LIFE CYCLE COST IN THE CONCEPTUAL DESIGN OF SUBSONIC COMMERCIAL AIRCRAFT

VOLUME 2 - SOFTWARE-RELATED APPENDICES

Dissertation

by

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INTRODUCTION

This volume contains details related to the software used in the LCC Conceptual Design System which is described in Volume 1. Documentation for the FLOPS (Flight Optimization System) code is contained in Appendix A and a listing of the code in Appendix B. Both of these were provided by L. Arnold McCullers of PRC Kentron. Documentation of the LCC Module developed for this effort is contained in Appendix C while Appendix D contains a listing of the source code. Finally, Appendix E contains a descritpion of the process to integrate the cost module into FLOPS.

APPENDIX A

FLOPS DOCUMENTATION

From L. Arnold McCullers

FLOPS

Flight Optimization System

Release 2.0

User's Guide

Revised October 1986

L. A. McCullers

Introduction

The Flight Optimization System (FLOPS) is a multidisciplinary system of computer programs for conceptual and preliminary design and evaluation of advanced aircraft concepts. It consists of four primary modules: 1) weights, 2) aerodynamics, 3) mission performance, and 4) takeoff and landing.

The weights module uses statistical/empirical equations to predict the weight of each item in a group weight statement. Centers of gravity and moments of inertia can also be calculated for multiple fuel conditions.

The aerodynamics module uses a version of the EDET (Empirical Drag Estimation Technique*) program to provide drag polars for performance calculations. Alternatively, drag polars may be input and then scaled with variations in wing area and engine (nacelle) size.

The mission performance module uses the calculated weights and aerodynamics data and an engine deck to calculate performance. The engine deck consists of thrust and fuel flow data at a variety of Mach-altitude conditions. Based on energy considerations, optimum climb profiles may be flown to start of cruise conditions. The cruise segments may be flown at the optimum altitude for maximum range, at the long range cruise Mach number, or at the optimum Mach number for maximum endurance. Descent may be flown at the optimum lift-drag ratio. Reserve calculations include flight to an alternate airport and a specified hold segment.

The takeoff and landing module computes the all-engine takeoff field length, the balanced field length including one-engine-out takeoff and aborted takeoff, and landing field length. The approach speed is also calculated, and the second segment climb gradient and the missed approach climb gradient criteria are evaluated.

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*Feagin, Richard C. and Morrison, William D., Jr.: Delta Method, An Empirical Drag Buildup Technique. NASA CR-15171, December 1978.

FLOPS may be used to analyze a point design, parametrically vary certain design variables, or optimize a configuration with respect to these design variables (for minimum gross weight, minimum fuel burned, or maximum range) using nonlinear programming techniques. The available design variables are wing area, wing sweep, wing aspect ratio, wing taper ratio, wing thickness-chord ratio, gross weight, thrust (size of engine), cruise Mach number, and maximum cruise altitude.

Most of the input data is in Namelist format with default values coded into the program. For new users, it is recommended that these default values be used whenever there is some uncertainty as to the meaning or appropriate value of a given parameter (i.e., "When in doubt, leave it out"). In most cases, this will provide reasonable results.

Input Data Stream Order

Job Control Cards

Option Card

Title Card

Namelist $WTIN

Namelist $CONFIN

Namelist $AERIN

Namelist $ARIDE

Namelist $COSTIN

Namelist $ENGDIN

Engine Deck

Namelist $MISSIN

Mission Definition Data

Aerodynamic Data

Namelist $TOLIN

Namelist $SYNTIN

A. Job Control Cards

```
Job Card

User Card

Charge Card

GET, BFLOP/UN = 581650C.

* GET, BTRNWT/UN = 581650C.  (For fighter/attack aircraft, use BFAWT in place
                               of BTRNWT (2 places).  See also SPECIAL instruc-
                               tions immediately before Namelist $WTIN section
                               of the Users Guide.)

GET, BEDET/UN = 581650C.

GET, BMISS/UN = 581650C.

GET, BTOFF/UN = 581650C.

LDSET, PRESET = ZERO.

* LOAD (BFLOP, BTRNWT, BEDET, BMISS, BTOFF)

EXECUTE.

SAVE, TAPE7.  (If plot data has been generated)

-EOR-
```

B. Option Card

Columns 1-4

ANALysis	Analyze input configuration
PARAmetric variation	Perform a matrix of analyses varying the design variables as indicated in Namelist $CONFIN
OPTImization	Optimize the configuration using the design variables as indicated in Namelist $CONFIN
CONTour plot	Prepare data on TAPE7 for plotting contours of OBJ versus two parametrically varying design variables (See Namelist $CONFIN)

Columns 39-40

NCONINT	Number of contour intervals (≤40) to be plotted for CONTour plot option (Default = 10)

Columns 41-44

WEIGht	Compute only weights
AERODynamics	Compute weights and aerodynamics
TAKEoff Land Only	Compute only detailed takeoff and/or landing performance as specified in AERIN. (Weights specified in WTIN and in WLDG in WTIN)
(blank)	Full analysis including mission

C. Title Card

Columns 1-80	Any alphanumeric title

SPECIAL INFORMATION FOR FIGHTER ATTACK TYPE AIRCRAFT

Namelist $WTIN - The following information is to be used only when BFAWTS is selected (fighter/attack type aircraft). If not, go on to Namelist $WTIN section. (Default = 0. unless noted.)

Name	Description
VSINK	Sink rate (Default = 9.)
VARSWP	= 0., Normal =1., Variable sweep wing
DELFAC	= 0., Normal = 1., Delta wing (When 1. is selected, the sweep of the 3/4 chord line should be input in SWEEP (Namelist $CONFIN) for wing weight estimation. Aerodynamics computed by MYAERO = 0. in Namelist $AERIN will be incorrect.)
GLOV	Total glove and bat area beyond theoretical wing, sq.ft.
TCR CAN	Canard thickness-ratio at root
TCT CAN	Canard thickness-ratio at tip
FRLG	Landing gear weight override parameter
WPMISC	Additional miscellaneous propulsion system wts. (see report)

* Omit TCCAN, TCFIN, and NFIN, FRLGN and FRLGM as described in Namelist $WTIN Section.

Namelist $CONFIN

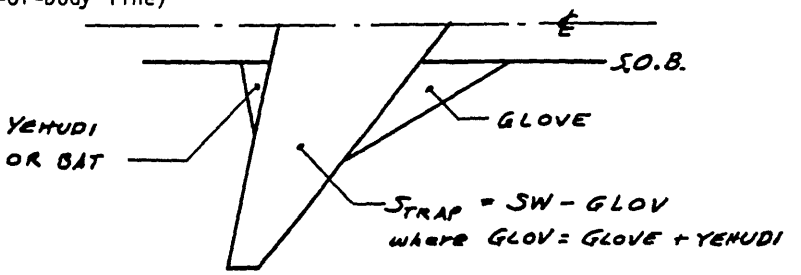
The relationship between AR and SW from $CONFIN, and SPAN and GLOV from $WTIN is as follows:

$$AR = SPAN^{**}2/(SW-GLOV)$$

Non zero values for two of AR, SW and SPAN must be input. The other is calculated. If all three are input, GLOV is calculated.

The definition of wing area used in (BFAWTS) is different than that normally used in FLOPS. This definition for BFAWTS is:

SW = Reference wing area, sq.ft. (trapezoidal plus glove and yehundi area outside the side-of-body line)



D. Namelist $WTIN (Default = 0. unless otherwise noted)

Name	Description
VMMO	Maximum operating Mach number, if less than 0.5 and less than VCMN (Namelist $CONFIN), it is assumed to be an increment above VCMN (Maximum value 1.0)
ULF	Structural ultimate load factor
DGW	Fraction or input design gross weight (Default = 1.0) x GW in $CONFIN
NWREF	The number of the reference weight for percentage weight output. Typical values are: 39 - Ramp Weight (Default) 37 - Zero Fuel Weight 33 - Operating Weight Empty 26 - Weight Empty
CGREFL	Reference length for percentage C.G. location output, in. (Default = XL*12., fuselage length)
CGREFX	X - location of start of reference length, in. (Default =0.)
MYWTS	= 0, weights will be computed (Default) = 1, otherwise
HYDPR	Hydraulic System pressur (Default = 3000.)

Wing Data

TCR*	Thickness-chord ratio at wing root
TCB*	Thickness-chord ratio at wing break
TCT*	Thickness-chord ratio at wing tip
PCTB*	Wing break location - fraction of semispan
PCTR*	Decimal portion of span over which TCR applicable (optional), "carry-thru" width/wing span
SPAN	Wing span (optional, see $CONFIN - SW and AR)
DIH	Wing dihedral (positive or anhedral (negative angle), deg
FLAPR	Flap ratio; ratio of total movable surface area (flaps, elevators, spoilers, etc.) to wing area (Default = .333)
FLAPC	Flap complexity factor (Default = 1.0)

*Note: These five values are used to calculate an initial value of TCA (Namelist $CONFIN). If a non-zero value of TCA is input, they are not used.

Namelist $WTIN - Continued

Name	Description
FCOMP	Decimal fraction of amount of composites used in wing structure
FAERT	Decimal fraction of amount of aeroelastic tailoring used in design of wing
FSTRT	= 0, no wing strut = 1, wing is strut braced
Horizontal Tail Data	(This component must be input if drag is to be internally completed, i.e., MYAERO = 0 in AERIN)
SHT	Horizontal tail theoretical area, sq ft
SWPHT	Horizontal tail 25% chord sweep angle, deg
ARHT	Horizontal tail theoretical aspect ratio
TRHT	Horizontal tail theoretical taper ratio
TCHT	Thickness-chord ratio for the horizontal tail
HHT	Decimal portion of vertical tail span where horizontal tail is mounted (zero for body mounted)
Vertical Tail Data	(For multiple components, input as per NVERT in AERIN)
SVT	Vertical tail theoretical area, sq ft
SWPVT	Vertical tail sweep angle at 25% chord, deg
ARVT	Vertical tail theoretical aspect ratio
TRVT	Vertical tail theoretical taper ratio
TCVT	Thickness-chord ratio for the vertical tail
Fin Data	(Drag will not be computed internally)
SFIN	Vertical fin theoretical area, sq ft
ARFIN	Vertical fin theoretical aspect ratio
TRFIN	Vertical fin theoretical taper ratio
SWPFIN	Vertical fin sweep angle at 25% chord, deg
TCFIN	Vertical fin thickness - chord ratio
NFIN	Number of fins

Name	Description
Canard Data	(Drag will not be computed internally)
SCAN	Canard theoretical area, sq ft
SWPCAN	Canard sweep angle at 25% chord, deg
ARCAN	Canard theoretical aspect ratio
TRCAN	Canard theoretical taper ratio
TCCAN	Canard thickness-chord ratio
VCAN	Any variable geometry feature in the canard (= 1, will be computed . = 0, omitted)
Fuselage Data	
XL	Fuselage total length, ft
WF	Maximum fuselage width, ft
DF	Maximum fuselage depth, ft
XLP*	Length of passenger compartment, ft (Default is internally computed)
WP*	Maximum width of passenger compartment (optional), ft
HP*	Maximum depth of passenger compartment (optional), ft
Landing Gear Data	
XMLG	Length of extended main landing gear oleo (optional), in.
XNLG	Length of extended nose landing gear oleo (optional), in.
WLDG	Design landing weight (optional), lbf (if WRATIO is input in Namelist $AERIN, WLDG = GW*WRATIO)

*Note: Input of non-zero values for these three parameters triggers an alternate Furnishings Weight equation. XLP is also used in the equation for Air Conditioning Weight.

Namelist $WTIN - Continued

Propulsion System Data

Name	Description
NEW	Number of wing mounted engines
NEF	Number of fuselage mounted engines
THRSO	Rated thrust of baseline engine as described in Engine Deck, lbf (Default = THRUST, see $CONFIN)
WENG	Weight of each baseline engine, lbf (Default = .197*THRSO)
EEXP	Engine weight scaling parameter (default = 1.15) W(Engine) = WENG*(THRUST/THRSO)**EEXP If EEXP is less than 0.3, W(Engine) = WENG + (THRUST-THRSO)*EEXP
XNAC	Average length of baseline engine nacelles, ft
DNAC	Average diameter of baseline engine nacelles, ft
FUELWMX	Total fuel capacity of wing, lbm (calculated internally if less than 50 or if a negative value is input)
FUELFMX	Total fuel capacity of fuselage (wing "carry-thru" structure and/or in fuselage tanks), lbm
NTANK	Number of tanks (Default = 1, Maximum = 20)

Crew and Payload Data

NPF	Number of first class passengers
NPT	Number of tourist passengers
NSTU	Number of stewardesses (optional)
NGALC	Number of galley crew (optional)
NFLCR	Number of flight crew (optional)
CARGF	Cargo aircraft floor factor (= 1, will be computed, = 0, omitted)
CARGOW	Cargo (other than passenger baggage, which is computed internally) carried in wing, lbf
CARGOF	Cargo (other than passenger baggage) carried in fuselage, lbf
CONDEN	Cargo container weight per foot fuselage width, lbf/ft (Default=2.54)

Override Parameters

The following parameters are used to modify or override internally computed weights for various components as follows: (Default = 1. if not otherwise noted)

< 0., negative of starting weight which will be modified as appropriate during optimization or parametric variation, lbf

= 0., no weight for that component

> 0. but ≤ 5., scale factor applied to internally computed weight

> 5., actual fixed weight for component, lbf

Name	Description
FRWI	Wing weight
FRHT	Horizontal tail weight
FRVT	Vertical tail weight
FRFIN	Wing vertical fin weight
FRCAN	Canard weight
FRFU	Fuselage weight
FRLGN	Landing gear weight, nose
FRLGM	Landing gear weight, main
FRNA	Total weight of nacelles
WPMSC	Weight of miscellaneous propulsion systems such as starter and wiring
WFSYS	Weight of fuel system
FRSC	Surface controls weight
WIN	Instrument Group weight
WHYD	Hydraulics Group weight
WELEC	Electrical Group weight
WAVONC	Avionics Group weight
WFURN	Furnishings Group weight
WAC	Air Conditioning Group weight

Namelist $WTIN - Continued

WAI	Anti-icing Group weight (Will compute auxiliary gear for fighters)
WUF	Weight of unusable fuel
WOIL	Engine oil weight
WSRV	Passenger service weight (Will compute armament weight for fighters)
WAPU	Auxiliary power unit weight (Transport only - BTRNWT)
WCON	Cargo and baggage container weight (Transport only - BTRNWT)

* Remaining item in this section must be input if wanted, i.e., Default = 0.)*

WTHR	Total weight of thrust reversers

Center of Gravity (C.G.) Data - Used only in C.G. and inertia calculations. C.G. and inertia results are not currently used in other FLOPS modules and are therefore not necessary. All C.G. dimensions are in inches.

CGW	Horizontal C.G. of wing
CGHT	Horizontal C.G. of horizontal tail
CGVT	Horizontal C.G. of vertical tail
CGFIN	Horizontal C.G. of wing vertical fins
CGCAN	Horizontal C.G. of canard
CGF	Horizontal C.G. of fuselage
CGLGN	Horizontal C.G. of nose landing gear
CGLGM	Horizontal C.G. of main landing gear
CGEF	Horizontal C.G. of two forward mounted engines
CGEA	Horizontal C.G. of one or two aft mounted engines
CGAP	Horizontal C.G. of APU
CGAV	Horizontal C.G. of Avionics Group (optional)
CGCR	Horizontal C.G. of flight crew
CGP	Horizontal C.G. of passengers
CGCW	Horizontal C.G. of cargo in wing

Namelist $WTIN - Continued

CGCF	Horizontal C.G. of cargo in fuselage
CGZWF	Horizontal C.G. of fuselage fuel
CGFWF	Horizontal C.G. of wing fuel in full condition

Inertia Data - Used only in inertia and vertical C.G. calculations. Vertical distances are measured from and perpendicular to the bottom of the fuselage.

Name	Description
INERTIA	= 1, Aircraft inertias will be calculated = 0, Otherwise (Default)
ZHT	Vertical C.G. of the horizontal tail (optional)
ZVT	Vertical C.G. of the vertical tail (optional)
ZFIN	Vertical C.G. of the vertical fin (optional)
YFIN	Lateral C.G. of the vertical fin (optional)
ZEF	Vertical C.G. of two forward mounted engines (optional)
YEF	Lateral C.G. of two forward mounted engines (optional, may be input as a fraction of the semispan)
ZEA	Vertical C.G. of one or two aft mounted engines (optional)
YEA	Lateral C.G. of one or two aft mounted engines (optional, may be input as a fraction of the semispan)
ZBW	Lowermost point of wing root airfoil section
ZAP	Vertical C.G. of APU (optional)
ZRVT	Vertical datum line (Water Line) of vertical tail theoretial root chord (optional, if blank assumes at maximum height of fuselage)
YMLG	Lateral C.G. of extended main landing gear
YFUSE	Lateral C.G. of outboard fuselage if there is more than one fuselage
YVERT	Lateral C.G. of outboard vertical tail if there is more than one vertical tail
SWTFF	Gross fuselage wetted area, sq ft (Default = internally computed)

For inertia calculations, all mission fuel and payload (passengers, passenger baggage, and cargo) are placed in "tanks."

Name	Description
NTANK	Number of tanks (Default = 1, Maximum = 20)(Already input in propulsion section)
NFCON	Number of fuel conditions (Default = 1, Maximum = 3)
TX(i), TY(i), TZ(i)	x, y and z coordinates of the centroid of the i^{th} tank
TL(i), TW(i), TD(i)	Length, width and depth of the i^{th} tank (optional, used only in calculating I_0's which may be negligible)
TF(i,j)	Weight of fuel (or payload) in i^{th} tank for j^{th} fuel condition, lbm

E. Namelist $CONFIN (Default = 0. unless otherwise noted)

Name	Description
DESRNG	Design range, n.mi. (or endurance, min. See INDR in Namelist $MISSIN)
WSR	>0., required wing loading (Namelist $MISSIN). Do not use during optimization or if wing area is being varied. = -1., interpret SW as wing loading for optimization and parametric variation.
TWR	>0., required thrust-weight ratio. Do not use during optimization or if thrust is being varied. = -1., interpret THRUST as thrust-weight ratio for optimization and parametric variation.
HTVC	Modified horizontal tail volume coefficient. If HTVC > 0., SHT = HTVC*SW*(SW/AR)**.5/XL. If HTVC = 1., the horizontal tail volume coefficient calculated from the input values of SHT, SW, AR and XL will be maintained during design or parametric variation.
VTVC	Modified vertical tail volume coefficient. If VTVC > 0., SVT=VTVC*SW*(SW*AR)**.5/XL. If VTVC=1., the vertical tail volume coefficient calculated from the input values of SVT, SW, AR and XL will be maintained during design or parametric variation.
OFC	Objective weighting factor for cost (Default = 0. Should be negative to maximize
OFG	Objective function weighting factor for gross weight
OFF	Objective function weighting factor for mission fuel (Default = 1.)
OFM	Objective function weighting factor for Mach*(L/D), should be negative to maximize
OFR	Objective function weighting factor for Range, should be negative to maximize.

The function that is minimized is

OBJ = OFG*GW + OFF*Fuel + OFM*VCMN*(Lift/Drag) + OFR*Range

Design Variables

Each design variable is actually a five element vector. For optimization, the elements are:

(1) Initial value
(2) Activity status, active if > 0. (Default = 0.)
(3) Lower bound (Default = Initial value/10.)
(4) Upper bound (Default = Initial value * 10.)
(5) Optimization scale factor. (See AUTOSCL (Namelist $SYNTIN) for default value. If negative, the inverse of the design variable will be used for optimization.

If the design variable is inactive or if only an analysis is being performed, the design variable may be input as a scalar.

Namelist $CONFIN - Concluded

Name	Description
GW	Ramp weight, lbf
AR	Wing aspect ratio
THRUST	Maximum rated thrust per engine, lbf, or thrust-weight ratio if TWR = -1.
SW	Reference wing area, sq ft, or wing loading (GW/SW) if WSR = -1. (Wing geometry, SW, R, TR, includes glove and/or bat area to side-of-body, then projected in perpendicular to fuselage center line.
TR	Taper ratio of the wing
SWEEP	Quarter-chord sweep angle of the wing, degrees
TCA	Thickness-chord ratio (weighted average, Default is computed from TCR, TCB, and TCT)
VCMN	Cruise Mach number
CH	Maximum cruise Altitude, ft

The relationship between AR and SW from $CONFIN, and SPAN and GLOV from $WTIN is as follows:

$$AR = SPAN^{**}2/(SW)$$

Nonzero values for two of AR, SW and SPAN must be input. The other is calculated. If all three are input, GLOV is calculated.

Parametric Variation

For parametric variation, the design variable vector elements change definition. If Element (2) is less than 2., Element (1) is used as the fixed value for that variable (except for GW if RW = 1, and SW and/or THRUST if WSR and/or TWR, respectively, are input). Otherwise, that design variable will be varied Element (2) times, from Element (3) to Element (4) in equal steps. In this case, Element (5) is ignored, and Element (1) is used only as a reference value, e.g., SW(1) and AR(1) in calculating HTVC if it is input as 1. or THRUST(1) as a default for THRSO (Namelist $WTIN). For example, inputting AR = 10., 3., 9., 13., TCA = 0., 4., .10, .13, would result in a matrix of 12 analyses with aspect ratios of 9, 11 and 13 and thickness-chord ratios of .10, .11, .12 and .13. For contour plotting, only two design variables may be varied with up to 15 values each.

F. Namelist $AERIN (Default = 0. unless otherwise noted)

Name	Description
MYAERO	= 0, drag polars computed internally (Default) = 1, Aerodynamic Data (Section J) read in = 2, Input Aerodynamic Data will be scaled (See Section J) = 3, Special Aerodynamic Data format (See Section J)
IWAVE	= 1, Input Wave Drag Data (see Section J) will be formatted = 0, Otherwise
INENG	= 0, engine deck is not read in (Default if no mission analysis is to be performed) = 1, engine deck is read in (Default if mission analysis is to be performed)

Internally Computed Aerodynamics Input Data

NFUSE	Number of fuselages (Default = 1)
NVERT	Number of vertical tails (Default = 1)
CAM	Maximum camber at 70% semispan, percent of local chord
SBASE	Aircraft base area (total exit cross-section area minus inlet capture areas for internally mounted engines), sq ft
AITEK	Airfoil technology parameter. Limiting values are: 1. = conventional wing (Default) 2. = advanced technology wing
MODAERO	= 1, Data tables in EDET are to be modified, Namelist $ARIDE (Section F-1) read in = 0, Otherwise (Default)
XLLAM	= 0., Turbulent flow assumed = 1., Laminar Flow (LF) assumed as indicated below
TRUW, TRLW	Percent LF wing upper surface, lower surface
TRUH, TRLH	Percent LF horizontal tail upper surface, lower surface
TRUV, TRLV	Percent LF vertical tail upper surface, lower surface
TRUB, TRLB	Percent LF fuselage upper surface, lower surface
TRUN, TRLN	Percent LF nacelle upper surface, lower surface
E	Aerodynamic efficiency factor = 1., "normal" wing efficiency assumed (Default) $\leq$ 0., "normal" wing efficiency modified for taper ratio and aspect ratio plus E Otherwise, "normal" wing efficiency multiplied by E

The following parameters may be used to override internally computed values of wetted area in the same manner and with the same options described in Section D for the weight override parameters.

Name	Description
SWETW	Wing wetted area
SWETH	Horizontal tail wetted area
SWETV	Vertical tail wetted area
SWETF	Fuselage wetted area
SWETN	Nacelle wetted area

Takeoff and Landing Data

WRATIO	Ratio of maximum landing weight to maximum takeoff weight (Default = WLDG/GW if WLDG is input, Default = 1. - .000075 * DESRNG, otherwise)
VAPPR	Maximum allowable landing approach velocity, kts (Default = 150.)
FLTO	Maximum allowable takeoff field length, ft (Default = 12000.)
FLLDG	Maximum allowable landing field length, ft (Default = FLTO)
ITAKOFF	= 1, Detailed takeoff performance will be calculated (Namelist $TOLIN required) = 0, Otherwise (Default)
ILAND	= 1, Detailed landing performance will be calculated (Namelist $TOLIN required) = 0, Otherwise (Default)

The following parameters are used only for approximate takeoff and landing calculations, or, for CLTOM and CLLDM, as default values for data in Namelist $TOLIN.

Name	Description
CLTOM	Maximum C_L in takeoff configuration (Default = 2.)
CLLDM	Maximum C_L in landing configuration (Default = 3. or 1.69 CLAPP if it is input)
CLAPP	Approach C_L
DRATIO	Takeoff and landing air density ratio (Default = 1., sea level standard day)
ELODSS	Lift-Drag ratio for second segment climb (Default is internally computed)
ELODMA	Lift-Drag ratio for missed approach climb (Default is internally computed)
THRSS	Thrust per engine for second segment climb, lbf (Default = THRUST, Namelist $CONFIN)
THRMA	Thrust per engine for missed approach climb, lbf (Default = THRSS)

F-1. Namelist $ARIDE (Used only if MODAERO = 1 in Namelist $AERIN)

The namelist contains replacement data for the aerodynamic data tables in EDET. The data can be modified on an element by element basis, or entire arrays may be replaced. The arrays which can be modified with their maximum dimensions are listed below. See the EDET documentation and listing for definitions and current values.

AR05 (132)
AR1 (132)
AR2 (132)
AR4 (132)
AR6 (120)
ARS07 (110)
ARS08 (110)
ARS10 (110)
ARS12 (110)
ARS14 (110)
ARS16 (110)
ARS18 (110)
ARS20 (110)
AMDES (36)
CMDES (32)
HSMDES (28)
PCW (112)
BSUB (90)
PCAR (170)
BSUP (105)
BINT (154)
BUFT (99)

G. Namelist $ENGDIN

Name	Description
EXTFAC	Slope factor for extrapolating engine fuel flows for thrust levels above the maximum for that Mach number and altitude (Default = 1.)
IDLE	$\geq$ 1, Flight idle data will be internally generated with zero thrust and an extrapolated fuel flow. The fuel flow must be at least 8 percent of the fuel flow for the IDLEth power setting. = 0, The lowest input power setting is assumed to be flight idle (Default)
IXTRAP	= 1, Prevents improvement in SFC for engine data extrapolated beyond altitudes provided in input data (Default) = 0, Linear extrapolation of both thrust and fuel flow data may result in radically improved SFC's
IFILL	= 0, no part power data will be generated > 0, part power cruise data will be filled in for Mach-altitude points for which IFILL (or fewer) thrust levels have been input (Default = 2)
MAXCR	Maximum power setting used for cruise (Default = 2)
BOOST	> 0., Scale factor for boost engine to be added to baseline engine for takeoff and climb. Climb thrust of the boost engine in the Engine Deck must be artificially increased by 100,000. = 0., No boost engine (Default)
NGPRT	= 0, No printout of engine input data = 1, Print engine data tables (Default) = 2, Also print sorted engine input data
DFFAC	Fuel flow scaling constant term (Default = 0.)
FFFAC	Fuel flow scaling linear term (Default = 0.)

The engine fuel flow scale factor for ENGSKAL = THRUST/THRSO is

ENGSKAL*[1. + DFFAC + FFFAC*(1. - ENGSKAL)]

H. Engine Deck

The Engine Deck consists of one card for each Mach-altitude-thrust combination. From 2 to 20 distinct Mach numbers may be input with 2 to 10 altitudes per Mach number. The number of altitudes per Mach number and the altitudes themselves do not have to be consistent between Mach numbers. Up to 16 thrust levels may be input for each Mach-altitude combination. Climb thrust must be input for each Mach-altitude point, and part power cruise data must be input for at least one Mach-altitude point. If IFILL $\neq$ 0, part power data will be generated for any point for which part power data are not input. If IDLE $\geq$ 1, flight idle data will be generated for all points. The Engine Deck is order independent, and duplicate cards will be ignored. The Engine deck is terminated with a Mach number greater than 5. There is a limit of 900 cards including duplicates and the terminator.

Card Format: (F5.2, F10.0, 5X, 3F10.0)

Columns	Description
1-5	Mach number
6-15	Altitude, ft
21-30	Gross thrust, lbf
31-40	Ram drag, lbf
41-50	Fuel flow, lbm/hr

Note: The program uses only the Net thrust = Gross thrust - Ram drag. Also, data appearing in Col. 16-20 and Col. 51-80 are ignored.

I. Namelist $MISSIN (Default = 0. unless otherwise noted)

Name	Description
INDR	= 0, DESRNG (Namelist $CONFIN) is in n.mi. (Default) = 1, Endurance mission - DESRNG is in minutes
FACT	Factor to increase or decrease fuel flows (Default = 1.)
ESKAL	= 1, if engine scaling factor (See Namelist $ENGDIN) to be used (Default) = 0, if engine scaling factor not to be used
OWFACT	Factor for increasing or decreasing OWE (Default = 1.)
IFLAG	= 0, Prints mission summary data (Default) = 1, plus details of cruise optimization = 2, plus climb and descent profiles = 3, plus scaled engine data
DTC	Deviation from standard day temperature in degrees C (See also in TOLIN. These temp deviations are independent)
RW	= 1, calculates ramp weight with fixed range = 2, fixed ramp weight, calculates range (Default)
RTOL	Tolerance in range calculation for RW = 1, n.mi. (Default = .001)
IATA	= 1, Range is adjusted for ATA Traffic Allowance (Default) = 0, Otherwise
DWT	Weight increment, lbf (Default is internally computed)
OFFDR	Off design range, n.mi. (up to 10 values)
IDOQ	= 1, drag increments are in the form of D/q, ft^2 = 0, drag increments are drag coefficients (Default)
IRADACC	= 0 if centrifugal acceleration is to be ignored (V^2/earth radius)

Namelist $MISSIN - Continued

Store Drags (When a variable drag increment is required)

STMA (20,3)	Mach number schedule (up to 20)
CDST (20,3)	Corresponding drag coefficients or D/g's
ISTCL	= 1, apply store drag to Ith climb-profile = 0, otherwise
ISFCR	Same for cruise
ISTDE	Same for descent

Can also be assessed in ACCEL and TURN segments of the mission as covered in Segment Definition Cards section

Input Weights

MYWTS	= 0, weights will be computed (Default) = 1, the following four parameters will be used in mission analysis
RAMPWT	Gross weight before taxi out, lbf
DOWE	Operating weight empty, lbf
PAYLOAD	Payload weight, lbf
MAXFUEL	Total usable fuel weight, lbf

Ground Operations and Takeoff Allowances

Name	Description
IDFUEFL	Taxi fuel flow, lbm/hr/engine
TAXOTIM	Taxi-out time, min
TAKOFF	Takeoff fuel flow, lbm/hr/engine
TAKOTIM	Takeoff time, min
TAXITIM	Taxi-in time, min

Climb Schedule Definition - Tabular data for each possible climb schedule are generated. Which schedule is flown when is defined in the next section.

NCLIMB	Number of climb schedules to be defined (Default = 1, Maximum = 4) (Include reserve climb)

The following data are subscripted to correspond to the appropriate climb schedule.

CLMMIN(I)	Minimum Mach number (Default = .3)
CLMMAX(I)	Maximum Mach number (Default = VCMN, Namelist $CONFIN)
CLAMIN(I)	Minimum altitude, ft
CLAMAX(I)	Maximum altitude, ft (Default = CH, Namelist $CONFIN)
NINCL(I)	Number of climb steps (Default = 31 = Maximum)
FWF(I)	Fuel weighting factor in climb profile optimization function (Default = -.001) = 1., minimum fuel-to-distance profile = 0., minimum time-to-distance profile 1.>FWF>0., combination of above = -.001, minimum time-to-climb profile (to start of cruise conditions) = -1., minimum fuel-to-climb profile -1.<FWF<-.001, combination of above
NCRCL(I)	Number of the cruise schedule to be used in climb optimization comparisons (Default = 1)
CLDCD(I)	Drag coefficient increment
IPPCL(I)	Number of power settings to be considered for climb. Program will select the most efficient. (Default = 1, full thrust only)

Namelist $MISSIN - Continued

Name	Description
NO(I)	Number of input climb altitudes and speeds (Maximum = 10) = 0, Climb profile will be optimized (Default)
ACTAB(J,I)	Altitude schedule, ft (up to 10 values)
VCTAB(J,I)	Climb speed schedule, kts or Mach number (up to 10 values)

Note: For NO > 0, if only part of the climb profile is specified, the portion of the profile outside the energy range defined by values of ACTAB and VCTAB will be optimized.

The following parameters apply to all climb schedules:

IFAACL	= 1, Climb at 250 KCAS below 10,000 ft (Default) = 0, Climb at optimum speed
NODIVE	= 0, Program will select the optimum altitude for each energy level. (Default) = 1, Decreasing altitude during climb (e.g., diving through Mach 1.) is not allowed.
QLIM	Dynamic pressure limit during climb, psf (Default: no limit)

Cruise Schedule Definition - Tabular data for each possible cruise schedule are generated. Which schedule is flown when is defined in the next section.

NCRUISE	Number of cruise schedules to be defined (Default = 1, Maximum = 5) Include reserve definition(s).

The following data are subscripted to correspond to the appropriate cruise schedule.

OC(I)	Cruise option switch = 0, optimum altitude and Mach number for specific range = 1, fixed Mach number, optimum altitude for specific range (Default) = 2, fixed Mach number at input maximum altitude or cruise ceiling = 3, fixed altitude, optimum Mach number for specific range = 4, fixed altitude, optimum Mach number for endurance (minimum fuel flow) = 5, fixed altitude, constant lift coefficient (CRCLMAX) = 6, fixed Mach number, optimum altitude for endurance = 7, optimum Mach number and altitude for endurance = 8, maximum Mach number at input fixed altitude = 9, maximum Mach number at optimum altitude
CRMACH(I)	Maximum or fixed Mach number (Default = VCMN, Namelist $CONFIN)

Namelist $MISSIN - Continued

Name	Description
CRALT(I)	Maximum or fixed altitude, ft (Default = CH, Namelist $CONFIN)
CRDCD(I)	Drag coefficient increment
FLRCR(I)	Specific range factor for long range cruise Mach number - used if OC = 3 (Default = 1, Typical value = .99)
CRMMIN(I)	Minimum Mach number
CRCLMAX(I)	Maximum lift coefficient

Feathered Engines During Cruise

IFEATH(I)	= 1, Engines may be feathered during cruise to improve performance = 0, Otherwise (Default) = -1, Engines must be feathered (Engine out condition)
FEATHF(I)	Fraction of engines remaining after feathering (Default = 0.5)
CDFEATH(I)	Increase in drag coefficient due to feathered engines.

The following parameters apply to all cruise schedules:

HPMIN	Minimum cruise altitude, ft (Default = 1000.)
DCWT	Increment in cruise weight, lbf (Default = DWT/20)
RCIN	Instantaneous rate of climb for ceiling calculation, ft/min (Default = 100.)

Descent Schedule Definition (IFAACL and QLIM apply here as well as in climb)

VS	Descent option switch = 0, no descent time, distance or fuel = 1, descent at optimum lift-drag ratio (Default) = 2, descent at constant lift coefficient
DECL	Descent lift coefficient for VS = 2 (Default = .8)
DEMMIN	Minimum Mach number (Default = .3)
DEMMAX	Maximum Mach number (Default = VCMN, Namelist $CONFIN)
DEAMIN	Minimum altitude, ft
DEAMAX	Maximum altitude, ft (Default = CH, Namelist $CONFIN)

Namelist $MISSIN - Continued

Name	Description
NINDE	Number of descent steps (Default = 31 = Maximum)
DEDCD	Drag coefficient increment
NS	Number of input descent altitudes and speeds (Maximum = 10)
ADTAB	Altitude schedule, ft (up to 10 values)
VDTAB	Descent speed schedule, kts or Mach number (up to 10 values)

Reserve Segment

RS	= 1, reserve at calculated reserve fuel plus RESERFU = 2, reserve at constant value (RESERFU) only (Default)
RESERFU	Reserve fuel, lbm. If RESERFU < 1., Reserve fuel = MAXFUEL*RESERFU.
MAPTIM	Missed approach time, min
ALTRAN	Range to alternate airport, n.mi. (Default = 250.)
NCLRES	Climb schedule number used in reserve mission (Default = 1)
NCRRES	Cruise schedule number used in reserve mission (Default = 1)
HOLDTIM	Reserve holding time, min
NCRHOL	Cruise schedule number used in hold (Default = 1)
IHOPOS	Hold position switch = 0, hold occurs between main mission descent and missed approach = 1, Hold occurs at end of reserve cruise (Default)
SREMACH	Start reserve Mach number (Default = CLMMIN (NCLRES))
EREMACH	End reserve Mach number (Default = DEMMIN)
SREALT	Start reserve altitude (Default = CLAMIN(NCLRES))
EREALT	End reserve altitude (Default = DEAMIN)

Namelist $MISSIN - Concluded

Climb Data Plots

Name	Description
IPLOTPS	= 0, No plot (Default) < 0, Contour plots of Lift/Drag > 0, a data file (TAPE 7) will be prepared for contour plots of the climb profile optimization function for climb schedule (IPLOTS) IPLOTS = Number of the climb schedule with the desired store drag increment, etc. GW, Namelist $CONFIN, desired weight for Specific Excess Power, SEP, calculations. FWF = -.001 is the required factor for SEP contours, IPPCL is the power setting limiter (should be = 1 for max power.)
XMAX	Maximum Mach number for plot
XMIN	Minimum Mach number for plot
XINC	Mach number increment for plot (XMAX - XMIN)/XINC$\leq$15
YMAX	Maximum altitude for plot
YMIN	Minimum altitude for plot
YINC	Altitude increment for plot (YMAX - YMIN)/YINC$\leq$15
WTPLOT	Gross weight for plot data
NCONINT	Number of contour intervals to be plotted ($\leq$40)

I-1. Mission Definition Data

Climb, cruise, and descent schedules were defined in Namelist $MISSIN along with a complete definition of the reserve mission. These schedules are now combined with other segments to define the main mission. The segments available are defined below. They can be sequenced in almost any logical order. The deck must start with a START card and end with an END card. The first segment will be a CLIMB or an ACCEL card and the last will be the only DESCENT card. Intermediate descents will be assumed to be instantaneous per military specifications. All CLIMB segments should be followed by a CRUISE or HOLD segment, and the DESCENT should be preceded by a CRUISE or HOLD segment. Continuity in Mach number, altitude and energy is maintained wherever possible.

Segment Definition Cards (Maximum of 40)

Columns	Contents
1-5	START
11-20	Starting Mach number (Default = CLMMIN for first climb segment)
21-30	Starting altitude, ft (Default = CLAMIN for first climb segment)
1-5	CLIMB
10	Climb schedule number (Default = 1)
1-6	CRUISE
10	Cruise schedule number (Default = 1)
11-20	Total distance at the end of this cruise segment, n.mi. Required for all but the last cruise segment
1-6	REFUEL
11-20	Fuel added, lb
21-30	Time required, min
1-7	RELEASE
11-20	Weight of payload released, lb
1-5	ACCEL
8	Apply store drag to this segment
10	Power Setting for acceleration (Default = 1, max power)
11-20	Ending Mach number
21-30	Not used
31-40	Starting Mach number (Default = ending Mach number for previous segment) If M input, distance is not included in mission range. (Some MIL SPECS)
41-50	Altitude, ft (Default = ending altitude for previous segment)
51-60	Drag coefficient increment
61-70	Weight specified for point performance
1-4	TURN (Sustained turn solution is for instantaneous condition, i.e., wt at start of turn. For long turns, use multiples.)
10	Power setting for max G turn (Default is specified G turn)
11-20	Turn arc, deg
21-30	Turn acceleration, G's (Not used if power setting is specified)
31-40	Starting Mach number (Default = ending Mach number for previous segment)
41-50	Altitude, ft (Default = ending altitude for previous segment)
51-60	Drag coefficient increment
61-70	Weight specified for point performance
1-4	HOLD
10	Cruise schedule number (Default = 1)
11-20	Holding time, min
1-7	DESCENT
1-3	END
11-20	Ending Mach number (Default = DEMMIN)
21-30	Ending altitude (Default - DEAMIN)

Aerodynamic Data, Namelist $ASCLIN - Concluded

Namelist $ASCLIN Input only if MYAERO = 2.

Name	Description
SREF	Reference wing area, ft^2 (Default = SW)
TREF	Reference thrust, lbf (Default = THRUST)
AWETT (I)*	Total wetted area/SREF
AWETW (I)*	Wing wetted area/SREF
AWETN	Nacelle wetted area/SREF
ELTOT	Total configuration length, ft (Default = fuselage length)
ELW (I)*	Total length of exposed wing, ft
VOLTOT	Total configuration volume, ft^3
VOLW (I)*	Total volume of exposed wing, ft^3
FORM (I)*	Subsonic form factor for total configuration
EQL (I)*	Equivalent friction length for total baseline configuration, ft
CDWAV	Wave drag coefficients (NMP values)
DCDNAC	Delta wave drag coefficients, nacelles on - nacelles off (NMP values)

*(NMP values if required, i.e., variable geometry = f(M). Single values 0 K)

Namelist $RFHIN Input in place of Card(s) 4 if MYAERO = 3.

CDMIN(I)	Minimum drag for each of NMD Mach numbers
CK(I)	Drag-due-to-lift factors for each Mach number
CLB(I)	Lift coefficients corresponding to each CDMIN(I)

The drag coefficients of Card(s) 4 are then computed from:

$$CD(J, I) = CDMIN(I) + CK(I) * [CL(J) - CLB(I)] ** 2$$

K. Namelist $TOLIN (Used only if ITAKOFF and/or ILAND = 1 in Namelist $AERIN)

Name	Description
APA	Airport Altitude, ft (Default = 0.)
DTC	Delta temperature from standard day, deg C (Default = 0.) (This parameter is independent from the DTC in Namelist $MISSIN.)
SWREF	Wing reference area used for drag polars, sq ft (Default = SW, Namelist $CONFIN)
ARREF	Wing reference aspect ratio (Default = AR, Namelist $CONFIN)
WHGT	Wing height above ground, ft (Default = 8.)
ALPRUN	Angle of attack on ground, deg (Default = 0.)
TINC	Thrust incidence on ground, deg (Default = 0.)
ROLLMU	Coefficient of rolling friction (Default = .025)
BRAKEMU	Coefficient of friction, brakes on (Default = .3)
VANGL	Rotation or flare rate, deg/sec (Default = 2.)
CDGEAR	Landing gear drag coefficient (Default = 0.)
CLSPOIL	Spoiler lift coefficient (Default = 0.)
CDSPOIL	Spoiler Drag Coefficient (Default = 0.)
ITIME	= 1, Takeoff and landing profiles will be printed at one second increments = 0, Otherwise (Default)

Takeoff

CLTOM	Maximum C_L for takeoff (Default, see $AERIN)
CDMTO	Minimum C_D for takeoff (Default = 0.)
FCDMWTO	Fraction of CDMTO due to wing (Default = .3)
ALPMXTO	Maximum angle of attack during takeoff, deg (Default internally computed)
OBSTO	Takeoff obstacle height, ft (Default = 35.)
ALPTO	Alpha's for takeoff polar, deg (10 values)
CLTO	C_L's for takeoff polar (10 values)
CDTO	C_D's for takeoff polar (10 values)

K. Namelist $TOLIN - Continued

Name	Description
INTHRTO	= 0, Input thrust values will be used (Default) = 1, The input values will be scaled ≥ 2, Scaled engine data deck for the (INTHRTO-1)th power setting will be used
VELTO	Velocities for takeoff thrust, ft/sec (10 values, Default = 0., 50., 100., ..., 450.)
THRTO	Thrust values, lbf (10 values, Default is INTHRTO = 2)
ALPROT	Maximum angle of attack during rotation phase of takeoff, deg (Default = ALPMXTO)
VROTATE	Rotation start speed, knots or fraction of V_{stall} (Default = 1.05)
THRFACT	Thrust multiplier for input or extracted thrust data (Default = 1.)
CLDPOCL	Velocity dependent lift coefficients (10 values corresponding to VELTO, Default = 10*0.)
CDDP	Velocity dependent drag coefficients (10 values corresponding to CLDPOCL, Default = 10*0.)
TIGEAR	Time to raise landing gear, sec (Default = 2.)
IBAL	= 1, Balanced field length will be computed (Default) = 0, Otherwise

Aborted Takeoff

TISPA	Time from engine failure to spoiler actuation, sec (Default = 3.)
TIBRA	Time from engine failure to brake application, sec (Default = 3.)
TICUT	Time from engine failure to cut back of remaining engine(s), sec (Default = 3.)

K. Namelist $TOLIN - Continued

Landing

Name	Description
CLLDM	Maximum C_L for landing (Default, see $AERIN)
CDMLD	Minimum C_D for landing (Default = 0.)
FCDMWLD	Fraction of CDMLD due to wing (Default = .3)
ALPMXLD	Maximum angle of attack during landing, deg (Default internally computed)
OBSLD	Landing obstacle height, ft (Default = 50.)
ALPLD	Alpha's for landing polar, deg (10 values)
CLLD	C_L's for landing polar (10 values)
CDLD	C_D's for landing polar (10 values)
INTHRLD	= 0, Input thrust values will be used (Default) = 1, The input values will be scaled $\geq$ 2, Scaled engine data deck will be used
VELLD	Velocities for landing (idle) thrust, ft/sec (10 values, Default = 0., 50., 100., ..., 450.)
THRLD	Thrust values, lbf (10 values, Default = 10*0.)
APRHGT	Height above ground for start of approach, ft (Default = 100.)
APRANG	Approach flight path angle, deg (Default = 3.)
TISPOIL	Time after touchdown to spoiler actuation, sec (Default = 2.)
TIBRAKE	Time after touchdown to brake application (Default = 4.)
ACCLIM	Deceleration limit, ft/sec^2 (Default = 16.)

Namelist $TOLIN - Concluded

Thrust Reverser

INTHRRV	= -1, Use takeoff thrust (Default) = 0, Input thrust values will be used = 1, Input values will be scaled ≥ 2, Scaled engine deck for the (INTHRRV-1)th power setting will be used
REVFACT	Fraction of thrust reversed - net (Default = 0, no reverst thrust. Real values should be negative)
VELRV	Velocities for reverse thrust, ft/sec (10 values, Default = 0., 50., ..., 450.)
THRRV	Thrust values, lbf (10 values)
TIREVRS	Time after touchdown to reverse thrust, sec (Default = 5.)
TIRVA	Time from engine failure to thrust reversal, sec (Default = 1000., no thrust reversal on aborted takeoff)

Integration Intervals (Default values will provide precision of ±.25 ft)

DELVTO	Velocity step during ground run, ft/sec (Default = 4.)
DELTRO	Time step during rotation, sec (Default = .2)
DELTCL	Time step during climbout, sec (Default = .2)
DELHAP	Altitude step during approach, ft (Default = 10.)
DELDFL	Distance step during flare, ft (Default = 10.)
DELTRUN	Time step during runout, sec (Default = .25)

L. Namelist $SYNTIN

This Namelist is required only for optimization. The optimization uses the Sequence of Unconstrained Minimizations Technique (SUMT) with a Fiacco - McCormick penalty function (with optional quadratic extension) of the form:

$$F = OBJ + RK \sum [1./G(J)]$$

where OBJ was described in Namelist $CONFIN and G(J) is the value of the Jth constraint. The constraints are of the form:

G = 1. - value/upper limit, or 1. - lower limit/value

The compatibility constraints are upper and lower limits on each active design variable. In addition, there are six behavioral constraints:

(1) Lower limit on range (not used if RW = 1)
(2) Upper limit on approach speed
(3) Upper limit on take-off field length
(4) Upper limit on landing field length
(5) Lower limit on missed approach climb gradient thrust
(6) Lower limit on second segment climb gradient thrust

The optimization is performed as a series of minimizations of F (called drawdowns) with the value of the penalty function factor RK successively lowered so that the constraints have less and less effect on F. A drawdown consists of several finite difference gradient calculations and corresponding one-dimensional searches. The nonlinear programming algorithm modifies the gradient to determine the direction for the one-dimensional search.

The parameters in this Namelist (except ITFINE), along with the scaling factors in the design variable input, control the convergence speed and accuracy of the optimization process. Experimentation is recommended.

Name	Description
NDD	Number of drawdowns (Defaults to analysis option)
RK	Initial value of RK (Default internally computed)
FDD	RK multiplier for successive drawdowns (Default = .2)
NLIN	Maximum number of gradients per drawdown (Default = number of active design variables times 2)
EF	Limits one-dimensional minimization step size to EF times previous step (Default = 3.)
EPS	Fraction of initial design variable value used as a finite difference delta (Default = .001)

Namelist $SYNTIN - Concluded

AMULT	The initial step in a one-dimensional search is controlled by the design variable value times EPS times AMULT (Default = 10.)
DEP	One-dimensional search convergence criterion on step size as afraction of move distance (Default = .001)
ACCUX	One-dimensional search convergence criterion on step size as a fraction of initial design variable value (Default = .003)
GLM	Value of G at which constraint switches to quadratic extended form, a value of .01 is recommended (Default = 0., no quadratic extension)
ITFINE	= 1, sets RW = 1 for final analysis = 0, otherwise (Default)
IBFGS	= 0, Davidon-Fletcher-Powell Algorithm = 1, Broyden-Fletcher-Goldfarb-Shano Algorithm (Default)
IG(I)	= 1, I^{th} behavioral constraint is used in optimization (Default) = 0, Otherwise
GFACT(I)	Scaling factor for I^{th} behavioral constraint (Default = 1.)
AUTOSCL	Design variable scale factor exponent (Default = .667). Scale factors for design variables default to VALUE**AUTOSCL
ICENT	= 0, Forward differences will be used in gradient calculations (Default) = 1, central differences will be used

APPENDIX B

FLOPS LISING

From L. Arnold McCullers

```
      PROGRAM FLOPS(INPUT=128,OUTPUT=128,TAPE7=256,TAPE5=INPUT,          00001
     1 TAPE6=OUTPUT)                                                     00002
      COMMON/THUMB/THOBJ(49),THOFF(49),THLDG(49),THSSG(49),THMAP(49),    00003
     1 THVAP(49),THSW(49),THEXF(49),ITH                                  00004
      COMMON/ACON/VLB(12),VUB(12),SCAL(12),DUM(167)                      00005
      COMMON/PLTV/Z(15,15)                                               00006
      COMMON/CONSTRT/XBJ,G(25),GFACT(25),IG(25)                          00007
      COMMON/SYNT/ACCUX,EPS,NDD,RK,GLM,PEN,OBJ,JECT,AMULT,EF,DEP,JVKC    00008
      COMMON/CONTRL/PLIM                                                 00009
      COMMON/ESB/DUS(11),RW                                              00010
      COMMON/CNMN1/DUP(12),NADV,DUR(14)                                  00011
      COMMON/VARABLE/XO(12)                                              00012
      COMMON/CONFIG/DES(12),DESRNG                                       00013
      COMMON/INDEX/K1,K2,K3,K4,K5,K6,K7,K8,K9                            00014
      COMMON/PARVAR/DVD(5,12)                                            00015
      COMMON/STEP/GF(12),EMOVE,ICENT                                     00016
      COMMON/DMINOP/NRESET,IBFGS                                         00017
      DIMENSION TITLE(20),JA(9),X1(12)                                   00018
      INTEGER RW                                                         00019
      EQUIVALENCE (JA(1),K1)                                             00020
      NAMELIST/SYNTIN/ACCUX,EPS,NDD,FDD,RK,GLM,NLIN,AMULT,EF,DEP,ITFINE  00021
     1 ,IBFGS,GFACT,IG,JVKC,EMOVE,AUTOSCL,ICENT                          00022
      NAMELIST/PLOT/XMIN,XMAX,XINC,YMIN,YMAX,YINC,Z,NCONINT              00023
      DATA NRESET,ITFINE,NDD/3*0/,DEP,EPS/2*.001/,EF/3./,                00024
     1 ACCUX/.0003/,GLM,RK/2*0./,GFACT/25*1./,IG/6*1,19*0/,FDD/.2/       00025
     2,EMOVE/.05/,IBFGS/1/,AUTOSCL/.667/,AMULT/10./,ICENT/0/             00026
      READ(5,10)PARA,NCONINT,PLIM                                        00027
   10 FORMAT(A4,34X,I2,A4)                                               00028
      IF(NCONINT.LE.0)NCONINT=10                                         00029
      READ(5,20)TITLE                                                    00030
   20 FORMAT(20A4)                                                       00031
      IF(EOF(5).NE.0)GO TO 40                                            00032
      WRITE(6,30)TITLE                                                   00033
   30 FORMAT(1H1,20A4)                                                   00034
      IF(PARA.EQ.4HPARA.OR.PARA.EQ.4HCONT.OR.PARA.EQ.4HTHUM)GO TO 500    00035
      CALL DEFINEF                                                       00036
      NLIN=NADV*2                                                        00037
      IF(PARA.NE.4HANAL)READ(5,SYNTIN)                                   00038
      IF(NADV.EQ.0)GO TO 140                                             00039
      DO 50 I=1,NADV                                                     00040
      IF(SCAL(I).NE.0.)GO TO 35                                          00041
      SCAL(I)=XO(I)                                                      00042
      IF(SCAL(I).LE.0.)SCAL(I)=VUB(I)-VLB(I)                             00043
      IF(SCAL(I).LE.0.)SCAL(I)=1.                                        00044
      SCAL(I)=SCAL(I)**AUTOSCL                                           00045
   35 IF(VUB(I).EQ.0.)VUB(I)=10.*ABS(XO(I))                              00046
      IF(VLB(I).EQ.0.)VLB(I)=XO(I)/10.                                   00047
      IF(XO(I).LT.0..AND.XO(I).LT.VLB(I))VLB(I)=10.*XO(I)                00048
      IF(XO(I).EQ.VLB(I))VLB(I)=0.999*VLB(I)                             00049
      IF(XO(I).EQ.VUB(I))VUB(I)=1.001*VUB(I)                             00050
      XO(I)=XO(I)/SCAL(I)                                                00051
      IF(SCAL(I).LT.0.) XO(I)=-1./XO(I)                                  00052
   50 X1(I)=XO(I)                                                        00053
      IF(PARA.EQ.4HANAL)GO TO 140                                        00054
      WRITE(6,700)NDD,RK,FDD,NLIN,EF,EPS,AMULT,DEP,ACCUX                 00055
  700 FORMAT(/38HOOPTIMIZATION INPUT (NAMELIST $SYNTIN)/                 00056
     1 14H0  DESCRIPTION,16X,4HNAME,7X,18H VALUE  DIMENSIONS//           00057
     1 37H   NUMBER OF DRAWDOWNS        NDD    ,I11/                    00058
     2 37H   INITIAL VALUE OF RK        RK     ,F11.4/                  00059
     3 37H   RK MULT. FOR SUCCESSIVE            /                       00060
     4 37H    DRAWDOWNS                 FDD    ,F11.4/                  00061
     5 37H   MAX. NO. GRADIENTS                /                       00062
     6 37H    PER DRAWDOWN              NLIN   ,I11/                    00063
     7 37H   LIMIT 1-D MINIMIZATION           /                       00064
     8 37H    STEP SIZE MULTIPLIER      EF     ,F11.4/                  00065
     9 37H   FRACTION OF DESIGN VAR.          /                       00066
     1 37H    FOR FINITE DIFF. DELTA    EPS    ,F11.4/                  00067
     2 37H   INITIAL STEP 1-D                 /                       00068
     3 37H    SEARCH MULTIPLIER         AMULT  ,F11.4/                  00069
     4 37H   1-D SEARCH CONVERGENCE           /                       00070
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   5 37H    CRITERION ON REL. STEP    DEP    ,F11.6/                    00071
   6 37H   1-D SEARCH CONVERGENCE             /                          00072
   7 37H    CRITERION ON ABS. STEP    ACCUX  ,F11.6)                    00073
    WRITE(6,701)GLM,ITFINE,IBFGS,AUTOSCL,ICENT                          00074
701 FORMAT(37H   VALUE OF G FOR SWITCH TO          ,/                   00075
   1 37H    QUADRATIC EXTENDED FORM   GLM    ,F11.6/                   00076
   2 37H   RW=1 FOR FINAL ANALYSIS    ITFINE ,I11/                      00077
   3 37H   BFGS ALGORITHM SWITCH      IBFGS  ,I11/                      00078
   4 37H   VARIABLE SCALING EXPONENT  AUTOSCL,F11.3/                    00079
   5 37H   CENTRAL DIFFERENCES SWITCH ICENT  ,I11/)                     00080
    WRITE(6,702)(IG(I),GFACT(I),I=1,7)                                  00081
702 FORMAT(27H0BEHAVIORAL CONSTRAINT DATA//                             00082
   1 56H       CONSTRAINT                ACTIVITY    SCALE FACTOR/      00083
   2 56H                                   (IG)        (GFACT)   //     00084
   2 34H LOWER LIMIT ON RANGE             ,I2,5X,F11.4/                 00085
   3 34H UPPER LIMIT ON APPROACH SPEED    ,I2,5X,F11.4/                 00086
   4 34H UPPER LIMIT T-O FIELD LENGTH     ,I2,5X,F11.4/                 00087
   5 34H UPPER LIMIT LANDING FIELD LENGTH ,I2,5X,F11.4/                 00088
   4 34H LOWER LIMIT ON MISSED APPROACH   /                             00089
   5 34H  CLIMB GRADIENT THRUST           ,I2,5X,F11.4/                 00090
   6 34H LOWER LIMIT ON 2ND SEG.          /                             00091
   7 34H  CLIMB GRADIENT THRUST           ,I2,5X,F11.4/                 00092
   8 34H WING STRUCTURAL WEIGHT           ,I2,5X,F11.4)                 00093
    IF(EOF(5).NE.0)GO TO 140                                            00094
    IF(NDD.EQ.0.OR.NLIN.EQ.0)GO TO 140                                  00095
    DO 70 I=1,NADV                                                      00096
 70 GF(I)=EPS*XO(I)                                                     00097
    IC=1                                                                00098
    WRITE(6,30)TITLE                                                    00099
    CALL FEVAL(X1,FO,IC)                                                00100
    IF(JECT.NE.0)GO TO 400                                              00101
    IF(RK.EQ.0.)RK=OBJ/100000.                                          00102
    FO=OBJ+RK*PEN                                                       00103
    WRITE(6,105)FO,RK                                                   00104
105 FORMAT(13H0INITIAL FO =,G11.4,9H FOR RK =,G11.4)                    00105
    DO 130 II=1,NDD                                                     00106
    CALL DMIN(X1,FO,NADV,NLIN)                                          00107
    IF(II.GE.NDD)GO TO 135                                              00108
    RK=RK*FDD                                                           00109
    GLM = GLM*FDD                                                       00110
    IC=1                                                                00111
    CALL FEVAL(X1,FO,IC)                                                00112
130 CONTINUE                                                            00113
135 IF(ITFINE.EQ.1)RW=1                                                 00114
140 IC=5                                                                00115
    WRITE(6,30)TITLE                                                    00116
    CALL FEVAL(X1,FO,IC)                                                00117
    STOP                                                                00118
400 WRITE(6,401)                                                        00119
401 FORMAT(28H0INITIAL DESIGN UNACCEPTABLE)                             00120
 40 STOP                                                                00121
500 CALL DEFINEF                                                        00122
    ICONT=0                                                             00123
    DO 510 I=1,9                                                        00124
    JA(I)=1                                                             00125
    VLB(I)=DES(I)                                                       00126
    IF(DVD(2,I).EQ.1.)VLB(I)=DVD(3,I)                                   00127
    VUB(I)=0.                                                           00128
    IF(DVD(2,I).LT.1.5.OR.ICONT.EQ.2)GO TO 510                          00129
    JA(I)=DVD(2,I)+.5                                                   00130
    VLB(I)=DVD(3,I)                                                     00131
    VUB(I)=(DVD(4,I)-DVD(3,I))/(JA(I)-1)                                00132
    IF(PARA.NE.4HCONT)GO TO 510                                         00133
    ICONT=ICONT+1                                                       00134
    IF(ICONT.EQ.2)GO TO 505                                             00135
    XMIN=VLB(I)                                                         00136
    XMAX=DVD(4,I)                                                       00137
    XINC=VUB(I)                                                         00138
    GO TO 510                                                           00139
505 YMIN=VLB(I)                                                         00140
```

```
      YMAX=DVD(4,I)                                                    00141
      YINC=VUB(I)                                                      00142
      NYM=JA(I)                                                        00143
  510 CONTINUE                                                         00144
      NX=1                                                             00145
      NY=0                                                             00146
      ITH=0                                                            00147
      DO 600 J1=1,K1                                                   00148
      DES(1)=VLB(1)+(J1-1)*VUB(1)                                      00149
      DES1=DES(1)                                                      00150
      DO 600 J2=1,K2                                                   00151
      DES(2)=VLB(2)+(J2-1)*VUB(2)                                      00152
      DO 600 J3=1,K3                                                   00153
      DES(3)=VLB(3)+(J3-1)*VUB(3)                                      00154
      DO 600 J4=1,K4                                                   00155
      DES(4)=VLB(4)+(J4-1)*VUB(4)                                      00156
      DO 600 J5=1,K5                                                   00157
      DES(5)=VLB(5)+(J5-1)*VUB(5)                                      00158
      DO 600 J6=1,K6                                                   00159
      DES(6)=VLB(6)+(J6-1)*VUB(6)                                      00160
      DO 600 J7=1,K7                                                   00161
      DES(7)=VLB(7)+(J7-1)*VUB(7)                                      00162
      DO 600 J8=1,K8                                                   00163
      DES(8)=VLB(8)+(J8-1)*VUB(8)                                      00164
      DO 600 J9=1,K9                                                   00165
      DES(9)=VLB(9)+(J9-1)*VUB(9)                                      00166
      IF(RW.EQ.1)DES(1)=DES1                                           00167
      JECT=0                                                           00168
      NRESET=0                                                         00169
      ITH=ITH+1                                                        00170
      IF(ITH.GT.49)ITH=49                                              00171
      IF(PARA.EQ.4HTHUM)GO TO 550                                      00172
      IF(PARA.EQ.4HCONT)GO TO 580                                      00173
      CALL PARV                                                        00174
      GO TO 600                                                        00175
  550 CALL PPLT                                                        00176
      GO TO 600                                                        00177
  580 CALL PPLT                                                        00178
      NY=NY+1                                                          00179
      IF(NY.LE.NYM)GO TO 590                                           00180
      NY=1                                                             00181
      NX=NX+1                                                          00182
  590 Z(NX,NY)=XBJ                                                     00183
  600 CONTINUE                                                         00184
      IF(PARA.EQ.4HCONT)WRITE(7,PLOT)                                  00185
      IF(K3*K4.EQ.0)STOP                                               00186
      WRITE(7,800)TITLE                                                00187
  800 FORMAT(1X,20A4)                                                  00188
      WRITE(7,805)K4,((VLB(4)+(J4-1)*VUB(4)),J4=1,K4)                  00189
  805 FORMAT(11HW/S OR REFA/I5/(7F15.5))                               00190
      WRITE(7,810)K3,((VLB(3)+(J3-1)*VUB(3)),J3=1,K3)                  00191
  810 FORMAT(13HT/W OR THRUST/I5/(7F15.5))                             00192
      WRITE(7,815)                                                     00193
      DO 812 J=1,K3                                                    00194
  812 WRITE(7,855)(THOBJ((J-1)*K4+I),I=1,K4)                           00195
  815 FORMAT(26H GROSS WEIGHT OR OBJECTIVE)                            00196
      WRITE(7,820)                                                     00197
      DO 817 J=1,K3                                                    00198
  817 WRITE(7,855)(THOFF((J-1)*K4+I),I=1,K4)                           00199
  820 FORMAT(16H TO FIELD LENGTH)                                      00200
      WRITE(7,825)                                                     00201
      DO 822 J=1,K3                                                    00202
  822 WRITE(7,855)(THLDG((J-1)*K4+I),I=1,K4)                           00203
  825 FORMAT(21H LANDING FIELD LENGTH)                                 00204
      WRITE(7,830)                                                     00205
      DO 827 J=1,K3                                                    00206
  827 WRITE(7,855)(THSSG((J-1)*K4+I),I=1,K4)                           00207
  830 FORMAT(35H SECOND SEGMENT CLIMB EXCESS THRUST)                   00208
      WRITE(7,835)                                                     00209
      DO 832 J=1,K3                                                    00210
```

```
832 WRITE(7,855)(THMAP((J-1)*K4+I),I=1,K4)                    00211
835 FORMAT(30H MISSED APPROACH EXCESS THRUST)                  00212
    WRITE(7,840)                                              00213
    DO 837 J=1,K3                                             00214
837 WRITE(7,855)(THVAP((J-1)*K4+I),I=1,K4)                    00215
840 FORMAT(6H V,APP)                                          00216
    WRITE(7,845)                                              00217
    DO 842 J=1,K3                                             00218
842 WRITE(7,855)(THSW((J-1)*K4+I),I=1,K4)                     00219
845 FORMAT(10H WING AREA)                                     00220
    WRITE(7,850)                                              00221
    DO 847 J=1,K3                                             00222
847 WRITE(7,855)(THEXF((J-1)*K4+I),I=1,K4)                    00223
850 FORMAT(21H EXCESS FUEL CAPACITY)                          00224
855 FORMAT(7F15.4)                                            00225
    END                                                       00226
```

```
      SUBROUTINE FEVAL(DV,FO,IC)                                        00227
      COMMON/ACON/VLB(12),VUB(12),SCAL(12),DUM(167)                     00228
      COMMON/FPRINT/IPRNT                                               00229
      COMMON/DMINOP/NRESET,IBFGS                                        00230
      COMMON/SYNT/ACCUX,EPS,NDD,RK,GLM,PEN,OBJ,JECT,AMULT,EF,DEP,JVKC   00231
      COMMON/CONFIG/GW,AR,THRUST,SW,TR,SWEEP,TCA,VCMN,CH,WWSTR,         00232
     1 DUMV1,DUMV2,DESRNG                                               00233
      COMMON/VARABLE/DX(12)                                             00234
      COMMON/CONSTRT/XBJ,G(25),GFACT(25),IG(25)                         00235
      COMMON/AKEY/AK(12),OFG,OFF,OFM,OFT                                00236
      DIMENSION TYPE(3,6),DV(12)                                        00237
      DATA TYPE/4H1-D ,4HSEAR,4HCH  ,4HINIT,4HIAL ,4HF                  00238
     14HGRAD,4HIENT,4H F  ,4HHIC=,4H3   ,4H    ,4HHIC=,                00239
     24H4   ,4H    ,4HFINA,4HL AN,4HAL  /                              00240
      IPRNT=0                                                           00241
      IF(IC.NE.ICO)WRITE(6,20)(TYPE(L,IC+1),L=1,3)                      00242
   20 FORMAT(1H0,3A4)                                                   00243
      ICO=IC                                                            00244
      IF(IC.EQ.1)IPRNT=1                                                00245
      IF(IC.EQ.5)IPRNT=5                                                00246
      JECT=0                                                            00247
      PEN=0.                                                            00248
      J=1                                                               00249
      DO 100 I=1,12                                                     00250
      IF(AK(I).LE.0.)GO TO 100                                          00251
      DX(J)=DV(J)*SCAL(J)                                               00252
      IF(SCAL(J).LT.0.) DX(J)=-SCAL(J)/DV(J)                            00253
      IF(DX(J).LE.VLB(J).OR.DX(J).GE.VUB(J))JECT=1                      00254
      IF(JECT.NE.0)GO TO 200                                            00255
      FACT=0.                                                           00256
      IF(VLB(J).EQ.0..OR.DX(J).EQ.0.)FACT=1.                            00257
      GL=1.-(VLB(J)+FACT)/(DX(J)+FACT)                                  00258
      GU=1.-DX(J)/VUB(J)                                                00259
      PEN=PEN+1./GU+1./GL                                               00260
      J=J+1                                                             00261
  100 CONTINUE                                                          00262
      CALL ANALF                                                        00263
      OBJ=XBJ                                                           00264
      IF(JECT.GT.0)GO TO 200                                            00265
      DO 150 I=1,25                                                     00266
      IF(IG(I).LE.0)GO TO 150                                           00267
      GC=-G(I)                                                          00268
      IF(GC.GT.GLM)GO TO 140                                            00269
      IF(GC.LE.0..AND.GLM.LE.0.)JECT=1                                  00270
      IF(JECT.NE.0)GO TO 200                                            00271
      GC=GLM**3/(GC*GC-3.*GC*GLM+3.*GLM*GLM)                            00272
  140 PEN=PEN+GFACT(I)/GC                                               00273
  150 CONTINUE                                                          00274
      FO=OBJ+RK*PEN                                                     00275
      WRITE(6,160)FO,OBJ,PEN,(G(I),I=1,6)                               00276
  160 FORMAT(4H FO=,E14.6,5H,OBJ=,E14.6,5H,PEN=,E14.6,                  00277
     1 3H,G=,6F10.6)                                                    00278
      RETURN                                                            00279
  200 NRESET=NRESET+1                                                   00280
      IF(NRESET.LT.10)RETURN                                            00281
      WRITE(6,250)                                                      00282
  250 FORMAT(27H0ANALYSIS COULD NOT RECOVER)                            00283
      STOP                                                              00284
      END                                                               00285
```

```
      SUBROUTINE DMIN (XO, FO, N, NLIN)                                 00286
C     FLETCHER-POWELL UNCONSTRAINED MINIMIZATION ALGORITHM              00287
C                                                                       00288
      COMMON/DMINOP/ NRESET,IBFGS                                       00289
      COMMON/STEP/ GF(12),EMOVE,ICENT                                   00290
      COMMON/SYNT/ACCUX,EPQ,NDD,RK,GLM,PEN,OBJ,JECT,AMULT,EF,DEP,JVKC   00291
      COMMON /OUTP/ IDD,ILIN, IDV                                       00292
      INTEGER OPTD                                                      00293
C                                                                       00294
      COMMON/PLTV/      EPS(12), H(12,12), X(12), G(12), G1(12),        00295
     1 DEL(12), E(4), EE(4), F(4), DUM(9)                               00296
      DIMENSION XO(12)                                                  00297
      LOGICAL  IDENT                                                    00298
      KIF = 0                                                           00299
      ABSG = 1.                                                         00300
      ILIN =  0                                                         00301
      LOWEST  =  1                                                      00302
      OPTD = 5                                                          00303
      E(1)  =  1.                                                       00304
      A=1.                                                              00305
      C=0.                                                              00306
      NCOUNT =  1                                                       00307
      CALL  GRADF(XO,FO,G,1)                                            00308
C     SET  H  EQUAL  TO  THE  IDENTITY  MATRIX                          00309
    5 IDENT  =  .TRUE.                                                  00310
      DO  10  I = 1, N                                                  00311
      G1(I)=0.                                                          00312
      DO   9  J = 1, N                                                  00313
    9 H ( I, J)  = 0.                                                   00314
   10 H ( I, I)  = 1.                                                   00315
C     SET  UP  FOR  A  LINEAR  MINIMIZATION                             00316
   15 D =  0.                                                           00317
      DELMAX = 0.                                                       00318
      DO  25  I = 1, N                                                  00319
      DEL (I)  =  0.0                                                   00320
      DO 20  J =  1, N                                                  00321
   20 DEL (I) = DEL (I) + H(I,J) * (G1(J)*C/A-G(J))                     00322
      DM = ABS(DEL(I))                                                  00323
      IF(DM.LE.DELMAX) GO TO 21                                         00324
      DELMAX = DM                                                       00325
      MKAM = I                                                          00326
   21 D = D + G (I) * DEL (I)                                           00327
   25 CONTINUE                                                          00328
C     IF THE PREDICTED DIRECTION IS UPHILL, RESET H TO THE IDENTITY     00329
C     MATRIX.  IF  H = I,  RETURN.                                      00330
      IF (D .LT. 0.0)  GO TO 30                                         00331
      IF ( .NOT. IDENT)  GO TO  5                                       00332
      NCONV= 2                                                          00333
      GO TO 500                                                         00334
   30 WRITE(6,50)(DEL(I),I=1,N)                                         00335
   50 FORMAT(17H0SEARCH DIRECTION/(6E14.6))                             00336
      E(2) = ABS(GF(MKAM)/DEL(MKAM))*AMULT                              00337
      EP=E(2)*ACCUX/AMULT/EPQ                                           00338
C     PERFORM  THE  LINEAR  MINIMIZATION                                00339
      EMAX = 1.E10                                                      00340
      IF(JVKC.EQ.0) GO TO 80                                            00341
      DO 70 I=1,N                                                       00342
   70 EMAX = AMIN1(EMAX,ABS(EMOVE*XO(I)/DEL(I)))                        00343
   80 F (1)  =  FO                                                      00344
      E (1)  =  0.0                                                     00345
      IMAX=0                                                            00346
      KKK  =  0                                                         00347
      NRESET = 0                                                        00348
      KNUM = 0                                                          00349
      KIF = 1                                                           00350
  103 DO 105  I = 1,N                                                   00351
  105 X (I)  =  XO (I)  +  E(2) * DEL (I)                               00352
      CALL FEVAL  (X, F(2),0)                                           00353
      IF(F(2).GT.FO.OR.NRESET.GT.KNUM)AMULT=AMULT/2.                    00354
```

```
      IF(AMULT.LT.1.)AMULT=1.                                                  00355
      IF ( NRESET.EQ.KNUM) GO TO 1010                                          00356
      E(2) = .4*E(2)                                                           00357
      KNUM = KNUM + 1                                                          00358
      GO TO 103                                                                00359
 1010 NCOUNT = NCOUNT  +  1                                                    00360
      DEFF = D*E(2) + F(1) - F(2)                                              00361
      IF (DEFF.NE.0.) GO TO 8001                                               00362
      ED = EF*E(2)                                                             00363
      GO TO 8002                                                               00364
 8001 ED = .5 * D * E(2)**2  / DEFF                                            00365
 8002 IF (ED .LE. 0.0 )  ED =  EF   * E(2)                                     00366
      IF (F(2) .LT. F (1) )  GO TO  120                                        00367
      E (2)  = ED                                                              00368
      KKK  =  KKK  + 1                                                         00369
      NRESET = 0                                                               00370
      KNUM = 0                                                                 00371
      IF  (KKK .LT. 2 )  GO TO 103                                             00372
      F(3)  =  F(2)                                                            00373
      F(2)  =  FO                                                              00374
      E(3)  =  E(2)                                                            00375
      E(2)  =  0.                                                              00376
      E(1) = -E(3)                                                             00377
  108 DO 110  I = 1, N                                                         00378
  110 X(I) =  XO(I)  + E(1)  * DEL (I)                                         00379
      CALL FEVAL  (X, F(1) ,0)                                                 00380
      IF ( NRESET.EQ.KNUM) GO TO 115                                           00381
      E(1) = .4*E(1)                                                           00382
      KNUM = KNUM + 1                                                          00383
      GO TO 108                                                                00384
  115 CONTINUE                                                                 00385
      NCOUNT = NCOUNT  + 1                                                     00386
      GO  TO  150                                                              00387
  120 LOWEST  =  2                                                             00388
      IF (ED .GT. EF * E (2) )  ED = EF * E(2)                                 00389
      IF (ABS (E(2) - ED) .LT. EP)  ED = E(2) +  1.1 * EP                      00390
      IF (ABS (E(2) - ED) .LT. DEP * ABS(E(2)))   ED = 1.1 * E (2)             00391
      KNUM = 0                                                                 00392
      NRESET = 0                                                               00393
      DO  130  I = 1, N                                                        00394
  130 X (I) =  XO (I)  + ED * DEL (I)                                          00395
      IF (ED .GT. E (2))  GO TO  140                                           00396
      E(3) =  E (2)                                                            00397
      F(3) = F(2)                                                              00398
      EBAP = E(2) - ED                                                         00399
  131 E(2) = ED                                                                00400
      CALL FEVAL(X,F(2),0)                                                     00401
      IF(NRESET.EQ.KNUM) GO TO 133                                             00402
      EBAP = 0.53*EBAP                                                         00403
      ED = E(3) - EBAP                                                         00404
      DO 132 I = 1,N                                                           00405
  132 X(I) = XO(I) + ED*DEL(I)                                                 00406
      KNUM = KNUM + 1                                                          00407
      GO TO 131                                                                00408
  133 CONTINUE                                                                 00409
      NCOUNT = NCOUNT  + 1                                                     00410
      GO TO  150                                                               00411
  140 ECAP = ED - E(2)                                                         00412
  141 E(3) = ED                                                                00413
      CALL FEVAL  (X, F(3) ,0)                                                 00414
      IF (NRESET.EQ.KNUM) GO TO 145                                            00415
      ECAP = .53*ECAP                                                          00416
      ED = E(2) + ECAP                                                         00417
      DO 142 I=1,N                                                             00418
  142 X(I) = XO(I) + ED*DEL(I)                                                 00419
      KNUM = KNUM + 1                                                          00420
      GO TO 141                                                                00421
  145 CONTINUE                                                                 00422
      NCOUNT = NCOUNT  + 1                                                     00423
      IEND=0                                                                   00424
```

```
  150 CALL ONED(EMAX,DEP,EP,EF,E,EE,F,LOWEST,EEE,IE,KKK,IEND,IMAX)      00425
      IF(IEND.EQ.2)GO TO 250                                            00426
      KNUM = 0                                                          00427
      NRESET = 0                                                        00428
      ESML = E(1)                                                       00429
      IF (IE.EQ.1) ESML = E(2)                                          00430
      ELRG = E(4)                                                       00431
      IF (IE.EQ.4) ELRG = E(3)                                          00432
      EDS = ESML - EEE                                                  00433
      EDL = EEE - ELRG                                                  00434
  197 DO 190 I=1,N                                                      00435
  190 X(I) = XO(I) + EEE*DEL(I)                                         00436
      CALL FEVAL(X,F(IE),0)                                             00437
      IF (NRESET.EQ.KNUM) GO TO 195                                     00438
      IF (EEE.LT.0.) GO TO 196                                          00439
      EDL = .41*EDL                                                     00440
      EEE = ELRG + EDL                                                  00441
      KNUM = KNUM + 1                                                   00442
      GO TO 197                                                         00443
  196 EDS = .41*EDS                                                     00444
      EEE = ESML - EDS                                                  00445
      KNUM = KNUM + 1                                                   00446
      GO TO 197                                                         00447
  195 E(IE) = EEE                                                       00448
      NCOUNT = NCOUNT  +  1                                             00449
      GO TO 150                                                         00450
C     IF THERE WAS NO MOTION, RETURN.                                   00451
 0250 IF (E(LOWEST) .NE. 0.0)  GO TO 260                                00452
      NCONV= 3                                                          00453
      GO TO  500                                                        00454
C     IF THE FUNCTION VALUE WAS NOT CHANGED, RETURN.                    00455
  260 IF (F(LOWEST) .NE. FO)  GO TO 270                                 00456
      NCONV= 4                                                          00457
      GO TO 500                                                         00458
C     TEST  FOR  CONVERGENCE                                            00459
  270 FO = F(LOWEST)                                                    00460
      NCONV= 1                                                          00461
      ETEST = AMIN1 (1., ABS (E(LOWEST)))                               00462
      DO 280  I = 1, N                                                  00463
      IF (ABS (ETEST * DEL (I)) .GT. GF(I)) NCONV = 0                   00464
      DEL (I)  =  E(LOWEST) * DEL (I)                                   00465
      XO(I) = XO(I) + DEL (I)                                           00466
  280 G1 (I)  =  G (I)                                                  00467
      IF(NCONV.EQ.1.AND.ILIN.GT.2) GO TO 500                            00468
C     IF MAX. NUM. OF LINEAR MINIMIZATIONS HAS BEEN EXCEEDED, RETURN.   00469
      ILIN  =  ILIN +  1                                                00470
      NCONV=  5                                                         00471
      IF (ILIN  .GE.  NLIN )  GO TO 500                                 00472
      KIF = 0                                                           00473
      ABSGO = ABSG                                                      00474
      IF(JVKC.EQ.0) GO TO 295                                           00475
      KNUM = 0                                                          00476
      NRESET = 0                                                        00477
  285 NF = 4                                                            00478
      CALL FEVAL (XO,FO,NF)                                             00479
      IF(NRESET.EQ.KNUM) GO TO 295                                      00480
      KNUM = KNUM + 1                                                   00481
      DO 290 I = 1,N                                                    00482
  290 XO(I) = XO(I) - 0.12*DEL(I)                                       00483
      GO TO 285                                                         00484
  295 CALL GRADF(XO, FO, G, 0)                                          00485
C     IF THE MINIMUM WAS FOUND ALONG -DEL, RESET H TO THE IDENTITY      00486
C     MATRIX.                                                           00487
      IF(OPTD.LT.3) GO TO 5                                             00488
      IF(OPTD.EQ.4) GO TO 600                                           00489
      IF (E(LOWEST) .LT. 0. )  GO TO 5                                  00490
      IF(IMAX.EQ.2) GO TO 5                                             00491
C     MODIFY  H  AND  GO  BACK  FOR  ANOTHER  ITERATION.                00492
      IDENT =  .FALSE.                                                  00493
      A = 0.                                                            00494
```

```
      C = 0.                                                                    00495
      DO 300 I=1,N                                                              00496
      G1(I) = G(I) - G1(I)                                                      00497
      C=C+G(I)*DEL(I)                                                           00498
  300 A = A + G1(I)*DEL(I)                                                      00499
      B =  0.                                                                   00500
      DO  330  I = 1, N                                                         00501
      X(I) = 0.                                                                 00502
      DO  320  J = 1, N                                                         00503
  320 X (I)  =  X (I) + H (I,J)  * G1(J)                                        00504
  330 B = B -  X (I) *  G1(I)                                                   00505
      DO  340  I = 1, N                                                         00506
      DO  340  J = I, N                                                         00507
      H(I,J) = H(I,J) + DEL (I) * DEL (J) /A + X(I) * X(J) / B                  00508
      IF(IBFGS.EQ.1)H(I,J)=H(I,J)-B*(DEL(I)/A+X(I)/B)*(DEL(J)/A+X(J)/B)         00509
  340 H (J,I)  =  H (I, J)                                                      00510
      GO TO 15                                                                  00511
 0500 RETURN                                                                    00512
  600 DO 650 I = 1,N                                                            00513
  650 DEL(I) =-G(I) + (ABSG/ABSGO)*DEL(I)                                       00514
      GO TO 30                                                                  00515
      END                                                                       00516
```

```
      SUBROUTINE ONED(EMAX,DEP,EP,EF,E,EE,F,LOWEST,EEE,IE,KKK,IEND,IMAX)00517
      DIMENSION E(4),EE(4),F(4)                                         00518
      IF(IEND.EQ.1)GO TO 190                                            00519
      IEND=1                                                            00520
  150 KONT = 0                                                          00521
      CALL  INITPM  (  E,  F,  EE,  A,   KONT  )                        00522
  160 LOWEST  =  1                                                      00523
      DO 165  I =  2, 3                                                 00524
  165 IF (F(I) .LT. F (LOWEST) )  LOWEST = I                            00525
      IE = 2. + SIGN  (1., EE (2))                                      00526
      IF (A .LT. 0.)  IE =  4 - IE                                      00527
      IF(A.LT.0..OR.ABS(EE(2)).GT.ABS(EF* EE(IE)))EE(2)=EF*EE(IE)       00528
      EEE = E(2) + EE (2)                                               00529
      IF(EEE.LT.EMAX) GO TO 167                                         00530
      EEE = EMAX                                                        00531
      IMAX = 1 + IMAX                                                   00532
      IF(IMAX.EQ.2) GO TO 250                                           00533
  167 IF (ABS (EEE - E(LOWEST)) .LT. EP) GO TO 250                      00534
      IF(ABS(EEE-E(LOWEST)).LT.DEP*ABS(E(LOWEST))) GO TO 250            00535
      IF (EE (IE) .LT. EE (2))  IE = IE + 1                             00536
      IF (IE .EQ. 4)  GO TO 180                                         00537
      DO 170  LL = IE , 3                                               00538
      L = 3 - LL + IE                                                   00539
      E (L+1)  =  E (L)                                                 00540
  170 F (L+1)  =  F (L)                                                 00541
  180 E (IE)  =  EEE                                                    00542
      IEND=1                                                            00543
      RETURN                                                            00544
  190 IF (IE .EQ. 1 )  GO TO 150                                        00545
      KKK  =  1                                                         00546
      IF (IE .EQ. 4 )  GO TO 220                                        00547
      IF (F (1) .GT. F(4))  GO TO  200                                  00548
      KONT =  0                                                         00549
      CALL  INITPM  (  E,  F,  EE,  A,   KONT  )                        00550
      IF (E (2) + EE (2) .LT. E(4) .AND. A .GT. 0. ) GO TO 160          00551
      GO TO  210                                                        00552
  200 KKK  =  2                                                         00553
      KONT =  1                                                         00554
      CALL  INITPM  (  E,  F,  EE,  A,   KONT  )                        00555
      IF (E (3) + EE (2) .GT. E(1) .AND. A .GT. 0.0) GO TO 220          00556
  210 KKK = 1                                                           00557
      IF (F (2) .LT. F(1) .AND. F(2) .LE. F(3) .OR. F(2) .LE. F(1) .AND.00558
     1 F(2) .LT. F(3))  GO TO  150                                      00559
  220 DO 230  I = 1, 3                                                  00560
      E (I)  =  E (I+1)                                                 00561
  230 F (I)  =  F (I+1)                                                 00562
      IF(KKK.EQ.1)GO TO 150                                             00563
      IF(KKK.EQ.2)GO TO 160                                             00564
C     FINISH  OF  THE  LINEAR  MINIMIZATION                             00565
  250 IEND=2                                                            00566
      RETURN                                                            00567
      END                                                               00568
```

```
      SUBROUTINE GRADF(XO,FP,G,NF)                                          00569
C     CALCULATE GRADIENT USING FORWARD DIFFERENCES                          00570
C                                                                           00571
      COMMON/SYNT/ACCUX,EPS,NDD,RK,GLM,PEN,OBJ,JECT,AMULT,EF,DEP,JVKC       00572
      COMMON/STEP/ GF(12),EMOVE,ICENT                                       00573
      COMMON/DMINOP/ NRESET,IBFGS                                           00574
      COMMON/CNMN1/DUP(12),NADV,DUR(12)                                     00575
      COMMON / OUTP/   IDD, ILIN, IDV                                       00576
      COMMON /KICKIT/  IFLAG                                                00577
      DIMENSION XO(12), G(12)                                               00578
C                                                                           00579
      IFLAG= 0                                                              00580
      IC  = 2                                                               00581
      F1=FP                                                                 00582
      CENT=1.+ICENT                                                         00583
      DO 100 I = 1,NADV                                                     00584
      IDV  =  I                                                             00585
      ITRY = 0                                                              00586
      NRESET = 0                                                            00587
      EH = GF(I)                                                            00588
   10 XO(I) = XO(I) - EH                                                    00589
      CALL FEVAL (XO ,FO , IC )                                             00590
      XO(I) = XO(I) + EH                                                    00591
      IF(ICENT.EQ.0)GO TO 15                                                00592
      IF(JECT.NE.0)GO TO 12                                                 00593
      XO(I)=XO(I)+EH                                                        00594
      CALL FEVAL(XO,F1,IC)                                                  00595
      XO(I)=XO(I)-EH                                                        00596
      IF(JECT.EQ.0)GO TO 50                                                 00597
   12 ITRY=ITRY+1                                                           00598
      IF(ITRY.GT.4)GO TO 40                                                 00599
      EH=EH/3.                                                              00600
      GO TO 10                                                              00601
   15 IF(JECT.EQ.0) GO TO 50                                                00602
C     IF ANALYSIS WAS REJECTED, MODIFY STEP SIZE AND TRY AGAIN              00603
      ITRY = ITRY + 1                                                       00604
      GO TO (30,30,20,35,20,35,40),ITRY                                     00605
   20 EH = -EH                                                              00606
      GO TO 10                                                              00607
   30 EH = EH/3.                                                            00608
      GO TO 10                                                              00609
   35 EH = -EH/3.                                                           00610
      GO TO 10                                                              00611
   50 G(I) = (F1 - FO)/EH/CENT                                              00612
      GF(I) = SIGN(EH,G(I))                                                 00613
  100 CONTINUE                                                              00614
      WRITE(6,110) (G(I),I = 1,NADV)                                        00615
  110 FORMAT(17H0GRADIENT FOLLOWS/(6E14.6))                                 00616
      RETURN                                                                00617
   40 IFLAG= 1                                                              00618
      WRITE (6,500)                                                         00619
  500 FORMAT (10X,31HA GRADIENT COULD NOT BE FOUND.  )                      00620
      RETURN                                                                00621
      END                                                                   00622
```

```
      SUBROUTINE ANALYS                                                 00623
      COMMON/THUMB/THOBJ(49),THOFF(49),THLDG(49),THSSG(49),THMAP(49),   00624
     1 THVAP(49),THSW(49),THEXF(49),ITH                                 00625
      COMMON/COSTDAT/VWTS(41),COST                                      00626
      COMMON/COSTCON/ICOST,OFC                                          00627
      COMMON/EDETIN/CAM,SBASE,BL,XD,AMODE,AITEK,SHT,TCHT,SVT,           00628
     1 TCVT,ARHT,ARVT,XNAC,DNAC,NEW,NEF,TRHT,TRVT,HHT,GLOV              00629
      COMMON/VLIMIT/VMAX,VMMO                                           00630
      COMMON/FPRINT/IPRNT                                               00631
      COMMON/SYNT/ACCUX,EPS,NDD,RK,GLM,PEN,XBJ,JECT,AMULT,EF,DEP        00632
      COMMON/LANDG/VAPPR,DRATIO,CLLDM,CLTOM,FLTO,FLLDG,XENG,            00633
     1 THRSS,THRMA,ELODSS,ELODMA,THROFF                                 00634
      COMMON/CONTRL/PLIM                                                00635
      COMMON/MISWT/WTHR,WIN,WHYD,WELEC,WAVONC,WFURN,WAC,WAPU,WAI,EEXP,  00636
     1 WENG,THRSO,FWMAX,WRATIO,WCON,WUF,WOIL,WPMSC,WFSYS,WSRV           00637
      COMMON/RATIOS/WSR,TWR,HTVC,VTVC,PGLOV,INENG                       00638
      COMMON/CONFIG/GW,AR,THRUST,SW,TR,SWEEP,TCA,VCMN,CH,WWSTR,         00639
     1 DUMV1,DUMV2,DESRNG                                               00640
      COMMON/VARABLE/DV(12)                                             00641
      COMMON/CONSTRT/OBJ,G(25),GFACT(25),IG(25)                         00642
      COMMON/AKEY/AK(12),OFG,OFF,OFM,OFR                                00643
      COMMON/ANDATA/LOOPCNT                                             00644
      COMMON/ESB/RAMPWT,DOWE,PAYLOAD,TFL,MYWTS,MYAERO,RANGE,            00645
     1 TIME,ELOD,ITAKOFF,ILAND,RW                                       00646
      DIMENSION DVA(12)                                                 00647
      INTEGER RW                                                        00648
      EQUIVALENCE (DVA(1),GW)                                           00649
      IPRNT=0                                                           00650
      IF(LOOPCNT.EQ.1)IPRNT=1                                           00651
      IF(LOOPCNT.EQ.-999)IPRNT=5                                        00652
      PLIM=4H                                                           00653
      ENTRY ANALF                                                       00654
      J=1                                                               00655
      DO 100 I=1,12                                                     00656
      IF(AK(I).LE.0.)GO TO 100                                          00657
      DVA(I)=DV(J)                                                      00658
      J=J+1                                                             00659
  100 CONTINUE                                                          00660
      GO TO 110                                                         00661
      ENTRY PARV                                                        00662
      IPRNT=1                                                           00663
      IF(PLIM.NE.4H    )IPRNT=3                                         00664
      GO TO 110                                                         00665
      ENTRY PPLT                                                        00666
      IPRNT=0                                                           00667
  110 IWSR=6                                                            00668
      IPRO=IPRNT                                                        00669
      IPRNT=0                                                           00670
      IF(WSR.LT.0.)WSR=-SW                                              00671
      IF(TWR.LT.0.)TWR=-THRUST/XENG                                     00672
      VMAX=VMMO                                                         00673
      IF(VMMO.LT.VCMN.AND.VMMO.LT..5)VMAX=VMMO+VCMN                     00674
      IF(WSR.NE.0.)SW=GW/ABS(WSR)                                       00675
      IF(PGLOV.GT.0.)GLOV=PGLOV*SW                                      00676
      IF(TWR.NE.0.)THRUST=GW*ABS(TWR)                                   00677
      IF(RW.NE.1)GO TO 170                                              00678
      GWO=GW                                                            00679
      IF(WSR.NE.0..OR.TWR.NE.0.)IWSR=1                                  00680
      GO TO 170                                                         00681
  120 IWSR=IWSR+1                                                       00682
      DGW=GW-GWO                                                        00683
      IF(ABS(DGW).LT..1)IWSR=6                                          00684
      DELGW=1.25*DGW                                                    00685
      IF(IWSR.GT.2.AND.(DGW-DGO).NE.0.)DELGW=DGW*(GWP-GWO)/(DGW-DGO)    00686
      IF(DELGW.LT.10..AND.IWSR.GT.2)IWSR=6                              00687
      IF(ABS(DELGW).GT.GWO/2.)DELGW=0.5*SIGN(GWO,DELGW)                 00688
      DGO=DGW                                                           00689
      GWP=GWO                                                           00690
      GWO=GWP+DELGW                                                     00691
```

```
      GW=GWO                                                                  00692
      IF(WSR.NE.0.)SW=GW/ABS(WSR)                                             00693
      IF(PGLOV.GT.0.)GLOV=PGLOV*SW                                            00694
      IF(TWR.NE.0.)THRUST=GW*ABS(TWR)                                         00695
  170 IF(IWSR.GE.6)IPRNT=IPRO                                                 00696
      IF(HTVC.GT.0.)SHT=HTVC*SW*SQRT(SW/AR)/BL                                00697
      IF(VTVC.GT.0.)SVT=VTVC*SW*SQRT(SW*AR)/BL                                00698
      ESCALE=THRUST/THRSO                                                     00699
      ESCTO=ESCALE                                                            00700
      THROFF=THROFF*ESCALE                                                    00701
      THRSS=THRSS*ESCALE                                                      00702
      THRMA=THRMA*ESCALE                                                      00703
      XNAC=XNAC*SQRT(ESCALE)                                                  00704
      DNAC=DNAC*SQRT(ESCALE)                                                  00705
      IF(MYWTS.EQ.0)CALL WEIGHT(IPRNT)                                        00706
      THRSO=THRUST                                                            00707
      IF(JECT.NE.0)GO TO 200                                                  00708
      RANGE=0.                                                                00709
      G(1)=1.                                                                 00710
      IF(PLIM.NE.4HAERO.AND.PLIM.NE.4H    )GO TO 80                           00711
      IF(MYAERO.EQ.0)CALL EDET(IPRNT)                                         00712
      IF(MYAERO.EQ.2)CALL AERSCL(IPRNT)                                       00713
      IF(PLIM.NE.4H    )GO TO 80                                              00714
      CALL MISSION(ESCALE,IPRNT,ENDESWT)                                      00715
C     WLDG=ENDESWT                                                            00716
      IF(IWSR.LT.6)GO TO 120                                                  00717
      IF(ICOST.EQ.1)CALL CALCOST(IPRNT)                                       00718
      OBJ=GW*OFG+TFL*OFF+VCMN*ELOD*OFM+OFR*RANGE+OFC*COST                     00719
C     DESIGN RANGE                                                            00720
      IF(RANGE.LE.0.)JECT=1                                                   00721
      G(1)=1.-RANGE/DESRNG                                                    00722
      IF(RW.EQ.1)G(1)=-1.                                                     00723
C     APPROACH SPEED                                                          00724
   80 CLAPP=CLLDM/1.69                                                        00725
      WLDG=WRATIO*GW                                                          00726
      VAPP=17.18644*SQRT(WLDG/(SW*DRATIO*CLAPP))                              00727
C     LANDING FIELD LENGTH                                                    00728
      FARLDG=(118.*WLDG/SW/DRATIO/CLAPP/1.69+400.)/.6                         00729
C     TAKE-OFF FIELD LENGTH                                                   00730
      ENGOP=XENG-1.                                                           00731
      IF(XENG.LT.1.5)ENGOP=1.                                                 00732
      FAROFF=20.9*GW**2/SW/DRATIO/CLTOM/THROFF/ENGOP                          00733
     1 +87.*SQRT(GW/SW/DRATIO/CLTOM)                                          00734
      IF(XENG.LT.1.5)FAROFF=FAROFF*1.15                                       00735
C     MISSED APPROACH CLIMB GRADIENT                                          00736
      ALOD=ELODMA                                                             00737
      IF(ALOD.LE.0.)ALOD=2.6*AR**.7/CLAPP**.79                                00738
      CGRAD1=(1.5+.3*XENG)/100.                                               00739
      AMFOR=THRMA*ENGOP-WLDG*(CGRAD1+1./ALOD)                                 00740
C     SECOND SEGMENT CLIMB GRADIENT                                           00741
      CLOD=ELODSS                                                             00742
      IF(CLOD.LE.0.)CLOD=2.68*AR**.76/(CLTOM/1.44)**.95                       00743
      CGRAD2=(1.8+.3*XENG)/100.                                               00744
      SSFOR=THRSS*ENGOP-GW*(CGRAD2+1./CLOD)                                   00745
      IF(PLIM.NE.4H    .AND.INENG.EQ.1)CALL SKALENG(ESCALE,0)                 00746
      IF(ITAKOFF.EQ.1.OR.ILAND.EQ.1)CALL THTOL(ESCTO)                         00747
      IF(ILAND.EQ.1)CALL LANDING(FARLDG,WLDG,IPRNT,AR,SW,GLOV,XENG,           00748
     + AMFOR,VAPP)                                                            00749
      IF(ITAKOFF.EQ.1)CALL TOFF(FAROFF,GW,IPRNT,AR,SW,GLOV,XENG,SSFOR)        00750
      G(2)=VAPP/VAPPR-1.                                                      00751
      G(4)=FARLDG/FLLDG-1.                                                    00752
      G(3)=FAROFF/FLTO-1.                                                     00753
      G(5)=1.-(AMFOR+THRMA)/THRMA                                             00754
      G(6)=1.-(SSFOR+THRSS)/THRSS                                             00755
      WOS=GW/SW                                                               00756
      TOW=THRUST*XENG/GW                                                      00757
      WRITE(6,10)TFL,RANGE,VAPP,FAROFF,FARLDG,AMFOR,SSFOR,                    00758
     1 (DVA(I),I=1,9),WOS,TOW                                                 00759
   10 FORMAT(49H0       FUEL  RANGE  VAPP FAROFF FARLDG   AMFOR             00760
     1,60HSSFOR       GW     AR    THRUST     SW    TR  SWEEP   TCA    , 00761
```

```
   223HVCMN     CH     W/S    T/W/F11.1,F7.1,F6.1,2F7.0,2F8.0,F11.1,      00762
   3 F7.3,2F8.1,F6.3,F6.2,F7.5,F6.4,F8.0,F6.1,F6.4)                      00763
    GO TO 210                                                            00764
200 OBJ=OBJ*10.                                                          00765
210 THOBJ(ITH)=OBJ                                                       00766
    THOFF(ITH)=FAROFF                                                    00767
    THLDG(ITH)=FARLDG                                                    00768
    THSSG(ITH)=SSFOR                                                     00769
    THMAP(ITH)=AMFOR                                                     00770
    THVAP(ITH)=VAPP                                                      00771
    THSW(ITH)=SW                                                         00772
    IF(WSR.LT.0.)SW=-WSR                                                 00773
    IF(TWR.LT.0.)THRUST=-TWR*XENG                                        00774
    RETURN                                                               00775
    END                                                                  00776
```

```
      SUBROUTINE INITPM(E, F, EE, A, KONT)                              00777
C     CALCULATES LOCATION OF THE MINIMUM OF A PARABOLA THRU 3 POINTS    00778
C                                                                       00779
      DIMENSION E(4), EE(4), F(4)                                       00780
C                                                                       00781
      EE(1) = E(KONT + 1) - E(KONT + 2)                                 00782
      EE(3) = E(KONT + 3) - E(KONT + 2)                                 00783
      DF1   = EE(1) * (F(KONT + 3) - F(KONT + 2))                       00784
      DF3   = EE(3) * (F(KONT + 1) - F(KONT + 2))                       00785
      IF (DF1.EQ.DF3) GO TO 30                                          00786
      IF (EE(1).EQ.EE(3).OR.EE(1).EQ.0..OR.EE(3).EQ.0.)STOP             00787
      EE(2) = .5 * (EE(1) * DF1 - EE(3) * DF3) / (DF1 - DF3)            00788
      A     = (DF3 - DF1) / (EE(1) * EE(3) * (EE(1) - EE(3)))           00789
      RETURN                                                            00790
   30 EE(2) = EE(3) - EE(1)                                             00791
      IF(F(KONT+3).GT.F(KONT+1))EE(2)=-EE(2)                            00792
      A = 0.                                                            00793
      RETURN                                                            00794
      END                                                               00795
```

```
      SUBROUTINE ORIDE(VAL,OVAL)                                        00796
      IF(OVAL.GT.5.)GO TO 10                                            00797
      IF(VAL.EQ.0.)RETURN                                               00798
      IF(OVAL.LT.0.)OVAL=-OVAL/VAL                                      00799
      VAL=VAL*OVAL                                                      00800
      RETURN                                                            00801
   10 VAL=OVAL                                                          00802
      RETURN                                                            00803
      END                                                               00804
```

```
      SUBROUTINE DEFENG                                                 00805
      COMMON/EDATA/NM,NA,NT,EMACH(20),ALT(10,20),FF(16,10,20),          00806
     1 THR(16,10,20),EXTFAC,FFFAC,DFFAC,IDFUEFL,TAKOFF,IXTRAP,MAXCR     00807
      COMMON/MISS/EM(1275),AL(1275),TH(1275),FL(1275),K(1275)           00808
     1,SFC(25)                                                          00809
      NAMELIST/ENGDIN/ EXTFAC,FFFAC,DFFAC,IDLE,IXTRAP,IFILL,MAXCR,      00810
     1 BOOST,NGPRT                                                      00811
      DATA DFFAC,FFFAC/2*0./,EXTFAC/1./,IDLE,ISTOP/2*0/,MAXCR/2/,       00812
     1 NM/20/,NA/10/,NT/16/,NIP/1275/,IXTRAP/1/,IFILL/2/,BOOST/0./      00813
     2,NGPRT/1/                                                         00814
C     READ NAMELIST $ENGDIN                                            00815
      READ(5,ENGDIN)                                                    00816
      IF(MAXCR.EQ.0)MAXCR=2                                             00817
      WRITE(6,405)EXTFAC,IDLE,IXTRAP,IFILL,MAXCR,BOOST,DFFAC,FFFAC      00818
  405 FORMAT(37H0ENGINE INPUT DATA (NAMELIST $ENGDIN)/                  00819
     1 14H0  DESCRIPTION,16X,4HNAME,7X,18H VALUE  DIMENSIONS//          00820
     1 37H   SLOPE FACTOR FOR                    /                      00821
     2 37H    EXTRAPOLATING FUEL FLOWS  EXTFAC ,F11.4/                  00822
     3 37H   FLIGHT IDLE SWITCH         IDLE   ,I11/                    00823
     4 37H   SFC EXTRAPOLATION SWITCH   IXTRAP ,I11/                    00824
     5 37H   PART POWER DATA SWITCH     IFILL  ,I11/                    00825
     6 37H   MAX. CRUISE POWER SETTING  MAXCR  ,I11/                    00826
     7 37H   BOOST ENGINE SWITCH        BOOST  ,F11.4/                  00827
     8 37H   FUEL FLOW SCALING                 /                      00828
     9 37H    CONSTANT TERM             DFFAC  ,F11.4/                  00829
     1 37H   FUEL FLOW SCALING                 /                      00830
     2 37H    LINEAR TERM               FFFAC  ,F11.4/)                 00831
C     READ ENGINE DECK                                                 00832
      DO 20 I=1,NIP                                                     00833
      K(I)=I                                                            00834
      READ(5,10)EM(I),AL(I),TG,RD,FL(I)                                 00835
   10 FORMAT(F5.2,F10.0,5X,3F10.0)                                      00836
      IF(EM(I).GT.5.)GO TO 30                                           0083*
   20 TH(I)=TG-RD                                                       00838
      WRITE(6,25)NIP                                                    00839
   25 FORMAT(21H0* * * ONLY THE FIRST,I5,                               00840
     1 30H ENGINE POINTS WERE READ * * */)                              00841
   30 NIT=I-2                                                           00842
C     SORT ENGINE DECK BY MACH NUMBER                                  00843
      DO 45 J=1,NIT                                                     00844
      NIP=NIT-J+1                                                       00845
      DO 40 I=1,NIP                                                     00846
      IF(EM(K(I)).GE.EM(K(I+1)))GO TO 40                                00847
      KT=K(I)                                                           00848
      K(I)=K(I+1)                                                       00849
      K(I+1)=KT                                                         00850
   40 CONTINUE                                                          00851
   45 CONTINUE                                                          00852
C     BY ALTITUDE                                                      00853
      NAT=NA*NT-1                                                       00854
      DO 55 J=1,NAT                                                     00855
      NIP=NIT-J+1                                                       00856
      DO 50 I=1,NIP                                                     00857
      IF(EM(K(I)).NE.EM(K(I+1)).OR.AL(K(I)).GE.AL(K(I+1)))GO TO 50      00858
      KT=K(I)                                                           00859
      K(I)=K(I+1)                                                       00860
      K(I+1)=KT                                                         00861
   50 CONTINUE                                                          00862
   55 CONTINUE                                                          00863
C     BY THRUST LEVEL                                                  00864
      NT1=NT-1                                                          00865
      DO 65 J=1,NT1                                                     00866
      NIP=NIT-J+1                                                       00867
      DO 60 I=1,NIP                                                     00868
      IF(EM(K(I)).NE.EM(K(I+1)).OR.AL(K(I)).NE.AL(K(I+1))               00869
     1 .OR.TH(K(I)).GE.TH(K(I+1)))GO TO 60                              00870
      KT=K(I)                                                           00871
      K(I)=K(I+1)                                                       00872
      K(I+1)=KT                                                         00873
```

```
   60 CONTINUE                                                          00874
   65 CONTINUE                                                          00875
C     PACK DATA INTO ARRAYS                                             00876
      NI=NIT+1                                                          00877
      DO 75 M=1,NM                                                      00878
      EMACH(M)=0.                                                       00879
      DO 75 N=1,NA                                                      00880
      ALT(N,M)=0.                                                       00881
      DO 75 L=1,NT                                                      00882
      THR(L,N,M)=0.                                                     00883
   75 FF(L,N,M)=0.                                                      00884
      M=0                                                               00885
      EMT=-3.                                                           00886
      NA=1                                                              00887
      NT=1                                                              00888
      IF(NGPRT.GT.1)WRITE(6,77)                                         00889
   77 FORMAT(52H0 MACH NUMBER     ALTITUDE   NET THRUST    FUEL FLOW)   00890
      DO 100 I=1,NI                                                     00891
      J=K(I)                                                            00892
      IF(ABS(EM(J)-EMT).LT.0.010)GO TO 80                               00893
      IF(NGPRT.GT.1)WRITE(6,78)                                         00894
   78 FORMAT(1H0)                                                       00895
      M=M+1                                                             00896
      EMT=EM(J)                                                         00897
      EMACH(M)=EMT                                                      00898
      N=1                                                               00899
      ALS=AL(J)                                                         00900
      L=0                                                               00901
      ALT(N,M)=ALS                                                      00902
      GO TO 90                                                          00903
   80 IF(ABS(AL(J)-ALS).LT.100.)GO TO 85                                00904
      IF(NGPRT.GT.1)WRITE(6,78)                                         00905
      N=N+1                                                             00906
      IF(N.GT.NA)NA=N                                                   00907
      L=0                                                               00908
      ALS=AL(J)                                                         00909
      ALT(N,M)=ALS                                                      00910
      GO TO 90                                                          00911
   85 IF(ABS(TH(J)-THR(L,N,M)).LT.1.)GO TO 95                           00912
   90 L=L+1                                                             00913
      IF(L.GT.NT)NT=L                                                   00914
      FF(L,N,M)=FL(J)                                                   00915
      THR(L,N,M)=TH(J)                                                  00916
   95 IF(NGPRT.GT.1)WRITE(6,96)EM(J),AL(J),TH(J),FL(J)                  00917
   96 FORMAT(F13.4,3F13.1)                                              00918
  100 CONTINUE                                                          00919
      NM=M                                                              00920
C                                                                       00921
      IF(IFILL.EQ.0)GO TO 400                                           00922
C     FILL IN PART POWER DATA                                           00923
      DO 300 M=1,NM                                                     00924
      DO 300 N=1,NA                                                     00925
      IF(FF(1,N,M).LE.0.)GO TO 300                                      00926
      DO 310 I=1,IFILL                                                  00927
      IP1=I+1                                                           00928
  310 IF(FF(IP1,N,M).LE.0.)GO TO 464                                    00929
      GO TO 300                                                         00930
  464 M1=M-1                                                            00931
      N1=0                                                              00932
      IF(N.GT.1)N1=N-1                                                  00933
  200 M1=M1+1                                                           00934
      IF(M1.GT.NM)GO TO 400                                             00935
      DO 210 N2=N,NA                                                    00936
  210 IF(FF(IFILL+1,N2,M1).GT.0.)GO TO 220                              00937
      IF(N1.GT.0)GO TO 465                                              00938
      IF(M.EQ.1)GO TO 200                                               00939
      M1=M-1                                                            00940
      N1=1                                                              00941
      GO TO 465                                                         00942
  220 IF(N1.GT.0)GO TO 230                                              00943
```

```
      SUBROUTINE EDET(IPRINT)                                           00001
      COMMON/COSTDAT/VWTS(26),VSM,VDUM(15)                              00002
      COMMON/OSWALD/E                                                   00003
       COMMON/AERO/ CDTAB(500),CDPA(400)                                00004
      COMMON/MISS/AR,CAM,CDCTAB(20),CDF(42),CDFCRD(10),                 00005
     1 CDFTAB(20),CDITAB(15),CDPTAB(20,15),CDREF(20),CF(41),            00006
     2 CH,CL(15),CLBUF(20),DB,FF(40),FR(40),ITAB,AITEK,L(40),           00007
     3 LAM,LDBODY,M(20),MNO,N,NCRUD,RN(40),SBASE,SPI,                   00008
     4 SREF,SWET(41),SW25,TAPER,TC,TRU(40),TRL(40),VCMIN,               00009
     5 DUMMY(5578)                                                      00010
      REAL L,LDBODY,M,MDES                                              00011
      ITAB=IPRINT                                                       00012
       CALL INPUT                                                       00013
      EO=E                                                              00014
      IF(EO.LE.0.)EO=1.01+(.4226*SQRT(TAPER)-.35*TAPER-.143)*AR/10.+E   00015
      IF(EO.GT.1.)EO=1.                                                 00016
       CALL CDFF(CH,VCMIN,ANS)                                          00017
       CALL CLDESN(TC,AR,SW25,CAM,CLDES,CL,NUMCL)                       00018
       CALL MDESN(TC,AR,SW25,AITEK,CLDES,MDES,M,MNO,TAPER)              00019
       VSM=MDES                                                         00020
       DO 40 I=1,20                                                     00021
          CDFTAB(I)=0.                                                  00022
          CLBUF(I)=0.                                                   00023
          CDCTAB(I)=0.                                                  00024
          DO 40 J=1,15                                                  00025
          CDPTAB(I,J)=0.                                                00026
          CDITAB(J)=0.                                                  00027
40     CONTINUE                                                         00028
      CDTAB(1)=1000.*MNO+NUMCL                                          00029
      DO 41 I=1,NUMCL                                                   00030
  41  CDTAB(I+1)=CL(I)                                                  00031
      NNNL=NUMCL+1                                                      00032
      TH=(1.-TAPER)/(1.+TAPER)/AR                                       00033
      COSA=1./SQRT(1.+(TAN(SW25/57.2958)-3*TH)**2)                      00034
      COSB=1./SQRT(1.+(TAN(SW25/57.2958)+TH)**2)                        00035
       DO 50 I=1,20                                                     00036
          IF(M(I).LT.0.2) GO TO 50                                      00037
      CAYT=((1.1-.11/(1.1-M(I)*COSA))/(1.1-.11/(1.1-M(I)*COSB))         00038
     C -1.)**2/2.                                                       00039
      NNNL=NNNL+1                                                       00040
      CDTAB(NNNL)=M(I)                                                  00041
          DELM=M(I)-MDES                                                00042
      IF(ITAB.EQ.0)GO TO 35                                             00043
          CALL BUFFET(TC,DELM,SW25,AR,CAM,DELCLB)                       00044
        IF (DELM.LE.0.15)  CLBUF(I)=DELCLB+CLDES                        00045
  35  ITSAVE=ITAB                                                       00046
      ITAB=0                                                            00047
          CALL CDFF(CH,M(I),CDFTAB(I))                                  00048
      ITAB=ITSAVE                                                       00049
          CALL CDCC(AR,TC,CAM,SW25,SREF,DB,TAPER,SBASE,SPI,             00050
     C      LDBODY,M(I),DELM,CDCTAB(I))                                 00051
          DO 45 J=1,NUMCL                                               00052
       NNNL=NNNL+1                                                      00053
            DELCL=CL(J)-CLDES                                           00054
            CALL CDPP(AR,TC,DELCL,DELM,CAM,CDPTAB(I,J))                 00055
            CDITAB(J)=CL(J)*CL(J)/3.1416/AR/EO                          00056
            CDTAB(NNNL)=CDFTAB(I)+CDCTAB(I)+CDPTAB(I,J)+CDITAB(J)       00057
      IF(SW25.LT.0.)CDTAB(NNNL)=CDTAB(NNNL)+CAYT*CL(J)*CL(J)            00058
45        CONTINUE                                                      00059
50    CONTINUE                                                          00060
                     CALL RNCORR                                        00061
       IF(ITAB.EQ.0) RETURN                                             00062
54    FORMAT(1H ,F10.3,F20.5,F20.5,F20.3)                               00063
55    FORMAT (1H ,F10.3,F20.5)                                          00064
                     WRITE (6,60) CH                                    00065
62    FORMAT(1H ,4HMACH,50X,2HCL)                                       00066
      WRITE (6,62)                                                      00067
      WRITE (6,56) (CL(I),I=1,NUMCL)                                    00068
60    FORMAT(1H0,10X,11HDRAG POLARS,5X,10HALTITUDE =,F6.0,3H FT)        00069
      DO 52 I=1,MNO                                                     00070
```

```
      J8=I*(NUMCL+1)+1                                                  00071
      J9=J8+NUMCL                                                       00072
       WRITE (6,57) (CDTAB(J),J=J8,J9)                                  00073
52     CONTINUE                                                         00074
       WRITE (6,64) MDES,CLDES                                          00075
64     FORMAT(22H0 DESIGN MACH NUMBER =,F6.3,13H, DESIGN CL =,F6.3)     00076
       WRITE (6,69)                                                     00077
57     FORMAT(1H ,F5.3,15F8.4)                                          00078
69     FORMAT(1H0,6X,4HMACH,15X,3HCDF,17X,3HCDC,15X,9HBUFFET CL/)       00079
       DO 70 I=1,MNO                                                    00080
       IF (CLBUF(I).EQ.0.0) WRITE (6,54) M(I),CDFTAB(I),CDCTAB(I)       00081
       IF (CLBUF(I).NE.0.0) WRITE (6,54) M(I),CDFTAB(I),CDCTAB(I),      00082
     C    CLBUF(I)                                                     00083
 70    CONTINUE                                                         00084
       WRITE (6,67)                                                     00085
67     FORMAT(/8X,2HCL,16X,3HCDI/)                                      00086
       WRITE (6,55) (CL(I),CDITAB(I),I=1,NUMCL)                         00087
       WRITE (6,58)                                                     00088
       WRITE (6,62)                                                     00089
58     FORMAT(1H0,10X,32HPRESSURE DRAG COEFFICIENTS...CDP )             00090
       WRITE(6,56) (CL(I),I=1,NUMCL)                                    00091
56     FORMAT(5X,15F8.3)                                                00092
       DO 65 I=1,MNO                                                    00093
          WRITE (6,59) M(I),(CDPTAB(I,J),J=1,NUMCL)                     00094
65     CONTINUE                                                         00095
59     FORMAT(1H ,F5.3,15F8.5)                                          00096
       RETURN                                                           00097
       END                                                              00098
```

```
C      ****************************************************************     00099
C      *                                                              *     00100
C      *   SKIN FRICTION SUBROUTINE                                   *     00101
C      *                                                              *     00102
C      ****************************************************************     00103
C                                                                             00104
       SUBROUTINE CDFF(ALT,MACH,ANS)                                         00105
       COMMON/MISS/AR,CAM,CDCTAB(20),CDF(42),CDFCRD(10),                     00106
      1 CDFTAB(20),CDITAB(15),CDPTAB(20,15),CDREF(20),CF(41),                00107
      2 CH,CL(15),CLBUF(20),DB,FF(40),FR(40),ITAB,AITEK,L(40),               00108
      3 LAM,LDBODY,M(20),MNO,N,NCRUD,RN(40),SBASE,SPI,                       00109
      4 SREF,SWET(41),SW25,TAPER,TC,TRU(40),TRL(40),VCMIN,                   00110
      5 DUMMY(5578)                                                          00111
       COMMON/CONPON/NAME(4,40)                                              00112
       REAL L,LDBODY,M,MACH                                                  00113
        DIMENSION F(25)                                                      00114
       DATA F/11*0.,4.34255,-1.14281,                                        00115
      C .171203,-.0138334,.000621712,.000000137442,-.0000145532,             00116
      C 2.94206,7.16974,48.8876,-1403.02,8598.76,-15834.3,4.275/             00117
        CDF(42)=0.                                                           00118
        ANS=0.                                                               00119
        SWET(41)=0.                                                          00120
        DO 99 I=1,N                                                          00121
       CALL CFF(ALT,L(I),MACH,CF(I),RN(I))                                   00122
       IF(LAM.EQ.1)CF(I)=CF(I)-.5*(CF(I)-1.328/SQRT(RN(I)))*                 00123
      1 (TRU(I)*(.0064164+TRU(I)*(.48087E-4-.12234E-6*TRU(I)))               00124
      1 +TRL(I)*(.0064164+TRL(I)*(.48087E-4-.12234E-6*TRL(I))))              00125
C                                                                            00126
C            FORM FACTOR FOR BODIES                                          00127
C                                                                            00128
           IF(FR(I).GT.1.0) FF(I)=F(12)+FR(I)*(F(13)+FR(I)*(F(14)+FR(I)*(00129
      C      F(15)+FR(I)*(F(16)+FR(I)*(F(17)*FR(I)+F(18))))))              00130
           IF (FR(I).GE.20.) FF(I)=1.                                        00131
C                                                                            00132
C            FORM FACTORS FOR SURFACES                                       00133
C                                                                            00134
       IF(FR(I).GT.1.)GO TO 80                                               00135
           FF1=1.+FR(I)*(F(19)+FR(I)*                                        00136
      C     (F(20)+FR(I)*(F(21)+FR(I)*(F(22)+FR(I)*(F(23)+FR(I)*F(24))))))00137
           FF2=1.+ FR(I)*F(25)                                               00138
        FF(I)=FF1*(2.-AITEK)+FF2*(AITEK-1.)                                  00139
   80 CDF(I)=SWET(I)*CF(I)*FF(I)/SREF                                        00140
           CDF(42)=CDF(42)+CDF(I)                                            00141
           SWET(41)=SWET(41)+SWET(I)                                         00142
   99     CONTINUE                                                          00143
          ANS=CDF(42)                                                       00144
          CDF(41)=.06*CDF(42)                                               00145
         IF(NCRUD.EQ.0)GO TO 101                                             00146
          DO 100 I=1,NCRUD                                                  00147
             CDF(42)=CDF(42)+CDFCRD(I)                                      00148
  100     CONTINUE                                                          00149
  101     ANS=CDF(42)+CDF(41)                                               00150
          CFAVG=ANS*SREF/SWET(41)                                           00151
          IF (ITAB.EQ.0) RETURN                                             00152
          WRITE(6,3)                                                        00153
    3     FORMAT(1H1,60HMACH NUMBER     ALTITUDE     REFERENCE AREA       T00154
         CECHNOLOGY)                                                        00155
          WRITE (6,4)VCMIN,ALT,SREF,AITEK                                   00156
    4     FORMAT(5X,F4.2,F16.0,2HFT,F13.3,6H SQ FT,6X,7HLEVEL =,F5.2/)      00157
          WRITE(6,5)                                                        00158
    5     FORMAT(1H ,5X,9HCOMPONENT,11X,4HSWET,5X,17HLENGTH   FINENESS,     00159
         +        4X,4HFORM,6X,2HRN,6X,13HCF         CDF/1H ,25X,5HSQ FT,  00160
         +        6X,2HFT,7X,5HRATIO,4X,16HFACTOR  MILLIONS)                00161
          DO 10 I=1,N                                                       00162
             TEMP=RN(I)*1.E-6                                               00163
          WRITE(6,7)(NAME(J,I),J=1,4),SWET(I),L(I),FR(I)                    00164
         C        ,FF(I),TEMP,CF(I),CDF(I)                                 00165
    7       FORMAT(1H ,4A4,4X,2F10.3,F10.4,F10.3,F8.1,2F10.5)               00166
   10     CONTINUE                                                          00167
```

```
      IF (NCRUD.EQ.0) GO TO 25                                          00168
      DO 11 I=1,NCRUD                                                   00169
   11    WRITE(6,8)CDFCRD(I)                                            00170
    8    FORMAT(12H EXCRESCENCE,71X,F10.5)                              00171
   25  CONTINUE                                                        00172
      WRITE(6,9)CDF(41)                                                 00173
    9  FORMAT(14H MISCELLANEOUS,65X,F10.5)                             00174
      WRITE(6,12) SWET(41),CFAVG,ANS                                    00175
   12  FORMAT(1H0, 6H TOTAL,10X,F14.3,38X,2F10.5  )                    00176
      RETURN                                                            00177
      END                                                               00178
```

```
      SUBROUTINE RNCORR                                                 00179
C     ****************************************************************  00180
C     *                                                              *  00181
C     *  CHANGE OF SKIN FRICTION DRAG DUE TO CHANGES IN ALTITUDE     *  00182
C     *                                                              *  00183
C     *  AND MACH NUMBER                                             *  00184
C     *                                                              *  00185
C     ****************************************************************  00186
      COMMON/AERO/ CDTAB(500),CDPA(400)                                 00187
     COMMON/MISS/AR,CAM,CDCTAB(20),CDF(42),CDFCRD(10),                  00188
     1 CDFTAB(20),CDITAB(15),CDPTAB(20,15),CDREF(20),CF(41),            00189
     2 CH,CL(15),CLBUF(20),DB,FF(40),FR(40),ITAB,AITEK,L(40),           00190
     3 LAM,LDBODY,M(20),MNO,N,NCRUD,RN(40),SBASE,SPI,                   00191
     4 SREF,SWET(41),SW25,TAPER,TC,TRU(40),TRL(40),VCMIN,               00192
     5 DUMMY(5578)                                                      00193
      REAL L,LDBODY,M                                                   00194
       ITSAVE = ITAB                                                    00195
       ITAB=0                                                           00196
       DO 61 I=1,MNO                                                    00197
   61 CALL CDFF(CH,M(I),CDREF(I))                                       00198
      CDPA(1)=13000.+MNO                                                00199
      DO 50 J=1,MNO                                                     00200
   50 CDPA(J+1)=M(J)                                                    00201
      N10=MNO+2                                                         00202
      DO 62 I=1,13                                                      00203
      HCDP=5000.*(I-1)                                                  00204
      CDPA(N10)=HCDP                                                    00205
      N10=N10+1                                                         00206
      DO 62 J=1,MNO                                                     00207
      ITAB=0                                                            00208
      CALL CDFF(HCDP,M(J),CDRN)                                         00209
      CDPA(N10)=CDRN-CDREF(J)                                           00210
      N10=N10+1                                                         00211
   62 CONTINUE                                                          00212
      ITAB=ITSAVE                                                       00213
       IF(ITAB.EQ.0) RETURN                                             00214
       WRITE(6,66)                                                      00215
66     FORMAT(1H0,6X,47HCHANGE IN DRAG COEFFICIENT FROM CRUISE ALTITUDE)00216
       WRITE (6,67)                                                     00217
67     FORMAT (4X,8HALTITUDE,33X,11HMACH NUMBER)                        00218
      WRITE(6,65) (M(I),I=1,MNO)                                        00219
   65 FORMAT(1H ,10X,14F8.3)                                            00220
   64 FORMAT(1H ,2X,F8.0,14F8.4)                                        00221
      M8=MNO+2                                                          00222
      M9=MNO+M8                                                         00223
      DO 70 I=1,13                                                      00224
      WRITE(6,64)(CDPA(K),K=M8,M9)                                      00225
      M8=M8+MNO+1                                                       00226
      M9=MNO+M8                                                         00227
   70 CONTINUE                                                          00228
      RETURN                                                            00229
      END                                                               00230
```

```
      SUBROUTINE CDPP(AR,TC,DELCL,DELM,CAM,DCDP)                        00231
C     ***************************************************************   00232
C     *                                                             *   00233
C     *  PRESSURE DRAG COEFFICIENT SUBROUTINE                       *   00234
C     *                                                             *   00235
C     ***************************************************************   00236
      COMMON/AEROTB/AR05(132),AR1(132),AR2(132),AR4(132),AR6(120),      00237
     1 ARS07(110),ARS08(110),ARS10(110),ARS12(110),ARS14(110),          00238
     2 ARS16(110),ARS18(110),ARS20(110),AMDES(36),CMDES(32),HSMDES(28), 00239
     3 PCW(112),BSUB(90),PCAR(170),BSUP(105),BINT(154),BUFT(99)         00240
      DIMENSION B(5),C(5)                                               00241
      A=AR*TC**0.3333333333                                             00242
      IF (DELM.GT.0.07) GO TO 30                                        00243
      IF (A.LT.0.5)     GO TO 11                                        00244
      IF (A.GT.6.)      GO TO 12                                        00245
      C(1)= TRP2(AR05,DELM,DELCL,1)                                     00246
      C(2)= TRP2(AR1,DELM,DELCL,1)                                      00247
      C(3)= TRP2(AR2,DELM,DELCL,1)                                      00248
      C(4)= TRP2(AR4,DELM,DELCL,1)                                      00249
      C(5)= TRP2(AR6,DELM,DELCL,1)                                      00250
      B(1)=.5                                                           00251
      B(2)=1.                                                           00252
      B(3)=2.                                                           00253
      B(4)=4.                                                           00254
      B(5)=6.                                                           00255
      GO TO 100                                                         00256
30    IF (A.GT.1.4)  GO TO 20                                           00257
      IF (A.LT.0.7)  GO TO 21                                           00258
      B(1)=.7                                                           00259
      B(2)=.8                                                           00260
      B(3)=1.0                                                          00261
      B(4)=1.2                                                          00262
      B(5)=1.4                                                          00263
      C(1)= TRP2(ARS07,DELM,DELCL,1)                                    00264
      C(2)= TRP2(ARS08,DELM,DELCL,1)                                    00265
      C(3)= TRP2(ARS10,DELM,DELCL,1)                                    00266
      C(4)= TRP2(ARS12,DELM,DELCL,1)                                    00267
      C(5)= TRP2(ARS14,DELM,DELCL,1)                                    00268
      GO TO 100                                                         00269
20    IF (A.GT.2.)  GO TO 22                                            00270
      B(1)=1.2                                                          00271
      B(2)=1.4                                                          00272
      B(3)=1.6                                                          00273
      B(4)=1.8                                                          00274
      B(5)=2.                                                           00275
      C(1)= TRP2(ARS12,DELM,DELCL,1)                                    00276
      C(2)= TRP2(ARS14,DELM,DELCL,1)                                    00277
      C(3)= TRP2(ARS16,DELM,DELCL,1)                                    00278
      C(4)= TRP2(ARS18,DELM,DELCL,1)                                    00279
      C(5)= TRP2(ARS20,DELM,DELCL,1)                                    00280
100   CALL XTERP(B,C,A,FCDP)                                            00281
110   DCDP=FCDP*TC**(1./3.)*(1.+CAM/10.)                                00282
      IF (DCDP.LT.0.)  DCDP=0.0                                         00283
      RETURN                                                            00284
11    SL1= TRP2(AR05,DELM,DELCL,1)                                      00285
      SL2= TRP2(AR1,DELM,DELCL,1)                                       00286
      FCDP=SL1+(A-.5)*(SL2-SL1)/.5                                      00287
      GO TO 110                                                         00288
12    SL1= TRP2(AR4,DELM,DELCL,1)                                       00289
      SL2= TRP2(AR6,DELM,DELCL,1)                                       00290
      FCDP=2.*SL1*SL2/((A-4.)*SL1-(A-6.)*SL2)                           00291
      GO TO 110                                                         00292
21    SL1= TRP2(ARS07,DELM,DELCL,1)                                     00293
      SL2= TRP2(ARS08,DELM,DELCL,1)                                     00294
      FCDP=SL1+(A-.7)*(SL2-SL1)/.1                                      00295
      GO TO 110                                                         00296
22    SL1= TRP2(ARS18,DELM,DELCL,1)                                     00297
      SL2= TRP2(ARS20,DELM,DELCL,1)                                     00298
      FCDP=SL2+(A-2.)*(SL2-SL1)/.2                                      00299
```

```
      GO TO 110
C
C     ***************************************************************
C     *                                                             *
C     *  TABLES OF CDP/(T/C)**(1/3)/(1+%CAM/10)                     *
C     *  DELTA MACH ON THE VERTICAL, DELTA CL ON THE HORIZONTAL     *
C     *                                                             *
C     ***************************************************************
C
C                          AR * (T/C)**(1/3) = 0.5
C
      DATA AR05/011010.,
     *        -.40,  -.30, -.20, -.10, -.05, 0.0,  .05, .10,  .20, .30,
     *-.80,  .00150,.0004,.0015,.0024,.0055,.0060,.014,.028,.0825,.1500,
     *-.20,  .00150,.0004,.0015,.0024,.0055,.0060,.014,.028,.0825,.1500,
     *-.16,  .00150,.0004,.0015,.0024,.0055,.0060,.014,.028,.0825,.1500,
     *-.12,  .00150,.0004,.0015,.0024,.0055,.0060,.014,.028,.0825,.1500,
     *-.08,  .00150,.0004,.0015,.0024,.0055,.0060,.014,.028,.0825,.1500,
     *-.04,  .00150,.0004,.0015,.0026,.0055,.0075,.014,.028,.0825,.1525,
     *-.02,  .00160,.0004,.0016,.0028,.0055,.0085,.014,.029,.0840,.1560,
     *0.00,  .00180,.0004,.0018,.0030,.0056,.0100,.014,.031,.0860,.1620,
     * .02,  .00205,.0004,.0021,.0031,.0059,.0100,.016,.033,.0895,.1680,
     * .04,  .00230,.0004,.0023,.0032,.0065,.0100,.018,.034,.0955,.1725,
     * .05,  .00240,.0004,.0024,.0032,.0069,.0100,.019,.034,.1000,.1750/
C
C                          AR * (T/C)**(1/3) = 1.0
      DATA AR1/011010.,
     *       -.40, -.30, -.20,  -.10, -.05, 0.0,  .05,   .10,  .20,  .30,
     *-.80,.0016,.0005,.0016,.00290,.0051,.0065,.0130,.0240,.0600,.1200,
     *-.20,.0016,.0005,.0016,.00290,.0051,.0065,.0130,.0240,.0600,.1200,
     *-.16,.0016,.0005,.0016,.00295,.0051,.0065,.0130,.0240,.0600,.1200,
     *-.12,.0016,.0005,.0016,.00305,.0051,.0065,.0130,.0240,.0600,.1200,
     *-.08,.0016,.0005,.0016,.00315,.0051,.0065,.0130,.0240,.0600,.1200,
     *-.04,.0017,.0005,.0017,.00350,.0053,.0065,.0135,.0245,.0600,.1200,
     *-.02,.0018,.0005,.0018,.00390,.0055,.0075,.0150,.0260,.0620,.1235,
     *0.00,.0019,.0005,.0019,.00425,.0060,.0095,.0165,.0275,.0645,.1275,
     * .02,.0022,.0005,.0022,.00450,.0069,.0115,.0190,.0300,.0670,.1325,
     * .04,.0026,.0005,.0026,.00465,.0084,.0140,.0230,.0340,.0710,.1380,
     * .05,.0030,.0005,.0030,.00475,.0093,.0160,.0260,.0375,.0740,.1410/
C
C                          AR * (T/C)**(1/3) = 2.0
      DATA AR2/011010.,
     *       -.40, -.30, -.20, -.10, -.05,  0.0,  .05,  .10,  .20,  .30,
     *-.80,.0015,.0005,.0015,.0028,.0047,.0075,.0110,.0180,.0350,.0730,
     *-.20,.0015,.0005,.0015,.0028,.0047,.0075,.0110,.0180,.0350,.0730,
     *-.16,.0015,.0005,.0015,.0029,.0047,.0075,.0110,.0180,.0350,.0730,
     *-.12,.0016,.0005,.0016,.0031,.0047,.0075,.0110,.0180,.0350,.0730,
     *-.08,.0016,.0005,.0016,.0034,.0047,.0075,.0110,.0180,.0350,.0730,
     *-.04,.0018,.0005,.0018,.0037,.0049,.0075,.0120,.0185,.0350,.0730,
     *-.02,.0019,.0005,.0019,.0041,.0053,.0087,.0140,.0205,.0365,.0735,
     *0.00,.0021,.0005,.0021,.0047,.0065,.0106,.0165,.0235,.0400,.0750,
     * .02,.0022,.0006,.0026,.0057,.0084,.0140,.0215,.0280,.0460,.0780,
     * .04,.0029,.0006,.0033,.0075,.0110,.0200,.0285,.0355,.0550,.0840,
     * .05,.0037,.0007,.0037,.0088,.0125,.0250,.0330,.0400,.0600,.0900/
C
C                          AR * (T/C)**(1/3) = 4.0
      DATA AR4/011010.,
     *       -.40, -.30, -.20,  -.10,  -.05,  0.0,  .05,  .10, .20, .30,
     *-.80,.0011,.0004,.0011,.00280,.00340,.0055,.0090,.0115,.020,.036,
     *-.20,.0011,.0004,.0011,.00280,.00340,.0055,.0090,.0115,.020,.036,
     *-.16,.0011,.0004,.0011,.00280,.00345,.0055,.0090,.0115,.020,.036,
     *-.12,.0012,.0004,.0012,.00285,.00355,.0055,.0090,.0115,.020,.036,
     *-.08,.0013,.0004,.0013,.00290,.00365,.0055,.0090,.0115,.020,.036,
     *-.04,.0014,.0004,.0014,.00305,.00390,.0060,.0090,.0115,.020,.036,
     *-.02,.0016,.0004,.0016,.00320,.00410,.0068,.0091,.0123,.021,.037,
     *0.00,.0019,.0004,.0019,.00355,.00460,.0080,.0122,.0158,.026,.040,
     * .02,.0024,.0005,.0024,.00450,.00600,.0120,.0200,.0225,.035,.046,
     * .04,.0032,.0006,.0035,.00880,.01020,.0220,.0330,.0360,.048,.056,
     * .05,.0044,.0006,.0044,.01330,.01410,.0320,.0420,.0480,.058,.064/
C
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C                                  AR * (T/C)**(1/3) = 6.0                      00370
      DATA AR6/011009.,                                                        00371
     *       -.40,  -.30,  -.20,  -.10,  -.05,  0.0,  .05,  .10,  .20,        00372
     *-.80,.00085,.00020,.00085,.00200,.00270,.0041,.0058,.0071,.0107,        00373
     *-.20,.00085,.00020,.00085,.00200,.00270,.0041,.0058,.0071,.0107,        00374
     *-.16,.00089,.00020,.00089,.00200,.00270,.0041,.0058,.0071,.0107,        00375
     *-.12,.00096,.00020,.00096,.00200,.00270,.0041,.0058,.0071,.0107,        00376
     *-.08,.00108,.00020,.00108,.00200,.00270,.0041,.0058,.0071,.0107,        00377
     *-.04,.00120,.00026,.00120,.00200,.00270,.0041,.0058,.0071,.0117,        00378
     *-.02,.00130,.00030,.00130,.00200,.00270,.0041,.0058,.0077,.0167,        00379
     *0.00,.00148,.00034,.00148,.00230,.00290,.0043,.0081,.0112,.0260,        00380
     * .02,.00185,.00037,.00185,.00320,.00450,.0072,.0150,.0185,.0395,        00381
     * .04,.00290,.00045,.00290,.00700,.01050,.0175,.0290,.0330,.0545,        00382
     * .05,.00390,.00052,.00390,.01250,.01600,.0300,.0420,.0470,.0620/        00383
C                                                                             00384
C                                  AR * (T/C)**(1/3) =  .7                    00385
      DATA ARS07/009010.,                                                     00386
     *       -.40, -.30, -.20, -.10, -.05,  0.0,  .05,  .10, .20, .30,       00387
     * .05, .0015,.0000,.0015,.0045,.0080,.0135,.0200,.0360,.085,.165,        00388
     * .10, .0017,.0000,.0017,.0045,.0090,.0150,.0235,.0415,.091,.200,        00389
     * .15, .0018,.0000,.0018,.0047,.0105,.0170,.0265,.0480,.100,.230,        00390
     * .20, .0020,.0000,.0020,.0050,.0120,.0190,.0300,.0550,.112,.260,        00391
     * .30, .0030,.0000,.0030,.0060,.0155,.0240,.0395,.0720,.145,.320,        00392
     * .50, .0040,.0000,.0040,.0083,.0225,.0360,.0675,.1120,.210,.440,        00393
     * .70, .0040,.0005,.0040,.0120,.0295,.0550,.0900,.1460,.273,.550,        00394
     * .90, .0036,.0007,.0036,.0160,.0365,.0650,.1100,.1740,.330,.630,        00395
     *1.10, .0034,.0008,.0034,.0200,.0425,.0740,.1300,.2000,.380,.700/        00396
C                                                                             00397
C                                  AR * (T/C)**(1/3) =  .8                    00398
      DATA ARS08/009010.,                                                     00399
     *    -.40,-.30, -.20, -.10, -.05,  0.0, .05, .10, .20, .30,             00400
     * .05,0.0,.001,.0020,.0040,.0050,.0100,.015,.025,.080,.140,              00401
     * .10,0.0,.001,.0025,.0050,.0075,.0140,.018,.029,.086,.158,              00402
     * .15,0.0,.001,.0030,.0062,.0090,.0170,.026,.037,.094,.171,              00403
     * .20,0.0,.001,.0035,.0075,.0115,.0200,.032,.051,.103,.185,              00404
     * .30,0.0,.001,.0040,.0090,.0160,.0275,.045,.072,.130,.236,              00405
     * .50,0.0,.001,.0050,.0130,.0265,.0440,.069,.106,.190,.335,              00406
     * .70,0.0,.001,.0060,.0160,.0350,.0590,.092,.143,.245,.420,              00407
     * .90,0.0,.001,.0065,.0210,.0430,.0710,.113,.175,.290,.480,              00408
     *1.10,0.0,.001,.0070,.0260,.0510,.0800,.135,.200,.320,.520/              00409
C                                                                             00410
C                                  AR * (T/C)**(1/3) = 1.0                    00411
      DATA ARS10/009010.,                                                     00412
     *    -.40, -.30, -.20, -.10, -.05,  0.0, .05,  .10, .20, .30,           00413
     * .05,0.0,.0001,.0030,.0060,.0080,.0155,.020,.0270,.072,.126,            00414
     * .10,0.0,.0002,.0037,.0075,.0115,.0187,.026,.0365,.076,.135,            00415
     * .15,0.0,.0003,.0042,.0095,.0135,.0220,.033,.0450,.082,.148,            00416
     * .20,0.0,.0004,.0048,.0115,.0160,.0255,.040,.0530,.089,.160,            00417
     * .30,0.0,.0006,.0060,.0140,.0205,.0325,.051,.0670,.110,.203,            00418
     * .50,0.0,.0010,.0075,.0185,.0310,.0480,.070,.0980,.160,.280,            00419
     * .70,0.0,.0014,.0090,.0245,.0425,.0650,.090,.1270,.204,.350,            00420
     * .90,0.0,.0018,.0110,.0315,.0540,.0820,.112,.1520,.240,.405,            00421
     *1.10,0.0,.0022,.0123,.0380,.0655,.1000,.136,.1760,.270,.450/            00422
C                                                                             00423
C                                  AR * (T/C)**(1/3) = 1.2                    00424
      DATA ARS12/009010.,                                                     00425
     *    -.40, -.30, -.20, -.10, -.05,  0.0,  .05, .10, .20, .30,           00426
     * .05,0.0,.0001,.0030,.0080,.0110,.0175,.0275,.039,.064,.115,            00427
     * .10,0.0,.0002,.0040,.0100,.0145,.0220,.0325,.045,.068,.120,            00428
     * .15,0.0,.0003,.0050,.0120,.0165,.0250,.0375,.050,.072,.129,            00429
     * .20,0.0,.0004,.0060,.0135,.0180,.0280,.0435,.055,.077,.138,            00430
     * .30,0.0,.0006,.0070,.0165,.0225,.0355,.0535,.065,.094,.165,            00431
     * .50,0.0,.0010,.0090,.0235,.0330,.0520,.0710,.088,.140,.250,            00432
     * .70,0.0,.0014,.0150,.0300,.0465,.0690,.0895,.114,.190,.350,            00433
     * .90,0.0,.0018,.0140,.0375,.0620,.0870,.1125,.140,.240,.460,            00434
     *1.10,0.0,.0022,.0170,.0450,.0770,.1050,.1375,.165,.300,.600/            00435
C                                                                             00436
C                                  AR * (T/C)**(1/3) = 1.4                    00437
      DATA ARS14/009010.,                                                     00438
     *    -.40, -.30, -.20, -.10, -.05,  0.0,  .05,  .10, .20, .30,          00439
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     * .05,0.0,.0010,.0030,.0100,.0160,.0200,.0300,.0475,.060,.100,      00440
     * .10,0.0,.0010,.0040,.0115,.0165,.0235,.0360,.0500,.062,.105,      00441
     * .15,0.0,.0011,.0050,.0130,.0180,.0270,.0410,.0520,.066,.111,      00442
     * .20,0.0,.0012,.0060,.0140,.0190,.0310,.0450,.0560,.071,.122,      00443
     * .30,0.0,.0014,.0070,.0170,.0235,.0375,.0540,.0640,.082,.145,      00444
     * .50,0.0,.0017,.0095,.0235,.0345,.0520,.0710,.0890,.116,.235,      00445
     * .70,0.0,.0020,.0125,.0315,.0475,.0690,.0890,.1140,.180,.350,      00446
     * .90,0.0,.0022,.0150,.0395,.0630,.0890,.1120,.1350,.240,.450,      00447
     *1.10,0.0,.0025,.0185,.0475,.0780,.1090,.1370,.1550,.300,.550/      00448
C                                                                        00449
C                                  AR * (T/C)**(1/3) = 1.6               00450
      DATA ARS16/009010.,                                                00451
     *    -.40, -.30, -.20, -.10, -.05,  0.0,  .05,  .10, .20, .30,      00452
     * .05,0.0,.0010,.0035,.0095,.0130,.0200,.0300,.0450,.055,.088,      00453
     * .10,0.0,.0010,.0040,.0120,.0160,.0245,.0360,.0480,.061,.092,      00454
     * .15,0.0,.0010,.0050,.0135,.0180,.0280,.0410,.0525,.065,.097,      00455
     * .20,0.0,.0010,.0060,.0150,.0200,.0310,.0450,.0565,.072,.104,      00456
     * .30,0.0,.0010,.0070,.0180,.0245,.0380,.0540,.0655,.081,.125,      00457
     * .50,0.0,.0015,.0095,.0240,.0350,.0525,.0715,.0860,.108,.190,      00458
     * .70,0.0,.0020,.0125,.0320,.0470,.0685,.0890,.1080,.170,.280,      00459
     * .90,0.0,.0025,.0170,.0400,.0625,.0870,.1120,.1300,.240,.380,      00460
     *1.10,0.0,.0030,.0220,.0480,.0780,.1100,.1370,.1500,.300,.490/      00461
C                                                                        00462
C                                  AR * (T/C)**(1/3) = 1.8               00463
      DATA ARS18/009010.,                                                00464
     *    -.40, -.30, -.20, -.10, -.05,  0.0,  .05,  .10,  .20, .30,     00465
     * .05,0.0,.0007,.0035,.0110,.0145,.0210,.0300,.0460,.0500,.080,      00466
     * .10,0.0,.0008,.0042,.0120,.0165,.0245,.0355,.0500,.0600,.082,      00467
     * .15,0.0,.0009,.0052,.0135,.0180,.0285,.0405,.0525,.0655,.085,      00468
     * .20,0.0,.0010,.0060,.0150,.0200,.0320,.0455,.0555,.0705,.090,      00469
     * .30,0.0,.0012,.0070,.0180,.0245,.0395,.0545,.0645,.0790,.105,      00470
     * .50,0.0,.0016,.0095,.0235,.0350,.0530,.0715,.0875,.1080,.150,      00471
     * .70,0.0,.0020,.0125,.0315,.0475,.0705,.0895,.1100,.1670,.230,      00472
     * .90,0.0,.0025,.0164,.0400,.0630,.0900,.1125,.1310,.2400,.330,      00473
     *1.10,0.0,.0030,.0220,.0485,.0785,.1100,.1380,.1550,.3100,.440/      00474
C                                                                        00475
C                                  AR * (T/C)**(1/3) = 2.0               00476
      DATA ARS20/009010.,                                                00477
     *    -.40, -.30, -.20, -.10, -.05, 0.0, .05, .10,  .20,  .30,      00478
     * .05,0.0,.0007,.0030,.0110,.0140,.020,.031,.046,.0510,.0680,       00479
     * .10,0.0,.0008,.0045,.0120,.0160,.024,.036,.049,.0590,.0705,       00480
     * .15,0.0,.0009,.0050,.0135,.0180,.028,.041,.052,.0650,.0730,       00481
     * .20,0.0,.0010,.0057,.0150,.0200,.032,.045,.055,.0695,.0755,       00482
     * .30,0.0,.0012,.0070,.0180,.0245,.039,.054,.064,.0760,.0940,       00483
     * .50,0.0,.0016,.0095,.0240,.0350,.053,.072,.087,.0930,.1340,       00484
     * .70,0.0,.0020,.0126,.0315,.0480,.070,.090,.111,.1460,.2000,       00485
     * .90,0.0,.0028,.0160,.0400,.0635,.090,.112,.131,.2140,.2900,       00486
     *1.10,0.0,.0036,.0220,.0480,.0790,.110,.138,.155,.2750,.3750/       00487
C                                                                        00488
      END                                                                00489
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C                                                                       00490
      REAL FUNCTION TRP2 (T,X,Y,M)                                      00491
C     ************************************************************      00492
C     *                                                          *      00493
C     *  BIVARIANT INTERPOLATION SUBROUTINE                      *      00494
C     *                                                          *      00495
C     ************************************************************      00496
C     TRP2   BIVARIATE PARABOLIC INTERPOLATION                          00497
C     T(1) HAS COUNTERS IN IT  AS NUMBER OF Y POINTS * 1000 + NUMBER OF 00498
C       X POINTS.                                                       00499
C     T(2) TO T(1 + NUMBER OF Y'S)  IS  Y VALUES                        00500
C    .T(2 + NUMBER OF Y'S) IS  1ST X VALUE                              00501
C    .  T(3 + NUMBER OF Y'S) TO T(2 + NUMBER OF Y'S * 2)                00502
C    .    ARE THE Z VALUES                                             00503
C     THIS THEN (.) IS REPEATED NUMBER OF X TIMES                       00504
C     M = 1 THEN IT USES EVERY POINT FOR BRACKETING AND INTERPOLATION   00505
C     M = 2 EVERY OTHER POINT FOR BRACKETING.                           00506
C                                                                       00507
C                                                                       00508
      DIMENSION  T(1) , Z(3)                                            00509
      NDIM = T(1)                                                       00510
      I = NDIM/1000                                                     00511
      J =     NDIM-1000*I+1                                             00512
      I=I+1                                                             00513
      L = J*M                                                           00514
      J1 = J*3  + 1                                                     00515
      L1 = I*J                                                          00516
      DO 100  K=J1,L1,L                                                 00517
      IF (T(K).GE.X)    GO TO 120                                       00518
  100 CONTINUE                                                          00519
      K = L1+1-J                                                        00520
  120 K =  K-3*J - 1                                                    00521
      DO 130  L= 4,J,M                                                  00522
      IF (T(L).GE.Y)   GO TO 140                                        00523
  130 CONTINUE                                                          00524
      L = J                                                             00525
  140 L = L-2                                                           00526
      L1=1                                                              00527
      J1 = K+J                                                          00528
  170 Z(L1) = T(J1+L  ) + (Y  - T(L  )) * ((T(J1+L+1) - T(J1+L  )) /    00529
     1  (T(L+1) - T(L  )) + (Y  - T(L+1)) / (T(L+2) - T(L  )) *         00530
     2  ((T(J1+L+2) - T(J1+L+1)) / (T(L+2) - T(L+1)) - (T(J1+L+1) -     00531
     3  T(J1+L  )) / (T(L+1) - T(L  ))))                                00532
      L1=L1+1                                                           00533
      J1=J1+J                                                           00534
      IF (L1 .LT. 4) GO TO 170                                          00535
      K = K+1                                                           00536
      TRP2 = Z(1) + (X - T(K+J)) * ((Z(2) - Z(1)) / (T(K+2*J) - T(K+J)) 00537
     1     + (X - T(K+2*J)) / (T(K+3*J) - T(K+J)) * ((Z(3) - Z(2)) /    00538
     2     (T(K+3*J) - T(K+2*J)) - (Z(2) - Z(1)) / (T(K+2*J) - T(K+J))))00539
      RETURN                                                            00540
      END                                                               00541
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      SUBROUTINE XTERP(X,Y,XO,YO)                                       00542
C     ****************************************************************  00543
C     *                                                              *  00544
C     * MONOVARIANT INTERPOLATION SUBROUTINE                         *  00545
C     *                                                              *  00546
C     ****************************************************************  00547
C                                                                       00548
C       X IS A SET OF 5 ABSCISSA POINTS                                 00549
C       Y IS A SET OF 5 ORDINATE POINTS                                 00550
C       XO IS THE QUESTION....YO IS THE ANSWER                          00551
C                                                                       00552
        DIMENSION X(5),Y(5)                                             00553
        DIMENSION T(5)                                                  00554
        REAL M(5)                                                       00555
        REAL ME1,MS1,MS2                                                00556
C                                                                       00557
        DO 5 I=1,4                                                      00558
        DX = X(I+1)-X(I)                                                00559
        DY = Y(I+1)-Y(I)                                                00560
        M(I) = DY/DX                                                    00561
    5   CONTINUE                                                        00562
C                                                                       00563
        XE1 = X(4)+X(5)-X(3)                                            00564
        XE2 = 2.*X(5)-X(3)                                              00565
C                                                                       00566
        D1 = Y(5)-Y(4)                                                  00567
        D2 = X(5)-X(4)                                                  00568
        D3 = Y(4)-Y(3)                                                  00569
        D4 = X(4)-X(3)                                                  00570
        D5 = XE1-X(5)                                                   00571
        D7 = XE2-XE1                                                    00572
        YE1 = (2.*D1/D2-D3/D4)*D5 + Y(5)                                00573
        D6 = YE1-Y(5)                                                   00574
        YE2 = (2.*D6/D5-D1/D2)*D7 + YE1                                 00575
C                                                                       00576
        XS2 = X(2)-X(3)+X(1)                                            00577
        XS1 = 2.*X(1)-X(3)                                              00578
C                                                                       00579
        D1 = Y(2)-Y(1)                                                  00580
        D2 = X(2)-X(1)                                                  00581
        D3 = Y(3)-Y(2)                                                  00582
        D4 = X(3)-X(2)                                                  00583
        D5 = X(1)-XS2                                                   00584
        D7 = X(1)-XS2                                                   00585
        D8 = XS2-XS1                                                    00586
        YS2 = -(2.*D1/D2-D3/D4)*D5 + Y(1)                               00587
        D6 = Y(1)-YS2                                                   00588
        YS1 = -(2.*D6/D7-D1/D2)*D8 + YS2                                00589
C                                                                       00590
        M(5) = (YE1-Y(5))/(XE1-X(5))                                    00591
        ME1 = (YE2-YE1)/(XE2-XE1)                                       00592
        MS2 = D6/D7                                                     00593
        MS1 = (YS2-YS1)/D8                                              00594
C                                                                       00595
        D1 = ABS(M(2)-M(1))                                             00596
        D2 = ABS(MS2-MS1)                                               00597
        T(1) = (D1*MS2+D2*M(1))/(D1+D2)                                 00598
        D3 = ABS(M(3)-M(2))                                             00599
        D4 = ABS(M(1)-MS2)                                              00600
        T(2) = (D3*M(1)+D4*M(2))/(D3+D4)                                00601
C                                                                       00602
        D5 = ABS(M(4)-M(3))                                             00603
        D6 = ABS(M(2)-M(1))                                             00604
        T(3) = (D5*M(2)+D6*M(3))/(D5+D6)                                00605
C                                                                       00606
        D7 = ABS(M(5)-M(4))                                             00607
        D8 = ABS(M(3)-M(2))                                             00608
        T(4) = (D7*M(3)+D8*M(4))/(D7+D8)                                00609
        D9 = ABS(ME1-M(5))                                              00610
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      D10 = ABS(M(4)-M(3))                                                  00611
      T(5) = (D9*M(4)+D10*M(5))/(D9+D10)                                    00612
C                                                                           00613
C                                                                           00614
      IF (XO.LT.X(1).AND.XO.GE.XS2) GO TO 40                                00615
      IF (XO.LT.XS2.AND.XO.GE.XS1) GO TO 42                                 00616
C                                                                           00617
      DO 15 J=2,5                                                           00618
      IF (XO.GT.X(J)) GO TO 15                                              00619
      JJ = J-1                                                              00620
      GO TO 25                                                              00621
   15 CONTINUE                                                              00622
      GO TO 45                                                              00623
   25 P0 = Y(JJ)                                                            00624
      P1 = T(JJ)                                                            00625
      DY = Y(JJ+1)-Y(JJ)                                                    00626
      DX = X(JJ+1)-X(JJ)                                                    00627
      P2 = (3.*DY/DX-2.*T(JJ)-T(JJ+1))/DX                                   00628
      P3 = (T(JJ)+T(JJ+1)-2.*DY/DX)/(DX*DX)                                 00629
      DEL = XO-X(JJ)                                                        00630
      YO = P0+DEL*(P1+DEL*(P2+DEL*P3))                                      00631
      GO TO 100                                                             00632
   40 YO = (Y(1)-YS2)/(X(1)-XS2)*(XO-XS2)+YS2                               00633
      GO TO 99                                                              00634
   42 YO = (YS2-YS1)/(XS2-XS1)*(XO-XS1)+YS1                                 00635
      GO TO 99                                                              00636
   45 IF (XO.LE.XE1.AND.XO.GT.X(5)) GO TO 47                                00637
      IF (XO.LE.XE2.AND.XO.GT.XE1) GO TO 49                                 00638
      YO = 999999999.                                                       00639
      WRITE(6,90) XO                                                        00640
      WRITE (6,89) (X(I), I=1,5)                                            00641
   89 FORMAT(1H ,4HB    ,5E13.5)                                            00642
       WRITE (6,89) (Y(I), I=1,5)                                           00643
   90 FORMAT(1H0,3HXO=,E13.5,26H OUTSIDE RANGE EXTRAP DATA)                 00644
      GO TO 100                                                             00645
   47 YO = (YE1-Y(5))/(XE1-X(5))*(XO-X(5))+Y(5)                             00646
      GO TO 99                                                              00647
   49 YO = (YE2-YE1)/(XE2-XE1)*(XO-XE1)+YE1                                 00648
   99 WRITE(6,91)                                                           00649
   91 FORMAT(1H0,40HOUTPUT DETERMINED FROM EXTRAPOLATED DATA)               00650
  100 CONTINUE                                                              00651
C                                                                           00652
      RETURN                                                                00653
      END                                                                   00654
```

```
      SUBROUTINE CLDESN(TOC,AR,SWP,HOC,DESCL,CL,NUMCL)                  00655
C      ****************************************************************  00656
C      *                                                              *  00657
C      *  DESIGN CL SUBROUTINE                                        *  00658
C      *                                                              *  00659
C      ****************************************************************  00660
      DIMENSION CL(15)                                                  00661
      IF(TOC.GT.0.065)DESCL=(.029+.1843*AR)*COS(SWP/57.2958)            00662
     C  *(1.+HOC/10.)/(SQRT(AR))                                        00663
      FAR=AR*TOC**(1./3.)                                               00664
      IF(TOC.LE.0.065)DESCL=-.06416+FAR*(.530389+FAR*                   00665
     C(.0376684*FAR-.214493))                                           00666
C                                                                       00667
C     ROUNDOFF FUNCTION TO NEAREST .05                                  00668
C                                                                       00669
      X=DESCL                                                           00670
      Y=AINT(X*10.)/10.                                                 00671
      IF((X-Y).GT.0.075.AND.(X-Y).LT.01.)Z=Y+.1                         00672
      IF((X-Y).GT.0.025.AND.(X-Y).LE.0.075)Z=Y+.05                      00673
      IF((X-Y).LE.0.025)Z=Y                                             00674
      CLLOP=Z                                                           00675
      DO 11 I=1,5                                                       00676
         CL(I)=0.0                                                      00677
 11   CONTINUE                                                          00678
      CL(1)=CLLOP-.4                                                    00679
      IF (CL(1).LT.0.)  CL(1) = 0.0                                     00680
      DO 10 I=2,15                                                      00681
         NUMCL=I                                                        00682
         CL(I)=CL(I-1)+.05                                              00683
         IF ((CL(I)-DESCL).GT.0.3)  GO TO 12                            00684
 10   CONTINUE                                                          00685
 12   RETURN                                                            00686
      END                                                               00687
```

```
      SUBROUTINE MDESN(TOC,AR,SWP,AITEK,CLD,DESM,TABMN,MNO,TAPER)        00688
C     ************************************************************     00689
C     *                                                          *     00690
C     *  DESIGN MACH NUMBER ROUTINE                              *     00691
C     *                                                          *     00692
C     ************************************************************     00693
      REAL MLIMIT                                                       00694
      COMMON/AEROTB/AR05(132),AR1(132),AR2(132),AR4(132),AR6(120),      00695
     1 ARS07(110),ARS08(110),ARS10(110),ARS12(110),ARS14(110),          00696
     2 ARS16(110),ARS18(110),ARS20(110),AMDES(36),CMDES(32),HSMDES(28), 00697
     3 PCW(112),BSUB(90),PCAR(170),BSUP(105),BINT(154),BUFT(99)         00698
      DIMENSION TABMN(20)                                               00699
C                                                                       00700
C     THESE ARE TABLES OF 2-DIMENSIONAL (MACH**2 - 1).                  00701
C     DESIGN CL ON THE VERTICAL...THICKNESS RATIO FUNCTION ON           00702
C     THE HORIZONTAL                                                    00703
C                                                                       00704
      DATA AMDES/008003.,   .18,   .24,   .30,                          00705
     C            .1,     -.208, -.333, -.459,                         00706
     C            .2,     -.218, -.343, -.468,                         00707
     C            .3,     -.229, -.353, -.478,                         00708
     C            .4,     -.242, -.365, -.488,                         00709
     C            .5,     -.258, -.377, -.495,                         00710
     C            .6,     -.271, -.388, -.507,                         00711
     C            .7,     -.294, -.413, -.530,                         00712
     C            .8,     -.317, -.431, -.546/                         00713
C                                                                       00714
      DATA CMDES/007003.,   .18,   .24,   .30,                          00715
     C            .1,     -.374, -.445, -.513,                         00716
     C            .2,     -.385, -.461, -.537,                         00717
     C            .3,     -.401, -.478, -.556,                         00718
     C            .4,     -.416, -.490, -.564,                         00719
     C            .5,     -.441, -.509, -.578,                         00720
     C            .6,     -.474, -.532, -.591,                         00721
     C            .7,     -.518, -.571, -.621/                         00722
C                                                                       00723
C     HERE, THE WING THICKNESS RATIO IS ON THE HORIZONTAL               00724
C                                                                       00725
      DATA HSMDES/006003.,  .02,   .04,   .06,                          00726
     C             0,      .844,  .822,  .801,                         00727
     C            .1,      .836,  .815,  .793,                         00728
     C            .2,      .829,  .807,  .786,                         00729
     C            .3,      .820,  .799,  .778,                         00730
     C            .4,      .811,  .791,  .770,                         00731
     C            .5,      .802,  .781,  .759/                         00732
C                                                                       00733
      TC23=TOC**(2./3.)                                                 00734
      IF(TOC.GT..065)GO TO 100                                          00735
      DESM2D=TRP2(HSMDES,CLD,TOC,1)                                     00736
      GO TO 110                                                         00737
  100 ANS1=TRP2(CMDES,CLD,TC23,1)                                       00738
      ANS2=TRP2(AMDES,CLD,TC23,1)                                       00739
      ANS=ANS1*(2.-AITEK)+ANS2*(AITEK-1.)                               00740
      DESM2D=SQRT(ANS+1.)                                               00741
  110 DMDSWP=.32*(1.-COS(SWP/57.2958))                                  00742
      DMDAR=.144/AR                                                     00743
      DESM=DESM2D+DMDSWP+DMDAR                                          00744
      IF(SWP.GE.0.)GO TO 5                                              00745
      TH=TAN(SWP/57.2958)-(1.-TAPER)/(1.+TAPER)/AR                      00746
      S2A=2.*TH/(1.+TH*TH)                                              00747
      DESM=DESM*(1.+(.01+.04/AR)*(1.-TAPER)*S2A)                        00748
    5 IF (TOC.GT.0.065)  MLIMIT=DESM+0.075                              00749
      IF (TOC.LE.0.065)  MLIMIT = 2.                                    00750
      DO 10  I=1,20                                                     00751
        TABMN(I)=0.                                                     00752
   10 CONTINUE                                                          00753
      TABMN(1)=0.2                                                      00754
      MF=1                                                              00755
      IF(MLIMIT.GT.1.6)MF=2                                             00756
```

```
      DM=0.1*MF                                                          00757
      DO 20    I=2,20                                                    00758
         MNO=I-1                                                         00759
         TABMN(I)=TABMN(I-1)+DM                                          00760
         IF (TABMN(I).GE.MLIMIT)  GO TO  30                              00761
         IF ((TABMN(I)-DESM).GT.-.15)  DM=.05                            00762
         IF ((TABMN(I)-DESM).GT.-.075)  DM=.025                          00763
         IF (TABMN(I).GT.(DESM+.05))  DM=.05                             00764
         IF (TABMN(I).GT.1.15)  DM=.1*MF                                 00765
20    CONTINUE                                                           00766
30    RETURN                                                             00767
      END                                                                00768
```

```
      SUBROUTINE INPUT                                                  00769
      COMMON/AWETO/SWETW,SWETH,SWETV,SWETF,SWETN                        00770
      COMMON/CONFIG/ED(13)                                              00771
      COMMON/EDETIN/EDX(6),SHT,TCHT,SVT,TCVT,ARHT,ARVT,XNAC,DNAC,       00772
     CNEW,NEF,TRHT,TRVT,HHT,GLOV                                        00773
      COMMON/XLAM/XLLAM,TRUW,TRLW,TRUH,TRLH,TRUV,TRLV,TRUB,TRLB         00774
     1,NFUSE,NVERT,TRUN,TRLN                                            00775
      COMMON/MISS/AR,CAM,CDCTAB(20),CDF(42),CDFCRD(10),                 00776
     1 CDFTAB(20),CDITAB(15),CDPTAB(20,15),CDREF(20),CF(41),            00777
     2 CH,CL(15),CLBUF(20),DB,FF(40),FR(40),ITAB,AITEK,L(40),           00778
     3 LAM,LDBODY,M(20),MNO,N,NCRUD,RN(40),SBASE,SPI,                   00779
     4 SREF,SWET(41),SW25,TAPER,TC,TRU(40),TRL(40),VCMIN,               00780
     5 DUMMY(5578)                                                      00781
      COMMON/CONPON/NAME(4,40)                                          00782
      REAL L,LDBODY,M                                                   00783
      DATA NAME/4HWING,4H    ,4H    ,4H    ,4HHORI,4HZONT,4HAL T,4HAIL ,00784
     14HVERT,4HICAL,4H TAI,4HL   ,4HFUSE,4HLAGE,4H    ,4H    ,4HNACE,4HL00785
     2LE ,4H    ,4H    /                                               00786
      AR=ED(2)                                                          00787
      SREF=ED(4)                                                        00788
      TAPER=ED(5)                                                       00789
      SW25=ED(6)                                                        00790
      TC=ED(7)                                                          00791
       VCMIN=ED(8)                                                      00792
      CAM=EDX(1)                                                        00793
      SBASE=EDX(2)                                                      00794
      CH=ED(9)                                                          00795
      AITEK=EDX(6)                                                      00796
      XL=EDX(3)                                                         00797
      XD=EDX(4)                                                         00798
      XMULT=.387*TC+2.0                                                 00799
      XMULTH=.387*TCHT+2.0                                              00800
      XMULTV=.387*TCVT+2.0                                              00801
      SPAN=(AR*(SREF-GLOV))**.5                                         00802
      SPANHT=(ARHT*SHT)**.5                                             00803
      IF(SPANHT.EQ.0.)GO TO 5                                           00804
      CROOTHT=(2.*SHT)/(SPANHT*(1+TRHT))                                00805
      CROTHT=((SPANHT/2.-XD/4.)/(SPANHT/2.))*(1.-TRHT)+TRHT             00806
    5 CROTHTB=CROTHT*CROOTHT                                            00807
      CROOT=((SREF-GLOV)*2.)/((1+TAPER)*SPAN)                           00808
      CROTM=((SPAN/2.-XD/2.)/(SPAN/2.))*(1-TAPER)+TAPER                 00809
      CROOTB=CROOT*CROTM                                                00810
      SPANVT=(ARVT*SVT)**.5                                             00811
      IF(SPANVT.GT.0.)CROOTVT=(2.*SVT)/(SPANVT*(1.+TRVT))               00812
      SWET(1)=XMULT*((SREF)-(NFUSE*XD/2.)*(CROOT+CROOTB))               00813
      CALL ORIDE(SWET(1),SWETW)                                         00814
      SWET(2)=XMULTH*SHT-(.185+NEF*.063)*(1.-HHT)*XMULT*SHT             00815
      CALL ORIDE(SWET(2),SWETH)                                         00816
      SWET(3)=XMULTV*SVT                                                00817
      CALL ORIDE(SWET(3),SWETV)                                         00818
      DB=XD/(AR*(SREF-GLOV))**.5                                        00819
      SPI=3.14159*((XD/2.)**2.)                                         00820
      LDBODY=XL/XD                                                      00821
      N=4+NEW+NEF                                                       00822
      NCRUD=0                                                           00823
      SWET(4)=3.14159*XD**2.*((XL/XD)-1.70)-.673*CROOTB*(TC*CROOTB)*2.  00824
     C-((.673*CROTHTB*(TCHT*CROTHTB)*2.)*(1.-HHT))                      00825
     C-(.673*CROOTVT*(TCVT*CROOTVT))                                    00826
      CALL ORIDE(SWET(4),SWETF)                                         00827
      L(1)=((SREF-GLOV)/AR)**.5                                         00828
      IF(ARHT.GT.0.)L(2)=(SHT/ARHT)**.5                                 00829
      IF(ARVT.GT.0.)L(3)=(SVT/ARVT)**.5                                 00830
      L(4)=XL                                                           00831
      FR(1)=TC                                                          00832
      FR(2)=TCHT                                                        00833
      FR(3)=TCVT                                                        00834
      FR(4)=XL/XD                                                       00835
      LAM=XLLAM+.05                                                     00836
      TRU(1)=TRUW                                                       00837
```

```
      TRL(1)=TRLW                                                       00838
      TRU(2)=TRUH                                                       00839
      TRL(2)=TRLH                                                       00840
      TRU(3)=TRUV                                                       00841
      TRL(3)=TRLV                                                       00842
      TRU(4)=TRUB                                                       00843
      TRL(4)=TRLB                                                       00844
      DO 10 I=5,40                                                      00845
      TRU(I)=0.                                                         00846
   10 TRL(I)=0.                                                         00847
      IF(N.EQ.4) GO TO 30                                               00848
      DO 20 I=5,N                                                       00849
      SWET(I)=2.8*DNAC*XNAC                                             00850
      CALL ORIDE(SWET(I),SWETN)                                         00851
      L(I)=XNAC                                                         00852
      TRU(I)=TRUN                                                       00853
      TRL(I)=TRLN                                                       00854
      DO 15 J=1,4                                                       00855
   15 NAME(J,I)=NAME(J,5)                                               00856
   20 IF(DNAC.GT.0.)FR(I)=XNAC/DNAC                                     00857
   30 IF(NFUSE.LE.1)GO TO 40                                            00858
      DO 45 I=2,NFUSE                                                   00859
      N=N+1                                                             00860
      SWET(N)=SWET(4)                                                   00861
      L(N)=L(4)                                                         00862
      FR(N)=FR(4)                                                       00863
      DO 50 J=1,4                                                       00864
   50 NAME(J,N)=NAME(J,4)                                               00865
      TRU(N)=TRU(4)                                                     00866
   45 TRL(N)=TRL(4)                                                     00867
   40 IF(NVERT.LE.1)RETURN                                              00868
      DO 35 I=2,NVERT                                                   00869
      N=N+1                                                             00870
      SWET(N)=SWET(3)                                                   00871
      L(N)=L(3)                                                         00872
      FR(N)=FR(3)                                                       00873
      DO 55 J=1,4                                                       00874
   55 NAME(J,N)=NAME(J,3)                                               00875
      TRU(N)=TRU(3)                                                     00876
   35 TRL(N)=TRL(3)                                                     00877
      RETURN                                                            00878
      END                                                               00879
```

```
      SUBROUTINE CDCC(AR,TC,CAM,SW25,SREF,DB,TAPER,SBASE,                00880
     *   SPI,LDBODY,M,DELM,CDCTAB)                                       00881
C     ***************************************************************  00882
C     *                                                             *  00883
C     *  COMPRESSIBLE DRAG SUBROUTINE...CDCC                        *  00884
C     *                                                             *  00885
C     ***************************************************************  00886
      COMMON/AEROTB/AR05(132),AR1(132),AR2(132),AR4(132),AR6(120),       00887
     1 ARS07(110),ARS08(110),ARS10(110),ARS12(110),ARS14(110),           00888
     2 ARS16(110),ARS18(110),ARS20(110),AMDES(36),CMDES(32),HSMDES(28),  00889
     3 PCW(112),BSUB(90),PCAR(170),BSUP(105),BINT(154),BUFT(99)          00890
      REAL M,LDBODY                                                      00891
C                                                                        00892
C                BODY COMPRESSIBILITY DRAG TABLES                        00893
C     MACH NUMBER ON THE VERTICAL..BASE AREA FUNCTION ON THE HORIZONTAL  00894
C                                                                        00895
C                                                                        00896
      DATA CD5 / 0.0 /                                                   00897
      DATA BSUB/017004.,    1.0,    1.2,    1.4,    1.5,                 00898
     *             .200,    0.0,    0.0,    0.0,    0.0,                 00899
     *             .500,    0.0,    0.0,    0.0,    0.0,                 00900
     *             .700,    0.0,    0.0,    0.0,    0.0,                 00901
     *             .780,    0.0,    0.0,    0.0,    0.0,                 00902
     *             .820,    0.0,    0.0,   0.15,   0.21,                 00903
     *             .840,    0.0,   0.15,   0.20,   0.35,                 00904
     *             .860,   0.09,   0.22,   0.40,   0.52,                 00905
     *             .880,   0.20,   0.38,   0.61,   0.78,                 00906
     *             .900,   0.38,   0.58,   0.91,   1.10,                 00907
     *             .910,   0.53,   0.75,   1.10,   1.33,                 00908
     *             .920,   0.73,   0.95,   1.30,   1.60,                 00909
     *             .930,   0.95,   1.20,   1.65,   1.93,                 00910
     *             .940,   1.30,   1.55,   2.05,   2.49,                 00911
     *             .950,   1.75,   2.20,   2.90,   3.65,                 00912
     *             .960,   2.45,   3.25,   4.50,   6.40,                 00913
     *             .965,   3.00,   4.22,   6.30,   8.45,                 00914
     *             .970,   3.90,   5.60,   9.50,  11.50/                 00915
C                                                                        00916
C                                                                        00917
      DATA BSUP/014006.,   1.0,   1.1,   1.2,   1.3,   1.4,   1.5,      00918
     *            1.00,  24.5,  20.0,  16.2,  13.4,  11.1,   9.5,      00919
     *            1.05,  30.7,  23.6,  20.0,  16.0,  12.9,  10.5,      00920
     *            1.10,  33.0,  26.2,  21.5,  17.4,  14.0,  11.1,      00921
     *            1.15,  34.3,  27.3,  22.3,  18.2,  14.8,  11.6,      00922
     *            1.20,  34.7,  27.7,  22.5,  18.5,  15.0,  11.9,      00923
     *            1.25,  34.5,  27.5,  22.4,  18.2,  14.9,  11.9,      00924
     *            1.30,  33.8,  27.0,  22.0,  17.6,  14.5,  11.7,      00925
     *            1.35,  32.9,  26.4,  21.7,  17.3,  14.2,  11.4,      00926
     *            1.40,  32.4,  25.9,  21.4,  17.2,  14.1,  11.0,      00927
     *            1.50,  32.0,  25.6,  21.1,  17.0,  14.1,  10.9,      00928
     *            1.60,  32.0,  25.6,  21.0,  17.0,  14.1,  10.9,      00929
     *            1.80,  32.0,  25.6,  21.0,  17.0,  14.2,  11.4,      00930
     *            2.00,  32.0,  25.6,  21.0,  17.1,  14.4,  11.8,      00931
     *            2.20,  32.0,  25.6,  21.0,  17.3,  14.6,  12.0/      00932
C                                                                        00933
C                                                                        00934
C                WING COMPRESSIBILITY DRAG TABLES                        00935
C     DELTA MACH ON THE VERTICAL...WING T/C FUNCTION ON THE HORIZONTAL   00936
C                                                                        00937
      DATA PCW/013007., .10, .12, .14, .16,  .18,  .22,  .30,            00938
     *          -.80, .0,   .0,   .0,   .0,   .0,   .0,   .0,           00939
     *          -.20, .060, .04,  .02,  .020, .010, .008, .002,         00940
     *          -.16, .072, .05,  .03,  .026, .017, .016, .006,         00941
     *          -.12, .100, .06,  .04,  .038, .025, .024, .012,         00942
     *          -.08, .125, .08,  .05,  .049, .035, .033, .019,         00943
     *          -.04, .160, .12,  .08,  .068, .054, .047, .030,         00944
     *          -.02, .200, .16,  .12,  .110, .070, .059, .039,         00945
     *          0.00, .280, .22,  .16,  .120, .093, .077, .052,         00946
     *           .01, .340, .27,  .20,  .152, .118, .093, .061,         00947
     *           .02, .440, .33,  .24,  .197, .153, .117, .073,         00948
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     *            .03, .640, .45, .31, .255, .203, .148, .087,          00949
     *            .04,1.100, .66, .41, .325, .270, .187, .103,          00950
     *            .05,1.900,1.02, .56, .400, .350, .235, .127/          00951
C                                                                        00952
C      LAST 2 COLUMNS ADDED 4/8/82-LAM                                   00953
      DATA PCAR/016009.,1.0,  1.5,  2.0,  2.5,  3.0,  3.5, 4.0, 5.0,6.0,00954
     *            .05,  2.4,  1.7,  1.17,  .85,  .73,  .67, .60,.54,.52,00955
     *            .07,  3.1,  2.25, 1.58, 1.10,  .89,  .77, .70,.62,.60,00956
     *            .09,  3.55, 2.61, 1.88, 1.24,  .99,  .87, .75,.67,.65,00957
     *            .11,  3.85, 2.88, 2.03, 1.33, 1.07,  .92, .80,.71,.68,00958
     *            .13,  3.97, 3.05, 2.14, 1.41, 1.12,  .96, .84,.74,.71,00959
     *            .15,  4.00, 3.10, 2.17, 1.48, 1.16,  .99, .86,.75,.72,00960
     *            .20,  3.90, 3.00, 2.20, 1.55, 1.20, 1.00, .86,.74,.70,00961
     *            .25,  3.68, 2.85, 2.16, 1.57, 1.20, 1.00, .83,.70,.65,00962
     *            .30,  3.43, 2.70, 2.10, 1.55, 1.17,  .92, .77,.63,.58,00963
     *            .40,  3.03, 2.45, 1.90, 1.47, 1.10,  .88, .73,.59,.53,00964
     *            .50,  2.75, 2.22, 1.71, 1.37, 1.02,  .84, .73,.57,.52,00965
     *            .60,  2.49, 2.00, 1.55, 1.26,  .97,  .81, .74,.56,.51,00966
     *            .70,  2.25, 1.80, 1.41, 1.17,  .91,  .79, .71,.55,.51,00967
     *            .80,  1.99, 1.62, 1.30, 1.10,  .88,  .75, .70,.55,.50,00968
     *            .90,  1.80, 1.50, 1.20, 1.00,  .84,  .70, .66,.54,.50,00969
     *           1.00,  1.65, 1.40, 1.10,  .95,  .80,  .70, .66,.54,.50/00970
C                                                                        00971
      DATA BINT/013010.,                                                 00972
     *     .1,.12, .14,   .15,   .16,   .17,   .18,   .19,  .20,  .22,  00973
     * 1.0, 0.,0.,  0.,    0.,    0.,    0.,    0.,    0.,   0.,   0.,  00974
     * 1.05,0.,0.,.0004,-.0003,-.0008,-.0011,-.0010,-.0004,.0003,.0018, 00975
     * 1.10,0.,0.,.0006,-.0006,-.0014,-.0018,-.0014,-.0006,.0004,.0026, 00976
     * 1.15,0.,0.,.0003,-.0008,-.0017,-.0020,-.0015,-.0006,.0004,.0024, 00977
     * 1.20,0.,0.,.0002,-.0008,-.0017,-.0018,-.0014,-.0006,.0003,.0020, 00978
     * 1.30,0.,0.,.0002,-.0006,-.0010,-.0010,-.0008,-.0005,.0001,.0012, 00979
     * 1.40,0.,0.,.0001,-.0003,-.0003,-.0003,-.0002,-.0001,.0003,.0009, 00980
     * 1.50,0.,0.,.0001,0.0000, .0003, .0003, .0004, .0004,.0005,.0007, 00981
     * 1.60,0.,0.,.0000, .0004, .0005, .0009, .0009, .0008,.0007,.0005, 00982
     * 1.70,0.,0.,.0000, .0005, .0007, .0012, .0011, .0010,.0008,.0005, 00983
     * 1.80,0.,0.,.0000, .0006, .0009, .0012, .0011, .0010,.0008,.0005, 00984
     * 1.90,0.,0.,.0000, .0006, .0009, .0010, .0010, .0009,.0008,.0005, 00985
     * 2.00,0.,0.,.0000, .0005, .0009, .0011, .0010, .0009,.0007,.0005/ 00986
C                                                                        00987
C                                                                        00988
C     SUBSONIC                                                           00989
C                                                                        00990
      IF(DELM.GT.0.05)GO TO 100                                          00991
      TOC=TC**(2./3.)                                                    00992
      CD1=TRP2(PCW,DELM,TOC,1)                                           00993
      CDCWNG=AMAX1(CD1,0.)*(TC)**(5./3.)*(1.+CAM/10.)                    00994
      SOS=1.+ SBASE/SPI                                                  00995
      CD2=TRP2(BSUB,M,SOS,1)                                             00996
      CDCFUS=AMAX1(CD2,0.)*SPI/SREF*(1./LDBODY**2.)                      00997
      CDCTAB=CDCWNG + CDCFUS                                             00998
      GO TO 200                                                          00999
C                                                                        01000
C     SUPERSONIC                                                         01001
C                                                                        01002
100   ART=AR * TAN(SW25/57.2958) + (1.-TAPER)/(1.+TAPER)                 01003
      CD3=TRP2(PCAR,DELM,ART,1)                                          01004
      CDCWNG=AMAX1(CD3,0.) * TC**(5./3.) * (1. + CAM/10.)                01005
      SOS=1. + SBASE/SPI                                                 01006
      CD4=TRP2(BSUP,M,SOS,1)                                             01007
      CDCFUS=AMAX1(CD4,0.) * SPI/SREF*(1./LDBODY**2.)                    01008
       IF (M.GE.1.0) CD5 = TRP2(BINT,M,DB,1)                             01009
       IF (TAPER.EQ.1.)  TAPERR=.5                                       01010
       IF (TAPER.NE.1.)  TAPERR=TAPER                                    01011
       CDCINT=CD5/(1.-TAPERR)/COS(SW25/57.2958)                          01012
      CDCTAB=CDCWNG + CDCFUS + CDCINT                                    01013
200   RETURN                                                             01014
      END                                                                01015
```

```
      SUBROUTINE BUFFET(TC,DELM,SW25,AR,CAM,DELCLB)                     01016
C                                                                       01017
CCC    ************************************************************     01018
CCC    *                                                          *     01019
CCC    *  BUFFET LIFT COEFFICIENT SUBROUTINE                      *     01020
CCC    *                                                          *     01021
CCC    ************************************************************     01022
C                                                                       01023
      COMMON/AEROTB/AR05(132),AR1(132),AR2(132),AR4(132),AR6(120),      01024
     1 ARS07(110),ARS08(110),ARS10(110),ARS12(110),ARS14(110),          01025
     2 ARS16(110),ARS18(110),ARS20(110),AMDES(36),CMDES(32),HSMDES(28), 01026
     3 PCW(112),BSUB(90),PCAR(170),BSUP(105),BINT(154),BUFT(99)         01027
      ART=TC**(2./3.)                                                   01028
      FCLB=TRP2(BUFT,ART,DELM,1)                                        01029
      DELCLB=FCLB*AR*(1+CAM/10.)/COS(SW25/57.295)                       01030
      RETURN                                                            01031
C                                                                       01032
CCC                BUFFET TABLE DATA                                    01033
CCC   THICKNESS FUNCTION ON THE VERTICAL...DELTA MACH ON THE HORIZONTAL 01034
C                                                                       01035
      DATA BUFT/8010.,                                                  01036
     *   -.8,  -.6,  -.4,  -.3,  -.2,  -.1,  0.,     .05,  .1,   .15,  01037
     *.1, .078, .076, .061, .050, .046, .051, .070,  .09,  .12,  .156,  01038
     *.12,.078, .076, .061, .050, .043, .036, .039,  .051, .073, .104,  01039
     *.14,.078, .076, .061, .050, .042, .034, .030,  .031, .040, .057,  01040
     *.16,.078, .076, .061, .050, .041, .031, .023,  .020, .016, .010,  01041
     *.18,.078, .076, .061, .050, .040, .030, .018,  .010, .002,-.009,  01042
     *.20,.078, .076, .061, .050, .040, .029, .015,  .005,-.007,-.020,  01043
     *.24,.078, .076, .061, .050, .040, .028, .009, -.005,-.020,-.036,  01044
     *.30,.078, .076, .061, .050, .040, .028, .004, -.015,-.037,-.060/  01045
      END                                                               01046
```

```
      SUBROUTINE AERORID                                                01047
      COMMON/AEROTB/AR05(132),AR1(132),AR2(132),AR4(132),AR6(120),      01048
     1 ARS07(110),ARS08(110),ARS10(110),ARS12(110),ARS14(110),          01049
     2 ARS16(110),ARS18(110),ARS20(110),AMDES(36),CMDES(32),HSMDES(28), 01050
     3 PCW(112),BSUB(90),PCAR(170),BSUP(105),BINT(154),BUFT(99)         01051
      NAMELIST /ARIDE/ AR05,AR1,AR2,AR4,AR6,ARS07,ARS08,ARS10,ARS12,    01052
     1 ARS14,ARS16,ARS18,ARS20,AMDES,CMDES,HSMDES,PCW,BSUB,PCAR,        01053
     2 BSUP,BINT,BUFT                                                   01054
      READ(5,ARIDE)                                                     01055
      WRITE(6,10)                                                       01056
   10 FORMAT(43H0EDET AERODYNAMIC ARRAYS HAVE BEEN MODIFIED)            01057
      CALL AERPRNT(AR05   ,6HAR05  )                                    01058
      CALL AERPRNT(AR1    ,6HAR1   )                                    01059
      CALL AERPRNT(AR2    ,6HAR2   )                                    01060
      CALL AERPRNT(AR4    ,6HAR4   )                                    01061
      CALL AERPRNT(AR6    ,6HAR6   )                                    01062
      CALL AERPRNT(ARS07  ,6HARS07 )                                    01063
      CALL AERPRNT(ARS08  ,6HARS08 )                                    01064
      CALL AERPRNT(ARS10  ,6HARS10 )                                    01065
      CALL AERPRNT(ARS12  ,6HARS12 )                                    01066
      CALL AERPRNT(ARS14  ,6HARS14 )                                    01067
      CALL AERPRNT(ARS16  ,6HARS16 )                                    01068
      CALL AERPRNT(ARS18  ,6HARS18 )                                    01069
      CALL AERPRNT(ARS20  ,6HARS20 )                                    01070
      CALL AERPRNT(AMDES  ,6HAMDES )                                    01071
      CALL AERPRNT(CMDES  ,6HCMDES )                                    01072
      CALL AERPRNT(HSMDES,6HHSMDES)                                     01073
      CALL AERPRNT(PCW    ,6HPCW   )                                    01074
      CALL AERPRNT(BSUB   ,6HBSUB  )                                    01075
      CALL AERPRNT(PCAR   ,6HPCAR  )                                    01076
      CALL AERPRNT(BSUP   ,6HBSUP  )                                    01077
      CALL AERPRNT(BINT   ,6HBINT  )                                    01078
      CALL AERPRNT(BUFT   ,6HBUFT  )                                    01079
      RETURN                                                            01080
      END                                                               01081
```

```
      SUBROUTINE AERPRNT(AR,NAME)                                       01082
      DIMENSION AR(3)                                                   01083
      LD=AR(1)/1000+1                                                   01084
      LA=AR(1)-1000*(LD-1)+1.1                                          01085
      WRITE(6,10)NAME                                                   01086
   10 FORMAT(1H0,A6)                                                    01087
      DO 20 I=1,LD                                                      01088
   20 WRITE(6,30)(AR((I-1)*LA+J),J=1,LA)                                01089
   30 FORMAT(F12.5,12F9.5/(12X,12F9.5))                                 01090
      RETURN                                                            01091
      END                                                               01092
```

```
      SUBROUTINE CFF(H,L,M,CF,R)                                        01093
C     SOMMER AND SHORT T PRIME METHOD FOR                               01094
C     SKIN FRICTION CALCULATIONS                                        01095
      REAL L,M                                                          01096
      CALL REYNO(RE,T,H)                                                01097
      T=T*1.8                                                           01098
      T216=T+198.72                                                     01099
      E=.80                                                             01100
      ESH=4.593153E-6*E*T216/(RE*M*T**1.5)                              01101
      R=RE*M*L                                                          01102
      TAW=(1.+.176*M*M)*T                                               01103
      TW=TAW                                                            01104
      CFPC=(.242/ALOG10(R*.0015))**2                                    01105
      TPT=1.+.035*M*M+.45*(TW/T-1.)                                     01106
      DO 100 I=1,5                                                      01107
      CFL=CFPC/(1.+3.59*SQRT(CFPC))/TPT                                 01108
      TW=(TAW/(1.+ESH*TW**3/CFL)+TW)*.5                                 01109
      TW=(TAW/(1.+ESH*TW**3/CFL)+TW)*.5                                 01110
      TPT=1.+.035*M*M+.45*(TW/T-1.)                                     01111
      RP=R*(TPT*T+198.72)/(T216*TPT*TPT*SQRT(TPT))                      01112
      DO 10 K=1,3                                                       01113
   10 CFPC=(.242/ALOG10(RP*CFPC))**2                                    01114
      CF=CFPC/TPT                                                       01115
  100 CONTINUE                                                          01116
      RETURN                                                            01117
      END                                                               01118
```

```
      SUBROUTINE REYNO(RE,T,HP)                                          01119
      H = HP*.0003048                                                    01120
      IF( H .GT. 11 ) GO TO 10                                           01121
      T = 288.15-6.5*H                                                   01122
      RE = 1.479301E+9*(T/288.15)**5.255876*((T+110.4)/(T**2))           01123
      RETURN                                                             01124
10    IF( H .GT. 20 ) GO TO 20                                           01125
      DH = H-11                                                          01126
      T = 216.65                                                         01127
      RE = 2.302294E+6*EXP(-.157688*DH)                                  01128
      RETURN                                                             01129
20    IF( H .GT. 32 ) GO TO 30                                           01130
      DH = H-20                                                          01131
      T = 216.65+DH                                                      01132
      RE = 7.99309E+7*(216.65/T)**34.1632*((T+110.4)/(T**2))             01133
      RETURN                                                             01134
30    IF( H .GT. 47 ) GO TO 40                                           01135
      DH = H-32                                                          01136
      T = 228.65+2.8*DH                                                  01137
      RE = 1.267264E+7*(228.65/T)**12.20114*((T+110.4)/(T**2))           01138
      RETURN                                                             01139
40    IF( H .GT. 52 ) GO TO 50                                           01140
      DH = H-47                                                          01141
      T = 270.65                                                         01142
      RE = 8.42284E+3*EXP(-.126226*DH)                                   01143
      RETURN                                                             01144
50    IF( H .GT. 61 ) GO TO 60                                           01145
      DH = H-52                                                          01146
      T = 270.65-2.0*DH                                                  01147
      RE = 8.613282E+5*(T/270.65)**17.0816*((T+110.4)/(T**2))            01148
      RETURN                                                             01149
60    IF( H .GT. 70 ) GO TO 70                                           01150
      DH = H-61                                                          01151
      T = 252.65-3.6*DH                                                  01152
      RE = 2.65857E+5*(T/252.65)**9.56641*((T+110.4)/(T**2))             01153
      RETURN                                                             01154
70    IF( H .GT. 80 ) GO TO 80                                           01155
      DH = H-70                                                          01156
      T = 220.25-2.9*DH                                                  01157
      RE = 7.1525E+4*(T/220.25)**12.3328*((T+110.4)/(T**2))              01158
      RETURN                                                             01159
80    IF( H .GT. 90 ) GO TO 90                                           01160
      DH = H-80                                                          01161
      T = 191.25                                                         01162
      RE = 103.414*EXP(-.188858*DH)                                      01163
      RETURN                                                             01164
90    DH = H-90                                                          01165
      T = 191.25+3.0*DH                                                  01166
      RE = 1.89706E+3*(191.25/T)**11.3877*((T+110.4)/(T**2))             01167
      RETURN                                                             01168
      END                                                                01169
```

```
      SUBROUTINE DEFAER(IWAVE,IBO,MYAERO)                                01170
      COMMON/EDETIN/CAM,SBASE,BL,XD,AMODE,AITEK,SHT,TCHT,SVT,            01171
     1 TCVT,ARHT,ARVT,XNAC,DNAC,NEW,NEF,TRHT,TRVT,HHT,GLOV               01172
      COMMON/CONFIG/GW,AR,THRUST,SW,TR,SWEEP,TCA,VCMN,CH,WWSTR,          01173
     1 DUMV1,DUMV2,DESRNG                                               01174
      COMMON/WAVDAT/CDWAV(30),DCDNAC(30),TREF,SREF,ELTOT,ELW(30),VOLTOT,01175
     1VOLW(30),AWETT(30),AWETW(30),AWETN,FORM(30),EQL(30),CEXP           01176
       COMMON /AERO/ CDTAB(500),CDPA(400)                               01177
      DIMENSION CDMIN(30),CK(30),CLB(30)                                01178
      NAMELIST/RFHIN/CDMIN,CK,CLB                                       01179
      NAMELIST/ASCLIN/CDWAV,DCDNAC,TREF,SREF,ELTOT,ELW,VOLTOT,VOLW      01180
     1,AWETT,AWETW,AWETN,FORM,EQL                                       01181
      DATA CDWAV,DCDNAC,AWETT,AWETW,ELW,VOLW,FORM,EQL/240*0./           01182
      READ(5,300)LM,LC                                                  01183
  300 FORMAT(I3,I4)                                                     01184
      CDTAB(1)=1000.*LM+LC                                              01185
      READ(5,200)(CDTAB((LC+1)*I+1),I=1,LM)                             01186
      READ(5,200)(CDTAB(I+1),I=1,LC)                                    01187
  200 FORMAT(10F8.1)                                                    01188
      IF(IBO.EQ.1)GO TO 302                                             01189
      IF(MYAERO.EQ.3)GO TO 100                                          01190
      READ(5,200)((CDTAB((LC+1)*I+1+J),J=1,LC),I=1,LM)                  01191
      GO TO 307                                                         01192
  302 DO 305 I=1,LM                                                     01193
  305 READ(5,200)(CDTAB((LC+1)*I+1+J),J=1,LC)                           01194
      GO TO 307                                                         01195
  100 READ(5,RFHIN)                                                     01196
      WRITE(6,RFHIN)                                                    01197
      DO 150 I=1,LM                                                     01198
      DO 150 J=1,LC                                                     01199
  150 CDTAB((LC+1)*I+1+J)=CDMIN(I)+CK(I)*(CDTAB(J+1)-CLB(I))**2         01200
      MYAERO=1                                                          01201
  307 WRITE(6,310)(CDTAB(I+1),I=1,LC)                                   01202
  310 FORMAT(17H0DRAG DUE TO LIFT/8H0MACH/CL,17F7.3)                    01203
      L1=LC+1                                                           01204
      DO 320 I=1,LM                                                     01205
  320 WRITE(6,330)(CDTAB(L1*I+J),J=1,L1)                                01206
  330 FORMAT(F8.3,17F7.5)                                               01207
      READ(5,300)LM,LC                                                  01208
      CDPA(1)=1000.*LM+LC                                               01209
      READ(5,200)(CDPA((LC+1)*I+1),I=1,LM)                              01210
      READ(5,200)(CDPA(I+1),I=1,LC)                                     01211
       IF(MYAERO.NE.1)GO TO 360                                         01212
      IF(IBO.EQ.1)GO TO 340                                             01213
      READ(5,200)((CDPA((LC+1)*I+1+J),J=1,LC),I=1,LM)                   01214
      GO TO 360                                                         01215
  340 DO 350 I=1,LM                                                     01216
  350 READ(5,200)(CDPA((LC+1)*I+1+J),J=1,LC)                            01217
  360 IF(IWAVE.EQ.1)READ(5,200)(CDWAV(I),I=1,LC)                        01218
       IF(MYAERO.EQ.1)GO TO 400                                         01219
      TREF=THRUST                                                       01220
      SREF=SW                                                           01221
      ELTOT=BL                                                          01222
      CEXP=XD/(1.+TR)/SQRT(AR)                                          01223
      READ(5,ASCLIN)                                                    01224
      DO 380 I=2,30                                                     01225
      IF(AWETT(I).EQ.0.)AWETT(I)=AWETT(I-1)                             01226
      IF(AWETW(I).EQ.0.)AWETW(I)=AWETW(I-1)                             01227
      IF(ELW(I).EQ.0.)ELW(I)=ELW(I-1)                                   01228
      IF(VOLW(I).EQ.0.)VOLW(I)=VOLW(I-1)                                01229
      IF(FORM(I).EQ.0.)FORM(I)=FORM(I-1)                                01230
  380 IF(EQL(I).EQ.0.)EQL(I)=EQL(I-1)                                   01231
      WRITE(6,ASCLIN)                                                   01232
      RETURN                                                            01233
  400 WRITE(6,410)(CDPA(I+1),I=1,LC)                                    01234
  410 FORMAT(22H0LIFT INDEPENDENT DRAG/9H0ALT/MACH,17F7.3)              01235
      L1=LC+1                                                           01236
      DO 420 I=1,LM                                                     01237
      DO 415 J=1,LC                                                     01238
```

```
415 CDPA(L1*I+J+1)=CDPA(L1*I+J+1)+CDWAV(J)                              01239
420 WRITE(6,430)(CDPA(L1*I+J),J=1,L1)                                  01240
430 FORMAT(F9.0,17F7.5,(/9X,17F7.5))                                   01241
    RETURN                                                             01242
    END                                                                01243
```

```
      SUBROUTINE AERSCL(IPRNT)                                          01244
      REAL MACH                                                         01245
      COMMON/CONFIG/GW,AR,THRUST,SW,TR,SWEEP,TCA,VCMN,CH,WWSTR,         01246
     1 DUMV1,DUMV2,DESRNG                                               01247
      COMMON/WAVDAT/CDWAV(30),DCDNAC(30),TREF,SREF,ELTOT,ELW(30),VOLTOT,01248
     1VOLW(30),AWETT(30),AWETW(30),AWETN,FORM(30),EQL(30),CEXP          01249
       COMMON /AERO/ CDTAB(500),CDPA(400)                               01250
      DIMENSION CDW(30),ATO(30)                                         01251
      DATA IFIR/1/                                                      01252
      T3=SW/SREF                                                        01253
      T4=(THRUST/TREF-1.)/T3                                            01254
      T5=(1.-CEXP/SQRT(SW))/(1.-CEXP/SQRT(SREF))                        01255
      LM=CDPA(1)/1000.                                                  01256
      LC=CDPA(1)-1000.*LM                                               01257
      L1=LC+1                                                           01258
      DO 100 J=1,LC                                                     01259
      T1=(VOLTOT-VOLW(J))/ELTOT                                         01260
      T2=VOLW(J)/ELW(J)                                                 01261
      AT=(AWETT(J)+AWETW(J)*(T3*T5-1.)+AWETN*(THRUST/TREF-1.))/T3       01262
      MACH=CDPA(J+1)                                                    01263
      CDWJ=0.                                                           01264
      ROUGH=1.045                                                       01265
      IF(MACH.GT..99)ROUGH=ROUGH+.356*(MACH-.99)**.08/(MACH**3+3.)      01266
      B=0.                                                              01267
      IF(MACH.LT.1.)GO TO 10                                            01268
      B=SQRT(MACH**2-1.)/2.                                             01269
 10   CDWJ=CDWAV(J)*((T1+B*T2*T3)/(T1+B*T2))**2/T3+T4*DCDNAC(J)         01270
      DO 90 I=1,LM                                                      01271
      IF(IFIR.EQ.0) GO TO 50                                            01272
      ALT=CDPA(L1*I+1)                                                  01273
      FF=FORM(J)                                                        01274
      IF(MACH.GE.1.)FF=1.                                               01275
      CALL CFF(ALT,EQL(J),MACH,CF,RN)                                   01276
      CDF=CF*FF*AT                                                      01277
      CDF=CDF*ROUGH                                                     01278
      GO TO 90                                                          01279
 50   CDF = (CDPA(L1*I+J+1)-CDW(J))*AT/ATO(J)                           01280
 90   CDPA(L1*I+J+1)=CDF+CDWJ                                           01281
      CDW(J)=CDWJ                                                       01282
      ATO(J)=AT                                                         01283
100   CONTINUE                                                          01284
      IFIR=0                                                            01285
      IF(IPRNT.EQ.0)RETURN                                              01286
      WRITE(6,410)(CDPA(I+1),I=1,LC)                                    01287
410   FORMAT(22H0LIFT INDEPENDENT DRAG/9H0ALT/MACH,17F7.3)              01288
      DO 420 I=1,LM                                                     01289
420   WRITE(6,430)(CDPA(L1*I+J),J=1,L1)                                 01290
430   FORMAT(F9.0,17F7.5,(/9X,17F7.5))                                  01291
      WRITE(6,440)(CDW(J),J=1,LC)                                       01292
440   FORMAT(9H0  WAVE  ,17F7.5,(/9X,17F7.5))                           01293
      RETURN                                                            01294
      END                                                               01295
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```
      SUBROUTINE DEFINE                                                 00001
      COMMON/COSTCON/ICOST,OFC                                          00002
      COMMON/COSTDAT/VWTS(42)                                           00003
      COMMON/UPFUEL/IFUFU,NWREF,CGREFX,CGREFL,SWRAT,VARSWP              00004
      COMMON/OSWALD/E                                                   00005
      COMMON/AWETO/SWETW,SWETH,SWETV,SWETF,SWETN                        00006
      COMMON/ININ/NTANK,NFCON,SWTFF,YMLG,TX(40),TY(40),TZ(40),          00007
     1 TL(40),TW(40),TD(40),TF(40,3)                                    00008
      COMMON/VLIMIT/VMAX,VMMO                                           00009
      COMMON/ESB/RAMPWT,DOWE,PAYLOAD,TFL,MYWTS,MYAERO,RANGE,            00010
     1 TIME,ELOD,ITAKOFF,ILAND,RW                                       00011
      COMMON/CONTRL/PLIM                                                00012
      COMMON/XLAM/XLLAM,TRUW,TRLW,TRUH,TRLH,TRUV,TRLV,TRUB,TRLB         00013
     1,NFUSE,NVERT,TRUN,TRLN                                            00014
      COMMON/LANDG/VAPPR,DRATIO,CLLDM,CLTOM,FLTO,FLLDG,XENG,            00015
     1 THRSS,THRMA,ELODSS,ELODMA,THROFF                                 00016
      COMMON/CONFIG/DVA(12),DESRNG                                      00017
      COMMON/EDETIN/CAM,SBASE,BL,XD,AMODE,AITEK,SHT,TCHT,SVT,           00018
     1 TCVT,ARHT,ARVT,XNAC,DNAC,NEW,NEF,TRHT,TRVT,HHT,GLOV              00019
      COMMON/MISWT/WTHR,WIN,WHYD,WELEC,WAVONC,WFURN,WAC,WAPU,WAI,EEXP,  00020
     1 WENG,THRSO,FWMAX,WRATIO,WCON,WUF,WOIL,WPMSC,WFSYS,WSRV           00021
      COMMON/RATIOS/WSR,TWR,HTVC,VTVC,PGLOV,INENG                       00022
      COMMON/VARABLE/X(12)                                              00023
      COMMON/ACON/VLB(12),VUB(12),SCAL(12),DUM(167)                     00024
      COMMON/CNMN1/DUP(12),NDV,DUR(14)                                  00025
      COMMON/AKEY/AK(12),OFG,OFF,OFM,OFR                                00026
      COMMON/WTS/CGSP(40,2),WSP(40,2),FLAPR,FCOMP,FAERT,FLAPC,          00027
     1FSTRT,DGW,ULF,TCR,TCB,TCT,PCTB,DIH,                               00028
     1SWPHT,SWPVT,SFIN,ARFIN,TRFIN,TCFIN,SWPFIN,NFIN,SCAN,SWPCAN,       00029
     2ARCAN,TRCAN,TCCAN,VCAN,XL,WF,DF,CARGF,INERTIA,FUELWMX,            00030
     3FUELFMX,CARGOW,CARGOF,PCTR,XMLG,XNLG,WLDG,XLP,ZRVT,FRWI,          00031
     5FRHT,FRVT,FRFIN,FRCAN,FRFU,FRLGN,FRLGM,FRNA,FRSC,YFUSE,YVERT,     00032
     6NPF,NPT,CGLGN,CGLGM,CGEF,CGEA,NSTU,NGALC,NFLCR,CONDEN,HYDPR,      00033
     1CGCW,CGCF,CGZWF,CGFWF,ZHT,ZVT,ZFIN,YFIN,ZEF,YEF,ZEA,YEA,ZBW,ZAP   00034
      COMMON/PARVAR/DVD(5,12)                                           00035
      DIMENSION ZERO(160),GW(5),AR(5),THRUST(5),SW(5),                  00036
     1 TR(5),SWEEP(5),TCA(5),VCMN(5),CH(5),WWSTR(5)                     00037
      EQUIVALENCE (DVD(1,1),GW(1)),(DVD(1,2),AR(1)),(DVD(1,3),THRUST(1))00038
     1,(DVD(1,4),SW(1)),(DVD(1,5),TR(1)),(DVD(1,6),SWEEP(1)),           00039
     2(DVD(1,7),TCA(1)),(CGSP(1,1),ZERO(1))                             00040
     3,(DVD(1,8),VCMN(1)),(DVD(1,9),CH(1)),(DVD(1,10),WWSTR(1))         00041
      EQUIVALENCE (CGW,CGSP(1,2)),(CGHT,CGSP(2,2)),(CGVT,CGSP(3,2)),    00042
     1(CGFIN,CGSP(4,2)),(CGCAN,CGSP(5,2)),(CGF,CGSP(6,2)),              00043
     2(CGLG,CGSP(7,2)),(CGN,CGSP(8,2)),(CGSTRUC,CGSP(9,2)),             00044
     3(CGTHR,CGSP(11,2)),(CGMS,CGSP(12,2)),          (CGPRO,CGSP(15,2)),00045
     4(CGSC,CGSP(16,2)),(CGAP,CGSP(17,2)),(CGIN,CGSP(18,2)),(CGHYD,CGSP 00046
     5(19,2)),(CGEL,CGSP(20,2)),(CGAV,CGSP(21,2)),(CGFRN,CGSP(22,2)),   00047
     6(CGAC,CGSP(23,2)),(CGAI,CGSP(24,2)),(CGSYS,CGSP(25,2)),(CGWE,CGSP 00048
     7(26,2)),(CGCR,CGSP(27,2)),                                        00049
     8(CGOWE,CGSP(33,2)),(CGZF,CGSP(37,2)),(CGFM,CGSP(38,2)),(CGWGW,    00050
     9CGSP(39,2))                                                       00051
      EQUIVALENCE (CGE,CGSP(10,2)),(CGP,CGSP(28,2)),(CGC,CGSP(32,2)),   00052
     1(CGFSYS,CGSP(13,2))                                               00053
      NAMELIST/WTIN/DGW,ULF,TCR,TCB,TCT,PCTB,DIH,TCHT,TCVT,EEXP,VMMO,   00054
     1GLOV,SHT,SWPHT,ARHT,TRHT,HHT,SVT,SWPVT,ARVT,TRVT,SFIN,ARFIN,TRFIN,00055
     2TCFIN,SWPFIN,NFIN,SCAN,SWPCAN,ARCAN,TRCAN,TCCAN,VCAN,XL,WF,DF,    00056
     3CARGF,INERTIA,DNAC,FUELWMX,FUELFMX,CARGOW,CARGOF,PCTR,XMLG,XNLG,  00057
     4WLDG,XLP,ZRVT,WENG,WTHR,WIN,WHYD,WELEC,WAVONC,WFURN,WAC,          00058
     5WAPU,WAI,FRWI,FRHT,FRVT,FRFIN,FRCAN,FRFU,FRNA,FRSC,YFUSE,         00059
     6YVERT,WFSYS,WSRV,XNAC,NPF,NPT,NEW,NEF,NSTU,NGALC,NFLCR,CONDEN,    00060
     7WCON,WUF,WOIL,WPMSC,HYDPR,CGW,CGHT,CGVT,CGFIN,CGCAN,CGF,CGLGN,    00061
     1CGLGM,CGEF,CGEA,CGAP,NWREF,CGAV,CGCR,CGP,CGCW,CGCF,CGZWF,CGFWF,   00062
     2ZHT,ZVT,ZFIN,YFIN,ZEF,YEF,ZEA,YEA,ZBW,ZAP,FLAPR,FCOMP,FAERT,FSTRT,00063
     3THRSO,SPAN,FLAPC,CGREFX,CGREFL,NTANK,NFCON,SWTFF,YMLG,TX,TY,TZ,TL,00064
     4TW,TD,TF,IFUFU,MYWTS,FRLGN,FRLGM,VARSWP                           00065
      NAMELIST/CONFIN/GW,AR,THRUST,SW,TR,SWEEP,TCA,VCMN,DESRNG,OFG,OFF,  00066
     1 CH,OFM,OFR,WSR,TWR,HTVC,VTVC,WWSTR,PGLOV,SWRAT,OFC,ICOST         00067
      NAMELIST/AERIN/CAM,SBASE,AMODE,AITEK,VAPPR,WRATIO,DRATIO,CLAPP    00068
     1,CLTOM,CLLDM,FLTO,FLLDG,MYAERO,MODAERO,E,IWAVE,ITAKOFF,ILAND,IBO, 00069
     2 XLLAM,TRUW,TRLW,TRUH,TRLH,TRUV,TRLV,TRUB,TRLB,NFUSE,NVERT,TRUN   00070
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     3,SWETW,SWETH,SWETV,SWETF,SWETN,THRSS,THRMA,ELODSS,ELODMA,INENG     00071
     4,TRLN,THROFF                                                       00072
      DATA ZERO/160*0./                                                  00073
      DATA WIN,WHYD,WELEC,WAVONC,WFURN,WAC,WAPU,WAI,FRWI,FRHT,FRVT,      00074
     1 FRFIN,FRCAN,FRFU,FRLGN,FRLGM,FRNA,FRSC/18*1./,EEXP/1.15/,         00075
     2 NEW,NEF/2*0/,WENG,WTHR,VMMO,HTVC,VTVC,YFUSE,YVERT/7*0./           00076
      DATA WCON,WUF,WOIL,WPMSC,WFSYS,WSRV,FLAPC/7*1./,MYWTS,INENG/2*0/   00077
     1 ,INERTIA,ICOST/2*0/,OFC,VWTS,VARSWP/44*0./                        00078
      DATA FCOMP,FAERT,FSTRT,ULF,TCR,TCB,TCT,PCTB,PCTR,DIH,              00079
     1SWPHT,SWPVT,SFIN,ARFIN,TRFIN,SWPFIN,SCAN,SWPCAN,ARCAN,             00080
     2TRCAN,TCRCAN,TCTCAN,XL,WF,DF,FUELWMX,FUELFMX,CARGOW,               00081
     3CARGOF,XMLG,XNLG,WLDG,XLP,ZRVT,CGLGN,CGLGM,CGEF,                   00082
     4CGEA,CGCW,CGCF,CGZWF,CGFWF,ZHT,ZVT,ZFIN,YFIN,ZEF,YEF,              00083
     5ZEA,YEA,ZBW,ZAP/52*0./,INERTIA,NPF,NPT/3*0/                        00084
      DATA CAM,SBASE,CLAPP,FLLDG,XLLAM,TRUW,TRUV,TRUH,TRUB,TRLW,TRLV,    00085
     1 TRLH,TRLB/13*0./,MYAERO,MODAERO/2*0/,AMODE,AITEK,DRATIO,E/4*1./   00086
     2,VAPPR/150./,CLLDM/3./,CLTOM/2./,FLTO/12000./,IFUFU/0/,THRSO,OFG,  00087
     3 OFM,OFR,WSR,TWR,DVD,THRMA,ELODSS,ELODMA,THRSS/70*0./,FLAPR/.333/   00088
      DATA SWTFF,YMLG,TX,TY,TZ,TL,TW,TD,TF/362*0./,NTANK,NFCON/2*1/       00089
     4,NSTU,NGALC,NFLCR/3*-1/,CONDEN/2.54/,OFF/1./,NFUSE,NVERT/2*1/      00090
     5,SWETW,SWETH,SWETV,SWETF,SWETN/5*1./,IWAVE,ITAKOFF,ILAND,IBO/4*0/  00091
     6,NWREF/39/,FWMAX,CGREFX,CGREFL,PGLOV,TRUN,TRLN,THROFF/7*0./,       00092
     7CARGF/0./,HYDPR/3000./,DGW/0./,SWRAT/1./,TCFIN/.03/                00093
      PLIM=4H                                                            00094
      ENTRY DEFINEF                                                      00095
      READ(5,WTIN)                                                       00096
      READ(5,CONFIN)                                                     00097
      IF(WSR.LT.0.)WSR=-SW(1)                                            00098
      IF(WSR.NE.0.)SW(1)=GW(1)/ABS(WSR)                                  00099
      IF(TWR.LT.0.)TWR=-THRUST(1)                                        00100
      IF(NEW+NEF.GT.0)TWR=TWR/(NEW+NEF)                                  00101
      IF(TWR.NE.0.)THRUST(1)=GW(1)*ABS(TWR)                              00102
      IF(PGLOV.GT.0..AND.PGLOV.LT.1.)GLOV=SW(1)*PGLOV                    00103
      IF(SW(1)*AR(1)*SPAN.GT.0.)GLOV=SW(1)-SPAN**2/AR(1)                 00104
      IF(SW(1).LE.0.)SW(1)=SPAN**2/AR(1)+GLOV                            00105
      IF(AR(1).LE.0.)AR(1)=SPAN**2/(SW(1)-GLOV)                          00106
      IF(PGLOV.GT.0.)PGLOV=GLOV/SW(1)                                    00107
      SPAN=SQRT(AR(1)*(SW(1)-GLOV))                                      00108
      IF(THRSO.EQ.0.)THRSO=THRUST(1)                                     00109
      IF(WENG.EQ.0.)WENG=.126*THRSO**.104                                00110
      IF(PCTB.LT.PCTR)PCTB=PCTR                                          00111
      IF(TCR.EQ.0.)TCR=TCA(1)                                            00112
      IF(TCT.EQ.0.)TCT=TCR                                               00113
      IF(TCB.LE.0.)TCB=TCR                                               00114
      IF(CGREFL.EQ.0.)CGREFL=XL*12.                                      00115
      WRITE(6,200)VMMO,ULF,NWREF,CGREFL,CGREFX,MYWTS,DGW                 00116
  200 FORMAT(48H0GEOMETRY AND WEIGHT INPUT DATA (NAMELIST $WTIN)/        00117
     1 14H0  DESCRIPTION,16X,4HNAME,7X,18H VALUE  DIMENSIONS//           00118
     2 37H   MAX OPER MACH NUMBER        VMMO    ,F11.4/                00119
     3 37H   ULTIMATE LOAD FACTOR        ULF     ,F11.4/                00120
     5 37H   REF WEIGHT NUMBER           NWREF   ,I11/                  00121
     6 37H   CG REFERENCE LENGTH         CGREFL ,F11.1,4H  IN/          00122
     7 37H   X FOR START OF CGREFL       CGREFX ,F11.1,4H  IN/          00123
     8 37H   SWITCH TO COMPUTE WEIGHTS   MYWTS   ,I11/                  00124
     9 34H   DESIGN GROSS WT. (RATIO)    DGW   ,F14.3/                  00125
     4 10H0WING DATA)                                                   00126
      IF(TCA(1).LE.0.)WRITE(6,210)TCR,TCB,TCT,PCTB,PCTR                 00127
  210 FORMAT(37H   T/C AT ROOT                    TCR     ,F11.5/       00128
     1 37H   T/C AT BREAK                 TCB     ,F11.5/               00129
     2 37H   T/C AT TIP                   TCT     ,F11.5/               00130
     3 37H   BREAK FRACTION OF SEMISPAN   PCTB    ,F11.5/               00131
     4 37H   ROOT FRACTION OF SEMISPAN    PCTR    ,F11.5)               00132
      IF(TCA(1).LE.0.)TCA(1)=                                           00133
     1 (TCR*(4.*PCTB+PCTR)+TCB*(4.-3.*PCTB-PCTR)+TCT*(1.-PCTB))/5.      00134
      WRATIO=WLDG/GW(1)                                                 00135
      IF(WLDG.LE.5.)WRATIO=WLDG                                         00136
      IF(WLDG.LE.0.)WRATIO=1.-.000075*DESRNG                            00137
      IF(HTVC.EQ.1.)HTVC=SHT*XL*SQRT(AR(1)/SW(1))/SW(1)                 00138
      IF(VTVC.EQ.1.)VTVC=SVT*XL/SQRT(AR(1)*SW(1))/SW(1)                 00139
      IF(FUELWMX.LT.50.)FWMAX=FUELWMX                                   00140
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      IF(FUELWMX.LT.0.)FWMAX=18.45                                      00141
      IF(FWMAX.LE.0.)FWMAX=FUELWMX*AR(1)/(SW(1)-GLOV)/SPAN/TCA(1)       00142
      READ(5,AERIN)                                                     00143
      IF(FLLDG.EQ.0.)FLLDG=FLTO                                         00144
      IF(THROFF.LE.0.)THROFF=THRSO                                      00145
      IF(THRSS.LE.0.)THRSS=THRSO                                        00146
      IF(THRMA.LE.0.)THRMA=THRSS                                        00147
      IF(CLAPP.GT.0..AND.CLLDM.EQ.3.)CLLDM=1.69*CLAPP                   00148
      XENG=NEW+NEF                                                      00149
      WLDG=GW(1)*WRATIO                                                 00150
      IF(TCHT.LE.0.)TCHT=TCA(1)                                         00151
      IF(TCVT.LE.0.)TCVT=TCHT                                           00152
      WRITE(6,220)DIH,GLOV,SPAN,SWRAT,FLAPR,FLAPC,FCOMP,FAERT,FSTRT     00153
     1 ,VARSWP                                                          00154
  220 FORMAT(37H   DIHEDRAL(POSITIVE)          DIH    ,F11.3,5H  DEG/  00155
     1 37H   GLOVE AND BAT AREA          GLOV   ,F11.2,7H  SQ FT/      00156
     2 37H   SPAN                        SPAN   ,F11.2,4H  FT/         00157
     2 37H   WT/AERO WING AREA RATIO     SWRAT  ,F11.4/                00158
     3 37H   CONTROL SURFACE AREA RATIO FLAPR  ,F11.4/                 00159
     4 37H   FLAP COMPLEXITY FACTOR      FLAPC  ,F11.4/                00160
     5 37H   FRACTION OF COMPOSITES      FCOMP  ,F11.4/                00161
     6 37H   AEROELASTIC TAILORING FACT FAERT  ,F11.4/                 00162
     7 37H   STRUT BRACING FACTOR        FSTRT  ,F11.4/                00163
     8 37H   VARIABLE SWEEP FACTOR       VARSWP ,F11.4)                00164
      WRITE(6,230)SHT,SWPHT,ARHT,TRHT,TCHT,HHT                          00165
  230 FORMAT(21H0HORIZONTAL TAIL DATA/                                  00166
     1 37H   AREA                        SHT    ,F11.2,7H  SQ FT/      00167
     2 37H   1/4 CHORD SWEEP ANGLE       SWPHT  ,F11.2,5H  DEG/        00168
     3 37H   ASPECT RATIO                ARHT   ,F11.2/                00169
     4 37H   TAPER RATIO                 TRHT   ,F11.4/                00170
     5 37H   T/C                         TCHT   ,F11.4/                00171
     6 37H   LOCATION ON VERTICAL TAIL   HHT    ,F11.4)                00172
      WRITE(6,240)SVT,SWPVT,ARVT,TRVT,TCVT                              00173
  240 FORMAT(19H0VERTICAL TAIL DATA/                                    00174
     1 37H   AREA                        SVT    ,F11.2,7H  SQ FT/      00175
     2 37H   1/4 CHORD SWEEP ANGLE       SWPVT  ,F11.2,5H  DEG/        00176
     3 37H   ASPECT RATIO                ARVT   ,F11.4/                00177
     4 37H   TAPER RATIO                 TRVT   ,F11.4/                00178
     5 37H   T/C                         TCVT   ,F11.4)                00179
      IF(SFIN.GT.1.)WRITE(6,250)SFIN,ARFIN,TRFIN,TCFIN,SWPFIN,NFIN      00180
  250 FORMAT(14H0WING FIN DATA/                                         00181
     1 37H   AREA                        SFIN   ,F11.2,7H  SQ FT/      00182
     2 37H   ASPECT RATIO                ARFIN  ,F11.4/                00183
     3 37H   TAPER RATIO                 TRFIN  ,F11.4/                00184
     4 37H   T/C                         TCFIN  ,F11.4/                00185
     5 37H   1/4 CHORD SWEEP ANGLE       SWPFIN ,F11.2,5H  DEG/        00186
     6 37H   NUMBER OF FINS              NFIN   ,I11)                  00187
      IF(SCAN.GT.1.)WRITE(6,260)SCAN,SWPCAN,ARCAN,TRCAN,TCCAN,VCAN      00188
  260 FORMAT(12H0CANARD DATA/                                           00189
     1 37H   AREA                        SCAN   ,F11.2,7H  SQ FT/      00190
     2 37H   1/4 CHORD SWEEP ANGLE       SWPCAN ,F11.2,5H  DEG/        00191
     3 37H   ASPECT RATIO                ARCAN  ,F11.4/                00192
     4 37H   TAPER RATIO                 TRCAN  ,F11.4/                00193
     5 37H   T/C                         TCCAN  ,F11.4/                00194
     6 37H   VARIABLE SWEEP FACTOR       VCAN   ,F11.4)                00195
      WRITE(6,270)XL,WF,DF,CARGF,XLP                                    00196
  270 FORMAT(14H0FUSELAGE DATA/                                         00197
     1 37H   TOTAL LENGTH                XL     ,F11.2,4H  FT/         00198
     2 37H   MAXIMUM WIDTH               WF     ,F11.2,4H  FT/         00199
     3 37H   MAXIMUM DEPTH               DF     ,F11.2,4H  FT/         00200
     4 37H   CARGO AIRCRAFT FACTOR       CARGF  ,F11.4/                00201
     5 37H   PASSENGER COMPART LENGTH    XLP    ,F11.2,4H  FT)         00202
      WRITE(6,280)XMLG,XNLG,WLDG                                        00203
  280 FORMAT(18H0LANDING GEAR DATA/                                     00204
     1 37H   LENGTH OF MAIN GEAR         XMLG   ,F11.2,4H  IN/         00205
     2 37H   LENGTH OF NOSE GEAR         XNLG   ,F11.2,4H  IN/         00206
     3 37H   DESIGN LANDING WEIGHT       WLDG   ,F11.1,5H  LBF)        00207
      WRITE(6,290)NEW,NEF,THRSO,WENG,EEXP,XNAC,DNAC,FUELWMX,            00208
     1 FUELFMX                                                          00209
  290 FORMAT(23H0PROPULSION SYSTEM DATA/                                00210
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   1 37H   NUMBER OF ENGINES ON WING  NEW    ,I11/                        00211
   2 37H   NUMBER OF ENGINES ON FUSE  NEF    ,I11/                        00212
   3 37H   BASELINE ENGINE THRUST     THRSO  ,F11.1,5H  LBF/              00213
   4 37H   BASELINE ENGINE WEIGHT     WENG   ,F11.1,5H  LBF/              00214
   5 37H   WEIGHT SCALING PARAMETER   EEXP   ,F11.5/                      00215
   6 37H   BASELINE NACELLE LENGTH    XNAC   ,F11.2,4H  FT/               00216
   7 37H   BASELINE NACELLE DIAMETER  DNAC   ,F11.2,4H  FT/               00217
   9 37H   FUEL CAPACITY OF WING      FUELWMX,F11.1,5H  LBM/              00218
   O 37H   FUEL CAPACITY OF FUSELAGE  FUELFMX,F11.1,5H  LBM)             00219
    WRITE(6,300)NPF,NPT,NSTU,NGALC,NFLCR,CARGOW,CARGOF,CONDEN           00220
300 FORMAT(22H0CREW AND PAYLOAD DATA/                                   00221
   1 37H   FIRST CLASS PASSENGERS     NPF    ,I11/                        00222
   2 37H   TOURIST PASSENGERS         NPT    ,I11/                        00223
   3 37H   STEWARDESSES               NSTU   ,I11/                        00224
   4 37H   GALLEY CREW                NGALC  ,I11/                        00225
   5 37H   FLIGHT CREW                NFLCR  ,I11/                        00226
   6 37H   CARGO IN WING              CARGOW ,F11.1,5H  LBF/              00227
   7 37H   CARGO IN FUSELAGE          CARGOF ,F11.1,5H  LBF/              00228
   8 37H   CARGO CONTAINER WEIGHT/FT  CONDEN ,F11.3,8H  LBF/FT)          00229
    WRITE(6,310)FRWI,FRHT,FRVT,FRFIN,FRCAN,FRFU,FRLGN,FRLGM,FRNA,       00230
   1 WTHR,WPMSC,WFSYS,FRSC,WAPU                                         00231
310 FORMAT(32H0OVERRIDE PARAMETERS FOR WEIGHTS/                         00232
   1 37H   WING                      FRWI   ,F11.4/                     00233
   2 37H   HORIZONTAL TAIL            FRHT   ,F11.4/                     00234
   3 37H   VERTICAL TAIL              FRVT   ,F11.4/                     00235
   4 37H   WING VERTICAL FIN          FRFIN  ,F11.4/                     00236
   5 37H   CANARD                     FRCAN  ,F11.4/                     00237
   6 37H   FUSELAGE                   FRFU   ,F11.4/                     00238
   7 37H   NOSE LANDING GEAR          FRLGN  ,F11.4/                     00239
   8 37H   MAIN LANDING GEAR          FRLGM  ,F11.4/                     00240
   9 37H   NACELLES - TOTAL           FRNA   ,F11.4/                     00241
   O 37H   THRUST REVERSERS - TOTAL   WTHR   ,F11.4/                     00242
   A 37H   MISC PROPULSION SYSTEMS    WPMSC  ,F11.4/                     00243
   B 37H   FUEL SYSTEM                WFSYS  ,F11.4/                     00244
   C 37H   SURFACE CONTROLS           FRSC   ,F11.4/                     00245
   D 37H   AUXILIARY POWER UNIT       WAPU   ,F11.4)                     00246
    WRITE(6,320)WIN,WHYD,WELEC,WAVONC,WFURN,WAC,WAI,WUF,WOIL,WSRV,      00247
   1 WCON,HYDPR                                                         00248
320 FORMAT(37H   INSTRUMENT GROUP          WIN    ,F11.4/              00249
   1 37H   HYDRAULICS GROUP          WHYD   ,F11.4/                     00250
   2 37H   ELECTRICAL GROUP          WELEC  ,F11.4/                     00251
   3 37H   AVIONICS GROUP            WAVONC ,F11.4/                     00252
   4 37H   FURNISHINGS GROUP         WFURN  ,F11.4/                     00253
   5 37H   AIR CONDITIONING GROUP    WAC    ,F11.4/                     00254
   6 37H   ANTI-ICING GROUP          WAI    ,F11.4/                     00255
   7 37H   UNUSABLE FUEL             WUF    ,F11.4/                     00256
   8 37H   ENGINE OIL                WOIL   ,F11.4/                     00257
   9 37H   PASSENGER SERVICE         WSRV   ,F11.4/                     00258
   O 37H   CARGO AND BAGGAGE CONTAIN WCON   ,F11.4/                     00259
   A 37H   HYDRAULIC SYSTEM PRESSURE HPRESS ,F11.0)                     00260
    WRITE(6,330)CGW,CGHT,CGVT,CGFIN,CGCAN,CGF,CGLGN,CGLGM,CGEF,CGEA,    00261
   1 CGAP,CGAV,CGCR,CGP,CGCW,CGCF,CGZWF,CGFWF                           00262
330 FORMAT(34H0HORIZONTAL CENTER OF GRAVITY DATA/                       00263
   1 37H   WING                      CGW    ,F11.1,4H  IN/              00264
   2 37H   HORIZONTAL TAIL            CGHT   ,F11.1,4H  IN/              00265
   3 37H   VERTICAL TAIL              CGVT   ,F11.1,4H  IN/              00266
   4 37H   WING VERTICAL FINS         CGFIN  ,F11.1,4H  IN/              00267
   5 37H   CANARD                     CGCAN  ,F11.1,4H  IN/              00268
   6 37H   FUSELAGE                   CGF    ,F11.1,4H  IN/              00269
   7 37H   NOSE LANDING GEAR          CGLGN  ,F11.1,4H  IN/              00270
   8 37H   MAIN LANDING GEAR          CGLGM  ,F11.1,4H  IN/              00271
   9 37H   TWO FORWARD ENGINES        CGEF   ,F11.1,4H  IN/              00272
   O 37H   ONE OR TWO AFT ENGINES     CGEA   ,F11.1,4H  IN/              00273
   A 37H   AUXILIARY POWER UNIT       CGAP   ,F11.1,4H  IN/              00274
   B 37H   AVIONICS GROUP             CGAV   ,F11.1,4H  IN/              00275
   C 37H   FLIGHT CREW                CGCR   ,F11.1,4H  IN/              00276
   D 37H   PASSENGERS                 CGP    ,F11.1,4H  IN/              00277
   E 37H   CARGO IN WING              CGCW   ,F11.1,4H  IN/              00278
   F 37H   CARGO IN FUSELAGE          CGCF   ,F11.1,4H  IN/              00279
   G 37H   FUSELAGE FUEL              CGZWF  ,F11.1,4H  IN/              00280
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   H 37H   WING FUEL                    CGFWF  ,F11.1,4H  IN)          00281
    IF(INERTIA.EQ.0)GO TO 350                                           00282
    WRITE(6,340)ZHT,ZVT,ZFIN,YFIN,ZEF,YEF,ZEA,YEA,ZBW,ZAP,ZRVT,YMLG,   00283
   1 YFUSE,YVERT,SWTFF                                                  00284
340 FORMAT(13H0INERTIA DATA/                                            00285
   1 37H   VERTICAL CG HORIZ TAIL      ZHT    ,F11.1,4H  IN/          00286
   2 37H   VERTICAL CG VERTICAL TAIL   ZVT    ,F11.1,4H  IN/          00287
   3 37H   VERTICAL CG WING VERT FIN   ZFIN   ,F11.1,4H  IN/          00288
   4 37H   LATERAL CG WING VERT FIN    YFIN   ,F11.1,4H  IN/          00289
   5 37H   VERT CG TWO FORWARD ENG     ZEF    ,F11.1,4H  IN/          00290
   6 37H   LAT CG TWO FORWARD ENGINES  YEF    ,F11.1,4H  IN/          00291
   7 37H   VERT CG AFT ENGINE(S)       ZEA    ,F11.1,4H  IN/          00292
   8 37H   LAT CG AFT ENGINE(S)        YEA    ,F11.1,4H  IN/          00293
   9 37H   LOWEST POINT WING ROOT      ZBW    ,F11.1,4H  IN/          00294
   O 37H   VERTICAL CG OF APU          ZAP    ,F11.1,4H  IN/          00295
   A 37H   BOTTOM OF VERTICAL TAIL     ZRVT   ,F11.1,4H  IN/          00296
   B 37H   LAT CG MAIN LANDING GEAR    YMLG   ,F11.1,4H  IN/          00297
   C 37H   LAT CG FOR MULTI-FUSELAGE   YFUSE  ,F11.1,4H  IN/          00298
   D 37H   LAT CG FOR MULTI-VERT TAIL  YVERT  ,F11.1,4H  IN/          00299
   E 37H   GROSS FUSELAGE WETTED AREA  SWTFF  ,F11.1,7H  SQ FT)       00300
    IF(NTANK.EQ.0)GO TO 350                                             00301
    WRITE(6,20)                                                         00302
 20 FORMAT(/6H  TANK,8X,1HX,10X,1HY,10X,1HZ,10X,1HL,10X,1HW,10X,1HD,    00303
   1 9X,2HF1,9X,2HF2,9X,2HF3/)                                          00304
    DO 30 I=1,NTANK                                                     00305
 30 WRITE(6,40)I,TX(I),TY(I),TZ(I),TL(I),TW(I),TD(I),(TF(I,J),          00306
   1 J=1,NFCON)                                                         00307
 40 FORMAT(I5,9F11.1)                                                   00308
350 WRITE(6,360)DESRNG,WSR,TWR,PGLOV,HTVC,VTVC,ICOST                   00309
360 FORMAT(//38H0CONFIGURATION DATA (NAMELIST $CONFIN)/                 00310
   1 14H0  DESCRIPTION,16X,4HNAME,9X,17HVALUE  DIMENSIONS//             00311
   2 37H   DESIGN RANGE                DESRNG ,F11.1,6H  N MI/         00312
   3 37H   WING LOADING REQUIRED       WSR    ,F11.2/                  00313
   4 37H   THRUST/WEIGHT REQUIRED      TWR    ,F11.5/                  00314
   4 37H   GLOVE/WING AREA REQUIRED    PGLOV  ,F11.5/                  00315
   5 37H   HORIZ TAIL VOLUME COEF      HTVC   ,F11.6/                  00316
   6 37H   VERT TAIL VOLUME COEF       VTVC   ,F11.6/                  00317
   7 37H   COST CALCULATION SWITCH     ICOST  ,I11)                    00318
    WRITE(6,370)OFG,OFF,OFM,OFR,OFC                                     00319
370 FORMAT(33H0FUNCTION TO BE OPTIMIZED - OBJ =,F10.5,                  00320
   1 16H*(RAMP WEIGHT) +,F10.5,7H*FUEL +,F10.5,13H*MACH*(L/D) +,        00321
   2 F10.5,8H*RANGE +,F10.5,5H*COST)                                    00322
    WRITE(6,380)((DVD(I,J),I=1,5),J=1,9)                                00323
380 FORMAT(/21H0DESIGN VARIABLE DATA/11H0  VARIABLE,18X,4HNAME,7X,      00324
   1 55HVALUE  ACTIVITY  LOWER BOUND  UPPER BOUND  SCALE FACTOR//       00325
   2 35H   RAMP WEIGHT, LBF            GW     ,F11.1,F6.0,2X,2F13.1,F14.500326
   3/35H   WING ASPECT RATIO           AR     ,F11.4,F6.0,2X,2F13.4,F14.500327
   4/35H   THRUST PER ENGINE, LBF      THRUST,F11.1,F6.0,2X,2F13.3,F14.500328
   5/35H   REF WING AREA, SQ FT        SW     ,F11.1,F6.0,2X,2F13.1,F14.500329
   6/35H   WING TAPER RATIO            TR     ,F11.5,F6.0,2X,2F13.5,F14.500330
   7/35H   WING 1/4 CHORD SWEEP, DEG   SWEEP ,F11.2,F6.0,2X,2F13.2,F14.500331
   8/35H   WING T/C                    TCA    ,F11.5,F6.0,2X,2F13.5,F14.500332
   9/21H   CRUISE MACH NUMBER,8X,6HVCMN  ,F11.5,F6.0,2X,2F13.5,F14.5   00333
   O/31H   MAX CRUISE ALTITUDE, FT    CH,F15.1,F6.0,2X,2F13.1,F14.5)   00334
    IF(DVD(2,10).GT.0.)WRITE(6,390)(DVD(I,10),I=1,5)                    00335
390 FORMAT(                                                             00336
   A 22H   WING STRUCT WT, LBF,7X,6HWWSTR ,F11.1,F6.0,2X,2F13.1,F14.5)00337
    WRITE(6,400)MYAERO,IWAVE,INENG,NFUSE,NVERT,CAM,SBASE,AMODE,AITEK,   00338
   1MODAERO,XLLAM                                                       00339
400 FORMAT(//35H0AERODYNAMIC DATA (NAMELIST $AERIN)/                    00340
   1 14H0  DESCRIPTION,16X,4HNAME,7X,18H VALUE  DIMENSIONS//            00341
   1 37H   AERODYNAMIC INPUT METHOD    MYAERO ,I11/                    00342
   2 37H   WAVE DRAG INPUT             IWAVE  ,I11/                    00343
   3 37H   READ ENGINE DECK SWITCH     INENG  ,I11/                    00344
   3 37H   NUMBER OF FUSELAGES         NFUSE  ,I11/                    00345
   4 37H   NUMBER OF VERTICAL TAILS    NVERT  ,I11/                    00346
   5 37H   MAX CAMBER AT 70 PERCENT           /                        00347
   6 37H    SEMISPAN                   CAM    ,F11.5,14H PERCENT CHORD/00348
   7 37H   AIRCRAFT BASE AREA          SBASE  ,F11.1,7H  SQ FT/        00349
   8 37H   WIND TUNNEL/FLIGHT VEHICLE  AMODE  ,F11.1/                  00350
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   9 37H    WING TECHNOLOGY              AITEK  ,F11.1/                    00351
   1 37H    MODIFY EDET DATA             MODAERO,I11/                      00352
   2 37H    TURBULENT/LAMINAR FLOW       XLLAM  ,F11.1)                    00353
    IF(XLLAM.EQ.1.)WRITE(6,410)TRUW,TRLW,TRUH,TRLH,TRUV,TRLV,TRUB,TRLB00354
   1,TRUN,TRLN                                                           00355
410 FORMAT(37H   LF WING UPPER SURFACE      TRUW   ,F11.4,9H  PERCENT/00356
   1 37H    LF WING LOWER SURFACE        TRLW   ,F11.4,9H  PERCENT/      00357
   1 37H    LF HOR. TAIL UPPER SURFACE   TRUH   ,F11.4,9H  PERCENT/      00358
   2 37H    LF HOR. TAIL LOWER SURFACE   TRLH   ,F11.4,9H  PERCENT/      00359
   3 37H    LF VRT. TAIL UPPER SURFACE   TRUV   ,F11.4,9H  PERCENT/      00360
   4 37H    LF VRT. TAIL LOWER SURFACE   TRLV   ,F11.4,9H  PERCENT/      00361
   5 37H    LF FUSELAGE UPPER SURFACE    TRUB   ,F11.4,9H  PERCENT/      00362
   6 37H    LF FUSELAGE LOWER SURFACE    TRLB   ,F11.4,9H  PERCENT/      00363
   5 37H    LF NACELLE UPPER SURFACE     TRUN   ,F11.4,9H  PERCENT/      00364
   6 37H    LF NACELLE LOWER SURFACE     TRLN   ,F11.4,9H  PERCENT)      00365
    WRITE(6,420)E                                                        00366
420 FORMAT(37H   AERO EFFICIENCY FACTOR      E      ,F11.1)              00367
    WRITE(6,430)SWETW,SWETH,SWETV,SWETF,SWETN                            00368
430 FORMAT(37H0OVERRIDE PARAMETERS FOR WETTED AREAS/                     00369
   1 37H    WING WETTED AREA             SWETW  ,F11.4/                  00370
   2 37H    HOR. TAIL WETTED AREA        SWETH  ,F11.4/                  00371
   3 37H    VERT. TAIL WETTED AREA       SWETV  ,F11.4/                  00372
   4 37H    FUSELAGE WETTED AREA         SWETF  ,F11.4/                  00373
   5 37H    NACELLE WETTED AREA          SWETN  ,F11.4)                  00374
    WRITE(6,440)WRATIO,VAPPR,FLTO,FLLDG,ITAKOFF,ILAND,CLTOM,CLLDM,      00375
   1CLAPP,DRATIO,ELODSS,ELODMA,THROFF,THRSS,THRMA                        00376
440 FORMAT(25H0TAKEOFF AND LANDING DATA/                                 00377
   1 37H    RATIO OF MAX. LANDING WT.    /                              00378
   2 37H    MAX. TAKE OFF WT.            WRATIO ,F11.4/                  00379
   3 37H    MAX. LANDING VELOCITY        VAPPR  ,F11.4,5H  KTS/          00380
   4 37H    MAX. TAKEOFF FIELD LENGTH    FLTO   ,F11.1,4H  FT/           00381
   5 37H    MAX. LANDING FIELD LENGTH    FLLDG  ,F11.1,4H  FT/           00382
   6 37H    DETAILED TAKEOFF             ITAKOFF,I11/                    00383
   7 37H    DETAILED LANDING             ILAND  ,I11/                    00384
   8 37H    MAX. CL TAKEOFF CONFIG.      CLTOM  ,F11.4/                  00385
   9 37H    MAX. CL LANDING CONFIG.      CLLDM  ,F11.4/                  00386
   1 37H    APPROACH CL                  CLAPP  ,F11.4/                  00387
   2 37H    AIR DENSITY RATIO            DRATIO ,F11.4/                  00388
   3 37H    L/D RATIO 2ND SEG. CLIMB     ELODSS ,F11.4/                  00389
   4 37H    L/D RATIO MISSED APPROACH    ELODMA ,F11.4/                  00390
   4 37H    THRUST PER ENGINE-TAKEOFF    THROFF ,F11.1,5H  LBF/          00391
   6 37H        -SECOND SEGMENT CLIMB    THRSS  ,F11.1,5H  LBF/          00392
   8 37H        -MISSED APPROACH         THRMA  ,F11.1,5H  LBF/)         00393
    IF(NTANK.LE.0)NTANK=1                                                00394
    IF(NFCON.LE.0)NFCON=1                                                00395
    IF(MODAERO.EQ.1)CALL AERORID                                         00396
    XD=(WF+DF)/2.                                                        00397
    BL=XL                                                                00398
    SWPHT=SWPHT/57.296                                                   00399
    SWPVT=SWPVT/57.296                                                   00400
    SWPFIN=SWPFIN/57.296                                                 00401
    SWPCAN=SWPCAN/57.296                                                 00402
    DIH=DIH/57.296                                                       00403
    DO 120 I=1,12                                                        00404
120 DVA(I)=DVD(1,I)                                                      00405
    IF(ICOST.EQ.1)CALL RDCOST                                            00406
    IF(PLIM.EQ.4H    )INENG=1                                            00407
    IF(INENG.GT.0)CALL DEFENG                                            00408
    IF(PLIM.EQ.4H    )CALL DEFMSS(NEW,NEF)                               00409
    IF(PLIM.NE.4H    .AND.PLIM.NE.4HAERO)GO TO 180                       00410
    IF(MYAERO.GT.0)CALL DEFAER(IWAVE,IBO,MYAERO)                         00411
180 IF(ITAKOFF.EQ.1.OR.ILAND.EQ.1)CALL DEFTOL(AR(1),SW(1),CLTOM,CLLDM)00412
    IF(WSR.LT.0.)SW(1)=-WSR                                              00413
    IF(TWR.LT.0.)THRUST(1)=-TWR*(NEW+NEF)                                00414
    J=0                                                                  00415
    DO 100 I=1,12                                                        00416
    DVA(I)=DVD(1,I)                                                      00417
    AK(I)=DVD(2,I)                                                       00418
    IF(AK(I).LE.0.)GO TO 100                                             00419
    J=J+1                                                                00420
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      X(J)=DVD(1,I)                                                    00421
      VLB(J)=DVD(3,I)                                                  00422
      VUB(J)=DVD(4,I)                                                  00423
      SCAL(J)=DVD(5,I)                                                 00424
  100 CONTINUE                                                         00425
      NDV=J                                                            00426
      RETURN                                                           00427
      END                                                              00428
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      SUBROUTINE WEIGHT(IPRNT)                                          00429
      COMMON/THUMB/THOBJ(49),THOFF(49),THLDG(49),THSSG(49),THMAP(49),   00430
     1 THVAP(49),THSW(49),THEXF(49),ITH                                 00431
      COMMON/COSTCON/ICOST,OFC                                          00432
      COMMON/COSTDAT/VWTS(25),NENGV,VSM,VTHR,VDU(6),NSV,VTGD,NCRV,      00433
     1 WLDGV,FUELV,CARV,SWV,COST                                        00434
      COMMON/ININ/NTANK,NFCON,SWTFF,YMLG,TX(40),TY(40),TZ(40),          00435
     1 TL(40),TW(40),TD(40),TF(40,3)                                    00436
      COMMON/XLAM/XLLAM,TRUW,TRLW,TRUH,TRLH,TRUV,TRLV,TRUB,TRLB         00437
     1,NFUSE,NVERT,TRUN,TRLN                                            00438
      COMMON/UPFUEL/IFUFU,NWREF,CGREFX,CGREFL,SWRAT,VARSWP              00439
      COMMON/VLIMIT/VCMN,VMMO                                           00440
      COMMON/ESB/RAMPWT,DOWE,PAYLOAD,ZFUEL,MYWTS,D(7)                   00441
      COMMON/SYNT/DD(7),JECT,DA(4)                                      00442
      COMMON/CONFIG/GW,AR,THRUST,SXP,TR,SWEEP,TCA,VCMX,CH,WWSTX,        00443
     1 DUMV1,DUMV2,DESRNG                                               00444
      COMMON/INI/CI(5),TI(5),CO(5),TO(5),BS(5),CONH,CONHM               00445
     1,CENG,CONA1,CONA2,CONF2,FUELF,FUELW,NENG,RNI,WCANC,WLGM,WTCANM,    00446
     2WTFINM,WTHTC,WTHTCM,WTVTC,WTVTCM,YCAN,YHT,YW,ZW,ZBFIN,ZBVT        00447
     3,ZMFC,WTFC,WTFCM,WTWC,WTWCM,WTNFC,WTNFCM,WTNAC,WTNACM,WFINC       00448
      COMMON/WTS/CGSP(40,2),WSP(40,2),FLAPR,FCOMP,FAERT,FLAPC,          00449
     1FSTRT,DGW,ULF,TCR,TCB,TCT,PCTB,DIH,                               00450
     1SWPHT,SWPVT,SFIN,ARFIN,TRFIN,TCFIN,SWPFIN,NFIN,SCAN,SWPCAN,       00451
     2ARCAN,TRCAN,TCCAN,VCAN,XL,WF,DF,CARGF,INERTIA,FUELWMX,            00452
     3FUELFMX,CARGOW,CARGOF,PCTR,XMLG,XNLG,WLDG,XLP,ZRVT,FRWI,          00453
     5FRHT,FRVT,FRFIN,FRCAN,FRFU,FRLGN,FRLGM,FRNA,FRSC,YFUSE,YVERT,     00454
     6NPF,NPT,CGLGN,CGLGM,CGEF,CGEA,NSTU,NGALC,NFLCR,CONDEN,HYDPR,      00455
     1CGCW,CGCF,CGZWF,CGFWF,ZHT,ZVT,ZFIN,YFIN,ZEF,YEF,ZEA,YEA,ZBW,ZAP   00456
      COMMON/EDETIN/CAM,SBASE,BL,XD,AMODE,AITEK,SHT,TCHT,SVT,           00457
     1 TCVT,ARHT,ARVT,XNAC,DNAC,NEW,NEF,TRHT,TRVT,HHT,GLOV              00458
      COMMON/MISWT/OTHR,OIN,OHYD,OELEC,OAVONC,OFURN,OAC,OAPU,OAI,EEXP,  00459
     1 OENG,THRSO,FWMAX,WRATIO,OCON,OUF,OOIL,OPMSC,OFSYS,OSRV           00460
      EQUIVALENCE (CGW,CGSP(1,2)),(CGHT,CGSP(2,2)),(CGVT,CGSP(3,2)),    00461
     1(CGFIN,CGSP(4,2)),(CGCAN,CGSP(5,2)),(CGF,CGSP(6,2)),              00462
     2(CGLG,CGSP(7,2)),(CGN,CGSP(8,2)),(CGSTRUC,CGSP(9,2)),             00463
     3(CGTHR,CGSP(11,2)),(CGMS,CGSP(12,2)),          (CGPRO,CGSP(15,2)),00464
     4(CGSC,CGSP(16,2)),(CGAP,CGSP(17,2)),(CGIN,CGSP(18,2)),(CGHYD,CGSP 00465
     5(19,2)),(CGEL,CGSP(20,2)),(CGAV,CGSP(21,2)),(CGFRN,CGSP(22,2)),   00466
     6(CGAC,CGSP(23,2)),(CGAI,CGSP(24,2)),(CGSYS,CGSP(25,2)),(CGWE,CGSP 00467
     7(26,2)),(CGCR,CGSP(27,2)),                                        00468
     8(CGOWE,CGSP(33,2)),(CGZF,CGSP(37,2)),(CGFM,CGSP(38,2)),(CGWGW,    00469
     9CGSP(39,2))                                                       00470
      EQUIVALENCE (CGE,CGSP(10,2)),(CGP,CGSP(28,2)),(CGC,CGSP(32,2)),   00471
     1(CGFSYS,CGSP(13,2))                                               00472
      EQUIVALENCE (WSP(1,2),WWING),(WSP(2,2),WHT),(WSP(3,2),WVT),       00473
     1(WSP(4,2),WFIN),(WSP(5,2),WCAN),(WSP(6,2),WFUSE),(WSP(7,2),WLG),  00474
     2(WSP(8,2),WNAC),(WSP(9,2),WSTRUCT),(WSP(10,2),WENG),(WSP(11,2),   00475
     3WTHR),(WSP(12,2),WPMSC),(WSP(13,2),WFSYS),                        00476
     4(WSP(15,2),WPRO),(WSP(16,2),WSC),(WSP(17,2),WAPU),(WSP(18,2),WIN),00477
     5(WSP(19,2),WHYD),(WSP(20,2),WELEC),(WSP(21,2),WAVONC),(WSP(22,2), 00478
     6WFURN),(WSP(23,2),WAC),(WSP(24,2),WAI),(WSP(25,2),WSYS),(WSP(26,2)00479
     7,WWE),(WSP(27,2),WFLCRAB),(WSP(28,2),WSTUAB),(WSP(29,2),WUF),     00480
     8(WSP(30,2),WOIL),(WSP(31,2),WSRV),(WSP(32,2),WCON),(WSP(33,2),WOWE00481
     9),(WSP(34,2),WPASS),(WSP(35,2),WPBAG),(WSP(36,2),WCARGO),         00482
     1(WSP(37,2),WZF),(WSP(38,2),FUELM),(WSP(39,2),WGW)                 00483
      REAL NENG,NNAC                                                    00484
      DATA FYEF,FYEA/2*0./,TMLG,TNLG,FUFU/3*-1./                        00485
      IF(TMLG.LT.0.)TMLG=XMLG                                           00486
      IF(TNLG.LT.0.)TNLG=XNLG                                           00487
      XMLG=TMLG                                                         00488
      XNLG=TNLG                                                         00489
      DG=DGW                                                            00490
      IF(DGW.LT.5) DG=DGW*GW                                            00491
      IF(DGW.LE.0) DG=GW                                                00492
      NPASS=NPF+NPT                                                     00493
      SX=SXP*SWRAT                                                      00494
      SW=SX-GLOV                                                        00495
      NENG=NEW+NEF                                                      00496
      B=SQRT(AR*SW)                                                     00497
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      IF(FUFU.GE.0..AND.IFUFU.EQ.1)FUELFMX=FUFU                          00498
      FUELWMX=FWMAX*SW*B*TCA/AR                                          00499
      FUELMX=FUELWMX+FUELFMX                                             00500
      IF(NSTU.GE.0)GO TO 9                                               00501
      NSTU=NPASS/40+1                                                    00502
      IF(NPASS.LT.51)NSTU=1                                              00503
    9 IF(NGALC.GE.0)GO TO 10                                             00504
      NGALC=NPASS/250+1                                                  00505
      IF(NPASS.LT.151)NGALC=0                                            00506
   10 IF(NFLCR.GE.0)GO TO 15                                             00507
      NFLCR=3                                                            00508
      IF(NPASS.LT.151)NFLCR=2                                            00509
   15 NCABCR=NSTU+NGALC                                                  00510
      WFLCRAB=NFLCR*225.                                                 00511
      WSTUAB=NSTU*155.+NGALC*200.                                        00512
      WSRV=(5.164*NPF+2.529*NPT)*(DESRNG/VCMN)**.225                     00513
      CALL ORIDE(WSRV,OSRV)                                              00514
      WPASS=NPASS*165.                                                   00515
      BPP=35.                                                            00516
      IF(DESRNG.GT.900.)BPP=40.                                          00517
      IF(DESRNG.GT.2900.)BPP=44.                                         00518
      WPBAG=NPASS*BPP                                                    00519
      WCARGO=CARGOW+CARGOF                                               00520
      CGC=CGCF                                                           00521
      IF(WCARGO.GT.0.)CGC=(CGCW*CARGOW+CGCF*CARGOF)/WCARGO               00522
      CGPBAG=CGCF                                                        00523
      FUELM=FUELMX                                                       00524
      NCON=(WCARGO+WPBAG)/950.+.99                                       00525
      WCON=NCON*175.                                                     00526
      CALL ORIDE(WCON,OCON)                                              00527
      WUF=(.8*NTANK**.52+.69*NEF)*XL**1.13                               00528
      CALL ORIDE(WUF,OUF)                                                00529
      WOIL=(20.+.00216*THRUST)*NENG                                      00530
      CALL ORIDE(WOIL,OOIL)                                              00531
      XXE=NENG/2.                                                        00532
      NXE=NENG/2.                                                        00533
      CENG=1.                                                            00534
      IF(XXE.LE.NXE)CENG=0.                                              00535
      TAND=TAN(DIH)                                                      00536
      RNI=6.*DNAC                                                        00537
      WFI=12.*WF                                                         00538
      WFIO2=WFI/2.                                                       00539
      DFI=12.*DF                                                         00540
      BS(1)=B*6.                                                         00541
      IF(FYEF.GT.0.)GO TO 32                                             00542
      FYEF=YEF                                                           00543
      IF(FYEF.LE.0.)FYEF=.4                                              00544
      IF(YEF.GT.1.)FYEF=.4*YEF/(WFIO2+RNI)                               00545
      IF(YEF.GT.1..AND.NEW.GT.0)FYEF=YEF/BS(1)                           00546
   32 YEF=FYEF*2.5*(WFIO2+RNI)                                           00547
      IF(NEW.GT.0.)YEF=FYEF*BS(1)                                        00548
      IF(FYEA.GT.0.)GO TO 38                                             00549
      FYEA=YEA                                                           00550
      IF(FYEA.LE.0.)FYEA=.7                                              00551
      IF(YEA.GT.1.)FYEA=.7*YEA/(WFIO2+RNI)                               00552
      IF(YEA.GT.1..AND.NEW.GT.2)FYEA=YEA/BS(1)                           00553
   38 YEA=FYEA*(WFIO2+RNI)/.7                                            00554
      IF(NEW.GT.2)YEA=FYEA*BS(1)                                         00555
      YEA=(1.-CENG)*YEA                                                  00556
      IF(ZRVT.LE.0.)ZRVT=DFI                                             00557
      ZBVT=DFI+CENG*RNI/2.                                               00558
      IF(ZEF.NE.0.)GO TO 47                                              00559
      ZEF=DFI/2.                                                         00560
      IF(NEW.GT.0)ZEF=ZBW+TAND*YEF-3.*RNI                                00561
   47 IF(ZEA.NE.0.)GO TO 52                                              00562
      ZEA=DFI/2.                                                         00563
      IF(NEW.GT.2)ZEA=ZBW+TAND*YEA-3.*RNI                                00564
   52 CI(1)=144.*SW/(BS(1)*(1.+TR))                                      00565
      CO(1)=TR*CI(1)                                                     00566
      TI(1)=CI(1)*TCR                                                    00567
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      TO(1)=CO(1)*TCT                                                   00568
      BS(2)=SQRT(ARHT*SHT)*6.+.001                                      00569
      CI(2)=144.*SHT/(BS(2)*(1.+TRHT))                                  00570
      CO(2)=TRHT*CI(2)                                                  00571
      TI(2)=.11*CI(2)                                                   00572
      TO(2)=.09*CO(2)                                                   00573
      BSVI=SQRT(ARVT*SVT)*12.+.001                                      00574
      CIVI=288.*SVT/(BSVI*(1.+TRVT))                                    00575
      CO(3)=TRVT*CIVI                                                   00576
      TO(3)=.09*CO(3)                                                   00577
      DELVT=ZBVT-ZRVT                                                   00578
      BS(3)=BSVI-DELVT                                                  00579
      CI(3)=CIVI-DELVT*(CIVI-CO(3))/BSVI                                00580
      TI(3)=.11*CI(3)                                                   00581
      SVADJ=SVT-DELVT*(CI(3)+CIVI)/288.                                 00582
      BS(4)=SQRT(ARFIN*SFIN)*12.+.001                                   00583
      CI(4)=288.*SFIN/(BS(4)*(1.+TRFIN))                                00584
      CO(4)=TRFIN*CI(4)                                                 00585
      TO(4)=.09*CO(4)                                                   00586
      TI(4)=.11*CI(4)                                                   00587
      BS(5)=SQRT(ARCAN*SCAN)*6.+.001                                    00588
      CI(5)=144.*SCAN/(BS(5)*(1.+TRCAN))                                00589
      CO(5)=TRCAN*CI(5)                                                 00590
      TI(5)=CI(5)*.11                                                   00591
      TO(5)=CO(5)*.09                                                   00592
      IF(YFIN.LE.0.)YFIN=.70*BS(1)                                      00593
      ZBFIN=ZBW+TAND*YFIN                                               00594
      ICNT=1                                                            00595
   55 ARI=CI(ICNT)*TI(ICNT)                                             00596
      ARO=CO(ICNT)*TO(ICNT)                                             00597
      ARM=ARI+ARO+CI(ICNT)*TO(ICNT)+CO(ICNT)*TI(ICNT)                   00598
      YZBAR=BS(ICNT)*(ARO+ARM/2.)/(ARI+ARO+ARM+.001)                    00599
      GO TO (58,59,60,602,605),ICNT                                     00600
   58 YW=YZBAR                                                          00601
      ICNT=2                                                            00602
      GO TO 55                                                          00603
   59 YHT=YZBAR                                                         00604
      ICNT=3                                                            00605
      GO TO 55                                                          00606
   60 CKVT=1.427+.92*HHT                                                00607
      ZBAR=(.67*HHT*BS(3)*(CKVT-1.427)+1.427*YZBAR)/CKVT                00608
      IF(ZVT.GT.0.)ZBVT=ZVT-ZBAR                                        00609
      IF(ZVT.LE.0.)ZVT=ZBVT+ZBAR                                        00610
      ICNT=4                                                            00611
      GO TO 55                                                          00612
  602 IF(ZFIN.GT.0.)ZBFIN=ZFIN-YZBAR                                    00613
      IF(ZFIN.LE.0.)ZFIN=ZBFIN+YZBAR                                    00614
      ICNT=5                                                            00615
      GO TO 55                                                          00616
  605 YCAN=0.                                                           00617
      IF(SCAN.GE.1.) YCAN=YZBAR                                         00618
      TDEL=(TI(1)-YW*(TI(1)-TO(1))/BS(1))/2.                            00619
      ZW=ZBW+TAND*YW+TDEL                                               00620
      WLDG=GW*WRATIO                                                    00621
      IF(XMLG.GT.0.)GO TO 76                                            00622
      IF(NEW.GT.0)XMLG=12.*DNAC+(.26-TAND)*(YEF-WFIO2)                  00623
      IF(XMLG.LT.12.)XMLG=.75*XL                                        00624
   76 IF(XNLG.LE.0.)XNLG=.7*XMLG                                        00625
      WLGM=.0116*WLDG**.95*XMLG**.431                                   00626
      WLGN=.0279*WLDG**.835*XNLG**.125                                  00627
      CALL ORIDE(WLGN,FRLGN)                                            00628
      CALL ORIDE(WLGM,FRLGM)                                            00629
      WLG=WLGN+WLGM                                                     00630
      CGLG=(WLGN*CGLGN+WLGM*CGLGM)/WLG                                  00631
      CONH=.5*WLGN/WLG                                                  00632
      CONHM=.5-CONH                                                     00633
      NNAC=NENG+CENG*0.5                                                00634
        WNAC=.2*NNAC*DNAC**.6*XNAC**.873*THRUST**.495                   00635
      CALL ORIDE(WNAC,FRNA)                                             00636
       WHT=.225*SHT**.88*DG**.275*ARHT**.15*(1.+TRHT)                   00637
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      CALL ORIDE(WHT,FRHT)                                              00638
      WVT=(.2342*DG**.42*SVT**.54*ARVT**.84*TRVT**.9*NVERT)/            00639
     1  (TCVT**.25*(COS(SWPVT))**2)                                     00640
      CALL ORIDE(WVT,FRVT)                                              00641
      WFIN=(.565*DG**.38*SFIN**.5*ARFIN**.8*TRFIN*NFIN)/(TCFIN**.3      00642
     1 *COS(SWPFIN))                                                   00643
      CALL ORIDE(WFIN,FRFIN)                                            00644
      WCAN=0.                                                           00645
      IF(SCAN.GE.1.0)                                                   00646
     1 WCAN=(.0048*(DG*ULF*ARCAN)**.5*SCAN**.7*(1.+TRCAN)**.4/          00647
     1  (COS(SWPCAN)**1.6*TCCAN**.4))*(1.+.15*VCAN)                     00648
      CALL ORIDE(WCAN,FRCAN)                                            00649
      WENG=OENG*(THRUST/THRSO)**EEXP                                    00650
      IF(EEXP.LE..3)WENG=OENG+(THRUST-THRSO)*EEXP                       00651
      OENG=WENG                                                         00652
      WENG=WENG*NENG                                                    00653
      WTHR=.0063*THRUST**1.16*NENG                                      00654
      CALL ORIDE(WTHR,OTHR)                                             00655
      WFUSE=1.35*(XL*((WF+DF)/2))**1.28*(1.+.05*NEF)*(1.+.38*CARGF)*    00656
     1 NFUSE                                                           00657
      CALL ORIDE(WFUSE,FRFU)                                            00658
      C1=1.-.40*FCOMP                                                   00659
      C2=1.-.17*FCOMP                                                   00660
      C3=1.-.30*FCOMP                                                   00661
      C4=1.-.50*FAERT                                                   00662
      C5=1.-.10*FAERT                                                   00663
      CAYA=AR-5.                                                        00664
      IF(CAYA.LT.0.)CAYA=0.                                             00665
      CAYF=1.                                                           00666
      IF(NFUSE.GT.1)CAYF=.5                                             00667
      TLX=TAN((SWEEP-5.)/57.296)-(2.*(1.-TR))/((1.+TR)*AR)              00668
      SL=TLX/SQRT(1.+TLX**2)                                            00669
      CAYL=1.-SL**2+.03*CAYA*SL*C4                                      00670
      CAY=(1.8E-6)*C1*C5*CAYF*(1.+.166*VARSWP)                          00671
      WWING=(CAY*DG*ULF*B**3*(.375+.7*TR))/(TCA*CAYL*SX)                00672
     1 +1.15*(SX*FLAPR)**.56*DG**.46*C2*FLAPC*(1.+.118*VARSWP)          00673
     2 +.235*SX**1.17*C3                                               00674
      CALL ORIDE(WWING,FRWI)                                            00675
      WFSYS=2.275*FUELMX**.463*NTANK**.2*NENG**.587*VCMN**.291          00676
      CALL ORIDE(WFSYS,OFSYS)                                           00677
      WEC=58*NEF+145*NEW                                                00678
      WSTART=.004*THRUST*NENG                                           00679
      WPMSC=WEC+WSTART                                                  00680
      WPX=WPMSC                                                         00681
      CALL ORIDE(WPMSC,OPMSC)                                           00682
      WEC=WEC*WPMSC/WPX                                                 00683
      WSTART=WSTART*WPMSC/WPX                                           00684
      WPRO=WENG+WTHR+WPMSC+WFSYS                                        00685
      WSC=.9136*VCMN**.52*SX**.225*DG**.57*FLAPR**.55*(1.+.134*VARSWP)  00686
      CALL ORIDE(WSC,FRSC)                                              00687
      ELF=2.5                                                           00688
      IF(NEW.EQ.0)ELF=2.0                                               00689
      IF(NEF.EQ.0)ELF=1.5                                               00690
      WHYD=0.04*VCMN**.444*DG**.78*B**.2*(3000/HYDPR)**.354             00691
     1 *(1.+.186*VARSWP)                                               00692
      CALL ORIDE(WHYD,OHYD)                                             00693
      WAVONC=20.785*DESRNG**.064*NFLCR**1.24*DG**.226                   00694
      CALL ORIDE(WAVONC,OAVONC)                                         00695
      WELEC=6.887*(XL+B)**.866*NENG**.45*ELF                            00696
      CALL ORIDE(WELEC,OELEC)                                           00697
      WIN=2.176*VCMN**1.38*ELF**.77*FLAPR**.66*B**1.33                  00698
      CALL ORIDE(WIN,OIN)                                               00699
      IF(XLP.EQ.0.)  XLP=.6085*XL*(ATAN(XL/59.))**1.1                   00700
      FINSL=1.                                                          00701
      IF(VCMN.GT.1.)FINSL=VCMN**.142                                    00702
      WFURN=250.*NFLCR+70.*NPF+44.*NPT+2.57*XLP*(WF+DF)*FINSL           00703
      CALL ORIDE(WFURN,OFURN)                                           00704
      WAC=0.05*WAVONC+1.435*XL**.98*XLP**.53*VCMN**.235                 00705
      CALL ORIDE(WAC,OAC)                                               00706
      WAPU=1.12*NFUSE*(DG/NFUSE)**.55                                   00707
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      CALL ORIDE(WAPU,OAPU)                                                     00708
      EAI=0.5                                                                   00709
      IF( NEW .EQ. 0 ) EAI=1.0                                                  00710
      IF( NEF .EQ. 0 ) EAI=0.0                                                  00711
      WAI=.374*B**1.18+3.*DNAC*NENG+.02*EAI*XL**2                               00712
      CALL ORIDE(WAI,OAI)                                                       00713
      WSYS=WSC+WAPU+WIN+WHYD+WELEC+WAVONC+WFURN+WAC+WAI                         00714
      CONF1=2./NNAC                                                             00715
      IF(NNAC.LT.2.)CONF1=1.                                                    00716
      CONF2=2./NENG                                                             00717
      IF(NENG.LT.2)CONF2=1.                                                     00718
      CONA1=1.-CONF1                                                            00719
      CONA2=1.-CONF2                                                            00720
      CGN=CONF1*CGEF+CONA1*CGEA                                                 00721
      CGE=CONF2*CGEF+CONA2*CGEA                                                 00722
      CGTHR=CGE+6.*XNAC                                                         00723
      CON1=.05*NEF/NENG+FUELFMX/FUELMX                                          00724
      CON2=.25                                                                  00725
      CON3=1.-CON1-CON2                                                         00726
      CGFL1=CGEA                                                                00727
      IF(NEW.EQ.0)CGFL1=CGEF                                                    00728
      CGFL1=CON1*(CGFL1*NEF/2.+CGZWF)/(1.+NEF/2.)                               00729
      CGFL3=CON3*(CGFWF*FUELWMX+CGZWF*FUELFMX)/FUELMX                           00730
      CGFSYS=CGFL1+.25*CGE+CGFL3                                                00731
      CGMS=0.                                                                   00732
      IF(WEC+WSTART.GT.0.)                                                      00733
     +CGMS=(WSTART*CGE+WEC*(CGCR+CGE)/2.)/(WEC+WSTART)                          00734
      CGPRO=(WENG*CGE+WTHR*CGTHR+WPMSC*CGMS+WFSYS*CGFSYS)                       00735
     1/WPRO                                                                     00736
      CGSC=.09*CGF+.62*CGW+.18*CGHT+.11*CGVT                                    00737
      CGIN=.6*CGCR+.16*CGF+.12*CGW+.01*CGVT+.11*CGE                             00738
      CGHYD=.5*CGLG+.32*CGF+.05*CGW+.13*CGE                                     00739
      CGEL=.5*CGCR+.35*CGF+.02*CGW+.13*CGE                                      00740
      IF(CGAV.EQ.0.)CGAV=.6*CGCR+.35*CGF+.05*CGVT                               00741
      CGFRN=.05*CGCR+.95*CGP                                                    00742
      CGAC=.05*CGCR+.8*CGP+.15*CGAP                                             00743
      CGAI=.12*CGCR+.08*CGVT+.15*CGHT+.65*CGW                                   00744
      CGSYS=(WSC*CGSC+WAPU*CGAP+WIN*CGIN+WHYD*CGHYD+WELEC*CGEL+WAVONC*CG00745
     1AV+WFURN*CGFRN+WAC*CGAC+WAI*CGAI)/WSYS                                    00746
      WTFC=WFUSE+WLGN+.09*WSC+CON1*WFSYS+.75*WEC+WAPU+.76*WIN+(.32+CONH)00747
     1*WHYD+.85*WELEC+WAVONC+WFURN+WAC+.12*WAI                                  00748
      WTFCM=CGF*(WFUSE+.09*WSC+.16*WIN+.32*WHYD+.35*WELEC)+.25*WEC*CGE  00749
     1+CGCR*(.5*WEC+.6*WIN+.5*WELEC+.12*WAI)+CGLGN*(WLGN+CONH*WHYD)     00750
     2+CGFL1*WFSYS+CGAP*WAPU+CGAV*WAVONC+CGFRN*WFURN+CGAC*WAC           00751
      WTWC=WWING+.62*WSC+.12*WIN+.05*WHYD+.02*WELEC+.65*WAI                     00752
      WTWCM=WTWC*CGW+WFSYS*CGFL3+(CONHM*WHYD+WLGM)*CGLGM                        00753
      WTWC=WTWC+WFSYS*CON3+CONHM*WHYD+WLGM                                      00754
      WTHTC=WHT+.18*WSC+.15*WAI                                                 00755
      WTHTCM=WTHTC*CGHT                                                         00756
      WTVTC=WVT+.11*WSC+.01*WIN+.08*WAI                                         00757
      WTVTCM=CGVT*WTVTC                                                         00758
      WFINC=WFIN                                                                00759
      WTFINM=WFINC*CGFIN                                                        00760
      WCANC=WCAN                                                                00761
      WTCANM=WCANC*CGCAN                                                        00762
      WTNFA=WENG+WTHR+WSTART+.25*WEC+.11*WIN+.13*WELEC+.13*WHYD                 00763
     1+CON2*WFSYS                                                               00764
      WTNFC=CONF2*WTNFA+CONF1*WNAC                                              00765
      WTNFCM=CONF2*(WTNFA*CGEF+6.*XNAC*WTHR)+CONF1*WNAC*CGEF                    00766
      WTNAC=CONA2*WTNFA+CONA1*WNAC                                              00767
      WTNACM=CONA2*(WTNFA*CGEA+6.*XNAC*WTHR)+CONA1*WNAC*CGEA                    00768
      WWE=WTFC+WTWC+WTHTC+WTVTC+WTNFC+WTNAC+WCANC+WFINC                         00769
      WWEM=WTFCM+WTWCM+WTHTCM+WTVTCM+WTNFCM+WTNACM+WTCANM+WTFINM                00770
      WOWE=WWE+WFLCRAB+WSTUAB+WUF+WOIL+WSRV+WCON                                00771
      WZF=WOWE+WPASS+WPBAG+CARGOW+CARGOF                                        00772
      FUELM=GW-WZF                                                              00773
      FUELW=FUELM                                                               00774
      IF(FUELW.GT.FUELWMX)FUELW=FUELWMX                                         00775
      FUELF=FUELM-FUELW                                                         00776
      CGFM=(CGZWF*FUELF+CGFWF*FUELW)/FUELM                                      00777
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      WOWEM=WWEM+CGCR*WFLCRAB+CGP*(WSTUAB+WSRV)+CGFM*WUF+CGE*W          00778
     1OIL+CGC*WCON                                                      00779
      WSTRUCT=WWING+WHT+WVT+WCAN+WFUSE+WLG+WNAC+WFIN                    00780
      CGSTRUC=(WWING*CGW+WHT*CGHT+WVT*CGVT+WCAN*CGCAN+WFUSE*CGF+WLG*CGLG00781
     1+WNAC*CGN+WFIN*CGFIN)/WSTRUCT                                     00782
      WZFM=WOWEM+CGP*WPASS+CGCF*WPBAG+CGC*(WCARGO)                      00783
      CGWE=WWEM/WWE                                                     00784
      CGOWE=WOWEM/WOWE                                                  00785
      CGZF=WZFM/WZF                                                     00786
      WGW=GW                                                            00787
      THEXF(ITH)=FUELMX-FUELM                                           00788
      IF(FUELM.GT.10.)GOTO 1744                                         00789
      JECT=1                                                            00790
      WRITE(6,1745)                                                     00791
 1745 FORMAT(29H NO WEIGHT AVAILABLE FOR FUEL)                          00792
      RETURN                                                            00793
 1744 CONTINUE                                                          00794
      ZFW=WZF                                                           00795
      RAMPWT=GW                                                         00796
      DOWE=WOWE                                                         00797
      PAYLOAD=ZFW-WOWE                                                  00798
      ZFUEL=FUELM                                                       00799
      IF(IFUFU.EQ.1)FUFU=FUELM-FUELWMX+WUF                              00800
      IF(FUFU.LT.0.)FUFU=0.                                             00801
      IF(ICOST.NE.1)GO TO 1750                                          00802
      VWTS(1)=WWING                                                     00803
      VWTS(2)=WHT                                                       00804
      VWTS(3)=WVT                                                       00805
      VWTS(4)=WFUSE                                                     00806
      VWTS(5)=WLG                                                       00807
      VWTS(9)=WNAC                                                      00808
      VWTS(10)=WTHR                                                     00809
      VWTS(11)=WFSYS                                                    00810
      VWTS(12)=WPMSC                                                    00811
      VWTS(13)=WSC                                                      00812
      VWTS(14)=WHYD                                                     00813
      VWTS(15)=WELEC                                                    00814
      VWTS(17)=WAC                                                      00815
      VWTS(18)=WAI                                                      00816
      VWTS(19)=WAPU                                                     00817
      VWTS(20)=WFURN                                                    00818
      VWTS(21)=WIN                                                      00819
      VWTS(23)=WAVONC                                                   00820
      VWTS(25)=WENG                                                     00821
      NENGV=NENG                                                        00822
      VTHR=THRUST                                                       00823
      NSV=NPASS                                                         00824
      NCRV=NFLCR                                                        00825
      WLDGV=WLDG                                                        00826
      FUELV=FUELMX                                                      00827
      CARV=WCARGO                                                       00828
      SWV=SXP                                                           00829
 1750 IF(IPRNT.EQ.0)RETURN                                              00830
      CGWGW=(WZFM+FUELM*CGFM)/WGW                                       00831
      CGSP(29,2)=CGFM                                                   00832
      CGSP(30,2)=CGE                                                    00833
      CGSP(14,2)=CGW                                                    00834
      CGSP(31,2)=CGP                                                    00835
      CGSP(34,2)=CGP                                                    00836
      CGSP(35,2)=CGPBAG                                                 00837
      CGSP(36,2)=CGC                                                    00838
      WRITE(6,189)                                                      00839
  189 FORMAT(1H1,3X,24HMASS AND BALANCE SUMMARY,18X,12HPERCENT WREF,    00840
     1 7X,6HPOUNDS,5X,28HPERCENT LREF  HORI CG-INCHES)                  00841
      DO 100 I=1,39                                                     00842
      WSP(I,1)=WSP(I,2)*100./WSP(NWREF,2)                               00843
      IF (WSP(I,1).EQ.0.0) GO TO 100                                    00844
      CGSP(I,1)=(CGSP(I,2)-CGREFX)*100./CGREFL                          00845
  100 CONTINUE                                                          00846
      WRITE(6,190) ((WSP(I,J),J=1,2),(CGSP(I,K),K=1,2),I=1,3)           00847
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      IF(WSP(4,2).GT.0)WRITE(6,390)(WSP(4,J),J=1,2),(CGSP(4,K),K=1,2)    00848
      IF(WSP(5,2).GT.0)WRITE(6,391)(WSP(5,J),J=1,2),(CGSP(5,K),K=1,2)    00849
      WRITE(6,392)  ((WSP(I,J),J=1,2),(CGSP(I,K),K=1,2),I=6,13)          00850
      IF(WSP(14,2).GT.0)WRITE(6,393)(WSP(14,J),J=1,2),(CGSP(14,K),K=1,2)00851
      WRITE(6,394)  ((WSP(I,J),J=1,2),(CGSP(I,K),K=1,2),I=15,24)         00852
  190 FORMAT(9X,4HWING,27X,1F15.2,1F15.0,2F15.1,/,9X,15HHORIZONTAL TAIL,00853
     116X,1F15.2,1F15.0,2F15.1,/,9X,13HVERTICAL TAIL,18X,1F15.2,1F15.0, 00854
     22F15.1)                                                           00855
  390 FORMAT(9X,12HVERTICAL FIN,19X,1F15.2,1F15.0,2F15.1)               00856
  391 FORMAT(9X,12HCANARD       ,19X,1F15.2,1F15.0,2F15.1)              00857
  392 FORMAT(9X,8HFUSELAGE,23X,1F15.2,1F15.0,2F15.1                     00858
     4,/,9X,12HLANDING GEAR,19X,1F15.2,1F15.0,2F15.1,/,9X,7HNACELLE,24X,00859
     51F15.2,1F15.0,2F15.1,/,4X,15HSTRUCTURE TOTAL,28X,1H(,F7.2,1H),5X, 00860
     61H(,F8.0,1H),8X,1H(,F5.1,1H),7X,1H(,F6.1,1H),/,9X,7HENGINES,24X,  00861
     71F15.2,1F15.0,2F15.1,/,9X,16HTHRUST REVERSERS,15X,1F15.2,1F15.0,  00862
     82F15.1,/,9X,21HMISCELLANEOUS SYSTEMS,10X,1F15.2,1F15.0,2F15.1,/,  00863
     99X,30HFUEL SYSTEM-TANKS AND PLUMBING,1X,1F15.2,1F15.0,2F15.1)     00864
  393 FORMAT(20X,11H-INSULATION,9X,1F15.2,1F15.0,2F15.1)                00865
  394 FORMAT(                                        4X,16HPROPULSION TOT00866
     2AL,27X,1H(,F7.2,1H),5X,1H(,F8.0,1H),8X,1H(,F5.1,1H),7X,1H(,F6.1,1H00867
     3),/,9X,16HSURFACE CONTROLS,15X,1F15.2,1F15.0,2F15.1,/,9X,15HAUXILI00868
     4ARY POWER,16X,1F15.2,1F15.0,2F15.1,/,9X,11HINSTRUMENTS,20X,1F15.2,00869
     51F15.0,2F15.1,/,9X,10HHYDRAULICS,21X,1F15.2,1F15.0,2F15.1,/,9X,   00870
     610HELECTRICAL,21X,1F15.2,1F15.0,2F15.1,/,9X,8HAVIONICS,23X,1F15.2,00871
     71F15.0,2F15.1,/,9X,25HFURNISHINGS AND EQUIPMENT,6X,1F15.2,1F15.0, 00872
     82F15.1,/,9X,16HAIR CONDITIONING,15X,1F15.2,1F15.0,2F15.1,/,9X,    00873
     910HANTI-ICING,21X,1F15.2,1F15.0,2F15.1)                           00874
      WRITE(6,1900) ((WSP(I,J),J=1,2),(CGSP(I,K),K=1,2),I=25,26)        00875
 1900 FORMAT(4X,27HSYSTEMS AND EQUIPMENT TOTAL,16X,1H(,F7.2,1H),5X,1H(, 00876
     1F8.0,1H),8X,1H(,F5.1,1H),7X,1H(,F6.1,1H),//,4X,12HWEIGHT EMPTY,   00877
     224X,1F15.2,1F15.0,2F15.1)                                         00878
      WRITE(6,191) NFLCR,WSP(27,1),WFLCRAB,CGSP(27,1),CGCR              00879
  191 FORMAT(/9X,24HCREW AND BAGGAGE-FLIGHT,,I2,5X,1F15.2,1F15.0,2F15.1)00880
      WRITE(6,1911)NCABCR,((WSP(I,J),J=1,2),(CGSP(I,K),K=1,2),I=28,31)  00881
 1911 FORMAT(  25X, 7H-CABIN,     ,I3,5X,1F15.2,1F15.0,2F15.1,/,9X,13HUNU00882
     1SABLE FUEL,18X,1F15.2,1F15.0,2F15.1,/,9X,10HENGINE OIL,21X,1F15.2,00883
     21F15.0,2F15.1,/,9X,17HPASSENGER SERVICE,14X,1F15.2,1F15.0,2F15.1) 00884
      WRITE(6,1912) ((WSP(I,J),J=1,2),(CGSP(I,K),K=1,2),I=32,33)        00885
 1912 FORMAT(9X,20HCARGO CONTAINERS     ,11X,1F15.2,1F15.0,2F15.1,//,    00886
     14X,16HOPERATING WEIGHT,20X,1F15.2,1F15.0,2F15.1)                  00887
      WRITE(6,1913) NPASS,((WSP(I,J),J=1,2),(CGSP(I,K),K=1,2),I=34,39)  00888
 1913 FORMAT(/,9X,15HPASSENGERS,          ,I4,12X,1F15.2,1F15.0,2F15.1,/, 00889
     19X,17HPASSENGER BAGGAGE,14X,1F15.2,1F15.0,2F15.1,/,9X,5HCARGO,26X,00890
     21F15.2,1F15.0,2F15.1,//,4X,16HZERO FUEL WEIGHT,20X,1F15.2,1F15.0, 00891
     32F15.1,//,9X,12HMISSION FUEL,19X,1F15.2,1F15.0,2F15.1,//,4X,      00892
     419HRAMP (GROSS) WEIGHT,17X,1F15.2,1F15.0,2F15.1)                  00893
      WRITE(6,200)B,GLOV,SHT,SVT,XNAC,DNAC,XMLG,XNLG,WLDG,FUELWMX,      00894
     1 FUELFMX,FUELMX                                                   00895
  200 FORMAT(12H0WING SPAN =,F7.2,14H,  GLOVE AREA =,F7.1,              00896
     128H,  TAIL AREAS - HORIZONTAL =,F8.2,12H, VERTICAL =,F8.2/        00897
     217H NACELLE LENGTH =,F6.2,12H, DIAMETER =,F6.2,                   00898
     331H,  LANDING GEAR LENGTH - MAIN =,F7.2,8H, NOSE =,F7.2/          00899
     4 25H MAXIMUM LANDING WEIGHT =,F9.1,26H,  FUEL CAPACITY -- WING =, 00900
     5 F9.1,12H, FUSELAGE =,F9.1,9H, TOTAL =,F9.1)                      00901
      IF(FUELM.GT.FUELMX)WRITE(6,210)                                   00902
  210 FORMAT(39H * * * INSUFFICIENT FUEL CAPACITY * * * )               00903
      IF(IPRNT.LT.1.OR.INERTIA.EQ.0)RETURN                              00904
      IF(ZHT.LE.0.)ZHT=DFI/2.+HHT*(BSVI+DFI/2.)                         00905
      IF(ZAP.LE.0.)ZAP=DFI/4.                                           00906
      ZMFC=DFI*(.5*WFUSE+.027*WSC+.3*CON1*WFSYS+.375*WEC                00907
     1+.5*WIN+.144*WHYD+.51*WELEC+.55*WAVONC                            00908
     2+.7*WFURN+.68*WAC+.096*WAI                                        00909
     3+.7*(WFLCRAB+WSTUAB+WSRV)                                         00910
     4+.3*WCON)+ZAP*(WAPU+.15*WAC)                                      00911
      CALL INERT                                                        00912
      RETURN                                                            00913
      END                                                               00914
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      SUBROUTINE INERT                                                  00915
      COMMON/ININ/NTANK,NFCON,SWTFF,YMLG,TX(40),TY(40),TZ(40),          00916
     1 TL(40),TW(40),TD(40),TF(40,3)                                    00917
      COMMON/CONFIG/GW,AR,THRUST,SX,TR,SWEEP,TCA,VCMX,CH,WWSTX,         00918
     1 DUMV1,DUMV2,DESRNG                                               00919
      COMMON/INI/CI(5),TI(5),CO(5),TO(5),BS(5),CONH,CONHM               00920
     1,CENG,CONA1,CONA2,CONF2,FUELF,FUELW,NENG,RNI,WCANC,WLGM,WTCANM,   00921
     2WTFINM,WTHTC,WTHTCM,WTVTC,WTVTCM,YCAN,YHT,YW,ZW,ZBFIN,ZBVT        00922
     3,ZMFC,WTFC,WTFCM,WTWC,WTWCM,WTNFC,WTNFCM,WTNAC,WTNACM,WFINC       00923
      COMMON/WTS/CGSP(40,2),WSP(40,2),FLAPR,FCOMP,FAERT,FLAPC,          00924
     1FSTRT,DGW,ULF,TCR,TCB,TCT,PCTB,DIH,                               00925
     1SWPHT,SWPVT,SFIN,ARFIN,TRFIN,TCFIN,SWPFIN,NFIN,SCAN,SWPCAN,       00926
     2ARCAN,TRCAN,TCCAN,VCAN,XL,WF,DF,CARGF,INERTIA,FUELWMX,            00927
     3FUELFMX,CARGOW,CARGOF,PCTR,XMLG,XNLG,WLDG,XLP,ZRVT,FRWI,          00928
     5FRHT,FRVT,FRFIN,FRCAN,FRFU,FRLGN,FRLGM,FRNA,FRSC,YFUSE,YVERT,     00929
     6NPF,NPT,CGLGN,CGLGM,CGEF,CGEA,NSTU,NGALC,NFLCR,CONDEN,HYDPR,      00930
     1CGCW,CGCF,CGZWF,CGFWF,ZHT,ZVT,ZFIN,YFIN,ZEF,YEF,ZEA,YEA,ZBW,ZAP   00931
      COMMON/EDETIN/CAM,SBASE,BL,XD,AMODE,AITEK,SHT,TCHT,SVT,           00932
     1 TCVT,ARHT,ARVT,XNAC,DNAC,NEW,NEF,TRHT,TRVT,HHT,GLOV              00933
      COMMON/MISWT/OTHR,OIN,OHYD,OELEC,OAVONC,OFURN,OAC,OAPU,OAI,EEXP,  00934
     1 OENG,THRSO,FWMAX,WRATIO,OCON,OUF,OOIL,OPMSC,OFSYS,OSRV           00935
      DIMENSION TIX(40),TIY(40),TIZ(40),TIP(40)                         00936
      EQUIVALENCE (CGW,CGSP(1,2)),(CGHT,CGSP(2,2)),(CGVT,CGSP(3,2)),    00937
     1(CGFIN,CGSP(4,2)),(CGCAN,CGSP(5,2)),(CGF,CGSP(6,2)),              00938
     2(CGLG,CGSP(7,2)),(CGN,CGSP(8,2)),(CGSTRUC,CGSP(9,2)),             00939
     3(CGTHR,CGSP(11,2)),(CGMS,CGSP(12,2)),          (CGPRO,CGSP(15,2)),00940
     4(CGSC,CGSP(16,2)),(CGAP,CGSP(17,2)),(CGIN,CGSP(18,2)),(CGHYD,CGSP 00941
     5(19,2)),(CGEL,CGSP(20,2)),(CGAV,CGSP(21,2)),(CGFRN,CGSP(22,2)),   00942
     6(CGAC,CGSP(23,2)),(CGAI,CGSP(24,2)),(CGSYS,CGSP(25,2)),(CGWE,CGSP 00943
     7(26,2)),(CGCR,CGSP(27,2)),                                        00944
     8(CGOWE,CGSP(33,2)),(CGZF,CGSP(37,2)),(CGFM,CGSP(38,2)),(CGWGW,    00945
     9CGSP(39,2))                                                       00946
      EQUIVALENCE (CGE,CGSP(10,2)),(CGP,CGSP(28,2)),(CGC,CGSP(32,2)),   00947
     1(CGFSYS,CGSP(13,2))                                               00948
      EQUIVALENCE (WSP(1,2),WWING),(WSP(2,2),WHT),(WSP(3,2),WVT),       00949
     1(WSP(4,2),WFIN),(WSP(5,2),WCAN),(WSP(6,2),WFUSE),(WSP(7,2),WLG),  00950
     2(WSP(8,2),WNAC),(WSP(9,2),WSTRUCT),(WSP(10,2),WENG),(WSP(11,2),   00951
     3WTHR),(WSP(12,2),WPMSC),(WSP(13,2),WFSYS),                        00952
     4(WSP(15,2),WPRO),(WSP(16,2),WSC),(WSP(17,2),WAPU),(WSP(18,2),WIN),00953
     5(WSP(19,2),WHYD),(WSP(20,2),WELEC),(WSP(21,2),WAVONC),(WSP(22,2), 00954
     6WFURN),(WSP(23,2),WAC),(WSP(24,2),WAI),(WSP(25,2),WSYS),(WSP(26,2)00955
     7,WWE),(WSP(27,2),WFLCRAB),(WSP(28,2),WSTUAB),(WSP(29,2),WUF),     00956
     8(WSP(30,2),WOIL),(WSP(31,2),WSRV),(WSP(32,2),WCON),(WSP(33,2),WOWE00957
     9),(WSP(34,2),WPASS),(WSP(35,2),WPBAG),(WSP(36,2),WCARGO),         00958
     1(WSP(37,2),WZF),(WSP(38,2),FUELM),(WSP(39,2),WGW)                 00959
      REAL NENG                                                         00960
      DFI=DF*12.                                                        00961
      WLGNC=WLG-WLGM+CONH*WHYD                                          00962
      WLGNCM=WLGNC*CGLGN                                                00963
      WLGMC=WLGM+CONHM*WHYD                                             00964
      WLGMCM=WLGMC*CGLGM                                                00965
      WTFC=WTFC+WFLCRAB+FUELF/FUELM*WUF+WSTUAB+WSRV+WCON-WLGNC          00966
      WTFCM=WTFCM+WUF*FUELF/FUELM*CGZWF+WFLCRAB*CGCR+                   00967
     1 WSTUAB*CGP+WSRV*CGP+WCON*CGSP(32,2)-WLGNCM                       00968
      CGFC=WTFCM/WTFC                                                   00969
      WTWC=WTWC+FUELW/FUELM*WUF-WLGMC                                   00970
      WTWCM=WTWCM+(FUELW/FUELM*WUF)*CGFWF-WLGMCM                        00971
      CGWC=WTWCM/WTWC                                                   00972
      WTNFC=WTNFC+CONF2*WOIL                                            00973
      WTNAC=WTNAC+CONA2*WOIL                                            00974
      WTNFCM=WTNFCM+CONF2*WOIL*CGEF                                     00975
      WTNACM=WTNACM+CONA2*WOIL*CGEA                                     00976
      CGNAC=0.                                                          00977
      IF(CGEA.GT.0.)CGNAC=WTNACM/WTNAC                                  00978
      CGNFC=WTNFCM/WTNFC                                                00979
      WTTOT=WTFC+WTWC+WTHTC+WTVTC+WFINC+WCANC+WTNFC+WTNAC+WLGNC+WLGMC   00980
      CGTOT=(WTFCM+WTWCM+WTHTCM+WTVTCM+WTFINM+WTCANM+WTNFCM+WTNACM      00981
     1+WLGNCM+WLGMCM)/WTTOT                                             00982
      ZFC=ZMFC/WTFC                                                     00983
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      IF(CENG.GT.0..AND.NENG.GT.2.)GO TO 202                            00984
      ZMNAC=WTNAC*ZEA                                                   00985
      ZNAC=ZEA                                                          00986
      GO TO 204                                                         00987
  202 WSNC=WNAC*CONA1/2.                                                00988
      WSNCO=WTNAC-WSNC                                                  00989
      ZMNAC=ZEA*WSNCO+(DFI+RNI)*WSNC                                    00990
      ZNAC=0.                                                           00991
      IF(WTNAC.GT.0.)ZNAC=ZMNAC/WTNAC                                   00992
  204 YNLG=0.                                                           00993
      ZNLG=-XNLG/2.                                                     00994
      ZMLG=XMLG/2.-XNLG                                                 00995
      YVTC=0.                                                           00996
      YFC=0.                                                            00997
      ZCAN=0.                                                           00998
      IF(WCAN.GE.1.)ZCAN=.5*DFI                                         00999
      YTOT=0.                                                           01000
      ZTOT=(ZMFC+WTWC*ZW+WTVTC*ZVT+WFINC*ZFIN+WCANC*ZCAN+WTNFC*ZEF+     01001
     1ZMNAC+WLGNC*ZNLG+WLGMC*ZMLG+WTHTC*ZHT)/WTTOT                      01002
      WRITE(6,225)                                                      01003
  225 FORMAT(22H1 STRUCTURE + CONTENTS,                                 01004
     14X,6HWEIGHT,5X,7HHORI CG,6X,6HLAT CG,5X,7HVERT CG,/,              01005
     229X,3HLBS,3(9X,3HINS))                                            01006
      WRITE(6,230)WTFC,CGFC,YFC,ZFC,WTWC,CGWC,YW,ZW,WTHTC,CGHT,YHT,     01007
     1ZHT,WTVTC,CGVT,YVTC,ZVT,WFINC,CGFIN,YFIN,ZFIN,                    01008
     2WCANC,CGCAN,YCAN,ZCAN,WTNFC,CGNFC,YEF,ZEF,                        01009
     3WTNAC,CGNAC,YEA,ZNAC,WLGNC,CGLGN,YNLG,ZNLG,                       01010
     4WLGMC,CGLGM,YMLG,ZMLG,WTTOT,CGTOT,YTOT,ZTOT                       01011
  230 FORMAT(/,4X,8HFUSELAGE,10X,F10.0,3F12.1/                          01012
     14X,17HWING + CARRY-THRU,1X,F10.0,3F12.1/                          01013
     24X,15HHORIZONTAL TAIL,3X,F10.0,3F12.1/                            01014
     34X,13HVERTICAL TAIL,5X,F10.0,3F12.1/                              01015
     44X,4HFINS,14X,F10.0,3F12.1/                                       01016
     54X,6HCANARD,12X,F10.0,3F12.1/                                     01017
     64X,16HFORWARD NACELLES,2X,F10.0,3F12.1/                           01018
     74X,12HAFT NACELLES,6X,F10.0,3F12.1/                               01019
     74X,18HNOSE LANDING GEAR ,F10.0,3F12.1/                            01020
     74X,18HMAIN LANDING GEAR ,F10.0,3F12.1//                           01021
     84X,12HAIRCRAFT OWE,6X,F10.0,3F12.1/)                              01022
      ICNT=1                                                            01023
      TANS=TAN(SWEEP/57.296)+(1.-TR)/(1.+TR)/AR                         01024
      IF(TANS.LT.0.)TANS=4.*(1.-TR)/(1.+TR)/AR-TANS                     01025
      WT=WTWC                                                           01026
  240 TCHD=CI(ICNT)+CO(ICNT)                                            01027
      XIXWI=WT*BS(ICNT)**2*(TCHD+2.*CO(ICNT))/(TCHD+.001)/6.E06         01028
      CA=BS(ICNT)*TANS                                                  01029
      CC=CA+CO(ICNT)                                                    01030
      IF(CA.GT.CI(ICNT))GO TO 245                                       01031
      CB=CI(ICNT)                                                       01032
      GO TO 250                                                         01033
  245 CB=CA                                                             01034
      CA=CI(ICNT)                                                       01035
  250 CW=CB+CC-CA+.001                                                  01036
      CWX=(CB*CB+CC*CC-CA*CA+CB*CC)/3.                                  01037
      CWXX=(CB**3+CC**3-CA**3+CB*CB*CC+CB*CC*CC)/6.                     01038
      XIYWI=WT*(CWXX/CW-(CWX/CW)**2)/1.E06                              01039
      VALI=1.+(2.*CI(ICNT)*CO(ICNT))/(TCHD**2+.001)                     01040
      XIZWI=(WT*BS(ICNT)**2*VALI)/18.E06                                01041
      DFACT=BS(ICNT)*(TCHD+CO(ICNT))/(TCHD+.001)/3.                     01042
      GO TO (255,260,261,262,265),ICNT                                  01043
  255 ICNT=2                                                            01044
      EF=YW/DFACT                                                       01045
      XIXW=XIXWI*(.79*(1.-EF)+.88*EF*EF)                                01046
      XIYW=XIYWI*.703                                                   01047
      XIZW=XIXW+XIYW                                                    01048
      TANS=TAN(SWPHT)                                                   01049
      WT=WTHTC                                                          01050
      GO TO 240                                                         01051
  260 ICNT=3                                                            01052
      EF=YHT/(DFACT+.001)                                               01053
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      XIXH=XIXWI*(1.967*EF-1.043)                                       01054
      XIYH=XIYWI*.771                                                   01055
      XIZH=XIXH+XIYH                                                    01056
      TANS=TAN(SWPVT)                                                   01057
      WT=WTVTC                                                          01058
      GO TO 240                                                         01059
  261 ICNT=4                                                            01060
      EF=(ZVT-ZBVT)/(DFACT+.001)                                        01061
      XIXV=XIZWI*(2.4*EF-1.18)                                          01062
      XIZV=XIYWI*.771                                                   01063
      XIYV=XIXV+XIZV                                                    01064
      TANS=TAN(SWPFIN)                                                  01065
      WT=WFINC                                                          01066
      GO TO 240                                                         01067
  262 ICNT=5                                                            01068
      EF=(ZFIN-ZBFIN)/(DFACT+.001)                                      01069
      XIXFIN=XIZWI*(2.4*EF-1.18)                                        01070
      XIZFIN=XIYWI*.771                                                 01071
      XIYFIN=XIXFIN+XIZFIN                                              01072
      TANS=TAN(SWPCAN)                                                  01073
      WT=WCANC                                                          01074
      GO TO 240                                                         01075
  265 EF=YCAN/(DFACT+.001)                                              01076
      XIXCAN=XIXWI*(1.967*EF-1.043)                                     01077
      XIYCAN=XIYWI*.771                                                 01078
      XIZCAN=XIXCAN+XIYCAN                                              01079
      WFIO2S=36.*WF**2/1.E06                                            01080
      DFIO2S=DFI**2/4.E06                                               01081
      DAV=(WF+DF)/2.                                                    01082
      ELOD=XL/DAV                                                       01083
      SWF=(ELOD-1.7)/ELOD/12.                                           01084
      IF(SWTFF.GT.0.)SWF=SWTFF/(37.68*XL*DAV)                           01085
      C2=.98-.9*(XL-CGFC/6.)/XL                                         01086
      XLI=12.*XL                                                        01087
      XLIS=XLI**2/1.E06                                                 01088
      XIXF=36.*WTFC*(12.*DAV*SWF)**2*(.07+WFUSE*.184*SQRT(12.*DAV)/WTFC)01089
     1 /1.E06                                                           01090
      XIYF=SWF*WTFC*(5*DFIO2S+XLIS)*C2                                  01091
      XIZF=SWF*WTFC*(5*WFIO2S+XLIS)*C2                                  01092
      XIXNG=WLGNC*XNLG**2/12.E06                                        01093
      XIYNG=XIXNG                                                       01094
      XIZNG=0.                                                          01095
      XIXMG=WLGMC*XMLG**2/12.E06                                        01096
      XIYMG=XIXMG                                                       01097
      XIZMG=0.                                                          01098
      XNI=12.*XNAC                                                      01099
      XNIS=XNI**2/1.E06                                                 01100
      RNIS=RNI**2/1.E06                                                 01101
      XIXNF=.332*WTNFC*RNIS                                             01102
      XIYNF=.061*WTNFC*(3.*RNIS+XNIS*.7)                                01103
      XIZNF=XIYNF                                                       01104
      IF(CENG.GT.0..AND.NENG.GT.2.)GO TO 275                            01105
      XIXNA=.332*WTNAC*RNIS                                             01106
      XIYNA=.061*WTNAC*(3.*RNIS+XNIS*.7)                                01107
      XIZNA=XIYNA                                                       01108
      GO TO 277                                                         01109
  275 DXL=(CGEA+XNI*(1.*WSNC+.5*WTHR)/WSNCO-CGNAC)**2/1.E06             01110
      DXH=(.9*XNI+CGNAC-CGEA)**2/1.E06                                  01111
      DZL=(ZNAC-ZEA)**2/1.E06                                           01112
      DZH=(DFI+RNI-ZNAC)**2/1.E06                                       01113
      XIXNA=WSNCO*(DZL+.332*RNIS)+WSNC*(DZH+.747*RNIS)                  01114
      XIZNA=WSNCO*(DXL+.183*RNIS+.0427*XNIS)+WSNC*(DXH+.417*RNIS        01115
     1 +.0427*XNIS)                                                     01116
      XIYNA=XIZNA+WSNCO*DZL+WSNC*DZH                                    01117
  277 CGO=CGTOT                                                         01118
      ZO=ZTOT                                                           01119
      DO 500 J=1,NFCON                                                  01120
      TXM=0.                                                            01121
      TZM=0.                                                            01122
      TWT=0.                                                            01123
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      DO 350 I=1,NTANK                                                    01124
      TWT=TWT+TF(I,J)                                                     01125
      TXM=TXM+TF(I,J)*TX(I)                                               01126
      TZM=TZM+TF(I,J)*TZ(I)                                               01127
      TIL=TL(I)**2/12.E06                                                 01128
      TIW=TW(I)**2/12.E06                                                 01129
      TID=TD(I)**2/12.E06                                                 01130
      TIX(I)=TF(I,J)*(TIW+TID)                                            01131
      TIY(I)=TF(I,J)*(TIL+TID)                                            01132
  350 TIZ(I)=TF(I,J)*(TIL+TIW)                                            01133
      WTTOT=WOWE+TWT                                                      01134
      CGTOT=(WOWE*CGO+TXM)/WTTOT                                          01135
      ZTOT=(WOWE*ZO+TZM)/WTTOT                                            01136
      XBAR=CGWC-CGTOT                                                     01137
      ZBAR=ZW-ZTOT                                                        01138
      XIPW=WTWC*XBAR*ZBAR/1.E06                                           01139
      RXW=XBAR**2/1.E06                                                   01140
      RZW=ZBAR**2/1.E06                                                   01141
      ZBAR=ZHT-ZTOT                                                       01142
      XBAR=CGHT-CGTOT                                                     01143
      XIPH=WTHTC*XBAR*ZBAR/1.E06                                          01144
      RXH=XBAR**2/1.E06                                                   01145
      RZH=ZBAR**2/1.E06                                                   01146
      XBAR=CGVT-CGTOT                                                     01147
      ZBAR=ZVT-ZTOT                                                       01148
      RXV=XBAR**2/1.E06                                                   01149
      XIPV=WTVTC*XBAR*ZBAR/1.E06                                          01150
      RYV=YVERT**2/1.E06                                                  01151
      RZV=ZBAR**2/1.E06                                                   01152
      XBAR=CGFIN-CGTOT                                                    01153
      ZBAR=ZFIN-ZTOT                                                      01154
      RXFIN=XBAR**2/1.E06                                                 01155
      XIPFIN=WFINC*XBAR*ZBAR/1.E06                                        01156
      RYFIN=YFIN**2/1.E06                                                 01157
      RZFIN=ZBAR**2/1.E06                                                 01158
      XBAR=CGCAN-CGTOT                                                    01159
      ZBAR=ZCAN-ZTOT                                                      01160
      XIPCAN=WCANC*XBAR*ZBAR/1.E06                                        01161
      RXCAN=XBAR**2/1.E06                                                 01162
      RZCAN=ZBAR**2/1.E06                                                 01163
      XBAR=(CGFC-CGTOT)/1000.                                             01164
      ZBAR=(ZFC-ZTOT)/1000.                                               01165
      XIPF=WTFC*XBAR*ZBAR                                                 01166
      RXF=XBAR**2                                                         01167
      RYF=YFUSE**2/1.E06                                                  01168
      RZF=ZBAR**2                                                         01169
      XBAR=CGLGN-CGTOT                                                    01170
      ZBAR=ZNLG-ZTOT                                                      01171
      XIPNG=WLGNC*XBAR*ZBAR/1.E06                                         01172
      RXNG=XBAR**2/1.E06                                                  01173
      RZNG=ZBAR**2/1.E06                                                  01174
      XBAR=CGLGM-CGTOT                                                    01175
      ZBAR=ZMLG-ZTOT                                                      01176
      XIPMG=WLGMC*XBAR*ZBAR/1.E06                                         01177
      RXMG=XBAR**2/1.E06                                                  01178
      RYMG=YMLG**2/1.E06                                                  01179
      RZMG=ZBAR**2/1.E06                                                  01180
      XBAR=(CGNFC-CGTOT)/1000.                                            01181
      ZBAR=(ZEF-ZTOT)/1000.                                               01182
      XIPNF=WTNFC*XBAR*ZBAR                                               01183
      RXNF=XBAR**2                                                        01184
      RYNF=YEF**2/1.E06                                                   01185
      RZNF=ZBAR**2                                                        01186
      XBAR=(CGNAC-CGTOT)/1000.                                            01187
      ZBAR=(ZNAC-ZTOT)/1000.                                              01188
      XIPNA=WTNAC*XBAR*ZBAR                                               01189
      RXNA=XBAR**2                                                        01190
      RYNA=YEA**2/1.E06                                                   01191
      RZNA=ZBAR**2                                                        01192
      XIXTOT=XIXF+XIXW+XIXH+XIXV+XIXFIN+XIXCAN+XIXNF+XIXNA+XIXNG+XIXMG+   01193
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     1WTFC*(RZF+RYF)+WTWC*RZW+WTHTC*RZH+WTVTC*(RYV+RZV)+                    01194
     2WFINC*(RYFIN+RZFIN)+WCANC*RZCAN+WTNFC*(RYNF+RZNF)+                   01195
     3WTNAC*(RYNA+RZNA)+WLGNC*RZNG+WLGMC*(RYMG+RZMG)                       01196
      XIYTOT=XIYF+XIYW+XIYH+XIYV+XIYFIN+XIYCAN+XIYNF+XIYNA+XIYNG+XIYMG+    01197
     1WTFC*(RZF+RXF)+WTWC*(RZW+RXW)+WTHTC*(RZH+RXH)+WTVTC*(RZV+RXV)+       01198
     2WFINC*(RZFIN+RXFIN)+WCANC*(RZCAN+RXCAN)+WTNFC*(RZNF+RXNF)+           01199
     3WTNAC*(RZNA+RXNA)+WLGNC*(RZNG+RXNG)+WLGMC*(RZMG+RXMG)                01200
      XIZTOT=XIZF+XIZW+XIZH+XIZV+XIZFIN+XIZCAN+XIZNF+XIZNA+XIZNG+XIZMG+    01201
     1WTFC*(RXF+RYF)+WTWC*RXW+WTHTC*RXH+WTVTC*(RXV+RYV)+                   01202
     2WFINC*(RYFIN+RXFIN)+WCANC*RXCAN+WTNFC*(RYNF+RXNF)+                   01203
     3WTNAC*(RYNA+RXNA)+WLGNC*RXNG+WLGMC*(RYMG+RXMG)                       01204
      XIPTOT=XIPF+XIPW+XIPH+XIPV+XIPFIN+XIPCAN+XIPNF+XIPNA+XIPNG+XIPMG     01205
      DO 380 I=1,NTANK                                                     01206
      TIL=(TX(I)-CGTOT)**2/1.E06                                           01207
      TIW=TY(I)**2/1.E06                                                   01208
      TID=(TZ(I)-ZTOT)**2/1.E06                                            01209
      TIP(I)=TF(I,J)*(TX(I)-CGTOT)*(TZ(I)-ZTOT)/1.E06                      01210
      XIXTOT=XIXTOT+TIX(I)+TF(I,J)*(TIW+TID)                               01211
      XIYTOT=XIYTOT+TIY(I)+TF(I,J)*(TIL+TID)                               01212
      XIZTOT=XIZTOT+TIZ(I)+TF(I,J)*(TIL+TIW)                               01213
380   XIPTOT=XIPTOT+TIP(I)                                                 01214
      WRITE(6,285)                                                         01215
285   FORMAT(21H  RESPECTIVE INERTIAS,4X,7HIX,ROLL,4X,8HIY,PITCH,          01216
     16X,6HIZ,YAW,4X,8HIXZ,PROD,/,25X,43H---------- (LB-SQ IN)/1,000,00001217
     2 ----------)                                                         01218
      WRITE(6,290)XIXF,XIYF,XIZF,XIPF,XIXW,XIYW,XIZW,XIPW,                 01219
     1XIXH,XIYH,XIZH,XIPH,XIXV,XIYV,XIZV,XIPV,                             01220
     2XIXFIN,XIYFIN,XIZFIN,XIPFIN,XIXCAN,XIYCAN,XIZCAN,XIPCAN,             01221
     3XIXNF,XIYNF,XIZNF,XIPNF,XIXNA,XIYNA,XIZNA,XIPNA,                     01222
     3XIXNG,XIYNG,XIZNG,XIPNG,XIXMG,XIYMG,XIZMG,XIPMG                      01223
      DO 450 I=1,NTANK                                                     01224
450   WRITE(6,291)I,TIX(I),TIY(I),TIZ(I),TIP(I)                            01225
      WRITE(6,292)XIXTOT,XIYTOT,XIZTOT,XIPTOT                              01226
290   FORMAT(/,4X,8HFUSELAGE,8X,4E12.5/,                                   01227
     14X,17HWING + CARRY-THRU,E11.5,3E12.5,/,                              01228
     24X,15HHORIZONTAL TAIL,1X,4E12.5,/,                                   01229
     34X,13HVERTICAL TAIL,3X,4E12.5,/,                                     01230
     44X,4HFINS,12X,4E12.5,/,                                              01231
     54X,6HCANARD,10X,4E12.5,/,                                            01232
     64X,16HFORWARD NACELLES,4E12.5,/,                                     01233
     74X,12HAFT NACELLES,4X,4E12.5,/,                                      01234
     74X,9HNOSE GEAR,7X,4E12.5/                                            01235
     74X,9HMAIN GEAR,7X,4E12.5)                                            01236
291   FORMAT(4X,4HTANK,I3,9X,4E12.5)                                       01237
292   FORMAT(/4X,14HTOTAL AIRCRAFT,2X,4E12.5)                              01238
      IF(XIXTOT.LE.0.)GO TO 293                                            01239
      TVAL=2.*XIPTOT/(XIZTOT-XIXTOT)                                       01240
      ANGIN=28.648*ATAN(TVAL)                                              01241
293   WRITE(6,295)WTTOT,CGTOT,ZTOT,ANGIN                                   01242
295   FORMAT(6H0 GW =,F8.0,11H,  HORI CG =,F7.1,                           01243
     1 11H, VERT CG =,F7.1//4X,                                            01244
     221HINCLINATION ANGLE  = ,F7.1,8H DEGREES/)                          01245
500   CONTINUE                                                             01246
      WRITE(6,600)                                                         01247
600   FORMAT(4X,                                                           01248
     363HNOTE- COORDINATES 0,0,0 ARE AT INTERSECTION OF CENTER, NOSE AND01249
     4,/,10X,59HLOWEST CONTOUR FUSELAGE LINES.  LATERAL CGS OF AIRFOILS 01250
     5AND,/,10X,60HNACELLES ARE PER SIDE.  INERTIAS ARE FOR TOTAL STRUCT01251
     6URE AND,/,10X,57HCONTENTS WEIGHTS.  ROLL, PITCH AND YAW INERTIAS A01252
     7RE ABOUT,/,10X,58HRESPECTIVE CENTROIDS OF EACH COMPONENT, BUT ALL 01253
     8PRODUCT OF,/,10X,43HINERTIAS ARE ABOUT TOTAL AIRCRAFT CENTROID.)  01254
      RETURN                                                               01255
      END                                                                  01256
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      SUBROUTINE DEFMSS(NEW,NEF)                                        00001
      COMMON/STDRAG/CDST(20,3),STMA(20,3),ISTCL(4),ISTCR(5),ISTAC(40),  00002
     1 ISTDE,NSTD(3)                                                    00003
      COMMON/FLIGHT/STMACH,STALT,NUMSEG,DISPOZE,IFREE,FSEG(40),GSEG(40),00004
     1 JSEG(40),MSEG(40),DSEG(40),ESEG(40),SEGT(9,2),HSEG(40),CSEG(40)  00005
      COMMON/RADACC/REARTH,RADA                                         00006
      COMMON/FEATH/IFEATH(5),FEATHF(5),CDFEATH(5)                       00007
      COMMON/ROCIN/FWF(4),IPPCL(4)                                      00008
      COMMON/MISIN/INDR,ESKAL,OWFACT,RTOL,IATA,                         00009
     1 OFFDR(10),DWT,TAXOTIM,TAKOTIM,TAXITIM,RS,NHOLD,                  00010
     2 RESERFU,DSTGRNG                                                  00011
      COMMON/DESCIN/NCLIMB,QLIM,NODIVE,IFAACL,CLMMIN(4),CLMMAX(4),      00012
     1 CLAMIN(4),CLAMAX(4),NINCL(4),CLDCD(4),NO(4),                     00013
     2 ACTAB(10,4),VCTAB(10,4),DEMMAX,DEMMIN,DEAMAX,DEAMIN,VS,DECL,     00014
     3 NS,ADTAB(10),VDTAB(10),DEDCD,NINDE,NCRCL(4)                      00015
      COMMON/CRUIN/HPMIN,DCWT,RCIN,OC(5),CRMACH(5),CRALT(5),CRDCD(5),   00016
     1 CRMMIN(5),FLRCR(5),CRCLMAX(5),NCRUISE                            00017
      COMMON/RESIN/NCRRES,NCLRES,MAPTIM,ALTRAN,HOLDTIM,NCRHOL,IHOPOS    00018
     1,SREMACH,EREMACH,SREALT,EREALT                                    00019
      COMMON/PLTP/XMAX,XMIN,XINC,YMAX,YMIN,YINC,NCONINT,WTPLOT          00020
     1,IPLOTPS                                                          00021
      COMMON/TRNSF/ASTAR,CDT,CL,CLM,D,DCD,DIST,DELTA,ENG,FUEL,G,HP,HPL, 00022
     1 II,LD,MACH,NW,Q,RCI,RCM,RSM,RSR,SR,SREF,THETA,TIME,VH,VT,        00023
     2 WF,WFD,WT,DTC,IFLAG,FACT,IDOQ,ENGO,VMIN                          00024
      COMMON/ESB/RAMPWT,DOWE,PAYLOAD,MAXFUEL,MYWTS,MYAERO,              00025
     1 ATARANG,FLIGTIM,AVCRLD,ITAKOFF,ILAND,RW                          00026
      COMMON/EDATA/NM,NA,NT,EMACH(20),ALT(10,20),FF(16,10,20),          00027
     1 THR(16,10,20),EXTFAC,FFFAC,DFFAC,IDFUEFL,TAKOFF,IXTRAP,MAXCR     00028
      REAL MACH,LD,IDFUEFL,MAXFUEL,MAPTIM                               00029
      INTEGER VS,RS,RW,OC,ESKAL                                         00030
      NAMELIST /MISSIN/ INDR,FACT,ESKAL,OWFACT,IFLAG,DTC,RW,RTOL,       00031
     1 IATA,OFFDR,DWT,MYWTS,RAMPWT,DOWE,PAYLOAD,MAXFUEL,                00032
     2 IDFUEFL,TAXOTIM,TAKOFF,TAKOTIM,TAXITIM,IDOQ,NHOLD,               00033
     3 NCLIMB,QLIM,NODIVE,IFAACL,CLMMIN,CLMMAX,CLAMIN,CLAMAX,NINCL,     00034
     4 FWF,IPPCL,CLDCD,NO,ACTAB,VCTAB,DEMMAX,DEMMIN,DEAMAX,DEAMIN,      00035
     5 VS,DECL,NS,ADTAB,VDTAB,DEDCD,NINDE,NCRCL,REARTH,IRADACC,         00036
     6 HPMIN,DCWT,RCIN,OC,CRMACH,CRALT,CRDCD,CRMMIN,FLRCR,CRCLMAX,      00037
     7 IFEATH,FEATHF,CDFEATH,NCRUISE,NCRHOL,IHOPOS,CDST,STMA,           00038
     7 EREMACH,EREALT,SREALT,SREMACH,ISTCL,ISTCR,ISTDE,                 00039
     8 NCRRES,NCLRES,MAPTIM,ALTRAN,HOLDTIM,RS,RESERFU,DSTGRNG,          00040
     9 IPLOTPS,XMAX,XMIN,XINC,YMAX,YMIN,YINC,WTPLOT,NCONINT             00041
      DATA DTC,OFFDR,RAMPWT,DOWE,PAYLOAD,MAXFUEL,IDFUEFL,               00042
     1 TAXOTIM,TAKOFF,TAKOTIM,TAXITIM,QLIM,CLMMAX,CLAMIN,CLAMAX,        00043
     2 CLDCD,ACTAB,VCTAB,CRMACH,CRDCD,CRMMIN,CRCLMAX,CDFEATH,           00044
     3 DEMMAX,DEAMAX,DEAMIN,ADTAB,VDTAB,DEDCD,RESERFU,MAPTIM,           00045
     4 HOLDTIM,XMAX,XMIN,XINC,YMAX,YMIN,YINC,WTPLOT,DSTGRNG/177*0./     00046
      DATA INDR,IFLAG,MYWTS,NODIVE,NO,IFEATH,NS,IPLOTPS,NCRHOL,IDOQ     00047
     1 ,NHOLD,IRADACC/19*0/,CRALT/5*-1./                                00048
      DATA ESKAL,IATA,NCLIMB,NCRUISE,IFAACL,IPPCL,OC,VS,NCRRES,         00049
     1 NCLRES,NCRCL,IHOPOS/22*1/,REARTH/20890000./                      00050
      DATA DWT,DCWT,FACT,OWFACT,FLRCR/9*1./,CLMMIN,DEMMIN/5*.3/,        00051
     1 DECL/.8/,FEATHF/5*.5/,RTOL/.001/,FWF/4*-.001/,HPMIN/1000./,      00052
     2 ALTRAN/0./,RCIN/100./,NCONINT/20/,NINCL,NINDE/5*31/              00053
     1,SREMACH,EREMACH,SREALT,EREALT/4*-1./,RW,RS/2*2/                  00054
      DATA CDST,STMA/120*0./,ISTCL,ISTCR,ISTDE,ISTAC/50*0/              00055
      DATA SEGT/4HCLIM,4HCRUI,4HREFU,4HRELE,4HACCE,4HHOLD,              00056
     1 4HDESC,4HEND ,4HTURN,4HB   ,4HSE  ,4HEL  ,4HASE ,4HL   ,        00057
     2 4H    ,4HENT ,4H    ,4H    /                                    00058
C                                                                       00059
      ENG=NEW+NEF                                                       00060
      READ (5,MISSIN)                                                   00061
      DO 2 I=1,4                                                        00062
    2 IF(NO(I).LT.2)NO(I)=0                                             00063
      IF(NS.LT.2)NS=0                                                   00064
      WRITE(6,442)                                                      00065
      IF(IDOQ.EQ.1)WRITE(6,443)                                         00066
      WRITE(6,444)                                                      00067
  442 FORMAT(//38H0MISSION INPUT DATA (NAMELIST $MISSIN)/)              00068
  443 FORMAT(44H0  DRAG INCREMENTS WILL BE D/Q INSTEAD OF CD/)          00069
  444 FORMAT(14H0  DESCRIPTION,16X,4HNAME,7X,18H VALUE  DIMENSIONS/)    00070
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      WRITE(6,450)INDR,FACT,ESKAL,OWFACT,IFLAG,DTC,RW,RTOL,IATA,DWT      00071
  450 FORMAT(37H   ENDURANCE MISSION SWITCH   INDR   ,I11/               00072
     1 37H   FUEL FLOW FACTOR            FACT   ,F11.4/                  00073
     2 37H   ENGINE SCALING SWITCH       ESKAL  ,I11/                    00074
     3 37H   OWE FACTOR                  OWFACT ,F11.4/                  00075
     4 37H   PRINT FLAG                  IFLAG  ,I11/                    00076
     5 37H   TEMPERATURE DEVIATION       DTC    ,F11.1,7H  DEG C/        00077
     7 37H   CALC RAMP WT OR RANGE       RW     ,I11/                    00078
     8 37H   RANGE TOLERANCE             RTOL   ,F11.4,6H  N MI/         00079
     9 37H   ATA TRAFFIC ALLOWANCE       IATA   ,I11/                    00080
     1 37H   WEIGHT INCREMENT            DWT    ,F11.0,5H  LBF)          00081
      IF(IRADACC.EQ.1.)WRITE(6,452)REARTH                                00082
  452 FORMAT(37H   RADIUS OF EARTH              REARTH ,F11.0,4H  FT)     00083
      DO 2001 I=1,10                                                     00084
      IF(OFFDR(I).LE.0.)GO TO 455                                        00085
 2001 WRITE(6,2011)I,OFFDR(I)                                            00086
 2011 FORMAT(21H   OFF DESIGN RANGE (,I2,12H)       OFFDR,F13.1,6H  N MI)00087
  455 IF(MYWTS.GT.0)WRITE(6,460)RAMPWT,DOWE,PAYLOAD,MAXFUEL              00088
  460 FORMAT(14H0INPUT WEIGHTS/                                          00089
     2 37H   GROSS WT. BEFORE TAXI OUT  RAMPWT ,F11.1,5H  LBF/          00090
     3 37H   OPERATING WEIGHT EMPTY     DOWE   ,F11.1,5H  LBF/          00091
     4 37H   PAYLOAD WEIGHT             PAYLOAD,F11.1,5H  LBF/          00092
     5 37H   TOTAL USABLE FUEL WEIGHT   MAXFUEL,F11.1,5H  LBF)          00093
      WRITE(6,470)IDFUEFL,TAXOTIM,TAKOFF,TAKOTIM,TAXITIM                 00094
  470 FORMAT(36H0GROUND OPERATIONS AND TAKEOFF INPUT/                    00095
     1 37H   TAXI FUEL FLOW             IDFUEFL,F11.1,15H  LBM/HR/ENGINE00096
     2/                                                                  00097
     3 37H   TAXI-OUT TIME              TAXOTIM,F11.1,5H  MIN/          00098
     4 37H   TAKEOFF FUEL FLOW          TAKOFF ,F11.1,15H  LBM/HR/ENGINE00099
     5/                                                                  00100
     6 37H   TAKEOFF TIME               TAKOTIM,F11.1,5H  MIN/          00101
     7 37H   TAXI-IN TIME               TAXITIM,F11.1,5H  MIN)          00102
      WRITE(6,480)NCLIMB,CLMMIN,CLMMAX,CLAMIN,CLAMAX,NINCL,FWF,NCRCL,   00103
     1 CLDCD,IPPCL,ISTCL,IFAACL,NODIVE,QLIM                              00104
  480 FORMAT(10H0INPUT FOR,I2,16H CLIMB SCHEDULES,17X,3H(1),8X,3H(2),   00105
     1 8X,3H(3),8X,3H(4)/                                                00106
     1 37H   MINIMUM CLIMB MACH NUMBER  CLMMIN ,4F11.4/                  00107
     2 37H   MAXIMUM CLIMB MACH NUMBER  CLMMAX ,4F11.4/                  00108
     3 37H   MINIMUM CLIMB ALTITUDE     CLAMIN ,4F11.0,3H FT/           00109
     4 37H   MAXIMUM CLIMB ALTITUDE     CLAMAX ,4F11.0,3H FT/           00110
     5 37H   NUMBER OF CLIMB STEPS      NINCL  ,4I11/                   00111
     6 37H   CLIMB OPTIMIZATION FACTOR  FWF    ,4F11.4/                 00112
     6 37H   FOLLOWING CRUISE SEGMENT   NCRCL  ,4I11/                   00113
     7 37H   DRAG COEFFICIENT INCREMENT CLDCD  ,4F11.5/                 00114
     8 37H   NO. OF POWER SETTINGS      IPPCL  ,4I11/                   00115
     8 37H   STORE DRAG DURING CLIMB    ISTCL  ,4I11/                   00116
     9 37H   FAA CLIMB ENFORCED         IFAACL ,I11/                    00117
     2 37H   DIVING IN CLIMB SWITCH     NODIVE ,I11/                    00118
     3 37H   Q LIMIT IN CLIMB           QLIM   ,F11.1,5H  PSF)          00119
      DO 520 J=1,NCLIMB                                                  00120
      NN=NO(J)                                                           00121
      IF(NN.EQ.0)GO TO 520                                               00122
      WRITE(6,500)NN,J                                                   00123
  500 FORMAT(/I3,33H POINT CLIMB SCHEDULE FOR SEGMENT,I2//               00124
     1,13X,26HALTITUDE       CLIMB SPEED)                               00125
      IF(VCTAB(1,J).GT.5.)WRITE(6,510)                                   00126
  510 FORMAT(16X,20HFT                KNTS)                              00127
      IF(VCTAB(1,J).LE.5.)WRITE(6,511)                                   00128
  511 FORMAT(16X,20HFT            MACH NO)                               00129
      WRITE(6,514)                                                       00130
  514 FORMAT(13X,24H(ACTAB)           (VCTAB)/)                          00131
      WRITE(6,512)(ACTAB(I,J),VCTAB(I,J),I=1,NN)                         00132
  512 FORMAT(12X,F8.1,10X,F7.2)                                          00133
  520 CONTINUE                                                           00134
      IF(DCWT.LE.0.)DCWT=DWT/20.                                         00135
      WRITE(6,530)NCRUISE,OC,CRMACH,CRALT,CRDCD,ISTCR,FLRCR,CRMMIN,      00136
     1 CRCLMAX,IFEATH,FEATHF,CDFEATH,HPMIN,DCWT,RCIN                     00137
  530 FORMAT(10H0INPUT FOR,I2,17H CRUISE SCHEDULES,16X,3H(1),8X,3H(2),   00138
     1 8X,3H(3),8X,3H(4),8X,3H(5)/                                       00139
     2 37H   CRUISE OPTION SWITCH       OC     ,5I11/                   00140
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     3 37H    MAXIMUM MACH NUMBER          CRMACH ,5F11.4/                    00141
     4 37H    MAXIMUM ALTITUDE             CRALT  ,5F11.0,3H FT/              00142
     5 37H    DRAG COEFFICIENT INCREMENT   CRDCD  ,5F11.5/                    00143
     8 37H    STORE DRAG DURING CRUISE     ISTCR  ,5I11/                      00144
     5 37H    LONG RANGE CRUISE FACTOR     FLRCR  ,5F11.3/                    00145
     6 37H    MINIMUM MACH NUMBER          CRMMIN ,5F11.4/                    00146
     7 37H    MAXIMUM LIFT COEFFICIENT     CRCLMAX,5F11.4/                    00147
     8 37H    ENGINE FEATHERING ALLOWED    IFEATH ,5I11/                      00148
     9 37H    ENGINE FRACTION REMAINING    FEATHF ,5F11.4/                    00149
     1 37H    CD INCREASE FOR FEATHERING   CDFEATH,5F11.5/                    00150
     1 37H    MINIMUM CRUISE ALTITUDE      HPMIN  ,F11.1,4H  FT/              00151
     1 37H    INCREMENT IN CRUISE WT.      DCWT   ,F11.1,5H  LBF/             00152
     3 37H    RATE OF CLIMB CEILING        RCIN   ,F11.1,8H  FT/MIN)          00153
      WRITE(6,560)VS,DECL,DEMMIN,DEMMAX,DEAMIN,DEAMAX,NINDE,DEDCD,ISTDE      00154
  560 FORMAT(27H0INPUT FOR DESCENT SCHEDULE/                                 00155
     1 37H    DESCENT OPTION SWITCH        VS     ,I11/                      00156
     2 37H    DESCENT LIFT COEFF.          DECL   ,F11.4/                    00157
     3 37H    MINIMUM DESCENT MACH NO.     DEMMIN ,F11.4/                    00158
     4 37H    MAXIMUM DESCENT MACH NO.     DEMMAX ,F11.4/                    00159
     5 37H    MINIMUM DESCENT ALTITUDE     DEAMIN ,F11.0,3H FT/              00160
     6 37H    MAXIMUM DESCENT ALTITUDE     DEAMAX ,F11.0,3H FT/              00161
     7 37H    NUMBER OF DESCENT STEPS      NINDE  ,I11/                      00162
     4 37H    DRAG COEFFICIENT INCREMENT   DEDCD  ,F11.5/                    00163
     8 37H    STORE DRAG DURING DESCENT    ISTDE  ,I11)                      00164
      IF(NS.GT.1)WRITE(6,571)NS                                              00165
  571 FORMAT(/,1X,I2,23H POINT DESCENT SCHEDULE//                            00166
     3,13X,28HALTITUDE       DESCENT SPEED/                                  00167
     4,16X,20HFT              KNTS/                                          00168
     5,13X,28H(ADTAB)          (VDTAB)     /)                               00169
      IF(NS.GT.1)WRITE(6,575)(ADTAB(I),VDTAB(I),I=1,NS)                      00170
  575 FORMAT(12X,F8.1,10X,F7.2)                                              00171
      IF(SREMACH.LT.0.)SREMACH=CLMMIN(NCLRES)                                00172
      IF(EREMACH.LT.0.)EREMACH=DEMMIN                                        00173
      IF(SREALT.LT.0.)SREALT=CLAMIN(NCLRES)                                  00174
      IF(EREALT.LT.0.)EREALT=DEAMIN                                          00175
      IF(NCRHOL.LE.0)NCRHOL=NCRRES                                           00176
      WRITE(6,600)RS,RESERFU,MAPTIM,ALTRAN,NCLRES,NCRRES,HOLDTIM             00177
     1,NCRHOL,IHOPOS,SREMACH,EREMACH,SREALT,EREALT                           00178
  600 FORMAT(22H0RESERVE SEGMENT INPUT/                                      00179
     1 37H    RESERVE CALC. OR CONST       RS     ,I11/                      00180
     2 37H    RESERVE FUEL                 RESERFU,F11.3,5H  LBM/            00181
     3 37H    MISSED APPROACH TIME         MAPTIM ,F11.1,5H  MIN/            00182
     5 37H    RANGE TO ALTERNATE AIRPORT   ALTRAN ,F11.1,6H  N MI/            00183
     6 37H    RESERVE CLIMB SCHEDULE       NCLRES ,I11/                      00184
     7 37H    RESERVE CRUISE SCHEDULE      NCRRES ,I11/                      00185
     9 37H    RESERVE HOLDING TIME         HOLDTIM,F11.1,5H  MIN/            00186
     5 37H    HOLD CRUISE SCHEDULE         NCRHOL ,I11/                      00187
     6 37H    HOLD POSITION SWITCH         IHOPOS ,I11/                      00188
     1 37H    START RESERVE MACH NUMBER    SREMACH,F11.4/                    00189
     2 37H    END RESERVE MACH NUMBER      EREMACH,F11.4/                    00190
     3 37H    START RESERVE ALTITUDE       SREALT ,F11.0,3H FT/              00191
     4 37H    END RESERVE ALTITUDE         EREALT ,F11.0,3H FT)              00192
      IF(IPLOTPS.EQ.1)WRITE(6,620)XMAX,XMIN,XINC,YMAX,YMIN,YINC,             00193
     1 WTPLOT,NCONINT                                                        00194
  620 FORMAT(23H0CLIMB DATA PLOTS INPUT/                                     00195
     1 37H    MAX. MACH NO.                XMAX   ,F11.4/                    00196
     1 37H    MIN. MACH NO.                XMIN   ,F11.4/                    00197
     2 37H    MACH NO. INCREMENT           XINC   ,F11.4/                    00198
     3 37H    MAX. ALTITUDE                YMAX   ,F11.1,4H  FT/             00199
     4 37H    MIN. ALTITUDE                YMIN   ,F11.1,4H  FT/             00200
     5 37H    ALTITUDE INCREMENT           YINC   ,F11.1,4H  FT/             00201
     6 37H    GROSS WEIGHT                 WTPLOT ,F11.1,5H  LBM/            00202
     7 37H    NO. OF CONTOUR INTERVALS     NCONINT,I11//)                    00203
C                                                                            00204
      DO 750 I=1,3                                                           00205
      NSTD(I)=0                                                              00206
      DO 700 J=2,20                                                          00207
      IF(STMA(J,I).LE.0.)GO TO 710                                           00208
  700 NSTD(I)=J                                                              00209
  710 IF(NSTD(I).EQ.0)GO TO 750                                              00210
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      WRITE(6,720)I                                                     00211
  720 FORMAT(26H0STORE DRAG COEFFICIENTS -,I2)                          00212
      INS=NSTD(I)                                                       00213
      IF(INS.GT.10)INS=10                                               00214
      WRITE(6,730)(STMA(J,I),J=1,INS)                                   00215
      WRITE(6,740)(CDST(J,I),J=1,INS)                                   00216
      IF(NSTD(I).LT.11)GO TO 750                                        00217
      INS=NSTD(I)                                                       00218
      WRITE(6,730)(STMA(J,I),J=11,INS)                                  00219
      WRITE(6,740)(CDST(J,I),J=11,INS)                                  00220
  730 FORMAT(17H0MACH NUMBER      ,10F11.5)                             00221
  740 FORMAT(17H DRAG COEFFICIENT,10F11.5)                              00222
  750 CONTINUE                                                          00223
      G=22.5886                                                         00224
      RADA=0.                                                           00225
      IF(IRADACC.EQ.1)RADA=2./G                                         00226
      DO 300 J=1,NCLIMB                                                 00227
      NN=NO(J)                                                          00228
      IF(NN.LE.0)GO TO 300                                              00229
      DO 284 N=1,NN                                                     00230
      ASTAR=1.                                                          00231
      IF(VCTAB(N,J).LE.10.)CALL ATMO(ACTAB(N,J),DTC,DELTA,THETA,ASTAR)  00232
  284 VCTAB(N,J)=ACTAB(N,J)+(ASTAR*VCTAB(N,J))**2/G                     00233
      DO 286 N=2,NN                                                     00234
      DO 285 I=2,NN                                                     00235
      IF(VCTAB(I,J).GE.VCTAB(I-1,J))GO TO 285                           00236
      V1=VCTAB(I,J)                                                     00237
      A1=ACTAB(I,J)                                                     00238
      VCTAB(I,J)=VCTAB(I-1,J)                                           00239
      ACTAB(I,J)=ACTAB(I-1,J)                                           00240
      VCTAB(I-1,J)=V1                                                   00241
      ACTAB(I-1,J)=A1                                                   00242
  285 CONTINUE                                                          00243
  286 CONTINUE                                                          00244
  300 CONTINUE                                                          00245
      IF(NS.LE.0)GO TO 5                                                00246
      DO 384 N=1,NS                                                     00247
      ASTAR=1.                                                          00248
      IF(VDTAB(N).LE.10.)CALL ATMO(ADTAB(N),DTC,DELTA,THETA,ASTAR)      00249
  384 VDTAB(N)=ADTAB(N)+(ASTAR*VDTAB(N))**2/G                           00250
      DO 386 N=2,NS                                                     00251
      DO 385 I=2,NS                                                     00252
      IF(VDTAB(I).GE.VDTAB(I-1))GO TO 385                               00253
      V1=VDTAB(I)                                                       00254
      A1=ADTAB(I)                                                       00255
      VDTAB(I)=VDTAB(I-1)                                               00256
      ADTAB(I)=ADTAB(I-1)                                               00257
      VDTAB(I-1)=V1                                                     00258
      ADTAB(I-1)=A1                                                     00259
  385 CONTINUE                                                          00260
  386 CONTINUE                                                          00261
    5 READ(5,10)ASEG,BSEG,I,M,STMACH,STALT                              00262
   10 FORMAT(A4,A3,I1,I2,7F10.0)                                        00263
      IFREE=0                                                           00264
      IQUIT=0                                                           00265
      I=0                                                               00266
      DISPOZE=0.                                                        00267
      IF(ASEG.NE.4HSTAR)GO TO 80                                        00268
   20 I=I+1                                                             00269
      IF(I.GT.40)GO TO 250                                              00270
      READ(5,10)ASEG,BSEG,ISTAC(I),MSEG(I),DSEG(I),ESEG(I),FSEG(I),     00271
     1 GSEG(I),HSEG(I),CSEG(I)                                          00272
      IF(I.GT.1)GO TO 50                                                00273
      IF(ASEG.NE.4HCLIM)GO TO 30                                        00274
      M=MSEG(I)                                                         00275
      IF(M.LE.0)M=1                                                     00276
      IF(STMACH.LT.CLMMIN(M))STMACH=CLMMIN(M)                           00277
      IF(STALT.LT.CLAMIN(M))STALT=CLAMIN(M)                             00278
   30 WRITE(6,40)STMACH,STALT                                           00279
   40 FORMAT(30H0SEGMENT DEFINITION INPUT DATA//8H   START,10X,          00280
```

```
     1 13HMACH NUMBER =,F7.4,10X,10HALTITUDE =,F10.0,3H FT)                    00281
  50 DO 60 J=1,9                                                              00282
     JSEG(I)=J                                                                00283
  60 IF(ASEG.EQ.SEGT(J,1))GO TO(110,120,130,140,150,160,170,180,190)J         00284
  80 WRITE(6,90)ASEG,BSEG                                                     00285
  90 FORMAT(3H  *,A4,A3,8X,25HUNRECOGNIZED SEGMENT TYPE)                      00286
     IQUIT=1                                                                  00287
     GO TO 20                                                                 00288
 110 IF(MSEG(I).LE.0)MSEG(I)=1                                                00289
     WRITE(6,115)MSEG(I)                                                      00290
 115 FORMAT(8H   CLIMB,10X,18HUSE CLIMB SCHEDULE,I3)                          00291
     GO TO 20                                                                 00292
 120 IF(MSEG(I).LE.0)MSEG(I)=1                                                00293
     WRITE(6,125)MSEG(I),DSEG(I)                                              00294
 125 FORMAT(9H   CRUISE,9X,19HUSE CRUISE SCHEDULE,I2,9X,                      00295
    1 21HEND CRUISE DISTANCE =,F8.1,5H N MI)                                  00296
     IF(DSEG(I).GE.0..OR.IFREE.EQ.0)IFREE=I                                   00297
     GO TO 20                                                                 00298
 130 WRITE(6,135)DSEG(I),ESEG(I)                                              00299
 135 FORMAT(9H   REFUEL,9X,12HFUEL ADDED =,F9.1,3H LB,                        00300
    1 6X,15HTIME REQUIRED =,F5.1,4H MIN)                                      00301
     GO TO 20                                                                 00302
 140 WRITE(6,145)DSEG(I)                                                      00303
 145 FORMAT(10H   RELEASE,8X,16HPAYLOAD WEIGHT =,F10.1,3H LB)                 00304
     DISPOZE=DISPOZE+DSEG(I)                                                  00305
     GO TO 20                                                                 00306
 150 IF(MSEG(I).LE.0)MSEG(I)=1                                                00307
     WRITE(6,155)DSEG(I),MSEG(I)                                              00308
 155 FORMAT(13H   ACCELERATE,5X,16HTO MACH NUMBER =,F7.4,7X,                  00309
    1 16HAT POWER SETTING,I2)                                                 00310
     IF(FSEG(I).GT.0..OR.GSEG(I).GT.0.)WRITE(6,157)FSEG(I),GSEG(I)            00311
 157 FORMAT(18X,19HSTART MACH NUMBER =,F7.4,4X,10HALTITUDE =,F10.0,           00312
    1 3H FT)                                                                  00313
     IF(HSEG(I).NE.0.)WRITE(6,158)HSEG(I)                                     00314
 158 FORMAT(18X,16HACCEL DELTA CD =,F11.5)                                    00315
     IF(CSEG(I).GT.0.)WRITE(6,159)CSEG(I)                                     00316
 159 FORMAT(18X,13HAT A WEIGHT =,F10.1,3H LB)                                 00317
     IF(ISTAC(I).GT.0)WRITE(6,161)                                            00318
 161 FORMAT(18X,27HSTORE DRAG WILL BE INCLUDED)                               00319
     GO TO 20                                                                 00320
 160 IF(MSEG(I).LE.0)MSEG(I)=1                                                00321
     WRITE(6,165)MSEG(I),DSEG(I)                                              00322
 165 FORMAT(7H   HOLD,11X,19HUSE CRUISE SCHEDULE,I2,9X,                       00323
    1 11HHOLD TIME =,F5.1,4H MIN)                                             00324
     GO TO 20                                                                 00325
 170 WRITE(6,175)                                                             00326
 175 FORMAT(10H   DESCENT)                                                    00327
     GO TO 20                                                                 00328
 190 IF(MSEG(I).LE.0)GO TO 194                                                00329
     WRITE(6,192)DSEG(I),MSEG(I)                                              00330
 192 FORMAT(7H   TURN,11X,5HARC =,F6.1,8H DEGREES,11X,                        00331
    1 16HAT POWER SETTING,I2)                                                 00332
     GO TO 198                                                                00333
 194 WRITE(6,196)DSEG(I),ESEG(I)                                              00334
 196 FORMAT(7H   TURN,11X,5HARC =,F6.1,8H DEGREES,11X,                        00335
    1 14HACCELERATION =,F5.2,2H G)                                            00336
 198 IF(FSEG(I).GT.0..OR.GSEG(I).GT.0.)WRITE(6,199)FSEG(I),GSEG(I)            00337
 199 FORMAT(18X,13HMACH NUMBER =,F7.4,10X,10HALTITUDE =,F10.0,3H FT)          00338
     IF(HSEG(I).NE.0.)WRITE(6,200)HSEG(I)                                     00339
 200 FORMAT(18X,15HTURN DELTA CD =,F11.5)                                     00340
     IF(CSEG(I).GT.0.)WRITE(6,159)CSEG(I)                                     00341
     IF(ISTAC(I).GT.0)WRITE(6,161)                                            00342
     GO TO 20                                                                 00343
 180 IF(DSEG(I).LT.DEMMIN)DSEG(I)=DEMMIN                                      00344
     IF(ESEG(I).LT.DEAMIN)ESEG(I)=DEAMIN                                      00345
     WRITE(6,185)DSEG(I),ESEG(I)                                              00346
 185 FORMAT(6H   END,12X,                                                     00347
    1 13HMACH NUMBER =,F7.4,10X,10HALTITUDE =,F10.0,3H FT)                    00348
     NUMSEG=I-1                                                               00349
     IF(IQUIT.EQ.0)RETURN                                                     00350
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250 WRITE(6,260)                                                    00351
260 FORMAT(28H0ERROR IN SEGMENT INPUT DATA)                         00352
    STOP                                                            00353
    END                                                             00354
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      SUBROUTINE MISSION(ENGSKAL,IPRNT,ENDESWT)                          00355
      COMMON/COSTCON/ICOST,OFC                                           00356
      COMMON/COSTDAT/VWTS(28),VQ,VRANG,VGW,VBLF,VBLT,VSPD,NSV,VTGM,      00357
     1 NVCR,VDU(4),VCOST                                                 00358
C  MISSION ANALYSIS PROGRAM                                             00359
      COMMON/FLIGHT/STMACH,STALT,NUMSEG,DISPOZE,IFREE,FSEG(40),GSEG(40),00360
     1 JSEG(40),MSEG(40),DSEG(40),ESEG(40),SEGT(9,2),HSEG(40),CSEG(40)  00361
      COMMON/PLTP/XMAX,XMIN,XINC,YMAX,YMIN,YINC,NCONINT,WTPLOT           00362
     1,IPLOTPS                                                           00363
      COMMON/PLTV/Z(15,15)                                               00364
      COMMON /AERO/ CDTAB(500),CDPA(400)                                 00365
      COMMON/MISS/WTAB(30),HPTB(31,30,4),HPDE(31,30),CRANGE(60,5),       00366
     1 CRTIME(60,5),CWEIGHT(60),HOTAB(30,5),WFTAB(30,5),VOTAB(30,5),     00367
     2 LDTAB(30,5),WTA(40),HPA(40),EMA(40),CDIST(40),CTIME(40),          00368
     3 CFUEL(40),RESFUEL(30),ENRESWT(30),ENRCL(32,4),ENRDE(32)           00369
      COMMON/MISIN/INDR,ESKAL,OWFACT,RTOL,IATA,                          00370
     1 OFFDR(10),DWT,TAXOTIM,TAKOTIM,TAXITIM,RS,NHOLD,                   00371
     2 RESERFU,DSTGRNG                                                   00372
      COMMON/DESCIN/NCLIMB,QLIM,NODIVE,IFAACL,CLMMIN(4),CLMMAX(4),       00373
     1 CLAMIN(4),CLAMAX(4),NINCL(4),CLDCD(4),NO(4),                      00374
     2 ACTAB(10,4),VCTAB(10,4),DEMMAX,DEMMIN,DEAMAX,DEAMIN,VS,DECL,      00375
     3 NS,ADTAB(10),VDTAB(10),DEDCD,NINDE,NCRCL(4)                       00376
      COMMON/CRUIN/HPMIN,DCWT,RCIN,OC(5),CRMACH(5),CRALT(5),CRDCD(5),    00377
     1 CRMMIN(5),FLRCR(5),CRCLMAX(5),NCRUISE                             00378
      COMMON/TRNSF/ASTAR,CDT,CL,CLM,D,DCD,DIST,DELTA,ENG,FUEL,G,HP,HPL,  00379
     1 II,LD,MACH,NW,Q,RCI,RCM,RSM,RSR,SR,SREF,THETA,TIME,VH,VT,         00380
     2 WF,WFD,WT,DTC,IFLAG,FACT,IDOQ,ENGO,VMIN                           00381
      COMMON/ESB/RAMPWT,DOWE,PAYLOAD,MAXFUEL,MYWTS,MYAERO,               00382
     1 ATARANG,FLIGTIM,AVCRLD,ITAKOFF,ILAND,RW                           00383
      COMMON/EDATA/NM,NA,NT,EMACH(20),ALT(10,20),FF(16,10,20),           00384
     1 THR(16,10,20),EXTFAC,FFFAC,DFFAC,IDFUEFL,TAKOFF,IXTRAP,MAXCR      00385
      COMMON/CONFIG/GW,AR,THRM,SW,TR,SWEEP,TCA,VCMN,CH,WWSTR,            00386
     1 DUMV1,DUMV2,DESRNG                                                00387
      REAL MACH,LD,IDFUEFL,MAXFUEL,LINT1,LDTAB                           00388
      INTEGER VS,RS,RW,OC,ESKAL                                          00389
      NAMELIST/PLOT/XMIN,XMAX,XINC,YMIN,YMAX,YINC,Z,NCONINT              00390
      DATA IFLO/0/                                                       00391
C                                                                        00392
      IF(IFLO.EQ.0)IFLO=IFLAG                                            00393
      IFLAG=IFLO                                                         00394
      IF(IPRNT.EQ.0)IFLAG=0                                              00395
      I=CDTAB(1)/1000.                                                   00396
      J=(CDTAB(1)-I*1000.+.5)+1                                          00397
      CLM=CDTAB(J)                                                       00398
      SREF=SW                                                            00399
      RANG=DESRNG                                                        00400
    1 WTMAX=(IFIX((RAMPWT+DWT/2.)/DWT)+1)*DWT                            00401
      WTMIN=(IFIX((DOWE+PAYLOAD-DISPOZE-DWT/2.)/DWT))*DWT                00402
      TWT=(WTMAX-WTMIN)/29.                                              00403
      IF(TWT.LE.DWT)GO TO 4                                              00404
      DTWT=1.                                                            00405
      DO 2 I=1,10                                                        00406
      DDTW=TWT/DTWT                                                      00407
      IF(DDTW.LE.10.)GO TO 3                                             00408
    2 DTWT=DTWT*10.                                                      00409
      STOP                                                               00410
    3 IF(DDTW.LT.4.)DTWT=DTWT/2.                                         00411
      IF(DDTW.LT.2.)DTWT=DTWT/2.5                                        00412
      DWT=(IFIX(TWT/DTWT)+1)*DTWT                                        00413
      GO TO 1                                                            00414
    4 IF((WTMAX-WTMIN)/DCWT.GT.599.)DCWT=DWT/20.                         00415
      NW=0                                                               00416
C                                                                        00417
      DO 10 J=1,30                                                       00418
      WTAB(J)=WTMIN+DWT*(J-1)                                            00419
      NW=NW+1                                                            00420
      IF (WTAB(J)-WTMAX) 10,480,11                                       00421
   10 CONTINUE                                                           00422
   11 WTAB(NW)=WTMAX                                                     00423
```

```
 480  CONTINUE                                                          00424
C                                                                      00425
      IF(ESKAL.NE.0) CALL SKALENG(ENGSKAL,IFLAG)                       00426
      DO 20 M=1,NCRUISE                                                00427
      VMAX=CRMACH(M)                                                   00428
      IF(VMAX.LE.0.)VMAX=VCMN                                          00429
      HPL=CRALT(M)                                                     00430
      IF(HPL.LT.0.)HPL=CH                                              00431
      DCD=CRDCD(M)                                                     00432
      VFIX=CRMMIN(M)                                                   00433
      CALL CRUISE(HPMIN,DCWT,RCIN,OC(M),VMAX,VFIX,FLRCR(M),            00434
     1 CRCLMAX(M),M,IQUIT,NCW,MAXCR)                                   00435
      IF(IQUIT.EQ.0)GO TO 20                                           00436
      ATARANG=0.                                                       00437
      RETURN                                                           00438
   20 CONTINUE                                                         00439
C                                                                      00440
      IF(IPLOTPS.EQ.0)GO TO 80                                         00441
      M=IABS(IPLOTPS)                                                  00442
      IF(M.GT.NCLIMB)M=NCLIMB                                          00443
      MM=NCRCL(M)                                                      00444
      DCD=CLDCD(M)                                                     00445
      N=0                                                              00446
      IF(IPLOTPS.LT.0)N=1                                              00447
      IPLOTPS=0                                                        00448
      NX=(XMAX-XMIN)/XINC+1.1                                          00449
      NY=(YMAX-YMIN)/YINC+1.1                                          00450
      WT=WTPLOT                                                        00451
      CVO=LINT1(WT,WTAB,NW,VOTAB(1,MM))                                00452
      CWF=LINT1(WT,WTAB,NW,WFTAB(1,MM))                                00453
      DO 50 J=1,NY                                                     00454
      HP=YMIN+(J-1)*YINC                                               00455
      CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                              00456
      DO 50 I=1,NX                                                     00457
      MACH=XMIN+(I-1)*XINC                                             00458
      VT=MACH*ASTAR                                                    00459
      ENERGY=HP+VT*VT/G                                                00460
      CALL RCINST(ENERGY,IPS,CVO,CWF,M,N)                              00461
      Z(I,J)=RCM                                                       00462
   50 IF(N.EQ.0)Z(I,J)=RCM/60.                                         00463
      WRITE(7,PLOT)                                                    00464
C                                                                      00465
   80 DO 100 M=1,NCLIMB                                                00466
      VMAX=CLMMAX(M)                                                   00467
      IF(VMAX.LE.0.)VMAX=VCMN                                          00468
      HPL=CLAMAX(M)                                                    00469
      IF(HPL.LE.0.)HPL=CH                                              00470
      II=NINCL(M)                                                      00471
      MM=NCRCL(M)                                                      00472
      DCD=CLDCD(M)                                                     00473
  100 CALL OPTCL(VMAX,QLIM,CLAMIN(M),RCIN,WTAB,HPTB(1,1,M),0,NODIVE,   00474
     1 NO(M),ACTAB(1,M),VCTAB(1,M),0,DECL,CLMMIN(M),M,ENRCL(1,M),      00475
     2 IFAACL,VOTAB(1,MM),WFTAB(1,MM))                                 00476
C                                                                      00477
      IF(VS.EQ.0)GO TO 600                                             00478
      VMAX=DEMMAX                                                      00479
      IF(VMAX.LE.0.)VMAX=VCMN                                          00480
      HPL=DEAMAX                                                       00481
      IF(HPL.LE.0.)HPL=CH                                              00482
      DCD=DEDCD                                                        00483
      II=NINDE                                                         00484
      CALL OPTCL(VMAX,QLIM,DEAMIN,0.,WTAB,HPDE,1,NODIVE,NS,ADTAB,VDTAB,00485
     1 VS,DECL,DEMMIN,1,ENRDE,IFAACL,VOTAB,WFTAB)                      00486
C                                                                      00487
  600 IF(IFLAG .EQ. 0) GO TO 618                                       00488
      WRITE (6,321)(M,M=1,5)                                           00489
      DO 610 I=1,NCW                                                   00490
  610 WRITE(6,311)CWEIGHT(I),(CRANGE(I,J),CRTIME(I,J),J=1,NCRUISE)     00491
C                                                                      00492
  618 IF (RS.EQ.1)CALL RESERVE(VS,NINCL,NINDE,NCW,CLDCD,DEDCD)         00493
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      TAXOFUE=(TAXOTIM*IDFUEFL/60.)*ENG                                 00494
      TAKOFUE=(TAKOTIM*TAKOFF/60.)*ENG                                  00495
      TAXIFUE=(TAXITIM*IDFUEFL/60.)*ENG                                 00496
      IOFF=0                                                            00497
      ICOUNT=1                                                          00498
      GW=RAMPWT                                                         00499
C                                                                       00500
  632 TOGW=RAMPWT-TAXOFUE                                               00501
      VQ=0.                                                             00502
      OWE=DOWE*OWFACT                                                   00503
      WTA(1)=TOGW-TAKOFUE                                               00504
      EMA(1)=STMACH                                                     00505
      HPA(1)=STALT                                                      00506
      ZFW=OWE+PAYLOAD-DISPOZE                                           00507
      TOTFUEL=RAMPWT-ZFW-DISPOZE                                        00508
      FIXRFU=RESERFU                                                    00509
      IF(RESERFU.LT.1.)FIXRFU=RESERFU*TOTFUEL                           00510
      RFUEL=0.                                                          00511
      IF(RS.EQ.1)RFUEL=LINT1(ZFW,ENRESWT,NW,RESFUEL)                    00512
      RFUEL=RFUEL+FIXRFU                                                00513
      N=NUMSEG+1                                                        00514
      WTA(N)=ZFW+RFUEL                                                  00515
      EMA(N)=DSEG(N)                                                    00516
      IF(IOFF.EQ.0)ENDESWT=WTA(N)                                       00517
      HPA(N)=ESEG(N)                                                    00518
      SDIST=0.                                                          00519
C                                                                       00520
      DO 1000 J=1,NUMSEG                                                00521
      I=J                                                               00522
      IMOD=0                                                            00523
      IF(I.LT.IFREE)GO TO 105                                           00524
      I=NUMSEG-J+IFREE                                                  00525
      IMOD=1                                                            00526
      IF(I.EQ.NUMSEG)SDIST=0.                                           00527
  105 M=MSEG(I)                                                         00528
      IF(I.EQ.IFREE)GO TO 500                                           00529
      WT=WTA(I+IMOD)                                                    00530
      HP=HPA(I+IMOD)                                                    00531
      MACH=EMA(I+IMOD)                                                  00532
      CFUEL(I)=0.                                                       00533
      CDIST(I)=0.                                                       00534
      CTIME(I)=0.                                                       00535
      GO TO (110,120,130,140,150,160,170,1000,190)JSEG(I)               00536
C                                                                       00537
C     CLIMB                                                             00538
  110 IF(IFLAG.GT.1)WRITE(6,4055)I                                      00539
 4055 FORMAT(/31H0CLIMB PROFILE DATA FOR SEGMENT,I3/58X,                00540
     1 19H- - INCREMENTAL - -,12X,22H- - - CUMULATIVE - - -)            00541
      IF(IFLAG.GT.1)WRITE(6,4057)                                       00542
 4057 FORMAT(13H    WEIGHT    ,                                        00543
     155HENERGY   ALT      MACH     VEL       RCI  PC   TIME   DIST,    00544
     257H     FUEL     Q       TIME     DIST       FUEL      CL    L/D/)00545
C                                                                       00546
      N=MSEG(I+1)                                                       00547
      CVO=LINT1(WT,WTAB,NW,VOTAB(1,N))                                  00548
      CWF=LINT1(WT,WTAB,NW,WFTAB(1,N))                                  00549
      II=NINCL(M)                                                       00550
      DCD=CLDCD(M)                                                      00551
      CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                               00552
      ENERGY=HP+(MACH*ASTAR)**2/G                                       00553
      CALL RCINST(ENERGY,IPS,CVO,CWF,M,0)                               00554
      CALL CLIMB(VOTAB(1,N),ENERGY,1,ENRCL(1,M),HOTAB(1,N),WTAB,        00555
     1 HPTB(1,1,M),0,VS,WFTAB(1,N),M,IPS)                               00556
      CFUEL(I)=FUEL                                                     00557
      CDIST(I)=DIST                                                     00558
      CTIME(I)=TIME                                                     00559
      WTA(I+1)=WTA(I)-FUEL                                              00560
      HPA(I+1)=HP                                                       00561
      EMA(I+1)=MACH                                                     00562
      SDIST=SDIST+DIST                                                  00563
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      GO TO 1000                                                        00564
C                                                                       00565
C     CRUISE                                                            00566
  120 CDIST(I)=DSEG(I)-SDIST                                            00567
      TDIST=LINT1(WT,CWEIGHT,NCW,CRANGE(1,M))+CDIST(I)                  00568
      WTA(I+1-IMOD)=LINT1(TDIST,CRANGE(1,M),NCW,CWEIGHT)                00569
      CFUEL(I)=WTA(I)-WTA(I+1)                                          00570
      CTIME(I)=(LINT1(TDIST,CRANGE(1,M),NCW,CRTIME(1,M))-               00571
     1 LINT1(WT,CWEIGHT,NCW,CRTIME(1,M)))*60.                           00572
      SDIST=DSEG(I)                                                     00573
      WT=WTA(I+1-IMOD)                                                  00574
      HPA(I+1-IMOD)=LINT1(WT,WTAB,NW,HOTAB(1,M))                        00575
      CALL ATMO(HPA(I+1-IMOD),DTC,DELTA,THETA,ASTAR)                    00576
      EMA(I+1-IMOD)=LINT1(WT,WTAB,NW,VOTAB(1,M))/ASTAR                  00577
      IF(IMOD.EQ.0)GO TO 1000                                           00578
      CDIST(I)=-CDIST(I)                                                00579
      CTIME(I)=-CTIME(I)                                                00580
      GO TO 1000                                                        00581
C                                                                       00582
C     REFUEL                                                            00583
  130 WTA(I+1)=WTA(I)+DSEG(I)                                           00584
      HPA(I+1)=HPA(I)                                                   00585
      EMA(I+1)=EMA(I)                                                   00586
      CFUEL(I)=-DSEG(I)                                                 00587
      CTIME(I)=ESEG(I)                                                  00588
      GO TO 1000                                                        00589
C                                                                       00590
C     RELEASE                                                           00591
  140 WTA(I+1)=WTA(I)-DSEG(I)                                           00592
      HPA(I+1)=HPA(I)                                                   00593
      EMA(I+1)=EMA(I)                                                   00594
      GO TO 1000                                                        00595
C                                                                       00596
C     ACCELERATION                                                      00597
  150 CALL ACCEL(I,MPS)                                                 00598
      IF(CSEG(I).GT.0.)GO TO 151                                        00599
      CDIST(I)=DIST                                                     00600
      CFUEL(I)=FUEL                                                     00601
      CTIME(I)=TIME                                                     00602
  151 WTA(I+1)=WTA(I)-CFUEL(I)                                          00603
      HPA(I+1)=HP                                                       00604
      EMA(I+1)=MACH                                                     00605
      IF(IFLAG.GT.0)WRITE(6,152)TIME,DIST,FUEL                          00606
  152 FORMAT(20H0ACCELERATION TIME =,F8.4,                              00607
     1 12H, DISTANCE =,F9.4,8H, FUEL =,F10.4)                           00608
      IF(MPS.NE.MSEG(I).AND.IFLAG.GT.0)WRITE(6,155)MPS                  00609
  155 FORMAT(34H * * * ACCELERATE AT POWER SETTING,I2,6H * * *)         00610
      GO TO 1000                                                        00611
C                                                                       00612
C     HOLD                                                              00613
  160 HOTIM=LINT1(WT,CWEIGHT,NCW,CRTIME(1,M))+(1-2*IMOD)*DSEG(I)/60.    00614
      WTA(I+1-IMOD)=LINT1(HOTIM,CRTIME(1,M),NCW,CWEIGHT)                00615
      CFUEL(I)=WTA(I)-WTA(I+1)                                          00616
      CTIME(I)=DSEG(I)                                                  00617
      HPA(I+1-IMOD)=LINT1(WTA(I+1-IMOD),WTAB,NW,HOTAB(1,M))             00618
      CALL ATMO(HPA(I+1-IMOD),DTC,DELTA,THETA,ASTAR)                    00619
      EMA(I+1-IMOD)=LINT1(WTA(I+1-IMOD),WTAB,NW,VOTAB(1,M))/ASTAR       00620
      GO TO 1000                                                        00621
C                                                                       00622
C     DESCENT                                                           00623
  170 IF(IFLAG.GT.1.AND.VS.GT.0)WRITE(6,4056)I                          00624
 4056 FORMAT(/33H0DESCENT PROFILE DATA FOR SEGMENT,I3/58X,              00625
     1 19H- - INCREMENTAL - -,12X,22H- - - CUMULATIVE - - -)            00626
      IF(IFLAG.GT.1.AND.VS.GT.0)WRITE(6,4057)                           00627
C                                                                       00628
      N=MSEG(I-1)                                                       00629
      II=NINDE                                                          00630
      DCD=DEDCD                                                         00631
      CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                               00632
      ENERGY=HP+(MACH*ASTAR)**2/G                                       00633
```

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      CALL RCINST(ENERGY,IPS,CVO,CWF,M,2)                                00634
      CALL CLIMB(VOTAB(1,N),ENERGY,1,ENRDE,HOTAB(1,N),WTAB,HPDE,         00635
     1 2,VS,WFTAB(1,N),M,IPS)                                            00636
      CTIME(I)=-TIME                                                     00637
      CDIST(I)=DIST                                                      00638
      CFUEL(I)=-FUEL                                                     00639
      WTA(I)=WTA(I+1)-FUEL                                               00640
      HPA(I)=HP                                                          00641
      EMA(I)=MACH                                                        00642
      SDIST=SDIST-DIST                                                   00643
      GO TO 1000                                                         00644
C                                                                        00645
C     TURN                                                               00646
  190 CALL TURN(I,GEES,AR,OMEGA)                                         00647
      CFUEL(I)=FUEL                                                      00648
      CTIME(I)=TIME                                                      00649
      WTA(I+1)=WTA(I)-CFUEL(I)                                           00650
      HPA(I+1)=HP                                                        00651
      EMA(I+1)=MACH                                                      00652
      IF(IFLAG.GT.0)WRITE(6,195)GEES,OMEGA                               00653
  195 FORMAT(7H0TURN =,F8.4,11H G, OMEGA =,F6.2,8H DEG/SEC)              00654
 1000 CONTINUE                                                           00655
C                                                                        00656
C     FINAL CRUISE SEGMENT                                               00657
  500 CDIST(I)=LINT1(WTA(I+1),CWEIGHT,NCW,CRANGE(1,M))-                  00658
     1 LINT1(WTA(I),CWEIGHT,NCW,CRANGE(1,M))                             00659
      CTIME(I)=(LINT1(WTA(I+1),CWEIGHT,NCW,CRTIME(1,M))-                 00660
     1 LINT1(WTA(I),CWEIGHT,NCW,CRTIME(1,M)))*60.                        00661
      CFUEL(I)=WTA(I)-WTA(I+1)                                           00662
      IF(IOFF.EQ.0)AVCRLD=0.5*(LINT1(WTA(I),WTAB,NW,LDTAB(1,M))+         00663
     1 LINT1(WTA(I+1),WTAB,NW,LDTAB(1,M)))                               00664
      IF(VS.GT.0)GO TO 505                                               00665
      HPA(I+1)=LINT1(WTA(I+1),WTAB,NW,HOTAB(1,M))                        00666
      CALL ATMO(HPA(I+1),DTC,DELTA,THETA,ASTAR)                          00667
      EMA(I+1)=LINT1(WTA(I+1),WTAB,NW,VOTAB(1,M))/ASTAR                  00668
C                                                                        00669
C     SUMMARIZE SEGMENTS                                                 00670
  505 DESIRAN=0.                                                         00671
      FLIGTIM=0.                                                         00672
      TFUEL=0.                                                           00673
      DO 510 I=1,NUMSEG                                                  00674
      DESIRAN=DESIRAN+CDIST(I)                                           00675
      FLIGTIM=FLIGTIM+CTIME(I)                                           00676
  510 TFUEL=TFUEL+CFUEL(I)                                               00677
      BLOCTIM=(TAXOTIM+TAKOTIM+FLIGTIM+TAXITIM)/60.                      00678
      BLOCFUE=TAXOFUE+TAKOFUE+TFUEL+TAXIFUE                              00679
      VCR=LINT1(WTA(IFREE+1),WTAB,NW,VOTAB(1,M))                         00680
      AIRMAN=VCR/10.                                                     00681
      APTAL=17.4                                                         00682
      AWDFACT=.02*DESIRAN                                                00683
      ATATRAL=AIRMAN+APTAL+AWDFACT                                       00684
      ATARANG=DESIRAN-ATATRAL                                            00685
      IF(IATA.EQ.0) ATARANG=DESIRAN                                      00686
      IF(INDR.NE.0)ATARANG=FLIGTIM                                       00687
      IF (RW.EQ.2) GO TO 661                                             00688
      IF(DSTGRNG.GT.0.)RANG=2.*CDIST(1)+DSTGRNG                          00689
      IF(ICOUNT.GE.10.OR.ABS(ATARANG-RANG).LE.RTOL) GO TO 660            00690
      IF(IPRNT.GT.0) WRITE(6,653) ATARANG,RAMPWT                         00691
  653 FORMAT(2X,8H  RANGE=,F9.3,2X,19HFOR GROSS WEIGHT OF,F10.2)         00692
      ICOUNT=ICOUNT+1                                                    00693
      IF(NHOLD.LE.0)GO TO 654                                            00694
      IF(ICOUNT.GT.2)GO TO 555                                           00695
      DELRPWT=(ATARANG-RANG)*CFUEL(IFREE)/CDIST(IFREE)                   00696
     1 *DSEG(NHOLD)/CFUEL(NHOLD)                                         00697
      GO TO 557                                                          00698
  555 DELRPWT=(W1-DSEG(NHOLD))*(ATARANG-RANG)/(ATARANG-R1)               00699
  557 W1=DSEG(NHOLD)                                                     00700
      R1=ATARANG                                                         00701
      DSEG(NHOLD)=DSEG(NHOLD)+DELRPWT                                    00702
      GO TO 632                                                          00703
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  654 IF(ICOUNT.GT.2) GO TO 655                                          00704
      DELRPWT=MAXFUEL*(RANG/ATARANG-1.)                                  00705
      IF(DELRPWT.GT.MAXFUEL*.5)DELRPWT=.5*MAXFUEL                        00706
      IF(ATARANG.LT.0.)DELRPWT=MAXFUEL*.5                                00707
      GO TO 657                                                          00708
  655 DELRPWT=(W1-RAMPWT)*(ATARANG-RANG)/(ATARANG-R1)                    00709
  657 IF(ABS(DELRPWT).GT.MAXFUEL)DELRPWT=MAXFUEL*SIGN(1.,DELRPWT)        00710
      W1=RAMPWT                                                          00711
      R1=ATARANG                                                         00712
      RAMPWT=RAMPWT+DELRPWT                                              00713
      GW=RAMPWT                                                          00714
      IF(IOFF.EQ.0.AND.MYWTS.EQ.0) CALL WEIGHT (0)                       00715
      GO TO 632                                                          00716
C                                                                        00717
  660 IF(IPRNT.GT.0.AND.IOFF.EQ.0.AND.MYWTS.EQ.0)CALL WEIGHT(IPRNT)      00718
  661 IF(ICOST.EQ.0) GO TO 670                                           00719
      VGW=GW                                                             00720
      VRANG=ATARANG*1.15078                                              00721
      VBLF=BLOCFUE                                                       00722
      VBLT=BLOCTIM                                                       00723
      VTGM=(TAXOTIM+TAXITIM)/60.                                         00724
      DO 664 J=1,NUMSEG                                                  00725
      IF(JSEG(J).EQ.2) GO TO 667                                         00726
  664 CONTINUE                                                           00727
      J=IFREE                                                            00728
  667 VSPD=60.*1.15078*CDIST(J)/CTIME(J)                                 00729
  670 IF(IPRNT .EQ. 0) GO TO 875                                         00730
      WRITE (6,299) SREF,ENGSKAL                                         00731
      WRITE (6,700) OWE,PAYLOAD,MAXFUEL,OWFACT                           00732
      WRITE(6,705)RAMPWT,TAXOFUE,TAXOFUE,TAXOTIM,TAXOTIM                 00733
  705 FORMAT(//30X,43H* * *  M I S S I O N   S U M M A R Y  * * *//      00734
     1 12X,7HINITIAL,9X,8HFUEL(LB),10X,9HTIME(MIN),6X,                   00735
     2 14HDISTANCE(N MI),4X,11HMACH NUMBER,4X,12HALTITUDE(FT)/           00736
     3 21H SEGMENT   WEIGHT(LB),3(18H    SEGMT    TOTAL),               00737
     4 2(16H   START    END )/9H0TAXI OUT,F12.0,2F9.0,2F9.1)             00738
      WT=RAMPWT-TAXOFUE                                                  00739
      FUEL=TAXOFUE+TAKOFUE                                               00740
      TIME=TAXOTIM+TAKOTIM                                               00741
      WRITE(6,710)WT,TAKOFUE,FUEL,TAKOTIM,TIME,STMACH,STALT              00742
  710 FORMAT(9H TAKE OFF,F12.0,2F9.0,2F9.1,26X,F8.3,8X,F8.0/)            00743
      DIST=0.                                                            00744
      DO 750 I=1,NUMSEG                                                  00745
      J=JSEG(I)                                                          00746
      TIME=TIME+CTIME(I)                                                 00747
      FUEL=FUEL+CFUEL(I)                                                 00748
      DIST=DIST+CDIST(I)                                                 00749
      MACH=EMA(I)                                                        00750
      HP=HPA(I)                                                          00751
      IF(FSEG(I).GT.0.)MACH=FSEG(I)                                      00752
      IF(GSEG(I).GT.0.)HP=GSEG(I)                                        00753
      IF(J.NE.2.AND.J.NE.6)GO TO 715                                     00754
      WT=WTA(I)                                                          00755
      M=MSEG(I)                                                          00756
      HP=LINT1(WT,WTAB,NW,HOTAB(1,M))                                    00757
      CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                                00758
      MACH=LINT1(WT,WTAB,NW,VOTAB(1,M))/ASTAR                            00759
  715 WRITE(6,720)SEGT(J,1),SEGT(J,2),WTA(I),CFUEL(I),FUEL,CTIME(I),     00760
     1 TIME,CDIST(I),DIST,MACH,EMA(I+1),HP,HPA(I+1)                      00761
  720 FORMAT(1X,2A4,F12.0,2F9.0,4F9.1,2F8.3,2F8.0)                       00762
  750 CONTINUE                                                           00763
      WT=WTA(NUMSEG+1)-RFUEL                                             00764
      TIME=TIME+TAXITIM                                                  00765
      FUEL=FUEL+RFUEL                                                    00766
      WRITE(6,760)WTA(NUMSEG+1),RFUEL,FUEL,TAXIFUE,TAXITIM,TIME,WT      00767
  760 FORMAT(9H0RESERVES,F12.0,2F9.0/8H TAXI IN,13X,F9.0,9X,2F9.1/       00768
     1 10H ZERO FUEL,F11.0)                                              00769
      WRITE (6,790) DESIRAN                                              00770
      WRITE (6,795) FLIGTIM                                              00771
      WRITE (6,800) BLOCTIM,BLOCFUE                                      00772
      WRITE (6,805) ATATRAL                                              00773
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      WRITE (6,810) AIRMAN                                                  00774
      WRITE (6,815) APTAL                                                   00775
      WRITE (6,820) AWDFACT                                                 00776
      WRITE (6,825) ATARANG                                                 00777
  299 FORMAT(1H1,5X,6HSREF= ,F7.0,5X,9HENGSKAL= ,F5.3)                      00778
  311 FORMAT (F10.0,5(F11.1,F9.2))                                          00779
  321 FORMAT(/39H0CRUISE SCHEDULE RANGE AND TIME SUMMARY /                  00780
     1 /4X,6HWEIGHT,5(6X,7HRANGE -,I1,6H- TIME)/3X,8H(POUNDS),              00781
     1 5(4X,7H(N.MI.),4X,5H(HR) )/)                                         00782
  700 FORMAT (/,3X,5HOWE= ,F8.0,2X,6HPOUNDS,5X,9HPAYLOAD= ,F8.0,            00783
     12X,6HPOUNDS,5X,14HMAXIMUM FUEL= ,F8.0,2X,6HPOUNDS,5X,7HOWFACT=,       00784
     2 F8.4,/)                                                              00785
  790 FORMAT(/5X,12HDESIGN RANGE,F9.1)                                      00786
  795 FORMAT (5X,11HFLIGHT TIME,F10.1/)                                     00787
  800 FORMAT (5X,13HBLOCK TIME = ,F6.2,1X,5HHOURS,/,5X,13HBLOCK FUEL = ,    00788
     1F8.0,1X,6HPOUNDS)                                                     00789
  805 FORMAT(/,5X,24HATA TRAFFIC ALLOWANCE = ,F7.1,1X,14HNAUTICAL MILES)    00790
  810 FORMAT (8X,15HAIR MANEUVER = ,F5.1)                                   00791
  815 FORMAT (8X,28HAIRPORT TRAFFIC ALLOWANCE = ,F4.1)                      00792
  820 FORMAT (8X,25HAIRWAY DISTANCE FACTOR = ,F5.1)                         00793
  825 FORMAT (/,5X,12HATA RANGE = ,F8.1,1X,14HNAUTICAL MILES)               00794
C                                                                           00795
      IOFF=IOFF+1                                                           00796
      IF(OFFDR(IOFF).LE.0.) GO TO 850                                       00797
      IF(IOFF.NE.1)GO TO 845                                                00798
      RO=RANG                                                               00799
      ATO=ATARANG                                                           00800
      WO=RAMPWT                                                             00801
  845 RAMPWT=RAMPWT-TFUEL*(1.-OFFDR(IOFF)/RANG)                             00802
      RANG=OFFDR(IOFF)                                                      00803
      GO TO 632                                                             00804
  850 IF(IOFF.LE.1)GO TO 875                                                00805
      RAMPWT=WO                                                             00806
      RANG=RO                                                               00807
      GW=WO                                                                 00808
      ATARANG=ATO                                                           00809
  875 CONTINUE                                                              00810
      RETURN                                                                00811
      END                                                                   00812
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      SUBROUTINE ATMO(HP,DTC,DELTA,THETA,ASTAR)                          00813
      H = HP*.0003048                                                    00814
      IF( H .GT. 11 ) GO TO 110                                          00815
      SAVE = 288.15-6.5*H                                                00816
      DELTA = ((SAVE)/288.15)**5.255876                                  00817
      GO TO 900                                                          00818
110   IF( H .GT. 20 ) GO TO 120                                          00819
      DH = H-11.0                                                        00820
      SAVE = 216.65                                                      00821
      DELTA = .2233611*EXP(-.1576887*DH)                                 00822
      GO TO 900                                                          00823
120   IF( H .GT. 32 ) GO TO 130                                          00824
      DH = H-20                                                          00825
      SAVE = 216.65+DH                                                   00826
      DELTA = .05403281*(216.65/SAVE)**34.16325                          00827
      GO TO 900                                                          00828
130   IF( H .GT. 47 ) GO TO 140                                          00829
      DH = H-32                                                          00830
      SAVE = 228.65+2.8*DH                                               00831
      DELTA = .008566631*(228.65/SAVE)**12.20116                         00832
      GO TO 900                                                          00833
140   IF( H .GT. 52 ) GO TO 150                                          00834
      DH = H-47                                                          00835
      SAVE = 270.65                                                      00836
      DELTA = .001094551*EXP(-.1262265*DH)                               00837
      GO TO 900                                                          00838
150   IF( H .GT. 61 ) GO TO 160                                          00839
      DH = H-52                                                          00840
      SAVE = 270.65-2.0*DH                                               00841
      DELTA = .0005822891*(SAVE/270.65)**17.08159                        00842
      GO TO 900                                                          00843
160   IF( H .GT. 70 ) GO TO 170                                          00844
      DH = H-61                                                          00845
      SAVE = 252.65-3.6*DH                                               00846
      DELTA = .000179718*(SAVE/252.65)**9.566413                         00847
      GO TO 900                                                          00848
170   IF( H .GT. 80 ) GO TO 180                                          00849
      DH = H-70                                                          00850
      SAVE = 220.25-2.9*DH                                               00851
      DELTA = 4.83505E-5*(SAVE/220.25)**12.3328                          00852
      GO TO 900                                                          00853
180   IF( H .GT. 90 ) GO TO 190                                          00854
      DH = H-80                                                          00855
      SAVE = 191.25                                                      00856
      DELTA = 8.476603E-6*EXP(-.1888576*DH)                              00857
      GO TO 900                                                          00858
190   DH = H-90                                                          00859
      SAVE = 191.25+3.0*DH                                               00860
      DELTA = 1.2824E-6*(191.25/SAVE)**11.3877                           00861
900   THETA = (SAVE+DTC)/288.15                                          00862
      ASTAR = 661.479*SQRT(THETA)                                        00863
      RETURN                                                             00864
      END                                                                00865
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      SUBROUTINE CRUISE(HPMIN,DCWT,RCIN,OC,VMAX,VFIX,RATIO,                00866
     1 CRCLMAX,M,IQUIT,NCW,MAXCR)                                          00867
      COMMON/FEATH/IFEATH(5),FEATHF(5),CDFEATH(5)                          00868
      COMMON/MISS/WTAB(30),HPTB(31,30,4),HPDE(31,30),CRANGE(60,5),         00869
     1 CRTIME(60,5),CWEIGHT(60),HOTAB(30,5),WFTAB(30,5),VOTAB(30,5),       00870
     2 LDTAB(30,5),RCLDIST(30),RCLFUEL(30),RDEDIST(30),RDEFUEL(30),        00871
     3 DUM(120),RESFUEL(30),ENRESWT(30),ENRCL(32,4),ENRDE(32)              00872
      COMMON/RADACC/REARTH,RADA                                            00873
      COMMON/TRNSF/ASTAR,CDT,CL,CLM,D,DCD,DIST,DELTA,ENG,FUEL,G,HP,HPL,    00874
     1 II,LD,MACH,NW,Q,RCI,RCM,RSM,RSR,SR,SREF,THETA,TIME,VH,VT,           00875
     2 WF,WFD,WT,DTC,IFLAG,FACT,IDOQ,ENGO,VMIN                             00876
      DIMENSION E(4),EE(4),F(4)                                            00877
      REAL MACH,LD,LINT1,LDTAB                                             00878
      INTEGER OC                                                           00879
      EMAX=100000.                                                         00880
      IMAX=0                                                               00881
      DEP=0.                                                               00882
      ENGO=ENG                                                             00883
      IF(IFEATH(M).LT.0)ENGO=ENG*FEATHF(M)                                 00884
      IF(IFLAG.GT.0)WRITE(6,100)M                                          00885
  100 FORMAT(/33H0SUMMARY DATA FOR CRUISE SCHEDULE,I2//                    00886
     1 4X,6HWEIGHT,2X,8HALTITUDE,8X,6HTHRUST,10X,4HFUEL,5X,3HSFC,4X,       00887
     1 4HMACH,2X,8HVELOCITY,1X,8HSPECIFIC,2X,7HRATE OF,4X,2HCL,6X,         00888
     2 3HL/D,3X,7HENGINES/22X,9HAVAILABLE,9H REQUIRED,4X,                  00889
     4 4HFLOW,11X,6HNUMBER,12X,5HRANGE,4X,5HCLIMB,18X,9HOPERATING/)        00890
      IQUIT=0                                                              00891
      ISR=1                                                                00892
      IF(OC.GT.3)ISR=0                                                     00893
      IF(OC.GT.7)ISR=2                                                     00894
      EP=.001                                                              00895
      IOC=OC+1                                                             00896
      IF(IOC.GT.4)IOC=9-IOC                                                00897
      IF(OC.EQ.8)IOC=3                                                     00898
      IF(OC.EQ.9)IOC=2                                                     00899
      HP=HPL                                                               00900
      MACH=VMAX                                                            00901
      IF(IOC/2.NE.1.OR.ISR.EQ.2)MACH=AMAX1((VMAX+VFIX)/2.,VMAX-.2)         00902
      IF(IOC.LT.3)HP=AMAX1((HPL-HPMIN)/2.,HPL-10000.)                      00903
      EF=3.                                                                00904
      DO 149 JJ=1,NW                                                       00905
C     J=NW+1-JJ                                                            00906
      J=JJ                                                                 00907
      WT=WTAB(J)                                                           00908
      IOM=1                                                                00909
      IF(IOC/2.EQ.1)IOM=0                                                  00910
      IOA=1                                                                00911
      IF(IOC.GT.2)IOA=0                                                    00912
      IF(IOA.EQ.0)HP=HPL                                                   00913
      VMIN=VFIX                                                            00914
      IF(CRCLMAX.LE.0.)GO TO 1130                                          00915
      CALL ATMO (HP,DTC,DELTA,THETA,ASTAR)                                 00916
      CLBAR=CRCLMAX+RADA*WT*ASTAR**2/(1481.35*DELTA*SREF*(REARTH+HP))      00917
      VMIN=SQRT(WT/1481.35/DELTA/CLBAR/SREF)                               00918
      IF(VFIX.GT.VMIN)VMIN=VFIX                                            00919
 1130 IF(MACH.LT.VMIN.OR.OC.EQ.5)MACH=VMIN                                 00920
      DELA=1.                                                              00921
      DELM=1.                                                              00922
      FA=-1000.*IOA                                                        00923
      FM=-.01*IOM                                                          00924
      I2=0                                                                 00925
      IF(ISR.EQ.2.OR.IOC.EQ.3)GO TO 133                                    00926
      IF(IOA*IOM.EQ.0)GO TO 200                                            00927
      IGRD=0                                                               00928
  320 CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,POBJ)                           00929
      HP=HP+.1*FA                                                          00930
      CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,OBJ)                            00931
      HP=HP-.2*FA                                                          00932
      CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,OOBJ)                           00933
      HP=HP+.1*FA                                                          00934
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      DELA=(OBJ-POBJ)/.1                                                    00935
      IF(OBJ.GT.OOBJ)DELA=(POBJ-OOBJ)/.1                                    00936
      IF(OBJ.GT.POBJ.AND.OOBJ.GT.POBJ)DELA=(OBJ-OOBJ)/.2                    00937
      MACH=MACH+.1*FM                                                       00938
      CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,OBJ)                             00939
      MACH=MACH-.2*FM                                                       00940
      CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,OOBJ)                            00941
      MACH=MACH+.1*FM                                                       00942
      DELM=(OBJ-POBJ)/.1                                                    00943
      IF(OBJ.GT.OOBJ)DELM=(POBJ-OOBJ)/.1                                    00944
      IF(OBJ.GT.POBJ.AND.OOBJ.GT.POBJ)DELM=0.                               00945
      IGRD=IGRD+1                                                           00946
      GNORM=-SQRT(DELA*DELA+DELM*DELM)*IGRD*IGRD                            00947
      IF(ABS(GNORM).LT.1.E-10)GO TO 200                                     00948
      DELA=DELA/GNORM                                                       00949
      DELM=DELM/GNORM                                                       00950
  200 CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,OBJ)                             00951
      E(1)=0.                                                               00952
      F(1)=OBJ                                                              00953
      HPO=HP                                                                00954
      OMACH=MACH                                                            00955
      MACH=OMACH+FM*DELM                                                    00956
      HP=HPO+FA*DELA                                                        00957
      CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,OBJ)                             00958
      IE=2                                                                  00959
      IF(OBJ.GT.F(1))IE=3                                                   00960
      E(IE)=1.                                                              00961
      F(IE)=OBJ                                                             00962
      E(5-IE)=3.5-IE                                                        00963
      MACH=OMACH+E(5-IE)*FM*DELM                                            00964
      HP=HPO+E(5-IE)*FA*DELA                                                00965
      CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,OBJ)                             00966
      F(5-IE)=OBJ                                                           00967
      IEND=0                                                                00968
      IL=0                                                                  00969
 1180 CALL ONED(EMAX,DEP,EP,EF,E,EE,F,LOWEST,EEE,IE,KKK,IEND,IMAX)          00970
      IL=IL+1                                                               00971
      IF(IEND.EQ.2.OR.IL.GT.20)GO TO 1250                                   00972
      MACH=OMACH+EEE*FM*DELM                                                00973
      HP=HPO+EEE*FA*DELA                                                    00974
      CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,OBJ)                             00975
      F(IE)=OBJ                                                             00976
      GO TO 1180                                                            00977
 1250 MACH=OMACH+E(LOWEST)*FM*DELM                                          00978
      HP=HPO+E(LOWEST)*FA*DELA                                              00979
      IF(IOM*IOA.EQ.1.AND.IGRD.LT.4.AND.E(LOWEST).NE.0.)GO TO 320           00980
      IF(IOM.EQ.1.AND.MACH.LT.VMAX.AND.RATIO.LT.1.)                         00981
     1 CALL SRATIO(MAXCR,RATIO,M)                                           00982
  133 IF (HP.GT.HPL)HP=HPL                                                  00983
      IF(HP.LT.HPMIN)HP=HPMIN                                               00984
      IF(MACH.LT.VMIN)MACH=VMIN                                             00985
      IF(MACH.GT.VMAX)MACH=VMAX                                             00986
      I1=0                                                                  00987
      OMACH=MACH                                                            00988
  110 CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,OBJ)                             00989
C                                                                           00990
      IF(ISR.NE.2)GO TO 113                                                 00991
      IF(I1-1)400,420,450                                                   00992
  400 DM=.001                                                               00993
      I1=1                                                                  00994
      GO TO 490                                                             00995
  420 IF(RCI.LT.R1)GO TO 450                                                00996
      DM=DM*3                                                               00997
      GO TO 490                                                             00998
  450 I1=I1+1                                                               00999
      DM=DM*(RCIN-RCI)/(RCI-R1)                                             01000
      IF(ABS(DM).GT..0001.AND.I1.LT.15)GO TO 490                            01001
      I2=I2+1                                                               01002
      MACH=MACH+DM                                                          01003
      IF(OC.EQ.8)GO TO 460                                                  01004
```

```
      IF(I2.EQ.1)GO TO 200                                                    01005
      IF(ABS(MACH-OMACH).GT..0001.AND.I2.LT.5)GO TO 200                       01006
  460 CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,OBJ)                               01007
      GO TO 124                                                               01008
  490 R1=RCI                                                                  01009
      MACH=MACH+DM                                                            01010
      GO TO 110                                                               01011
C                                                                             01012
  113 IF(I1.GT.0) GO TO 115                                                   01013
      IF(RCI.GE.RCIN)GO TO 124                                                01014
      DHP=-100.                                                               01015
      GO TO 117                                                               01016
  115 DHP=DHP*(RCIN-RCI)/(RCI-R1)                                             01017
      IF(ABS(DHP).LT.EP.OR.I1.GT.20) GO TO 124                                01018
  117 R1=RCI                                                                  01019
      I1=I1+1                                                                 01020
      IF(HP.LE.HPMIN.AND.DHP.LT.0.) GO TO 122                                 01021
      IF(HP+DHP.LT.HPMIN)DHP=HPMIN-1.-HP                                      01022
      HP=HP+DHP                                                               01023
      GO TO 110                                                               01024
 122  IQUIT=1                                                                 01025
C     CANNOT FLY BETWEEN HPMIN AND HPMAX WITH WEIGHT WT                       01026
C     RETURNS WITH 0.0 RANGE                                                  01027
      VMIN=VFIX                                                               01028
      RETURN                                                                  01029
  124 HOTAB(J,M)=HP                                                           01030
      WFTAB(J,M)=WF                                                           01031
      VOTAB(J,M)=VT                                                           01032
      LDTAB(J,M)=LD                                                           01033
      IF(IFLAG.LT.1)GO TO 149                                                 01034
      TMAX=TMX*ENGO                                                           01035
      EOP=ENG*ENGF                                                            01036
      TDUM=WT/LD                                                              01037
      SFC=WF/TDUM                                                             01038
      WRITE(6,1000)WT,HP,TMAX,TDUM,WF,SFC,MACH,VT,SR,RCI,CL,LD,EOP            01039
 1000 FORMAT(3F10.0,2F9.0,F9.4,F8.4,F9.1,F9.5,F9.1,F8.4,F8.2,F8.1)            01040
 149  CONTINUE                                                                01041
      VMIN=VFIX                                                               01042
      WT=WTAB(NW)                                                             01043
      R=0.0                                                                   01044
      T=0.0                                                                   01045
      ICOUNT=0                                                                01046
      I=1                                                                     01047
      CWEIGHT(1)=WTAB(NW)                                                     01048
      CRANGE(1,M)=0.0                                                         01049
      CRTIME(1,M)=0.0                                                         01050
      WF=WFTAB(NW,M)                                                          01051
      VT=VOTAB(NW,M)                                                          01052
      N=(WTAB(NW)-WTAB(1))/DCWT+.5                                            01053
      DO 950 K=1,N                                                            01054
      ICOUNT=ICOUNT+1                                                         01055
      WT=WT-DCWT                                                              01056
C                                                                             01057
      WFNEW=LINT1(WT,WTAB,NW,WFTAB(1,M))                                      01058
      VTNEW=LINT1(WT,WTAB,NW,VOTAB(1,M))                                      01059
C                                                                             01060
      WFAVG=0.5*(WF+WFNEW)                                                    01061
      VTAVG=0.5*(VT+VTNEW)                                                    01062
      DT=DCWT/WFAVG                                                           01063
      T=T+DT                                                                  01064
      R=R+DT*VTAVG                                                            01065
      WF=WFNEW                                                                01066
      VT=VTNEW                                                                01067
      IF (ICOUNT.NE.10)GO TO 950                                              01068
      ICOUNT=0                                                                01069
      I=I+1                                                                   01070
      CWEIGHT(I)=WT                                                           01071
      CRANGE(I,M)=R                                                           01072
      CRTIME(I,M)=T                                                           01073
      NCW=I                                                                   01074
```

```
950  CONTINUE                                                    01075
     RETURN                                                      01076
     END                                                         01077
```

```
      SUBROUTINE OPTCL(CRMACH,QLIM,STALT,RCIN,WTAB,HPTB,LDESC,NODIVE,    01078
     1 NO,ACTAB,VCTAB,VS,DECL,TOMACH,M,ENRCL,IFAACL,VOTAB,WFTAB)        01079
      COMMON/RADACC/REARTH,RADA                                         01080
      COMMON/TRNSF/ASTAR,CDT,CL,CLM,D,DCD,DIST,DELTA,ENG,FUEL,G,HP,HPL,  01081
     1 II,LD,MACH,NW,Q,RCI,RCM,RSM,RSR,SR,SREF,THETA,TIME,VH,VT,        01082
     2 WF,WFD,WT,DTC,IFLAG,FACT,IDOQ,ENGO,VMIN                          01083
      DIMENSION E(4),EE(4),F(4),WTAB(30),HPTB(31,30),ACTAB(10),VCTAB(10)01084
     1 ,ENRCL(32),VOTAB(30),WFTAB(30)                                   01085
      REAL MACH,LD,LINT1                                                01086
      INTEGER VS                                                        01087
      EMAX=100000.                                                      01088
      IMAX=0                                                            01089
      DEP=0.                                                            01090
      CALL ATMO(HPL,DTC,DELTA,THETA,ASTAR)                              01091
      ENRMAX=HPL+(CRMACH*ASTAR)**2/G                                    01092
      HP=STALT                                                          01093
      CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                               01094
      ENRMIN=(TOMACH*ASTAR)**2/G+HP                                     01095
      ENRCL(1)=ENRMIN                                                   01096
      IF(IFAACL.EQ.0.OR.ENRMIN.GE.13689.56)GO TO 90                     01097
      TENR=ENRMIN                                                       01098
      ENRMIN=13689.56                                                   01099
      IFAACL=II*(ENRMIN-TENR)/ENRMAX                                    01100
      IF(IFAACL.LT.3)IFAACL=3                                           01101
   90 DENERGY=(ENRMAX-ENRMIN)/(II-IFAACL)                               01102
      DO 450 JZ=1,NW                                                    01103
      ISUP=0                                                            01104
      PMACH=0.                                                          01105
      HP=0.                                                             01106
      WT=WTAB(JZ)                                                       01107
      CVO=LINT1(WT,WTAB,NW,VOTAB)                                       01108
      CWF=LINT1(WT,WTAB,NW,WFTAB)                                       01109
      DO 445 IZ=1,II                                                    01110
      VTO=VT                                                            01111
      ENERGY=DENERGY*(IZ-IFAACL)+ENRMIN                                 01112
      IF(IZ.GT.IFAACL)GO TO 95                                          01113
      HP=IZ*10000./IFAACL                                               01114
      VT=(3.515*HP+.0000354*HP*HP)/1000.+250.                           01115
      ENERGY=HP+VT*VT/G                                                 01116
      GO TO 400                                                         01117
   95 IF(IZ.LT.II)GO TO 96                                              01118
      HP=HPL                                                            01119
      GO TO 400                                                         01120
   96 IF(NO.LE.0)GO TO 100                                              01121
      IF(ENERGY.LT.VCTAB(1).OR.ENERGY.GT.VCTAB(NO))GO TO 100            01122
      HP=LINT1(ENERGY,VCTAB,NO,ACTAB)                                   01123
      CALL RCINST(ENERGY,IPS,CVO,CWF,M,LDESC)                           01124
      IF(RCI.GE.RCIN)GO TO 260                                          01125
      DHP=-1000.                                                        01126
   98 R1=RCI                                                            01127
      HP=HP+DHP                                                         01128
      CALL RCINST(ENERGY,IPS,CVO,CWF,M,LDESC)                           01129
      IF(ABS(RCI-RCIN).LT..01)GO TO 260                                 01130
      DHP=DHP*(RCIN-RCI)/(RCI-R1)                                       01131
      GO TO 98                                                          01132
  100 IF(VS.LT.2)GO TO 150                                              01133
      CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                               01134
      CLBAR=DECL+RADA*WT*ASTAR**2/(1481.35*DELTA*SREF*(REARTH+HP))      01135
      QF=WT/CLBAR/SREF                                                  01136
      IF(QF.GT.QLIM.AND.QLIM.GT.0.)QF=QLIM                              01137
      QF=13.0763*QF                                                     01138
      HPO=HP                                                            01139
      HP=ENERGY-QF*THETA/DELTA                                          01140
      DHO=HP-HPO                                                        01141
  120 CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                               01142
      DHP=ENERGY-QF*THETA/DELTA-HP                                      01143
      DELH=DHP*(HPO-HP)/(DHP-DHO)                                       01144
      HPO=HP                                                            01145
      DHO=DHP                                                           01146
```

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      HP=HP+DELH                                                        01147
      IF(ABS(DELH).LT.1.)GO TO 260                                      01148
      GO TO 120                                                         01149
  150 CALL RCINST(ENERGY,IPS,CVO,CWF,M,LDESC)                           01150
      EP=1.                                                             01151
      E(1)=0.                                                           01152
      F(1)=-RCM                                                         01153
      HPO=HP                                                            01154
      DHP=1000.                                                         01155
      IF(HPO+DHP.GT.ENERGY)DHP=(ENERGY-HPO)*0.8                         01156
      HP=HPO+DHP                                                        01157
      CALL RCINST(ENERGY,IPS,CVO,CWF,M,LDESC)                           01158
      IE=2                                                              01159
      IF(-RCM.GT.F(1))IE=3                                              01160
      E(IE)=DHP                                                         01161
      F(IE)=-RCM                                                        01162
      E(5-IE)=(2.5-IE)/.001+DHP                                         01163
      IF(HPO+E(5-IE).GT.ENERGY)E(5-IE)=(ENERGY-HPO)*0.95                01164
      HP=HPO+E(5-IE)                                                    01165
      CALL RCINST(ENERGY,IPS,CVO,CWF,M,LDESC)                           01166
      F(5-IE)=-RCM                                                      01167
      EF=3.                                                             01168
      IEND=0                                                            01169
  180 CALL ONED(EMAX,DEP,EP,EF,E,EE,F,LOWEST,EEE,IE,KKK,IEND,IMAX)      01170
      IF(IEND.EQ.2)GO TO 250                                            01171
  185 HP=HPO+EEE                                                        01172
      IF(HP.LT.ENERGY)GO TO 190                                         01173
      EEE=(ENERGY-HPO)*0.9                                              01174
      E(IE)=EEE                                                         01175
      GO TO 185                                                         01176
  190 CALL RCINST(ENERGY,IPS,CVO,CWF,M,LDESC)                           01177
      F(IE)=-RCM                                                        01178
      GO TO 180                                                         01179
  250 RCM=-F(LOWEST)                                                    01180
      HP=E(LOWEST)+HPO                                                  01181
      IF(QLIM.LE.0.)GO TO 260                                           01182
      I=0                                                               01183
      DHP=1000.                                                         01184
  255 CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                               01185
      VT=SQRT((ENERGY-HP)*G)                                            01186
      MACH=VT/ASTAR                                                     01187
      Q=1481.35*DELTA*MACH**2                                           01188
      IF(I.EQ.0.AND.Q.LE.QLIM)GO TO 260                                 01189
      I=I+1                                                             01190
      IF(I.GT.1)DHP=DHP*(QLIM-Q)/(Q-QO)                                 01191
      QO=Q                                                              01192
      HP=HP+DHP                                                         01193
      IF(ABS(DHP).LT.1..OR.I.GE.10)GO TO 260                            01194
      GO TO 255                                                         01195
  260 IF(HP.GT.HPL)HP=HPL                                               01196
      IF(HP.LT.0.)HP=0.                                                 01197
      IF(IFAACL.NE.0.AND.HP.LT.10000.)HP=10000.                         01198
      IF(NODIVE.EQ.1.AND.HP.LT.STALT)HP=STALT                           01199
      IF(IZ.EQ.1)GO TO 400                                              01200
      IF(NODIVE.EQ.1.AND.HP.LT.HPTB(IZ-1,JZ))HP=HPTB(IZ-1,JZ)           01201
  400 CALL RCINST(ENERGY,IPS,CVO,CWF,M,LDESC)                           01202
      IF(NO.GT.0)GO TO 410                                              01203
      IF(MACH.GT.1.)ISUP=ISUP+1                                         01204
      IF(ISUP.NE.1)GO TO 410                                            01205
      IF(MACH.LE.1.)GO TO 405                                           01206
      HP1=HP                                                            01207
      RCO=RCM                                                           01208
      HP=ENERGY-VTO*VTO/G                                               01209
      GO TO 100                                                         01210
  405 IF(RCM.LT.RCO)GO TO 408                                           01211
      ISUP=0                                                            01212
      GO TO 410                                                         01213
  408 HP=HP1                                                            01214
      GO TO 400                                                         01215
  410 IF(MACH.LE.CRMACH.AND.MACH.GE.PMACH)GO TO 430                     01216
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      IF(MACH.GT.CRMACH)PMACH=CRMACH                                    01217
      HP=ENERGY-(PMACH*ASTAR)**2/G                                      01218
      DO 415 I=1,5                                                      01219
      CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                               01220
  415 HP=ENERGY-(PMACH*ASTAR)**2/G                                      01221
      MACH=PMACH                                                        01222
  430 PMACH=MACH                                                        01223
      HPTB(IZ,JZ)=HP                                                    01224
      ENRCL(IZ+1)=ENERGY                                                01225
  445 CONTINUE                                                          01226
  450 CONTINUE                                                          01227
      RETURN                                                            01228
      END                                                               01229
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      SUBROUTINE RCINST(ENERGY,IPS,CVO,CWF,M,LDESC)                     01230
      COMMON/RADACC/REARTH,RADA                                         01231
      COMMON/STDRAG/CDST(20,3),STMA(20,3),ISTCL(4),ISTCR(5),ISTAC(40),  01232
     1 ISTDE,NSTD(3)                                                    01233
      COMMON/ROCIN/FWF(4),IPPCL(4)                                      01234
      COMMON/TRNSF/ASTAR,CDT,CL,CLM,D,DCD,DIST,DELTA,ENG,FUEL,G,HP,HPL, 01235
     1 II,LD,MACH,NW,Q,RCI,RCM,RSM,RSR,SR,SREF,THETA,TIME,VH,VT,        01236
     2 WF,WFD,WT,DTC,IFLAG,FACT,IDOQ,ENGO,VMIN                          01237
      COMMON /AERO/ CDTAB(500),CDPA(400)                                01238
      REAL MACH,LD,LINT1                                                01239
      IPMAX=1                                                           01240
      FWP=0.                                                            01241
      IF(LDESC.GT.0)GO TO 10                                            01242
      IPMAX=IPPCL(M)                                                    01243
      FWP=FWF(M)                                                        01244
   10 CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                               01245
      VT=SQRT((ENERGY-HP)*G)                                            01246
      MACH=VT/ASTAR                                                     01247
      Q=1481.35*DELTA*MACH**2                                           01248
      CL=WT*(1.-RADA*VT*VT/(REARTH+HP))/Q/SREF                          01249
C                                                                       01250
      CD=TRP2(CDTAB,MACH,CL,1)                                          01251
      CDP=TRP2(CDPA,HP,MACH,1)                                          01252
C                                                                       01253
      DELCD=DCD                                                         01254
      IF(LDESC.GT.0)GO TO 30                                            01255
      IF(ISTCL(M).GT.0)DELCD=DCD+LINT1(MACH,STMA(1,ISTCL(M)),           01256
     1 NSTD(ISTCL(M)),CDST(1,ISTCL(M)))                                 01257
      GO TO 40                                                          01258
   30 IF(ISTDE.GT.0)DELCD=DCD+LINT1(MACH,STMA(1,ISTDE),                 01259
     1 NSTD(ISTDE),CDST(1,ISTDE))                                       01260
   40 IF(IDOQ.EQ.1)DELCD=DELCD/SREF                                     01261
      CDT=CD+DELCD+CDP                                                  01262
      LD=CL/CDT                                                         01263
      IF(LDESC.NE.1)GO TO 50                                            01264
      RCM=LD                                                            01265
      RCI=LD                                                            01266
      RETURN                                                            01267
   50 D=CDT*Q*SREF                                                      01268
C                                                                       01269
      RCO=-100000.                                                      01270
      DO 100 IPP=1,IPMAX                                                01271
      CALL ENINT(MACH,HP,TMC,FDUM,LDESC+1,IMD,IAD,ITD,IPP)              01272
C                                                                       01273
      TTMC=ENG*TMC                                                      01274
      SG=(TTMC-D)/WT                                                    01275
      WF=FDUM*ENG*FACT                                                  01276
      RCI=SG*VT*6076.1155/60.                                           01277
      IF(LDESC.GT.0)RETURN                                              01278
      WR=WF/CWF                                                         01279
      RCM=RCI*(1.+FWP-FWP/WR)                                           01280
      IF(FWP.GE.0.)RCM=RCI/(1.-FWP+FWP*WR                               01281
     1 -0.9*(COS(1.-0.9*VT/CVO))**4)                                    01282
      IF(RCI.LT.0.)RCM=RCI                                              01283
      IF(RCM.LE.RCO)GO TO 200                                           01284
      RCO=RCM                                                           01285
      RCIO=RCI                                                          01286
      WFO=WF                                                            01287
  100 CONTINUE                                                          01288
      IPP=IPMAX+1                                                       01289
  200 RCM=RCO                                                           01290
      IPS=IPP-1                                                         01291
      RCI=RCIO                                                          01292
      WF=WFO                                                            01293
      RETURN                                                            01294
      END                                                               01295
```

```
      SUBROUTINE SPRAN(TMX,MAXCR,M,VMAX,ENGF,ISR,OBJ)                    01296
      COMMON/RADACC/REARTH,RADA                                          01297
      COMMON/STDRAG/CDST(20,3),STMA(20,3),ISTCL(4),ISTCR(5),ISTAC(40),   01298
     1 ISTDE,NSTD(3)                                                     01299
      COMMON/FEATH/IFEATH(5),FEATHF(5),CDFEATH(5)                        01300
      COMMON/MISIN/INDR,ESKAL,OWFACT,RTOL,IATA,                          01301
     1 OFFDR(10),DWT,TAXOTIM,TAKOTIM,TAXITIM,RS,NHOLD,                   01302
     2 RESERFU,DSTGRNG                                                   01303
      COMMON/CRUIN/HPMIN,DCWT,RCIN,OC(5),CRMACH(5),CRALT(5),CRDCD(5),    01304
     1 CRMMIN(5),FLRCR(5),CRCLMAX(5),NCRUISE                             01305
      COMMON /AERO/ CDTAB(500),CDPA(400)                                 01306
      COMMON/TRNSF/ASTAR,CDT,CL,CLM,D,DCD,DIST,DELTA,ENG,FUEL,G,HP,HPL,  01307
     1 II,LD,MACH,NW,Q,RCI,RCM,RSM,RSR,SR,SREF,THETA,TIME,VH,VT,         01308
     2 WF,WFD,WT,DTC,IFLAG,FACT,IDOQ,ENGO,VMIN                           01309
      REAL MACH,LD,LINT1                                                 01310
C                                                                        01311
      CALL ATMO (HP,DTC,DELTA,THETA,ASTAR)                               01312
C                                                                        01313
      Q=1481.35*DELTA*MACH**2                                            01314
      ENGF=1.                                                            01315
      CL=WT/Q/SREF*(1.-RADA*(MACH*ASTAR)**2/(REARTH+HP))                 01316
C                                                                        01317
      CD=TRP2(CDTAB,MACH,CL,1)                                           01318
      CDP=TRP2(CDPA,HP,MACH,1)                                           01319
C                                                                        01320
      DELCD=DCD                                                          01321
      IF(ISTCR(M).GT.0)DELCD=DELCD+LINT1(MACH,STMA(1,ISTCR(M)),          01322
     1 NSTD(ISTCR(M)),CDST(1,ISTCR(M)))                                  01323
      IF(IDOQ.EQ.1)DELCD=DELCD/SREF                                      01324
      CDT=CD+DELCD+CDP                                                   01325
      WF=1.E+10                                                          01326
      IF(IFEATH(M).LT.0)GO TO 20                                         01327
      D=CDT*Q*SREF                                                       01328
      T=D/ENG                                                            01329
C                                                                        01330
      CALL ENINT(MACH,HP,T,FFL,2,TMX,IAD,ITD,MAXCR)                      01331
C                                                                        01332
      WF=ENG*FFL*FACT                                                    01333
      IF(IFEATH(M).EQ.0)GO TO 50                                         01334
   20 DCDF=CDFEATH(M)                                                    01335
      IF(IDOQ.EQ.1)DCDF=DCDF/SREF                                        01336
      CDTF=CDT+DCDF                                                      01337
      DF=CDTF*Q*SREF                                                     01338
      T=DF/ENG/FEATHF(M)                                                 01339
      CALL ENINT(MACH,HP,T,FFL,2,TMX,IAD,ITD,MAXCR)                      01340
      IF(ITD.EQ.1.AND.IFEATH(M).GT.0)GO TO 50                            01341
      WFF=ENG*FEATHF(M)*FFL*FACT                                         01342
      IF(WFF.GT.WF)GO TO 50                                              01343
      ENGF=FEATHF(M)                                                     01344
      CDT=CDTF                                                           01345
      D=DF                                                               01346
      WF=WFF                                                             01347
   50 VT=MACH*ASTAR                                                      01348
      LD=CL/CDT                                                          01349
      SR=VT/WF                                                           01350
      OBJ=WF                                                             01351
      IF(ISR.EQ.1)OBJ=-SR                                                01352
      RCI=(TMX*ENGO-D)*VT*6076.1155/WT/60.                               01353
      IF(ISR.EQ.2)OBJ=-RCI                                               01354
      IF(RCI.LT.RCIN.AND.RCIN.GT.0.)OBJ=OBJ+ABS(OBJ)*(1-RCI/RCIN)**2/10.01355
      IF(HP.GT.HPL)OBJ=OBJ+ABS(OBJ)*200.*(1-HPL/HP)**2                   01356
      IF(HP.LT.HPMIN.AND.HPMIN.GT.0.)OBJ=OBJ+ABS(OBJ)*200.*(1-HP/HPMIN)  01357
     1 **2                                                               01358
      IF(MACH.GT.VMAX)OBJ=OBJ+ABS(OBJ)*200.*(1-VMAX/MACH)**2             01359
      IF(MACH.LT.VMIN.AND.VMIN.GT.0.)OBJ=OBJ+ABS(OBJ)*200.*(1-MACH/VMIN)01360
     1 **2                                                               01361
      RETURN                                                             01362
      END                                                                01363
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      SUBROUTINE CLIMB(VOTAB,ENERGY,IPR,ENRCL,HRC,WTAB,HPTB,LDESC,VS,    01364
     1 WFTAB,M,IPS)                                                      01365
      COMMON/COSTDAT/VWTS(28),VQ,VDUM(13)                                01366
      COMMON/TRNSF/ASTAR,CDT,CL,CLM,D,DCD,DIST,DELTA,ENG,FUEL,G,HP,HPL,  01367
     1 II,LD,MACH,NW,Q,RCI,RCM,RSM,RSR,SR,SREF,THETA,TIME,VH,VT,         01368
     2 WF,WFD,WT,DTC,IFLAG,FACT,IDOQ,ENGO,VMIN                           01369
      DIMENSION HRC(30),WTAB(30),HPTB(31,30),VOTAB(30),ENRCL(32),        01370
     1 WFTAB(30)                                                         01371
      REAL MACH,LD                                                       01372
      INTEGER VS                                                         01373
      HPMIN=HP                                                           01374
      SMACH=MACH                                                         01375
      TIME=0.0                                                           01376
      DIST=0.0                                                           01377
      FUEL=0.0                                                           01378
      IF(LDESC.EQ.2.AND.VS.EQ.0)RETURN                                   01379
      ENRMIN=ENERGY                                                      01380
      IPRNT=IFLAG*IPR                                                    01381
      IF(IPRNT.GT.1)WRITE(6,205)WT,ENERGY,HP,MACH,VT,                    01382
     1 RCI,IPS,TIME,DIST,FUEL,Q,TIME,DIST,FUEL,CL,LD                     01383
      IPS=0                                                              01384
      DO 620 I=1,II                                                      01385
      IF(ENRCL(I+1).LE.ENRMIN)GO TO 620                                  01386
      ENO=ENERGY                                                         01387
      RCO=RCI                                                            01388
      WFO=WF                                                             01389
      VTO=VT                                                             01390
      HPO=HP                                                             01391
      WTO=WT                                                             01392
      ENERGY=ENRCL(I+1)                                                  01393
      DFUEL=WF*(ENERGY-ENO)/RCI/60.                                      01394
      DO 200 K=1,4                                                       01395
      JW=NW-1                                                            01396
      WT=WTO-DFUEL                                                       01397
      ENERGY=ENRCL(I+1)                                                  01398
   50 IF(WTAB(JW).LE.WT.OR.JW.EQ.1)GO TO 100                             01399
      JW=JW-1                                                            01400
      GO TO 50                                                           01401
  100 DELW=(WT-WTAB(JW))/(WTAB(JW+1)-WTAB(JW))                           01402
      IF(DELW.LT.0.)DELW=0.                                              01403
      IF(DELW.GT.1.)DELW=1.                                              01404
      HP=DELW*HPTB(I,JW+1)+(1.-DELW)*HPTB(I,JW)                          01405
      HPMAX=DELW*HRC(JW+1)+(1.-DELW)*HRC(JW)                             01406
      VTMAX=DELW*VOTAB(JW+1)+(1.-DELW)*VOTAB(JW)                         01407
      CWF=DELW*WFTAB(JW+1)+(1.-DELW)*WFTAB(JW)                           01408
      ENMAX=HPMAX+VTMAX*VTMAX/G                                          01409
      IF(ENERGY.GT.ENMAX)ENERGY=ENMAX                                    01410
      IF(HP.GT.HPMAX)HP=HPMAX                                            01411
      IF(HP.LT.HPMIN)HP=HPMIN                                            01412
      VT=SQRT((ENERGY-HP)*G)                                             01413
      IF(VT.GT.VTMAX)HP=ENERGY-VTMAX*VTMAX/G                             01414
      CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                                01415
C     IF(VT.LT.SMACH*ASTAR)HP=ENERGY-(SMACH*ASTAR)**2/G                  01416
      CALL RCINST(ENERGY,IPS,VTMAX,CWF,M,LDESC)                          01417
      DTIME=2.*(ENERGY-ENO)/(RCI+RCO)                                    01418
  200 DFUEL=(WF+WFO)*DTIME/120.                                          01419
      IF(Q.GT.VQ)VQ=Q                                                    01420
      WT=WTO-DFUEL                                                       01421
      DDIST=(VT+VTO)*DTIME/120.                                          01422
      DDIST=(DDIST**2-((HP-HPO)/6076.1155)**2)                           01423
      IF(DDIST.LT.0.)DDIST=0.                                            01424
      DDIST=SQRT(DDIST)                                                  01425
      TIME=TIME+DTIME                                                    01426
      DIST=DIST+DDIST                                                    01427
      FUEL=FUEL+DFUEL                                                    01428
      IF(IPRNT.GT.1)WRITE(6,205)WT,ENERGY,HP,MACH,VT,                    01429
     1 RCI,IPS,DTIME,DDIST,DFUEL,Q,TIME,DIST,FUEL,CL,LD                  01430
  205 FORMAT(F10.0,F9.0,F8.0,F7.3,F8.1,F9.0,I3,F7.2,F7.1,F9.1,F8.1,      01431
     1 F8.2,F8.1,F11.1,F7.3,F7.2)                                        01432
```

```
      IF(ENERGY+1..GT.ENMAX)RETURN                                      01433
620   CONTINUE                                                          01434
      RETURN                                                            01435
      END                                                               01436
```

```
      SUBROUTINE SRATIO(MAXCR,RATIO,M)                                  01437
      COMMON/TRNSF/ASTAR,CDT,CL,CLM,D,DCD,DIST,DELTA,ENG,FUEL,G,HP,HPL, 01438
     1 II,LD,MACH,NW,Q,RCI,RCM,RSM,RSR,SR,SREF,THETA,TIME,VH,VT,        01439
     2 WF,WFD,WT,DTC,IFLAG,FACT,IDOQ,ENGO,VMIN                          01440
      REAL MACH,LD                                                      01441
      CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,1,OBJ)                           01442
      IL=0                                                              01443
      EP=.00003                                                         01444
      SRO=SR                                                            01445
      PMACH=MACH                                                        01446
      DM=.03                                                            01447
      RSR=SRO*RATIO                                                     01448
  841 IF(MACH+DM.GT.PMACH)GO TO 845                                     01449
      DM=PMACH-MACH                                                     01450
  845 IF(ABS(DM).LT.EP)RETURN                                           01451
      IL=IL+1                                                           01452
      IF(IL.GT.8)GO TO 900                                              01453
      MACH=MACH+DM                                                      01454
      CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,1,OBJ)                           01455
      DM=DM*(SR-RSR)/(SRO-SR)                                           01456
      SRO=SR                                                            01457
      GO TO 841                                                         01458
  900 MACH=PMACH                                                        01459
      DM=.03                                                            01460
      SRO=RSR/RATIO                                                     01461
      DO 950 I=1,4                                                      01462
  920 MACH=MACH+DM                                                      01463
      CALL SPRAN(TMX,MAXCR,M,VMAX,ENGF,1,OBJ)                           01464
      IF(SR.GT.SRO.OR.SR.LT.RSR)GO TO 940                               01465
      SRO=SR                                                            01466
      GO TO 920                                                         01467
  940 MACH=MACH-DM                                                      01468
  950 DM=DM/3.                                                          01469
      RETURN                                                            01470
      END                                                               01471
```

```
      SUBROUTINE TURN(I,GEES,AR,OMEGA)                                  01472
      COMMON/RADACC/REARTH,RADA                                         01473
      COMMON/STDRAG/CDST(20,3),STMA(20,3),ISTCL(4),ISTCR(5),ISTAC(40),  01474
     1 ISTDE,NSTD(3)                                                    01475
      COMMON/FLIGHT/STMACH,STALT,NUMSEG,DISPOZE,IFREE,FSEG(40),GSEG(40),01476
     1 JSEG(40),MSEG(40),DSEG(40),ESEG(40),SEGT(9,2),HSEG(40),CSEG(40)  01477
      COMMON/TRNSF/ASTAR,CDT,CL,CLM,D,DCD,DIST,DELTA,ENG,FUEL,G,HP,HPL,  01478
     1 II,LD,MACH,NW,Q,RCI,RCM,RSM,RSR,SR,SREF,THETA,TIME,VH,VT,         01479
     2 WF,WFD,WTA,DTC,IFLAG,FACT,IDOQ,ENGO,VMIN                         01480
      COMMON /AERO/ CDTAB(500),CDPA(400)                                01481
      REAL MACH,LINT1                                                   01482
C                                                                       01483
      WT=WTA                                                            01484
      IF(CSEG(I).GT.0.)WT=CSEG(I)                                       01485
      IF(GSEG(I).GT.0.)HP=GSEG(I)                                       01486
      IF(FSEG(I).GT.0.)MACH=FSEG(I)                                     01487
      CALL ATMO (HP,DTC,DELTA,THETA,ASTAR)                              01488
      V=MACH*ASTAR                                                      01489
      Q=1481.35*DELTA*MACH**2                                           01490
      CDP=TRP2(CDPA,HP,MACH,1)                                          01491
      M=MSEG(I)                                                         01492
      GEES=ESEG(I)                                                      01493
      IF(M.GT.0)GO TO 100                                               01494
C                                                                       01495
C     SPECIFIED G TURN                                                  01496
C                                                                       01497
      CL=GEES*WT/Q/SREF                                                 01498
      CD=TRP2(CDTAB,MACH,CL,1)                                          01499
      DELCD=HSEG(I)                                                     01500
      IF(ISTAC(I).GT.0)DELCD=DELCD+LINT1(MACH,STMA(1,ISTAC(I)),         01501
     1 NSTD(ISTAC(I)),CDST(1,ISTAC(I)))                                 01502
      IF(IDOQ.EQ.1)DELCD=DELCD/SREF                                     01503
      CDT=CD+DELCD+CDP                                                  01504
      T=CDT*Q*SREF/ENG                                                  01505
      CALL ENINT(MACH,HP,T,FFL,2,IMD,IAD,ITD,1)                         01506
      IF(ITD.EQ.1)GO TO 90                                              01507
C                                                                       01508
   50 GLAT=GEES**2-(1.-RADA*V*V/(REARTH+HP))**2                         01509
      IF(GLAT.LT.1.)GLAT=1.                                             01510
      GLAT=SQRT(GLAT)                                                   01511
      OMEGA=1092.2*GLAT/V                                               01512
      TIME=DSEG(I)/(OMEGA*60.)                                          01513
      FUEL=FFL*TIME*ENG/60.                                             01514
      RETURN                                                            01515
C                                                                       01516
C     MAX G TURN                                                        01517
C                                                                       01518
   90 M=1                                                               01519
  100 CALL ENINT(MACH,HP,T,FFL,1,IMD,IAD,ITD,M)                         01520
      DELCD=HSEG(I)                                                     01521
      IF(ISTAC(I).GT.0)DELCD=DELCD+LINT1(MACH,STMA(1,ISTAC(I)),         01522
     1 NSTD(ISTAC(I)),CDST(1,ISTAC(I)))                                 01523
      IF(IDOQ.EQ.1)DELCD=DELCD/SREF                                     01524
      CDT=T*ENG/Q/SREF-CDP-DELCD                                        01525
      E=2.6                                                             01526
      J=0                                                               01527
      GEES=0.                                                           01528
      TIME=0.                                                           01529
      FUEL=0.                                                           01530
      IF(CDT.LE.0.)RETURN                                               01531
  110 CL=SQRT(CDT*E*AR)                                                 01532
      CD=TRP2(CDTAB,MACH,CL,1)                                          01533
      E=CL*CL/CD/AR                                                     01534
      J=J+1                                                             01535
      IF(ABS((CDT-CD)/CDT).GT..0001.AND.J.LT.20)GO TO 110               01536
      GEES=CL*Q*SREF/WT                                                 01537
      GO TO 50                                                          01538
      END                                                               01539
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      SUBROUTINE ACCEL(I,M)                                                 01540
      COMMON/RADACC/REARTH,RADA                                             01541
      COMMON/STDRAG/CDST(20,3),STMA(20,3),ISTCL(4),ISTCR(5),ISTAC(40),      01542
     1 ISTDE,NSTD(3)                                                        01543
      COMMON/FLIGHT/STMACH,STALT,NUMSEG,DISPOZE,IFREE,FSEG(40),GSEG(40),    01544
     1 JSEG(40),MSEG(40),DSEG(40),ESEG(40),SEGT(9,2),HSEG(40),CSEG(40)      01545
      COMMON/TRNSF/ASTAR,CDT,CL,CLM,D,DCD,DIST,DELTA,ENG,FUEL,G,HP,HPL,     01546
     1 II,LD,MACH,NW,Q,RCI,RCM,RSM,RSR,SR,SREF,THETA,TIME,VH,VT,            01547
     2 WF,WFD,WTA,DTC,IFLAG,FACT,IDOQ,ENGO,VMIN                             01548
      COMMON /AERO/ CDTAB(500),CDPA(400)                                    01549
      REAL MACH,LINT1                                                       01550
C                                                                           01551
      DIST=0.                                                               01552
      FUEL=0.                                                               01553
      TIME=0.                                                               01554
      WT=WTA                                                                01555
      IF(CSEG(I).GT.0.)WT=CSEG(I)                                           01556
      IF(GSEG(I).GT.0.)HP=GSEG(I)                                           01557
      IF(FSEG(I).GT.0.)MACH=FSEG(I)                                         01558
      IF(DSEG(I).LE.MACH)RETURN                                             01559
      CALL ATMO (HP,DTC,DELTA,THETA,ASTAR)                                  01560
      J=1                                                                   01561
      DFUEL=0.                                                              01562
      GK=1143.758/ASTAR                                                     01563
      DM=(IFIX((MACH+.00001)/.05)+1)*.05-MACH                               01564
   50 Q=1481.35*DELTA*MACH**2                                               01565
      CDP=TRP2(CDPA,HP,MACH,1)                                              01566
      M=MSEG(I)                                                             01567
      CL=WT/Q/SREF*(1.-RADA*(MACH*ASTAR)**2/(REARTH+HP))                    01568
      CD=TRP2(CDTAB,MACH,CL,1)                                              01569
      DELCD=HSEG(I)                                                         01570
      IF(ISTAC(I).GT.0)DELCD=DELCD+LINT1(MACH,STMA(1,ISTAC(I)),             01571
     1 NSTD(ISTAC(I)),CDST(1,ISTAC(I)))                                     01572
      IF(IDOQ.EQ.1)DELCD=DELCD/SREF                                         01573
      D=(CD+DELCD+CDP)*Q*SREF                                               01574
  100 CALL ENINT(MACH,HP,T,FFL,1,IMD,IAD,ITD,M)                             01575
      DO 170 K=1,3                                                          01576
      A=GK*(T*ENG-D)/WT                                                     01577
      IF(A.GT.0..OR.M.EQ.1)GO TO 150                                        01578
      M=M-1                                                                 01579
      GO TO 100                                                             01580
  150 IF(J.EQ.1)GO TO 200                                                   01581
      DTIME=2.*(MACH-OLDM)/(A+AO)                                           01582
      DFUEL=DTIME*(FFL+FFO)*ENG/120.                                        01583
  170 WT=WTO-DFUEL                                                          01584
      DIST=DIST+DTIME*(V+(2.*AO+A)*DTIME/6.)/60.                            01585
      IF(FSEG(I).GT.0.)DIST=0.                                              01586
      TIME=TIME+DTIME                                                       01587
      FUEL=FUEL+DFUEL                                                       01588
      DM=.05                                                                01589
      IF(MACH+.00001.GE.DSEG(I))RETURN                                      01590
  200 AO=A                                                                  01591
      OLDM=MACH                                                             01592
      V=MACH*ASTAR                                                          01593
      MACH=MACH+DM                                                          01594
      WTO=WT                                                                01595
      WT=WTO-DFUEL                                                          01596
      FFO=FFL                                                               01597
      IF(MACH.GT.DSEG(I))MACH=DSEG(I)                                       01598
      J=J+1                                                                 01599
      GO TO 50                                                              01600
      END                                                                   01601
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      SUBROUTINE RESERVE(VS,NINCL,NINDE,NCW,CLDCD,DEDCD)                01602
      COMMON/MISS/WTAB(30),HPTB(31,30,4),HPDE(31,30),CRANGE(60,5),      01603
     1 CRTIME(60,5),CWEIGHT(60),HOTAB(30,5),WFTAB(30,5),VOTAB(30,5),    01604
     2 LDTAB(30,5),RCLDIST(30),RCLFUEL(30),RDEDIST(30),RDEFUEL(30),     01605
     3 DUM(120),RESFUEL(30),ENRESWT(30),ENRCL(32,4),ENRDE(32)           01606
      COMMON/MISIN/INDR,ESKAL,OWFACT,RTOL,IATA,                         01607
     1 OFFDR(10),DWT,TAXOTIM,TAKOTIM,TAXITIM,RS,NHOLD,                  01608
     2 RESERFU,DSTGRNG                                                  01609
      COMMON/RESIN/NCRRES,NCLRES,MAPTIM,ALTRAN,HOLDTIM,NCRHOL,IHOPOS    01610
     1,SREMACH,EREMACH,SREALT,EREALT                                    01611
      COMMON/TRNSF/ASTAR,CDT,CL,CLM,D,DCD,DIST,DELTA,ENG,FUEL,G,HP,HPL, 01612
     1 II,LD,MACH,NW,Q,RCI,RCM,RSM,RSR,SR,SREF,THETA,TIME,VH,VT,        01613
     2 WF,WFD,WT,DTC,IFLAG,FACT,IDOQ,ENGO,VMIN                          01614
      COMMON/EDATA/NM,NA,NT,EMACH(20),ALT(10,20),FF(16,10,20),          01615
     1 THR(16,10,20),EXTFAC,FFFAC,DFFAC,IDFUEFL,TAKOFF,IXTRAP,MAXCR     01616
      COMMON/CONFIG/GW,AR,THRM,SW,TR,SWEEP,TCA,VCMN,CH,WWSTR,           01617
     1 DUMV1,DUMV2,DESRNG                                               01618
      DIMENSION NINCL(4),CLDCD(4)                                       01619
      REAL MACH,LD,MISAP,MAPTIM,LDTAB,LINT1                             01620
      INTEGER VS                                                        01621
      IF(ALTRAN.GT.0.)GO TO 200                                         01622
      IHOPOS=0                                                          01623
      CLBFUEL=0.                                                        01624
      CLBDIST=0.                                                        01625
      CRUFUEL=0.                                                        01626
      CRRANGE=0.                                                        01627
      DESFUEL=0.                                                        01628
      DESDIST=0.                                                        01629
      NCRRES=NCRHOL                                                     01630
      GO TO 350                                                         01631
  200 DO 875 JZ=1,NW                                                    01632
      WT=WTAB(JZ)                                                       01633
      HP=SREALT                                                         01634
      CVO=LINT1(WT,WTAB,NW,VOTAB(1,NCRRES))                             01635
      CWF=LINT1(WT,WTAB,NW,WFTAB(1,NCRRES))                             01636
      II=NINCL(NCLRES)                                                  01637
      DCD=CLDCD(NCLRES)                                                 01638
      CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                               01639
      ENERGY=HP+(SREMACH*ASTAR)**2/G                                    01640
      CALL RCINST(ENERGY,IPS,CVO,CWF,NCLRES,0)                          01641
      CALL CLIMB(VOTAB(1,NCRRES),ENERGY,0,ENRCL(1,NCLRES),              01642
     1 HOTAB(1,NCRRES),WTAB,HPTB(1,1,NCLRES),0,VS,WFTAB(1,NCRRES),      01643
     2 NCLRES,IPS)                                                      01644
C                                                                       01645
      RCLDIST(JZ)=DIST                                                  01646
      RCLFUEL(JZ)=FUEL                                                  01647
  875 CONTINUE                                                          01648
      DO 880 J=1,NW                                                     01649
      WT=WTAB(J)                                                        01650
      HP=EREALT                                                         01651
C                                                                       01652
      II=NINDE                                                          01653
      DCD=DEDCD                                                         01654
      CALL ATMO(HP,DTC,DELTA,THETA,ASTAR)                               01655
      ENERGY=HP+(EREMACH*ASTAR)**2/G                                    01656
      CALL RCINST(ENERGY,IPS,CVO,CWF,1,2)                               01657
      CALL CLIMB(VOTAB(1,NCRRES),ENERGY,0,ENRDE,HOTAB(1,NCRRES),WTAB,   01658
     1 HPDE,2,VS,WFTAB(1,NCRRES),1,IPS)                                 01659
C                                                                       01660
      RDEDIST(J)=DIST                                                   01661
      RDEFUEL(J)=-FUEL                                                  01662
  880 CONTINUE                                                          01663
  350 MISAP=TAKOFF*ENG*MAPTIM/60.                                       01664
       IF(IFLAG .EQ. 0) GO TO 900                                       01665
      WRITE (6,360)MISAP                                                01666
  360 FORMAT(/17H0 RESERVE SUMMARY/                                     01667
     325H0 MISSED APPROACH FUEL = ,F6.0,4H LB./)                        01668
      WRITE (6,361)                                                     01669
  361 FORMAT(4X,5HSTART,4X,7HHOLDING,3X,2(7H  CLIMB,3X),2(7H CRUISE,    01670
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     1 3X),2(7HDESCENT,3X),7HRESERVE,5X,3HEND,/,4X,7HRESERVE,4X,4HFUEL,  01671
     2 3(6X,4HDIST,6X,4HFUEL),6X,4HFUEL,4X,7HRESERVE,3X,4HMACH/4X,       01672
     3 6HWEIGHT,84X,34HWEIGHT  NUMBER  ALTITUDE  VELOCITY/)              01673
  900 CONTINUE                                                          01674
      DO 899 J=1,NW                                                     01675
      WT=WTAB(J)                                                        01676
      WFHOTIM=0.                                                        01677
      IF(IHOPOS.EQ.1.OR.HOLDTIM.EQ.0.)GO TO 400                         01678
      HOTIM=LINT1(WT,CWEIGHT,NCW,CRTIME(1,NCRHOL))+HOLDTIM/60.          01679
      WFHOTIM=WT-LINT1(HOTIM,CRTIME(1,NCRHOL),NCW,CWEIGHT)              01680
  400 STCLBWT=WT-MISAP-WFHOTIM                                          01681
      IF(ALTRAN.LE.0.)GO TO 891                                         01682
C                                                                       01683
      CLBFUEL=LINT1(STCLBWT,WTAB,NW,RCLFUEL)                            01684
      CLBDIST=LINT1(STCLBWT,WTAB,NW,RCLDIST)                            01685
C                                                                       01686
      STCRWT=STCLBWT-CLBFUEL                                            01687
C                                                                       01688
      STCRRAN=LINT1(STCRWT,CWEIGHT,NCW,CRANGE(1,NCRRES))                01689
C                                                                       01690
      CDRAN=ALTRAN-CLBDIST                                              01691
      DELWT=CLBFUEL*1.5                                                 01692
      ICOUNT=1                                                          01693
  882 ENDESWT=STCRWT-DELWT                                              01694
C                                                                       01695
      DESDIST=LINT1(ENDESWT,WTAB,NW,RDEDIST)                            01696
      DESFUEL=LINT1(ENDESWT,WTAB,NW,RDEFUEL)                            01697
C                                                                       01698
      STDESWT=ENDESWT+DESFUEL                                           01699
      ENCRWT=STDESWT                                                    01700
      IF(IHOPOS.NE.1.OR.HOLDTIM.EQ.0.)GO TO 500                         01701
      HOTIM=LINT1(STDESWT,CWEIGHT,NCW,CRTIME(1,NCRHOL))-HOLDTIM/60.     01702
      ENCRWT=LINT1(HOTIM,CRTIME(1,NCRHOL),NCW,CWEIGHT)                  01703
      WFHOTIM=ENCRWT-STDESWT                                            01704
  500 ENCRRAN=LINT1(ENCRWT,CWEIGHT,NCW,CRANGE(1,NCRRES))                01705
C                                                                       01706
      CRRANGE=ENCRRAN-STCRRAN                                           01707
      CRUFUEL=STCRWT-ENCRWT                                             01708
      CRUDES=CRRANGE+DESDIST                                            01709
      IF(ICOUNT.GE.50.OR.ABS(CRUDES-CDRAN).LE.RTOL) GO TO 891           01710
      ICOUNT=ICOUNT+1                                                   01711
      IF(ICOUNT.GT.2) GO TO 885                                         01712
      DDW=(DESFUEL+CRUFUEL)*(CDRAN/CRUDES-1.)                           01713
      GO TO 887                                                         01714
  885 DDW=(W1-DELWT)*(CRUDES-CDRAN)/(CRUDES-R1)                         01715
  887 W1=DELWT                                                          01716
      R1=CRUDES                                                         01717
      DELWT=DELWT+DDW                                                   01718
      GO TO 882                                                         01719
  891 RESFUEL(J)=WFHOTIM+MISAP+CLBFUEL+CRUFUEL+DESFUEL                  01720
      ENRESWT(J)=WTAB(J)-RESFUEL(J)                                     01721
       IF(IFLAG .EQ. 0) GO TO 898                                       01722
      CALL ATMO(HOTAB(J,NCRRES),DTC,DELTA,THETA,ASTAR)                  01723
      MACH=VOTAB(J,NCRRES)/ASTAR                                        01724
      WRITE (6,312) WTAB(J),WFHOTIM,CLBDIST,CLBFUEL,CRRANGE,CRUFUEL,    01725
     1 DESDIST,DESFUEL,RESFUEL(J),ENRESWT(J),MACH,HOTAB(J,NCRRES),      01726
     2 VOTAB(J,NCRRES)                                                  01727
  312 FORMAT(2F10.0,6F10.1,2F10.0,F8.4,F10.0,F10.1)                     01728
  898 CONTINUE                                                          01729
  899 CONTINUE                                                          01730
      RETURN                                                            01731
      END                                                               01732
```

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      SUBROUTINE TOFF(FAROFF,GROSWT,IPRNO,ARN,SW,GLOV,ENGS,FORCE2)       00001
C                                                                        00002
C     ***************************************************************00003
C                                                                        00004
C     THIS PROGRAM COMPUTES TAKEOFF PROFILE.  PROGRAM INCORPORATES       00005
C     DEYOUNGS GROUND EFFECT EQUATIONS.                                  00006
C                                                                        00007
C     ***************************************************************00008
C                                                                        00009
      COMMON/BALFLD/ISTEP,TI,DE,VE,CDW,CL,TCUT,THM1,ALPRUN,TINC,BRAKEMU,00010
     1 ROLLMU,CLSPOIL,CDSPOIL,WHGT,RHOS,TIBR,TISP                       00011
     2,CDGEAR,ITME,VANGL                                                00012
      COMMON/TOLTH/INTHR,VELOC(10),SLTH(10),INTID,VELL(10),TIDLE(10),    00013
     + ALTITDE,THRFACT,SPDSND,ANS1,DTC                                  00014
      COMMON/TAKOFF/CDDP(10),CDMW,DMO,ALPRT,DELTCL,SWING,AR,             00015
     1   CLDPOCL(10),OROTATE,HGT,JBAL,DELTAT,DEEVEE,ALPMX,TIGEAR,       00016
     3 CLMAX,CDMIN,ALPHTB(10),CLTB1(10),CDTB1(10)                       00017
      COMMON/MISS/T(200),D(200),ALT(200),V(200),EM(200),GAM(200),        00018
     *ALP(200),TANG(200),TH(200),CLL(200),CDD(200),ELOD(200),           00019
     * DELFOR(10),VIT(10),ALWR(10),HFOR(10),DUMMY(3960)                 00020
      COMMON/FALZAR/ARGEF                                                00021
      REAL LINT1                                                         00022
      SPAN=SQRT(ARN*(SW-GLOV))                                           00023
      CDM=CDMW+DMO/SW                                                    00024
      DO 400 I=1,10                                                      00025
  400 CDTB1(I)=(CDTB1(I)-CDMIN)*AR/ARN+CDM                               00026
      CDGEAR=CDGEAR*SWING/SW                                             00027
      CDMIN=CDM                                                          00028
      AR=ARN                                                             00029
      SWING=SW                                                           00030
      CL8=CLMAX*.6944444                                                 00031
      G=32.174                                                           00032
      IBAL=0                                                             00033
      DBAL=0.                                                            00034
      ALPMX2=ALPMX                                                       00035
      IF(NE.EQ.1)JBAL=0                                                  00036
      IPRNT=0                                                            00037
      IF(JBAL.EQ.0)IPRNT=IPRNO                                           00038
      RAD=.0174533                                                       00039
      SPD=6076.1155/3600.0                                               00040
      NE=ENGS                                                            00041
      RHOS=ANS1*SW*.5                                                    00042
      VSTALL=SQRT(GROSWT/(CLMAX*RHOS))/SPD                               00043
      VROTATE=VSTALL                                                     00044
      CALL ORIDE(VROTATE,OROTATE)                                        00045
      VOSREQ=1.2*VSTALL                                                  00046
      NEOP=NE                                                            00047
C                                                                        00048
C     SECOND SEGMENT CLIMB                                               00049
      IF(NE.EQ.1)GO TO 1                                                 00050
      GAM2=ATAN(.018+.003*NE)                                            00051
      SG=SIN(GAM2)                                                       00052
      CG=COS(GAM2)                                                       00053
      V2=VOSREQ*SPD                                                      00054
      THRU=LINT1(V2,VELOC,10,SLTH)*(NE-1)                                00055
      RHV2=V2*V2*RHOS                                                    00056
      M=0                                                                00057
      CL=GROSWT*CG/RHV2                                                  00058
      ALP2=LINT1(CL,CLTB1,10,ALPHTB)                                     00059
      ALPO=ALP2                                                          00060
  270 FORCV=RHV2*LINT1(ALP2,ALPHTB,10,CLTB1)-GROSWT*CG+                  00061
     1 THRU*SIN((ALP2-ALPRUN+TINC)*RAD)                                  00062
      M=M+1                                                              00063
      IF(ABS(FORCV).LT..000001*GROSWT.OR.M.GT.15)GO TO 300               00064
      IF(M.GT.1)GO TO 290                                                00065
      FORO=FORCV                                                         00066
      ALP2=ALP2-.1                                                       00067
      GO TO 270                                                          00068
  290 DELTALP=-FORCV*(ALP2-ALPO)/(FORCV-FORO)                            00069
      ALPO=ALP2                                                          00070
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      FORO=FORCV                                                        00071
      ALP2=ALP2+DELTALP                                                 00072
      GO TO 270                                                         00073
  300 M=0                                                               00074
      ALPMX2=ALP2                                                       00075
      ALPO=ALP2                                                         00076
  310 FORCH=-RHV2*LINT1(ALPMX2,ALPHTB,10,CDTB1)-GROSWT*SG+              00077
     1 THRU*COS((ALPMX2-ALPRUN+TINC)*RAD)                               00078
      M=M+1                                                             00079
      IF(M.GT.1)GO TO 320                                               00080
      FORO=FORCH                                                        00081
      FORCE2=FORCH                                                      00082
      IF(FORCH.LT.0.)GO TO 330                                          00083
      ALPMX2=ALPMX2+1.                                                  00084
      GO TO 310                                                         00085
  320 IF(ABS(FORCH).LT..00001*GROSWT.OR.M.GT.15)GO TO 330               00086
      DELTALP=-FORCH*(ALPMX2-ALPO)/(FORCH-FORO)                         00087
      FORO=FORCH                                                        00088
      ALPO=ALPMX2                                                       00089
      ALPMX2=ALPMX2+DELTALP                                             00090
      GO TO 310                                                         00091
  330 IF(IPRNO.LE.0)GO TO 1                                             00092
      WRITE(6,325)GAM2,ALP2,FORCE2                                      00093
  325 FORMAT(37H1 * * * ONE ENGINE OUT TAKE OFF * * * /                 00094
     1 42HOSECOND SEGMENT CLIMB FLIGHT PATH ANGLE = ,F5.3,              00095
     1 8H RADIANS/18H ANGLE OF ATTACK =,F8.4,24H DEGREES - - NET FORCE =00096
     2,F8.1,7H POUNDS/)                                                 00097
      IF(FORCE2.LT.0.)WRITE(6,326)                                      00098
  326 FORMAT(50H * * * FAILED SECOND SEGMENT CLIMB CRITERION * * * /)   00099
C                                                                       00100
C     COMPUTE TIME AND DISTANCE TO VROTATION                            00101
    1 IM1=0                                                             00102
      IF(JBAL.EQ.0)WRITE(6,995)                                         00103
      IF(JBAL.EQ.0.AND.ITME.GT.0)WRITE(6,127)                           00104
      ALPMAX=LINT1(CL8,CLTB1,10,ALPHTB)                                 00105
      IF(ALPMAX.GT.ALPMX)ALPMAX=ALPMX                                   00106
      ALPROT=ALPRT                                                      00107
      IF(ALPROT.GT.ALPMAX)ALPROT=ALPMAX                                 00108
      VROT=VROTATE*SPD                                                  00109
      DELTAV=DEEVEE                                                     00110
      I=1                                                               00111
      DE=0.0                                                            00112
      TI=0.0                                                            00113
      VE=0.0                                                            00114
      IF(ALPMX2.GT.ALPMAX)ALPMX2=ALPMAX                                 00115
    7 CALL GEFFECT(ALPRUN,0.,0.,ALPHTB,CLTB1,CDTB1,CDMIN,CL,CDG,        00116
     C AR*ARGEF,WHGT,SPAN)                                              00117
      COUNT=0.0                                                         00118
      STINC=NEOP*SIN(TINC*RAD)                                          00119
      CTINC=NEOP*COS(TINC*RAD)                                          00120
      GAMFLT=0.                                                         00121
      HT=0.                                                             00122
      ACO=0.                                                            00123
      IA=TI+1                                                           00124
    8 V1=VE+DELTAV                                                      00125
      IF(V1.LT.VROT)GO TO 5                                             00126
      V1=VROT                                                           00127
      DELTAV=VROT-VE                                                    00128
      COUNT=COUNT+1.                                                    00129
    5 CDP=LINT1(V1,VELOC,10,CDDP)                                       00130
      DRAG=(CDG+CDGEAR+CDP)*V1*V1*RHOS                                  00131
      THRU=LINT1(V1,VELOC,10,SLTH)                                      00132
      CLP=LINT1(V1,VELOC,10,CLDPOCL)                                    00133
      DCL=CLP/CL                                                        00134
      CLIFT=(CL+DCL)*RHOS*V1*V1+STINC*THRU                              00135
      ACC=(THRU*CTINC-DRAG-ROLLMU*(GROSWT-CLIFT))*G/GROSWT              00136
      IF(ACO.EQ.0.)ACO=ACC                                              00137
      DELT=2.*DELTAV/(ACC+ACO)                                          00138
      TI=TI+DELT                                                        00139
      DE=DE+DELT*(VE+(2.*ACO+ACC)*DELT/6.)                              00140
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      VE=VE+DELTAV                                                          00141
      ACO=ACC                                                               00142
      IF(TI.GT.195.)GO TO 1025                                              00143
      IF (TI.LT.IA.AND.V1.LT.VROT) GO TO 9                                  00144
      IF(IPRNT.LE.0.OR.ITME.LE.0)GO TO 66                                   00145
      CPL=CL+DCL                                                            00146
      CPD=CDG+CDGEAR+CDP                                                    00147
      VP=VE/SPD                                                             00148
      THP=THRU*NEOP                                                         00149
      EP=VE/SPDSND                                                          00150
      ELP=CPL/CPD                                                           00151
      WRITE(6,126)TI,DE,HT,VP,EP,GAMFLT,ALPRUN,TINC,THP,CPL,CPD,ELP         00152
   66 IF(IM1.EQ.1.AND.VE/SPD.LE.VROTATE)GO TO 6                             00153
      CDD(I)=CDG+CDGEAR+CDP                                                 00154
      CLL(I)=CL+DCL                                                         00155
      V(I)=VE/SPD                                                           00156
      T(I)=TI                                                               00157
      D(I)=DE                                                               00158
      TANG(I)=TINC                                                          00159
      ALP(I)=ALPRUN                                                         00160
      ALT(I)=0.0                                                            00161
      TH(I)=THRU*NEOP                                                       00162
      GAM(I)=0.0                                                            00163
      EM(I)=VE/SPDSND                                                       00164
      ELOD(I)=CLL(I)/CDD(I)                                                 00165
      I=I+1                                                                 00166
    6 IF(TI.GE.IA)IA=IA+1                                                   00167
    9 IF (COUNT.EQ.0.0) GO TO 8                                             00168
      DROT=DE                                                               00169
      TROT=TI                                                               00170
      VROTE=VROT/SPD                                                        00171
      IF(IBAL.EQ.0.AND.IM1.EQ.0.AND.JBAL.EQ.1)GO TO 211                     00172
C     COMPUTE ROTATIONAL VELOCITY TO LIFTOFF                                00173
      ALPOL=ALPRUN                                                          00174
      COUNT=2.0                                                             00175
      DELT=DELTAT                                                           00176
      ALPH1=ALPRUN                                                          00177
      DELF=1.                                                               00178
11    DELTAV=DELT*ACO                                                       00179
      DELTAL=VANGL*DELT                                                     00180
      ALPH1=ALPH1+DELTAL                                                    00181
      IF (ALPH1.GT.ALPROT)ALPH1=ALPROT                                      00182
      CALL GEFFECT(ALPH1,0.,0.,ALPHTB,CLTB1,CDTB1,CDMIN,CL,CDG,             00183
     C AR*ARGEF,WHGT,SPAN)                                                  00184
      V1=VE+DELTAV                                                          00185
      CDP=LINT1(V1,VELOC,10,CDDP)                                           00186
      DRAG=(CDG+CDGEAR+CDP)*V1**2  *RHOS                                    00187
      THRU=LINT1(V1,VELOC,10,SLTH)                                          00188
      CLP=LINT1(V1,VELOC,10,CLDPOCL)                                        00189
      DCL=CLP/CL                                                            00190
      DELTALP=ALPH1-ALPRUN                                                  00191
      CLIFT=(CL+DCL)*RHOS*V1**2 +(NE-IM1)*SIN((TINC+DELTALP)*RAD)*THRU      00192
      FRICT=ROLLMU*(GROSWT-CLIFT)                                           00193
      IF(FRICT.LT.0.)FRICT=0.                                               00194
      TNET=THRU*(NE-IM1)*COS((TINC+DELTALP)*RAD)                            00195
      FORC=TNET-DRAG-FRICT                                                  00196
      ACC=FORC*G/GROSWT                                                     00197
C     ITERATION ON LIFTOFF VELOCITY                                         00198
      IF (COUNT.GT.2.0) GO TO 13                                            00199
      IF (CLIFT.LT.GROSWT) GO TO 18                                         00200
      M=1                                                                   00201
      COUNT=COUNT+1.0                                                       00202
13    VIT(M)=DELT                                                           00203
      DELFOR(M)=CLIFT-GROSWT                                                00204
      ALWR(M)=ALPH1                                                         00205
      HFOR(M)=FORC                                                          00206
      IF (ABS(DELFOR(M)).LT..000001*GROSWT) GO TO 17                        00207
      IF (M.GT.1) GO TO 14                                                  00208
      DELT=DELT*(1.-DELFOR(M)/(DELFOR(M)-DELF))                             00209
      IF(DELT.LT.0.)DELT=0.                                                 00210
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      GO TO 15                                                          00211
14    IF (M.EQ.10) GO TO 16                                             00212
      DELT=VIT(M)-(VIT(M)-VIT(M-1))*DELFOR(M)/                          00213
     1 (DELFOR(M)-DELFOR(M-1))                                          00214
      IF(DELT.LE.0.)DELT=VIT(M)/2.                                      00215
      IF(DELT.LE.0.)GO TO 17                                            00216
      IF(M.GT.5.AND.(DELFOR(M)*DELFOR(M-1)).LT.0.)DELT=(VIT(M)+VIT(M-1))00217
     1 /2.                                                              00218
15    M=M+1                                                             00219
      ALPH1=ALPOL                                                       00220
      GO TO 11                                                          00221
16    IF (ABS(VIT(M)-VIT(M-1)).LT..001) GO TO 17                        00222
      WRITE (6,94) (M,VIT(M),DELFOR(M),ALWR(M),HFOR(M),M=1,10)          00223
17    COUNT=10.0                                                        00224
   18 DELTAV=(ACC+ACO)*DELT/2.                                          00225
      ALPOL=ALPH1                                                       00226
      DELF=CLIFT-GROSWT                                                 00227
      TI=TI+DELT                                                        00228
      DE=DE+DELT*(VE+(2.*ACO+ACC)*DELT/6.)                              00229
      VE=VE+DELTAV                                                      00230
      ACO=ACC                                                           00231
      IF(TI.GT.195.)GO TO 1025                                          00232
      IF((TI.LT.IA.AND.COUNT.LT.10.).OR.IPRNT.LE.0.OR.ITME.LE.0)GO TO 1900233
      CPL=CL+DCL                                                        00234
      CPD=CDG+CDGEAR+CDP                                                00235
      VP=VE/SPD                                                         00236
      TP=TINC+ALPH1-ALPRUN                                              00237
      THP=THRU*(NE-IM1)                                                 00238
      EP=VE/SPDSND                                                      00239
      ELP=CPL/CPD                                                       00240
      WRITE(6,126)TI,DE,HT,VP,EP,GAMFLT,ALPH1,TP,THP,CPL,CPD,ELP        00241
      IF(TI.GE.IA)IA=IA+1                                               00242
19    CONTINUE                                                          00243
      IF (COUNT.LT.10.0) GO TO 11                                       00244
      TLO=TI                                                            00245
      VLO=VE/SPD                                                        00246
      ALPHLO=ALPH1                                                      00247
      DLO=DE                                                            00248
      IA=TLO+1.0                                                        00249
      VVERT=0.0                                                         00250
      VHORZ=VE                                                          00251
      GAMO=0.                                                           00252
      DELO=0.                                                           00253
      HOO=0.                                                            00254
      ACHO=ACO                                                          00255
      ACVO=0.                                                           00256
      DGAM=0.                                                           00257
      MAL=0                                                             00258
      COUNT=3.0                                                         00259
C     COMPUTE TRAJECTORY FROM LIFTOFF TO OBSTACLE HEIGHT (HGHT = 35.0)  00260
      HT=0.0                                                            00261
      DELT=DELTCL                                                       00262
      GAMFLT=0.0                                                        00263
20    DELTAV=DELT*ACO                                                   00264
      DELTAL=VANGL*DELT                                                 00265
      ALPOL=ALPH1                                                       00266
      ALPH1=ALPH1+DELTAL                                                00267
   21 IF (ALPH1.GT.ALPMAX)ALPH1=ALPMAX                                  00268
      GAMFLT=GAMO+DELT*DGAM                                             00269
      DELTALP=ALPH1-ALPRUN                                              00270
      H1=HT+DELT*(VVERT+DELT*ACVO/2.)                                   00271
      CALL GEFFECT(ALPH1,H1,GAMFLT,ALPHTB,CLTB1,CDTB1,CDMIN,CL,CDG,     00272
     C AR*ARGEF,WHGT,SPAN)                                              00273
      V1=VE+DELTAV                                                      00274
      IF ((TI+DELT-TLO).GT.TIGEAR) GO TO 22                             00275
      CDGR=CDGEAR*COS(((TI+DELT-TLO)/TIGEAR)*90.0*RAD)                  00276
      GO TO 23                                                          00277
22    CDGR=0.0                                                          00278
23    CDP=LINT1(V1,VELOC,10,CDDP)                                       00279
      DRAG=(CDG+CDGR+CDP)*V1**2  *RHOS                                  00280
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      CLP=LINT1(V1,VELOC,10,CLDPOCL)                                    00281
      DCL=CLP/CL                                                        00282
      CLIFT=(CL+DCL)*V1**2  *RHOS                                       00283
      THRU=LINT1(V1,VELOC,10,SLTH)                                      00284
      CG=COS(GAMFLT*RAD)                                                00285
      SG=SIN(GAMFLT*RAD)                                                00286
      TNETH=THRU*(NE-IM1)*COS((TINC+DELTALP+GAMFLT)*RAD)                00287
      TNETV=THRU*(NE-IM1)*SIN((TINC+DELTALP+GAMFLT)*RAD)                00288
      FORCH=TNETH-CLIFT*SG-DRAG*CG                                      00289
      FORCV=TNETV+CLIFT*CG-GROSWT-DRAG*SG                               00290
      ACCH=FORCH*G/GROSWT                                               00291
      ACCV=FORCV*G/GROSWT                                               00292
      AB=(2.*ACVO+ACCV)/6.                                              00293
      HO=HT+DELT*(VVERT+DELT*AB)                                        00294
      TVERT=VVERT+DELT*(ACVO+ACCV)/2.                                   00295
      THORZ=VHORZ+DELT*(ACHO+ACCH)/2.                                   00296
      GAMFLT=ATAN(TVERT/THORZ)/RAD                                      00297
      ACC=ACCH*COS(GAMFLT*RAD)+ACCV*SIN(GAMFLT*RAD)                     00298
      IF(MAL.GT.0)GO TO 500                                             00299
      IF(ACC.GT.0.)GO TO 600                                            00300
      DAL=-.1                                                           00301
  490 MAL=MAL+1                                                         00302
      ALPO=ALPH1                                                        00303
      ACACO=ACC                                                         00304
      ALPH1=ALPH1+DAL                                                   00305
      GO TO 21                                                          00306
  500 IF(ABS(ACC).GT..001.AND.MAL.LT.10.AND.ACC.NE.ACACO)GO TO 510      00307
      MAL=0                                                             00308
      GO TO 600                                                         00309
  510 DAL=-ACC*(ALPH1-ALPO)/(ACC-ACACO)                                 00310
      GO TO 490                                                         00311
  600 DGAM=(GAMFLT-GAMO)/DELT                                           00312
      IF(ABS(HO-HGT).LT..001) GO TO 25                                  00313
      IF (COUNT.GT.3.0) GO TO 24                                        00314
      IF (HO.LT.HGT) GO TO 26                                           00315
   24 DV=(DELT-DELO)*(HO-HGT)/(HO-HOO)                                  00316
      DELO=DELT                                                         00317
      HOO=HO                                                            00318
      DELT=DELT-DV                                                      00319
      IF(DELT.LT.0.) DELT=DELO/2.                                       00320
      IF(DELT.GT.DELTCL) DELT=(DELTCL+DELO)/2.                          00321
      ALPH1=ALPOL                                                       00322
      COUNT=COUNT+1.0                                                   00323
      IF (COUNT.LT.21.0) GO TO 20                                       00324
25    COUNT=21.0                                                        00325
26    CONTINUE                                                          00326
      HT=HO                                                             00327
      HOO=HT                                                            00328
      DE=DE+DELT*(VHORZ+(2.*ACHO+ACCH)*DELT/6.)                         00329
      VVERT=TVERT                                                       00330
      VHORZ=THORZ                                                       00331
      VE=SQRT(VVERT**2+VHORZ**2)                                        00332
      GAMO=GAMFLT                                                       00333
      ACO=ACC                                                           00334
      ACHO=ACCH                                                         00335
      ACVO=ACCV                                                         00336
      TI=TI+DELT                                                        00337
      IF(TI.LE.195.)GO TO 1027                                          00338
 1025 WRITE(6,1026)                                                     00339
 1026 FORMAT(27H0* * * FAILED TAKEOFF * * * )                           00340
      FAROFF=1.25*DE*VSTALL/VE                                          00341
      RETURN                                                            00342
 1027 IP=0                                                              00343
      IF(TI.LT.IA.OR.IPRNT.LE.0.OR.ITME.LE.0)GO TO 28                   00344
27    CPL=CL+DCL                                                        00345
      CPD=CDG+CDGR+CDP                                                  00346
      VP=VE/SPD                                                         00347
      TP=TINC+DELTALP                                                   00348
      THP=THRU*(NE-IM1)                                                 00349
      EP=VE/SPDSND                                                      00350
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      ELP=CPL/CPD                                                          00351
      WRITE(6,126)TI,DE,HT,VP,EP,GAMFLT,ALPH1,TP,THP,CPL,CPD,ELP           00352
      IA=IA+1                                                              00353
      IP=1                                                                 00354
28    CONTINUE                                                             00355
      IF (COUNT.LT.21.0) GO TO 20                                          00356
      IF(IP.EQ.0.AND.IPRNT.GT.0.AND.ITME.GT.0)GO TO 27                     00357
C                                                                          00358
      TOBST=TI                                                             00359
      VOBST=VE/SPD                                                         00360
      ACCOBST=ACC                                                          00361
      GAMOBST=GAMFLT                                                       00362
      ALPOBST=ALPH1                                                        00363
      HOBST=HT                                                             00364
      DOBST=DE                                                             00365
      FAROFF=1.15*DOBST                                                    00366
      IF(IPRNT.LE.0) GO TO 211                                             00367
      WRITE (6,101) DROT,TROT,VROTE                                        00368
      WRITE (6,102) DLO,TLO,VLO,ALPHLO                                     00369
      WRITE (6,103) DOBST,HOBST,TOBST,VOBST,ALPOBST,GAMOBST,ACCOBST        00370
      WRITE (6,104) VSTALL,VOSREQ                                          00371
  211 IF(IM1.EQ.0.AND.IBAL.GT.0)GO TO 1000                                 00372
      IF(JBAL.EQ.0)GO TO 1000                                              00373
      IF(IM1.EQ.1)GO TO 195                                                00374
      VOUT=VROTE                                                           00375
  212 VES=VOUT                                                             00376
      VROT=VROTATE*SPD                                                     00377
      NEOP=NE-1                                                            00378
      IF(VES.LT.VROTATE)GO TO 215                                          00379
      VES=VROTATE                                                          00380
      VROT=VOUT*SPD                                                        00381
      NEOP=NE                                                              00382
  215 DO 220 I=2,200                                                       00383
  220 IF(V(I)+.01.GT.VES)GO TO 230                                         00384
C     VOUT TOO HIGH                                                        00385
  230 DELI=(V(I)-VES)/(V(I)-V(I-1))                                        00386
      DOUT=D(I)*(1.-DELI)+DELI*D(I-1)                                      00387
      TOUT=T(I)*(1.-DELI)+DELI*T(I-1)                                      00388
      VE=VES*SPD                                                           00389
      DE=DOUT                                                              00390
      TI=TOUT                                                              00391
      ALPMAX=ALPMX2                                                        00392
      IF(ALPROT.GT.ALPMAX)ALPROT=ALPMAX                                    00393
      IM1=1                                                                00394
      DELTAV=DEEVEE/5.                                                     00395
      IF(NEOP.EQ.NE)I=I+1                                                  00396
      IF(IPRNT.LE.0.OR.ITME.LE.0)GO TO 7                                   00397
      WRITE (6,127)                                                        00398
      ICNT=I-1                                                             00399
      WRITE (6,126) (T(J),D(J),ALT(J),V(J),EM(J),GAM(J),ALP(J),TANG(J),    00400
     1TH(J),CLL(J),CDD(J),ELOD(J),J=1,ICNT)                                00401
      GO TO 7                                                              00402
  195 DO 200 I=2,200                                                       00403
  200 IF(V(I)+.01.GT.VOUT)GO TO 210                                        00404
C     VOUT TOO HIGH                                                        00405
  210 DELI=(V(I)-VOUT)/(V(I)-V(I-1))                                       00406
      ISTEP=I                                                              00407
      DOUT=D(I)*(1.-DELI)+DELI*D(I-1)                                      00408
      TOUT=T(I)*(1.-DELI)+DELI*T(I-1)                                      00409
      CLOUT=CLL(I)*(1.-DELI)+DELI*CLL(I-1)                                 00410
      CDOUT=CDD(I)*(1.-DELI)+DELI*CDD(I-1)                                 00411
      THOUT=(TH(I)*(1.-DELI)+DELI*TH(I-1))/NE                              00412
      VE=VOUT*SPD                                                          00413
      DE=DOUT                                                              00414
      TI=TOUT                                                              00415
      CL=CLOUT                                                             00416
      CDW=CDOUT                                                            00417
      THM1=THOUT                                                           00418
      IF(IPRNT.GT.0)WRITE(6,985)                                           00419
  985 FORMAT(30H1 * * * ABORTED TAKE OFF * * * /)                          00420
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      CALL DECEL(FSTOP,GROSWT,IPRNT,ARN,SW,GLOV,ENGS)                    00421
      IBAL=IBAL+1                                                        00422
      IF(IBAL.GT.10)GO TO 999                                            00423
      DELST=FSTOP-DOBST                                                  00424
      IF(ABS(DELST).GT.1.0.AND.IBAL.LT.10)GO TO 990                      00425
      IPRNT=IPRNO                                                        00426
      IBAL=10                                                            00427
  990 DELV2=-DELST*.5*VOUT/(DOBST+FSTOP)                                 00428
      IF(IBAL.GT.1)DELV2=DELST*(VOUT-VOO)/(DELSO-DELST)                  00429
      VOO=VOUT                                                           00430
      DELSO=DELST                                                        00431
      VOUT=VOUT+DELV2                                                    00432
      GO TO 212                                                          00433
  999 IM1=0                                                              00434
      NEOP=NE                                                            00435
      DBAL=(FSTOP+DOBST)/2.                                              00436
      IF(VOUT.GT.VROTATE)VROTATE=VOUT                                    00437
      IF(IPRNT.EQ.0)GO TO 1                                              00438
      WRITE(6,995)                                                       00439
  995 FORMAT(33H1 * * * ALL ENGINE TAKE OFF * * * /)                     00440
      IF(ITME.GT.0)WRITE(6,127)                                          00441
      GO TO 1                                                            00442
 1000 IF(DBAL.GT.FAROFF)FAROFF=DBAL                                      00443
      IF(IPRNT.EQ.0)RETURN                                               00444
      WRITE (6,112)                                                      00445
      WRITE (6,113) (ALPHTB(I),I=1,10)                                   00446
      WRITE (6,114) (CLTB1(I),I=1,10)                                    00447
      WRITE (6,115) (CDTB1(I),I=1,10)                                    00448
      WRITE (6,116)                                                      00449
      WRITE (6,117) (VELOC(I),I=1,10)                                    00450
      WRITE (6,118) (SLTH(I),I=1,10)                                     00451
112   FORMAT (32X,35HDRAG POLAR - GEAR DRAG NOT INCLUDED/)               00452
113   FORMAT (7X,15HANGLE OF ATTACK,4X,10F10.2)                          00453
114   FORMAT (7X,16HLIFT COEFFICIENT,3X,10F10.4)                         00454
115   FORMAT (7X,16HDRAG COEFFICIENT,3X,10F10.4/)                        00455
116   FORMAT (41X,34HINPUT NET THRUST VALUES FOR ENGINE)                 00456
117   FORMAT (6X,8HVELOCITY,10F11.1)                                     00457
118   FORMAT (6X,8HTHRUST  ,10F11.1)                                     00458
      RETURN                                                             00459
C                                                                        00460
   94 FORMAT (54H   * * ITERATION OF LIFTOFF VELOCITY IS INCOMPLETE * */00461
     1(I5,6H DELT=,F7.3,8H DELFOR=,F10.2,7H ALPHA=,F7.3,6H HFOR=F9.2))   00462
101   FORMAT (10X,20HROTATION DISTANCE = ,1F8.2,5H FEET,9X,16HROTATION T00463
     1IME = ,1F5.2,8H SECONDS,9X,20HROTATION VELOCITY = ,1F6.2,6H KNOTS/00464
     2)                                                                  00465
102   FORMAT (24X,19HLIFTOFF DISTANCE = ,1F8.2,5H FEET,24X,15HLIFTOFF TI00466
     1ME = ,1F5.2,8H SECONDS,/20X,19HLIFTOFF VELOCITY = ,1F6.2,6H KNOTS,00467
     220X,26HLIFTOFF ANGLE OF ATTACK = ,1F7.4,8H DEGREES/)               00468
104   FORMAT(4X,9HVSTALL = ,F10.2,10X,17HV OBSTACLE REQ = ,F10.2,/)      00469
103   FORMAT (2X,20HOBSTACLE DISTANCE = ,1F8.2,5H FEET,2X,18HOBSTACLE HE00470
     1IGHT = ,1F6.2,5H FEET,2X,16HOBSTACLE TIME = ,1F5.2,8H SECONDS,2X,200471
     20HOBSTACLE VELOCITY = ,1F6.2,6H KNOTS,/3X,27HOBSTACLE ANGLE OF ATT00472
     3ACK = ,1F7.4,8H DEGREES,3X,24HOBSTACLE FLIGHT ANGLE = ,1F7.4,8H DE00473
     4GREES,3X,22HOBSTACLE ACCEL RATE = ,1F7.4,11H FT/SEC/SEC/)          00474
126   FORMAT (1F8.2,1F12.2,1F12.2,1F12.2,1F11.4,1F10.3,1F11.3,1F12.3,1F100475
     13.1,1F9.4,1F10.4,1F10.2)                                           00476
127   FORMAT (1H ,2X,4HTIME,6X,8HDISTANCE,4X,8HALTITUDE,4X,8HVELOCITY,5X00477
     1,4HMACH,6X,5HCLIMB,5X,6HATTACK,6X,6HENGINE,6X,6HENGINE,6X,4HLIFT,600478
     2X,4HDRAG,6X,3HL/D,/49X,6HNUMBER,5X,5HANGLE,6X,5HANGLE,5X,9HINCIDEN00479
     3CE,4X,6HTHRUST,5X,6HCOEFF.,4X,6HCOEFF.,4X,5HRATIO,/2X,7HSECONDS,6X00480
     4,4HFEET,8X,4HFEET,7X,5HKNOTS,16X,7HDEGREES,4X,7HDEGREES,5X,7HDEGRE00481
     5ES,5X,6HPOUNDS/)                                                   00482
      END                                                                00483
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      SUBROUTINE GEFFECT(ALPHA,H,GAM,ATB,CLT,CDT,CDM,CL,CDG,AR,WHGT,     00484
     1 SPAN)                                                             00485
      DIMENSION ATB(10),CLT(10),CDT(10)                                  00486
      REAL LINT1                                                         00487
C                                                                        00488
      CL=LINT1(ALPHA,ATB,10,CLT)                                         00489
      CDG=LINT1(ALPHA,ATB,10,CDT)                                        00490
      HF=(H+WHGT)/SPAN                                                   00491
C     CHECK FOR OUT OF GROUND EFFECT                                     00492
      IF(HF.GT.1.)RETURN                                                 00493
C     PREVENT RIDICULOUS VALUES IF H IS NEGATIVE                         00494
      IF(H.LT.0.)HF=(WHGT*WHGT/(WHGT-H))/SPAN                            00495
C                                                                        00496
      A=(6+AR)**2  /(36.0+AR)                                            00497
      B=32.0*(HF*A)**2  +1.0                                             00498
      D=(ALPHA+GAM)*.0174533                                             00499
      DENOM=B-0.5+4.0*HF*A*B**0.5                                        00500
      CLFACT=1.0+1.0/DENOM                                               00501
      B=1+32.0*HF**2                                                     00502
      DENOM=4.0*HF*B**0.5+B                                              00503
      PHII=1.0-1.0/DENOM                                                 00504
      CDG=CDM+CLFACT*PHII*(CDG-CDM)+D*CL*(CLFACT-1.0)                    00505
      CL =CL*CLFACT                                                      00506
      RETURN                                                             00507
      END                                                                00508
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      SUBROUTINE DEFTOL(AR,SW,CLTOA,CLAPP)                              00509
      COMMON/BALFLD/ISTEP,TI,DE,VE,CDW,CL,TICUT,THM1,ALPRUN,TINC,       00510
     1 BRAKEMU,ROLLMU,CLSPOIL,CDSPOIL,WHGT,RHOA,TIBRA,TISPA,            00511
     2 CDGEAR,ITIME,VANGL                                               00512
      COMMON/TOLTH/INTHRTO,VELTO(10),THRTO(10),INTHRLD,VELLD(10),       00513
     + THRLD(10),APA,THRFACT,SPDSND,ANS1,DTC                            00514
      COMMON /TAKOFF/ CDDP(10),CDMT,DMT,ALPROT,DELTCL,SWREF,ARREF,      00515
     1    CLDPOCL(10),VROTATE,OBSTO,IBAL,DELTRO,DELVTO,ALPMXTO,TIGEAR,  00516
     3 CLTOM,CDMTO,ALPTO(10),CLTO(10),CDTO(10)                          00517
      COMMON/LAND/ALPMXLD,APRANG,CLLDM,TISPOIL,TIBRAKE,CDML,DML,        00518
     3 ACCLIM,DELTRUN,OBSLD,DELHAP,DELDFL,CLLD(10),CDLD(10),            00519
     5 ALPLD(10),CDMLD,APRHGT,SREF,AREF                                 00520
      COMMON/TREVRS/INTHRRV,VELRV(10),THRRV(10),REVFACT,TIREVRS,TIRVA   00521
      COMMON/FALZAR/ARGEF                                               00522
C                                                                       00523
      DATA VELTO/0.0,50.,100.,150.,200.,250.,300.,350.,400.,450./       00524
     1,ALPRUN,TINC,CDGEAR,CDMTO,THRTO/14*0./,ALPROT,ALPMXTO/2*25./      00525
     2,ITIME,INTHRTO/2*0/,FCDMWTO/.3/,VROTATE/1.05/,THRFACT/1./,WHGT/8./00526
     3,TIGEAR/2./,CDDP,CLDPOCL/20*0./,OBSTO/35./,IBAL/1/,               00527
     4 DELTRO/.2/,DELVTO/4./,APRHGT/100.001/,ALPMXLD/25./,OBSLD/50./,   00528
     5 VELLD/0.,50.,100.,150.,200.,250.,300.,350.,400.,450./,           00529
     6 CLSPOIL,CDSPOIL,APA,CDMLD,THRLD,DTC/15*0./,INTHRLD/0/,           00530
     7 APRANG,TISPA,TIBRA,TICUT/4*3./,BRAKEMU/.3/,ROLLMU/.025/,         00531
     8 VANGL,TISPOIL/2*2./,FCDMWLD/-1./,TIBRAKE/4./,ACCLIM/16./,        00532
     9 DELHAP/10./,DELDFL/10./,DELTRUN/.25/,DELTCL/.2/,ARGEF/1./        00533
      DATA VELRV/0.0,50.,100.,150.,200.,250.,300.,350.,400.,450./       00534
     1,THRRV,REVFACT/11*0./,INTHRRV/-1/,TIREVRS/5./,TIRVA/1000./        00535
C                                                                       00536
      NAMELIST/TOLIN/WHGT,SWREF,ARREF,APA,ALPRUN,TINC,CDGEAR,ITIME,     00537
     1 TIGEAR,CLSPOIL,CDSPOIL,BRAKEMU,ROLLMU,CLTOM,ALPMXTO,CDMTO,       00538
     2 FCDMWTO,ALPTO,CLTO,CDTO,INTHRTO,VELTO,THRTO,VROTATE,ALPROT,      00539
     3 THRFACT,CDDP,CLDPOCL,TISPA,TIBRA,TICUT,OBSTO,IBAL,DELTRO,        00540
     4 DELVTO,CLLDM,ALPMXLD,CDMLD,FCDMWLD,ALPLD,CLLD,CDLD,VELLD,        00541
     5 THRLD,INTHRLD,OBSLD,TISPOIL,TIBRAKE,APRANG,ACCLIM,DELHAP,        00542
     6 DELDFL,DELTRUN,APRHGT,VANGL,DELTCL,DTC,INTHRRV,VELRV,THRRV,      00543
     7 REVFACT,TIREVRS,TIRVA,ARGEF                                      00544
C                                                                       00545
      ARREF=AR                                                          00546
      SWREF=SW                                                          00547
      CLTOM=CLTOA                                                       00548
      CLLDM=CLAPP                                                       00549
C                                                                       00550
      READ(5,TOLIN)                                                     00551
      SREF=SWREF                                                        00552
      AREF=ARREF                                                        00553
      CDMT=FCDMWTO*CDMTO                                                00554
      DMT=(1.-FCDMWTO)*CDMTO*SWREF                                      00555
      DO 10 I=1,10                                                      00556
   10 THRTO(I)=THRTO(I)*THRFACT                                         00557
      IF(THRTO(1).LE.0..AND.INTHRTO.LT.2)INTHRTO=2                      00558
      IF(FCDMWLD.LT.0.)FCDMWLD=FCDMWTO                                  00559
      CDML=FCDMWLD*CDMLD                                                00560
      DML=(1.-FCDMWLD)*CDMLD*SWREF                                      00561
      IF(APRHGT.LE.100.)APRHGT=100.001                                  00562
      WRITE(6,20)APA,SWREF,ARREF,WHGT,ALPRUN,TINC,ROLLMU,BRAKEMU,VANGL, 00563
     1 CDGEAR,CLSPOIL,CDSPOIL,DTC                                       00564
   20 FORMAT(44H1 * * * TAKEOFF AND LANDING INPUT DATA * * * /          00565
     1 19H0AIRPORT ALTITUDE =,F6.0,24H, WING: REFERENCE AREA =,F7.1,     00566
     2 16H, ASPECT RATIO =,F6.2,23H, HEIGHT ABOVE GROUND =,F5.1/        00567
     3 18H ALPHA ON GROUND =,F4.1,30H, THRUST INCIDENCE ON GROUND =,F4.100568
     4,35H, FRICTION COEFFICIENTS - ROLLING =,F5.3,13H, BRAKES ON =,F5.300569
     5/25H ROTATION OR FLARE RATE =,F4.1,19H DEG/SEC, GEAR CD =,F6.4,   00570
     6 16H, SPOILER - CL =,F6.4,6H, CD =,F6.4,14H, TEMP DELTA =,        00571
     7 F5.1,6H DEG C)                                                   00572
      IF(ITIME.GT.0)WRITE(6,30)                                         00573
   30 FORMAT(39H TIME STEP SUMMARY DATA WILL BE PRINTED)                00574
      IF(ARGEF.NE.1.)WRITE(6,35)ARGEF                                   00575
   35 FORMAT(41H ASPECT RATIO FACTOR FOR GROUND EFFECTS =,F7.4)         00576
      WRITE(6,40)                                                       00577
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   40 FORMAT(17H0 * * TAKEOFF * */)                                        00578
      WRITE(6,50)CLTOM,CDMTO,FCDMWTO,ALPMXTO,OBSTO                         00579
   50 FORMAT(8H CLMAX =,F7.4,9H, CDMIN =,F6.4,33H, FRACTION OF CDMIN DUE00580
     1 TO WING =,F5.3,13H, ALPHA MAX =,F6.2,19H, OBSTACLE HEIGHT =,F5.1)00581
      WRITE(6,60)ALPROT,VROTATE,THRFACT,TIGEAR,DELVTO,DELTRO,DELTCL        00582
   60 FORMAT(23H ROTATION - ALPHA MAX =,F6.2,9H, SPEED =,F8.3,             00583
     1 44H (KNOTS OR FACTOR X VSTALL), THRUST FACTOR =,F6.3/               00584
     221H TIME TO RAISE GEAR =,F4.1,30H, VELOCITY STEP - GROUND RUN =,     00585
     3 F5.2,24H, TIME STEP - ROTATION =,F6.3,12H, CLIMBOUT =,F6.3)         00586
      IF(IBAL.GT.0)WRITE(6,70)TISPA,TIBRA,TICUT                            00587
   70 FORMAT(39H0BALANCED FIELD LENGTH WILL BE COMPUTED/                   00588
     149H FOR ABORTED TAKEOFF, TIME TO SPOILER ACTUATION =,F5.2,           00589
     2 24H, TO BRAKE APPLICATION =,F5.2,21H, TO ENGINE CUTBACK =,F5.2)     00590
      IF(IBAL.GT.0.AND.TIRVA.LT.1000.)WRITE(6,75)TIRVA                     00591
   75 FORMAT(10X,19HTO REVERSE THRUST =,F5.2)                              00592
      LTIT=8HTAKEOFF                                                       00593
      WRITE (6,112)LTIT                                                    00594
      WRITE (6,113) (ALPTO(I),I=1,10)                                      00595
      WRITE (6,114) (CLTO(I),I=1,10)                                       00596
      WRITE (6,115) (CDTO(I),I=1,10)                                       00597
      WRITE (6,116)LTIT,INTHRTO                                            00598
      WRITE (6,117) (VELTO(I),I=1,10)                                      00599
      WRITE (6,118) (THRTO(I),I=1,10)                                      00600
      IF(CDDP(10).NE.0.)WRITE(6,80)(CLDPOCL(I),I=1,10),(CDDP(J),J=1,10)    00601
   80 FORMAT(6X,8HDELTA CL,10F11.4/6X,8HDELTA CD,10F11.4)                  00602
      WRITE(6,90)                                                          00603
   90 FORMAT(17H0 * * LANDING * * /)                                       00604
      WRITE(6,50)CLLDM,CDMLD,FCDMWLD,ALPMXLD,OBSLD                         00605
      WRITE(6,100)APRHGT,APRANG,TISPOIL,TIBRAKE,ACCLIM,DELHAP,DELDFL,      00606
     1 DELTRUN                                                             00607
  100 FORMAT(24H START APPROACH HEIGHT =,F6.1,30H, APPROACH FLIGHT PATH 00608
     1ANGLE =,F5.2/44H TIME AFTER TOUCHDOWN TO SPOILER ACTUATION =,F5.2,00609
     2 21H, BRAKE APPLICATION =,F5.2,22H, DECELERATION LIMIT =,F6.2/       00610
     3 32H ALTITUDE STEP DURING APPROACH =,F6.2,                           00611
     4 30H, DISTANCE STEP DURING FLARE =,F6.2,                             00612
     5 27H, TIME STEP DURING RUNOUT =,F6.2)                                00613
      LTIT=8HLANDING                                                       00614
      WRITE (6,112)LTIT                                                    00615
      WRITE (6,113) (ALPLD(I),I=1,10)                                      00616
      WRITE (6,114) (CLLD(I),I=1,10)                                       00617
      WRITE (6,115) (CDLD(I),I=1,10)                                       00618
      WRITE (6,116)LTIT,INTHRLD                                            00619
      WRITE (6,117) (VELLD(I),I=1,10)                                      00620
      WRITE (6,118) (THRLD(I),I=1,10)                                      00621
  112 FORMAT(/24X,A8,35HDRAG POLAR - GEAR DRAG NOT INCLUDED/)              00622
  113 FORMAT (7X,15HANGLE OF ATTACK,4X,10F10.2)                            00623
  114 FORMAT (7X,16HLIFT COEFFICIENT,3X,10F10.4)                           00624
  115 FORMAT (7X,16HDRAG COEFFICIENT,3X,10F10.4/)                          00625
  116 FORMAT(24X,A8,43HINPUT NET THRUST VALUES PER ENGINE - OPTION,I2/)    00626
  117 FORMAT (6X,8HVELOCITY,10F11.1)                                       00627
  118 FORMAT (6X,8HTHRUST  ,10F11.1)                                       00628
      IF(REVFACT.EQ.0.)RETURN                                              00629
      WRITE (6,216)INTHRRV                                                 00630
      WRITE (6,117) (VELRV(I),I=1,10)                                      00631
      WRITE (6,118) (THRRV(I),I=1,10)                                      00632
  216 FORMAT(/24X,41HREVERSE THRUST VALUES PER ENGINE - OPTION,I2/)         00633
      WRITE(6,120)REVFACT,TIREVRS                                          00634
  120 FORMAT(24H0REVERSE THRUST FACTOR =,F7.4,                             00635
     143H, TIME AFTER TOUCHDOWN TO THRUST REVERSAL =,F5.2)                 00636
      RETURN                                                               00637
      END                                                                  00638
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      SUBROUTINE LANDING (FDLNGT,GROSWT,IFLAG,ARN,SW,GLOV,ENGS,FORCE2,   00639
     + APRVEL)                                                          00640
      COMMON/MISS/T(200),D(200),ALT(200),V(200),EM(200),GAM(200),       00641
     *ALP(200),TANG(200),TH(200),CLL(200),CDD(200),ELOD(200),           00642
     * ACN(10),ALPHE(10),DELFOR(10),H(10),HLAND(10),DUMMY(3950)         00643
      COMMON/BALFLD/ISTEP,TI,DE,VE,CDW,CL,TCUT,THM1,ALPRUN,TINC,BRAKEMU,00644
     1 ROLLMU,CLSPOIL,CDSPOIL,WHGT,RHOA,TIBRA,TISPA                     00645
     2,CDGEAR,ITIME,VANGL                                               00646
      COMMON/TOLTH/INTHR,TVEL(10),SLTH(10),INTID,VELOC(10),TIDLE(10),   00647
     + APA,THRFACT,SPDSND,ANS1,DTC                                      00648
      COMMON/TREVRS/INTHRRV,VELRV(10),THRRV(10),REVFACT,TIREVRS,TIRVA   00649
C                                                                       00650
      COMMON/LAND/ALPMAX,APRANG,CLMAX,TISPOIL,TIBRAKE,CDMW,DMO,         00651
     3 ACCLIM,DTRUN,HOBS,DELH,DELTAD                                    00652
     4  ,CLTB1(10),CDTB1(10),                                           00653
     5  ALPHTB(10),CDMIN,APRHGT,SWING,AR                                00654
      COMMON/FALZAR/ARGEF                                               00655
      REAL LINT1                                                        00656
C                                                                       00657
C                                                                       00658
C     ********************************************************************00659
C                                                                       00660
C     PROGRAM LANDING CALCULATES THE LANDING PROFILE FROM THE APPROACH  00661
C     SPEED AND THE APPROACH ANGLE. THE GEAR DRAG IS INCORPORATED AS A  00662
C     TIME FUNCTION AND DEYOUNG,S GROUND EFFECT EQUATIONS ARE INCLUDED. 00663
C     PROGRAM DATED JANUARY 1977                                        00664
C     MODIFY TO A SUBROUTINE IN FLOPS IN 8/81                           00665
C                                                                       00666
C     ********************************************************************00667
C                                                                       00668
C                                                                       00669
C  ************************************************************       00670
      SPAN=SQRT(ARN*(SW-GLOV))                                          00671
      CDM=CDMW+DMO/SW                                                   00672
      DO 400 I=1,10                                                     00673
  400 CDTB1(I)=(CDTB1(I)-CDMIN)*AR/ARN+CDM                              00674
      CDGEAR=CDGEAR*SWING/SW                                            00675
      CDMIN=CDM                                                         00676
      SWING=SW                                                          00677
      AR=ARN                                                            00678
      FARFACT=.6                                                        00679
      G=32.174                                                          00680
      ISTOP=0                                                           00681
      ALPMIN=ALPHTB(1)-3.                                               00682
      CUTBK=1.                                                          00683
      THM1=0.                                                           00684
      TIBR=TIBRAKE                                                      00685
      TISP=TISPOIL                                                      00686
      TIRV=TIREVRS                                                      00687
      IM1=0                                                             00688
      RAD=0.0174533                                                     00689
      SPD=6076.1155/3600.                                               00690
      NE=ENGS                                                           00691
      IF(IFLAG.GT.0)WRITE(6,94)                                         00692
C                                                                       00693
      RHOA=ANS1*SWING/2.                                                00694
      APRVEL=1.3*SQRT(GROSWT/(CLMAX*RHOA))/SPD                          00695
C                                                                       00696
C     MISSED APPROACH CLIMB                                             00697
      IF(NE.EQ.1)GO TO 1                                                00698
      GAM2=ATAN(.015+.003*NE)                                           00699
      SG=SIN(GAM2)                                                      00700
      CG=COS(GAM2)                                                      00701
      V2=APRVEL*SPD                                                     00702
      THRU=LINT1(V2,TVEL,10,SLTH)*(NE-1)                                00703
      RHV2=V2*V2*RHOA                                                   00704
      M=0                                                               00705
      CL=GROSWT*CG/RHV2                                                 00706
      ALP2=LINT1(CL,CLTB1,10,ALPHTB)                                    00707
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      ALPO=ALP2                                                          00708
  270 FORCV=RHV2*LINT1(ALP2,ALPHTB,10,CLTB1)-GROSWT*CG+                  00709
     1 THRU*SIN((ALP2-ALPRUN+TINC)*RAD)                                  00710
      M=M+1                                                              00711
      IF(ABS(FORCV).LT..000001*GROSWT.OR.M.GT.15)GO TO 330               00712
      IF(M.GT.1)GO TO 290                                                00713
      FORO=FORCV                                                         00714
      ALP2=ALP2-.1                                                       00715
      GO TO 270                                                          00716
  290 DELTALP=-FORCV*(ALP2-ALPO)/(FORCV-FORO)                            00717
      ALPO=ALP2                                                          00718
      FORO=FORCV                                                         00719
      ALP2=ALP2+DELTALP                                                  00720
      GO TO 270                                                          00721
  330 FORCE2=-RHV2*(LINT1(ALP2,ALPHTB,10,CDTB1)+CDGEAR)                  00722
     1+THRU*COS((ALP2-ALPRUN+TINC)*RAD)-GROSWT*SG                        00723
      IF(IFLAG.LE.0)GO TO 1                                              00724
      WRITE(6,325)GAM2,ALP2,FORCE2                                       00725
  325 FORMAT(43H0MISSED APPROACH CLIMB FLIGHT PATH ANGLE = ,F5.3,        00726
     1 8H RADIANS/18H ANGLE OF ATTACK =,F8.4,24H DEGREES - - NET FORCE =00727
     2,F8.1,7H POUNDS/)                                                  00728
      IF(FORCE2.LT.0.)WRITE(6,326)                                       00729
  326 FORMAT(51H * * * FAILED MISSED APPROACH CLIMB CRITERION * * * /)   00730
C                                                                        00731
     1 DELTALP=TINC-ALPRUN                                               00732
      HSTOP=100.0                                                        00733
      IA=1                                                               00734
      I=1                                                                00735
      HT=APRHGT                                                          00736
      CDGR=CDGEAR                                                        00737
      TI=0.0                                                             00738
      DE=0.0                                                             00739
      GAMFLT=APRANG                                                      00740
      SGAM=SIN(GAMFLT*RAD)                                               00741
      CGAM=COS(GAMFLT*RAD)                                               00742
      TGAM=TAN(GAMFLT*RAD)                                               00743
      VE=APRVEL*SPD                                                      00744
    5 RHOS=RHOA*VE*VE                                                    00745
      CL=GROSWT/RHOS                                                     00746
      ALPH1=LINT1(CL,CLTB1,10,ALPHTB)                                    00747
      DELD=DELH/TGAM                                                     00748
      DELT=DELH/SGAM/VE                                                  00749
9     HNEW=HT-DELH                                                       00750
      IF (HNEW.GT.HSTOP) GO TO 16                                        00751
      HNEW=HSTOP                                                         00752
      DELT=(HT-HSTOP)/SGAM/VE                                            00753
      DELD=(HT-HNEW)/TGAM                                                00754
   16 TI=TI+DELT                                                         00755
      DE=DE+DELD                                                         00756
      ALPHE(1)=ALPH1                                                     00757
      K=1                                                                00758
   17 CALL GEFFECT(ALPHE(K),HNEW,GAMFLT,ALPHTB,CLTB1,CDTB1,CDMIN,CL,CDG,00759
     C AR*ARGEF,WHGT,SPAN)                                               00760
      CLIFT=CL*RHOS                                                      00761
      DRAG=(CDG+CDGR)*RHOS                                               00762
      ALPNU=(ALPHE(K)+DELTALP)*RAD                                       00763
      FH=DRAG-GROSWT*SGAM                                                00764
      FORCH=FH/COS(ALPNU)                                                00765
      FV=GROSWT*CGAM-CLIFT                                               00766
      FORCV=FV/SIN(ALPNU)                                                00767
      DELFOR(K)=FORCH-FORCV                                              00768
      IF (ABS(DELFOR(K)).LT.0.0001*GROSWT) GO TO 20                      00769
      IF (K.GT.1) GO TO 18                                               00770
      K=K+1                                                              00771
      ALPHE(K)=ALPHE(K-1)-.1                                             00772
      GO TO 17                                                           00773
18    IF (K.EQ.10) GO TO 19                                              00774
      DALPHE=(ALPHE(K)-ALPHE(K-1))/(DELFOR(K)-DELFOR(K-1))*DELFOR(K)     00775
      IF(K.GE.3)DALPHE=DALPHE*(1.-DALPHE/(ALPHE(K)-ALPHE(K-1))/2.)       00776
      K=K+1                                                              00777
```

```
      ALPHE(K)=ALPHE(K-1)-DALPHE                                        00778
      IF(ALPHE(K).LT.ALPMIN.AND.ALPHE(K-1).GT.ALPMIN)ALPHE(K)=ALPMIN    00779
      IF(ALPHE(K).GT.ALPMAX.AND.ALPHE(K-1).LT.ALPMAX)ALPHE(K)=ALPMAX    00780
      GO TO 17                                                          00781
19    WRITE (6,84)                                                      00782
      WRITE (6,85) (K,ALPHE(K),K,DELFOR(K),K=1,10)                      00783
20    THRU=(FORCH+FORCV)/(2.0*NE)                                       00784
      ALPH1=ALPHE(K)                                                    00785
      IF (TI.LT.IA.AND.I.GT.1) GO TO 23                                 00786
      CDD(I)=CDG+CDGR                                                   00787
      CLL(I)=CL                                                         00788
      V(I)=VE/SPD                                                       00789
      T(I)=TI                                                           00790
      D(I)=DE                                                           00791
      TANG(I)=ALPH1+DELTALP                                             00792
      ALP(I)=ALPH1                                                      00793
      ALT(I)=HNEW                                                       00794
      TH(I)=THRU*NE                                                     00795
      GAM(I)=GAMFLT                                                     00796
      EM(I)=VE/SPDSND                                                   00797
      ELOD(I)=0.0                                                       00798
C                                                                       00799
      IF(I.GT.1)IA=IA+1                                                 00800
      I=I+1                                                             00801
23    HT=HNEW                                                           00802
      IF (HNEW.NE.HSTOP) GO TO 9                                        00803
      IF (HNEW.NE.100.) GO TO 31                                        00804
      MCUT=1                                                            00805
      HST=100.                                                          00806
      DST=DE                                                            00807
      TST=TI                                                            00808
      ALPHST=ALPH1                                                      00809
      GAMST=GAMFLT                                                      00810
      VST=VE                                                            00811
      H(MCUT)=25.0                                                      00812
      GO TO 45                                                          00813
31    CONTINUE                                                          00814
      DFLAR=DE                                                          00815
      TFLAR=TI                                                          00816
      HFLAR=HNEW                                                        00817
      ALPFLAR=ALPH1                                                     00818
      VFLAR=VE                                                          00819
      FLDMAX=0.25*G                                                     00820
      FLDMX1=FLDMAX                                                     00821
      FLDMX2=1.0                                                        00822
      LAN=1                                                             00823
      DELT=DELTAD/VST                                                   00824
      THMAX=THRU                                                        00825
C     COMPUTE TRAJECTORY FROM START OF FLARE TO LANDING                 00826
      VVERT=VE*SGAM                                                     00827
      VHORZ=VE*CGAM                                                     00828
      IANG=1                                                            00829
      IGAM=1                                                            00830
      ACCH=0.                                                           00831
      ACCV=0.                                                           00832
      ACVO=ACHO=ACVE=ACHE=0.                                            00833
   33 VVO=VVERT-(DELT*ACVE+2.*ACVO)*DELT/2.                             00834
      IF(DELT.LT.0.1*DELTAD/VST)GO TO 34                                00835
      IF(VVO.GE.0.)GO TO 34                                             00836
      VVO=0.                                                            00837
      DELTA=VVERT/ACVO                                                  00838
      IF(ACVE.NE.0.)DELTA=(SQRT(ACVO**2+2.*ACVE*VVERT)-ACVO)/ACVE       00839
      IF(DELT.GT.DELTA)DELT=DELTA                                       00840
   34 VHO=VHORZ-(DELT*ACHE+2.*ACHO)*DELT/2.                             00841
      VO=SQRT(VVO*VVO+VHO*VHO)                                          00842
      SANGLE=VVO/VO                                                     00843
      CANGLE=VHO/VO                                                     00844
      GAMFLT=SANGLE/RAD                                                 00845
      M=1                                                               00846
      H1=HT-(VVERT-(3.*ACVO+DELT*ACVE)*DELT/6.)*DELT                    00847
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      RHOS=RHOA*VO*VO                                                   00848
      THNU=LINT1(VO,VELOC,10,TIDLE)                                     00849
      THRU=THNU+(THMAX-THNU)*SANGLE/SGAM                                00850
C     ITERATE ON ALPHA TO GET MAXIMUM VALUE AT MAXIMUM NORMAL ACCEL.    00851
      IF(IGAM.NE.1)FLDMAX=FLDMX2+(FLDMX1-FLDMX2)/GAMMAX*GAMFLT          00852
      ALPOLD=ALPH1                                                      00853
      IF (IANG.GT.1) GO TO 35                                           00854
      ALPH1=ALPH1+VANGL*DELT                                            00855
      IF (ALPH1.LE.ALPMAX) GO TO 35                                     00856
      ALPH1=ALPMAX                                                      00857
      IANG=2                                                            00858
   35 CALL GEFFECT(ALPH1,H1,GAMFLT,ALPHTB,CLTB1,CDTB1,CDMIN,CL,CDG,     00859
     C AR*ARGEF,WHGT,SPAN)                                              00860
      DRAG=(CDG+CDGR)*RHOS                                              00861
      CLIFT=CL*RHOS                                                     00862
      FORCV=CLIFT*CANGLE+DRAG*SANGLE-GROSWT+THRU*(NE-IM1)*SIN((ALPH1+D  00863
     1ELTALP-GAMFLT)*RAD)                                               00864
      ACCV=FORCV*G/GROSWT                                               00865
      IF (ACCV.LT.FLDMAX.AND.M.EQ.1.AND.ACCV.GE.0.0) GO TO 38           00866
      ACN(M)=ACCV-FLDMAX                                                00867
      IANG=2                                                            00868
      IF (ABS(ACN(M)).LT..001.AND.ACCV.GE.0.0) GO TO 38                 00869
      ALPHE(M)=ALPH1                                                    00870
      M=M+1                                                             00871
      IF (M.GT.2) GO TO 36                                              00872
C     SET ANGLE EQUAL TO MINIMUM ALLOWABLE ANGLE                        00873
      ALPH1=ALPOLD-VANGL*DELT                                           00874
      GO TO 35                                                          00875
36    IF (M.GT.10) GO TO 37                                             00876
      IF (ACCV.GT.FLDMAX.AND.M.EQ.3) GO TO 38                           00877
      ALPH1=ALPHE(M-1)-(ALPHE(M-1)-ALPHE(M-2))/(ACN(M-1)-ACN(M-2))*ACN(M00878
     1-1)                                                               00879
      GO TO 35                                                          00880
37    WRITE (6,86)                                                      00881
      WRITE (6,87) (M,ALPHE(M),M,ACN(M),M=1,10)                         00882
C     CHECK HORIZONTAL  ACCELERATION                                    00883
38    FORCH=DRAG*CANGLE-CLIFT*SANGLE-THRU*(NE-IM1)*COS((ALPH1+DELTALP-  00884
     1GAMFLT)*RAD)                                                      00885
      ACCH=FORCH*G/GROSWT                                               00886
      DELV=(ACCV+ACVO)*DELT/2.                                          00887
      IF((VVERT-DELV).GT.-.000001.AND.DELT.GT..001)GO TO 40             00888
      DELV=VVERT                                                        00889
      DELT=2.*VVERT/(ACCV+ACVO)                                         00890
      LAN=LAN+1                                                         00891
40    HT=HT-DELT*(VVERT-(2.*ACVO+ACCV)*DELT/6.)                         00892
      DE=DE+DELT*(VHORZ-(2.*ACHO+ACCH)*DELT/6.)                         00893
      VVERT=VVERT-DELV                                                  00894
      VHORZ=VHORZ-(ACCH+ACHO)*DELT/2.                                   00895
      IF (IGAM.GT.1) GO TO 41                                           00896
      IF (IANG.EQ.1) GO TO 41                                           00897
      VE=SQRT(VHORZ*VHORZ+VVERT*VVERT)                                  00898
      GAMMAX=VVERT/VE/RAD                                               00899
      IGAM=2                                                            00900
   41 ACVE=(ACCV-ACVO)/DELT                                             00901
      ACHE=(ACCH-ACHO)/DELT                                             00902
      ACVO=ACCV                                                         00903
      ACHO=ACCH                                                         00904
      IF(IANG.LT.2)ALPH1=ALPOLD+VANGL*DELT                              00905
      TI=TI+DELT                                                        00906
      IF (TI.LT.IA) GO TO 42                                            00907
      VE=SQRT(VHORZ*VHORZ+VVERT*VVERT)                                  00908
      CDD(I)=CDG+CDGR                                                   00909
      CLL(I)=CL                                                         00910
      V(I)=VE/SPD                                                       00911
      T(I)=TI                                                           00912
      D(I)=DE                                                           00913
      TANG(I)=ALPH1+DELTALP                                             00914
      ALP(I)=ALPH1                                                      00915
      ALT(I)=HT                                                         00916
      TH(I)=THRU*NE                                                     00917
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      GAM(I)=VVERT/VE/RAD                                                   00918
      EM(I)=VE/SPDSND                                                       00919
      ELOD(I)=SQRT(ACCV*ACCV+ACCH*ACCH)                                     00920
C                                                                           00921
      IA=IA+1                                                               00922
      I=I+1                                                                 00923
42    IF (LAN.LT.2) GO TO 33                                                00924
      VE=VHORZ                                                              00925
C     ITERATE ON FLARE ALTITUDE UNTIL ALTITUDE IS 0 AT END OF FLARE         00926
      IF (ABS(HT).LT..3) GO TO 47                                           00927
      H(MCUT)=HSTOP                                                         00928
      HLAND(MCUT)=HT                                                        00929
      MCUT=MCUT+1                                                           00930
      IF (MCUT.GT.2) GO TO 43                                               00931
      H(MCUT)=H(MCUT-1)-HLAND(MCUT-1)*1.25                                  00932
      GO TO 45                                                              00933
43    IF (MCUT.GT.10) GO TO 44                                              00934
      H(MCUT)=H(MCUT-1)-(H(MCUT-1)-H(MCUT-2))/(HLAND(MCUT-1)-HLAND(MCUT-00935
     12))*HLAND(MCUT-1)                                                     00936
      IF(ABS(HLAND(MCUT-1)).GE.ABS(HLAND(MCUT-2)))H(MCUT)=(H(MCUT)+         00937
     1 H(MCUT-1))/2.                                                        00938
      IF(H(MCUT).LE.0.)H(MCUT)=H(MCUT-1)/2.                                 00939
      GO TO 45                                                              00940
44    WRITE (6,88)                                                          00941
      WRITE (6,89)  (MCUT,H(MCUT),MCUT,HLAND(MCUT),MCUT=1,10)               00942
      GO TO 47                                                              00943
45    DE=DST                                                                00944
      TI=TST                                                                00945
      GAMFLT=GAMST                                                          00946
      IA=TST+1                                                              00947
      HT=HST                                                                00948
      ALPH1=ALPHST                                                          00949
      VE=VST                                                                00950
      HSTOP=H(MCUT)                                                         00951
      I=2                                                                   00952
      GO TO 5                                                               00953
      ENTRY DECEL                                                           00954
      TIBR=TIBRA                                                            00955
      TISP=TISPA                                                            00956
      TIRV=TIRVA                                                            00957
      ISTOP=0                                                               00958
      IA=TI+1                                                               00959
      I=ISTEP+1                                                             00960
      FARFACT=1.                                                            00961
      CUTBK=0.                                                              00962
      IM1=1                                                                 00963
      ALPNU=ALPRUN                                                          00964
      ACCH=0.                                                               00965
      CDGR=0.                                                               00966
47    CONTINUE                                                              00967
      IF(IFLAG.GT.0 .AND. ITIME.GT.0) WRITE (6,91)                          00968
      ICNT=I-1                                                              00969
      IF(IFLAG.GT.0 .AND. ITIME.GT.0)                                       00970
     1              WRITE (6,92) (T(J),D(J),ALT(J),V(J),EM(J),GAM(J),      00971
     1ALP(J),TANG(J),TH(J),CLL(J),CDD(J),ELOD(J),J=1,ICNT)                  00972
      CDSP=0.0                                                              00973
      CLSP=0.0                                                              00974
      FMU=ROLLMU                                                            00975
      SPOIL=0.0                                                             00976
      BRAKE=0.0                                                             00977
      REVRS=0.                                                              00978
      TTD=TI                                                                00979
      DTD=DE                                                                00980
      VTD=VE                                                                00981
      ALPHTD=ALPH1                                                          00982
      HTD=0.0                                                               00983
48    DELT=DTRUN                                                            00984
      TIA=TI-TTD+DELT                                                       00985
      IF(TIA.GT.TISP.AND.SPOIL.EQ.0.)TIA=TISP                               00986
      IF(TIA.GT.TIBR.AND.BRAKE.EQ.0.)TIA=TIBR                               00987
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      IF(TIA.GT.TIRV.AND.REVRS.EQ.0.)TIA=TIRV                          00988
      IF(TIA.GT.TCUT.AND.CUTBK.EQ.0.)TIA=TCUT                          00989
      DELT=TIA+TTD-TI                                                  00990
49    IF ((IA-TI).GT.1) IA=IA-1                                        00991
      IF (ALPNU.EQ.ALPRUN) GO TO 51                                    00992
      ALPNU=ALPH1-VANGL*DELT/2.0                                       00993
      ALPH1=ALPH1-VANGL*DELT                                           00994
      IF (ALPH1.GT.ALPRUN) GO TO 50                                    00995
      ALPNU=(ALPH1+VANGL*DELT+ALPRUN)/2.0                              00996
      ALPH1=ALPRUN                                                     00997
   50 CALL GEFFECT(ALPNU,0.,0.,ALPHTB,CLTB1,CDTB1,CDMIN,CL,CDG,        00998
     C AR*ARGEF,WHGT,SPAN)                                           00999
      CDW=CDG                                                          01000
   51 VO=VE-ACCH*DELT/2.                                               01001
      RHOS=RHOA*VO*VO                                                  01002
      CDG=CDW+CDGR+CDSP                                                01003
      DRAG=CDG*RHOS                                                    01004
      CLIFT=(CL-CLSP)*RHOS                                             01005
      FORCV=CLIFT-GROSWT                                               01006
      FFRICT=0.0                                                       01007
      IF (FORCV.LT.0.0) FFRICT=-FMU*FORCV                              01008
      THRU=THM1                                                        01009
      IF(CUTBK.GT.0.)THRU=LINT1(VO,VELOC,10,TIDLE)                     01010
      IF(REVRS.GT.0.)THRU=REVFACT*LINT1(VO,VELRV,10,THRRV)             01011
      FORCH=FFRICT+DRAG-THRU*(NE-IM1)                                  01012
      ACCH=FORCH/GROSWT*G                                              01013
      IF (ACCH.GT.ACCLIM) ACCH=ACCLIM                                  01014
C     ITERATE ON BRAKE COEFFICIENT UNTIL DECELERATION LIMIT IS OKAY    01015
      DE=DE+(VE-ACCH*DELT/2.0)*DELT                                    01016
      TI=TI+DELT                                                       01017
      VE=VE-ACCH*DELT                                                  01018
      IF(IFLAG.EQ.0.OR.ITIME.EQ.0)GO TO 53                             01019
      IF(TIA.EQ.TISP.OR.TIA.EQ.TIBR.OR.TIA.EQ.TCUT.OR.ISTOP.EQ.1)      01020
     1 GO TO 52                                                        01021
      IF(TI.LT.IA)GO TO 53                                             01022
   52 VP=VE/SPD                                                        01023
      TP=ALPH1+DELTALP                                                 01024
      AP=0.0                                                           01025
      THP=THRU*(NE-IM1)                                                01026
      EP=VE/SPDSND                                                     01027
C                                                                      01028
      WRITE(6,92)TI,DE,AP,VP,EP,AP,ALPH1,TP,THP,CL,CDG,ACCH            01029
C                                                                      01030
      IA=IA+1                                                          01031
53    IF(TIA.NE.TISP)GO TO 57                                          01032
      CDSP=CDSPOIL                                                     01033
      CLSP=CLSPOIL                                                     01034
      SPOIL=1.0                                                        01035
      DSP=DE                                                           01036
      TSP=TI                                                           01037
      HSP=0.0                                                          01038
      ALPSP=ALPH1                                                      01039
      VSP=VE                                                           01040
57    IF (TIA.NE.TIBR) GO TO 58                                        01041
      BRAKE=1.0                                                        01042
      DBRK=DE                                                          01043
      TBRK=TI                                                          01044
      HBRK=0.0                                                         01045
      ALPBRK=ALPH1                                                     01046
      VBRK=VE                                                          01047
      FMU=BRAKEMU                                                      01048
   58 IF(TIA.NE.TIRV)GO TO 59                                          01049
      REVRS=1.0                                                        01050
      DREV=DE                                                          01051
      TREV=TI                                                          01052
      HREV=0.                                                          01053
      ALPREV=ALPH1                                                     01054
      VREV=VE                                                          01055
   59 IF(TIA.EQ.TCUT)CUTBK=1.                                          01056
      IF (ISTOP.EQ.1) GO TO 60                                         01057
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      IF (VE.GT.0.0) GO TO 48                                           01058
      TI=TI-DELT                                                        01059
      VE=VE+ACCH*DELT                                                   01060
      DE=DE-(VE-ACCH*DELT/2.0)*DELT                                     01061
      DELT=VE/ACCH                                                      01062
      ISTOP=1                                                           01063
      GO TO 49                                                          01064
60    CONTINUE                                                          01065
      TSTOP=TI                                                          01066
      DSTOP=DE                                                          01067
      HSTOP=0.0                                                         01068
      ALPSTOP=ALPRUN                                                    01069
      VSTOP=0.0                                                         01070
      VST=VST/SPD                                                       01071
      VFLAR=VFLAR/SPD                                                   01072
      VTD=VTD/SPD                                                       01073
      VSP=VSP/SPD                                                       01074
      VBRK=VBRK/SPD                                                     01075
      VREV=VREV/SPD                                                     01076
      DISTLND=DSTOP                                                     01077
      IF(IM1.EQ.0)DISTLND=DSTOP-LINT1(HOBS,ALT,ICNT,D)                  01078
      FDLNGT=DISTLND/FARFACT                                            01079
      IF(IFLAG.LE.0) GO TO 63                                           01080
      IF(IM1.GT.0)GO TO 102                                             01081
      I=1                                                               01082
      WRITE (6,93) I                                                    01083
      WRITE (6,75) (ALPHTB(I),I=1,10)                                   01084
      WRITE (6,76) (CLTB1(I),I=1,10)                                    01085
      WRITE (6,101) (CDTB1(I),I=1,10)                                   01086
      WRITE (6,90) CDMIN,CDGEAR,CLMAX,GROSWT                            01087
75    FORMAT (7X,15HANGLE OF ATTACK,4X,10F10.2)                         01088
76    FORMAT (7X,16HLIFT COEFFICIENT,3X,10F10.4)                        01089
93    FORMAT(/51X,27HDRAG POLAR FOR FLAP SETTING,I2/)                   01090
90    FORMAT( 7X,7HCDMIN =,1F7.4,10X,8HCDGEAR =,F7.4,                   01091
     1 10X,7HCLMAX =,F7.4,10X,16HLANDING WEIGHT =,F10.1)                01092
101   FORMAT (7X,16HDRAG COEFFICIENT,3X,10F10.4/)                       01093
      WRITE (6,116)                                                     01094
      WRITE (6,117) (VELOC(I),I=1,10)                                   01095
      WRITE (6,118)(TIDLE(I),I=1,10)                                    01096
      IF(REVFACT.EQ.0.)GO TO 102                                        01097
      WRITE (6,216)                                                     01098
      WRITE (6,117) (VELRV(I),I=1,10)                                   01099
      WRITE (6,118)(THRRV(I),I=1,10)                                    01100
116   FORMAT(/41X,33HIDLE NET THRUST VALUES FOR ENGINE)                 01101
216   FORMAT(/41X,32HREVERSE THRUST VALUES FOR ENGINE)                  01102
117   FORMAT (6X,8HVELOCITY,10F11.1)                                    01103
118   FORMAT (6X,8HTHRUST  ,10F11.1)                                    01104
  102 WRITE(6,194)                                                      01105
      IF(IM1.GT.0)GO TO 103                                             01106
      WRITE (6,100) TST,DST,HST,ALPHST,VST                              01107
      WRITE (6,95) TFLAR,DFLAR,HFLAR,ALPFLAR,VFLAR                      01108
  103 WRITE (6,96) TTD,DTD,HTD,ALPHTD,VTD                               01109
      WRITE (6,97) TSP,DSP,HSP,ALPSP,VSP                                01110
      WRITE (6,98) TBRK,DBRK,HBRK,ALPBRK,VBRK                           01111
      IF(REVRS*REVFACT.NE.0.)WRITE (6,80) TREV,DREV,HREV,ALPREV,VREV    01112
      WRITE (6,99) TSTOP,DSTOP,HSTOP,ALPSTOP,VSTOP                      01113
      WRITE (6,68) DISTLND,FARFACT,FDLNGT                               01114
63    RETURN                                                            01115
C                                                                       01116
68    FORMAT (17X,23HLANDING FIELD LENGTH = ,1F8.2,5H FEET,             01117
     1 8H   OVER ,F3.1,3H = ,F8.2,5H FEET,//,2X,40(3H  *))             01118
84    FORMAT (36X,60HITERATION OF CONSTANT VELOCITY ANGLE OF ATTACK IS I01119
     1NCOMPLETE//)                                                     01120
85    FORMAT (10X,6HALPHE(,I2,4H) = ,F9.4,5X,7HDELFOR(,I2,4H) = ,F11.2/)01121
86    FORMAT (30X,65HUNABLE TO ITERATE ON FLARE NORMAL ACCELERATION - PR01122
     1OGRAM CONTINUE//)                                                01123
87    FORMAT (10X,6HALPHE(,I2,4H) = ,F9.4,5X,4HACN(,I2,4H) = ,F9.4)     01124
88    FORMAT (30X,64HITERATION OF TOUCHDOWN ALTITUDE IS INCOMPLETE - PRO01125
     1GRAM CONTINUE//)                                                 01126
89    FORMAT (10X,2HH(,I2,4H) = ,F10.4,5X,6HHLAND(,I2,4H) = ,F10.4)     01127
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91     FORMAT (1H ,2X,4HTIME,6X,8HDISTANCE,4X,8HALTITUDE,4X,8HVELOCITY,5X01128
     1,4HMACH,5X,7HDESCENT,4X,6HATTACK,6X,6HENGINE,6X,6HENGINE,6X,4HLIFT01129
     2,6X,4HDRAG,6X,3HACC/49X,6HNUMBER,5X,5HANGLE,6X,5HANGLE,5X,9HINCIDE01130
     3NCE,4X,6HTHRUST,5X,6HCOEFF.,4X,6HCOEFF.,4X,/2X,7HSECONDS,6X,4HFEET01131
     4,8X,4HFEET,7X,5HKNOTS,16X,7HDEGREES,4X,7HDEGREES,5X,7HDEGREES,5X,601132
     5HPOUNDS,26X,6HFT/S/S/)                                            01133
92     FORMAT (1F8.2,2F12.2,1F12.2,1F11.4,1F10.3,1F11.3,1F12.3,1F13.1,1F901134
     1.4,1F10.4,1F10.2)                                                 01135
94     FORMAT(49H1 * * * LANDING PERFORMANCE CHARACTERISTICS * * * /)     01136
  194 FORMAT(                                                  /23X,9HPARAMETE01137
     1R,24X,4HTIME,7X,9HDOWNRANGE,5X,8HALTITUDE,5X,6HATTACK,6X,8HVELOCIT01138
     2Y/67X,8HDISTANCE,20X,5HANGLE/55X,7HSECONDS,7X,4HFEET,10X,4HFEET,7X01139
     3,7HDEGREES,6X,5HKNOTS/)                                           01140
95     FORMAT (17X,14HSTART OF FLARE,1F30.2,1F13.1,1F12.2,2F13.2/)        01141
96     FORMAT (17X,9HTOUCHDOWN,1F35.2,1F13.1,1F12.2,2F13.2/)              01142
97     FORMAT (17X,17HSPOILER ACTUATION,1F27.2,1F13.1,1F12.2,2F13.2/)     01143
98     FORMAT (17X,20HWHEEL BRAKES APPLIED,1F24.2,1F13.1,1F12.2,2F13.2/) 01144
99     FORMAT (17X,14HEND OF LANDING,1F30.2,1F13.1,1F12.2,2F13.2/)        01145
100    FORMAT (17X,15HTHRESHOLD POINT,1F29.2,1F13.1,1F12.2,2F13.2/)       01146
 80    FORMAT (17X,15HTHRUST REVERSAL,1F29.2,1F13.1,1F12.2,2F13.2/)       01147
       END                                                                01148
```

```
      SUBROUTINE THTOL(ESCALE)                                          01149
      COMMON/TREVRS/INTHRRV,VELRV(10),THRRV(10),REVFACT,TIREVRS,TIRVA   01150
      COMMON/TOLTH/INTHR,VELOC(10),SLTH(10),INTID,VELL(10),TIDLE(10),   01151
     + ALTITDE,THRFACT,SPDSND,ANS1,DTC                                  01152
      CALL ATMO(ALTITDE,DTC,DELTA,THETA,ASTAR)                          01153
      SPDSND=ASTAR*6076.1155/3600.                                      01154
      ANS1=.0023769*DELTA/THETA                                         01155
      IF(INTHR-1)2004,2001,2003                                         01156
2001  DO 2005 I=1,10                                                    01157
2005  SLTH(I)=SLTH(I)*ESCALE                                            01158
      GO TO 2004                                                        01159
2003  DO 2002 I=1,10                                                    01160
      XMACH=VELOC(I)/SPDSND                                             01161
      CALL ENINT (XMACH,ALTITDE,THU,FDUM,1,IMD,IAD,ITD,INTHR-1)         01162
      SLTH(I)=THU*THRFACT                                               01163
2002  CONTINUE                                                          01164
2004  IF(INTID-1)1004,1001,1003                                         01165
1001  DO 1005 I=1,10                                                    01166
1005  TIDLE(I)=TIDLE(I)*ESCALE                                          01167
      GO TO 1004                                                        01168
1003  DO 1002 I=1,10                                                    01169
      XMACH=VELL(I)/SPDSND                                              01170
      CALL ENINT (XMACH,ALTITDE,THU,FDUM,3,IMD,IAD,ITD,1)               01171
      TIDLE(I)=THU                                                      01172
1002  CONTINUE                                                          01173
1004  IF(INTHRRV.GT.1)GO TO 3003                                        01174
      IF(INTHRRV)3005,3004,3001                                         01175
3001  DO 3007 I=1,10                                                    01176
3007  THRRV(I)=THRRV(I)*ESCALE                                          01177
      GO TO 3004                                                        01178
3003  DO 3002 I=1,10                                                    01179
      XMACH=VELRV(I)/SPDSND                                             01180
      CALL ENINT (XMACH,ALTITDE,THU,FDUM,1,IMD,IAD,ITD,INTHRRV-1)       01181
      THRRV(I)=THU                                                      01182
3002  CONTINUE                                                          01183
3004  RETURN                                                            01184
3005  DO 3006 I=1,10                                                    01185
      THRRV(I)=SLTH(I)                                                  01186
3006  VELRV(I)=VELOC(I)                                                 01187
      RETURN                                                            01188
      END                                                               01189
```

APPENDIX C

LCC MODULE DOCUMENTATION

NAMELIST $COSTIN DEFINITION.

VARIABLE	DEFAULT	DEFINITION
AC	350.	Airconditioning total pack air flow, lb/min
APUFLW	400.	Auxiliary power unit flow rate, lb/min
APUSHP	170.	Auxiliary power unit shaft horsepower, hp
DEPPER	14.	Depreciation period, years
DEVST	1980	Development start time, year
DEVTI		Development time, quarters
DYEAR	1986	Desired year for dollar calculations
EPR	20	Engine pressure ratio at sea level static
F	0.25	Spares factor for production aircraft
FAFMSP	0.1	Spares factor for production airframes
FARE	0.0	Fare, dollars per passenger per seat
FENGSP	0.3	Spares factor for production engines
FPPFT	0.5	Spares factor for prototype and flight test
FUELPR	0.5	Fuel price, dollars per gallon
HYDGPM	150.	Gallon per minute flow of hydraulic pumps
IACOUS	0	Acoustic treatment in nacelle =0, no =1, yes
IBODY	0	Body type indicator =0, narrow body =1, wide body
ICIRC	1	Circuit indicator - fire detection =1, single circuit =2, dual circuit
ICOREV	1	Thrust reverser =0, no core reverser =1, core reverser
ICOSTYP	1	Cost type calculation desired =1, life cycle cost (LCC) =2, acquisition cost =3, direct operating cost (DOC) =4, indirect operating cost (IOC) =5, total operating cost (DOC + IOC) =6, fare for a given return on investment =7, return on investment for a given fare
IDOM	1	Operation type indicator =1, domestic =2, international
IDTLNK	0	Data link indicator =0, no data link =1, data link
IMUX	0	Multiplex indicator =0, no multiplex =1, multiplex

INOZ	1	Nozzle type indicator =1, cascade or target type reverser with translating sleeve =2, simple target type reverser with separate flow exhaust nozzle =3, simple target type reverser with mixed flow exhaust nozzle =4, separate flow engine exhaust system without thrust reverser =5, short duct engine without thrust reverser
IPFLAG	0	Print controller for Cost Module =0, only print major cost elements >0, print all details
IRAD	1	Indicator to include research and development =0, ignore R & D costs =1, include R & D costs distributed over entire program
IRANGE	1	Range indicator =0, short range =1, medium range =2, long range
ISPOOL	0	Auxiliary power unit complexity indicator =0, single spool, fixed APU =1, double spool, variable vane APU
ITRAN	0	Transfer operation indicator =0, through (no transfer) operation =1, transfer operation
IWIND	0	Windshield type indicator =0, flat windshield =1, curved windshield
KVA	200.	KVA rating of full-time generators (100-300)
LF	55.	Passenger load factor, percent
LIFE	14.	Number of years for Life Cycle Cost calculation
NAPU	1	Number of auxiliary power units
NCHAN	1	Number of channels (1, 2, or 3; 1 most common)
NFLTTST	2	Number of flight test aircraft
NGEN	3	Number of inflight operated generators (3 or 4)
NINS	0	Number of inertial navigation systems (3 or 4)
NPOD	4	Number of podded engines
NPROTYP	2	Number of prototype aircraft
PCTFC	10.	Percent of seats for first class
PLMQT	1984.	planned MQT (150-hour Model Qualification Test or FAA certification), year

PRPROC	0.	prior number of engines procured
Q	100.	airframe production quantities
RESID	2.	Residual value at end of lifetime, percent
ROI	10.	Return on investment, percent
SFC	0.6	engine specific fuel consumption, lb/hr/lb
TEMP	1800.	Maximum turbine inlet temperature, degrees F

TECHNOLOGY SENSITIVITY PARAMETERS IN NAMELIST COSTIN
(1.0 = no change)

R&D		
FAFRD	1.0	airframe R&D
FENRD	1.0	engine R&D
MANUFACTURING		
FMAC	1.0	air conditioning
FMAI	1.0	anti-icing
FMAPU	1.0	auxiliary power unit
FMAV	1.0	avionics
FMBODY	1.0	fuselage
FMCOMP	1.0	composite materials
FMEL	1.0	electrical systems
FMENG	1.0	engine
FMENSY	1.0	engine systems
FMFCS	1.0	flight control system
FMFEQ	1.0	furnishings and equipment
FMFUSY	1.0	fuel systems
FMGEAR	1.0	landing gear
FMHYD	1.0	hydraulic systems
FMINS	1.0	instruments
FMNAC	1.0	nacelles
FMPNM	1.0	pneumatics
FMTAIL	1.0	tail
FMTRV	1.0	thrust reversers
FMWING	1.0	wing
OPERATING		
FOAC	1.0	air conditioning
FOAI	1.0	anti-icing
FOAPU	1.0	auxiliary power unit
FOAV	1.0	avionics
FOBODY	1.0	fuselage
FOCOMP	1.0	composite materials
FOEL	1.0	electrical systems
FOFCS	1.0	flight control system
FOFEQ	1.0	furnishings and equipment
FOFUSY	1.0	fuel systems
FOGEAR	1.0	landing gear
FOINS	1.0	instruments

FONAC	1.0	nacelles
FOPNM	1.0	pneumatics
FOPROP	1.0	propulsion system
FOWING	1.0	wing
ECONOMICS		
FEACSR	1.0	aircraft servicing
FECFEE	1.0	control fee
FECRW	1.0	flight crew
FEDEP	1.0	depreciation
FEFLTA	1.0	flight attendants
FEINS	1.0	insurance
FELABR	1.0	R&D labor rate
FELDFE	1.0	landing fee
FEMAIN	1.0	maintenance man hours increase

APPENDIX D

LCC MODULE LISTING

```
      SUBROUTINE RDCOST                                                 00001
                                                                        00002
      COMMON/MASTER/ICOSTYP,IRAD,DYEAR,IPFLAG                           00003
                                                                        00004
      COMMON/COSTDAT/WTS(25),NENG,SMACH,THRMAX,QMAX,RANGE,TOGWMX,       00005
     * FUELBL,TBLOCK,SPEED,NS,TGNDMAN,NCREW,WLDGMX,FUELCP,CARGO,SREF,    00006
     * COST                                                             00007
                                                                        00008
      COMMON/AIRFRM/INOZ,IACOUS,Q,AMPR,FAFMSP,FENGSP,AFMCST,ARDCST      00009
                                                                        00010
      COMMON/ENGINE/PRPROC,FPPFT,F,EPR,TEMP,SFC,PLMQT,DEVST,            00011
     * NPROTYP,NFLTTST,ENGCST,ENGRD,ENPROD                              00012
                                                                        00013
      COMMON/DOCCOM/AFMSP,ENGSP,RESID,DEPPER,IDTLNK,IBODY,              00014
     * FUELPR,CET,ICOREV,HYDGPM,NINS,ISPOOL,APUSHP,APUFLW,IWIND,        00015
     * NPOD,AC,NCHAN,IMUX,NGEN,KVA,IRANGE,ICIRC,NAPU,LIFE,DOCDPD,       00016
     * FARE,ROI,N                                                       00017
                                                                        00018
      COMMON/IOCCOM/IDOM,LF,PCTFC,ITRAN,IOCDPD                          00019
                                                                        00020
      COMMON/FLY/DESMCH,DPRESMX                                         00021
                                                                        00022
      COMMON/SENSI/FAFRD,FENRD,FMWING,FMTAIL,FMBODY,FMGEAR,FMNAC,       00023
     * FMTRV,FMFUSY,FMENSY,FMFCS,FMHYD,FMEL,FMPNM,FMAC,FMAI,FMAPU,      00024
     * FMFEQ,FMINS,FMAV,FMENG,FMCOMP,FOWING,FOAC,FOINS,FOAV,FOEL,       00025
     * FOFEQ,FOFCS,FOFUSY,FOPNM,FOAI,FOGEAR,FOAPU,FOBODY,FONAC,FOHYD,   00026
     * FOPROP,FOCOMP,FEDEP,FEINS,FECFEE,FELDFE,FEACSR,FEFLTA,           00027
     * FECRW,FEMAIN,FELABR                                              00028
                                                                        00029
      REAL KVA, LF, IOCDPD, LIFE                                        00030
      INTEGER DYEAR                                                     00031
                                                                        00032
      NAMELIST/COSTIN/INOZ,IACOUS,Q,PRPROC,FPPFT,F,EPR,TEMP,SFC,PLMQT,  00033
     * DEVST,NPROTYP,NFLTTST,RESID,DEPPER,IDTLNK,IBODY,                 00034
     * FUELPR,ICOREV,HYDGPM,NINS,ISPOOL,APUSHP,APUFLW,IWIND,            00035
     * NPOD,IDOM,LF,PCTFC,ITRAN,ICOSTYP,DYEAR,AC,NCHAN,IMUX,NGEN,KVA,   00036
     * IRANGE,ICIRC,NAPU,IRAD,LIFE,FAFMSP,FENGSP,FARE,ROI,IPFLAG,       00037
     * FAFRD,FENRD,FMWING,FMTAIL,FMBODY,FMGEAR,FMNAC,FMTRV,FMFUSY,      00038
     * FMENSY,FMFCS,FMHYD,FMEL,FMPNM,FMAC,FMAI,FMAPU,FMFEQ,FMINS,       00039
     * FMAV,FMENG,FMCOMP,FOWING,FOAC,FOINS,FOAV,FOEL,FOFEQ,FOFCS,       00040
     * FOFUSY,FOPNM,FOAI,FOGEAR,FOAPU,FOBODY,FONAC,FOHYD,FOPROP,        00041
     * FOCOMP,FEDEP,FEINS,FECFEE,FELDFE,FEACSR,FEFLTA,FECRW,FEMAIN,     00042
     * FELABR,DESMCH,DPRESMX                                            00043
                                                                        00044
                                                                        00045
      DPRESMX=0.                                                        00046
      DESMCH=0.                                                         00047
                                                                        00048
C  READ NAMELIST                                                        00049
                                                                        00050
      READ(5,COSTIN)                                                    00051
                                                                        00052
                                                                        00053
C  WRITE OUT INPUT DATA                                                 00054
                                                                        00055
      WRITE(6,100)ICOSTYP,IRAD,IPFLAG,DYEAR                             00056
100   FORMAT(//1X,"COST INPUT DATA (NAMELIST $COSTIN)"//                00057
     * 3X,"DESCRIPTION",26X,"NAME",15X,"VALUE  DIMENSIONS"//            00058
     * 3X,"COST TYPE SWITCH",T40,"ICOSTYP",T50,I11/                     00059
     * 3X,"R&D SWITCH",T40,"IRAD",T50,I11/                              00060
     * 3X,"PRINT SWITCH",T40,"IPFLAG",T50,I11/                          00061
     * 3X,"YEAR FOR CALCULATIONS",T40,"DYEAR",T50,I11)                  00062
                                                                        00063
      WRITE(6,110)FAFMSP,FENGSP,IACOUS,INOZ,Q                           00064
110   FORMAT(3X,"SPARES FACTOR FOR AIRFRAME",T40,"FAFMSP",T50,F11.2/    00065
     * 3X,"SPARES FACTOR FOR ENGINES",T40,"FENGSP",T50,F11.2/           00066
     * 3X,"NACELLE ACOUSTICAL TREAT SWITCH",T40,"IACOUS",T50,I11/       00067
     * 3X,"NOZZLE TYPE SWITCH",T40,"INOZ",T50,I11/                      00068
     * 3X,"AIRFRAME PRODUCTION QUANTITY",T40,"Q",T50,F11.2)             00069
                                                                        00070
```

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      WRITE(6,120)DEVST,PLMQT,NPROTYP,NFLTTST,FPPFT,F                    00071
120   FORMAT(3X,"DEVELOPMENT START TIME",T40,"DEVST",T50,F11.2,"  YEAR"/00072
     * 3X,"FAA CERTIFICATION DATE",T40,"PLMQT",T50,F11.2,"  YEAR"/      00073
     * 3X,"NO OF PROTOTYPE AIRCRAFT",T40,"NPROTYP",T50,I11/             00074
     * 3X,"NO OF FLIGHT TEST AIRCRAFT",T40,"NFLTTST",T50,I11/           00075
     * 3X,"SPARES FACTOR FOR DEVELOPMENT",T40,"FPPFT",T50,F11.2/        00076
     * 3X,"SPARES FACTOR FOR AIRCRAFT",T40,"F",T50,F11.2)               00077
                                                                        00078
      WRITE(6,130)PRPROC,EPR,SFC,CET                                    00079
130   FORMAT(3X,"PRIOR NO OF ENGINES PROCURRED",T40,"PRPROC",T50,F11.2/ 00080
     * 3X,"ENGINE PRESSURE RATIO",T40,"EPR",T50,F11.2/                  00081
     * 3X,"ENGINE DESIGN SFC",T40,"SFC",T50,F11.4,"  LB/HR/LB"/         00082
     * 3X,"MAX TURBINE INLET TEMP",T40,"TEMP",T50,F11.4,"  DEG F")     00083
                                                                        00084
      WRITE(6,140)IBODY,ICIRC,ICOREV,IDTLNK,IMUX                        00085
140   FORMAT(3X,"BODY TYPE SWITCH",T40,"IBODY",T50,I11/                 00086
     * 3X,"CIRCUIT INDICATOR",T40,"ICIRC",T50,I11/                      00087
     * 3X,"THRUST REVERSER SWITCH",T40,"ICOREV",T50,I11/                00088
     * 3X,"DATA LINK SWITCH",T40,"IDTLNK",T50,I11/                      00089
     * 3X,"MULTIPLEX SWITCH",T40,"IMUX",T50,I11)                        00090
                                                                        00091
      WRITE(6,150)IRANGE,ISPOOL,IWIND                                   00092
150   FORMAT(3X,"RANGE TYPE SWITCH",T40,"IRANGE",T50,I11/               00093
     * 3X,"APU COMPLEXITY SWITCH",T40,"ISPOOL",T50,I11/                 00094
     * 3X,"WINDSHIELD TYPE SWITCH",T40,"IWIND",T50,I11)                 00095
                                                                        00096
      WRITE(6,160)AC,APUFLW,APUSHP,HYDGPM,KVA                           00097
160   FORMAT(3X,"AC TOTAL PACK FLOW",T40,"AC",T50,F11.4,"  LB/MIN"/     00098
     * 3X,"APU FLOW RATE",T40,"APUFLW",T50,F11.4,"  LB/MIN"/           00099
     * 3X,"APU SHAFT HORSEPOWER",T40,"APUSHP",T50,F11.4,"  HP"/        00100
     * 3X,"HYDRAULIC PUMP FLOW RATE",T40,"HYDGPM",T50,F11.4,"  GAL/MIN"/00101
     * 3X,"KVA RATING OF FULL-TIME GENS",T40,"KVA",T50,F11.4,"  KVA")  00102
                                                                        00103
      WRITE(6,170)NAPU,NCHAN,NGEN,NINS,NPOD                             00104
170   FORMAT(3X,"NO OF APUS",T40,"NAPU",T50,I11/                        00105
     * 3X,"NO OF AUTOPILOT CHANNELS",T40,"NCHAN",T50,I11/               00106
     * 3X,"NO OF INFLIGHT-OPERATED GENS",T40,"NGEN",T50,I11/            00107
     * 3X,"NO OF INERTIAL NAV SYSTEMS",T40,"NINS",T50,I11/              00108
     * 3X,"NO OF PODDED ENGINES",T40,"NPOD",T50,I11)                    00109
                                                                        00110
      WRITE(6,180)DEPPER,FARE,FUELPR,LIFE,RESID,ROI                     00111
180   FORMAT(3X,"DEPRECIATION PERIOD",T40,"DEPPER",T50,F11.2,"  YRS"/   00112
     * 3X,"FARE",T40,"FARE",T50,F11.4,"  DOL/PASS/SEAT"/               00113
     * 3X,"FUEL PRICE",T40,"FUELPR",T50,F11.4,"  DOL/GAL"/            00114
     * 3X,"NO OF YEARS FOR LCC CALCULATION",T40,"LIFE",T50,F11.2/      00115
     * 3X,"RESIDUAL VALUE AT END OF DEPPER",T40,"RESID",T50,F11.2,     00116
     * "  PER"/                                                        00117
     * 3X,"RETURN ON INVESTMENT",T40,"ROI",T50,F11.4,"  PER")          00118
                                                                        00119
      WRITE(6,190)IDOM,ITRAN,LF,PCTFC                                   00120
190   FORMAT(3X,"OPERATION TYPE SWITCH",T40,"IDOM",T50,I11/             00121
     * 3X,"TRANSER OPERATION SWITCH",T40,"ITRAN",T50,I11/               00122
     * 3X,"LOAD FACTOR",T40,"LF",T50,F11.2,"  PER"/                     00123
     * 3X,"PERCENT OF SEATS FOR 1ST CLASS",T40,"PCTFC",T50,F11.4,       00124
     * "  PER"///)                                                     00125
                                                                        00126
      WRITE(6,200)FAFRD,FENRD                                           00127
200   FORMAT(3X,"TECHNOLOGY FACTORS"/5X,"R&D"/7X,"AIRFRAME",T40,        00128
     * "FAFRD",T50,F5.2/7X,"ENGINE",T40,"FENRD",T50,F5.2/)              00129
                                                                        00130
      WRITE(6,210)FMWING,FMTAIL,FMBODY,FMGEAR,FMNAC,FMTRV,FMENG         00131
210   FORMAT(5X,"MANUFACTURING"/7X,"WING",T40,"FMWING",T50,F5.2/        00132
     * 7X,"TAIL",T40,"FMTAIL",T50,F5.2/7X,"FUSELAGE",T40,"FMBODY",     00133
     * T50,F5.2/7X,"LANDING GEAR",T40,"FMGEAR",T50,F5.2/7X,"NACELLE",   00134
     * T40,"FMNAC",T50,F5.2/7X,"THRUST REVERSER",T40,"FMTRV",T50,F5.2/  00135
     * 7X,"ENGINE",T40,"FMENG",T50,F5.2)                                00136
                                                                        00137
      WRITE(6,220)FMFUSY,FMENSY,FMFCS,FMHYD,FMEL,FMPNM,FMAC             00138
220   FORMAT(7X,"FUEL SYSTEM",T40,"FMFUSY",T50,F5.2/7X,"ENGINE SYSTEM", 00139
     * T40,"FMENSY",T50,F5.2/7X,"FLIGHT CONTROL SYSTEM",T40,"FMFCS",    00140
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     * T50,F5.2/7X,"HYDRAULICS",T40,"FMHYD",T50,F5.2/7X,                  00141
     * "ELECTRICAL SYSTEM",T40,"FMEL",T50,F5.2/7X,"PNEUMATICS",T40,       00142
     * "FMPNM",T50,F5.2/7X,"AIR CONDITIONING",T40,"FMAC",T50,F5.2)        00143
                                                                          00144
      WRITE(6,230)FMAI,FMAPU,FMFEQ,FMINS,FMAV,FMCOMP                      00145
230   FORMAT(7X,"ANTI-ICING",T40,"FMAI",T50,F5.2/7X,"AUX. POWER UNIT",    00146
     * T40,"FMAPU",T50,F5.2/7X,"FURNISHINGS AND EQP",T40,"FMFEQ",T50,     00147
     * F5.2/7X,"INSTRUMENTS",T40,"FMINS",T50,F5.2/7X,"AVIONICS",T40,      00148
     * "FMAV",T50,F5.2/7X,"COMPOSITE STRUCTURES",T40,"FMCOMP",T50,F5.2)   00149
                                                                          00150
      WRITE(6,240)FOCOMP,FOWING,FOBODY,FONAC,FOGEAR,FOPROP                00151
240   FORMAT(/5X,"OPERATING"/7X,"COMPOSITES",T40,"FOCOMP",T50,F5.2/       00152
     * 7X,"WING",T40,"FOWING",T50,F5.2/7X,"FUSELAGE",T40,"FOBODY",        00153
     * T50,F5.2/7X,"NACELLE",T40,"FONAC",T50,F5.2/7X,"LANDING GEAR",      00154
     * T40,"FOGEAR",T50,F5.2/7X,"PROPULSION SYSTEM",T40,"FOPROP",         00155
     * T50,F5.2)                                                          00156
                                                                          00157
      WRITE(6,250)FOFCS,FOFUSY,FOPNM,FOEL,FOFEQ,FOAC                      00158
250   FORMAT(7X,"FLIGHT CONTROL SYSTEM",T40,"FOFCS",T50,F5.2/             00159
     * 7X,"FUEL SYSTEM",T40,"FOFUSY",T50,F5.2/7X,"PNEUMATICS",T40,        00160
     * "FOPNM",T50,F5.2/7X,"ELECTRICAL",T40,"FOEL",T50,F5.2/              00161
     * 7X,"FURNISHINGS AND EQP",T40,"FOFEQ",T50,F5.2/,7X,                 00162
     * "AIR CONDITIONING",T40,"FOAC",T50,F5.2)                            00163
                                                                          00164
      WRITE(6,260)FOINS,FOAV,FOAI,FOAPU,FOHYD                             00165
260   FORMAT(7X,"INSTRUMENTS",T40,"FOINS",T50,F5.2/7X,"AVIONICS",T40,     00166
     * "FOAV",T50,F5.2/7X,"ANTI-ICING",T40,"FOAI",T50,F5.2/7X,            00167
     * "AUX. POWER UNIT",T40,"FOAPU",T50,F5.2/7X,"HYDRAULICS",T40,        00168
     * "FOHYD",T50,F5.2/)                                                 00169
                                                                          00170
      WRITE(6,270)FEDEP,FEINS,FECFEE,FELDFE,FEACSR                        00171
270   FORMAT(5X,"ECONOMICS"/7X,"DEPRECIATION",T40,"FEDEP",T50,F5.2/       00172
     * 7X,"INSURANCE",T40,"FEINS",T50,F5.2/7X,"CONTROL FEE",T40,          00173
     * "FECFEE",T50,F5.2/7X,"LANDING FEE",T40,"FELDFE",T50,F5.2/          00174
     * 7X,"A/C SERVICING",T40,"FEACSR",T50,F5.2)                          00175
                                                                          00176
      WRITE(6,280)FEFLTA,FECRW,FEMAIN,FELABR                              00177
280   FORMAT(7X,"FLIGHT ATTENDANTS",T40,"FEFLTA",T50,F5.2/7X,             00178
     * "FLIGHT CREW",T40,"FECRW",T50,F5.2/7X,"MAINTAINENCE LABOR RATE",   00179
     * T40,"FEMAIN",T50,F5.2/7X,"R&D LABOR RATE",T40,"FELABR",T50,        00180
     * F5.2////)                                                          00181
                                                                          00182
C  END OF WRITING OUT INPUT                                               00183
                                                                          00184
C  TEMPERATURE CONVERSION FOR TURBINE INLET TEMPERATURE (INPUT IN         00185
C  DEGREES F)                                                             00186
                                                                          00187
      CET=TEMP                                                            00188
      TEMP=TEMP + 459.                                                    00189
      RESID=RESID/100.                                                    00190
                                                                          00191
                                                                          00192
      RETURN                                                              00193
      END                                                                 00194
```

```
      SUBROUTINE CALCOST(IPRNT)                                          00195
                                                                         00196
      COMMON/MASTER/ICOSTYP,IRAD,DYEAR,IPFLAG                            00197
                                                                         00198
      COMMON/COSTDAT/WTS(25),NENG,SMACH,THRMAX,QMAX,RANGE,TOGWMX,        00199
     * FUELBL,TBLOCK,SPEED,NS,TGNDMAN,NCREW,WLDGMX,FUELCP,CARGO,SREF,     00200
     * COST                                                              00201
                                                                         00202
      COMMON/AIRFRM/INOZ,IACOUS,Q,AMPR,FAFMSP,FENGSP,AFMCST,ARDCST       00203
                                                                         00204
      COMMON/ENGINE/PRPROC,FPPFT,F,EPR,TEMP,SFC,PLMQT,DEVST,             00205
     * NPROTYP,NFLTTST,ENGCST,ENGRD,ENPROD                               00206
                                                                         00207
      COMMON/DOCCOM/AFMSP,ENGSP,RESID,DEPPER,IDTLNK,IBODY,               00208
     * FUELPR,CET,ICOREV,HYDGPM,NINS,ISPOOL,APUSHP,APUFLW,IWIND,         00209
     * NPOD,AC,NCHAN,IMUX,NGEN,KVA,IRANGE,ICIRC,NAPU,LIFE,DOCDPD,        00210
     * FARE,ROI,N                                                        00211
                                                                         00212
      COMMON/IOCCOM/IDOM,LF,PCTFC,ITRAN,IOCDPD                           00213
                                                                         00214
      COMMON/FLY/DESMCH,DPRESMX                                          00215
                                                                         00216
      REAL KVA, LF, IOCDPD, IOC, N, LIFE,LCC                             00217
                                                                         00218
      INTEGER DYEAR                                                      00219
                                                                         00220
      C(R)=1.92*(ACQCST-RES)*(R/(((1.0+R)**LIFE)-1.0)) + 1.92*ACQCST*R   00221
                                                                         00222
                                                                         00223
C     WRITE(6,*)"WTS(I)  ",(WTS(I),I=1,25)                              00224
C     WRITE(6,*)"NENG= ",NENG," SMACH= ",SMACH," THRMAX= ",THRMAX       00225
C     WRITE(6,*)"QMAX= ",QMAX," RANGE= ",RANGE," TOGWMX= ",TOGWMX       00226
C     WRITE(6,*)"SPEED= ",SPEED," NS= ",NS," TGNDMAN= ",TGNDMAN         00227
C     WRITE(6,*)"NCREW= ",NCREW," WLDGMX= ",WLDGMX                      00228
C     WRITE(6,*)"FUELCP= ",FUELCP," CARGO= ",CARGO," SREF= ",SREF       00229
                                                                         00230
C  CHECK FOR DESIGN MACH NUMBER                                          00231
                                                                         00232
      IF(SMACH.NE.0.0)GO TO 101                                          00233
      IF(DESMCH.NE.0.0)GO TO 100                                         00234
      WRITE(6,105)                                                       00235
105   FORMAT(///1X,"*****************************************************"/ 00236
     * 3X,"DESIGN MACH NUMBER MUST BE DEFINED IN $COSTIN"/               00237
     * 3X,"PROGRAM EXECUTION STOPPING"/                                  00238
     * 1X,"*****************************************************")       00239
      STOP                                                               00240
100   SMACH=DESMCH                                                       00241
      WRITE(6,*)"SMACH= ",SMACH                                          00242
                                                                         00243
101   IF(QMAX.NE.0.0)GO TO 102                                           00244
      IF(DPRESMX.NE.0.0)GO TO 111                                        00245
      WRITE(6,115)                                                       00246
115   FORMAT(///1X,"*******************************************"/        00247
     * 3X,"MAXIMUM DYNAMIC PRESSURE MUST BE DEFINED IN $COSTIN"/         00248
     * 3X,"PROGRAM EXECUTION STOPPING"/                                  00249
     * 1X,"*******************************************")                00250
      STOP                                                               00251
111   QMAX=DPRESMX                                                       00252
      WRITE(6,*)"DPRESMX= ",DPRESMX                                      00253
                                                                         00254
                                                                         00255
C  CALCULATION OF COST ELEMENTS.  IF IRAD=0, NO R&D IS CALCULATED        00256
                                                                         00257
102   CALL AFCOST(IPRNT)                                                 00258
      ARDCST=0.0                                                         00259
      IF(IRAD.EQ.1)CALL AFRAD(IPRNT)                                     00260
      ENGRD=0.0                                                          00261
      CALL ENCOST(IPRNT)                                                 00262
      ENGCST=ENGRD + ENPROD                                              00263
```

```
      ENGCS=ENGCST*NENG                                                 00264
      ACQCST=AFMCST + ARDCST + ENGCS                                    00265
      AFMSP=FAFMSP*AFMCST                                               00266
      ENGSP=FENGSP*ENGCST                                               00267
      CALL AADOC(IPRNT)                                                 00268
      CALL LGIOC(IPRNT)                                                 00269
                                                                        00270
      DOC=DOCDPD*N*LIFE                                                 00271
      IOC=IOCDPD*N*LIFE                                                 00272
      LCC=ACQCST + DOC + IOC                                            00273
                                                                        00274
      IF(IPRNT.NE.0)WRITE(6,4)AFMCST,ARDCST,ENPROD,                     00275
     * ENGRD,ACQCST,DOCDPD,DOC,IOCDPD,IOC,LCC                           00276
4     FORMAT(//3X,"ASSOCIATED COSTS"/5X,"AIRFRAME PRODUCTION COST =",   00277
     * F20.2/5X,"AIRFRAME R&D =",F20.2/5X,"ENGINGE PRODUCTION COST =", 00278
     * F20.2/5X,"ENGINE R&D COST =",F20.2/5X,"ACQUISTION COST =",       00279
     * F20.2/5X,"DOC($/TRIP) =",F20.2,5X,"DOC(LIFE)=",F20.2/           00280
     * 5X,"IOC($/TRIP) =",F20.2,5X,"IOC(LIFE)=",F20.2/                 00281
     * 5X,"LCC= ",F20.2)                                               00282
                                                                        00283
                                                                        00284
      IF(IPRNT.NE.0.AND.IRAD.EQ.0)WRITE(6,1)                            00285
1     FORMAT(//1X," NO R&D INCLUDED IN CALCULATIONS"/)                  00286
      IF(IPRNT.NE.0.AND.IRAD.NE.0)WRITE(6,2)                            00287
2     FORMAT(//1X," R&D INCLUDED IN CALCULATIONS"/)                     00288
                                                                        00289
                                                                        00290
C  CALCULATION FOR LIFE CYCLE COST OPTION                               00291
                                                                        00292
      IF(ICOSTYP.NE.1)GO TO 10                                          00293
                                                                        00294
      COST=LCC                                                          00295
                                                                        00296
                                                                        00297
      COSTM=COST/1.0E06                                                 00298
      IF(IPRNT.NE.0)WRITE(6,5)COSTM,LIFE                                00299
5     FORMAT(/1X,"LIFE CYCLE COST= ",F25.2," (MILLIONS OF DOLLARS)"     00300
     * ," OVER ",F4.0," YEARS")                                         00301
                                                                        00302
      RETURN                                                            00303
                                                                        00304
C  CALCULATION FOR ACQUISITION COST OPTION                              00305
                                                                        00306
10    IF(ICOSTYP.NE.2)GO TO 20                                          00307
                                                                        00308
      COST=ACQCST                                                       00309
                                                                        00310
                                                                        00311
      COSTM=COST*1.0E-06                                                00312
      IF(IPRNT.NE.0)WRITE(6,12)COSTM                                    00313
12    FORMAT(/1X,"ACQUISITION COST= ",F25.2," (MILLIONS OF DOLLARS)"//) 00314
                                                                        00315
      RETURN                                                            00316
                                                                        00317
C  CALCULATION FOR DIRECT OPERATING COST OPTION                         00318
                                                                        00319
20    IF(ICOSTYP.NE.3)GO TO 30                                          00320
                                                                        00321
      COST=DOC                                                          00322
                                                                        00323
      IF(IPRNT.NE.0.AND.IPFLAG.NE.0)WRITE(6,21)DOCDPD                   00324
21    FORMAT(5X,"DOC($/TRIP) =",F20.2)                                  00325
                                                                        00326
      COSTM=COST*1.0E-06                                                00327
      IF(IPRNT.NE.0)WRITE(6,22)COSTM,LIFE                               00328
22    FORMAT(1X,"DOC= ",F25.2, " OVER THE LIFE (",F4.0," YEARS) "       00329
     * ,"OF THE AIRCRAFT"/32X," (MILLIONS OF DOLLARS)"//)               00330
                                                                        00331
      RETURN                                                            00332
                                                                        00333
```

```
C  CALCULATION FOR INDIRECT OPERATING COST OPTION                    00334
                                                                     00335
30     IF(ICOSTYP.NE.4)GO TO 40                                      00336
                                                                     00337
       COST=IOC                                                      00338
                                                                     00339
       IF(IPRNT.NE.0.AND.IPFLAG.NE.0)WRITE(6,31)IOCDPD               00340
31     FORMAT(5X,"IOC($/TRIP) =",F20.2)                              00341
                                                                     00342
       COSTM=COST*1.0E-06                                            00343
       IF(IPRNT.NE.0)WRITE(6,32)COSTM,LIFE                           00344
32     FORMAT(1X,"IOC= ",F25.2," OVER THE LIFE (",F4.0," YEARS) ",   00345
      * "OF THE AIRCRAFT"/35X," (MILLIONS OF DOLLARS)"//)             00346
                                                                     00347
       RETURN                                                        00348
                                                                     00349
C  CALCULATION FOR OPERATING COST (BOTH DIRECT AND INDIRECT)          00350
                                                                     00351
40     IF(ICOSTYP.NE.5)GO TO 50                                      00352
                                                                     00353
       COST=DOC + IOC                                                00354
                                                                     00355
       IF(IPRNT.NE.0.AND.IPFLAG.NE.0)WRITE(6,41)DOCDPD,IOCDPD        00356
41     FORMAT(5X,"DOC($/TRIP) =",F20.2/5X,"IOC($/TRIP) =",F20.2)     00357
                                                                     00358
       COSTM=COST*1.0E-06                                            00359
       IF(IPRNT.NE.0)WRITE(6,42)COSTM,LIFE                           00360
42     FORMAT(1X,"DOC + IOC = ",F25.2," OVER THE LIFE (",F4.0," YEARS)" 00361
      * " OF THE AIRCRAFT"/35X," (MILLIONS OF DOLLARS)"//)            00362
                                                                     00363
       RETURN                                                        00364
                                                                     00365
C  CALCULATION OF FARE FOR A GIVEN RETURN ON INVESTMENT              00366
                                                                     00367
50     CONTINUE                                                      00368
                                                                     00369
       RES=ACQCST*RESID                                              00370
       ROIP=ROI/100.                                                 00371
       PLF=LF/100.                                                   00372
                                                                     00373
       IF(ICOSTYP.NE.6)GO TO 60                                      00374
                                                                     00375
       FARE=1.0/(NS*PLF*SPEED*N*TBLOCK)*((1.92*(ACQCST-RES)*(ROIP/   00376
      * ((1.0+ROIP)**LIFE - 1.0))) + 1.92*ACQCST*ROIP +              00377
      *  1.92*(RES-ACQCST)/LIFE+(DOCDPD + IOCDPD)/RANGE*SPEED*N*TBLOCK) 00378
                                                                     00379
       IF(IPRNT.NE.0)WRITE(6,51)FARE,ROI                             00380
51     FORMAT(1X,"FARE= ",F20.9," DOLLARS/PASS/MILE FOR A ROI OF ",  00381
      * F6.3," PERCENT")                                             00382
       GO TO 90                                                      00383
                                                                     00384
60     CONTINUE                                                      00385
                                                                     00386
C  CALCULATION OF RETURN ON INVESTMENT FOR A GIVEN FARE              00387
                                                                     00388
       ROI=0.1                                                       00389
       ROIM=0.01                                                     00390
       ICOUNT=0                                                      00391
                                                                     00392
                                                                     00393
       A=1.0/(NS*LF*SPEED*N*TBLOCK)                                  00394
                                                                     00395
       B=1.92*(RES-ACQCST)/LIFE + (DOC + IOC)*NS*SPEED*N*TBLOCK      00396
                                                                     00397
       R=ROIM                                                        00398
       CROI=C(R)                                                     00399
       ZEROM=(B + CROI)*A - FARE                                     00400
                                                                     00401
       R=ROI                                                         00402
       CROI=C(R)                                                     00403
```

```
      ZERO=(B + CROI)*A - FARE                                          00404
      ICOUNT=0                                                          00405
                                                                        00406
70    ROIP=(ZERO*ROIM - ZEROM*ROI)/(ZERO - ZEROM)                       00407
                                                                        00408
      IF(ABS(ROIP-ROI).LT.0.000001)GO TO 75                             00409
                                                                        00410
      ICOUNT=ICOUNT+1                                                   00411
      IF(ICOUNT.GT.5000)GO TO 80                                        00412
      ROIM=ROI                                                          00413
      ROI=ROIP                                                          00414
      ZEROM=ZERO                                                        00415
      R=ROI                                                             00416
      CROI=C(R)                                                         00417
      ZERO=(B + CROI)*A - FARE                                          00418
      GO TO 70                                                          00419
                                                                        00420
75    ROIP=ROI*100.                                                     00421
      IF(IPRNT.NE.0)WRITE(6,76)ROIP                                     00422
76    FORMAT(//1X,"ROI= ", F10.1," FOR A FARE OF ",F10.2,               00423
     * " $/PASS/SEAT")                                                  00424
      GO TO 90                                                          00425
                                                                        00426
80    WRITE(6,81)ICOUNT                                                 00427
81    FORMAT(//1X,"AFTER ",I6," ITERATIONS, NO CONVERGENCE")            00428
                                                                        00429
90    CONTINUE                                                          00430
                                                                        00431
      RETURN                                                            00432
      END                                                               00433
```

```
      SUBROUTINE AFCOST(IPRNT)                                          00434
                                                                        00435
      COMMON/MASTER/ICOSTYP,IRAD,DYEAR,IPFLAG                           00436
                                                                        00437
      COMMON/COSTDAT/WTS(25),NENG,SMACH,THRMAX,QMAX,RANGE,TOGWMX,       00438
     * FUELBL,TBLOCK,SPEED,NS,TGNDMAN,NCREW,WLDGMX,FUELCP,CARGO,SREF,    00439
     * COST                                                             00440
                                                                        00441
      COMMON/AIRFRM/INOZ,IACOUS,Q,AMPR,FAFMSP,FENGSP,AFMCST,ARDCST      00442
                                                                        00443
      COMMON/SENSI/FAFRD,FENRD,FMWING,FMTAIL,FMBODY,FMGEAR,FMNAC,       00444
     * FMTRV,FMFUSY,FMENSY,FMFCS,FMHYD,FMEL,FMPNM,FMAC,FMAI,FMAPU,      00445
     * FMFEQ,FMINS,FMAV,FMENG,FMCOMP,FOWING,FOAC,FOINS,FOAV,FOEL,       00446
     * FOFEQ,FOFCS,FOFUSY,FOPNM,FOAI,FOGEAR,FOAPU,FOBODY,FONAC,FOHYD,   00447
     * FOPROP,FOCOMP,FEDEP,FEINS,FECFEE,FELDFE,FEACSR,FEFLTA,           00448
     * FECRW,FEMAIN,FELABR                                              00449
                                                                        00450
                                                                        00451
      INTEGER CYEAR, DYEAR                                              00452
                                                                        00453
      XM=1.0E06                                                         00454
      CYEAR=1975                                                        00455
      CALL DOLLARS(FACTOR,CYEAR,DYEAR)                                  00456
                                                                        00457
C  PRINT STATEMENTS TO CHECK THIS OUT                                   00458
                                                                        00459
                                                                        00460
C  WING                                                                 00461
                                                                        00462
      C1=1730.*WTS(1)**.766*Q**(-.218)*FACTOR*FMWING*FMCOMP             00463
                                                                        00464
C  TAIL                                                                 00465
                                                                        00466
      W2=WTS(2) + WTS(3)                                                00467
      C2=1820.*W2**.766*Q**(-.218)*FACTOR*FMTAIL*FMCOMP                 00468
                                                                        00469
C  BODY                                                                 00470
                                                                        00471
      C3=2060.*WTS(4)**.766*Q**(-.218)*FACTOR*FMBODY*FMCOMP             00472
                                                                        00473
C  LANDING GEAR                                                         00474
                                                                        00475
                                                                        00476
      WTS(6)=WTS(5)*0.12                                                00477
      WTS(7)=WTS(5)*0.23                                                00478
      WTS(8)=WTS(5)*0.13                                                00479
      WTS(5)=WTS(5)*0.52                                                00480
                                                                        00481
C  LANDING GEAR STRUCTURE                                               00482
                                                                        00483
      IF(WTS(5).LE.10000.)C4A=1180.*WTS(5)**.766*Q**(-.218)*FACTOR      00484
      IF(WTS(5).GT.10000.)C4A=136.*WTS(5)*Q**(-.218)*FACTOR             00485
                                                                        00486
C  LANDING GEAR CONTROLS                                                00487
                                                                        00488
      C4B=157.*WTS(6)*Q**(-.0896)*FACTOR                                00489
                                                                        00490
C  LANDING GEAR WHEELS AND BRAKES                                       00491
                                                                        00492
      C4C=23.8*WTS(7)*Q**(-.0896)*FACTOR                                00493
                                                                        00494
C  LANDING GEAR TIRES                                                   00495
                                                                        00496
      C4D=2.0*WTS(8)*FACTOR                                             00497
                                                                        00498
C  TOTAL GEAR                                                           00499
                                                                        00500
      WTS(5)=WTS(5) + WTS(6) + WTS(7) + WTS(8)                          00501
      C4=(C4A + C4B + C4C + C4D)*FMGEAR                                 00502
```

```
C  NACELLE                                                                00503
                                                                          00504
                                                                          00505
                                                                          00506
      IF(IACOUS.EQ.0)C5=2660.*WTS(9)**.766*Q**(-.218)*FACTOR              00507
      IF(IACOUS.EQ.1)C5=3470.*WTS(9)**.766*Q**(-.218)*FACTOR              00508
      C5=C5*FMNAC*FMCOMP                                                  00509
                                                                          00510
C  STRUCTURE TOTAL                                                       00511
                                                                          00512
      WST=WTS(1) + W2 + WTS(4) + WTS(5) + WTS(9)                          00513
      CST=C1 + C2 + C3 + C4 + C5                                          00514
                                                                          00515
C  PROPULSION (LESS ENGINE)                                              00516
                                                                          00517
C  THRUST REVERSER                                                       00518
                                                                          00519
      IF(INOZ.EQ.0)C6A=0.                                                 00520
      IF(IACOUS.EQ.1.AND.INOZ.EQ.1)C6A=3830.*WTS(10)**.766*Q**(-.218)     00521
      IF(IACOUS.EQ.0.AND.INOZ.EQ.1)C6A=2800.*WTS(10)**.766*Q**(-.218)     00522
      IF(INOZ.EQ.2)C6A=2330.*WTS(10)**.766*Q**(-.218)                     00523
      C6A=C6A*FACTOR*FMTRV                                                00524
                                                                          00525
C  FUEL SYSTEM                                                           00526
                                                                          00527
      C6B=61.9*WTS(11)*Q**(-.0896)*FACTOR*FMFUSY                          00528
                                                                          00529
C  ENGINE SYSTEM                                                         00530
                                                                          00531
                                                                          00532
      C6C=159.*WTS(12)*Q**(-.0896)*FACTOR*FMENSY                          00533
                                                                          00534
C  TOTAL PROPULSION SYSTEM                                               00535
                                                                          00536
      W6= WTS(10) + WTS(11) + WTS(12)                                     00537
      C6=C6A + C6B + C6C                                                  00538
                                                                          00539
C  FLIGHT CONTROLS                                                       00540
                                                                          00541
      C7=205.*WTS(13)*Q**(-.0896)*FACTOR*FMFCS                            00542
                                                                          00543
C  HYDRAULICS                                                            00544
                                                                          00545
      WTS(16)=WTS(14)*0.2                                                 00546
      WTS(14)=WTS(14)*0.8                                                 00547
      C8=54.4*WTS(14)*Q**(-.0896)*FMHYD                                   00548
                                                                          00549
C  ELECTRICAL                                                            00550
                                                                          00551
      IF(WTS(15).LE.5000.)C9=209.*WTS(15)*Q**(-.0896)*FACTOR              00552
      IF(WTS(15).GT.5000.)C9=178.*WTS(15)*Q**(-.0896)*FACTOR              00553
      C9=C9*FMEL                                                          00554
                                                                          00555
C  PNEUMATIC                                                             00556
                                                                          00557
      IF(WTS(16).LE.400.)C10=151.*WTS(16)*Q**(-.0896)*FMPNM               00558
      IF(WTS(16).GT.400.)C10=201.*WTS(16)*Q**(-.0896)*FMPNM               00559
                                                                          00560
C  AIR CONDITIONING                                                      00561
                                                                          00562
      C11=234.*WTS(17)*Q**(-.0896)*FACTOR*FMAC                            00563
                                                                          00564
C  ANTI-ICING                                                            00565
                                                                          00566
      C12=230.*WTS(18)*Q**(-.0896)*FACTOR*FMAI                            00567
                                                                          00568
C  AUXILIARY POWER                                                       00569
                                                                          00570
      C13=243.*WTS(19)*Q**(-.0896)*FACTOR*FMAPU                           00571
                                                                          00572
```

```
C  FURNISHINGS AND EQUIPMENT                                                00573
                                                                            00574
      IF(WTS(20).LE.25000.)C14=102.*WTS(20)*Q**(-.0896)*FACTOR               00575
      IF(WTS(20).GT.25000.)C14=115.*WTS(20)*Q**(-.0896)*FACTOR               00576
      C14=C14*FMFEQ                                                         00577
                                                                            00578
C  INSTRUMENTS                                                              00579
                                                                            00580
      WTS(22)=WTS(21)*0.30                                                  00581
      WTS(21)=WTS(21)*0.70                                                  00582
                                                                            00583
C  EQUIPMENT                                                                00584
                                                                            00585
      C15A=1930.*WTS(21)*Q**(-.184)*FACTOR                                  00586
                                                                            00587
C  OTHER                                                                    00588
                                                                            00589
      C15B=154.*WTS(22)*Q**(-.184)*FACTOR                                   00590
                                                                            00591
C  TOTAL INSTRUMENTS                                                        00592
                                                                            00593
      WTS(21)= WTS(21) + WTS(22)                                            00594
      C15=(C15A + C15B)*FMINS                                               00595
                                                                            00596
C  AVIONICS                                                                 00597
                                                                            00598
                                                                            00599
      WTS(24)=WTS(23)*0.31                                                  00600
      WTS(23)=WTS(23)*0.69                                                  00601
                                                                            00602
C  EQUIPMENT                                                                00603
                                                                            00604
      C16A=1930.*WTS(23)*Q**(-.184)*FACTOR                                  00605
                                                                            00606
C  OTHER                                                                    00607
                                                                            00608
      C16B=154.*WTS(24)*Q**(-.184)*FACTOR                                   00609
                                                                            00610
C  TOTAL AVIONICS                                                           00611
                                                                            00612
      WTS(23)=WTS(23) + WTS(24)                                             00613
      C16=(C16A + C16B)*FMAV                                                00614
                                                                            00615
C  LOAD AND HANDLING                                                        00616
      W17=50.                                                               00617
      C17=(W17/WTS(4))*C3                                                   00618
                                                                            00619
C  TOTAL SYSTEMS AND EQUIPMENT                                              00620
                                                                            00621
      WSEQP=WTS(13) + WTS(14) + WTS(15) + WTS(16) + WTS(17) + WTS(18)       00622
     * + WTS(19) + WTS(20) + WTS(21) + WTS(23) + 50.                        00623
                                                                            00624
      CSEQP=C7 + C8 + C9 + C10 + C11 + C12 + C13 + C14 + C15 +              00625
     * C16 + C17                                                           00626
                                                                            00627
C  WEIGHT EMPTY                                                             00628
                                                                            00629
                                                                            00630
      WEMPT=WST + W6 + WSEQP                                                00631
                                                                            00632
C  AMPR WEIGHT                                                              00633
                                                                            00634
                                                                            00635
      AMPR=WEMPT - (WTS(7) + WTS(8) + WTS(10) + WTS(11) + WTS(12) +         00636
     * WTS(15) + WTS(17) + WTS(18) + WTS(19) + WTS(20) + WTS(21) +          00637
     * WTS(22) + WTS(23) + 50.)                                            00638
                                                                            00639
C  FINAL ASSEMBLY AND DELIVERY                                              00640
                                                                            00641
      C18=(C1 + C2 + C3 + C4 + C5 + C6 + C7 + C8 + C9 + C10 + C11 +         00642
```

```
     * C12 + C13 + C14 + C15 + C16 + C17)*.25                          00643
                                                                       00644
C  TOTAL COST                                                         00645
                                                                       00646
      C19=C1 + C2 + C3 + C4 + C5 + C6 + C7 + C8 + C9 + C10 + C11 +    00647
     * C12 + C13 + C14 + C15 + C16 + C17 + C18                        00648
                                                                       00649
      AFMCST=C19                                                       00650
                                                                       00651
C  END OF COST SECTION  --  BEGINNING OF PRINTING SECTION              00652
                                                                       00653
      IF(IPRNT.EQ.0)GO TO 9999                                         00654
      IF(ICOSTYP.GT.2)GO TO 9999                                       00655
                                                                       00656
C  CONVERSION TO MILLIONS OF DOLLARS                                   00657
                                                                       00658
      C1=C1/XM                                                         00659
      C2=C2/XM                                                         00660
      C3=C3/XM                                                         00661
      C4=C4/XM                                                         00662
      C5=C5/XM                                                         00663
      C6A=C6A/XM                                                       00664
      C6B=C6B/XM                                                       00665
      C6C=C6C/XM                                                       00666
      C6=C6/XM                                                         00667
      C7=C7/XM                                                         00668
      C8=C8/XM                                                         00669
      C9=C9/XM                                                         00670
      C10=C10/XM                                                       00671
      C11=C11/XM                                                       00672
      C12=C12/XM                                                       00673
      C13=C13/XM                                                       00674
      C14=C14/XM                                                       00675
      C15=C15/XM                                                       00676
      C16=C16/XM                                                       00677
      C17=C17/XM                                                       00678
      C18=C18/XM                                                       00679
      C19=C19/XM                                                       00680
      CST=CST/XM                                                       00681
      CSEQP=CSEQP/XM                                                   00682
                                                                       00683
      IF(IPFLAG.EQ.0)GO TO 9999                                        00684
                                                                       00685
C..... WRITE OUT RESULTS                                               00686
                                                                       00687
      WRITE(6,8000)                                                    00688
8000  FORMAT(25X,"AIRCRAFT WEIGHTS STATEMENT"//)                       00689
      WRITE(6,8001)                                                    00690
8001  FORMAT(1X," ")                                                   00691
      WRITE(6,8002)                                                    00692
8002  FORMAT(12X,"ITEM",35X,"WEIGHT",4X,"COST"/                        00693
     * 59X,"MILLIONS OF DOLLARS")                                      00694
                                                                       00695
      WRITE(6,8001)                                                    00696
      WRITE(6,8003)WTS(1),C1                                           00697
8003  FORMAT(12X,"WING",30X,2(1X,F10.3))                               00698
      WRITE(6,8006)W2,C2                                               00699
8006  FORMAT(12X,"TAIL",30X,2(1X,F10.3))                               00700
      WRITE(6,8008)WTS(4),C3                                           00701
8008  FORMAT(12X,"FUSELAGE",26X,2(1X,F10.3))                           00702
      WRITE(6,8009)WTS(5),C4                                           00703
8009  FORMAT(12X,"LANDING GEAR",22X,2(1X,F10.3))                       00704
      WRITE(6,8010)WTS(9),C5                                           00705
8010  FORMAT(12X,"NACELLE",27X,2(1X,F10.3))                            00706
      WRITE(6,8001)                                                    00707
                                                                       00708
      WRITE(6,8011)WST,CST                                             00709
8011  FORMAT(6X,"STRUCTURE TOTAL",25X,2(1X,F10.3))                     00710
      WRITE(6,8001)                                                    00711
                                                                       00712
```

```
      WRITE(6,8013)WTS(10),C6A                                          00713
8013  FORMAT(12X,"THRUST REVERSER",19X,2(1X,F10.3))                     00714
      WRITE(6,8014)WTS(12),C6C                                          00715
8014  FORMAT(12X,"MISC SYSTEMS",22X,2(1X,F10.3))                        00716
      WRITE(6,8015)WTS(11),C6B                                          00717
8015  FORMAT(12X,"FUEL SYSTEM",23X,2(1X,F10.3))                         00718
      WRITE(6,8001)                                                     00719
                                                                        00720
      WRITE(6,8016)W6,C6                                                00721
8016  FORMAT(6X,"PROPULSION TOTAL*",23X,2(1X,F10.3))                    00722
      WRITE(6,8028)                                                     00723
      WRITE(6,8001)                                                     00724
                                                                        00725
      WRITE(6,8017)WTS(13),C7                                           00726
8017  FORMAT(12X,"SURFACE CONTROLS",18X,2(1X,F10.3))                    00727
      WRITE(6,8018)WTS(19),C13                                          00728
8018  FORMAT(12X,"AUX POWER UNIT",20X,2(1X,F10.3))                      00729
      WRITE(6,8019)WTS(21),C15                                          00730
8019  FORMAT(12X,"INSTRUMENTS",23X,2(1X,F10.3))                         00731
      WRITE(6,8020)WTS(14),C8                                           00732
8020  FORMAT(12X,"HYDRAULICS",24X,2(1X,F10.3))                          00733
      WRITE(6,8021)WTS(15),C9                                           00734
8021  FORMAT(12X,"ELECTRICAL",24X,2(1X,F10.3))                          00735
      WRITE(6,8022)WTS(23),C16                                          00736
8022  FORMAT(12X,"AVIONICS",26X,2(1X,F10.3))                            00737
      WRITE(6,8023)WTS(20),C14                                          00738
8023  FORMAT(12X,"FURNISHINGS & EQUIP",15X,2(1X,F10.3))                 00739
      WRITE(6,8024)WTS(17),C11                                          00740
8024  FORMAT(12X,"AIR CONDITIONING",18X,2(1X,F10.3))                    00741
      WRITE(6,8025)WTS(18),C12                                          00742
8025  FORMAT(12X,"ANTI-ICING",24X,2(1X,F10.3))                          00743
      WRITE(6,8004)WTS(16),C10                                          00744
8004  FORMAT(12X,"PNEUMATIC",25X,2(1X,F10.3))                           00745
      WRITE(6,8005)W17,C17                                              00746
8005  FORMAT(12X,"LOAD AND HANDLING",17X,2(1X,F10.3))                   00747
      WRITE(6,8001)                                                     00748
                                                                        00749
      WRITE(6,8026)WSEQP,CSEQP                                          00750
8026  FORMAT(6X,"SYS & EQUIP TOTAL",23X,2(1X,F10.3))                    00751
      WRITE(6,8001)                                                     00752
      WRITE(6,8029)C18                                                  00753
8029  FORMAT(6X,"FINAL ASSEMBLY AND DELIVERY",25X,F10.3)                00754
                                                                        00755
      WRITE(6,8027)WEMPT,C19                                            00756
8027  FORMAT(6X,"WEIGHT EMPTY*",27X,2(1X,F10.3))                        00757
      WRITE(6,8001)                                                     00758
      WRITE(6,8028)                                                     00759
8028  FORMAT(1X,"*LESS BARE ENGINES")                                   00760
      WRITE(6,8001)                                                     00761
8031  WRITE(6,8030)AMPR                                                 00762
80 0  FORMAT(6X,"AMPR WEIGHT",28X,F10.0///)                            00763
      WRITE(6,8032)C19                                                  00764
8032  FORMAT(6X,"AIRFRAME COST= ",F10.3," (MILLIONS OF DOLLARS)"//)     00765
                                                                        00766
9999  CONTINUE                                                          00767
      RETURN                                                            00768
      END                                                               00769
```

```
      SUBROUTINE AFRAD(IPRNT)                                                   00770
                                                                                00771
      COMMON/MASTER/ICOSTYP,IRAD,DYEAR,IPFLAG                                   00772
                                                                                00773
      COMMON/AIRFRM/INOZ,IACOUS,Q,AMPR,FAFMSP,FENGSP,AFMCST,ARDCST              00774
                                                                                00775
      COMMON/ENGINE/PRPROC,FPPFT,F,EPR,TEMP,SFC,PLMQT,DEVST,                    00776
     * NPROTYP,NFLTTST,ENGCST,ENGRD,ENPROD                                      00777
                                                                                00778
      COMMON/COSTDAT/WTS(25),NEA,SMACH,THRMAX,DPRESMX,RANGE,TOGWMX,             00779
     * FUELBL,TBLOCK,SPEED,NS,TGNDMAN,NCREW,WLDGMX,FUELCP,CARGO,SREF,           00780
     * COST                                                                     00781
                                                                                00782
      COMMON/SENSI/FAFRD,FENRD,FMWING,FMTAIL,FMBODY,FMGEAR,FMNAC,               00783
     * FMTRV,FMFUSY,FMENSY,FMFCS,FMHYD,FMEL,FMPNM,FMAC,FMAI,FMAPU,             00784
     * FMFEQ,FMINS,FMAV,FMENG,FMCOMP,FOWING,FOAC,FOINS,FOAV,FOEL,              00785
     * FOFEQ,FOFCS,FOFUSY,FOPNM,FOAI,FOGEAR,FOAPU,FOBODY,FONAC,FOHYD,          00786
     * FOPROP,FOCOMP,FEDEP,FEINS,FECFEE,FELDFE,FEACSR,FEFLTA,                  00787
     * FECRW,FEMAIN,FELABR                                                     00788
                                                                                00789
                                                                                00790
      INTEGER DYEAR,CYEAR                                                       00791
                                                                                00792
      CYEAR=1970                                                                00793
      CALL DOLLARS(FACTOR,CYEAR,DYEAR)                                          00794
                                                                                00795
C  UNIT CONVERSIONS (TO KILOGRAMS AND KNOTS)                                    00796
                                                                                00797
      CAMPR=AMPR*0.4536                                                         00798
      CSPEED=SPEED*0.8684                                                       00799
                                                                                00800
C  ENGINEERING DEVELOPMENT                                                      00801
                                                                                00802
      ENGDEV=0.02766*CAMPR**1.0940*CSPEED**0.9186                               00803
      EDC=ENGDEV*15.14*FACTOR*FELABR                                            00804
                                                                                00805
C  TOOLING, DEVELOPMENT PHASE                                                   00806
                                                                                00807
      TOODEV=1.519*CAMPR**0.9977*CSPEED**0.4568                                 00808
      TDC=TOODEV*11.08*FACTOR*FELABR                                            00809
                                                                                00810
C  MANUFACTURING, DEVELOPMENT PHASE                                             00811
                                                                                00812
      MANDEV=(56.48*CAMPR**1.209*CSPEED**1.023)*1.0E-04                         00813
      MFDC=MANDEV*9.46*FACTOR*FELABR                                            00814
                                                                                00815
C  MATERIALS, DEVELOPMENT PHASE                                                 00816
                                                                                00817
      MATDC=(20.02*CAMPR**1.182*CSPEED**1.402)*1.0E-04*FACTOR                   00818
                                                                                00819
C  DEVELOPMENT SUPPORT                                                          00820
                                                                                00821
      DSC=4.824*CAMPR**0.7844*CSPEED**0.900*FACTOR                              00822
                                                                                00823
C  FLIGHT-TEST OPERATIONS                                                       00824
                                                                                00825
      FTOC=15.22*CAMPR**0.690*CSPEED**0.887*FACTOR                              00826
                                                                                00827
C  TOTAL DESIGN, DEVELOPMENT, TEST AND EVALUATION COST                          00828
                                                                                00829
      DEV=EDC + TDC + MFDC + MATDC + DSC + FTOC                                 00830
      ARDTOT=DEV*NFLTTST*FAFRD                                                  00831
      ARDCST=ARDTOT/Q                                                           00832
                                                                                00833
C  OUTPUT IF REQUESTED                                                          00834
                                                                                00835
      IF(ICOSTYP.GT.2)GO TO 30                                                  00836
      IF(IPFLAG.EQ.0)GO TO 30                                                   00837
                                                                                00838
```

```
      EDCM=EDC/1.0E06                                                   00839
      TDCM=TDC/1.0E06                                                   00840
      MFDCM=MFDC/1.0E06                                                 00841
      MATDCM=MATDC/1.0E06                                               00842
      DSCM=DSC/1.0E06                                                   00843
      FTOCM=FTOC/1.0E06                                                 00844
      IF(IPRNT.NE.0)WRITE(6,10)EDCM,TDCM,MFDCM,MATDCM,DSCM,FTOCM        00845
10    FORMAT(//1X,"RDT&E COSTS (MILLIONS OF DOLLARS)"//                 00846
     * 1X,"ENGINEERING DEVELOPMENT COST=",                              00847
     * F25.3/1X,"DEVELOPMENT TOOLING COST=",F25.3/1X,"DEVELOPMENT "     00848
     * "MANUFACTURING COST=",F25.3/1X,"DEVELOPMENT MATERIALS=",F25.3/   00849
     * 1X,"DEVELOPMENT SUPPORT=",F25.3/1X,"FLIGHT-TEST OPERATIONS=",    00850
     * F25.3)                                                           00851
                                                                        00852
      ARDTOT=ARDTOT/1.0E06                                              00853
      IF(IPRNT.NE.0)WRITE(6,11)ARDTOT                                   00854
11    FORMAT(/1X,"TOTAL AIRFRAME R&D COST =",F15.3," (MILLIONS OF"      00855
     * " DOLLARS)")                                                    00856
                                                                        00857
15    CONTINUE                                                          00858
      ARDCM=ARDCST/1.0E06                                               00859
      IF(IPRNT.NE.0)WRITE(6,20)ARDCM                                    00860
20    FORMAT(///1X,"AIRFRAME R&D COST PER AIRCRAFT = ",F20.3,           00861
     * " (MILLIONS OF DOLLARS)"//)                                      00862
                                                                        00863
30    CONTINUE                                                          00864
      RETURN                                                            00865
      END                                                               00866
```

```
      SUBROUTINE ENCOST(IPRNT)                                          00867
                                                                        00868
      COMMON/MASTER/ICOSTYP,IRAD,DYEAR,IPFLAG                           00869
                                                                        00870
      COMMON/COSTDAT/WTS(25),NEA,SMACH,THRMAX,DPRESMX,RANGE,TOGWMX,     00871
     * FUELBL,TBLOCK,SPEED,NS,TGNDMAN,NCREW,WLDGMX,FUELCP,CARGO,SREF,    00872
     * COST                                                             00873
                                                                        00874
      COMMON/AIRFRM/INOZ,IACOUS,QPROD,AMPR,FAFMSP,FENGSP,AFMCST,ARDCST  00875
                                                                        00876
      COMMON/ENGINE/PRPROC,FPPFT,F,EPR,TEMP,SFC,PLMQT,DEVST,            00877
     * NPROTYP,NFLTTST,ENGCST,ENGRD,ENPROD                              00878
                                                                        00879
      COMMON/DOCCOM/AFMSP,ENGSP,RESID,DEPPER,IDTLNK,IBODY,              00880
     * FUELPR,CET,ICOREV,HYDGPM,NINS,ISPOOL,APUSHP,APUFLW,IWIND,        00881
     * NPOD,AC,NCHAN,IMUX,NGEN,KVA,IRANGE,ICIRC,NAPU,LIFE,DOCDPD,       00882
     * FARE,ROI,N                                                       00883
                                                                        00884
      COMMON/SENSI/FAFRD,FENRD,FMWING,FMTAIL,FMBODY,FMGEAR,FMNAC,       00885
     * FMTRV,FMFUSY,FMENSY,FMFCS,FMHYD,FMEL,FMPNM,FMAC,FMAI,FMAPU,      00886
     * FMFEQ,FMINS,FMAV,FMENG,FMCOMP,FOWING,FOAC,FOINS,FOAV,FOEL,       00887
     * FOFEQ,FOFCS,FOFUSY,FOPNM,FOAI,FOGEAR,FOAPU,FOBODY,FONAC,FOHYD,   00888
     * FOPROP,FOCOMP,FEDEP,FEINS,FECFEE,FELDFE,FEACSR,FEFLTA,           00889
     * FECRW,FEMAIN,FELABR                                              00890
                                                                        00891
                                                                        00892
      INTEGER CYEAR,DYEAR                                               00893
      REAL LIFE, KVA                                                    00894
                                                                        00895
      XM=1.0E06                                                         00896
      CYEAR=1975                                                        00897
      CALL DOLLARS(FACTOR,CYEAR,DYEAR)                                  00898
                                                                        00899
      WENG=WTS(25)/NEA                                                  00900
                                                                        00901
C  FLIGHT TEST STAGE                                                    00902
      TOTENG=NEA*(1. + FPPFT)                                           00903
      QEPT=PRPROC + TOTENG*NPROTYP                                      00904
      QEPTFT=QEPT + TOTENG*NFLTTST                                      00905
                                                                        00906
C     WRITE(6,*)"DPRESMX=",DPRESMX,"SMACH=",SMACH                       00907
C     WRITE(6,*)"THRMAX=",THRMAX,"TEMP=",TEMP                           00908
C     WRITE(6,*)"WENG=",WENG,"SFC=",SFC                                 00909
C     WRITE(6,*)"EPR= ",EPR                                             00910
                                                                        00911
      THRMXL=ALOG(THRMAX)                                               00912
      SMACHL=ALOG(SMACH)                                                00913
      TOTPRS=DPRESMX*EPR                                                00914
C     WRITE(6,*)"TOTPRS= ",TOTPRS                                       00915
                                                                        00916
      TOA=-856.38 + 110.10*ALOG(TEMP) + 11.407*ALOG(TOTPRS)             00917
     * - 26.077*ALOG(WENG) - 16.024*ALOG(SFC) + 18.369*THRMXL           00918
                                                                        00919
      DATE=4.*(PLMQT - 1942.5) + 0.5                                    00920
      DELTOA=TOA - DATE                                                 00921
      DEVCSTI=EXP(0.93374 + 0.3988*THRMXL + 1.2867*SMACHL)              00922
                                                                        00923
      DATE=4.*(PLMQT - DEVST) + 0.5                                     00924
                                                                        00925
      DEVMQT=EXP(-1.3096 + 0.08538*DATE + 0.04099*DELTOA                00926
     * + 0.4963*THRMXL + 0.4137*SMACHL)*FACTOR*FENRD                    00927
                                                                        00928
      PROCSTI=EXP(-8.2068 + 0.7053*THRMXL + 0.00674*TOA                 00929
     * + 0.4571*SMACHL + 0.01804*DELTOA)/(1000.**0.8480                 00930
     * - 999.**.8480)                                                   00931
                                                                        00932
      TDEVPT=DEVCSTI*QEPT**0.086146                                     00933
      TDVPTFT=DEVCSTI*QEPTFT**0.086146                                  00934
      RCDEVFT=(TDVPTFT - TDEVPT)/(1. + FPPFT)*FACTOR*FENRD              00935
```

```
      PRDCPT=PROCSTI*QEPT**0.85                                          00936
                                                                         00937
      PRDPTFT=PROCSTI*QEPTFT**0.85                                       00938
      TPRFYFT=(PRDPTFT - PRDCPT)/(1. + FPPFT)*FACTOR*FENRD               00939
      TEDVFYC=DEVMQT + RCDEVFT + TPRFYFT                                 00940
      CSPRFT=FPPFT*(RCDEVFT + TPRFYFT)                                   00941
                                                                         00942
      CON=1.25                                                           00943
      IF(IBODY.EQ.1)CON=1.55                                             00944
      DEVMQT=DEVMQT*CON                                                  00945
      RCDEVFT=RCDEVFT*CON                                                00946
      TPRFYFT=TPRFYFT*CON                                                00947
      TEDVFYC=TEDVFYC*CON                                                00948
      CSPRFT=CSPRFT*CON                                                  00949
                                                                         00950
      IF(ICOSTYP.GT.2)GO TO 15                                           00951
      IF(IPRNT.EQ.0)GO TO 15                                             00952
      IF(IPFLAG.EQ.0)GO TO 15                                            00953
                                                                         00954
      IF(IRAD.EQ.0)GO TO 12                                              00955
                                                                         00956
      WRITE(6,9)                                                         00957
9     FORMAT(1H //T7,"DEVELOPMENT COSTS"////T61,"COSTS"/                 00958
     * T57,"(MILLIONS OF DOLLARS)")                                      00959
                                                                         00960
      WRITE(6,10)DEVMQT,RCDEVFT,TPRFYFT,TEDVFYC                          00961
10    FORMAT(1H ///"  ENGINES"//"  MQT DEVELOPMENT",T58,F9.3/            00962
     *  "  RECURRING DEVELOPMENT",T58,F9.3/"  PRODUCTION",               00963
     * T58,F9.3//"     TOTAL ENGINES",T58,F9.3)                          00964
                                                                         00965
      WRITE(6,11)CSPRFT                                                  00966
11    FORMAT(1H ///"(COST OF SPARE ENGINES FOR FLIGHT-TEST AIRCRAFT",    00967
     * T58,F9.3,")")                                                     00968
                                                                         00969
C  PRODUCTION COSTS                                                      00970
                                                                         00971
12    CONTINUE                                                           00972
      WRITE(6,13)                                                        00973
13    FORMAT(1H ////T34,"ENGINE PRODUCTION COSTS"/T2,"AIRFRAME"          00974
     * T13,"ENGINE"/T2,2("QUANTITY",3X)/T24,"<--CUMULATIVE ",           00975
     * "AVERAGE-->",T55,"<----------UNIT--------->"/T16,                 00976
     * 2(8X,"PROD",3X,"RECUR DEV",3X,"TOTAL")/)                         00977
                                                                         00978
15    CONTINUE                                                           00979
      QEPRSP=NEA*QPROD*(1. + F) + 0.5                                    00980
      TOTENG=QEPTFT + QEPRSP                                             00981
      TPPFPSP=PROCSTI*TOTENG**0.85                                       00982
      TDPFPSP=DEVCSTI*TOTENG**0.086146                                   00983
      TPFWP=(TPPFPSP - PRDPTFT)/(1. + F)                                 00984
      TRDFWP=(TDPFPSP - TDVPTFT)/(1. + F)                                00985
      CAPFWP=TPFWP/QPROD*FACTOR                                          00986
      CARDFWP=TRDFWP/QPROD*FACTOR                                        00987
      SCARPFW=CAPFWP + CARDFWP                                           00988
                                                                         00989
C  ENGINE SPARES FOR PRODUCTION AIRCRAFT (USE SPARES FACTOR INSTEAD)     00990
                                                                         00991
C     TFWP=TPFWP + TRDFWP                                                00992
C     CSPP=F*TFWP                                                        00993
                                                                         00994
      Q=TOTENG - NEA*(1. + F)                                            00995
      UPFW=(TPPFPSP - PROCSTI*Q**0.85)/(1. + F)*FACTOR*FMENG             00996
      URDC=(TDPFPSP - DEVCSTI*Q**0.086146)/(1. + F)*FACTOR*FMENG         00997
      SUPRDC=UPFW + URDC                                                 00998
                                                                         00999
      CAPFWP=CAPFWP*CON                                                  01000
      CARDFWP=CARDFWP*CON                                                01001
      SCARPFW=SCARPFW*CON                                                01002
      UPFW=UPFW*CON                                                      01003
      URDC=URDC*CON                                                      01004
      SUPRDC=SUPRDC*CON                                                  01005
```

```
      ENPROD=SUPRDC*XM/NEA                                                  01006
      ENGRD=TEDVFYC/QEPRSP*XM                                               01007
                                                                            01008
C  WRITE OUT RESULTS                                                        01009
                                                                            01010
      IF(ICOSTYP.GT.2)GO TO 20                                              01011
      IF(IPRNT.EQ.0)GO TO 20                                                01012
      IF(IPFLAG.EQ.0)GO TO 20                                               01013
                                                                            01014
      WRITE(6,16)QPROD,QEPRSP,CAPFWP,CARDFWP,SCARPFW,                       01015
     * UPFW,URDC,SUPRDC                                                    01016
16    FORMAT(1H ,T2,F5.0,T13,F5.0,T20,3(1X,F9.3),T51,3(1X,F9.3))            01017
                                                                            01018
17    CONTINUE                                                              01019
      ENGCM=(ENPROD + ENGRD)/XM                                             01020
      WRITE(6,18)ENGCM                                                      01021
18    FORMAT(1X,"COST FOR ONE ENGINE IS ",F25.2,                            01022
     *  " (MILLIONS OF DOLLARS)"//)                                         01023
                                                                            01024
20    CONTINUE                                                              01025
                                                                            01026
      RETURN                                                                01027
      END                                                                   01028
                                                                            01029
```

```
      SUBROUTINE AADOC(IPRNT)                                           01030
                                                                        01031
C  PROGRAM TO CALCULATE DIRECT OPERATING COSTS BASED ON                 01032
C  AMERICAN AIRLINES MODEL                                              01033
                                                                        01034
      COMMON/MASTER/ICOSTYP,IRAD,DYEAR,IPFLAG                           01035
                                                                        01036
      COMMON/COSTDAT/WTS(25),NENG,SMACH,THRMAX,QMAX,RANGE,TOGWMX,       01037
     * FUELBL,FL,SPEED,NSEATS,TGNDMAN,NCREW,WLDGMX,FUELCP,CARGO,SREF,   01038
     * COST                                                             01039
                                                                        01040
      COMMON/DOCCOM/AFMSP,ENGSP,RESID,DEPPER,IDTLNK,IBODY,FUELPR,CET,   01041
     * ICOREV,HYDGPM,NINS,ISPOOL,APUSHP,APUFLW,IWIND,NPOD,AC,NCHAN,     01042
     * IMUX,NGEN,KVA,IRANGE,ICIRC,NAPU,LIFE,DOCDPT,FARE,ROI,N           01043
                                                                        01044
      COMMON/AIRFRM/INOZ,IACOUS,Q,AMPR,FAFMSP,FENGSP,AFMCST,ARDCST      01045
                                                                        01046
      COMMON/ENGINE/PRPROC,FPPFT,F,EPR,TEMP,SFC,PLMQT,DEVST,            01047
     * NPROTYP,NFLTTST,ENGCST,ENGRD,ENPROD                              01048
                                                                        01049
      COMMON/SENSI/FAFRD,FENRD,FMWING,FMTAIL,FMBODY,FMGEAR,FMNAC,       01050
     * FMTRV,FMFUSY,FMENSY,FMFCS,FMHYD,FMEL,FMPNM,FMAC,FMAI,FMAPU,      01051
     * FMFEQ,FMINS,FMAV,FMENG,FMCOMP,FOWING,FOAC,FOINS,FOAV,FOEL,       01052
     * FOFEQ,FOFCS,FOFUSY,FOPNM,FOAI,FOGEAR,FOAPU,FOBODY,FONAC,FOHYD,   01053
     * FOPROP,FOCOMP,FEDEP,FEINS,FECFEE,FELDFE,FEACSR,FEFLTA,           01054
     * FECRW,FEMAIN,FELABR                                              01055
                                                                        01056
      REAL KVA, N, LDWT, LFEE, LIFE                                     01057
      INTEGER CYEAR,DYEAR                                               01058
                                                                        01059
      CYEAR=1976                                                        01060
      CALL DOLLARS(FACTOR,CYEAR,DYEAR)                                  01061
                                                                        01062
C  INITIALIZE FLIGHT CYCLE/FLIGHT HOURS RATIOS                          01063
                                                                        01064
      FH99=1.0                                                          01065
      FH21=0.58                                                         01066
      FH22=0.59                                                         01067
      FH23=0.66                                                         01068
      FH24=0.74                                                         01069
      FH25=0.38                                                         01070
      FH26=0.25                                                         01071
      FH27=0.70                                                         01072
      FH28=0.94                                                         01073
      FH29=0.70                                                         01074
      FH30=0.50                                                         01075
      FH31=0.65                                                         01076
      FH32=0.18                                                         01077
      FH33=0.78                                                         01078
      FH34=0.67                                                         01079
      FH35=0.55                                                         01080
      FH36=0.26                                                         01081
      FH38=0.33                                                         01082
      FH50=1.0                                                          01083
      FH52=0.51                                                         01084
      FH53=0.50                                                         01085
      FH54=0.80                                                         01086
      FH55=0.49                                                         01087
      FH56=0.80                                                         01088
      FH57=0.49                                                         01089
                                                                        01090
C  UNIT CONVERSIONS (TO METRIC UNITS)                                   01091
                                                                        01092
      TOGW=TOGWMX/2.205                                                 01093
      LDWT=WLDGMX/2.205                                                 01094
      CETC=(CET + 40.)*5./9. - 223.15                                   01095
      WENG=WTS(25)/2.205/NENG                                           01096
      AMPRC=AMPR/2.205                                                  01097
      ACC=AC/2.205                                                      01098
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      FULCPC=FUELCP/2.205                                                   01099
      HYGPMC=HYDGPM*3.785                                                   01100
      THENG=THRMAX/2.205                                                    01101
      APUSPC=APUSHP*745.7                                                   01102
      APUFLC=APUFLW/2.205                                                   01103
      SREFC=SREF*0.3048**2                                                  01104
                                                                            01105
C  MAINTENANCE COSTS                                                        01106
                                                                            01107
C     AIRFRAME - INSPECTION & MISC.                                         01108
                                                                            01109
      FOAF=(FOWING + FOBODY + FONAC + FOGEAR)/4.0                           01110
      ATA99L=(7.66 + 0.377*AMPRC/1000.)*FACTOR*FOAF*FOCOMP                  01111
      ATA99M=(1.21 + 0.062*AMPRC/1000.)*FACTOR*FOAF*FOCOMP                  01112
      ATA99L=ATA99L*(FL*FH99 + (1.0-FH99))/(2.5*FH99 + (1.0-FH99))          01113
      ATA99M=ATA99M*(FL*FH99 + (1.0-FH99))/(2.5*FH99 + (1.0-FH99))          01114
                                                                            01115
C     AIRCONDITIONING                                                       01116
                                                                            01117
      ATA21L=(2.0386 + 0.01532*ACC)*FACTOR*FOAC                             01118
      ATA21M=(2.32 + 0.011*ACC)*FACTOR*FOAC                                 01119
      ATA21L=ATA21L*(FL*FH21 + (1.0-FH21))/(2.5*FH21 + (1.0-FH21))          01120
      ATA21M=ATA21M*(FL*FH21 + (1.0-FH21))/(2.5*FH21 + (1.0-FH21))          01121
                                                                            01122
C     AUTOPILOT                                                             01123
                                                                            01124
      ATA22L=2.238*NCHAN*FACTOR*FOINS                                       01125
      ATA22M=(0.631 + 0.398*NCHAN)*FACTOR*FOINS                             01126
      ATA22L=ATA22L*(FL*FH22 + (1.0-FH22))/(2.5*FH22 + (1.0-FH22))          01127
      ATA22M=ATA22M*(FL*FH22 + (1.0-FH22))/(2.5*FH22 + (1.0-FH22))          01128
                                                                            01129
C     COMMUNICATIONS                                                        01130
                                                                            01131
      IF(IMUX.EQ.0)ATA23L=0.01772*NSEATS*FACTOR*FOINS                       01132
      IF(IMUX.EQ.1)ATA23L=0.0276*NSEATS*FACTOR*FOINS                        01133
      IF(IMUX.EQ.0)ATA23M=0.00693*NSEATS*FACTOR*FOINS                       01134
      IF(IMUX.EQ.1)ATA23M=0.0118*NSEATS*FACTOR*FOINS                        01135
      ATA23L=ATA23L*(FL*FH23 + (1.0-FH23))/(2.5*FH23 + (1.0-FH23))          01136
      ATA23M=ATA23M*(FL*FH23 + (1.0-FH23))/(2.5*FH23 + (1.0-FH23))          01137
                                                                            01138
C     ELECTRICAL POWER                                                      01139
                                                                            01140
      ATA24L=(1.336 + 0.00396*NGEN*KVA)*FACTOR*FOEL                         01141
      ATA24M=(1.42 + 0.00577*NGEN*KVA)*FACTOR*FOEL                          01142
      ATA24L=ATA24L*(FL*FH24 + (1.0-FH24))/(2.5*FH24 + (1.0-FH24))          01143
      ATA24M=ATA24M*(FL*FH24 + (1.0-FH24))/(2.5*FH24 + (1.0-FH24))          01144
                                                                            01145
C     EQUIPMENT AND FURNISHINGS                                             01146
                                                                            01147
      IF(IRANGE.EQ.0)CF=0.6                                                 01148
      IF(IRANGE.EQ.1)CF=1.0                                                 01149
      IF(IRANGE.EQ.2)CF=1.6                                                 01150
      ATA25L=(9.11 + 0.0531*NSEATS*CF)*FACTOR*FOFEQ                         01151
      ATA25M=(2.38 + 0.0361*NSEATS*CF)*FACTOR*FOFEQ                         01152
      ATA25L=ATA25L*(FL*FH25 + (1.0-FH25))/(2.5*FH25 + (1.0-FH25))          01153
      ATA25M=ATA25M*(FL*FH25 + (1.0-FH25))/(2.5*FH25 + (1.0-FH25))          01154
                                                                            01155
C     FIRE PROTECTION                                                       01156
                                                                            01157
      IF(ICIRC.EQ.0)ATA26L=0.0726*(NENG + NAPU)                             01158
      IF(ICIRC.EQ.1)ATA26L=0.213 + 0.359*(NENG + NAPU)                      01159
      IF(ICIRC.EQ.0)ATA26M=0.082 + 0.0552*(NENG + NAPU)                     01160
      IF(ICIRC.EQ.1)ATA26M=0.365*(NENG + NAPU)                              01161
      ATA26L=ATA26L*FACTOR*FOAPU*FOPROP                                     01162
      ATA26M=ATA26M*FACTOR*FOAPU*FOPROP                                     01163
      ATA26L=ATA26L*(FL*FH26 + (1.0-FH26))/(2.5*FH26 + (1.0-FH26))          01164
      ATA26M=ATA26M*(FL*FH26 + (1.0-FH26))/(2.5*FH26 + (1.0-FH26))          01165
                                                                            01166
C  FLIGHT CONTROLS                                                          01167
                                                                            01168
```

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      ATA27L=(6.84 + 0.0035*TOGW/1000.)*FACTOR*FOFCS                    01169
      ATA27M=(3.876 + 0.00655*TOGW/1000.)*FACTOR*FOFCS                  01170
      ATA27L=ATA27L*(FL*FH27 + (1.0-FH27))/(2.5*FH27 + (1.0-FH27))      01171
      ATA27M=ATA27M*(FL*FH27 + (1.0-FH27))/(2.5*FH27 + (1.0-FH27))      01172
                                                                        01173
C     FUEL                                                            01174
                                                                        01175
      ATA28L=(1.114 + 0.0262*FULCPC/1000.)*FACTOR*FOFUSY                01176
      ATA28M=(0.595 + 0.0123*FULCPC/1000.)*FACTOR*FOFUSY                01177
      ATA28L=ATA28L*(FL*FH28 + (1.0-FH28))/(2.5*FH28 + (1.0-FH28))      01178
      ATA28M=ATA28M*(FL*FH28 + (1.0-FH28))/(2.5*FH28 + (1.0-FH28))      01179
                                                                        01180
C     HYDRAULIC POWER                                                 01181
                                                                        01182
      ATA29L=(2.31 + 0.0034*HYGPMC)*FACTOR*FOHYD                        01183
      ATA29M=(1.55 + 0.0080*HYGPMC)*FACTOR*FOHYD                        01184
      ATA29L=ATA29L*(FL*FH29 + (1.0-FH29))/(2.5*FH29 + (1.0-FH29))      01185
      ATA29M=ATA29M*(FL*FH29 + (1.0-FH29))/(2.5*FH29 + (1.0-FH29))      01186
                                                                        01187
C     ICE AND RAIN PROTECTION                                         01188
                                                                        01189
      ATA30L=(0.5089 + 0.0013*TOGW/1000.)*FACTOR*FOAI                   01190
      ATA30M=(0.0847 + 0.0037*TOGW/1000.)*FACTOR*FOAI                   01191
      ATA30L=ATA30L*(FL*FH30 + (1.0-FH30))/(2.5*FH30 + (1.0-FH30))      01192
      ATA30M=ATA30M*(FL*FH30 + (1.0-FH30))/(2.5*FH30 + (1.0-FH30))      01193
                                                                        01194
C     INSTRUMENTS                                                     01195
                                                                        01196
      ATA31L=(0.509 + 0.009*AMPRC/1000.)*FACTOR*FOINS                   01197
      ATA31M=(0.235 + 0.0031*AMPRC/1000.)*FACTOR*FOINS                  01198
      ATA31L=ATA31L*(FL*FH31 + (1.0-FH31))/(2.5*FH31 + (1.0-FH31))      01199
      ATA31M=ATA31M*(FL*FH31 + (1.0-FH31))/(2.5*FH31 + (1.0-FH31))      01200
                                                                        01201
C     LANDING GEAR                                                    01202
                                                                        01203
      ATA32L=(4.58 + 0.0710*TOGW/1000.)*FACTOR*FOGEAR                   01204
      ATA32M=(4.961 + 0.1810*TOGW/1000.)*FACTOR*FOGEAR                  01205
      ATA32L=ATA32L*(FL*FH32 + (1.0-FH32))/(2.5*FH32 + (1.0-FH32))      01206
      ATA32M=ATA32M*(FL*FH32 + (1.0-FH32))/(2.5*FH32 + (1.0-FH32))      01207
                                                                        01208
C     LIGHTING                                                        01209
                                                                        01210
      ATA33L=(1.51 + 0.0072*NSEATS*CF)*FACTOR*FOFEQ                     01211
      ATA33M=(0.047 + 0.0087*NSEATS*CF)*FACTOR*FOFEQ                    01212
      ATA33L=ATA33L*(FL*FH33 + (1.0-FH33))/(2.5*FH33 + (1.0-FH33))      01213
      ATA33M=ATA33M*(FL*FH33 + (1.0-FH33))/(2.5*FH33 + (1.0-FH33))      01214
                                                                        01215
C     NAVIGATION                                                      01216
                                                                        01217
      ATA34L=(2.94 + 2.1*NINS + 3.58*CF)*FACTOR*FOINS                   01218
      ATA34M=(0.086 + 1.2*NINS + 3.675*CF)*FACTOR*FOINS                 01219
      ATA34L=ATA34L*(FL*FH34 + (1.0-FH34))/(2.5*FH34 + (1.0-FH34))      01220
      ATA34M=ATA34M*(FL*FH34 + (1.0-FH34))/(2.5*FH34 + (1.0-FH34))      01221
                                                                        01222
C     OXYGEN                                                          01223
                                                                        01224
      ATA35L=(0.515 + 0.00265*NSEATS)*FACTOR*FOFEQ                      01225
      ATA35M=0.00458*NSEATS*FACTOR*FOFEQ                                01226
      ATA35L=ATA35L*(FL*FH35 + (1.0-FH35))/(2.5*FH35 + (1.0-FH35))      01227
      ATA35M=ATA35M*(FL*FH35 + (1.0-FH35))/(2.5*FH35 + (1.0-FH35))      01228
                                                                        01229
C     PNEUMATICS                                                      01230
                                                                        01231
      ATA36L=(0.181 + 0.0003*ACC*NENG*THENG/10000.)*FACTOR*FOPNM        01232
      ATA36M=0.0019*ACC*NENG*THENG/10000.*FACTOR*FOPNM                  01233
      ATA36L=ATA36L*(FL*FH36 + (1.0-FH36))/(2.5*FH36 + (1.0-FH36))      01234
      ATA36M=ATA36M*(FL*FH36 + (1.0-FH36))/(2.5*FH36 + (1.0-FH36))      01235
                                                                        01236
C     WATER/WASTE                                                     01237
                                                                        01238
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      ATA38L=(0.338 + 0.0023*NSEATS*CF)*FACTOR*FOFEQ                    01239
      ATA38M=0.00485*NSEATS*CF*FACTOR*FOFEQ                             01240
      ATA38L=ATA38L*(FL*FH38 + (1.0-FH38))/(2.5*FH38 + (1.0-FH38))      01241
      ATA38M=ATA38M*(FL*FH38 + (1.0-FH38))/(2.5*FH38 + (1.0-FH38))      01242
                                                                        01243
C     AIRBORNE AUXILIARY POWER                                          01244
                                                                        01245
      DPAPUH=0.7185 + 0.0003*SQRT(APUSPC*APUFLC)                        01246
      IF(ISPOOL.EQ.1)DPAPUH=DPAPUH*1.8                                  01247
      ATA49L=DPAPUH*1.24*EXP(-0.17*FL)*FL*FACTOR*FOAPU                  01248
                                                                        01249
      DPAPUH=1.466 + 0.0007*SQRT(APUSPC*APUFLC)                         01250
      ATA49M=DPAPUH*1.24*EXP(-.17*FL)*FL*FACTOR*FOAPU                   01251
                                                                        01252
C     STRUCTURES - GENERAL                                              01253
                                                                        01254
      ATA50L=(3.0 + 0.0099*AMPRC/1000.)*FACTOR*FOAF*FOCOMP              01255
      ATA50M=0.0                                                        01256
      ATA50L=ATA50L*(FL*FH50 + (1.0-FH50))/(2.5*FH50 + (1.0-FH50))      01257
      ATA50M=ATA50M*(FL*FH50 + (1.0-FH50))/(2.5*FH50 + (1.0-FH50))      01258
                                                                        01259
C     DOORS                                                             01260
                                                                        01261
      ATA52L=(1.147 + 0.006*NSEATS)*FACTOR*FOBODY                       01262
      ATA52M=(0.387 + 0.00785*NSEATS)*FACTOR*FOBODY                     01263
      ATA52L=ATA52L*(FL*FH52 + (1.0-FH52))/(2.5*FH52 + (1.0-FH52))      01264
      ATA52M=ATA52M*(FL*FH52 + (1.0-FH52))/(2.5*FH52 + (1.0-FH52))      01265
                                                                        01266
C     FUSELAGE                                                          01267
      ATA53L=(1.5 + 0.046*AMPRC/1000.)*FACTOR*FOBODY                    01268
      ATA53M=0.5833*FACTOR*FOBODY                                       01269
      ATA53L=ATA53L*(FL*FH53 + (1.0-FH53))/(2.5*FH53 + (1.0-FH53))      01270
      ATA53M=ATA53M*(FL*FH53 + (1.0-FH53))/(2.5*FH53 + (1.0-FH53))      01271
                                                                        01272
C     NACELLES/PYLONS                                                   01273
                                                                        01274
      ATA54L=0.3366*NPOD*FACTOR*FONAC                                   01275
      ATA54M=0.1391*NPOD*FACTOR*FONAC                                   01276
      ATA54L=ATA54L*(FL*FH54 + (1.0-FH54))/(2.5*FH54 + (1.0-FH54))      01277
      ATA54M=ATA54M*(FL*FH54 + (1.0-FH54))/(2.5*FH54 + (1.0-FH54))      01278
                                                                        01279
C     STABILIZERS                                                       01280
                                                                        01281
      ATA55L=0.834*FACTOR*FOFCS                                         01282
      ATA55M=0.3737*FACTOR*FOFCS                                        01283
      ATA55L=ATA55L*(FL*FH55 + (1.0-FH55))/(2.5*FH55 + (1.0-FH55))      01284
      ATA55M=ATA55M*(FL*FH55 + (1.0-FH55))/(2.5*FH55 + (1.0-FH55))      01285
                                                                        01286
C     WINDOWS                                                           01287
                                                                        01288
      ATA56L=(0.763 + 0.00043*NSEATS)*FACTOR*FOBODY                     01289
      IF(IWIND.EQ.0)ATA56M=0.0284*NSEATS*FACTOR*FOBODY                  01290
      IF(IWIND.EQ.1)ATA56M=0.0362*NSEATS*FACTOR*FOBODY                  01291
      ATA56L=ATA56L*(FL*FH56 + (1.0-FH56))/(2.5*FH56 + (1.0-FH56))      01292
      ATA56M=ATA56M*(FL*FH56 + (1.0-FH56))/(2.5*FH56 + (1.0-FH56))      01293
                                                                        01294
C     WINGS                                                             01295
                                                                        01296
      ATA57L=2.9475*FACTOR*FOWING*FOCOMP                                01297
      ATA57M=(0.126 + 0.00506*SREFC)*FACTOR*FOWING*FOCOMP               01298
      ATA57L=ATA57L*(FL*FH57 + (1.0-FH57))/(2.5*FH57 + (1.0-FH57))      01299
      ATA57M=ATA57M*(FL*FH57 + (1.0-FH57))/(2.5*FH57 + (1.0-FH57))      01300
                                                                        01301
                                                                        01302
C  TOTAL AIRFRAME MAINTENANCE MATERIAL AND LABOR                        01303
                                                                        01304
C     AIRFRAME MATERIAL, $/TRIP                                         01305
                                                                        01306
      AFMDPT=ATA99M + ATA21M + ATA22M + ATA23M + ATA24M + ATA25M +      01307
                                                                        01308
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     * ATA26M + ATA27M + ATA28M + ATA29M + ATA30M + ATA31M +                01309
     * ATA32M + ATA33M + ATA34M + ATA35M + ATA36M + ATA38M +                01310
     * ATA49M + ATA50M + ATA52M + ATA53M + ATA54M + ATA55M +                01311
     * ATA56M + ATA57M                                                      01312
                                                                            01313
C    AIRFRAME LABOR, $/TRIP                                                01314
                                                                            01315
      AFLDPT=ATA99L + ATA21L + ATA22L + ATA23L + ATA24L + ATA25L +          01316
     * ATA26L + ATA27L + ATA28L + ATA29L + ATA30L + ATA31L +                01317
     * ATA32L + ATA33L + ATA34L + ATA35L + ATA36L + ATA38L +                01318
     * ATA49L + ATA50L + ATA52L + ATA53L + ATA54L + ATA55L +                01319
     * ATA56L + ATA57L                                                      01320
                                                                            01321
C  PROPULSION SYSTEM MAINTENANCE COST, LABOR AND MATERIAL, PER ENGINE       01322
      MTBR=3604.*FL**0.28/EXP(0.000324*CETC)                                01323
                                                                            01324
C    LABOR MANHOURS PER TRIP                                               01325
                                                                            01326
      PLMHPT=0.0440 + 0.143*FL + (FL*(1936. + 0.705*WENG)/MTBR*FL)          01327
     * *FEMAIN                                                             01328
      IF(ICOREV.EQ.0)PLMHPT=PLMHPT - (0.0188 + 0.0612*FL)                   01329
                                                                            01330
C    LABOR, $/TRIP                                                         01331
                                                                            01332
      PLDPT=PLMHPT*9.50*FACTOR*FOPROP                                       01333
                                                                            01334
C    MATERIALS, $/TRIP                                                     01335
      PMDPT=0.326 + 0.829*FL + 0.0906*ENGCST/MTBR*FL                        01336
      IF(ICOREV.EQ.0)PMDPT=PMDPT - (0.131 + 0.331*FL)                       01337
      PMDPT=PMDPT*FACTOR*FOPROP                                             01338
                                                                            01339
C  TOTAL MATERIAL, $/TRIP                                                  01340
                                                                            01341
      TMDPT=AFMDPT + PMDPT*NENG                                             01342
                                                                            01343
C  TOTAL LABOR, $/TRIP                                                     01344
                                                                            01345
      TLDPT=AFLDPT + PLDPT*NENG                                             01346
                                                                            01347
C  REMAINDER OF DIRECT OPERATING COST ELEMENTS                             01348
                                                                            01349
C  N=NUMBER OF TRIPS PER YEAR=UTILIZATION                                  01350
                                                                            01351
      N=3205./FL                                                            01352
                                                                            01353
C    DEPRECIATION                                                          01354
                                                                            01355
      DEP=((AFMCST + AFMSP + ENGCST*NENG + ENGSP*NENG) - RESID*             01356
     * (AFMCST + AFMSP + ENGCST*NENG + ENGSP*NENG))/(DEPPER*N)*             01357
     * FEDEP                                                                01358
                                                                            01359
C    INSURANCE                                                             01360
                                                                            01361
      INS=0.01*(AFMCST + ENGCST*NENG)/NSEATS*FEINS                          01362
                                                                            01363
C    CONTROL FEE                                                           01364
                                                                            01365
      IF(IDTLNK.EQ.0)CFEE=7.00*FACTOR*FECFEE                                01366
      IF(IDTLNK.EQ.1)CFEE=4.00*FACTOR*FECFEE                                01367
                                                                            01368
C    LANDING FEE                                                           01369
                                                                            01370
      LFEE=1.54*LDWT/1000.*FACTOR*FELDFE                                    01371
                                                                            01372
C    AIRCRAFT SERVICING                                                    01373
                                                                            01374
      IF(IBODY.EQ.0)ACSER=(0.02*NSEATS*9.50 + 0.002*NSEATS)*FACTOR          01375
      IF(IBODY.EQ.1)ACSER=(0.033*NSEATS*9.50 + 0.003*NSEATS)*FACTOR         01376
      ACSER=ACSER*FEACSR                                                    01377
                                                                            01378
```

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C     FLIGHT ATTENDANT COST                                                    01379
                                                                               01380
      FLATD=(0.691*FL + 0.00175*FL**2)*NSEATS*FACTOR*FEFLTA                    01381
                                                                               01382
C     FLIGHT CREW COST                                                         01383
                                                                               01384
      FLCR=174.*FL + 43.5 + (0.452*FL + 0.1129)*TOGW/1000.                     01385
      IF(NCREW.EQ.2)FLCR=FLCR*0.75                                             01386
      FLCR=FLCR*FACTOR*FECRW                                                   01387
                                                                               01388
C     FUEL COST                                                                01389
                                                                               01390
      FUEL=FUELBL*FUELPR/6.74                                                  01391
                                                                               01392
C   TOTAL DIRECT OPERATING COST, $/TRIP                                        01393
                                                                               01394
      DOCDPT=DEP + INS + CFEE + LFEE + ACSER + FLATD + FLCR +                  01395
     * FUEL + TMDPT + TLDPT                                                    01396
                                                                               01397
C   DIRECT OPERATING COST, DOLLARS/BLOCK HOUR                                  01398
                                                                               01399
      DOCDBH=DOCDPT/FL                                                         01400
                                                                               01401
C   DIRECT OPERATING COST, DOLLARS/AVAIL. SEAT/TRIP                            01402
                                                                               01403
      DOCDPS=DOCDPT/NSEATS                                                     01404
                                                                               01405
C   DIRECT OPERATING COST, CENTS/AVAIL. SEAT MILE                              01406
                                                                               01407
      DOCCSM=DOCDPS/RANGE*100.                                                 01408
                                                                               01409
C   TOTAL LIFETIME DIRECT OPERATING COST , DOLLARS                             01410
                                                                               01411
      DOC=DOCDPT*N*LIFE                                                        01412
                                                                               01413
C    WRITE STATEMENTS                                                          01414
                                                                               01415
      IF(IPRNT.EQ.0)GO TO 50                                                   01416
      IF(ICOSTYP.EQ.2.OR.ICOSTYP.EQ.4)GO TO 50                                 01417
      IF(IPFLAG.EQ.0)GO TO 50                                                  01418
                                                                               01419
      WRITE(6,1)                                                               01420
1     FORMAT(/////15X,"DIRECT OPERATING COST ($/DEPARTURE)" //                 01421
     * 7X,"CATEGORY ", 25X,"MATERIAL",4X,"LABOR")                             01422
      WRITE(6,2)ATA99M,ATA99L                                                  01423
2     FORMAT(2X,"AIRFRAME - INSPECT. & MISC.",T41,2(F7.2,4X))                  01424
      WRITE(6,3)ATA21M,ATA21L                                                  01425
3     FORMAT(2X,"AIRCONDITIONING",T41,2(F7.2,4X))                              01426
      WRITE(6,4)ATA22M,ATA22L                                                  01427
4     FORMAT(2X,"AUTOPILOT",T41,2(F7.2,4X))                                    01428
      WRITE(6,5)ATA23M,ATA23L                                                  01429
5     FORMAT(2X,"COMMUNICATIONS",T41,2(F7.2,4X))                               01430
      WRITE(6,6)ATA24M,ATA24L                                                  01431
6     FORMAT(2X,"ELECTRICAL POWER",T41,2(F7.2,4X))                             01432
      WRITE(6,7)ATA25M,ATA25L                                                  01433
7     FORMAT(2X,"EQUIPMENT & FURNISHINGS",T41,2(F7.2,4X))                      01434
      WRITE(6,8)ATA26M,ATA26L                                                  01435
8     FORMAT(2X,"FIRE PROTECTION",T41,2(F7.2,4X))                              01436
      WRITE(6,9)ATA27M,ATA27L                                                  01437
9     FORMAT(2X,"FLIGHT CONTROLS",T41,2(F7.2,4X))                              01438
      WRITE(6,10)ATA28M,ATA28L                                                 01439
10    FORMAT(2X,"FUEL",T41,2(F7.2,4X))                                         01440
      WRITE(6,11)ATA29M,ATA29L                                                 01441
11    FORMAT(2X,"HYDRAULIC POWER",T41,2(F7.2,4X))                              01442
      WRITE(6,12)ATA30M,ATA30L                                                 01443
12    FORMAT(2X,"ICE & RAIN PROTECTION",T41,2(F7.2,4X))                        01444
      WRITE(6,13)ATA31M,ATA31L                                                 01445
13    FORMAT(2X,"INSTRUMENTS",T41,2(F7.2,4X))                                  01446
      WRITE(6,14)ATA32M,ATA32L                                                 01447
14    FORMAT(2X,"LANDING GEAR",T41,2(F7.2,4X))                                 01448
```

```
      WRITE(6,15)ATA33M,ATA33L                                          01449
15    FORMAT(2X,"LIGHTING",T41,2(F7.2,4X))                              01450
      WRITE(6,16)ATA34M,ATA34L                                          01451
16    FORMAT(2X,"NAVIGATION",T41,2(F7.2,4X))                            01452
      WRITE(6,17)ATA35M,ATA35L                                          01453
17    FORMAT(2X,"OXYGEN",T41,2(F7.2,4X))                                01454
      WRITE(6,18)ATA36M,ATA36L                                          01455
18    FORMAT(2X,"PNEUMATICS",T41,2(F7.2,4X))                            01456
      WRITE(6,19)ATA38M,ATA38L                                          01457
19    FORMAT(2X,"WATER/WASTE",T41,2(F7.2,4X))                           01458
      WRITE(6,20)ATA49M,ATA49L                                          01459
20    FORMAT(2X,"AIRBORNE AUXILIARY POWER",T41,2(F7.2,4X))              01460
      WRITE(6,21)ATA50M,ATA50L                                          01461
21    FORMAT(2X,"STRUCTURES",T41,2(F7.2,4X))                            01462
      WRITE(6,22)ATA52M,ATA52L                                          01463
22    FORMAT(2X,"DOORS",T41,2(F7.2,4X))                                 01464
      WRITE(6,23)ATA53M,ATA53L                                          01465
23    FORMAT(2X,"FUSELAGE",T41,2(F7.2,4X))                              01466
      WRITE(6,24)ATA54M,ATA54L                                          01467
24    FORMAT(2X,"NACELLES",T41,2(F7.2,4X))                              01468
      WRITE(6,25)ATA55M,ATA55L                                          01469
25    FORMAT(2X,"STABILIZERS",T41,2(F7.2,4X))                           01470
      WRITE(6,26)ATA56M,ATA56L                                          01471
26    FORMAT(2X,"WINDOWS",T41,2(F7.2,4X))                               01472
      WRITE(6,27)ATA57M,ATA57L                                          01473
27    FORMAT(2X,"WINGS",T41,2(F7.2,4X))                                 01474
                                                                        01475
      WRITE(6,28)AFMDPT,AFLDPT                                          01476
28    FORMAT(/2X,"TOTAL AIRFRAME",T38,2(F10.2,1X))                      01477
                                                                        01478
      WRITE(6,29)PMDPT,PLDPT                                            01479
29    FORMAT(2X,"TOTAL PROPULSION SYSTEM", T38,2(F10.2,1X))             01480
                                                                        01481
      WRITE(6,30)TMDPT,TLDPT                                            01482
30    FORMAT(2X,"TOTAL MAINTENANCE",T38,2(F10.2,1X))                    01483
                                                                        01484
      WRITE(6,31)DEP                                                    01485
31    FORMAT(///1X,"REMAINDER OF DOC ELEMENTS",/3X,"DEPRECIATION =",    01486
     * F15.2)                                                           01487
                                                                        01488
      WRITE(6,32)INS                                                    01489
32    FORMAT(3X,"INSURANCE =",F15.2)                                    01490
                                                                        01491
      WRITE(6,33)CFEE                                                   01492
33    FORMAT(3X,"CONTROL FEE =",F15.2)                                  01493
                                                                        01494
      WRITE(6,34)LFEE                                                   01495
34    FORMAT(3X,"LANDING FEE =",F15.2)                                  01496
                                                                        01497
      WRITE(6,35)ACSER                                                  01498
35    FORMAT(3X,"AIRCRAFT SERVICING =",F15.2)                           01499
                                                                        01500
      WRITE(6,36)FLATD                                                  01501
36    FORMAT(3X,"FLIGHT ATTENDANT COST =",F15.2)                        01502
                                                                        01503
      WRITE(6,37)FLCR,NCREW                                             01504
37    FORMAT(3X,"FLIGHT CREW COST =",F15.2," FOR A CREW OF ",I2)        01505
                                                                        01506
      WRITE(6,38)FUEL,FUELPR                                            01507
38    FORMAT(3X,"FUEL COST =",F10.2," FOR A FUEL PRICE OF ",F5.2,       01508
     * " DOLLARS/GALLON")                                              01509
                                                                        01510
      WRITE(6,39)DOCDBH                                                 01511
39    FORMAT(//1X,"DOC, $/BLOCK HOUR =",F10.2)                          01512
                                                                        01513
      WRITE(6,40)DOCDPS                                                 01514
40    FORMAT(1X,"DOC, DOLLARS/AVAILABLE SEAT/TRIP =",F10.2)             01515
                                                                        01516
      WRITE(6,41)DOCCSM                                                 01517
41    FORMAT(1X,"DOC, CENTS/AVAILABLE SEAT MILE =",F10.2)               01518
```

```
                                                                      01519
47    CONTINUE                                                        01520
      WRITE(6,48)DOCDPT                                               01521
48    FORMAT(//2X,"DOC, $/TRIP = ",F15.2)                             01522
                                                                      01523
      DOC=DOC/1.0E06                                                  01524
      WRITE(6,49)LIFE,DOC                                             01525
49    FORMAT(//2X,"FOR A LIFE OF ",F4.0," YEARS, DOC = ",F15.2,       01526
     * " (MILLIONS OF DOLLARS)"////)                                  01527
                                                                      01528
50    CONTINUE                                                        01529
      RETURN                                                          01530
      END                                                             01531
```

```
      SUBROUTINE LGIOC(IPRNT)                                           01532
                                                                        01533
C  PROGRAM TO CALCULATE INDIRECT OPERATING COST IN 1980 DOLLARS         01534
C  PER DEPARTURE                                                        01535
                                                                        01536
      COMMON/MASTER/ICOSTYP,IRAD,DYEAR,IPFLAG                           01537
                                                                        01538
      COMMON/COSTDAT/WTS(25),NENG,SMACH,THRMAX,QMAX,RANGE,TOGWMX,       01539
     * FUELBL,TBLOCK,SPEED,NSEATS,TGNDMAN,NCREW,WLDGMX,FUELCP,CARGO,     01540
     * SREF,COST                                                        01541
                                                                        01542
      COMMON/IOCCOM/IDOM,LF,PCTFC,ITRAN,IOCDPD                          01543
                                                                        01544
      COMMON/SENSI/FAFRD,FENRD,FMWING,FMTAIL,FMBODY,FMGEAR,FMNAC,       01545
     * FMTRV,FMFUSY,FMENSY,FMFCS,FMHYD,FMEL,FMPNM,FMAC,FMAI,FMAPU,      01546
     * FMFEQ,FMINS,FMAV,FMENG,FMCOMP,FOWING,FOAC,FOINS,FOAV,FOEL,       01547
     * FOFEQ,FOFCS,FOFUSY,FOPNM,FOAI,FOGEAR,FOAPU,FOBODY,FONAC,FOHYD,   01548
     * FOPROP,FOCOMP,FEDEP,FEINS,FECFEE,FELDFE,FEACSR,FEFLTA,           01549
     * FECRW,FEMAIN,FELABR                                              01550
                                                                        01551
      REAL NFCSTS, NCOSTS, LF, NPCS, KA, KB, KC, KD, KE, KF,            01552
     * KGB, KGC, KH, KJ, IOCDPD                                         01553
                                                                        01554
      INTEGER DYEAR,CYEAR                                               01555
                                                                        01556
C  SET DEFAULT VALUES FOR IDOM=1 (DOMESTIC)                             01557
                                                                        01558
      IF(IDOM.EQ.2)GO TO 10                                             01559
                                                                        01560
      PEOBR=0.90                                                        01561
      NPCS=5.                                                           01562
      AVGWT=600.                                                        01563
      CEOBR=0.75                                                        01564
      KA=1.54                                                           01565
      KB=21.97                                                          01566
      KC=0.89                                                           01567
      KD=0.0048                                                         01568
      KE=23.00                                                          01569
      KF=4.90                                                           01570
      KGB=67.00                                                         01571
      KGC=1.00                                                          01572
      KH=0.40                                                           01573
      KJ=0.91                                                           01574
      GO TO 20                                                          01575
                                                                        01576
C  SET DEFAULT VALUES FOR IDOM=2 (INTERNATIONAL)                        01577
                                                                        01578
10    PEOBR=0.70                                                        01579
      NPCS=8.                                                           01580
      AVGWT=1000.                                                       01581
      CEOBR=0.60                                                        01582
      KA=3.13                                                           01583
      KB=25.65                                                          01584
      KC=1.15                                                           01585
      KD=0.0069                                                         01586
      KE=43.00                                                          01587
      KF=8.03                                                           01588
      KGB=88.00                                                         01589
      KGC=1.00                                                          01590
      KH=1.37                                                           01591
      KJ=0.10                                                           01592
                                                                        01593
20    CONTINUE                                                          01594
                                                                        01595
C  PRELIMINARY CALCULATIONS                                             01596
      CYEAR=1980                                                        01597
      CALL DOLLARS(FACTOR,CYEAR,DYEAR)                                  01598
                                                                        01599
      NFCSTS=FLOAT(NSEATS)*PCTFC/100.                                   01600
```

```
      NCOSTS=FLOAT(NSEATS) - NFCSTS                                     01601
      AVWTPC=0.0                                                        01602
      IF(NPCS.NE.0)AVWTPC=AVGWT/NPCS                                    01603
      PLF=LF/100.                                                       01604
      TNCAR=CARGO/2000.                                                 01605
                                                                        01606
C     BAGGAGE WEIGHT ASSUMES 40 LBS/PASSENGER                           01607
      TNBAG=FLOAT(NSEATS)*PLF*40./2000.                                 01608
                                                                        01609
C     BEGINNING OF IOC CALCULATIONS                                     01610
                                                                        01611
C     GROUP A - GROUND PROPERTY AND EQUIPMENT MAINTENANCE, AIRCRAFT     01612
C               SERVICING (EXCEPT AIRCRAFT CONTROL), AND GROUND         01613
C               PROPERTY AND EQUIPMENT DEPRECIATION                     01614
                                                                        01615
      DPDA=KA*TOGWMX/1000.*FACTOR                                       01616
                                                                        01617
C     GROUP B - PASSENGER SERVICE (CABIN CREW SALARY AND RELATED EXPENSE) 01618
                                                                        01619
      IF(IDOM.EQ.1)DPDB=KB*(NCOSTS/40. + NFCSTS/20.)*TBLOCK             01620
      IF(IDOM.EQ.2)DPDB=KB*(NCOSTS/30. + NFCSTS/15.)*TBLOCK             01621
      DPDB=DPDB*FACTOR*FEFLTA                                           01622
                                                                        01623
C     GROUP C - PASSENGER SERVICE (FOOD AND BEVERAGE)                   01624
                                                                        01625
      IF(IDOM.EQ.1)DPDC=KC*(0.50*TBLOCK + 1.00)*(NCOSTS*PLF +           01626
     * 2.25*NFCSTS*PLF)                                                01627
      IF(IDOM.EQ.2)DPDC=KC*(0.50*TBLOCK + 1.20)*(NCOSTS*PLF +           01628
     * 3.50*NFCSTS*PLF)                                                01629
      DPDC=DPDC*FACTOR                                                  01630
                                                                        01631
C     GROUP D - PASSENGER SERVICE SUPPORT, PASSENGER RESERVATIONS AND   01632
C               SALES, AND PASSENGER ADVERTISING AND PUBLICITY          01633
                                                                        01634
      DPDD=KD*(NCOSTS*PLF + NFCSTS*PLF)*RANGE*FACTOR                    01635
                                                                        01636
C     GROUP E - AIRCRAFT SERVICING (AIRCRAFT CONTROL)                   01637
                                                                        01638
      DPDE=KE*FACTOR*FEACSR                                             01639
                                                                        01640
C     GROUP F - TRAFFIC SERVICING (PASSENGER HANDLING) AND PASSENGER    01641
C               RESERVATIONS AND SALES (EXCEPT COMMISSIONS)             01642
                                                                        01643
      DPDF=KF*(NCOSTS*PLF + NFCSTS*PLF)*PEOBR*FACTOR                    01644
                                                                        01645
C     GROUP G - TRAFFIC SERVICING (BAGGAGE AND CARGO)                   01646
                                                                        01647
      IF(AVWTPC.EQ.0.)GO TO 40                                          01648
      IF(ITRAN.EQ.1)GO TO 30                                            01649
      FAC=13000./AVWTPC                                                 01650
      IF(FAC.GT.6.50)FAC=6.50                                           01651
      DPTN=KGC*(4000. + 550.*NPCS)/AVGWT + FAC                          01652
      GO TO 40                                                          01653
                                                                        01654
30    FAC=11000./AVWTPC                                                 01655
      IF(FAC.GT.5.50)FAC=5.50                                           01656
      DPTN=KGC*(400. + 250.*NPCS)/AVGWT + FAC                           01657
                                                                        01658
40    IF(AVWTPC.EQ.0.)DPTN=0.0                                          01659
      DPDGC=DPTN*TNCAR*CEOBR*FACTOR                                     01660
      DPDGB=KGB*TNBAG*PEOBR*FACTOR                                      01661
                                                                        01662
C     GROUP H - FREIGHT RESERVATIONS AND SALES AND FREIGHT ADVERTISING  01663
C               AND PUBLICITY                                           01664
                                                                        01665
      IF(IDOM.EQ.1)DPDH=KH*(3.00/AVGWT + 0.02)*TNCAR*RANGE              01666
      IF(IDOM.EQ.2)DPDH=KH*(3.00/AVGWT + 0.01)*TNCAR*RANGE              01667
      DPDH=DPDH*FACTOR                                                  01668
                                                                        01669
C     GROUP J - GENERAL AND ADMINISTRATIVE                              01670
```

```
      DPDJ=KJ*FACTOR
C  TOTAL IOC PER DEPARTURE

      DPD=DPDA + DPDB + DPDC + DPDD + DPDE + DPDF +
     * DPDGB + DPDGC + DPDH + DPDJ

      IOCDPD=DPD

C  WRITE STATEMENTS

      IF(IPRNT.EQ.0)GO TO 70
      IF(ICOSTYP.EQ.2.OR.ICOSTYP.EQ.3.)GO TO 70
      IF(IPFLAG.EQ.0)GO TO 70

      WRITE(6,50)
50    FORMAT(/////8X,"INDIRECT OPERATING COST  ($/DEPARTURE",//)

      WRITE(6,51)DPDA
51    FORMAT(3X,"GROUP A  ",F10.2)
      WRITE(6,52)DPDB
52    FORMAT(3X,"GROUP B  ",F10.2)
      WRITE(6,53)DPDC
53    FORMAT(3X,"GROUP C  ",F10.2)
      WRITE(6,54)DPDD
54    FORMAT(3X,"GROUP D  ",F10.2)
      WRITE(6,55)DPDE
55    FORMAT(3X,"GROUP E  ",F10.2)
      WRITE(6,56)DPDF
56    FORMAT(3X,"GROUP F  ",F10.2)
      WRITE(6,57)DPDGB
57    FORMAT(3X,"GROUP GB ",F10.2)
      WRITE(6,58)DPDGC
58    FORMAT(3X,"GROUP GC ",F10.2)
      WRITE(6,59)DPDH
59    FORMAT(3X,"GROUP H  ",F10.2)
      WRITE(6,60)DPDJ
60    FORMAT(3X,"GROUP J  ",F10.2)
61    CONTINUE
      WRITE(6,62)DPD
62    FORMAT(//3X,"TOTAL IOC ($/DEPARTURE) ",F15.2///)

70    CONTINUE
      RETURN
      END
```

```
      SUBROUTINE DOLLARS(FACTOR,CYEAR,DYEAR)                            01717
                                                                        01718
C  SUBROUTINE TO CONVERT DOLLARS IN YEAR CYEAR TO DOLLARS               01719
C   IN YEAR DYEAR                                                       01720
                                                                        01721
      INTEGER DYEAR,CYEAR                                               01722
      DIMENSION DFLAT(25)                                               01723
                                                                        01724
      DATA DFLAT/29.6,29.8,30.3,31.2,32.3,33.3,34.6,36.6,38.0,          01725
     * 38.4,42.9,47.2,53.0,58.0,62.1,65.4,72.3,80.3,90.4,100.,          01726
     * 104.9,112.1,112.0,113.7,115.6/                                   01727
                                                                        01728
      IC=CYEAR - 1963 + 1                                               01729
      ID=DYEAR - 1963 + 1                                               01730
                                                                        01731
      FACTOR=DFLAT(ID)/DFLAT(IC)                                        01732
                                                                        01733
      RETURN                                                            01734
      END                                                               01735
```

```
      BLOCK DATA                                                        01736
                                                                        01737
      COMMON/MASTER/ICOSTYP,IRAD,DYEAR,IPFLAG                           01738
                                                                        01739
      COMMON/AIRFRM/INOZ,IACOUS,Q,AMPR,FAFMSP,FENGSP,AFMCST,ARDCST      01740
                                                                        01741
      COMMON/ENGINE/PRPROC,FPPFT,F,EPR,TEMP,SFC,PLMQT,DEVST,            01742
     * NPROTYP,NFLTTST,ENGCST,ENGRD,ENPROD                              01743
                                                                        01744
      COMMON/DOCCOM/AFMSP,ENGSP,RESID,DEPPER,IDTLNK,IBODY,              01745
     * FUELPR,CET,ICOREV,HYDGPM,NINS,ISPOOL,APUSHP,APUFLW,IWIND,        01746
     * NPOD,AC,NCHAN,IMUX,NGEN,KVA,IRANGE,ICIRC,NAPU,LIFE,DOCDPD,       01747
     * FARE,ROI,N                                                       01748
                                                                        01749
      COMMON/IOCCOM/IDOM,LF,PCTFC,ITRAN,IOCDPD                          01750
                                                                        01751
      COMMON/SENSI/FAFRD,FENRD,FMWING,FMTAIL,FMBODY,FMGEAR,FMNAC,       01752
     * FMTRV,FMFUSY,FMENSY,FMFCS,FMHYD,FMEL,FMPNM,FMAC,FMAI,FMAPU,      01753
     * FMFEQ,FMINS,FMAV,FMENG,FMCOMP,FOWING,FOAC,FOINS,FOAV,FOEL,       01754
     * FOFEQ,FOFCS,FOFUSY,FOPNM,FOAI,FOGEAR,FOAPU,FOBODY,FONAC,FOHYD,   01755
     * FOPROP,FOCOMP,FEDEP,FEINS,FECFEE,FELDFE,FEACSR,FEFLTA,           01756
     * FECRW,FEMAIN,FELABR                                              01757
                                                                        01758
      REAL KVA, LF, IOCDPD, LIFE                                        01759
      INTEGER DYEAR                                                     01760
                                                                        01761
      DATA INOZ/1/, IACOUS/0/, Q/100./, PRPROC/0./, FPPFT/0.5/,         01762
     * F/0.25/, NPROTYP/2/, NFLTTST/2/, RESID/2.0/,                     01763
     * DEPPER/14./, LIFE/14./, IDTLNK/0/, IBODY/0/, ICOREV/1/,          01764
     * AC/350./, NCHAN/1/, IMUX/0/, NGEN/3/, KVA/200./, IRANGE/1/,      01765
     * ICIRC/1/, NINS/0/, ISPOOL/0/, IWIND/0/, IDOM/1/, LF/55./,        01766
     * PCTFC/10./, ITRAN/0/, ICOSTYP/1/, IRAD/1/, DYEAR/1986/,          01767
     * FAFMSP/0.1/, FENGSP/0.3/, FARE/0.0/, ROI/10./,IPFLAG/0/,         01768
     * FUELPR/0.5/, APUSHP/170./, APUFLW/400./, DEVST/1980./,           01769
     * PLMQT/1984./, SFC/0.6/, NPOD/4/, NAPU/1/, EPR/20./,              01770
     * TEMP/1800./, HYDGPM/150./                                        01771
                                                                        01772
      DATA  FAFRD/1.0/, FENRD/1.0/, FMWING/1.0/, FMTAIL/1.0/,           01773
     * FMBODY/1.0/, FMGEAR/1.0/, FMNAC/1.0/, FMTRV/1.0/, FMFUSY/1.0/,   01774
     * FMENSY/1.0/, FMFCS/1.0/, FMHYD/1.0/, FMEL/1.0/, FMPNM/1.0/,      01775
     * FMAC/1.0/, FMAI/1.0/, FMAPU/1.0/, FMFEQ/1.0/, FMINS/1.0/,        01776
     * FMAV/1.0/, FMENG/1.0/, FMCOMP/1.0/, FOWING/1.0/, FOAC/1.0/,      01777
     * FOINS/1.0/, FOAV/1.0/, FOEL/1.0/, FOFEQ/1.0/, FOFCS/1.0/,        01778
     * FOFUSY/1.0/, FOPNM/1.0/, FOAI/1.0/, FOGEAR/1.0/, FOAPU/1.0/,     01779
     * FOBODY/1.0/, FONAC/1.0/, FOPROP/1.0/, FOCOMP/1.0/,               01780
     * FEDEP/1.0/, FEINS/1.0/, FECFEE/1.0/, FELDFE/1.0/, FEACSR/1.0/,   01781
     * FEFLTA/1.0/, FECRW/1.0/, FEMAIN/1.0/, FELABR/1.0/, FOHYD/1.0/    01782
                                                                        01783
      END                                                               01784
```

APPENDIX E

INTEGRATION INFORMATION

The Life Cycle Cost Module was included in FLOPS through two additions to namelist $CONFIN which was already in FLOPS, the addition of a namelist ($COSTIN), and the addition of a common block (COSTDAT). The necessary additions to namelist $CONFIN included:

ICOST = 1, cost analysis will be performed

= 0, otherwise (default)

OFC Objective function weighting factor for cost (default = 0.)

The inputs to $COSTIN are described in Appendix C. Only variables that are not available in FLOPS are included in this namelist to limit the amount of input required of the user. COSTIN is input between namelists $AERIN (or $ARIDE in the unlikely event that it exists) and $ENGDIN. If ICOST = 0, data between these namelists are ignored. The variables in the common block COSTDAT are described in Table E.1. This common block was added to all FLOPS subroutines where the variables of interest are defined or modified.

If the cost option is requested, FLOPS calls Subroutine RDCOST in the LCC Module once to read $COSTIN when all other namelists are read. The Subroutine Calcost is called each time the cost calculation must be made. Subroutine Calcost is the controlling routine for the cost calculations; it calls the appropriate cost subroutines to generate the individual cost pieces and then combines them in the proper manner to send the result back to FLOPS if necessary.

TABLE E.1 - CONCEPTUAL DESIGN VARIABLES FROM FLOPS.

WTS(25) where:
WTS(1) = wing weight, lbs
WTS(2) = horizontal tail weight, lbs
WTS(3) = vertical tail weight, lbs
WTS(4) = fuselage weight, lbs
WTS(5) = landing gear structural weight, lbs
WTS(6) = landing gear controls weight, lbs
WTS(7) = wheels and brakes weight, lbs
WTS(8) = tires weight, lbs
WTS(9) = nacelle weight, lbs
WTS(10) = thrust reverser weight, lbs
WTS(11) = fuel system weight, lbs
WTS(12) = engine system weight, lbs
WTS(13) = flight controls weight, lbs
WTS(14) = hydraulic system weight, lbs
WTS(15) = electrical system weight, lbs
WTS(16) = pneumatic system weight, lbs
WTS(17) = air conditioning weight, lbs
WTS(18) = anti-icing system weight, lbs
WTS(19) = auxiliary power system weight, lbs
WTS(20) = furnishings and equipment weight, lbs
WTS(21) = instruments - equipment weight, lbs
WTS(22) = instruments - other weight, lbs
WTS(23) = avionics - equipment weight, lbs
WTS(24) = avionics - other weight, lbs
WTS(25) = total weight of engines, lbs
NENG = number of engines per aircraft
SMACH = maximium Mach number at best altitude
THRMAX = maximum thrust per engine, lbs
QMAX = maximum dynamic pressure during climb, lb/ft^2
RANGE = block distance, st. mi.
FUELBL = block fuel, lbs
TBLOCK = block time, hr.
SPEED = cruise speed, st. mi. per hr.
NS = number of seats
TGNDMAN = time in ground maneuver, hr
NCREW = total number of crew
WLDGMX = maximum landing weight, lbs
FUELCP = maximum total fuel capacity, lbs
CARGO = cargo weight, lbs
SREF = wing reference area, ft^2
COST = final result returned to FLOPS, dollars