	0.000	1.000
.8100	-2.477	TRIMMED	28.000	0.000	1.000

END OF INPUT *****

GEOMETRY DATA DUMP, COMMON BLKG01

9.3529	5.7599	6.8457	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.4609	2.5528	.1041	.1041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
506.1379	106.6742	28.6163	28.6163	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.0185	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	.0500	.1150	.4000	2973.4763	.363	1537.1936
1438.2827	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.4930
.4764	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.3295
.3959	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	7.9257
.3367	3228.0000	21.3077	35.5450	54.2342	31.6700	20.0583	10.9908	29.7167	46.2587
1537.1936	1438.2827	2.2979	7.7649	22.9708	7.1983	2075.6246	.493	.4764	.3295
.3959	.4253	.4850	.2264	.2078	-.1309	134.5225	72.8822	76.9661	.3035
.0316									

CONFIGURATION SUMMARY

	LENGTH (FT.)	WETTED AREA (SQ. FT.)	FR OR T/C	INTERFERENCE FACTOR	MAX. T/C SWEEP (DEG.)
BODY NUMBER 1	132.50000	4347.52000	9.35294	1.00000	
BODY NUMBER 2	33.66667	822.00000	5.75991	1.20000	
BODY NUMBER 3	24.98667	136.80000	6.84566	1.30000	
NACELLE NO. 1	16.60167	1045.95000	3.01848	1.30000	
WING PANEL NO. 1	25.85833	3134.20000	.11950		25.00001
WING PANEL NO. 2	15.52500	2932.20000	.11000		25.00001
AIRFOIL SURFACE NO. 2	9.62500	893.74000	.10500	1.10000	35.00001
AIRFOIL SURFACE NO. 3	18.30833	819.40000	.13000	1.10000	73.00003
AIRFOIL SURFACE NO. 4	16.66667	223.24000	.10000	1.30000	73.00003
AIRFOIL SURFACE NO. 5	16.66667	214.88000	.10000	1.30000	

4-DIGIT AIRFOIL SECTION

MACH CRITICAL TABLE

CL	MACH CRITICAL
0.0000	.8310
.1000	.8186
.2000	.8062
.3000	.7915
.4000	.7763
.5000	.7600
.6000	.7421
.7000	.7226
.8000	.7013
.9000	.6787
1.0000	.6559

FUSLAGE AFT-END UPSWEEP DRAG

WING ANGLE	DFLCD
0.00000	.00188
1.00000	.00154
2.00000	.00125
3.00000	.00101
4.00000	.00080
5.00000	.00063
6.00000	.00048
7.00000	.00035
8.00000	.00024
9.00000	.00016
10.00000	.00010
11.00000	.00007
12.00000	.00006
13.00000	.00006
14.00000	.00007
15.00000	.00007
16.00000	.00007
17.00000	-.00001
18.00000	-.00007
19.00000	-.00017
20.00000	-.00029

C-141A FLIGHT TEST ANALYSIS NASA CR - 1558
MACH NO. = .700 RN/FT = 2.4768E+06 L.E. SWEEP ANGLE = 0.00 DEG. TAIL DEFL. (DH) = .00 DEG.

CL	TOTAL CD	CM	ALPHA	CD LIFT	CD R+AFT	CL AT DH=0	CD AT DH=0
0.000	.01706	.06785	-5.05	.00025	.00194	.0000	.01706
.050	.01658	.06972	-4.61	.00002	.00178	.0500	.01658
.100	.01656	.05749	-4.18	.00005	.00164	.1000	.01656
.150	.01671	.04620	-3.74	.00034	.00150	.1500	.01671
.200	.01713	.03[illegible]5	-3.31	.00089	.00137	.2000	.01713
.250	.01782	.03145	-2.87	.00170	.00125	.2500	.01782
.300	.01878	.02798	-2.43	.00277	.00114	.3000	.01878
.350	.02001	.01647	-2.00	.00410	.00104	.3500	.02001
.400	.02150	.00890	-1.56	.00569	.00094	.4000	.02150
.450	.02326	.00129	-1.12	.00757	.00085	.4500	.02326
.500	.02528	-.00637	-.69	.00964	.00077	.5000	.02528
.550	.02756	-.01408	-.25	.01200	.00069	.5500	.02756
.600	.03012	-.02183	.18	.01463	.00061	.6000	.03012
.650	.03293	-.02962	.62	.01751	.00055	.6500	.03293
.700	.03601	-.03744	1.06	.02065	.00048	.7000	.03601
.750	.03936	-.04530	1.49	.02406	.00042	.7500	.03936
.800	.04297	-.05320	1.93	.02772	.00037	.8000	.04297
.850	.04720	-.06112	2.37	.03164	.00068	.8500	.04720
.900	.05261	-.06908	2.80	.03582	.00192	.9000	.05261
.950	.05925	-.07705	3.24	.04026	.00412	.9500	.05925
1.000	.06710	-.08506	3.68	.04496	.00727	1.0000	.06710

CLA = .11460 PER DEG. ALC =-5.05355 DEG. CLDB = 1.29036
K = .05186 CFLCL = .06851 CLMAX = 1.28090
CM0 = -.03042 CM/CL = .1154

DRAG BREAKDOWN -----	FUSLAGE	BODIES	NACELLES	WING	HORIZ TAIL	VERT TAIL	SURFACES
FRICTION = .00950	.00233	.00062	.00075	.00422	.00069	.00058	.00031
FORM = .00178	.00023	.00019	.00009	.00098	.00012	.00013	.00005
INTERF = .00208	.00004	.00017	.00025	.00105	.00025	.00019	.00013
WAVE =0.00000	0.00000	0.00000	0.00000	0.00000	[illegible]	[illegible]	[illegible]
BASE =0.00000	0.00000	0.00000					
CAMBER = .00085							
DRAG RISE=0.00000							
MISC = .00067							

COMIN = .01487

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C-141A FLIGHT TEST ANALYSIS NASA CR - 1558
MACH NO. = .70 RN/FT = 2.4768E+06 L.E. SWEEP ANGLE = 0.00 DEG. TRIMMED CONDITION

CL	TOTAL CD	DH	ALPHA	CD LIFT	CD RAFT	CL AT DH=0	CD AT DH=0
.021	.01646	1.47893	-5.05	.00025	.00194	0.00000	.01716
.068	.01639	1.31974	-4.61	.00002	.00178	.05000	.01660
.116	.01623	1.15997	-4.18	.00005	.00164	.10000	.01656
.164	.01645	.99966	-3.74	.00034	.00150	.15000	.01671
.212	.01695	.83882	-3.31	.00089	.00137	.20000	.01713
.259	.01775	.67748	-2.87	.00170	.00125	.25000	.01782
.307	.01878	.51565	-2.43	.00277	.00114	.30000	.01878
.355	.02011	.35337	-2.00	.00416	.00104	.35000	.02001
.403	.02151	.19065	-1.56	.00569	.00094	.40000	.02150
.451	.02326	.02752	-1.12	.00753	.00085	.45000	.02326
.498	.02525	-.13601	-.69	.00964	.00077	.50000	.02528
.546	.02749	-.29998	-.25	.01200	.00069	.55000	.02756
.594	.02997	-.46414	.18	.01463	.00061	.60000	.03012
.641	.03273	-.62850	.62	.01751	.00055	.65000	.03293
.689	.03557	-.79357	1.06	.02065	.00048	.70000	.03601
.737	.03893	-.95873	1.49	.02406	.00042	.75000	.03936
.784	.04234	-1.12415	1.93	.02772	.00037	.80000	.04297
.832	.04649	-1.28981	2.37	.03164	.00068	.85000	.04729
.880	.05163	-1.45578	2.80	.03582	.00192	.90000	.05261
.927	.05886	-1.62178	3.24	.04026	.00412	.95000	.05925
.975	.06568	-1.78806	3.68	.04496	.00727	1.00000	.06710

CLA = .11480 PER DEG. ALC =-5.05055 DEG. CLOB = 1.29036
K = .05186 DELCL = .6891 CLMAX = 1.28790
CMC = -.03012 CM/CL = .1154

DRAG BREAKDOWN -----	FUSLAGE	BODIES	NACELLES	WING	HORIZ TAIL	VERT TAIL	SURFACES
FRICTION = .01950	.00233	.00062	.00075	.00422	.00169	.00158	.00731
FORM = .00174	.00	.00019	.00009	.00098	.00012	.00013	.00405
INTERF = .00208	.00000	.00017	.00025	.00105	.00025	.00019	.00013
WAVE = 0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
BASE = 0.00000	0.00000	0.00000					
CAMBER = .00000							
DRAG RISE= 0.00000							
MISC = .00067							

CDMIN = .01487

Table 3 SAMPLE PROBLEM 2

```
NACA TN D-7034   4-ENGINE STOL TRANSPORT  (HIGH WING)          005573P060001
1          1111 1111    1111                                   005573P060002
FORMAT INPUT                                                   005573P060003
    1    0    3    1    1    0    1    1                       005573P060004
5.143      11.28      27.09      -3.73                         005573P060005
68.268     10.404     9.504                                    005573P060006
           0.0        12.15      25.2       0.0                005573P060007
7.0        0.3        29.0       5.143      -5.05      2.85    005573P060008
66-012     0.0        0.12       24.27      14.7692    4.75    005573P060009
25.0                                                           005573P060010
66-012     0.0        0.12       7.5        1.0                005573P060011
12.5       -7.5       0.44       9.816                         005573P060012
58.255     0.0        17.67      0.0                           005573P060013
66-012     0.0        0.12       22.0       1.0                005573P060014
27.0       6.0        0.52       14.628                        005573P060015
D.S. FLAP             SLAT                                     005573P060016
0.134      1.0        0.16       0.134      1.0        0.15    005573P060017
0.38                                                           005573P060018
    0    1                                                     005573P060019
30.0       30.0       1.16       19.0       1.1                005573P060020
1.14                                                           005573P060021
END OF INPUT                                                   005573P060022
SAVE                                                           005573P060023
NACA TN D-7034  PARTIAL SPAN FLAP                              005573P060024
    1                                                          005573P060025
 $STOL  BF10=0.75$                                             005573P060026
END OF PROBLEM                                                 005573P060027

                                                        CC = 00027
```

EMPIRICALLY BASED COMPUTER PROGRAM

TO PREDICT THE AERODYNAMIC CHARACTERISTICS

OF LARGE AIRCRAFT

NACA TN D-7634 4-ENGINE STOL TRANSPORT (HIGH WING)

```
KPRINT( 1) =  1
KPRINT(11) =  1
KPRINT(12) =  1
KPRINT(13) =  1
KPRINT(14) =  1
KPRINT(16) =  1
KPRINT(17) =  1
KPRINT(18) =  1
KPRINT(19) =  1
KPRINT(24) =  1
KPRINT(25) =  1
KPRINT(26) =  1
KPRINT(27) =  1
```

```
GENERAL DYNAMICS          CONVAIR AEROSPACE DIVISION          FORT WORTH OPERATION
6600 PROCEDURE R1T          PROBLEM 005573-06                 10/30/73   PAGE 0003

  PROBLEM INPUT PARAMETERS

    NBODYS = 1     NNACS = 0     NSURFS = 3     NHT = 1     NVT = 1     ISWP = 0     NPNLS = 1

    SREF =    5.143 SQ.FT.     CMAC =   11.280 IN.     FUS. STA. C.G. =   27.090 IN.     ZCG =  -3.730 IN.

 NO.    BLEN      BWID .    BHGT      BAWET     BAMX      BABS      BLNS      BLBT      BASE      BQ        BNO

   1    68.268    10.404     9.504    -0.000    -0.000     0.000    12.150    25.200     0.000     1.000     1.000

ASPECT RATIO =  7.000     TAPER RATIO = .3000     L.E.SWEEP = 29.000     PLANFORM AREA =    5.14 SQ.FT.
    TWIST = -5.050 DEG.     INCIDENCE =  2.850 DEG.
    AIRFOIL TYPE =  66-012      CAMBER = 0.0000     THICKNESS =   .1200
    WING LOCATION (X,Y) =      24.2700     14.7692FUSLAGE INTERSECTION =   4.7500
    MAX. THICKNESS SWP. = 25.000     CBAR = -0.0000     AWET =  -0.000


    GEOMETRY FOR ADDITIONAL AIRFOIL SURFACES
AIRFOIL      CAMBER     T/C       SMTSW     SMF       L.E.SWP   T.E.SWP   TAPER     CR        SBAR      SAWET

 66-012      0.000      .120     7.500     1.000    12.500    -7.500     .440     9.816    -0.000    -0.000
 66-012      0.000      .120    22.000     1.000    27.000     6.000     .520    14.628    -0.000    -0.000

    END OF INPUT            *****
```

GEOMETRY DATA DUMP, COMMON BLK001

6.8654	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.4023	3.1234	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.5271	1.3414	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.5061	.4454	.3869	.2418	.1319	.1200	0.0000	4.1472	.3869	4.1472
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.5061
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.3869
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	7.0000
.3610	5.1433	.9400	1.2398	2.0225	1.1969	0.0000	.3956	2.6042	0.0000
4.1472	0.0000	0.0000	6.5411	0.0000	0.0000	0.0000	.5061	0.0000	.3869
0.0000	.4454	.5061	.2418	.2198	-.1383	5.1343	2.6590	3.3847	.5549
0.0000									

CONFIGURATION SUMMARY

	LENGTH (FT.)	WETTED AREA (SQ. FT.)	FR OR T/C	INTERFERENCE FACTOR	MAX. T/C SWEEP (DEG.)	
BODY NUMBER 1	5.68900	11.96429	6.86537	1.00000		
WING PANEL NO. 1	.86346	8.47136	.12000		25.00001	
AIRFOIL SURFACE NO. 2	.61865	3.11425	.12000	1.00000	7.50000	
AIRFOIL SURFACE NO. 3	.95724	2.77793	.12000	1.00000	22.00001	
CFEQ INPUT	7.1007E+06	1.0000000	5.6890000	0.0000000	-0.0000000	
CFEQ OUTPUT	.0022403	.0022403	0.0000000	.9859024	7.1007E+06	0.
CFEQ INPUT	7.1007E+06	1.0000000	.8634587	0.0000000	-0.0000000	
CFEQ OUTPUT	.0030117	.0030117	0.0000000	.9859024	7.1007E+06	0.
CFEQ INPUT	7.1007E+06	1.0000000	.8634587	0.0000000	-0.0000000	
CFEQ OUTPUT	.0030117	.0030117	0.0000000	.9859024	7.1007E+06	0.
CFEQ INPUT	7.1007E+06	1.0000000	.6186535	0.0000000	-0.0000000	
CFEQ OUTPUT	.0031854	.0031854	0.0000000	.9859024	7.1007E+06	0.
CFEQ INPUT	7.1007E+06	1.0000000	.9572406	0.0000000	-0.0000000	
CFEQ OUTPUT	.0029607	.0029607	0.0000000	.9859024	7.1007E+06	0.
CFEQ INPUT	6.3906E+06	.9000000	5.6890000	0.0000000	-0.0000000	
CFEQ OUTPUT	.0023031	.0023031	0.0000000	.9884409	6.3906E+06	0.
CFEQ INPUT	6.3906E+06	.9000000	.8634587	0.0000000	-0.0000000	
CFEQ OUTPUT	.0030996	.0030996	0.0000000	.9884409	6.3906E+06	0.
CFEQ INPUT	6.3906E+06	.9000000	.8634587	0.0000000	-0.0000000	
CFEQ OUTPUT	.0030496	.0030496	0.0000000	.9884409	6.3906E+06	0.
CFEQ INPUT	6.3906E+06	.9000000	.6186535	0.0000000	-0.0000000	
CFEQ OUTPUT	.0032791	.0032791	0.0000000	.9884409	6.3906E+06	0.
CFEQ INPUT	6.3906E+06	.9000000	.9572406	0.0000000	-0.0000000	
CFEQ OUTPUT	.0030468	.0030468	0.0000000	.9884409	6.3906E+06	0.
AER2 DUMP	.91000	.06000	.14518	.40759	1.03332	5.14300
	5.14300	.91300	.78781	.90781	1.12000	.92833
	.91255	.10000	.12000	.30000	7.00000	0.00000
	.00000	0.00000	.13194	1.00000	.38091	
AER2 DUMP	.10000	.08101	.07839	1.00000	1.03332	5.14300
	5.14300	.91300	.78781	.90781	1.12000	.92833
	.91255	.10000	.12000	.30000	7.00000	0.00000
	0.00000	0.00000	.13194	1.00000	.38091	
AER2 DUMP	.90000	.01403	.11337	.41667	1.00000	1.52706
	5.14300	.91944	.77110	.89110	1.12000	.99899
	.91944	.10000	.12000	.44000	4.49234	0.00000
	0.00000	0.00000	0.00000	1.00000	.34499	
AALO DUMP ALO = 2.029	ALOC =-0.000		ALOT = 1.085	ALOI = .945		
.9.000	.44539	.12000	0.00000	-5.35000	47.00153	.13194
.33000	.26030	.03625	.01110	.01949	.17823	1.10369
2.85000	0.00000	2.85000				
CFEQ INPUT	7.8108E+06	1.1000000	5.6890000	0.0000000	-0.0000000	
CFEQ OUTPUT	.0021799	.0021799	0.0000000	.9831659	7.8108E+06	0.
CFEQ INPUT	7.8108E+06	1.1000000	.8634587	0.0000000	-0.0000000	
CFEQ OUTPUT	.0029278	.0029278	0.0000000	.9831659	7.8108E+06	0.
CFEQ INPUT	7.8108E+06	1.1000000	.8634587	0.0000000	-0.0000000	

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```
        CFEQ OUTPUT      .0 29278       .0 2927a      0.0000000       .9831659     7.8108E+06      0.
        CFEQ INPUT     7.81f8E+06     1.1000000       .6186535      0.0000000    -0.0000000
        CFEQ OUTPUT      .0130962       .0030962      0.0000000       .9831659     7.8108E+06      0.
        CFEQ INPUT     7.81f8E+06     1.1000000       .9572406      0.0000000    -0.0000000
        CFEQ OUTPUT      .0026784       .0028784      0.0000000       .9831659     7.8108E+06      0.
        AER2 DUMP       1.11100        .12569         .12207         .99652       1.03332         5.14300
                        5.14300        .91300         .78781         .90781       1.12000          .92833
                         .91255        .10000         .12000         .30000       7.00000         0.00000
                        0.00000        0.00000        .13194        1.00000        .38091
        AER2 DUMP        .10100        .08101         .07639        1.00000       1.03332         5.14300
                        5.14300        .91300         .78781         .90781       1.12000          .92833
                         .91255        .10000         .12000         .30000       7.00000         0.00000
                        0.00000        0.00000        .13194        1.00000        .38091
        AER2 DUMP       1.11100        .03298         .11139         .99727       1.00000         1.52706
                        5.14300        .91944         .77110         .89110       1.12000          .99899
                         .91944        .10000         .12000         .44000       4.40234         0.00000
                        0.00000        0.00000       0.00000        1.00000        .04499
   AALO DUMP     ALO =  .830     ALOC =-0.000     ALOT = 0.000     ALOI =  .890
          1.10000        .44539         .12000        0.00000      -5.05000       47.60153         .13194
           .30000        .12509         .00625         .01854        .03572        .17823         1.10369
          2.85000       0.00000        2.85000
        CFEQ INPUT     1.4201E+06     .2000000      5.6890000      0.0000000    -0.0000000
        CFEQ OUTPUT      .0034466       .0034466      0.0000000       .9993988     1.4201E+06      0.
        CFEQ INPUT     1.4201E+06     .2000000       .8634587      0.0000000    -0.0000000
        CFEQ OUTPUT      .0042091       .0042091      0.0000000       .9993988     1.4201E+06      0.
        CFEQ INPUT     1.4201E+06     .2000000       .8634587      0.0000000    -0.0000000
        CFEQ OUTPUT      .0042091       .0042091      0.0000000       .9993988     1.4201E+06      0.
        CFEQ INPUT     1.4201E+06     .2000000       .6186535      0.0000000    -0.0000000
        CFEQ OUTPUT      .0044769       .0044769      0.0000000       .9993988     1.4201E+06      0.
        CFEQ INPUT     1.4201E+06     .2000000       .9572406      0.0000000    -0.0000000
        CFEQ OUTPUT      .0041309       .0041309      0.0000000       .9993988     1.4201E+06      0.
        AER2 DUMP        .20000        .08141         .07678        1.00000       1.03332         5.14300
                        5.14300        .91300         .78781         .90781       1.12000          .92833
                         .91255        .10000         .12000         .30000       7.00000         0.00000
                        0.00000        0.00000        .13194        1.00000        .38091
        AER2 DUMP        .10000        .08101         .07639        1.00000       1.03332         5.14300
                        5.14300        .91300         .78781         .90781       1.12000          .92833
                         .91255        .10000         .12000         .30000       7.00000         0.00000
                        0.00000        0.00000        .13194        1.00000        .38091
        AER2 DUMP        .20000        .02106         .07694        1.00000       1.00000         1.52706
                        5.14300        .91944         .77110         .89110       1.12000          .99899
                         .91944        .10000         .12000         .44000       4.4023          0.00000
                        0.00000        0.00000       0.00000        1.00000        .04499
   AALO DUMP     ALO = 2.054     ALOC =-0.000     ALOT = 1.147     ALOI =  .906
           .20000        .44539         .12000        0.00000      -5.05000       25.97673         .13194
           .30000        .08141         .00625         .01511        .02643        .17823         1.10369
          2.85000       0.00000        2.85000
        CLERK DUMP
         .91255         .98166        9.84114        0.88814        .00000       2.23200        0.00000
        1.03990        1.29200        2.20200         .50000        .00000      16.55988        3.04894
        2.23671         .45000        1.27915        0.00000        .64831       0.00000         .22678
```

1.32500	1.31000	1.28500	1.28000	1.21345	-.23390	6.12546

CMON DUMP

.02304	0.00000	.02265	4.01693	0.00000	6.94112	.12000
-5.05600	.44539	.33053	-.00449	.9000	4.00000	0.00000
4.14724						

WBAC DUMP

.59349	-.85180	.00625	.09785	.07809	.43528
.61132	.08522	.20000	1.88860	.17838	

CULZ DUMP

.20000	0.00000	0.00000	.06079	0.00000	.19579	.91263
.93166	.04654	1.88057				

AERA DUMP HIGH ASPECT RATIO

0.00000	2.05362	7.00000	4.28671	1.11346	.74785	3.61475
.10277	2.05362					

SSET DUMP

3.25725	1.52946	.29814	-.64410	-.04650	.69475	0.00000
.19657	1.16000	1.10000	2.01537	1.24190	-.03000	.77000
.54970	-.00000	4.99879	4.31481	.00000	.87952	.04993
-.00000	.27533	.33018	.00000	1.58593	-.43737	-.20674
-.00000	-.09230	-.07126	.00000	2.36593	-.14022	1.37270
1.69581	.90000	3.00000	2.00000	30.00000	30.00000	0.00000
19.00000	.13793	.32759	0.00000	.13636	7.22400	.07890

HIGH LIFT CONSTANTS

ZKB =	.014410	ZKC =	1.106458	ZKS =	.798797
CLDC1=	.824255	DC1F =	3.257277	DC1MF=	1.529456
DC1CS=	-.046497	DC1MS =	.694746	DCLBS=	-.030626
DCLCF=	2.201473				

SWPHL=	.391467	ZMD =	.809729	ZKA =	1.276285
ZKF =	.164200	CDC =	1.206210	SWPLE=	.506145
AR =	7.000000	TPR =	.300000	AK =	.660792
DCL =	0.000000				

DCDMIN =	.029376	CDI =	.046185	DCDS =	0.000000
DCDF =	.223149	DCL =	0.000000	DCLF =	.976828
CDC =	.066142				

DCMLF =	-.874933
DCMCS =	.198419
DCMC =	-.031826

GENERAL DYNAMICS
6600 PROCEDURE R1T

CONVAIR AEROSPACE DIVISION
PROBLEM 00573-06

FORT WORTH OPERATION
10/30/73 PAGE 0009

HIGH LIFT SURVEY

ALPHA	CL	CD	CM	AGRD	CLG	CDG	CMG
0.00	1.95979	.44972	-.72670	.261	1.96283	.39114	-.74092
1.00	2.17493	.46795	-.77365	1.291	2.18319	.40266	-.79993
2.00	2.17970	.49790	-.82034	2.380	2.19321	.42533	-.86027
3.00	2.26852	.53279	-.86847	3.457	2.28714	.45323	-.92137
4.00	2.34138	.57400	-.91740	4.518	2.30492	.48772	-.98297
5.00	2.39828	.62369	-.96709	5.559	2.42651	.53169	-1.04481
6.00	2.43923	.68031	-1.01750	6.579	2.47188	.58694	-1.10671
7.00	2.46422	.74934	-1.06857	7.576	2.50101	.66284	-1.16847
8.00	2.47326	.88962	-1.12027	8.548	2.51389	.77427	-1.22997
9.00	2.46634	1.08998	-1.17255	9.496	2.51752	.90095	-1.29114

NAMELIST INPUT COMPLETED
GEOMETRY DATA DUMP, COMMON BLKGD1

6.8654	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.4023	3.1234	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.5271	1.3474	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.5061	.4454	.3009	.2418	.1319	.1200	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.1472	.3809	4.1472
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	.5061
0.0000	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.000	.3009
.3100	5.1430	.9400	1.2308	2.0225	1.1909	0.0000	0.0000	0.0000	7.0000
4.1472	0.0000	0.0000	6.5411	0.0000	0.0000	.3956	2.6042	0.0000	0.0000
0.0000	.4454	.5061	.2418	.2198	-.1383	5.1343	2.6590	3.3047	.5549
0.0000									

Table 4 SAMPLE PROBLEM 3

```
 WING 1     NASA TN D-5805      Q/C SWP = 25 DEG.
              1
 NAMELIST INPUT
  $BODYS NBODYS=1,XCG=25.013,BLEN(1)=48.8,BWID(1)=4.9,BHGT(1)=4.9,
         BLNS(1)=14.0,BLBT(1)=10.0,BASE(1)=0.0$
  $NACEL NNACS=0$
  $WING  SREF=1.5,SPLAN=1.5,NPNLS=1,AR=6.0,TAPR=0.4,SWPLE=28.27,
         TW=5.,CAN(1)=0.0,TOC(1)=0.08,XLEW=20.587,YWW=2.45,YB=2.45,
         CBAR(1)=6.38,SWMT=25.0$
  $SURFS NSURFS=1,NHT=0,NVT=0$
  $SURV  NSURV=7,NHLSV=1,FMSURV(1)=0.225,0.456,0.665,0.717,0.77,
         0.822,0.883,ALT(1)=-1.5,-2.55,5*-3.5,DHSV(1)=7*0.0,
         SWPV(1)=7*28.27,CLLO(1)=7*0.0,CLHI(1)=7*1.0,NCLAS=21$
  $STOL  IHLS=0$
  $ADJUST IVAL(1)=20*0$
 SAVE
 WING 2  NASA TN D-5805  Q/C SWEEP = 35 DEG.
 1 1
  $BODYS XCG=26.416$
  $WING  SWPLE=37.663,XLEW=20.6136,SWMT=35.$
 SAVE
 WING 3  NASA TN D-5805  Q/C SWEEP = 45 DEG.
 1 1
  $BODYS XCG=28.2$
  $WING  SWPLE=47.01,XLEW=20.964,SWMT=45.$
 SAVE
 WING 4  NASA TN D-5805     Q/C SWEEP = 35 DEG.  T/C = 0.06
 1 1 1
  $BODYS XCG=26.418$
  $WING  SWPLE=37.66,XLEW=20.6136,SWMT=35.,TOC(1)=0.06$
  $SURV  FMSURV(1)=0.292,.5,.702,.755,.807,.863,.932,
         ALT(1)=-1.8,-2.7,5*-3.6$
END
```

EMPIRICALLY BASED COMPUTER PROGRAM

TO PREDICT THE AERODYNAMIC CHARACTERISTICS

OF LARGE AIRCRAFT

WING 1 NASA TN D-5805 Q/C SWP = 25 DEG.

```
KPRINT(12) =  1
NAMELIST INPUT COMPLETED
GEOMETRY DATA DUMP,  COMMON BLKG01
  9.3592      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
  0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
  0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
  0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
   .4934       .4364       .3761       .2469       .1361       .0000      0.0000      1.2202       .3761      1.2202
  0.0000      0.0000      1.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000       .4934
  0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000       .3761
  0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
   .4000      1.5000       .5306       .6429      1.9515       .6500      0.0000       .2857      1.2956      0.0000
  1.2202      0.0000      0.0000      5.5344      0.0000      0.0000      0.0000       .4934      0.0000       .3761
  0.0000       .4364       .4934       .2469       .2381      -.1117      0.0000      2.3201      0.0000      0.0000
  0.0000
```

CONFIGURATION SUMMARY

	LENGTH (FT.)	WETTED AREA (SQ. FT.)	FR OR T/C	INTERFERENCE FACTOR	MAX. T/C SWEEP (DEG.)
BODY NUMBER 1	.06667	4.36693	9.95918	1.00000	
WING PANEL NO. 1	.53167	2.46988	.08000		25.00001

6A SERIES AIRFOIL SECTION

MACH CRITICAL TABLE

CL	MACH CRITICAL
0.0000	.8675
.1000	.8516
.2000	.8351
.3000	.8165
.4000	.7932
.5000	.7658
.6000	.7342
.7000	.6986
.8000	.6578
.9000	.6159
1.0000	.5740

WING 1 NASA TN D-5835 Q/C SWP = 25 DEG.
MACH NO. = .225 RN/FT = 1.500E+06 L.E. SWEEP ANGLE = 28.27 DEG. TAIL DEFL. (DH) = 0.00 DEG.

CL	TOTAL CD	CM	ALPHA	CD LIFT	CD RISE	CL AT DH=0	CD AT DH=0
0.000	.02049	0.00000	0.00	0.00000	0.00000	0.00000	.02049
.050	.02075	.00331	.61	.00026	0.00000	.05000	.02075
.100	.02153	.00661	1.22	.00104	0.00000	.10000	.02153
.150	.02283	.00992	1.82	.00234	0.00000	.15000	.02283
.200	.02465	.01323	2.43	.00416	0.00000	.20000	.02465
.250	.02699	.01653	3.04	.00651	0.00000	.25000	.02699
.300	.02985	.01984	3.65	.00937	0.00000	.30000	.02985
.350	.03324	.02315	4.26	.01275	0.00000	.35000	.03324
.400	.03714	.02645	4.86	.01665	0.00000	.40000	.03714
.450	.04156	.02976	5.47	.02108	0.00000	.45000	.04156
.500	.04651	.03307	6.08	.02602	0.00000	.50000	.04651
.550	.05263	.03596	6.74	.03214	0.00000	.55000	.05263
.600	.06338	.03285	7.62	.04290	0.00000	.60000	.06338
.650	.07893	.02649	8.76	.05844	0.00000	.65000	.07893
.700	.09926	-.00300	10.13	.07878	0.00000	.70000	.09926
.750	.12439	-.03951	11.78	.10390	0.00000	.75000	.12439
.800	.15430	-.09092	13.63	.13381	0.00000	.80000	.15430
.850	.18900	-.09865	20.75	.16851	0.00000	.85000	.18900
.900	.22849	-.10445	23.12	.20801	0.00000	.90000	.22849
.950	.27277	-.11026	25.73	.25229	0.00000	.95000	.27277
1.000	.32185	-.11606	28.59	.30136	0.00000	1.00000	.32185

CLA = .08223 PER DEG. ALO = 0.00000 DEG. CLOB = .53272
K = .10438 DELCL = 0.00000 CLMAX = .88178
CMO = 0.00000 CM/CL = .0661

DRAG BREAKDOWN -----

		FUSLAGE	BODIES	NACELLES	WING	HORIZ TAIL	VERT TAIL	SURFACE
FRICTION	= .01678	.00928	0.00000	0.00000	.00750	0.00000	0.00000	0.0000
FORM	= .00175	.00079	0.00000	0.00000	.00096	0.00000	0.00000	0.0000
INTERF	= .00195	.00076	0.00000	0.00000	.00119	0.00000	0.00000	0.0000
WAVE	=0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000
BASE	=0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000
CAMBER	=0.00000							
DRAG RISE	=0.00000							
MISC	=0.00000							

COMIN = .02349

4. PROGRAM AND SUBROUTINE DESCRIPTIONS

(arranged in alphabetical order)

This section contains a brief outline of the purpose and use of each program or subroutine.

Subroutine AALO

Purpose

To compute zero lift angle of attack. The zero-lift angle of attack is computed as the sum of the increments due to camber, twist and incidence.

Use

CALL AALO (SPEED)

where speed is the Mach number, the computed value of zero-lift angle is contained in COMMON BLKC01.

Subroutine ACCR

Purpose

ACCR computes the aerodynamic center at low lift and at stall for single panel wings. The subroutine also obtains the lift curve slope of the wing. The low lift aerodynamic center is obtained through use of triple-interpolation of the data presented in Figures 4.1.4.2-22 and -27 in the DATCOM.

Use

CALL ACCR (SPEED, AR, SWPLE, SWPMC, TR, SPLAN, TOC, TW, FMCRO, XACR, CLAX, XACS)

where input is

SPEED	Mach number
AR	Aspect ratio of exposed wing
SWPLE	Leading-edge sweep
SWPMC	Mid-chord sweep
TR	Taper ratio

SPAN	Exposed planform area
TOC	Thickness ratio
TW	Type airfoil section indicator
FMCRO	Zero-lift critical Mach number for complete configuration

and output is

XACR	Low lift aerodynamic center referenced to leading-edge of exposed root chord
CLAX	Lift-curve slope of exposed planform
XACS	Aerodynamic center at stall

Subroutines called

TLNT
AER2
LNTP

Subroutine ADCL

Purpose

To compute the effect of camber on the displacement of the drag polar. For Mach numbers less than 1.0, the lift coefficient for minimum profile drag is computed; for Mach numbers greater than or equal to 1.0, the lift coefficient for minimum drag is computed.

Use

```
CALL ADCL (SPEED, CLOPT)
```

where speed is the Mach number and CLOPT is the C_L for minimum profile drag subsonically. Supersonically, CLOPT is the polar displacement C_L for $C_{D_{min}}$.

Subroutine ADJUST

Purpose

The subroutine adjusts an aerodynamic parameter, y_1, to a new value, y_2, by the equation

$$y_2 = y_1 \cdot V_M + V_A$$

where V_M and V_A are correlation multiplier and adder factors determined from input. The factors V_M and V_A are a function of either Mach number or C_L.

Use

CALL ADJUST (ID, ID2, XVAR, YVAR), where

ID	Parameter identification number for Mach number cases
ID2	Parameter identification number for C_L cases
XVAR	Value of Mach number if ID greater than 0, or value of C_L if ID = 0 and ID2 greater than 0
YVAR	Input value y_1 is changed to output value y_2

Subroutines called

LNTP

Subroutine AERA

Purpose

The subroutine calculates angle of attack for a given untrimmed C_L condition. For supersonic Mach numbers the linear relation

$$\alpha = C_L/C_{L_\alpha} + \alpha_{L0}$$

is used. For subsonic conditions the angle of attack is calculated by one of three different methods depending on whether the wing is a high aspect ratio, low aspect ratio or has a cranked leading edge. For low-aspect-ratio and cranked wings the effect of vortex lift is accounted for in the angle calculations.

Use

CALL AERA (SPEED, CL, ALPHA), where

SPEED	Mach number (I)
CL	Lift coefficient (I)
ALPHA	Angle of attack (O)

Subroutines called

DLNT
LNTP

Program AERO

Purpose

This program controls the sequence of calculations required to compute the trimmed lift, drag, moment, and angle of attack for a given set of conditions. The set of conditions are contained in COMMON BLKOV3 as one Mach number, altitude, trim indicator and untrimmed lift coefficient. The trim indicator is used to determine if a fixed horizontal tail setting is specified (in which case moment is calculated) or if the tail setting is calculated to produce a zero moment. The results of the aerodynamic calculations are contained in COMMON BLKC01.

The sequence of the calling of subroutines for aerodynamic calculations is controlled by the parameter JPASS, contained in COMMON BLKOV3, which is defined by program SURVEY. The parameter JPASS is used to prevent calling certain subroutines on repeat passes through AERO if the value they calculate remains fixed. An example would be where lift is the only change in the set of conditions received from COMMON BLKOV3; in this case it is unnecessary to recompute minimum drag for each CL.

Use

CALL OVERLAY (4HOVLY,3,3)

Subroutines called

ADJUST
AERA
AERA1 (second entry point in AERA)
AFTCD
ATMOS
CDDR
CDDR1 (second entry point in CDDR)
CDL1
CDL2
CDRG
CLBRK

(AERO continued)

Subroutines called

CLWBT
CMOW
DMIN
TDRG
WBAC

Subroutine AER2

Purpose

AER2 computes the lift-curve slope for a wing surface defined by the data in COMMON BLKCLA. The lift-curve slope is computed using a modified Polhamus expression in the subsonic range which is extended to match the two-dimensional linear-theory value at high supersonic Mach numbers.

Use

CALL AER2 (SPEED, CLA), where

SPEED	is the Mach number and
CLA	is the computed lift-curve value in per degree units

Subroutine AFTCD

Purpose

Subroutine AFTCD computes the drag increment, as a function of alpha, due to the fuselage aft-end upsweep.

Use

CALL AFTCD (ALPHA, CDAFT), where

ALPHA	is the angle of attack of the wing
CDAFT	is the aft-end drag increment due to upsweep angle

Subroutines called

DLNT

Subroutine ATMOS

Purpose

Given a geometric altitude H in feet the following quantities are computed:

T - Temperature in degrees Rankin

SIGMA - Ratio of density to that at sea level

D - Density in Lb-sec^2/ft^4

THETA - Ratio of temperature to that at sea level

DELTA - Ratio of pressure to that at sea level

A - Speed of sound in ft/sec

V - Viscosity coefficient in Lb-sec/ft^2

K - Error indicator

Data represents mean annual, mid-latitude, dry air conditions. Data below altitudes of -5000 meters or greater than 90 kilometers is invalid.

The equations and tables used in computation are essentially the same as those used in computing U.S. Standard Atmosphere, 1962, and this routine maintains the same degree of accuracy as the tables in U.S. Standard Atmosphere, 1962.

Use

CALL ATMOS (H, T, SIGMA, D, THETA, DELTA, A, V, K)

Reference

U.S. Standard Atmosphere, 1962; Government Printing Office

Subroutine BDRG

Purpose

To compute the base drag of an arbitrary body. The subroutine uses an empirical equation to determine base drag.

Use

CALL BDRG (SPEED, AB, SREF, CBD), where

SPEED	Mach number (I)
AB	Base area (I)
SREF	Reference area (I)
CDB	Base drag coefficient (O)

BLOCK DATA

Purpose

To define data in COMMON blocks which represent tables and charts that are used in various subroutines.

Subroutine CDDR

Purpose

Subroutine CDDR calculates the drag rise along with defining the two limit Mach numbers and the lift-curve slope at those Mach numbers. The limit Mach numbers and associated lift-curves are used later in subroutine CDL1 to define the polar shape in the transonic region.

CDDR has two entry points, on the first pass through the constants in the drag rise equation are computed along with the two limit Mach numbers and their associated lift-curves. For subsequent passes only the drag rise is computed.

Use

CALL CDDR (CL, XMACH, RNOFT, CDR)
CALL CDDR1

Subroutines called

CLWBT
FDRG
LNTP
WDRG

Subroutine CDL1

Purpose

This subroutine calculates the constants which are used by subroutine CDL2 to determine the drag polar.

Use

CALL CDL1 (SPEED, RNOFT, FK, DELCL, PRIMEK, AKD, AKB), where

SPEED	Mach number (I)
RNOFT	Reynolds no./foot (I)
FK	Polar shape factor below polar break lift coefficient (O)
DELCL	Polar lift displacement (O)
PRIMEK	Additional drag factor for drag polar above polar break (O)
AKD	Theoretical drag-due-to-lift factor (O)
AKB	Separation drag factor used to calculate drag polar above separation lift coefficient (O)

Subroutines called

ADCL
DLNT
KGIN
LNTP

Subroutine CDL2

Purpose

This subroutine computes the drag-due-to-lift using the polar shape factors determined by subroutine CDL1 and the polar break and separation lift coefficients determined by subroutine CLBRK.

Use

CALL CDL2 (SPEED, CL, AEROK, DELCL, PRIMEK, AKD, AKB, CDL), where

SPEED	Mach number (I)
CL	Lift coefficient (I)
AEROK	Polar shape factor below polar break lift coefficient (I)
DELCL	Polar lift displacement (I)
PRIMEK	Additional drag factor for drag polar above polar break (I)
AKD	Theoretical drag-due-to-lift factor (I)
AKB	Separation drag factor (I)
CDL	Drag due to lift (O)

Subroutine CDRG

Purpose

This subroutine calculates the drag increment due to wing camber. Wing camber causes a lift displacement in the drag polar; this displacement lift increment is related to the difference between the minimum profile drag and the minimum drag of the polar.

Use

CALL CDRG (SPEED, AEROK, DELCL, CDC), where

SPEED	Mach number (I)
AEROK	Polar shape factor (I)
DELCL	Polar lift displacement (I)
CDC	Camber drag (O)

Subroutine CDWN

Purpose

This subroutine calculates the nose wave drag of body and nacelle components.

Use

CALL CDWN (AMAX, XLNOS, RIN, CDW), where

AMAX	Maximum cross-sectional area (I)
XLNOS	Length of nose (I)
RIN	Radius of inlet area (I)
CDW	Wave drag of component based on maximum cross-sectional area (O)

Subroutine called

DLNT

Subroutine CDWT

Purpose

This subroutine calculates the boattail wave drag of body and nacelle components.

Use

CALL CDWT (AMAX, XLAFT, REX, CDW), where

AMAX	Maximum cross-sectional area (I)
XLAFT	Length of boattail (I)
REX	Exit or base area (I)
CDW	Wave drag of component based on maximum cross-sectional area (O)

Subroutine called

LNTP

Subroutine CDWW

Purpose

This subroutine calculates the wave drag for airfoil surface components.

Use

CALL CDWW (CDOSR), where CDOSR is the wing wave drag based on the configuration reference area.

Also the data in COMMON BLKWPD must be defined prior to calling CDWW. The data in BLKWPD is

AR	Aspect ratio of surface based on exposed planform area
ZLAM	Taper ratio of exposed planform
ZLE	Leading-edge sweep
ZTE	Trailing-edge sweep
ZM	Mach number
SOSR	Exposed area to reference area ratio
TYPE	Airfoil type indicator
CAM	Section camber
TOC	Section thickness to chord ratio

Subroutine CFEQ

Purpose

This subroutine calculates the flat-plate skin friction coefficient using the White-Christoph technique for turbulent

flow, the Blasius relation for laminar flow, and a momentum thickness matching technique for partial laminar-turbulent flow.

Use

CALL CFEQ (RNOFT, ZMACH, CBAR, XTR, CF), where

RNOFT	Reynolds number/foot
ZMACH	Mach number
CBAR	Length
XTR	Distance along CBAR where transition occurs
CF	Skin friction coefficient

Subroutine CLBRK

Purpose

Subroutine CLBRK calculates the lift coefficients for polar break, separation drag onset, and maximum lift. The subroutine also calculates other aerodynamic parameters used in subroutine AERA to compute angle of attack as a function of C_L.

Use

CALL CLBRK (SPEED, RE, RNOFT), where

SPEED	Mach number (I)
RE	Reynolds number parameter (I)
RNOFT	Reynolds number/foot (I)

The output, contained in COMMON BLKCO1, is defined as,

CLPB	Polar break lift coefficient
CLDB	Separation lift coefficient
CLMAX	Maximum lift coefficient
ABRK	Angle of attack for polar break
AMAX	Angle of attack at CLMAX
DAMAX	Increment in angle of attack between AMAX and a linear value of alpha at CLMAX
DEL	Tail lift increment to CLMAX
CLS	Lift coefficient where CL versus alpha becomes nonlinear
ARLO	Aspect ratio limit between low AR and high AR calculations

Subroutines called

DLNT
LNTP

Subroutine CLWBT

Purpose

CLWBT controls the sequence of calculations that compute the total wing-body-tail lift curve slope, zero lift angle of attack, and the factors used to compute drag and lift increments due to a horizontal tail deflection.

Use

CALL CLWBT (SPEED), where SPEED is the Mach number, the output is contained in COMMON BLKCO1.

Subroutines called

AALO
ADJUST
AER2
TAIL

Subroutine CMOW

Purpose

Subroutine CMOW computes the moment at zero-lift for the wing-body configuration.

Use

CALL CMOW (SPEED, CMO), where

SPEED	Mach number (I)
CMO	Wing-body C_{m_o}

Subroutine called

TLNT

Subroutine CONV

Purpose

CONV converts input data to feet and radian units for the namelist input program NINPT. The subroutine makes the conversion only to the variables that are redefined in the NINPT program.

Use

```
CALL CONV
CALL CONV1
```

Subroutine CPUOV

Purpose

This subroutine calculates the pressure coefficient, C_p at x/c for an infinite sheared wing. The C_p is obtained by solving Equations (93) and (90) in the Royal Aero. Soc. TDM-6312. The arrays corresponding to $S^{(1)}(x)$, $S^{(2)}(x)$, $S^{(3)}(x)$, $S^{(4)}(x)$, and $S^{(5)}(x)$ in Equation (93) are obtained from COMMON BLKCPI and were defined in subroutine CPZT.

Use

CALL CPUOV (S, A, SWP, IV, CPI, CP, XM), where

S	Sign indicator (+1 for upper surface C_p, and -1 for lower surface C_p) (I)
A	Angle of attack (I)
SWP	Sweep angle (I)
IV	Control point, $x/c = \frac{1}{2}(1 - \cos(\frac{IV\pi}{32}))$ (I)
CPI	Incompressible C_p (O)
CP	Compressible value of C_p (O)
XM	Mach number (I)

Subroutine CPZT

Purpose

This subroutine computes the critical Mach number using the local Mach number normal to the isobar in the mid-span region

of the wing. The mid-chord sweep and the aspect ratio of the wing are used to define an effective isobar sweep. The subroutine obtains the airfoil geometry from subroutine SECT and the pressure distribution around the airfoil from subroutine CPUOV. The subroutine then uses the incompressible pressure at the crest of the airfoil and isentropic flow relationships to calculate the critical Mach number on the wing. The predicted wing critical Mach number is prevented from exceeding the critical Mach number of the fuselage which is calculated as a function of fuselage fineness ratio.

Use

CALL CPZT (ID, XMACH, TOC, CLD, SWEEP), where

ID	Type identification of the airfoil (I)
XMACH	Mach number for compressible Cp solutions (I) (set equal to 0.6 in Program MCRIT)
TOC	Airfoil section thickness ratio (I)
CLD	Airfoil section camber (I)
SWEEP	Mid-chord sweep at mid-semi-span of the wing (I)

The output which consists of a series of critical Mach number and lift combinations, [illegible]creasing from a six-degree angle of attack are contained in COMMON BLKA05.

Subroutines called

CPUOV
LNTP
SECT

Subroutine DAERO

Purpose

This subroutine computes the lift, moment and drag in free air and in ground effect of the high-lift system. Subroutine DAERO uses the incremental effect of flap and leading-edge device computed in subroutines DSET and MSET along with the clean airplane aerodynamics computed by program AERO to compute the total lift, drag and moment versus angle of attack in both free air and ground effect.

Use

CALL DAERO (ALPHA, CL, CD, CM, AGRD, CLG, CDG, CMG, H, DF), where

ALPHA	Angle of attack (I)
CL	Lift coefficient (O)
CD	Drag coefficient (O)
CM	Moment coefficient (O)
AGRD	Angle of attack in ground effect (O)
CLG	Lift coefficient in ground effect (O)
CDG	Drag coefficient in ground effect (O)
CMG	Moment coefficient in ground effect (O)
H	Height of wing $\bar{c}/4$ point above ground (I)
DF	Flap deflection (I)

Subroutines called

DLNT
LNTP

Function DLNT

Purpose

DLNT is a two-dimensional, nth-order Lagrangian interpolation procedure.

Use

CALL DLNT (XBAR, YBAR, X, Y, F, NX, NY, NXMAX, LOX, LOY), where

XBAR	The X value at which a value of the function is to be interpolated (I)
YBAR	The Y value at which a value of the function is to be interpolated (I)
X	The array of X values (I)
Y	The array of Y values (I)
F	The values of the function f(x,y) (I)
NX	The size of the X array and the F array in the X direction (I)
NY	The size of the Y array and the F array in the Y direction (I)
NXMAX	The dimension of the F array in the X direction in the calling routine (I)
LOX, LOY	Number of points to be used in the X and Y directions, respectively, in the interpolations: 1 for step, 2 for linear, 3 for parabolic, 4 for cubic, etc. (I)

Subroutine called

LNTP

Subroutine DMIN

Purpose

Subroutine DMIN controls the sequence of calculations necessary to compute minimum drag.

Use

CALL DMIN (SPEED, RNOFT, CDMIN), where

SPEED	Mach number (I)
RNOFT	Reynolds number/ft (I)
CDMIN	Minimum drag (O)

Subroutines called

ADJUST
BDRG
FDRG
WDRG

Subroutine DSET

Purpose

Subroutine DSET computes the incremental lift and drag of flaps and leading-edge devices. This subroutine uses the two-dimensional section data calculated in subroutine SSET along with the geometry of the high lift system in order to compute the incremental effect on the airplane.

Use

CALL DSET (BFI, BFO, BSI, BSO, CF), where

BFI	Inboard span station of flap (I)
BFO	Outboard span station of flap (I)
BSI	Inboard span station of leading-edge device (I)
BSO	Outboard span station of leading-edge device (I)
CF	Chord ratio of trailing-edge flap (I)

The output is contained in COMMON BLKCO2 where

DCLOF	Increment in lift at zero angle of attack due to flap deflection
DCLOS	Increment in lift at zero angle of attack due to leading-edge device
DCLMF	Increment in maximum lift due to flap deflection
DCLMS	Increment in maximum lift due to leading-edge device
DCDMIN	Increment in minimum drag due to high-lift system
DCLF	Displacement in drag polar due to flap deflection
DCLS	Displacement in drag polar due to leading-edge device
SPLANX	Planform area with high-lift system deployed
RCLA	Ratio of lift curve slope with high-lift system to clean airplane lift-curve slope.

Subroutines called

DLNT
LNTP

Subroutine FDRG

Purpose

This subroutine calculates friction, form and interference drag for all the components on the airplane.

Use

CALL FDRG (SPEED, RNOFT), where

SPEED	Mach number (I)
RNOFT	Reynolds number/ft (I)

The output is contained in COMMON BLKCO1.

Subroutines called

CFEQ
FFACT
IFACT

Subroutine FFACT

Purpose

Subroutine FFACT computes the form factors for each component.

Use

CALL FFACT (ID, GEOM, TYP, CLD, SPEED, CRITM, FF), where

ID	Identification for bodies, nacelles, or surface components (I)
GEOM	Fineness ratio for bodies and nacelle components; or thickness ratio for surface components (I)
TYP	Airfoil type identification number (I)
CLD	Airfoil camber (I)
SPEED	Mach number (I)
CRITM	Critical Mach number of configuration (I)
FF	Form factor (O)

Program GEOM

Purpose

Program GEOM computes many of the geometric parameters that are used in aerodynamic calculations. The geometry that was read in as input is used to calculate the additional geometry needed for aerodynamic calculations. The input geometry is contained in COMMON's BLKA01, BLKA02, and BLKA03 and the geometry calculated in program GEOM is output in COMMON BLKG01.

Use

CALL OVERLAY (4HOVLY, 2, 0)

Subroutine IFACT

Purpose

Subroutine IFACT computes the interference factors for each component.

Use

CALL IFACT (ID, PARM, CRITM, SPEED, FI), where

ID	Identification for bodies or surface components (I)
PARM	Fuselage Reynolds number for bodies, or maximum thickness sweep for surface components (I)
CRITM	Critical Mach number of configuration (I)
SPEED	Mach number (I)
FI	Interference factor (O)

Subroutine called

DLNT

Program INPT

Purpose

The configuration geometry and the aerodynamic conditions to be run are read in using formatted input statements. The program also converts the input data from inch and degree units to feet and radians.

Use

CALL OVERLAY (4HOVLY, 1, 1)

Subroutine KGIN

Purpose

This subroutine computes the polar shape factor and polar displacement for a drag polar with drag rise added. A least-squares, second-degree curve is fitted to the drag polar with drag rise. This is needed by subroutine CDL1 in order to interpolate the polar shape in the transonic region between M_{L1} and M_{L2}.

Use

CALL KGIN (CLDB, AKIN, DECLIN, SPEED, AKOUT, DCLOUT), where

CLDB	Upper C_L limit for polar calculation (I)
AKIN	Polar shape factor without drag rise (I)
DECLIN	Polar displacement C_L without drag rise (I)

SPEED	Mach number (I)
AKOUT	Equivalent polar shape factor with drag rise (O)
DCLOUT	Equivalent polar displacement with drag rise (O)

Subroutines called

CDDR1
LSPCF

Subroutine LNTP

Purpose

LNTP is a one-dimensional, nth-order Lagrangian interpolation procedure.

Use

CALL LNTP (XBAR, YBAR, X, Y, M, NO), where

XBAR	The abscissa value at which an ordinate is to be interpolated (I)
YBAR	The interpolated ordinate (O)
X	The array of abscissas (I)
Y	The array of ordinates (I)
M	The size of the arrays (I)
NO	The number of points to be used in the interpolation. NO=1 for step, NO=2 for linear, NO=3 for parabolic, NO=4 for cubic, etc. (I)

Program LSHL

Purpose

LSHL controls the sequence of calculations to produce lift, moment, and drag variations with angle of attack for each low-speed, high-lift survey condition specified by the input. For each high-lift survey, the program computes the incremental effect for an inboard and an outboard high-lift system segment. The program then sets up a DO LOOP to calculate the total lift, drag and moment for changing angle of attack up to $C_{L_{MAX}}$.

Use

CALL OVERLAY (4HOVLY, 3, 4)

Subroutines called

DAERO
DSET
MSET
SSET

Program MCRIT

Purpose

Program MCRIT constructs a table of critical Mach number versus C_L from either an input table or by using an empirical method.

Use

CALL OVERLAY (4HOVLY, 3, 2)

Subroutines called

ADJUST
CPZT
LNTP

Program MRIT (MAIN PROGRAM)

Purpose

This program controls the logic of the calling of the three primary overlays. The lengths of the principal COMMON blocks used in all three overlays are also specified in this program.

Programs called

OVERLAY(4HOVLY, 1, 0)	(XINPT)
OVERLAY(4HOVLY, 2, 0)	(GEOM)
OVERLAY(4HOVLY, 3, 0)	(SURVEY)

Subroutine MSET

Purpose

Subroutine MSET computes the incremental moment at zero lift of flaps and leading-edge devices. This subroutine uses the two-dimensional section data calculated in Subroutine SSET along with the geometry of the high-lift system in order to compute the incremental effect on the airplane.

Use

CALL MSET (BFI, BFO, BSI, BSO), where

BFI	Inboard span station of flap (I)
BFO	Outboard span station of flap (I)
BSI	Inboard span station of leading-edge device (I)
BSO	Outboard span station of leading-edge device (I)

The output is contained in COMMON BLKC2 where,

DCMO	Increment in C_{m_0} due to high-lift system
CDMCL	Increment in slope of the moment versus lift curve

Subroutines called

DLNT

Subroutine MTXEQ

Purpose

MTXEQ solves a set of simultaneous equations. This subroutine will solve the matrix equation AX = B for the unknown matrix X. The dimensions of the matrices must be:

A: NxN B: NxM

where M is the number of B vectors to be transformed into X vectors. At the same time, this subroutine computes a scaled version of the determinant of the matrix A.

The solution of the matrix equation AX = B is accomplished by upper triangularizing the A matrix using a maximum row element as a pivot point for each stage in the reduction of the matrix A.

This entails searching in the first column of the reduced (N-K) x (N-K) A matrix for the element whose absolute value is the largest. A row interchange is then performed to bring this element into the A_{KK} position. After completion of the triangularization, back substitution is used to obtain the X matrix.

Use

CALL MTXEQ (A, X, B, N, K), where

A	The array containing the elements of the matrix A. Array A must have dimensions NxN.
X	The array containing the elements of the matrix X. Array X must have dimensions NxK.
B	The array containing the elements of the matrix B. Array B must have dimensions NxK.
N	Number of columns and rows in the matrix A.
K	Number of columns in the matrix B and X.

Program NINPT

Purpose

The configuration geometry and the aerodynamic conditions to be run are read in using NAMELIST input statements. The program calls subroutine CONV to convert the input data to feet and radians units. For cases which are to be rerun with only a slight change in input from the previous case, an indicator is used to read only certain sets of namelist data.

Use

CALL OVERLAY (4HOVLY, 1, 2)

Subroutines called

CONV
CONV1 (second entry point in CONV)

Subroutine PLSQ

Purpose

To fit a polynomial of degree K to the set of points (X_i, Y_i) for $i = 1, \ldots, N$, by the method of least squares.

The method of solution is as follows:

Given a set of N points, coefficients are found such that:

$$Y = C(K+1) + C(K)\cdot X + C(K-1)\cdot X^2 + \ldots$$

$$+ C(\ )\cdot X^{K-1} + C(1)\cdot X^K$$

is the best least-square fit to Y_i for an Kth degree fit.

PLSQ solves the regression matrix equation by calling MTXEQ.

Use

CALL PLSQ (X, Y, N, K, C, LIST, EMAX, ERMS, EMEQ), where

X	Array of N independent variables
Y	Array of N dependent variables
N	Number of variables
K	Degree of the least-squares polynomial
C	Array of coefficients, high order to low order, of the least-squares polynomial
LIST	Error analysis output indicator =0 suppresses error analysis printout =1 prints error analysis
EMAX	Maximum absolute error obtained by using the least-square fit polynomial to approximate the dependent variable
ERMS	RMS error obtained by using the least-square fit polynomial
EMEQ	Maximum derivation from unity in the linear system check solution

Subroutine called

MTXEQ

Subroutine SECT

Purpose

Subroutine SECT calculates the thickness and camber airfoil ordinates which are used in subroutine CPZT to calculate pressure distributions. SECT can calculate, using internal methods, the section data for the standard NACA 6-series and 4-digit airfoils along with a biconvex and Whitcomb's supercritical airfoil. The subroutine can also obtain the airfoil ordinates at the control points, x/c, needed for pressure solutions by interpolation on a table of input ordinates.

Use

CALL SECT (ID, TOC, CLD), where

ID	Airfoil section identification number (I)
TOC	Airfoil thickness ratio (I)
CLD	Airfoil camber (I)

The output is contained in COMMON BLKR07.

Subroutine called

LNTP

Subroutine SETUP

Purpose

Places initial values of 0.0 in the input and geometry common blocks. This is done to prevent indeterminate values to be used in program calculations if input data did not specify values.

Use

CALL SETUP

Subroutine SSET

Purpose

Subroutine SSET computes the two-dimensional section data used in subroutines DSET and MSET to compute the incremental lift, drag and moment due to a high-lift system. SSET either computes the two-dimensional increments using a empirical modification of thin-airfoil theory, or SSET obtains the two-dimensional increments from input data if available.

Use

CALL SSET (DF, DS, CFOC, CSOC, OTE, ROT), where

DF	An array containing the flap deflection of each element of the trailing-edge flap (I)
DS	Deflection of the leading-edge device (I)
CFOC	An array containing the chord length ratios of each element of the trailing-edge flap (I)
CSOC	Chord length ratio of the leading-edge device (I)
OTE	Airfoil trailing-edge angle (I)
ROT	Airfoil leading-edge radius divided by thickness (I)

The output is contained in COMMON BLKC01, where

DC1F	Two-dimensional increment in lift at zero angle of attack due to flap deflection
DC1MF	Two-dimensional increment in maximum lift due to flap deflection
DCDFS	Increment in profile drag due to flap deflection
DCMFS	Two-dimensional increment in momentum at zero alpha due to flap deflection
DC1S	Two-dimensional increment in lift at zero angle of attack due to leading-edge device
DC1MS	Two-dimensional increment in maximum lift due to leading-edge device
DCDSS	Increment in profile drag due to leading-edge device

DCDMSS Two-dimensional increment in moment at zero alpha due to leading-edge device

Subroutines called

DLNT
LNTP

Program SURVEY

Purpose

SURVEY controls the sequence of calculations to produce a lift, moment and drag variation for each high-speed survey condition specified by the input.

For variable sweep configurations the program will first call program VGEOM with the wing leading-edge sweep set at the forward position and then recall program VGEOM with the sweep set at the aft position. This is done in order to setup program VGEOM for geometry calculations at any arbitrary sweep position. SURVEY then enters a DO LOOP where the high sweep survey conditions are set up. SURVEY calls VGEOM and MCRIT to recalculate the geometry and the configuration critical Mach number each time the leading-edge sweep is changed in a survey. SURVEY then enters an inner DO LOOP where a sequence of untrimmed C_L are generated and program AERO is called to obtain the trimmed lift, moment and drag. SURVEY then prints out the results.

If a series of low-speed, high-lift surveys were specified by the input, SURVEY then calls program LSHL to perform those calculations.

Use

CALL OVERLAY (4HOVLY, 3, 0)

Programs called

OVERLAY(4HOVLY, 3, 1)	(VGEOM)
OVERLAY(4HOVLY, 3, 2)	(MCRIT)
OVERLAY(4HOVLY, 3, 3)	(AERO)
OVERLAY(4HOVLY, 3, 4)	(LSHL)

Subroutine TAIL

Purpose

Subroutine TAIL computes the lift curve slope contribution of the tail along with factors used to compute lift and drag increments due to a horizontal tail deflection. These factors are computed by first solving for the downwash, dynamic-pressure, exposed area lift-curve slope, carry-over lift factors and induced drag for the tail.

Use

CALL TAIL (SPEED), where SPEED is the input Mach number.

The output, contained in COMMON BLKC01, is

CLAT	Lift-curve slope contribution of the tail
A	Trim drag factor
B	Trim drag factor
AOH	Angle of zero lift of the tail
CLDH	Change in lift due to tail deflection factor
DEDA	Change in downwash per change in angle of attack

Subroutines called

AER2
LNTP

Subroutine TDRG

Purpose

Subroutine TDRG calculates moment using the wing-body C_{m_0} and aerodynamic center along with the tail lift and moment arm. Depending upon user options the moment can be calculated at a fixed horizontal tail setting, or a tail setting can be computed which will trim out the moment. Lift and drag increments due to tail deflection are also computed.

Use

CALL TDRG (ITRIM, SPEED, DCLT, DCDT), where

ITRIM	Trim indicator, =0 if tail setting specified by input, =1 if tail setting is to be computed to trim out moment
SPEED	Mach number
DCLT	Increment in lift due to tail deflection relative to zero tail setting
DCDT	Increment in drag due to tail deflection relative to zero tail setting

Subroutine TLNT

Purpose

TLNT is a triple-linear interpolation procedure.

Use

CALL TLNT (XBAR, YBAR, ZBAR, FBAR, X, Y, Z, F, NX, NY, NZ, NXMAX, NYMAX), where

XBAR	The X value at which a value of the function is to be interpolated (I)
YBAR	The Y value at which a value of the function is to be interpolated (I)
ZBAR	The Z value at which a value of the function is to be interpolated (I)
FBAR	The interpolated value of the function F(X,Y,X) (I)
X	The array of X values (I)
Y	The array of Y values (I)
Z	The array of Z values (I)
F	The three-dimension array F values (I)
NX	The size of the X array and the F array in the X direction (I)
NY	The size of the Y array and the F array in the Y direction (I)
NZ	The size of the Z array and the F array in the Z direction (I)
NXMAX	The dimension of the F array in the X direction in the calling routine (I)
NYMAX	The dimension of the F array in the Y direction in the calling routine (I)

Subroutines called

DLNT, LNTP

Program VGEOM

Purpose

Program VGEOM computes the geometry parameters that vary with wing sweep for variable-sweep configurations. The program is first called by program SURVEY at the forward and most aft sweep positions in order to set up VGEOM for any arbitrary sweep calculation.

Use

CALL OVERLAY (4HOVLY, 3, 1)

Subroutine WBAC

Purpose

Subroutine WBAC computes the aerodynamic center location for wing-body configurations. The subroutine calculates the aerodynamic center of the wing carry-over lift on the body, and the aerodynamic center of the forebody. A composite aerodynamic center is then computed using the aerodynamic center and lift curve slope of each component.

Use

CALL WBAC (SPEED, XACR), where

SPEED	Mach number (I)
XACR	Aerodynamic center of the wing-body configuration reference to the leading edge of the exposed root chord

Subroutines called

ACCR
DLNT
LNTP

Subroutine WDRG

Purpose

This subroutine calculates the wave drag for all the components on the airplane.

Use

CALL WDRG (FMACH), where

FMACH Mach number

The output is contained in COMMON BLKC01.

Subroutines called

CDWN
CDWT
CDWW

Program XINPT

Purpose

XINPT controls the sequence of input for new problems or allows the previous problem to be repeated with only a small change in input. For each new problem the title card, print dump card, and input control card are read from the input file. The subroutine SETUP is then called to zero out all the input common blocks, then depending upon the input control card either of the secondary overlay programs INPT or NINPT are then called to continue reading the input file. After the input file is read for a given problem, control is then transferred back to MRIT where the solution to the problem is obtained. After each solution is obtained control is then transferred back to XINPT and the repeat problem control card is then read. If end-of-file on tape 5 is read the program is terminated. If a perturbation of the previous problem is indicated, NINPT is called where the revised input is then read.

Use

CALL OVERLAY (4HOVLY, 1, 0)

Programs called

```
SETUP
OVERLAY(4HOVLY, 1, 1)          (INPT)
OVERLAY(4HOVLY, 1, 2)          (NINPT)
EXIT
```

5. PROGRAM LISTING

```
      OVERLAY (OVLY,0,0)                                                R1T0001
      PROGRAM MR1T(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)               R1T0002
C     LARGE AIRCRAFT AERODYNAMIC PREDICTION PROCEDURE                   R1T0003
C                                                                       R1T0004
      COMMON /BLKA01/ N4(7)                                             R1T0005
      COMMON /BLKA02/ A02(433)                                          R1T0006
      COMMON /BLKA03/ A03(20)                                           R1T0007
      COMMON /BLKA04/ N3(3), A04(78)                                    R1T0008
      COMMON /BLKA05/ A05(131), NMCR, NXSET                             R1T0009
      COMMON /BLKSUR/ N1(42), SUR(370)                                  R1T0010
      COMMON /BLKHLS/ N2, HLS(70)                                       R1T0011
      COMMON /BLKG01/ G1(200)                                           R1T0012
      COMMON /BLKPRT/ KPRINT(50)                                        R1T0013
      COMMON /BLKADJ/ ADJ(322)                                          R1T0014
      COMMON /BLKTIL/ TITLE(6)                                          R1T0015
      COMMON /BLKOV1/ IJ                                                R1T0016
C                                                                       R1T0017
   15 IJ     = 0                                                        R1T0021
   20 CALL OVERLAY(4HOVLY,1,0)                                          R1T0022
C                                                                       R1T0023
      CALL OVERLAY(4HOVLY,2,0)                                          R1T0024
      CALL OVERLAY(4HOVLY,3,0)                                          R1T0025
C                                                                       R1T0026
      GO TO 20                                                          R1T0027
C                                                                       R1T0028
      END                                                               R1T0029

                                                        CC = 00026
```

```
      SUBROUTINE LNTP(XBAR,YBAR,X,Y,M,NO)                                R1T0031
C                                                                        R1T0032
C     LAGRANGIAN INTERPOLATION                                           R1T0033
C           1) INCREASING OR DECREASING X ARRAY                          R1T0034
C           2) LINEAR EXTRAPOLATION ONLY                                 R1T0035
C           3) NO = NUMBER OF POINTS USED IN INTERPOLATION               R1T0036
C           4) M  = TOTAL NUMBER OF POINTS IN X ARRAY                    R1T0037
C           5) IF(NO.LE.0.OR.M.LE.0) YBAR = 0.0                          R1T0038
C           6) IF(M.EQ.1.AND.NO.GT.0) YBAR=Y(1)                          R1T0039
C           7) IF(NO.EQ.1.AND.M.GT.0) YBAR=Y(NEAREST X(I))               R1T0040
C           8) IF(NO.GT.M) INTERPOLATION AS IF NO=M                      R1T0041
C                                                                        R1T0042
      DIMENSION  X(M) , Y(M)                                             R1T0043
C                                                                        R1T0044
      YBAR=0.0                                                           R1T0045
      N=NO                                                               R1T0046
      IF(N.GT.M) N=M                                                     R1T0047
      IF(M.LE.0.OR.N.LE.0) RETURN                                        R1T0048
      IF(M.GT.1) GO TO 10                                                R1T0049
      YBAR=Y(1)                                                          R1T0050
      RETURN                                                             R1T0051
C                                                                        R1T0052
   10 MDC=0                                                              R1T0053
      IF(X(M).LT.X(1)) MDC=1                                             R1T0054
      DO 20 I=2,M                                                        R1T0055
      I1=I-1+MDC                                                         R1T0056
      I2=I-MDC                                                           R1T0057
      IF(XBAR.GE.X(I1).AND.XBAR.LE.X(I2)) GO TO 40                       R1T0058
   20 CONTINUE                                                           R1T0059
      I1=1                                                               R1T0060
      IF((MDC.EQ.0.AND.XBAR.GE.X(M)).OR.(MDC.NE.0.AND.XBAR.LE.X(M)))     R1T0061
     1   I1=M-1                                                          R1T0062
      I2=I1+1                                                            R1T0063
      GO TO 45                                                           R1T0064
C                                                                        R1T0065
   40 IF(N.GT.2) GO TO 60                                                R1T0066
   45 IF(N.LT.2) GO TO 55                                                R1T0067
   50 YBAR=Y(I1)+(XBAR-X(I1))*(Y(I2)-Y(I1))/(X(I2)-X(I1))                R1T0068
      RETURN                                                             R1T0069
C                                                                        R1T0070
   55 YBAR=Y(I1)                                                         R1T0071
      IF(ABS(XBAR-X(I2)).LT.ABS(XBAR-X(I1))) YBAR=Y(I2)                  R1T0072
      RETURN                                                             R1T0073
C                                                                        R1T0074
   60 J=I-N/2                                                            R1T0075
      IF(I.LE.N/2+1) J=1                                                 R1T0076
      IF(I.GT.M-N/2) J=M-N+1                                             R1T0077
      NT=N+J-1                                                           R1T0078
C                                                                        R1T0079
      DO 80 I=J,NT                                                       R1T0080
      ELL=1.0                                                            R1T0081
      DO 70 K=J,NT                                                       R1T0082
      IF(K.NE.I) ELL=ELL*(XBAR-X(K))/(X(I)-X(K))                         R1T0083
   70 CONTINUE                                                           R1T0084
   80 YBAR=YBAR+ELL*Y(I)                                                 R1T0085
      RETURN                                                             R1T0086
```

```
                                                                    R1T0087
                                                                    R1T0088
C
      END
                                                                CC = 00058
```

```
      FUNCTION DLNT (XBAR,YBAR,X,Y,F,NX,NY,NXMAX,LOX,LOY)
C
C     DOUBLE LAGRANGE INTERPOLATION
C
      DIMENSION X(1),Y(1),F(NXMAX,1),FT(25)
C
      FBAR=0.0
      IF(LOY.GT.25) LOY=25
      LLX=LOX
      IF(LOX.GT.NX) LLX=NX
      IF(NY.GT.1) GO TO 10
      CALL LNTP (XBAR,FBAR,X,F(1,1),NX,LLX)
      GO TO 30
C
   10 LLY=LOY
      IF(LOY.GT.NY) LLY=NY
      DO 20 I=1,NY
      CALL LNTP (XBAR,FT(I),X,F(1,I),NX,LLX)
   20 CONTINUE
      CALL LNTP (YBAR,FBAR,Y,FT,NY,LLY)
C
   30 DLNT=FBAR
C
      RETURN
      END
```

CC = 00025

```
      SUBROUTINE TLNT(XBAR,YBAR,ZBAR,FBAR,X,Y,Z,F,NX,NY,NZ,NXMAX,NYMAX) R1T0116
C                                                                       R1T0117
C         TRIPLE LINEAR INTERPOLATOR                                    R1T0118
C                                                                       R1T0119
      DIMENSION X(1),Y(1),Z(1),F(NXMAX,NYMAX,1),FT(25)                  R1T0120
C                                                                       R1T0121
      DO 10  I=1,NZ                                                     R1T0122
C                                                                       R1T0123
   10 FT(I)  = DLNT(XBAR,YBAR,X,Y,F(1,1,I),NX,NY,NXMAX,2,2)             R1T0124
C                                                                       R1T0125
      CALL LNTP(ZBAR,FBAR,Z,FT,NZ,2)                                    R1T0126
C                                                                       R1T0127
      RETURN                                                            R1T0128
      END                                                               R1T0129
                                                              CC = 00014
```

```
      OVERLAY(1,0)                                                      R1T0131
      PROGRAM XINPT                                                     R1T0132
C                                                                       R1T0133
      COMMON /BLKPRT/ KPRINT(50)                                        R1T0134
      COMMON /BLKTIL/ TITLE(6)                                          R1T0135
      COMMON /BLKOV1/ IJ                                                R1T0136
C                                                                       R1T0137
      DIMENSION W(4), IS(12)                                            R1T0138
      DATA  W  / 4HFORM, 4HNAME, 4HSAVE, 4HEND /                        R1T0139
C                                                                       R1T0140
      IF( IJ.GE.1 ) GO TO 70                                            R1T0141
   20 CONTINUE                                                          R1T0142
C                                                                       R1T0143
C                                                                       R1T0145
      READ(5,1000) (TITLE(I), I = 1,6 )                                 R1T0146
      IF (EOF(5).NE.0) CALL EXIT                                        R1T0147
      WRITE(6,2000) (TITLE(I), I= 1,6 )                                 R1T0148
C                                                                       R1T0149
      READ(5,1001) (KPRINT(I), I=1,50)                                  R1T0150
C                                                                       R1T0151
      DO 50 I = 1, 50                                                   R1T0152
      IF( KPRINT(I).GT.0 ) WRITE(6,2001) I, KPRINT(I)                   R1T0153
   50 CONTINUE                                                          R1T0154
      CALL SETUP                                                        R1T0155
C                                                                       R1T0156
      IJ     = 1                                                        R1T0157
   70 READ(5,1002) WORD                                                 R1T0158
      IF( EOF(5).NE.0 ) CALL EXIT                                       R1T0159
      IF( WORD.EQ.W(1) ) CALL OVERLAY(4HOVLY,1,1)                       R1T0160
      IF( WORD.EQ.W(2) ) IJ = 1                                         R1T0161
      IF( WORD.EQ.W(2) ) CALL OVERLAY(4HOVLY,1,2)                       R1T0162
      IF( WORD.EQ.W(3) ) IJ = 2                                         R1T0163
      IF( WORD.EQ.W(3) ) CALL OVERLAY(4HOVLY,1,2)                       R1T0164
      IF( WORD.EQ.W(4) ) GO TO 20                                       R1T0165
C                                                                       R1T0166
 1000 FORMAT( 6A10 )                                                    R1T0167
 1001 FORMAT( 50I1 )                                                    R1T0168
 1002 FORMAT( A4 )                                                      R1T0169
 2000 FORMAT(1H1,/////, 27X,*EMPIRICALLY BASED COMPUTER PROGRAM* //     R1T0170
     1                  23X,*TO PREDICT THE AERODYNAMIC CHARACTERISTICS*R1T0171
     2  //              35X,*OF LARGE AIRCRAFT* (10(/)), 27X, 6A10 )    R1T0172
 2001 FORMAT(5X,*KPRINT(*,I2,*) = *,I2)                                 R1T0173
C                                                                       R1T0174
      END                                                               R1T0175
```

CC = 00044

```
      SUBROUTINE SETUP                                                  R1T0177
C                                                                       R1T0178
C     ZEROES OUT INPUT COMMON BLOCKS                                    R1T0179
C                                                                       R1T0180
      COMMON /BLKA01/ N(7)                                              R1T0181
      COMMON /BLKA02/ A02(433)                                          R1T0182
      COMMON /BLKA03/ A03(20)                                           R1T0183
      COMMON /BLKA04/ N3(3), A04(78)                                    R1T0184
      COMMON /BLKSUR/ N1(42), SUR(370)                                  R1T0185
      COMMON /BLKHLS/ N2, HLS(70)                                       R1T0186
      COMMON /BLKADJ/ IVAL(20),X(15),YM(135),YA(135),XCL(15),NXVAR,NXCL R1T0187
      COMMON /BLKG01/ G1(200)                                           R1T0188
C                                                                       R1T0189
      N2     = 0                                                        R1T0190
      NXVAR  = 1                                                        R1T0191
      NXCL   = 1                                                        R1T01911
C                                                                       R1T0192
      DO 10 I = 1, 20                                                   R1T0193
      A03(I) = 0.0                                                      R1T0194
      IVAL(I)= 0                                                        R1T0195
      IF( I.LE.3 ) N3(I) = 0                                            R1T0196
      IF ( I.LE.7 ) N(I) = 0                                            R1T0197
      IF ( I.LE.15) X(I) = 0.0                                          R1T0198
      IF( I.LE.15) XCL(I) = 0.0                                         R1T01991
   10 CONTINUE                                                          R1T0199
C                                                                       R1T0200
      DO 20 I = 1, 433                                                  R1T0201
      A02(I) = 0.0                                                      R1T0202
      IF( I.LE.41 ) N1(I) = 0                                           R1T0203
      IF( I.LE.50 ) HLS(I) = 0.0                                        R1T0204
      IF( I.LE.78 ) A04(I) = 0.0                                        R1T0205
      IF( I.LE.140) SUR(I) = 0.0                                        R1T0206
      IF( I.LE.200 ) G1(I) = 0.0                                        R1T0207
      IF( I.GT.135) GO TO 20                                            R1T0208
      YM(I)  = 1.0                                                      R1T0209
      YA(I)  = 0.0                                                      R1T0210
   20 CONTINUE                                                          R1T0211
C                                                                       R1T0212
      DO 30 I = 1, 20                                                   R1T0213
      I1     = I + 44                                                   R1T0214
      I2     = I + 204                                                  R1T0215
      I3     = I + 379                                                  R1T0216
      A02(I1) = 1.0                                                     R1T0217
      A02(I2) = 1.0                                                     R1T0218
      IF( I.LE.10 ) A02(I3) = 1.0                                       R1T0219
   30 CONTINUE                                                          R1T0220
C                                                                       R1T0221
      RETURN                                                            R1T0222
      END                                                               R1T0223
```

CC = 00049

```
      OVERLAY(1,1)                                                      R1T0225
      PROGRAM INPT                                                      R1T0226
C                                                                       R1T0227
C     PROBLEM DATA INPUT                                                R1T0228
C                                                                       R1T0229
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS      R1T0230
      COMMON /BLKA02/ SREF, AR, TAPR, SWPLE,                            R1T0231
     1                BLEN(10), BWID(10), BHGT(10), BAWET(10), BC(10),  R1T0232
     2                BNO(10), BAMX(10), BABS(10), BLNS(10), BLBT(10),  R1T0233
     3                BASE(10),  ELEN(10), EWID(10), EHGT(10),          R1T0234
     4                EAWET(10), EAMX(10), EIN(10), EXIT(10), ELNS(10), R1T0235
     5                ELBT(10), EQF(10), ENO(10), CBAR(10), TW,         R1T0236
     5                XLEW, YWW, YB, CR, BO2, BFUS, FMISC, AB, AFTAW,   R1T0237
     6                CAM(10), TOC(10), AWET(10), SWMT, SPLAN, CCNCL,   R1T0238
     7                TWIST, ETWIST, WINC, XLE(11), CRW(11), YW(11),    R1T0239
     8                XPIVOT, YPIVOT, XAPEX, AFTSW, AFTCB, AFTOC,       R1T0240
     9                SBAR(10), TS(10), SCAM(10), STOC(10), SAWET(10),  R1T0241
     1                SMTSW(10), SHF(10), SWL(10), SWT(10), STAPR(10),  R1T0242
     2                SCR(10), HTLE, HTY, HTZ, HTINC                    R1T0243
      COMMON /BLKA03/ ROUGHK,CLE(3),CCR(3),YC(3),XCG,ZCG,CMAC,IREF,A1(6)R1T0244
      COMMON /BLKA04/ IHLS, NF, NS, FLAP, SLAT, DF(5), CFOC(5),         R1T0245
     1                DCLOF(5), DCLMF(5), DCDF(5), DCMOF(5),            R1T0246
     2                DS(5), CSOC(5), DCLOS(5), DCLMS(5), DCDS(5),      R1T0247
     3                DCMOS(5), BF1I, BF1O, CF1(3), BF2I, BF2O, CF2(3), R1T0248
     4                BS1I, BS1O, CS1, BS2I, BS2O, CS2                  R1T0249
      COMMON /BLKA05/ XMU,ZMU,XML,ZML,ZPTE,ZTHICK,                      R1T0250
     1                RLE, OTE, DY, XMT, DYC,                           R1T0251
     2                C1MAX, CLMCR(10), XMCR(10),                       R1T0252
     3                XT(33), YT(33),XYC(33), NMCR, NXSET               R1T0253
C                                                                       R1T0254
      COMMON /BLKSUR/ NSURV, NCLAS, IT(20), ITRM(20), FMSURV(20),       R1T0255
     1                ALT(20), DHSV(20), SWPV(20), CLLO(20), CLHI(20),  R1T0256
     2                TRB(5,10), TRN(5,10), TRU(5,10), TRL(5,10),       R1T0257
     3                TRS(5,10)                                         R1T0258
      COMMON /BLKHLS/ NHLSV, DFI(3,5), CPF(5), DSI(5), CPS(5),          R1T0259
     1                DELCD(5), H(5), DFI2(3,5), CPF2(5), DSI2(5),      R1T0260
     2                CPS2(5)                                           R1T0261
C                                                                       R1T0262
      COMMON /BLKADJ/ IVAL(20),X(15),YM(15,9),YA(15,9),XCL(15),         R1T0263
     1                NXVAR, NXCL                                       R1T0264
C                                                                       R1T0265
      DIMENSION W(10), TTT(22), TS1(10), TS3(10)                        R1T0266
C                                                                       R1T0267
      DATA  W   / 4HPLAI, 4HS.S., 4HD.S., 4HT.S., 4HINPU, 4HL.E.,       R1T0268
     1            4HSLAT, 4HKRUE, 4HINPU, 4HADJU/                       R1T0269
      DATA  TTT / 3H63-,3H64-,3H65-,3H66-,3H63A,3H64A,3H65A,3HSUP,3HBIC,R1T0270
     1            3H-62,3H-63,3H-64,3H-65,3H-66,3H-33,3H-34,3H-35,3H-93,R1T0271
     2            3H-94,3H-95,3HINP,3H2IN /                             R1T0272
      DATA  TS1 / 10*0.0 /, TS3 / 10* 0.0 /                             R1T0273
C                                                                       R1T0274
C     CONFIGURATION DEFINITION                                          R1T0275
C                                                                       R1T0276
  100 READ(5,1001) NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS, IHLS,  R1T0277
     1             IREF                                                 R1T0278
      WRITE(6,2000) NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS        R1T0279
C                                                                       R1T0280
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      READ(5,1000) SREF, CMAC, XCG, ZCG, ROUGHK, FMISC                  R1T0281
      WRITE(6,2001) SREF, CMAC, XCG, ZCG                                R1T0282
C                                                                       R1T0283
      IF( NBODYS.EQ.0 ) GO TO 120                                       R1T0284
      DO 110 I = 1, NBODYS                                              R1T0285
      READ(5,1000) BLEN(I), BWID(I), BHGT(I), BAWET(I), BQ(I), BNO(I)   R1T0286
      IF( I.EQ.1 ) READ(5,1008) BAMX(I), BABS(I), BLNS(I), BLBT(I),     R1T0287
     1                 BASE(I), BFUS, AB                                R1T0288
      IF( I.NE.1 ) READ(5,1000) BAMX(I), BABS(I), BLNS(I), BLBT(I),     R1T0289
     1                          BASE(I)                                 R1T0290
C                                                                       R1T0291
      IF( BQ(I).EQ.0.0 ) BQ(I) = 1.0                                    R1T0292
      IF( BNO(I).EQ.0.0) BNO(I) =1.0                                    R1T0293
      IF( I.EQ.1 ) WRITE(6,2002)                                        R1T0294
      WRITE(6,2003) I,BLEN(I),BWID(I),BHGT(I),BAWET(I),BAMX(I),BABS(I), R1T0295
     1              BLNS(I),BLBT(I),BASE(I),BQ(I), BNO(I)               R1T0296
C                                                                       R1T0297
  110 CONTINUE                                                          R1T0298
C                                                                       R1T0299
  120 IF( NNACS.EQ.0 ) GO TO 140                                        R1T0300
      DO 130 I = 1, NNACS                                               R1T0301
      READ(5,1000) ELEN(I), EWID(I), EHGT(I), EAWET(I), EQF(I), ENO(I)  R1T0302
      READ(5,1000) EAMX(I), EIN(I), EXIT(I), ELNS(I), ELBT(I)           R1T0303
C                                                                       R1T0304
      IF( EQF(I).EQ.0.0 ) EQF(I) = 1.0                                  R1T0305
      IF( ENO(I).EQ.0.0 ) ENO(I) = 1.0                                  R1T0306
      IF( I.EQ.1 ) WRITE(6,2004)                                        R1T0307
      WRITE(6,2003) I,ELEN(I),EWID(I),EHGT(I),EAWET(I),EAMX(I),EIN(I),  R1T0308
     1                EXIT(I),ELNS(I),ELBT(I),EQF(I), ENO(I)            R1T0309
C                                                                       R1T0310
  130 CONTINUE                                                          R1T0311
C                                                                       R1T0312
  140 IF( NPNLS.GT.1 ) GO TO 145                                        R1T0313
      READ(5,1000) AR, TAPR, SWPLE, SPLAN, TWIST, WINC                  R1T0314
      WRITE(6,2006) AR, TAPR, SWPLE, SPLAN, TWIST, WINC                 R1T0315
      READ(5,1004) TW1,TW2,TW3,CAM(1),TOC(1),XLEW,YWW, YB               R1T0316
      READ(5,1000) SWMT, CBAR(1), AWET(1), CONCL                        R1T0317
C                                                                       R1T0318
      WRITE(6,2008) TW1,TW2,TW3, CAM(1), TOC(1), XLEW, YWW, YB,         R1T0319
     1              SWMT, CBAR(1), AWET(1)                              R1T0320
      GO TO 160                                                         R1T0321
C                                                                       R1T0322
  145 READ(5,1000) SPLAN, TAPR, SWPLE                                   R1T0323
      READ(5,1004) TW1,TW2,TW3, TWIST, WINC, SWMT, CONCL                R1T0324
      WRITE(6,2009) TW1,TW2,TW3, TWIST, WINC, SWMT                      R1T0325
      IF( ISWP.GT.0 ) WRITE(6,2010) SPLAN, TAPR, SWPLE                  R1T0326
C                                                                       R1T0327
      DO 150 I = 1, NPNLS                                               R1T0328
      IF( I.EQ.1 ) WRITE(6,2011)                                        R1T0329
      READ(5,1008) CAM(I), TOC(I), XLE(I), YW(I), CRW(I),               R1T0330
     1             CBAR(I), AWET(I)                                     R1T0331
      WRITE(6,2003)      I, CAM(I), TOC(I), XLE(I), YW(I), CRW(I),      R1T0332
     1              CBAR(I), AWET(I)                                    R1T0333
C                                                                       R1T0334
  150 CONTINUE                                                          R1T0335
      I       = 1 + NPNLS                                               R1T0336
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      READ(5,1000) XLE(I), YW(I), CRW(I)                                R1T0337
      WRITE(6,2012) XLE(I), YW(I), CRW(I)                               R1T0338
C                                                                       R1T0339
  160 IF( TW1.EQ.TTT(8) ) READ(5,1000) XMU,ZMU,XML,ZML,ZPTE,ZTHICK      R1T0340
C                                                                       R1T0341
      IF( TW1.EQ.TTT(21).OR.TW1.EQ.TTT(22) ) READ(5,1000)               R1T0342
     1          RLE, OTE, DY, XMT, DYC, C1MAX                           R1T0343
      IF( TW1.EQ.TTT(21) ) READ(5,1009) NXSET, ( XT(I), YT(I),          R1T0344
     1                  XYC(I), I = 1,NXSET )                           R1T0345
      IF( TW1.EQ.TTT(22) ) READ(5,1009) NMCR, ( CLMCR(I),               R1T0346
     1                              XMCR(I), I = 1, NMCR  )             R1T0347
      IF( ISWP.EQ.0 ) GO TO 170                                         R1T0348
      READ(5,1008) XPIVOT, YPIVOT, XAPEX, AFTSW, AFTCB, AFTOC, AFTAW    R1T0349
C                                                                       R1T0350
  170 IF( NSURFS.LE.1 ) GO TO 185                                       R1T0351
      DO 180 I = 2, NSURFS                                              R1T0352
      J      = I - 1                                                    R1T0353
      IF( J.EQ.1 ) WRITE(6,2013)                                        R1T0354
      READ(5,1004) TS1(J),TS2,TS3(J), SCAM(J), STOC(J), SMTSW(J),       R1T0355
     1             SHF(J)                                               R1T0356
      READ(5,1000) SWL(J), SWT(J), STAPR(J), SCR(J), SBAR(J), SAWET(J)  R1T0357
      WRITE(6,2007) TS1(J),TS2,TS3(J), SCAM(J),STOC(J),SMTSW(J),        R1T0358
     1              SHF(J),SWL(J),SWT(J),STAPR(J),SCR(J).SBAR(J),       R1T0359
     2              SAWET(J)                                            R1T0360
      IF( NHT.NE.0.AND.J.EQ.1 ) READ(5,1000) HTLE, HTY, HTZ, HTINC      R1T0361
C                                                                       R1T0362
  180 CONTINUE                                                          R1T0363
  185 IF( NPNLS.LE.2 ) GO TO 190                                        R1T0364
C                                                                       R1T0365
      READ(5,1000) (CLE(I), YC(I), CCR(I), I =1,3)                      R1T0366
C                                                                       R1T0367
  190 CONTINUE                                                          R1T0368
C                                                                       R1T0369
C                                                                       R1T0370
C     HIGH LIFT SYSTEM GEOMETRY IS READ IN IF IHLS GE 1                 R1T0371
C                                                                       R1T0372
  200 IF( IHLS.EQ.0 ) GO TO 205                                         R1T0373
      READ(5,1007) FLAP, SLAT, NF, NS                                   R1T0374
      READ(5,1000) BF1I, BF1O, CF1(1), BS1I, BS1O, CS1                  R1T0375
      IF( IHLS.EQ.2 ) READ(5,1000) BF2I,BF2O,CF2(1),BS2I,BS2O,CS2       R1T0376
      IF( FLAP.EQ.W(3).OR.FLAP.EQ.W(4) ) READ(5,1000)  CF1(2), CF1(3),  R1T0377
     1                  CF2(2), CF2(3)                                  R1T0378
      IF( FLAP.EQ.W(5)) READ(5,1000) (DF(I), CFCC(I), DCLOF(I),         R1T0379
     1                        DCLMF(I), DCDF(I), DCMOF(I), I=1,NF )     R1T0380
C                                                                       R1T0381
      IF( SLAT.EQ.W(5)) READ(5,1000) (DS(I), CSOC(I), DCLOS(I),         R1T0382
     1                        DCLMS(I), DCDS(I), DCMOS(I), I=1,NS )     R1T0383
C                                                                       R1T0384
C     PROBLEM CONTROL                                                   R1T0385
C                                                                       R1T0386
  205 READ(5,1003) NSURV, NHLSV, NCLAS, (IT(I),I=1,20), (ITRM(I),I=1,20)R1T0387
      IF( NSURV.EQ.0 ) GO TO 220                                        R1T0388
      WRITE(6,2014) NSURV                                               R1T0389
      DO 210 I =1, NSURV                                                R1T0390
      READ(5,1000) FMSURV(I), ALT(I), DHSV(I), SWPV(I), CLLO(I),CLHI(I) R1T0391
      IF( ITRM(I).EQ.0 ) WRITE(6,2015) FMSURV(I), ALT(I), DHSV(I),      R1T0392
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     1                    SWPV(I), CLLO(I), CLHI(I)                          R1T0393
      IF( ITRM(I).EQ.1 ) WRITE(6,2016) FMSURV(I), ALT(I), SWPV(I),           R1T0394
     1                    CLLO(I), CLHI(I)                                   R1T0395
  210 CONTINUE                                                               R1T0396
C                                                                            R1T0397
C     B.L. TRANSITION LOCATIONS ARE READ IN FOR EACH COMPONENT               R1T0398
C                                                                            R1T0399
      J1      = 0                                                            R1T0400
      DO 215 I = 1, NSURV                                                    R1T0401
      IF( IT(I).EQ.0 ) GO TO 215                                             R1T0402
      J       = IT(I)                                                        R1T0403
      IF( J.LE.J1 ) GO TO 215                                                R1T0404
      IF( NBODYS.GT.0 ) READ(5,1000) (TRB(J,K), K=1,NBODYS)                  R1T0405
      IF( NNACS.GT.0 )  READ(5,1000) (TRN(J,K), K=1,NNACS)                   R1T0406
      IF( NPNLS.GT.0 )  READ(5,1000) (TRU(J,K),TRL(J,K),K=1,NPNLS)           R1T0407
      IF( NSURFS.GT.0)  READ(5,1000) (TRS(J,K), K =2, NSURFS)                R1T0408
      J1      = J                                                            R1T0409
  215 CONTINUE                                                               R1T0410
C                                                                            R1T0411
C                                                                            R1T0412
  220 IF( NHLSV.EQ.0 ) GO TO 250                                             R1T0413
      DO 230 I = 1, NHLSV                                                    R1T0414
      NDF     = 1                                                            R1T0415
      IF( FLAP.EQ.W(3) ) NDF = 2                                             R1T0416
      IF( FLAP.EQ.W(4) ) NDF = 3                                             R1T0417
C                                                                            R1T0418
      READ(5,1000) (DFI(J,I), J=1,NDF), CPF(I), DSI(I), CPS(I),              R1T0419
     1                DELCD(I), H(I)                                         R1T0420
      IF( IHLS.EQ.2 ) READ(5,1000) (DFI2(J,I), J=1,NDF), CPF2(I),            R1T0421
     1                  DSI2(I), CPS2(I)                                     R1T0422
  230 CONTINUE                                                               R1T0423
C                                                                            R1T0424
C                                                                            R1T0425
  250 READ(5,1005) WORD, WRD                                                 R1T0426
      IF( WORD.EQ.W(10)) GO TO 260                                           R1T0427
      GO TO 270                                                              R1T0428
  260 READ(5,1006) (IVAL(I), I=1,20), NXVAR, NADJ, NXCL, NADJ2               R1T0429
      IF(NXVAR.EQ.0) GO TO 266                                               R1T0430
      READ(5,1000) ( X(I), I =1, NXVAR )                                     R1T0431
      DO 265 I = 1, NADJ                                                     R1T0432
      READ(5,1000) (YM(J,I), YA(J,I), J= 1, NXVAR )                          R1T0433
  265 CONTINUE                                                               R1T0434
  266 IF( NXCL.EQ.0 ) GO TO 268                                              R1T0435
      READ(5,1000) ( XCL(I), I =1, NXCL)                                     R1T0436
      DO 267 I = 1, NADJ2                                                    R1T0437
      READ(5,1000) (YM(J,NXVAR+I), YA(J,NXVAR+I), J=1,NXCL)                  R1T0438
  267 CONTINUE                                                               R1T0439
  268 CONTINUE                                                               R1T0440
      READ(5,1005) WORD, WRD                                                 R1T0441
C                                                                            R1T0442
  270 WRITE(6,2005) WORD,WRD                                                 R1T0443
C                                                                            R1T0444
C                                                                            R1T0445
      A       = 1./57.2957796                                                R1T0446
      B       = 1./12.                                                       R1T0447
      C       = 1./144.                                                      R1T0448
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```
C
      SWPLE  = SWPLE * A
      SWMT   = SWMT * A
      AFTSW  = AFTSW * A
      DO 300 I = 1, 10
      SMTSW(I) = SMTSW(I) * A
      SWL(I) = SWL(I) * A
      SWT(I) = SWT(I) * A
  300 CONTINUE
C
      XPIVOT = XPIVOT * B
      YPIVOT = YPIVOT * B
      XAPEX  = XAPEX * B
      AFTCB  = AFTCB * B
      HTLE   = HTLE * B
      HTY    = HTY * B
      HTZ    = HTZ * B
      CMAC   = CMAC * B
      XCG    = XCG * B
      ZCG    = ZCG * B
      XLEW   = XLEW * B
      YWW    = YWW  * B
      YB     = YB   * B
      CR     = CR   * B
      BO2    = BO2  * B
      DO 310 I = 1, 10
      BLEN(I) = BLEN(I) * B
      BWID(I) = BWID(I) * B
      BHGT(I) = BHGT(I) * B
      BLNS(I) = BLNS(I) * B
      BLBT(I) = BLBT(I) * B
      ELEN(I) = ELEN(I) * B
      EWID(I) = EWID(I) * B
      EHGT(I) = EHGT(I) * B
      ELNS(I) = ELNS(I) * B
      ELBT(I) = ELBT(I) * B
      CBAR(I) = CBAR(I) * B
      XLE(I)  = XLE(I)  * B
      CRW(I)  = CRW(I)  * B
      YW(I)   = YW(I)   * B
      SBAR(I) = SBAR(I) * B
      SCR(I)  = SCR(I)  * B
  310 CONTINUE
      XLE(11) = XLE(11) * B
      CRW(11) = CRW(11) * B
      YW(11)  = YW(11)  * B
      DO 315 I = 1,3
      CLE(I)  = CLE(I) * B
      CCR(I)  = CCR(I)  * B
      YC(I)   = YC(I)  * B
  315 CONTINUE
C
      DO 320 I = 1, 10
      BAMX(I) = BAMX(I) * C
      BABS(I) = BABS(I) * C
      BASE(I) = BASE(I) * C
```

```
      EAMX(I) = EAMX(I) * C                                             R1T0505
      EIN(I)  = EIN(I)  * C                                             R1T0506
      EXIT(I) = EXIT(I) * C                                             R1T0507
  320 CONTINUE                                                          R1T0508
C                                                                       R1T0509
      DO 340 I = 1, 10                                                  R1T0510
      DO 330 J = 1, 22                                                  R1T0511
C                                                                       R1T0512
      IF( TW1.EQ.TTT(J) ) TW = J                                        R1T0513
      IF( TW3.EQ.TTT(J) ) TW = J                                        R1T0514
      IF( TS1(I).EQ.TTT(J) ) TS(I) = J                                  R1T0515
      IF( TS3(I).EQ.TTT(J) ) TS(I) = J                                  R1T0516
C                                                                       R1T0517
  330 CONTINUE                                                          R1T0518
  340 CONTINUE                                                          R1T0519
C                                                                       R1T0520
      XFLAP  = FLAP                                                     R1T0521
      XSLAT  = SLAT                                                     R1T0522
      FLAP   = 0.0                                                      R1T0523
      SLAT   = 0.0                                                      R1T0524
C                                                                       R1T0525
      DO 350 I = 1,5                                                    R1T0526
      IF(XFLAP.EQ.W(I)) FLAP = I                                        R1T0527
      J      = I + 5                                                    R1T0528
      IF(XSLAT.EQ.W(J)) SLAT = I                                        R1T0529
  350 CONTINUE                                                          R1T0530
C                                                                       R1T0531
 1000 FORMAT(6F10.0)                                                    R1T0532
 1001 FORMAT(12I5)                                                      R1T0533
 1002 FORMAT(F10.0, A3, F3.0, F4.0, 4F10.0)                             R1T0534
 1003 FORMAT(3I5, 5X, 40I1 )                                            R1T0535
 1004 FORMAT(A3,A1,A3,3X, 5F10.0)                                       R1T0536
 1005 FORMAT( A4,A10)                                                   R1T0537
 1006 FORMAT( 20I1, 4I5 )                                               R1T0538
 1007 FORMAT( A4, 16X, A4, 16X, 4I5 )                                   R1T0539
 1008 FORMAT(6F10.0,F6.0)                                               R1T0540
 1009 FORMAT( 1I5/(6F10.0) )                                            R1T0541
C                                                                       R1T0542
 2000 FORMAT(1H1, *  PROBLEM INPUT PARAMETERS*//5X, *NBODYS =*,I2,      R1T0543
     1        5X,*NNACS =*,I2,5X,*NSURFS =*,I2,5X,*NHT =*,I2,5X,        R1T0544
     2        *NVT =*,I2,5X,*ISWP =*,I2,5X,*NPNLS =*,I2 / )             R1T0545
 2001 FORMAT(5X,*SREF =*,F9.3,* SQ.FT.*,5X,*CMAC =*,F9.3,* IN.*,        R1T0546
     1       5X,*FUS. STA. C.G. =*F9.3,* IN.*,5X,*ZCG =*F8.3,* IN.*// )  R1T0547
 2002 FORMAT(T3,*NO.*, T10,*BLEN*, T20,*BWID*,T30,*BHGT*, T40,*BAWET*,  R1T0548
     1        T50,*BAMX*,T60,*BABS*,T70,*BLNS*,T80,*BLBT*,T90,*BASE*,   R1T0549
     2        T100,*BQ*, T110,*BNO* / )                                 R1T0550
 2003 FORMAT(I5, 11F10.3 )                                              R1T0551
 2004 FORMAT(/T3,*NO.*, T10,*ELEN*, T20,*EWID*,T30,*EHGT*, T40,*EAWET*, R1T0552
     1        T50,*EAMX*,T60,*EIN*, T70,*EXIT*,T80,*ELNS*,T90,*ELBT*,   R1T0553
     2        T100,*EQF*,T110,*ENO* / )                                 R1T0554
 2005 FORMAT(//5X, A4, A10, 10X, 5H*****, /1H1  )                       R1T0555
 2006 FORMAT(//* ASPECT RATIO =*F7.3, 5X,*TAPER RATIO =*F6.4,           R1T0556
     1        5X,*L.E.SWEEP =*F7.3, 5X,*PLANFORM AREA =*F8.2,* SQ.FT.*/ R1T0557
     2        5X,*TWIST =*F7.3,* DEG.*, 5X,*INCIDENCE =*F7.3,* DEG.* )  R1T0558
 2007 FORMAT(2X,A3,A1,A3,   11F10.3)                                    R1T0559
 2008 FORMAT(5X, *AIRFOIL TYPE =*,2X,A3,A1,A3,5X,*CAMBER =*F7.4,5X,     R1T0560
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     1            *THICKNESS =*F8.4 /5X, *WING LOCATION (X,Y) = *,
     2           2F12.4,*FUSLAGE INTERSECTION =*F9.4 /5X,
     3          *MAX. THICKNESS SWP. =*F7.3,5X,*CBAR =*F8.4,5X,
     4          *AWET =*F8.3 // )
 2009 FORMAT(/ 5X,*AIRFOIL TYPE =*,2X,A3,A1,A3,5X,*TWIST =*F7.3,* DEG.*,
     1        5X,*INCIDENCE =*F7.3,* DEG.*,5X,*MAX. THICKNESS SWP. =*,
     2        F7.3,* DEG.*  )
 2010 FORMAT(5X,*VARIABLE GEOM. WING PLANFORM AREA =*F9.3,* SQ.FT.*,
     1        5X,*TAPER RATIO =*F6.4,5X,*L.E.SWEEP =*F7.3,* DEG.* /  )
 2011 FORMAT(/5X,*WING PANEL GEOMETRY*/T3,*NO.*,T10,*CAMBER*, T20,
     1        *T/C*, T30,*XLE*, T40,*YW*, T50,*CRW*, T60,*CBAR*,
     2        T70,*AWET* / )
 2012 FORMAT(25X,3F10.3 )
 2013 FORMAT(/5X,*GEOMETRY FOR ADDITIONAL AIRFOIL SURFACES* /
     1        T2,*AIRFOIL *,     T15,*CAMBER*, T25,*T/C*, T35,*SMTSW*,
     2        T45,*SHF*, T55,*L.E.SWP*, T65,*T.E.SWP*, T75,*TAPER*,
     3        T85,*CR*, T95,*SBAR*, T105,*SAWET* / )
 2014 FORMAT(//5X, I5,* DRAG POLARS TO BE GENERATED AT THE FOLLOWING CON
     1DITIONS* /T5, *MACH NO.*, T20,*ALTITUDE*, T35,*TAIL SETTING*,
     2           T53,*L.E.SWEEP*, T70,*FROM CL*, T85,*TO CL* / )
 2015 FORMAT( F15.4, 5F15.3)
 2016 FORMAT( F15.4, F15.3,15H          TRIMMED,  3F15.3)
C
C
      END
```

CC = 00361

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      OVERLAY(1,2)                                                      R1T0587
      PROGRAM NINPT                                                     R1T0588
C                                                                       R1T0589
C     READS IN OUT WITH A NAMELIST FORMAT                               R1T0590
C                                                                       R1T0591
      COMMON /BLKOV1/ IJ                                                R1T0592
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS      R1T0593
      COMMON /BLKA02/ SREF, AR, TAPR, SWPLE,                            R1T0594
     1                BLEN(10), BWID(10), BHGT(10), BAWET(10), BQ(10),  R1T0595
     2                BNO(10), BAMX(10), BABS(10), BLNS(10), BLBT(10),  R1T0596
     3                BASE(10),  ELEN(10), EWID(10), EHGT(10),          R1T0597
     4                EAWET(10), EAMX(10), EIN(10), EXIT(10), ELNS(10), R1T0598
     5                ELBT(10), EQF(10), ENO(10), CBAR(10), TW,         R1T0599
     5                XLEW, YWW, YB, CR, BO2, BFUS, FMISC, AB, AFTAW,   R1T0600
     6                CAM(10), TOC(10), AWET(10), SWMT, SPLAN, CONCL,   R1T0601
     7                TWIST, ETWIST, WINC, XLE(11), CRW(11), YW(11),    R1T0602
     8                XPIVOT, YPIVOT, XAPEX, AFTSW, AFTCB, AFTOC,       R1T0603
     9                SBAR(10), TS(10), SCAM(10), STOC(10), SAWET(10),  R1T0604
     1                SMTSW(10), SHF(10), SWL(10), SWT(10), STAPR(10),  R1T0605
     2                SCR(10), HTLE, HTY, HTZ, HTINC                    R1T0606
      COMMON /BLKA03/ ROUGHK,CLE(3),CCR(3),YC(3),XCG,ZCG,CMAC,IREF,A1(6)R1T0607
      COMMON /BLKA04/ IHLS, NF, NS, FLAP, SLAT, DF(5), CFOC(5),         R1T0608
     1                DCLOF(5), DCLMF(5), DCDF(5), DCMOF(5),            R1T0609
     2                DS(5), CSOC(5), DCLOS(5), DCLMS(5), DCDS(5),      R1T0610
     3                DCMOS(5), BF1I, BF1O, CF1(3), BF2I, BF2O, CF2(3), R1T0611
     4                BS1I, BS1O, CS1, BS2I, BS2O, CS2                  R1T0612
C                                                                       R1T0613
C                                                                       R1T0614
      COMMON /BLKSUR/ NSURV, NCLAS, IT(20), ITRM(20), FMSURV(20),       R1T0615
     1                ALT(20), DHSV(20), SWPV(20), CLLO(20), CLHI(20),  R1T0616
     2                TRB(5,10), TRN(5,10), TRU(5,10), TRL(5,10),       R1T0617
     3                TRS(5,10)                                         R1T0618
      COMMON /BLKHLS/ NHLSV, DFI(3,5), CPF(5), DSI(5), CPS(5),          R1T0619
     1                DELCD(5), H(5), DFI2(3,5), CPF2(5), DSI2(5),      R1T0620
     2                CPS2(5)                                           R1T0621
C                                                                       R1T0622
      COMMON /BLKADJ/ IVAL(20),X(15),YM(15,9),YA(15,9),XCL(15),         R1T0623
     1                NXVAR, NXCL                                       R1T0624
      COMMON /BLKTIL/ TITLE(6)                                          R1T0625
      COMMON /BLKPRT/ KPRINT(50)                                        R1T0626
C                                                                       R1T0627
      DIMENSION L(9)                                                    R1T0628
C                                                                       R1T0629
      NAMELIST/BODYS/ NBODYS,NNACS,NSURFS,NHT,NVT,ISWP,NPNLS,CMAC,IREF, R1T0630
     1                SREF,ROUGHK,XCG,ZCG,BFUS,AB,FMISC,BLEN,BWID,BHGT, R1T0631
     2                BAWET,BQ,BNO,BAMX,BABS,BLNS,BLBT,BASE/            R1T0632
     3         NACEL/ NNACS,SREF,ELEN,EWID,EHGT,EAWET,EQF,ENO,          R1T0633
     4                EAMX,EIN,EXIT,ELNS,ELBT/                          R1T0634
     5          WING/ NSURFS,ISWP,NPNLS, AR,TAPR,SWPLE,SPLAN,TWIST,     R1T0635
     6                WINC,TW,CAM,TOC,XLE,YW,CRW,CBAR,AWET,SWMT,CMAC,   R1T0636
     7                XPIVOT,YPIVOT,XAPEX,AFTSW,AFTCB,AFTOC,SREF,AFTAW, R1T0637
     8                CLE,YC,CCR,XLEW,YWW,YB,CR,BO2,XCG,CONCL/          R1T0638
     9         SURFS/ NSURFS,NHT,NVT,SREF, SBAR,TS,SCAM,STOC,SAWET,     R1T0639
     0                SMTSW,SHF,SWL,SWT,STAPR,SCR,HTLE,HTY,HTZ,HTINC/   R1T0640
     A          SURV/ NSURV, NCLAS, NHLSV, IT,ITRM,FMSURV,ALT,DHSV,SWPV,R1T0641
     A                CLLO,CLHI,TRB,TRN,TRU,TRL,TRS,DFI,CPF,DSI,CPS,    R1T0642
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     B                 DELCD,H,DFI2,CPF2,DSI2,CPS2,KPRINT/                R1T0643
     C           STOL/ IHLS,NF,NS,FLAP,SLAT,DF,CFOC,DCLOF,DCLMF,DCDF,     R1T0644
     D                 DCMOF,DS,CSOC,DCLOS,DCLMS,DCDS,DCMCS,BF1I,         R1T0645
     E                 BF1O,CF1,BF2I,BF2O,CF2,BS1I,BS1O,CS1,BS2I,         R1T0646
     F                 BS2O,CS2,H,DFI2,CPF2,DSI2,CPS2/                    R1T0647
     C        ADJUST/ IVAL, NXVAR, NXCL, X, XCL, YM, YA                   R1T0648
C                                                                         R1T0649
      DO 100 I = 1,9                                                      R1T0650
      L(I)   = 1                                                          R1T0651
  100 CONTINUE                                                            R1T0652
C                                                                         R1T0653
      CALL CONV                                                           R1T0654
      IF( IJ.EQ.1 ) GO TO 200                                             R1T0655
      READ(5,1000) (TITLE(I), I =1,6)                                     R1T0656
      READ(5,1001) (L(I), I = 1,9)                                        R1T0657
C                                                                         R1T0658
  200 IF( L(1).EQ.1 ) READ(5,BODYS)                                       R1T0659
      IF( L(2).EQ.1 ) READ(5,NACEL)                                       R1T0660
      IF( L(3).EQ.1 ) READ(5,WING)                                        R1T0661
      IF( L(4).EQ.1 ) READ(5,SURFS)                                       R1T0662
      IF( L(5).EQ.1 ) READ(5,SURV)                                        R1T0663
      IF( L(6).EQ.1 ) READ(5,STOL)                                        R1T0664
      IF( L(7).EQ.1 ) READ(5,ADJUST)                                      R1T0665
C                                                                         R1T0666
      WRITE(6,2000)                                                       R1T0667
C                                                                         R1T0668
      CALL CONV1                                                          R1T0669
C                                                                         R1T0670
  350 CONTINUE                                                            R1T0671
 1000 FORMAT( 6A10 )                                                      R1T0672
 1001 FORMAT( 50I1 )                                                      R1T0673
 2000 FORMAT(5X,*NAMELIST INPUT COMPLETED* )                              R1T0674
C                                                                         R1T0675
      END                                                                 R1T0676
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CC = 00090

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      SUBROUTINE CONV                                                   R1T0678
C                                                                       R1T0679
C     CONVERTS INPUT DATA TO FEET AND RADIANS UNITS                     R1T0680
C                                                                       R1T0681
      COMMON /BLKA02/ A1(433)                                           R1T0682
      COMMON /BLKA03/ A2(20)                                            R1T0683
C                                                                       R1T0684
      DIMENSION B1(433), B2(20)                                         R1T0685
C                                                                       R1T0686
      DO 100 I = 1, 20                                                  R1T0687
  100 B2(I)  = A2(I)                                                    R1T0688
C                                                                       R1T0689
      DO 200 I = 1, 433                                                 R1T0690
  200 B1(I)  = A1(I)                                                    R1T0691
C                                                                       R1T0692
      RETURN                                                            R1T0693
C                                                                       R1T0694
      ENTRY CONV1                                                       R1T0695
C                                                                       R1T0696
      A       = 1./57.2957796                                           R1T0697
      B       = 1./12.                                                  R1T0698
      C       = 1./144.                                                 R1T0699
C                                                                       R1T0700
      IF( A1(4).NE.B1(4) ) A1(4) = A1(4) * A                            R1T0701
      IF( A1(275).NE.B1(275) ) A1(275) = A1(275) * A                    R1T0702
      IF( A1(317).NE.B1(317) ) A1(317) = A1(317) * A                    R1T0703
      DO 300 I = 1, 10                                                  R1T0704
      IF( A1(369+I).NE.B1(369+I)) A1(369+I) = A1(369+I)*A               R1T0705
      IF( A1(389+I).NE.B1(389+I)) A1(389+I) = A1(389+I)*A               R1T0706
      IF( A1(399+I).NE.B1(399+I)) A1(399+I) = A1(399+I)*A               R1T0707
  300 CONTINUE                                                          R1T0708
C                                                                       R1T0709
      DO 400 I = 1, 10                                                  R1T0710
      IF( A1(224+I).NE.B1(224+I)) A1(224+I) = A1(224+I) * B             R1T0711
      IF( A1(319+I).NE.B1(319+I)) A1(319+I) = A1(319+I) * B             R1T0712
      IF( A1(419+I).NE.B1(419+I)) A1(419+I) = A1(419+I) * B             R1T0713
      IF( A1(104+I).NE.B1(104+I)) A1(104+I) = A1(104+I) * C             R1T0714
      IF( A2(1+I).NE.B2(1+I) ) A2(1+I) = A2(1+I) * B                    R1T0715
  400 CONTINUE                                                          R1T0716
C                                                                       R1T0717
      DO 500 I = 1, 20                                                  R1T0718
      IF( A1(84 +I).NE.B1(84 +I)) A1(84 +I) = A1(84 +I) * B             R1T0719
      IF( A1(184+I).NE.B1(184+I)) A1(184+I) = A1(184+I) * B             R1T0720
      IF( A1(64 +I).NE.B1(64 +I)) A1(64 +I) = A1(64 +I) * C             R1T0721
  500 CONTINUE                                                          R1T0722
C                                                                       R1T0723
      DO 600 I = 1, 30                                                  R1T0724
      IF( A1(4 + I).NE.B1(4 + I)) A1(4 + I) = A1(4 + I) * B             R1T0725
      IF( A1(114+I).NE.B1(114+I)) A1(114+I) = A1(114+I) * B             R1T0726
      IF( A1(280+I).NE.B1(280+I)) A1(280+I) = A1(280+I) * B             R1T0727
      IF( A1(154+I).NE.B1(154+I)) A1(154+I) = A1(154+I) * C             R1T0728
  600 CONTINUE                                                          R1T0729
C                                                                       R1T0730
      IF( A1(314).NE.B1(314) ) A1(314) = A1(314) * B                    R1T0731
      IF( A1(315).NE.B1(315) ) A1(315) = A1(315) * B                    R1T0732
      IF( A1(316).NE.B1(316) ) A1(316) = A1(316) * B                    R1T0733
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      IF( A1(318).NE.B1(318) ) A1(318) = A1(318) * B                    R1T0734
      IF( A1(430).NE.B1(430) ) A1(430) = A1(430) * B                    R1T0735
      IF( A1(431).NE.B1(431) ) A1(431) = A1(431) * B                    R1T0736
      IF( A1(432).NE.B1(432) ) A1(432) = A1(432) * B                    R1T0737
      IF( A1(236).NE.B1(236) ) A1(236) = A1(236) * B                    R1T0738
      IF( A1(237).NE.B1(237) ) A1(237) = A1(237) * B                    R1T0739
      IF( A1(238).NE.B1(238) ) A1(238) = A1(238) * B                    R1T0740
      IF( A1(239).NE.B1(239) ) A1(239) = A1(239) * B                    R1T0741
      IF( A1(240).NE.B1(240) ) A1(240) = A1(240) * B                    R1T0742
      IF( A1(241).NE.B1(241) ) A1(241) = A1(241) * B                    R1T0743
      IF( A1(291).NE.B1(291) ) A1(291) = A1(291) * B                    R1T0744
      IF( A1(302).NE.B1(302) ) A1(302) = A1(302) * B                    R1T0745
      IF( A1(313).NE.B1(313) ) A1(313) = A1(313) * B                    R1T0746
      IF( A2(12).NE.B2(12) ) A2(12) = A2(12) * B                        R1T0747
      IF( A2(13).NE.B2(13) ) A2(13) = A2(13) * B                        R1T0748
C                                                                       R1T0749
      RETURN                                                            R1T0750
      END                                                               R1T0751

                                                        CC = 00074
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      OVERLAY(2,0)                                                      R1T0753
      PROGRAM GEOM                                                      R1T0754
C                                                                       R1T0755
C     COMPUTES GEOMETRIC PARAMETERS FOR AERO CALCULATIONS               R1T0756
C                                                                       R1T0757
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS      R1T0758
      COMMON /BLKA02/ SREF, AR, TAPR, SWPLE,                            R1T0759
     1                BLEN(10), BWID(10), BHGT(10), BAWET(10), BQ(10),  R1T0760
     2                BNO(10), BAMX(10), BABS(10), BLNS(10), BLBT(10),  R1T0761
     3                BASE(10),  ELEN(10), EWID(10), EHGT(10),          R1T0762
     4                EAWET(10), EAMX(10), EIN(10), EXIT(10), ELNS(10), R1T0763
     5                ELBT(10), EQF(10), END(10), CBAR(10), TW,         R1T0764
     5                XLEW, YWW, YBOD, CR, BO2, A2(4),                  R1T0765
     6                CAM(10), TOC(10), AWET(10), SWMT, SPLAN, CONCL,   R1T0766
     7                TWIST, ETWIST, WINC, XLE(11), CRW(11), YW(11),    R1T0767
     8                XPIVOT, YPIVOT, XAPEX, AFTSW, AFTCB, AFTOC,       R1T0768
     9                SBAR(10), TS(10), SCAM(10), STOC(10), SAWET(10),  R1T0769
     1                SMTSW(10), SHF(10), SWL(10), SWT(10), STAPR(10),  R1T0770
     2                SCR(10), HTLE, HTY, HTZ, HTINC                    R1T0771
      COMMON /BLKA03/ ROUGHK, CLE(3),CCR(3),YC(3), XCG,ZCG,CMAC,A1(7)   R1T0772
C                                                                       R1T0773
      COMMON /BLKG01/ FRBOD(10), ARS(10), SSEX(10), FRNAC(10), SWP,     R1T0774
     1                SWPQC, SWPMC, SWPTE, DOB, TOCW, CLD, SEXW, ESWMC, R1T0775
     2                SXX(10), XLESWX(10), XMCSWX(10), ARW, TR, WPLAN,  R1T0776
     3                CB, YB, XB,                                       R1T0777
     4                CRX, CBX, CTX, YIX, YOX, SIX, SCX, ARI, ARXR,     R1T0778
     5                CBXP, AROP, SOXP, SWPLEI, SWPLEO, SWPMCI, SWPMCO, R1T0779
     6                ESWQC, ESWLE, ESWTE, CROB, DXOB, XHT, XCRTE,      R1T0780
     7                XH, OMEGA, FOC, TWST, DINC, G1(5), DXQC, G3(81)   R1T0781
C                                                                       R1T0782
      COMMON /BLKPRT/ KPRINT(50)                                        R1T0783
C                                                                       R1T0784
      DIMENSION FOCX(22)                                                R1T0785
      DIMENSION G2(200)                                                 R1T0786
      EQUIVALENCE (G2(1), FRBOD(1))                                     R1T0787
      DATA FOCX / 4*0.05515,3*0.06651,15*0.079 /                        R1T0788
C                                                                       R1T0789
      TWST   = TWIST                                                    R1T0790
      DINC   = WINC                                                     R1T0791
C                                                                       R1T0792
      DO 100 I = 1, NBODYS                                              R1T0793
      BDIA2  = BWID(I) * BHGT(I)                                        R1T0794
      FRBOD(I) = 0.0                                                    R1T0795
      IF( BAMX(I).EQ.0.0 ) BAMX(I) = 0.7854 * BDIA2                     R1T0796
      IF( BAWET(I).EQ.0.0 ) BAWET(I) = (2.8*BLNS(I) +2.5*BLBT(I)        R1T0797
     1       *(1.+SQRT(BABS(I)/BAMX(I))) + (BLEN(I) -BLNS(I) -BLBT(I))  R1T0798
     2        *4. ) * SQRT(.7854 * BAMX(I)) * BNO(I)                    R1T0799
      IF( BDIA2.GT.0.0 ) FRBOD(I) = BLEN(I)/SQRT(BDIA2)                 R1T0800
  100 CONTINUE                                                          R1T0801
C                                                                       R1T0802
      DO 200 I = 1, NNACS                                               R1T0803
      EDIA2  = EWID(I) * EHGT(I)                                        R1T0804
      FRNAC(I) = 0.0                                                    R1T0805
      IF( EAMX(I).EQ.0.0 ) EAMX(I) = 0.7854 * EDIA2                     R1T0806
      IF( EAWET(I).EQ.0.0 ) EAWET(I) = (2.5*ELNS(I) * (1. +             R1T0807
     1       SQRT(EIN(I)/EAMX(I)))   + 2.5 *ELBT(I)                     R1T0808
```

```
     1        *(1.+SQRT(EXIT(I)/EAMX(I))) + (ELEN(I) -ELNS(I) -ELBT(I))  R1T0809
     2        *4.) * SQRT(.7854 * BAMX(I)) * ENO(I)                      R1T0810
      IF( EDIA2.GT.0.0 ) FRNAC(I) = ELEN(I)/SQRT(EDIA2)                  R1T0811
  200 CONTINUE                                                           R1T0812
C                                                                        R1T0813
  210 NP      = NPNLS + 1                                                R1T0814
      IF( NPNLS.NE.1 ) GO TO 220                                         R1T0815
      TSWP    = TAN(SWPLE)                                               R1T0816
      CO      = 4./AR  *(1.-TAPR)/(1.+TAPR)                              R1T0817
C                                                                        R1T0818
C     GEOMETRY FOR SIMPLE TRAPEZOIDAL WINGS IS CALCULATED HERE           R1T0819
C                                                                        R1T0820
      SWP     = SWPLE                                                    R1T0821
      SWPQC   = ATAN(TSWP - CO * 0.25)                                   R1T0822
      SWPMC   = ATAN(TSWP - CO * 0.50)                                   R1T0823
      SWPTE   = ATAN(TSWP - CO )                                         R1T0824
      BO2     = 0.5 * SQRT(SPLAN * AR)                                   R1T0825
      YW(1)   = YBOD                                                     R1T0826
      XLE(1)  = XLEW + (YBOD - YWW) * TSWP                               R1T0827
      DOB     = YW(1)/BO2                                                R1T0828
C                                                                        R1T0829
      CR      = SPLAN/(BO2*(1.+TAPR))                                    R1T0830
      XCRTE   = XLEW -YWW * TSWP + CR                                    R1T0831
      CRX     = CR * (1. - DOB*(1.-TAPR) )                               R1T0832
      CTX     = CR * TAPR                                                R1T0833
      IF( CBAR(1).EQ.0.0 ) CBAR(1) = (CRX + CTX**2/(CRX+CTX))*0.66667    R1T0834
      YIX     = BO2 * (1.-DOB)                                           R1T0835
      CB      = 0.66667 * CR * (1. + TAPR*TAPR/(1. + TAPR))              R1T0836
      YB      = BO2/3. * (1. + 2.*TAPR)/(1.+ TAPR)                       R1T0837
      XB      = YB * TSWP + XLE(1) - YW(1)*TSWP                          R1T0838
C                                                                        R1T0839
      ESWMC   = SWPMC                                                    R1T0840
      ESWQC   = SWPQC                                                    R1T0841
      ESWLE   = SWPLE                                                    R1T0842
      ESWTE   = SWPTE                                                    R1T0843
      TOCW    = TOC(1)                                                   R1T0844
      CLD     = CAM(1)                                                   R1T0845
      TR      = TAPR                                                     R1T0846
      SEXW    = SPLAN/(1.+TR) * (2.-(1.-TR)*(YW(1)/BO2 +1.))             R1T0847
     1                * (1.-YW(1)/BO2)                                   R1T0848
      SXX(1) = SEXW                                                      R1T0849
      IF( AWET(1).EQ.0.0 ) AWET(1) = SEXW * (2. +.1843*TOCW              R1T0850
     1                    +1.5268*TOCW**2 -.8395*TOCW**3)                R1T0851
      XLESWX(1) = SWPLE                                                  R1T0852
      XMCSWX(1) = SWPMC                                                  R1T0853
      ARW     = AR                                                       R1T0854
      WPLAN   = SPLAN                                                    R1T0855
      SIX     = SEXW                                                     R1T0856
      ARXR    = 4.* YIX**2/SIX                                           R1T0857
      SWPLEI  = SWP                                                      R1T0858
      SWPMCI  = SWPMC                                                    R1T0859
C                                                                        R1T0860
      YW(2)   = BO2                                                      R1T0861
      XLE(2)  = XLE(1) + (YW(2)-YW(1)) * TSWP                            R1T0862
      CRW(1)  = CRX                                                      R1T0863
      CRW(2)  = CTX                                                      R1T0864
```

```
      CROB    = 0.5 * CR/BO2                                            R1T0865
      DXOB    = CROB - 0.75 * TAN(SWPQC)                                R1T0866
C                                                                       R1T0867
  220 IF( NPNLS.GT.2 ) GO TO 240                                        R1T0868
      DO 230 I = 1, NP                                                  R1T0869
      CLE(I) = XLE(I)                                                   R1T0870
      CCR(I) = CRW(I)                                                   R1T0871
      YC(I)  = YW(I)                                                    R1T0872
  230 CONTINUE                                                          R1T0873
C                                                                       R1T0874
  240 IF(NPNLS.LE.1) GO TO 310                                          R1T0875
C     GEOMETRY FOR MULTIPLE PANEL WINGS IS CALCULATED HERE              R1T0876
C                                                                       R1T0877
      WPLAN   = SPLAN                                                   R1T0878
      BO2     = YW(NP)                                                  R1T0879
      TR      = TAPR                                                    R1T0880
      SWP     = SWPLE                                                   R1T0881
      ETA     = YW(1)/YW(2)                                             R1T0882
      CRCL    = (CRW(1) - ETA * CRW(2)) /(1.-ETA)                       R1T0883
      CROB    = 0.5 * CRCL/BO2                                          R1T0884
      DOB     = YW(1)/BO2                                               R1T0885
      SFXW    = 0.0                                                     R1T0886
      TOCW    = 0.0                                                     R1T0887
      CLD     = 0.0                                                     R1T0888
      COSMC   = 0.0                                                     R1T0889
      COSQC   = 0.0                                                     R1T0890
      TANLE   = 0.0                                                     R1T0891
      TANTE   = 0.0                                                     R1T0892
      SUMCB   = 0.0                                                     R1T0893
      SUMYB   = 0.0                                                     R1T0894
      SUMXB   = 0.0                                                     R1T0895
C                                                                       R1T0896
      DO 300 I =1, NPNLS                                                R1T0897
      DYW     = YW(I+1) - YW(I)                                         R1T0898
      SX      = (CRW(I+1) + CRW(I)) * DYW                               R1T0899
      DXLE    = -XLE(I) + XLE(I+1)                                      R1T0900
      XLESW   = ATAN(DXLE/DYW)                                          R1T0901
      DXTE    = DXLE  + (CRW(I+1) - CRW(I))                             R1T0902
      IF( I.EQ.1 ) XCRTE = XLE(1) + YW(1)*TAN(XLESW) + CRCL             R1T0903
      DX      = DXLE + 0.5 * (CRW(I+1) - CRW(I))                        R1T0904
      DXQ     = DXLE + 0.25 * (CRW(I+1) - CRW(I))                       R1T0905
      XTESW   = ATAN(DXTE/DYW)                                          R1T0906
      XMCSW   = ATAN(DX/DYW)                                            R1T0907
      XQCSW   = ATAN(DXQ/DYW)                                           R1T0908
C                                                                       R1T0909
      CR      = CRW(I)                                                  R1T0910
      CT      = CRW(I+1)                                                R1T0911
      T       = CT/CR                                                   R1T0912
C                                                                       R1T0913
      SXX(I) = SX                                                       R1T0914
      XLESWX(I) = XLESW                                                 R1T0915
      XMCSWX(I) = XMCSW                                                 R1T0916
C                                                                       R1T0917
      CB      = 0.66667 * CR * (1. + T*T/(1.+T))                        R1T0918
      IF( CBAR(I).EQ.0.0 ) CBAR(I) = CB                                 R1T0919
      YB      = 0.33333 * DYW * (1.+2.*T)/(1.+T) + YW(I)                R1T0920
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```
      XB      = XLE(I) - XLE(1) + (YB - YW(I))*TAN(XLESW)                R1T0921
C                                                                        R1T0922
      DYX1    = 0.75*BO2 - YW(I)                                         R1T0923
      DYX2    = 0.75*BO2 - YW(I+1)                                       R1T0924
      IF( DYX1.GE.0.0.AND.DYX2.LT.0.0 ) X1 = XLE(I) + CRW(I)*0.25        R1T0925
     1                + DYX1 * TAN(XQCSW)                                R1T0926
C                                                                        R1T0927
C                                                                        R1T0928
      IF( AWET(I).EQ.0.0 ) AWET(I) = SX * (2. +.1843*TOC(I)              R1T0929
     1                  +1.5268*TOC(I)**2 -.8395*TOC(I)**3)              R1T0930
      TOCW    = TOCW + SX * TOC(I)**2                                    R1T0931
      COSMC   = COSMC + COS(XMCSW) * SX                                  R1T0932
      COSQC   = COSQC + COS(XQCSW) * SX                                  R1T0933
      TANLE   = TANLE + TAN(XLESW) * SX                                  R1T0934
      TANTE   = TANTE + TAN(XTESW) * SX                                  R1T0935
      CLD     = CLD + CAM(I)**2 * SX                                     R1T0936
      SEXW    = SEXW + SX                                                R1T0937
C                                                                        R1T0938
      SUMCB   = SUMCB + CB*SX                                            R1T0939
      SUMYB   = SUMYB + YB*SX                                            R1T0940
      SUMXB   = SUMXB + XB*SX                                            R1T0941
C                                                                        R1T0942
  300 CONTINUE                                                           R1T0943
C                                                                        R1T0944
      TOCW    = SQRT(TOCW/SEXW)                                          R1T0945
      CLD     = SQRT(CLD/SEXW)                                           R1T0946
      ESWMC   = ACOS(COSMC/SEXW)                                         R1T0947
      ESWQC   = ACOS(COSQC/SEXW)                                         R1T0948
      ESWLE   = ATAN(TANLE/SEXW)                                         R1T0949
      ESWTE   = ATAN(TANTE/SEXW)                                         R1T0950
C                                                                        R1T0951
      CB      = SUMCB/SEXW                                               R1T0952
      YB      = SUMYB/SEXW                                               R1T0953
      XB      = SUMXB/SEXW + XLE(1)                                      R1T0954
      X2      = XLE(1) - YW(1)*TAN(XLESWX(1)) + 0.75 * CRCL              R1T0955
      DXOB    = (X2 - X1)/BO2                                            R1T0956
C                                                                        R1T0957
      IF( WPLAN.EQ.0.0 ) WPLAN = SEXW + (CRCL + CRW(1)) * YW(1)          R1T0958
      ARW     = 4. * BO2**2/WPLAN                                        R1T0959
      TRK     = (TAN(ESWLE) - TAN(ESWTE) ) *0.25 * ARW                   R1T0960
      IF( ISWP.EQ.0 ) TR = (1.-TRK)/(1.+TRK)                             R1T0961
      TRLIM   = CRW(NP)/CRCL                                             R1T0962
      IF( TR.LT.TRLIM ) TR = TRLIM                                       R1T0963
C                                                                          T0964
  310 IF( NSURFS.LE.1 ) GO TO 410                                        R1T0965
      XNVT    = NVT                                                      R1T0966
      DO 400 J = 2, NSURFS                                               R1T0967
      I       = J-1                                                      R1T0968
C                                                                        R1T0969
      SSEX(I) = SAWET(I)*0.5                                             R1T0970
      IF(SCR(I).LE.0.0) GO TO 400                                        R1T0971
      ARS(I)  = SSEX(I)/SCR(I)**2                                        R1T0972
C                                                                        R1T0973
      IF(SWL(I).EQ.SWT(I)) GO TO 400                                     R1T0974
      ARS(I) = 4.*(1.-STAPR(I))/(1.+STAPR(I))/(TAN(SWL(I))-TAN(SWT(I))) R1T0975
      SSEX(I) = (SCR(I) * (1.+STAPR(I)))**2 * ARS(I) * 0.25              R1T0976
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      IF(NHT.EQ.0.AND.NVT.GT.0) SSEX(1) = 0.5 * XNVT * SSEX(1)          R1T0977
      IF(NHT.EQ.1.AND.NVT.GT.0) SSEX(2) = 0.5 * XNVT * SSEX(2)          R1T0978
C                                                                       R1T0979
      IF( SAWET(I).EQ.0.0 ) SAWET(I) = SSEX(I) * (2. +.1843*STOC(I)     R1T0980
     1                  +1.5268*STOC(I)**2 -.8395*STOC(I)**3)          R1T0981
      IF( SBAR(I).EQ.0.0 ) SBAR(I) = 0.66667 * SCR(I) *                 R1T0982
     1                          (1.+STAPR(I)**2/(1.+STAPR(I)))         R1T0983
C                                                                       R1T0984
  400 CONTINUE                                                          R1T0985
C                                                                       R1T0986
  410 IF( XCG.EQ.0.0 ) XCG = XB + 0.25 * CB                             R1T0987
      IF( CMAC.EQ.0.0 ) CMAC = CB                                       R1T0988
      NI      = TW                                                      R1T0989
      FOC     = CLD * FOCX(NI)                                          R1T0990
      DXQC    = XLE(1+NPNLS)+CRW  +NPNLS)*0.25  -XLE(1)-CRW(1)*0.25     R1T0991
C                                                                       R1T0992
C     GEOMETRY FOR THE HORIZONTAL TAIL IS CALCULATED                    R1T0993
C                                                                       R1T0994
      XH      = 0.0                                                     R1T0995
      OMEGA   = 0.0                                                     R1T0996
C                                                                       R1T0997
      IF( NHT.EQ.0 ) GO TO 415                                          R1T0998
      BHT     = SQRT(ABS(1) * SSEX(1))                                  R1T0999
      XHT     = BHT/6. * (1. + 2.*STAPR(1))/(1.+ STAPR(1))*TAN(SWL(1))  R1T1000
     1            + SBAR(1) * 0.25 + HTLE                               R1T1001
C                                                                       R1T1002
      XH      = SQRT((HTZ-ZCG)**2 + (XHT-XCG)**2)                       R1T1003
      OMEGA   = ATAN((HTZ-ZCG)/(XHT-XCG))                               R1T1004
C                                                                       R1T1005
  415 IF( NPNLS.LE.1 ) GO TO 420                                        R1T1006
C                                                                       R1T1007
C     CRANKED WING GEOMETRY IS CALCULATED                               R1T1008
C                                                                       R1T1009
      CRX     = CCR(1)                                                  R1T1010
      CBX     = CCR(2)                                                  R1T1011
      CTX     = CCR(3)                                                  R1T1012
      YIX     = YC(2) - YC(1)                                           R1T1013
      YOX     = YC(3) - YC(2)                                           R1T1014
C                                                                       R1T1015
      SIX     = (CRX + CBX) * YIX                                       R1T1016
      SOX     = (CBX + CTX) * YOX                                       R1T1017
      ARI     = 4. * YIX**2 / SIX                                       R1T1018
      ARXR    = 4. * (YIX+YOX)**2 /(SIX+SOX)                            R1T1019
C                                                                       R1T1020
      DYP     = YIX * 0.5                                               R1T1021
      CBXP    = CTX + (YOX + DYP) * (CBX-CTX)/YOX                       R1T1022
      SOXP    = (CBXP + CTX) * (YOX + DYP)                              R1T1023
      AROP    = 4. * (YOX + DYP)**2 /SOXP                               R1T1024
C                                                                       R1T1025
      SWPLEI  = ATAN((CLE(2)-CLE(1))/YIX)                               R1T1026
      SWPLEO  = ATAN((CLE(3)-CLE(2))/YOX)                               R1T1027
      SWPMCI  = ATAN((CLE(2)-CLE(1)+(CBX-CRX)*0.5)/YIX)                 R1T1028
      SWPMCO  = ATAN((CLE(3)-CLE(2)+(CTX-CBX)*0.5)/YOX)                 R1T1029
C                                                                       R1T1030
  420 IF( KPRINT(12).EQ.0 ) GO TO 421                                   R1T1031
      WRITE(6,1000) (G2(I), I = 1, 111)                                 R1T1032
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C                                                                       R1T1033
  421 WRITE(6,2000)                                                     R1T1034
      IF( NBODYS.GT.0 ) WRITE(6,2001) (I,BLEN(I),BAWET(I),FRBCD(I),     R1T1035
     1             BQ(I), I = 1, NBODYS)                                R1T1036
C                                                                       R1T1037
      IF( NNACS.GT.0 )  WRITE(6,2002) (I,ELEN(I),EAWET(I),FRNAC(I),     R1T1038
     1             EQF(I), I = 1,NNACS)                                 R1T1039
C                                                                       R1T1040
      IF( NSURFS.EQ.0 ) GO TO 450                                       R1T1041
      X       = SWMT * 57.2958                                          R1T1042
      DO 425 I = 1, NPNLS                                               R1T1043
      IF( I.NE.NPNLS ) WRITE(6,2003) I, CBAR(I), AWET(I), TOC(I)        R1T1044
  425 IF( I.EQ.NPNLS ) WRITE(6,2003) I, CBAR(I), AWET(I), TOC(I), X     R1T1045
C                                                                       R1T1046
      NS      = NSURFS - 1                                              R1T1047
      IF( NS.LE.0 ) GO TO 450                                           R1T1048
      DO 430 I = 1, NS                                                  R1T1049
      J       = I +1                                                    R1T1050
      X       = SMTSW(I) * 57.2958                                      R1T1051
      WRITE(6,2004) J, SBAR(I), SAWET(I), STOC(I), SHF(I), X            R1T1052
  430 CONTINUE                                                          R1T1053
  450 CONTINUE                                                          R1T1054
 1000 FORMAT(5X, *GEOMETRY DATA DUMP,  COMMON BLKG01*/(1X,10F12.4))     R1T1055
 2000 FORMAT(1H1, 5X, *CONFIGURATION SUMMARY* ///                       R1T1056
     1         31X, *LENGTH*, 7X, *WETTED AREA*, 5X, *FR OR T/C*,       R1T1057
     2         4X, *INTERFERENCE*, 4X, *MAX. T/C SWEEP* /               R1T1058
     3         30X, * (FT.)*, 8X, * (SQ. FT.) *, 20X,                   R1T1059
     4         *FACTOR*, 8X, * (DEG.) * / )                             R1T1060
 2001 FORMAT(5X, *BODY NUMBER* I2, 5X, 4F15.5)                          R1T1061
 2002 FORMAT(5X, *NACELLE NO.* I2, 5X, 4F15.5)                          R1T1062
 2003 FORMAT(5X, *WING PANEL NO.*I2, 2X, 3F15.5, 15X, F15.5)            R1T1063
 2004 FORMAT(5X, *AIRFOIL SURFACE NO.*I2, F12.5, 4F15.5)                R1T1064
C                                                                       R1T1065
      END                                                               R1T1066
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CC = 00314

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      OVERLAY(3,0)                                                      R1T1068
      PROGRAM SURVEY                                                    R1T1069
C                                                                       R1T1070
C     AERODYNAMIC SURVEY                                                R1T1071
C                                                                       R1T1072
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS      R1T1073
C                                                                       R1T1074
      COMMON/BLKSUR/ NSURV, NCLAS, IT(20), ITRM(20), FMSURV(20),        R1T1075
     1               ALT(20), DHSV(20), SWPV(20), CLLO(20), CLHI(20),   R1T1076
     2               TRBNWS(250)                                        R1T1077
C                                                                       R1T1078
      COMMON /BLKHLS/ NHLSV, HLS(70)                                    R1T1079
C                                                                       R1T1080
      COMMON /BLKTIL/ TITLE(6)                                          R1T1081
      COMMON /BLKOV3/ ITYP, XMACH, TOC, CLD, SWPMC, H, FM, ITL, JPASS,  R1T1082
     1                ROT, OTE, ITRIM                                   R1T1083
C                                                                       R1T1084
      COMMON /BLKC01/ CL, CD, CM, ALPHA, CDM, CDL, CDR, CDRO, CLT, CDT, R1T1085
     1                DR, FK, DELCL, CMO, DCMCL, XACWB, CLA, ALO,       R1T1086
     2                TCD(5), CDFUS(5), CDBOD(5), CDNAC(4), CDWING(4),  R1T1087
     3                CDHT(4), CDVT(4), CDSURF(4),                      R1T1088
     4                C1(9), CLPB, CLDB, CLMAX, C2(9), CDC, C3(10),     R1T1089
     5                C4(7), CDMISC, DEDA, CDAFT, C5(5)                 R1T1090
      COMMON /BLKA02/ A1(433)                                           R1T1091
      COMMON /BLKA03/ A2(13), IREF, A3(6)                               R1T1092
      COMMON /BLKVGM/ KPASS, SWP, VGM(27)                               R1T1093
      COMMON /BLKC03/ CO3(22)                                           R1T1094
C                                                                       R1T1095
      COMMON /BLKC01/ G1(200)                                           R1T1096
C                                                                       R1T1097
      COMMON /BLKB02/ AA(22), BB(22), CC(22), DD(22), XT(22)            R1T1098
C                                                                       R1T1099
      DIMENSION  XOTE(20), YOTE(20)                                     R1T1100
      DATA XOTE / 34.6,38.4,46.4,60.2,57.5,59.5,66.5,30.0,95.0,50.0,    R1T1101
     1            63.0,82.8,113.0,153.0,63.0,82.8,113.0,63.0,82.8,113./,R1T1102
     2      YOTE / 4*14.8,3*14.05,40.0,0.0,11*13.8 /                   R1T1103
C                                                                       R1T1104
      IF( ISWP.EQ.0 ) GO TO 100                                         R1T1105
      KPASS  = 1                                                        R1T1106
      SWP    = A1(4)                                                    R1T1107
      CALL OVERLAY(4HOVLY,3,1)                                          R1T1108
      KPASS  = 2                                                        R1T1109
      SWP    = A1(317)                                                  R1T1110
      CALL OVERLAY(4HOVLY,3,1)                                          R1T1111
  100 KPASS  = 0                                                        R1T1112
C                                                                       R1T1113
      TOC    = G1(46)                                                   R1T1114
      CLD    = G1(47)                                                   R1T1115
      ITYP   = A1(235)                                                  R1T1116
      WINC   = A1(280)                                                  R1T1117
      IF( NSURV.EQ.0 ) GO TO 510                                        R1T1118
C                                                                       R1T1119
      SWP2   = SWPV(1)                                                  R1T1120
C                                                                       R1T1121
      JPASS  = 0                                                        R1T1122
      DO 500 L = 1, NSURV                                               R1T1123
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      FM      = FMSURV(L)                                                R1T1124
      H       = ALT(L)                                                   R1T1125
      DH      = DHSV(L)                                                  R1T1126
      SWEEP   = SWPV(L)                                                  R1T1127
      CLLOW   = CLLO(L)                                                  R1T1128
      ITL     = IT(L)                                                    R1T1129
      ITRIM   = ITRM(L)                                                  R1T1130
C                                                                        R1T1131
      XNCL    = NCLAS - 1                                                R1T1132
      DCL     = 0.0                                                      R1T1133
      IF( XNCL.GT.0.0 ) DCL = (CLHI(L) - CLLO(L))/XNCL                   R1T1134
C                                                                        R1T1135
      SWP     = SWEEP/57.2957796                                         R1T1136
      IF( ISWP.GT.0.AND.SWEEP.NE.SWP2 ) JPASS = 0                        R1T1137
      SWP2    = SWEEP                                                    R1T1138
C                                                                        R1T1139
      IF( ISWP.GT.0.AND.JPASS.EQ.0 ) CALL OVERLAY(4HOVLY,3,1)            R1T1140
      EO2     = 0.25 * SQRT(G1(80)*G1(82))                               R1T1141
      DO 200 IP = 1, NPNLS                                               R1T1142
      SWPMW   = G1(69+IP)                                                R1T1143
      IF( ISWP.GT.0.AND.IP.EQ.NPNLS ) GO TO 190                          R1T1144
      IF(A1(302+IP).LE.EO2.AND.A1(303+IP).GT.EO2)  GO TO 210             R1T1145
      GO TO 200                                                          R1T1146
  190 IF( A1(302+NPNLS).LE.EO2 ) SWPMW = G1(69+NPNLS)                    R1T1147
  200 CONTINUE                                                           R1T1148
C                                                                        R1T1149
  210 IF( SWPMW.GT.G1(49) ) SWPMW = G1(49)                               R1T1150
      SWPMC   = SWPMW * 57.2958                                          R1T1151
      TOG     = G1(46)                                                   R1T1152
      CLD     = G1(47)                                                   R1T1153
      ITYP    = A1(235)                                                  R1T1154
      XMACH   = 0.6                                                      R1T1155
C                                                                        R1T1156
      IF( JPASS.EQ.0 ) CALL OVERLAY(4HOVLY,3,2)                          R1T1157
C                                                                        R1T1158
      IF( JPASS.EQ.2 ) JPASS = 1                                         R1T1159
C                                                                        R1T1160
      DO 300 M = 1, NCLAS                                                R1T1161
      XM1     = M-1                                                      R1T1162
      CL      = CLLOW + DCL * XM1                                        R1T1163
C                                                                        R1T1164
      CALL OVERLAY(4HOVLY,3,3,6HRECALL)                                  R1T1165
C                                                                        R1T1166
      SWEEP   = G1(41) * 57.29578                                        R1T1167
      IF( M.NE.1 ) GO TO 220                                             R1T1168
      WRITE(6,1005) (TITLE(K), K=1,6)                                    R1T1169
      IF( H.GE.0.0.AND.ITRIM.EQ.0 ) WRITE(6,1000) FM,H,SWEEP,DH          R1T1170
      RN      = -H * 1.0E6                                               R1T1171
      IF( H.LT.0.0.AND.ITRIM.EQ.0 ) WRITE(6,1006) FM,RN,SWEEP,DH         R1T1172
      IF( H.GE.0.0.AND.ITRIM.NE.0 ) WRITE(6,1008) FM, H, SWEEP           R1T1173
      IF( H.LT.0.0.AND.ITRIM.NE.0 ) WRITE(6,1009) FM,RN, SWEEP           R1T1174
  220 ANGLE   = ALPHA                                                    R1T1175
      IF( IREF.EQ.1 ) ANGLE = ALPHA - WINC                               R1T1176
C                                                                        R1T1177
      CDRA    = CDR + CDAFT                                              R1T11771
      IF( ITRIM.EQ.0 ) WRITE(6,1001) CLT, CDT, CM, ANGLE, CDL, CDRA,     R1T1178
```

```
     1                                  CL, CD
      IF( ITRIM.EQ.1 ) WRITE(6,1001) CLT, CDT, DH, ANGLE, CDL, CDRA,
     1                                  CL, CD
C
  300 CONTINUE
C
      ALOR    = ALO
      IF( IREF.EQ.1 ) ALOR  = ALO - WINC
      WRITE(6,1002) CLA, ALOR, CLDB, FK, DELCL, CLMAX, CMO, DCMCL
C
      WRITE(6,1003)(TCD(J), CDFUS(J), CDBOD(J), CDNAC(J), CDWING(J),
     1              CDHT(J), CDVT(J), CDSURF(J),  J = 1, 4)
C
      WRITE(6,1004) TCD(5), CDFUS(5), CDBOD(5), CDC, CDRO, CDMISC
      WRITE(6,1007) CDM
C
C
  500 CONTINUE
C
  510 IF( NHLSV.EQ.0 ) GO TO 700
      ROT     = AA(ITYP)/TOC + BB(ITYP) + CC(ITYP)*TOC + DD(ITYP)*TOC**2
      IF( ITYP.EQ.8 ) ROT = 0.88216 * TOC**0.606
      OTE     = XOTE(ITYP)*TOC + YOTE(ITYP) *CLD
C
C
      IF( NSURV.GT.0 ) GO TO 600
      CO3(1) = 0.0
      DO 520 I = 1, 11
      IF( I.GT.1 ) CO3(I) = CO3(I-1) + 0.1
      CO3(11+I) = 0.9
  520 CONTINUE
C
  600 DH      = 0.0
      FM      = 0.2
      H       = 0.0
      CL      = 0.0
      JPASS   = 0
      ITL     = 0
      ITRIM   = 0
C
      CALL OVERLAY(4HOVLY,3,3)
      CALL OVERLAY(4HOVLY,3,4)
C
  700 CONTINUE
C
 1000 FORMAT(1X, *MACH NO. =*F6.3, 5X,*ALTITUDE =*F7.0,* FT.*, 5X,
     1        *SWEEP ANGLE =*F6.2,* DEG.*, 5X,*TAIL DEFL. (DH) =*F6.2,
     2        * DEG.* //T10,*CL*, T22,*TOTAL CD*, T38,*CM*, T53,*ALPHA*,
     3           T68,*CD LIFT*, T82,*CD R+AFT*, T97,*CL AT DH =0*,
     4         T113,*CD AT DH=0*, / )
 1001 FORMAT(5X,F8.3,2F15.5, F15.2, 4F15.5)
 1002 FORMAT(/10H      CLA =,F8.5,1X,*PER DEG.*,10H      ALO =,F8.5,1X,
     1   *DEG.*,  29X,10H     CLDB =,F8.5 /
     1         10H        K =,F8.5, 9X,          10H   DELCL =,F8.5 ,
     2             34X,10H   CLMAX =,F8.5 /
     2         10H      CMO =,F8.5, 9X,          10H   CM/CL =,F8.4 //
```

```
     3 * DRAG BREAKDOWN ----- *, 8X,*FUSLAGE*, 9X,*BODIES*, 7X,*NACELLESR1T1235
     4*,11X,*WING*, 5X,*HORIZ TAIL*, 6X,*VERT TAIL*, 7X,*SURFACES* )    R1T1236
 1003 FORMAT(5X,10HFRICTION =,F7.5,7F15.5 /                            R1T1237
     1        5X,10HFORM      =,F7.5,7F15.5 /                          R1T1238
     2        5X,10HINTERF    =,F7.5,7F15.5 /                          R1T1239
     3        5X,10HWAVE      =,F7.5,7F15.5     )                      R1T1240
 1004 FORMAT(5X,10HBASE      =,F7.5, 2F15.5 /                          R1T1241
     1        5X,10HCAMBER    =,F7.5  /                                R1T1242
     2        5X,10HDRAG RISE=,F7.5  /                                 R1T1243
     3        5X,10HMISC      =,F7.5 )                                 R1T1244
 1005 FORMAT(1H1, /1X, 6A10 )                                          R1T1245
 1006 FORMAT(1X, *MACH NO. =*F6.3, 5X,*RN/FT =*1PE15.4,5X,             R1T1246
     1        *L.E. SWEEP ANGLE =* 0PF6.2,* DEG.*,5X,*TAIL DEFL. (DH) =* R1T1247
     2        F6.2,* DEG.*                                             R1T1248
     2                //T10,*CL*, T22,*TOTAL CD*, T38,*CM*, T53,*ALPHA*, R1T1249
     3             T68,*CD LIFT*, T82,*CD R+AFT*, T97,*CL AT DH=0*,    R1T1250
     4       T113,*CD AT DH=0*, / )                                    R1T1251
 1007 FORMAT(/5X, 10H   COMIN =,F7.5 //)                               R1T1252
 1008 FORMAT(1X, *MACH NO. =*F6.3, 5X,*ALTITUDE =*F7.0,* FT.*, 5X,     R1T1253
     1       *L.E. SWEEP ANGLE =*F6.2,* DEG.*,5X,*TRIMMED CONDITION*   R1T1254
     2       //T10,*CL*, T22,*TOTAL CD*, T38,*DH*, T53,*ALPHA*,        R1T1255
     3           T68,*CD LIFT*, T82,*CD R+AFT*, T97,*CL AT DH =0*,     R1T1256
     4         T113,*CD AT DH=0*, / )                                  R1T1257
 1009 FORMAT(1X, *MACH NO. =*F6.3, 5X,*RN/FT =*1PE15.4,5X,             R1T1258
     1        *L.E. SWEEP ANGLE =* 0PF6.2,* DEG.*,5X,*TRIMMED CONDITION* R1T1259
     2       //T10,*CL*, T22,*TOTAL CD*, T38,*DH*, T53,*ALPHA*,        R1T1260
     3             T68,*CD LIFT*, T82,*CD R+AFT*, T97,*CL AT DH=0*,    R1T1261
     4       T113,*CD AT DH=0*, / )                                    R1T1262
C                                                                      R1T1263
      END                                                              R1T1264
```

CC = 00198

```
      SUBROUTINE ADJUST(ID, ID2, XVAR, YVAR)                            R1T1266
C                                                                       R1T1267
C     ADJUST Y-VARIABLE USING CORRELATION FACTORS                       R1T1268
C                                                                       R1T1269
      COMMON /BLKADJ/ IVAL(20), X(15), YM(15,9), YA(15,9), XCL(15),     R1T1270
     1                NXVAR, NXCL                                      R1T1271
C                                                                       R1T1272
      COMMON /BLKPRT/ KPRINT(50)                                        R1T1273
C                                                                       R1T1274
      YVAR1  = YVAR                                                     R1T1275
      IF( ID.EQ.0 ) GO TO 300                                           R1T1276
   50 NV     = IVAL(ID)                                                 R1T1277
C                                                                       R1T1278
      IF( NV.EQ.0 ) RETURN                                              R1T1279
  100 CALL LNTP(XVAR, VM, X,YM(1,NV), NXVAR, 2)                         R1T1280
  200 CALL LNTP(XVAR, VA, X,YA(1,NV), NXVAR, 2)                         R1T1281
      GO TO 500                                                         R1T1282
C                                                                       R1T1283
  300 NV     = IVAL(ID2)                                                R1T1284
      IF( NV.EQ.0 ) RETURN                                              R1T1285
  400 CALL LNTP(XVAR, VM, XCL,YM(1,NV), NXCL, 2)                        R1T1286
      CALL LNTP(XVAR, VA, XCL,YA(1,NV), NXCL, 2)                        R1T1287
C                                                                       R1T1288
  500 YVAR   = YVAR1 * VM + VA                                          R1T1289
C                                                                       R1T1290
      IF( KPRINT(24).EQ.0 ) RETURN                                      R1T1291
      WRITE(6,1000) ID, YVAR1, XVAR, VM, VA, YVAR                       R1T1292
 1000 FORMAT(5X,*ADJUST DUMP*, 5X, *ID =*,I5/1X,5F15.5 )                R1T1293
      RETURN                                                            R1T1294
      END                                                               R1T1295
```

CC = 00030

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      BLOCK DATA                                                        R1T1297
C                                                                       R1T1298
      COMMON /BLKBD1/ XSWPL(11), YRMIN(11)                              R1T1299
C                                                                       R1T1300
      COMMON /BLKBD2/ AAA(22), BBB(22), CCC(22), DDD(22), XTT(22)       R1T1301
C                                                                       R1T1302
      COMMON /BLKBD3/ BOT(12),ATSW(6),TPRT(6),FXAC1(216),FXAC2(216)     R1T1303
C                                                                       R1T1304
      COMMON /BLKBD4/ XBD4(5), YBD4(5), ZBD4(3), FBD4(5,5,3)            R1T1305
C                                                                       R1T1306
      COMMON /BLKBD5/ XDYO(6), YXMN(6), ZLBD5(6,6)                      R1T1307
C                                                                       R1T1308
      COMMON /BLKBD6/ XBD6(4), YBD6(4), ZBD6(6), FBD61(4,4,6),          R1T1309
     1                FBD62(4,4,6), FBD63(4,4,6)                        R1T1310
C                                                                       R1T1311
      COMMON /BLKMAP/ MAP, TRANS, DY, AMAP(22), BMAP(11)                R1T1312
      COMMON /BLKT22/ XIN13(10), YIN13(7), ZOUT13(10,7), ZOUY14(10,7)   R1T13[illegible]
      COMMON /BLKA15/ NXIN15, XIN15(6),  NYIN15, YIN15(5),              R1T13[illegible]
     1                FOUT15(6,5), FOUT16(6,5)                          R1T1315
      COMMON /BLKCLB/ X1(6), Y1(6), X9(8), Y9(8), XAR(5), YDCL(5)       R1T1316
      COMMON /BLKA16/ XSWP(7), YTR(4), FEP35(7,4), FEP7(7,4),           R1T1317
     1                XCLDB(7), YAKB(7)                                 R1T1318
C                                                                       R1T1319
C                                                                       R1T1320
      COMMON /BLKMAX/ XTR(6), YC1(6), YC2(6), XSWP1(4), YA(4),          R1T1321
     1                YB(4), XDY(8), XM(4), CTAB(8,4), DTAB(8,4),       R1T1322
     2                XXCLM(13), YYDY(6), FCLMX(13,6), XXC2(9),         R1T1323
     3                YYMACH(5), FDCLMX(9,5),XDY1(9),  YXMT(4),         R1T1324
     4                 ZC1MAX(9,4), XDY2(8), YFOC(6), ZDC1M(8,6),       R1T1325
     5                ZFDC1M(8,6)                                       R1T1326
      COMMON /B[illegible]2/ XSP(8), YDYA(6), FDA(8,6), XAB(6), YCO(8), R1T1327
     1                FKVOFM(6,8), XANG(10), YRTOC(7), FRA(10,7)        R1T1328
      COMMON /[illegible]MX3/ SPAN(6), YTPR(4), FKB(6,4), FKS(6), FKD(6,4) R1T1329
      COMMON [illegible]/ XC2(6),YAST(9),FDAM(6,9),XCT(6),YM(5),FDAM2(6,5) R1T1330
      COMMON [illegible]X5/ XXXCLM(9), FCLMXX(9,6)                      R1T1331
      COMMON /BLKMX6/ XX(12), XY(7), XF(12,7)                           R1T1332
      COMMON/BLKMX7/ SPAN2(11), YTPR2(5), FKSW(11,5)                    R1T1333
      COMMON/BLKMX8/ SPAN3(6), YTPR3(4), FKM(6,4)                       R1T1334
      COMMON /BLKMX9/ SPAN4(5), YBFI1(5), FKA(5,5),                     R1T1335
     1                SPAN5(5), YBFI2(3), FKF(5,3)                      R1T1336
C                                                                       R1T1337
C                                                                       R1T1338
C                                                                       R1T1339
      DATA XSWPL / 0.0,.17453,.34906,.5236,.69813,.87266,1.04719,       R1T1340
     1             1.13446,1.22173,1.34390,1.57079 /,                   R1T1341
     2     YRMIN / 0.53, 0.53, 0.52, 0.515, 0.505, 0.49, 0.45,          R1T1342
     3             0.39, 0.30, 0.12, 0.10 /                             R1T1343
C                                                                       R1T1344
      DATA BOT  / 0.0, .4, .8, 1.2, 1.6, 1.8, 2., 2.4, 2.8, 3.2,3.6,4./,R1T1345
     1    ATSW  / 1.,  2., 3., 4., 5., 6. /,                            R1T1346
     2    TPRT  / 0., 0.2, 0.25, 0.33, 0.5, 1.0 /                       R1T1347
C                                                                       R1T1348
C     FIG. 4.1.4.2-22   DATCOM          ****                            R1T1349
      DATA FXAC1/.25,.24,.23,.22,.20,.18,.17,.25,.32,.37,.40,.42,       R1T1350
     1          7*0.335, .39, .44, .48, .495, .5,                       R1T1351
     2         .42, .44, .45, .46, .465,.475,.50, .56, .56, .57,2*.58,  R1T1352
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     3     .50, .53, .55, .575,.60, .62, 6*0.67,                          R1T1353
     4     .58, .62, .66, .695,.73, .755,.83, .78, .78, .765,.75, .75,    R1T1354
     5     .68, .72, .76, .79, .83, .765,.98, .90, .90, .87, .85, .84,    R1T1355
     6     .29, .27, .25, .25, .23, .215,.20, .28, .33, .39, .44, .46,    R1T1356
     7     .40, .41, .41, .405,.40, .40, .40, .48, .52, .54, .56, .57,    R1T1357
     8     .51, .53, .54, .555,.57, .58, .60, .65, .665,.68, .69, .69,    R1T1358
     9     .64, .66, .68, .70, .73, .75, .795,.80, .81, .815,.805,.80,    R1T1359
     A     .75, .77, .80, .82, .87, .91, .97, .955,.95, .96, .93, .92,    R1T1360
     B     .87, .895,.915,.945,1.0, 1.05,1.15,1.12,1.1, 1.1, 1.05,1.03,   R1T1361
     C     .30, .29, .275,.26, .245,.24, .23, .30, .35, .40, .45, .475,   R1T1362
     D     .41, .42, .425,.425,.42, .415,.41, .50, .54, .57, .595,.60,    R1T1363
     E     .54, .555,.57, .58, .60, .61, .63, .68, .69, .71, .72, .72,    R1T1364
     F     .67, .69, .71, .73, .76, .79, .82, .83, .845,.865,.85, .845,   R1T1365
     G     .80, .82, .84, .86, .90, .95, 1.02,1.01,1.0, 1.01,.98, .97,    R1T1366
     H     .93, .95, .97, .99, 1.05,1.1, 1.25,1.2, 1.16,1.17,1.11,1.1/    R1T1367
      DATA FXAC2 /                                                        R1T1368
     I     .32, .31, .30, .28, .25, .24, .23, .31, .37, .42, .475,.50,    R1T1369
     J     .45, .46, .46, .455,.45, .445,.44, .54, .57, .60, .63, .64,    R1T1370
     K     .595,.60, .61, .62, .64, .65, .665,.72, .74, .76, .78, .775,   R1T1371
     L     .73, .745,.765,.78, .80, .83, .88, .89, .90, .93, .92, .91,    R1T1372
     M     .89, .90, .91, .93, .96, 1.0, 1.07,1.08,1.08,1.1, 1.06,1.05,   R1T1373
     N     1.04,1.05,1.06,1.09,1.12,1.17,1.27,1.26,1.25,1.26,1.21,1.2,    R1T1374
     O     .36, .34, .325,.31, .30, .275,.25, .34, .41, .48, .52, .55,    R1T1375
     P     .52, .52, .52, .52, .51, .505,.50, .60, .63, .67, .71, .72,    R1T1376
     Q     .70, .70, .705,.71, .72, .735,.75, .80, .82, .87, .89, .89,    R1T1377
     R     .88, .885,.89, .90, .915,.94, .98, 1.0, 1.02,1.07,1.05,1.05,   R1T1378
     S     1.04,1.05,1.05,1.06,1.09,1.12,1.19,1.2, 1.22,1.26,1.22,1.21,   R1T1379
     T     1.2, 1.21,1.22,1.24,1.27,1.3, 1.36,1.4, 1.42,1.45,1.4, 1.38,   R1T1380
     U     .50, .48, .46, .44, .40, .38, .34, .42, .50, .60, .70, .76,    R1T1381
     V     .75, .75, .745,.74, .72, .70, .68, .73, .80, .88, .97, 1.0,    R1T1382
     W     5*1.0, .98,.96,1.01,1.08,1.19,1.22,1.23,                       R1T1383
     X     5*1.24,1.23,1.2,1.29,1.38,1.48,1.48,1.49,                      R1T1384
     Y     5*1.49,1.47,1.44,1.55,1.66,1.77,1.73,1.75,                     R1T1385
     Z     3*1.74,1.73,1.71,1.70,1.68,1.81,1.96,2.06,1.98,2.0 /           R1T1386
C                                                                         R1T1387
C  ** FIGURE  4.1.4.1-2 , DATCOM  ******                                  R1T1388
      DATA  XBD4 / 0.0, .34907, .69813, .87267, 1.0472 /,                 R1T1389
     1      YBD4 / 0.0, 1.5, 3.5, 6.0, 10.0 /,                            R1T1390
     2      ZBD4 / 0.0, 0.5, 1.0 /,                                       R1T1391
     3      FBD4 / 5*0.0, 0.0, 0.0, 0.0, -.0002, -.0005,                  R1T1392
     4             0.0, -.0007, -.002, -.0027, -.0037,                    R1T1393
     5             0.0, -.0019, -.0044, -.006, -.008,                     R1T1394
     6             0.0, -.008, -.016, -.021, -.0265,                      R1T1395
     7             5*0.0, 0.0, 0.0, -.0005, -.0008, -.0011,               R1T1396
     8             0.0, -.001, -.0029, -.0045, -.0068,                    R1T1397
     9             0.0, -.003, -.007, -.0093, -.013,                      R1T1398
     1             0.0, -.008, -.016, -.021, -.0265,                      R1T1399
     2             5*0.0, 0.0, -.0002, -.0006, -.001, -.0012,             R1T1400
     3             0.0, -.0013, -.003, -.004, -.0052,                     R1T1401
     4             0.0, -.0031, -.0066, -.0088, -.012,                    R1T1402
     5             0.0, -.008, -.016, -.0207, -.026   /                   R1T1403
C                                                                         R1T1404
      DATA  XDYO / 0.8, 1.1, 1.4, 1.6, 2.0, 2.4 /,                        R1T1405
     1      YXMN / 0.2, 0.3, 0.4, 0.5, 0.6, 0.7 /,                        R1T1406
     2      Z1BD5/ 3.784,4.395,5.432,6.348,8.545,11.231, 4.029,4.517,     R1T1407
     3             5.249,5.982,7.874,10.254, 4.395,4.639,5.127,5.616,     R1T1408
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     4              7.081,8.973, 4.7,4.834,5.127,5.432,6.287,7.691,       R1T1409
     5              5.371,5.213,5.188,5.31,5.799,6.836,                   R1T1410
     6              6.226,5.738,5.432,5.335,5.616,6.409 /                 R1T1411
C                                                                         R1T1412
C                                                                         R1T1413
C     FIGURE 4.1.4.2-25    DATCOM    *****                               R1T1414
      DATA  XBD6 / 0., 1., 2., 3. /,                                      R1T1415
     1      YBD6 / -2., -1., 0., 1. /,                                    R1T1416
     2      ZBD6 / 0., 1., 2., 3., 4., 5. /,                              R1T1417
     3     FBD61 / 0.,.125,.16,.17,0.,.115,.17,.2,0.,.15,.195,.195,0.,    R1T1418
     4 .165,.2,.2,.18,.26,.28,.3,.18,.27,.305,.32,.18,.285,.32,.32,.18,   R1T1419
     5 .3,2*.32,.34,.39,.4,.412,.34,.405,.435,.45,.34,.425,2*.445,.34,    R1T1420
     6.445,.45,.45,.5,.505,.515,.53,.5,.525,.54,.55,.5,.545,2*.55,.5,3*   R1T1421
     7.55, .665,.62,.623,.626,.665,.653,.66,.665,8*.665,                  R1T1422
     8  .815,.73,.728,.722,.815,.775,.778,.78,.815,.79,.78,.78,.815,     R1T1423
     9   3*.775 /                                                        R1T1424
      DATA FBD62 / 0.,.135,.17,.186,0.,.12,.19,.215,0.,.175,2*.215,0.,.2R1T1425
     1,2*.235,.2,.28,.298,.314,.2,.3,.35,.365,.2,.32,2*.36,.2,.365,2*.38R1T1426
     2, .4,.43,.44,.45,.4,.47,.495,.508,.4,.49,2*.51,.4,3*.52,           R1T1427
     3 .6,.575,.578,.58,.6,.61,.63,.65,.6,.64,2*.65,.6,3*.65,            R1T1428
     4 .8,3*.72,.8,.77,.78,.792,.8,.795,.792,.79,.8,3*.78,               R1T1429
     5 .98,.84,.83,.82,.98,3*.92,.98,.925,2*.915,.98,3*.885 /,           R1T1430
     6 FBD63 / 0.,.15,.18,.2,0.,.135,.23,.28,0.,.2,2*.275,0.,.24,2*.28,  R1T1431
     7 .26,.35,.365,.38,.26,.365,.42,.45,.26,.405,2*.455,.26,3*.475,     R1T1432
     8 .5,.535,.55,.565,.5,.585,.61,.63,.5,.605,2*.63,.5,3*.65,          R1T1433
     9 .75,3*.735,.75,.78,.795,.81,.75,3*.8,.75,3*.82,                   R1T1434
     1 .98,.905,.895,.885,.98,3*.95,.98,.95,2*.945,.98,3*.96,            R1T1435
     2 1.17,1.06,1.03,1.,1.17,1.1,1.08,1.065,1.17,1.09,2*1.065,1.17,     R1T1436
     3 3*1.08 /                                                          R1T1437
C                                                                         R1T1438
      DATA XIN13/ 0.0,1., 2., 3., 4., 5., 6., 7., 8., 20. /,              R1T1439
     1     YIN13/ 0.0, 20.0, 35.0, 50.0, 65.0, 72.5, 90.0 /,              R1T1440
     2    ZOUT13/ .00973,.00973,.0093,.009,.0089,.0087,4*0.0086,          R1T1441
     3            .00973,.00973,.0093,.009,.0089,.0087,4*0.0086,          R1T1442
     4            .0097, .0097,.00927,.00902,.0089,.00872,4*.00862,       R1T1443
     5            .0096,.0096,.0092,.009,.0089,.00872, 4*0.00863,         R1T1444
     6            .00943,.00943,.00897,.00882,.00875,.0086,4*.00854,      R1T1445
     7            .0093,.0093,.0088,.0087,.00862,.0085,4*0.00844,         R1T1446
     8            .0093,.0093,.0088,.0087,.00862,.0085,4*0.00844 /        R1T1447
      DATA ZOUT14/1.28,1.28,1.27,1.252,1.244,1.233,1.227,1.217,2*1.21,    R1T1448
     1            1.28,1.28,1.27,1.252,1.244,1.233,1.227,1.217,2*1.21,    R1T1449
     2            1.324,1.324,1.311,1.295,1.281,1.266,1.258,1.24,2*1.23,R1T1450
     3            1.363,1.363,1.35,1.33,1.313,1.292,1.283,1.261,2*1.25,   R1T1451
     4            1.392,1.392,1.38,1.36,1.339,1.317,1.303,1.279,2*1.27,   R1T1452
     5            1.403,1.403,1.392,1.371,1.349,1.325,1.31,1.285,2*1.28,R1T1453
     6            1.403,1.403,1.392,1.371,1.349,1.325,1.31,1.285,2*1.28/R1T1454
C                                                                         R1T1455
      DATA AMAP / 22.0, 21.7, 19.2, 18.35, 22.0, 21.2, 19.2, 27.0,11.75,R1T1456
     1            24.,24.,22.,20.,20.,19.,17.,15.,29.,27.,25., 2*0. /,    R1T1457
     2     BMAP / 4 * 1.75, 3 * 2.0, 4 * 0.0 /                            R1T1458
C                                                                         R1T1459
      DATA NXIN15/ 6 /,                                                   R1T1460
     1      XIN15/ 0.0, 0.5, 0.6, 0.8, 0.9, 1.0 /,                        R1T1461
     2      NYIN15/ 5 /,                                                  R1T1462
     3      YIN15 / 0.0, 5.0, 15.0, 20.0, 23.0 /,                         R1T1463
     4      FOUT15/ 0.865, 0.756, 0.71, 0.6, 0.51, 0.45,                  R1T1464
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5                0.865, 0.756, 0.71, 0.6, 0.51, 0.45,                    R1T1465
6                0.925, 0.965, 0.958,.905,.845, 0.78,                    R1T1466
7                0.978, 1.02,1.03, 1.02, 0.99, 0.975,                    R1T1467
8                0.99,  1.04,1.05, 1.05, 1.045,1.04 /,                   R1T1468
9       FOUT16/ 6 * 1.05, 1.05, 1.04, 1.02,.94,.88,.84,                  R1T1469
1                 1.05,  1.05, 1.04, 1.01, 0.995, 0.985,                 R1T1470
2                6 * 1.05,  6 * 1.05 /                                   R1T1471
 DATA X1    / 0.7243, 0.8727, 1.0472, 1.2217, 1.3963, 1.5708 /,          R1T1472
1     Y1    / 0.85, 0.69, 0.575, 0.51, 0.483, 0.48 /,                    R1T1473
2     X9    / 0.3665,0.5236,0.6981,0.8727,1.0472,1.2217,1.3963,1.6/,R1T1474
3     Y9    / 0.85,.625,.435,.35,0.375,0.447,0.478, 0.48 /,              R1T1475
4     XAR   / 1.0, 2.3, 3.0, 4.0, 5.0 /,                                 R1T1476
5     YOCL  / -0.16, 0.0, 0.05, 0.085, 0.0855 /                          R1T1477
C                                                                        R1T1478
 DATA  AAA / 8.48243E-4, 8.03417E-4, 3.31322E-6, -1.72323E-3,            R1T1479
4            2.02978E-3, 1.36146E-4, 3.79206E-5, 15 * 0.0 /,             R1T1480
5      BBB / -.0296429, -.0349676, -.0142049, .0310185,                  R1T1481
6            -.07305, -4.05767E-3, -1.03545E-3, 15 * 0.0  /,             R1T1482
7      CCC / 1.23835, 1.15999, 1.03825, 0.585837, 1.57142, .712684,R1T1483
8            .639394, 0.0, 0.0, 5 * 1.1019, 3 * .275475,                 R1T1484
9            3 * 3.3057, 0.0, 0.0 /,                                     R1T1485
1      DDD / -2.47002, -1.71448, -1.9292, -.559968, -2.99739,            R1T1486
2            .0188291, .0607728, 15 * 0.0 /,                             R1T1487
3      XTT / .35, .375, .41, .45, .37, .39, .42, .371, .5, .2,           R1T1488
4            .3, .4, .5, .6, .3, .4, .5, .3, .4, .5, 0.0, 0.0 /          R1T1489
 DATA  XSWP  / 0.0, 10.0, 20.0, 30.0, 40.0, 50.0, 60.0 /,                R1T1490
1      YTR   / 0.0, 0.25, 0.5, 1.0 /,                                    R1T1491
2      FFP35 / 0.94,0.951,0.96,0.968,0.973,0.974,0.971,                  R1T1492
3              0.992,0.995,0.997,0.999,0.998,0.992,0.984,                R1T1493
4              1.0,1.0,0.999,0.997,0.988,0.971,0.944,                    R1T1494
5              0.996,0.992,0.986,0.975,0.959,0.93,0.863 /,               R1T1495
6      FEP7  / 0.89,0.907,0.923,0.936,0.944,0.948,0.942,                 R1T1496
7              0.99,0.994,0.996,0.998,0.991,0.978,0.956,                 R1T1497
8              0.996,0.992,0.987,0.98,0.961,0.924,0.86,                  R1T1498
9              0.986,0.968,0.942,0.91,0.874,0.833,0.79 /                 R1T1499
 DATA  XCLDB / 0.0, 0.3, 0.4, 0.5, 0.6, 0.7, 2.0 /,                      R1T1500
1      YAKB  / 0.33,0.352,0.44,0.625,1.0,1.47, 2.0 /                     R1T1501
C                                                                        R1T1502
C                                                                        R1T1503
 DATA XTR    / 0.0, 0.1, 0.2, 0.3, 0.5, 1.0 /,                           R1T1504
1     YC1    / 0.0,0.225,0.47,0.5,0.32, 0.0 /,                           R1T1505
2     YC2    / 0.0,0.22,0.5, 0.91, 1.05, 0.85 /,                         R1T1506
3      XSWP1   / 0.0, 30.0, 50.0, 60.0              /,                   R1T1507
4     YA     / 0.9, 1.04, 1.2, 1.3              /,                       R1T1508
5     YB     / 0.0, 0.24, 0.5, 0.71             /,                       R1T1509
6     XDY    / 0.0, 2.0, 2.25, 2.5, 3.0, 4.0, 4.5, 10.0 /,               R1T1510
7     XM     / 0.2, 0.4, 0.6, 1.0               /                        R1T1511
 DATA CTAB   / 8 * 0.0, -.02,-.02,-.26,-.32,-.355,-.41,-.445,-.45,       R1T1512
9              .12,.12, -.36, -.43, -.5, -.64, -.72, -.72,               R1T1513
1              .58,.58, -.15, -.34, -.57, -.76, -.92, -.92 /,            R1T1514
2     DTAB   / 8 * 0.0, -.085,-.085, .02, .055, .045, .02,.02,.02,       R1T1515
3              -.2, -.2, -.01, -.02, -.03, -.07, -.09, -.09,8*0.0/,R1T1516
4     XXCLM  / 0.0, .2, .4, .6, .8, 1., 1.2, 1.6, 2.0, 2.4, 2.8,         R1T1517
5              3.2, 4.4 /,                                               R1T1518
6     YYDY   / 0.0, .25, .5, .75, 1.0, 10.0 /                            R1T1519
 DATA FCLMX  / 0.9, 1.375, 1.57, 1.645, 1.645, 1.575, 1.4, 1.14,         R1T1520
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     8                1.02, .96, .92, .91, .9,   .75, 1.28, 1.48, 1.55,   R1T1521
     9                1.56, 1.5, 1.33, 1.11, 1.0, .94, .9, .88, .875,    R1T1522
     1                .68, 1.19, 1.4, 1.47, 1.475, 1.4, 1.27, 1.08,      R1T1523
     2                .975, .92, .88, .85, .84,    .6, 1.1, 1.3, 1.375,  R1T1524
     3                1.385, 1.33, 1.23, 1.06, .96, .9, .865, .84, .83,  R1T1525
     4                .4,1.02, 1.2, 1.29, 1.31, 1.27, 1.19, 1.04, .94,   R1T1526
     5                .88, .84, .83, .82,    .4, 1.02, 1.2, 1.29, 1.31,  R1T1527
     6                1.27, 1.18, 1.02, .91, .85, .82, .8, .8    /,      R1T1528
     7       XXC2   / 0.0, 2.0, 4., 6., 8., 10., 12., 14., 20./,        R1T1529
     8       YYMACH / 0.0, 0.2, 0.4, 0.6, 1.0   /,                      R1T1530
     9       FDCLMX / -.11, -.08, 0.0, .115, .23, .335, .36, .22, 0.0,  R1T1531
     1                -.11, -.08, 0.0, .115, .23, .335, .36, .22, 0.0,  R1T1532
     2                -.11, -.08, 0.0, .1, .2, .3, .32, .18, 0.0,       R1T1533
     3                -.11, -.08, 0.0, .08, .15, .21, .205, .08, 10*0.0/ R1T1534
C                                                                       R1T1535
C  ** FIGURE  4.1.1.4-5,   DATCOM   *****                               R1T1536
C                                                                       R1T1537
      DATA   XDY1   / 0.0, 1.1, 2.25, 2.5, 3.0, 3.5, 4., 4.5, 6. /,     R1T1538
     1        YXMT   / 0.3, 0.35, 0.4, 0.45 /,                          R1T1539
     2       ZC1MAX / 0.8, 0.8, 1.315,1.43,1.58,1.58,1.54,1.47,1.41,    R1T1540
     3                0.8, 0.8, 1.315,1.43,1.51,1.52,1.49,1.41,1.36,    R1T1541
     4                0.8, 0.8, 1.315,1.39,1.45,1.45,1.43,1.35,1.34,    R1T1542
     5                0.8, 0.8, 1.3,  1.33,1.35,1.36,1.33,1.32,1.32/,   R1T1543
     6        XDY2   / 0.0,1.0,2.0,2.2,2.4,3.0,5.2,10.0 /,              R1T1544
     7        YFDC   / 0.0, 2.0, 4.0, 6.0, 8.0, 100.0 /,                R1T1545
     8       ZDC1M   / 10*0.0, 0.1, 0.13, 0.15, 0.145,0.05, 0.0,        R1T1546
     9                0.0, 0.11,0.275,0.3,0.3,0.22,0.10,0.0,            R1T1547
     1                0.1,0.26,0.44,0.465,0.45,0.30,0.17,0.0,           R1T1548
     2                0.2,0.40,0.60,0.620,0.60,0.39,0.25,0.0,           R1T1549
     3                0.2,0.40,0.60,0.620,0.60,0.39,0.25,0.0 /          R1T1550
      DATA Z2DC1M/ 9*0.,.15,.28, .28, .27, .18, .07, .07,               R1T1551
     1              .1, .28, .49, .47, .41, .26, .12, .12,              R1T1552
     2              .2, .41, .61, .60, .55, .35, .17, .17,              R1T1553
     3              .33,.52, .68, .65, .60, .39, .20, .20,              R1T1554
     4              .33,.52, .68, .65, .60, .39, .20, .20 /             R1T1555
C                                                                       R1T1556
      DATA XSP   / 0.0, 10.0, 20.0, 30.0, 40.0, 50.0, 60.0, 90.0/,      R1T1557
     1       YDYA / 0.0, 1.2, 2.0, 3.0, 4.0, 50.0 /,                    R1T1558
     2       FDA  / 1.8, 2.2, 3.4, 5.0, 7.4, 10.2, 13.4, 13.4,          R1T1559
     3              1.8, 2.2, 3.4, 5.0, 7.4, 10.2, 13.4, 13.4,          R1T1560
     4              0.1, 1.1, 2.3, 3.9, 5.8, 6.75, 9.9 , 9.9 ,          R1T1561
     5              1.3, 1.7, 2.4, 3.2, 4.2, 5.3 , 6.7 , 6.7 ,          R1T1562
     6              2.2, 2.0, 2.1, 2.3, 2.5, 2.85, 3.25, 3.25,          R1T1563
     7              2.2, 2.0, 2.1, 2.3, 2.5, 2.85, 3.25, 3.25 /         R1T1564
C                                                                       R1T1565
      DATA   XAB    / 0.0, 1.0, 2.0, 3.0, 4.0, 6.0 /,                   R1T1566
     1        YCO    / -1., -.75, -.5, -.25, 0.0, .25, .5, .75 /,       R1T1567
     2      FKVOFM   / 1.57, 1.74, 2.02, 2.30, 2.58, 2.75,              R1T1568
     3                1.78, 1.95, 2.18, 2.52, 2.85, 2.90,               R1T1569
     4                2.03, 2.21, 2.42, 2.71, 3.00, 3.15,               R1T1570
     5                2.48, 2.60, 2.73, 2.93, 3.19, 3.33,               R1T1571
     6                3.13, 3.15, 3.20, 3.28, 3.45, 3.60,               R1T1572
     7                3.79, 3.80, 3.81, 3.82, 3.88, 3.98,               R1T1573
     8                6 * 4.45, 6 * 5.0 /                               R1T1574
      DATA   XANG   / 0.0,.0698,.1396,.2094,.2792,.3490,.4188,.4886,    R1T1575
     1                0.5584, 0.6980 /,                                 R1T1576
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     2      YRTOC  / 0.0, 0.03, 0.05, 0.08, 0.12, 0.16, 0.5 /,          R1T1577
     3      FRA / 0.45,0.245,0.075, 7*0.0,                              R1T1578
     4              1.0,.62,.40,.255,.19,.148,.11,.079,.05, 0.0,        R1T1579
     5              1.0,.84,.72,.48,.34,.252,.195,.142,.1,  0.0,        R1T1580
     6              1.0,.90,.858,.758,.618,.46,.345,.25, .17, 0.0,      R1T1581
     7              1.0,.917,.885,.814,.72,.62,.51,.38, .23, 0.0,       R1T1582
     8              1.0,.925,.895,.835,.76,.665,.565, .46, .35, 0.0,    R1T1583
     9              1.0,.925,.895,.835,.76,.665,.565, .46, .35, 0.0 /   R1T1584
C                                                                       R1T1585
      DATA  SPAN / 0.0, 0.2, 0.4, 0.6, 0.8, 1.0 /,                      R1T1586
     1      YTPR / 0.0, 0.25, 0.5, 1.0 /,                               R1T1587
     2      FKB  / 0.0, 0.3, 0.555, 0.77, 0.925, 1.0,                   R1T1588
     3             0.0, 0.28,0.53, 0.75, 0.915, 1.0,                    R1T1589
     4             0.0, 0.265, 0.51, 0.73, 0.9, 1.0,                    R1T1590
     5             0.0, 0.25, 0.48, 0.70, 0.885, 1.0 /,                 R1T1591
     6      FKS  / 0.0, 0.31, 0.63, 0.85, 0.945, 1.0 /,                 R1T1592
     7      FKD  / 0.0, 0.38, 0.64, 0.84, 0.965, 1.0,                   R1T1593
     8             0.0,0.295, 0.54, 0.74, 0.9,   1.0,                   R1T1594
     9             0.0, 0.24, 0.475, 0.68, 0.855, 1.0,                  R1T1595
     1             0.0, 0.2, 0.4, 0.6, 0.8, 1.0 /                       R1T1596
C                                                                       R1T1597
      DATA  XC2  / 0.0, 1.0, 2.0, 3.0, 4.0, 5.0 /,                      R1T1598
     1      YAST  / 0.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 9.0, 30.0 /,     R1T1599
     2      FDAM  / 10.,7.,4.,1.5,0.,.5, 8.6,5.5,2.5,.5,-.3,.5,         R1T1600
     3             7.5,4.,1.,-.6,-1.,.5, 5.5,1.5,-1.2,-2.5,-1.,.5,      R1T1601
     4             3.,-1.5,-4.1,-3.,-1.,.5, .2,-4.5,-5.,-3.,-1.,.5,     R1T1602
     5             -2.3,-6.5,-5.,-3.,-1.,.5, -4.5,-7.,-5.,-3.,-1.,.5,   R1T1603
     6             -8.,-7.,-5.,-3.,-1.,0.5  /,                          R1T1604
     7      XCT   / 4.0, 6.0, 8.0, 10.0, 12.0, 14.0 /,                  R1T1605
     8      YM    / 0.2, 0.4, 0.6, 0.8, 1.0 /,                          R1T1606
     9      FDAM2 / 0.,1.5,4.,7.2,11.,15., 0.,.8,3.,6.,9.5,13.5,        R1T1607
     1             0.,.3,1.5,3.2,5.5,8.6, 0.,0.,.5,2.,4.,7.,            R1T1608
     2             0., .8, 3., 6., 9.5, 13.5 /                          R1T1609
C                                                                       R1T1610
      DATA XXXCLM / 0.0, .2, .4, .6, .8, 1., 1.2, 1.6, 2.0 /,           R1T1611
     1      FCLMXX / 0.7,1.2,1.37,1.43,1.43,1.365,1.25,1.08,.99,        R1T1612
     1               .65,1.12,1.29,1.355,1.365,1.305,1.21,1.07,.98,     R1T1613
     2               .6,1.09,1.23,1.29,1.295,1.24,1.17,1.05,.97,        R1T1614
     3               .55,1.0,1.15,1.23,1.24,1.20,1.15,1.04,.96,         R1T1615
     4               .5,.91,1.09,1.17,1.20,1.175,1.13,1.02,.935,        R1T1616
     5               .5,.91,1.09,1.17,1.20,1.165,1.11,1.0,.91 /         R1T1617
C                                                                       R1T1618
      DATA  XX  / 0.0,.4,.8,1.0,1.2,1.4,1.6,2.0,2.4,2.8,3.2,3.37 /,     R1T1619
     1      XY  / 0.,.1309,.1745,.2618,.3490,.4363,1.0 /,               R1T1620
     2      XF  / 8*1.0,.915,.63,.29,0.0,                               R1T1621
     3            8*1.0,.915,.63,.29,0.0,                               R1T1622
     4            7*1.0,.915,.755,.52,.245,0.0,                         R1T1623
     5            1.0,.97,.95,.97,1.0,.95,.87,.69,.552,.38,.185,0.0,    R1T1624
     6            .92,.90,.90,.95,1.0,.95,.845,.63,.48,.31,.150,0.0,    R1T1625
     7            .79,.80,.84,.91,1.0,.945,.83,.585,.425,.27,.128,0.,   R1T1626
     8            .79,.80,.84,.91,1.0,.945,.83,.585,.425,.27,.128,0. /  R1T1627
C                                                                       R1T1628
      DATA SPAN2 /0.0,0.1,0.2,0.3,0.4,0.5,0.6,0.7,0.8,0.9,1.0 /,        R1T1629
     1      YTPR2 / 0.0, 0.2, 0.333, 0.5, 1.0 /,                        R1T1630
     2      FKSW  / 0.0, 0.0285, 0.0435, 0.0490, 0.0480, 0.0417,        R1T1631
     3           0.0320, 0.0212, 0.0112, 0.0035, 0.0,                   R1T1632
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4              0.0, 0.0310, 0.0460, 0.0545, 0.0565, 0.0530,          R1T1633
5           0.0460, 0.0350, 0.0240, 0.0120, 0.0,                     R1T1634
6              0.0, 0.0290, 0.0460, 0.0560, 0.0590, 0.0570,          R1T1635
7           0.0510, 0.0410, 0.0290, 0.0150, 0.0,                     R1T1636
8              0.0, 0.0270, 0.0450, 0.0560, 0.0610, 0.0600,          R1T1637
9           0.0545, 0.0450, 0.0330, 0.0180, 0.0,                     R1T1638
1              0.0, 0.0225, 0.0400, 0.0525, 0.0605, 0.0620,          R1T1639
2           0.0600, 0.0520, 0.0400, 0.0230, 0.0 /                    R1T1640
C                                                                    R1T1641
 DATA SPAN3 / 0.0, 0.2, 0.4, 0.6, 0.8, 1.0 /,                        R1T1642
1     YTPR3 / 0.0, 0.25, 0.5, 1.0 /,                                 R1T1643
2     FKM   / 0.0, 0.645, 1.045, 1.240, 1.320, 1.330,                R1T1644
3             0.0, 0.440, 0.760, 0.955, 1.070, 1.120,                R1T1645
4             0.0, 0.310, 0.575, 0.775, 0.930, 1.030,                R1T1646
5             0.0, 0.200, 0.400, 0.600, 0.800, 1.000  /              R1T1647
 DATA SPAN4 /  0.0, 0.4, 0.8, 1.6, 2.4 /,                            R1T1648
1     YBFI1 /  0.0, 0.05, 0.1, 0.15, 0.2 /,                          R1T1649
2     FKA   /  0.0, 0.38, 0.68, 1.00, 1.13,                          R1T1650
3              0.0, 0.40, 0.74, 1.12, 1.32,                          R1T1651
4              0.0, 0.49, 0.83, 1.38, 1.75,                          R1T1652
5              0.0, 0.57, 1.05, 1.81, 2.43,                          R1T1653
6              0.0, 0.70, 1.27, 2.34, 3.37 /                         R1T1654
 DATA SPAN5 /  0.2, 0.4, 0.6, 0.8, 1.0 / ,                           R1T1655
1     YBFI2 /  0.0, 0.1, 0.2 /,                                      R1T1656
2     FKF   /  4.00, 1.60, 0.60, 0.17, 0.0,                          R1T1657
3              3.40, 1.55, 0.65, 0.26, 0.12,                         R1T1658
4              2.96, 1.46, 0.72, 0.40, 0.25 /                        R1T1659
 END                                                                 R1T1660

                                                        CC = 00364
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      OVERLAY(3,1)                                                      R1T1662
      PROGRAM VGEOM                                                     R1T1663
C                                                                       R1T1664
C     COMPUTES GEOMETRY FOR VARIABLE-SWEEP CONFIGURATIONS               R1T1665
C                                                                       R1T1666
      COMMON /BLKVGM/ KPASS, SWPLE, DOBR, CLDR, ARWR, SWLER, SWQCR,     R1T1667
     1                SWMCR, SWTER, TOCR, TANSR, DZ, SXR, SWPMCR,      R1T1668
     2                CBXR, CTXR, CBXPR, SOXPR, ARXRR, AROPR, FOCR,    R1T1669
     2                DA1, DAC1, DSWP1, CPOCR,                         R1T1670
     3                DA2, DAC2, DSWP2, DTOC                           R1T1671
C                                                                       R1T1672
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS      R1T1673
C                                                                       R1T1674
      COMMON /BLKA02/ SREF, AR, TAPR, SWPR,                             R1T1675
     1                BLEN(10), BWID(10), BHGT(10), BAWET(10), BQ(10),  R1T1676
     2                BNO(10), BAMX(10), BABS(10), BLNS(10), BLBT(10),  R1T1677
     3                BASE(10),  ELEN(10), EWID(10), EHGT(10),          R1T1678
     4                EAWET(10), EAMX(10), EIN(10), EXIT(10), ELNS(10), R1T1679
     5                ELBT(10)  EQF(10), ENO(10), CBAR(10), TW,         R1T1680
     6                XLEW, YWW, YBD,CR, BO2, BFUS, FMISC, AB, AFTAW,   R1T1681
     6                CAM(10), TOC(10), AWET(10), SWMT, SPLAN, CONCL,   R1T1682
     7                TWIST, ETWIST, WINC, XLE(11), CRW(11), YW(11),    R1T1683
     8                XPIVOT, YPIVOT, XAPEX, AFTSW, AFTCB, AFTOC,       R1T1684
     9                SBAR(10), TS(10), SCAM(10), STOC(10), SAWET(10),  R1T1685
     1                SMTSW(10), SHF(10), SWL(10), SWT(10), STAPR(10),  R1T1686
     2                SCR(10), HTLE, HTY, HTZ, HTINC                    R1T1687
C                                                                       R1T1688
      COMMON /BLKG01/ FRBOD(10),ARS(10),SSEX(10),FRNAC(10),SWP,SWPQC,   R1T1689
     1                SWPMC, SWPTE, DOB, TOCW, CLD, SEXW,  ESWMC,       R1T1690
     2                SXX(10), XLESWX(10), XMCSWX(10), ARW, TR, WPLAN,  R1T1691
     3                CB, YB, XB, CRX, CBX, CTX, YIX, YOX, SIX, SOX,    R1T1692
     4                ARI, ARXR, CBXP, AROP, SOXP, SWPLEI, SWPLEC,      R1T1693
     5              SMPMCI, SWPMCO, ESWQC, ESWLE, ESWTE, CROB, DXOB,    R1T1694
     6              XHT, XCRTE, XH, OMEGA, FOC, TWIST, DINC, SWPMT,     R1T1695
     7                CBAR2, CLDS, TOCS, SWET, DXQC, G1(81)             R1T1696
C                                                                       R1T1697
      COMMON /BLKPRT/ KPRINT(50)                                        R1T1698
      DIMENSION X(6), Y(6), XT(6), YT(6), D(6), P(6)                    R1T1699
C                                                                       R1T1700
C                                                                       R1T1701
C                                                                       R1T1702
      IF( KPASS.EQ.1 ) GO TO 5                                          R1T1703
      IF(SWPLE.EQ.SWPR) GO TO 10                                        R1T1704
      IF( KPASS.EQ.2 ) GO TO 20                                         R1T1705
      GO TO 25                                                          R1T1706
    5 DOBR   = DOB                                                      R1T1707
      CLDR   = CLD                                                      R1T1708
      SWLER  = ESWLE                                                    R1T1709
      SWQCR  = ESWQC                                                    R1T1710
      SWMCR  = ESWMC                                                    R1T1711
      SWTER  = ESWTE                                                    R1T1712
      ARWR   = ARW                                                      R1T1713
      TOCR   = TOCW                                                     R1T1714
      CBXR   = CBX                                                      R1T1715
      CTXR   = CTX                                                      R1T1716
      CBXPR  = CBXP                                                     R1T1717
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      SOXPR  = SOXP                                                     R1T1718
      ARXRR  = ARXR                                                     R1T1719
      AROPR  = AROP                                                     R1T1720
      FOCR   = FOC                                                      R1T1721
      SXR    = SXX(NPNLS)                                               R1T1722
      SWPMCR = XMCSWX(NPNLS)                                            R1T1723
      GO TO 15                                                          R1T1724
C                                                                       R1T1725
C                                                                       R1T1726
   10 DOB    = DOBR                                                     R1T1727
      TR     = TAPR                                                     R1T1728
      CLD    = CLDR                                                     R1T1729
      CBAR2  = CBAR(NPNLS)                                              R1T1730
      TWIST  = TWIST                                                    R1T1731
      DINC   = WINC                                                     R1T1732
      SWPMT  = SWMT                                                     R1T1733
      WPLAN  = SPLAN                                                    R1T1734
      ARW    = ARWR                                                     R1T1735
      CLDS   = CAM(NPNLS)                                               R1T1736
      TOCS   = TOC(NPNLS)                                               R1T1737
      SWET   = AWET(NPNLS)                                              R1T1738
      DXQC   = XLE(1+NPNLS)+CRW(1+NPNLS)*0.25  -XLE(1)-CRW(1)*0.25      R1T1739
      CLD    = CLDR                                                     R1T1740
      DOB    = DOBR                                                     R1T1741
      TOCW   = TOCR                                                     R1T1742
      SXX(NPNLS) = SXR                                                  R1T1743
      XLESWX(NPNLS)= SWPR                                               R1T1744
      XMCSWX(NPNLS)= SWPMCR                                             R1T1745
      CBX    = CBXR                                                     R1T1746
      CTX    = CTXR                                                     R1T1747
      SOX    = SXR                                                      R1T1748
      YOX    = YW(1+NPNLS) - YW(NPNLS)                                  R1T1749
      CBXP   = CBXPR                                                    R1T1750
      SOXP   = SOXPR                                                    R1T1751
      ARXR   = ARXRR                                                    R1T1752
      AROP   = AROPR                                                    R1T1753
      SWPLEO = SWPR                                                     R1T1754
      SWPMCO = SWPMCR                                                   R1T1755
      SEXW   = SXX(1) + SXX(2)                                          R1T1756
C                                                                       R1T1757
      ESWLF  = SWLER                                                    R1T1758
      ESWQC  = SWQCR                                                    R1T1759
      ESWMC  = SWMCR                                                    R1T1760
      ESWTF  = SWTER                                                    R1T1761
      GO TO 50                                                          R1T1762
C                                                                       R1T1763
   15 BO2    = YW(1+NPNLS)                                              R1T1764
      CR     = SPLAN/(1.+TAPR) /BO2                                     R1T1765
      CRX2   = CR *.(1.- YW(NPNLS)/BO2 *(1.-TAPR) )                     R1T1766
      DZ     = CR * TAPR * TAN(TWIST/57.296)                            R1T1767
      TANSR  = TAN(SWPR) * (1.- (1.-TAPR)*CR/BO2/TAN(SWPR) )            R1T1768
      SX2    = (CRX2 + CR*TAPR) * (YW(1+NPNLS) - YW(NPNLS) )            R1T1769
      SWET   = SX2 * (2.+.1843*TOC(NPNLS) +1.5268*TOC(NPNLS)**2         R1T1770
     1                 -.8395*TOC(NPNLS)**3)                            R1T1771
      DA1    = AWET(NPNLS) - SWET                                       R1T1772
      DAC1   = CBAR(NPNLS) -.66667 *(CRX2 + (CR*TAPR)**2/               R1T1773
```

```
     1                                  (CRX2 + CR*TAPR) )
      SWPMC   = ATAN(0.5 *(TANSR + TAN(SWPR)) )
      DSWP1   = SWMT - ATAN(0.5 *(TAN(SWPR) + TAN(SWPMC)) )
      SWPTE   = ATAN(TANSR)
      CPOCR   = 0.5 * (COS(SWPR)/COS(SWPR-SWPMC) + COS(SWPTE)/
     1                                          COS(SWPMC-SWPTE) )
C
      DA2     = 0.0
      DAC2    = 0.0
      DSWP2   = 0.0
      DTOC    = 0.0
C
      GO TO 50
C
   20 CONTINUE
C
C
C
   25 Y(2)    = YW(1+NPNLS)
      CR      =  SPLAN/(Y(2)*  (1.+TAPR))
      X(4)    = CR + XAPEX
      X(1)    = XAPEX
      Y(1)    = 0.0
      Y(4)    = 0.0
      X(2)    = X(1) + Y(2) * TAN(SWPR)
      X(3)    = X(2) + TAPR * CR
      Y(3)    = Y(2)
      DO 30 I =1,4
      D(I)    = SQRT((X(I) - XPIVOT)**2 + (Y(I) - YPIVOT)**2)
      P(I)    = ATAN((X(I) - XPIVOT) / ( Y(I) - YPIVOT) )
      IF((Y(I) - YPIVOT).LE.0.0) P(I) = P(I) + 3.141592
   30 CONTINUE
C
      DSWP    = SWPLE - SWPR
C
      DO 40 I =1,4
      XT(I)   = XPIVOT +D(I) * SIN(DSWP + P(I))
      YT(I)   = YPIVOT +D(I) * COS(DSWP + P(I))
   40 CONTINUE
      DXQC    = 0.75* XT(2) +0.25* XT(3) -XLE(1) - CRW(1)*0.25
      SWPTE   = ATAN((XT(3) - XT(4))/(YT(3) - YT(4)))
      CO      = TAN(SWPTE) / TAN(SWPLE )
      SWPQC   = ATAN((1.0 - (1.0 - CO)/4.0)* TAN(SWPLE) )
      SWPMC   = ATAN((1.0 - (1.0 - CO)/2.0)* TAN(SWPLE) )
      XFWD      = XT(2) - YT(2) * TAN(SWPLE)
      XAFT      = XT(3) - YT(3) * TAN(SWPTE)
      CRCLP   = XAFT - XFWD
      CPOC    = 0.5 * ( COS(SWPLE)/COS(SWPLE - SWPMC) + COS(SWPTE)/
     1                                          COS(SWPMC - SWPTE) )
      CLDS    = CAM(NPNLS) * CPOC/CPOCR
      TOCS    = TOC(NPNLS) * CPOC/CPOCR
      DOB     = DOBR * Y(2)/YT(2)
C
   45 CONTINUE
      TTIP    = 1.0 + YT(2)* TAN(SWPLE) * (CO - 1.0)/CRCLP
      TWIST   = ATAN(DZ/(CRCLP*TTIP)) * 57.296
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```
      DINC    = WINC * (1.-TAN(DSWP) * TANSR) * COS(DSWP)                R1T1830
C                                                                        R1T1831
      C3      = CRCLP * (1.0 -(YT(3)/YT(2))*(1.0 - TTIP) )               R1T1832
      WPLAN   = (CRCLP + C3) *YT(3) + C3 *(YT(2)-YT(3))                  R1T1833
      ARW     = 4. * YT(2)**2/WPLAN                                      R1T1834
      YMID    = YT(3) +(YT(2) - YT(3)) /(1.0/SQRT(C3/(TTIP*CRCLP)) + 1.0)R1T1835
      TR      = 1. - (YMID/YT(2)) * (1.-TTIP)                            R1T1836
      XTE2    = XT(4) + YW(NPNLS)*TAN(SWPTE)                             R1T1837
      CRX2    = CRCLP * (1.-YW(NPNLS)/YT(2)  * (1.-TTIP))                R1T1838
      SX2     = WPLAN - (CRCLP + CRX2) * YW(NPNLS)                       R1T1839
      STOTAL  = SX2                                                      R1T1840
      TOCW    = TOCS                                                     R1T1841
      CLD     = CLDS                                                     R1T1842
      IF( NPNLS.EQ.1 ) GO TO 46                                          R1T1843
C                                                                        R1T1844
      S1      = (XT(4)-XT(3))/(YT(4)-YT(3))                              R1T1845
      S2      = (XLE(1)+CRW(1)-XLE(2)-CRW(2))/(YW(1)-YW(2))              R1T1846
      IF( S1.EQ.S2 ) GO TO 46                                            R1T1847
      YI      =(XT(4)-XLE(1)-CRW(1) +S1*YT(4) -S2*YW(1))/(S1-S2)         R1T1848
      DA      =(XTE2 - XLE(2) - CRW(2)) * (YW(2) - YI)                   R1T1849
      SX2     = SX2 + DA                                                 R1T1850
      STOTAL  = SXX(1) + SX2                                             R1T1851
      TOCW    = SQRT((TOC(1)**2*SXX(1) + TOCS**2*SX2)/STOTAL)            R1T1852
      CLD     = SQRT((CAM(1)**2*SXX(1) + CLDS**2*SX2)/STOTAL)            R1T1853
C                                                                        R1T1854
   46 SWET    = SX2 * (2.+.1843*TOCS +1.5268*TOCS**2 -.8395*TOCS**3)     R1T1855
     1          +DA1 +(DA2-DA1) * (SWPLE-SWPR)/(AFTSW-SWPR)              R1T1856
      TP      = TR * CRCLP/CRX2                                          R1T1857
      CBAR2   = 0.66667 * CRX2 * (1. + (TP**2/(1.+TP)) )                 R1T1858
      CBAR2   = CBAR2 + DAC1 + (DAC2 - DAC1) * DSWP/(AFTSW-SWPR)         R1T1859
C                                                                        R1T1860
      SWPMT   = SWPQC + DSWP1 + (DSWP2-DSWP1) * DSWP/(AFTSW-SWPR)        R1T1861
      TOCW    = TOCW + DTOC * DSWP/(AFTSW - SWPR)                        R1T1862
C                                                                        R1T1863
      COSMC   = COS(XMCSWX(1)) * SXX(1) + COS(SWPMC) * SX2               R1T1864
      COSQC   = COS(ATAN(0.5*(TAN(XLESWX(1))+TAN(XMCSWX(1))))) * SXX(1)  R1T1865
     1                + COS(SWPQC) * SX2                                 R1T1866
      TANLE   = TAN(XLESWX(1)) * SXX(1) + TAN(SWPLE) * SX2               R1T1867
      TANTE   = (2.*TAN(XMCSWX(1))- TAN(XLESWX(1))) *SXX(1)              R1T1868
     1                + TAN(SWPTE) * SX2                                 R1T1869
C                                                                        R1T1870
      ESWMC   = ACOS(COSMC/STOTAL)                                       R1T1871
      ESWQC   = ACOS(COSQC/STOTAL)                                       R1T1872
      ESWLE   = ATAN(TANLE/STOTAL)                                       R1T1873
      ESWTE   = ATAN(TANTE/STOTAL)                                       R1T1874
C                                                                        R1T1875
      SEXW    = STOTAL                                                   R1T1876
      SXX(NPNLS) = SX2                                                   R1T1877
      XLESWX(NPNLS)= SWPLE                                               R1T1878
      XMCSWX(NPNLS)= SWPMC                                               R1T1879
      CBX     = CRX2                                                     R1T1880
      CTX     = CRCLP * TR                                               R1T1881
      SOX     = SX2                                                      R1T1882
      YOX     = YMID - YW(NPNLS)                                         R1T1883
      CBXP    = CRCLP * (1.-(YW(1)+YW(2))*.5 *(1.-TR)/YMID )             R1T1884
      SOXP    = (CBXP + CTX) * (YMID -(YW(1)+YW(2))*.5)                  R1T1885
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      ARXR    = 4. * (YMID - YW(1))**2 /SEXW                                R1T1886
      AROP    = 4. * (YMID - (YW(1)+YW(2)*.5) )**2/SOXP                     R1T1887
      SWPLEO = SWPLE                                                        R1T1888
      SWPMCO = SWPMC                                                        R1T1889
      FOC     = CLD * FOCR /CLOR                                            R1T1890
C                                                                           R1T1891
      IF( KPASS.NE.2) GO TO 50                                              R1T1892
C                                                                           R1T1893
      IF( AFTAW.GT.0.0 ) DA2 = AFTAW - SWET                                 R1T1894
      IF( AFTCB.GT.0.0 ) DAC2 = AFTCB - CBAR2                               R1T1895
      IF( AFTOC.GT.0.0 ) DTOC = AFTOC - TOCS                                R1T1896
   50 CONTINUE                                                              R1T1897
      SWP     = SWPLE                                                       R1T1898
C                                                                           R1T1899
      IF( KPRINT(12).EQ.1 ) WRITE(6,1000) KPASS, SWPLE, DA1, DAC1,          R1T1900
     1         DSWP1, CPOCR, DA2, DAC2, DSWP2, DTOC, DA                     R1T1901
     2           ,TW1ST,DINC,SWPMT,CBAR2,CLDS,TOCS,SWET,DOB,TOCW,           R1T1902
     3            CLD,SEXW,ESWLE,ESWOC,ESWMC,ESWTE,ARW,TR,WPLAN             R1T1903
 1000 FORMAT(5X, *VGEOM DUMP,  KPASS =*,I3, 10X,*SWPLE =* F12.4 /           R1T1904
     1           (1X, 7F15.5 )                                              R1T1905
C                                                                           R1T1906
      END                                                                   R1T1907
```

CC = 00246

```
      OVERLAY(3,2)                                                      R1T1909
      PROGRAM MCRIT                                                     R1T1910
C                                                                       R1T1911
C     COMPUTES CRITICAL MACH NUMBER                                     R1T1912
C                                                                       R1T1913
      COMMON /BLKOV3/ ID, XMACH, TOC, CLD, SWEEP, CV3(3), JPASS,        R1T1914
     1                OV3A(3)                                          R1T1915
      COMMON /BLKA05/ SCW(6), SECTG(5), C1MAX, CLMCR(10), XMCR(10),     R1T1916
     1                XT(33), YT(33), YC(33), NMCR, NXSET               R1T1917
C                                                                       R1T1918
      COMMON /BLKC03/ CLTAB(11), TABMCR(11)                             R1T1919
C                                                                       R1T1920
      IF( ID.LE.23 ) CALL CPZT(ID, 0.6, TOC, CLD, SWEEP)                R1T1921
C                                                                       R1T1922
  100 CLTAB(1) = 0.0                                                    R1T1923
      DO 200 I = 1, 11                                                  R1T1924
      IF( I.GT.1 ) CLTAB(I) = CLTAB(I-1) + 0.1                          R1T1925
      CALL LNTP(CLTAB(I), TABMCR(I), CLMCR, XMCR, NMCR, 2)              R1T1926
      CALL ADJUST(0.4, CLTAB(I), TABMCR(I))                             R1T1927
      IF( TABMCR(I).LT.0.0 ) TABMCR(I) = 0.0                            R1T1928
C                                                                       R1T1929
  200 CONTINUE                                                          R1T1930
C                                                                       R1T1931
  300 WRITE(6,1000) (CLTAB(I), TABMCR(I) , I =1,11)                     R1T1932
C                                                                       R1T1933
 1000 FORMAT(1H1, 5X, * MACH CRITICAL TABLE * /// 5X *  CL  *, 5X       R1T1934
     1                * MACH CRITICAL * //(5X,2F15.4) )                R1T1935
C                                                                       R1T1936
      END                                                               R1T1937
```

CC = 00029

```
      SUBROUTINE CPZT(ID, XMACH, TOC, CLD, SWEEP)
C
C     CALCULATES AIRFOIL PRESSURES - BRITISH METHOD
C     AND COMPUTES MACH CRITICAL USING  CREST CRITERIA
C
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS
C
      COMMON /BLKA05/ SCW(6), SECTG(5), CLMAX, CLMCR(10), XMCR(10),
     1                ORD(99), NMCR, NXSET
      COMMON /BLKR07/ XU(32), ZT(32), ZS(32), ROC, ZTE
      COMMON /BLKCPI/ SA(32), SB(32), SC(32), SD(32), SE(32)
      COMMON /BLKPRT/ KPRINT(50)
      COMMON /BLKG01/ G1(200)
C
      DIMENSION COSE(32), SINE(32), S1(32,32), S2(32,32), S3(33,32),
     1                S4(32,32), S5(32,32), YCPI(32), DZDXUT(32)
C
      PI     = 3.1415927
      AR     = G1(80)
      SWP    = SWEEP/57.29578
      COSPHI = ( COS(SWP) )**(AR/(1.4+AR))
      IF( SWEEP.GT.40.0 ) COSPHI = 0.5 * (COSPHI +.76604**(AR/(1.4+AR)))
C     COSPHI IS THE COSINE OF THE EFFECTIVE ISOBAR SWEEP
      SWP    = ACOS(COSPHI)
C
      NCP    = 31
      NMCR   = 0
C
      DO 100 I= 1,NCP
C
      XI     = I
      XN     = NCP + 1
      NX      = NCP + 1
      COSE(I)= COS(XI*PI/XN)
      SINE(I)= SIN(XI*PI/XN)
      XU(I)  = 0.5*(1.0 + COSE(I))
  100 CONTINUE
C
      CALL SECT(ID, TOC, CLD)
C
      DO 300 IV = 1, NCP
      DO 200 IU = 1, NCP
C
      IMV    = IU - IV
      S1(IU,IV) = XN/SINE(IU)
      S2(IU,IV) = COSE(IU)/(SINE(IU)**2)
      S3(IU,IV) = XN/SINE(IU)
      S4(IU,IV) = XN/SINE(IU) - 2.0 * ((-1.0)**IU -1.0) /
     1              ( XN * SINE(IU) * (1.0 - COSE(IU)) )
      S5(IU,IV) = - S2(IU,IV)
      IF( IU.EQ.IV ) GO TO 150
C
      SIGN      = ((-1.0)**IMV - 1.0)/XN
      DEM       = (COSE(IU) - COSE(IV))
      S1(IU,IV) = SIGN * 2.0 * SINE(IU) /(DEM**2)
      S2(IU,IV) = (-2.0*(-1.0)**IMV*SINE(IU))/(SINE(IV)*DEM)
```

```
      S3(IU,IV) = S1(IU,IV) - SIGN * 2.0 * (1.0/(SINE(IU)*DEM))          R1T1995
      S4(IU,IV) = 2.0 * SIGN * (1.0 - COSE(IU)*COSE(IV) ) /              R1T1996
     1            (SINE(IV) * DEM**2 )                                   R1T1997
     2          - 2.0 * ((-1.0)**IU -1.0) /                              R1T1998
     3            (XN * SINE(IV) * (1.0 - COSE(IU)) )                    R1T1999
      S5(IU,IV) = -2.0 * (-1.0)**IMV /DEM                                R1T2000
C                                                                        R1T2001
  150 IF( KPRINT(26).NE.3 ) GO TO 200                                    R1T2002
      WRITE(6,1000) S1(IU,IV), S2(IU,IV), S3(IU,IV)                      R1T2003
     1              ,S4(IU,IV), S5(IU,IV)                                R1T2004
  200 CONTINUE                                                           R1T2005
      S3(NX,IV) = ((-1.0)**IV -1.0)/(XN*(1.0 + COSE(IV)))                R1T2006
  300 CONTINUE                                                           R1T2007
C                                                                        R1T2008
      IF( KPRINT(26).EQ.3 ) WRITE(6,1000)  (S3(NX,J), J=1,NCP)           R1T2009
C                                                                        R1T2010
      ALPHA  = 6.0                                                       R1T2011
  350 A      = ALPHA/57.296                                              R1T2012
      NMCR   = NMCR + 1                                                  R1T2013
      XM     = XMACH                                                     R1T2014
      IF( XM.GT.0.9 ) XM = 0.9                                           R1T2015
      IF(XM.LE.0.0 ) XM = 0.01                                           R1T2016
      XM2      = XM**2                                                   R1T2017
      IF( KPRINT(1).EQ.1 ) WRITE(6,1001) XM, ALPHA, SWEEP                R1T2018
      CLI    = 0.0                                                       R1T2019
      CL     = 0.0                                                       R1T2020
      DCPIM1 = 0.0                                                       R1T2021
      DCPM1  = 0.0                                                       R1T2022
      CMI    = 0.0                                                       R1T2023
      CM     = 0.0                                                       R1T2024
      DO 500 IV = 1, NCP                                                 R1T2025
      SA(IV)    = 0.0                                                    R1T2026
      IF(ID.LT.10.OR.ID.GT.20) SB(IV) = 0.0                              R1T2027
      SC(IV)    = S3(NX,IV) * SQRT(ROC/2.0)                              R1T2028
      SD(IV)    = 0.0                                                    R1T2029
      SE(IV)    = 0.0                                                    R1T2030
      DO 400 IU = 1, NCP                                                 R1T2031
C                                                                        R1T2032
      SA(IV)    = SA(IV) + S1(IU,IV)*ZT(IU)                              R1T2033
      IF(ID.LT.10.OR.ID.GT.20) SB(IV) = SB(IV) +S2(IU,IV)*ZT(IU)         R1T2034
      SC(IV)    = SC(IV) + S3(IU,IV)*ZT(IU)                              R1T2035
      SD(IV)    = SD(IV) + S4(IU,IV)*ZS(IU)                              R1T2036
      SE(IV)    = SE(IV) + S5(IU,IV)*ZS(IU)                              R1T2037
  400 CONTINUE                                                           R1T2038
C                                                                        R1T2039
      CALL CPUOV(1.0, A, SWP, IV, CPIU, CPU, XM)                         R1T2040
C                                                                        R1T2041
      CALL CPUOV(-1., A, SWP, IV, CPIL, CPL, XM)                         R1T2042
C                                                                        R1T2043
      DCPI   = CPIL - CPIU                                               R1T2044
      DCP    = CPL  - CPU                                                R1T2045
C                                                                        R1T2046
      DZDXU  = SB(IV) + SE(IV)                                           R1T2047
      DZDXL  =-SB(IV) + SE(IV)                                           R1T2048
C                                                                        R1T2049
      YCPI(IV) = CPIU                                                    R1T2050
```

```
      DZDXUT(IV) = DZDXU                                                R1T2051
C                                                                       R1T2052
      IF( KPRINT(1).EQ.1 ) WRITE(6,1000) XU(IV),CPIU,CPIL,DCPI,DZDXU,   R1T2053
     1                     DZDXL, CPU, CPL, DCP, XU(IV)                 R1T2054
C                                                                       R1T2055
      DX      = XU(NCP)                                                 R1T2056
      XB      = 0.5 * (1. + XU(1))                                      R1T2057
      IF( IV.NE.1 )  DX = XU(IV-1) - XU(IV)                             R1T2058
      IF( IV.NE.1 ) XB = 0.5 * (XU(IV-1) + XU(IV))                      R1T2059
      CLI     = CLI + DX * (DCPI + DCPIM1) * 0.5                        R1T2060
      CL      = CL  + DX * (DCP  + DCPM1 ) * 0.5                        R1T2061
      CMI     = CMI + DX * (DCPI + DCPIM1)*0.5 * (XB - 0.25)            R1T2062
      CM      = CM  + DX * (DCP + DCPM1) *0.5 * (XB - 0.25)             R1T2063
C                                                                       R1T2064
      DCPIM1 = DCPI                                                     R1T2065
      DCPM1  = DCP                                                      R1T2066
C                                                                       R1T2067
  500 CONTINUE                                                          R1T2068
C                                                                       R1T2069
      CLI     = CLI + XU(NCP) * DCPI* 0.5                               R1T2070
      CL      = CL  + XU(NCP) * DCP * 0.5                               R1T2071
      CMI     = CMI + XU(NCP) * DCPI * 0.5 * (0.5*XU(NCP) -0.25)        R1T2072
      CM      = CM  + XU(NCP) * DCP * 0.5 * (0.5*XU(NCP) -0.25)         R1T2073
      CPCRIT = (1.42857/XM2) * (0.52828 *(1. + 0.2 *XM2)**3.5 -1.)      R1T2074
C                                                                       R1T2075
      IF( KPRINT(1).GT.0 ) WRITE(6,1002) CLI,CMI,CPCRIT,ZTE,CL,CM       R1T2076
  600 CONTINUE                                                          R1T2077
C                                                                       R1T2078
      IF( A.LT.DZDXUT(NCP) ) GO TO 610                                  R1T2079
      NMCR    = NMCR - 1                                                R1T2080
      ALPHA   = ALPHA -1.                                               R1T2081
      GO TO 350                                                         R1T2082
C                                                                       R1T2083
  610 CALL LNTP(A, XCREST, DZDXUT, XU, NCP, 4)                          R1T2084
C                                                                       R1T2085
  620 CALL LNTP(XCREST, CPCR, XU, YCPI, NCP, 4)                         R1T2086
C                                                                       R1T2087
      CPCRST = CPCR/COSPHI**2                                           R1T2088
  630 CPI2   = CPCRST * CPCRST                                          R1T2089
      XMDDN  = 1./(1.0323 -.8365*CPCRST -.361*CPI2 -.1336*CPCRST**3     R1T2090
     1                -.0173*CPCRST**4)                                R1T2091
      IF( ID.EQ.8 )  XMDDN = 1./(1.012 -.8551*CPCRST                    R1T2092
     1           -.4493*CPI2 -.2219*CPCRST**3 -.0447*CPCRST**4)         R1T2093
C                                                                       R1T2094
      XMDD    = XMDDN/COSPHI                                            R1T2095
      IF( XMDD.LE.0.82.OR.ID.EQ.8 ) GO TO 640                           R1T2096
      IF( XMDD.LE.1.08 ) XMDD = .2686 -.5729*XMDD +2.7123*XMDD**2       R1T2097
     1                                  -1.4582*XMDD**3                 R1T2098
      IF( XMDD.GT.1.08 ) XMDD = 0.8545 +.1132*XMDD                      R1T2099
C                                                                       R1T2100
  640 FMCRB  = 1.0                                                      R1T2101
      IF( NBODYS.GE.1 ) FMCRB = 1.0439 - 0.5828/G1(1)                   R1T2102
      IF( G1(1).GT.10.0 ) FMCRB = 0.98                                  R1T2103
      IF( XMDD.GT.FMCRB ) XMDD = FMCRB                                  R1T2104
C                                                                       R1T2105
      BMDD2  = 1. - (XMDD * COS(SWP))**2                                R1T2106
```

```
      IF( BMDD2.GT.0.0 ) CLMDD = CLI/SQRT(BMDD2)                        R1T2107
C                                                                       R1T2108
      IF( KPRINT(1).GT.0 ) WRITE(6,1003) XMDD,CLMDD,XCREST,CPCR,COSPHI  R1T2109
      CLMCR(NMCR) = CLMDD                                               R1T2110
      XMCR(NMCR)  = XMDD                                                R1T2111
C                                                                       R1T2112
  700 IF( CLI.LE.0.0 ) RETURN                                           R1T2113
      IF( NMCR.GE.10 ) RETURN                                           R1T2114
      ALPHA  = ALPHA - 1.                                               R1T2115
      GO TO 350                                                         R1T2116
C                                                                       R1T2117
 1000 FORMAT(5X,10F12.4)                                                R1T2118
C                                                                       R1T2119
 1001 FORMAT(1H1, ////10X, 57HPRESSURE DISTRIBUTION AND SURFACE SLOPES FR1T2120
     10R 2-D AIRFOIL   , 6X,*MACH =*F6.4, 5X,*ALPHA =*F6.3 ///          R1T2121
     1               10X,*SWEEP ANGLE =*, F7.3 //                       R1T2122
     2        12X,*X/C*,7X,*CPI(UPPER)*,2X,*CPI(LOWER)*,4X,*DCPI*,      R1T2123
     3        5X,*DZ/DX(UPPER)*,2X,*DZ/DX(LOWER)*,1X,*CP(UPPER)*,       R1T2124
     4        2X,*CP(LOWER)*,4X,*DCP*, 9X,*X/C* // )                    R1T2125
C                                                                       R1T2126
 1002 FORMAT(//10X,*CLI =*F7.4, 10X,*CMI =*F7.4, 20X,*CP(M=1) = *,      R1T2127
     1        F8.4, 10X, *ZTE =*F7.4 /11X,*CL =*F7.4, 6X,*CM(C/4) =*    R1T2128
     2        F7.4 / )                                                  R1T2129
C                                                                       R1T2130
 1003 FORMAT( /10X,*MACH CRIT =*F7.4, 10X, *CL AT MDD =*F7.4, 10X,      R1T2131
     1             *X-CREST =*F7.4, 10X,*CP-CREST =*F8.4 /              R1T2132
     2             50X, *COSINE OF EFFECTIVE ISOBAR =*F7.4 //)          R1T2133
C                                                                       R1T2134
      END                                                               R1T2135
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CC = 00197

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      SUBROUTINE SECT(ID, TOC, CLD)                                     R1T2137
C                                                                       R1T2138
C     CALCULATES THICKNESS AND CAMBER                                   R1T2139
C                                                                       R1T2140
      COMMON /BLKCPI/ SA(32), SB(32), SC(32), SD(32), SE(32)            R1T2141
      COMMON /BLKR07/ XU(32), ZT(32), ZS(32), ROC, ZTE                  R1T2142
      COMMON /BLKA05/ XMU, ZMU, XML, ZML, ZPTE, ZTHIK, RLE, A4(25),     R1T2143
     1                XT(33), YT(33), YC(33), NMCR, NXSET               R1T2144
      COMMON /BLKBD2/ AA(22), BB(22), CC(22), DD(22), XTT(22)           R1T2145
      COMMON /BLKPRT/ KPRINT(50)                                        R1T2146
C                                                                       R1T2147
      DIMENSION XSECT(26),Y164A(26),CAMB(26)                            R1T2148
      DIMENSION Y163A(26),Y165A(26),Y163(26),Y164(26),Y165(26),         R1T2149
     1          Y166(26),CAMB1(26)                                      R1T2150
      DIMENSION A0(11), A1(11), A2(11), A3(11), D1(11), D2(11), D3(11)  R1T2151
C                                                                       R1T2152
      DATA XSECT/ 0.0,0.005,0.0075,0.0125,0.025,0.05,0.075,0.1,         R1T2153
     1            0.15,0.2,0.25,0.3,0.35,0.4,0.45,0.5,0.55,0.6,         R1T2154
     2            0.65,0.7,0.75,0.8,0.85,0.9,0.95,1.0 /                 R1T2155
      DATA Y163 / 0.0,.00829,.01004,.01275,.01756,.0244,.0295,.03362,   R1T2156
     1            .03994,.04445,.04753,.04938,.05,.04938,.04766,.04496, R1T2157
     2            .0414,.03715,.03234,.02712,.02166,.01618,.01088,      R1T2158
     3            .00604,.00214,0.0 /                                   R1T2159
      DATA Y164 / 0.0,.0082,.00989,.0125,.01701,.02343,.02826,.03221,   R1T2160
     1            .03842,.04302,.04639,.04864,.0498,.04988,.04843,      R1T2161
     2            .04586,.04238,.0382,.03345,.02827,.02281,.01722,      R1T2162
     3            .01176,.00671,.00248,0.0 /                            R1T2163
      DATA Y165 / 0.0,.00772,.00932,.01169,.01574,.02177,.02647,.0304,  R1T2164
     1            .03666,.04143,.04503,.0476,.04924,.04996,.04963,      R1T2165
     2            .04812,.0453,.04146,.03682,.03156,.02584,.01987,      R1T2166
     3            .01385,.0081,.00306,0.0 /                             R1T2167
      DATA Y166 / 0.0,.00759,.00913,.01141,.01516,.02087,.02536,.02917, R1T2168
     1            .0353,.04001,.04363,.04636,.04832,.04953,.05,.04971,  R1T2169
     2            .04865,.04665,.04302,.03787,.03176,.02494,.01773,     R1T2170
     3            .01054,.00408,0.0 /                                   R1T2171
      DATA Y163A/ 0.0,.00816,.00983,.0125,.01737,.02412,.02917,.03324,  R1T2172
     1            .0395,.044,.04714,.04913,.04995,.04968,.04837,.04613, R1T2173
     2            .04311,.03943,.03517,.03044,.02545,.02004,.01535,.0103,R1T2174
     3            .00525,.00021 /                                       R1T2175
      DATA Y164A/ 0.0,0.00804,0.00969,0.01225,0.01688,0.02327,          R1T2176
     1            0.02815,0.03199,0.03813,0.04272,0.04606,0.04837,      R1T2177
     2            0.04968,0.04995,0.04894,0.04684,0.04388,0.04021,      R1T2178
     3            0.03597,0.03127,0.02623,0.02103,0.01582,0.01062,      R1T2179
     4            0.00541,0.00021 /                                     R1T2180
      DATA Y165A/ 0.0,.00765,.00928,.01183,.01623,.02182,.0265,.0304,   R1T2181
     1            .03658,.04127,.04483,.04742,.04912,.04995,.04983,     R1T2182
     2            .04863,.04632,.04304,.03899,.03432,.02912,.02352,     R1T2183
     3            .01771,.01188,.00604,.00021 /                         R1T2184
      DATA CAMB / 0.0,0.00281,0.00396,0.00603,0.01055,0.01803,          R1T2185
     1            0.02432,0.02981,0.03903,0.04651,0.05257,0.05742,      R1T2186
     2            0.06120,0.06394,0.06571,0.06651,0.06631,0.06508,      R1T2187
     3            0.06274,0.05913,0.05401,0.04673,0.03607,0.02452,      R1T2188
     4            0.01226,0.0  /                                        R1T2189
      DATA CAMB1/ 0.0,.0025,.0035,.00535,.0093,.0158,.0212,.02585,      R1T2190
     1            .03365,.0398,.04475,.0486,.0515,.05355,.05475,.05515, R1T2191
     2            .05475,.05355,.0515,.0486,.04475,.0398,.03365,.02585, R1T2192
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     3            .0158,0.0 /                                          R1T2193
      DATA A0  / 5 * 0.2969, 3 * 0.14845, 3 *0.514246 /,               R1T2194
     1     A1  / 0.213337, -.096082, -.246867, -.310275, -.27118,      R1T2195
     2           0.412103, 0.193233, 0.083362, -.840115, 2*0.0   /,    R1T2196
     3     A2  / -2.931954, -.54331, 0.175334, 0.3417, 0.1402,         R1T2197
     4           -1.67261, -.558166, -.18315,  1.1101,  2*0.0    /,    R1T2198
     5     A3  / 5.22917, 0.559395, -.266917, -.32182, -.082137,       R1T2199
     6                 1.68869, .283208, -.00691, -1.09401, 2*0.0  /,  R1T2200
     7     D1  / 0.2,  0.234, 0.315, 0.465, 0.7, 0.234, 0.315,         R1T2201
     8           0.465, 0.234, 0.315, 0.465                        /,  R1T2202
     9     D2  / -.040625, -.068571, -.233333, -.684, -1.6625,         R1T2203
     1           -.068571, -.233333, -.684, -.068571, -.23333, -.684/, R1T2204
     2     D3  / -.070312, -.093878, -.032407, 0.292, 1.3125,          R1T2205
     3           -.093878, -.032407, 0.292, -.093878, -.032407, 0.292/ R1T2206
C                                                                      R1T2207
      NCP     = 31                                                     R1T2208
      ROC     = AA(ID) + BB(ID)*TOC +CC(ID)*TOC*TOC + DD(ID)*TOC**3    R1T2209
C                                                                      R1T2210
C     ID  = 1 TO 4, 6  SERIES AIRFOIL          IJ = 1                R1T2211
C     ID  = 5 TO 7, 6A SERIES AIRFOIL          IJ = 1                R1T2212
C     ID  = 8, SUPERCRITICAL  AIRFOIL          IJ = 2                R1T2213
C     ID  = 9, BICONVEX                        IJ = 3                R1T2214
C     ID  = 10 TO 20, 4 DIGIT AIRFOIN          IJ = 4                R1T2215
C     ID  = 21,22, INPUT AIRFOIL               IJ = 5                R1T2216
C                                                                      R1T2217
      IF( ID.LE.7 ) IJ = 1                                             R1T2218
      IF( ID.EQ.8 ) IJ = 2                                             R1T2219
      IF( ID.EQ.9 ) IJ = 3                                             R1T2220
      IF( ID.GE.10.AND.ID.LE.20 ) IJ = 4                               R1T2221
      IF( ID.GE.21 ) IJ = 5                                            R1T2222
C                                                                      R1T2223
      GO TO (200,300,100,900,700) , IJ                                 R1T2224
C                                                                      R1T2225
  100 WRITE(6,2000)                                                    R1T2226
      DO 110 I = 1,NCP                                                 R1T2227
      ZT(I)     = 2.0*TOC*XU(I)*(1.0 - XU(I))                          R1T2228
      SB(I)   = 2.*TOC * (1.-XU(I))                                    R1T2229
      ZS(I)     = 0.0                                                  R1T2230
  110 CONTINUE                                                         R1T2231
      ROC       = 0.0                                                  R1T2232
      GO TO 960                                                        R1T2233
C                                                                      R1T2234
  200 IF( ID.LE.4 ) WRITE(6,2003)                                      R1T2235
      IF( ID.GT.4 ) WRITE(6,2001)                                      R1T2236
      DO 220 I = 1,NCP                                                 R1T2237
      X         = XU(I)                                                R1T2238
      IF( ID.LE.4 ) CALL LNTP(X, ZS1, XSECT, CAMB1, 26, 4)             R1T2239
      IF( ID.GT.4 ) CALL LNTP(X, ZS1, XSECT, CAMB,  26, 4)             R1T2240
      ZS(I)     = ZS1 * CLD                                            R1T2241
  210 IF( ID.EQ.1 ) CALL LNTP(X, ZT(I), XSECT, Y163,  26, 4)           R1T2242
      IF( ID.EQ.2 ) CALL LNTP(X, ZT(I), XSECT, Y164,  26, 4)           R1T2243
      IF( ID.EQ.3 ) CALL LNTP(X, ZT(I), XSECT, Y165,  26, 4)           R1T2244
      IF( ID.EQ.4 ) CALL LNTP(X, ZT(I), XSECT, Y166,  26, 4)           R1T2245
      IF( ID.EQ.5 ) CALL LNTP(X, ZT(I), XSECT, Y163A, 26, 4)           R1T2246
      IF( ID.EQ.6 ) CALL LNTP(X, ZT(I), XSECT, Y164A, 26, 4)           R1T2247
      IF( ID.EQ.7 ) CALL LNTP(X, ZT(I), XSECT, Y165A, 26, 4)           R1T2248
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C                                                                       R1T2249
  220 ZT(I)     = ZT(I) * TOC/0.1                                       R1T2250
      GO TO 960                                                         R1T2251
C                                                                       R1T2252
  300 WRITE(6,2002)                                                     R1T2253
      WRITE(6,1000) XMU,ZMU, XML,ZML, ZPTE, ZTHIK                       R1T2254
  400 CONTINUE                                                          R1T2255
C                                                                       R1T2256
C     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *       R1T2257
C                                                                       R1T2258
C     CARDS 2257 THRU 2335 ARE NOT SHOWN IN THIS LISTING                R1T2259
C                                                                       R1T2334
C     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *       R1T2335
C                                                                       R1T2336
      GO TO 960                                                         R1T2337
C                                                                       R1T2338
C                                                                       R1T2339
  700 ROC     = RLE                                                     R1T2340
C                                                                       R1T2341
      DO 800 I = 1, NCP                                                 R1T2342
      X         = XU(I)                                                 R1T2343
      CALL LNTP(X, ZT(I), XT, YT, NXSET, 4)                             R1T2344
      CALL LNTP(X, ZS1,   XT, YC, NXSET, 4)                             R1T2345
      ZS(I)     = ZS1 * CLD                                             R1T2346
  800 CONTINUE                                                          R1T2347
      GO TO 960                                                         R1T2348
C                                                                       R1T2349
  900 WRITE(6,2004)                                                     R1T2350
      I4D     = ID - 9                                                  R1T2351
      ROC     = 0.5 * (A0(I4D)*TOC/.2)**2                               R1T2352
C                                                                       R1T2353
      DO 950 I =1, NCP                                                  R1T2354
      X       = XU(I)                                                   R1T2355
      IF( X.GT.XTT(ID) ) GO TO 910                                      R1T2356
C                                                                       R1T2357
      ZT(I)   = A0(I4D) * SQRT(X) + A1(I4D) * X  + A2(I4D) * X*X        R1T2358
     1                    + A3(I4D) * X**3                              R1T2359
      SB(I)   = 0.5 * A0(I4D)/SQRT(X) +A1(I4D) +2.*A2(I4D)*X            R1T2360
     1                  + 3.* A3(I4D) * X**2                            R1T2361
      GO TO 940                                                         R1T2362
C                                                                       R1T2363
  910 X       = (1. - X)                                                R1T2364
      ZT(I)   = 0.002   + D1(I4D) * X + D2(I4D) * X*X  + D3(I4D) * X**3 R1T2365
      SB(I)   = -D1(I4D) -2.* D2(I4D)*X  -3.* D3(I4D)*X*X               R1T2366
C                                                                       R1T2367
  940 ZT(I)   = TOC/.2 * ZT(I)                                          R1T2368
      SB(I)   = TOC/.2 * SB(I)                                          R1T2369
      CALL LNTP(X, ZS1, XSECT, CAMB1, 26, 4)                            R1T2370
      ZS(I)   = ZS1 * CLD                                               R1T2371
C                                                                       R1T2372
  950 CONTINUE                                                          R1T2373
C                                                                       R1T2374
  960 IF( KPRINT(1).EQ.0 ) RETURN                                       R1T2375
      WRITE(6,1004) TOC, CLD, ROC                                       R1T2376
      DO 970 I = 1, NCP                                                 R1T2377
      INV     = NCP + 1 - I                                             R1T2378
```

```
      ZUP     = ZT(INV) + ZS(INV)                                       R1T2379
      ZLO     =-ZT(INV) + ZS(INV)                                       R1T2380
      WRITE(6,1005) XU(INV), ZT(INV), ZS(INV), ZUP, ZLO                 R1T2381
  970 CONTINUE                                                          R1T2382
C                                                                       R1T2383
 1000 FORMAT(/5X,*XMU =*,F10.6,3X,*ZMU =*,F10.6,3X,*XML =*,F10.6,       R1T2384
     1            3X,*ZML =*F10.6, /                                    R1T2385
     1           3X,*ZPTE =*F10.6,3X,*ZTHIK =*,F10.6 // )               R1T2386
 1001 FORMAT(5X, 7F10.6 / )                                             R1T2387
 1002 FORMAT( I5,5X,5F10.0 )                                            R1T2388
 1003 FORMAT( 10F6.0 )                                                  R1T2389
 1004 FORMAT(10X, *T/C =*F7.4, 10X,*CAMBER =*F7.4, 10X,*L.E.RADIUS =*,  R1T2390
     1        F8.5 //T17,*X/C*,T26,*THICKNESS*,T44,*CAMBER*,T60,        R1T2391
     2        *UPPER*,T75,*LOWER*   )                                   R1T2392
 1005 FORMAT(5X, 5F15.5 )                                               R1T2393
 2000 FORMAT(/ 10X, *BICONVEX AIRFOIL SECTION*/ )                       R1T2394
 2001 FORMAT(/10X, *6A SERIES AIRFOIL SECTION * /)                      R1T2395
 2002 FORMAT(/ 10X, *SUPERCRITICAL AIRFOIL SECTION*  /)                 R1T2396
 2003 FORMAT( /10X, *6 SERIES AIRFOIL SECTION* /)                       R1T2397
 2004 FORMAT( /10X, *4-DIGIT AIRFOIL SECTION* /)                        R1T2398
      RETURN                                                            R1T2399
      END                                                               R1T2400

                                                          CC = 00190
```

```
      SUBROUTINE CPUOV(S, A, SWP, IV, CPI, CP, XM)
C
C     COMPUTES CP FOR AN INFINITELY SHEARED WING
C
      COMMON /BLKCPI/ SA(32), SB(32), SC(32), SD(32), SE(32)
C
      COMMON /BLKR07/ XU(32), ZT(32), ZS(32), RCC, ZTE
C
   10 COSA    = COS(A)
      SINA    = SIN(A)
      COSL    = COS(SWP)
      SINL    = SIN(SWP)
C
   20 F1      = SA(IV)
      F2      = SB(IV)
      F3      = SC(IV)
      F4      = SD(IV)
      F5      = SE(IV)
      FX      = SQRT((1. - XU(IV))/XU(IV))
   30 DUL     = 1.0/(1. +((F2 +S* F5)/COSL)**2 )
C
   40 UIOV2   = DUL * ( COSA * (1. + F1 * COSL +S* F4 * COSL)
     1           +S* SINA * COSL * (1. + F3/COSL) * FX )**2
     2        + DUL * ( COSA * SINL * (F1 +S* F4)
     3           +S* SINA * SINL * (1. + F3/COSL) * FX )**2
     4        + (SINL * COSA)**2 * (1. - DUL)
C
      CPI     = 1.0 - UIOV2
C
      CP      = CPI
C
   50 CPIO    = (1. - SINL * SINL + F1 * F1 + 2.0 * F1 * COSL)
     1           /(1. + (F2/COSL)**2 )    - SINL * SINL
      CPIO    = 1.0  - CPIO
      IF( CPIO.GT.0.0 ) CPIO = 0.0
C
      XMN     = XM * COSL
      IF( XM.LE.0.01.OR.XMN.GE.1.0 ) RETURN
C
      XM2     = XM * XM
      BETA    = SQRT(1. - XMN * XMN)
C
      SINA    = SINA/BETA
   60 TEST    = (COSL * COSL - CPIO * XMN) * XM2
      IF( TEST.GE.1.0 ) WRITE(6,1000)
      IF( TEST.GE.1.0 ) GO TO 200
C
   70 B       = SQRT(1.0 - TEST)
C
      F1      = F1/B
      F4      = F4/BETA
      F3      = F3/B
   80 DUL     = 1.0/(1. + ((F2 +S* F5)/(B * COSL))**2 )
C
   90 UOV2    = DUL * ( COSA * (1. + F1 * COSL +S* F4 * COSL)
     1           +S* SINA * COSL * (1. + F3/COSL) * FX )**2
```

```
     2        + DUL * ( COSA * SINL * (F1 +S* F4)                          R1T2458
     3           +S* SINA * SINL * (1. + F3/COSL) * FX )**2                R1T2459
     4        + (SINL * COSA)**2 * (1. - DUL)                              R1T2460
C                                                                          R1T2461
  100 CP      = -1.42857/XM2                                               R1T2462
C                                                                          R1T2463
      TEST    = 1.0 + 0.2 * XM2 * (1. - UOV2)                              R1T2464
      IF( TEST.LE.0.0 ) GO TO 200                                          R1T2465
      CP     = -CP * ( TEST**3.5 - 1.0 )                                   R1T2466
C                                                                          R1T2467
  200 CONTINUE                                                             R1T2468
      RETURN                                                               R1T2469
 1000 FORMAT(10X,*KUCHEMAN-WEBER CORRECTION FACTOR REACHES LIMIT* )        R1T2470
      END                                                                  R1T2471

                                                              CC = 00070
```

```
      OVERLAY(3,3)                                                      R1T2473
      PROGRAM AERO                                                      R1T2474
C                                                                       R1T2475
C     AERODYNAMICS                                                      R1T2476
C                                                                       R1T2477
      COMMON /BLKOV3/ ITYP, OV3A(4), ALT, SPEED, SWEEP, JPASS, OV3B(2), R1T2478
     1                ITRIM                                            R1T2479
C                                                                       R1T2480
      COMMON /BLKG01/ G1(200)                                           R1T2481
C                                                                       R1T2482
      COMMON /BLKA02/ A1(433)                                           R1T2483
C                                                                       R1T2484
      COMMON /BLKC01/ CL, CD, CM, ALPHA, CDM, CDL, CDR, CDRO, CLT, CDT, R1T2485
     1                DH, FK, DELCL, CMO, DCMCL, XACWB, CLA, ALO,      R1T2486
     2                C1(45), CLDB, CLMAX, C2(7), FML1, FML2, CDC,     R1T2487
     3                C3(12), XACS, C4(6), CDAFT, C5(5)                R1T2488
C                                                                       R1T2489
C                                                                       R1T2490
      CB      = G1(83)                                                  R1T2491
C                                                                       R1T2492
      RNOFT = ABS(ALT) * 10.0**6                                        R1T2493
      IF( ALT.LT.0.0) GO TO 80                                          R1T2494
      CALL ATMOS(ALT,T,SIGMA,RHO,THETA,DELTA,CA,AMU,1)                  R1T2495
      RNOFT   = SPEED*CA*RHO/AMU                                        R1T2496
   80 CONTINUE                                                          R1T2497
C                                                                       R1T2498
   70 FMACH=SPEED                                                       R1T2499
C                                                                       R1T2500
C                                                                       R1T2501
      IF( JPASS.EQ.0 ) CALL CDDR(0.0, FMACH, RNOFT, CDRO)               R1T2502
      IF( JPASS.EQ.1 ) CALL CDDR1(0.0, FMACH, RNOFT, CDRO)              R1T2503
      CALL CDDR1(CL, FMACH, RNOFT, CDRCL)                               R1T2504
      CDR     = CDRCL - CDRO                                            R1T2505
      IF( SPEED.GT.FML1 ) CDR = 0.0                                     R1T2506
C                                                                       R1T2507
      IF( JPASS.EQ.2 ) GO TO 30                                         R1T2508
C                                                                       R1T2509
      CALL DMIN(FMACH, RNOFT, CDMIN)                                    R1T2510
      CALL CLWBT(FMACH)                                                 R1T2511
      RE      = RNOFT * CB                                              R1T2512
      IF( RE.GT.4.0E6 ) RE = 4.0E6                                      R1T2513
      RE      = RE/1.0E6                                                R1T2514
C                                                                       R1T2515
      CALL CLBRK(FMACH, RE, RNOFT)                                      R1T2516
      CALL CDL1(FMACH, RNOFT, FK, DELCL, PRIMEK, AKD, AKB)              R1T2517
      CALL CDRG(FMACH, FK, DELCL, CDC)                                  R1T2518
      CALL CMOW(FMACH, CMO)                                             R1T2519
      CALL ADJUST(1,0, FMACH, CMO)                                      R1T2520
C                                                                       R1T2521
      CALL WBAC(FMACH, XACWB)                                           R1T2522
C                                                                       R1T2523
   30 CONTINUE                                                          R1T2524
      CALL CDL2(FMACH, CL, FK, DELCL, PRIMEK, AKD, AKB, CDL)            R1T2525
      IF( JPASS.LE.1 ) CALL AERA(FMACH, CL, ALPHA)                      R1T2526
      CALL AERA1(FMACH, CL, ALPHA)                                      R1T2527
      IF( JPASS.GT.0 ) GO TO 50                                         R1T2528
```

```
      IF( A1(241).EQ.0.0 ) GO TO 50                                     R1T2529
C                                                                       R1T2530
      DO 40 I = 1, 21                                                   R1T2531
      ANG     = I - 1                                                   R1T2532
      CALL AFTCD(ANG, DCD)                                              R1T2533
      IF ( I.EQ.1 ) WRITE(6,1000)                                       R1T2534
   40 WRITE(6,1001)  ANG, DCD                                           R1T2535
   50 CALL AFTCD(ALPHA, CDAFT)                                          R1T2536
      CALL TDRG(ITRIM, FMACH, DCLT, DCDT)                               R1T2537
C                                                                       R1T2538
      CDM     = CDMIN + CDC + CDRO                                      R1T2539
      CD      = CDM + CDL + CDR + CDAFT                                 R1T2540
C                                                                       R1T2541
      CDT = CD + DCDT                                                   R1T2542
      CLT = CL + DCLT                                                   R1T2543
C                                                                       R1T2544
C                                                                       R1T2545
      JPASS  = 2                                                        R1T2546
C                                                                       R1T2547
 1000 FORMAT( /// 10X, *FUSLAGE AFT-END UPSWEEP DRAG * //               R1T2548
     1              10X, *WING ANGLE*, 10X, *DELCD*  / )                R1T2549
 1001 FORMAT( 1X, 2F15.5 )                                              R1T2550
      END                                                               R1T2551
```

CC = 00079

```
      SUBROUTINE CDDR(CL, XMACH, RNOFT, CDR)                            R1T2553
C                                                                       R1T2554
C     COMPUTES DRAG RISE                                                R1T2555
C                                                                       R1T2556
      COMMON /BLKC03/ CLTAB(11), TABMCR(11)                             R1T2557
C                                                                       R1T2558
      COMMON /BLKC01/ C1(18), TCD(5), C2(48), FMCRO, FML1, FML2, CDC,   R1T2559
     1                CLAMCR, CLAML2, C3(12), PO, A3, PL, C4(8)        R1T2560
C                                                                       R1T2561
      COMMON /BLKG01/ G1(200)                                           R1T2562
C                                                                       R1T2563
      COMMON /BLKPRT/ KPRINT(50)                                        R1T2564
C                                                                       R1T2565
      ESWMC  = G1(49)                                                   R1T2566
      TOC    = G1(46)                                                   R1T2567
      FOC    = G1(111)                                                  R1T2568
C                                                                       R1T2569
      RNOFT1 = RNOFT / XMACH                                            R1T2570
      CALL LNTP(0.0, FMCRO, CLTAB, TABMCR, 11, 2)                       R1T2571
C                                                                       R1T2572
      CALL FDRG(1.0, RNOFT1)                                            R1T2573
      CDFF   = TCD(2) + TCD(3)                                          R1T2574
C                                                                       R1T2575
      CALL WDRG(1.00001)                                                R1T2576
      CDW1   = TCD(4)                                                   R1T2577
C                                                                       R1T2578
      CALL WDRG(1.01)                                                   R1T2579
      CDW2   = TCD(4)                                                   R1T2580
C                                                                       R1T2581
      CDWP   = (CDW2 - CDW1) * 100.                                     R1T2582
      CDW1   = CDW1 - CDFF                                              R1T2583
C                                                                       R1T2584
      XM     = 1.-FMCRO                                                 R1T2585
C                                                                       R1T2586
      A3     = (XM * CDWP -2.* CDW1)/XM**3                              R1T2587
      A2     = (3.* CDW1 - XM * CDWP)/XM**2                             R1T2588
      PL     = 25. * (TOC + 2.* FOC) * COS(ESWMC)**3                    R1T2589
      PO     = A2 - PL                                                  R1T2590
C                                                                       R1T2591
C                                                                       R1T2592
      FML1   = 0.95                                                     R1T2593
      IF( FMCRO.GT.0.90 ) FML1 = FMCRO    .05                           R1T2594
      IF( FML1.GT.1.0 ) FML1 = 1.0                                      R1T2595
      FML2   = FML1 + 0.15                                              R1T2596
C                                                                       R1T2597
      RNOFT2 = RNOFT*FMCRO/XMACH                                        R1T2598
      CALL FDRG(FMCRO,RNOFT2)                                           R1T2599
      CALL WDRG(FMCRO)                                                  R1T2600
      CALL CLWBT(FMCRO)                                                 R1T2601
      CLAMCR = C1(17)                                                   R1T2602
C                                                                       R1T2603
      RNOFT2 = RNOFT*FML2/XMACH                                         R1T2604
      CALL FDRG(FML2,RNOFT2)                                            R1T2605
      CALL WDRG(FML2)                                                   R1T2606
      CALL CLWBT(FML2)                                                  R1T2607
      CLAML2 = C1(17)                                                   R1T2608
```

```
C                                                                       R1T2609
      IF( KPRINT(23).EQ.1 ) WRITE(6,1000) FMCRO, A2, A3, FML1, FML2,    R1T2610
     1                CLAMCR, CLAML2, CDW1, CDFF, CDWP                  R1T2611
C                                                                       R1T2612
C                                                                       R1T2613
      ENTRY CDDR1                                                       R1T2614
      CDR     = 0.0                                                     R1T2615
      CDRO    = 0.0                                                     R1T2616
      CALL LNTP(CL, XMCR, CLTAB, TABMCR, 11, 2)                         R1T2617
      IF( XMACH.GT.1.0  ) RETURN                                        R1T2618
      XM      = XMACH - XMCR                                            R1T2619
      XMO     = XMACH - FMCRO                                           P1T2620
      IF( XMO.GT.0.0 ) CDRO = PO * XMO**2 + A3 * XMO**3                 R1T2621
      IF( XM.GT.0.0 )  CDR  = PL * XM**2                                R1T2622
      IF( XM.GT.0.12 ) CDR = 0.0144*PL + 0.24*PL *(XM -.12)             R1T2623
      CDR     = CDR + CDRO                                              R1T2624
C                                                                       R1T2625
      RETURN                                                            R1T2626
 1000 FORMAT(5X, *CDDR DUMP* /(1X, 7F15.5))                             R1T2627
      END                                                               R1T2628
```

CC = 0.076

```
      SUBROUTINE CLWBT(SPEED)                                           R1T2630
C                                                                       R1T2631
C     COMPUTES WING-BODY-TAIL LIFT CONTRIBUTION                         R1T2632
C                                                                       R1T2633
      COMMON /BLKG01/ G1(44), DOB, TOC, CLD, SEXW, ESWMC, G2(30),       R1T2634
     1                AR, TR, SPLAN, G3(118)                            R1T2635
C                                                                       R1T2636
      COMMON /BLKA01 / NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS     R1T2637
C                                                                       R1T2638
      COMMON /BLKA02 / SREF, A1(432)                                    R1T2639
C                                                                       R1T2640
      COMMON /BLKC01/ C1(16), CLA, ALO, C2(35), CLAW, CLAB, CLAT, A, B, R1T2641
     1                AOH, C, ABREAK, CLDH, CLPB, CLDB, CLMAX, ABRK,    R1T2642
     2                AMAX, DAMAX, DEL, CLS, ARLO, C3(29)               R1T2643
C                                                                       R1T2644
      COMMON /BLKCLA/ CLAI(11)                                          R1T2645
C                                                                       R1T2646
C                                                                       R1T2647
      CLAW   = 0.0                                                      R1T2648
C                                                                       R1T2649
      CLAI(1) = SPLAN                                                   R1T2650
      CLAI(2) = TOC                                                     R1T2651
      CLAI(3) = TR                                                      R1T2652
      CLAI(4) = AR                                                      R1T2653
      CLAI(5) = 0.0                                                     R1T2654
      IF( A1(234).EQ.8. ) CLAI(5) = 0.0334                              R1T2655
      CLAI(6) = CLD                                                     R1T2656
      CLAI(7) = 0.0                                                     R1T2657
      IF( A1(234).EQ.8. ) CLAI(7) = 0.09                                R1T2658
      CLAI(8) = DOB                                                     R1T2659
      CLAI(9) = 0.0                                                     R1T2660
      IF( A1(234).EQ.8. ) CLAI(9) = 1.173763 * TOC                      R1T2661
      CLAI(10)=ESWMC                                                    R1T2662
      CLAI(11)= SREF                                                    R1T2663
C                                                                       R1T2664
      CALL AER2(SPEED, CLA)                                             R1T2665
      CLAW   = CLA                                                      R1T2666
C                                                                       R1T2667
      CLAT   = 0.0                                                      R1T2668
      A      = 0.0                                                      R1T2669
      B      = 0.0                                                      R1T2670
      C      = 0.0                                                      R1T2671
      ABREAK = 90.0                                                     R1T2672
C                                                                       R1T2673
      IF( NHT.EQ.0 ) GO TO 30                                           R1T2674
C                                                                       R1T2675
   20 CALL TAIL(SPEED)                                                  R1T2676
   30 CONTINUE                                                          R1T2677
C                                                                       R1T2678
      CLAB= 0.0                                                         R1T2679
      IF (NBODYS.EQ.0) GO TO 50                                         R1T2680
C                                                                       R1T2681
      WB     = A1(14)                                                   R1T2682
      HB     = A1(24)                                                   R1T2683
      AB     = A1(64)                                                   R1T2684
      BL     = A1(4)                                                    R1T2685
```

```
      BLN     = A1(84)                                                  R1T2686
      PERIM = 3.14159*SQRT((WB**2 + HB**2)/2.)                          R1T2687
      BHPF = WB/HB*PERIM/SQRT(AB)                                       R1T2688
      AK1     = 0.009942*BHPF -.000379*BHPF**2 +.00001*BHPF**3          R1T2689
      CLAB    = AK1 * (BL/BLN)**0.3333 * AB/SREF                        R1T2690
C                                                                       R1T2691
   50 CLA = CLAW + CLAT + CLAB                                          R1T2692
C                                                                       R1T2693
      CALL AALO(SPEED)                                                  R1T2694
      CALL ADJUST(3,0, SPEED, ALO)                                      R1T2695
C                                                                       R1T2696
      RETURN                                                            R1T2697
      END                                                               R1T2698
```

CC = 00069

```
      SUBROUTINE AER2(SPEED, CLA)                                       R1T2700
C                                                                       R1T2701
C     LIFT CURVE SLOPE                                                  R1T2702
C                                                                       R1T2703
      COMMON /BLKPRT/ KPRINT(50)                                        R1T2704
      COMMON /BLKCLA/ SPLAN, TOC, TAPER, ARWS, DMSTR, CLD, DM1, DOB,    R1T2705
     1                EPSL, SWPMC, SREF                                 R1T2706
C                                                                       R1T2707
C                                                                       R1T2708
C                                                                       R1T2709
      COSZ  = COS(SWPMC)                                                R1T2710
      PI    = 3.1.159                                                   R1T2711
      TWOD   = 1.0                                                      R1T2712
      IF( SPEED.LT.1.0 ) TWOD = 1. + EPSL/SQRT(1.-SPEED**2)             R1T2713
C                                                                       R1T2714
C                                                                       R1T2715
      CSUBO  = (10.0 + 0.91 * ARWS**3)/(10.0 + ARWS**3)                 R1T2716
      ZMSTR  = CSUBO + (1.0 -CSUBO) * (1.0 - COSZ)**2                   R1T2717
      ZMSTRO  = ZMSTR                                                   R1T2718
      ZMSTR = ZMSTR + DMSTR                                             R1T2719
      ZM1   = 1.0 -2.0 * TOC * (ARWS**3/(4.0 +ARWS**3))                 R1T2720
     1          * COSZ**1.5* (1.0 + 1.5*CLD**1.5)                       R1T2721
      ZM10     = ZM1                                                    R1T2722
      IF( ZM10.GT.ZMSTRO ) ZM10= ZMSTRO                                 R1T2723
      ZM1   = ZM10 + DM1                                                R1T2724
      IF( ZM1.GT.ZMSTR ) ZMSTR = ZM1                                    R1T2725
      ZM2   = ZM1 + TOC + DM1*0.5                                       R1T2726
      ZM30     = 1.0 + TOC                                              R1T2727
      ZM3      = ZM30                                                   R1T2728
      IF( ZM2.GT.1.0 ) ZM3 = ZM2 + TOC                                  R1T2729
C                                                                       R1T2730
      SIG1=0.0                                                          R1T2731
      SIG2=0.0                                                          R1T2732
      IF( ZM2.NE.ZM1)  SIG1 = 0.5*((SPEED -ZM1)/(ZM2 -ZM1))             R1T2733
      IF( ZM3.NE.ZM2)  SIG2 = 0.5*(1.0 + (SPEED -ZM2)/(ZM3 -ZM2))       R1T2734
C                                                                       R1T2735
      TOCL    = 1.0/(4.4*ARWS*COSZ**1.5    )                            R1T2736
      DTOCL  =(TOC - TOCL)/COSZ                                         R1T2737
      IF( DTOCL.LT.0.0) DTOCL = 0.0                                     R1T2738
      ARDT  = ARWS * DTOCL                                              R1T2739
      IF( DTOCL.GT.0.07) DTOCL = 0.07                                   R1T2740
      IF( ARDT.GT.0.1 ) ARDT = 0.1                                      R1T2741
      GAMMA = 9.0 * (DTOCL/(1.0 + 0.5 * ARDT) )                         R1T2742
C                                                                       R1T2743
      GAMAO    = GAMMA                                                  R1T2744
      IF( ZM30.NE.ZM10 ) GAMMA = GAMAO *(ZM3-ZM1)/(ZM30-ZM10)           R1T2745
      IF (GAMMA.GT.GAMAO ) GAMMA = GAMAO                                R1T2746
C                                                                       R1T2747
      XF      = (16.0 +3.0*ARWS**2)/(8.0 +5.0*ARWS**2)                  R1T2748
      XKB     =(1.0 +DOB)*(1.0 -DOB)**XF                                R1T2749
      XKT    = 1.0                                                      R1T2750
      IF(SPEED.GE.ZM1.AND.SPEED.LE.ZM2) XKT = 1.0 -(4.0*SIG1*(1.0       R1T2751
     1                    - SIG1))**3 * GAMMA                           R1T2752
      IF(SPEED.GT.ZM2.AND.SPEED.LE.ZM3) XKT = 1.0 -(4.0*SIG2*(1.0       R1T2753
     1                    - SIG2))**3 * GAMMA                           R1T2754
    5 CONTINUE                                                          R1T2755
```

```
C
      Y1     = 2.0 + 0.66667 * SQRT(TAPER) - TAPER**2
      Y      = (1.0 + PI *ARWS)/(3.0 + PI * ARWS)  * Y1
      TWOS   = 1.0
      IF( ZMSTR.LT.1.0 ) TWOS = 1. + EPSL/SQRT(1.-ZMSTR**2)
C
      CLAO   = (TWOS * PI * ARWS)/(TWOS + SQRT(TWOS + (1.0 -
     1          COSZ**1.3334) * (ARWS/(2.0*COSZ))**2 ) )
      IF( SPEED.GT.0.0 ) BETAP = (SPEED - ZMSTR) * (1.0 +
     1                  (ZMSTR/SPEED)**Y )**2
      Z1     = PI * ARWS / CLAO
      Z1     = 3.0 * Z1 * ( Z1 - 1.0 ) * COSZ**0.6667
      Z      = ZMSTR * CLAO  + ARWS**2/Z1
C
C
      IF(SPEED.GT.ZMSTR)   GO TO 10
C
      CLAB   = (.0548311*TWOD*ARWS)/(TWOD + SQRT(TWOD + (1.0 -
     1          COSZ**1.3334 *(SPEED/ZMSTR)**2.667)*(ARWS/(2.*COSZ))**2
     2                                                              ))
      GO TO 20
   10 CLAB  = 1.0/(57.3 *((ZMSTR/SPEED)**Z /CLAO  + BETAP/4.0) )
C
C
C
C
   20 CONTINUE
      CLA    = CLAB * XKT * XKB * SPLAN/SREF
C
C
C
   25 IF( KPRINT(11).EQ.0 ) GO TO 30
      WRITE(6,1000) SPEED, CLA, CLAB, XKT, XKB, SPLAN, SREF,
     1              ZMSTR, ZM1, ZM2, ZM3, COSZ, CSUBO, ARDT,
     2              TOC, TAPER, ARWS, DMSTR, CLD, DM1, DOB, TWOD, SWPMC
 1000 FORMAT(10X*AER2 DUMP*, 6F15.5 /(19X,6F15.5) )
C
   30 RETURN
      END
```

CC = 00095

```
      SUBROUTINE TAIL(SPEED)                                            R1T2796
C                                                                       R1T2797
C     COMPUTES TAIL FLOW FIELD AND LIFT                                 R1T2798
C                                                                       R1T2799
      COMMON /BLKCLA/ CLAI(11)                                          R1T2800
C                                                                       R1T2801
      COMMON /BLKA02/ SREF, A1(428), HTLE, HTY, HTZ, TINC               R1T2802
      COMMON /BLKBD1/ XSWPL(11), YRMIN(11)                              R1T2803
C                                                                       R1T2804
      COMMON /BLKG01/ G1(79), AR, TR, SPLAN, CB, YB, XMAC, G2(16),      R1T2805
     1                SWPQC, G3(4), XHT, XCRTE, G4(92)                  R1T2806
C                                                                       R1T2807
      COMMON /BLKC01/ C1(37), CDWING(4), C2(12), CLAW, CLAB, CLAT, A, B,R1T2808
     1                AOH, C, ASTR, CLDH, C3(31), DEDA, C4(6)           R1T2809
C                                                                       R1T2810
      COMMON /BLKPRT/ KPRINT(50)                                        R1T2811
C                                                                       R1T2812
C                                                                       R1T2813
C  ** DOWNWASH IS CALCULATED ***                                        R1T2814
C                                                                       R1T2815
      ARHT    = G1(11)                                                  R1T2816
      SEXHT   = G1(21)                                                  R1T2817
      SWLHT   = A1(389)                                                 R1T2818
      HTLAM   = A1(409)                                                 R1T2819
      CAMHT   = A1(339)                                                 R1T2820
      HTOC    = A1(349)                                                 R1T2821
      SWMCHT  = ATAN(TAN(SWLHT) -2./ARHT * (1.-HTLAM)/(1.+HTLAM))       R1T2822
C                                                                       R1T2823
   10 ZKA     = 1./AR -1./(1. + AR**1.7)                                R1T2824
      IF( AR.LT.2.3 ) ZKA = 0.37 - 0.0567 * AR                          R1T2825
      ZKTR    = (10. - 3.0 * TR)/7.0                                    R1T2826
      B       = SQRT( AR * SPLAN )                                      R1T2827
C                                                                       R1T2828
      DEDA    = 0.0                                                     R1T2829
      XLHT    = XHT - XMAC                                              R1T2830
      IF( XLHT.LE.0.0 ) GO TO 30                                        R1T2831
C                                                                       R1T2832
      HHT     = HTZ                                                     R1T2833
C                                                                       R1T2834
      ZKH     = (1. - HHT/B)/(2.0 * XLHT/B)**0.33333                    R1T2835
C                                                                       R1T2836
      COSQ    = SQRT(COS(SWPQC))                                        R1T2837
   20 DEDAO   = 4.44 * (ZKA * ZKTR * ZKH * COSQ )**1.19                 R1T2838
C                                                                       R1T2839
      IF( KPRINT(21).EQ.0 ) GO TO 21                                    R1T2840
      WRITE(6,1000)CLAW,DEDAO,CDWING(1),CDWING(2),CDWING(3),CDWING(4),  R1T2841
     1             HTLE,A1(281),CB,ZKA,ZKTR,ZKH,COSQ                    R1T2842
   21 CONTINUE                                                          R1T2843
      CALL AER2(0.1, CLAMO)                                             R1T2844
      DEDA    = DEDAO *CLAW/CLAMO                                       R1T2845
C                                                                       R1T2846
C  ** DYNAMIC PRESSURE AT THE TAIL  ***                                 R1T2847
C                                                                       R1T2848
   30 CDO     = CDWING(1)+CDWING(2)+CDWING(3)+CDWING(4)                 R1T2849
C                                                                       R1T2850
      XOC     = (XHT - XCRTE)/CB                                        R1T2851
```

```
      DQOQ    = 0.0                                                     R1T2852
      IF( XOC.LE.0.0 ) GO TO 50                                         R1T2853
C                                                                       R1T2854
      ZWOC    = 0.68 * SQRT(CDO * (XOC + 0.15))                         R1T2855
      DQOQO   = 2.42 * SQRT(CDO)/(XOC + 0.3)                            R1T2856
C                                                                       R1T2857
      GAMMA   = ATAN(HTZ/(XOC*CB))                                      R1T2858
      AW      = 2.0                                                     R1T2859
      CL      = CLAW* AW                                                R1T2860
      EW      = 0.51566 * CL/AR                                         R1T2861
      ZOC     = XOC * TAN(GAMMA + EW - AW/57.3)                         R1T2862
      ZOZW    = ZOC/ZWOC                                                R1T2863
C                                                                       R1T2864
      IF( ZOZW.GE.1.0 ) GO TO 50                                        R1T2865
C                                                                       R1T2866
      DQOQ    = DQOQO * (COS(1.570796* ZOZW))**2                        R1T2867
C                                                                       R1T2868
   50 QOQ     = 1.0 - DQOQ                                              R1T2869
C                                                                       R1T2870
C  ** CARRY-OVER FACTORS ZKWB AND ZKBW ARE COMPUTED ***                 R1T2871
C                                                                       R1T2872
                                                                        R1T2873
   60 DOBHT   = 2.0 * HTY/(2.0 * HTY + SQRT(ARHT * SEXHT) )             R1T2874
C                                                                       R1T2875
      ZKWB    = 1.0028 +.7116*DOBHT +.42*DOBHT**2 -.1366*DOBHT**3       R1T2876
      ZKBW    = .0004 +1.2662*DOBHT +.6018*DOBHT**2 +.1263*DOBHT**3     R1T2877
C                                                                       R1T2878
C  ** LIFT-CURVE-SLOPE OF THE EXPOSED SURFACE IS COMPUTED ***           R1T2879
C                                                                       R1T2880
      CLAI(1)  = SEXHT                                                  R1T2881
      CLAI(2)  = HTOC                                                   R1T2882
      CLAI(3)  = HTLAM                                                  R1T2883
      CLAI(4)  = ARHT                                                   R1T2884
      CLAI(5)  = 0.0                                                    R1T2885
      CLAI(6)  = CAMHT                                                  R1T2886
C                                                                       R1T2887
      CLAI(7)  = 0.0                                                    R1T2888
      CLAI(8)  = 0.0                                                    R1T2889
      CLAI(9)  = 0.0                                                    R1T2890
      CLAI(10) = SWMCHT                                                 R1T2891
C                                                                       R1T2892
   70 CALL AER2(SPEED, CLA)                                             R1T2893
      CLAT    = CLA * (ZKWB + ZKBW) * (1. - DEDA) * QOQ                 R1T2894
      CLDH    = CLA * ZKWB * QOQ                                        R1T2895
C                                                                       R1T2896
C  ** INDUCED DRAG FACTOR FOR TAIL IS COMPUTED ***                      R1T2897
C                                                                       R1T2898
      CALL LNTP(SWLHT, RTSUB, XSWPL, YRMIN, 11, 2)                      R1T2899
      RTAIL   = RTSUB                                                   R1T2900
      IF( SPEED.LE.0.9 ) GO TO 80                                       R1T2901
      ZNDM    = 12.0 * (COS(SWLHT)**1.6) * (SPEED - 0.9)                R1T2902
      FNDM    = 1.0/(1. + ZNDM + ZNDM*ZNDM)                             R1T2903
      RTAIL   = RTSUB * FNDM                                            R1T2904
C                                                                       R1T2905
   80 HTK1    = (1.-RTAIL) * 0.01745 /(CLA * ZKWB)                      R1T2906
      HTK2    = RTAIL * 0.31831/ARHT * SREF/SEXHT                       R1T2907
```

```
      HTK     = HTK1 + HTK2                                              R1T2908
C                                                                        R1T2909
      A       = HTK * CLDH * CLDH                                        R1T2910
      B       = 2.0 * HTK * CLAT * CLDH                                  R1T2911
      AOH     = (1.-DEDA) * (A1(279) - TINC)                             R1T2912
C                                                                        R1T2913
C                                                                        R1T2914
      IF( KPRINT(21).EQ.1 ) WRITE(6,1000) CLAT, SPEED, CLA, ZKWB, DOBHT,R1T2915
     1                      ZKBW, DEDA, QOQ, CLDH, A, B, AOH,DEDAO,     R1T2916
     2                 RTSUB,RTAIL,HTK1,HTK2,HTK                        R1T2917
C                                                                        R1T2918
      RETURN                                                             R1T2919
 1000 FORMAT(10X,*TAIL LIFT DUMP* /(1X, 7F15.5) )                        R1T2920
      END                                                                R1T2921

                                                          CC = 00126
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```
      SUBROUTINE AALO(SPEED)                                            R1T2923
C                                                                       R1T2924
C     CALCULATE . ZERO LIFT ANGLE OF ATTACK                             R1T2925
C                                                                       R1T2926
      COMMON /BLKA02/ A1(433)                                           R1T2927
C                                                                       R1T2928
      COMMON /BLKG01/ G1(44), DOB, TOC, CLD, G2(33), TAP, G3(20),       R1T2929
     1                ESWQC, G4(98)                                    R1T2930
C                                                                       R1T2931
      COMMON /BLKC01/ C4(16), CLA, ALO, C5(35), C1, C2, C3, C6(44)      R1T2932
C                                                                       R1T2933
      COMMON /BLKPRT/ KPRINT(50)                                        R1T2934
C                                                                       R1T2935
C                                                                       R1T2936
C                                                                       R1T2937
      ALOC   = 0.0                                                      R1T2938
      ALOT   = 0.0                                                      R1T2939
      ALOI   = 0.0                                                      R1T2940
      TWIST  = G4(10)                                                   R1T2941
      RINC   = A1(280)                                                  R1T2942
      DINC   = G4(11)                                                   R1T2943
      TINC   = A1(433)                                                  R1T2944
C                                                                       R1T2945
      XMCR   = 0.75                                                     R1T2946
      XMNO   = SPEED * COS(ESWQC)                                       R1T2947
C                                                                       R1T2948
      TOCO   = TOC/COS(ESWQC)                                           R1T2949
      IF( TOCO.LT.0.1 ) XMCR = 0.75 + 1.25 * (0.1 - TOCO)               R1T2950
      DALODC = 5.6                                                      R1T2951
      IF(  XMNO.GT.XMCR ) DALODC = 5.6 - 249.0 * (XMNO - XMCR)**2       R1T2952
      IF( DALODC.LT.0.0 ) DALODC = 0.0                                  R1T2953
C                                                                       R1T2954
      ALOC   = - DALODC * CLD                                           R1T2955
C                                                                       R1T2956
C                                                                       R1T2957
  200 IF( TWIST.EQ.0.0 ) GO TO 300                                      R1T2958
      IF( SPEED.GT.1.0 ) GO TO 300                                      R1T2959
      TAU = TWIST                                                       R1T2960
      BETA = SQRT(1.0 - SPEED**2)                                       R1T2961
      SWPQCB = 90.0                                                     R1T2962
      IF( BETA.GT.0.0 ) SWPQCB = ATAN(TAN(ESWQC)/BETA) * 57.29578       R1T2963
      DALO   = 0.093 - 0.000571*SWPQCB + 0.5761*TAP -0.2645*TAP**2      R1T2964
      ALOT   = - DALO * TAU                                             R1T2965
C                                                                       R1T2966
  300 IF( DINC.EQ.0.0.AND.TINC.EQ.0.0 ) GO TO 400                       R1T2967
      ZKBW   = .0004 +1.2662*DOB +.6018*DOB**2 +.1263*DOB**3            R1T2968
      ZKWB   = 1.0028 +.7116*DOB +.42 *DOB**2 -.1366*DOB**3             R1T2969
      CLAB   = C3 + ZKBW/(ZKBW + ZKWB) * C1                             R1T2970
      ALOI   = (CLAB * DINC + C2 *(DINC - TINC))/CLA                    R1T2971
     1               + (RINC - DINC)                                    R1T2972
C                                                                       R1T2973
  400 ALO    =          + ALOC + ALOT + ALOI                            R1T2974
      IF( KPRINT(13).GT.0 ) WRITE(6,1000) ALO, ALOC, ALOT,              R1T2975
     1                ALOI, SPEED, ESWQC, TOC, CLD, TAU, SWPQCB, DOB,   R1T2976
     2                  TAP, C1, C2, C3, CLAB, ZKBW, ZKWB, DINC,TINC    R1T2977
     3                ,RINC                                             R1T2978
```

```
C                                                                       R1T2979
 1000 FORMAT(5X,*AALO DUMP*,5X,*ALO =*,F6.3,5X,*ALOC =*,F6.3,           R1T2980
     1        5X,*ALOT =*,F6.3,5X,*ALOI =*,F6.3 /(5X,7F15.5) )         R1T2981
      RETURN                                                            R1T2982
      END                                                               R1T2983
```

CC = 00061

```
      SUBROUTINE CLBRK(SPEED, RE, RNOFT)                                R1T2985
C                                                                       R1T2986
C     CALCULATES LIFT BREAK CL AND CLMAX                                R1T2987
C                                                                       R1T2988
      COMMON /BLKG01/ G1(45), TOC, CLD, SEXW, G2(31), AR, TR, SPLAN,    R1T2989
     1                CB, G3(18), SWPQC, SWPLE, G4(97)                 R1T2990
C                                                                       R1T2991
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS      R1T2992
C                                                                       R1T2993
      COMMON /BLKA02/ SREF, A1(432)                                     R1T2994
C                                                                       R1T2995
      COMMON /BLKPRT/ KPRINT(50)                                        R1T2996
      COMMON /BLKC01/ C3(16), CLA, ALO, C4(35), CLAW, CLAB, CLAT, C6(6),R1T2997
     1                CLPB, CLDB, CLMAX, ABRK, AMAX, DAMAX, DEL,        R1T2998
     2                CLS, ARLO, C5(29)                                 R1T2999
C                                                                       R1T3000
      COMMON /BLKMAP/ MAP, TRANS, DY, AMAP(22), BMAP(11)                R1T3001
      COMMON /BLKCLB/ X1(6), Y1(6), X9(8), Y9(8), XAR(5), YDCL(5)       R1T3002
C                                                                       R1T3003
      COMMON /BLKBD2/ AA(22), BB(22), CC(22), DD(22), XT(22)            R1T3004
C                                                                       R1T3005
      COMMON /BLKBD5/ XDYO(6), YXMN(6), Z1BD5(6,6)                      R1T3006
C                                                                       R1T3007
      COMMON /BLKMAX/ XTR(6), YC1(6), YC2(6), XSWP(4), YA(4),           R1T3008
     1                YB(4), XDY(8), XM(4), CTAB(8,4), DTAB(8,4),       R1T3009
     2                XXCLM(13), YYDY(6), FCLMX(13,6), XXC2(9),         R1T3010
     3                YYMACH(5), FDCLMX(9,5),XDY1(9), YXMT(4),          R1T3011
     4                 ZC1MAX(9,4), XDY2(8), YFOC(6), ZDC1M(8,6),       R1T3012
     5                Z2DC1M(8,6)                                       R1T3013
      COMMON /BLKMX2/  XSP(8), YDY(6), FDA(8,6), XAB(6), YCO(8),        R1T3014
     1                FKVOFM(6,8), XANG(10), YRTOC(7), FRA(10,7)        R1T3015
      COMMON /BLKMX4/ XC2(6),YAST(9),FDAM(6,9),XCT(6),YM(5),FDAM2(6,5)  R1T3016
      COMMON /BLKMX5/ XXXCLM(9), FCLMXX(9,6)                            R1T3017
C                                                                       R1T3018
      DIMENSION XF1(7), YF1(7), YF2(7)                                  R1T3019
C                                                                       R1T3020
      DATA  XF1 / 5.0, 6.0, 6.47712, 6.77815, 6.95424, 7.39794, 8. /,   R1T3021
     1      YF1 / -.125, -.11, -.02, -.01, 0., 0.03, 0.035 /,          R1T3022
     2      YF2 / -.1063, -.0713, -.055, -.0175, 0., 0.0375, 0.0463/   R1T3023
C                                                                       R1T3024
      IF( SPEED. GE.1.0 ) GO TO 20                                      R1T3025
C                                                                       R1T3026
      NI     = A1(234)                                                  R1T3027
      CONCL  = A1(276)                                                  R1T3028
      DYO    = AMAP(NI) * TOC                                           R1T3029
      IF( DYO.LT.0.8 ) DYO = 0.8                                        R1T3030
      IF( DYO.GT.2.4 ) DYO = 2.4                                        R1T3031
C                                                                       R1T3032
      XMN    = SPEED * COS(SWPQC)                                       R1T3033
      IF( XMN.LT.0.2 ) XMN = 0.2                                        R1T3034
      XMNO   = XMN                                                      R1T3035
      CLIN   = CLD/COS(SWPQC)**2                                        R1T3036
      IF( XMN.GT.0.7 ) XMNO = 0.7                                       R1T3037
C                                                                       R1T3038
      ABRKO  = DLNT(DYO, XMNO,XDYO, YXMN, Z1BD5, 6,6, 6, 4,2)           R1T3039
      ABRK   = ( ABRKO + (12.05-4.1*XMN)*CLIN ) * COS(SWPQC)            R1T3040
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      ABRKLO = 2./COS(SWPLE)                                            R1T3041
      IF( ABRK.LT.ABRKLO ) ABRK = ABRKLO                                R1T3042
      CLPBO  = CLA * ABRK                                               R1T3043
C                                                                       R1T3044
      DCLPB  = 0.0                                                      R1T3045
      FPB    = 1.54                                                     R1T3046
      IF( XMN.GT.0.5 ) FPB = 1.54 - 2.9 * (XMN - 0.5)                   R1T3047
      IF( CONCL.GT.0.0 ) DCLPB = FPB * ((CONCL + .0643)*COS(SWPQC))**2  R1T3048
C                                                                       R1T3049
      CLPB   = CLPBO + DCLPB                                            R1T3050
C                                                                       R1T3051
      DCLDRE = 0.1226 -.00714*SPEED -.12857*SPEED**2                    R1T3052
C                                                                       R1T3053
      IF( NI.LE.9 ) DY = AMAP(NI)*TOC +BMAP(NI)*CLD                     R1T3054
      IF( NI.GT.9 ) DY = AMAP(NI)*TOC +1.75*CLD                         R1T3055
C                                                                       R1T3056
      TRANS  = 0.0                                                      R1T3057
      IF( DY.GT.1.65 ) TRANS = (DY - 1.65)/.4                           R1T3058
      IF( DY.GE.2.05 ) TRANS = 1.0                                      R1T3059
      IF( SWPLE.GE.0.87 ) TRANS = 0.0                                   R1T3060
      CLDB   = CLPB + TRANS *(-.0376 -.24414*SPEED -.0685*SPEED**2      R1T3061
     1                 +.4149*SPEED**3 + RE * DCLDRE )                  R1T3062
C                                                                       R1T3063
      GO TO 30                                                          R1T3064
C                                                                       R1T3065
   20 BETAC  = SQRT(SPEED * SPEED - 1.)/TAN(SWPLE)                      R1T3066
      CLSB1  = 0.85                                                     R1T3067
      CLSB9  = 0.85                                                     R1T3068
      IF( SWPLE.GT.0.7243 ) CALL LNTP(SWPLE, CLSB1, X1, Y1, 6, 4)       R1T3069
      IF( SWPLE.GT.0.3665 ) CALL LNTP(SWPLE, CLSB9, X9, Y9, 8, 4)       R1T3070
      CALL LNTP(AR, DCLAR, XAR, YDCL, 5, 4)                             R1T3071
      CLSB9  = CLSB9 + DCLAR                                            R1T3072
      CLSB   = CLSB1 + (CLSB9 - CLSB1) *(BETAC - .1) * 1.25             R1T3073
      CLSB   = CLSB + 0.5 * CLD                                         R1T3074
      CLPB   = CLSB                                                     R1T3075
      CLDB   = CLSB                                                     R1T3076
C                                                                       R1T3077
C     SUPERSONIC MAXIMUM LIFT COEFFICIENT      ****                     R1T3078
      CNAO4B = CLAW * 14.325 * SQRT(SPEED*SPEED -1.)                    R1T3079
C                                                                       R1T3080
      OM     = 1./SPEED                                                 R1T3081
      CLMAX  = 0.7722 + 0.3384 * OM +1.1648 * OM*OM -0.8215 * OM**3     R1T3082
C                                                                       R1T3083
      CM1    = 1. - CNAO4B                                              R1T3084
      IF(CM1.LT.0.0 ) CM1 = 0.0                                         R1T3085
C                                                                       R1T3086
      CLMAX  = CLMAX - 0.048 * CM1                                      R1T3087
C                                                                       R1T3088
      AMAX   = 68.5429 -177.2327 * OM +461.9204 *OM*OM                  R1T3089
     1                 -629.4522 * OM**3 +321.4001 * CM**4              R1T3090
C                                                                       R1T3091
      AMAX   = AMAX +15.8074 -3.0001*CNAO4B -12.8073*CNAC4B**2          R1T3092
C                                                                       R1T3093
      IF( CLMAX.GT.1.25 ) CLMAX = 1.25                                  R1T3094
      IF( AMAX.GT.54.5  ) AMAX  = 54.5                                  R1T3095
C                                                                       R1T3096
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      GO TO 300                                                         R1T3097
   30 CONTINUE                                                          R1T3098
C                                                                       R1T3099
      CLMAX  = 0.0                                                      R1T3100
      NI     = A1(234)                                                  R1T3101
      DY     = AMAP(NI) * TOC                                           R1T3102
      CALL LNTP(TR, C1, XTR, YC1, 6, 4)                                 R1T3103
      CALL LNTP(TR, C2, XTR, YC2, 6, 4)                                 R1T3104
C                                                                       R1T3105
      C1COS  = (C1 + 1.) * COS(SWPLE)                                   R1T3106
      ARUP   = 4./C1COS                                                 R1T3107
      ARLO   = 3./C1COS                                                 R1T3108
C                                                                       R1T3109
C                                                                       R1T3110
      XMT      = XT(NI)                                                 R1T3111
      IF( XMT.LT.0.3 ) XMT = 0.3                                        R1T3112
      IF( XMT.GT.0.45) XMT = 0.45                                       R1T3113
      IF( AR.LE.ARLO ) GO TO 200                                        R1T3114
C                                                                       R1T3115
      C1MAXB = DLNT(DY, XMT, XDY1, YXMT, ZC1MAX, 9, 4, 9, 2,2)          R1T3116
      FOC    = 5.500 * CLD                                              R1T3117
      DC1MAX = DLNT(DY, FOC, XDY2, YFOC, ZDC1M, 8, 6, 8, 2,2)           R1T3118
      IF( XMT.GE.0.35 ) DC1MAX = DLNT(DY,FOC,XDY2,YFOC,Z2DC1M,8,6,8,2,2)R1T3119
C                                                                       R1T3120
      RNCB   = ALOG10(RNOFT * CB)                                       R1T3121
      CALL LNTP(RNCB, F1, XF1, YF , 7, 2)                               R1T3122
      CALL LNTP(RNCB, F2, XF1, YF , 7, 2)                               R1T3123
      DC1RN  = F1 + F2 * DY                                             R1T3124
C                                                                       R1T3125
      C1MAX  = C1MAXB + DC1MAX + DC1RN                                  R1T3126
C                                                                       R1T3127
      SWEEP = SWPLE * 57.2956                                           R1T3128
  100 CALL LNTP(SWEEP, A, XSWP, YA, 4, 4)                               R1T3129
      CALL LNTP(SWEEP, B, XSWP, YB, 4, 4)                               R1T3130
C                                                                       R1T3131
      DYM14  = DY - 1.4                                                 R1T3132
      IF( DYM14.LT.0.0 ) DYM14 = 0.0                                    R1T3133
      IF( DY.GT.2.5    ) DYM14 = 1.1                                    R1T3134
C                                                                       R1T3135
      CLMOC1 = A - B * DYM14                                            R1T3136
      CLMAX  = CLMOC1 * C1MAX                                           R1T3137
C                                                                       R1T3138
      C      = DLNT(DY, SPEED, XDY, XM, CTAB, 8, 4, 8, 2,2)             R1T3139
      D      = DLNT(DY, SPEED, XDY, XM, DTAB, 8, 4, 8, 2,2)             R1T3140
C                                                                       R1T3141
      DCLMAX = C  + (D - C) * SWEEP/60.                                 R1T3142
      CLMAX  = CLMAX + DCLMAX                                           R1T3143
C                                                                       R1T3144
  120 DAMAX  = DLNT(SWEEP, DY, XSP, YDY, FDA, 8, 6, 8, 2,2)             R1T3145
      AMAX   = CLMAX/CLAW  +ALO  +DAMAX                                 R1T3146
      CLS    = CLA * (AMAX - 2.*DAMAX - ALO)                            R1T3147
      GO TO 300                                                         R1T3148
C                                                                       R1T3149
C     LOW ASPECT RATIO METHOD                                           R1T3150
C                                                                       R1T3151
  200 CONTINUE                                                          R1T3152
```

```
C                                                                       R1T3153
      ABETA  = AR/SQRT(1. - SPEED * SPEED)                              R1T3154
      XCLM   = ABETA * C1COS                                            R1T3155
      IF( XMT.LE.0.35.OR.XCLM.GE.2.0 ) CLMXB =  DLNT(XCLM, DY, XXCLM,   R1T3156
     1                    YYDY, FCLMX, 13, 6, 13, 2,2)                  R1T3157
      IF( XMT.GT.0.35.AND.XCLM.LT.2.0 ) CLMXB =  DLNT(XCLM, DY, XXXCLM, R1T3158
     1                    YYDY, FCLMXX, 9, 6, 9, 2,2)                   R1T3159
C                                                                       R1T3160
      C2TAN  = (C2 + 1.) * AR * TAN(SWPLE)                              R1T3161
      DCLMX  = DLNT(C2TAN, SPEED, XXC2, YYMACH, FDCLMX, 9, 5, 9, 2,2)   R1T3162
C                                                                       R1T3163
      CLMAX  = CLMXB + DCLMX                                            R1T3164
      AST    = AR * COS(SWPLE) * (1.+ 4.0 * TR*TR)                      R1T3165
      AMAXB  = 35.0                                                     R1T3166
      IF( XCLM.GT.0.9 ) AMAXB = 49.8473 -20.6922*XCLM +5.0674*XCLM**2   R1T3167
     1                          -0.4279*XCLM**3                         R1T3168
      IF( XCLM.GT.3.6 ) AMAXB = 21.0                                    R1T3169
      IF( C2TAN.LE.4.5 ) DAM = DLNT(C2TAN,AST, XC2, YAST,FDAM,6,9,6,4,2)R1T3170
      IF( C2TAN.GT.4.5 ) DAM = DLNT(C2TAN,SPEED,XCT,YM,FDAM2,6,5,6,4,2) R1T3171
C                                                                       R1T3172
      AMAX   = AMAXB + DAM                                              R1T3173
C                                                                       R1T3174
  300 CONTINUE                                                          R1T3175
C     TAIL CONTRIBUTION TO CLMAX        ******                          R1T3176
C                                                                       R1T3177
      DEL    = CLAT * 57.3 * SIN(AMAX/57.3) * COS(AMAX/57.3)**2         R1T3178
      CLMAX  = CLMAX + DEL                                              R1T3179
C                                                                       R1T3180
      IF( KPRINT(16).EQ.1 ) WRITE(6,1000) CLPB, CLDB, ABRKO, ABRK,      R1T3181
     1             XMN, DYO, DCLPB, TRANS, BETAC, DY, C1, C2, AMAX, ARUP,R1T3182
     2                ARLO,XMT,C1MAXB,DC1MAX,CLMOC1,DCLMAX,DEL,         R1T3183
     3             XCLM, CLMXB, C2TAN, DCLMX, CLMAX, DC1RN, RNCB        R1T3184
 1000 FORMAT(10X,*CLBRK DUMP* /(1X, 7F15.5) )                           R1T3185
C                                                                       R1T3186
      RETURN                                                            R1T3187
      END                                                               R1T3188
```

CC = 00204

```
      SUBROUTINE CDL1(SPEED, RNOFT, FK, DELCL, PRIMEK, AKD, AKB)
C
C     COMPUTES DRAG DUE TO LIFT CONSTANTS
C
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS
C
      COMMON /BLKA02/ SREF, A1(223), CBAR(10), TW(10), CAM(10), TOC(10),
     1                A2(12), CONCL, A3(25), YW(11), A4(120)
C
      COMMON /BLKG01/ G1(44), DOB, TOCW, CLD,
     1                G3(12), XLESW(10), G4(10), AR, TR, SPLAN,CB,
     2                G5(18), SWPQC, SWPLE, G6(11), CBAR2, CLDS, TOCS,
     3                G7(83)
C
      COMMON /BLKBD1/ XSWPL(11), YRMIN(11)
C
      COMMON /BLKBD2 / AA(22), BB(22), CC(22), DD(22), XT(22)
      COMMON /BLKA16/ XSWP(7), YTR(4), FEP35(7,4), FEP7(7,4),
     1                XCLDB(7), YAKB(7)
C
      COMMON /BLKC01/ C1(100)
C
      COMMON /BLKPRT/ KPRINT(50)
C
      DIMENSION OCURV(13), RCURV(13), XRN(9), YDRT1(9), YDRT2(9)
C
      DATA OCURV / 2., 4., 6., 10., 20., 30., 40., 50., 60.,
     1             80., 100., 130., 200./,
     2     RCURV / 0.17,0.37,0.48,0.6,0.73,0.782,0.81,0.83,0.84,
     3             0.855,0.865,0.874,0.874 /
      DATA  XRN  / 0., 5., 7., 10., 20., 40., 100., 300., 600. /,
     1     YDRT1 / .07,.07,.05,.025, 5*0.0 /,
     2     YDRT2 / .175,.175,.165,.12,.05,.03,.015,.005,0.0 /
C
C
      CLM     = C1(17) * 57.29578 * SREF/SPLAN
      BO2X    = YW(1+NPNLS) - YW(1)
      FKL1    = 0.0
      DCL1    = 0.0
      FKL2    = 0.0
      DCL2    = 0.0
      CLMO    = CLM
      CLM2    = C1(77) * 57.29578 * SREF/SPLAN
      RBAR    = 0.0
C
      CLDB    = C1(64)
      CALL LNTP(CLDB, AKB, XCLDB, YAKB, 7, 2)
      FAKB    = 1.24 -.04 * RNOFT * CB * 1.0E-6
      IF( FAKB.LT.1.0 ) FAKB = 1.0
      AKB     = FAKB * AKB * SREF/SPLAN
C
      B       = -1.41 +1.442*TR -1.26*TR**2 +.528*TR**3
      C       = 0.7125 -1.497*TR +1.476*TR**2 -.6909*TR**3
      EO      = 1.0 + B * DOB + C * DOB**2
C
      FMACH   = SPEED
```

```
      FMCRO   = C1(72)                                                  R1T3246
      FML1    = C1(73)                                                  R1T3247
      FML2    = C1(74)                                                  R1T3248
      IF( FMACH.GT.FMCRO ) FMACH = FMCRO                                R1T3249
      IF( SPEED.GE.FMCRO.AND.SPEED.LT.FML2 ) CLMO= C1(76) *             R1T3250
     1            57.29578 * SREF/SPLAN                                 R1T3251
      IF( SPEED.GT.1.0 ) CALL ADCL(SPEED, CLOPT)                        R1T3252
      IF( SPEED.LT.FML2 ) CALL ADCL(FMACH, CLOPT)                       R1T3253
C                                                                       R1T3254
      NI      = TW(1)                                                   R1T3255
      DO 100 I = 1, NPNLS                                               R1T3256
C                                                                       R1T3257
      TC      = TOC(I)                                                  R1T3258
      RLEOC   = AA(NI) +BB(NI)*TOC(I) +CC(NI)*TOC(I)**2                 R1T3259
     1          +DD(NI)*TOC(I)**3                                       R1T3260
      IF( NI.EQ.8 ) RLEOC = 0.88216 * TOC(I)**1.606                     R1T3261
      RLE     = RLEOC * CBAR(I)                                         R1T3262
      IF( ISWP.EQ.0.OR.I.NE.NPNLS ) GO TO 90                            R1T3263
      RLEOC   = AA(NI) +BB(NI)*TOCS + CC(NI)*TOCS**2 + DD(NI)*TOCS**3   R1T3264
      IF( NI.EQ.8 ) RLEOC = 0.88216 * TOCS**1.606                       R1T3265
      RLE     = RLEOC * CBAR2                                           R1T3266
      TC      = TOCS                                                    R1T3267
C                                                                       R1T3268
   90 CONTINUE                                                          R1T3269
C                                                                       R1T3270
      RNLER   = RLE * RNOFT/10.0**3                                     R1T3271
      COTANS = 5.0 - 6.511 * XLESW(I)                                   R1T3272
      IF( SWPLE.GT.0.35 ) COTANS = 1./TAN(XLESW(I))                     R1T3273
C                                                                       R1T3274
      OMEGA   = RNLER * COTANS * SQRT(1. - (FMACH * COS(XLESW(I)))**2 ) R1T3275
      CALL LNTP(OMEGA, RT, OCURV, RCURV, 13, 2)                         R1T3276
      CALL LNTP(XLESW(I),RMIN,XSWPL,YRMIN, 11, 2)                       R1T3277
      IF(RT.LT.RMIN )  RT = RMIN                                        R1T3278
      DRT     = 0.0                                                     R1T3279
C                                                                       R1T3280
      CALL LNTP(RNLER, DRT1, XRN, YDRT1,9,2)                            R1T3281
      CALL LNTP(RNLER, DRT2, XRN, YDRT2,9,2)                            R1T3282
      IF( TC.GT.0.03 ) DRT = DRT1 * (TC - 0.03)/0.03                    R1T3283
      IF( TC.GT.0.06 ) DRT = DRT1 + DRT2 * (TC - 0.06)/0.06             R1T3284
      RT      = RT + DRT                                                R1T3285
C                                                                       R1T3286
      RI      = RT +(0.824 -RT) *(CLD + CONCL)/0.6                      R1T3287
C                                                                       R1T3288
      IF(RI.GT.0.874 ) RI = 0.874                                       R1T3289
C                                                                       R1T3290
      RBAR    = RBAR + RI * (YW(I+1) - YW(I))/BO2X                      R1T3291
  100 CONTINUE                                                          R1T3292
C                                                                       R1T3293
      AT      = AR * TR/COS(SWPLE)                                      R1T3294
      DELR    = 0.0482*AT -0.01102*AT**2 +0.001197*AT**3                R1T3295
     1          -0.00004833*AT**4                                       R1T3296
C                                                                       R1T3297
      R       = RBAR + DELR                                             R1T3298
C                                                                       R1T3299
      FK      = ((1.-R)/CLMO +R/(3.14159*AR*EO)) * SREF/SPLAN           R1T3300
C                                                                       R1T3301
```

```
      E       = 1./(3.14159 * AR * FK) * SREF/SPLAN                     R1T3302
      DELCL   = CLOPT * (1.-E)                                          R1T3303
      PRIMFK  = 0.518/SQRT(AR)                                          R1T3304
C                                                                       R1T3305
      SWPC4   = SWPQC * 57.29578                                        R1T3306
      IF( SWPC4.GT.60.0 ) SWPC4 = 60.0                                  R1T3307
      EP35    = DLNT(SWPC4, TR, XSWP, YTR, FEP35, 7, 4, 7, 2,2)         R1T3308
      EP7     = DLNT(SWPC4, TR, XSWP, YTR, FEP7,  7, 4, 7, 2,2)         R1T3309
      IF( AR.LE.3.5 ) EP = 1. - (1.-EP35) * AR/3.5                      R1T3310
      IF( AR.GT.3.5 ) EP = EP35 + (EP7 - EP35)*(AR-3.5)/3.5             R1T3311
C                                                                       R1T3312
      EPP     = EP * (1.-DOB**2)                                        R1T3313
      AKD     = 1./(3.14159 * AR * EPP) * SREF/SPLAN                    R1T3314
C                                                                       R1T3315
C                                                                       R1T3316
      RO      = R                                                       R1T3317
      H       = 1.1                                                     R1T3318
      ARTANS  = AR * TAN(SWPLE)                                         R1T3319
      IF( ARTANS.GT.3.5 ) H = 1.1 + 0.1*(ARTANS - 3.5)                  R1T3320
      IF( SPEED.GE.1.0 ) PRIMEK = H/CLM * SREF/SPLAN                    R1T3321
C                                                                       R1T3322
      IF( SPEED.LE.FML2 )  GO TO 200                                    R1T3323
      ZNDM    = 12. * (COS(SWPLE)**1.6) * (SPEED-FMCRO)                 R1T3324
      FNDM    = 1./(1. + ZNDM + ZNDM**2)                                R1T3325
      R       = RO * FNDM                                               R1T3326
      FK      = ((1.-R)/CLM  +R/(3.14159*AR*EO)) * SREF/SPLAN           R1T3327
      DELCL   = CLOPT                                                   R1T3328
C                                                                       R1T3329
      GO TO 500                                                         R1T3330
C                                                                       R1T3331
  200 CALL KGIN(CLDB, FK, DELCL, SPEED, FKL1, DCL1)                     R1T3332
      IF( SPEED.LE.FML1 ) GO TO 500                                     R1T3333
C     DRAG POLAR IS CALCULATED BY LINEAR INTERPOLATION BETWEEN THE      R1T3334
C     LIMITS FML1 AND FML2.                                             R1T3335
C                                                                       R1T3336
      ZNDM    = 12. * (COS(SWPLE)**1.6) * (FML2 - FMCRO)                R1T3337
      FNDM    = 1./(1. + ZNDM + ZNDM**2)                                R1T3338
      RL2     = RO * FNDM                                               R1T3339
      FKL2    = ((1.-RL2)/CLM2 + RL2/(3.14159*AR*EO)) * SREF/SPLAN      R1T3340
      CALL ADCL(FML2, DCL2)                                             R1T3341
C                                                                       R1T3342
      CALL KGIN(0.50, FK, DELCL, FML1, FKL1, DCL1)                      R1T3343
C                                                                       R1T3344
      FK      = FKL1 + (FKL2-FKL1)*(SPEED-FML1)/(FML2-FML1)             R1T3345
      DELCL   = DCL1 + (DCL2-DCL1)*(SPEED-FML1)/(FML2-FML1)             R1T3346
C                                                                       R1T3347
  500 IF( KPRINT(22).EQ.0 ) RETURN                                      R1T3348
      WRITE(6,1000) SPEED, FMACH, FK, DELCL, PRIMEK, AKD, AKB,          R1T3349
     1              CLDB, CLM, SREF, SPLAN, FMCRO, FML1, FML2,          R1T3350
     2              RLE,RNLER,OMEGA,R,RBAR,RT,CLD,CONCL,E,AR,SWPC4,     R1T3351
     3              EP, DOB, SWPLE, FKL1, DCL1, FKL2, DCL2,RMIN         R1T3352
     4                , (TOC(I), CBAR(I), XLESW(I), YW(I), I = 1,NPNLS),R1T3353
     5                YW(1+NPNLS)                                       R1T3354
C                                                                       R1T3355
 1000 FORMAT(5X, *CDL1 DUMP* /(1X, 7F15.5) )                            R1T3356
      RETURN                                                            R1T3357
```

END

RLT3358

CC = 00169

```
      SUBROUTINE ADCL(SPEED, CLOPT)                                     R1T3360
C                                                                       R1T3361
C     POLAR AXIS DISPLACEMENT                                           R1T3362
C                                                                       R1T3363
      COMMON /BLKA02/ SREF, A1(432)                                     R1T3364
C                                                                       R1T3365
      COMMON /BLKG01/ G1(46), CLD, SEXW, G2(33), SPLAN, G3(20),         R1T3366
     1                ESWLE, G4(97)                                    R1T3367
C                                                                       R1T3368
      CONCL  = A1(276)                                                  R1T3369
C                                                                       R1T3370
      CLOPT  = 0.0                                                      R1T3371
      IF (SPEED .GE. 1.0) GO TO 10                                      R1T3372
      FOC    = 0.06 * CLD                                               R1T3373
C                                                                       R1T3374
      IF( CLD.GT.0.0 ) CLOPT = -.001 +16.934*FOC -216.2697*FOC**2       R1T3375
     1                              +1781.3562*FOC**3                   R1T3376
      IF( CONCL.GT.0.0)CLOPT = CLOPT -.0017 +1.1334*CONCL               R1T3377
     1                          -1.8498*CONCL**2 +1.0605*CONCL**3       R1T3378
      IF( A1(234).EQ.8. ) CLOPT = 0.51951 * CLD**0.75                   R1T3379
      GO TO 20                                                          R1T3380
C                                                                       R1T3381
   10 BETAT  = 10.                                                      R1T3382
      IF( ESWLE.GT.0.0 ) BETAT = SQRT(SPEED**2 -1.)/TAN(ESWLE)          R1T3383
      DELCL  = CLD * (0.25 - 0.225 * BETAT )                            R1T3384
      IF( BETAT.GE.1.11 ) DELCL = 0.0                                   R1T3385
      CLOPT  = DELCL                                                    R1T3386
C                                                                       R1T3387
   20 CLOPT  = CLOPT * SPLAN/SREF                                       R1T3388
      RETURN                                                            R1T3389
      END                                                               R1T3390
```

CC = 00031

```
      SUBROUTINE KGIN(CLDB, AKIN,DECLIN,SPEED, AKOUT,DCLOUT)
C
C     COMPUTES POLAR USING LEAST-SQUARES CURVE FIT
C
      COMMON /BLKPRT/ KPRINT(50)
      DIMENSION CL(11), CDL(11), SA(12), RE(11)
C
      DCL    = CLDB/10.0
      CL(1) = 0.0
C
      DO 20 I = 1, 11
      IF( I.NE.1 ) CL(I) = CL(I-1) + DCL
      CLX    = CL(I)
C
      CALL CDDR1(CLX, SPEED, CDR)
C
      IF( I.EQ.1 ) CDRO = CDR
      DCDR  = CDR - CDRO
C
   40 CDL(I) = AKIN * (CL(I) - DECLIN)**2 + DCDR
   20 CONTINUE
C
      CALL PLSQ(CL,CDL,7,2,SA,0,EMAX,ERMS,EMEQ)
C
      AKOUT    = SA(1)
      DCLOUT   = -SA(2)/(2.0 * AKOUT )
      ERR      = SA(3) - AKOUT * DCLOUT**2
C
      IF( ABS(ERR).LT.0.001.OR.KPRINT(14).EQ.0 ) GO TO 30
C
      WRITE (6,1000) SPEED,ERR,AKOUT,DCLOUT,
     1        AKIN, DECLIN, ( CL(I), CDL(I), I = 1,7 )
 1000 FORMAT(10X *KGIN* 5X,*MACH =*F8.5,2X*ERR =*F8.5,2X,4F8.5,/
     1        1X, 4F8.5      )
C
   30 RETURN
      END
```

CC = 00037

```
      SUBROUTINE CDL2(SPEED, CL, AEROK, DELCL, PRIMEK, AKD, AKB, CDL)
C
C     COMPUTES DRAG DUE TO LIFT
C
      COMMON /BLKPRT/ KPRINT(50)
C
      COMMON /BLKCOI/ CI(100)
C
      CLPB   = CI(63)
      CLDB   = CI(64)
C
C
   20 CONTINUE
      CDL    = AEROK * (CL - DELCL)**2
      IF( CL.LE.CLPB ) GO TO 500
C
C     DRAG DUE TO LIFT ABOVE POLAR BREAK
      CDL    = CDL + PRIMEK * (CL - CLPB)**2
      IF( CL.LE.CLDB ) GO TO 500
C
C     DRAG DUE TO LIFT ABOVE DRAG BREAK (CLDB)
C
      IF( SPEED.GE.1.0 ) GO TO 410
      CDPDB  = AEROK * (CLDB - DELCL)**2  - AKD * CLDB**2
     1                 + PRIMEK * (CLDB - CLPB)**2
C
      DCDB   = AKB * (CL - CLDB)**2
      DCDB   = DCDB + 0.08 * SQRT(DCDB)
C
      CDL    = CDPDB + DCDB + AKD * CL**2
C
  400 IF( SPEED.LT.1.0 ) GO TO 500
  410 CONTINUE
      CDL    = (AEROK - PRIMEK) * (CLPB - DELCL)**2
     1           + PRIMEK * (CL - DELCL)**2
C
C
C
  500 CONTINUE
      IF( KPRINT(14).LE.0 ) GO TO 50
      WRITE(6,1000) SPEED, CL, CDL, AEROK, DELCL, PRIMEK, CLPB,
     1              CLDB, AKD, AKB
      KPRINT(14) = KPRINT(14) - 1
   50 CONTINUE
      RETURN
 1000 FORMAT (10X, *CDL2 DUMP*/(1X, 7F15.5 )  )
      END
```

CC = 00047

```
      SUBROUTINE AERA(SPEED, CL, ALPHA)                                 R1T3478
C                                                                       R1T3479
C     CALCULATES ANGLE OF ATTACK                                        R1T3480
C                                                                       R1T3481
      COMMON /BLKC01/ C1(100)                                           R1T3482
C                                                                       R1T3483
      COMMON /BLKG01/ G1(44), DOB, TOC, CLD, SEXW, SWPMC,               R1T3484
     1                G2(30), AR, TR, SPLAN, G3(6), YIX, YOX,          R1T3485
     2                SIX, SOX, ARI, G4(4), SWLEI, G5(3), SWPQC,       R1T3486
     3                  SWPLE, SWPTE, G6(96)                           R1T3487
C                                                                       R1T3488
      COMMON /BLKA02/ SREF, A1(432)                                     R1T3489
C                                                                       R1T3490
      COMMON /BLKPRT/ KPRINT(50)                                        R1T3491
C                                                                       R1T3492
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS      R1T3493
C                                                                       R1T3494
      COMMON /BLKT22/ XIN13(10), YIN13(7), ZOUT13(10,7), ZOUT14(10,7)   R1T3495
      COMMON /BLKMX2/ XSWP(8), YDY(6), FDA(8,6), XAB(6), YCO(8),        R1T3496
     1                FKVOFM(6,8), XANG(10), YRTOC(7), FRA(10,7)        R1T3497
      COMMON /BLKMX6/ XX(12), XY(7), XF(12,7)                           R1T3498
C                                                                       R1T3499
      DIMENSION CLTAB(13), ATAB(13)                                     R1T3500
      EQUIVALENCE (CLA,C1(17)), (ALO,C1(18)), (CLAW,C1(54)),            R1T3501
     1            (CLI,C1(64)), (CLMAX,C1(65)), (AMAX,C1(67)),          R1T3502
     2            (DAMAX,C1(68)), (DEL,C1(69)), (CLS,C1(70)),           R1T3503
     3            (ARLO,C1(71)), (CDL,C1(6))                            R1T3504
C                                                                       R1T3505
      SWEEP=SWPLE*57.29578                                              R1T3506
      KPRT   = KPRINT(17)                                               R1T3507
      CLVM1  = 0.0                                                      R1T3508
C                                                                       R1T3509
   10 ALPHA = CL/CLA + ALO                                              R1T3510
      IF( SPEED.GT.1.0 ) RETURN                                         R1T3511
      IF( NPNLS.GT.1 ) GO TO 290                                        R1T3512
      IF( AR.LE.ARLO ) GO TO 100                                        R1T3513
C                                                                       R1T3514
   20 CONTINUE                                                          R1T3515
C                                                                       R1T3516
      IF( KPRT.GT.0 ) WRITE(6,1000) CL, ALPHA, AR, ARLO, CLMAX, CLS,    R1T3517
     1                    DAMAX, CLA, ALO                               R1T3518
C                                                                       R1T3519
      IF( CL.LE.CLS ) GO TO 200                                         R1T3520
C                                                                       R1T3521
C     HIGH ASPECT RATIO LIFT METHOD      ****                           R1T3522
C                                                                       R1T3523
      DA     = 0.0                                                      R1T3524
      DCL     = CLMAX - CLS                                             R1T3525
      DA      = ((CL - CLS)/DCL)**2 * DAMAX                             R1T3526
   30 ALPHA = ALPHA + DA                                                R1T3527
      IF( CL.LE.CLMAX ) GO TO 200                                       R1T3528
      ALPHA = ALPHA + 5.0                                               R1T3529
      IF( ALPHA.GT.90.0 ) ALPHA = 90.0                                  R1T3530
C                                                                       R1T3531
      GO TO 200                                                         R1T3532
  100 CONTINUE                                                          R1T3533
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C     LOW ASPECT  RATIO LIFT METHOD    *****                          R1T3534
C                                                                     R1T3535
      AS      = 0.0                                                   R1T3536
      Z       = 2. * COS(SWPMC) / AR                                  R1T3537
      HOB     = (AMAX - AS)/114.6 /AR    * 1.5 * (TR +TR**2)/(1.+TR+TR**2)R1T3538
      XEP     = 1.0014 -1.969*HOB +3.0021*HOB**2 -2.0072*HOB**3       R1T3539
      DCLEP   = (Z + SQRT(1.+ Z**2))/(XEP*Z + SQRT(1. +(XEP*Z)**2))   R1T3540
      DCLPA   = (DCLEP -1.) * CLAW * 57.3                             R1T3541
      CLPA    = CLA * 57.3                                            R1T3542
      DCLO    = - CLA * ALO                                           R1T3543
      CLVM1   = CLMAX - CLPA * SIN(AMAX/57.3) * COS(AMAX/57.3)**2 -DCLO R1T3544
      CLVM2   = CLVM1 - DCLPA * SIN(AMAX/57.3) * COS(AMAX/57.3)**2    R1T3545
      IF( CLVM1.LE.0.0 ) DAMAX = AMAX - CLMAX/CLA - ALO               R1T3546
      IF( CLVM1.LE.0.0 ) CLS = CLA * (AMAX - 2.*DAMAX - ALO)          R1T3547
      IF( CLVM1.LE.0.0 ) GO TO 20                                     R1T3548
C                                                                     R1T3549
      CO      = TAN(SWPTE)/TAN(SWPLE)                                 R1T3550
      BETA    = SQRT(1. - SPEED**2)                                   R1T3551
      ABETA   = 4.0/TAN(SWPLE) /(1.-CO) * BETA                        R1T3552
      TOCR    = TOC                                                   R1T3553
      IF( A1(234).EQ.9 ) TOCR = 0.0                                   R1T3554
C                                                                     R1T3555
  110 CLVOFM = DLNT(ABETA, CO, XAB, YCO, FKVOFM, 6,8,6,2,2)           R1T3556
      TS2     = TAN(SWPLE)**2                                         R1T3557
      FM      = SQRT((1. + TS2)/(BETA**2 + TS2))                      R1T3558
      CLVA    = CLVOFM * FM * SEXW/SREF                               R1T3559
C                                                                     R1T3560
      ATAB(1)= 0.0                                                    R1T3561
      DO 120 I = 1, 13                                                R1T3562
      IF( I.GT.1 ) ATAB(I) = ATAB(I-1) + 3.0                          R1T3563
      ANG     = ATAB(I)* 0.01745                                      R1T3564
      DCLP    = 0.0                                                   R1T3565
      IF( ATAB(I).LE.AS ) GO TO 115                                   R1T3566
C                                                                     R1T3567
C     TIP VORTEX EFFECT                                               R1T3568
C                                                                     R1T3569
      HOB     = (ATAB(I) -AS)/114.6 /AR    *1.5 *(TR+TR*TR)/(1.+TR+TR*TR) R1T3570
      XEP     = 1.0014 -1.969*HOB +3.0021*HOB**2 -2.0072*HOB**3       R1T3571
      IF( HOB.LE.0.0 ) XEP = 1.0                                      R1T3572
      DCLEP   = (Z +SQRT(1.+Z*Z))/(XEP*Z + SQRT(1.+ (XEP*Z)**2))      R1T3573
      DCLPA   = (DCLEP -1.) * CLAW * 57.3                             R1T3574
      DCLP    = DCLPA * SIN(ANG)                                      R1T3575
  115 CONTINUE                                                        R1T3576
C     LEADING EDGE EFFECT (RA)                                        R1T3577
      RA      = DLNT(ANG, TOCR, XANG, YRTOC, FRA, 10, 7, 10, 2,2)     R1T3578
C                                                                     R1T3579
C     VORTEX BREAKDOWN EFFECT (FVL)                                   R1T3580
      X       = AR                                                    R1T3581
      FVL     = 0.0                                                   R1T3582
      IF( X.LT.3.37 ) FVL = DLNT(X,ANG, XX, XY, XF, 12, 7, 12, 4,2)   R1T3583
C                                                                     R1T3584
      CLV     = (1.-RA) * FVL * CLVA * SIN(ANG)**2 * COS(ANG)         R1T3585
      IF( CLV.GT.CLVM2 ) CLV = CLVM2                                  R1T3586
      CLP     = CLPA * SIN(ANG) * COS(ANG)**2                         R1T3587
      CLTAB(I) = DCLO + CLV + CLP + DCLP                              R1T3588
      IF( KPRINT(17).EQ.2.AND.I.EQ.1 ) WRITE(6,1002)                  R1T3589
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      IF( KPRINT(17).EQ.2 ) WRITE(6,1001) CLTAB(I), ATAB(I), RA,        R1T3590
     1              CLP, CLV, DCLP                                      R1T3591
C                                                                       R1T3592
  120 CONTINUE                                                          R1T3593
C                                                                       R1T3594
      IF( KPRT.GT.0 ) WRITE(6,1003) CL, ALPHA, AR, ARLO, Z, HOB, DCLPA, R1T3595
     1                CLPA, DCLO, CLVM1, CLVM2, TOCR, CLVA, RA, FVL,    R1T3596
     2                ANG                                               R1T3597
C                                                                       R1T3598
  125 IF( CLVM1.LE.0.0 ) GO TO 20                                       R1T3599
  130 CALL LNTP(CL, ALPHA, CLTAB, ATAB, 13, 4)                          R1T3600
C                                                                       R1T3601
      GO TO 200                                                         R1T3602
C                                                                       R1T3603
C     CALCULATES ANGLE OF ATTACK AT HIGH LIFT BY MODIFIED               R1T3604
C     WINSTAN METHOD.                                                   R1T3605
C                                                                       R1T3606
C                                                                       R1T3607
  290 CONTINUE                                                          R1T3608
  300 BETA  = SQRT(1. - SPEED**2)                                       R1T3609
      BETAN  = BETA * TAN(SWLEI)                                        R1T3610
      A      = DLNT(BETAN,SWEEP, XIN13,YIN13,ZOUT13, 10,7,10, 2,2)      R1T3611
      EN     = DLNT(BETAN,SWEEP, XIN13,YIN13,ZOUT14, 10,7,10, 2,2)      R1T3612
C                                                                       R1T3613
C                                                                       R1T3614
      ACLARU = CLDB/CLA + ALO                                           R1T3615
      EBRK   = YIX/(YIX + YOX)                                          R1T3616
      CLB    = A * ACLARU**EN * EBRK/ARI * CLAW * 57.29578              R1T3617
  310 IF( CL.LE.CLDB ) GO TO 200                                        R1T3618
      CLT    = CLB + CL - CLDB                                          R1T3619
      ALPHA  = (CLT * ARI/(A * CLAW * 57.29578 * EBRK))**(1./EN)        R1T3620
C                                                                       R1T3621
      IF( KPRT.GT.0 ) WRITE(6,1004) CL, ALPHA, AR, A, EN, ACLARU,       R1T3622
     1                EBRK, CLB, CLDB, CLAW                             R1T3623
C                                                                       R1T3624
  200 CONTINUE                                                          R1T3625
      IF( ALPHA.LT.6.0 ) GO TO 205                                      R1T3626
      CDLA   = CL * TAN(ALPHA/57.296)                                   R1T3627
      IF( CDLA.LT.CDL ) CDL = CDLA                                      R1T3628
  205 RETURN                                                            R1T3629
C                                                                       R1T3630
 1000 FORMAT(5X, *AERA DUMP   HIGH ASPECT RATIO* /(1X,7F15.5) )         R1T3631
 1003 FORMAT(5X, *AERA DUMP   LOW ASPECT RATIO* /(1X,7F15.5) )          R1T3632
 1004 FORMAT(5X, *AERA DUMP   CRANKED WING* /(1X,7F15.5) )              R1T3633
 1001 FORMAT(5X,*VORTEX LIFT*, 6F15.5)                                  R1T3634
 1002 FORMAT(///5X,*VORTEX LIFT*, 8X,*CL*,12X,*ALPHA*,13X,*R*, 13X,     R1T3635
     1              *CLP*, 11X,*CLV*, 11X, *DCLP*, / )                  R1T3636
      ENTRY AERA1                                                       R1T3637
  400 KPRT   = KPRINT(17) - 1                                           R1T3638
      ALPHA  = CL/CLA + ALO                                             R1T3639
      IF( SPEED.GT.1.0 ) RETURN                                         R1T3640
      IF( NPNLS.GT.1 ) GO TO 310                                        R1T3641
      IF( AR.LE.ARLO.AND.CLVM1.GT.0.0 ) GO TO 125                       R1T3642
      GO TO 20                                                          R1T3643
C                                                                       R1T3644
      END                                                               R1T3645
```

CC = 00168

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      SUBROUTINE AFTCD(ALPHA, CDAFT)                                    R1T3647
C                                                                       R1T3648
C     COMPUTE DRAG INCREMENT DUE TO FUSELAGE UPSWEEP                    R1T3649
C                                                                       R1T3650
      COMMON /BLKA02/ A1(433)                                           R1T3651
C                                                                       R1T3652
      DIMENSION X(6), Y(4), Z(6,4)                                      R1T3653
C                                                                       R1T3654
      DATA  X  / -5., 0., 5., 10., 15., 20. /,                          R1T3655
     1      Y  / 0., 5., 10., 15. /,                                   R1T3656
     2      Z  / 2*0.0, .01, .045, .125, .28, 0.,.0005,.013,.054,.142, R1T3657
     3           .33, 0.,.004,.0175,.065,.172,.41, 0.,.014,.023,       R1T3658
     4           .085, .215, .53 /                                     R1T3659
C                                                                       R1T3660
      WINC    = A1(280)                                                 R1T3661
      BFUS    = A1(241)                                                 R1T3662
      AB      = A1(243)                                                 R1T3663
      IF( AB.EQ.0.0 ) AB = 1.0                                          R1T3664
      BAMX    = A1(65)                                                  R1T3665
      SREF    = A1(1)                                                   R1T3666
C                                                                       R1T3667
      CDAFT   = 0.0                                                     R1T3668
      IF( BFUS.EQ.0.0 ) RETURN                                          R1T3669
      AFUS    = ALPHA - WINC                                            R1T3670
      BMA     = BFUS - AFUS                                             R1T3671
C                                                                       R1T3672
      DCD     = DLNT(BMA, AFUS, X,Y,Z, 6,4,6, 4,2)                      R1T3673
      CDAFT   = DCD * BAMX/SREF * AB/1.5                                R1T3674
C                                                                       R1T3675
      RETURN                                                            R1T3676
      END                                                               R1T3677
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CC = 00031

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      SUBROUTINE TDRG(ITRIM, SPEED, DCLT, DCDT)                         R1T3679
C                                                                       R1T3680
C     COMPUTES EFFECT OF TRIM                                           R1T3681
C                                                                       R1T3682
      COMMON /BLKA02/ A3(280), XLE(11), A4(142)                         R1T3683
C                                                                       R1T3684
      COMMON /BLKA03/ A1(10), XCG, ZCG, CMAC, A2(7)                     R1T3685
C                                                                       R1T3686
      COMMON /BLKG01/ G1(82), CB, YB, XB, CRX, G2(22), XH, OMEGA,       R1T3687
     1                G3(90)                                           R1T3688
C                                                                       R1T3689
      COMMON /BLKC01/ CL,CD,CM,ALPHA,C1(6),DH,FK,DELCL,CMO,DCMCL,XACWB, R1T3690
     1                C2(39), CLAT, AH, BH, HSTAR, CH, ABREAK, CLDH,    R1T3691
     2                CLPB, CLDB, CLMAX, C3(22), XACS, C4(12)           R1T3692
C                                                                       R1T3693
      DCLT = 0.0                                                        R1T3694
      DCDT = 0.0                                                        R1T3695
C                                                                       R1T3696
      CGOCR  = (XCG - XLE(1))/CRX                                       R1T3697
      XAC    = XACWB                                                    R1T3698
      IF( CL.GT.CLDB ) XAC = XACWB + (XACS - XACWB) * ((CL-CLDB)/       R1T3699
     1                                  (CLMAX-CLDB))**2                R1T3700
      IF( CL.GT.CLMAX ) XAC = XACS                                      R1T3701
      IF( SPEED.GE.1.0 ) XAC = XACWB                                    R1T3702
      DCMCL  = (CGOCR - XACWB) * CRX/CMAC                               R1T3703
      IF( ITRIM.EQ.1 ) DH = 0.0                                         R1T3704
C                                                                       R1T3705
      CLTAIL = CLAT * (ALPHA - HSTAR) + CLDH * DH                       R1T3706
      CLWB   = CL - CLTAIL                                              R1T3707
      XLT    = XH *COS(OMEGA - ALPHA/57.3) /CMAC                        R1T3708
C                                                                       R1T3709
      CM     = CMO + (CGOCR - XAC) *CRX/CMAC * CLWB - CLTAIL * XLT      R1T3710
      IF( CLDH.EQ.0.0.OR.XLT.EQ.0.0 ) GO TO 60                          R1T3711
      IF( ITRIM.EQ.1 ) DH = CM /(CLDH * XLT)                            R1T3712
      IF( ITRIM.EQ.1 ) CM = 0.0                                         R1T3713
C                                                                       R1T3714
   60 CONTINUE                                                          R1T3715
C                                                                       R1T3716
      IF( DH.EQ.0.0 ) GO TO 100                                         R1T3717
      DCLT   = DH*CLDH                                                  R1T3718
C                                                                       R1T3719
      DCDT   = AH*DH**2 + BH*DH*(ALPHA -HSTAR)                          R1T3720
      IF(ALPHA.GT.ABREAK) DCDT = DCDT  + CH*DH*(ALPHA-ABREAK)           R1T3721
C                                                                       R1T3722
  100 RETURN                                                            R1T3723
      END                                                               R1T3724
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CC = 00046

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      SUBROUTINE DMIN(SPEED, RNOFT, CDMIN)                              R1T3726
C                                                                       R1T3727
C     MINIMUM DRAG                                                      R1T3728
C                                                                       R1T3729
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS      R1T3730
C                                                                       R1T3731
      COMMON /BLKA02/ SREF, A1(103), BASE(10), A2(319)                  R1T3732
C                                                                       R1T3733
      COMMON /BLKC01/ C1(18), TCD(5), CDFUS(5), CDBOD(5), C2(59),       R1T3734
     1                CDMISC, C3(7)                                    R1T3735
C                                                                       R1T3736
C                                                                       R1T3737
      CDFUS(5) = 0.0                                                    R1T3738
      CDBOD(5) = 0.0                                                    R1T3739
C                                                                       R1T3740
      FMISC  = A2(128)                                                  R1T3741
C                                                                       R1T3742
      CALL FDRG(SPEED, RNOFT)                                           R1T3743
C                                                                       R1T3744
      CDMISC = (TCD(1) + TCD(2) + TCD(3)) * FMISC * 0.01                R1T3745
      CALL ADJUST(2,0, SPEED, CDMISC)                                   R1T3746
C                                                                       R1T3747
      DO 20 I = 1, NBODYS                                               R1T3748
      CALL BDRG(SPEED, BASE(I), SREF, CDB)                              R1T3749
      IF( I.EQ.1 ) CDFUS(5) = CDB                                       R1T3750
      IF( I.GT.1 ) CDBOD(5) = CDBOD(5) + CDB                            R1T3751
   20 CONTINUE                                                          R1T3752
C                                                                       R1T3753
      TCD(5) = CDFUS(5) + CDBOD(5)                                      R1T3754
C                                                                       R1T3755
      CALL WDRG(SPEED)                                                  R1T3756
C                                                                       R1T3757
      CDMIN  = TCD(1) + TCD(2) + TCD(3) + TCD(4) + TCD(5)               R1T3758
      CDMIN  = CDMIN + CDMISC                                           R1T3759
C                                                                       R1T3760
C                                                                       R1T3761
   30 RETURN                                                            R1T3762
      END                                                               R1T3763

                                                          CC = 00038
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      SUBROUTINE FDRG(SPEED, RNOFT)                                     R1T3765
C                                                                       R1T3766
C     THIS SUBROUTINE CALCULATES FRICTION, FORM, AND INTERFERENCE       R1T3767
C                                                                       R1T3768
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NWT, NVT, ISWP, NPNLS      R1T3769
      COMMON /BLKA02/ SREF, AR, TAPR, SWPLE,                            R1T3770
     1                BLEN(10), BWID(10), BHGT(10), BAWET(10), BQ(10),  R1T3771
     2                BNO(10), BAMX(10), BABS(10), BLNS(10), BLBT(10),  R1T3772
     3                BASE(10),  ELEN(10), EWID(10), EHGT(10),          R1T3773
     4                EAWET(10), EAMX(10), EIN(10), EXIT(10), ELNS(10), R1T3774
     5                ELBT(10), EQF(10), ENO(10), CBAR(10), TW,         R1T3775
     5                XLEW, YWW, YB, CR, BO2, BFUS, FMISC, AB, AFTAW,   R1T3776
     6                CAM(10), TOC(10), AWET(10), SWMT, SPLAN, CONCL,   R1T3777
     7                TWIST, FTWIST, WINC, XLE(11), CRW(11), YW(11),    R1T3778
     8                XPIVOT, YPIVOT, XAPEX, AFTSW, AFTCB, AFTOC,       R1T3779
     9                SBAR(10), TS(10), SCAM(10), STOC(10), SAWET(10),  R1T3780
     1                SMTSW(10), SHF(10), SWL(10), SWT(10), STAPR(10),  R1T3781
     2                SCR(10), HTLF, HTY, HTZ, HTINC                    R1T3782
C                                                                       R1T3783
      COMMON /BLKC01/ C1(18), TCD(5)  CDFUS(5), CDBOD(5), CDNAC(4),     R1T3784
     1                CDWING(4), CDHT(4), CDVT(4), CDSURF(4), C2(47)    R1T3785
C                                                                       R1T3786
      COMMON /BLKOV3/ OV3A(7), J, OV3B(4)                               R1T3787
C                                                                       R1T3788
      COMMON /BLKSUR/ SUR(162), TRB(5,10), TRN(5,10), TRU(5,10),        R1T3789
     1                TRL(5,10), TRS(5,10)                              R1T3790
      COMMON /BLKG01/ FRBOD(10), G1(20), FRNAC(10), G2(73),             R1T3791
     1                SWPMT, CBAR2, CLDS, TOCS, SWET, G3(82)            R1T3792
C                                                                       R1T3793
      CRITM  = C2(19)                                                   R1T3794
      XTR    = 0.0                                                      R1T3795
C                                                                       R1T3796
      DO 10 I=1,3                                                       R1T3797
      TCD(I)    = 0.0                                                   R1T3798
      CDFUS(I)  = 0.0                                                   R1T3799
      CDBOD(I)  = 0.0                                                   R1T3800
      CDNAC(I)  = 0.0                                                   R1T3801
      CDWING(I)= 0.0                                                    R1T3802
      CDHT(I)   = 0.0                                                   R1T3803
      CDVT(I)   = 0.0                                                   R1T3804
      CDSURF(I)= 0.0                                                    R1T3805
   10 CONTINUE                                                          R1T3806
C                                                                       R1T3807
C     BODY CONTRIBUTIONS                                                R1T3808
      IF (NBODYS.EQ.0) GO TO 30                                         R1T3809
      DO 20 I =1,NBODYS                                                 R1T3810
      IF( J.GT.0 ) XTR = TRB(J,I) * BLEN(I)                             R1T3811
      CALL CFEQ(RNOFT,SPEED,BLEN(I),XTR,CDF)                            R1T3812
      CALL FFACT(1, FRBOD(I), 0, 0, SPEED, 0.0, FF)                     R1T3813
      DRAG = CDF*BAWET(I)/SREF                                          R1T3814
      IF (I.EQ.1) GO TO 25                                              R1T3815
      FI = BQ(I)                                                        R1T3816
      IF( SPEED.GT.1.0 ) FI = 1.                                        R1T3817
      CDBOD(1) = CDBOD(1) + DRAG                                        R1T3818
      CDBOD(2) = CDBOD(2) + DRAG*(FF -1.)                               R1T3819
      CDBOD(3) = CDBOD(3) + DRAG*FF*(FI - 1.)                           R1T3820
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      GO TO 20                                                          R1T3821
   25 REFUS = RNOFT*BLEN(1)                                             R1T3822
      CALL IFACT(1, REFUS, CRITM, SPEED, FI)                            R1T3823
      CDFUS(1) =  DRAG                                                  R1T3824
      CDFUS(2) =  DRAG*(FF -1.)                                         R1T3825
      CDFUS(3) =  DRAG*(FF)*(FI -1.)                                    R1T3826
   20 CONTINUE                                                          R1T3827
C                                                                       R1T3828
C     NACELLE CONTRIBUTIONS                                             R1T3829
   30 IF (NNACS.EQ.0) GO TO 40                                          R1T3830
      DO 35 I =1,NNACS                                                  R1T3831
      IF( J.GT.0 ) XTR = TRN(J,I) * ELEN(I)                             R1T3832
      CALL CFEQ(RNOFT,SPEED,ELEN(I),XTR,CDF)                            R1T3833
      CALL FFACT(2, FRNAC(I), 0, 0, SPEED, 0.0, FF)                     R1T3834
      DRAG = CDF*EAWET(I)/SREF                                          R1T3835
      FI     = EQF(I)                                                   R1T3836
      IF( SPEED.GT.1. ) FI = 1.                                         R1T3837
      CDNAC(1)      = CDNAC(1) + DRAG                                   R1T3838
      CDNAC(2)      = CDNAC(2) + DRAG*(FF -1.)                          R1T3839
      CDNAC(3)      = CDNAC(3) + DRAG*FF*(FI-1.)                        R1T3840
   35 CONTINUE                                                          R1T3841
C                                                                       R1T3842
C     WING CONTRIBUTION                                                 R1T3843
   40 IF (NPNLS.EQ.0) GO TO 50                                          R1T3844
      DO 45 I = 1, NPNLS                                                R1T3845
      IF( J.GT.0 ) XTR = TRU(J,I) * CBAR(I)                             R1T3846
      CALL CFEQ(RNOFT,SPEED, CBAR(I), XTR, CDFU)                        R1T3847
      IF( J.GT.0 ) XTR = TRL(J,I) * CBAR(I)                             R1T3848
      CALL CFEQ(RNOFT,SPEED, CBAR(I), XTR, CDFL)                        R1T3849
      CDF    = 0.5 * (CDFU + CDFL)                                      R1T3850
C                                                                       R1T3851
      CALL FFACT(3, TOC(I), TW, CAM(I), SPEED, CRITM, FF)               R1T3852
      IF( I.EQ.1 ) CALL IFACT(2, SWMT, CRITM, SPEED, FI)                R1T3853
      DRAG = CDF*AWET(I)/SREF                                           R1T3854
C                                                                       R1T3855
      IF( ISWP.LT.0.AND.I.EQ.NPNLS ) CALL CFEQ(RNOFT,SPEED,CBARZ,       R1T3856
     1                0.0,CDF)                                          R1T3857
      IF( ISWP.GT.0.AND.I.EQ.NPNLS ) CALL FFACT(3,TOCS,TW,CLDS,         R1T3858
     1                SPEED,CRITM,FF)                                   R1T3859
      IF( ISWP.GT.0 ) CALL IFACT(2, SWPMT, CRITM, SPEED, FI)            R1T3860
      IF( ISWP.GT.0.AND.I.EQ.NPNLS ) DRAG = CDF * SWET / SREF           R1T3861
C                                                                       R1T3862
      CDWING(1)=  CDWING(1) + DRAG                                      R1T3863
      CDWING(2)=  CDWING(2) + DRAG*(FF-1.)                              R1T3864
      CDWING(3)=  CDWING(3) + DRAG*FF*(FI-1.)                           R1T3865
   45 CONTINUE                                                          R1T3866
C                                                                       R1T3867
C     SURFACE CONTRIBUTIONS                                             R1T3868
   50 IF (NSURFS.EQ.1) GO TO 60                                         R1T3869
      NSURF1 = NSURFS - 1                                               R1T3870
      DO 55 I = 1, NSURF1                                               R1T3871
      IF( J.GT.0 ) XTR = TRS(J,I) * SBAR(I)                             R1T3872
      CALL CFEQ(RNOFT, SPEED, SBAR(I), XTR, CDF)                        R1T3873
      CALL FFACT(3, STOC(I), TS(I), SCAM(I), SPEED, 0.0, FF)            R1T3874
      CALL IFACT(3, SMTSW(I), CRITM, SPEED, FI)                         R1T3875
      IF( SPEED.LE.1. ) FI = FI * SHF(I)                                R1T3876
```

```
      DRAG = CDF*SAWET(I)/SREF                                          R1T3877
      IF ( I. EQ. 1.AND. NHT.GT.0) GO TO 100                            R1T3878
  200 IF ( NHT.EQ.0 ) GO TO 260                                         R1T3879
      IF ( I.EQ.2.AND.NVT.GT.0) GO TO 101                               R1T3880
  201 IF (NVT.EQ.0) GO TO 270                                           R1T3881
      IF ( I.GT.2 ) GO TO 102                                           R1T3882
      GO TO 55                                                          R1T3883
  260 IF ( I.EQ.1.AND.NVT.GT.0) GO TO 101                               R1T3884
      IF ( NVT.EQ.0 ) GO TO 102                                         R1T3885
  270 IF ( I.GT.1 ) GO TO 102                                           R1T3886
      GO TO 55                                                          R1T3887
  100 CDHT(1) = DRAG                                                    R1T3888
      CDHT(2) = DRAG*(FF-1.)                                            R1T3889
      CDHT(3) = DRAG*FF*(FI - 1.)                                       R1T3890
      GO TO 200                                                         R1T3891
  101 CDVT(1) = DRAG                                                    R1T3892
      CDVT(2) = DRAG*(FF-1.)                                            R1T3893
      CDVT(3) = DRAG*FF*(FI - 1.)                                       R1T3894
      GO TO 201                                                         R1T3895
  102 CDSURF(1) = CDSURF(1) + DRAG                                      R1T3896
      CDSURF(2) = CDSURF(2) + DRAG*(FF-1.)                              R1T3897
      CDSURF(3) = CDSURF(3) + DRAG*FF*(FI - 1.)                         R1T3898
      GO TO 55                                                          R1T3899
   55 CONTINUE                                                          R1T3900
   60 CONTINUE                                                          R1T3901
      DO 70 I = 1,3                                                     R1T3902
      TCD(I) = CDFUS(I) + CDBOD(I) + CDNAC(I) +CDWING(I)                R1T3903
     1         +CDHT(I) + CDVT(I)  + CDSURF(I)                          R1T3904
   70 CONTINUE                                                          R1T3905
      RETURN                                                            R1T3906
      END                                                               R1T3907
```

CC = 00143

```
      SUBROUTINE CFEQ(RNOFT,ZMACH,CBAR,XTR,CF)                          R1T3909
C                                                                       R1T3910
C     THIS SUBROUTINE CALCULATES THE SKIN FRICTION COEFFICIENT          R1T3911
C     USING THE WHITE-CHRISTOPH TECHNIQUE.                              R1T3912
C                                                                       R1T3913
      COMMON /BLKPRT/ KPRINT(50)                                        R1T3914
      COMMON /BLKA03/ ROUGHK, A1(19)                                    R1T3915
C                                                                       R1T3916
      FTURB(X) = T*F**2*0.430/(ALOG10(RNL*X*T**1.67*F))**2.56           R1T3917
C                                                                       R1T3918
      FLAM(Y)  = 1.328*CFCFIL/SQRT(Y*RNL)                               R1T3919
C                                                                       R1T3920
      FPRIM(X) = 0.43*T*F*F*((ALOG10(RNL  *X*T**1.67*F))**(-2.56)       R1T3921
     1           -1.11178*(ALOG10(RNL  *X*T**1.67*F))**(-3.56))        R1T3922
C                                                                       R1T3923
      IF( KPRINT(19).GT.0 ) WRITE(6,1001) RNOFT,ZMACH,CBAR,XTR,ROUGHK   R1T3924
      IF( CBAR.LE.0.0.OR.CBAR.GT.10000.) GO TO 500                      R1T3925
C                                                                       R1T3926
      ZMACH2 = ZMACH*ZMACH                                              R1T3927
      T  =1.0/(1.0+ 0.178*ZMACH2)                                       R1T3928
      F  =1.0 + 0.03916*ZMACH2*T                                        R1T3929
      DXNP1  = 0.0                                                      R1T3930
      RNCO   = 0.0                                                      R1T3931
      RNL    = RNOFT                                                    R1T3932
      IF( ROUGHK.LE.0.0 ) GO TO 5                                       R1T3933
C                                                                       R1T3934
      RNL    = RNOFT * CBAR                                             R1T3935
      AK1= 37.587 + 4.615*ZMACH+2.949*ZMACH2+4.132*ZMACH*ZMACH2         R1T3936
      RNCO   = AK1*(CBAR*12./ROUGHK)**1.0489                            R1T3937
      IF (RNL.GT.RNCO) RNL = RNCO                                       R1T3938
      RNL    = RNL/CBAR                                                 R1T3939
    5 CONTINUE                                                          R1T3940
C                                                                       R1T3941
      CFCFIL   = (1.0+ 0.1256*ZMACH2)**(-.12)                           R1T3942
      IF (XTR.LE.0.0) GO TO 100                                         R1T3943
      DXN  = 0.1 * XTR                                                  R1T3944
C                                                                       R1T3945
   10 DP       = FPRIM(DXN)                                             R1T3946
      IF (DP.EQ.0.0) GO TO 200                                          R1T3947
      DXNP1    = DXN - (DXN * FTURB(DXN) - XTR * FLAM(XTR))/DP          R1T3948
      IF ( DXNP1.LE.0.0) DXNP1 = 0.5 * DXN                              R1T3949
      DX       = ABS(DXNP1 - DXN)                                       R1T3950
      DY       = 0.0001*CBAR                                            R1T3951
      IF (DX.LE.DY) GO TO 20                                            R1T3952
      DXN      = DXNP1                                                  R1T3953
      GO TO 10                                                          R1T3954
C                                                                       R1T3955
   20 XP       = DXNP1 + CBAR - XTR                                     R1T3956
      CF       = (XP/CBAR)*FTURB(XP)                                    R1T3957
      GO TO 300                                                         R1T3958
C                                                                       R1T3959
  100 CF       = FTURB(CBAR)                                            R1T3960
      GO TO 300                                                         R1T3961
C                                                                       R1T3962
  200 WRITE (6,1000) DXN, RNL                                           R1T3963
      CF       = 0.0                                                    R1T3964
```

```
  300 CFBAR = FTURB(CBAR)                                              R1T3965
      IF ( KPRINT(19).EQ.0) GO TO 400                                  R1T3966
      WRITE(6,1003) CF, CFBAR, DXNP1, CFCFIL, RNL, RNCO                R1T3967
C                                                                      R1T3968
  400 RETURN                                                           R1T3969
  500 CF     = 0.0                                                     R1T3970
      WRITE(6,1002) CBAR                                               R1T3971
      RETURN                                                           R1T3972
C                                                                      R1T3973
 1000 FORMAT (10X*SUBROUTINE CFEQ WILL NOT CONVERGE*/ 1X,3F15.7 )      R1T3974
 1001 FORMAT(10X,*CFEQ INPUT*, 1PE15.4,0P4F15.7  )                     R1T3975
 1002 FORMAT(10X,*CBAR =*,1PE14.5,2X,*OUT OF RANGE IN CFEQ, CF SET EQUALR1T3976
     1 TO ZERO* // )                                                   R1T3977
 1003 FORMAT(10X,*CFEQ OUTPUT*, 4F15.7, 1P2E15.4 )                     R1T3978
      END                                                              R1T3979
```

CC = 00071

```
      SUBROUTINE FFACT(ID,GEOM, TYP,CLD,SPEED,CRITM,FF)                 R1T3981
C                                                                       R1T3982
C     THIS SUBROUTINE CALCULATES FORM FACTORS FOR EACH COMPONENT.       R1T3983
C                                                                       R1T3984
      ITYP   = TYP                                                      R1T3985
      FF = 1.0                                                          R1T3986
      IF (SPEED.GT.1.0) GO TO 40                                        R1T3987
C                                                                       R1T3988
      GO TO (10,20,30) ID                                               R1T3989
C                                                                       R1T3990
C     FUSELAGE OR BODIES (ID=1)                                         R1T3991
   10 FR = GEOM                                                         R1T3992
      FF = 1.0 + 60./FR**3.0 + 0.0025*FR                                R1T3993
      GO TO 40                                                          R1T3994
C                                                                       R1T3995
C     NACELLE (ID=2)                                                    R1T3996
   20 FR = GEOM                                                         R1T3997
      FF = 1.0 + 0.35/FR                                                R1T3998
      GO TO 40                                                          R1T3999
C                                                                       R1T4000
C     WING AND SURFACES (ID=3)                                          R1T4001
   30 TOC = GEOM                                                        R1T4002
      TOC2= TOC*TOC                                                     R1T4003
      IF (ITYP.LE. 7) FF = 1.0 + 1.44*TOC + 2.0*TOC2                    R1T4004
      IF (ITYP.EQ. 9) FF = 1.0 + 1.2 *TOC + 100.*TOC2*TOC2              R1T4005
      IF (ITYP.GE. 10.AND. ITYP.LE.20) FF = 1.0 + 1.68*TOC +3.*TOC2     R1T4006
      IF (ITYP.NE. 8) GO TO 40                                          R1T4007
      DELTAM = SPEED - CRITM                                            R1T4008
      IF (DELTAM.GE.0.0) ZK = 0.202                                     R1T4009
      IF (DELTAM.LE.-.2) ZK = 0.12                                      R1T4010
      IF (DELTAM.GT.-.2.AND.DELTAM.LT.0.0) ZK = 0.202 + .8972*DELTAM    R1T4011
     1    +2.1944*DELTAM**2 -1.2340*DELTAM**3                           R1T4012
      FF =ZK*CLD/.4+1.44*TOC + 2.0*TOC2 +1.                             R1T4013
C                                                                       R1T4014
   40 RETURN                                                            R1T4015
      END                                                               R1T4016
```

CC = 00036

```
      SUBROUTINE IFACT(ID,PARAM,CRITM,SPEED,FI                          R1T4018
C                                                                       R1T4019
C     THIS SUBROUTINE CALCULATES INTERFERENCE FACTORS FOR THE           R1T4020
C     FUSELAGE AND LIFTING SURFACES.                                    R1T4021
C                                                                       R1T4022
      DIMENSION XMACH(7),REFUS(9), WBR(63)                              R1T4023
C                                                                       R1T4024
      DATA     XMACH /     0.25,0.4,0.6,0.7,0.8,0.85,0.9 /,             R1T4025
     1         REFUS / 3.0,10.,20.,30.,40.,60.,80.,200.,100000./,       R1T4026
     1         WBR   / 1.063,1.02,.979,.955,.926,.902,.867,             R1T4027
     1                 1.076,1.036,.996,.972,.942,.92,.884,             R1T4028
     1                 1.066,1.059,1.02,.996,.966,.943,.91,             R1T4029
     1                 1.044,1.049,1.037,1.013,.988,.968,.939,          R1T4030
     1                 0.993,1.018,1.032,1.015,1.003,.993,.973,         R1T4031
     1                 0.940,0.992,1.018,1.014,1.014,1.01,1.007,        R1T4032
     1                 0.932,0.984,5*1.015,                             R1T4033
     1                 0.924,0.976,5*1.015,0.924,0.976,5*1.015 /        R1T4034
C                                                                       R1T4035
      FI = 1.0                                                          R1T4036
      IF (SPEED.GT.1.0) GO TO 30                                        R1T4037
C                                                                       R1T4038
      GO TO (10,20,20) ID                                               R1T4039
C                                                                       R1T4040
C     FUSELAGE CORRELATION FACTOR (RWB)                                 R1T4041
   10 PAR10 = PARAM/10.0**6                                             R1T4042
      XM1    = CRITM - .1                                               R1T4043
      XM     = SPEED                                                    R1T4044
      IF( XM.GT.XM1 ) XM = XM1                                          R1T4045
C                                                                       R1T4046
      FI     = DLNT( XM, PAR10, XMACH, REFUS, WBR, 7,9,7,2,2)           R1T4047
      RWB = FI                                                          R1T4048
      GO TO 30                                                          R1T4049
C                                                                       R1T4050
C     LIFTING SURFACES                                                  R1T4051
   20 A = COS(PARAM)                                                    R1T4052
      IF (A.GE.0.75) RLS = -.9946 + 5.3568*A -4.5389*A*A +1.2487*A**3   R1T4053
      IF (A.GT.0.65.AND.A.LT.0.75) RLS=.9966 -.752*(.75-A)              R1T4054
      IF (A.LE.0.65) RLS = 0.9214                                       R1T4055
      B = SPEED - 0.25                                                  R1T4056
      IF (B.LT.0.0) B=0.0                                               R1T4057
      RLS = RLS - .0015 + .1818*B - .2756*B*B + 1.0677*B**3             R1T4058
      FI = RLS*RWB                                                      R1T4059
      IF (ID.EQ.3) FI = RLS                                             R1T4060
C                                                                       R1T4061
   30 RETURN                                                            R1T4062
      END                                                               R1T4063
```

CC = 00046

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      SUBROUTINE WDRG(FMACH)
C                                                                       R1T4065
C     COMPUTES TOTAL AIRPLANE WAVE DRAG                                 R1T4066
C                                                                       R1T4067
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS      R1T4068
C                                                                       R1T4069
      COMMON /BLKA02/ SREF, A1(53), BNO(10),                            R1T4070
     1                BAMX(10), BABS(10), BLNS(10),                    R1T4071
     2                BLBT(10), BASE(10), E1(40), EAMX(10), EIN(10),   R1T4072
     3                EXIT(10), ELNS(10), ELBT(10), EQF(10), ENO(10),  R1T4073
     4                W1(95), S1(30), STOC(10), S2(30),                R1T4074
     5                SWL(10), SWT(10), STAPR(10), SCR(10), S3(4)      R1T4075
C                                                                       R1T4076
      COMMON /BLKG01/ FRBOD(10),ARS(10),SSEX(10),FRNAC(10), SWPLE,      R1T4077
     1                SWPOC, SWPMC, SWPTE, DOB, TOCW, CLD, SEXW, B1(31),R1T4078
     2                AR, TAPR, SPLAN, G1(20), ESWLE, ESWTE, G2(96)    R1T4079
C                                                                       R1T4080
      COMMON /BLKWPD/ WPD(9)                                            R1T4081
C                                                                       R1T4082
      COMMON /BLKBTA/ BETA                                              R1T4083
C                                                                       R1T4084
      COMMON /BLKC01/ C1(18), TCD(5), CDFUS(5), CDBOD(5), CDNAC(4),     R1T4085
     1                CDWING(4), CDHT(4), CDVT(4), CDSURF(4), C2(47)   R1T4086
C                                                                       R1T4087
C                                                                       R1T4088
      TCD(4) = 0.0                                                      R1T4089
      CDFUS(4) = 0.0                                                    R1T4090
      CDBOD(4) = 0.0                                                    R1T4091
      CDNAC(4) = 0.0                                                    R1T4092
      CDWING(4)= 0.0                                                    R1T4093
      CDHT(4)  = 0.0                                                    R1T4094
      CDVT(4)  = 0.0                                                    R1T4095
      CDSURF(4)= 0.0                                                    R1T4096
C                                                                       R1T4097
      IF( FMACH.LE.1.0 ) RETURN                                         R1T4098
      BETA   = SQRT( FMACH**2 -1.)                                      R1T4099
C                                                                       R1T4100
C     BODY CONTRIBUTIONS                                                R1T4101
      IF( NBODYS.EQ.0 ) GO TO 100                                       R1T4102
      DO 50 I = 1, NBODYS                                               R1T4103
C                                                                       R1T4104
      CALL CDWN(BAMX(I), BLNS(I), 0.0, CDW1)                            R1T4105
      REX    = SQRT(BABS(I)/3.14159)                                    R1T4106
      CALL CDWT(BAMX(I), BLBT(I), REX, CDW2)                            R1T4107
C                                                                       R1T4108
      IF( I.EQ.1 ) CDFUS(4) = (CDW1 + CDW2) * BAMX(I)/SREF              R1T4109
      IF( BNO(I).EQ.0.0 ) BNO(I) = 1.0                                  R1T4110
      IF( I.GT.1 ) CDBOD(4) = CDBOD(4) + (CDW1+CDW2)*BAMX(I)/SREF*BNO(I)R1T4111
   50 CONTINUE                                                          R1T4112
C                                                                       R1T4113
C     NACELLE CONTRIBUTION                                              R1T4114
  100 IF( NNACS.EQ.0 ) GO TO 200                                        R1T4115
C                                                                       R1T4116
      DO 150 I =1, NNACS                                                R1T4117
      RIN    = SQRT(EIN(I)/3.141593)                                    R1T4118
      REX    = SQRT(EXIT(I)/3.141593)                                   R1T4119
                                                                        R1T4120
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C                                                                       R1T4121
      CALL CDWN(EAMX(I), ELNS(I), RIN, CDW1)                            R1T4122
      CALL CDWN(EAMX(I), ELBT(I), REX, CDW2)                            R1T4123
C                                                                       R1T4124
      IF( ENO(I).EQ.0.0 ) ENO(I) = 1.0                                  R1T4125
      CDNAC(4) = (CDW1 + CDW2) * EAMX(I)/SREF * ENO(I) + CDNAC(4)       R1T4126
  150 CONTINUE                                                          R1T4127
C                                                                       R1T4128
C     WING CONTRIBUTION                                                 R1T4129
  200 WPD(1) = AR * (1.-DOB)**2 * SPLAN/SEXW                            R1T4130
      WPD(2) = TAPR/(1.-DOB*(1.-TAPR))                                  R1T4131
      WPD(3) = ESWLE                                                    R1T4132
      WPD(4) = ESWTE                                                    R1T4133
      WPD(5) = FMACH                                                    R1T4134
      WPD(6) = SEXW/SREF                                                R1T4135
      WPD(7) = W1(11)                                                   R1T4136
      WPD(8) = CLD                                                      R1T4137
      WPD(9) = TOCW                                                     R1T4138
C                                                                       R1T4139
      CALL CDWW(CDW1)                                                   R1T4140
      CDWING(4) = CDW1                                                  R1T4141
C                                                                       R1T4142
  250 IF( NSURFS.LE.1 ) GO TO 300                                       R1T4143
      DO 290 J = 2, NSURFS                                              R1T4144
      I      = J-1                                                      R1T4145
C                                                                       R1T4146
      WPD(1) = ARS(I)                                                   R1T4147
      WPD(2) = STAPR(I)                                                 R1T4148
      WPD(3) = SWL(I)                                                   R1T4149
      WPD(4) = SWT(I)                                                   R1T4150
      WPD(6) = SSEX(I)/SREF                                             R1T4151
      WPD(7) = S1(10+I)                                                 R1T4152
      WPD(8) = S1(20+I)                                                 R1T4153
      WPD(9) = STOC(I)                                                  R1T4154
C                                                                       R1T4155
      CALL CDWW(CDW1)                                                   R1T4156
      IF( I.EQ.1.AND.NHT.GT.0 ) CDHT(4) = CDW1                          R1T4157
      IF( NHT.EQ.0 ) GO TO 260                                          R1T4158
      IF( I.EQ.2.AND.NVT.GT.0 ) CDVT(4) = CDW1                          R1T4159
      IF( NVT.EQ.0 ) GO TO 270                                          R1T4160
      IF( I.GT.2 ) CDSURF(4) = CDSURF(4) + CDW1                         R1T4161
      GO TO 290                                                         R1T4162
C                                                                       R1T4163
  260 IF( I.EQ.1.AND.NVT.GT.0 ) CDVT(4) = CDW1                          R1T4164
      IF( NVT.EQ.0 ) GO TO 280                                          R1T4165
  270 IF( I.GT.1 ) CDSURF(4) = CDSURF(4) + CDW1                         R1T4166
      GO TO 290                                                         R1T4167
C                                                                       R1T4168
  280 CDSURF(4) = CDSURF(4) + CDW1                                      R1T4169
  290 CONTINUE                                                          R1T4170
C                                                                       R1T4171
  300 TCD(4) = CDFUS(4) +CDBOD(4) +CDNAC(4) +CDWING(4) +CDHT(4)         R1T4172
     1          +CDVT(4) + CDSURF(4)                                    R1T4173
                                                                        R1T4174
C                                                                       R1T4175
      RETURN                                                            R1T4176
```

END

RLT4177

CC = 00113

```
      SUBROUTINE CDWN(AMAX, XLNOS, RIN, CDW)                            R1T4179
C                                                                       R1T4180
C     NOSE WAVE DRAG (BODY COMPONENT)                                   R1T4181
C                                                                       R1T4182
      COMMON /BLKBTA/ BETA                                              R1T4183
C                                                                       R1T4184
      DIMENSION XLD(7), YBETA(4), FCDW(7,4)                             R1T4185
C                                                                       R1T4186
      DATA  XLD / 1., 2., 3., 4., 6., 8., 12. /,                        R1T4187
     1      YBETA/ 0.0, 0.32,  .458, 0.6633 /,                         R1T4188
     2      FCDW / .1656,.0617,.0373,.0287,.0198,.0149,.0083,          R1T4189
     3             .2376, .1256, .088, .061, .0308, .0177, .0082,      R1T4190
     4             .2952, .1667, .1067, .066, .0311, .0175,.0081,      R1T4191
     5             .3816, .2010, .1031, .0624,.0297, .0172,.0079 /     R1T4192
C                                                                       R1T4193
      CDW   = 0.0                                                       R1T4194
      IF( AMAX.LE.0.0) GO TO 50                                         R1T4195
      DMAX=SQRT(AMAX/0.785398 )                                         R1T4196
      ELOD=XLNOS/DMAX                                                   R1T4197
      IF(RIN.GT.0.0) GO TO 40                                           R1T4198
      IF( ELOD.LE.0.0 ) GO TO 50                                        R1T4199
C                                                                       R1T4200
      IF( BETA.GE.0.6633 ) GO TO 20                                     R1T4201
C                                                                       R1T4202
   10 CDW    = DLNT(ELOD,BETA, XLD, YBETA, FCDW, 7,4,7, 2,2)            R1T4203
      GO TO 50                                                          R1T4204
C                                                                       R1T4205
   20 X      = BETA/SQRT(1.+ ELOD**2)                                   R1T4206
      CDW    = (1.2 + 1.15 * X)/(1. + 1.9 * X) /(1. + ELOD**2)          R1T4207
      GO TO 50                                                          R1T4208
C                                                                       R1T4209
C                                                                       R1T4210
C     FOR A BODY WITH AN OPEN NOSE, SUCH AS A NACELLE, THE CONTRIBUTION R1T4211
C     OF THE NOSE TO THE TOTAL BODY WAVE DRAG COEFFICIENT IS COMPUTED ASR1T4212
C     INDICATED BELOW. (THE EXPRESSIONS USED FOR OPEN AND CLOSED BODY   R1T4213
C     BOATTAIL CONTRIBUTIONS DO NOT REQUIRE THIS DISTINCTION--SEE CDWT.)R1T4214
C                                                                       R1T4215
   40 SQRTB  = SQRT(BETA)                                               R1T4216
      IF( SQRTB.LT.0.8144 ) SQRTB = 0.8144                              R1T4217
      CDW    = ((1.-2.*RIN/DMAX)/ELOD)**1.5/SQRTB                       R1T4218
C                                                                       R1T4219
   50 RETURN                                                            R1T4220
      END                                                               R1T4221
```

CC = 00043

```
      SUBROUTINE CDWT(AMAX, XLAFT, REX, CDW)                            R1T4223
C                                                                       R1T4224
C     BOATTAIL WAVE DRAG (BODY COMPONENT)                               R1T4225
C                                                                       R1T4226
      COMMON /BLKBTA/ BETA                                              R1T4227
C                                                                       R1T4228
      DIMENSION DBOD(5), CDWBT(5)                                       R1T4229
C                                                                       R1T4230
      CDW   = 0.0                                                       R1T4231
      IF( AMAX.LE.0.0) RETURN                                           R1T4232
      IF (XLAFT .LE. 0.0001) RETURN                                     R1T4233
      DMAX=SQRT(AMAX/0.785398 )                                         R1T4234
      ELOD=XLAFT/DMAX                                                   R1T4235
      X=BETA/ELOD                                                       R1T4236
      Y=X*X                                                             R1T4237
      Z=ELOD*ELOD                                                       R1T4238
C                                                                       R1T4239
C                                                                       R1T4240
C     BOATTAIL WAVE DRAG IS A FUNCTION OF BOATTAIL FINENESS RATIO, BASE R1T4241
C     DIAMETER/MAXIMUM DIAMETER, AND MACH NUMBER.  COMPUTE THE BOATTAIL R1T4242
C     WAVE DRAG COEFFICIENT AT FOUR  DBOD(I)  VALUES AND INTERPOLATE TO R1T4243
C                                                                       R1T4244
      DBOD(1)=0.0                                                       R1T4245
      CDWBT(1) = (1.165 -.5112*X -.5372*Y +.3964*X*Y)/Z                 R1T4246
      IF( X.GT.1.0 ) CDWBT(1) = 0.513/X/Z                               R1T4247
C                                                                       R1T4248
      DBOD(2)=0.4                                                       R1T4249
      CDWBT(2) = (1.067 -1.709*X +1.6632*Y -.686*X*Y)/Z                 R1T4250
      IF( X.GT.1.0 ) CDWBT(2) = 0.3352/X/Z                              R1T4251
C                                                                       R1T4252
      DBOD(3)=0.6                                                       R1T4253
      CDWBT(3) = (0.7346 -1.4618*X +1.5795*Y -.6542*X*Y)/Z              R1T4254
      IF( X.GT.1.0 ) CDWBT(3) = 0.1980/X/Z                              R1T4255
C                                                                       R1T4256
      DBOD(4)=0.8                                                       R1T4257
      CDWBT(4) = (0.2555 -.5008*X +.5024*Y -.2077*X*Y)/Z                R1T4258
      IF( X.GT.1.0 ) CDWBT(4) = 0.0494/X/Z                              R1T4259
C                                                                       R1T4260
      CDWBT(5)=0.0                                                      R1T4261
      DBOD(5)=1.0                                                       R1T4262
      BDOD=2.0*REX/DMAX                                                 R1T4263
      CALL LNTP(BDOD, CDW, DBOD, CDWBT, 5, 2)                           R1T4264
C                                                                       R1T4265
      RETURN                                                            R1T4266
      END                                                               R1T4267
```

CC = 00045

```
      SUBROUTINE CDWW(CDOSR)                                            R1T4269
C     PROCEDURE FOR WING PRESSURE DRAG                                  R1T4270
C                                                                       R1T4271
      COMMON /BLKWPD/ AR, ZLAM, ZLE, ZTE, ZM, SOSR, TYPE, CAM, TOC      R1T4272
C                                                                       R1T4273
      COMMON /BLKPRT/ KPRINT(50)                                        R1T4274
      COMMON /BLKBD2/ AA(22), BB(22), CC(22), DD(22), XT(22)            R1T4275
C                                                                       R1T4276
   10 N      = TYPE                                                     R1T4277
C                                                                       R1T4278
      HOT    = CAM * 0.055 /TOC                                         R1T4279
      XTOC=XT(N)                                                        R1T4280
      TOC2= TOC**2                                                      R1T4281
      ROOT=(AA(N)+BB(N)*TOC+CC(N)*TOC2+DD(N)*TOC2*TOC)/TOC              R1T4282
      IF (N.EQ.8) ROOT= 0.88216*(TOC)**1.606/TOC                        R1T4283
C                                                                       R1T4284
C                                                                       R1T4285
C     CALCULATION OF QUANTITIES THAT ARE FUNCTIONS OF GEOMETRY.         R1T4286
C                                                                       R1T4287
   17 ZKW =1.0                                                          R1T4288
      TOC2   = TOC**2                                                   R1T4289
      TOC13  = TOC**0.33333333                                          R1T4290
      TOC53  = TOC**1.6666667                                           R1T4291
      ARW    = AR*TOC13                                                 R1T4292
      ARW3   = TOC*AR**3                                                R1T4293
      DEN1   = 1.0/ARW+ARW3                                             R1T4294
      DEN2   = 2.0/ARW3+1.0                                             R1T4295
      ZKT     = 1.+4.*(.5-XTOC*(1.+.5*SQRT(ROOT)))**2                   R1T4296
     1            -0.25 * SQRT(ROOT) * (1.-XTOC)**2                    R1T4297
      ZKC = 1.0 +          2.5* HOT **2                                 R1T4298
      ZKB     = 1.069                                                   R1T4298
      IF( ZKW.EQ.1.2 ) ZKB = 1.0                                        R1T4298
      TR1     = 0.5/(1.+ZLAM)**2                                        R1T4299
      TR2     = 1./(1.+ZLAM**2)**2                                      R1T4300
      ZLAM1   = 1. + TR2 * (TAN(ZLE) + TAN(ZTE))**2                     R1T4301
      IF( ZLE.GE.ZTE ) ZKP = (COS(ZLE) + TR1 * (TAN(ZLE)**2             R1T4302
     1                          - TAN(ZTE)**2))/ZLAM1                   R1T4303
      IF( ZTE.GT.ZLE ) ZKP = (COS(ZTE) + TR1 * (TAN(ZTE)**2             R1T4304
     1                          - TAN(ZLE)**2))/ZLAM1                   R1T4305
C                                                                       R1T4306
      ZK    = (2.0/DEN1 + 3.33/DEN2)*ZKP                                R1T4307
      X     = ARW*ZKP                                                   R1T4308
      IF(ARW.GE.1.0) X=SQRT(ZKP/(1.7321*(1.0-ZKP)+1.0/(ZKP*ARW**2)))    R1T4309
C                                                                       R1T4310
C     THIS DO LOOP SOLVES FOR *ARE* BY NEWTON*S METHOD.                 R1T4311
C                                                                       R1T4312
      DO 100 I=1,10                                                     R1T4313
      X3    = X**3                                                      R1T4314
      X4    = X*X3                                                      R1T4315
      F     = (2.0*X)/(X4+1.0) + (3.33*X3)/(X3+2.0) - ZK                R1T4316
      FP    = (2.0-6.0*X4)/((X4+1.0)**2) + (20.0*X**2)/((X3+2.0)**2)    R1T4317
      FFP   = F/FP                                                      R1T4318
      IF(KPRINT(20).EQ.2 .AND. I.EQ.1) WRITE(6,90)                      R1T4319
C                                                                       R1T4320
      IF(KPRINT(20).EQ.2) WRITE(6,95) I, X, F, FP, FFP                  R1T4321
C                                                                       R1T4322
```

```
      X     = X-FFP                                                   R1T4323
      IF (ABS(FFP).LE.0.0001) GO TO 110                               R1T4324
  100 CONTINUE                                                        R1T4325
  110 IF(KPRINT(20).EQ.2) WRITE(6,36)                                 R1T4326
C                                                                     R1T4327
      IF(KPRINT(20).EQ.2) WRITE(6,45) ZLE, ZTE, TOC2, TOC13, TOC53,   R1T4328
     1              ARW, ARW3, DEN1, DEN2, ZKT, ZKC, ZLAM1, ZKP       R1T4329
C                                                                     R1T4330
C                                                                     R1T4331
      BETA2 = ZM**2-1.0                                               R1T4332
      BETA  = SQRT(BETA2)                                             R1T4333
      DIV   = BETA/TOC2                                               R1T4334
      BETAW = BETA/TOC13                                              R1T4335
      BETAW2= BETAW**2                                                R1T4336
      BETAW3= BETAW*BETAW2                                            R1T4337
      CD1   = 0.0                                                     R1T4338
      CD2   = 0.0                                                     R1T4339
      CDA   = TOC2*(2.0+3.333/(ZKW**2.8))                             R1T4340
      ZKLIN = CDA/TOC2                                                R1T4341
      IF (ZM .GT. 1.0)  CD1 = CDA/BETA                                R1T4342
      TEST1 = 1.0/COS(ZLE) + 0.01                                     R1T4343
      IF (ZM .GT. TEST1)CD2 = CDA/SQRT(BETA2-TAN(ZLE)**2)             R1T4344
      ARE=X                                                           R1T4345
      TEST    = ABS(TAN(ZLE))                                         R1T4346
      UEXP    = (1.+2.* ZLAM**0.33333)                                R1T4347
      FB   = 0.3 + 0.7*ZKP**UEXP                                      R1T4348
      XM      = 0.5* (1.+ZLAM**2 *(2.-ZLAM)**3 )                      R1T4349
      Z       = COS(ZLE) + COS(ZTE)                                   R1T4350
      IF( BETA.GT.TEST ) XM = (TEST/BETA)**Z                          R1T4351
  130 ZML   = SQRT(TEST**2+1.0)                                       R1T4352
      ARE3 = ARE**3                                                   R1T4353
      ZKW1    = ZKW**3.8                                              R1T4354
      T1      = 1./ARE /(1.+(1.+ZLAM) * FB * BETAW**(1.+ZKW) )        R1T4355
      T2      = ARE3 /(1.+0.33333 *ARE3 *BETAW**4)                    R1T4356
      T3      = 2./ARE3 /(1.+(.66667+ZLAM) *BETAW**(1.+ZKW1) *FB)     R1T4357
      T4      = 1./(1.+3.* ARE * BETAW**4)                            R1T4358
      ZFEXP   = FB**XM                                                R1T4359
      FBXM=FB**XM                                                     R1T4360
      D1      = ZKB * ZKW * BETAW * FBXM +(T1+T2)                     R1T4361
      D2      = ZKB * ZKW1 * BETAW * FBXM +(T3+T4)                    R1T4362
      CDW     = ZKT * ZKW * ZKC * ZKB * TOC53 * (2./D1 +3.33/D2)      R1T4363
      CDWA    = CDW/TOC53                                             R1T4364
      CDOSR=CDW*SOSR                                                  R1T4365
      IF (ZM.GT.1.0) CDD= CDW*DIV                                     R1T4366
      AREW = ARE                                                      R1T4367
      ARE  = AREW/TOC13                                               R1T4368
C                                                                     R1T4369
      IF(KPRINT(20).EQ.2) WRITE(6,47)                                 R1T4370
C                                                                     R1T4371
      IF (KPRINT(20).EQ.2)WRITE(6,48)DIV,BETA2,BETAW,BETAW2,CDA,CD1,CD2,R1T4372
     1        TEST,XM,FB,ZML,T1,T2,T3,T4,D1,D2,CDW,CDD                  R1T4373
C                                                                     R1T4374
      VLE     = ZLE * 57.2956                                         R1T4375
      VTE     = ZTE * 57.2956                                         R1T4376
      IF (KPRINT(20).GT.0) WRITE(6,25) AR,ZKP,ZLAM,ZKT,VLE,ZKC,VTE,   R1T4377
     1                ZKLIN,TOC,ARW,TYPE,CAM,TOC,TOC13,XTOC,TOC53,ROOT, R1T4378
```

```
     2              FB, HOT, ZML, ZKW, ARE, SOSR, AREW                    R1T4379
C                                                                         R1T4380
  550 IF (KPRINT(20).GT.0) WRITE(6,600)                                   R1T4381
C                                                                         R1T4382
      IF (KPRINT(20).EQ.1) WRITE(6,610) ZM,BETAW,XM,ZFEXP,CDWA,CDW,       R1T4383
     1                                  CD1,CD2,CDOSR                     R1T4384
C                                                                         R1T4385
C                                                                         R1T4386
   90 FORMAT(4H0  I,5X,1HX,14X,1HF,14X,2HFP,13X,3HFFP/)                   R1T4387
   95 FORMAT(1H ,I3,3X,1P4E15.7)                                          R1T4388
   36 FORMAT(1H0,2X,3HZLE,12X,3HZTE,12X,4HTOC2,11X,5HTOC13,10X,5HTOC53/ R1T4389
     1        1H ,2X,3HARW,12X,4HARW3,11X,4HDEN1,11X,4HDEN2,11X,3HZKT/   R1T4390
     1            3X,3HZKC,12X,5HZLAM1,10X,3HZKP )                       R1T4391
   45 FORMAT(1H0,1P5E15.7/(1X,1P5E15.7))                                  R1T4392
   47 FORMAT(1H0,2X,3HDIV,12X,5HBETA2,10X,5HBETAW,10X,6HBETAW2,9X,3HCDA/R1T4393
     1        1H ,2X,3HCD1,12X,3HCD2,12X,4HTEST,11X,2HXM,13X,2HFB/       R1T4394
     1        1H ,2X,3HZML,12X,2HT1,13X,2HT2,13X,2HT3,13X,2HT4/          R1T4395
     1        1H ,2X,2HD1,13X,2HD2,13X,3HCDW,12X,6HKLINEQ)               R1T4396
   48 FORMAT(1H0,1P5E15.7/(1X,1P5E15.7))                                  R1T4397
   25 FORMAT(///,16X,36H W I N G   P R E S S U R E   D R A G//           R1T4398
     111X,17H INPUT PARAMETERS,16X,18H OUTPUT PARAMETERS//                R1T4399
     17X,19H ASPECT RATIO  =   ,F7.4,10X,12H KPLANF  =  ,F7.4/            R1T4400
     17X,19H TAPER RATIO   =   ,F7.4,10X,12H KTHICK  =  ,F7.4/            R1T4401
     17X,19H LE SWEEP DEG  =   ,F7.4,10X,12H KCAMB   =  ,F7.4/            R1T4402
     17X,18H TE SWEEP DEG  =   ,F8.4,10X,12H KLINTH  =  ,F7.4/            R1T4403
     17X,19H THICK RATIO   =   ,F7.4,10X,12H ARWIG   =  ,F7.4/            R1T4404
     17X,19H AIRFOIL TYPE  =   ,F3.0,F4.3,F5.3,5X,12H T/C 1/3 =  ,F7.4/ R1T4405
     17X,19H XT/C          =   ,F7.4,10X,12H T/C 5/3 =  ,F7.4/           R1T4406
     17X,19H RO/T          =   ,F7.4,10X,12H F       =  ,F7.4/           R1T4407
     17X,19H H/T           =   ,F7.4,10X,12H M*      =  ,F7.4/           R1T4408
     17X,19H KW            =   ,F7.4,10X,12H ARE     =  ,F7.4/           R1T4409
     17X,19H SW/SREF       =   ,F7.4,10X,12H AREW    =  ,F7.4/)          R1T4410
  600 FORMAT (//31X,8H RESULTS //,72H MACH   BWIG    EXP    FEXP    CDWIGP1T4411
     1      CD      CDTH2D   CDTH3D   CD/SREF )                          R1T4412
  610 FORMAT(1H , 4(F5.3,2X),5(F7.5,2X))                                  R1T4413
      RETURN                                                              R1T4414
      END                                                                 R1T4415
```

CC = 00149

```
      SUBROUTINE CDRG(SPEED, AEROK, DELCL,CDC)                          R1T4417
C                                                                       R1T4418
C     CAMBER DRAG                                                       R1T4419
C                                                                       R1T4420
      COMMON /BLKG01/ G1(47), SEXW, G2(31), AR, TR, SPLAN, G3(118)      R1T4421
C                                                                       R1T4422
      COMMON /BLKA02/ SREF, A1(432)                                     R1T4423
      CDC   = 0.0                                                       R1T4424
      ARSREF = AR * SPLAN/SREF                                          R1T4425
      E      = 1.0/(3.14159*ARSREF*AEROK)                               R1T4426
C                                                                       R1T4427
C                                                                       R1T4428
      COEF1  = 1.0/(3.14159*ARSREF*(1.0-E))                             R1T4429
      COEF2  = 0.7 * SEXW/SREF                                          R1T4430
      IF( E.GE.1.0 ) GO TO 15                                           R1T4431
      IF( SPEED.GE.1.0 ) GO TO 5                                        R1T4432
      IF( COEF1.GT.COEF2 ) GO TO 15                                     R1T4433
    5 CDC    = COEF1 * DELCL**2                                         R1T4434
      GO TO 10                                                          R1T4435
   15 CONTINUE                                                          R1T4436
      CDC    = COEF2 * DELCL**2                                         R1T4437
C                                                                       R1T4438
   10 RETURN                                                            R1T4439
      END                                                               R1T4440
```

CC = 00024

```
      SUBROUTINE BDRG(SPEED, AB, SREF, CDB)                             R1T4442
C                                                                       R1T4443
C     BASE DRAG                                                         R1T4444
C                                                                       R1T4445
      COMMON /BLKPRT/ KPRINT(50)                                        R1T4446
C                                                                       R1T4447
      CDB   = 0.0                                                       R1T4448
      IF( AB.LE.0.0 ) RETURN                                            R1T4449
      IF(SPEED.GE.1.0), GO TO 10                                        R1T4450
      CDB   = (0.1 + 0.1222 * SPEED**8) * AB/SREF                       R1T4451
      GO TO 20                                                          R1T4452
C                                                                       R1T4453
   10 CONTINUE                                                          R1T4454
      CDB   = (1.42 /(3.15 + SPEED*SPEED) ) * AB /SREF                  R1T4455
      IF( SPEED.LE.1.8 )  CDB = 0.2222 * AB/SREF                        R1T4456
C                                                                       R1T4457
   20 CONTINUE                                                          R1T4458
      IF(KPRINT(15).EQ.0) GO TO 30                                      R1T4459
      WRITE(6,1000) SPEED, AB, SREF, CDB                                R1T4460
 1000 FORMAT(10X*MACH =*F10.7,5X*BASE AREA =*F10.7,5X*SREF =*           R1T4461
     1                  F12.5,5X*BASE DRAG =*F10.7 / )                  R1T4462
C                                                                       R1T4463
   30 RETURN                                                            R1T4464
      END                                                               R1T4465
```

CC = 00024

```
      SUBROUTINE CMOW(SPEED, CMO)                                       R1T4467
C                                                                       R1T4468
C     COMPUTES ZERO LIFT PITCHING MOMENT OF WING                        R1T4469
C                                                                       R1T4470
      COMMON /BLKBD4/ XBD4(5), YBD4(5), ZBD4(3), FBD4(5,5,3)            R1T4471
C                                                                       R1T4472
      COMMON /BLKA01/ NBODYS, NNACS, NSURFS, NHT, NVT, ISWP, NPNLS      R1T4473
C                                                                       R1T4474
      COMMON /BLKA02/ A1(433)                                           R1T4475
C                                                                       R1T4476
      COMMON /BLKC01/ C1(100)                                           R1T4477
C                                                                       R1T4478
      COMMON /BLKG01/ G1(49), SXX(10), G2(42), ESWQC, G3(98)            R1T4479
C                                                                       R1T4480
      COMMON /BLKPRT/ KPRINT(50)                                        R1T4481
C                                                                       R1T4482
      DIMENSION CMC4(20)                                                R1T4483
      DATA CMC4 / 4*-0.25, 3*-0.219, -0.3, 0.0, 11*-0.2066 /            R1T4484
C                                                                       R1T4485
C                                                                       R1T4486
      FMCR   = C1(72)                                                   R1T4487
      CMOS   = 0.0                                                      R1T4488
      NI     = A1(235)                                                  R1T4489
C                                                                       R1T4490
      DO 100 I = 1, NPNLS                                               R1T4491
      CMOS   = CMOS + A1(244 + I) * SXX(I) * CMC4(NI)                   R1T4492
  100 CONTINUE                                                          R1T4493
C                                                                       R1T4494
      CMO    = 0.0                                                      R1T4495
      IF( SPEED.GE.1. ) RETURN                                          R1T4496
C                                                                       R1T4497
      ARXR   = G2(35)                                                   R1T4498
      TOC    = G1(46)                                                   R1T4499
      TWIST  = A1(278)                                                  R1T4500
      SEXW   = G1(48)                                                   R1T4501
      CMOS   = CMOS/SEXW                                                R1T4502
C                                                                       R1T4503
      CMOB   = ARXR * COS(ESWQC)**2/(ARXR + 2.*COS(ESWQC)) * CMOS       R1T4504
C                                                                       R1T4505
      TRX    = G2(29)/G2(27)                                            R1T4506
      CALL TLNT(ESWQC,ARXR,TRX, CMOOT, XBD4,YBD4,ZBD4,FBD4, 5,5,3, 5,5) R1T4507
      CMOT   = CMOOT * TWIST                                            R1T4508
C                                                                       R1T4509
      FMACH  = SPEED                                                    R1T4510
      IF( FMACH.GT.FMCR ) FMACH = FMCR                                  R1T4511
      CMACH  = (1. + 5.9*TOC*FMACH**5)/SQRT(1.-(FMACH*COS(ESWQC))**2)   R1T4512
C                                                                       R1T4513
      CMO    = (CMOB + CMOT) * CMACH                                    R1T4514
C                                                                       R1T4515
      IF( KPRINT(25).GT.0 ) WRITE(6,1000) CMO, CMOB, CMOT, CMACH,       R1T4516
     1                CMOS, ARXR, TOC, TWIST, ESWQC, TRX, CMOOT, FMCR,  R1T4517
     2                ( A1(234+I), A1(244+I), SXX(I), I = 1,NPNLS)      R1T4518
C                                                                       R1T4519
 1000 FORMAT(5X, *CMOW DUMP*/(1X,7F15.5) )                              R1T4520
C                                                                       R1T4521
      RETURN                                                            R1T4522
```

END

RIT4523

CC = 00057

```
      SUBROUTINE WBAC(SPEED, XACR)                                      R1T4525
C                                                                       R1T4526
C     COMPUTES PITCHING MOMENT SLOPE OF WING                            R1T4527
C                                                                       R1T4528
C                                                                       R1T4529
      COMMON /BLKA01/ NBODYS,NNACS,NSURFS,NHT,NVT,ISWP,NPNLS            R1T4530
C                                                                       R1T4531
      COMMON /BLKA02/ A02(433)                                          R1T4532
C                                                                       R1T4533
      COMMON /BLKA03/ ROUGHK, CLE(3), CCR(3), YC(3), A03(10)            R1T4534
C                                                                       R1T4535
      COMMON /BLKG01/ G1(44), DOB, TOC, CLD, G2(32), AR, TR, SPLAN,     R1T4536
     1                G3(3), CRX, CBX, CTX, YIX, YOX, SIX, SOX, ARI,   R1T4537
     2                ARXR, CBXP, AROP, SOXP, SWPLEI, SWPLEO,           R1T4538
     3                SWPMCI, SWPMCO, G4(99)                            R1T4539
C                                                                       R1T4540
      COMMON /BLKC01/ C1(100)                                           R1T4541
C                                                                       R1T4542
      COMMON /BLKPRT/ KPRINT(50)                                        R1T4543
C                                                                       R1T4544
      DIMENSION XDB(8), YDOB(8), XBDOL(5), YAON(6), FCP(5,6)            R1T4545
C                                                                       R1T4546
      DATA XDB  / 0., .05, .1, .15, .2, .3, .4, .5 /,                   R1T4547
     1     YDOB / 0., .1, .154, .19, .219, .266, .3, .33 /              R1T4548
C                                                                       R1T4549
      DATA XBDOL / 0.4, .7, 1.0, 1.25, 1.67 /,                          R1T4550
     1     YAON  / 0., .4, .8, 1.2, 1.6, 2.0 /,                         R1T4551
     2     FCP   / .54,.535,.525,.516,.5, .42,.435,.45,.46,.46,         R1T4552
     3             .35,.377,.4,.414,.425, .295,.33,.355,.375,.394,      R1T4553
     4             .246,.285,.32,.345,.365, .21,.25,.288,.315,.34 /     R1T4554
C                                                                       R1T4555
      AR1     = ARXR                                                    R1T4556
      TR1     = CTX/CRX                                                 R1T4557
      TW      = A02(235)                                                R1T4558
      FMCRO   = C1(72)                                                  R1T4559
C                                                                       R1T4560
      IF(NPNLS.GT.1) AR1 = ARI                                          R1T4561
      IF(NPNLS.GT.1) TR1 = CBX/CRX                                      R1T4562
C                                                                       R1T4563
   20 CALL ACCR(SPEED,AR1,SWPLEI,SWPMCI,TR1,SIX,TOC,TW,FMCRO,XACR,CLAI, R1T4564
     1                XACSW)                                            R1T4565
      XACRX   = XACR                                                    R1T4566
      IF( NPNLS.EQ.1 ) GO TO 100                                        R1T4567
C                                                                       R1T4568
C     CRANKED WING PLANFORMS                                            R1T4569
C                                                                       R1T4570
      TR2     = CTX/CBXP                                                R1T4571
C                                                                       R1T4572
      CALL ACCR(SPEED,AROP,SWPLEO,SWPMCO,TR2,SOXP,TOC,TW,FMCRO,         R1T4573
     1                XACRP, CLAOP, XACSOP)                             R1T4574
C                                                                       R1T4575
      XACRO   = XACRP * CBXP/CRX - YIX*0.5*TAN(SWPLEO)/CRX              R1T4576
     1                + YIX * TAN(SWPLEI)/CRX                           R1T4577
      XACSO   = XACSOP * CBXP/CRX +XACRO - XACRP*CBXP/CRX               R1T4578
C                                                                       R1T4579
      XACR    = (CLAI * SIX * XACRX + CLAOP * SOXP * XACRO )/           R1T4580
```

```
     1            (CLAI * SIX + CLAOP * SOXP)                          R1T4581
C                                                                      R1T4582
      XACSW   = (CLAI * SIX * XACRX + CLAOP * SOXP * XACSO )/          R1T4583
     1            (CLAI * SIX + CLAOP * SOXP)                          R1T4584
  100 XACWB   = XACR                                                   R1T4585
C                                                                      R1T4586
C                                                                      R1T4587
C     WING-BODY COMBINATION                                            R1T4588
C                                                                      R1T4589
      BLN     = A02(85)                                                R1T4590
      XLE     = A02(281)                                               R1T4591
      TANSQC  = 0.5 * (TAN(SWPLEI) + TAN(SWPMCI) )                     R1T4592
      B02     = 0.5 * SQRT(AR * SPLAN)                                 R1T4593
      YWX     = A02(303)                                               R1T4594
      DIA     = DOB * B02 * 2.                                         R1T4595
      IF( SPEED.GE.1.2 ) GO TO 200                                     R1T4596
C     SUBSONIC CALCULATION OF XACN (NOSE) AND XACBW (WING CARRY-OVER)  R1T4597
      XLEQ    = BLN + 1.6 *(XLE - BLN)                                 R1T4598
      XACN    = -0.54 * XLEQ/CRX                                       R1T4599
C                                                                      R1T4600
      BARE    = ARXR * SQRT(1.-FMCRO**2)                               R1T4601
      IF( SPEED.LT.FMCRO ) BARE = ARXR * SQRT(1.-SPEED**2)             R1T46011
      CALL LNTP(DOB, FDOB, XDB,YDOB, 8,4)                              R1T4602
      DXQC    = G4(18)                                                 R1T4603
      XACBW   = 0.25 + DXQC * FDOB/CRX                                 R1T4604
C                                                                      R1T4605
      IF( BARE.GE.4. ) GO TO 190                                       R1T4606
      XACBWO = 0.125 * ARXR * TAN(SWPLEI) * (1.+CTX/CRX)               R1T4607
      IF( XACBWO.GT.0.5 ) XACBWO = 0.5                                 R1T46071
C                                                                      R1T4608
      XACBW   = (XACBWO - XACBW) * (BARE -4.)**2/16. + XACBW           R1T4609
  190 XACBW1  = XACBW                                                  R1T4610
      XACN1   = XACN                                                   R1T46101
C                                                                      R1T46102
      IF( SPEED.LE.FMCRO ) GO TO 290                                   R1T46103
C                                                                      R1T4611
C     SUPERSONIC CALCULATION OF XACN & XACBW                           R1T4612
  200 BETA    = 0.663325                                               R1T4613
      IF( SPEED.GT.1.2 ) BETA = SQRT(SPEED**2 -1.)                     R1T46131
C                                                                      R1T4614
      AON     = (XLE - BLN)/BLN                                        R1T4615
      IF( AON.LT.0. ) AON = 0.                                         R1T4616
      BDOL    = BETA *DIA /BLN                                         R1T4617
C                                                                      R1T4618
C     FIGURE 4.2.2.1-23A DATCOM                  *******               R1T4619
      XCPOL   = DLNT(BDOL, AON, XBDC ,YACN,FCP, 5,6,5, 2,2)            R1T4620
      XACN    = XLE/CRX * (XCPOL -1.)                                  R1T4621
C                                                                      R1T4622
      BDOC    = BETA * DIA/CRX                                         R1T4623
      BCOT    = BETA * TAN(SWPLEI)                                     R1T4624
      A1      = 0.5845                                                 R1T4625
      IF( BCOT.GE.1. ) A1 = 0.5985 + 0.00214*ALOG(BCOT)                R1T4626
      IF( BCOT.LT.1.0.AND.BCOT.GT.0.1) A1 = 0.5985 + 0.00607*ALOG(BCOT) R1T4627
C                                                                      R1T4628
C     FIGURE 4.3.2.1-37A DATCOM                  *******               R1T4629
      XACBW   = 0.5 + A1*BDOC -.1057*BDOC**2 +.0172*BDOC**3            R1T4630
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```
      IF( SPEED.GE.1.2 ) GO TO 290                                      R1T46301
C                                                                       R1T46302
      XACN    = XACN1 + (XACN -XACN1) *(SPEED-FMCRO)/(1.2-FMCRO)        R1T46303
      XACBW   = XACBW1+ (XACBW-XACBW1)*(SPEED-FMCRO)/(1.2-FMCRO)        R1T46304
C                                                                       R1T4631
  290 CLAB    = C1(55)                                                  R1T4632
      CLAW    = C1(54)                                                  R1T4633
      FKBW    = 0.0004 +1.2662*DOB +.6018*DOB**2 +.1263*DOB**3          R1T4634
      FKWB    = 1.0028 +.7116*DOB +.42*DOB**2 -.1366*DOB**3             R1T4635
      CLABW   = FKBW/(FKBW + FKWB) * CLAW                               R1T4636
      CLAWB   = FKWB/(FKBW + FKWB) * CLAW                               R1T4637
C                                                                       R1T4638
  300 XACR    = (XACN * CLAB + XACWB * CLAWB + XACBW * CLABW)/          R1T4639
     1                (CLAB + CLAW)                                    R1T4640
C                                                                       R1T4641
      XACS    = (XACN * CLAB + XACSW * CLAWB + XACBW * CLABW)/          R1T4642
     1                (CLAB + CLAW)                                    R1T4643
      C1(88)  = XACS                                                    R1T4644
C                                                                       R1T4645
      IF( KPRINT(18).EQ.0 ) GO TO 400                                   R1T4646
      WRITE(6,1000) XACR, XACN,CLAB, XACWB,CLAWB, XACBW,CLABW,          R1T4647
     1                XACS, SPEED, XLEQ, FDOB                           R1T4648
C                                                                       R1T4649
  400 RETURN                                                            R1T4650
 1000 FORMAT(5X,*WBAC DUMP* /(5X,6F15.5) )                              R1T4651
      END                                                               R1T4652
```

CC = 00138

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      SUBROUTINE ACCR( SPEED,AR,SWPLE,SWPMC,TR,SPLAN,TOC,TW,FMCRC,
     1                        XACR, CLAX, XACS )
C
C     COMPUTES AERODYNAMIC CENTER OF SINGLE PANEL WINGS
C
      COMMON /BLKBD3/ BOT(12), ATSW(6), TPRT(6), FXAC(12,6,6)
C
      COMMON /BLKBD6/ XBD6(4), YBD6(4), ZBD6(6), FBD61(4,4,6),
     1                FBD62(4,4,6), FBD63(4,4,6)
C
      COMMON /BLKCLA/ X(11)
      COMMON /BLKPRT/ KPRINT(50)
      COMMON /BLKC01/ C1(100)
      COMMON /BLKMAP/ MAP, TRANS, DY, AMAP(22), BMAP(11)
C
      DIMENSION XDY(6), YAC(6), XVAL(3), VAL(3)
      DATA  XVAL / 0.0,  0.2,  0.5 /
      DATA  XDY / .2, .4, .6, .8, 1.2, 1.6 /,
     1      YAC / .67,.585,.55,.555,.59,.61 /
C
      NI     = TW
      DY     = AMAP(NI) * TOC
      ARLO   = C1(71)
C
      SB     = 2.
      IF( SPEED.EQ.1.0 ) GO TO 20
      IF( SPEED.GT.1.0 ) GO TO 10
C
      TANOB  = TAN(SWPLE)/SQRT(1.-SPEED**2)
      IF( TANOB.LE.1.0 ) SB = TANOB
      IF( TANOB.GT.1.0 ) SB = 2. - 1./TANOB
      GO TO 20
C
   10 TANOB  = TAN(SWPLE)/SQRT(SPEED**2 -1.)
      IF( TANOB.LE.1. ) SB = 4.-TANOB
      IF( TANOB.GT.1. ) SB = 2.+1./TANOB
C
   20 ARTSW  = AR * TAN(SWPLE)
C
      CALL TLNT(SB,ARTSW,TR, XAC1, BOT,ATSW,TPRT,FXAC, 12,6,6, 12,6)
C
      KPR11      = KPRINT(11)
      KPRINT(11) = 0
      X(1)   = SPLAN
      X(2)   = 0.0
      X(3)   = TR
      X(4)   = AR
      X(5)   = 0.0
      IF( TW.EQ.8. ) X(5) = 0.0334
      X(6)   = 0.0
      X(7)   = 0.0
      IF( TW.EQ.8. ) X(7) = 0.09
      X(8)   = 0.0
      X(9)   = 0.0
      IF( TW.EQ.8. ) X(9) = 1.173763 * TOC
      X(10)  = SWPMC
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   30 X(11)  = SPLAN                                                    R1T4710
C                                                                       R1T4711
      CALL AER2(SPEED, CLAX)                                            R1T4712
C                                                                       R1T4713
      XAC2    = XAC1                                                    R1T4714
      VBAR    = (SPEED**2 -1.)/TOC**0.6667                              R1T4715
      ABAR    = AR * TOC**0.3333                                        R1T4716
C                                                                       R1T4717
      IF( VBAR.GE.1.0.OR.VBAR.LE.-2. ) GO TO 40                         R1T4718
C                                                                       R1T4719
C     TRANSONIC AERODYNAMIC CENTER                                      R1T4720
C                                                                       R1T4721
      CALL TLNT(ABAR,VBAR,ARTSW,VAL(1),XBD6,YBD6,ZBD6,FBD61,4,4,6,4,4)  R1T4722
      CALL TLNT(ABAR,VBAR,ARTSW,VAL(2),XBD6,YBD6,ZBD6,FBD62,4,4,6,4,4)  R1T4723
      CALL TLNT(ABAR,VBAR,ARTSW,VAL(3),XBD6,YBD6,ZBD6,FBD63,4,4,6,4,4)  R1T4724
C                                                                       R1T4725
      CALL LNTP(TR, XAC2, XVAL, VAL, 3, 2)                              R1T4726
C                                                                       R1T4727
   40 XACR    = XAC1                                                    R1T4728
      IF( SPEED.LE.FMCRO.OR.SPEED.GE.1.2 ) GO TO 50                     R1T4729
      FM1     = FMCRO + 0.05                                            R1T4730
      FM2     = SQRT(1.+ TOC**.66667)                                   R1T4731
      XACR    = XAC2                                                    R1T4732
C                                                                       R1T4733
      IF( SPEED.GT.FM1.AND.SPEED.LT.FM2 ) GO TO 50                      R1T4734
      IF( SPEED.LE.FM1 ) XACR = XAC1 + (XAC2-XAC1)*(SPEED-FMCRO)/.05    R1T4735
      IF( SPEED.GE.FM2 ) XACR = XAC2 + (XAC1-XAC2)*(SPEED-FM2)/         R1T4736
     1                     (1.2 - FM2)                                  R1T4737
C                                                                       R1T4738
   50 ARHI    = 2.* ARLO                                                R1T4739
      XACS    = (1.+2.*TR)/12.* ARTSW  + (1. + TR**2/(1.+TR))/3.        R1T4740
      IF( AR.GT.ARHI ) GO TO 60                                         R1T4741
      CALL LNTP(DY, XACS1, XDY, YAC, 6, 2)                              R1T4742
      XACS    = XACS1 + (1.+2.2*TR)/17.544 * ARTSW -0.2                 R1T4743
C                                                                       R1T4744
   60 IF( KPRINT(18).EQ.2 ) WRITE(6,1000) SPEED, AR, SWPLE, SWPMC,      R1T4745
     1                      TR, SPLAN, TOC, TW, FMCRO, XACR, CLAX,      R1T4746
     2                      SB, ARTSW, XAC1, ABAR,  VBAR, VAL, XAC2,    R1T4747
     3                      FM1, FM2, ARHI, XACS                        R1T4748
C                                                                       R1T4749
 1000 FORMAT(5X, *ACCR DUMP* /(5X,6F15.5) )                             R1T4750
C                                                                       R1T4751
      KPRINT(11) = KPR11                                                R1T4752
      RETURN                                                            R1T4753
      END                                                               R1T4754
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CC = 00101

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      OVERLAY(3,4)                                                      R1T4756
      PROGRAM LSHL                                                      R1T4757
C                                                                       R1T4758
      COMMON /BLKHLS/ NHLSV, DFI(3,5), CPFI(5), DSI(5), CPSI(5),        R1T4759
     1                DELCD(5), H(5), DFI2(3,5), CPF2(5), DSI2(5),      R1T4760
     2                CPS2(5)                                           R1T4761
      COMMON /BLKA04/ IHLS,NXF,NXS, A2(62), BF1I, BF1O, CF1(3), BF2I,   R1T4762
     1                BF2O, CF2(3), BS1I, BS1O, CS1, BS2I, BS2O, CS2    R1T4763
      COMMON /BLKC01/ C1(85), CPF, CPS, XACS, DCDLG, C2(11)             R1T4764
      COMMON /BLKG01/ G1(200)                                           R1T4765
      COMMON /BLKC02/ C02(11)                                           R1T4766
C                                                                       R1T4767
      COMMON /BLKOV3/ ITYP, OV3A(7), JPASS, ROT, OTE, ITRIM             R1T4768
C                                                                       R1T4769
      DIMENSION DF(3), CFOC(3), COL(10)                                 R1T4770
      DATA  DF / 3*0.0 /, CFOC / 3*0.0 /                                R1T4771
      DATA  COL / 10*0.0 /                                              R1T4772
C                                                                       R1T4773
      DO 700 I = 1, NHLSV                                               R1T4774
      DF(1) = DFI(1,I)                                                  R1T4775
      DF(2)  = DFI(2,I)                                                 R1T4776
      DF(3)  = DFI(3,I)                                                 R1T4777
      DS     = DSI(I)                                                   R1T4778
      CPF    = CPFI(I)                                                  R1T4779
      CPS    = CPSI(I)                                                  R1T4780
      IF( CPF.EQ.0. ) CPF = 1.                                          R1T4781
      CFOC(1)= CF1(1) / CPF                                             R1T4782
      CFOC(2)= CF1(2) / CPF                                             R1T4783
      CFOC(3)= CF1(3) / CPF                                             R1T4784
      IF( CPS.EQ.0. ) CPS = 1.                                          R1T4785
      CSOC   = CS1 / CPS                                                R1T4786
      DCDLG  = DELCD(I)                                                 R1T4787
      HGT    = H(I)                                                     R1T4788
      DFLAP  = DF(1) + DF(2) + DF(3)                                    R1T4789
C                                                                       R1T4790
      BFI    = BF1I                                                     R1T4791
      BFO    = BF1O                                                     R1T4792
      CF     = CF1(1) + CF1(2) + CF1(3)                                 R1T4793
      BSI    = BS1I                                                     R1T4794
      BSO    = BS1O                                                     R1T4795
C                                                                       R1T4796
      CALL SSET(DF, DS, CFOC, CSOC, OTE, ROT)                           R1T4797
      CALL DSET(BFI, BFO, BSI, BSO, CF)                                 R1T4798
      CALL MSET(BFI, BFO, BSI, BSO)                                     R1T4799
      IF( IHLS.EQ.1 ) GO TO 500                                         R1T4800
C                                                                       R1T4801
C     CALCULATION OF THE EFFECT OF THE SECOND HIGH LIFT SEGMENT         R1T4802
C                                                                       R1T4803
      DF(1)  = DFI2(1,I)                                                R1T4804
      DF(2)  = DFI2(2,I)                                                R1T4805
      DF(3)  = DFI2(3,I)                                                R1T4806
      DS     = DSI2(I)                                                  R1T4807
      CPF    = CPF2(I)                                                  R1T4808
      CPS    = CPS2(I)                                                  R1T4809
      CFOC(1)= CF2(1) * CPF                                             R1T4810
      CFOC(2)= CF2(2) * CPF                                             R1T4811
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      CFOC(3)= CF2(3) * CPF                                             R1T4812
      CSOC   = CS2 * CPS                                                R1T4813
C                                                                       R1T4814
      DA     = CO2(8) - G1(82)                                          R1T4815
      DR     = CO2(11) - 1.                                             R1T4816
      DO 300 J = 1, 10                                                  R1T4817
  300 COL(J) = CO2(J)                                                   R1T4818
C                                                                       R1T4819
      BFI    = BF2I                                                     R1T4820
      BFO    = BF2O                                                     R1T4821
      CF     = CF2(1) + CF2(2) + CF2(3)                                 R1T4822
      BSI    = BS2I                                                     R1T4823
      BSO    = BS2O                                                     R1T4824
C                                                                       R1T4825
      CALL SSET(DF, DS, CFOC, CSOC, OTE, ROT)                           R1T4826
      CALL DSET(BFI, BFO, BSI, BSO, CF)                                 R1T4827
      CALL MSET(BFI, BFO, BSI, BSO )                                    R1T4828
C                                                                       R1T4829
      CO2(8) = CO2(8) + DA                                              R1T4830
      CO2(11)= CO2(11) + DR                                             R1T4831
      DO 400 J = 1, 10                                                  R1T4832
  400 IF( J.NE.8 ) CO2(J) = CO2(J) + COL(J)                             R1T4833
C                                          L(I)                         R1T4834
  500 ALPHA  = -1.                                                      R1T4835
      CL     = - 10.                                                    R1T4836
  600 ALPHA  = ALPHA + 1.                                               R1T4837
      CL1    = CL                                                       R1T4838
      CALL DAERO(ALPHA, CL, CD, CM, AGRD, CLG, CDG, CMG, HGT, DFLAP)    R1T4839
      IF( ALPHA.EQ.0.0 ) WRITE(6,2000)                                  R1T4840
      IF( HGT.EQ.0.0 ) WRITE(6,2001) ALPHA, CL, CD, CM                  R1T4841
      IF( HGT.GT.0.0 ) WRITE(6,2001) ALPHA,CL,CD,CM,AGRD,CLG,CDG,CMG    R1T4842
C                                                                       R1T4843
      IF( ALPHA.GT.60.0 ) GO TO 700                                     R1T4844
      IF( CL.GT.CL1 ) GO TO 600                                         R1T4845
  700 CONTINUE                                                          R1T4846
 2000 FORMAT(1H1, 20X, *HIGH LIFT SURVEY* // 15X, *ALPHA*  10X,         R1T4847
     1   * CL * 10X,* CD * 10X,* CM *10X,*AGRD*10X,* CLG*10X,* CDG*     R1T4848
     2        10X, *CMG * / )                                          R1T4849
 2001 FORMAT(5X, F15.2, 3F15.5, F15.3, 3F15.5)                          R1T4850
      END                                                               R1T4851
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CC = 00096

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      SUBROUTINE SSET(DF, DS, CFOC, CSOC, DTE, ROT)                     R1T4853
C                                                                       R1T4854
C     COMPUTES SECTION INCREMENTS FOR FLAPS AND SLATS                   R1T4855
C                                                                       R1T4856
      COMMON /BLKPRT/ KPRINT(50)                                        R1T4857
C                                                                       R1T4858
      COMMON /BLKC01/ C1(77), DC1F, DC1MF, DCDFS, DCMFS, DC1S,          R1T4859
     1                DC1MS, DCDSS, DCMSS, CPF, CPS, C2(13)            R1T4860
C                                                                       R1T4861
      COMMON /BLKA04/ IHLS, NXF, NXS, TF, TS, XDF(5), FCPF(5),          R1T4862
     1                FDC1F(5), FDCMXF(5), FCDF(5), FCMF(5),            R1T4863
     2                XDS(5), FCPS(5), FDC1S(5), FDCMS(5), FDCDS(5),    R1T4864
     3                FDMS(5), A04(16)                                  R1T4865
C                                                                       R1T4866
      DIMENSION DF(3),CFOC(3), ETA(3), C10(3), DCL(3), RMAX(3),         R1T4867
     1          DCLM(3), PCM(3), DCM(3), X1(4), Y1(8), F1(4,8),         R1T4868
     2          X2(5), Y2(6), F2(5,6), X3(6), Y3(4), F3(6,4),           R1T4869
     3          A0(4), A1(4), XROT(5), YEMAX(5,3),XXDS(4), YED(4,3)     R1T4870
C                                                                       R1T4871
      DATA  A0  / 0.915, 1.215, 1.39, 1.545 /,                          R1T4872
     1      A1  / -.01186, -.0115, -.0125, -.0130 /,                    R1T4873
     2      X1  / 0., .1, .2, .3 /,                                     R1T4874
     3      Y1  / 0., 10., 20., 30., 40., 50., 60., 70. /,              R1T4875
     4      F1  / 5*0.0,.001,.004,.0085, 0.,.009,.02,.032,              R1T4876
     5            0.,.019,.0425,.07, 0.,.0325,.071,.118,                R1T4877
     5            0.,.049,.104,.17, 0.,.065,.14,.237,                   R1T4878
     5            0.,.084,.18,.295 /,                                   R1T4879
     6      X2  / 0., .1, .2, .3, .4 /,                                 R1T4880
     7      Y2  / 0., 10., 20., 30., 40., 50. /,                        R1T4881
     8      F2  / 6*0.0,.001,.003,.006,.012, 0.,.003,.0075,.013,.023,   R1T4882
     9            0.,.011,.024,.0385,.059, 0.,.02,.045,.079,.117,       R1T4883
     9            0.,.03,.069,.127,.205  /,                             R1T4884
     1      X3  / 0., 1., 2., 4., 6., 8. /,                             R1T4885
     2      Y3  / .2, .3, .4, .656 /,                                   R1T4886
     3      F3  / 0.,.01,.02,.058,.155,.28,0.,.01,.02,.05,.12,.24,      R1T4887
     4            0.,.01,.02,.046,.091,.2,0.,.008,.016,.032,.057,.106/  R1T4888
      DATA  XROT / 0.0, 0.07, 0.08, 0.1, 0.2 /,                         R1T4889
     1     YEMAX / 0.56, 0.98, 1.02, 0.95, 0.0,                         R1T4890
     2             .56,1.34,1.74,1.72,.8,.56,1.09,1.2,1.15,.2 /,        R1T4891
     3      XXDS / 0.0, 15.0, 25.0, 45.0 /,                             R1T4892
     4       YED / 1.0, 1.0, .96, .25,  1.0,1.0,.75,0.,                 R1T4893
     5             1.0, 1.0, .97, .67  /                                R1T4894
C                                                                       R1T4895
      DC1F   = 0.0                                                      R1T4896
      DC1MF  = 0.0                                                      R1T4897
      DCDFS  = 0.0                                                      R1T4898
      DCMFS  = 0.0                                                      R1T4899
      DC1S   = 0.0                                                      R1T4900
      DC1MS  = 0.0                                                      R1T4901
      DCDSS  = 0.0                                                      R1T4902
      DCMSS  = 0.0                                                      R1T4903
C                                                                       R1T4904
      IF( TF.EQ.0. ) GO TO 100                                          R1T4905
      IF( TF.GE.5. ) GO TO 60                                           R1T4906
C                                                                       R1T4907
C     TRAILING-EDGE DEVICE                    ****                      R1T4908
```

```
      NF      = TF                                                      R1T4909
      CFP     = CFOC(1) + CFOC(2) + CFOC(3)                             R1T4910
      IF (TF.EQ.1.)  ZKM = 1.0031 -.928*CFP + 9.9869*CFP**2             R1T4911
     1               -7.1843*CFP**3                                     R1T4912
      IF( TF.EQ.1.0.AND.CFP.LT.0.1 ) ZKM = 1.0                          R1T4913
      IF( TF.GT.1.) ZKM = 1.2029 -1.1834*CFP +13.145*CFP**2             R1T4914
     1               -11.5455*CFP**3                                    R1T4915
      IF( TF.GT.1.0.AND.CFP.LT.0.1 ) ZKM = 1.2                          R1T4916
      ZKD     = 1.9 - 0.0225 * (DF(1)+DF(2)+DF(3))                      R1T4917
      IF( ZKD.LT.1.0 ) ZKD = 1.0                                        R1T4918
      ZKT     = 1.23 + 4.5 * ROT                                        R1T4919
      ZKMAX   = ZKT * ZKD                                               R1T4920
C                                                                       R1T4921
      IF( TF.LE.2. ) NT = 1                                             R1T4922
      IF( TF.EQ.3. ) NT = 2                                             R1T4923
      IF( TF.EQ.4. ) NT = 3                                             R1T4924
C                                                                       R1T4925
      PHI     = DF(1)                                                   R1T4926
C                                                                       R1T4927
      DO 50 I = 1, NT                                                   R1T4928
      IF( I.GT.1 ) PHI = DF(I) + PHI                                    R1T4929
      IF( I.EQ.NT) PHI = PHI + OTE                                      R1T4930
      IF( I.GT.1 ) CFP = CFP - CFOC(I-1)                                R1T4931
      ETA(I) = A0(NF) + A1(NF)*PHI                                      R1T4932
      IF(TF.EQ.1.0.AND.PHI.GT.35.0 ) ETA(I) = 1.5912 -.05068*PHI        R1T4933
     1       +.000754*PHI**2 -.0000039*PHI**3                           R1T4934
      IF( ETA(I).GT.0.77 ) ETA(I) = 0.77                                R1T4935
C                                                                       R1T4936
      DFR     = DF(I)/57.2956                                           R1T4937
      OF      = ACOS(1. - 2.*CFP)                                       R1T4938
      C10(I) = 2.*(OF + SIN(OF))                                        R1T4939
C                                                                       R1T4940
      DCL(I) = ETA(I) * C10(I) * DFR                                    R1T4941
      DC1F    = DC1F + DCL(I)                                           R1T4942
C                                                                       R1T4943
      XS      = 0.0                                                     R1T4944
      IF( TS.GT.0.0.AND.DS.GT.0.0 ) XS = CSOC                           R1T4945
      X       = ACOS(2.*XS - 1.)                                        R1T4946
      RMAX(I) = 1. -(OF/(OF + SIN(OF))) * (1.+ ALOG(ABS(SIN(.5*(X+OF))/ R1T4947
     1               SIN(.5*(X-OF)) ) )/(OF * TAN(.5*X) ) )             R1T4948
C                                                                       R1T4949
      DCLM(I) = DCL(I) * RMAX(I) * ZKMAX                                R1T4950
      IF( DCLM(I).GT.DCL(I) ) DCLM(I) = DCL(I)                          R1T4951
      DC1MF   = DC1MF + DCLM(I)                                         R1T4952
C                                                                       R1T4953
      RCM(I) = - CFP    *  SIN(OF)/C10(I)                               R1T4954
C                                                                       R1T4955
      DCM(I) = DCL(I) * RCM(I) * ZKM                                    R1T4956
      DCMFS   = DCMFS + DCM(I)                                          R1T4957
C                                                                       R1T4958
   50 CONTINUE                                                          R1T4959
C                                                                       R1T4960
      DCL2    = DC1F*DC1F                                               R1T4961
      CFP     = CFOC(1) + CFOC(2) + CFOC(3)                             R1T4962
      IF( TF.EQ.1. ) DCDFS = DLNT(CFP, DF(1), X1, Y1, F1, 4,8,4,4,2)    R1T4963
      IF( TF.EQ.2. ) DCDFS = DLNT(CFP, DF(1), X2, Y2, F2, 5,6,5,4,2)    R1T4964
```

```
      IF( TF.GE.3.) DCDFS = DLNT(DCL2, CFP, X3, Y3, F3, 6,4, 6,4,2)      R1T4965
C                                                                        R1T4966
      GO TO 100                                                          R1T4967
   60 CALL LNTP(DF(1), DC1F, XDF, FDC1F, NXF, 4)                         R1T4968
      CALL LNTP(DF(1), DC1MF,XDF, FDCMXF,NXF, 4)                         R1T4969
      CALL LNTP(DF(1), DCDFS,XDF, FCDF,  NXF, 4)                         R1T4970
      CALL LNTP(DF(1), DCMFS,XDF, FCMF,  NXF, 4)                         R1T4971
      CALL LNTP(DF(1), CPF,  XDF, FCPF,  NXF, 4)                         R1T4972
C                                                                        R1T4973
  100 IF( TS.LE.0. ) GO TO 200                                           R1T4974
      IF( TS.GE.4. ) GO TO 150                                           R1T4975
C     LEADINE-EDGE DEVICE                          ****                  R1T4976
C                                                                        R1T4977
      OS     = ACOS(1. - 2.*CSOC)                                        R1T4978
      C1LE   = 2.*(SIN(OS) - OS)                                         R1T4979
      CMXLE  = 2.* SIN(OS)                                               R1T4980
      CMLE   = (1.-CSOC)*SIN(OS) C1LE                                    R1T4981
      DSR    = DS/57.2956                                                R1T4982
      NS     = TS                                                        R1T4983
      CALL LNTP(ROT, EMAX, XROT, YEMAX(1,NS), 5,2)                       R1T4984
      CALL LNTP(DS, ED,XXDS, YED(1,NS), 4, 2)                            R1T4985
C                                                                        R1T4986
      DC1S   = C1LE * DSR                                                R1T4987
      DC1MS  = CMXLE * EMAX * ED * DSR                                   R1T4988
      DCDSS  = 0.0                                                       R1T4989
      DCMSS  = CMLE * DC1S                                               R1T4990
C                                                                        R1T4991
      GO TO 200                                                          R1T4992
  150 CALL LNTP(DS, DC1S, XDS, FDC1S, NXS, 4)                            R1T4993
      CALL LNTP(DS, DC1MS,XDS, FDCMS, NXS, 4)                            R1T4994
      CALL LNTP(DS, DCDSS,XDS, FDCDS, NXS, 4)                            R1T4995
      CALL LNTP(DS, DCMSS,XDS, FDMS,  NXS, 4)                            R1T4996
      CALL LNTP(DS, CPS,  XDS, FCPS,  NXS, 4)                            R1T4997
C                                                                        R1T4998
  200 IF( KPRINT(27).EQ.1 ) WRITE(6,1000) DC1F, DC1MF, DCDFS, DCMFS,     R1T4999
     1            DC1S, DC1MS, DCDSS, DCMSS, CPF, CPS, DCL, ETA, C1D,    R1T5000
     2            DCLM, RMAX, ZKMAX, DCM, RCM, ZKM, C1LE, CMXLE, EMAX,   R1T5001
     3            ED, TF, TS, DF, DS, CFOC, CSOC, DTE, ROT               R1T5002
C                                                                        R1T5003
 1000 FORMAT(5X, *SSET DUMP* /(5X, 7F15.5) )                             R1T5004
C                                                                        R1T5005
      RETURN                                                             R1T5006
      END                                                                R1T5007
```

CC = 00155

```
      SUBROUTINE DSET(BFI, BFO, BSI, BSO, CF)                           R1T5009
C                                                                       R1T5010
C     AERODYNAMIC CONTROL ROUTINE FOR HIGH LIFT SYSTEMS                 R1T5011
C                                                                       R1T5012
      COMMON /BLKCO2/ DCLOF, DCLOS, DCLMF, DCLMS, DCDMIN, DCLF, DCLS,   R1T5013
     1                SPLANX, DCMO, DCMCL, RCLA                         R1T5014
      COMMON /BLKCO1/ C1(11), AK, DCL, C2(64), DC1F, DC1MF, DCDFS,      R1T5015
     1                DCMFS,DC1OS,DC1MS,DCDSS,DCMSS,CPF,CPS,C3(13)      R1T5016
      COMMON /BLKGO1/ G1(200)                                           R1T5017
C                                                                       R1T5018
      COMMON /BLKMX3/ SPAN(6),  YTPR(4), FKB( 6,4), FKS(6),  FKD( 6,4)  R1T5019
      COMMON /BLKMX9/ SPAN4(5),YBFI1(5), FKA(5,5),                      R1T5020
     1                SPAN5(5), YBFI2(3), FKF(5,3)                      R1T5021
C                                                                       R1T5022
      ZKT     = 1.0                                                     R1T5023
      SWPLE   = G1(103)                                                 R1T5024
      SWPMC   = G1(49)                                                  R1T5025
      TPR     = G1(81)                                                  R1T5026
      AR      = G1(80)                                                  R1T5027
      SPLAN   = G1(82)                                                  R1T5028
      DCLS    = 0.0                                                     R1T5029
C                                                                       R1T5030
      ZKBI    = DLNT(BFI, TPR, SPAN, YTPR, FKB,  6,4, 6,2,2)            R1T5031
      ZKBO    = DLNT(BFO, TPR, SPAN, YTPR, FKB,  6,4, 6,2,2)            R1T5032
      ZKB     = ZKBO - ZKBI                                             R1T5033
C                                                                       R1T5034
      ASC     = SQRT(1. - (1.-CF)**1.61 )                               R1T5035
      ZKC     = 1. + 1.875 * (1.-ASC)**2 /AR                            R1T5036
C                                                                       R1T5037
      CALL LNTP(BSI, ZKSI, SPAN, FKS,  6, 4)                            R1T5038
      CALL LNTP(BSO, ZKSO, SPAN, FKS,  6, 4)                            R1T5039
      ZKS     = ZKSO - ZKSI                                             R1T5040
C                                                                       R1T5041
C                                                                       R1T5042
      SPLANX = SPLAN * (1. + (CPF-1.)/(1.+TPR) * (2.-(1.-TPR)           R1T5043
     1                *(BFO + BFI)) *(BFO - BFI)                        R1T5044
     2                + (CPS-1.)/(1.+TPR) * (2.-(1.-TPR)*(BSO-BSI))     R1T5045
     3                * (BSO - BSI) )                                   R1T5046
C                                                                       R1T5047
   20 CLOC1   = AR/(2. + SQRT(4.+ (SPLAN * AR/SPLANX /COS(SWPMC))**2) ) R1T5048
      CLOC1R  = AR/(2.+ SQRT(4.+ (AR/COS(SWPMC))**2 ) )                 R1T5049
      RCLA    = CLOC1/CLOC1R                                            R1T5050
C                                                                       R1T5051
      DCLOF   = ZKT * DC1F * CLOC1 * ZKC * ZKB                          R1T5052
      DCLMF   = ZKT * DC1MF * CLOC1 * ZKC * ZKB * COS(SWPMC)            R1T5053
C                                                                       R1T5054
      DCLOS   = DC1OS * CLOC1 * ZKS                                     R1T5055
      DCLMS   = DC1MS * CLOC1 * ZKS * COS(SWPLE)                        R1T5056
C                                                                       R1T505
C                                                                       R1T5058
   30 WRITE(6,1000) ZKB, ZKC, ZKS, CLOC1, DC1F, DC1MF, DC1OS,           R1T5059
     1                DC1MS, DCLOS, DCLOF                               R1T5060
C                                                                       R1T5061
C     CALCULATION OF DRAG PARAMETERS                                    R1T5062
C                                                                       R1T5063
      SWPHL   = ATAN(TAN(SWPLE) - 4./AR * (1.-TPR)/(1.+TPR) * (1.-CF) ) R1T5064
```

```
C                                                                       R1T5065
      ZKDI    = DLNT(BFI, TPR, SPAN, YTPR, FKD,  6, 4,  6, 2,2)         R1T5066
      ZKDO    = DLNT(BFO, TPR, SPAN, YTPR, FKD,  6, 4,  6, 2,2)         R1T5067
      ZKD     = ZKDO - ZKDI                                             R1T5068
C                                                                       R1T5069
   40 CONTINUE                                                          R1T5070
      E       = AR/6.283                                                R1T5071
      D       = BFO                                                     R1T5072
C                                                                       R1T5073
      ZKA = DLNT(E, BFI,SPAN4, YBFI1,FKA, 5, 5, 5, 4, 2 )               R1T5074
      ZKF = DLNT(D, BFI,SPAN5, YBFI2,FKF, 5, 3, 5, 2, 2 )               R1T5075
C                                                                       R1T5076
C                                                                       R1T5077
C                                                                       R1T5078
   45 WRITE(6,1001) SWPHL, ZKD, ZKA, ZKF, CDO, SWPLE, AR, TPR, AK, DCL  R1T5079
      EK      = 0.31831/AR/AK                                           R1T5080
C                                                                       R1T5081
   50 CONTINUE                                                          R1T5082
      DCLF    = (1.-EK) * DCLOF/(1.+1.16*CLOC1*(.5-CF) )                R1T5083
      CDC     = 0.0                                                     R1T5084
      IF( EK.LT.1.0 ) CDC = (DCLF**2 + 2.*DCLF*DCL)*0.31831/            R1T5085
     1                      (AR * (1.-EK))                              R1T5086
C                                                                       R1T5087
      DCDF    = DCDFS * COS(SWPHL) * ZKD                                R1T5088
      DCDS    = DCDSS * COS(SWPLE) * ZKD                                R1T5089
      CDI     = ZKA * ZKF * DCLOF**2 *0.31831/AR                        R1T5090
C                                                                       R1T5091
      DCDMIN = DCDF + DCDS + CDI + CDC                                  R1T5092
      WRITE(6,1002) DCDMIN, CDI, DCDS, DCDF, DCL, DCLF, CDC             R1T5093
C                                                                       R1T5094
   60 RETURN                                                            R1T5095
 1000 FORMAT(1H1, 10X, *HIGH LIFT CONSTANTS*, // 10X                    R1T5096
     1       *ZKB  =* F10.6, 10X *ZKC  =* F10.6, 10X *ZKS  =*           R1T5097
     2       F10.6 / 10X  *CLOC1=* F10.6, 10X *DC1F =* F10.6,           R1T5098
     3       10X   *DC1MF=* F10.6  / 10X  *DC1OS=* F10.6, 10X           R1T5099
     4       *DC1MS =* F10.6, 10X                                       R1T5100
     6       *DCLOS=* F10.6 /10X *DCLOF=* F10.6 )                       R1T5101
 1001 FORMAT( /// 10X  *SWPHL=* F10.6, 10X *ZKD  =*  F10.6,             R1T5102
     1       10X *ZKA  =* F10.6 / 10X  *ZKF  =* F10.6, 10X              R1T5103
     2       *CDO  =* F10.6, 10X *SWPLE=* F10.6 / 10X                   R1T5104
     3       *AR   =* F10.6, 10X *TPR  =* F10.6,  10X                   R1T5105
     4       *AK   =* F10.6 /10X *DCL  =* F10.6 )                       R1T5106
 1002 FORMAT( ///10X, *DCDMIN =* F10.6, 10X *CDI =* F10.6, 10X          R1T5107
     1       *DCDS =* F10.6 /10X *DCDF =* F10.6, 10X                    R1T5108
     2       *DCL =* F10.6, 10X *DCLF =* F10.6 /10X *CDC =*F10.6 )      R1T5109
 1003 FORMAT (6F10.6)                                                   R1T5110
      END                                                               R1T5111
```

CC = 00103

```
      SUBROUTINE MSET(BFI, BFO, BSI, BSO )                              R1T5113
C                                                                       R1T5114
C     COMPUTES MOMENT SHIFT DUE TO FLAPS AND SLATS AT CL = 0            R1T5115
C                                                                       R1T5116
      COMMON /BLKC02/ DCLOF, DCLOS, DCLMF, DCLMS, DCDMIN, DCLF, DCLS,   R1T5117
     1                SPLANX, DCMO, DCMCL, RCLA                         R1T5118
      COMMON /BLKC01/ C1(77), DC1F, DC1MF, DCDFS, DCMFS,                R1T5119
     1                DC1S, DC1MS, DCDSS, DCMSS, CPF, CPS, C2(13)       R1T5120
      COMMON /BLKG01/ G1(200)                                           R1T5121
C                                                                       R1T5122
      COMMON/BLKMX7/ SPAN2(11), YTPR2(5), FKSW(11,5)                    R1T5123
      COMMON/BLKMX8/ SPAN3(6), YTPR3(4), FKM(6,4)                       R1T5124
C                                                                       R1T5125
      TPR    = G1(81)                                                   R1T5126
      AR     = G1(80)                                                   R1T5127
      SWPMC  = G1(49)                                                   R1T5128
      CMCL   = C1(15)                                                   R1T5129
      CLA    = C1(17)                                                   R1T5130
      ALO    = C1(18)                                                   R1T5131
C                                                                       R1T5132
C     FLAP CALCULATIONS START HERE                                      R1T5133
C                                                                       R1T5134
      DCMAF  = 0.0                                                      R1T5135
      DCMCLF = 0.0                                                      R1T5136
      IF( DCMFS.EQ.0.0.AND.DC1F.EQ.0.0.AND.CPF.EQ.0.0 ) GO TO 40        R1T5137
C                                                                       R1T5138
      ZKSWI= DLNT(BFI, TPR, SPAN2, YTPR2, FKSW, 11, 5, 11, 2, 2)        R1T5139
      ZKSWO= DLNT(BFO, TPR, SPAN2, YTPR2, FKSW, 11, 5, 11, 2, 2)        R1T5140
      ZKSW = ZKSWO - ZKSWI                                              R1T5141
C                                                                       R1T5142
      ZKMO = DLNT (BFO, TPR, SPAN3, YTPR3, FKM, 6, 4, 6, 2, 2)          R1T5143
      ZKMI = DLNT (BFI, TPR, SPAN3, YTPR3, FKM, 6, 4, 6, 2, 2)          R1T5144
      ZKM = ZKMO - ZKMI                                                 R1T5145
C                                                                       R1T5146
      DCMAF  = DCMFS * CPF**2 * ZKM  + 0.5 * AR * TAN(SWPMC)            R1T5147
     1                          * DC1F * ZKSW                           R1T5148
C                                                                       R1T5149
      DCMCLF = (-0.25 * CPF *(CPF-1.) + CMCL * (CPF**2-1.))* ZKM        R1T5150
   40 CONTINUE                                                          R1T5151
C                                                                       R1T5152
C     SLAT CALCULATIONS START HERE                                      R1T5153
C                                                                       R1T5154
      DCMAS  = 0.0                                                      R1T5155
      DCMCLS = 0.0                                                      R1T5156
      IF( DCMSS.EQ.0.0.AND.DC1S.EQ.0.0.AND.CPS.EQ.0.0 ) GO TO 50        R1T5157
      ZKMSO = DLNT(BSO, TPR, SPAN3, YTPR3, FKM, 6, 4, 6, 2, 2)          R1T5158
      ZKMSI = DLNT(BSI, TPR, SPAN3, YTPR3, FKM, 6, 4, 6, 2, 2)          R1T5159
      ZKMS  = ZKMSO - ZKMSI                                             R1T5160
C                                                                       R1T5161
      ZKSWSO = DLNT(BSO, TPR, SPAN2, YTPR2, FKSW, 11, 5, 11, 2, 2)      R1T5162
      ZKSWSI = DLNT(BSI, TPR, SPAN2, YTPR2, FKSW, 11, 5, 11, 2, 2)      R1T5163
      ZKSWS  = ZKSWSO - ZKSWSI                                          R1T5164
C                                                                       R1T5165
      DCMAS  = DCMSS * CPS**2 * ZKMS + 0.5 * AR * TAN(SWPMC)            R1T5166
     1                          * DC1S * ZKSWS                          R1T5167
C                                                                       R1T5168
```

```
      DCMCLS = (-0.25 * CPS *(CPS-1.) + CMCL * (CPS**2-1.))* ZKMS
C
C
C     ADD FLAP AND SLAT MOMENTS
C
   50 DCMA   = DCMAF + DCMAS
      DCMCL  = DCMCLF + DCMCLS
C
      CLO    = -CLA * ALO
      DCMO   = DCMA - CMCL * (DCLOF + DCLOS) - CMCL * (CLO+DCLOF+DCLOS)
C
C
      WRITE(6,1001) DCMAF, DCMAS, DCMO
C
 1001 FORMAT(///10X,*DCMOF = *F10.6/10X,*DCMOS = *F10.6/
     1          10X, *DCMO  = * F10.6)
      RETURN
      END
```

CC = 00074

```
      SUBROUTINE DAERO(ALPHA, CL, CD, CM, AGRD, CLG, CDG, CMG, H, DF)
C
C     COMPUTES LIFT MOMENT AND DRAG FOR HIGH-LIFT SYSTEMS IN
C     FREE AIR OR GROUND EFFECT
C
      COMMON /BLKC02/ DCLOF, DCLOS, DCLMF, DCLMS, DCDMIN, DCLF, DCLS,
     1                SPLANX, DCMO, DCMCL, RCLA
      COMMON /BLKG01/ G1(200)
      COMMON /BLKA02/ A1(433)
      COMMON /BLKA03/ A03(12), CMAC, A03A(7)
      COMMON /BLKA04/ A2(66), BF1C, A3(4), BF2O, A4(9)
      COMMON /BLKC01/ C1(4), CDMINB, C2(6), FK, DELCL, CMO, CMCL,
     1                XACWB, CLA, ALO, C3(19), CDWING(4), C7(12),
     1                CLAW, CLAN, CLAT, AH, BH, HSTAR,
     2                C4(5), CLMAXB, ABRK, AMAX, DAMAX,
     3                C5(25), DEDA, C6(6)
C
      DIMENSION XDX(6), YA(6), YB(6), XTR(6), YAR(4), Z1(6,4),
     1          XBF(6), Z2(6)
C
      DATA  XDX / -1., -.6, -.2,  .2, .6, 1. /,
     1      YA  / -3.71,-3.03,-2.63,-2.34,-2.13,-2. /,
     1      YB  / .466,.5,.664,.901,1.1,1.171 /
C
C     FIG.S  4.7.1-18A&B IN DATCOM
      DATA  XTR / 1., 2., 3., 4., 5., 6. /,
     1      YAR / 4., 6., 8., 10. /,
     2      Z1  / .825,.772,.745,.726,.715,.712, .855,.772,.738,.715,
     3            .7,.695, .68,.775,.727,.702,.69,.685,
     4            .895,.776,.723,.697,.68,.675 /,
     5      XBF / 0., .2, .4, .6, .8, 1. /,
     6      Z2  / 0., .34, .58, .76, .89, 1. /
C
      SPLAN  = G1(82)
      AR     = G1(80)
      TR     = G1(81)
      DCDLG  = C5(21)
      ESWOC  = G1(102)
      OMEGA  = G1(110)
      XH     = G1(109)
C
      CLO    = -CLA*ALO + DCLOF + DCLOS
      CLMAX  = CLMAXB + DCLMF + DCLMS
      CLAHL  =  CLAN + CLAT + CLAW * RCLA
      AK     = FK * SPLAN/SPLANX
      DCL    = DELCL + DCLF + DCLS
      CDMIN  = CDMINB + DCDMIN + DCDLG
C
      ALIN   = (CLMAX - CLO)/CLAHL  - DAMAX
C
      CL     = CLAHL * ALPHA + CLO
      IF( ALPHA.LE.ALIN ) GO TO 20
C
      DELM   = CLAHL * (ALIN + 2.* DAMAX) + CLO - CLMAX
      DEL    =((ALPHA - ALIN) *0.5/DAMAX )**2 * DELM
C
```

```
      CL      = CL - DEL                                                R1T5244
C                                                                       R1T5245
   20 CD      = CDMIN +AK*(CL - DCL)**2                                 R1T5246
      IF( ALPHA.LE.ALIN ) GO TO 30                                      R1T5247
C                                                                       R1T5248
      EO      = 0.31831/AR/AK                                           R1T5249
      E       = EO + (0.3 - EO) * 0.5 * (ALPHA - ALIN)/DAMAX            R1T5250
      IF( E.LE.0.0 ) E = 0.1                                            R1T5251
      CD      = CDMIN + 0.31831/AR/E * (CL - DCL)**2                    R1T5252
C                                                                       R1T5253
   30 CMOTOT = CMO + DCMO                                               R1T5254
      DCMDCL  = CMCL + DCMCL                                            R1T5255
      CLTAIL  = CLAT * (ALPHA-HSTAR)                                    R1T5256
      CLWB    = CL - CLTAIL                                             R1T5257
      CM      = CMOTOT + DCMDCL * CLWB                                  R1T5258
     1           -CLTAIL * XH * COS(OMEGA - ALPHA/57.3)/CMAC            R1T5259
C                                                                       R1T5260
C     GROUND EFFECTS ARE NOW CALCULATED                                 R1T5261
C                                                                       R1T5262
      DCLWG   = 0.0                                                     R1T5263
      DCLTG   = 0.0                                                     R1T5264
      DCMWG   = 0.0                                                     R1T5265
      DCMTG   = 0.0                                                     R1T5266
      DCDG    = 0.0                                                     R1T5267
      AGRD    = ALPHA                                                   R1T52671
      OMEGA   = G1(110)                                                 R1T5268
      BO2     = A1(240)                                                 R1T5269
      DXOB    = G1(106)                                                 R1T5270
      CROB    = G1(105)                                                 R1T5271
      HTZ     = A1(432)                                                 R1T5272
C                                                                       R1T5273
      IF( H.EQ.0.0 ) GO TO 50                                           R1T5274
      CDWNG   = CDWING(1) + CDWING(2) + CDWING(3) + CD - CDMIN          R1T5275
      CALL LNTP(DXOB, A, XDX, YA, 6, 4)                                 R1T5276
      CALL LNTP(DXOB, B, XDX, YB, 6, 4)                                 R1T5277
      SIGP    = 2.71828 **(A * (H/BO2)**B )                             R1T5278
C                                                                       R1T5279
      HOC     = H/(CROB*BO2) * 0.5                                      R1T5280
      A2D     = 9.1189 * CL /(COS(ESWQC)**2)                            R1T5281
      DLOLO   = 0.058/(HOC**1.7)  -0.0085/HOC * A2D                     R1T5282
      IF( HOC.LT.0.4 ) DLOLO = DLOLO - 0.02/(HOC**2) + 0.05/HOC         R1T52821
C                                                                       R1T5283
      DDCLF   = -.142 +.2272*HOC -.0902*HOC**2                          R1T5284
C                                                                       R1T5285
      SIG     = 2.71828 **(-2.48 * (H/BO2)**.768)                       R1T5286
C                                                                       R1T5287
      R       = SQRT(1. +(H/BO2)**2 ) - H/BO2                           R1T5288
      T       = 0.03979 * HOC /(HOC**2 - .015625)                       R1T5289
      DCLWG   = (9.12/AR +7.16*CROB) * CLWB * CLAW * SIGP * RCLA        R1T5290
     1            + 0.5 * AR * CROB * DLOLO * R * CLWB                  R1T5291
     2          + DDCLF * (DF/50.)**2                                   R1T5292
C                                                                       R1T5293
      DCDG1   = -SIG * 0.31831*CLWB**2/AR                               R1T5294
      DCDG    = DCDG1 -(CDWNG + DCDG1) *R *T *CLWB                      R1T5295
C                                                                       R1T5296
C     GROUND EFFECTS ON HORIZONTAL TAIL ARE CALCULATED                  R1T5297
```

```
      IF( CLAT.EQ.0.0 ) GO TO 40
C                                                                       R1T5298
      TRIV    = 6.                                                      R1T5299
      IF( TR.NE.0.0 ) TRIV = 1./TR                                      R1T5300
      BPWOB   = DLNT(TRIV, AR, XTR, YAR, Z1, 6,4, 6, 4,2)               R1T5301
C                                                                       R1T5302
      BF      = BF10                                                    R1T5303
      IF( BF20.GT.BF ) BF = BF20                                        R1T5304
      CALL LNTP(BF, BFOBWP, XBF, Z2, 6, 4)                              R1T5305
C                                                                       R1T5306
      SPAN    = B02 *2.                                                 R1T5307
      BWP     = BPWOB * SPAN                                            R1T5308
      BFP     = BWP * BFOBWP                                            R1T5309
C                                                                       R1T5310
      BEFF    = BWP                                                     R1T5311
      IF( BFP.NE.0.0 ) BEFF = CLO/((CLO -DCLOF)/BWP + DCLOF/BFP)        R1T5312
C                                                                       R1T5313
      HH      = (H + HTZ)*COS(ALPHA/57.3) - XH*SIN(ALPHA/57.3)          R1T5314
      DE      = DEDA * ALPHA * (BEFF**2 + (HH-H)**2)/(BEFF**2 +(HH+H)**2)R1T5315
C                                                                       R1T5316
      DCLTG   = DE * CLAT/(1.-DEDA)                                     R1T5317
   40 AGRD    = ALPHA -(DCLWG +DCLTG)/CLAHL                             R1T5318
C                                                                       R1T5319
      DCMWG   = DCMDCL * DCLWG                                          R1T5320
      DCMTG   = -DCLTG * XH * COS(OMEGA -AGRD/57.2956)                  R1T5321
C                                                                       R1T5322
   50 CLG     = CLWB + CLAT *(AGRD-HSTAR) + DCLTG                       R1T5323
      CMG     = CMOTOT  + DCMDCL * CLWB                                 R1T5324
     1           -(CLG-CLWB)* XH *COS(OMEGA -AGRD/57.2956)              R1T5325
      CDG     = CD + DCDG                                               R1T5325J
C                                                                       R1T5326
      RETURN                                                            R1T5327
      END                                                               R1T5328
                                                                        R1T5329
                                                          CC = 00145
```

```
      SUBROUTINE ATMOS (ZFT, TM, SIGMA, RHO, THETA, DELTA, CA, AMU, K)   CS
C   THIS IS A SUBROUTINE TO COMPUTE CERTAIN ELEMENTS OF THE 1962        CS
C   U.S. STANDARD ATMOSPHERE UP TO 90 KILOMETERS.                       CS
C                                                                       CS
C     ******************************************************************* CS
C                                                                       CS
C          THIS MODEL REPRESENTS MEAN ANNUAL, MID-LATITUDE, DRY AIR     CS
C     CONDITIONS.  DATA ON LATITUDINAL AND SEASONAL VARIATIONS ARE      CS
C     AVAILABLE FROM THE OFFICE OF THE STAFF METEOROLOGIST (ASD/WE).    CS
C                                                                       CS
C          CARE MUST BE EXERCISED WHEN USING THIS AND OTHER MODELS FOR  CS
C     ENGINEERING PURPOSES AND IT IS STRONGLY URGED THAT USERS CONTACT  CS
C     ASD/WE FOR INTERPRETATION AND ASSISTANCE.                         CS
C                                                                       CS
C     ************************  ************************************** CS
C                                                                       CS
C    CALLING SEQUENCE...                                                CS
C                                                                       CS
C    CALL ATMOS (ZFT, TM, SIGMA, RHO, THETA, DELTA, CA, AMU, K)         CS
C         ZFT    =   GEOMETRIC ALTITUDE (FEET)                          CS
C         TM     =   MOLECULAR SCALE TEMPERATURE (DEGREES RANKINE)      CS
C         SIGMA  =   RATIO OF DENSITY TO THAT AT SEA LEVEL              CS
C         RHO    =   DENSITY (LB-SEC**2+FT**(-4)   OR   SLUGS-FT**3)    CS
C         THETA  =   RATIO OF TEMPERATURE TO THAT AT SEA LEVEL          CS
C         DELTA  =   RATIO OF PRESSURE TO THAT AT SEA LEVEL             CS
C         CA     =   SPEED OF SOUND (FT/SEC)                            CS
C         AMU    =   VISCOSITY COEFFICIENT (LB-SEC/FT**2)               CS
C                                                                       CS
C         K = 1 NORMAL                                                  CS
C           = 2 ALTITUDE LESS THAN -5000 METERS OR GREATER THAN 90 KM   CS
C           = 3 FLOATING POINT OVERFLOW                                 CS
C                                                                       CS
C   ALL DATA AND FUNDAMENTAL CONSTANTS ARE IN THE METRIC SYSTEM AS      CS
C   THESE QUANTITIES ARE DEFINED AS EXACT IN THIS SYSTEM.               CS
C                                                                       CS
C   THE RADIUS OF THE EARTH (REFT59) IS THE VALUE ASSOCIATED WITH THE   CS
C   1959 ARDC ATMOSPHERE SO THAT PROGRAMS CURRENTLY USING THE LIBRARY   CS
C   ROUTINE WILL NOT REQUIRE ALTERATION TO USE THIS ROUTINE.            CS
      DIMENSION HB(10),TMB(10),DELTAB(10),ALM(10),ARAY(10,4)            CS
      EQUIVALENCE(ARAY(1,1),HB),(ARAY(1,2),TMB),(ARAY(1,3),DELTAB),     CS
     *           (ARAY(1,4),ALM)                                        CS
      DATA ((ARAY(I,J),J=1,4),I=1,10)/                                  CS
     X         -5.0   ,    320.65  ,   1.75363  E 00 ,   -6.5        ,  CS
     X          0.0   ,    288.15  ,   1.00000  E 00 ,   -6.5        ,  CS
     X         11.0   ,    216.65  ,   2.23361  E-01 ,    0.0        ,  CS
     X         20.0   ,    216.65  ,   5.40328  E-02 ,    1.0        ,  CS
     X         32.0   ,    228.65  ,   0.56663  E-03 ,    2.8        ,  CS
     X         47.0   ,    270.65  ,   1.09455  E-03 ,    0.0        ,  CS
     X         52.0   ,    270.65  ,   5.82289  E-04 ,   -2.0        ,  CS
     X         61.0   ,    252.65  ,   1.79718  E-04 ,   -4.0        ,  CS
     X         79.0   ,    180.6   ,   1.02410  E-05 ,    0.0        ,  CS
     X         88.743 ,    180.65  ,   1.62230  E-06 ,    0.0        /  CS
      DATA  REFT59/2.0855531E 07/, GZ    /9.80665/,                     CS
     A      AMZ   /28.9644      /, RSTAR /8.31432/,                     CS
     B      FTTOKM/3.048E-04    /, S     /110.4  /,                     CS
```

```
      C       AMUZ  /1.2024E-05   /, CAZ   /1116.45/,                CS1
      D       RHOZ  /0.076474     /, GZENG /32.1741/                 CS1
C  CONVERT GEOMETRIC ALTITUDE TO GEOPOTENTIAL ALTITUDE               CS1
      HFT = (REFT59/(REFT59+ZFT))*ZFT                                CS1
C  CONVERT HFT AND ZFT TO KILOMETERS                                 CS1
      Z = FTTOKM*ZFT                                                 CS1
      H = FTTOKM*HFT                                                 CS1
      K = 1                                                          CS1
      TMZ = TMB(2)                                                   CS1
      IF (H.LT.-5.0.OR.Z.GT.90.0)  GO TO 16                          CS1
      DO 10 M=1,10                                                   CS1
      IF (H-HB(M)) 11,12,10                                          CS1
   10 CONTINUE                                                       CS1
      GO TO 16                                                       CS1
   11 M = M-1                                                        CS1
   12 DELH = H-HB(M)                                                 CS1
      IF (ALM(M).EQ.0.0)  GO TO 13                                   CS1
      TMK = TMB(M)+ALM(M)*DELH                                       CS1
C  GRADIENT IS NON ZERO, PAGE 10, EQUATION I.2.10-(3)                CS1
      DELTA = DELTAB(M)*((TMB(M)/TMK)**(GZ*AMZ/(RSTAR*ALM(M))))      CS1
      GO TO 14                                                       CS1
   13 TMK = TMB(M)                                                   CS1
C  GRADIENT IS ZERO, PAGE 10, EQUATION I.2.10-(4)                    CS1
      DELTA = DELTAB(M)*EXP(-GZ*AMZ*DELH/(RSTAR*TMB(M)))             CS1
   14 THETA = TMK/TMZ                                                CS1
      SIGMA = DELTA/THETA                                            CS1
      ALPHA = SQRT(THETA**3)*((TMZ+S)/(TMK+S))                       CS1
C  CONVERSION TO ENGLISH UNITS                                       CS1
      TM = 1.8*TMK                                                   CS1
      RHO = RHOZ*SIGMA/GZENG                                         CS1
      CA = CAZ*SQRT(THETA)                                           CS1
      AMU = AMUZ*ALPHA/GZENG                                         CS1
C     CALL OVERFL(J)                                                 CS1
C       GO TO (15,17), J                                             CS1
C  15 K = K+2                                                        CS1
      GO TO 17                                                       CS1
   16 K = 2                                                          CS1
   17 RETURN                                                         CS1
      END                                                            CS1
```

```
      SUBROUTINE PLSQ(X,Y,N,K,C,LIST,EMAX,ERMS,EMEQ)                    CS1
C                                                                       CS1
C     PLSQ      POLYNOMIAL LEAST SQUARE CURVE FIT                       CS1
C                                                                       CS1
C                                                                       CS1
C          PLSQ WILL FIT A GIVEN SET OF DATA TO A                       CS1
C     POLYNOMIAL OF DEGREE K OF THE FORM...                             CS1
C                                                                       CS1
C          Y=C(K+1)+C(K)*X+C(K-1)*X**2+...+C(2)*X**(K-1)+C(1)*X**K      CS1
C                                                                       CS1
C     PLSQ THEN COMPUTES THE MAXIMUM ERROR AND ROOT                     CS1
C     MEAN SQUARE ERROR OBTAINED BY USING THE C                         CS1
C     COEFFICIENTS TO RE-COMPUTE Y FROM X                               CS1
C                                                                       CS1
C     USAGE...                                                          CS1
C                                                                       CS1
C     DIMENSION X(N), Y(N), C(L)                                        CS1
C          WHERE L IS K+1                                               CS1
C     CALL PLSQ(X,Y,N,K,C,LIST,EMAX,ERMS,EMEQ)                          CS1
C                                                                       CS1
C        WHERE,                                                         CS1
C                                                                       CS1
C        X  IS THE ARRAY OF N INDEPENDENT VARIABLES                     CS1
C                                                                       CS1
C        Y  IS THE ARRAY OF N DEPENDENT VARIABLES                       CS1
C                                                                       CS1
C        N  IS THE NUMBER OF INDEPENDENT(DEPENDENT)                     CS1
C           VARIABLES                                                   CS1
C                                                                       CS1
C        K  IS THE DEGREE OF THE LEAST SQUARES POLYNOMIAL               CS1
C                                                                       CS1
C        C  IS THE ARRAY OF THE COEFFICIENTS,HIGH ORDER                 CS1
C           TO LOW ORDER, OF THE LEAST SQUARES POLYNOMIAL               CS1
C                                                                       CS1
C        LIST  =0   SUPPRESSES THE ERROR ANALYSIS OUTPUT                CS1
C              =1   GIVES THE ERROR ANALYSIS OUTPUT                     CS1
C                                                                       CS1
C        EMAX  IS THE MAXIMUM ABSOLUTE ERROR OBTAINED                   CS1
C              BY USING THE COMPUTED C COEFFICIENTS TO                  CS1
C              APPROXIMATE THE DEPENDENT VARIABLE                       CS1
C                                                                       CS1
C        ERMS  IS THE ROOT MEAN SQUARE ERROR OBTAINED                   CS1
C              BY USING THE COMPUTED C COEFFICIENTS TO                  CS1
C              APPROXIMATE THE DEPENDENT VARIABLE                       CS1
C                                                                       CS1
C        EMEQ  IS THE MAXIMUM DEVIATION FROM UNITY                      CS1
C              IN THE LINEAR SYSTEM CHECK SOLUTION                      CS1
C                                                                       CS1
C                                                                       CS1
C     PLSQ CALLS SUBROUTINES FXEM AND MTXEQ                             CS1
C                                                                       CS1
C     PLSQ USES 1309 CELLS OF BLANK COMMON                              CS1
C                                                                       CS1
C                                                                       CS1
      COMMON    MTXEQT(664), CF, DIF, I, J, JC, JK,                     CS1
```

```
     *          L, LL, LU, M, SUM, XI, XM(576),                          CS1
     *          XMAX, XMIN, XP, YC, YM(48)                               CS1
      DIMENSION     X(N), Y(N), C(24),                                  CS1
     *              XDP(48), XYDP(24)                                   CS1
      EQUIVALENCE    (MTXEQT(1),XDP(1)), (MTXEQT(97),XYDP(1))           CS1
      DATA     KMAX/ 23/                                                CS1
C                                                                       CS1
C     CHECK K AND N FOR PROPER RANGE                                    CS1
C                                                                       CS1
      IF (K .GT. KMAX .OR. N .LE. K .OR. K .LE. 0)     GO TO 200        CS1
      L=K+1                                                             CS1
C                                                                       CS1
C     FIND MINIMUM AND MAXIMUM VALUES FOR X                             CS1
C                                                                       CS1
      XMIN=X(1)                                                         CS1
      XMAX=X(1)                                                         CS1
      DO 10 I=2,N                                                       CS1
      XMIN = AMIN1(XMIN,X(I))                                           CS1
   10 XMAX = AMAX1(XMAX,X(I))                                           CS1
C                                                                       CS1
C     ZERO DOUBLE PRECISION ARRAYS FOR SUMMING                          CS1
C                                                                       CS1
      M=2*K+1                                                           CS1
      DO 20 I=1,M                                                       CS1
   20 XDP(I) = 0.0                                                      CS1
      DO 25 I=1,L                                                       CS1
   25 XYDP(I) = 0.0                                                     CS1
C                                                                       CS1
C     TRANSFORM RANGE OF X TO (-1,+1) AND                               CS1
C     COMPUTE SUMS OF POWERS OF X AND SUMS                              CS1
C     OF Y TIMES POWERS OF X                                            CS1
C                                                                       CS1
      C1 = 2.0 / (XMAX - XMIN)                                          CS1
      C2 = (XMAX + XMIN) / (XMAX - XMIN)                                CS1
      LL=K+2                                                            CS1
      LU=2*K+1                                                          CS1
      DO 40 I=1,N                                                       CS1
      XP = 1.0                                                          CS1
      XI = C1 * X(I) - C2                                               CS1
      DO 30 J=1,L                                                       CS1
      XDP(J)=XDP(J)+XP                                                  CS1
      XYDP(J)=XYDP(J)+XP*Y(I)                                           CS1
   30 XP=XP*XI                                                          CS1
      DO 40 J=LL,LU                                                     CS1
      XDP(J)=XDP(J)+XP                                                  CS1
   40 XP=XP*XI                                                          CS1
C                                                                       CS1
C     STORE ABOVE COMPUTED SUMS IN ARRAY XM                             CS1
C     AND COMPUTE ROW SUMS FOR CHECK SOLUTION                           CS1
C                                                                       CS1
      DO 50 I=1,L                                                       CS1
      LL=I+L                                                            CS1
      YM(LL)=0.0                                                        CS1
      LU=(I-1)*L                                                        CS1
      JK=I-1                                                            CS1
```

```
      DO 50 J=1,L                                                       CS1
      JK=JK+1                                                           CS1
      JC=LU+J                                                           CS1
      XM(JC)=XDP(JK)                                                    CS1
 50   YM(LL)=YM(LL)+XM(JC)                                              CS1
      DO 60 I=1,L                                                       CS1
 60   YM(I)=XYDP(I)                                                     CS1
C                                                                       CS1
C     SOLVE THE SYSTEM XM*C=YM                                          CS1
C                                                                       CS1
      CALL MTXEQ(XM,YM,YM,L,2)                                          CS1
C                                                                       CS1
C     REORDER AND MOVE SOLUTION TO C AND FIND                           CS1
C     MAXIMUM ERROR IN CHECK SOLUTION                                   CS1
C                                                                       CS1
      EMEQ=0.0                                                          CS1
      DO 70 I=1,L                                                       CS1
      JK=K-I+2                                                          CS1
      C(JK)=YM(I)                                                       CS1
      JC=I+L                                                            CS1
 70   EMEQ=AMAX1(EMEQ,ABS(YM(JC)-1.0))                                  CS1
C                                                                       CS1
C     ADJUST COEFFICIENTS FOR ORIGINAL RANGE                            CS1
C     OF X                                                              CS1
C                                                                       CS1
      DO 80 I=1,K                                                       CS1
      DO 80 J=1,I                                                       CS1
 80   C(J) = C(J) * C1                                                  CS1
      C1 = (XMAX + XMIN) / 2.0                                          CS1
      DO 90 I=1,K                                                       CS1
      M=L-I+1                                                           CS1
      DO 90 J=2,M                                                       CS1
 90   C(J) = -C1 * C(J-1) + C(J)                                        CS1
C                                                                       CS1
C     INITIATE PRINT OF ERROR ANALYSIS IF LIST .NE. 0                   CS1
C                                                                       CS1
      IF (LIST.EQ.1) PRINT 1001                                         CS1
C                                                                       CS1
C     COMPUTE MAXIMUM AND ROOT MEAN SQUARE ERRORS                       CS1
C     AND OUTPUT ERROR ANALYSIS IF LIST .NE. 0                          CS1
C                                                                       CS1
      EMAX=0.0                                                          CS1
      SUM=0.0                                                           CS1
      DO 130 I=1,N                                                      CS1
      YC=C(1)                                                           CS1
      DO 100 J=1,K                                                      CS1
 100  YC=YC*X(I)+C(J+1)                                                 CS1
      DIF=YC-Y(I)                                                       CS1
      IF (LIST.EQ.0) GO TO 120                                          CS1
      IF (I .GT. L)    GO TO 110                                        CS1
      PRINT 1002, I, X(I), Y(I), YC, DIF, C(I)                          CS1
      GO TO 120                                                         CS1
 110  PRINT 1002, I, X(I), Y(I), YC, DIF                                CS1
 120  EMAX=AMAX1(EMAX,ABS(DIF))                                         CS1
 130  SUM=SUM+DIF**2                                                    CS1
```

```
      ERMS=SQRT(SUM/FLOAT(N))                                           CS1
      IF (LIST.EQ.1) PRINT 1003, EMAX, ERMS, EMEQ                       CS1
      RETURN                                                            CS1
C                                                                       CS1
C     GIVE ERROR MESSAGE AND RETURN TO                                  CS1
C     SYSTEM VIA FXEM                                                   CS1
C                                                                       CS1
  200 PRINT 1000, N, K                                                  CS1
      CALL SYSTEM (200,1L )                                             CS1
      RETURN                                                            CS1
 1000 FORMAT (3H0N=,I12,3H K=,I12,29HINCORRECT FOR SUBROUTINE PLSQ)     CS1
 1001 FORMAT (1H1,20X,32HPLSQ    POLYNOMIAL LEAST SQUARE                CS1
     *24HCURVE FIT ERROR ANALYSIS//                                     CS1
     *6H0    I,11X,9HX - GIVEN,11X,9HY - GIVEN,11X,                     CS1
     *10HY - FITTED,12X,5HERROR,16X,4HB(I)//)                           CS1
 1002 FORMAT (1X,I5,8X,5(1PE14.6,6X))                                   CS1
 1003 FORMAT (1H0,9X,5HEMAX=,1PE15.6,9X,5HERMS=,E15.6,                  CS1
     *9X,5HEMEQ=,E15.6)                                                 CS1
      END                                                               CS1
```

```
      SUBROUTINE MTXEQ(A,X,B,N,K)                                       CS1
C                                                                       CS1
C     MATRIX EQUATION SOLVER     (7094 FORTRAN IV)                      CS1
C                                                                       CS1
C     USAGE...                                                          CS1
C                                                                       CS1
C     TO SOLVE THE LINEAR SYSTEM     AX=B                               CS1
C                                                                       CS1
C     CALL MTXEQ(A,X,B,N,K)                                             CS1
C                                                                       CS1
C        WHERE A MUST BE DIMENSIONED N X N                              CS1
C              X MUST BE DIMENSIONED N X K                              CS1
C              B MUST BE DIMENSIONED N X K                              CS1
C              N IS THE NO. OF EQUATIONS (ROWS IN A,X,B)                CS1
C              K IS THE NO. OF SOLUTION VECTORS (COLS. IN X,B)          CS1
C                                                                       CS1
C     664 CELLS OF BLANK COMMON ARE USED.                               CS1
C                                                                       CS1
C     NOTE...   TO CHANGE DIMENSIONS OF ARRAYS C AND PIV, ALSO          CS1
C            CHANGE VALUES OF NMAX AND NKMAX IN DATA STATEMENT.         CS1
C                                                                       CS1
C                                                                       CS1
      DIMENSION   A(N,N), B(N,K), X(N,K)                                CS1
      COMMON   ATPE, I, IFROM, IP1, IPIV, ITO,                          CS1
     1         J, KP, L, NP, NP1, NPJ, NPK, RM                          CS1
      COMMON     PIV(26), C(24,26)                                      CS1
      DATA     NMAX, NKMAX/ 24, 26/                                     CS1
C                                                                       CS1
C     GET ARGUMENTS N AND K.                                            CS1
C                                                                       CS1
      NP=N                                                              CS1
      KP=K                                                              CS1
C                                                                       CS1
C       ST N AND K FOR CORRECT RANGE                                    CS1
C                                                                       CS1
      IF(NP.LE.0.OR.NP.GT.NMAX) GO TO 190                               CS1
      IF(KP.LE.0.OR.(NP+KP).GT.NKMAX) GO TO 190                         CS1
C                                                                       CS1
C     MOVE ARRAYS A(I,J) AND B(I,J) INTO C(I,J)                         CS1
C                                                                       CS1
      DO 10 J=1,NP                                                      CS1
      DO 10 I=1,NP                                                      CS1
   10 C(I,J)=A(I,J)                                                     CS1
      DO 20 J=1,KP                                                      CS1
      NPJ=NP+J                                                          CS1
      DO 20 I=1,NP                                                      CS1
   20 C(I,NPJ)=B(I,J)                                                   CS1
C                                                                       CS1
C     SET TO PERFORM N ELIMINATION SWEEPS (I=1,N)                       CS1
C                                                                       CS1
      NP1=NP+1                                                          CS1
      NPK=NP+KP                                                         CS1
      DO 120 I=1,NP                                                     CS1
      IP1=I+1                                                           CS1
C                                                                       CS1
```

```
C     SEARCH FOR NEXT PIVOT ROW (I-TH PIVOT IS IN COL. I)                CS1
C                                                                        CS1
      ATPE=0.                                                            CS1
      DO 40 J=I,NP                                                       CS1
      IF (ABS(C(J,I))-ATPE) 40,30,30                                     CS1
 30   ATPE=ABS(C(J,I))                                                   CS1
      IPIV=J                                                             CS1
 40   CONTINUE                                                           CS1
C                                                                        CS1
C     OPERATE ON THE PIVOT ROW                                           CS1
C                                                                        CS1
      IF (ATPE) 210,210,50                                               CS1
 50   DO 60 J=IP1,NPK                                                    CS1
 60   PIV(J)=C(IPIV,J)/C(IPIV,I)                                         CS1
C                                                                        CS1
C     PERFORM ELIMINATIONS BELOW THE DIAGONAL (COL. I)                   CS1
C                                                                        CS1
      IFROM=NP                                                           CS1
      ITO=NP                                                             CS1
 70   IF (IFROM-IPIV) 80,100,80                                          CS1
 80   RM=-C(IFROM,I)                                                     CS1
      DO 90 J=IP1,NPK                                                    CS1
 90   C(ITO,J)=C(IFROM,J)+RM*PIV(J)                                      CS1
      ITO=ITO-1                                                          CS1
 100  IFROM=IFROM-1                                                      CS1
      IF (IFROM-I) 110,70,70                                             CS1
C                                                                        CS1
C     PUT THE I-TH PIVOT ROW IN THE VACATED ROW I                        CS1
C                                                                        CS1
 110  DO 120 J=IP1,NPK                                                   CS1
 120  C(I,J)=PIV(J)                                                      CS1
C                                                                        CS1
C     NOW DO THE BACK SOLUTION                                           CS1
C                                                                        CS1
      I=NP                                                               CS1
 130  IP1=I                                                              CS1
      I=I-1                                                              CS1
      IF (I) 190,140,140                                                 CS1
 140  DO 150 J=IP1,NPK                                                   CS1
      DO 150 L=IP1,NP                                                    CS1
 150  C(I,J)=C(I,J)-C(I,L)*C(L,J)                                        CS1
      GO TO 130                                                          CS1
C                                                                        CS1
C     MOVE THE SOLUTION TO ARRAY X(I,J)                                  CS1
C                                                                        CS1
 160  DO 170 J=1,KP                                                      CS1
      NPJ=NP+J                                                           CS1
      DO 170 I=1,NP                                                      CS1
 170  X(I,J)=C(I,NPJ)                                                    CS1
 180  RETURN                                                             CS1
C                                                                        CS1
 190  PRINT 1000, NP, KP                                                 CS1
      CALL SYSTEM (200,1L )                                              CS1
      STOP                                                               CS1
 210  PRINT 1001                                                         CS1
```

```
      CALL SYSTEM (200,1L )                                          CS1
      STOP                                                           CS1
 1000 FORMAT(3H0N=I12,5H   K=I12,35H ARE INCORRECT FOR SUBROUTINE MTXEQ) CS1
 1001 FORMAT (37H0DET(A)=0 IN CALL TO SUBROUTINE MTXEQ)              CS1
      END                                                            CS1
```