

AD/A-002 857

A STRUCTURAL WEIGHT ESTIMATION PROGRAM  
(SWEEP) FOR AIRCRAFT. VOLUME V - AIR  
INDUCTION SYSTEM AND LANDING GEAR MOD-  
ULES. PART I: AIR INDUCTION SYSTEM  
MODULE

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Rockwell International Corporation

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Three computer programs were written with the objective of predicting the structural weight of aircraft through analytical methods. The first program, the structural weight estimation program (SWEEP), is a completely integrated program including routines for airloads, loads spectra, skin tem- peratures, material properties, flutter stiffness requirements, fatigue life, structural sizing, and for weight estimation of each of the major aircraft structural components. The program produces first-order weight estimates		

and indicates trends when parameters are varied. Fighters, bombers, and cargo aircraft can be analyzed by the program. The program operates within 100,000 octal units on the Control Data Corporation 6600 computer. Two stand-alone programs operating within 100,000 octal units were also developed to provide optional data sources for SWEEP. These include (1) the flexible airloads program to assess the effects of flexibility on lifting surface airloads, and (2) the flutter optimization program to optimize the stiffness distribution required for lifting surface flutter prevention.

The final report is composed of 11 volumes. This volume (volume V) contains the methodology program description, and user's information for the air induction system and landing gear modules of SWEEP.

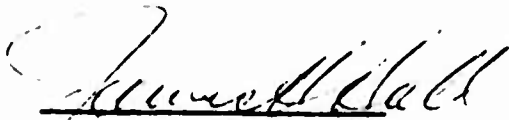
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Deputy for Development Planning

## PREFACE

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### Volume

I	"Executive Summary"
II	"Program Integration and Data Management Module"
III	"Airloads Estimation Module"
IV	"Material Properties, Structure Temperature, Flutter, and Fatigue"
V	"Air Induction System and Landing Gear Modules"
VI	"Wing and Empennage Module"
VII	"Fuselage Module"
VIII	"Programmer's Manual"
IX	"User's Manual"
X	"Flutter Optimization Stand-Alone Program"
XI	"Flexible Airloads Stand-Alone Program"

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## INTRODUCTION TO VOLUME V

The Structural Weight Estimation Program (SWEET) has been developed as an analytical aircraft structural weight prediction tool suitable for use in the preliminary design phase of vehicle synthesis. The functions of data development and assessment have been integrated into various program modules so that criteria, design constraints, and environment considerations are consistent. The purpose of the two parts of this volume is to present methods and formulations and to discuss program routines for the air induction system and landing gear modules:

- Part 1 discusses the air induction system module, which estimates air induction system, nacelle, and engine section structure weights
- Part 2 discusses the landing gear module

Appendix A presents autoflow diagrams and charts of the air induction system module. Autoflow diagrams and charts of the landing gear module are presented in Appendix B.

**PART 1**  
**AIR INDUCTION SYSTEM MODULE**

## Section I

### INTRODUCTION AND SUMMARY

#### PROGRAM OBJECTIVES

The objective of the air induction system weight estimation module is to provide weight of propulsion-system-oriented structural components during the preliminary design phase of vehicle synthesis. In this design phase, weight trade-off and point design data sensitive to a wide range of inlet-engine arrangements and design criteria are required.

Design of propulsion systems are, to a significant degree, dictated by optimum performance to meet primary mission objectives with compromise for other vehicle environmental conditions encountered by the system. Inlet boundary layer bleed and bypass requirements are some of many details that are not available in the preliminary design phase. These and other factors complicate structural arrangement definitions which are required in an analytical procedure.

Methods that are incorporated in this program evaluate those components that may be derived on an analytical basis within the limitations of design data that would be available in the preliminary design phase. Empirical and statistical formulations are used to estimate the weight for certain identifiable components as well as to estimate provisions for items that are not readily defined.

#### SUMMARY OF ANALYSIS CAPABILITIES AND LIMITATIONS

The estimating procedure accounts for wing-pylon-mounted or fuselage-pylon-mounted engine packages as well as for engines mounted inside the vehicle fuselage. It is limited to air-breathing engine concepts with inlet ducts forward of the engine compressor face. Nacelle-type installation evaluation is limited to two or four nacelle arrangements. The following propulsion-system-oriented components are evaluated in this module:

- Air induction system:
  - Ducts
  - Variable - geometry ramps

- Auxiliary inlet panels
- Duct bypass doors
- Fixed- and variable-geometry spikes
- Nacelle and engine section:
  - Nacelles and engine cowling
  - Pylons
  - Fittings
  - Engine mounts

For the purposes of weight accounting, air induction system structure is categorized as part of the propulsion group according to the definitions in MIL-STD-254. Nacelle and engine section structure components are categorized in a separate group. The weight estimating approach is based on calculating weights at the line item level of the detail weight statement report form, Figures 1 and 2.

The program approaches weight estimation for each of the structural elements as independent entities. Some interactive compatibility is evaluated such as optimum duct frame spacing or for duct requirements due to the presence of ramps.

#### AIR INDUCTION SYSTEM STRUCTURE WEIGHT ESTIMATION

Inlet duct and variable-geometry ramp structure weight estimation procedures account for factors such as geometry, type of construction, material properties, temperature, inlet pressures, and manufacturing limitations. Auxiliary inlet panels, duct bypass doors, and fixed- and variable-geometry spikes are estimated by statistical methods. Weights of these items are sensitive to specific item function and dimensional and descriptive data input by the user.

#### Inlet Pressure and Temperature

Inlet design pressures and temperature are determined for the vehicle speed-altitude profile envelope. Nine points on both the level-flight

NAME \_\_\_\_\_  
DATE \_\_\_\_\_

## PROPULSION GROUP

PAGE \_\_\_\_\_  
MODEL \_\_\_\_\_  
REPORT \_\_\_\_\_

1		Quantity	Wt.
2	CODE NO.		
3	ENGINE INSTALLATION		X
4	ENGINE (AS INSTALLED)		
5	ENGINE & AFTERBURNER (AS INSTALLED)		
6	REDUCTION GEAR BOX		
7	EXTENSION DRIVE SHAFT		
8			
9			
10	AFTERBURNERS (IF FURNISHED SEPARATELY)		
11	ACCESSORY GEAR BOXES & DRIVES		
12	SUPERCHARGER - COMPLETE (FOR TURBO)		
13	LUBRICATING SYSTEM		
14	SUPPORTS		
15	CONTROLS		
16	PIPING (EXHAUST TO SUPER.)		
17			
18			
19	AIR INDUCTION SYSTEM		X
20	INTERCOOLERS AND SUPPORTS		
21	AIR DUCTING AND SHROUDING		
22	INTAKE DOORS & OPERATING CONTROLS		
23	AIR FILTERS		
24	SCREENS & CONTROLS		
25			
26			
27			
28			
29			
30			
31	EXHAUST SYSTEM		X
32	EXHAUST STACKS		
33	EXHAUST COLLECTORS		
34	COLLECTOR OR ENGINE SHROUD		
35	TAIL PIPE		
36	TAIL PIPE SHROUD AND INSULATION		
37	TAIL CONE		
38	SILENCING DEVICES		
39	SUPPORTS, BRACKETS, ETC.		
40			
41			
42			
43			
44	COOLING SYSTEM		X
45	RADIATOR AND SUPPORTS		
46	WATTERS, SCOOP & DUCTS		
47	EXPANSION TANK & SUPPORTS		
48	LIQUID IN SYSTEM (GALS.)		
49	PIPING, VENTS, CLAMPS ETC.		
50			
51			
52	FANS		
53	CONTRAVANS		
54	FAN DRIVES		
55	CONTROLS & OPERATING MECH.		
56			
57	TOTALS (TO BE SUBMITTED FORWARD)		X

Figure 1. Detail weight report format for propulsion group.

ENGINE SECTION OR  
NACELLE GROUP

	Inboard	Center	Outboard
1			
2			
3			
4 ENGINE MOUNT			
5			
6 SUPPORT BAY			
7 VIBRATION ABSORPTION DEVICES			
8			
9			
10 NACELLE STRUCTURE			
11 BULKHEADS AND FRAMES			
12 COVERING & STIFFENERS			
13 FITTINGS			
14 LONGERONS			
15 ATTACHING ANGLES, ETC.			
16			
17			
18			
19 PYLONS & STRUTS			
20			
21			
22			
*23 FIREWALL			
24			
25 SHROUDS FOR FIRE PROTECTION			
26			
27 COWLING			
28 ENGINE COWL			
29			
30			
31			
32			
33			
34			
35 BAFFLES			
36 ACCESSORY COWL OR SKIRT			
37 COWL FLAPS			
38 COWL FLAP CONTROLS & OPERATING MECH.			
39			
40			
41			
42			
43			
44			
45 FAIRING - NACELLE TO WING OR PYLON			
46 STRIPS & GRIPS			
47 WORKING PLATFORM (BUILT IN)			
48 INTERNAL WALKWAYS			
49			
50			
51 INSTALLATION HARDWARE			
52			
53			
54			
55			
56 TOTALS - SECTIONS OR NACELLES			
57 TOTAL (TO BE SUBMITT FORWARDED)			

\*If in nacelle, or sub-structure in wing or body.

Figure 2. Detail weight report format for engine section or nacelle group.

**NACELLE GROUP  
DOORS, PANELS & MISCELLANEOUS**

NAME \_\_\_\_\_  
DATE \_\_\_\_\_

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57	CODE NO.	Location	Type Power	Area Sq. Ft.	Structure	Operating Mechanism			
						Mechanism & Controls	Power Trans.	Actuator	Lock Mech.
<b>DOORS &amp; FRAMES</b>									
- LANDINGS									
- BOMB									
- ACCESS									
- ENGINE									
<b>PANELS (NON STRUCTURAL)</b>									
<b>EXTERIOR FINISH</b>									
<b>TOTALS</b>									
<b>TOTAL - DOORS, PANELS &amp; MISC.</b>									
<b>TOTAL FROM PG 15</b>									
<b>TOTAL - ENGINE SECTION OR NACELLE GROUP</b>									

\*Indicate location for major doors by int'd, ext'd, out'd.

\*\*H-Hydraulic, E-Electrical, P-Pneumatic; power transmission from main distribution point to actuating unit.

Figure 2. Detail weight report format for engine section or nacelle group (concl).

maximum speed ( $M_H$ ) and the limit speed ( $M_L$ ) envelopes are evaluated for design pressure and temperature data based on standard day atmospheric properties. Total pressure is calculated by using isentropic compressible flow equations and inlet pressure recovery ratio. Static pressure is calculated as a function of total pressure and airflow. Transient overpressure, referred to as hammershock, is calculated as a function of inlet total pressure and engine bypass ratio. Inlet attenuation is approximated to develop longitudinal pressure variation in the duct.

### Material Properties

Material properties in the form of stress-strain diagrams, strength and fatigue characteristics, and physical properties are stored in a permanent data bank. Elevated-temperature properties are obtained by interpolation of the permanent file data. Properties for ducts, ramps, and nacelle are independently derived such that different materials may be selected for these structural components.

Since temperature varies with vehicle speed and altitude, separate sets of materials data are calculated for each speed profile point. Components are designed to the pressure loads and the attendant material properties.

### Inlet Ducts

The inlet duct weight estimating approach is a multi-station synthesis procedure. Geometry is represented as a family of shapes (rounded rectangles) that may be defined by straight lines and circular arcs. Shape may vary from fully circular to fully rectangular. Inlet geometry is defined at as many as 10 discrete synthesis locations, starting at the leading edge and ending at the engine front face.

Ducts are assumed to be sheet frame structure designed to pressure requirements. Panels are designed for either milled with lands at frames or unmilled construction. Strength, deflection restraint, and fabrication minimums are variables; frame spacing may be either fixed or variable. The optimum frame spacing search is conducted between predefined minimum and maximum limits.

### Variable-Geometry Ramps

Either two, three, or four ramp systems are evaluated. Variables in the weight estimation approach are differential ramp pressures, geometry, material properties, construction, and fabrication minimums.

Critical design pressure is determined by comparing the ratio of ultimate hammer shock pressure to the ramp material compression yield stress at each of the points on the speed profile envelope. Differential pressure on each ramp, a function of plenum pressure, is based on either predefined or user input pressure ratios.

Geometric descriptions of lengths, widths, angles, and actuator locations are combined to develop individual ramp loading diagrams. These loads are used to synthesize either stiffened sheet construction or honeycomb panel structure.

#### NACELLE AND ENGINE SECTION WEIGHT ESTIMATION

Nacelle structure weight estimates are performed for external podded engine installations. Geometry is defined in a manner similar to that used for the ducts. Synthesis cut geometry is defined at as many as 10 stations, starting at the inlet leading edge and ending at the last complete nacelle section.

Nacelle loads due to inertia effects are considered to be negligible. This premise is true for most nacelle systems in which engines are supported directly by the pylon strut. The estimating procedure is therefore limited to the design for local panel flutter, if critical, and fabrication minimums. Within this scope, frame weight and spacing compatibility is maintained forward of the engine front face. Duct frame weight and spacing are used in this forward section. Frame spacing aft of the engine face is defined by input definition.

Pylons, fittings, engine mounts, firewall, and miscellaneous door weights are calculated by empirical and statistical methods.

#### MODULE OPERATION

The program is written in FORTRAN extended language for operation on the CDC 6600 computer and is structured to operate within 50,000-octal core locations. Execution time varies with the type of inlet-engine arrangement. The range of computer core time varies between 1 to 5 system seconds.

The air induction system module operates within SWEEP either as a stand-alone program or in conjunction with other modules. Mode of operation is controlled by the SWEEP control program, OLAY00.

In the stand-alone mode, the SWEEP control program calls only the input data processing module and the air induction system module. All input data, required by the air induction system module are initially set up by the user, read by the input data processing module, and set up in labeled common and mass storage records for use by the air induction system module.

When the air induction system module is operated in conjunction with other SWEEP modules, input data are processed in the same manner as those used in the stand-alone mode. Part of the data required by the data management module are also used by the air induction system module. In this case, duplicated data are transferred to the input data record for use by the air induction system module.

Specific input data requirements and deck arrangement instructions are discussed in Volume IX, "User's Manual."

#### MODULE INPUT

Specific input to the air induction system module is discussed in the maps and program descriptions contained in Section III of this volume. Following is a summary of the types of input required by the module:

1. Basic constants used in synthesis equations: 275 inputs
2. Air induction system, nacelle, and engine section configuration dependent data: 260 inputs
3. Mach-altitude profile data: 30 inputs
4. Materials data:  $\leq 300$  inputs per material used
5. Program print indicators: 10 inputs

#### MODULE OUTPUT

Basic module weight summary results are shown in Figures 3 through 5. Optional output, which is controlled by user specifications, consists of input data tables, loads and sizing data tables, weight details, and intermediate calculations. Sample output tables are shown with the descriptions of the source routines in Section III of this volume. Warning and error messages are printed when erroneous or incompatible data are encountered. The program default procedure appears as part of the message.

3 OCT 1973

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VARI-SWEEP WING CONFIGURATION

3. I. S. & ENGINE SECTION OR NACELLE GROUP WEIGHT & C.G. SUMMARY

WT. 33097.39  
C.G. 2497.92

	WT.	C.G.
AIR INDUCTION SYSTEM		
INLET WEDGE	1899.44	2023.33
AIR DUCTING	27221.94	2548.41
INTAKE COCKS & OP. MECHANISM	0.0	1960.00
BYPASS COCKS & OP. MECHANISM	0.0	1960.00
VARIABLE GEOMETRY STRUCTURE	3986.01	2378.06
HALF ROUND FIXED SPIKE	0.0	1960.00
FULL ROUND TRANSLATING SPIKE	0.0	1960.00
FULL TRANS. & EXPND. SPIKE	0.0	1960.00

TOTAL

WT. 26685.43  
C.G. 2597.84

CUTBOARD

	WT.	C.G.
ENGINE MOUNTS	1263.15	0.0
BULKHEADS & FRAMES	16245.05	0.0
COVERING & STIFFENERS	7223.29	0.0
LCNGERONS	0.0	0.0
FITTINGS	234.64	0.0
PYLONS	0.0	0.0
FIRFWALL	120.21	0.0
SHROUD	1599.10	0.0
TOTAL ENG.SEC./NAC.	26685.43	0.0

	WT.	C.G.
ACCESS DOORS	0.0	1960.00
ENGINE DOORS	1600.92	2906.50
EXTERIOR FINISH	167.30	2503.50
TOTAL MISC.	1768.22	2868.37
TOTAL ENG.SEC./NAC.GROUP & MISC.	28453.64	2614.65

Figure 3. Sample output of weight summary and balance results.

VAPI-SWEEP WING CONFIGURATION

3 OCT 1973

\*\* SUMMARY \*\*

\*\*\* PROPULSION GROUP \*\*\*

AIR INDUCTION SYSTEM		
INLET WEDGE	1899.64	
AIR DUCTING	27221.94	
INTAKE DOORS & OPERATING MECHANISM	0.0	
BYPASS DOORS & OPERATING MECHANISM	0.0	
VARIABLE GEOMETRY STRUCTURE	3996.01	
		33007.39

Figure 4. Sample output of air induction system structure weight summary.

VART-SWEEP WING CONFIGURATION

3 OCT 1973

\*\* SUMMARY \*\*

E N G I N E   S E C T I O N   U R   N A C E L L E   G R O U P			
	INBOARD	OUTBOARD	TOTAL
ENGINE MOUNTS	1263.15	0.0	
NACELLE STRUCTURE			
BULKHEADS & FRAMES	16245.05	0.0	
COVERING & STIFFENERS	7723.28	0.0	
LONGERONS	0.0	0.0	
FITTINGS	234.64	0.0	
PYLON	0.0	0.0	
FIREWALL	120.21	0.0	
SHROUD	1599.10	0.0	
TOTAL .....	26685.43	0.0	26685.43
DOORS & MISCELLANEOUS DOORS			
ACCESS	0.0		
ENGINE	1600.92		
EXTERIOR FINISH	167.30		
TOTAL DOORS & MISCELLANEOUS .....			1768.22
TOTAL ENGINE SECTION OF NACELLE GROUP -----			28453.64

Figure 5. Sample output of engine section or nacelle group weight summary.

## MODULE STRUCTURE

The module is structured in a single overlay consisting of a main program (AISMN) and 21 subroutines. Figure 6 is a functional flow diagram which depicts the major operations of the program. Table 1 shows the routines for each of the functional groupings.

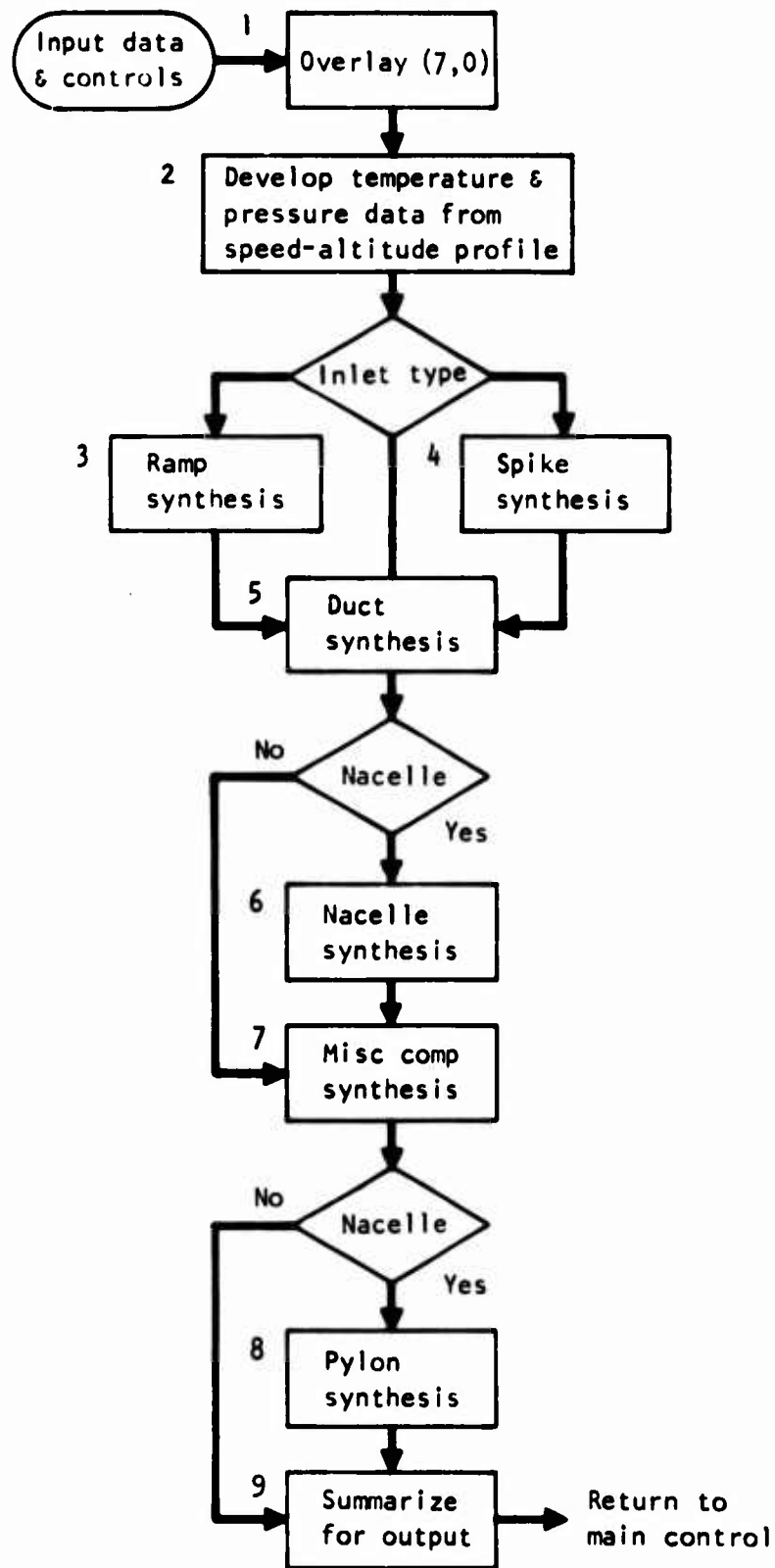


Figure 6. Air induction system module functional flow diagram.

TABLE 1. FUNCTIONAL SUBROUTINE GROUPING (AIS)

Overlay (7,0) Subroutine by Functional Groupings	
1.	Overlay (7,0) Control and Data Manipulation
●	Program AISMN - Program for AIS overlay, print system data
2.	Develop Temperature and Pressure Data From Speed-Altitude Profile
●	Subroutine SPAL - Set up temp and pressure for 9 PT speed profile
●	Subroutine TEMPR - Temp/pressure eval program at given geopotential alt
●	Subroutine DSGNP - Set up temp and pressure factors for air induction sys
●	Subroutine MCNTL1 - Develop material properties from library data
●	Subroutine MATLF1 - Material property curve fit program
●	Subroutine MATLP2 - Material property curve fit program
3.	Ramp Synthesis
●	Subroutine RAMPS - Ramp synthesis and weight for 2 to 4 ramps per inlet
●	Subroutine PRECRI - Determine critical RAMP design criteria
4.	Spike Synthesis
●	Subroutine SPIKE - Weight for spikes by statistical equations
5.	Duct Synthesis
●	Subroutine DUCTS - Control and print for ducts
●	Subroutine DUCTGEO - Duct geometry evaluation program
●	Subroutine FRMND3 - Frame node coordinates 61 nodes evaluation program
●	Subroutine FRMELD - Unit pressure ring load evaluation program
●	Subroutine DUCPNL - Duct panel synthesis program
●	Subroutine DUCFRM - Duct frame synthesis program
●	Subroutine DUCWET - Duct weight evaluation program - per nacelle or A/V
6.	Nacelle Synthesis
●	Subroutine NACELE - Nacelle shell weight
●	Subroutine NCLGEO - Develop nacelle geometry
7.	Miscellaneous Component Weights
●	Subroutine MISCOM - Weights of engine mounts, misc doors, etc; apply K-factor
8.	Pylon Synthesis
●	Subroutine PYLONS - Pylon and fitting weight
9.	Summarize for Output
●	Subroutine SUMMARY - Summarize AIS weights and CGS, and print

## Section II

### METHODS AND FORMULATIONS

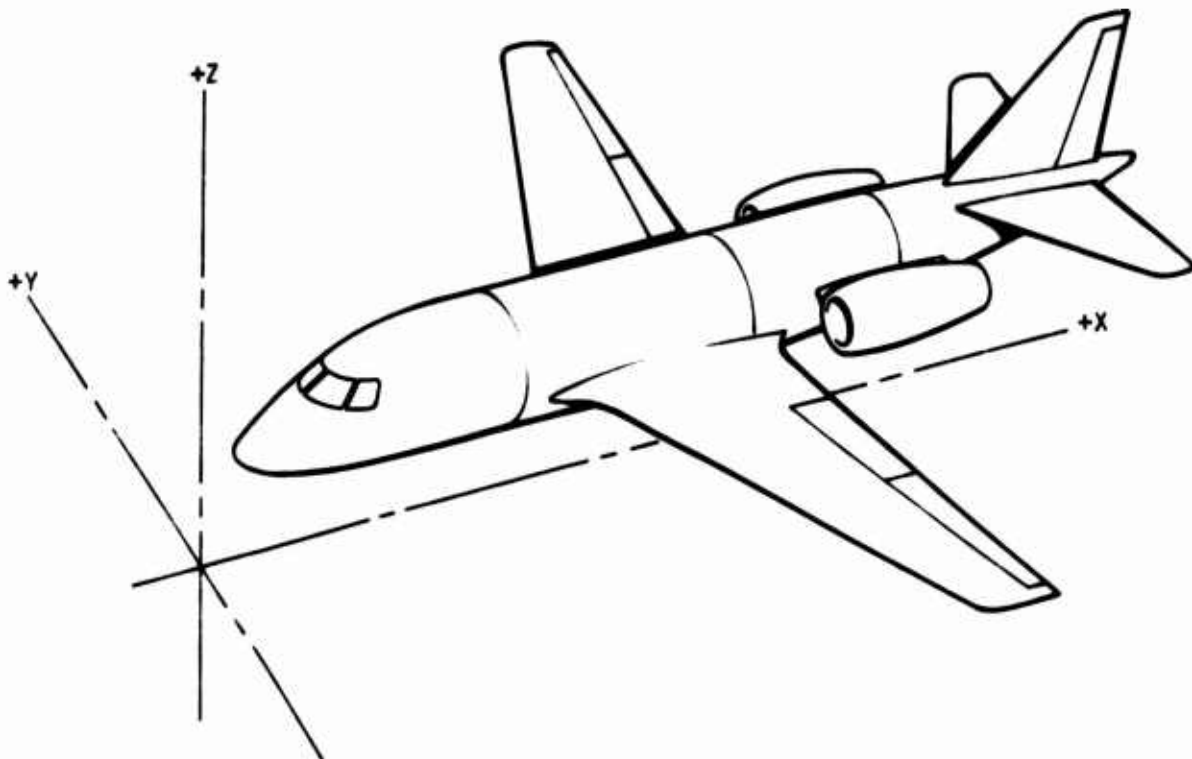
#### GENERAL DISCUSSION

Methods and formulations which are programmed in the air induction system weight estimation module are discussed in this section. Specific design data development and weight calculation functions are performed in separate routines which are called by the control program AISN. The discussions that follow present the process within each of these routines.

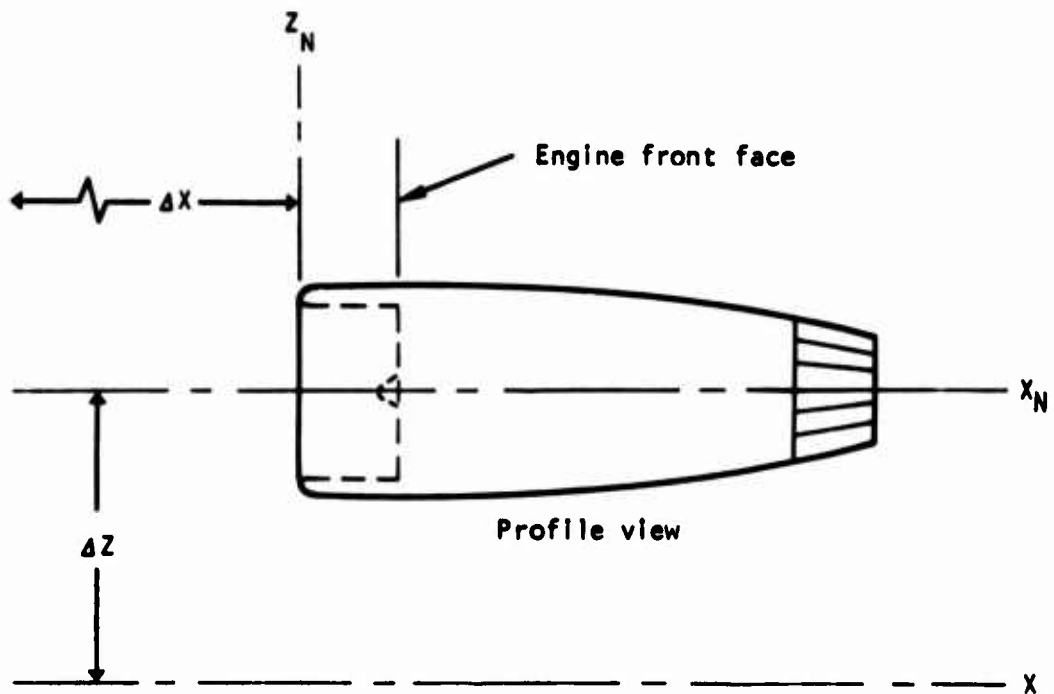
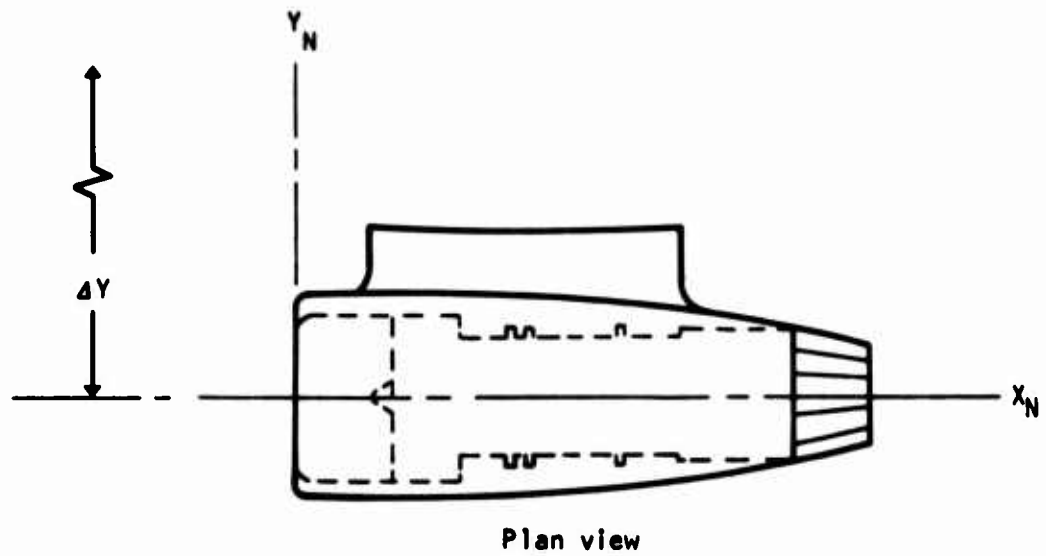
#### INLET COORDINATE SYSTEM

The air induction system weight estimation module, which is part of an integrated structure weight estimation program, provides propulsion system oriented structure weight. The procedure evaluates a wide range of propulsion system arrangements that can exist on fighter, attack, bomber, and transport vehicle categories. In order to minimize geometry definition requirements, an inlet coordinate system is used to locate and define structural components.

The following stability axis definitions are used to define the vehicle coordinate system.

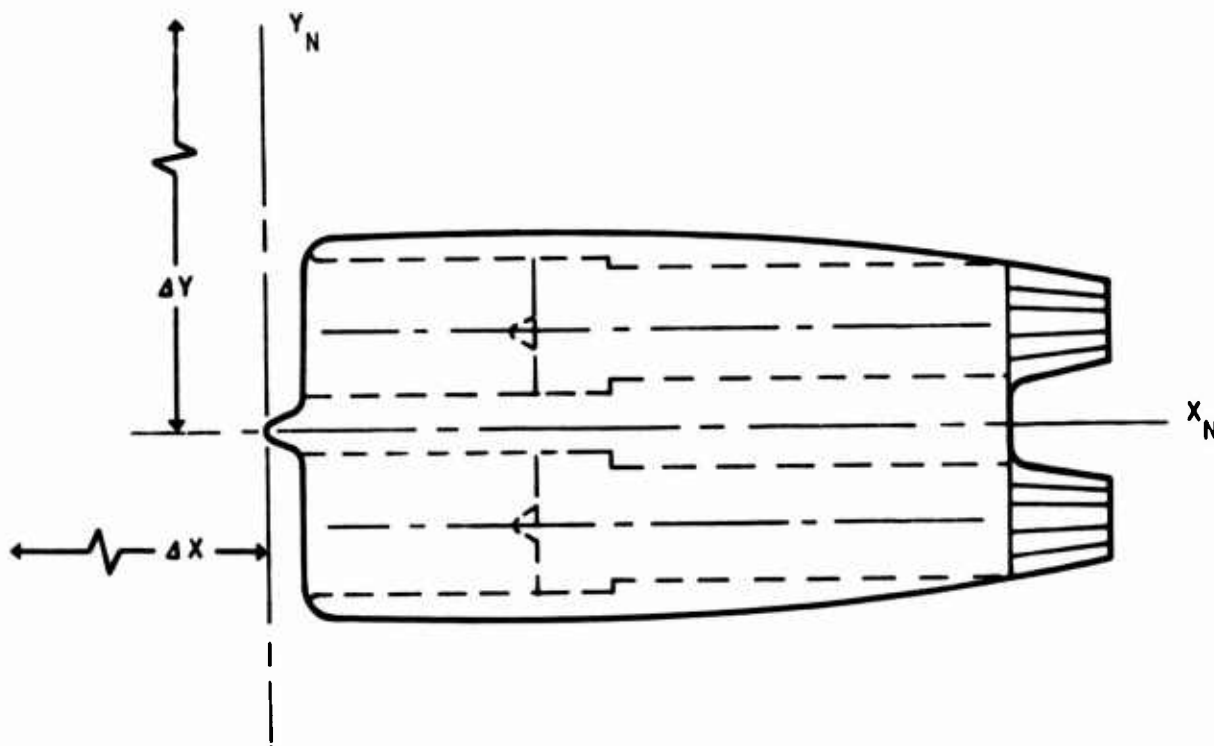


Propulsion systems, as with other systems such as the wing, are generally symmetrical. In the following sketch, left- and right-hand side engine packages are symmetrical. The inlet coordinate system is located relative to the vehicle coordinate system, as shown in the following sketches:



This coordinate system is offset from the vehicle coordinate system by  $\Delta X$ ,  $\Delta Y$ , and  $\Delta Z$ . Origin of the system,  $X_N = 0$ , is defined to be at the inlet leading edge. Origin of the other axes,  $Y_N = 0$  and  $Z_N = 0$ , is defined to be at the engine front face perpendicular to the engine axis,  $X_N$  - axis is assumed to be colinear with the engine axis.

Two engines may exist in a nacelle, as shown in the following sketch. The  $X_N$  - axis is located colinear with the engine axis midway between the engines (nacelle centerline).



This definition of inlet coordinate system also applies to fuselage-buried-engine arrangements. For this situation, inlet and vehicle Y-axis are coincident.

Geometric description and weight estimation of a single unit (one nacelle or one duct) can be evaluated. Total vehicle arrangement and weight is implied by the relative location with respect to the vehicle coordinate system and the inlet coordinate system. For the foregoing discussion of a two-engine arrangement, geometry of one inlet duct would be defined and presence of two ducts in the nacelle defined by the offset relative to the inlet coordinate system. There may be either two or four nacelles on a vehicle; i.e., an inboard set or an inboard and an outboard set. Therefore, the number of nacelles and their relative location ( $\Delta X$ ,  $\Delta Y$ ,  $\Delta Z$ ) can be used to determine the total number of detail units (such as number of ducts), total weight, and center of gravity. This accounting procedure is followed in the weight calculation routines and the weight summary subroutine SUMMARY.

## FLIGHT PROFILE AND DESIGN PRESSURES

The vehicle speed-altitude profile is evaluated for air induction system design pressures and local panel flutter requirements. Methods employed to develop and process this information are described herein. Routines which perform these operations are:

- SPAL Expand the input speed-altitude profile and calculate total temperature, total pressure, static inlet duct pressure, and dynamic pressure.
- TEMPR Calculate standard atmosphere temperature and pressure at speed profile altitudes.
- DSGNP Calculate inlet duct hammershock pressures and static pressure at the inlet throat.

### SPEED-ALTITUDE PROFILE

Input speed-altitude profile data consist of five points on both the level-flight maximum speed envelope,  $M_H$ , and the limit speed envelope,  $M_L$ , starting at sea level and extending to maximum altitude. Points on the  $M_L$  profile are defined relative to the  $M_H$  profile. Data type and its use in the program are as follows:

<u>Input Data Defining <math>M_L</math></u>	<u>Description</u>
0.0	$M_L$ equal to $M_H$
>0; <1.0	Decimal to be added to $M_H$
>1.0	Multiplier of $M_H$
<0.0	Fraction of $M_H$ to be added to $M_H$

This data set is expanded to define nine points by interpolating between the input points. Intermediate points are taken at altitudes midway between input altitudes; corresponding dynamic pressure is obtained by interpolation, and speed is then calculated to be compatible with the dynamic pressure and altitude. Figure 7 shows these speed-altitude profile points.

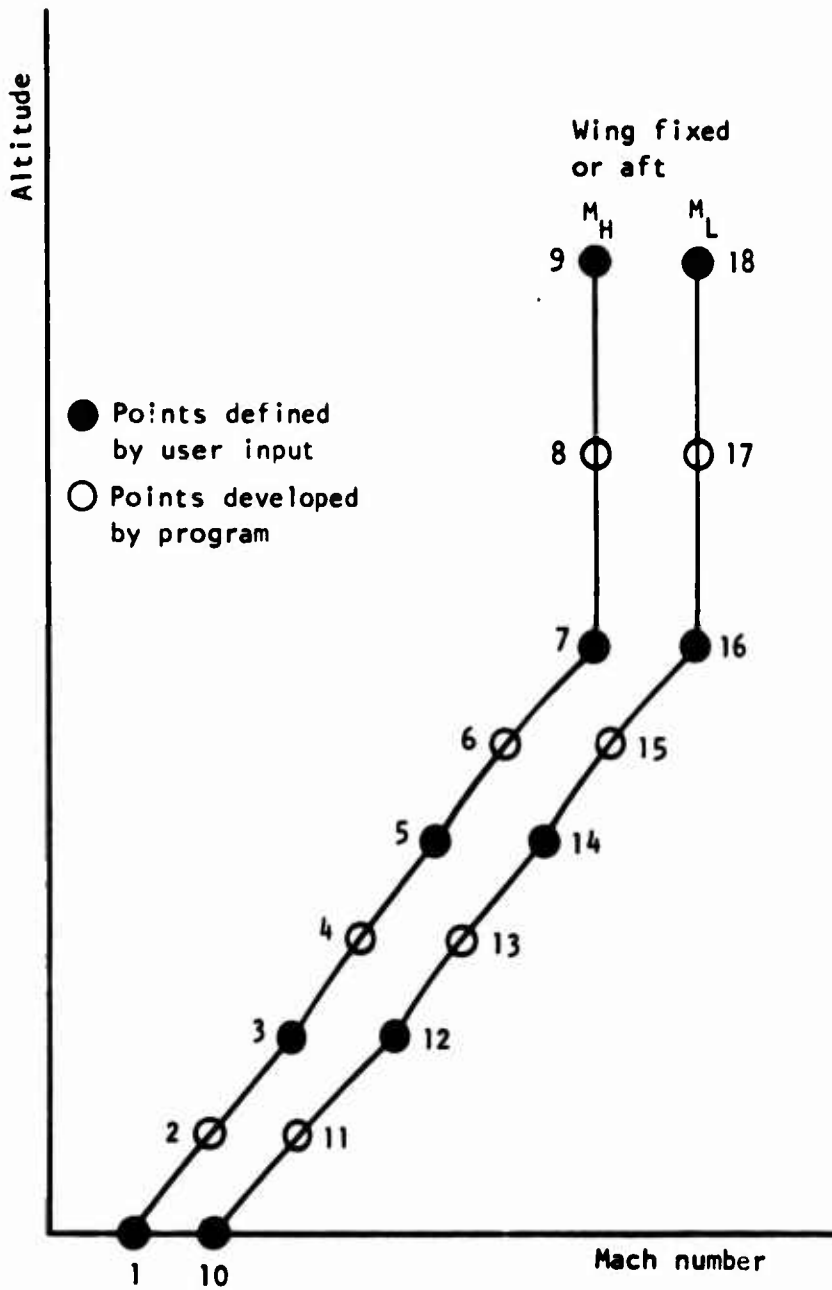


Figure 7. Speed-altitude profile points.

## Ambient Temperature and Pressure

U.S. standard atmosphere temperature,  $T_o$ , and pressure  $P_o$ , are calculated in subroutine TEMPR by curve fit equation for different altitude ranges. (1)

Between 0 and 36,089.24 feet,

$$T_o = 518.67 - 3.56616 (\text{ALT}) \quad (1)$$

$$P_o = 2116.22 [1.0 - 0.00687559 (\text{ALT})]^{5.25591} \quad (2)$$

where

$T_o$  = ambient temperature, °R

$P_o$  = ambient pressure, psf

ALT = geopotential altitude, ft/1,000

Between 36,089.24 and 65,616.88 feet,

$$T_o = 389.97 \quad (3)$$

$$P_o = \frac{472.68}{e^{\left(\frac{\text{ALT} - 36.08924}{20.80556}\right)}} \quad (4)$$

Between 65,616.88 and 104,986.9 feet,

$$T_o = 389.97 + 0.548641 (\text{ALT} - 65.61688) \quad (5)$$

$$P_o = 114.345 \left[ 1.0 + \frac{0.548641 (\text{ALT} - 65.61688)}{389.97} \right]^{-34.1634} \quad (6)$$

Between 104,986.9 and 154,199.5 feet ,

$$T_o = 411.57 + 1.53619 (ALT-104.9869) \quad (7)$$

$$P_o = 18.131 \left[ 1.0 + \frac{1.53619 (ALT-104.9869)}{411.57} \right]^{-12.2012} \quad (8)$$

Should the altitude exceed 154,119.5 feet, a warning message is printed, equation 7 is used to calculate  $T_o$ , and equation 8 is used to calculate  $P_o$ .

### Dynamic Pressure

Dynamic pressure is calculated in subroutine SPAL by using local temperature and pressure, equation fit approximation of the acceleration of gravity, and assuming constant specific heat ratio.

$$g = 32.17405 - 0.00000304 \text{ ALT} \quad (9)$$

$$\rho = \frac{P_o}{RT_o} \quad (10)$$

$$C_s = \sqrt{\gamma g RT_o} \quad (11)$$

$$q = \frac{\rho}{2g} (M_o C_s)^2 \quad (12)$$

where

$g$  = acceleration of gravity,  $\text{ft}/\text{sec}^2$

$\rho$  = density of air,  $\text{lb}/\text{ft}^3$

$R$  = gas constant,  $53.3 \text{ ft}\cdot\text{lb}/\text{lb}/^\circ\text{R}$

$\gamma$  = ratio of specific heats, 1.4

$C_s$  = speed of sound, ft/sec

$M_o$  = vehicle mach number

$q$  = dynamic pressure, psf

#### INLET DUCT PRESSURES AND TEMPERATURES

Inlet duct pressures and temperatures are calculated at each of nine points on the level-flight maximum speed envelope,  $M_H$ , and the limit speed envelope,  $M_L$ . Hammershock pressure is determined at points on the  $M_H$  and  $M_L$  profiles, and static pressure is determined along the  $M_L$  profile. These pressures are determined at the inlet throat and at the front face of the engine. Pressure from the leading edge to the throat is assumed to be constant. Pressure at inlet stations between the throat and the engine are determined by linear interpolation between pressures at the two points.

Total pressures and temperatures are calculated in subroutine SPAL. Static pressures at the engine face are also calculated in SPAL. Hammershock pressures and static pressures at the inlet throat are calculated in subroutine DSGNP. Isentropic compressible flow equations and empirical formulations for pressure recovery ratio, airflow, and attenuation are used to calculate the required data. The subscript, (1), is used to denote inlet throat station, and the subscript, (2), to denote engine front face station in the discussions that follow.

#### Total Temperature and Pressure

Total temperature,  $T_{T2}$ , and total pressure,  $P_{T2}$ , are calculated by equations 13 and 14.

$$T_{T2} = T_o \left( 1 + \frac{\gamma-1}{2} M_o^2 \right) \quad (13)$$

$$P_{T2} = (P_{T2}/P_{T0}) P_o \left( 1 + \frac{\gamma-1}{2} M_o^2 \right)^{\frac{\gamma}{\gamma-1}} \quad (14)$$

where

$P_{T2}/P_{T0}$  = inlet pressure recovery ratio

Pressure recovery ratio may be user input. However, if it is not available, equation 15 from reference 2 is used to calculate recovery ratio for supersonic speeds. For subsonic speeds, recovery ratio is assumed to be 1.0.

$$P_{T2}/P_{T0} = 1.0 - 0.075 (M_0 - 1.0)^{1.35} \quad (15)$$

### Static Pressure

Static pressure at the engine face,  $P_2$ , is calculated by equation 16.

$$P_2 = \frac{P_{T2}}{\left(1 + \frac{\gamma-1}{2} M_2^2\right)^{\frac{\gamma}{\gamma-1}}} \quad (16)$$

where

$M_2$  = mach number of air at engine face

Mach number of the air at the engine face may be user input or, if not available, is defined by the following approximations:

$$M_2 = 0.3 \quad \text{when } M_0 > 1.0$$

$$M_2 = 0.5 \quad \text{when } M_0 \leq 1.0$$

Static pressure at the inlet throat,  $P_1$ , is obtained from the curve of the ratio of static pressure to free-stream total pressure versus mach number

(Figure 8). This ratio, which is the pressure ratio behind the normal shock, is calculated by equation 17.

$$P_1/P_{T0} = 0.8 - 0.05M \quad (17)$$

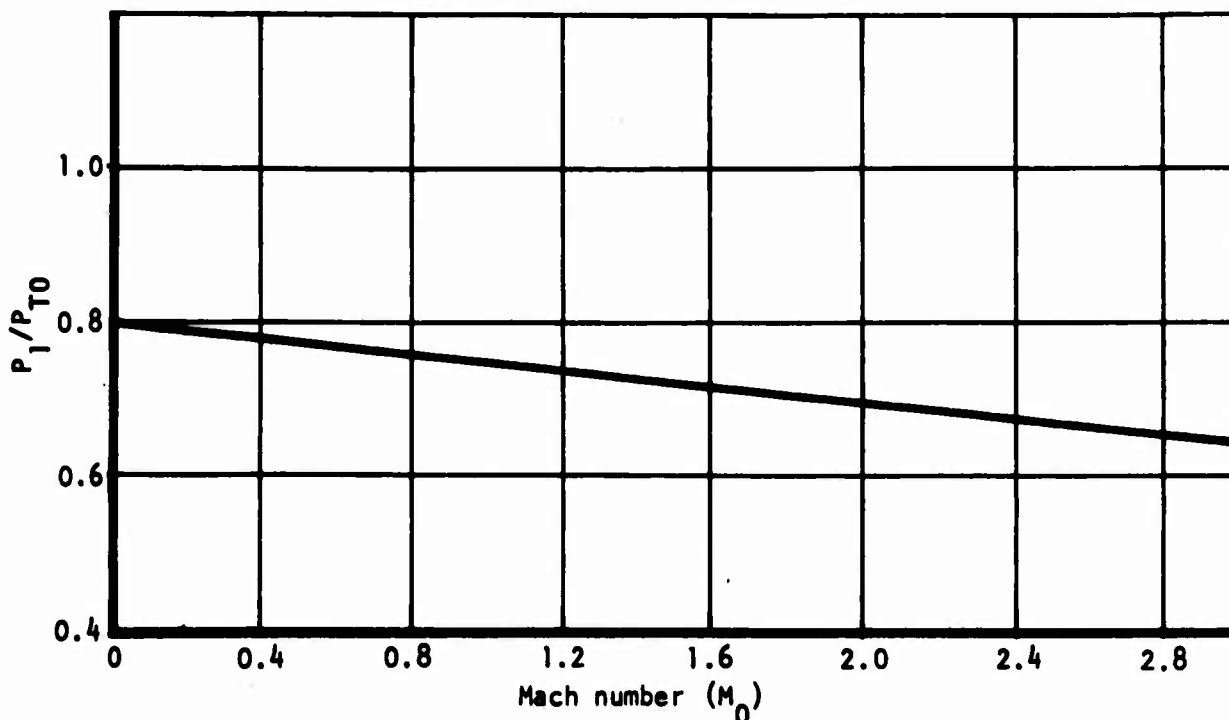


Figure 8. Throat static pressure ratio.

### Hammershock Pressure

Hammershock pressure in the inlet system is caused by engine stall and consequent airflow cutoff. This pressure is dependent on internal engine geometry. Hard stall of turbojet engines creates hammershock pressure ratios,  $P_{HS2}/P_2$ , of about 2, which indicates 100-percent inlet flow cutoff. In the case of fan engines, most of the stalls occur in the high-pressure compressor. As the hammershock pulse emerges from the compressor, the fan bypass ducting provides a path through which the pulse is vented; step change in fan back-pressure is reduced, and pressure rise in the inlet duct is correspondingly lower. As the bypass ratio of the fan is increased, the relative air mass

involved with compressor stall decreases, fan air bypass duct volume increases, and pressures forward of the fan are lower. Plots of hammershock pressure ratio versus total temperature,  $T_{T2}$ , for turbojet and fan engines are shown in Figure 9. These curves are based on corrected airflow,  $f(M_2)$ , versus total temperature data for typical engines, and hammershock pressure ratio data from Reference 3. Equations 18, 19, 20, and 21 approximate these curves and are used to calculate the pressure ratio for different engines.

- Turbojet:

$$P_{HS2}/P_{T2} = 1.019056 - 0.0289156 \left( \frac{T_{T2}}{400} \right) + 1.350112 \left( \frac{400}{T_{T2}} \right) - 0.664319 \left( \frac{400}{T_{T2}} \right)^2 \quad (18)$$

- Fan engine:  $BPR \leq 1.5$

$$P_{HS2}/P_{T2} = -0.00602627 + 0.080725 \left( \frac{T_{T2}}{400} \right) + 3.16503 \left( \frac{400}{T_{T2}} \right) - 1.588524 \left( \frac{400}{T_{T2}} \right)^2 \quad (19)$$

- Fan engine:  $1.5 < BPR \leq 2.5$

$$P_{HS2}/P_{T2} = -0.770476 + 0.1482515 \left( \frac{T_{T2}}{400} \right) + 4.371758 \left( \frac{400}{T_{T2}} \right) - 2.114969 \left( \frac{400}{T_{T2}} \right)^2 \quad (20)$$

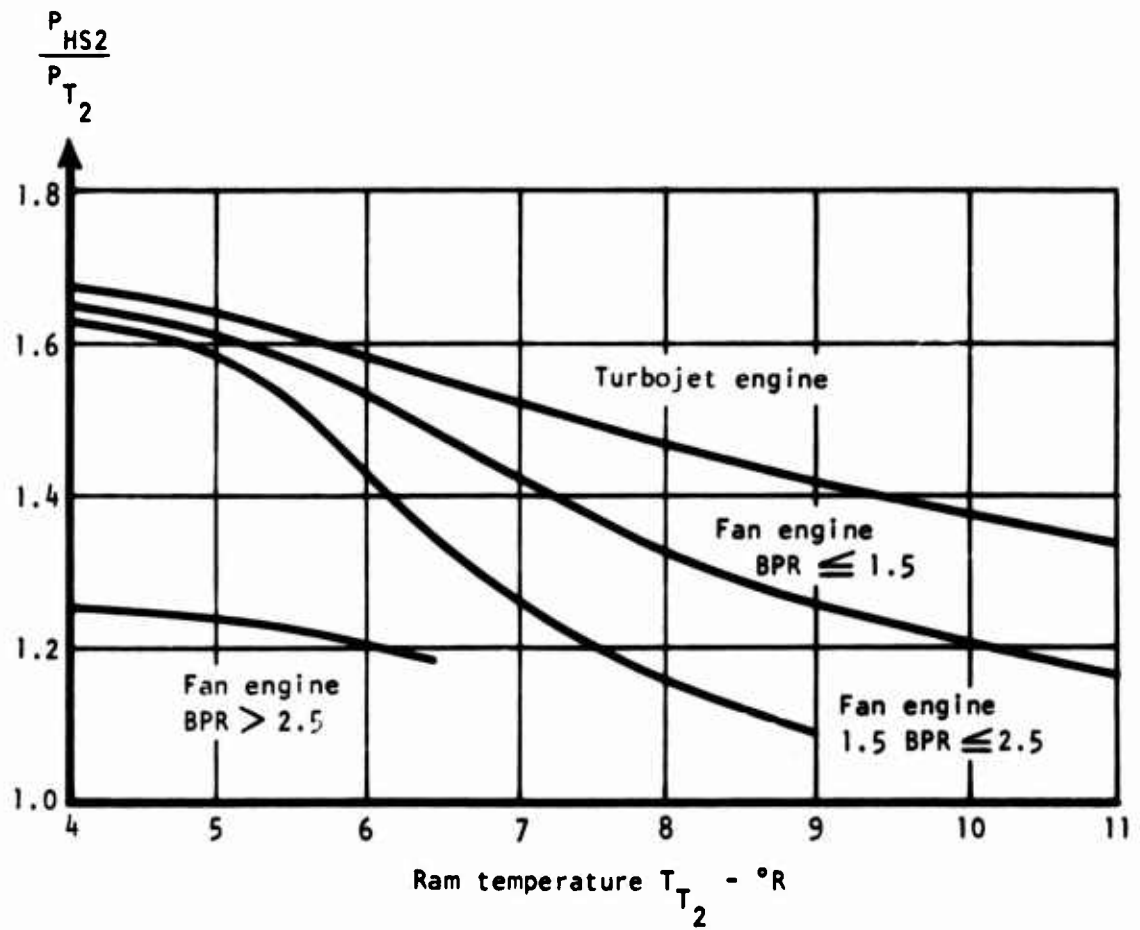


Figure 9. Hammershock pressure ratio.

- Fan engine:  $2.5 < \text{BPR}$

$$P_{\text{HS2}}/P_{\text{T2}} = 1.538116 - 0.3029697 \left( \frac{T_{\text{T2}}}{400} \right) + 0.4872335 \left( \frac{400}{T_{\text{T2}}} \right) - 0.4653126 \left( \frac{400}{T_{\text{T2}}} \right)^2 \quad (21)$$

As the hammershock moves forward in the inlet duct, experimental trends show an attenuation behind the shock, due to boundary layer-shock interaction, and bleed-off into boundary layer control plenums and bypass exits. Figure 10 shows a curve approximating the attenuation between engine face and inlet throat. Equation 22 is the approximation of this curve that is used in the program.

$$P_{\text{HS1}}/P_{\text{HS2}} = 0.984 - 0.0074 M_o - 0.0263 M_o^2 \quad (22)$$

### Design Pressures

The following factors are used for converting limit pressure to ultimate design pressure:

- Static pressure at  $M_L$  - 1.5
- Hammershock pressure at  $M_H$  - 1.5
- Hammershock pressure at  $M_L$  - 1.2

These factors are part of the input data set which may be revised for a specific design problem. The reduced safety factor for the transient over-pressure condition, referred to as hammershock, on the  $M_L$  diagram reflects the current design practice. Use of this reduced safety factor reflects the low probability of simultaneous occurrence of the two transient conditions, hammershock pressure and maximum attainable vehicle speed.

### MATERIAL PROPERTIES

Structural synthesis procedures are dependent on the modeling of physical and mechanical properties of the materials selected for structural design.

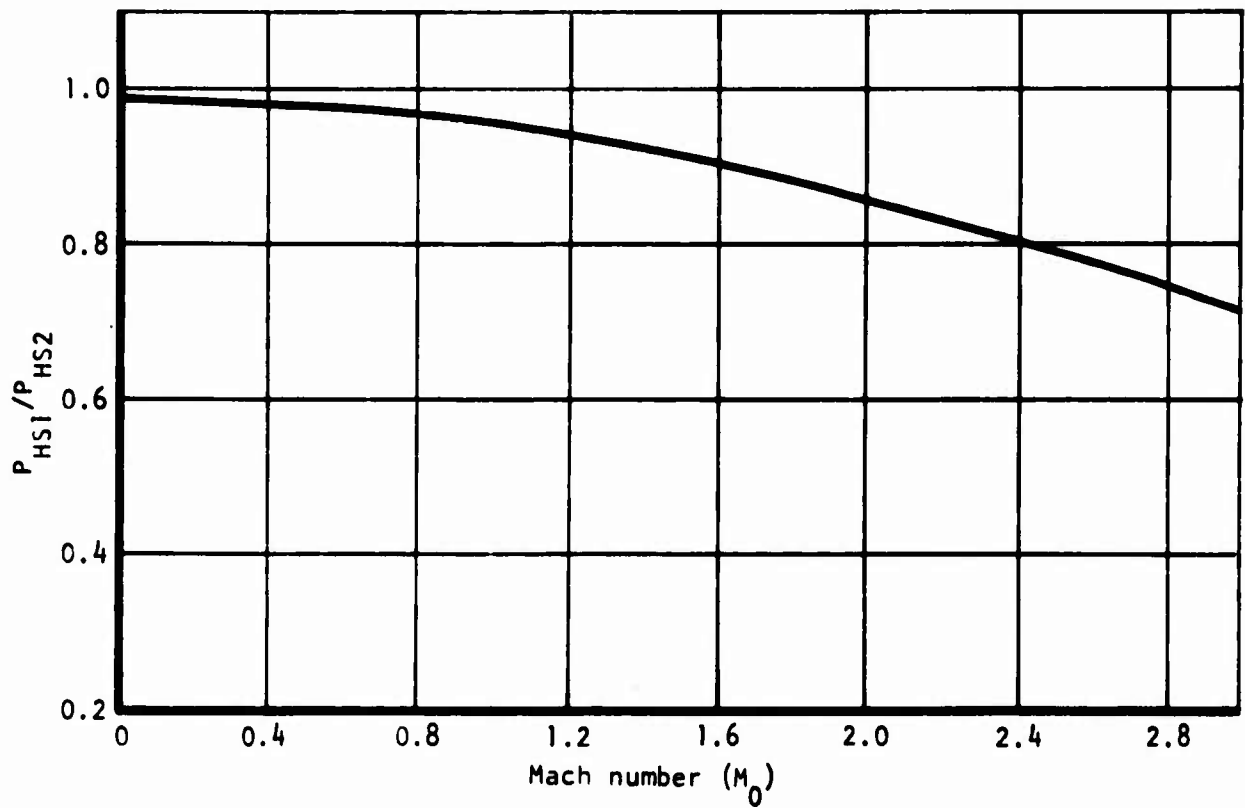


Figure 10. Hammershock attenuation at throat.

Material descriptions must be in a form that can be used to reflect their behavior under load so that structures can be synthesized to satisfy conditions of strength, stiffness, and stability.

Subroutines MCNTL1, MATLF1, and MATLP2 provide these data by processing properties stored in a material data file. This file consists of 20 records which describe physical and mechanical properties of different aluminum, titanium, and steel alloys. Each record consists of the following data:

1. Material identification number and descriptive title
2. Density
3. Modulus of elasticity at room temperature (80° F)
4. Shear modulus of rigidity at room temperature
5. Fatigue characteristic (reduction of area)
6. Stress-strain and strength data at different operating temperatures (a maximum of five sets of data)

Properties at temperatures other than those described in the data sets are determined by an interpolation or extrapolation procedure. Most of these properties are discrete allowables and characteristics.

Inelastic instability solutions require information given by the compressive stress-strain diagram. Stress-strain diagrams of isotropic materials consist of straight-line portions reflecting elastic behavior and curved portions reflecting plastic deformations. Material file data consist of the definition of key points on the stress-strain plot. Proportional limit defines that point on the curve at which the stress-strain diagram departs from the straight line that defines the modulus of elasticity. Figure 11 shows a typical diagram depicting the proportional limit and the yield stress defined by the 0.002 strain offset method. The true yield stress would be used for materials which have a definite yield point. Three other points at equal strain increments define the curved portion of the diagram.

A mathematical representation is used to provide a continuous description of the elastic and plastic properties through the yield stress-point and values for strain, tangent modulus, and secant modulus (Figure 12). The general form of the equation used to approximate the stress-strain curve is:

$$\epsilon = \frac{\sigma}{E} + Ae^{B\sigma} \quad (23)$$

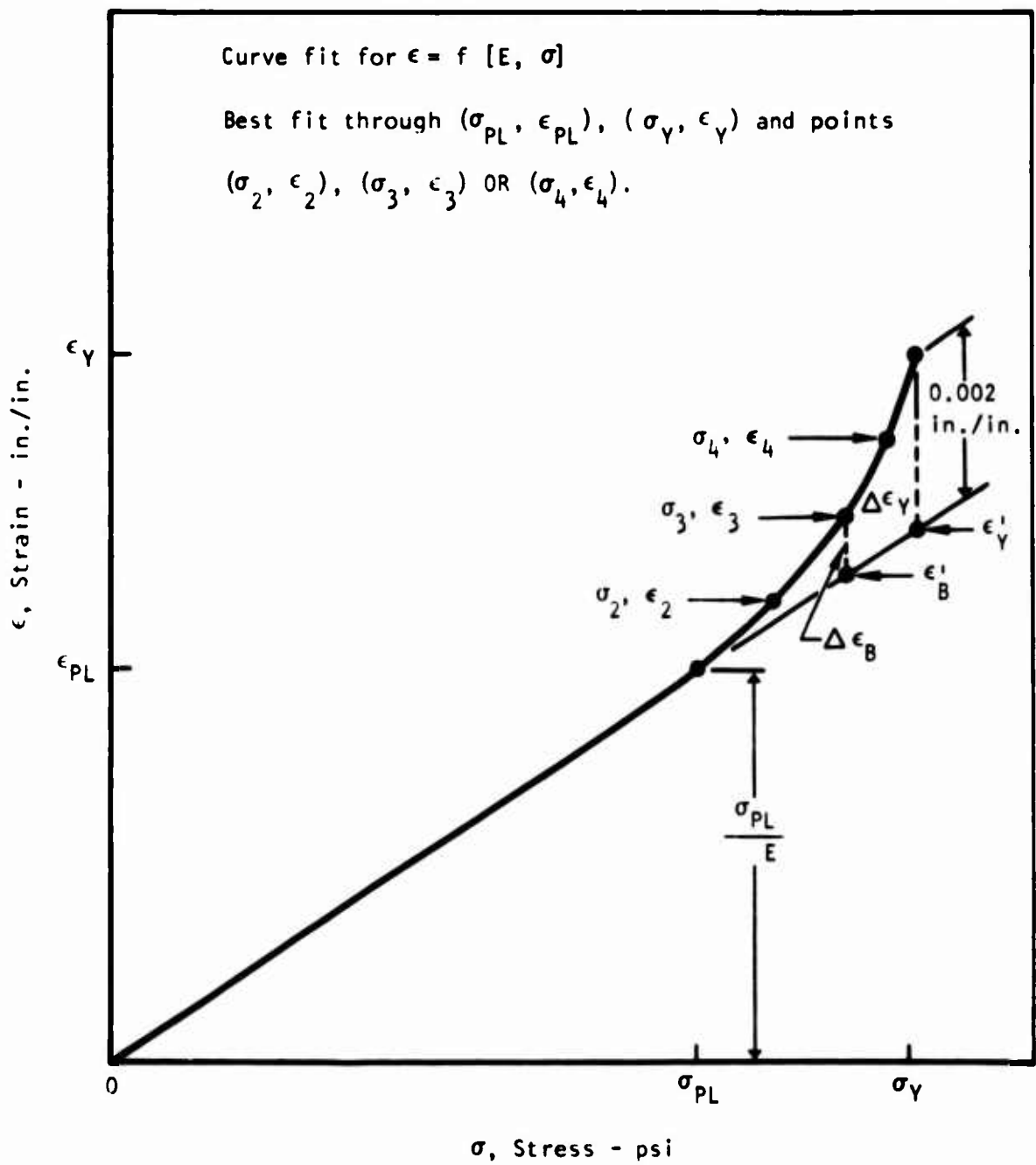


Figure 11. Stress-strain curve and curve fit control points.

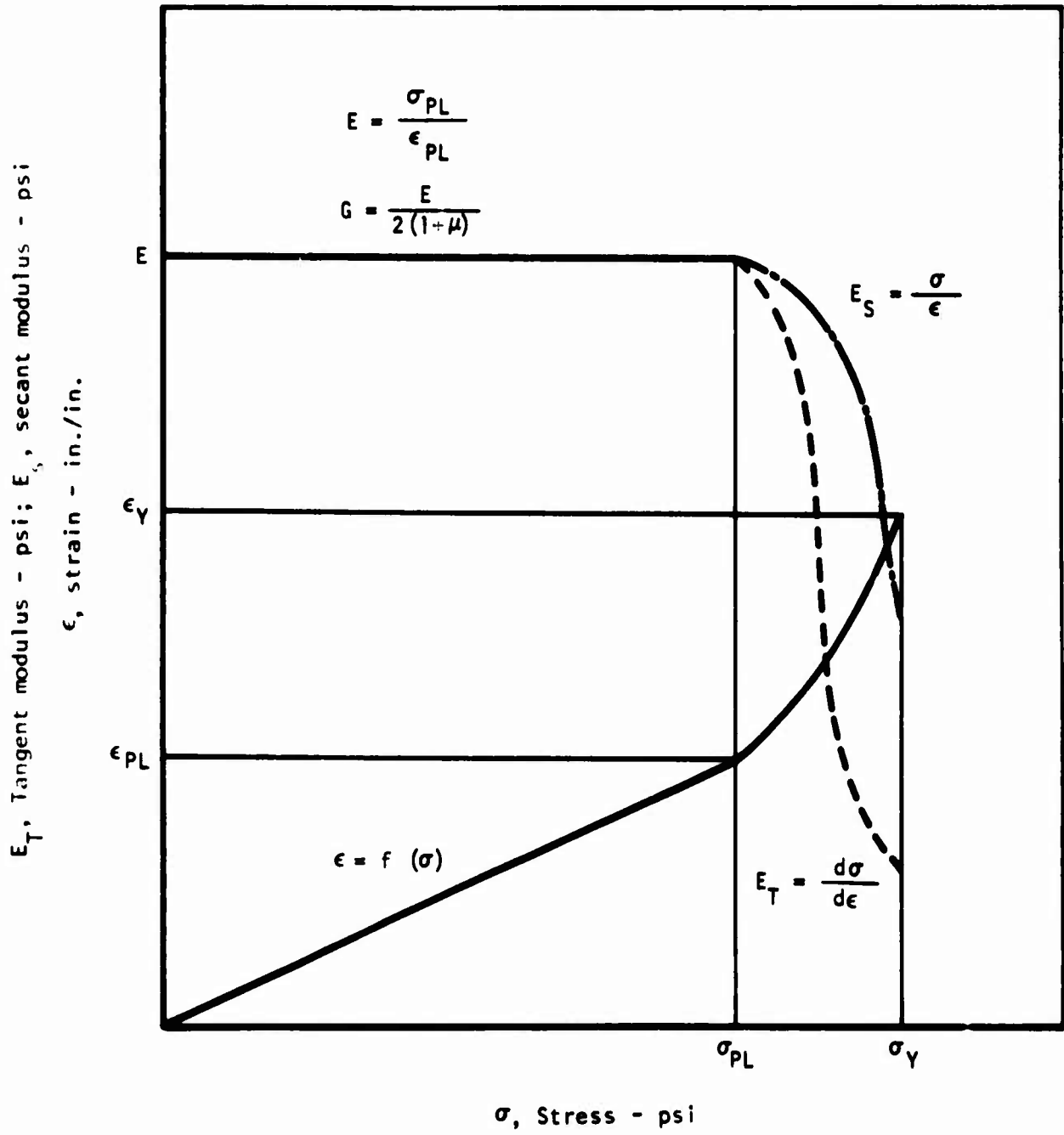


Figure 12. Material stress-strain curve evaluation for elastic and plastic properties.

where

$\epsilon$  = strain, in./in.

$\sigma$  = stress, psi

E = modulus of elasticity, psi

A = constant, function of material, in./in.

B = constant, function of material, 1/psi

e = base of the natural logarithm

The first term of the equation approximates the linear region of the curve where:

$$E = \frac{\sigma_{p1}}{\epsilon_{p1}} = \frac{\sigma_1}{\epsilon_1} \quad (24)$$

The second term fits the plastic region of the stress strain curve. If the curve passes through points 2 and 5, the constant B can be determined by substitution of the stress-strain data.

$$B = \log_e \left[ \frac{\epsilon_5 - \frac{\sigma_5}{E}}{\epsilon_2 - \frac{\sigma_2}{E}} \right] / (\sigma_5 - \sigma_2) \quad (25)$$

and

$$A = \frac{\epsilon_2 - \frac{\sigma_2}{E}}{e^{B\sigma_2}} = e \left[ \log_e \left( \epsilon_2 - \frac{\sigma_2}{E} \right) - B\sigma_2 \right] \quad (26)$$

Similarly, the constants A and B can be derived for curves passing through points 3 and 5 and points 4 and 5. All of the data points are evaluated for the least squares selection. The slope of the curve provides the values of the tangent modulus of the material, the key parameter in stability equations. Tangent modulus is obtained by differentiating the equation.

$$E_T = \frac{d\sigma}{d\epsilon} = \frac{1}{\frac{d\epsilon}{d\sigma}} = \frac{1}{\frac{1}{E} + AB\epsilon^{B-1}\sigma} \quad (27)$$

By definition, tangent modulus is equal to the modulus of elasticity at the proportional limit and, therefore, deviation at this point is also evaluated in the least square fit.

Other design properties obtained from the library are:

1. Poission's ratio
2. Ultimate tensile strength
3. Ultimate shear strength
4. Ultimate bearing strength
5. Fatigue factors, fraction of ultimate tensile strength

Table 2 lists the materials and alloys found in the initial compilation of the material data bank. To allow for ease in identification, each material is identified by record number and descriptive title. This title is always included in the output data set describing the selected structural material for the individual vehicle components being analyzed. This identification of the material used is necessary because material alloy and form, along with the source of the data, must be easily related to the solution of each problem. Data reflecting properties at several operating temperatures after specific exposure at temperatures are included in this file. These properties can be selected when similiar requirements are specified for a problem.

For additional discussion of the manner in which materials properties are established, refer to Volume IV.

TABLE 2. MATERIAL LIBRARY DATA

ID No.	Material		Density (lb/in. <sup>3</sup> )	Basis <sup>a</sup>	Thickness (in.)	Temperature Range (°F)	Room Temp Properties (psi)	
	Description						F <sub>Cy</sub>	F <sub>Su</sub>
1	2024-T81	Al clad sheet	0.100	S	0.063-0.250	80	57,000	39,000
2	2024-T851	Al bare plate	0.100	S <sup>b</sup>	0.500-1.000	80-300	58,500	38,000
3	2024-T851	Al bare plate	0.100	SC	1.000-3.000	80-350	54,500	37,500
4	7075-T6	Al clad sheet	0.101	B	0.040-0.062	80	65,000	44,000
5	7075-T6	Al bare plate	0.101	B	0.250-0.500	80	71,000	47,000
6	7075-T6511	Al extrusion	0.101	A	3.000-4.000	80	66,000	45,000
7	7075-T7351	Al bare plate	0.101	S	0.250-0.500	80	56,000	39,000
8	7050-T7351	Al bare plate	0.102	Est	-	80	66,000	42,200
9	2219-T851	Al bare sheet/plate	0.102	Est	0.250-2.000	80	48,000	36,000
10	7178-T6	Al clad sheet	0.102	B	0.045-0.249	80	75,000	48,000
11	7178-T6	Al bare sheet	0.102	B <sup>d</sup>	0.045-0.249	80-280	75,000	49,000
12	7079-T651	Al bare plate	0.099	A	0.250-1.500	80	63,000	42,000
13	6Al-4V Ti	annealed sheet/plate	0.160	B	-0.250	80-500	138,000	81,000
14	6Al-4V Ti	annealed plate	0.160	S	0.187-4.000	80-350	126,000	76,000
15	9Ni-4Co-0.2C	steel sheet/plate	0.283	Est	-	80	188,000	118,000
16	17-4PH (H900)		0.282	Est	-	80	165,000	120,000

<sup>a</sup>The basis A, B, and S are as defined in MIL-HDBK-5A.

<sup>b</sup>After exposure to 290° F for 120 hours

<sup>c</sup>After exposure to 265° F for 390 hours

<sup>d</sup>After exposure to 280° F for 120 hours

## INLET DUCTS AND DIFFUSERS

Inlet ducts are designed as pressure vessels consisting of panels which serve as pressure membranes, and frames for maintaining the shape. Duct synthesis and weight estimation are controlled by subroutine DUCTS. This routine controls the estimating procedure by calling the following geometry, design synthesis, and weight calculation routines:

- DCTGEO Calculates duct contour data at duct cut stations, and surface area and length for segments bounded by cuts.
- FRMND3 Calculates frame synthesis cut coordinates at each duct cut station. Frame synthesis cut coordinates are based on equal segment lengths.
- FRMELD Calculates unit internal loads at frame segments.
- DUCPNL Calculates duct panel sizing at specified duct cut and frame spacing.
- DUCFRM Calculates sizing and weight of a single duct frame at specified duct cut and frame spacing.
- DUCWET Calculates duct panel structure weight.

Subroutine DUCTS controls a frame spacing search procedure at each of the duct cut stations. The search is conducted between predefined minimum and maximum spacing. Spacing search starts at the minimum and proceeds at fixed spacing increments until the lumped weight of panels and frames indicates an upward trend. Increase of weight with increase in spacing or an optimum less than the initial spacing abbreviates the search. A final sizing pass is made at the spacing prior to the upward trend. Spacings are evaluated at fixed increments such that the derived optimum spacing could be in error by a maximum of half the increment. Weight-spacing variations are, in general, flat in the region of practical design limits such that a more precise solution is not consistent with the scope of this program. If required, spacing increment may be decreased by the user to obtain refined solutions. Controls are also provided such that frame spacing may be restricted to a user-determined input value.

Since all geometric constraints are established by DUCTS, synthesis routines FRMND3, FRMELD, DUCPNL, and DUCFRM are configured for point design solutions. Methods of analysis used to develop duct structure weight are presented in the following paragraphs.

## DUCT GEOMETRY

Duct cross-section geometry is defined at as many as 10 duct stations starting at the inlet lip, and ending at the front face of the engine. A one-dimensional leading edge is described by the single dimension; the next duct cut station describes the first section at which the duct is continuous.

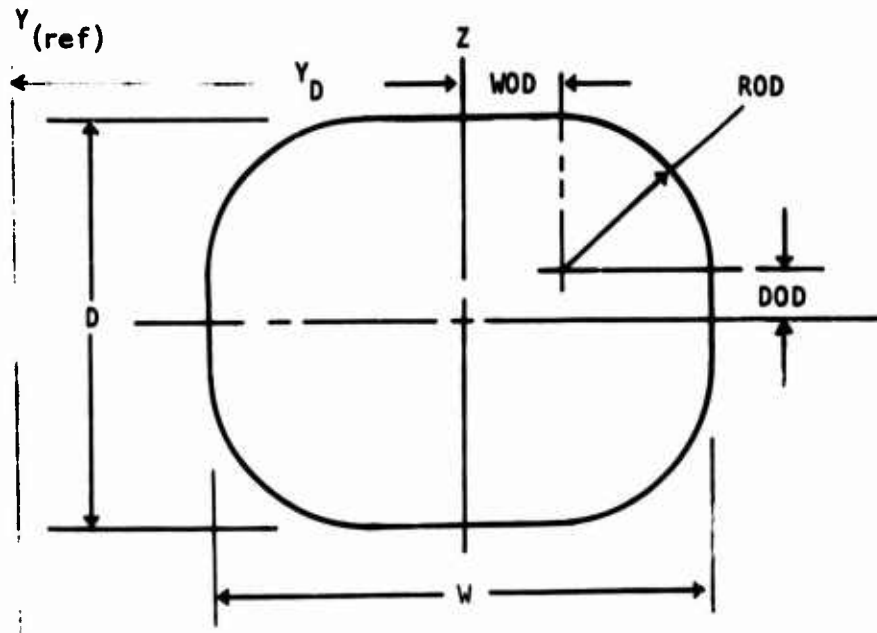
Ducts on a vehicle are assumed to be identical in shape, such that the description of a single duct is sufficient. The presence of bifurcated inlets on most current fighters which combine to form a single duct at a point forward of the engine face is defined by description of the lateral coordinate of the duct centerline relative to the nacelle center line for podded-engine concepts, or the lateral coordinate relative to the fuselage centerline on buried-engine concepts. A lateral nonzero coordinate defines the presence of two ducts per nacelle or fuselage, while zero indicates the presence of a single duct. Thus, if synthesis cuts are spaced close together at the juncture, one defining the geometry immediately forward, and the other the geometry immediately aft of the transition, the program is provided with sufficient logic to make the rational evaluation.

Duct contour data at duct synthesis stations are calculated in subroutine GEOMF1. Calculations in this routine determine shape parameters and perimeter at synthesis stations. Segment data calculated in this routine consists of length and surface area.

Section geometry calculations are based on a family of shapes that may be defined by straight lines and circular arcs. A sketch of the general shape and parameters at a cut follows.

Either of two input formats may be used to define the geometry at the duct cuts (XO):

1. Width (W), depth (D), lateral centroid ( $Y_D$ ), and perimeter (P)
2. Width (W), depth (D), lateral centroid ( $Y_D$ ), and perimeter correlation factor ( $K_c$ )



If the perimeter is not readily available, perimeter correction factor ( $K_c$ ) may be used to describe the shape. Figure 13 depicts the significance of  $K_c$ . The family of rounded rectangle shapes is defined within the region bounded by the curves for rectangular, vertical oval, and horizontal oval shapes. The intersection point of the curves for horizontal and vertical ovals represents a circular cross section. The perimeter is defined by the relationship.

$$P = K_c \frac{\pi}{2} (D + W) \quad (28)$$

where

$K_c = 1.0$  indicates a circular shape

$K_c = 1.273$  indicates a rectangular shape

The perimeter is defined as:

$$P = 4 (DOD + WOD) + 2\pi ROD \quad (29)$$

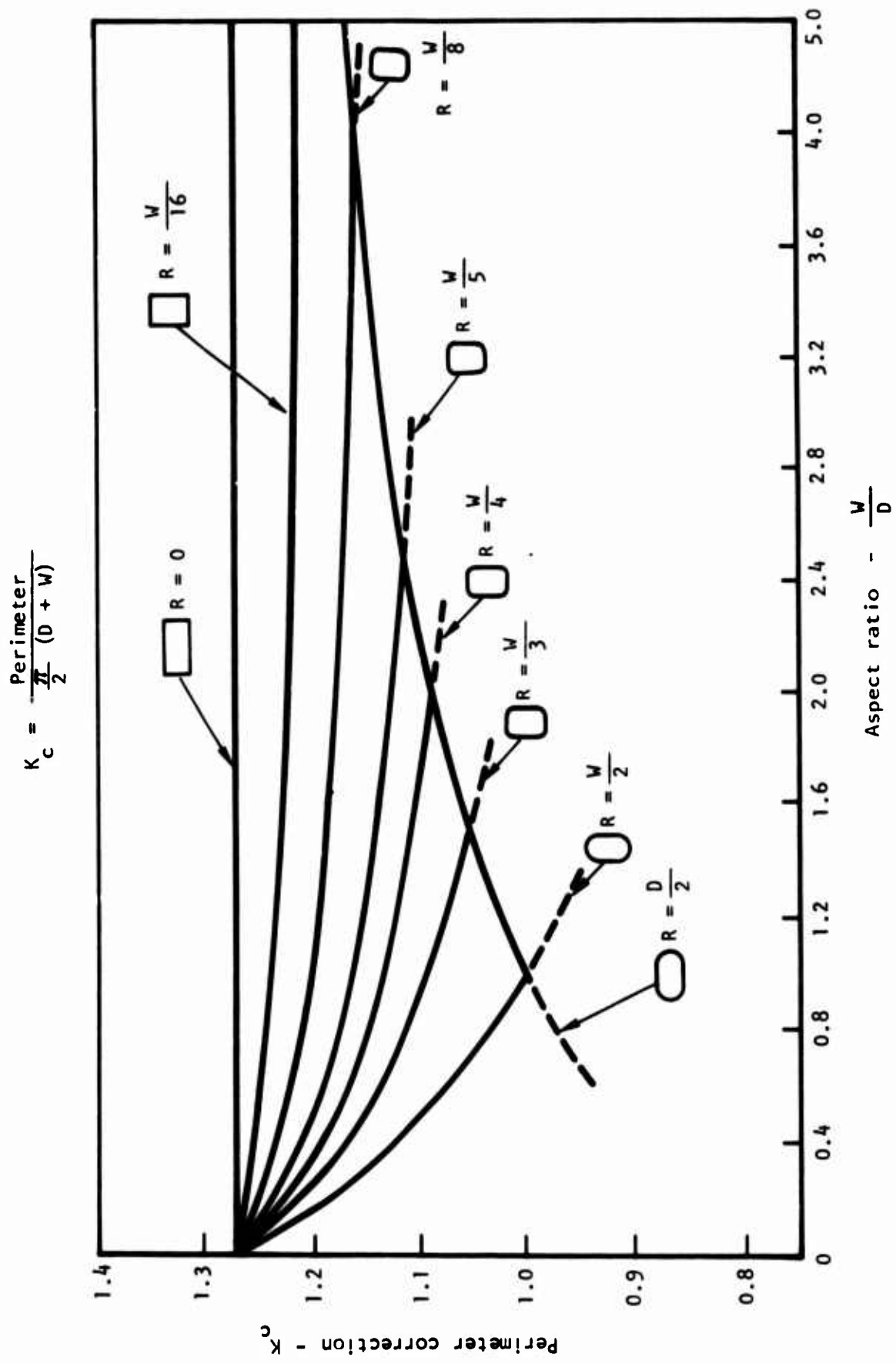


Figure 13. Programmed shapes and correction factors.

and

$$WOD = (W - 2ROD)/2 \quad (30)$$

$$DOD = (D - 2ROD)/2 \quad (31)$$

substituting and solving for the corner radius:

$$ROD = \frac{2D + 2W - P}{8 - 2\pi} \quad (32)$$

If the input parameters result in  $ROD < 0$  or  $2ROD > W$  or  $D$ , the perimeter is maintained and the parameters  $ROD$ ,  $DOD$ , and  $WOD$  are adjusted by a factor  $K$ .

If  $ROD < 0$ , the shape is adjusted to represent a rectangle in the following manner:

$$ROD = 0 \quad (33)$$

$$P = K (2D + 2W) \quad (34)$$

$$K = \frac{P}{2D + 2W} \quad (35)$$

If  $2ROD > W$  or  $D$ , the shape is adjusted to represent a horizontal or vertical oval in the following manner:

$$ROD = \text{minimum of } W/2 \text{ or } D/2 \quad (36)$$

$$X = \text{maximum of } W \text{ or } D \quad (37)$$

$$PER = K (2\pi ROD + 2 (X - 2ROD)) \quad (38)$$

$$K = \frac{P}{2\pi ROD + 2 (X - 2ROD)} \quad (39)$$

Then the adjusted values for DOD, WOD, and ROD are:

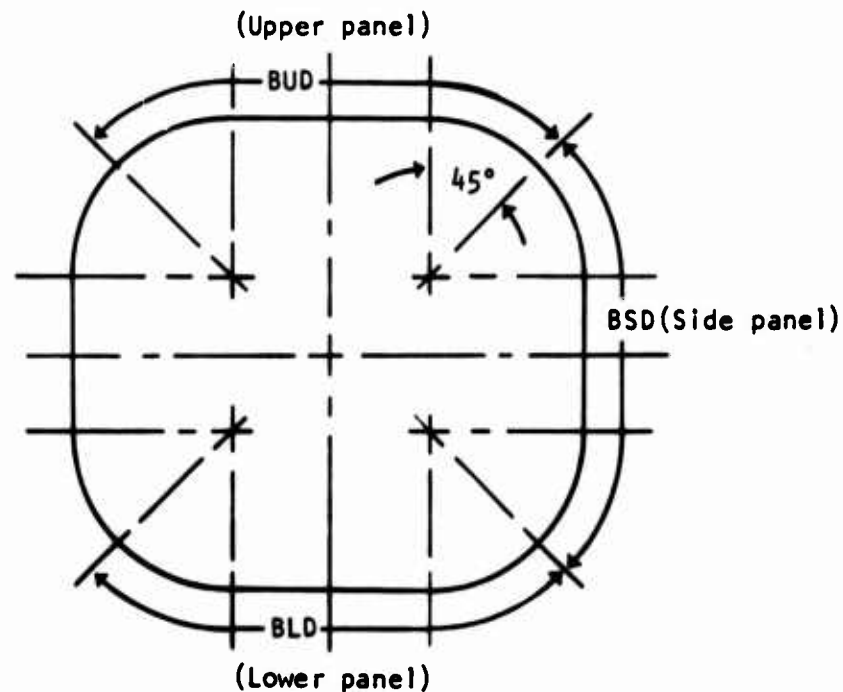
$$WOD = K (W - 2ROD)/2 \quad (40)$$

$$DOD = K (D - 2 ROD)/2 \quad (41)$$

$$ROD = K (ROD) \quad (42)$$

Should the geometry require adjustment by "K," a warning message is printed to indicate the amount of adjustment made to the depth and width at the section.

At each cut station, duct panels are divided into four sectors representing the upper, lower, and two sides. A 45-degree angle is used to define the limits of these sectors.



The peripheral length of the cover elements in these sectors are:

$$BUD = BLD = 2WOD + \frac{\pi}{2} ROD \quad (43)$$

$$BSD = 2DOD + \frac{\pi}{2} ROD \quad (44)$$

Segment geometric data are calculated from the cut data. The subscript  $n$  is used in the discussion that follows to denote the segment bounded by cuts  $j-1$  and  $j$ . Segment length (DLXD) is determined by taking the difference between adjacent cuts. Surface area (SFD) is calculated by using the average perimeter (equation 45):

$$SFD_n = DLXD_n (P_j + P_{j-1})/2 \quad (45)$$

A one-dimensional leading edge is described by the single dimension; the next synthesis cut describes the first section at which the duct is continuous. One-dimensional leading edge surface area and centroid are determined from geometric data at the first two cuts. For vertical leading edges, there are two possibilities; a third case, although improbable, is also programmed.

Case where lateral coordinates ( $Y_D$ ) at stations 1 and 2 are both positive:

$$SFD_1 = DLXD_1 (D_1 + BSD_2 + BUD_2 + ELD_2) \quad (46)$$

where

$SFD_1$  = duct lip surface area

$DLXD_1$  = leading edge segment length

$D_1$  = depth at station 1

$BSD_2$  = peripheral length of duct side sector at station 2

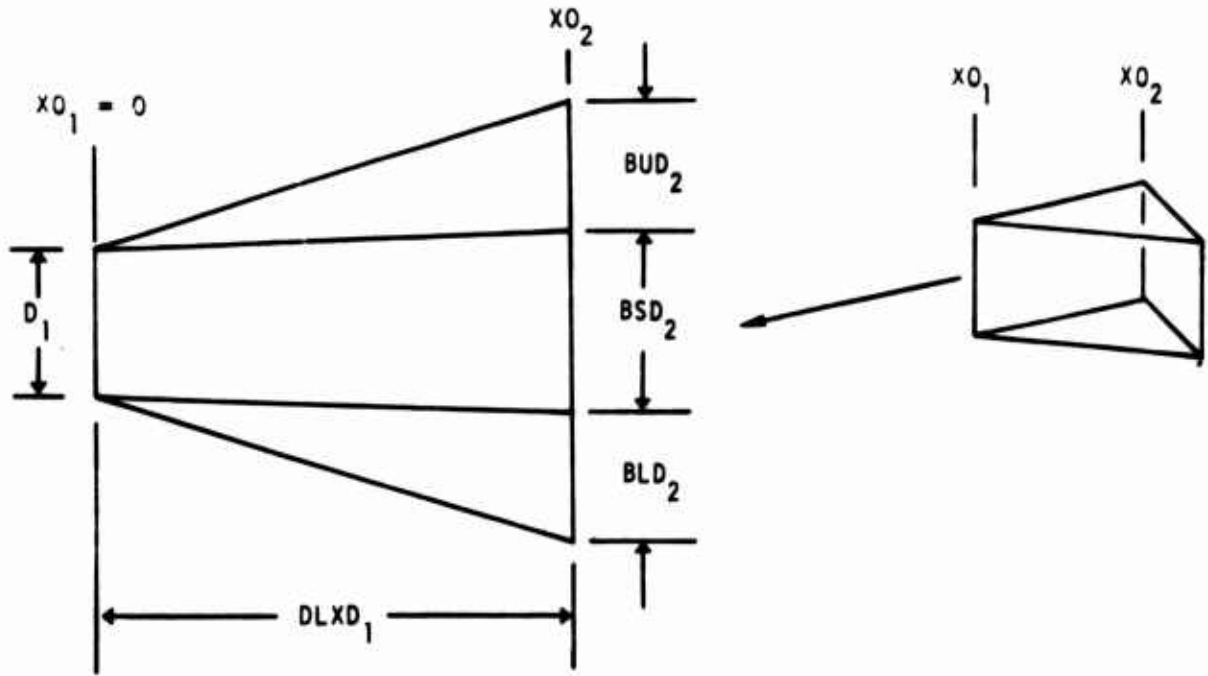
$BUD_2$  = peripheral length of duct upper sector at station 2

$BLD_2$  = peripheral length of duct lower sector at station 2

The foregoing calculation accounts for two separated inlets as would occur for fuselage-buried-engine concepts with side inlets. A flat pattern representation of one of these inlet surfaces follows.

Case where lateral coordinate at station 1 is zero and at station 2 is positive:

$$SFD_1 = DLXD_1 \left\{ \left( \frac{D_1 + BSD_2}{2} \right) + BUD_2 + BLD_2 \right\} \quad (47)$$



Equation 47 represents the case where there are two inlets per nacelle or, on fuselage-buried engine concepts, two inlets with a common vertical splitter.

Case where lateral coordinate at stations 1 and 2 are both zero:

$$SFD_1 = \frac{DLXD_1}{2} (D_1 + BSD_2 + BUD_2 + BLD_2) \quad (48)$$

For horizontal leading edges, there are two possibilities. Case where the lateral coordinate at station 2 is zero is calculated by equation 49. This situation represents a single inlet per nacelle or fuselage.

$$SFD_1 = \frac{DLXD_1}{2} (W_1 + BUD_2 + 2 BSD_2) \quad (49)$$

where

$W_1$  = width of inlet lip at station 1

The case where the lateral coordinate at station 2 is positive represents two inlets per nacelle or fuselage and is calculated by equation 50.

$$SFD_1 = DLXD_1 \left( W_1 + BUD_2 + \frac{3}{2} BSD_2 \right) \quad (50)$$

#### DUCT PANEL SYNTHESIS

Duct panel thickness requirements at continuous duct sections are calculated in subroutine DUCPNL. The synthesis approach assumes that the internal pressure is beamed to the frames by the combined bending and diaphragming action of the cover panels.

#### Strength and Deflection Equations

Strip theory is used to evaluate the combined bending diaphragm action. The maximum cover stress occurs at the supports. The bending moment is maximum at the edges, goes through an inflection point, and is smaller at the midspan. Combined bending and diaphragm action result in the second highest stresses occurring at the midspan. Therefore, single-thickness covers are design by the stress at the edges. Land thickness for milled cover panels is determined by the edge stress, and the field thickness is determined by the stress at the midspan. The analytical solutions are expressed by numerical values of dimensionless coefficients in Reference 4. This same information is presented as curves in the Royal Aeronautical Society notes. The log-log plot of these curves (Figure 14) suggests a numerical approximation. The derivation of thickness as an explicit function of these variables is obtained by a curve fit approach.

The curve fit approximation at the edge of the panel is:

$$\frac{\sigma}{E} \left( \frac{b}{t} \right)^2 \approx 1.4725 \left[ \frac{P}{E} \left( \frac{b}{t} \right)^4 \right]^{0.69412}$$

or

$$t = \frac{1.646 b P^{0.894} E^{0.394}}{\sigma^{1.288}} \quad (51)$$

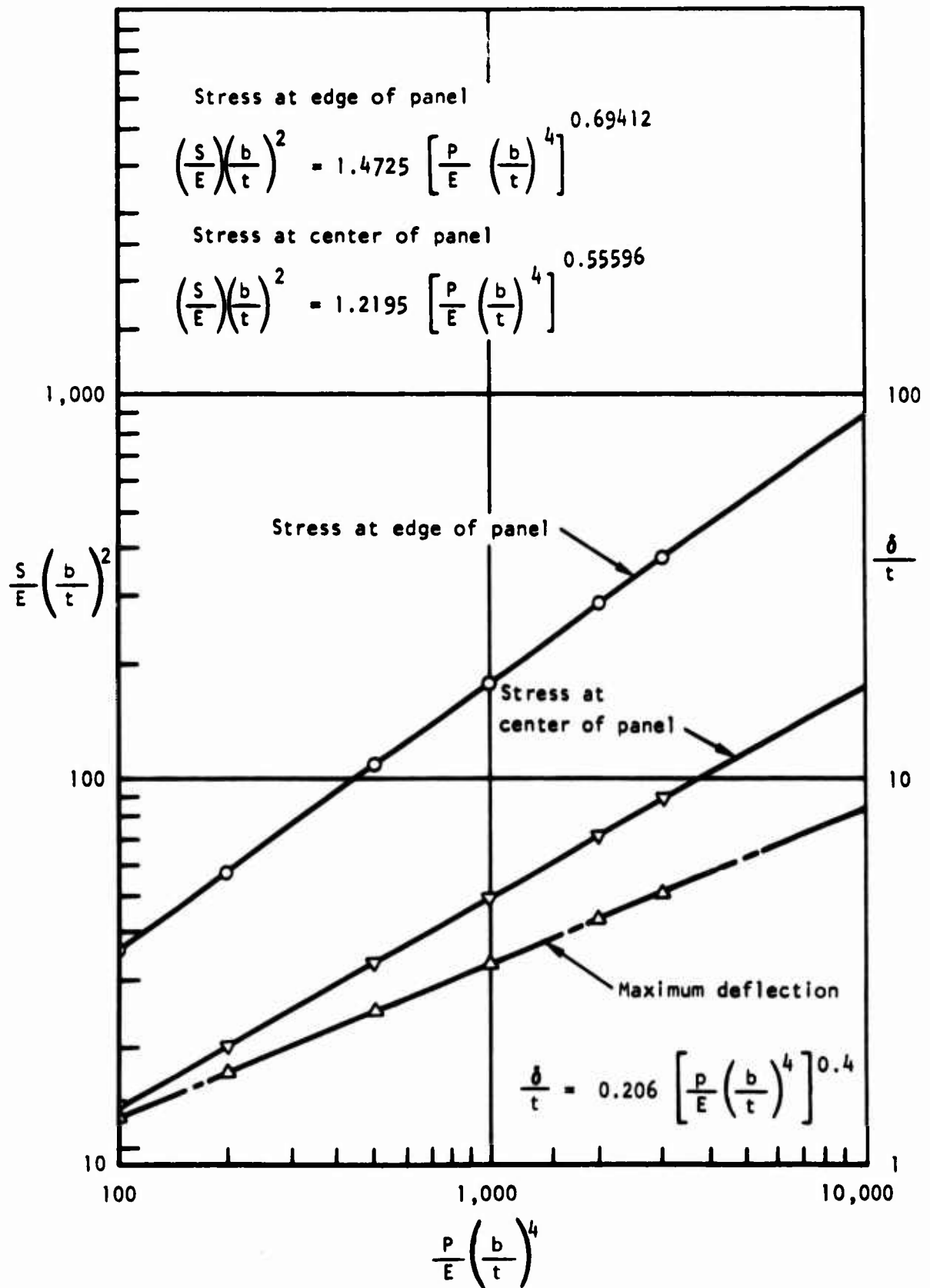


Figure 14. Diaphragm stresses and deflections.

where

t = panel thickness, in.

b = frame spacing, in.

P = limit duct pressure, psig

E = duct material modulus of elasticity, psi

$\sigma$  = duct material limit allowable tensile stress, psi

The midspan thickness and deflections are:

$$\frac{\sigma}{E} \left(\frac{b}{t}\right)^2 = 1.2195 \left[\frac{P}{E} \left(\frac{b}{t}\right)^4\right]^{0.55596}$$

or

$$t = \frac{1.3769 b P^{2.484}}{\sigma^{4.467}} E^{1.984} \quad (52)$$

and

$$\frac{\delta}{t} = 0.206 \left[\frac{P}{E} \left(\frac{b}{t}\right)^4\right]^{0.4}$$

or

$$t = \frac{0.071853 \left(\frac{P}{E}\right)^{2/3} b^{8/3}}{\delta^{5/3}} \quad (53)$$

where

$\delta$  = allowable panel deflection, in.

In the foregoing equations, stress and pressure are expressed in terms of limit rather than ultimate design. This is a normal design practice when internal loads are dependent on deflected shape.

Equations 51, 52, and 53 are used in a systematic check of strength and deflection requirements for pressures at the nine speed profile points. Minimum gage and, for milled panel designs, an additional constraint of maximum allowable ratio of land thickness to field thickness are also evaluated to determine the duct sizing.

### Allowable Stress

Allowable limit stress is obtained by evaluating ultimate strength and allowable stress under cyclic loading. Previously discussed safety factors are reiterated as follows:

- Static pressure at  $M_L$  - 1.5
- Hammershock pressure at  $M_H$  - 1.5
- Hammershock pressure at  $M_L$  - 1.2

Limit allowable tensile stress is obtained by dividing the duct material ultimate tensile strength at the pressure condition temperature by the appropriate safety factor.

Inlet pressures are cyclic occurrences that subject the duct to possible fatigue failure. The maximum allowable stress to prevent fatigue failure is a preprogrammed fraction (0.5) of the material ultimate tensile strength. Limit allowable stress corresponding to static pressure on the  $M_L$  profile is the lower of either that which satisfies strength or fatigue. Hammershock pressures are only investigated for strength requirements.

### Allowable Deflection

Duct panel deflection is evaluated for static pressures on the  $M_L$  profile. Allowable deflection constraints are predefined nondimensional parameters based on frame spacing in the form of  $\delta/b$ . This predefined allowable deflection forward of the throat is 0.03 inch per inch and is 0.06 from the throat to the engine face. Difference between these two values is attributed to flow field disturbance being detrimental to inlet performance at the throat and less so upon expansion of the air aft of the throat. If available, user input data can be used to override these deflection constraints.

## Duct Weight

Duct weight calculations are performed in subroutine DUCWET. The procedure consists of evaluating a one-dimensional leading edge segment, normal continuous cross-section duct segments, and segments blanked by the presence of two-dimensional variable geometry ramps.

The leading edge segment, should it occur, is assumed to consist of structure forward of the first complete cross-section defined at the second duct cut. This leading edge segment is estimated at 4 pounds per square foot of surface area.

Weight calculation for the remainder of the inlet duct panels is based on a linear taper of thickness between duct cuts. Should two-dimensional ramps exist, areas blanked by ramps are not required and, therefore, are deleted in the weight calculation.

A weight correlation factor is applied to the resultant weight. This factor is considered to be a calibration factor which accounts for design parameters and unique conditions not considered in the analysis.

## DUCT FRAME SYNTHESIS

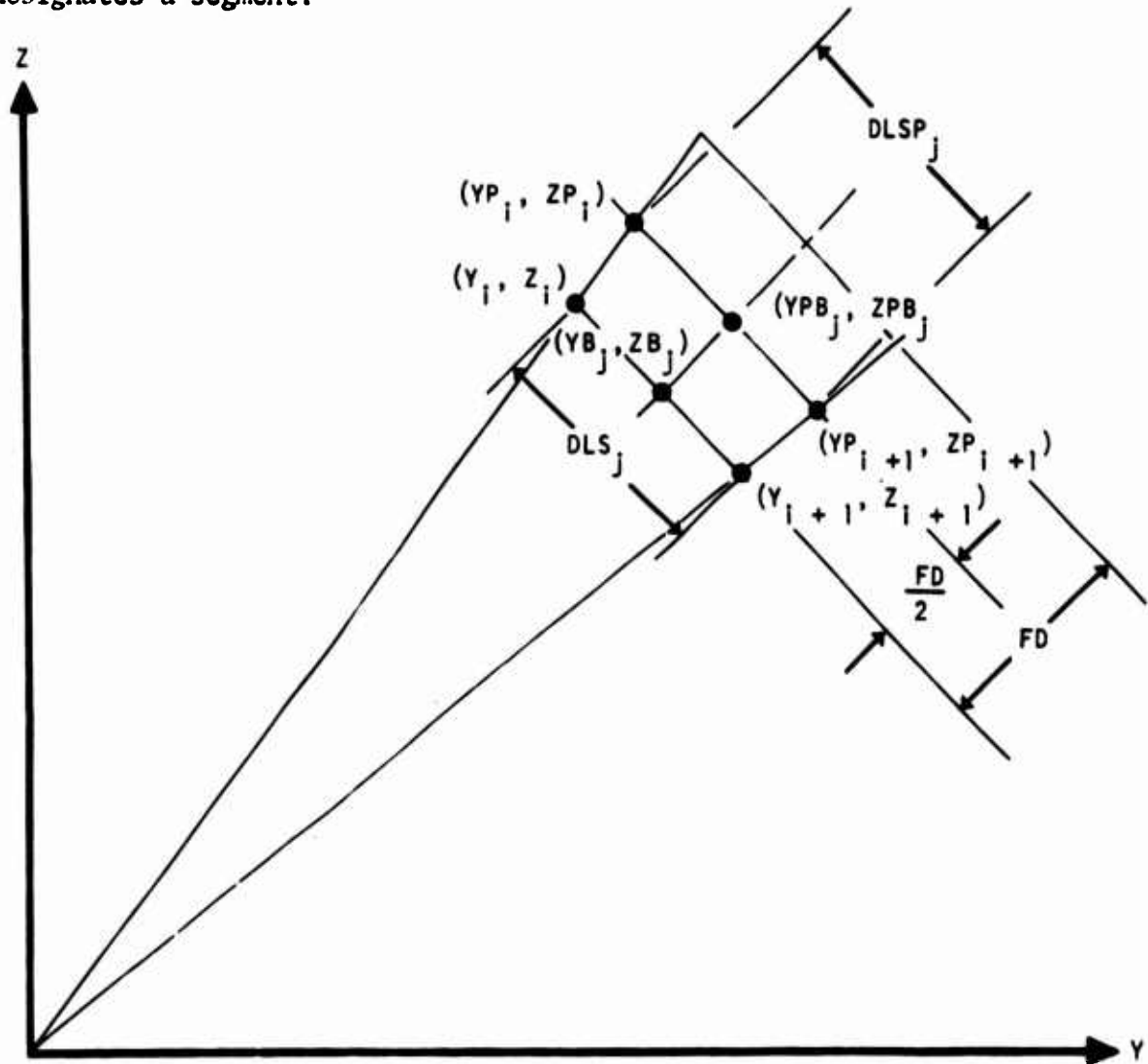
Duct frames are synthesized at duct cut stations with continuous duct sections. Pressure acts at the duct surface and is reacted by a frame with a neutral axis half a frame depth outside the duct lines. Pressure reacted by the frame is defined as the loading due to pressure times frame spacing.

The elastic center method<sup>(5)</sup> is used to derive internal loads at as many as 60 frame segments. In this approach, ring distortions due to axial and shear forces are neglected, based on the premise that these distortions are small compared to bending distortions. Iteration on internal loads, sizing, and flexibility are not included in this approach. Iteration cycles have been omitted to minimize computer execution time. Another economic consideration is the judicious use of the number of frame segments. Although the capability for evaluating 60 frame segments has been programmed, the evaluation of 20 synthesis segments should provide reasonable accuracy.

## Frame Geometry

Frame inner cap coordinates at a duct cut station are calculated in subroutine FRMND3. Duct contour data are used to calculate these coordinates. Cuts are located to provide segments of equal length (DLS) with the first and last cuts at the top centerline of the frame. Since frame structure extends

outside the duct mold line, neutral axis coordinates are then calculated in FRMELD by projecting outward a distance equal to half the frame depth. In the following sketch and discussions, the subscript  $i$  designates a cut, and  $j$  designates a segment.

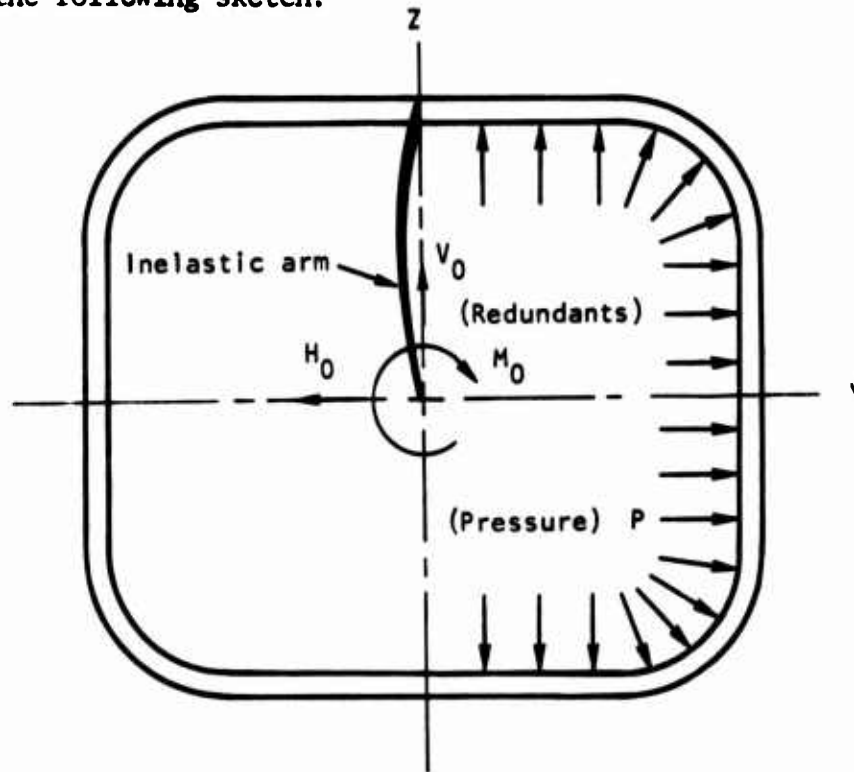


Perimeter of the outer cap, ( $P$ ), and perimeter of the frame, ( $PP$ ), are calculated by the following summations.

$$P = \sum DLS_j \quad (54)$$

$$PP = \sum DLSP_j \quad (55)$$

For most duct frames, the Z-axis is the axis of symmetry for both ring geometry and flexibility. Therefore, the rigid arm in the elastic center method is assumed to be attached to the top centerline of the ring. The positive sign convention and location of redundants and pressure forces are shown in the following sketch.



Since one of the assumptions is that frame flexibility is constant, unity may be used for stiffness ( $I_j$ ), and the elastic center and the geometric neutral axis are identical. The elastic center (ZS) is determined by:

$$ZS = \frac{\sum \frac{ZPB_j \text{ DLSP}_j}{I_j}}{\sum \frac{\text{DLSP}_j}{I_j}} = \frac{\sum ZB_j \text{ DLS}_j}{\sum \text{DLS}_j} \quad (56)$$

The section inertia about the two reference axes are:

$$IOZ = \sum YPB_j^2 \text{ DLSP}_j \quad (57)$$

$$IOY = \sum (ZPB_j - ZS)^2 \text{ DLSP}_j \quad (58)$$

### Unit Internal Frame Loads

Since pressure acts normal to the inner cap surface and is uniform around the section, internal loads for any frame shape can be determined on the basis of unit pressure loading. Unit internal loads, when multiplied by the design pressure provide the design loads. Subroutine FRMELD calculates these unit internal loads. Dimension of the unit pressure load, (p), is 1.0 lb/in. in the equations and discussions that follow.

Static frame moment, vertical, and horizontal loads are determined by combining effects of the unit pressure forces. Static moment at any cut is calculated by equation 59.

$$BM_i = P \sum_{n=2}^i (Z_n - Z_{n-1})(ZP_i - ZB_{n-1}) + (Y_n - Y_{n-1})(YP_i - YB_{n-1}) \quad (59)$$

Static vertical force at any cut is calculated by equation 60.

$$V_i = P \sum_{n=2}^i (Y_n - Y_{n-1}) \quad (60)$$

Static horizontal force at any cut is calculated by equation 61.

$$A_i = P \sum_{n=2}^i (Z_n - Z_{n-1}) \quad (61)$$

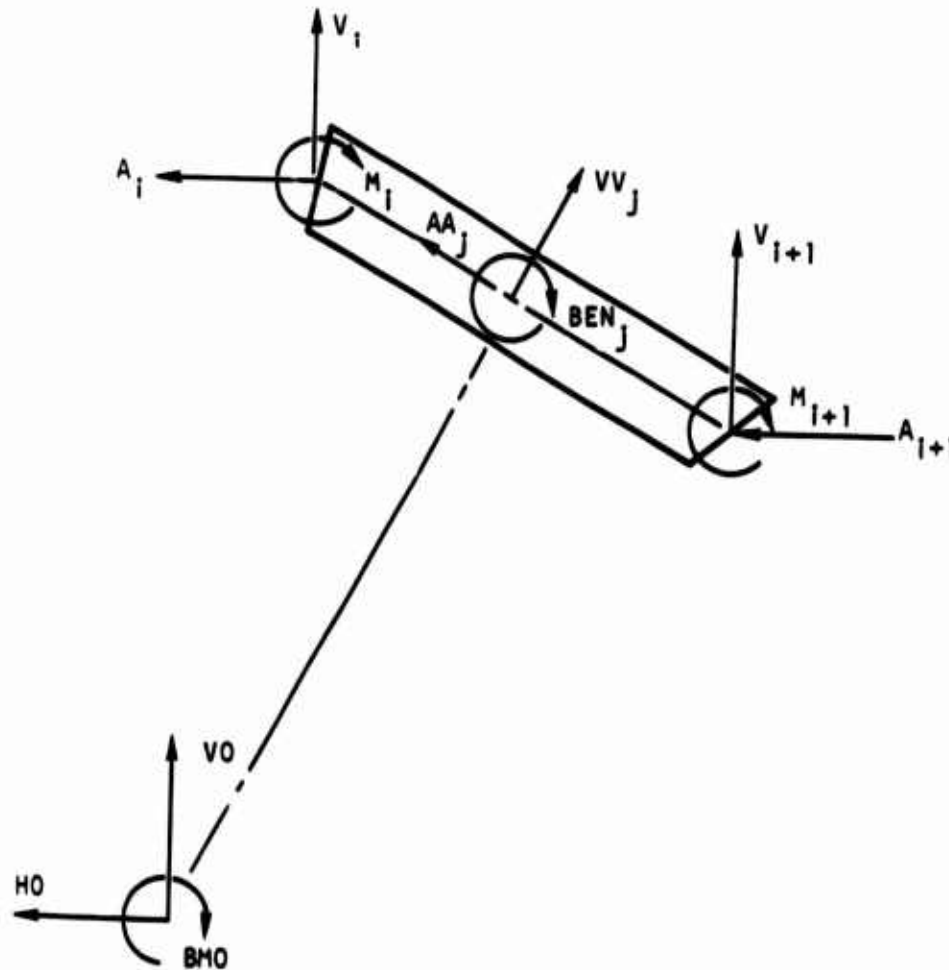
Due to ring symmetry about the Z-axis, the redundants at the elastic center are calculated by the three independent equations. These equations are further simplified by the assumption that ring flexibility (EI) is constant.

$$BMO = - \frac{\sum \frac{M \text{ DLSP}}{EI}}{\sum \frac{\text{DLSP}}{EI}} = - \frac{\sum M \text{ DLSP}}{PP} \quad (62)$$

$$H_0 = - \frac{\sum \frac{M (Z_{PB} - Z_{ZS}) DLSP}{EI}}{\sum \frac{(Z_{PB} - Z_{ZS})^2 DLSP}{EI}} = - \frac{\sum M (Z_{PB} - Z_{ZS}) DLSP}{I_{OY}} \quad (63)$$

$$V_0 = - \frac{\sum \frac{M Y_{PB} DLSP}{EI}}{\sum \frac{Y_{PB}^2 DLSP}{EI}} = - \frac{\sum M Y_{PB} DLSP}{I_{OZ}} \quad (64)$$

The unit internal ring bending moment, shear, and axial loads at any segment are obtained by taking the average of the loads at bounding cuts and the loads due to the redundants.



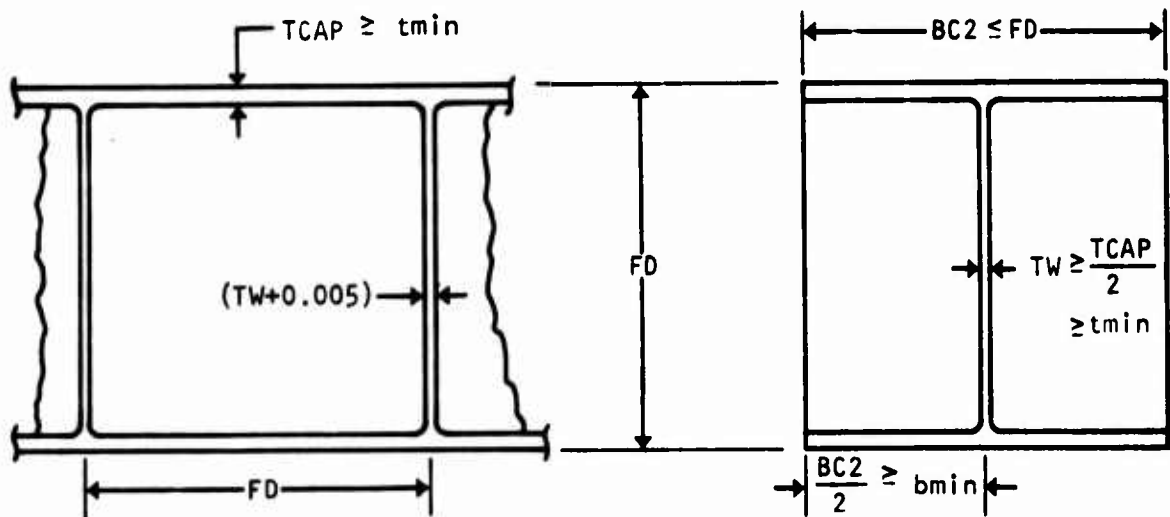
$$BEN_j = BMO + VO YPB_j + HO (ZPB_j - ZZS) + \left( \frac{M_i + M_{i+1}}{2} \right) \quad (65)$$

$$W_j = \frac{\left[ VO + \left( \frac{V_i + V_{i+1}}{2} \right) \right] (Y_{i+1} - Y_i) + \left[ HO + \left( \frac{A_i + A_{i+1}}{2} \right) \right] (Z_{i+1} - Z_i)}{DLS_j} \quad (66)$$

$$AA_j = \frac{\left[ VO + \left( \frac{V_i + V_{i+1}}{2} \right) \right] (Z_{i+1} - Z_i) + \left[ HO + \left( \frac{A_i + A_{i+1}}{2} \right) \right] (Y_{i+1} - Y_i)}{DLS_j} \quad (67)$$

### Frame Synthesis and Weight

Duct frame synthesis and weight calculations are performed in subroutine DUCFRM. The sizing approach assumes shear resistant webs with the caps determined by material allowable and flange crippling. Frame stiffeners are assumed to be one gage greater than the web gage. The structure model and geometric constraints are shown in the following sketch.



Frame segments are sized for hammershock pressures on the  $M_H$  and  $M_L$  profiles and for static pressures on the  $M_L$  profile. Sizing for each pressure condition is compared with minimums and sizing that satisfied all previous pressure conditions. Since each condition may be at a different structure design temperature, material properties at the appropriate condition are used. Ultimate loading on the frame is determined by equation 68.

$$w = W b FS \quad (68)$$

where

$w$  = frame loading, lb/in.

$W$  = limit gage pressure, psig

$b$  = frame spacing, in.

$FS$  = factor of safety:

- 1.5 for static pressure at  $M_L$
- 1.5 for hammershock pressure at  $M_H$
- 1.2 for hammershock pressure at  $M_L$

The limit gage pressure ( $W$ ) at the duct cut station is obtained by interpolating between pressures at the throat and at the engine face. Maximum cap load at a frame segment ( $j$ ) is obtained by equation 69.

$$FA_j = w \left( \left| \frac{BEN_j}{FD} \right| + \left| \frac{AA_j}{2} \right| \right) \quad (69)$$

where

$FA_j$  = cap load, lb

$BEN_j$  = unit internal bending moment, in.-lb/(lb/in.)

$FD$  = frame depth, in.

$AA_j$  = unit internal axial load, lb/(lb/in.)

Cap area that satisfies strength is

$$A_c = \frac{F A_i}{K F_{cy}} \quad (70)$$

where

$A_c$  = cap area, in.<sup>2</sup>

$K$  = reduction factor on allowable stress (0.9)

$F_{cy}$  = frame material compression yield stress, psi

Flange crippling allowable is

$$F_{CCR} = \frac{K_c \pi^2 E}{12 (1-\mu^2)} \left( \frac{2 TCAP}{BC2} \right)^2 \quad (71)$$

where

$K_c$  = flange crippling coefficient (0.426)

Equating strength and crippling stress and solving for cap thickness,

$$K F_{cy} = F_{CCR} \frac{K_c \pi^2 E}{12 (1-\mu^2)} \left( \frac{2 TCAP}{BC2} \right)^2 \quad (72)$$

$$\frac{2TCAP}{BC2} = \sqrt{\frac{K F_{cy} 12 (1-\mu^2)}{K_c \pi^2 E}} \quad (73)$$

$$TCAP = \sqrt{\frac{A_c}{2}} \sqrt{\frac{K F_{cy} 12 (1-\mu^2)}{K_c \pi^2 E}} \quad (74)$$

Web shear strength is

$$F_{su} = \frac{w |W_j|}{FD TW} \quad (75)$$

where

$F_{su}$  = frame material ultimate shear strength, psi

$W_j$  = unit internal shear, lb/(lb/in.)

Making the web shear resistant and equating shear stress and crippling stress, the web thickness is

$$F_{SCR} = \frac{K_s \pi^2 E}{12(1-\mu^2)} \left(\frac{TW}{FD}\right)^2 = \frac{w |W_j|}{FD TW} \quad (76)$$

where

$K_s$  = shear crippling coefficient (7.5)

$$TW = \left( \frac{w |W_j|}{K_s \pi^2 E} \frac{FD 12 (1-\mu^2)}{FD} \right)^{1/3} \quad (77)$$

The final web thickness is the maximum of that required for shear resistance, shear strength, or half the cap thickness.

After all load conditions have been evaluated, the frame weight is calculated by the summation of cap web and stiffener volume.

$$TWT = \sum \left[ BB2_j (TWW_j + 0.005) + TCC_j \cdot 2 \cdot BB2_j + \right. \\ \left. TWW_j \cdot FD \right] \cdot DLSP_j \cdot RHO \quad (78)$$

where

TWT = weight of one frame at duct cut station, in.

BB2<sub>j</sub> = BC2, cap width at a frame segment, in.

TWW<sub>j</sub> = TW, web thickness at a frame segment, in.

TCC<sub>j</sub> = TCAP, cap thickness at a frame segment, in.

RHO = frame material density, lb/in.<sup>3</sup>

#### TWO-DIMENSIONAL VARIABLE-GEOMETRY RAMPS

Variable geometry ramp structures are designed by differential pressures between the inlet and the plenum compartment behind the ramps. The critical design pressure condition is determined in subroutine DECRT by investigating hammershock pressures at points on the vehicle speed-altitude profile. Synthesis and weight calculations for two-, three-, and four-ramp variable-geometry systems are performed in subroutine RAMPS. Procedures in RAMPS consist of:

1. Calculation of design pressure differentials for each ramp panel
2. Calculation of local reactions based on equations of static equilibrium and component design loads
3. Structural synthesis based on loads and construction
4. Tests against minimum practical structure

## RAMP DESIGN PRESSURE

Hammershock pressure at each of nine points on both the level flight maximum speed and limit speed envelopes are investigated for critical ramp design pressure. Subroutine PRECRT selects the critical pressure for use by the variable-geometry ramp synthesis routine, RAMPS.

On two-dimensional variable-geometry inlet systems, boundary layer is bled through the ramps into plenum compartments located behind the ramps. In order to minimize ramp weights, plenum pressures are maintained as close as possible to the average of buzz and hammershock, but at a level which maintains a positive pressure differential between the inlet and plenum for steady-state conditions. The structural design condition for the ramps is assumed to occur during a hammershock condition when the pressure differential is presumed to be at its maximum level.

Different safety factors are used to convert limit pressure to ultimate design pressure. The rationale behind use of these factors has been presented in the paragraphs discussing pressure derivation. These safety factors (FACT) are as follows:

- Hammershock pressure at  $M_H - 1.5$
- Hammershock pressure at  $M_L - 1.2$

Structure temperature and corresponding material properties vary with pressure condition. The procedure for selecting design pressure evaluates these parameters. At each pressure condition, the ratio (PHS/FCY) of ultimate hammershock pressure to compression yield strength is calculated. Values of this ratio are compared for all conditions, and the parameters attendant with the largest value of this ratio are selected for ramp design. Following are parameters selected at the design pressure condition:

PHS = ultimate absolute design hammershock pressure, lb/in.<sup>2</sup>  
FCY = ramp material compression yield stress, lb/in.<sup>2</sup>  
FSU = ramp material ultimate shear strength, lb/in.<sup>2</sup>  
DENS = ramp material density, lb/in.<sup>3</sup>  
XMAT = material type identification

- 1 = aluminum
- 2 = titanium
- 3 = steel

The user has the option of inputting the foregoing design pressure condition data. Input of these data precludes the execution of PRECRT.

These design pressure parameters define the absolute inlet pressure condition. Since data pertaining to plenum and ramp bleed are normally not available in the preliminary design phase, ramp pressure differentials are estimated as fractions of the ultimate hammer shock pressure. Estimated percentages are used in the ramp synthesis routine, RAMPS, to calculate local design pressure differential.

#### RAMP SYNTHESIS METHODS AND ASSUMPTIONS

This program evaluates either conventional stiffened sheet or honeycomb construction ramp panels. Figure 15 shows the structural model of a stiffened sheet construction ramp. The ramp is assumed to consist of a panel, which resists longitudinal loads, and transverse hinge beams at the forward and aft edges. Two hinge points are located on each hinge beam at a fraction,  $K_w$ , of the ramp width. Should an actuator be located on the ramp, an actuator beam is also present. This beam is assumed to be similar to the hinge beam, except that beam depth may be greater than the panel depth.

The basic assumption in the synthesis approach is that elements may be identified as shear members and axial members, and that these elements may be sized for shear and bending moment, respectively. Ramps are either pinned jointed at both ends or pinned at one end with rollers on the other. Ramps with both edges pin-jointed may have axial load introduced at the hinges. This axial load is assumed to be negligible compared to bending moment and, therefore, is not considered in the sizing calculations. However, axial load is considered in the equations for system static equilibrium.

Since structure sized by loads may represent less than minimum gage structure, tests on minimum weight are also performed. Final estimated weights for each of the analytically calculated elements are derived by applying indexing factors. These factors are considered to be calibration factors for design parameters and unique conditions that are not considered in the analysis. Index factors are determined by program calibration runs on existing hardware.

Basic geometry and design data are shown in Table 3. Predefined values, which may be revised by user input, are also presented in this table.

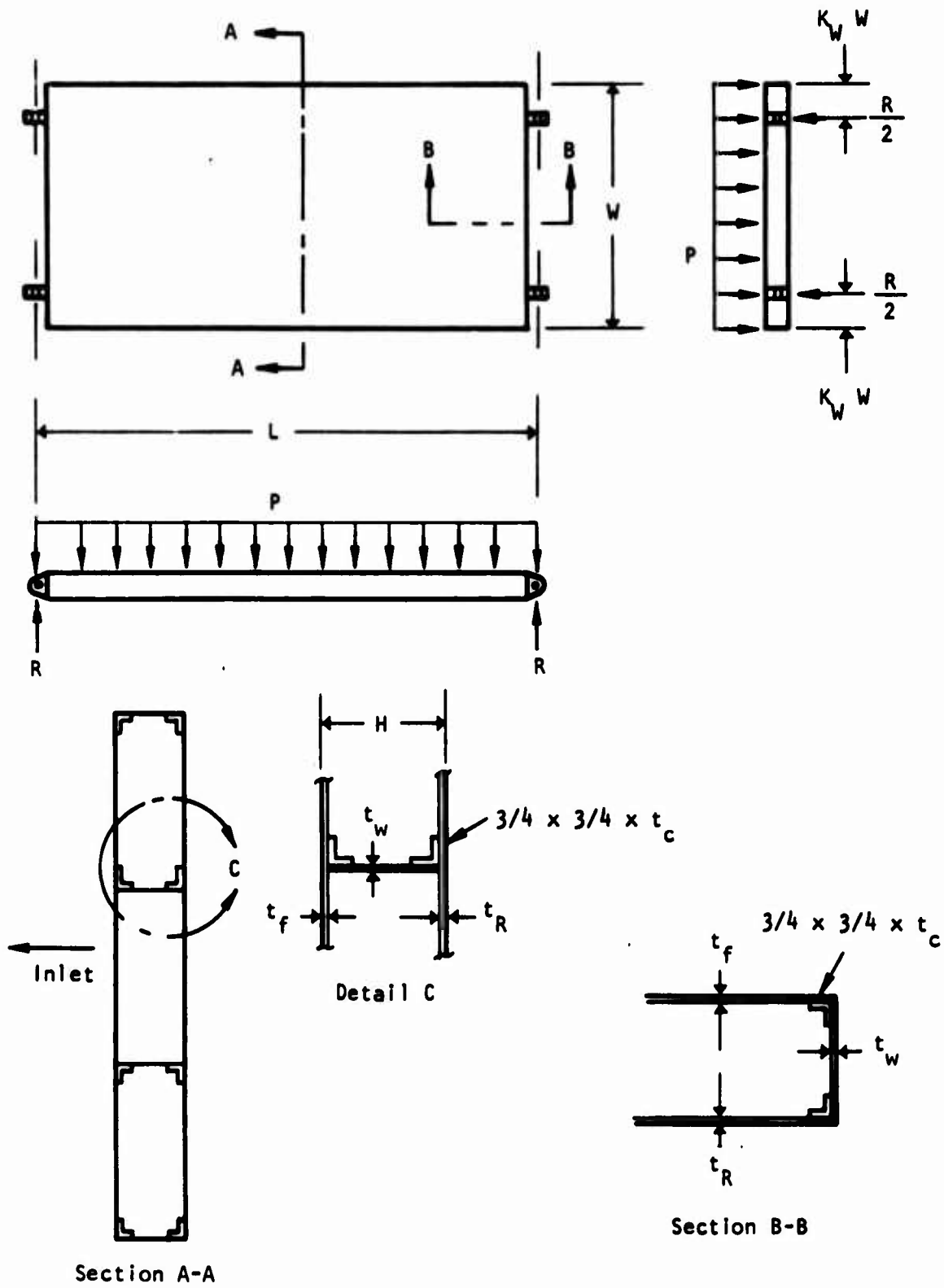


Figure 15. Ramp structural representation.

TABLE 3. BASIC RAMP GEOMETRY AND DESIGN DATA

FORTTRAN Name	Engrg Symbol	Value	Description
DADI	$\rho_a$	0.1	Adhesive density per honeycomb panel facesheet, psf
DCORE	$\rho_c$	4.4	Honeycomb core density, lb/ft <sup>3</sup>
DENS	$\rho$		Ramp material density, lb/in. <sup>3</sup>
FCY	$F_{cy}$		Ramp material compression yield stress, psi
FSU	$F_{su}$		Ramp material ultimate shear strength, psi
PHS			Ultimate absolute hammershock pressure, psia
W1	$W, W_1$		Width of ramp 1, in.
W2	$W, W_2$		Width of ramp 2, in.
W3	$W, W_3$		Width of ramp 3, in.
W4	$W, W_4$		Width of ramp 4, in.
XCL	$K_{CL}$	0.9	Ratio of effective height between axial members to total panel depth (stiffened sheet construction only)
XCT	$K_{CT}$	0.9	Ratio of effective height between transverse beam caps to total beam depth (stiffened sheet construction only)
XFCY	$K_{FCY}$	0.5	Ratio of allowable compression stress to compression yield stress (stiffened sheet construction only)

TABLE 3. BASIC RAMP GEOMETRY AND DESIGN DATA (CONCL)

FORTRAN Name	Engrg Symbol	Value	Description
XFSU	$K_{FSU}$	0.5	Ratio of allowable shear stress to ultimate shear strength (stiffened sheet construction only)
XL1	$L, L_1$		Length of ramp 1, in.
XL2	$L, L_2$		Length of ramp 2, in.
XL3	$L, L_3$		Length of ramp 3, in.
XL4	$L, L_4$		Length of ramp 4, in.
XW	$K_W$	0.25	Ratio of hinge position from panel edge to panel width ( $0.25 \leq K_W \leq 0.5$ )

### Panel Synthesis

For the arrangement and pressure loading (P) in Figure 15, the reactions and shear and bending moment diagrams are shown in the sketch.

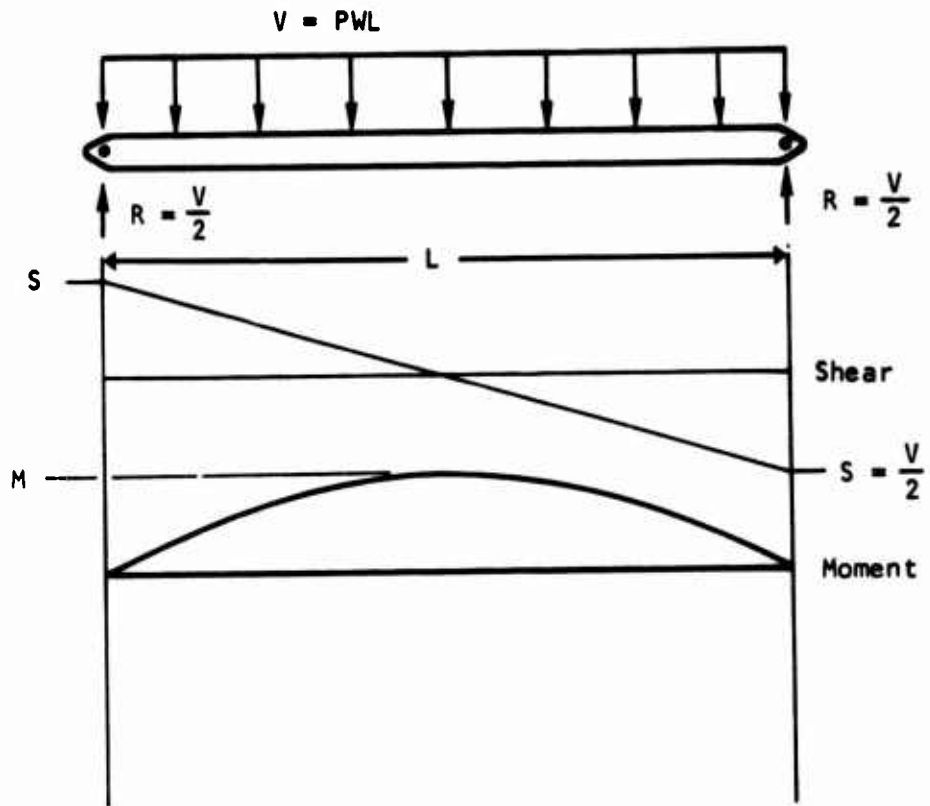
where

P = differential pressure, psi

Maximum shear, S, occurs at the hinge, and the maximum moment, M, occurs at midspan.

$$S = \frac{V}{2} \quad (79)$$

$$M = \frac{PL^2W}{8} = \frac{VL}{8} \quad (80)$$



### Stiffened Sheet Construction

Bending moment is assumed to be reacted by the cover and longitudinal beam caps. Axial load,  $F$ , and required area,  $A$ , are calculated by equations 81 and 82.

$$F = \frac{M}{K_{CL} H} \quad (81)$$

$$A_L = \frac{F}{K_{FCY} F_{CY}} = \frac{M}{K_{CL} H K_{FCY} F_{CY}} \quad (82)$$

where

$H$  = panel depth, in.

Shear flow, reacted by longitudinal beam webs, and required web thickness are calculated by equations 83 and 84.

$$q = \frac{S}{K_{CL} H} \quad (83)$$

$$t = \frac{q}{K_{FSU} F_{SU}} = \frac{S}{K_{CL} H K_{FSU} F_{SU}} \quad (84)$$

Panel weight can then be calculated by equation 85 which combines axial load elements and shear members.

$$\begin{aligned} WT_L &= I_L \rho (2A_L L + tHL) \\ &= \frac{I_L \rho L}{K_{CL}} \left( \frac{2M}{H K_{FCY} F_{CY}} + \frac{S}{K_{FSU} F_{SU}} \right) \end{aligned} \quad (85)$$

where

$I_L$  = panel weight correlation factor

#### Honeycomb Panel Construction

For honeycomb panels, bending moment is reacted by the facesheets, and shear is reacted by the honeycomb core. Since all of the axial load is reacted by the facesheets, panel depth is assumed to be the effective couple arm. Furthermore, due to stabilization by the core, the allowable facesheet stress is assumed to be equal to the material compression yield stress. Equations 86 and 87 are used to calculate axial load and facesheet area.

$$F = \frac{M}{H} \quad (86)$$

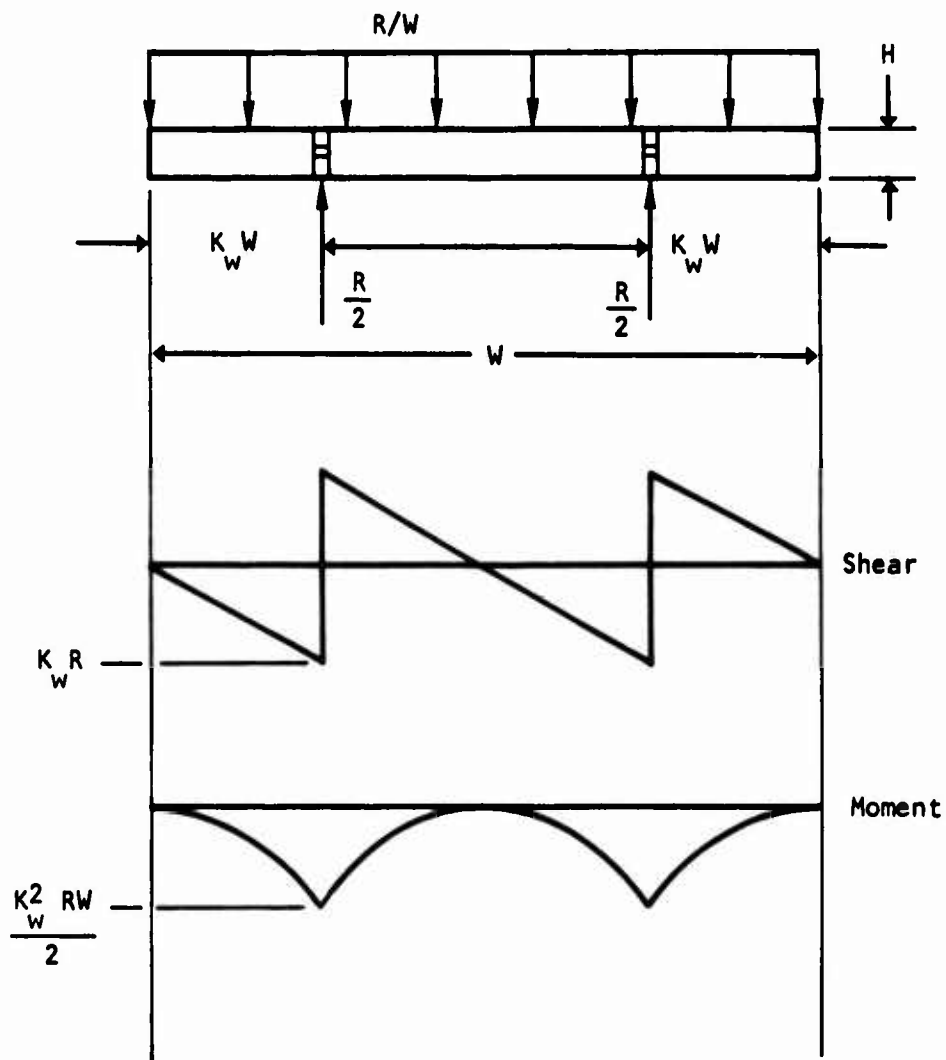
$$A = \frac{M}{H F_{CY}} \quad (87)$$

Panel weight is calculated by equation 88, which combines facesheet, core, and bonding material.

$$WT_L = I_L L \left( \frac{2\rho M}{H F_{CY}} + \frac{\rho_C WH}{1728} + \frac{2\rho_a W}{144} \right) \quad (88)$$

### Hinge and Actuator Beam Synthesis

For the assumed arrangement (Figure 15), hinge or actuator loads are assumed to be distributed to the panel as a uniform shear flow. With this assumption, shear and bending moment diagrams can be constructed as shown in the sketch.



In the foregoing diagrams, the maximum shear and moment occur at the hinge point. This is true when the value of  $K_w$  is equal to or greater than 0.25.

## Stiffened Sheet Construction

Transverse beam cap area and web thickness can be calculated by using equations 89 and 90, which are obtained by substituting terms in equations 81 through 84.

$$A_T = \frac{M}{K_{CT} H K_{FCY} F_{CY}} = \frac{k_W^2 RW}{2 K_{CT} H K_{FCY} F_{CY}} \quad (89)$$

$$t_T = \frac{K_W R}{K_{CT} H K_{FSU} F_{SU}} \quad (90)$$

where

H = panel depth for hinge beams or actuator beam depth, in.

Weight of one hinge beam or actuator beam is calculated by equation 91.

$$\begin{aligned} WT_t &= I_T \rho (2A_T W + t_T HW) \\ &= \frac{I_T \rho K_W WR}{K_{CT}} \left( \frac{K_W W}{H K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \end{aligned} \quad (91)$$

where

$I_T$  = transverse beam weight correlation factor

## Honeycomb Construction

Transverse beams on honeycomb panels are assumed to be stabilized by the core. Weight is calculated by equation 92 which assumes fully effective cap and web material.

$$WT_T = I_T \rho K_W WR \left( \frac{K_W W}{H F_{CY}} + \frac{1}{F_{SU}} \right) \quad (92)$$

## Minimum Weight

Minimum practical structure is not considered in the preceding synthesis and weight formulations. To preclude ramp weights that are not practical, minimum structure weight is compared with structure weight based on loading, and the heavier weight is used. Minimum weight structure is calculated for the same size ramp with assumed practical minimum type construction and material gages.

Predefined fabrication minimums are shown in Table 4. Thickness and density values in this table may be revised by user input.

### Panel, Stiffened Sheet Construction

Minimum-weight panel is assumed to consist of two cover panels and four longitudinal beams, as shown in Figure 12. Weight is calculated by equation 93.

$$WTML = I_M \rho L (W (t_f + t_r) + 4 (3t_c + Ht_w)) \quad (93)$$

where

$I_M$  = minimum-weight correlation factor

### Panel, Honeycomb Construction

Minimum honeycomb panel weight is calculated by equation 94.

$$WTML = I_M \rho L \left( 2 \rho t_s + \frac{H \rho_c}{1728} + \frac{2 \rho_a}{144} \right) \quad (94)$$

### Transverse Beams

Cross-section geometry of a minimum transverse hinge beam is identical to that of a longitudinal beam. Weight is calculated by equation 95.

$$WTMT = I_P W (3t_c + Ht_w) \quad (95)$$

TABLE 4. RAMP STRUCTURE MINIMUM GAGES AND DENSITIES

General Terms		Aluminum		Titanium		Steel		
FORTRAN Name	Engrg Symbol	Description	FORTRAN Name	Value	FORTRAN Name	Value	FORTRAN Name	Value
TC	$t_c$	Longitudinal stiffener or transverse beam cap thickness, in. ( $3/4 \times 3/4 \times t_c$ )	TCA	0.040	TCT	0.025	TCS	0.020
TW	$t_w$	Stiffener or beam web thickness, in.	TWA	0.020	TWT	0.013	TWS	0.010
TBARF	$t_f$	Panel front sheet thickness, in.	TBARFA	0.040	TBARFT	0.025	TBARFS	0.020
TBARA	$t_r$	Panel rear sheet thickness, in.	TBARRA	0.010	TBARRT	0.010	TBARRS	0.010
TS	$t_s$	Honeycomb panel facesheet thickness, in.	TSA	0.015	TST	0.010	TSS	0.010
DCORE	$\rho_c$	Honeycomb core density, lb/ft <sup>3</sup>	DCORE	4.4	DCORE	4.4	DCORE	4.4
DADH	$\rho_a$	Adhesive density per facesheet, lb/ft <sup>2</sup>	DADH	0.1	DADH	0.1	DADH	0.1

Minimum actuator beam weight, WTMA, is also calculated by equation 95. Actuator beam depth is substituted for panel depth, H, in the foregoing equation.

## TWO-RAMP SYSTEM

Figure 16 is a schematic diagram illustrating pressure forces, actuator location, and geometry assumptions for a two-ramp system. Basic geometry, pressure, material properties, and minimum gage data and symbols are presented in Tables 3 and 4. Additional detail input data are shown in Table 5. Predefined values, which may be revised by user input, are also presented in these tables.

Ramp 2 in a two-ramp system is always assumed to be stiffened sheet construction. Ramp 1 may be specified to be either honeycomb or stiffened sheet structure.

### Ramp Structure Geometry

Panel lengths and widths are user input data. Panel depths are defined as fractions of length and or width. Actuator beam depth is defined as a fraction of panel width. Depth of ramps 1 and 2 ( $H_1$ ,  $H_2$ ) are calculated as follows:

$$H_1 = \text{Maximum of } (XHT2 W, \text{ or } XH21 L_1) \quad (96)$$

$$H_2 = \text{Maximum of } (XHT2 W_2 \text{ or } XH22 L_2) \quad (97)$$

Actuator beam depth is calculated by equation 98.

$$H_{A2} = XHTA2 W_2 \quad (98)$$

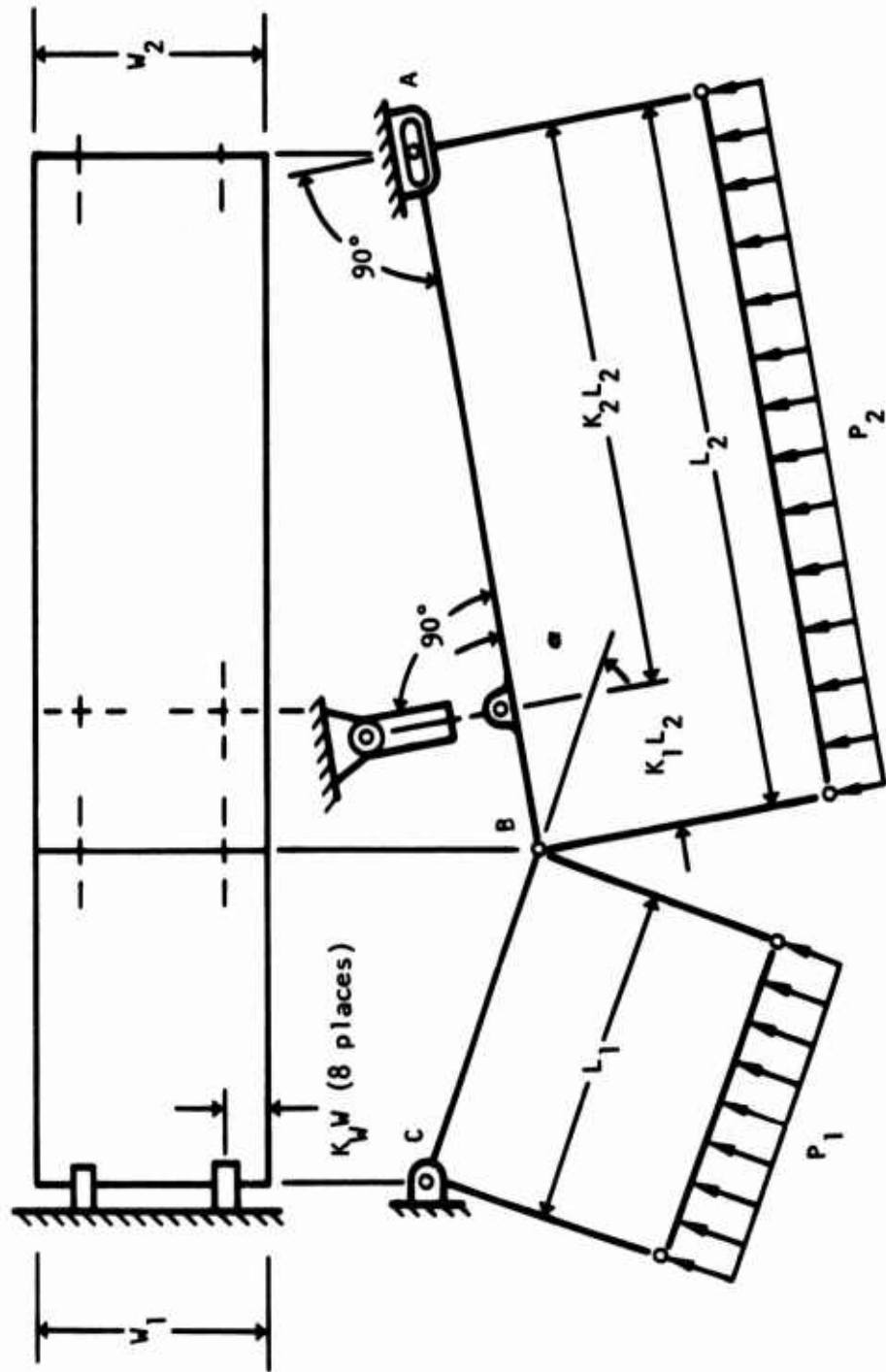


Figure 16. Typical two-ramp system.

TABLE 5. TWO-RAMP SYSTEM VARIABLES

FORTTRAN Name	Engrg Symbol	Value	Description
ALPHA2	$\alpha$	30.0	Angle between projected face of ramp 1 and ramp 2, deg
XHTA2		0.15	Actuator beam depth to panel width ratio for ramp 2
XHT2		0.1	Panel depth to width ratio for each ramp
XH21		0.1	Panel depth to length ratio for ramp 1
XH22		0.07	Panel depth to length ratio for ramp 2
XIL21	$I_L$	1.0	Ramp 1 panel weight correlation factor
XIL22	$I_L$	1.0	Ramp 2 panel weight correlation factor
XIM21	$I_M$	1.0	Ramp 1 minimum weight correlation factor
XIM22	$I_M$	1.0	Ramp 2 minimum weight correlation factor
XITAH2	$I_T$	1.0	Ramp 2 aft hinge beam weight correlation factor
XITA2	$I_T$	1.0	Ramp 2 actuator beam weight correlation factor
XITFH2	$I_T$	1.0	Ramp 2 forward hinge beam weight correlation factor
XIT21	$I_T$	1.0	Ramp 1 hinge beam weight correlation factor

TABLE 5. TWO-RAMP SYSTEM VARIABLES (CONCL)

FORTRAN Name	Engrg Symbol	Value	Description
XK21	$K_1$	0.2	Fraction of length of ramp 2 from forward edge to actuator location
XK22	$K_2$	0.8	Fraction of length of ramp 2 from aft edge to actuator location
XP21		0.5	Differential pressure on ramp 1, fraction of ultimate hammershock pressure
XP22		0.4	Differential pressure on ramp 2, fraction of ultimate hammershock pressure

Resolution of Forces

Differential pressure on ramps 1 and 2 are calculated by equations 99 and 100.

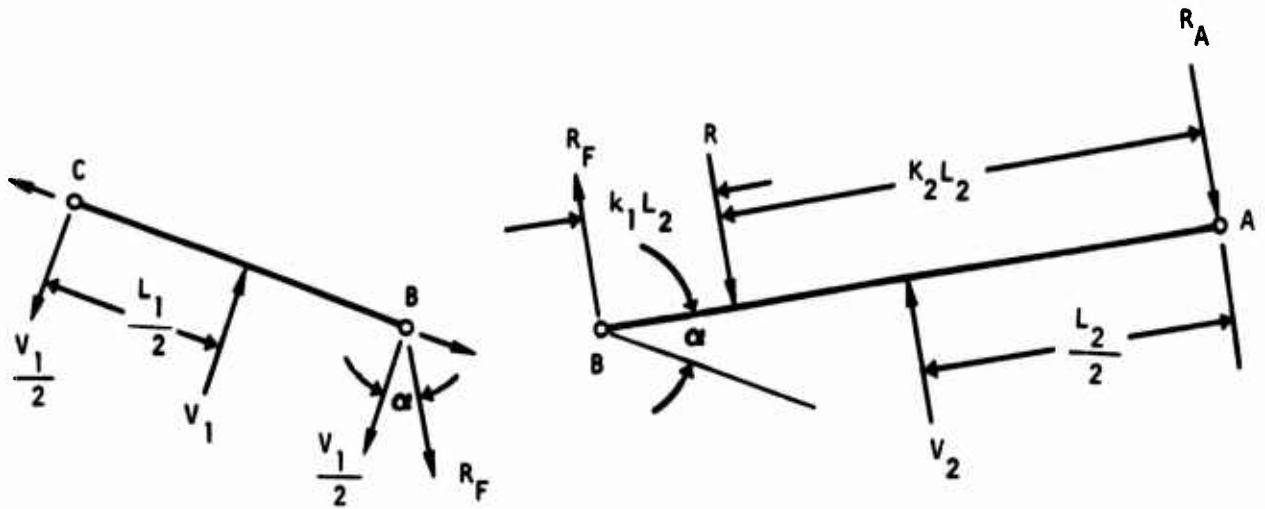
$$P_1 = PHS \text{ XP21} \tag{99}$$

$$P_2 = PHS \text{ XP22} \tag{100}$$

The total force on the panels due to differential pressure is the resultant of pressure times the corresponding panel area

$$V_1 = P_1 L_1 W_1 \tag{101}$$

$$V_2 = P_2 L_2 W_2 \tag{102}$$



For moment equilibrium of ramp 1, reactions normal to the panel surface at the hinges are equal to half the force,  $V_1$ , on the panel. At the hinge between ramps 1 and 2, the forces are equal and opposite. Therefore, reaction at the hinge is calculated by equation 103.

$$R_F = \frac{V_1}{2\cos \alpha} \quad (103)$$

Actuator reaction,  $R$ , is obtained by solving for moment equilibrium about A.

$$\sum M_A = 0 = R_F L_2 + \frac{V_2 L_2}{2} - R K_2 L_2 \quad (104)$$

and

$$R = \frac{R_F}{K_2} + \frac{V_2}{2K_2} \quad (105)$$

Reaction at A is calculated for force equilibrium.

$$\Sigma F = 0 = R_F + V_2 - R - R_A \quad (106)$$

and

$$R_A = R_F + V_2 - R \quad (107)$$

### Ramp 1 Weight

Ramp 1 loading is identical to that for the typical structural representation (Figure 15). Therefore, component weights are calculated by substitution of ramp 1 parameters in the previously derived equations, equations 79 through 88.

Maximum panel bending moment, M, is calculated by equation 108. Panel weight is calculated by equation 109 for stiffened sheet construction or equation 110 for honeycomb construction.

$$M = \frac{P_1 L_1^2 W_1}{8} = \frac{V_1 L_1}{8} \quad (108)$$

$$WT_L = \frac{I_L \rho V_1 L_1}{2K_{CL}} \left( \frac{L_1}{2H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (109)$$

$$WT_L = I_L L_1 \left( \frac{\rho V_1 L_1}{4H_1 F_{CY}} + \frac{\rho W_1 H_1}{1728} + \frac{2\rho W_1}{144} \right) \quad (110)$$

Hinge beam weight (two hinges) is calculated by equation 111 if the panel is stiffened sheet construction or equation 112 on a honeycomb panel.

$$WT_T = \frac{I_T \rho K_W W_1 V_1}{K_{CT}} \left( \frac{K_W W_1}{H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (111)$$

$$WT_T = I_T \rho K_W W_1 V_1 \left( \frac{K_W W_1}{H_1 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (112)$$

### Ramp 2 Weight

Ramp 2 is always assumed to be stiffened sheet construction. Assuming that the maximum shear and moment on ramp 2 occurs at the actuator reaction point, equations 113 and 114 are used to calculate bending moment and shear.

$$M = K_1 L_2 \left( R_F + \frac{K_1 V_2}{2} \right) \quad (113)$$

$$S = R_F + K_1 V_2 \quad (114)$$

Panel weight is calculated by equation 115 which is obtained by substitution of terms in equation 85.

$$WT_L = \frac{I_L \rho L_2}{K_{CL}} \left( \frac{2M}{H_2 K_{FCY} F_{CY}} + \frac{S}{K_{FSU} F_{SU}} \right) \quad (115)$$

The hinge and actuator beam weights are calculated by equations 116 through 118. These equations are the result of substitution in equation 91.

$$WT_{TFH} = \frac{I_T \rho K_W W_2 R_F}{K_{CT}} \left( \frac{K_W W_2}{H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SI}} \right) \quad (116)$$

$$WT_{TAH} = \frac{I_T \rho K_W W_2 R_A}{K_{CT}} \left( \frac{K_W W_2}{H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (117)$$

$$WT_{TA} = \frac{I_T^P K_W W_2^R}{K_{CT}} \left( \frac{K_W W_2}{H_{A2} K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (118)$$

where

$WT_{TFH}$  = forward hinge beam weight, lb

$WT_{TAH}$  = aft hinge beam weight, lb

$WT_{TA}$  = actuator beam weight, lb

### THREE-RAMP SYSTEM

Figure 17 is a schematic diagram illustrating pressure forces, actuator locations, and geometry assumptions for a three-ramp system. Basic geometry, pressure, material properties, and minimum gage data and symbols are presented in Tables 3 and 4. Additional detail input data are shown in Table 6. Predefined values, which may be revised by user input, are also presented in these tables.

Ramp 3 in a three-ramp system is always assumed to be stiffened sheet construction. Ramps 1 and 2 may be specified to be either honeycomb or stiffened sheet structure.

#### Ramp Structure Geometry

Panel lengths and widths are user input data. Panel depths are defined as fractions of length and or width. Ramp 3 actuator beam depth is defined to be a fraction of panel width. Depth of ramps 1, 2, and 3 ( $H_1$ ,  $H_2$ ,  $H_3$ ) are calculated as follows:

$$H_1 = \text{Maximum of } (XHT3 W_1 \text{ or } XH31 L_1) \quad (119)$$

$$H_2 = \text{Maximum of } (XHT3 W_2 \text{ or } XH32 L_2) \quad (120)$$

$$H_3 = \text{Maximum of } (XHT3 W_3 \text{ or } XH33 L_3) \quad (121)$$

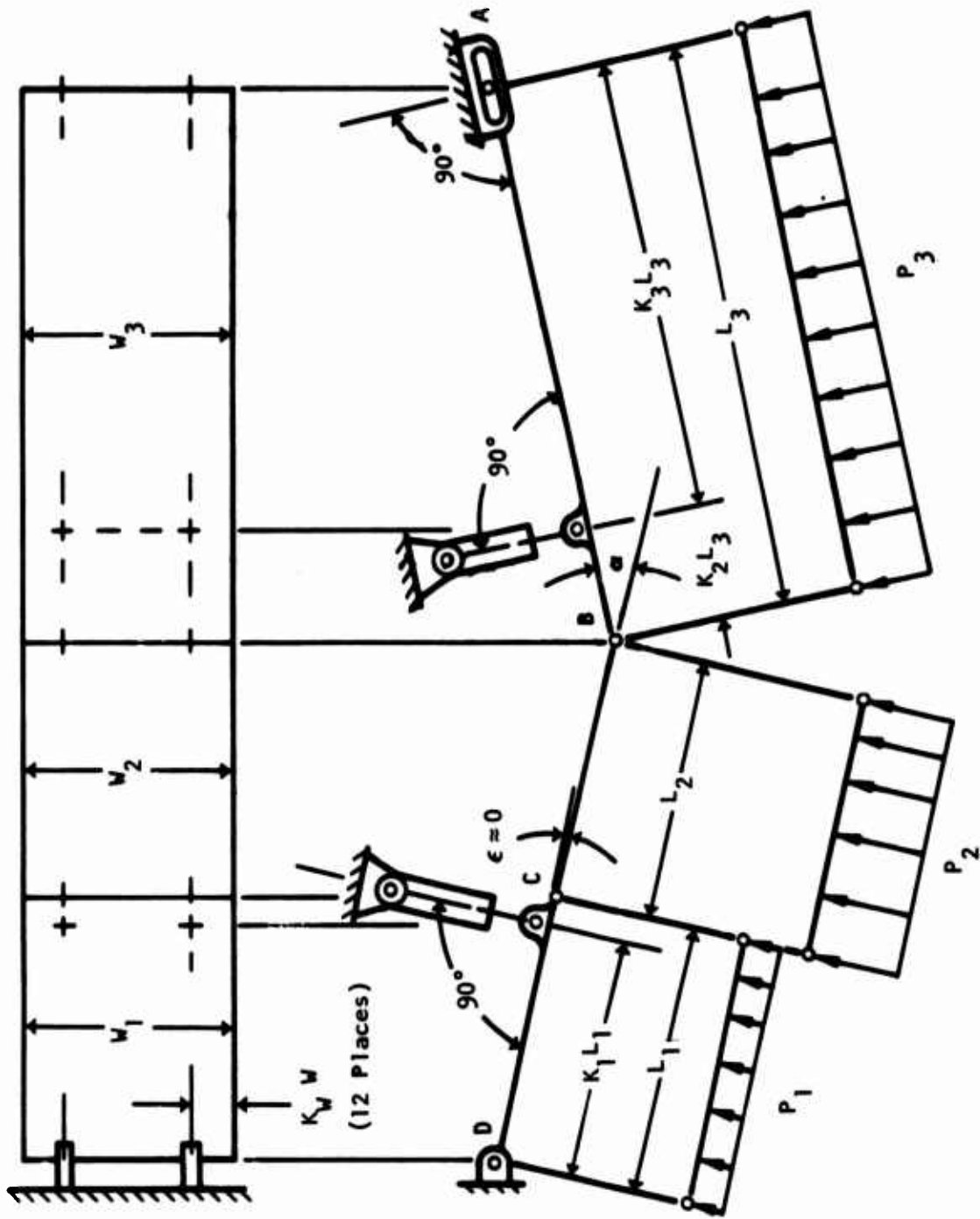


Figure 17. Typical three-ramp system.

TABLE 6. THREE-RAMP SYSTEM VARIABLES

FORTRAN Name	Engrg Symbol	Value	Description
ALPHA3	$\alpha$	30.0	Angle between projected face of ramp 2 and ramp 3, deg
XHTA3		0.15	Actuator beam depth to width ratio for ramp 3
XHT3		0.1	Panel depth to width ratio for each ramp
XH31		0.1	Panel depth to length ratio for ramp 1
XH32		0.1	Panel depth to length ratio for ramp 2
XH33		0.07	Panel depth to length ratio for ramp 3
XIL31	$I_L$	1.0	Ramp 1 panel weight correlation factor
XIL32	$I_L$	1.0	Ramp 2 panel weight correlation factor
XIL33	$I_L$	1.0	Ramp 3 panel weight correlation factor
XIM31	$I_M$	1.0	Ramp 1 minimum weight correlation factor
XIM32	$I_M$	1.0	Ramp 2 minimum weight correlation factor
XIM33	$I_M$	1.0	Ramp 3 minimum weight correlation factor
XITAH3	$I_T$	1.0	Ramp 3 aft hinge beam weight correlation factor

TABLE 6. THREE-RAMP SYSTEM VARIABLES (CONCL)

FORTRAN Name	Engrg Symbol	Value	Description
XITA3	$I_T$	1.0	Ramp 3 actuator beam weight correlation factor
XITFH3	$I_T$	1.0	Ramp 3 forward hinge weight correlation factor
XIT31	$I_T$	1.0	Ramp 1 transverse beam weight correlation factor
XIT32	$I_T$	1.0	Ramp 2 transverse beam weight correlation factor
XK31	$K_1$	0.9	Fraction of length of ramp 1 from forward edge to actuator location
XK32	$K_2$	0.2	Fraction of length of ramp 3 from forward edge to actuator location
XK33	$K_3$	0.8	Fraction of length of ramp 3 from aft edge to actuator location
XP31		0.2	Differential pressure on ramp 1, fraction of ultimate hammershock pressure
XP32		0.5	Differential pressure on ramp 2, fraction of ultimate hammershock pressure
XP33		0.4	Differential pressure on ramp 3, fraction of ultimate hammershock pressure

Actuator beam depths on ramps 1 and 3 ( $H_{A1}$ ,  $H_{A3}$ ) are defined as follows:

$$H_{A1} = H_1 \quad (122)$$

$$H_{A3} = XHTA3 W_3 \quad (123)$$

### Resolution of Forces

Differential pressure and the resultant forces due to these pressures are calculated by equations 124 through 129. These resultants act at the panel centroids (.5L, .5W).

$$P_1 = PHS \text{ XP31} \quad (124)$$

$$P_2 = PHS \text{ XP32} \quad (125)$$

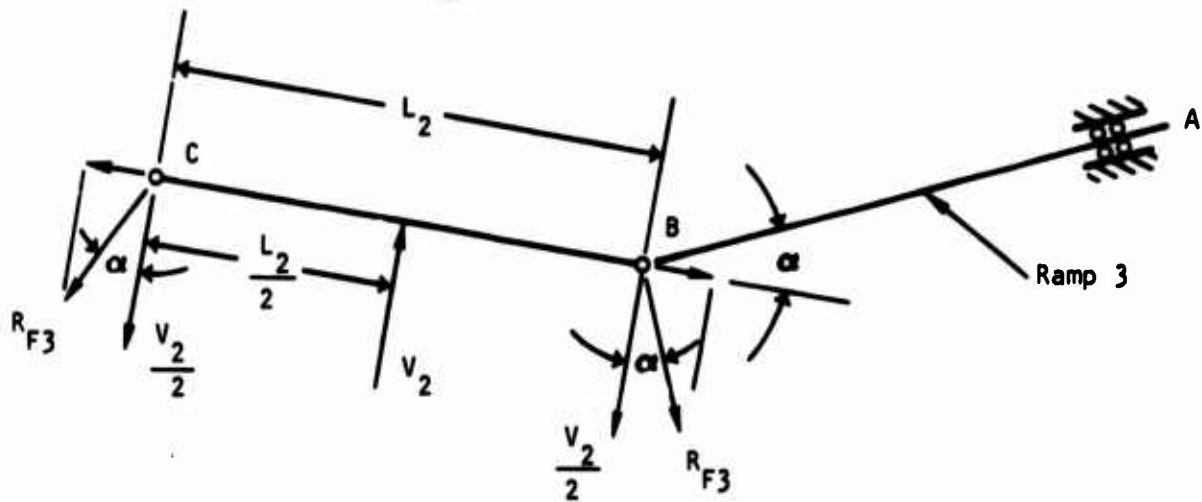
$$P_3 = PHS \text{ XP33} \quad (126)$$

$$V_1 = P_1 W_1 L_1 \quad (127)$$

$$V_2 = P_2 W_2 L_2 \quad (128)$$

$$V_3 = P_3 W_3 L_3 \quad (129)$$

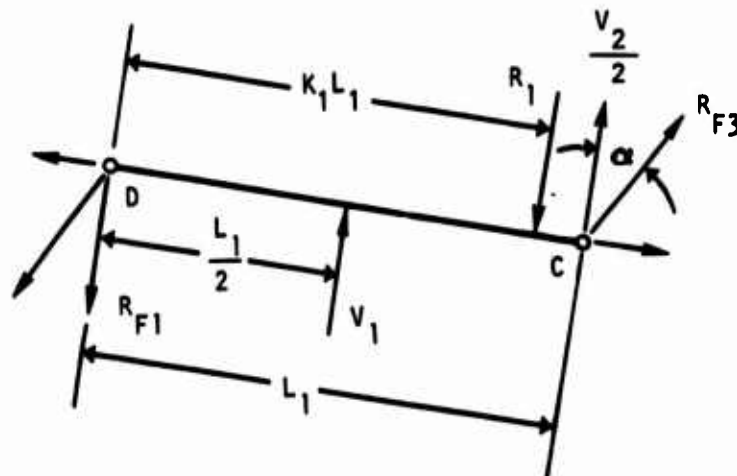
Ramp 2, Freebody



Due to hinges at each end of ramp 2, reactions normal to the panel at B and C are equal to half the pressure force,  $V_2$ , on the panel. Due to the roller at A and actuator orientation perpendicular to ramp 3, all forces acting on ramp 3 are normal to the panel. Therefore, reaction at B is calculated by equation 130.

$$R_{F3} = \frac{V_2}{2 \cos \alpha} \quad (130)$$

Ramp 1, Freebody



From the freebody of ramp 2, reaction at C is defined. Actuator reaction on ramp 1,  $R_1$ , is obtained by solving for moment equilibrium about D.

$$\Sigma M_D = 0 = \frac{V_1 L_1}{2} + \frac{V_2 L_1}{2} - R_1 K_1 L_1 \quad (131)$$

and

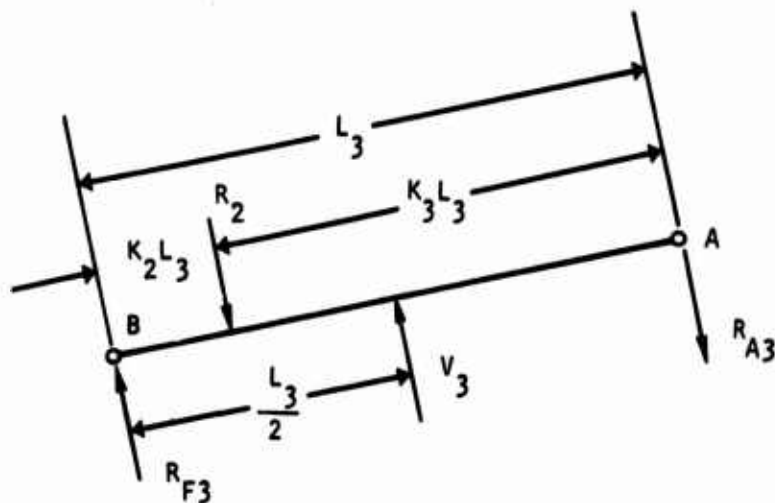
$$R_1 = \frac{V_1 + V_2}{2K_1} \quad (132)$$

Reaction normal to the panel at D,  $R_{F1}$ , is calculated by the equation of force equilibrium.

$$\Sigma F_V = 0 = V_1 + \frac{V_2}{2} - R_1 - R_{F1} \quad (133)$$

$$\begin{aligned} R_{F1} &= V_1 + \frac{V_2}{2} - R_1 \\ &= V_1 \left(1 - \frac{1}{2K_1}\right) + \frac{V_2}{2} \left(1 - \frac{1}{K_1}\right) \end{aligned} \quad (134)$$

Ramp 3, Freebody



Actuator reaction,  $R_2$ , is calculated by solving for moment equilibrium about A.

$$\Sigma M_A = 0 = R_{F3}L_3 + \frac{V_3L_3}{2} - R_2K_3L_3 \quad (135)$$

and

$$R_2 = \frac{R_{F3}}{K_3} + \frac{V_3}{2K_3} \quad (136)$$

Reaction at the aft hinge (roller) is calculated for force equilibrium.

$$\Sigma F_V = 0 = R_{F3} + V_3 - R_2 - R_{A3} \quad (137)$$

$$R_{A3} = R_{F3} + V_3 - R_2 \quad (138)$$

### Ramp 1 Weight

The actuator on this ramp is assumed to be on or very near the aft hinge beam, such that the reaction at the forward hinge,  $R_{F1}$ , approaches the same value as on ramp 1 of a two-ramp system. Panel loads for this situation also approaches that for ramp 1 of a two-ramp system.

$$R_{F1} = V_1 \left( 1 - \frac{1}{2K_1} \right) + \frac{V_2}{2} \left( 1 - \frac{1}{K_1} \right) \rightarrow \frac{V_1}{2} \quad \left| \quad K_1 = 1 \quad (139) \right.$$

Panel weight can be calculated by using the same equations as are used for ramp 1 of a two-ramp system.

• Stiffened sheet construction:

$$W_{T_L} = \frac{I_L \rho V_1 L_1}{2 K_{CL}} \left( \frac{L_1}{2H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (140)$$

● Honeycomb construction:

$$W_{T_L} = I_L L_1 \left( \frac{\rho V_1 L_1}{4H_1 F_{CY}} + \frac{\rho W_1 H_1}{1728} + \frac{2\rho W_1}{144} \right) \quad (141)$$

There are three transverse members - forward and aft hinge beams and an actuator beam. The actuator beam depth is assumed to be equal to the panel depth. Equation 142 is used to calculate the weight of these beams in stiffened sheet construction panels, and equation 143 is used for honeycomb construction.

● Stiffened sheet construction:

$$W_{T_T} = \frac{I_T \rho K_W W_1}{K_{CT}} \left( R_{F1} + \frac{V_2}{2} + R_1 \right) \left( \frac{K_W W_1}{H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (142)$$

● Honeycomb construction:

$$W_{T_T} = I_T \rho K_W W_1 \left( R_{F1} + \frac{V_2}{2} + R_1 \right) \left( \frac{K_W W_1}{H_1 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (143)$$

Ramp 2 Weight

The loading on this panel is similar to that for ramp 1 of a two-ramp system. The following equations are used to calculate the component weights.

● Stiffened sheet construction:

$$W_{T_L} = \frac{I_L \rho V_2 L_2}{2K_{CL}} \left( \frac{L_2}{2H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (144)$$

$$W_{T_T} = \frac{I_T \rho K_W W_2 V_2}{K_{CT}} \left( \frac{K_W W_2}{H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (145)$$

● Honeycomb construction:

$$WT_L = I_L L_2 \left( \frac{\rho V_2 L_2}{4 H_2 F_{CY}} + \frac{\rho W_2 H_2}{1728} + \frac{2 \rho W_2}{144} \right) \quad (146)$$

$$WT_T = I_T \rho K_W W_2 V_2 \left( \frac{K_W W_2}{H_2 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (147)$$

Ramp 3 Weight

Ramp 3 analysis is similar to that for ramp 2 of a two-ramp system. Equations 148 through 151 are used to calculate the component weights.

$$WT_L = \frac{I_L \rho L_3}{K_{CL}} \left( \frac{K_2 L_3 (2 R_{F3} + K_2 V_3)}{H_3 K_{FCY} F_{CY}} + \frac{R_{F3} + K_2 V_3}{K_{FSU} F_{SU}} \right) \quad (148)$$

$$WT_{TFH} = \frac{I_T \rho K_W W_3 R_{F3}}{K_{CT}} \left( \frac{K_W W_3}{H_3 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (149)$$

$$WT_{TAH} = \frac{I_T \rho K_W W_3 R_{A3}}{K_{CT}} \left( \frac{K_W W_3}{H_3 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (150)$$

$$WT_{TA} = \frac{I_T \rho K_W W_3 R_2}{K_{CT}} \left( \frac{K_W W_3}{H_{A3} K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (151)$$

FOUR-RAMP SYSTEM

Figure 18 is a schematic diagram illustrating pressure forces, actuator locations, and geometry assumptions for a four-ramp system. Basic geometry, pressure, material properties, and minimum gage data and symbols are presented in Tables 3 and 4. Additional detail input data are shown in Table 7. Pre-defined values, which may be revised by user input, are also presented in these tables.

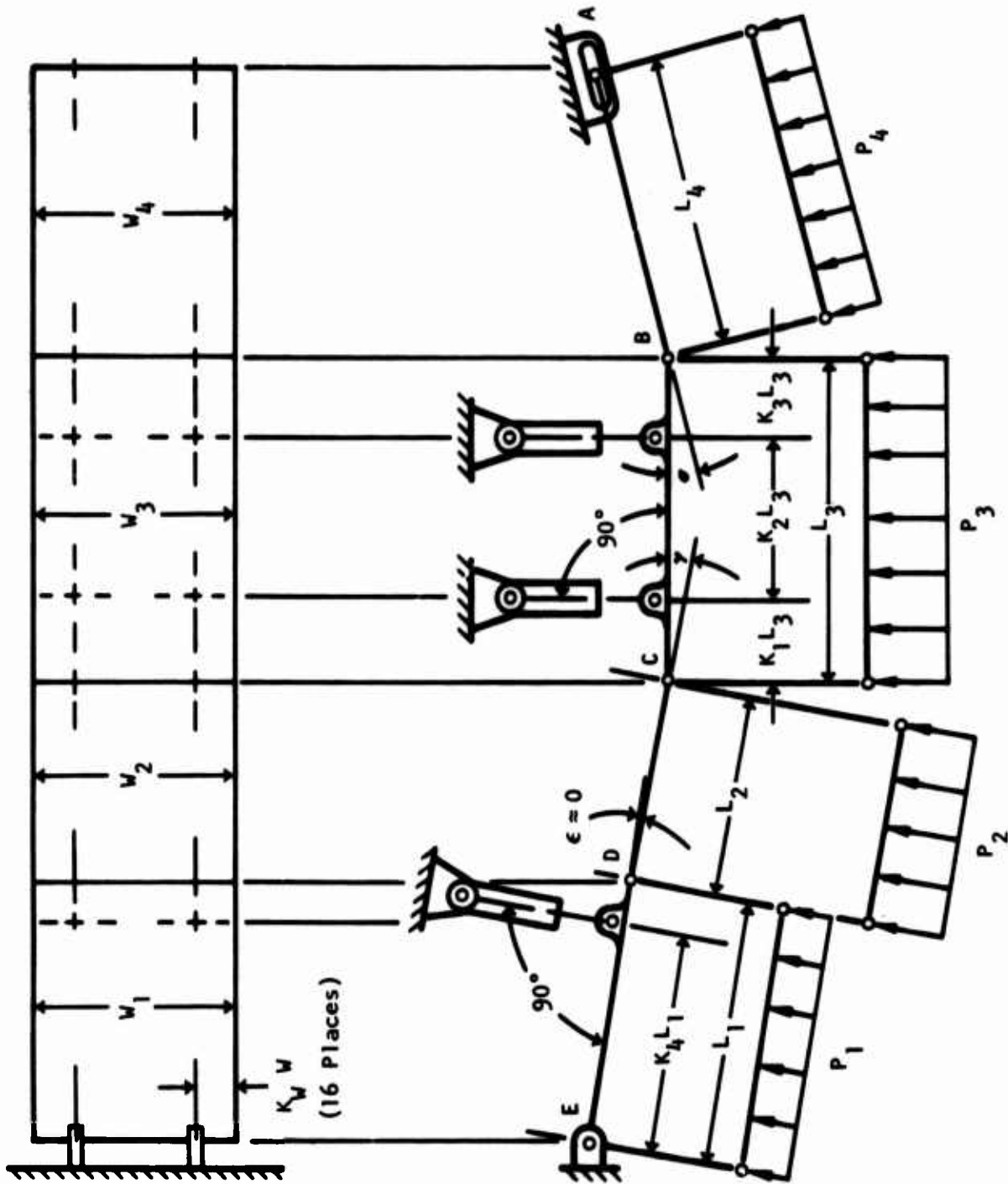


Figure 18. Typical four-ramp system.

TABLE 7. FOUR-RAMP SYSTEM VARIABLES

FORTRAN Name	Engrg Symbol	Value	Description
GAMMA	$\gamma$	20.0	Angle between projected face of ramp 2 and ramp 3, deg
SIGMA	$\sigma$	10.0	Angle between projected face of ramp 3 and ramp 4, deg
XHTA4		0.125	Actuator beam depth to width ratio for ramp 3
XHT4		0.1	Panel depth to width ratio for each ramp
XH41		0.1	Panel depth to length ratio for ramp 1
XH42		0.1	Panel depth to length ratio for ramp 2
XH43		0.08	Panel depth to length ratio for ramp 3
XH44		0.1	Panel depth to length ratio for ramp 4
XIL41	$I_L$	1.0	Ramp 1 panel weight correlation factor
XIL42	$I_L$	1.0	Ramp 2 panel weight correlation factor
XIL43	$I_L$	1.0	Ramp 3 panel weight correlation factor
XIL44	$I_L$	1.0	Ramp 4 panel weight correlation factor
XIM41	$I_M$	1.0	Ramp 1 minimum weight correlation factor

TABLE 7. FOUR-RAMP SYSTEM VARIABLES (CONT)

FORTRAN Name	Engrg Symbol	Value	Description
XIM42	$I_M$	1.0	Ramp 2 minimum weight correlation factor
XIM43	$I_M$	1.0	Ramp 3 minimum weight correlation factor
XIM44	$I_M$	1.0	Ramp 4 minimum weight correlation factor
XITAA4	$I_T$	1.0	Ramp 3 aft actuator beam weight correlation factor
XITAH4	$I_T$	1.0	Ramp 3 aft hinge beam weight correlation factor
XITFA4	$I_T$	1.0	Ramp 3 forward actuator beam weight correlation factor
XITFH4	$I_T$	1.0	Ramp 3 forward hinge beam weight correlation factor
XIT41	$I_T$	1.0	Ramp 1 transverse beam weight correlation factor
XIT42	$I_T$	1.0	Ramp 2 transverse beam weight correlation factor
XIT44	$I_T$	1.0	Ramp 4 transverse beam weight correlation factor
XK41	$K_1$	0.1	Fraction of length of ramp 3 from forward edge to forward actuator location
XK42	$K_2$	0.75	Fraction of length of ramp 3 distance between actuators
XK43	$K_3$	0.15	Fraction of length of ramp 3 from aft edge to aft actuator location

TABLE 7. FOUR-RAMP SYSTEM VARIABLES (CONCL)

FORTRAN Name	Engrg Symbol	Value	Description
XK44	$K_4$	0.9	Fraction of length of ramp 1 from forward edge to actuator location
XP41		0.6	Differential pressure on ramp 1, fraction of ultimate hammershock pressure
XP42		1.0	Differential pressure on ramp 2, fraction of ultimate hammershock pressure
XP43		1.0	Differential pressure on ramp 3, fraction of ultimate hammershock pressure
XP44		0.4	Differential pressure on ramp 4, fraction of ultimate hammershock pressure

Ramp 3 in a four-ramp system is always assumed to be stiffened sheet construction. All of the other ramps may be specified to be either honeycomb or stiffened sheet structure.

Ramp Structure Geometry

Panel lengths and widths are user input data. Panel depths are defined as fractions of length and or width. Ramp 3 actuator beam depth is defined to be a fraction of panel width. Depth of ramps 1, 2, 3, and 4 ( $H_1$ ,  $H_2$ ,  $H_3$ , and  $H_4$ ) are calculated as follows:

$$H_1 = \text{Maximum of } (XHT4 W_1 \text{ or } XH41 L_1) \tag{152}$$

$$H_2 = \text{Maximum of } (XHT4 W_2 \text{ or } XH42 L_2) \tag{153}$$

$$H_3 = \text{Maximum of } (XHT4 W_3 \text{ or } XH43 L_3) \quad (154)$$

$$H_4 = \text{Maximum of } (XHT4 W_4 \text{ or } XH44 L_4) \quad (155)$$

Actuator beam depths on ramps 1 and 3 ( $H_{A1}$ ,  $H_{A3}$ ) are defined as follows:

$$H_{A1} = H_1 \quad (156)$$

$$H_{A3} = XHTA4 W_3 \quad (157)$$

### Resolution of Forces

Differential pressure and the resultant forces due to these pressures are calculated by equations 158 through 165. These resultants act at the panel centroids (.5L, .5W).

$$P_1 = PHS \text{ XP41} \quad (158)$$

$$P_2 = PHS \text{ XP42} \quad (159)$$

$$P_3 = PHS \text{ XP43} \quad (160)$$

$$P_4 = PHS \text{ XP44} \quad (161)$$

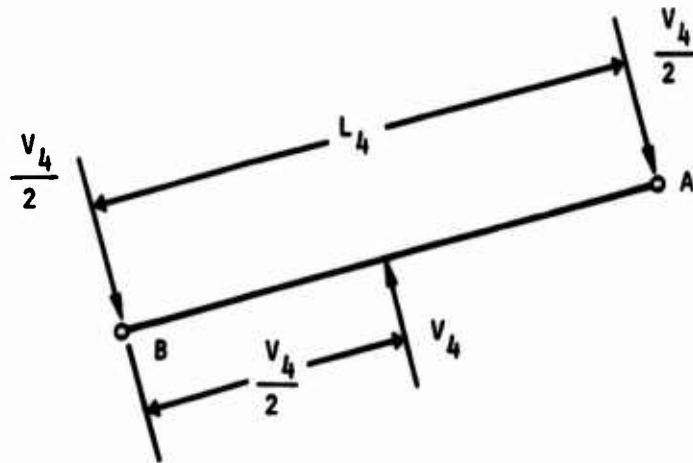
$$V_1 = P_1 L_1 W_1 \quad (162)$$

$$V_2 = P_2 L_2 W_2 \quad (163)$$

$$V_3 = P_3 L_3 W_3 \quad (164)$$

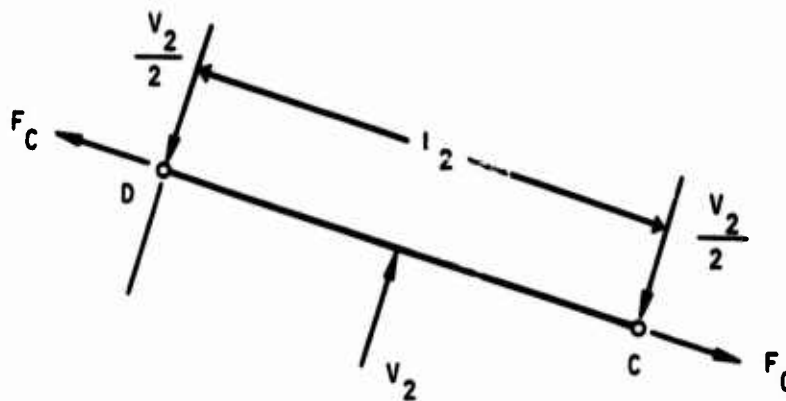
$$V_4 = P_4 L_4 W_4 \quad (165)$$

Ramp 4 Freebody

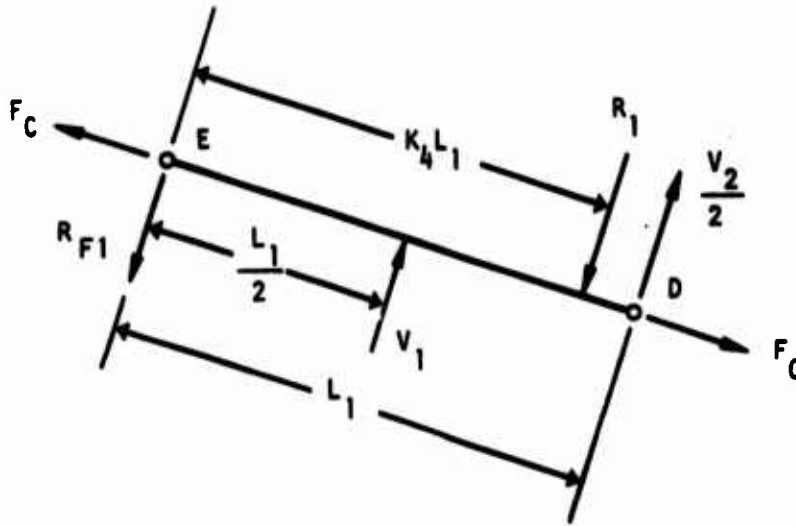


Due to the pin joint at B and the roller at A, reactions at the hinges are normal to the panel as shown in the freebody sketch.

Ramp 2 Freebody



Ramp 1 Freebody

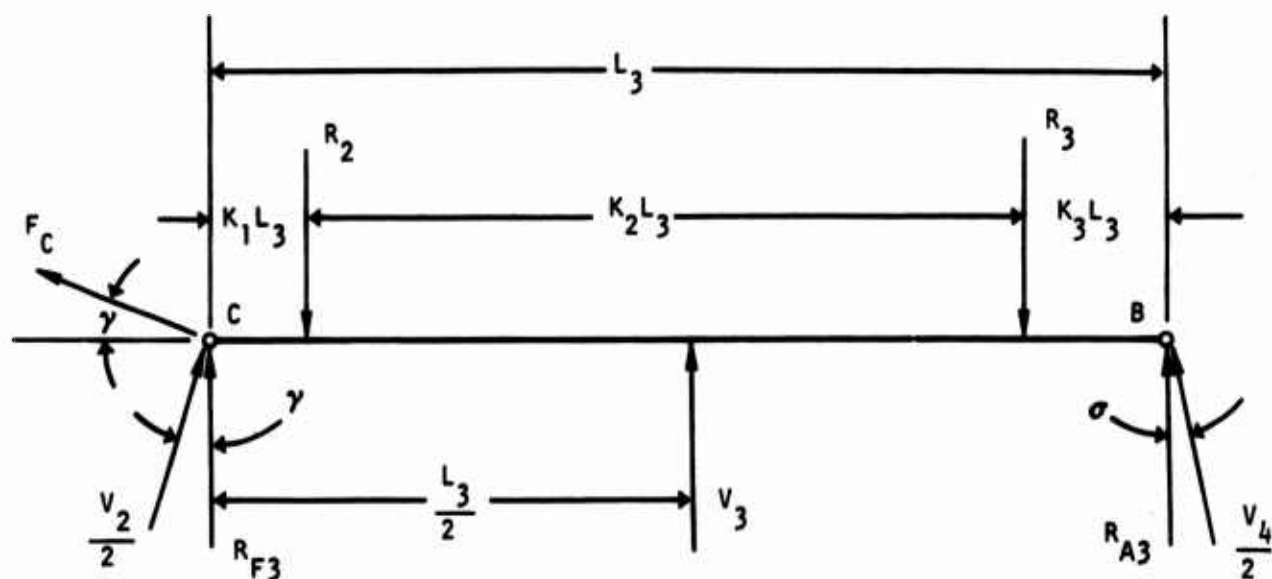


Similar to ramp 1 of a three-ramp system, the reactions normal to the panel are calculated by equations 166 and 167.

$$R_1 = \frac{V_1 + V_2}{2K_4} \quad (166)$$

$$R_{F1} = V_1 \left(1 - \frac{1}{2K_4}\right) + \frac{V_2}{2} \left(1 - \frac{1}{K_4}\right) \quad (167)$$

### Ramp 3 Freebody



From the freebody diagrams of ramps 2 and 4, reactions at the hinges are determined except for the force,  $F_C$ .  $F_C$  is determined for longitudinal balance of forces on ramp 3.

$$\Sigma F_L = 0 = \frac{V_4 \sin \sigma}{2} + F_C \cos \gamma - \frac{V_2 \sin \gamma}{2} \quad (168)$$

and

$$F_c = \frac{V_2 \tan \gamma}{2} - \frac{V_4 \sin \sigma}{2 \cos \gamma} \quad (169)$$

Reaction at B normal to the panel is given by equation 170.

$$R_{A3} = \frac{V_4 \cos \sigma}{2} \quad (170)$$

Reaction at C normal to the panel is obtained by equation 171.

$$\begin{aligned} R_{F3} &= F_c \sin \gamma + \frac{V_2 \cos \gamma}{2} \\ &= (V_2 \sin \gamma - V_4 \sin \sigma) \frac{\tan \gamma}{2} + \frac{V_2 \cos \gamma}{2} \end{aligned} \quad (171)$$

Actuator reactions,  $R_2$  and  $R_3$ , are obtained by solving for moment equilibrium.

$$\begin{aligned} \Sigma M_{R3} = 0 &= R_{F3} (K_1 + K_2) L_3 + V_3 \left( \frac{1}{2} - K_3 \right) L_3 - \\ &R_{A3} K_3 L_3 - R_2 K_2 L_3 \end{aligned} \quad (172)$$

and

$$R_2 = \frac{R_{F3} (K_1 + K_2) + V_3 \left(\frac{1}{2} - K_3\right) - R_{A3} K_3}{K_2} \quad (173)$$

$$\Sigma M_{R2} = 0 = R_{F3} L_1 L_3 - V_3 \left(\frac{1}{2} - K_1\right) L_3 - R_{A3} (K_2 + K_3) \quad (174)$$

$$L_3 + R_3 K_2 L_3$$

$$R_3 = \frac{V_3 \left(\frac{1}{2} - K_1\right) + R_{A3} (K_2 + K_3) - R_{F3} K_1}{K_2} \quad (175)$$

### Ramp 1 Weight

This ramp is similar to ramp 1 of a three-ramp system.

- Stiffened sheet construction:

$$W_{T_L} = \frac{I_L \rho V_1 L_1}{2 K_{CL}} \left( \frac{L_1}{2H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (176)$$

$$W_{T_T} = \frac{I_T \rho K_W W_1}{K_{CF}} \left( R_{F1} + \frac{V_2}{2} + R_1 \right) \left( \frac{K_W W_1}{H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (177)$$

- Honeycomb construction:

$$W_{T_L} = I_L L_1 \left( \frac{\rho V_1 L_1}{4H_1 F_{CY}} + \frac{\rho_c W_1 H_1}{1728} + \frac{2\rho W_a L_1}{144} \right) \quad (178)$$

$$W_{T_T} = I_T \rho K_W W_1 \left( R_{F1} + \frac{V_2}{2} + R_1 \right) \left( \frac{K_W W_1}{H_1 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (179)$$

## Ramp 2 Weight

This ramp is similar to ramp 2 of a three-ramp system.

● Stiffened shut construction:

$$W_{T_L} = \frac{I_L \rho V_2 L_2}{2 K_{CL}} \left( \frac{L_2}{2H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (180)$$

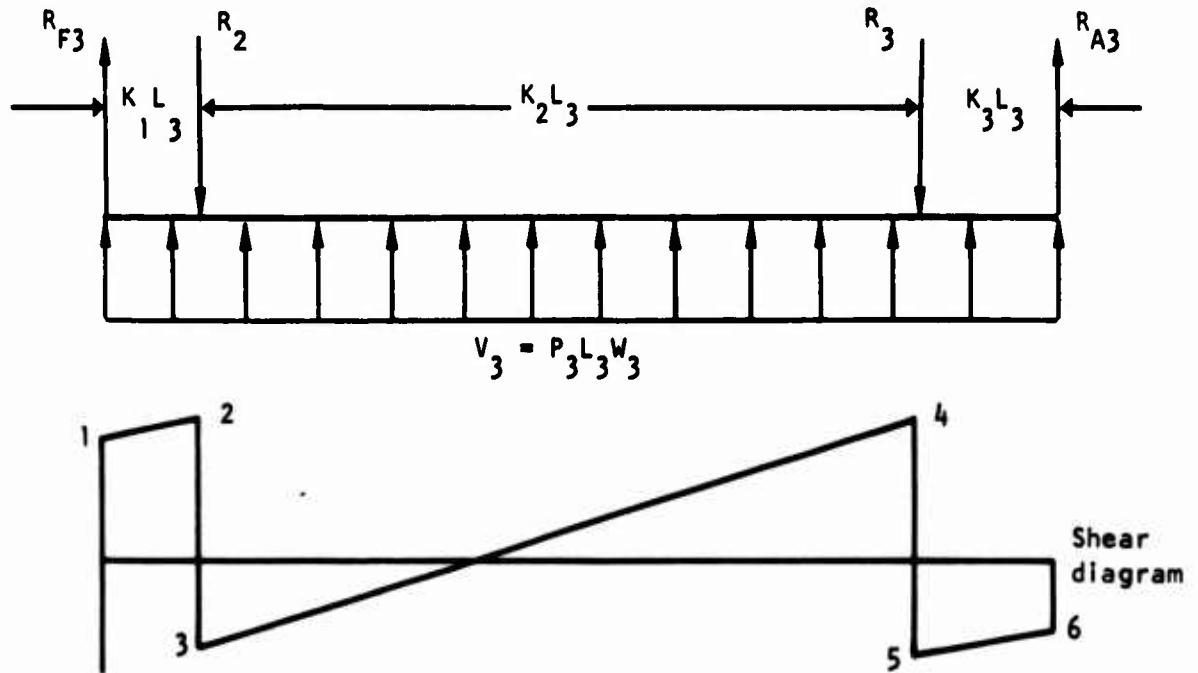
$$W_{T_T} = \frac{I_T \rho K_W W_2 V_2}{K_{CT}} \left( \frac{K_W W_2}{H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (181)$$

● Honeycomb construction:

$$W_{T_L} = I_L L_2 \left( \frac{\rho V_2 L_2}{4H_2 F_{CY}} + \frac{\rho W_2 H_2}{1728} + \frac{2 \rho_a W_2}{144} \right) \quad (182)$$

$$W_{T_T} = I_T \rho K_W W_2 V_2 \left( \frac{K_W W_2}{H_2 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (183)$$

Ramp 3 Weight



For weight estimating purposes, the maximum moment is assumed to be the maximum of the bending moment at the actuators and at the panel midspan.

$$M_{R2} = K_1 L_3 \left( R_{F3} + \frac{V_3 K_1}{2} \right) \quad (184)$$

$$M_{R3} = K_3 L_3 \left( R_{A3} + \frac{V_3 K_3}{2} \right) \quad (185)$$

$$M_{L2} = \frac{L_3}{2} \left( R_{F3} - R_2 (1 - 2K_1) + \frac{V_3}{4} \right) \quad (186)$$

$$M = \text{Absolute maximum of } (M_{R2}, M_{R3}, M_{L2}) \quad (187)$$

Design shear is obtained by selecting the absolute maximum shear of the values at points 1 through 6.

$$S_1 = R_{F3} \quad (188)$$

$$S_2 = R_{F3} + K_1 V_3 \quad (189)$$

$$S_3 = S_2 - R_2 \quad (190)$$

$$S_6 = R_{A3} \quad (191)$$

$$S_5 = R_{A3} + K_3 V_3 \quad (192)$$

$$S_4 = S_5 - R_3 \quad (193)$$

$$S = \text{Absolute maximum of } (S_1, S_2, S_3, S_4, S_5, S_6) \quad (194)$$

Design shear and bending moment are substituted into equation 85 to calculate panel weight as shown in equation 195.

$$WT_L = \frac{I_L L_3}{K_{CL}} \left( \frac{2M}{H_3 K_{FCY} F_{CY}} + \frac{S}{K_{FSU} F_{SU}} \right) \quad (195)$$

Hinge and actuator beam weights are calculated by equations 196 through 199.

$$WT_{TFH} = \frac{I_T \rho K_W R_3}{K_{CT}} \left( \frac{K_W W_3}{H_3 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (196)$$

$$WT_{TAH} = \frac{I_T \rho K_W R_{A3}}{K_{CT}} \left( \frac{K_W W_3}{H_3 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (197)$$

$$WT_{TFA} = \frac{I_T \rho K_W R_2}{K_{CT}} \left( \frac{K_W W_3}{H_{A3} K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (198)$$

$$WT_{TAA} = \frac{I_T \rho K_W R_3}{K_{CT}} \left( \frac{K_W W_3}{H_{A3} K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (199)$$

### Ramp 4 Weight

This ramp is similar to ramp 2.

● Stiffened sheet construction:

$$WT_L = \frac{I_L \rho V_4 L_4}{2 K_{CL}} \left( \frac{L_4}{2H_4 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (200)$$

$$WT_T = \frac{I_T \rho K_W V_4}{K_{CT}} \left( \frac{K_W W_4}{H_4 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (201)$$

● Honeycomb construction:

$$WT_L = I_L L_4 \left( \frac{\rho V_4 L_4}{4H_4 F_{CY}} + \frac{\rho W_4 H_4}{1728} + \frac{2\rho W_4}{144} \right) \quad (202)$$

$$WT_T = I_T \rho K_W V_4 \left( \frac{K_W W_4}{H_4 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (203)$$

### THREE-DIMENSIONAL AXIAL FLOW SYSTEMS (SPIKES)

Several types of spike arrangements are generally used in supersonic aircraft which are functions of inlet performance and operating environment. These include fixed spikes with no area control, translating spikes, and fully collapsing spikes for full area control. In the preliminary design phase of vehicle synthesis, geometry for three-dimensional inlet spike systems is not readily available. The estimating equations derived in Reference 6 account for this fact and, therefore, are based on inlet capture area which would be available in phase zero of configuration synthesis. The equations are the result of correlation with available inlet component weight with the significant design parameters.

Subroutine SPIKE uses equations 204 through 206 from Reference 6 to calculate weight estimates for the different types of three-dimensional spikes. Spike center of gravity is assumed to be at the inlet throat.

- Fixed spike weight, WFHS

$$WFHS = 12.53 (N_i) (A_i) \quad (204)$$

- Translating spike weight, WFTS

$$WFTS = 15.65 (N_i) (A_i) \quad (205)$$

- Translating and expanding spike weight, WTES

$$WTES = 5.18 (N_i) (A_i) \quad (206)$$

where

$N_i$  = number of inlets

$A_i$  = capture area per inlet, ft<sup>2</sup>

## NACELLE SHELL STRUCTURE

Nacelle weight estimating procedure consists of the evaluation of structural minimums, local panel flutter, and duct-nacelle compatibility. Loads are not evaluated in the current estimating method. This approach has been taken since nacelle shells are normally designed by other considerations. Engines, which produce the greatest impact on loads, are generally supported directly by pylon structure.

Nacelle synthesis and weight estimation calculations are performed in subroutine NACELE. This subroutine calls NCLGEO to calculate contour and segment geometry data.

## NACELLE GEOMETRY

Nacelle cross-sectional geometry is defined at as many as 10 longitudinal stations, starting at the inlet lip, station zero, and ending at the last full section of the nacelle. One-dimensional leading edges are defined as follows:

1. Horizontal leading edge - input zero for perimeter and actual width of leading edge
2. Wedge leading edges as would occur on nacelles with two inlet ducts with vertical leading edges - input zero for perimeter and depth at leading edge

Detail description of continuous section geometry and contour calculations is identical to that used to define duct geometry. Surface area for one-dimensional leading edge segments are calculated by equation 207 for horizontal leading edges and by equation 208 for wedge leading edges.

$$SFN_1 = \frac{DLXN_1}{2} (W_1 + BUN_2 + 2 BSN_2) \quad (207)$$

$$SFN_1 = \frac{DLXN_1}{2} (BUN_2 + BLN_2) \quad (208)$$

where

$SFN_1$  = nacelle leading edge segment surface area

$DLXN_1$  = leading edge segment length

$W_1$  = width of nacelle lip at station 1

$BUN_2$  = peripheral length of nacelle upper sector at station 2

$BSN_2$  = peripheral length of nacelle side sector at station 2

$BLN_2$  = peripheral length of nacelle lower sector at station 2

Curvature of the panels, although not pertinent in the current estimating procedure, are also calculated. The radius of curvature for circular nacelle sections are implicit. However, in the case of noncircular shapes, there is no true radius of curvature. Therefore, a nominal (weighted average) radius of curvature is defined in the following manner:

$$RCSN^2 = [RCSN - RON (1 - \cos 45^\circ)]^2 + (RON \sin 45^\circ + DON)^2 \quad (209)$$

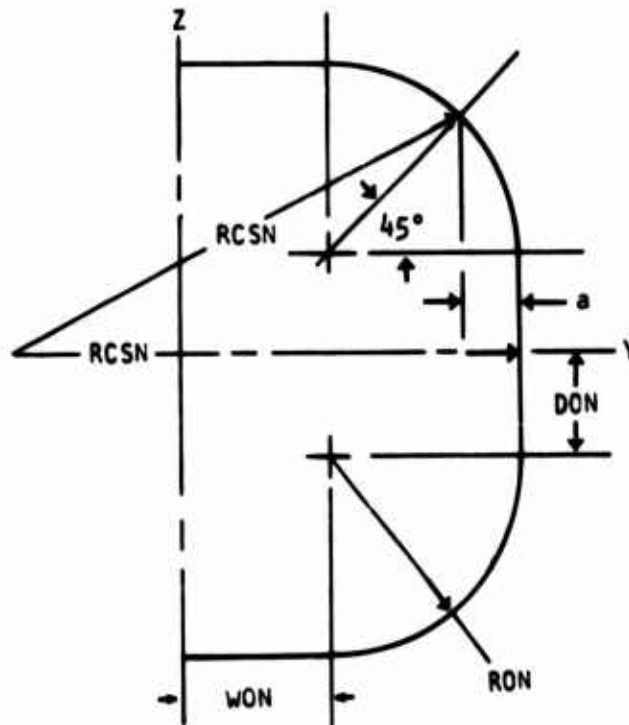
let

$$a = RON (1 - \cos 45^\circ) \quad (210)$$

$$b = RON \sin 45^\circ + DON \quad (211)$$

then

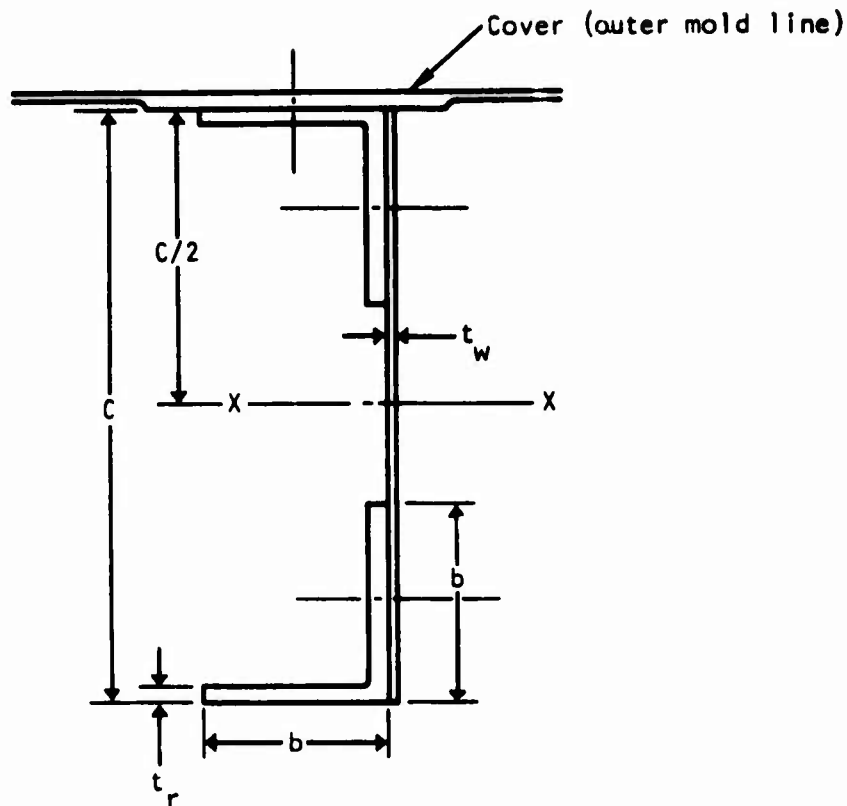
$$RCS = \frac{a^2 + b^2}{2a} \quad (212)$$



The nominal radius of curvature for the upper (RCUN) and lower (RCLN) sectors are calculated in the same manner. If the corner radius is less than 2 inches, the nominal radius of curvature is assumed to be infinite. A value of zero for curvature is used to designate the flat panel.

#### NACELLE SYNTHESIS

The nacelle is assumed to consist of an inlet section and an engine compartment section. This distinction is made to evaluate structural arrangement differences in the two sections. In the inlet section, frame weight and spacing are determined for duct design requirements. These data are developed by the duct estimating routines. Frame weight and spacing at nacelle cuts are obtained by interpolating between bounding duct cuts. Should two inlet ducts exist at a nacelle cut, the corresponding nacelle frame is assumed to be equivalent to two duct frames. Frame spacing in the engine compartment section is defined by input nacelle data. These frames are assumed to be constructed as shown in the following sketch. Frame weight is calculated from the user input parameters, frame depth (c), cap flange width (b), cap thickness ( $t_r$ ) and web thickness ( $t_w$ ).



Nacelle cover thicknesses at nacelle cuts are established by minimum gage and, for supersonic aircraft, by local panel flutter requirements, if critical. The appropriate frame spacing and side sector panel width (BSN) are used to determine thickness required to prevent local panel flutter at each nacelle cut.

### Local Panel Flutter

Critical panel flutter requirements are derived by the program through a process of checking mach-altitude points for each of nine points on the limit speed envelope. The user has the option of inputting his own estimates of critical panel flutter parameters. These user inputs are checked against program-derived values to insure that all reasonably probable panel flutter conditions are adequately surveyed. The foregoing process does not evaluate subsonic flight conditions.

The approach used to insure the prevention of local panel flutter is based on methods described in Reference 7. This approach consists of the determination of the mach number parameter and the baseline design parameter. The baseline panel thickness obtained by this approach can then be revised by correction factors. These correction factors are independently derived to account for in-plane loaded panels, pressure differentials, curvature, and other parameters that influence flutter design.

The two significant parameters (in-plane stress and curvature) are not evaluated in SWEEP. The effect due to neglecting panel loading could introduce optimistic panel sizing, while the omission of curvature effects introduces conservatism in the analysis.

The mach number effects are derived by a curve-fit approximation of Figure 19<sup>(7)</sup>. The curve-fit equations are as follows:

- For mach 1.0 to 1.4:

$$F(M) = 0.4851674 + 1.66456 (M-1)^3 \quad (213)$$

- For mach 1.4 to 2.0:

$$F(M) = 0.488412 - 0.4037203 \cos\left(\frac{M - 1.4}{0.6} \pi\right) + 0.4849271 \sqrt{M^2 - 1} \quad (214)$$

- For mach > 2.0:

$$F(M) = \beta = \sqrt{M^2 - 1} \quad (215)$$

The baseline panel design curve <sup>(7)</sup> is shown in Figure 20. The curve used in SWEEP (subroutine NACELE) deviates from the proposed baseline curve for values of L/W less than 2. This difference, although less than the curve presented in NACA TN D-451 which reference 7 states as "excessive over design for some applications," reflects the current design practice.

The curve-fit approximation for this parameter is as follows:

$$\left(\frac{F(M)E}{q}\right)^{1/3} t/L = \phi_B = 0.5551841 - 0.1686944 (L/W) + 0.2169992 (L/W)^2 - 0.0007636935 (L/W)^3 \quad (216)$$

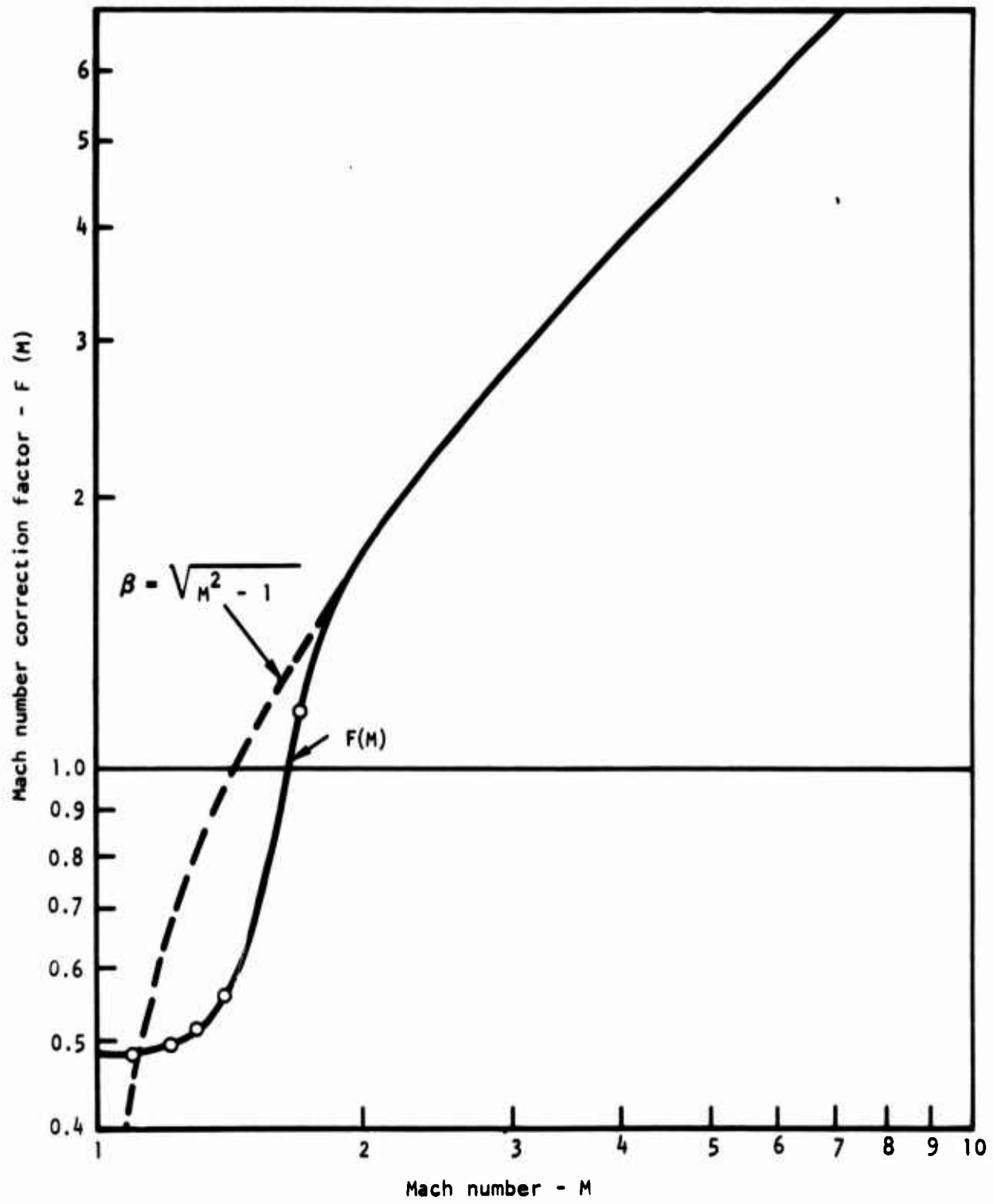


Figure 19. Panel flutter mach number correction factor.

$$\phi_B = \left[ \frac{F(M)E}{q} \right]^{1/3} t/L$$

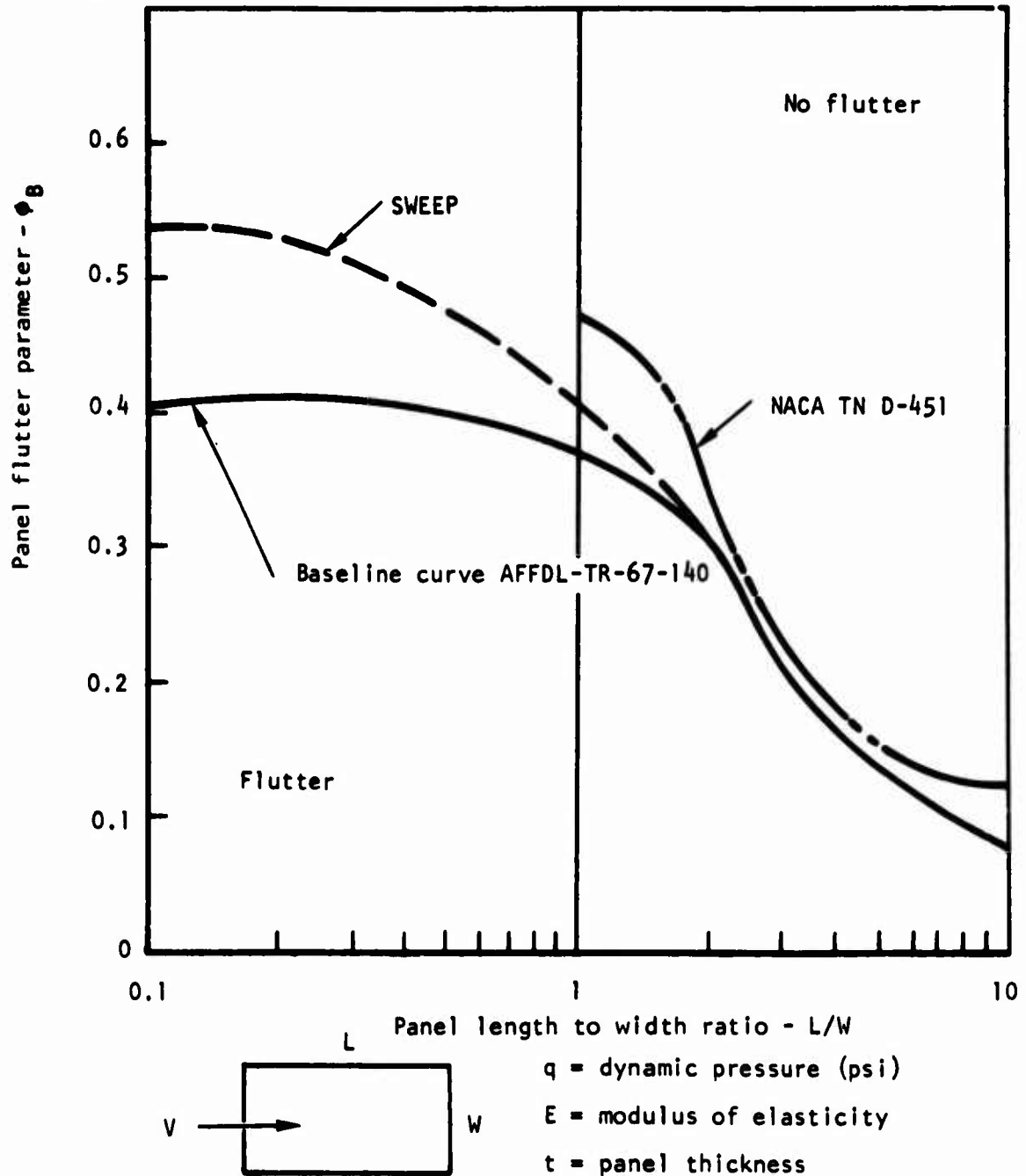


Figure 20. Panel flutter parameter versus aspect ratio.

For values of L/W greater than 10, this curve-fit approach is not valid. The value 10 is substituted for L/W should this condition occur. Although this assumption seems questionable, panels with aspect ratios greater than 10 rarely exist on nacelle structures.

The baseline thickness is then determined

$$t_b = \frac{\phi_B L}{\left[ \frac{F(M)E}{q} \right]^{1/3}} \quad (217)$$

The critical panel flutter speed is determined by investigating the vehicle flight envelope in terms of mach number and altitude. The flutter design point occurs when  $q/F(M) E$  is maximum.

#### Nacelle Shell Weight

Nacelle component weights are calculated for each nacelle segment. Should the first nacelle segment geometry define a one-dimensional leading edge structure, weight for that segment is not calculated to avoid duplication since the weight for that segment is calculated as part of the inlet duct structure.

Cover weight calculations are based on linear thickness taper between the forward and aft boundaries of segments. Cover panels which are replaced by engine removal doors are deleted in these weight calculations. Frame weight within segments are based on weight per linear inch at the bounding cuts.

Load redistribution structure weight is based on nacelle profile area. This calculation is performed for multiple engine nacelle arrangements where engine loads are reacted by nacelle structure which then transfers the loads to pylons. The weight is calculated at 1 pound per square foot of profile area.

Weight correlation factors are applied to the resultant weights for each of the shell components. Center-of-gravity calculations assume longitudinal segment weight centroids to be midway between bounding cuts.

## MISCELLANEOUS STRUCTURE WEIGHT

Miscellaneous air induction system, nacelle, and engine section structure, should they exist, are calculated in subroutines MISCOM and PYLONS. Table 8 is a summary of these components.

TABLE 8. MISCELLANEOUS STRUCTURE COMPONENT WEIGHTS

FORTTRAN Symbol	Description	Engine Instl Type	Calculation Routine
WTEM	Engine mount weight, lb	All	MISCOM
WTAI	Auxiliary inlet doors weight, lb	All	MISCOM
WTBP	Duct bypass doors weight, lb	All	MISCOM
WTED	Engine removal doors weight, lb	Nacelle	MISCOM
WTMD	Miscellaneous doors weight, lb	Nacelle	MISCOM
WTFW	Firewall weight, lb	Nacelle	MISCOM
WTEF	Exterior finish weight, lb	Nacelle	MISCOM
WTSD	Engine compartment shroud weight, lb	Nacelle	MISCOM
WTPI	Inboard pylons weight, lb	Nacelle	PYLONS
WTPO	Outboard pylons weight, lb	Nacelle	PYLONS
WFTI	Inboard fittings weight, lb	Nacelle	PYLONS
WFTO	Outboard fittings weight, lb	Nacelle	PYLONS

## ENGINE MOUNTS

Engine mounts and fittings weight is calculated by equation 218. The center of gravity is assumed to be at the engine CG.

$$W_{EM} = 0.015 W_E \quad (218)$$

where

$W_E$  = engine weight, lb

## AUXILIARY INLET AND DUCT BYPASS DOORS

The determination of duct bypass provisions or auxiliary inlet requirements are not within the scope of this program. However, should data be available for these items in the form of total panel size, the weights are calculated by equations 219 and 220. Center of gravity for the auxiliary inlet is assumed to be located one-third of the inlet length aft of the leading edge. Center of gravity for the duct bypass doors is assumed to be located two-thirds of the inlet length aft of the leading edge.

$$W_{TAI} = 12.0 S_{AI} \quad (219)$$

$$W_{TBP} = 15.0 S_{BP} \quad (220)$$

where

$S_{AI}$  = auxiliary inlet panel area, ft<sup>2</sup>

$S_{BP}$  = by-pass door area, ft<sup>2</sup>

## ENGINE REMOVAL DOORS

Equation 221 is used to calculate engine removal doors weight. This item is calculated when door width is defined by user input. Door length is assumed to extend from the engine face to the end of the nacelle. Center of gravity is assumed to be located at half the door length.

$$WTED = 2.93 S_{ED}$$

(221)

where

$$S_{ED} = \text{engine removal door area, ft}^2$$

#### MISCELLANEOUS DOORS

Miscellaneous doors weight is calculated by equation 222 if door area is defined by the user. Center of gravity of this item is assumed to be located at half the nacelle length.

$$WTMD = 2.5 S_{MD}$$

(222)

where

$$S_{MD} = \text{miscellaneous doors area, ft}^2$$

#### FIREWALL

A firewall is located at engine front face station separating the combustion chamber from the inlet. Firewall surface area is calculated by subtracting the duct(s) cross-sectional area at the engine face from the nacelle cross-sectional area at the same location. The weight for this component is estimated at 0.8 pound per square foot.

#### EXTERIOR FINISH

Nacelle exterior finish is estimated at 0.026 pound per square foot of nacelle surface area and is located at half the nacelle length.

#### ENGINE COMPARTMENT SHROUD

The requirement of engine compartment shroud is defined by the user. Shroud surface area may be input or, if not available, calculated by equation 223. The shroud is assumed to extend from the engine face to the end of the nacelle.

$$S_{SD} = N L \left[ \frac{\pi}{2} (D + 5.0) + H \right] / 144 \quad (223)$$

where

$S_{SD}$  = shroud area,  $ft^2$

$N$  = number of engines in nacelle

$L$  = shroud length, in.

$D$  = maximum engine diameter, in.

$H$  = nacelle depth at engine front face, in.

Shroud weight to 0.8 pound per square foot and is assumed to be located at half the shroud length.

#### PYLONS AND NACELLE SUPPORT FITTINGS

Equation 224 is used to calculate pylon weight. Since inboard and outboard pylons may be different, separate calculations are performed for each pylon. The center of gravity is calculated by equation 225.

$$WTPI = 12.0 S_p \quad (224)$$

$$CG_p = CG_E + \frac{L}{2} \sin \Lambda_p \quad (225)$$

where

$S_p$  = pylon planform area,  $ft^2$

$CG_E$  = engine center of gravity, in.

$L$  = pylon length, in.

$\Lambda_p$  = sweep angle of pylon

Fittings (equation 226) at the pylon to wing or fuselage attach points are calculated according to the load and nacelle material properties.

$$\text{Fittings} = \text{Load} \left[ \frac{141.312 \rho}{F_{tu} + F_{cy}} + \frac{78.20 \rho}{F_{su} + F_{bru}} + 2.5 \times 10^{-5} \right] \quad (226)$$

where

- $\rho$  = material density, lb/in.<sup>3</sup>
- $F_{tu}$  = ultimate tensile strength, psi
- $F_{cy}$  = compression yield strength, psi
- $F_{su}$  = ultimate shear strength, psi
- $F_{bru}$  = ultimate bearing strength, psi

The maximum load is determined by the vehicle maneuver load factor and yaw velocity. Equation 227 is used to determine the maximum load on vertical installations, and equation 228 for horizontal pylons.

$$\text{Load} = (N_z W_t + \dot{\psi}^2 Y b W_n / (12 G t)) 1.5 \quad (227)$$

$$\text{Load} = (W_t + W_n b/t) 1.5 N_z \quad (228)$$

where

- $\dot{\psi}$  = vehicle yaw velocity, radians/sec
- $N_z$  = vehicle vertical maneuver load factor
- $W_t$  = weight of nacelle and contents plus pylon, lb
- $W_n$  = weight of nacelle and contents, lb
- $Y$  = lateral coordinate of nacelle installation, in.
- $b$  = distance from the nacelle center to the tie point, in.
- $t$  = maximum thickness of the pylon, in.
- $G$  = acceleration of gravity, ft/sec<sup>2</sup>

## Section III

### PROGRAM DESCRIPTION

#### GENERAL DISCUSSION

The air induction system module has been developed to estimate weight of air induction system, nacelle, and engine section structure. Methods, equations, and logic discussed in the previous section have been programmed in FORTRAN extended language for the CDC 6600 computer. The module is structured in a single overlay consisting of a control program (AISMN) and 21 subroutines. One of the subroutines (MATLP2) is a material properties data print routine. Module weight summary results are printed by subroutine SUMARY as shown in Figures 3 through 5. Optional output of intermediate calculations are provided within individual data development routines.

Error messages, warning messages, and corrective measures have been built into the program such that most user errors will not result in catastrophic failure. In some cases, the warning is of a nature for which no user action is necessary. In other instances, incompatible data are either corrected, revised, or bypassed. The implications, probable cause, and recommended action associated with the various messages are presented in the subroutine discussions.

#### LOGIC FLOW

The module subroutine flow diagram is shown in Figure 21. System routines READMS and WRITMS are also shown in this diagram to indicate routines which read and store data in the mass storage file records. Figure 22 shows the logic flow diagram of this module. This diagram shows the major data manipulation and search procedures within this module.

#### GENERAL MAPS

Data storage and transmittal are accomplished through the use of blank common, labeled common, and mass storage file records. Mass storage file records are read into and written from data regions in common. Certain calculated variables are stored in the program region of individual routines. In this case, these variables are included in the discussion of the applicable routine.

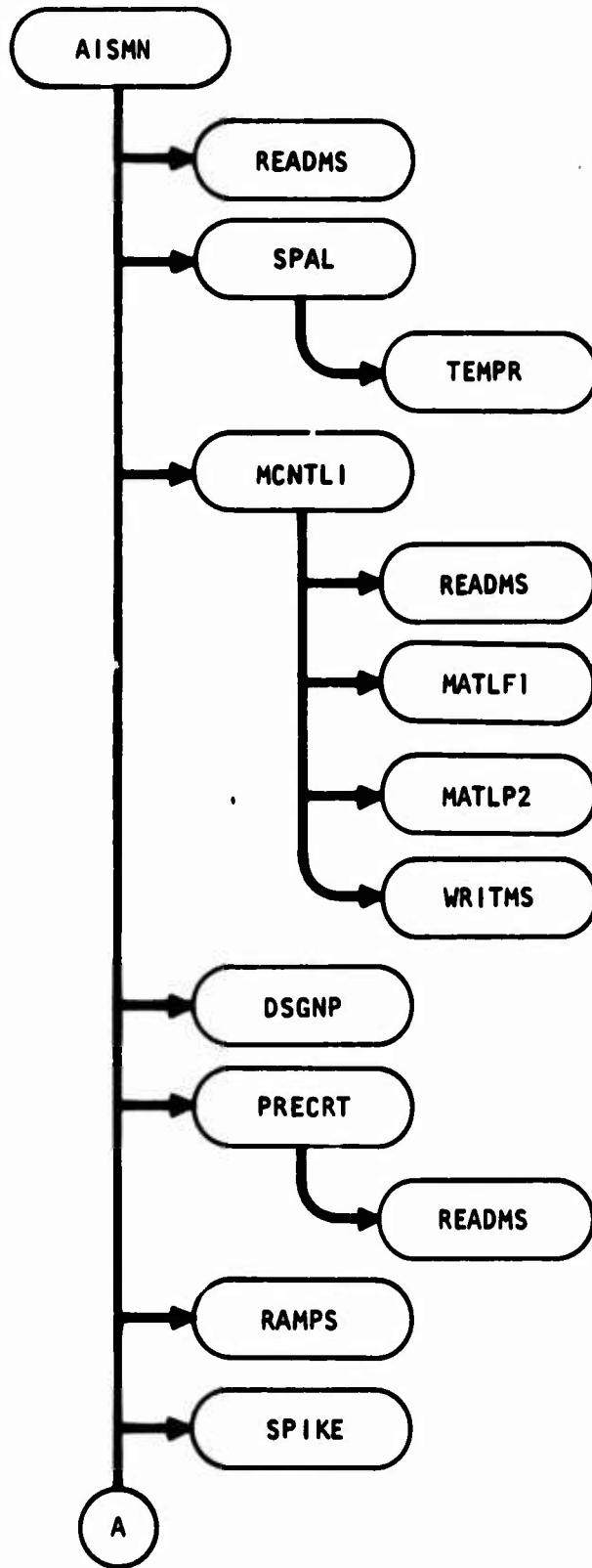


Figure 21. Air induction system module subroutine flow diagram, overlay (7,0).

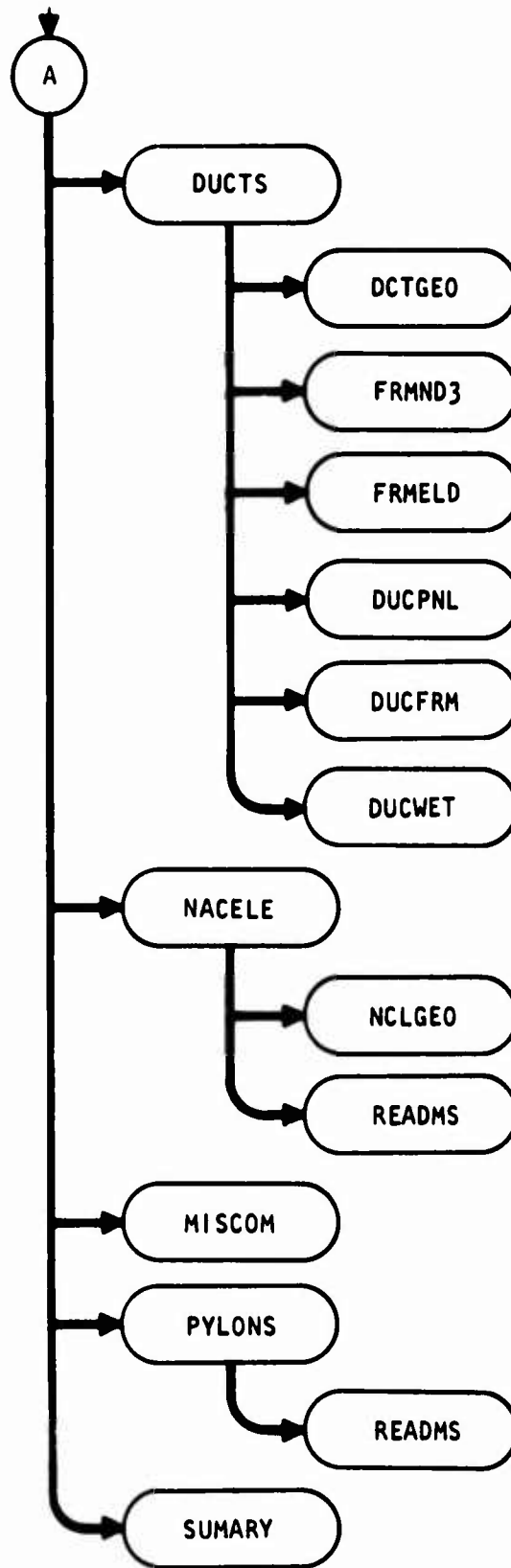


Figure 21. Air induction system module subroutine flow diagram, overlay (7,0) (concl).

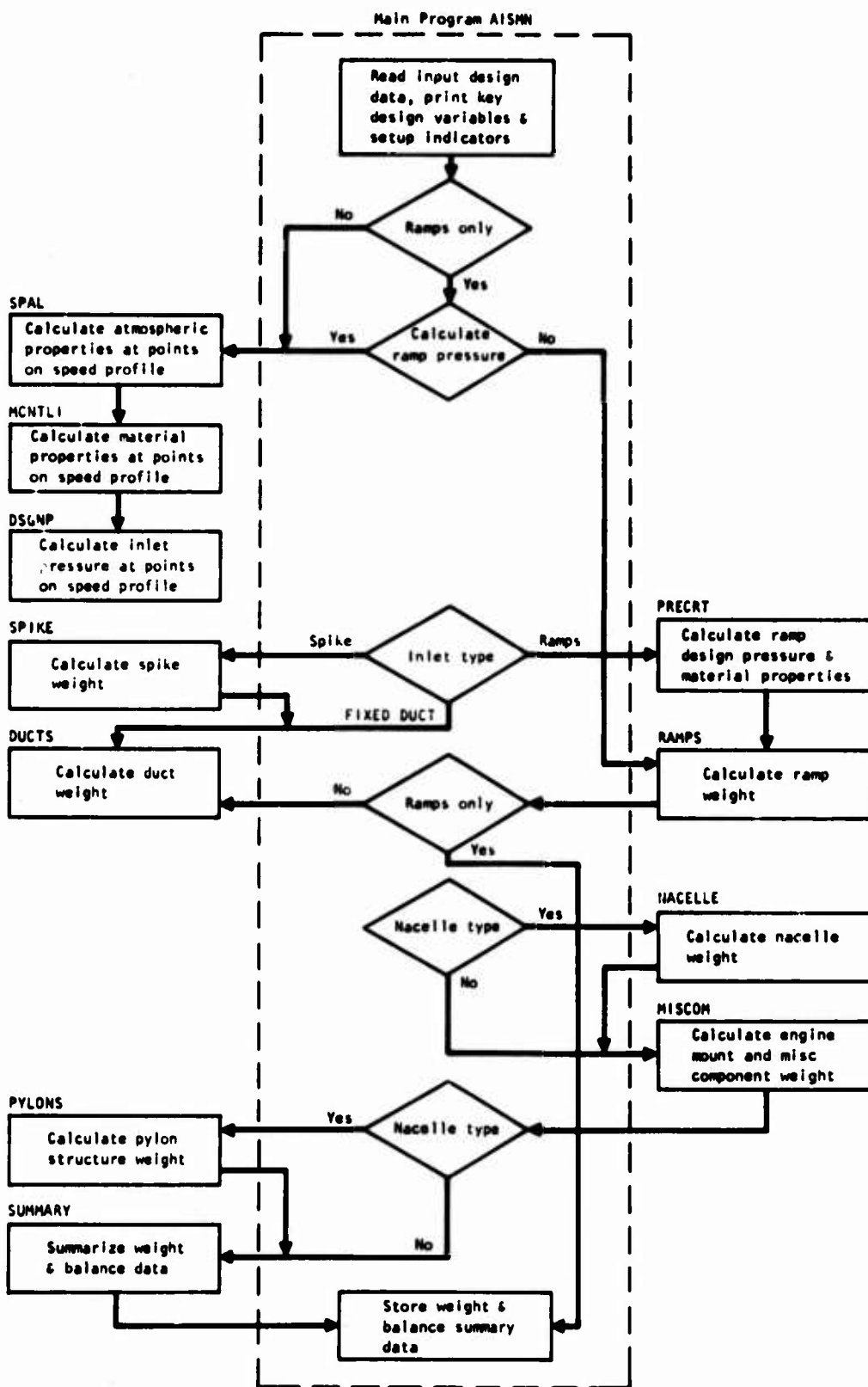


Figure 22. Logic flow diagram for air induction system module.

## COMMON

Blank common consists of 4,400 cells which are organized as shown in Table 9. Table 10 presents an alphabetical listing of arrays and variables within the common region. Items in the table are classified according to type as either input (I) or calculated (C). Many items that appear as calculated (C) variables may take on values that are input to the air induction system module. This is a function of whether or not default values or inputs are overridden in the synthesis procedure. However, items designated as input (I) types will always take on values that are input to this module. When variables in Table 10 are subsets of larger arrays, the higher order array is referenced in brackets.

Tables 11 through 25 are maps of those arrays that have specific significance which are not explained in the alphabetical listing.

## LABELED COMMON

Labeled common arrays are used to transfer program control words and certain vehicle design data.

- FDAT (Block FDATT) - This array is used to store air induction system, nacelle, and engine section (also other components) weight summary data for use in total vehicle summary calculations and output as shown in Table 26.
- IP (Block IPRINT) - This array is used to transmit print control indicators to various subroutines as shown in Table 27.
- XMISC (Block MISC) - The first location in this block is used to transmit the number of different materials which exist in the material library file records. Locations 85 through 100 are used to transmit alphanumeric case title information.

## MASS STORAGE FILE RECORDS

Mass storage file records used by this module are shown in Table 28. Variables in these records are discussed in the blank common region tables.

TABLE 9. COMMON ARRANGEMENT

Common Location	Variable Name and Locations	Variable Name and Locations	Variable Name and Locations	Detail Description Table Reference
1-80	D(1)-D(80)			11
81-270	EQU(1)-EQU(190)			17
271-280	EQU(191)-EQU(200)	DATK(1)-DATK(10)		17
281-320	DATS(1)-DATS(40)			16
321-400	DATD(1)-DATD(80)			12
401-520	DATR(1)-DATR(120)			16
521-600	DATN(1)-DATN(80)			14
601-640	DATM(1)-DATM(40)			13
641-733	DR(1)-DR(93)			15
734-770				Not used
771-1700	F(1)-F(930)			18
1701-1900	SUMM(1)-SUMM(200)			20
1901-2000				Not used
2001-2100	T(1)-T(100)	S(1)-S(100)		Refer to subrou- tine discussions
2101-2200	TOT(1)-TOT(100)			24
2201-2210	ALT(1)-ALT(10)			10
2211-2220	TEM(1)-TEM(10)			10
2221-2230	PO(1)-PO(10)			10
2231-2240	G(1)-G(10)			10
2241-2250	CS(1)-CS(10)			10
2251-2260	RHO(1)-RHO(10)			10
2261-2270	VH(1)-VH(10)			10
2271-2280	VL(1)-VL(10)			10
2281-2290	QH(1)-QH(10)			10
2291-2300	QL(1)-QL(10)			10
2301-2310	EMH(1)-EMH(10)			10
2311-2320	EML(1)-EML(10)			10
2321-2330	RATH(1)-RATH(10)			10
2331-2340	RATL(1)-RATL(10)			10
2341-2350	TEMH(1)-TEMH(10)			10
2351-2360	TEML(1)-TEML(10)			10
2361-2370	PTH(1)-PTH(10)			10
2371-2380	PTL(1)-PTL(10)			10
2381-2390	PSH(1)-PSH(10)			10
2391-2400	PSL(1)-PSL(10)			10
2401-2410	RIH(1)-RIH(10)			10
2411-2420	R1L(1)-R1L(10)			10
2421-2430	R2H(1)-R2H(10)			10
2431-2440	R2L(1)-R2L(10)			10
2441-2450	R3H(1)-R3H(10)			10

TABLE 9. COMMON ARRANGEMENT (CONT)

Common Location	Variable Name and Locations	Variable Name and Locations	Variable Name and Locations	Detail Description Table Reference
2451-2460	R3L(1)-R3L(10)			10
2461-2470	PHTH(1)-PHTH(10)			10
2471-2480	PHEH(1)-PHEH(10)			10
2481-2490	PHTL(1)-PHTL(10)			10
2491-2500	PHEL(1)-PHEL(10)			10
2501-2510	PST(1)-PST(10)			10
2511-2520	WOD(1)-WOD(10)			10
2521-2530	ROD(1)-ROD(10)			10
2531-2540	DOD(1)-DOD(10)			10
2541-2550	BUD(1)-BUD(10)			10
2551-2560	BLD(1)-BLD(10)			10
2561-2570	BSD(1)-BSD(10)			10
2571-2580	DLXD(1)-DLXD(10)			10
2581-2590	SFD(1)-SFD(10)			10
2591-2600	FTUH(1)-FTUH(10)	WTD(1)-WTD(10)		10
2601-2610	FTUL(1)-FTUL(10)			10
2611-2620	FCYH(1)-FCYH(10)			10
2621-2630	FCYL(1)-FCYL(10)			10
2631-2640	FSUH(1)-FSUH(10)			10
2641-2650	FSUL(1)-FSUL(10)			10
2651-2660	FMUH(1)-FMUH(10)			10
2661-2670	FMUL(1)-FMUL(10)			10
2671-2680	EH(1)-EH(10)			10
2681-2690	EL(1)-EL(10)			10
2691-2700	FKTH(1)-FKTH(10)			10
2701-2709	FKTL(1)-FKTL(9)			10
2710	FKTL(10)	RHOD		10
2711-2720	SFRM(1)-SFRM(10)			10
2721-2730	TC(1)-TC(10)			10
2731-2740	TL(1)-TL(10)			10
2741-2750	FRWT(1)-FRWT(10)			10
2751-2760	WON(1)-WON(10)			10
2761-2770	RON(1)-RON(10)			10
2771-2780	DON(1)-DON(10)			10
2781-2790	BUN(1)-BUN(10)			10
2791-2800	BLN(1)-BLN(10)			10
2801-2810	BSN(1)-BSN(10)			10
2811-2820	DLXN(1)-DLXN(10)			10
2821-2830	SFN(1)-SFN(10)			10
2831-2840	RCUN(1)-RCUN(10)			10
2841-2850	RCLN(1)-RCLN(10)			10

TABLE 9. COMMON ARRANGEMENT (CONCL)

Common Location	Variable Name and Locations	Variable Name and Locations	Variable Name and Locations	Detail Description Table Reference
2851-2860	RCSN(1)-RCSN(10)			10
2861-2869	ELN(1)-ELN(9)			10
2870	ELN(10)	RHON		10
2871-2880	TCN(1)-TCN(10)			10
2881-2890	SFRN(1)-SFRN(10)			10
2891-2900	FRWN(1)-FRWN(10)			10
2901-2910	WTCN(1)-WTCN(10)			10
2911-2920	WTFN(1)-WTFN(10)			10
2921-2930	WTLN(1)-WTLN(10)			10
2931-3020				Not used
3021-3080	DLSP(1)-DLSP(60)			10
3081-3140	BEN(1)-BEN(60)			10
3141-3200	VV(1)-VV(60)			10
3201-3260	TMD(1)-TMD(60)	AA(1)-AA(60)		22, 10
3261-3320	TMD(61)-TMD(120)	YB(1)-YB(60)		22, 10
3321-3380	TMD(121)-TMD(180)	ZB(1)-ZB(60)		22, 10
3381-3440	TMD(181)-TMD(240)	DLS(1)-DLS(60)		22, 10
3441-3500	TMD(241)-TMD(300)	YPB(1)-YPB(60)		22, 10
3501-3560	TM(1)-TM(60)	ZPB(1)-ZPB(60)		21, 10
3561-3621	TM(61)-TM(121)	Y(1)-Y(61)		21, 10
3622-3660	TM(122)-TM(160)	Z(1)-Z(39)		21, 10
3661-3682	TT(1)-TT(22)	Z(40)-Z(61)		25, 10
3683-3690	TT(23)-TT(30)	YP(1)-YP(8)		25, 10
3691-3743	TMS(1)-TMS(53)	YP(9)-YP(61)	TWW(1)-TWW(53)	23, 10
3744-3750	TMS(54)-TMS(60)	ZP(1)-ZP(7)	TWW(54)-TWW(60)	23, 10
3751-3804	TMS(61)-TMS(114)	ZP(8)-ZP(61)	TCC(1)-TCC(54)	23, 10
3805-3810	TMS(115)-TMS(120)	V(1)-V(6)	TCC(55)-TCC(60)	23, 10
3811-3865	TMS(121)-TMS(175)	V(7)-V(61)	BB2(1)-BB2(55)	23, 10
3866-3870	TMS(176)-TMS(180)	A(1)-A(5)	BB2(56)-BB2(60)	23, 10
3871-3926		A(6)-A(61)		10
3927-3987	BM(1)-BM(61)			10
3988-4100				Not used
4101-4200	DC(1)-DC(100)			Inactive
4201-4400	ND(1)-ND(200)			19

TABLE 10. COMMON REGION VARIABLE LIST

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
A	61	3866	C	Static lateral load at frame cuts, lb/(lb/in.)	FRWELD
AA	60	3201	C	Unit internal axial load at frame segment centroids, lb/(lb/in.)	DUCTS, FRWELD, DUCFRM
AACT	1	2131	C	Weight aft ramp actuator beam, lb (TOT)	RAMPS, AISW, PYLONS, SUMARY
AC	1	2058	C	Frame cap area, in. <sup>2</sup>	DUCFRM
ACT	1	2131	C	Weight aft ramp actuator beam, lb (TOT)	RAMPS, AISW, PYLONS, SUMARY
AHINGE	1	2132	C	Weight aft ramp hinge beam, lb (TOT)	RAMPS, AISW, PYLONS, SUMARY
ALOFT	1	2003	C	Altitude divided by 1,000, ft/1,000	TEMPR
ALPHA2	1	444	I	Angle between projected face of ramp 1 and ramp 2 for 2-ramp system, deg (DATR)	RAMPS
ALPHA3	1	467	I	Angle between projected face of ramp 2 and ramp 3 for 3-ramp system, deg (DATR)	RAMPS
ALT	10	2201	C	Nine altitudes on speed profile, ft	SPAL, TEMPR, DSGNP, PRECKT NACELE
AMI	1	2054	C	Minimum frame cap area, in. <sup>2</sup>	DUCFRM
BB2	60	3811	C	Frame cap width at frame segment centroids, in.	DUCTS, DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
BC2	1	2062	C	Frame cap width, in.	DUCFRM
BEN	60	3081	C	Unit internal bending moment at frame segment centroids, in.-lb/(lb/in.)	DUCTS, FRMELD, DUCFRM
BLD	10	2551	C	Lower sector duct panel peripheral length at cuts, in.	DUCTS, DCTGEO
BLN	10	2791	C	Lower sector nacelle panel peripheral length at cuts, in.	NACELE, NCLGEO
BM	61	3927	C	Static bending moment at frame cuts, in.-lb/(lb/in.)	FRMELD
BMO	1	2043	C	Frame moment redundant, in.-lb/(lb/in.)	FRMELD
BSD	10	2561	C	Side sector duct panel peripheral length at cuts, in.	DUCTS, DCTGEO, DUCMET
BSN	10	2801	C	Side sector nacelle panel peripheral length at cuts, in.	NACELE, NCLGEO
BUD	10	2541	C	Upper sector duct panel peripheral length at cuts, in.	DUCTS, DCTGEO, DUCMET
BUN	10	2781	C	Upper sector nacelle panel peripheral length at cuts, in.	NACELE, NCLGEO

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
CONST	1	402	I	Construction indicator (DATR) 0.0 = standard 1.0 = honeycomb	RAMPS
CS	10	2241	C	Speed of sound at nine speed profile altitude, ft/sec	SPAL
D	2000	1	I	Constants (refer to Table 11)	Most
DADH	1	427	I	Adhesive density per honeycomb panel face sheet, psf (DATR)	RAMPS
DATD	80	321	I/C	Duct geometry and design data (refer to Table 12)	DUCTS, DCTGEO, DUCPNL, DUOMET, NACELE, MISCOM
DATK	10	271	I	Weight correlation constants (refer to EQU array, Table 17)	AISW, DUCTS, NACELE
DATM	40	601	I	Speed-altitude profile data (refer to Table 13)	SPAL
DATN	80	521	I/C	Nacelle geometry and design data (refer to Table 14)	NACELE, NCLGEO, MISCOM, PYLONS
DATR	120	401	I/C	Ramp geometry and design data (refer to Table 15)	AISW, RAMPS, DUCNET, SUMMARY

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
DATS	40	281	I	Air induction system, nacelle, and engine section design data (refer to Table 16)	AISWN, MCNTLI, SPIKE, DUCPNL, DUCFRM, NACELE, MISCOM, PYLONS, SUMMARY
DCORE	1	426	I	Honeycomb core density, lb/ft <sup>3</sup> (DATR)	RAMPS
DENS	1	414	I/C	Ramp material density, lb/in. <sup>3</sup> (DATR)	RAMPS, PRECKT
DLS	60	3381	C	Frame segment lengths at duct mold line, in.	FRMND3, FRMELD
DLSP	60	3021	C	Frame segment length at frame centroids, in.	FRMELD, DUCFRM
DLVG	1	631	I	General relationship between limit speed and level-flight maximum speed (DATM)	SPAL
DLXD	10	2571	C	Duct segment lengths between cuts, in.	DUCTS, DCTGEO, DUCMET
DLXN	10	2811	C	Nacelle segment lengths between cuts, in.	NACELE, NCLGEO
DOD	10	2531	C	Vertical flat length of duct contour at cuts, in.	DUCTS, DCTGEO, FRMND3, MISCOM
DON	10	2771	C	Vertical flat length of nacelle contour at cuts, in.	NACELE, NCLGEO, MISCOM
DR	93	641	I	Permanent ramp design constants (refer to Table 15)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
D1	1	1	I	Constant, 1.0 (refer to Table 11)	DUCFRM
D12	1	12	I	Constant, 12.0 (refer to Table 11)	DUCFRM
D2	1	2	I	Constant, 2.0 (refer to Table 11)	DUCFRM
E	1	2051	C	Frame material modulus of elasticity, psi	DUCFRM
EGIP	1	282	I	Engine type (refer to DATS array, Table 16)	DSGNP
EH	10	2671	C	Duct material modulus of elasticity on $M_H$ diagram, psi	MCNTLI, DUCPNL, DUCFRM
EL	10	2681	C	Duct material modulus of elasticity on $M_L$ diagram, psi	MCNTLI, DUCPNL, DUCFRM
EIN	10	2861	C	Nacelle material modulus of elasticity, psi	NACELE
EMH	10	2301	C	Airflow at engine on $M_H$ diagram, M	SPAL
EML	10	2311	C	Airflow at engine on $M_L$ diagram, M	SPAL
EQU	200	81	I	Equation and physical constants (refer to Table 17)	SPAL, TEMPR, DSGNP, MCNTLI, PRECKT, SPIKE, DUCPNL, DUCMET, NACELE, MISCOM, PYLONS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
F	930	771	I	Alphanumeric ramp parameter titles (refer to Table 18)	RAMPS
FACT	1	416	I/C	Limit to ultimate design factor (DATR)	PRECRT
FACT	1	2130	C	Weight forward ramp actuator beam, lb (TOT)	RAMPS
FCY	1	412	I/C	Ramp material compression yield stress at design pressure, psi (DATR)	RAMPS, PRECRT
FCY	1	2047	C	Duct frame material compression yield stress, psi	DUCFRM
FCYH	10	2611	C	Duct material compression yield stress on $M_H$ diagram, psi	MCNTL1, DUCFRM
FCYL	10	2621	C	Duct material compression yield stress on $M_L$ diagram, psi	MCNTL1, DUCFRM
FD	1	2041	C	Frame depth, in.	DUCTS, FRWELD, DUCFRM
FDAT	60	FDAIT	C	Weight and balance summary (refer to Table 26)	AISMN
RHINGE	1	2129	C	Weight forward ramp hinge beam, lb (TOT)	RAMPS
FKC	1	2053	C	Frame buckling coefficient	DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
FKTH	10	2691	C	Duct material tensile strength under cyclic loading on $M_H$ diagram, fraction of ultimate tensile strength	MCNTL1, DUCPNL
FKTL	10	2701	C	Duct material tensile strength under cyclic loading on $M_L$ diagram, fraction of ultimate tensile strength	MCNTL1, DUCPNL
FRUJ	1	2050	C	Frame material Poisson's ratio	DUCFRM
FRUH	10	2651	C	Duct material Poisson's ratio on $M_H$ diagram	MCNTL1, DUCFRM
FRUL	10	2661	C	Duct material Poisson's ratio on $M_L$ diagram	MCNTL1, DUCFRM
FRWN	10	2891	C	Weight of one nacelle frame at nacelle cuts, lb	NACELE
FRWT	10	2741	C	Weight of one duct frame at duct cuts, lb	DUCTS, DUCFRM, NACELE
FSU	1	413	I/C	Ramp material ultimate shear strength at design pressure, psi (DAIR)	RAMPS, PRECRT
FSU	1	2048	C	Frame material ultimate shear strength, psi	DUCFRM
FSUH	10	2631	C	Duct material ultimate shear strength on $M_H$ diagram, psi	MCNTL1, DUCFRM
FSUL	10	2641	C	Duct material ultimate shear strength on $M_L$ diagram, psi	MCNTL1, DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
FTUH	10	2591	C	Duct material ultimate tensile strength on $M_1$ diagram, psi	MONTL1, DUCPNL
FTUL	10	2601	C	Duct material ultimate tensile strength on $M_L$ diagram, psi	MONTL1, DUCPNL
G	10	2231	C	Acceleration of gravity at nine speed profile altitudes, ft/sec <sup>2</sup>	SPAL
GAMMA	1	497	I	Angle between projected face of ramp 2 and ramp 3 for 4-ramp system, deg (DAIR)	RAMPS
HO	1	2044	C	Frame lateral load redundant, lb/(lb/in.)	FRMELD
I	1	4301	C	Scratch counter, also duct cut counter (ND)	most
IC	1	4320	C	Number of frame cuts (ND)	DUCTS, FRMELD
IGN	1	4325	C	Engine support-type indicator (ND) 0 = engine directly mounted to pylon or one engine per nacelle 1 = multiple engines per nacelle with engines mounted to nacelle structure	NACELE
ICNT	1	4328	C	Design pressure point counter (ND)	DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
ICRT	1	4317	C	Critical design point on speed profile (ND)	PRECRT
IFF	1	4319	C	Number of frame segments (ND)	DUCTS, FRND3, FRMELD, DUCFRM
IFRM	1	4321	C	Frame spacing search pass counter (ND) 1 = initial spacing pass 2 = second or subsequent spacing pass 3 = final or fixed spacing pass	DUCTS
IF3	1	4293	C	Material properties library file record number (ND)	MCNTL1
IF4	1	4294	C	Calculated material properties file record number (ND)	MCNTL1, PRECRT, NACELE, PYLONS
IGD	1	4314	C	Duct leading edge-type indicator (ND) 0 = complete section 1 = vertical lip 2 = horizontal lip	DUCTS, DCTGEO, DUCMET
IGN	1	4326	C	Nacelle leading edge-type indicator (ND) 0 = complete section 1 = vertical lip 2 = horizontal lip	NACELE, NCLGEO
II	1	4307	C	Counter through nine speed profile points (ND)	MCNTL1, MATLP2

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
IMIL		4322	C	Duct panel mill indicator (ND) 0 = panel not milled 1 = panel milled	DUCPNL
IP	80	IPRINT	I	Print controls (refer to Table 27)	AI5M, SPAL, DSGNP, MONTLL, RAMPS, PRECCT, DUCTS, FRWELD, NACELE, SUMARY
IQ	1	4318	C	Number of frame segments per quadrant (ND)	DUCTS, FRAND3, FRWELD
ITP	1	4311	C	Number of nacelles (ND)	AI5M
IVG	1	4312	C	Inlet-type indicator (ND) 1 = fixed duct 2 = fixed spike 3 = horizontal ramp 4 = vertical ramp 5 = translating spike 6 = translating and expanding spike	AI5M, DSGNP, MONTLL, SPIKE, DUOMET, SUMARY
J	1	4302	C	Scratch counter (ND)	most
JJ	1	4308	C	Counter for $M_H$ and $M_L$ at each speed profile altitude (ND)	MONTLL

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
K	1	4303	C	Scratch counter (ND)	Most
KC	1	4316	C	Duct perimeter code (ND) 1 = perimeter input 2 = perimeter correction factor input	DUCTS, DCTGEO
KCN	1	4324	C	Nacelle perimeter code (ND) 1 = perimeter input 2 = perimeter correction factor input	NACELE, NCLGEO
KK	1	4309	C	Scratch counter (ND)	MCNTLI, MATLP2, FRMND3, FRMELD
L	1	4304	C	Scratch counter, also duct cut counter (ND)	MCNTLI, DUCTS, FRMND3, FRMELD
MATLI	1	4260	C	Material identification number (ND)	MCNTLI, MATLP2
N	1	4306	C	Scratch counter (ND)	MCNTLI, MATLFI, MATLP2
NC	1	4315	C	Number of input duct cuts (ND)	DUCTS, DCTGEO, DUCPNL, DUCFRM, DUOMET, NACELE, MISCOM
NCN	1	4323	C	Number of input nacelle cuts (ND)	NACELE, NCLGEO, MISCOM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
ND	200	4201	C	Integer array (refer to Table 19)	All
NFLT	1	4327	C	Speed profile point critical for local panel flutter design (ND)	NACELE
NMATL	1	4259	C	Number of arrays of material properties in mass storage file, records 41 through 60 (ND)	AISMN, MONTLI
PAA	1	2057	C	Frame cap axial load from combined axial and bending load, lb	DUCFRM
PAX	1	2056	C	Frame axial load, lb	DUCFRM
PHEH	10	2471	C	Hammershock, pressure at engine on $M_H$ diagram, psia	DSGNP, DUCFRM
PHL	10	2491	C	Hammershock, pressure at engine on $M_L$ diagram, psia	DSGNP, DUCPNL, DUCFRM
PHS	1	403	I/C	Ultimate absolute hammershock pressure for ramp design, psia	RAMP, PRECKT
PHIH	10	2461	C	Hammershock pressure at throat on $M_H$ diagram, psia	DSGNP, PRECKT, DUCPNL, DUCFRM
PHIL	10	2481	C	Hammershock pressure at throat on $M_L$ diagram, psia	DSGNP, PRECKT, DUCPNL, DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
PI	1	15	I	Constant, $\pi$ (refer to Table 11)	DUCFRM
PO	10	2221	C	Ambient pressure at nine speed profile altitudes, psf	SPAL, DUCPNL, DUCFRM
PRESH	1	2002	C	Ambient pressure at altitude, psf	SPAL, TEMPR
PSH	10	2381	C	Static absolute pressure at engine on $M_H$ diagram, psia	SPAL
PSL	10	2391	C	Static absolute pressure at engine on $M_L$ diagram, psia	SPAL, DUCPNL, DUCFRM
PST	10	2501	C	Static absolute pressure at throat on $M_L$ diagram, psia	DSGNP, DUCPNL, DUCFRM
PTH	10	2361	C	Total pressure at engine on $M_H$ diagram, psia	SPAL, DSGNP
PTL	10	2371	C	Total pressure at engine on $M_L$ diagram, psia	SPAL, DSGNP
QH	10	2281	C	Dynamic pressure on $M_H$ diagram, psf	SPAL
QL	10	2291	C	Dynamic pressure on $M_L$ diagram, psf	SPAL, NACELE

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
RATG	1	632	I	General pressure recovery ratio (DAIM)	SPAL
RATH	10	2321	C	Inlet pressure recovery ratio on $M_H$ diagram	SPAL
RATL	10	2331	C	Inlet pressure recovery ratio on $M_L$ diagram	SPAL
RCLN	10	2841	C	Lower sector nacelle panel radius of curvature at cuts, in.	NCLGEO
RCSN	10	2851	C	Side sector nacelle panel radius of curvature at cuts, in.	NACELE, NCLGEO
RCUN	10	2831	C	Upper sector nacelle panel radius of curvature at cuts, in.	NACELE, NCLGEO
RHO	1	2052	C	Frame material density, lb/in. <sup>3</sup>	DUCFRM
RHO	10	2251	C	Density of air at nine speed profile altitudes, lb/ft <sup>3</sup>	SPAL
RHOD	1	2710	C	Duct material density, lb/in. <sup>3</sup>	MCNTLI, DUCPNL, DUCFRM, DUCNET
RHON	1	2870	C	Nacelle material density, lb/in. <sup>3</sup>	NACELE
RM	16	3485	I	Material descriptive title (refer to TMD array, Table 22)	MATLP2

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
ROD	10	2521	C	Corner radius of duct contour at cuts, in.	DUCTS, DCTGEO, FRMND3, MISCOM
RON	10	2761	C	Corner radius of nacelle contour at cuts, in.	NACELE, NCLGEO, MISCOM
RIH	10	2401	C	Ratio of static pressure at throat to free-stream total pressure on $M_H$ diagram	DSGNP
RLL	10	2411	C	Ratio of static pressure at throat to free-stream total pressure on $M_L$ diagram	DSGNP
RILONG	1	2124	C	Weight ramp 1 panel, lb (TOT)	RAMPS
RITRAN	1	2125	C	Weight ramp 1 transverse beams, lb (TOT)	RAMPS
R2H	10	2421	C	Ratio of hammershock pressure at engine face to total pressure on $M_H$ diagram	DSGNP
R2L	10	2431	C	Ratio of hammershock pressure at engine face to total pressure on $M_L$ diagram	DSGNP
R2LONG	1	2126	C	Weight ramp 2 panel, lb (TOT)	RAMPS
R2TRAN	1	2127	C	Weight ramp 2 transverse beams, lb (TOT)	RAMPS
R3H	10	2441	C	Ratio of hammershock pressure at inlet throat to total pressure on $M_H$ diagram	DSGNP

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
R3L	10	2451	C	Ratio of hamershock pressure at inlet throat to total pressure on $M_L$ diagram	DSGNP
R3LONG	1	2128	C	Weight ramp 3 panel, lb (TOT)	RAMPS
R4LONG	1	2133	C	Weight ramp 4 panel, lb (TOT)	RAMPS
R4TRAN	1	2134	C	Weight ramp 4 transverse beams, lb (TOT)	RAMPS
S	100	2001	C	Intermediate calculations, refer to subroutine descriptions	SPAL, DSGNP, PRECRT, SPIKE, DUCTS, DCTGEO, FRAND3, FRWELD, DUCPNL, DUCFRM, DUCNET, NACELE, NCLGEO, MISOOM, PYLONS, SUMARY
SFD	10	2581	C	Surface area of duct segments, in. <sup>2</sup>	DUCTS, DCTGEO, DUCNET
SFN	10	2821	C	Surface area of nacelle segments, in. <sup>2</sup>	NACELE, NCLGEO
SFRM	10	2711	C	Duct frame spacing at duct cuts, in.	DUCTS, DUCPNL, DUCFRM, DUCNET, NACELE
SFRN	10	2881	C	Nacelle frame spacing at nacelle cuts, in.	NACELE
SIGMA	1	498	I	Angle between projected face of ramp 3 and ramp 4 for 4-ramp system, deg (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
SUM	200	1701	C	Weight and balance summary (refer to Table 20)	AISN, SPIKE, DUCTS, NACELE, MISCOM, PYLONS, SUMMARY
T	2000	2001	C	Intermediate calculation	AISN
TBARFA	1	502	I	Aluminum front panel minimum skin thickness, in. (DATR)	RAMPS
TBARFS	1	512	I	Steel front panel minimum skin thickness, in. (DATR)	RAMPS
TBARFT	1	507	I	Titanium front panel minimum skin thickness, in. (DATR)	RAMPS
TBARRA	1	503	I	Aluminum rear panel minimum skin thickness, in. (DATR)	RAMPS
TBARBS	1	513	I	Steel rear panel minimum skin thickness, in. (DATR)	RAMPS
TBARBT	1	508	I	Titanium rear panel minimum skin thickness, in. (DATR)	RAMPS
TC	10	2721	C	Duct panel field thickness at duct cuts, in.	DUCTS, DUCPNL, DUCMET

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
TCA	1	499	I	Aluminum minimum cap thickness, in. (DATR)	RAMPS
TCAP	1	2061	C	Frame cap thickness, in.	DUCFRM
TCAP2	1	2063	C	Half of frame cap thickness, in.	DUCFRM
TCC	60	3751	C	Frame cap thickness at frame segment centroids, in.	DUCTS, DUCFRM
TCN	10	2871	C	Nacelle panel thickness at nacelle cuts, in.	NACELE
TCS	1	509	I	Steel minimum cap thickness, in. (DATR)	RAMPS
TCT	1	504	I	Titanium minimum cap thickness, in. (DATR)	RAMPS
TEM	10	2211	C	Ambient temperature at nine speed profile altitudes, OR	SPAL
TEMALT	1	2001	C	Ambient temperature at altitude, OR	SPAL, TEMPR
TEMH	10	2341	C	Total temperature on $M_H$ diagram, OR	SPAL, DSGNP, MCNTLL, PRECKI
TEML	10	2351	C	Total temperature on $M_L$ diagram, OR	SPAL, DSGNP, MCNTLL, PRECKI
TEMZ	1	2055	C	Intermediate calculation	DUCFRM
TL	10	2731	C	Duct panel land thickness at duct cuts, in.	DUCTS, DUCPNL, DUCNET

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
TM	160	3501	C	Calculated material data (refer to Table 21)	MONTL1, MATLF1, MATLP2
TMD	300	3201	I	Material properties file record data (refer to Table 22)	MONTL1, MATLF1, MATLP2
TMS	180	3691	C	Calculated material properties (refer to Table 23)	MONTL1, PRECRT, NACELE, PYLONS
TOT	100	2101	C	Weight summary data (refer to Table 24)	AISN, DUCTS, DUCPNL, DUCMET, NACELE, MISCOM, PYLONS, SUMMARY
TOTAL	1	2120	C	Two-dimensional variable-geometry ramp structure weight, lb (TOT)	RAMPS
TSA	1	501	I	Aluminum honeycomb panel minimum face sheet thickness, in. (DATR)	RAMPS
TSS	1	511	I	Steel honeycomb panel minimum face sheet thickness, in. (DATR)	RAMPS
TST	1	506	I	Titanium honeycomb panel minimum face sheet thickness, in. (DATR)	RAMPS
TT	30	3661	C	Intermediate material properties calculations (refer to Table 25)	MONTL1, MATLF1
TW	1	2059	C	Frame web thickness, in.	DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
TWA	1	500	I	Aluminum web minimum thickness, in. (DATR)	RAMPS
TWS	1	510	I	Steel web minimum thickness, in. (DATR)	RAMPS
TWS	1	2060	C	Frame stiffener thickness, in.	DUCFRM
TWT	1	505	I	Titanium web minimum thickness, in. (DATR)	RAMPS
TWT	1	2067	C	Frame weight, lb	DUCFRM
TWV	60	3691	C	Frame web thickness at frame segment centroids, in.	DUCTS, DUCFRM
ULD	240	3021		Unit loads (refer to DLSP, BEN, VV, and AA)	DUCTS, DUCFRM
V	61	3805	C	Static vertical load at frame cuts, lb/(lb/in.)	FRMELD
VH	10	2261	C	Level-flight maximum speed, $M_H$ , at nine speed profile altitudes, M	SPAL, DSGNP, PRECRT
VL	10	2271	C	Limit speed, $M_L$ , at nine speed profile altitudes, M	SPAL, DSGNP, PRECRT, NACELE
VO	1	2045	C	Frame vertical load redundant, lb/(lb/in.)	FRMELD

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
VV	60	3141	C	Unit internal shear at frame segment centroids, lb/(lb/in.)	DUCTS, FRMELD, DUCFRM
WFTI	1	2153	C	Weight inboard fittings, lb (TOT)	PYLONS
WFTO	1	2154	C	Weight outboard fittings, lb (TOT)	PYLONS
WFTS	1	2136	C	Weight translating spike, lb (TOT)	SPIKE
WHFS	1	2135	C	Weight fixed spike, lb (TOT)	SPIKE
WOD	10	2511	C	Horizontal flat length of duct contour at cuts, in.	DUCTS, DCTGEO, FRMND3, MISCOM
WON	10	2751	C	Horizontal flat length of nacelle contour at cuts, in.	NACELE, NCLGEO, MISCOM
WTAI	1	2141	C	Weight auxiliary inlets, lb (TOT)	MISCOM
WTBP	1	2142	C	Weight duct bypass doors, lb (TOT)	MISCOM
WTCN	10	2901	C	Nacelle panel weights within nacelle segments, lb	NACELE
WTD	10	2591	C	Duct segment weights, lb	DUCTS, DUCMET
WTED	1	2143	C	Weight engine removal doors, lb (TOT)	MISCOM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
WTEF	1	2147	C	Weight exterior finish, lb (TOT)	MISCOM
WTEM	1	2140	C	Weight engine mounts, lb (TOT)	MISCOM
WTES	1	2137	C	Weight translating and expanding spike, lb (TOT)	SPIKE
WTF	1	2064	C	Frame cap weight, lb	DUCFRM
WTFN	10	2911	C	Nacelle frame weights within nacelle segments, lb	NACELE
WTFW	1	2145	C	Weight firewall, lb (TOT)	MISCOM
WTILN	10	2921	C	Nacelle load redistribution member weights within nacelle segments, lb	NACELE
WTLP	1	2123	C	Weight inlet lip, lb (TOT)	DUCTS, DUCWET
WTMD	1	2144	C	Weight miscellaneous doors, lb (TOT)	MISCOM
WTPI	1	2151	C	Weight inboard pylon, lb (TOT)	PYLONS
WTPO	1	2152	C	Weight outboard pylon, lb (TOT)	PYLONS
WTSD	1	2146	C	Weight shroud, lb (TOT)	MISCOM
WTST	1	2066	C	Frame stiffener weight, lb	DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
WTW	1	2065	C	Frame web weight, lb	DUCFRM
W1	1	408	I	Width of ramp 1, in. (DAIR)	RAMPS
W2	1	409	I	Width of ramp 2, in. (DAIR)	RAMPS
W3	1	410	I	Width of ramp 3, in. (DAIR)	RAMPS
W4	1	411	I	Width of ramp 4, in. (DAIR)	RAMPS
XCL	1	421	I	Longitudinal bending couple correction factor, ratio of available to total beam depth (DAIR)	RAMPS
XCT	1	425	I	Transverse bending couple correction factor, ratio of available to total beam depth (DAIR)	RAMPS
XFCY	1	422	I	Ratio of allowable stress to compression yield stress (DAIR)	RAMPS
XFSU	1	423	I	Ratio of allowable shear stress to ultimate shear strength (DAIR)	RAMPS
XHTA2	1	443	I	Ratio of actuator beam depth to width of ramp 2 for 2-ramp system (DAIR)	RAMPS
XHTA3	1	466	I	Ratio of actuator beam depth to width of ramp 3 for 3-ramp system (DAIR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XHTA4	1	496	I	Ratio of actuator beam depth to width of ramp 4 for 4-ramp system (DAIR)	RAMPS
XHT2	1	442	I	Ratio of panel depth to ramp width for 2-ramp system (DAIR)	RAMPS
XHT3	1	465	I	Ratio of panel depth to ramp width for 3-ramp system (DAIR)	RAMPS
XHT4	1	495	I	Ratio of panel depth to ramp width for 4-ramp system (DAIR)	RAMPS
XH21	1	440	I	Depth to length ratio for ramp 1 of 2-ramp system (DAIR)	RAMPS
XH22	1	441	I	Depth to length ratio for ramp 2 of 2-ramp system (DAIR)	RAMPS
XH31	1	462	I	Depth to length ratio for ramp 1 of 3-ramp system (DAIR)	RAMPS
XH32	1	463	I	Depth to length ratio for ramp 2 of 3-ramp system (DAIR)	RAMPS
XH33	1	464	I	Depth to length ratio for ramp 3 of 3-ramp system (DAIR)	RAMPS
XH41	1	491	I	Depth to length ratio for ramp 1 of 4-ramp system (DAIR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XH42	1	492	I	Depth to length ratio for ramp 2 of 4-ramp system (DATR)	RAMPS
XH43	1	493	I	Depth to length ratio for ramp 3 of 4-ramp system (DATR)	RAMPS
XH44	1	494	I	Depth to length ratio for ramp 4 of 4-ramp system (DATR)	RAMPS
XIL21	1	428	I	Ramp 1 longitudinal beam weight index for 2-ramp system (DATR)	RAMPS
XIL22	1	431	I	Ramp 2 longitudinal beam weight index for 2-ramp system (DATR)	RAMPS
XIL31	1	445	I	Ramp 1 longitudinal beam weight index for 3-ramp system (DATR)	RAMPS
XIL32	1	448	I	Ramp 2 longitudinal beam weight index for 3-ramp system (DATR)	RAMPS
XIL33	1	451	I	Ramp 3 longitudinal beam weight index for 3-ramp system (DATR)	RAMPS
XIL41	1	468	I	Ramp 1 longitudinal beam weight index for 4-ramp system (DATR)	RAMPS
XIL42	1	471	I	Ramp 2 longitudinal beam weight index for 4-ramp system (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XIL43	1	474	I	Ramp 3 longitudinal beam weight index for 4-ramp system (DATR)	RAMPS
XIL44	1	480	I	Ramp 4 longitudinal beam weight index for 4-ramp system (DATR)	RAMPS
XIM21	1	430	I	Ramp 1 minimum weight index for 2-ramp system (DATR)	RAMPS
XIM22	1	435	I	Ramp 2 minimum weight index for 2-ramp system (DATR)	RAMPS
XIM31	1	447	I	Ramp 1 minimum weight index for 3-ramp system (DATR)	RAMPS
XIM32	1	450	I	Ramp 2 minimum weight index for 3-ramp system (DATR)	RAMPS
XIM33	1	455	I	Ramp 3 minimum weight index for 3-ramp system (DATR)	RAMPS
XIM41	1	470	I	Ramp 1 minimum weight index for 4-ramp system (DATR)	RAMPS
XIM42	1	473	I	Ramp 2 minimum weight index for 4-ramp system (DATR)	RAMPS
XIM43	1	479	I	Ramp 3 minimum weight index for 4-ramp system (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XIM44	1	482	I	Ramp 4 minimum weight index for 4-ramp system (DATR)	RAMPS
XITAA4	1	477	I	Ramp 3 aft actuator beam weight index for 4-ramp system (DATR)	RAMPS
XITAH2	1	434	I	Ramp 2 aft hinge beam weight index for 2-ramp system (DATR)	RAMPS
XITAH3	1	454	I	Ramp 3 aft hinge beam weight index for 3-ramp system (DATR)	RAMPS
XITAH4	1	478	I	Ramp 3 aft hinge beam weight index for 4-ramp system (DATR)	RAMPS
XITA2	1	433	I	Ramp 2 actuator beam weight index for 2-ramp system (DATR)	RAMPS
XITA3	1	453	I	Ramp 3 actuator beam weight index for 3-ramp system (DATR)	RAMPS
XITFA4	1	476	I	Ramp 3 fwd actuator beam weight index for 4-ramp system (DATR)	RAMPS
XITRH2	1	432	I	Ramp 2 fwd hinge beam weight index for 2-ramp system (DATR)	RAMPS
XITRH3	1	452	I	Ramp 3 fwd hinge beam weight index for 3-ramp system (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XITR4	1	475	I	Ramp 3 fwd hinge beam weight index for 4-ramp system (DAIR)	RAMPS
XIT21	1	429	I	Ramp 1 transverse beam weight index for 2-ramp system (DAIR)	RAMPS
XIT31	1	446	I	Ramp 1 transverse beam weight index for 3-ramp system (DAIR)	RAMPS
XIT32	1	449	I	Ramp 2 transverse beam weight index for 3-ramp system (DAIR)	RAMPS
XIT41	1	469	I	Ramp 1 transverse beam weight index for 4-ramp system (DAIR)	RAMPS
XIT42	1	472	I	Ramp 2 transverse beam weight index for 4-ramp system (DAIR)	RAMPS
XIT44	1	481	I	Ramp 4 transverse beam weight index for 4-ramp system (DAIR)	RAMPS
XX21	1	438	I	Fraction of length of ramp 2 from front to reaction point for 2-ramp system (DAIR)	RAMPS
XX22	1	439	I	Fraction of length of ramp 2 from back to reaction point for 2-ramp system (DAIR)	RAMPS
XX31	1	459	I	Fraction of length of ramp 1 from front to reaction point for 3-ramp system (DAIR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XK32	1	460	I	Fraction of length of ramp 3 from front to reaction point for 3-ramp system (DATR)	RAMPS
XK33	1	461	I	Fraction of length of ramp 3 from back to reaction point for 3-ramp system (DATR)	RAMPS
XK41	1	487	I	Fraction of length of ramp 3 from front to reaction point for 4-ramp system (DATR)	RAMPS
XK42	1	488	I	Fraction of length of ramp 3 between reaction points for 4-ramp system (DATR)	RAMPS
XK43	1	489	I	Fraction of length of ramp 3 from back to reaction point for 4-ramp system (DATR)	RAMPS
XK44	1	490	I	Fraction of length of ramp 1 from front to reaction point for 4-ramp system (DATR)	RAMPS
XL1	1	404	I	Length of ramp 1, in. (DATR)	RAMPS
XL2	1	405	I	Length of ramp 2, in. (DATR)	RAMPS
XL3	1	406	I	Length of ramp 3, in. (DATR)	RAMPS
XL4	1	407	I	Length of ramp 4, in. (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XMAT	1	415	I	Material type indicator (DAIR) 1 = aluminum 2 = titanium 3 = steel	RAMPS, PRECRT
XMISC	160	MISC	I	Number of material file records and alpha-numeric case title	AISMN, SPAL, RAMPS, DUCTS, NACELE, SUMMARY
XNUM	1	401	I	Number of ramps (DAIR)	RAMPS
XO	10	331	I	Duct cut stations, in. (refer to DAID array, Table 12)	DUCPNL, DUCFRM, DUCWET
XP21	1	436	I	Fraction of ultimate hammer shock pressure on ramp 1 of 2-ramp system (DAIR)	RAMPS
XP22	1	437	I	Fraction of ultimate hammer shock pressure on ramp 2 of 2-ramp system (DAIR)	RAMPS
XP31	1	456	I	Fraction of ultimate hammer shock pressure on ramp 1 of 3-ramp system (DAIR)	RAMPS
XP32	1	457	I	Fraction of ultimate hammer shock pressure on ramp 2 of 3-ramp system (DAIR)	RAMPS
XP33	1	458	I	Fraction of ultimate hammer shock pressure on ramp 3 of 3-ramp system (DAIR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XP41	1	483	I	Fraction of ultimate hammer shock pressure on ramp 1 of 4-ramp system (DATR)	RAMPS
XP42	1	484	I	Fraction of ultimate hammer shock pressure on ramp 2 of 4-ramp system (DATR)	RAMPS
XP43	1	485	I	Fraction of ultimate hammer shock pressure on ramp 3 of 4-ramp system (DATR)	RAMPS
XP44	1	486	I	Fraction of ultimate hammer shock pressure on ramp 4 of 4-ramp system (DATR)	RAMPS
XW	1	424	I	Fraction of ramp width for transverse beam reaction points (DATR)	RAMPS
Y	61	3561	C	Y-coordinate of frame cuts at duct mold line, in.	FRAND3, FRMELD
YB	60	3261	C	Y-centroid of frame segments at duct mold line, in.	FRAND3, FRMELD
YP	61	3683	C	Y-coordinate of frame neutral axis at cuts, in.	FRMELD
YPB	60	3441	C	Y-centroid of frame segments at neutral axis, in.	FRMELD

TABLE 10. COMMON REGION VARIABLE LIST (CONCL)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
Z	61	3622	C	Z-coordinate of frame cuts at duct mold line, in.	FRND3, FRMELD
ZB	60	3521	C	Z-centroid of frame segments at duct mold line, in.	FRND3, FRMELD
ZERO	1	24	I	Constant, 0.0 (refer to Table 11)	DUCFRM
ZP	61	3744	C	Z-coordinate of frame segment at neutral axis, in.	FRMELD
ZPB	60	3501	C	Z-centroid of frame segments at neutral axis, in.	FRMELD
ZZS	1	2042	C	Z-centroid of elastic center, in.	FRMELD

TABLE 11. D ARRAY VARIABLES

I.loc	Variable Name	Value	Description	Subroutine Reference
1	D1	1.0	Constant	Most
2	D2	2.0	Constant	Most
3		3.0	Constant	Most
4		4.0	Constant	MATLF1, NACELE, MISCOM
5		5.0	Constant	
6		6.0	Constant	
7		7.0	Constant	
8		8.0	Constant	DCTGEO, NCLGEO
9		9.0	Constant	
10		10.0	Constant	NACELE, PYLONS
11		11.0	Constant	
12		12.0	Constant	DUCFRM, PYLONS
13		20.0	Constant	
14		1000.0	Constant	TEMPR, DUCTS
15	PI	3.1415927	Constant, PI	Most
16		0.01745324	Constant, PI/180	PYLONS
17		144.0	Constant	Most
18		24.0	Constant	
19		0.5	Constant	DUCFRM
20		1.5	Constant	
21		0.333333	Constant	DUCFRM, NACELE
22		0.95	Constant	
23		0.25	Constant	
24		0.0	Constant	Most
25	ZERO	1.414214	Constant, square root of 2	NCLGEO
26		32.17405	Constant, acceleration of gravity, Ft/sec <sup>2</sup>	SPAL, PYLONS
27		180.0	Constant	
28		1.732051	Constant, square root of 3	MATLF1
29		2.5	Constant	
30		1.333333	Constant	
31		0.5	Increment for frame spacing search, in.	DUCTS
32			Not used	
●			To	
38			Not used	

TABLE 11. D ARRAY VARIABLES (CONT)

Loc	Variable Name	Value	Description	Subroutine Reference
39		1.5	Limit to ultimate factor for hammer-shock at $M_H$ , static pressure at $M_L$ , and basic loads	PRECRT, DUCPNL, DUCFRM, PYLONS
40		1.2	Limit to ultimate factor for hammer-shock at $M_L$	PRECRT, DUCPNL DUCFRM
41		5.0	Number of frame segments per quadrant (15 maximum)	DUCTS
42		0.426	Flange crippling coefficient, one edge free	DUCFRM
43		4.0		
44		7.5	Shear crippling coefficient for flat panels	DUCFRM
45		1.0		
46		0.9	Reduction factor for frame cap compression yield allowable	DUCFRM
47		0.75		
48		0.005	One gage increment to webs for frame stiffeners, in.	DUCFRM
49		2.0	Land width for frame attach, in.	DUCPNL, DUCWET
50		2.0		
51		0.050	Minimum land thickness for panel, in.	DUCPNL
52		0.032	Minimum field thickness for panel, in.	DUCPNL, NACELE
53		0.145		
54		0.050	Minimum frame cap thickness, in.	DUCFRM

TABLE 11. D ARRAY VARIABLES (CONCL)

Loc	Variable Name		Description	Subroutine Reference
55		0.032	Minimum frame web thickness, in.	DUCFRM
56		1.0	Minimum frame flange width, in.	DUCFRM, NACELE
57		0.050	Minimum nacelle frame cap thickness, in.	NACELE
58		0.025	Minimum nacelle frame web thickness, in.	NACELE
59		1.0		
60		0.9		
61		0.875		
62		0.3263434		
63		0.050		
64			Not used	
•			To	
80			Not used	
81			Refer to Table 9	
2000				

NOTE D array starts at common location 1.

TABLE 12. DATD DUCT INPUT DATA ARRAY VARIABLES

Loc	Variable Name	Description	Subroutine Reference
1		NCD, number of cuts through duct	DUCTS
2		KCD, duct geometry-type indicator 1.0 = perimeter input 2.0 = perimeter correction factor input	DUCTS
3		Not used	
4		Frame depth, in.	DUCTS
5		Minimum frame spacing, in.	DUCTS
6		Maximum frame spacing, in.	DUCTS
7		Duct panel mill indicator 0.0 = panel not milled 1.0 = panel milled (lands at frames)	DUCPNL
8		Not used	
●		To	
10		Not used	
11	X0(1)	X-station, duct cut 1 referenced from leading edge station (loc 11 = 0.0), in.	DUCTS, DCTGEO, DUCPNL, DUCFRM, DUCWET, NACELE, MISCOM
●	●	To	
20	X0(10)	X-station, duct cut 10, in.	
21		Y-station, duct cut 1, in. Distance from centerline of vehicle to centerline of duct for fuselage - buried engine concept, or distance from centerline of nacelle to centerline of duct for nacelle - mounted engines	DCTGEO, DUCWET, NACELE, MISCOM
●		To	
30		Y-station, duct cut 10, in.	
31		Not used	
●		To	
40		Not used	
41		Duct depth at duct cut 1, in.	DUCTS, DCTGEO
●		To	
50		Duct depth at duct cut 10, in.	

TABLE 12. DATD DUCT INPUT DATA ARRAY VARIABLES (CONCL)

Loc	Variable Name	Description	Subroutine Reference
51 ●		Duct width at duct cut 1, in. To	DUCTS DCTGEO
60 61 ●		Duct width at duct cut 10, in. Duct perimeter, in., or perimeter correction factor at duct cut 1 To	DUCTS, DCTGEO, DUCPNL,
70 ●		Duct perimeter, in., or perimeter correction factor at duct cut 10 To	
71 ●		Not used To	
80 ●		Not used	

NOTE DATD array starts at common location 321.

TABLE 13. DATM ARRAY VARIABLES

Loc	Variable Name	Description
1		Level-flight maximum speed ( $M_H$ ) at sea level with wing fixed or aft, M
•		To
5		Level-flight maximum speed at maximum altitude with wing fixed or aft, M
6		Sea-level altitude with wing fixed or aft, ft
•		To
10		Maximum altitude with wing fixed or aft, ft
11		Increment from level-flight maximum speed to limit speed ( $M_L$ ) at sea level  0.0 = use general increment in location 31 <1.0 = decimal increment to add to $M_H$ >1.0 = multiplier for $M_H$ <0.0 + fraction of $M_H$ to add to $M_H$
•		To
15		Increment from level-flight maximum speed to limit speed at maximum altitude
16		Inlet pressure recovery ratio at $M_H$ at sea level
•		To
20		Inlet pressure recovery ratio at $M_H$ at maximum altitude

TABLE 13. DATM ARRAY VARIABLES (CONCL)

Loc	Variable Name	Description
21		Inlet pressure recovery ratio at $M_L$ at sea level
•		To
25		Inlet pressure recovery ratio at $M_L$ at maximum altitude
26		Airflow at engine at sea level, M
•		To
30		Airflow at engine at maximum altitude, M
31	DVLG	General increment from level-flight maximum speed to limit speed
32	RATG	General inlet pressure recovery ratio
33		Not used
•		To
40		Not used

NOTE DATM array starts at common location 601.

TABLE 14. DATN NACELLE DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	NCN, number of nacelle cuts	NACELE
2	KCN, nacelle geometry-type indicator 1 = perimeter input 2 = perimeter correction factor input	NACELE
3	ICN, engine mounting type 0 = engine supported directly by pylons 1 = engine supported by nacelle structure which is tied to pylons	NACELE
4	Not used	
5	Not used	
6	Nacelle frame spacing, in.	NACELE
7	Nacelle frame depth, in.	NACELE
8	Engine access door(s) width, in.	NACELE, MISCOM
9	Nacelle maximum depth, in.	PYLONS
10	Nacelle maximum width, in.	PYLONS
11	X-station nacelle cut 1 referenced from leading edge station (loc 11 = 0.0), in. To	NACELE, NCLGEO, MISCOM
20	X-station duct cut 10, in.	
21	Not used To	
40	Not used	
41	Nacelle depth at nacelle cut 1, in. To	NACELE, NCLGEO, MISCOM
50	Nacelle depth at nacelle cut 10, in.	
51	Nacelle width at nacelle cut 1, in. To	NACELE, NCLGEO
60	Nacelle width at nacelle cut 10	
61	Nacelle perimeter, in., or perimeter correction factor at nacelle cut 1 To	NACELE, NCLGEO
70	Nacelle perimeter, in., or perimeter correction factor at nacelle cut 10	
71	Mach number for critical panel flutter, M	NACELE
72	Altitude that corresponds to critical panel flutter mach number, ft	NACELE

TABLE 14. DATN NACELLE DATA ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
73	Dynamic pressure that corresponds to critical mach number, psf	NACELE
74	Nacelle panel modulus of elasticity at critical flutter condition, psi	NACELE
75	Function of mach number for critical flutter condition	NACELE
76	Not used	
80	To Not used	

NOTE DATN array starts at common location 521.

TABLE 15. DATR AND DR ARRAY VARIABLES

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
1	XNUM			Number of ramps	DUCWET, SUMMARY
2	CONST			Construction indicator 0.0 = standard construction 1.0 = honeycomb construction	
3	PHS			Ultimate absolute hammershock pressure (refer to loc 18), psia	PRECRT
4	XL1			Length of ramp 1, in.	DUCWET, SUMMARY
5	XL2			Length of ramp 2, in.	DUCWET, SUMMARY
6	XL3			Length of ramp 3, in.	DUCWET, SUMMARY
7	XL4			Length of ramp 4, in.	DUCWET, SUMMARY
8	W1			Width of ramp 1, in.	
9	W2			Width of ramp 2, in.	
10	W3			Width of ramp 3, in.	
11	W4			Width of ramp 4, in.	
12	FCY			Compression yield stress of ramp material (refer to loc 18), psi	PRECRT
13	FSU			Ultimate shear stress of ramp material (refer to loc 18), psi	PRECRT
14	DENS			Density of ramp material (refer to loc 18), lb/in. <sup>3</sup>	PRECRT
15	XMAT			Material-type indicator 1.0 = aluminum 2.0 = titanium 3.0 = steel	PRECRT
16	FACT or FCT			Factor of safety (limit to ultimate factor) (refer to loc 18)	PRECRT
17				Distance from leading edge of duct to first ramp hinge, in.	DUCWET, SUMMARY
18				Design definition indicator 1.0 = locations 3, 12-16 are specified in input data set 0.0 = calculate data required in locations 3, 12-16	AISMN
19				Calculation indicator 1.0 = calculate ramp weights only 0.0 = calculate all component weights	AISMN

TABLE 15. DATR AND DR ARRAY VARIABLES (CONT)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
20				Not used	
21	XCL	1	0.9	Ratio of effective height between axial members to total panel depth (stiffened sheet construction only)	
22	XFCY	2	0.5	Ratio of allowable compression stress to compression yield stress (stiffened sheet construction only)	
23	XFSU	3	0.5	Ratio of allowable shear stress to ultimate shear strength (stiffened sheet construction only)	
24	XW	4	0.25	Ratio of hinge position from panel edge to panel width ( $0.25 \leq XW \leq 0.5$ )	
25	XCT	5	0.9	Ratio of effective height between transverse beam caps to total beam depth (stiffened sheet construction only)	
26	DCORE	6	4.4	Honeycomb core density, lb/ft <sup>3</sup>	
27	DADH	7	0.1	Adhesive density per honeycomb panel facesheet, psf	
DATR locations 28 through 44 contain data for two-ramp system					
28	XIL21	8	1.0	Ramp 1 panel weight correlation factor	
29	XIT21	9	1.0	Ramp 1 hinge beam weight correlation factor	
30	XIM21	10	1.0	Ramp 1 minimum weight correlation factor	
31	XIL22	11	1.0	Ramp 2 panel weight correlation factor	
32	XITFH2	12	1.0	Ramp 2 forward hinge beam weight correlation factor	
33	XITA2	13	1.0	Ramp 2 actuator beam weight correlation factor	
34	XITAH2	14	1.0	Ramp 2 aft hinge beam weight correlation factor	

TABLE 15. DATR AND DR ARRAY VARIABLES (CONT)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
35	XIM22	15	1.0	Ramp 2 minimum weight correlation factor	
36	XP21	16	0.5	Differential pressure on ramp 1, fraction of ultimate hammer shock pressure	
37	XP22	17	0.4	Differential pressure on ramp 1, fraction of ultimate hammer shock pressure	
38	XK21	18	0.2	Fraction of length of ramp 2 from forward edge to actuator location	
39	XK22	19	0.8	Fraction of length of ramp 2 from aft edge to actuator location	
40	XH21	20	0.1	Panel depth to length ratio for ramp 1	
41	XH2?	21	0.07	Panel depth to length ratio for ramp 2	
42	XHT2	22	0.1	Panel depth to width ratio for each ramp	
43	XHTA2	23	0.15	Actuator beam depth to panel width ratio for ramp 2	
44	ALPHA2	24	30.0	Angle between projected face of ramp 1 and ramp 2, deg	
DATR locations 45 through 67 contain data for three-ramp system					
45	XIL31	25	1.0	Ramp 1 panel weight correlation factor	
46	XIT31	26	1.0	Ramp 1 transverse beam weight correlation factor	
47	XIM31	27	1.0	Ramp 1 minimum weight correlation factor	
48	XIL32	28	1.0	Ramp 2 panel weight correlation factor	
49	XIT32	29	1.0	Ramp 2 transverse beam weight correlation factor	
50	XIM32	30	1.0	Ramp 2 minimum weight correlation factor	

TABLE 15. DATR AND DR ARRAY VARIABLES (CONT)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
51	XIL33	31	1.0	Ramp 3 panel weight correlation factor	
52	XIFFH3	32	1.0	Ramp 3 forward hinge beam weight correlation factor	
53	XITA3	33	1.0	Ramp 3 actuator beam weight correlation factor	
54	XITAH3	34	1.0	Ramp 3 aft hinge beam weight correlation factor	
55	XIM33	35	1.0	Ramp 3 minimum weight correlation factor	
56	XP31	36	0.2	Differential pressure on ramp 1, fraction of ultimate hammershock pressure	
57	XP32	37	0.5	Differential pressure on ramp 2, fraction of ultimate hammershock pressure	
58	XP33	38	0.4	Differential pressure on ramp 3, fraction of ultimate hammershock pressure	
59	XK31	39	0.9	Fraction of length of ramp 1 from forward edge to actuator location	
60	XK32	40	0.2	Fraction of length of ramp 3 from forward edge to actuator location	
61	XK33	41	0.8	Fraction of length of ramp 3 from aft edge to actuator location	
62	XH31	42	0.2	Panel depth to length ratio for ramp 1	
63	XH32	43	0.1	Panel depth to length ratio for ramp 2	
64	XH33	44	0.07	Panel depth to length ratio for ramp 3	
65	XH3	45	0.1	Panel depth to width ratio for each ramp	
66	XHFA3	46	0.15	Actuator beam depth to panel width ratio for ramp 3	
67	ALPHA3	47	30.0	Angle between projected face of ramp 2 and ramp 3, deg	

DATR locations 68 through 98 contain data for four-ramp system

TABLE 15. DATR AND DR ARRAY VARIABLES (CONT)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
68	XIL41	48	1.0	Ramp 1 panel weight correlation factor	
69	XIT41	49	1.0	Ramp 1 transverse beam weight correlation factor	
70	XIM41	50	1.0	Ramp 1 minimum weight correlation factor	
71	XIL42	51	1.0	Ramp 2 panel weight correlation factor	
72	XIT42	52	1.0	Ramp 2 transverse beam weight correlation factor	
73	XIM42	53	1.0	Ramp 2 minimum weight correlation factor	
74	XIL43	54	1.0	Ramp 3 panel weight correlation factor	
75	XITFH4	55	1.0	Ramp 3 forward hinge beam weight correlation factor	
76	XITFA4	56	1.0	Ramp 3 forward actuator beam weight correlation factor	
77	XITAA4	57	1.0	Ramp 3 aft actuator beam weight correlation factor	
78	XITAH4	58	1.0	Ramp 3 aft hinge beam weight correlation factor	
79	XIM43	59	1.0	Ramp 3 minimum weight correlation factor	
80	XIL44	60	1.0	Ramp 4 panel weight correlation factor	
81	XIT44	61	1.0	Ramp 4 transverse beam weight correlation factor	
82	XIM44	62	1.0	Ramp 4 minimum weight correlation factor	
83	XP41	63	0.6	Differential pressure on ramp 1, fraction of ultimate hammershock pressure	
84	XP42	64	1.0	Differential pressure on ramp 2, fraction of ultimate hammershock pressure	
85	XP43	65	1.0	Differential pressure on ramp 3, fraction of ultimate hammershock pressure	

TABLE 15. DATR and DR ARRAY VARIABLES (CONT)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
86	XP44	66	0.4	Differential pressure on ramp 4, fraction of ultimate hammershock pressure	
87	XK41	67	0.1	Fraction of length of ramp 3 from forward edge to forward actuator location	
88	XK42	68	0.75	Fraction of length of ramp 3 distance between actuators	
89	XK43	69	0.15	Fraction of length of ramp 3 from aft edge to aft actuator location	
90	XK44	70	0.9	Fraction of length of ramp 1 from forward edge to actuator location	
91	XH41	71	0.1	Panel depth to length ratio for ramp 1	
92	XH42	72	0.1	Panel depth to length ratio for ramp 2	
93	XH43	73	0.08	Panel depth to length ratio for ramp 3	
94	XH44	74	0.1	Panel depth to length ratio for ramp 4	
95	XHT4	75	0.1	Panel depth to width ratio for each ramp	
96	XHTA4	76	0.125	Actuator beam depth to panel width ratio for ramp 3	
97	GAMMA	77	20.0	Angle between projected face of ramp 2 and ramp 3, deg	
98	SIGMA	78	10.0	Angle between projected face of ramp 3 and ramp 4, deg	
DATR locations 99 through 113 contain minimum gage data					
99	TCA	79	0.04	Aluminum cap thickness, in.	
100	TWA	80	0.02	Aluminum web thickness, in.	
101	TSA	81	0.015	Aluminum honeycomb face sheet thickness, in.	
102	TBARFA	82	0.04	Aluminum front sheet thickness, in.	
103	TBARRA	83	0.015	Aluminum rear sheet thickness, in.	
104	TCT	84	0.025	Titanium cap thickness, in.	
105	TWT	85	0.013	Titanium web thickness, in.	

TABLE 15. DATR AND DR ARRAY VARIABLES (CONCL)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
106	TST	86	0.01	Titanium honeycomb face sheet thickness, in.	
107	TBARFT	87	0.025	Titanium front sheet thickness, in.	
108	TBARAT	88	0.01	Titanium rear sheet thickness, in.	
109	TCS	89	0.02	Steel cap thickness, in.	
110	TWT	90	0.01	Steel web thickness, in.	
111	TST	91	0.01	Steel honeycomb face sheet thickness, in.	
112	TBARFS	92	0.02	Steel front sheet thickness, in.	
113	TBARAS	93	0.01	Steel rear sheet thickness, in.	
114				Not used	
.				To	
120				Not used	

NOTE DATR array starts at common location 401, DR array starts at common location 641. If DATR values are not defined in the input data set, DR values are transferred to the corresponding DATR locations.

<sup>a</sup>All variables in these arrays, with the exception of DATR(17), DATR(18), and DATR(19), are used in subroutine RAMPS. DR array is only used in subroutine RAMPS.

TABLE 16. DATS ENGINE SECTION AND AIR INDUCTION  
SYSTEM INPUT DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	IPT, number of nacelles	AISMN, MISCOM, PYLONS SUMARY
2	EGTP, engine bypass ratio	AISMN, DSGNP
3	IVG, inlet type 1.0 = fixed duct 2.0 = fixed spike 3.0 = horizontal ramp 4.0 = vertical ramp 5.0 = translating spike 6.0 = translating and <sub>2</sub> expanding spike	AISMN
4	Capture area per inlet, in. <sup>2</sup>	AISMN, SPIKE
5	Number of Inlets	AISMN, SPIKE
6	Distance, leading edge of inlet to throat, in.	AISMN, SPIKE, DUCPNL, DUCFRM
7	Number of engines per vehicle	AISMN, NACELE, MISCOM, PYLONS
8	Maximum sea-level static thrust per engine, lb.	AISMN
9	Weight per engine, lb	AISMN, MISCOM, PYLONS
10	Engine length, in.	AISMN
11	Engine maximum diameter, in.	AISMN, MISCOM
12	Distance from front face to engine center of gravity, in.	AISMN, MISCOM
13	X-station inlet leading edge of inboard engine package, in.	AISMN, SUMARY
14	Y-station inboard nacelle centerline at engine front face, in.	AISMN, PYLONS
15	Z-station inboard nacelle centerline at engine front face, in.	AISMN
16	X-station inlet leading edge of outboard engine package, in.	AISMN, SUMARY
17	Y-station outboard nacelle centerline at engine front face, in.	AISMN, PYLONS
18	Z-station outboard nacelle centerline at engine front face, in.	AISMN
19	Not used	
20	Pylon, sweep of leading edge, deg	AISMN, PYLONS

TABLE 16. DATS ENGINE SECTION AND AIR INDUCTION  
SYSTEM INPUT DATA ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
21	Pylon type of mounting 0 = vertical 1 = horizontal	AISMN, PYLONS
22	Pylon, chord of inboard, in.	AISMN, PYLONS
23	Pylon, span of inboard, in.	AISMN, PYLONS
24	Pylon, chord of outboard, in.	AISMN, PYLONS
25	Pylon, span of outboard, in.	AISMN, PYLONS
26	Pylon, thickness to chord ratio	AISMN, PYLONS
27	Auxiliary inlet door area per nacelle, ft <sup>2</sup>	AISMN, MISC0M
28	Duct bypass door area per nacelle, ft <sup>2</sup>	AISMN, MISC0M
29	Miscellaneous door area per nacelle, ft <sup>2</sup>	AISMN, MISC0M
30	Shroud indicator 0.0 = no shroud 1.0 = shroud >1.0 = shroud area, ft <sup>2</sup>	AISMN, MISC0M
31	Duct structural material identification number	AISMN, MCNTL1
32	Variable-geometry ramps structural material identification number	AISMN, MCNTL1
33	Nacelle structural material identification number	AISMN, MCNTL1
34	Not used	
35	Not used	
36	Yaw velocity, radian/sec	AISMN, PYLONS
37	Maximum vertical maneuver load factor	AISMN, PYLONS

NOTE DATS array starts at common location 281.

TABLE 17. EQU ARRAY VARIABLES

Loc	Value	Description	Subroutine Reference
1	36.08924	Altitude, 1,000 ft	TEMPR
2	2116.22	Ambient pressure at sea level, psf	TEMPR
3	0.00687559	Curve fit constant	TEMPR
4	5.25591	Curve fit constant	TEMPR
5	65.61688	Altitude, 1,000 ft	TEMPR
6	20.80556	Curve fit constant	TEMPR
7	472.68	Ambient pressure at 36,089 ft, psf	TEMPR
8	104.9869	Altitude, 1,000 ft	TEMPR
9	114.345	Ambient pressure at 65,617 ft, psf	TEMPR
10	389.97	Curve fit constant	TEMPR
11	-34.1634	Curve fit constant	TEMPR
12	0.548641	Curve fit constant	TEMPR
13	18.131	Ambient pressure at 104,987 ft, psf	TEMPR
14	1.53619	Curve fit constant	TEMPR
15	411.57	Ambient temperature at 104,987 ft, ° R	TEMPR
16	-12.2012	Curve fit constant	TEMPR
17	154.19948	Altitude, 1,000 ft	TEMPR
18	518.67	Ambient temperature at sea level, ° R	TEMPR
19	3.56616	Curve fit constant	TEMPR
20	389.97	Ambient temperature between 36,089 and 65,617 ft, ° R	TEMPR
21	0.00000304	Curve fit constant	SPAL
22	53.3	Gas constant, ft-lb/lb/° R	SPAL
23	1.4	Ratio of specific heats	SPAL
24	0.075	Constant-pressure recovery calculation	SPAL
25	1.35	Constant-pressure recovery calculation	SPAL
26	0.3	Constant airflow at engine, M	SPAL
27	0.5	Constant airflow at engine, M	SPAL
28	460.0	Conversion ° R to ° F	MCNTL1, PRECRT
29	12.53	Fixed spike weight estimate constant	SPIKE
30	15.65	Translating spike weight estimate constant	SPIKE
31	51.8	Translating and expanding spike estimate constant	SPIKE
32	0.8	Constant-static-pressure calculation	DSGNP
33	0.05	Constant-static-pressure calculation	DSGNP
34	400.0	Constant-hammershock pressure calculation	DSGNP
35	1.019056	Constant-hammershock pressure calculation	DSGNP

TABLE 17. EQU ARRAY VARIABLES (CONT)

Loc	Value	Description	Subroutine Reference
36	0.0289156	Constant-hammershock pressure calculation	DSGNP
37	1.350112	Constant-hammershock pressure calculation	DSGNP
38	0.664319	Constant-hammershock pressure calculation	DSGNP
39	1.5	Constant-hammershock pressure calculation	DSGNP
40	0.00602627	Constant-hammershock pressure calculation	DSGNP
41	0.080725	Constant-hammershock pressure calculation	DSGNP
42	3.16503	Constant-hammershock pressure calculation	DSGNP
43	1.588524	Constant-hammershock pressure calculation	DSGNP
44	1100.0	Constant-hammershock pressure calculation	DSGNP
45	2.5	Constant-hammershock pressure calculation	DSGNP
46	0.770476	Constant-hammershock pressure calculation	DSGNP
47	0.1482515	Constant-hammershock pressure calculation	DSGNP
48	4.371758	Constant-hammershock pressure calculation	DSGNP
49	2.114969	Constant-hammershock pressure calculation	DSGNP
50	900.0	Constant-hammershock pressure calculation	DSGNP
51	1.538116	Constant-hammershock pressure calculation	DSGNP
52	0.3029697	Constant-hammershock pressure calculation	DSGNP
53	0.4872335	Constant-hammershock pressure calculation	DSGNP
54	0.4653126	Constant-hammershock pressure calculation	DSGNP
55	700.0	Constant-hammershock pressure calculation	DSGNP

TABLE 17. EQU ARRAY VARIABLES (CONT)

Loc	Value	Description	Subroutine Reference
56		Not used	
.		To	
60		Not used	
61	1.6	Constant-hammershock pressure calculation	DSGNP
62	0.984	Constant-hammershock pressure calculation	DSGNP
63	0.0074	Constant-hammershock pressure calculation	DSGNP
64	0.0263	Constant-hammershock pressure calculation	DSGNP
65		Not used	
.		To	
80		Not used	
81	0.03	Maximum ratio of deflection to frame spacing at inlet throat (deflection criteria), in./in.	DUCPNL
82	0.06	Maximum ratio of deflection to frame spacing aft of inlet throat (deflection criteria), in./in.	DUCPNL
83	0.071853	Panel deflection equation constant for pressure loading	DUCPNL
84	0.666667	Panel deflection equation constant for pressure loading	DUCPNL
85	2.666667	Panel deflection equation constant for pressure loading	DUCPNL
86	1.666667	Panel deflection equation constant for pressure loading	DUCPNL
87	1.3769	Panel thickness at midspan equation constant for pressure loading	DUCPNL
88	2.484	Panel thickness at midspan equation constant for pressure loading	DUCPNL
89	1.984	Panel thickness at midspan equation constant for pressure loading	DUCPNL
90	4.467	Panel thickness at midspan equation constant for pressure loading	DUCPNL
91	1.646	Panel thickness at edge equation constant for pressure loading	DUCPNL
92	0.894	Panel thickness at edge equation constant for pressure loading	DUCPNL

TABLE 17. EQU ARRAY VARIABLES (CONT)

Loc	Value	Description	Subroutine Reference
93	0.394	Panel thickness at edge equation constant for pressure loading	DUCPNL
94	1.288	Panel thickness at edge equation constant for pressure loading	DUCPNL
95	2.5	Maximum land thickness to field thickness ratio	DUCPNL
96	4.0	Duct lip unit weight, psf	DUCWET
97	0.4851674	Constant for calculation of flutter parameter, function of mach number	NACELE
98	1.166456	Constant for calculation of flutter parameter, function of mach number	NACELE
99	0.488412	Constant for calculation of flutter parameter, function of mach number	NACELE
100	0.4037203	Constant for calculation of flutter parameter, function of mach number	NACELE
101	1.4	Constant for calculation of flutter parameter, function of mach number	NACELE
102	0.6	Constant for calculation of flutter parameter, function of mach number	NACELE
103	0.484927	Constant for calculation of flutter parameter, function of mach number	NACELE
104	0.555184	Constant for calculation of cover flutter thickness parameter	NACELE
105	0.1686944	Constant for calculation of cover flutter thickness parameter	NACELE
106	0.02169992	Constant for calculation of cover flutter thickness parameter	NACELE
107	0.000963694	Constant for calculation of cover flutter thickness parameter	NACELE
108	12.0	Pylon unit weight, psf	PYLONS
109	141.3125	Fitting weight calculation parameter	PYLONS
110	78.2	Fitting weight calculation parameter	PYLONS
111	0.000025	Fitting weight calculation parameter	PYLONS
112	0.015	Engine mount weight estimate factor, fraction of engine weight	MISCOM
113	12.0	Auxiliary inlet door unit weight, psf	MISCOM
114	15.0	Duct bypass door unit weight, psf	MISCOM
115	2.93	Engine removal door unit weight, psf	MISCOM
116	2.5	Miscellaneous doors unit weight, psf	MISCOM
117	0.8	Firewalls and shrouds unit weight, psf	MISCOM

TABLE 17. EQU ARRAY VARIABLES (CONCL)

Loc	Value	Description	Subroutine Reference
118	5.0	Engine compartment clearance constant, in.	MISCOM
119	0.026	Unit weight of exterior finish, psf	MISCOM
120	1.0	Nacelle load redistribution structure unit weight, psf	NACELE
121	.	Not used	
.		To	
190		Not used	
191	1.0	DATK (1), Duct weight index factor	AISMN, DUCTS
192	1.0	DATK (2), Nacelle frame weight index factor	AISMN, NACELE
193	1.0	DATK (3), Nacelle cover weight index factor	AISMN, NACELE
194	1.0	DATK (4), Nacelle longitudinal members weight index factor	AISMN, NACELE
195		DATK (5), Not used	
.		To	
200		DATK (10), Not used	

NOTE EQU array starts at common location 81.

TABLE 18. F ARRAY RAMP TITLES

Locations	Title Data	Used With AIS Data Loc
1 - 10	21 CL	421
11 - 20	22 PERCENT OF COMPRESSION YIELD	422
21 - 30	23 PERCENT OF SHEAR ULTIMATE	423
31 - 40	24 XW	424
41 - 50	25 CT	425
51 - 60	26 DENSITY OF CORE (PSF)	426
61 - 70	27 DENSITY OF ADHESIVE (PSF)	427
71 - 80	28 INDEX RAMP 1 LONGITUDINAL	428
81 - 90	29 INDEX RAMP 1 TRANSVERSE	429
91 - 100	30 INDEX RAMP 2 MINIMUM GAGE	430
101 - 110	31 INDEX RAMP 2 LONGITUDINAL	431
111 - 120	32 INDEX RAMP 2 FWD HINGE BEAM	432
121 - 130	33 INDEX RAMP 2 ACTUATOR BEAM	433
131 - 140	34 INDEX RAMP 2 AFT HINGE BEAM	434
141 - 150	35 INDEX RAMP 2 MINIMUM GAGE	435
151 - 160	36 PERCENT HAMMERSHOCK RAMP 1	436
161 - 170	37 PERCENT HAMMERSHOCK RAMP 2	437
171 - 180	38 K21	438
181 - 190	39 K22	439
191 - 200	40 H21	440
201 - 210	41 H22	441
211 - 220	42 HT2	442
221 - 230	43 HTA2	443
231 - 240	44 ANGLE RAMP 1 - RAMP 2	444
241 - 250	45 INDEX RAMP 1 LONGITUDINAL	445
251 - 260	46 INDEX RAMP 1 TRANSVERSE	446
261 - 270	47 INDEX RAMP 1 MINIMUM GAGE	447
271 - 280	48 INDEX RAMP 2 LONGITUDINAL	448
281 - 290	49 INDEX RAMP 2 TRANSVERSE	449
291 - 300	50 INDEX RAMP 2 MINIMUM GAGE	450
301 - 310	51 INDEX RAMP 3 LONGITUDINAL	451
311 - 320	52 INDEX RAMP 3 FWD HINGE BEAM	452
321 - 330	53 INDEX RAMP 3 ACTUATOR BEAM	453
331 - 340	54 INDEX RAMP 3 AFT HINGE BEAM	454
341 - 350	55 INDEX RAMP 3 MINIMUM GAGE	455
351 - 360	56 PERCENT HAMMERSHOCK RAMP 1	456
361 - 370	57 PERCENT HAMMERSHOCK RAMP 2	457
371 - 380	58 PERCENT HAMMERSHOCK RAMP 3	458
381 - 390	59 K31	459
391 - 400	60 K32	460
401 - 410	61 K33	461

TABLE 18. F ARRAY RAMP TITLES (CONT)

Locations	Title Data	Used With AIS Data Loc
411 - 420	62 H31	462
421 - 430	63 H32	463
431 - 440	64 H33	464
441 - 450	65 HT3	465
451 - 460	66 HTA3	466
461 - 470	67 ANGLE RAMP 2 - RAMP 3	467
471 - 480	68 INDEX RAMP 1 LONGITUDINAL	468
481 - 490	69 INDEX RAMP 1 TRANSVERSE	469
491 - 500	70 INDEX RAMP 1 MINIMUM GAGE	470
501 - 510	71 INDEX RAMP 2 LONGITUDINAL	471
511 - 520	72 INDEX RAMP 2 TRANSVERSE	472
521 - 530	73 INDEX RAMP 2 MINIMUM GAGE	473
531 - 540	74 INDEX RAMP 3 LONGITUDINAL	474
541 - 550	75 INDEX RAMP 3 FWD HINGE BEAM	475
551 - 560	76 INDEX RAMP 3 FWD ACTUATOR BEAM	476
561 - 570	77 INDEX RAMP 3 AFT ACTUATOR BEAM	477
571 - 580	78 INDEX RAMP 3 AFT HINGE BEAM	478
581 - 590	79 INDEX RAMP 3 MINIMUM GAGE	479
591 - 600	80 INDEX RAMP 4 LONGITUDINAL	480
601 - 610	81 INDEX RAMP 4 TRANSVERSE	481
611 - 620	82 INDEX RAMP 4 MINIMUM GAGE	482
621 - 630	83 PERCENT HAMMERSHOCK RAMP 1	483
631 - 640	84 PERCENT HAMMERSHOCK RAMP 2	484
641 - 650	85 PERCENT HAMMERSHOCK RAMP 3	485
651 - 660	86 PERCENT HAMMERSHOCK RAMP 4	486
661 - 670	87 K41	487
671 - 680	88 K42	488
681 - 690	89 K43	489
691 - 700	90 K44	490
701 - 710	91 H41	491
711 - 720	92 H42	492
721 - 730	93 H43	493
731 - 740	94 H44	494
741 - 750	95 HT4	495
751 - 760	96 HTA4	496
761 - 770	97 ANGLE RAMP 2 - RAMP 3	497
771 - 780	98 ANGLE RAMP 3 - RAMP 4	498
781 - 790	99 ALUMINUM TC	499
791 - 800	100 ALUMINUM TW	506
801 - 810	101 ALUMINUM TS	507
811 - 820	102 ALUMINUM TBARF	508

TABLE 18. F ARRAY RAMP TITLES (CONCL)

Locations	Title Data	Used With AIS Data Loc
821 - 830	103 ALUMINUM TBARR	509
831 - 840	104 TITANIUM TC	510
841 - 850	105 TITANIUM TW	511
851 - 860	106 TITANIUM TS	512
861 - 870	107 TITANIUM TBARF	513
871 - 880	108 TITANIUM TBARR	514
881 - 890	109 STEEL TC	515
891 - 900	110 STEEL TW	516
901 - 910	111 STEEL TS	517
911 - 920	112 STEEL TBARF	518
921 - 930	113 STEEL TBARR	519
NOTE F array starts at common location 771.		

TABLE 19. ND ARRAY VARIABLES

Loc	Variable Name	Description	Subroutine Reference
1		Not used	
.		To	
58		Not used	
59	NMATL	Number of arrays of material properties in mass storage file, records 41 through 60	AISMN,MCNTL1
60	MATLI	Material identification number	MCNTL1,MATLP2
61		Not used	
.		To	
92		Not used	
93	IF3	Material properties library file record number	MCNTL1
94	IF4	Calculated material properties file record number	MCNTL1,PRECRT, NACELE, PYLONS
95		Not used	
.		To	
100		Not used	
101	I	Scratch counter, also duct cut counter in routines referenced	DUCTS,DUCPNL, DUCFRM
102	J	Scratch counter	Most
103	K	Scratch counter	Most
104	L	Scratch counter, also duct cut counter in routines referenced	DUCTS,FRMND3, FRMELD
105		Not used	
106	N	Scratch counter	MCNTL1,MATLF1, MATLP2
107	II	Counter through nine speed profile points	MCNTL1,MATLP2
108	JJ	Counter for $M_H$ and $M_L$ at each speed profile altitude	MCNTL1
109	KK	Scratch counter	MCNTL1,MATLP2, FRMND3,FRMELD
110		Not used	
111	ITP	Number of nacelles	AISMN
112	IVG	Inlet-type indicator 1 = fixed duct 2 = fixed spike 3 = horizontal ramp 4 = vertical ramp 5 = translating spike 6 = translating and expanding spike	AISMN,DSGNP, MCNTL1,SPIKE, DUCWET,SUMARY

TABLE 19. ND ARRAY VARIABLES (CONT)

Loc	Variable Name	Description	Subroutine Reference
113		Not used	
114	IGD	Duct leading edge-type indicator 0 = complete section 1 = vertical lip 2 = horizontal lip	DUCTS,DCTGEO, DUCWET
115	NC	Number of input duct cuts	DUCTS,DCTGEO, DUCPNL,DUCFRM, DUCWET,NACELE, MISCOM
116	KC	Duct perimeter code 1 = perimeter input 2 = perimeter correction factor input	DUCTS,DCTGEO
117	ICRT	Critical design point on speed profile	PRECRT
118	IQ	Number of frame segments per quadrant	DUCTS,FRMND3, FRMELD
119	IFF	Number of frame segments	DUCTS,FRMND3, FRMELD,DUCFRM
120	IC	Number of frame cuts	DUCTS,FRMELD,
121	IFRM	Frame spacing search pass counter 1 = initial spacing 2 = second or subsequent spacing 3 = final or fixed spacing	DUCTS
122	IMIL	Duct panel mill indicator 0 = panel not milled 1 = panel milled	DUCPNL
123	NCN	Number of input nacelle cuts	NACELE,NCLGEO, MISCOM
124	KCN	Nacelle perimeter code 1 = perimeter input 2 = perimeter correction factor input	NACELE,NCLGEO

TABLE 19. ND ARRAY VARIABLES (CONCL)

Loc	Variable Name	Description	Subroutine Reference
125	ICN	Engine support-type indicator 0 = engine directly mounted to pylon or one engine per nacelle 1 = multiple engines per nacelle with engines mounted to nacelle structure	NACELE
126	IGN	Nacelle leading edge-type indicator 0 = complete section 1 - vertical lip 2 = horizontal lip	NACELE,NCLGEO
127	NFLT	Speed profile point critical for local panel flutter design	NACELE
128	ICNT	Design pressure point counter	DUCFRM
129		Not used	
.		To	
200		Not used	

NOTE: ND array starts at common location 4201.

TABLE 20. SUMM ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Weight air induction system structure per vehicle, lb	SUMARY, AISMN
2	X-CG air induction system structure, in.	SUMARY, AISMN
3	Weight duct lip, per nacelle in DUCTS, per vehicle in SUMARY, lb	DUCTS, SUMARY
4	X-CG duct lip, relative to inlet leading edge in DUCTS, in vehicle system in SUMARY, in.	DUCTS, SUMARY
5	Weight duct, per nacelle in DUCTS, per vehicle in SUMARY, lb	DUCTS, SUMARY
6	X-CG duct, relative to inlet leading edge in DUCTS, in vehicle system in SUMARY, in.	DUCTS, SUMARY
7	Weight auxiliary inlet, per nacelle in MISCOM, per vehicle in SUMARY, lb	MISCOM, SUMARY
8	X-CG auxiliary inlet, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
9	Weight duct by pass doors, per nacelle in MISCOM, per vehicle in SUMARY, lb	MISCOM, SUMARY
10	X-CG duct bypass doors, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
11	Weight two-dimensional variable-geometry ramp structure per vehicle, lb	SUMARY
12	X-CG ramp structure, in.	SUMARY
13	Weight fixed spike, per nacelle in SPIKE, per vehicle in SUMARY, lb	SPIKE, SUMARY
14	X-CG fixed spike, relative to inlet leading edge in SPIKE, in vehicle system in SUMARY, in.	SPIKE, SUMARY
15	Weight translating spike, per nacelle in SPIKE, per vehicle in SUMARY, lb	SPIKE, SUMARY
16	X-CG translating spike, relative to inlet leading edge in SPIKE, in vehicle system in SUMARY, in.	SPIKE, SUMARY
17	Weight translating and expanding spike, per nacelle in SPIKE, per vehicle in SUMARY, lb	SPIKE, SUMARY

TABLE 20. SUMM ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
18	X-CG translating and expanding spike, relative to inlet leading edge in SPIKE, in vehicle system in SUMARY, in.	SPIKE, SUMARY
19	Not used	
20	Not used	
21	Weight engine mounts, per nacelle in MISCOM, per inboard engine package in SUMARY, 1b	MISCOM, SUMARY
22	X-CG engine mounts, relative to inlet leading edge in MISCOM and PYLONS, in vehicle system in SUMARY, in.	MISCOM, PYLONS, SUMARY
23	Weight engine mounts in outboard nacelle set, 1b	SUMARY
24	X-CG outboard nacelle engine mounts, in.	SUMARY
25	Weight nacelle frames, per nacelle in NACELE, per inboard engine package in SUMARY, 1b	NACELE, SUMARY
26	X-CG nacelle frames, relative to inlet leading edge in NACELE, in vehicle system in SUMARY, in.	NACELE, SUMARY
27	Weight nacelle frames in outboard nacelle set, 1b	SUMARY
28	X-CG outboard nacelle frames, in.	SUMARY
29	Weight nacelle covers, per nacelle in NACELE, per inboard engine package in SUMARY, 1b	NACELE, SUMARY
30	X-CG nacelle covers, relative to inlet leading edge in NACELE, in vehicle system in SUMARY, in.	NACELE, SUMARY
31	Weight nacelle frames in outboard nacelle set, 1b	SUMARY
32	X-CG outboard nacelle covers, in.	SUMARY
33	Weight nacelle longitudinal members, per nacelle in NACELE, per inboard engine package in SUMARY, 1b	NACELE, SUMARY
34	X-CG nacelle longitudinal members, relative to inlet leading edge in NACELE, in vehicle system in SUMARY, in.	NACELE, SUMARY

TABLE 20. SUMM ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
35	Weight nacelle longitudinal members in outboard nacelle set, 1b	SUMARY
36	X-CG outboard nacelle longitudinal members, in.	SUMARY
37	Weight inboard fittings per nacelle in PYLONS, per inboard nacelle set in SUMARY, 1b	PYLONS, SUMARY
38	X-CG inboard fittings, relative to inlet leading edge in PYLONS, in vehicle system in SUMARY, in.	PYLONS, SUMARY
39	Weight outboard fittings per nacelle in PYLONS, per outboard nacelle set in SUMARY, 1b	PYLONS, SUMARY
40	X-CG outboard fittings, relative to inlet leading edge in PYLONS, in vehicle system in SUMARY, in.	PYLONS, SUMARY
41	Weight inboard pylon, per nacelle in PYLONS, per inboard nacelle set in SUMARY, 1b	PYLONS, SUMARY
42	X-CG inboard pylon, relative to inlet leading edge in PYLONS, in vehicle system in SUMARY, in.	PYLONS, SUMARY
43	Weight outboard pylon, per nacelle in PYLONS, per outboard nacelle set in SUMARY, 1b	PYLONS, SUMARY
44	X-CG outboard pylon, relative to inlet leading edge in PYLONS, in vehicle system in SUMARY, in.	PYLONS, SUMARY
45	Weight firewall, per nacelle in MISCOM, per inboard nacelle set in SUMARY, 1b	MISCOM, SUMARY
46	X-CG firewall, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
47	Weight firewall in outboard nacelle set, 1b	SUMARY
48	X-CG outboard nacelle firewall, in.	SUMARY
49	Weight shroud, per nacelle in MISCOM, per inboard nacelle set in SUMARY, 1b	MISCOM, SUMARY
50	X-CG shroud, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY

TABLE 20. SUMM ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
51	Weight shroud in outboard nacelle set, 1b	SUMARY
52	X-CG outboard nacelle shroud, in.	SUMARY
53	Not used	
.	To	
56	Not used	
57	Weight inboard nacelle and engine section, 1b	SUMARY, AISMN
58	X-CG inboard nacelle and engine section, in.	SUMARY
59	Weight outboard nacelle and engine section, 1b	SUMARY, AISMN
60	X-CG outboard nacelle and engine section, in.	SUMARY
61	Weight nacelles and engine section, 1b	SUMARY
62	X-CG nacelles and engine section, in	SUMARY
63	Not used	
64	Not used	
65	Weight miscellaneous access doors, per nacelle in MISCOM, per vehicle in SUMARY, 1b	MISCOM, SUMARY
66	X-CG miscellaneous access doors, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
67	Weight engine removal doors, per nacelle in MISCOM, per vehicle in SUMARY, 1b	MISCOM, SUMARY
68	X-CG engine removal doors, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
69	Not used	
70	Not used	
71	Weight exterior finish, per nacelle in MISCOM, per vehicle in SUMARY, 1b	MISCOM, SUMARY
72	X-CG exterior finish, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
73	Weight doors panels and miscellaneous, 1b	SUMARY, AISMN

TABLE 20. SUMM ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
74	X-CG doors panels and miscellaneous, in.	SUMARY
75	Weight engine section and nacelle group, 1b	SUMARY, AISMN
76	X-CG engine section and nacelle group, in.	SUMARY, AISMN
77	Not used	
200	Not used	
NOTE SUMM array starts at common location 1701.		

TABLE 21. TM ARRAY VARIABLES

Loc	Engrg Symbol	Description	Subroutine Reference
1		Temperature (design), °F	MATLF1,MCNTL1,MATLP2
2	$\mu$	Poisson's ratio	MATLF1,MCNTL1,MATLP2
3	$A_C$	Constant for compression stress-strain curve fit, in./in.	MATLF1,MCNTL1,MATLP2
4	$B_C$	Constant for compression stress-strain curve fit, in <sup>2</sup> /lb	MATLF1,MCNTL1,MATLP2
5	$E_C$	Compression modulus of elasticity, psi	MATLF1,MCNTL1,MATLP2
6	$F_{CY}$	Compression yield stress, psi	MATLF1,MCNTL1,MATLP2
7	$A_T$	Constant for tension stress-strain curve fit, in./in.	MATLF1,MCNTL1,MATLP2
8	$B_T$	Constant for tension stress-strain curve fit, in. <sup>2</sup> /lb	MATLF1,MCNTL1,MATLP2
9	$E_T$	Tension modulus of elasticity, psi	MATLF1,MCNTL1,MATLP2
10	$F_{TY}$	Tension yield stress, psi	MATLF1,MCNTL1,MATLP2
11		Material density, lb/in. <sup>3</sup>	MATLF1,MCNTL1,MATLP2
12	$F_{TU}$	Ultimate tensile strength, psi	MATLF1,MCNTL1,MATLP2
13	$F_{CPL}$	Compressive stress at proportional limit, psi	MATLF1,MCNTL1,MATLP2
14	$E_{RT}$	Modulus of elasticity at room temperature, psi	MATLF1,MCNTL1,MATLP2
15	$G_{RT}$	Shear modulus at room temperature, psi	MATLF1,MCNTL1,MATLP2
16	$F_{SU}$	Ultimate shear strength, psi	MATLF1,MCNTL1,MATLP2
17	$F_{BRU}$	Ultimate bearing strength, psi	MATLF1,MCNTL1,MATLP2
18	$K_{FTU}$	Fraction of ultimate tensile strength at endurance limit for a polished specimen under cyclic load	MATLF1,MCNTL1,MATLP2

TABLE 21. TM ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference
19	$K_{FTU}$	Fraction of ultimate tension strength for shell-bending fatigue	MATLF1,MCNTL1,MATLP2
20	$K_{FTU}$	Fraction of ultimate tensile strength under cyclic pressure load	MATLF1,MCNTL1,MATLP2
21-30		Not used	
31	$\mu$	Poisson's ratio (interpolated)	MATLF1,MATLP2
32	$\epsilon_{C1}$	Compressive strain at point 1 (interpolated), in./in.	MATLF1,MATLP2
33	$\epsilon_{C5}$	Compressive strain at point 5 (interpolated), in./in.	MATLF1,MATLP2
34	$\sigma_{C1}$	Compressive stress at point 1 (interpolated), in./in.	MATLF1,MATLP2
35	$\sigma_{C2}$	Compressive stress at point 2 (interpolated), psi	MATLF1,MATLP2
36	$\sigma_{C3}$	Compressive stress at point 3 (interpolated), psi	MATLF1,MATLP2
37	$\sigma_{C4}$	Compressive stress at point 4 (interpolated), psi	MATLF1,MATLP2
38	$\sigma_{C5}$	Compressive stress at point 5 (interpolated), psi	MATLF1,MATLP2
39	$\epsilon_{T1}$	Tensile strain at point 1 (interpolated), in./in.	MATLF1,MATLP2
40	$\epsilon_{T5}$	Tensile strain at point 5 (interpolated), in./in.	MATLF1,MATLP2
41	$\sigma_{T1}$	Tensile stress at point 1 (interpolated), psi	MATLF1,MATLP2

TABLE 21. TM ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference
42	$\sigma_{T2}$	Tensile stress at point 2 (interpolated), psi	MATLF1,MATLP2
43	$\sigma_{T3}$	Tensile stress at point 3 (interpolated), psi	MATLF1,MATLP2
44	$\sigma_{T4}$	Tensile stress at point 4 (interpolated), psi	MATLF1,MATLP2
45	$\sigma_{T5}$	Tensile stress at point 5 (interpolated), psi	MATLF1,MATLP2
46	$F_{TU}$	Ultimate tensile strength (interpolated), psi	MATLF1
47	$F_{SU}$	Ultimate shear strength (interpolated), psi	MATLF1
48	$F_{BRU}$	Ultimate bearing strength (interpolated), psi	MATLF1
49		Not used	
50	$K_{FTU}$	Fraction of ultimate tensile strength at endurance limit (interpolated)	MATLF1
51	$K_{FTU}$	Fraction of ultimate tensile strength for shell-bending fatigue	MATLF1
52	$K_{FTU}$	Fraction of ultimate tensile strength under cyclic pressure load (interpolated)	MATLF1
53	$K_{FTU}$	Fatigue factor for wing (interpolated)	MATLF1
54	$K_{FTU}$	Fatigue factor for wing (interpolated)	MATLF1

TABLE 21. TM ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference
55		Temperature of material property data from library at temperature lower than design temperature, °F. Data in locations 56 through 79 are in same order as they appear in locations 31 through 54.	MATLF1
56	μ		MATLF1
57	εC1		MATLF1
58	εC5		MATLF1
59	σC1		MATLF1
60	σC2		MATLF1
61	σC3		MATLF1
62	σC4		MATLF1
63	σC5		MATLF1
64	εT1		MATLF1
65	εT5		MATLF1
66	σT1		MATLF1
67	σT2		MATLF1
68	σT3		MATLF1
69	σT4		MATLF1
70	σT5		MATLF1
71	FTU		MATLF1
72	FSU		MATLF1
73	FBRU		MATLF1
74			
75	KFTU		MATLF1
76	KFTU		MATLF1
77	KFTU		MATLF1
78	KFTU		MATLF1
79	KFTU		MATLF1
80		Temperature of material property data from library at temperature higher than design temperature, °F. Data in locations 81	MATLF1

TABLE 21. TM ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference
80 cont		through 104 are in same order as they appear in locations 31 through 54.	
81	$\mu$		MATLF1
82	$\epsilon C1$		MATLF1
83	$\epsilon C5$		MATLF1
83	$\sigma C1$		MATLF1
85	$\sigma C2$		MATLF1
86	$\sigma C3$		MATLF1
87	$\sigma C4$		MATLF1
88	$\sigma C5$		MATLF1
89	$\epsilon T1$		MATLF1
90	$\epsilon T5$		MATLF1
91	$\sigma T1$		MATLF1
92	$\sigma T2$		MATLF1
93	$\sigma T3$		MATLF1
94	$\sigma T4$		MATLF1
95	$\sigma T5$		MATLF1
96	FTU		MATLF1
97	FSU		MATLF1
98	FBRU		MATLF1
99			
100	KFTU		MATLF1
101	KFTU		MATLF1
102	KFTU		MATLF1
103	KFTU		MATLF1
104	KFTU		MATLF1
105		Not used	
.			
.			
109	Not used		
110	$A_{2,5}$	Curve fit constant for fit through points 2 and 5, in./in.	MATLF1
111	$A_{3,5}$	Curve fit constant for for through points 3 and 5, in./in.	MATLF1

TABLE 21. TM ARRAY VARIABLES (CONCL)

Loc	Enrg Symbol	Description	Subroutine Reference
112	$A_{4,5}$	Curve fit constant for fit through points 4 and 5, in./in.	MATLF1
113	$B_{2,5}$	Curve fit constant for fit through points 2 and 5, in. <sup>2</sup> /lb	MATLF1
114	$B_{3,5}$	Curve fit constant for fit through points 3 and 5, in. <sup>2</sup> /lb	MATLF1
115	$B_{4,5}$	Curve fit constant for fit through points 4 and 5, in. <sup>2</sup> /lb	MATLF1
116		Summation of errors squared for curve 2,5	MATLF1
117		Summation of errors squared for curve 3,5	MATLF1
118		Summation of errors squared for curve 4,5	MATLF1
119		Not used	
.			
.			
.			
160		Not used	

NOTE TM array starts at common location 3501. This array is used for interpolation of material data.

TABLE 22. TMD ARRAY VARIABLES

Loc	Variable Name	Engrg Symbol	Description	Subroutine Description	
1	MATLI		Material identification number	MCNTL1	
2		$\rho$	Material density, lb/in. <sup>3</sup>	MCNTL1	
3		$E_{RT}$	Modulus of elasticity at room temperature, psi	MCNTL1	
4		$G_{RT}$	Shear modulus at room temperature, psi	MCNTL1	
5		RA	Reduction area for fatigue	MCNTL1	
6			Not used		
.					
.					
109				Not used	
110				Temperature of material for data in locations 111 through 134, °F	MCNTL1,MATLF1
111		$\mu$	Poisson's ratio	MCNTL1,MATLF1	
112		$\epsilon_{C1}$	Compressive strain at point 1, in./in.	MCNTL1,MATLF1	
113		$\epsilon_{C5}$	Compressive strain at point 5, in./in.	MCNTL1,MATLF1	
114		$\sigma_{C1}$	Compression stress at point 1, psi	MCNTL1,MATLF1	
115		$\sigma_{C2}$	Compression stress at point 2, psi	MCNTL1,MATLF1	
116		$\sigma_{C3}$	Compression stress at point 3, psi	MCNTL1,MATLF1	
117		$\sigma_{C4}$	Compression stress at point 4, psi	MCNTL1,MATLF1	
118		$\sigma_{C5}$	Compression stress at point 5, psi	MCNTL1,MATLF1	
119		$\epsilon_{T1}$	Tensile strain at point 1, in./in.	MCNTL1,MATLF1	
120		$\epsilon_{T5}$	Tensile strain at point 5, in./in.	MCNTL1,MATLF1	
121		$\sigma_{T1}$	Tension stress at point 1, psi	MCNTL1,MATLF1	
122		$\sigma_{T2}$	Tension stress at point 2, psi	MCNTL1,MATLF1	

TABLE 22. TMD ARRAY VARIABLES (CONT)

Loc	Variable Name	Engrg Symbol	Description	Subroutine Description
123		$\sigma_{T3}$	Tension stress at point 3, psi	MCNTL1,MATLF1
124		$\sigma_{T4}$	Tension stress at point 4, psi	MCNTL1,MATLF1
125		$\sigma_{T5}$	Tension stress at point 5, psi	MCNTL1,MATLF1
126		$F_{TU}$	Ultimate tensile strength, psi	MCNTL1,MATLF1
127		$F_{SU}$	Ultimate shear strength, psi	MCNTL1,MATLF1
128		$F_{BRU}$	Ultimate bearing strength, psi	MCNTL1,MATLF1
129			Not used	
130		$K_{FTU}$	Fraction of ultimate tensile strength at endurance limit	MCNTL1,MATLF1
131		$K_{FTU}$	Fraction of ultimate tensile strength for shell-bending	MCNTL1,MATLF1
132		$K_{FTU}$	Fraction of ultimate tensile strength under cyclic pressure load	MCNTL1,MATLF1
133		$K_{FTU}$	Fatigue factor for wing	MCNTL1,MATLF1
134		$K_{FTU}$	Fatigue factor for wing	MCNTL1,MATLF1
135			Second temperature, °F, of material for data in locations 136 through 159	MCNTL1,MATLF1
136		$\mu$	Refer to description of location 111 through	MCNTL1,MATLF1
.				
.				
159		$K_{FTU}$	description of location 134	MCNTL1,MATLF1
160			Third temperature, °F, of material for data in locations 161 through 184	MCNTL1,MATLF1
161		$\mu$	Refer to description of location 111 through	MCNTL1,MATLF1
.				
.				
184		$K_{FTU}$	description of location 134	MCNTL1,MATLF1

TABLE 22. TMD ARRAY VARIABLES (CONCL)

Loc	Variable Name	Engrg Symbol	Description	Subroutine Description
185		$\mu$	Fourth temperature, °F, of material for data in locations 186 through 209	MCNTL1,MATLF1
186			Refer to description of location 111 through	MCNTL1,MATLF1
.				
.				
209		$K_{FTU}$	description of location 134	MCNTL1,MATLF1
210			Fifth temperature, °F, of material for data in locations 211 through 234	MCNTL1,MATLF1
211		$\mu$	Refer to description of location 111 through	MCNTL1,MATLF1
.				
.				
234		$K_{FTU}$	description of location 134	MCNTL1,MATLF
235			Sixth temperature, °F, of material for data in locations 236 through 259	MCNTL1,MATLF1
236		$\mu$	Refer to description of location 111 through	MCNTL1,MATLF1
.				
.				
259		$K_{FTU}$	description of location 134	MCNTL1,MATLF1
260			Not used	
.				
.				
284			Not used	
285	RM(1)		Alphanumeric material descriptive title	MCNTL1,MATLP2
.				
.				
300	RM(16)			MCNTL1,MATLP2

NOTE TMD array starts at common location 3201. This array is part of the permanent data file and is stored in mass storage file records 41 through 60.

TABLE 23. TMS ARRAY VARIABLES

Loc	Engrg Symbol	Description	Subroutine Reference <sup>a</sup>
Locations 1 through 90 contain material properties data for the temperature associated with the maximum level-flight speed profile ( $M_H$ )			
1		Temperature of duct material, °F, locations 2 through 20 contain duct material data at this temperature	
2	$\mu$	Poisson's ratio	
3	$A_C$	Constant for compression stress-strain curve fit, in./in.	
4	$B_C$	Constant for compression stress-strain curve fit, in. <sup>2</sup> /lb	
5	$E_C$	Compression modulus of elasticity, psi	
6	$F_{CY}$	Compression yield stress, psi	
7	$A_T$	Constant for tension stress-strain curve fit, in./in.	
8	$B_T$	Constant for tension stress-strain curve fit, in. <sup>2</sup> /lb	
9	$E_T$	Tension modulus of elasticity, psi	
10	$F_{TY}$	Tension yield stress, psi	
11	$\rho$	Material density, lb/in. <sup>3</sup>	
12	$F_{TU}$	Ultimate tensile strength, psi	
13	$F_{CPL}$	Compressive stress at proportional limit, psi	
14	$E_{RT}$	Modulus of elasticity at room temperature, psi	

TABLE 23. TMS ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference <sup>a</sup>
15	$G_{RT}$	Shear modulus at room temperature, psi	
16	$F_{SU}$	Ultimate shear strength, psi	
17	$F_{BRU}$	Ultimate bearing strength, psi	
18	$K_{FTU}$	Fraction of ultimate tensile strength at endurance limit	
19	$K_{FTU}$	Fraction of ultimate tensile strength for shell bending	
20	$KFTU$	Fraction of ultimate tensile strength under cyclic pressure load	
21		Not used	
.			
.			
30		Not used	
31		Temperature of ramp material, °F, locations 32 through 50 contain ramp material data at this temperature	
32	$\mu$		
33	$A_C$		
34	$B_C$		
35	$E_C$		
36	$F_{CY}$		PRECRT
37	$A_T$		
38	$B_T$		
39	$E_T$		
40	$F_{TY}$		
41	$\rho$		PRECRT
42	$F_{TU}$		
43	$F_{CPL}$		
44	$E_{RT}$		
45	$G_{RT}$		

TABLE 23. TMS ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference <sup>a</sup>
46	FSU		PRECRT
47	FBRU		
48	KFTU		
49	KFTU		
50	KFTU		
51		Not used	
.			
.			
60		Not used	
61		Temperature of nacelle material, °F, locations 62 through 80 contain nacelle material data at this temperature	
62	μ		
63	AC		
64	BC		
65	EC		
66	FCY		
67	AT		
68	BT		
69	ET		
70	FTY		
71	ρ		
72	FTU		
73	FCPL		
74	ERT		
75	GRT		
76	FSU		
77	FBRU		
78	KFTU		
79	KFTU		
80	KFTU		
81		Not used	
.			
.			
90		Not used	

TABLE 23. TMS ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference <sup>a</sup>
<p>Locations 91 through 180 contain material properties data for the temperature associated with the limit speed profile (<math>M_L</math>). Data are organized in the same sequence as noted for locations 1 through 90.</p>			
91		Temperature of duct material, °F, locations 92 through 110 contain duct material data at this temperature	
92	μ		
93	AC		
94	BC		
95	EC		
96	FCY		
97	AT		
98	BT		
99	ET		
100	FTY		
101	P		
102	FTU		
103	FCPL		
104	ERT		
105	GRT		
106	FSU		
107	FBRU		
108	KFTU		
109	KFTU		
110	KFTU		
111		Not used	
.			
.			
.			
120		Not used	
121		Temperature of ramp material, °F, locations 122 through 140 contain ramp material data at this temperature	

TABLE 23. TMS ARRAY VARIABLES (CONT)

Loc	Enrg Symbol	Description	Subroutine Reference <sup>a</sup>
122	μ		
123	AC		
124	EC		
125	BC		
126	FCY		PRECRT
127	AT		
128	BT		
129	ET		
130	FTY		
131	P		PRECRT
132	FTU		
133	FCPL		
134	ERT		
135	GRT		
136	FSU		PRECRT
137	FBRU		
138	KFTU		
139	KFTU		
140	KFTU		
141		Not used	
.			
.			
150		Not used	
151		Temperature of nacelle material, °F, locations 152 through 170 contain nacelle material data at this temperature	
152	μ		
153	AC		
154	BC		
155	EC		
156	FCY		PYLONS
157	AT		
158	BT		
159	ET		NACELE
160	FTY		
161	P		NACELE, PYLONS
162	FTU		PYLONS

TABLE 23. TMS ARRAY VARIABLES (CONCL)

Loc	Engrg Symbol	Description	Subroutine Reference <sup>a</sup>
163	FCPL		
164	ERT		
165	GRT		
166	FSU		PYLONS
167	FBRU		PYLONS
168	KFTU		
169	KFTU		
170	KFTU		
171		Not used	
.			
.			
.			
180		Not used	

NOTE TMS array starts at common location 3691. This array is calculated for each speed profile altitude and stored in mass storage file records 109 through 117.

<sup>a</sup>This array is defined and written by MCNTL1 and read by PRECRT, NACELE, and PYLONS. Using routines are referenced only when specific variables in this array are used.

TABLE 24. TOT ARRAY VARIABLES

Loc	Variable Name	Description	Subroutine Reference
1		Weight per inch of duct length of duct panels and frames at duct cut for initial frame spacing, lb/in.	DUCTS
2		Weight per inch of duct length of duct panels and frames at duct cut for subsequent frame spacing, lb/in.	DUCTS
3		Duct weight per inch of duct length at synthesis cut, lb/in.	DUCPNL, DUCTS
4		Duct frame weight per inch of duct length at duct cut, lb/in.	DUCFRM, DUCTS
5		Not used	
10		To	
11		Not used	
11		Duct surface area per nacelle, in. <sup>2</sup>	DUCTS
12		Nacelle surface area per nacelle, in. <sup>2</sup>	NACELE, MISCOM
13		Not used	
19		To	
19		Not used	
20	TOTAL	Two-dimensional variable-geometry ramp structure weight per inlet in RAMPS, weight per nacelle in AISMN, lb	RAMPS, AISMN, SUMMARY
21		Duct weight per nacelle, lb	DUCTS, PYLONS
22		Weight longitudinal members per nacelle, lb	NACELE, PYLONS
23	WTLP	Weight inlet lip per nacelle, lb	DUCWET, DUCTS, PYLONS
24	RILONG	Weight ramp 1 panel per inlet in RAMPS, weight per nacelle in AISMN, lb	RAMPS, AISMN, PYLONS, SUMMARY
25	RITRAN	Weight ramp 1 transverse beams per inlet in RAMPS, weight per nacelle in AISMN, lb	RAMPS, AISMN, PYLONS, SUMMARY
26	R2LONG	Weight ramp 2 panel per inlet in RAMPS, weight per nacelle in AISMN, lb	RAMPS, AISMN, PYLONS, SUMMARY

TABLE 24. TOT ARRAY VARIABLES (CONT)

Loc	Variable Name	Description	Subroutine Reference
27	R2TRAN	Weight ramp 2 transverse beams per inlet in RAMPS, weight per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
28	R3LONG	Weight ramp 3 panel per inlet in RAMPS, weight per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
29	FHINGE	Weight forward ramp hinge beam per inlet in RAMPS, weight per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
30	FACT	Weight forward ramp actuator beam per inlet in RAMPS, weight per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
31	AACT, ACT	Weight aft ramp actuator beam per inlet in RAMPS, weight per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
32	AHINGE	Weight aft ramp hinge beam per inlet in RAMPS, per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
33	R4LONG	Weight ramp 4 panel per inlet in RAMPS, per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
34	R4TRAN	Weight ramp 4 transverse beams per inlet in RAMPS, per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
35	WHFS	Weight fixed spike per nacelle, 1b	SPIKE,PYLONS
36	WFTS	Weight translating spike per nacelle,1b	SPIKE,PYLONS
37	WTES	Weight translating and expanding spike per nacelle, 1b	SPIKE,PYLONS
38		Weight nacelle covers per nacelle, 1b	NACELE,PYLONS
39		Weight nacelle frames per nacelle, 1b	NACELE,PYLONS
40	WTEM	Weight engine mounts per nacelle, 1b	MISCOM,PYLONS
41	WTAI	Weight auxiliary inlets per nacelle, 1b	MISCOM,PYLONS
42	WTBP	Weight duct bypass doors per nacelle, 1b	MISCOM,PYLONS

TABLE 24. TOT ARRAY VARIABLES (CONCL)

Loc	Variable Name	Description	Subroutine Reference
43	WTED	Weight engine removal doors per nacelle, 1b	MISCOM,PYLONS
44	WTMD	Weight miscellaneous doors per nacelle, 1b	MISCOM,PYLONS
45	WTFW	Weight firewall per nacelle, 1b	MISCOM,PYLONS
46	WTSD	Weight shroud per nacelle, 1b	MISCOM,PYLONS
47	WTEF	Weight exterior finish per nacelle, 1b	MISCOM,PYLONS
48		Not used	
.		To	
50		Not used	
51	WTPI	Weight inboard pylon per nacelle, 1b	PYLONS
52	WTPO	Weight outboard pylon per nacelle, 1b	PYLONS
53	WFTI	Weight inboard fittings per nacelle, 1b	PYLONS
54	WFTO	Weight outboard fittings per nacelle, 1b	PYLONS
55		Not used	
.		To	
100		Not used	

NOTE TOT array starts at common location 2101.

TABLE 25. TT ARRAY VARIABLES

Loc	Engrg Symbol	Description	Subroutine Reference
1		Material identification number	MCNTL1,MATLF1
2		Material temperature, °F	MCNTL1,MATLF1
3	A	Constant for stress-strain curve fit and interpolation factor, in./in.	MATLF1
4	B	Constant for stress-strain curve fit, in. <sup>2</sup> /lb	MATLF1
5	$E = \sigma_1 / \epsilon_1$	Modulus of elasticity, psi	MATLF1
6	$\epsilon_1$	Strain at point 1 (proportional limit), in./in.	MATLF1
7	$\epsilon_2$	Strain at point 2, in./in.	MATLF1
8	$\epsilon_3$	Strain at point 3, in./in.	MATLF1
9	$\epsilon_4$	Strain at point 4, in./in.	MATLF1
10	$\epsilon_5$	Strain at point 5 (yield stress), in./in.	MATLF1
11	$\sigma_1$	Stress at point 1 (proportional limit), psi	MATLF1
12	$\sigma_2$	Stress at point 2, psi	MATLF1
13	$\sigma_3$	Stress at point 3, psi	MATLF1
14	$\sigma_4$	Stress at point 4, psi	MATLF1
15	$\sigma_5$	Stress at point 5 (yield stress), psi	MATLF1
16	1/E	Reciprocal of modulus of elasticity, in. <sup>2</sup> /lb	MATLF1

TABLE 25. TT ARRAY VARIABLES (CONCL)

Loc	Enrg Symbol	Description	Subroutine Reference
17	$\epsilon_5 - \sigma_5/E$	Strain increment at yield stress, in./in.	MATLF1
18	$\epsilon_2 - \sigma_2/E,$ $\epsilon_3 - \sigma_3/E,$ $\epsilon_4 - \sigma_4/E$	Strain increment at other points, in./in.	MATLF1
19	$\sigma_5 - \sigma_2,$ $\sigma_5 - \sigma_3,$ $\sigma_5 - \sigma_4$	Stress increments, psi	MATLF1
20	$(d\sigma_1/d\epsilon_1) =$ $1/(1/E +$ $Ae^{B\sigma_1})$	Curve fit calculation of modulus of elasticity at proportional limit, psi	MATLF1
21	$1 - (d\sigma_1/d\epsilon_1)/E$	Error in calculated value of modulus of elasticity	MATLF1
22	$\sigma_n/E +$ $Ae^{B\sigma_n};$ $n = 1,5$	Calculated strain at points 1 through 5	MATLF1
23		Error in calculated value of strains	MATLF1
24		Summation of errors squared which produce best curve fit	MATLF1
25		Material temperature, °F	MCNTL1

NOTE TT array starts at common location 3661. This array is used for tension and compression stress-strain curve fit.

TABLE 26. FDAT ARRAY VARIABLES (FDATT BLOCK)

Loc	Description	Subroutine Reference
1 · 50	Locations 1 through 50 are used to store wing, empennage, fuselage, and landing gear weight data	
51	Air induction system structure weight, lb	AISMN
52	X-CG air induction system structure, in.	AISMN
53	Inboard nacelle and engine section weight, lb	AISMN
54	Outboard nacelle and engine section weight, lb	AISMN
55	Engine section doors, panels, and miscellaneous structure weight, lb	AISMN
56	Total engine section and nacelles weight, lb	AISMN
57	X-CG engine section and nacelles, in.	AISMN
58	Not used	
59	Not used	
60	Not used	

TABLE 27. IP ARRAY VARIABLES (IPRINT BLOCK)

Loc	Description	Figure Reference	Subroutine Reference
1 · 60	Locations 1 through 60 are print controls for other program modules		
61	Output print control of air induction system input design data	23	AISMN
62	Output print control of vehicle speed-altitude profile data	24	SPAL
63	Output print control of duct, ramp, and nacelle material properties (refer to Table 21)	25,26,27	MCNTL1 (MATLP2)
64	Output print control of calculated material properties data (refer to Table 23)	28	MCNTL1
65	Output print control of inlet duct design pressure data	29	DSGNP
66	Output print control of ramp design criteria	30	PRECRT
67	Output print control of ramp design constants, reaction forces, and detail weights	31	RAMPS
68	Output print control of duct frame redundants and geometry data	34	FRMELD
69	Output print control of duct frame sizing and unit internal loads data, duct geometry and sizing, and summary weight data	32,33	DUCTS
70	Output print control of nacelle geometry, sizing, and weight summary data	35	NACELE
71 · 80	Locations 71 through 80 are print controls for the fuselage module		

TABLE 28. MASS STORAGE FILE RECORDS

Record No.	Variables & Length	Write Routine	Read Routine	Description
28	D(2000)	Input data processing module	AISMN	Input air induction system, nacelle, and engine section design data; refer to first 2,000 locations in Table 9 (locations 1701-1900 are used for calculated variables, SUMM array)
41-60	TMD(300)	Input data processing module	MCNTL1	Permanent file material properties library data; refer to Table 22 for discussion of variables
109-117	TMS(180)	MCNTL1	PRECRT NACELE PYLONS	Duct, ramp, and nacelle material property data at each of 9 flight profile points; refer to Table 23 for discussion of variables

## SUBROUTINE DESCRIPTIONS

### PROGRAM AISMN

#### General Description

Deck name: AISMN  
Entry name: OVERLAY (5HALPHA, 7,0)  
Called by: OLAY00  
Subroutines called: SPAL, MCNTL1, DSGNP, PRECRT, RAMPS, SPIKE, DUCTS, NACELE, MISCOM, PYLONS, SUMMARY

This is the control routine for the air induction system weight estimation module. This routine initializes the blank common region and reads the input data from mass storage file record 28. Certain design variables from the input data set are printed by this routine (Figure 23).

Appropriate analysis routines are called, and the resultant weight and balance summaries are stored in the labeled common array, FDAT. This routine is designed to control the evaluation of air induction system, nacelle, and engine section structure or only two-dimensional variable-geometry ramps.

#### Arrays and Variables Used

DATK Weight correlation factors (refer to EQU array, Table 17)  
DATR Ramp geometry and design data (refer to Table 15)  
DATS Air induction system, nacelle, and engine section data (refer to Table 16)  
IP Print control (refer to "Labeled Common Arrays")  
SUMM Weight summary data (refer to Table 20)  
TOT Weight summary data (refer to Table 24)  
XMISC Refer to "Labeled Common Arrays"

#### Arrays and Variables Calculated

FDAT Weight summary data (refer to "Labeled Common Arrays")  
ITP Number of nacelles  
IVG Inlet type inductor

- 1 = fixed duct
- 2 = fixed spike
- 3 = horizontal ramp
- 4 = vertical ramp
- 5 = translating spike
- 6 = translating and expanding spike

VAPTI-SWEEP WING CONFIGURATION

AIR INDUCTION SYSTEM DATA

NUMBER OF MACELLES		2.0
BYPASS RATIO		0.0
INLET TYPE (1.=FIXED DUCT 2.=FIXED SPIKE)		4.0
(3.=HORIZ. RAMP 4.=VERT. RAMP )		
(5.=TRANSL. SPIKE 6.=EXPND. SPIKE)		
CAPTURE AREA PER INLET		11202.00
NUMBER OF INLETS PER AIR VEHICLE		2.0
X DISTANCE OF THRUST FROM L.E. OF COWL OR LIP		320.000
NUMBER OF ENGINES		4.0
THRUST PER ENGINE		78240.00
HEIGHT PER ENGINE		21052.500
LENGTH OF ENGINE		290.000
DIAMETER OF ENGINE		49.000
ENGINE C.G. DISTANCE AFT OF FACE		102.000
X AT COWL OR LIP, SET 1		1960.000
Y AT ENGINE FACE, SET 1		85.000
Z AT ENGINE FACE, SET 1		386.000
X AT COWL OR LIP, SET 2		0.0
Y AT ENGINE FACE, SET 2		0.0
Z AT ENGINE FACE, SET 2		0.0
AVERAGE SWEEP OF PYLON		3.0
MOUNTING TYPE (0.=VERT, 1.=HORIZ) 10-PYLON		0.0
AVERAGE CHORD OF INBOARD PYLON		0.0
SPAN OF INBOARD PYLON		0.0
AVERAGE CHORD OF OUTBOARD PYLON		0.0
SPAN OF OUTBOARD PYLON		0.0
PYLON THICKNESS TO CHORD RATIO		0.0
AUXILIARY INLET AREA PER MACELLE OR AIR VEHICLE		0.0
DUCT BYPASS AREA PER MACELLE OR AIR VEHICLE		0.0
AREA OF MISCELLANEOUS DOORS		0.0
SHROUD INDICATOR (0.=NO, 1.=YES=CALC.GT 1.=SHROUD AREA)		1.000
MATERIAL NUMBER FOR DUCTS		13.0
MATERIAL NUMBER FOR RAMPS		13.0
MATERIAL NUMBER FOR MACELLES		13.0
PRINT CHOICE (1.=MIN., 2.=ADD SPD.PRF., ... 4.=MAX.)		0.0
PITCHING ACCELERATION		2.000
VERTICAL LOAD FACTOR		2.50
X FACTORS...DUCTS= 1.00 FRAMES= 1.00 COVERS= 1.00 LONGERONS= 1.00		

Figure 23. Sample output from AISMN of air induction system design data (IP(61)).

MMATL Number of arrays of material properties in mass storage file,  
records 41 through 60  
T(1) Number of inlets per nacelle  
TOT Weight summary data (refer to Table 24)

#### Labeled Common Arrays

FDAT Weight summary data (refer to Table 26)  
IP(61) Print/no print indicator  
0 = print input design data (Figure 23)  
1 = do not print  
XMISC(1) Number of arrays of material properties in mass  
storage file, records 41 through 60  
XMISC(85) Alphanumeric case title  
XMISC(100)

#### Mass Storage File Records

Read by routine:

Record 28

Written by routine:

None

#### Error Messages

None

#### SUBROUTINE SPAL

#### General Description

Deck name: SPAL  
Entry name: SPAL  
Called by: AISMN  
Subroutines called: TEMPR

This subroutine expands the input speed-altitude profile data by interpolating between the input points. Profiles examined are level-flight maximum speed,  $M_H$ , and limit speed,  $M_L$ , envelopes with the wing fixed or in the aft position.

Limit speed at the input points is determined from the input  $M_H$  points and  $M_H$ - $M_L$  relationship. This relationship is either given for each of the input points or specified as a general relationship, as shown in the following:

<u>Input <math>M_H</math>-<math>M_L</math> Relationship</u>	<u>Description</u>
0.0	$M_L$ equal to $M_H$
>0.0; <1.0	Decimal to be added to $M_H$
>1.0	Multiplier of $M_H$
<0.0	Fraction of $M_H$ to be added to $M_H$

$M_H$  and  $M_L$  data are input of five altitudes. Intermediate altitudes are obtained by taking points midway between the input altitudes, thus defining nine altitudes. Subroutine TEMPR is called to calculate atmospheric properties at each of these altitudes. Dynamic pressure is then calculated for the input points. Dynamic pressure at the interpolated altitudes is obtained by interpolating between dynamic pressure at the input points, and speed is determined for the dynamic pressure and altitude.

Pressure recovery ratio and airflow at the engine is either input or calculated for the initial five points. Values at the four additional points are obtained by interpolation.

Having determined mach number, pressure recovery ratio, and airflow at the engine for the nine profile points, total temperature, total pressure, and static pressure are then calculated.

#### Arrays and Variables Used

D	Constants (refer to Table 11)
DATM	Speed-altitude profile data (refer to Table 13)
DVLG	General relationship between limit speed and level flight maximum speed (DATM)
EQU	Equation and physical constants (refer to Table 17)
IP	Print control (refer to "Labeled Common Arrays")
PRESH	S(2), ambient pressure at altitude, psf
RATC	General pressure recovery ratio (DATM)
TEMALT	S(1), ambient temperature at altitude, °R
XMISC	Refer to "Labeled Common Arrays"

#### Arrays and Variables Calculated

ALT	Nine altitudes on speed profile, ft
CS	Speed of sound at nine speed profile altitudes, ft/sec

EMH Airflow at engine on  $M_H$  diagram, M  
 EML Airflow at engine on  $M_L$  diagram, M  
 G Acceleration of gravity at nine speed profile altitudes,  $\text{ft/sec}^2$   
 PO Ambient pressure at nine speed profile altitudes, psf  
 PSH Static absolute pressure at engine on  $M_H$  diagram, psia  
 PSL Static absolute pressure at engine on  $M_L$  diagram, psia  
 PTH Total pressure at engine on  $M_H$  diagram, psia  
 PTL Total pressure at engine on  $M_L$  diagram, psia  
 QH Dynamic pressure on  $M_H$  diagram, psf  
 QL Dynamic pressure on  $M_L$  diagram, psf  
 RATH Inlet pressure recovery ratio on  $M_H$  diagram  
 RATL Inlet pressure recovery ratio on  $M_L$  diagram  
 RHO Density of air at nine speed profile altitudes,  $\text{lb/ft}^3$   
 TEM Ambient temperature at nine speed profile altitudes,  $^{\circ}\text{R}$   
 TEMH Total temperature on  $M_H$  diagram,  $^{\circ}\text{R}$   
 TEML Total temperature on  $M_L$  diagram,  $^{\circ}\text{R}$   
 VH Level-flight maximum speed,  $M_H$ , at nine speed profile altitudes, M  
 VL Limit speed,  $M_L$  at nine speed profile altitudes, M

#### Labeled Common Arrays

IP(62) Print/no print indicator

0 = print speed-altitude profile data (see Figure 24)  
 1 = do not print

XMISC(85) Case title  
 to  
 XMISC(100)

#### Mass Storage File Records

None

#### Error Messages

None

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VAPL-SWEEP WING CONFIGURATION

\*\*\* SPEED ALTITUDE PROFILE TABLES \*\*\*

STANDARD ATMOSPHERE

ALTITUDE FEET	TEMPERATURE DEG. RANKINE	DENSITY PCF	PRESSURE PSF	G FT/SFC SO	SPEED OF SOUND FT/SEC
0.0	519.670	0.0765455	2116.22	32.174	1115.90
14500.0	466.960	0.0489584	1218.52	32.130	1058.09
29000.0	415.251	0.0297103	657.57	32.086	997.10
37500.0	392.970	0.0212501	441.60	32.060	965.88
46000.0	389.970	0.0141222	293.56	32.034	965.49
53000.0	387.970	0.0100882	209.60	32.013	965.17
60000.0	389.970	0.0072060	149.78	31.992	964.85
65000.0	389.970	0.0056466	117.78	31.976	964.62
70000.0	392.375	0.0044318	92.68	31.961	967.36

PROFILE TABLE

ALT. FEET	V(M) MN	V(M) PSE	M2 MN	PT2/PTC	RAM T DEG P	PT2 PSI	P2 PSI	V(L) MN	Q(L) PSF	M2 MN	PT2/PTD	RAM T DEG R	PT2 PSI	P2 PSI
0.0	0.53	416.11	0.50	1.0000	547.91	17.79	15.00	0.64	599.20	0.50	1.0000	560.63	19.30	16.27
14500.0	0.70	415.77	0.50	1.0000	512.48	11.72	9.88	0.84	599.70	0.40	1.0000	532.51	13.40	12.00
29000.0	0.85	415.42	0.50	1.0000	490.20	8.16	6.88	1.14	599.21	0.30	0.9947	523.18	10.20	9.58
37500.0	1.39	500.42	0.40	0.5796	539.01	9.32	8.35	1.61	805.24	0.30	0.9612	593.10	12.79	12.02
46000.0	1.93	765.42	0.30	0.9320	680.49	13.34	12.53	2.22	1012.27	0.30	0.9020	974.18	20.27	19.04
53000.0	2.28	764.98	0.30	0.8950	766.40	15.86	14.90	2.63	1011.55	0.30	0.8555	927.47	25.85	24.28
60000.0	2.70	764.33	0.30	0.8465	958.54	20.50	19.26	3.10	1010.82	0.30	0.7951	1141.91	35.53	33.38
65000.0	2.70	601.95	0.30	0.8465	958.54	16.12	15.14	3.08	781.25	0.30	0.7987	1129.01	26.07	25.34
70000.0	2.70	472.07	0.30	0.8465	964.46	12.69	11.92	2.92	551.67	0.30	0.8196	1059.65	17.07	16.04

Figure 24. Sample output from SPAL of speed-altitude profile data (IP(62)).

## SUBROUTINE TEMPR

### General Description

Deck name: TEMPR  
Entry name: TEMPR  
Called by: SPAL  
Subroutines called: None

This subroutine calculates standard atmosphere temperature and pressure by using equation representations which are functions of geopotential altitude. Altitude at which pressure and temperature are to be calculated is determined by the counter, I, which is defined by the calling routine.

### Arrays and Variables Used

ALT Nine altitudes on speed profile, ft  
D Constants (refer to Table 11)  
EQU Equation and physical constants (refer to Table 17)  
I Index for speed profile altitude point

### Arrays and Variables Calculated

ALOFT S(3), altitude divided by 1,000, ft/1,000  
PRESH S(2), ambient pressure at ALT (I), °R  
TEMALT S(1), ambient temperature at ALT (I), °R

### Labeled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

● \*\*\* WARNING MESSAGE \*\*\*  
ALTITUDE IS BEYOND VALID RANGE OF PRESSURE

● \*\*\* WARNING MESSAGE \*\*\*  
ALTITUDE IS BEYOND VALID RANGE OF TEMPERATURE

These messages are printed for altitude greater than 154,199.48 feet. The pressure and temperature are calculated by the equation for the highest altitude range.

#### SUBROUTINE MCNTL1

#### General Description

Deck name: MCNTL1  
Entry name: MCNTL1  
Called by: AISMN  
Subroutines called: MATLF1, MATLP2

This subroutine controls development of material property data for the duct, two-dimensional variable-geometry ramps, and nacelles. Material properties for these components are calculated at each of the nine speed profile altitudes for temperatures associated with level-flight maximum speed and limit speed. This routine reads the material properties library data from mass storage file records 41 through 60, calls subroutine MATLF1 to calculate the material properties at the temperature, and stores this data on mass storage file records 109 through 117. Records 109 through 117 correspond to the nine speed profile altitudes. Certain duct structure material properties are also stored in blank common.

Ducts are assumed to exist on all flight vehicles. Material properties for ramp and nacelle structures are only calculated when they exist.

#### Arrays and Variables Used

DATS(1) Number of nacelles  
DATS(31) Duct structural material identification number  
DATS(32) Variable-geometry ramps structural material identification number  
DATS(33) Nacelle structural material identification number  
EQU(28) Conversion ° R to ° F,  $460 \text{ } ^\circ \text{R}$   
IP Print control (refer to "Labeled Common Arrays")  
IVG Inlet type indicator

1 = fixed duct  
2 = fixed spike  
3 = horizontal ramp

- 4 = vertical ramp
- 5 = translating spike
- 6 = translating and expanding spike

NMATL	Number of arrays of material properties in mass storage file records 41 through 60
TEMH	Total temperature on $M_H$ diagram, °R
TEML	Total temperature on $M_L$ diagram, °R
TM	Calculated material data (refer to Table 21)
TMD	Material properties file record data (refer to Table 22)

### Arrays and Variables Calculated

EH	Duct material modulus of elasticity on $M_H$ diagram, psi
EL	Duct material modulus of elasticity on $M_L$ diagram, psi
FCYH	Duct material compression yield stress on $M_H$ diagram, psi
FCYL	Duct material compression yield stress on $M_L$ diagram, psi
FKTH	Duct material tensile strength under cyclic loading on $M_H$ diagram, fraction of ultimate tensile strength
FKTL	Duct material tensile strength under cyclic loading on $M_L$ diagram, fraction of ultimate tensile strength
FMUH	Duct material Poisson's ratio on $M_H$ diagram
FMUL	Duct material Poisson's ratio on $M_L$ diagram
FSUH	Duct material ultimate shear strength on $M_H$ diagram, psi
FSUL	Duct material ultimate shear strength on $M_L$ diagram, psi
FTUH	Duct material ultimate tensile strength on $M_H$ diagram, psi
FTUL	Duct material ultimate tensile strength on $M_L$ diagram, psi
IF3	Material properties library file record number
IF4	Calculated material properties file record number
II	Counter through nine speed profile points
JJ	Counter for $M_H$ and $M_L$ at each speed profile altitude
KK	Structural component counter

- 1 = duct
- 2 = ramps
- 3 = nacelles

MATLI	Material identification number
RHOD	Duct material density, lb/in. <sup>3</sup>
TMS	Calculated material properties (refer to Table 23)
TT(1)	Material identification number
TT(2)	Material temperature, °F
TT(25)	Material temperature, °F

### Labeled Common Arrays

IP(63) Print/no print indicator

- 0 = print material properties of structural components for first profile point by calling MATLP2 (see Figures 25, 26, and 27)
- 1 = do not print

IP(64) Print/no print indicator

- 0 = print material properties in TMS array (see Figure 28)
- 1 = do not print

### Mass Storage File Records

Read by routine:

Records 41 through 60

Written by routine:

Records 109 through 117

### Error Messages

- MATL INPUT ERROR. ASSUMED MATL NO. 1 III XXX YYY

The foregoing message appears when the input material number is not within the limits of the material library. The total number of materials on file (III), the material number requested (XXX), and the design temperature (YYY) appear below the printed message. If the program assumption is unacceptable, the input data should be corrected.

- MATL TEMPERATURE ERROR MATL NO. XXX.X REQD YYY.Y DEG. ASSUMED TEMP = ZZZ.Z DEG

The foregoing message appears when the design temperature (YYY.Y) is less than or equal to zero. The program assumes the lowest temperature on file (ZZZ.Z) and proceeds. If the design temperature is as indicated, and the material properties at that temperature are required, the material library data should be changed to include properties at the design temperature.

6AL-4V TI-A SMT/PLATE TO .250 IN. REF-TF1.90/1.10 2-22-69  
 120 HRS AT 200 DEG. MIL-MDRK-5 R DATA

TEMP.= P7.91 DENSITY= 0.1600 MU= 0.3304

COMPRESSION      A      P      E      F(RT)      G(RT)  
 0.16166793E-12    0.16943787E-03    16361837.0    16490220.0    6165500.0  
 TENSION      0.16166793E-12    0.16943787E-03    16361837.0

COMPRESSION      EPS(P)    EPS(V)    F(P)    F(2)    F(3)    F(4)    F(V)  
 0.007209    0.010383    117958.9    125997.9    131121.6    134634.6    137154.1  
 TENSION      0.007209    0.010383    117958.9    125997.9    131121.6    134634.6    137154.1

FTU= 138154.1 FSU= 80577.1 FBRU= 250000.0

TM    1    0.07808105E+02    0.33039033E+00    0.16166793E-12    0.16943787E-03    0.16361837E+08  
      6    0.13715412E+06    0.16166793E-12    0.16943787E-03    0.16361837E+06    0.13715412E+06  
     11    0.16000003E+00    0.13815412E+06    0.11795887E+06    0.16400220E+08    0.61655000E+07  
     16    0.80577062E+05    0.25000000E+06    0.17828774E+00    0.69999999E+00    0.20924962E+00  
     21    0.0    0.0    0.0    0.0    0.0    0.0  
     26    0.0    0.0    0.0    0.0    0.0    0.0

TMD    10    0.0    0.0    0.0    0.0    0.0    0.0    0.0  
      20    0.0    0.0    0.0    0.0    0.0    0.0    0.0

Figure 25. Sample output from MATLP2 of duct material properties data (IP(63)).

```

POINT 1
***-RAMP MATERIAL DATA. MATL NO. 13-**-
6AL-6V TI-A* SMT/PLATE IN .250 IN. REF-TF1.90/1.10 2-22-60
170 HRS AT 290 DEG. MIL-HDBK-5 R DATA
** MATLP2 - IP(63) **

TEMP.= 87.81 DENSITY= 0.1600 MU= 0.3304

COMPRESSION
TENSION
COMPRESSION
TENSION

      1          2          3          4          5          6          7          8          9
0.16166793E-12  0.16043787E-03  16361837.0  16400220.0  16400220.0  164634.6  137154.1
0.16166793E-12  0.16943787E-03  16361837.0  16361837.0  16361837.0  134634.6  137154.1

      10         11         12         13         14         15         16         17         18
0.007209  0.010383  117958.9  125997.9  131121.6  131121.6  134634.6  137154.1
0.007209  0.010383  117558.9  125997.9  131121.6  131121.6  134634.6  137154.1

      19         20         21         22         23         24         25         26
0.007209  0.010383  117558.9  125997.9  131121.6  131121.6  134634.6  137154.1

FTU= 138154.1 FSU= 80577.1 FRAU= 250000.0

TV
1  0.87808105E+07  0.33039023E+00  0.16166793E-12  0.16943787E-03  0.16943787E-03  0.16361837E+08
6  0.13715412E+06  0.16166793E-12  0.16943787E-03  0.16943787E-03  0.16361837E+08  0.13715412E+06
11  0.16000003E+09  0.13815412E+06  0.11795887E+06  0.11795887E+06  0.16400220E+08  0.61655000E+07
16  0.80577062E+05  0.25000000E+06  0.17928774E+06  0.17928774E+06  0.69999999E+00  0.20924968E+00
21  0.0  0.0  0.0  0.0  0.0  0.0
26  0.0  0.0  0.0  0.0  0.0  0.0

TMD
10  0.0  0.0  0.0  0.0  0.0  0.0  0.0
20  0.0  0.0  0.0  0.0  0.0  0.0  0.0

```

Figure 26. Sample output from MATLP2 of ramp material properties data (IP(63)).

POINT 1                    -\*\*-NACELLE MATERIAL DATA.    MATL NO. 13-\*\*-                    \*\* MATLP2 - IP(63) \*\*

6AL-4V T1-A\* SMT/PLATE TO .250 IN. REF-IF1.90/1.10 2-72-69  
 120 MRS AT 290 DEG. MIL-HDBK-5 B DATA

TFMP.= 87.81    DENSITY= 0.1600    MU= 0.3304

	A	B	E	E (RT)	G (RT)
COMPRESSION	0.16166793E-12	0.16943787E-03	16361837.0	16400220.0	6165500.0
TENSION	0.16166793E-12	0.16943787E-03	16361837.0		

	EPS(P)	EPS(Y)	F(P)	F(2)	F(3)	F(4)	F(Y)
COMPRESSION	0.007209	0.010383	117958.9	125997.9	131121.6	134634.6	137154.1
TENSION	0.007209	0.010383	117958.9	125997.9	131121.6	134634.6	137154.1

FTU= 136154.1    FSU= 80577.1    FBU= 250XU0.0

T4	1	0.97809105E+02	0.33039073E+00	0.16166793E-12	0.16943787E-03	0.16361837E+04
	6	0.13715412E+06	0.16166793E-12	0.16943787E-03	0.16361837E+08	0.13715412E+04
	11	0.16000003E+00	0.13615412E+06	0.11795887E+06	0.16400220E+08	0.61655000E+07
	16	0.80977062E+05	0.25000000E+06	0.17828774E+00	0.69999999E+00	0.20924949E+00
	21	0.0	0.0	0.0	0.0	0.0
	26	0.0	0.0	0.0	0.0	0.0

TMO	10	0.0	0.0	0.0	0.0	0.0	0.0
	20	0.0	0.0	0.0	0.0	0.0	0.0

Figure 27. Sample output from MATLP2 of nacelle material properties data (IP(63)).

TMS REGION PROFILE PRINT = 1

1	0.57522105E+02	0.33035033E+00	0.16166793E-12	0.16943797E-03	0.16361837E+08
4	0.13715412E+06	0.16166793E-12	0.16943787E-03	0.16361837E+08	0.13715412E+06
11	0.16000003E+00	0.13715412E+06	0.11795487E+06	0.16400220E+08	0.61655000E+07
16	0.90577062E+05	0.25000000E+06	0.17826774E+00	0.69999999E+00	0.20924968E+00
21	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0
31	0.97909105E+02	0.33035033E+00	0.16166793E-12	0.16943797E-03	0.16361837E+08
34	0.13715412E+06	0.16166793E-12	0.16943787E-03	0.16361837E+08	0.13715412E+06
41	0.16000003E+00	0.13715412E+06	0.11795487E+06	0.16400220E+08	0.61655000E+07
46	0.90577062E+05	0.25000000E+06	0.17826774E+00	0.69999999E+00	0.20924968E+00
51	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0
61	0.57522105E+02	0.33035033E+00	0.16166793E-12	0.16943797E-03	0.16361837E+08
66	0.13715412E+06	0.16166793E-12	0.16943787E-03	0.16361837E+08	0.13715412E+06
71	0.16000003E+00	0.13715412E+06	0.11795487E+06	0.16400220E+08	0.61655000E+07
76	0.90577062E+05	0.25000000E+06	0.17826774E+00	0.69999999E+00	0.20924968E+00
81	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
91	0.10062033E+03	0.33103144E+00	0.34749222E-12	0.16553949E-03	0.16297727E+08
96	0.13576512E+06	0.34749222E-12	0.16553949E-03	0.16297727E+08	0.13576512E+06
101	0.16000003E+00	0.13676512E+06	0.11624937E+06	0.16400220E+08	0.61655000E+07
106	0.79992562E+05	0.25000000E+06	0.17826774E+00	0.69999999E+00	0.20924968E+00
111	0.0	0.0	0.0	0.0	0.0
116	0.0	0.0	0.0	0.0	0.0
121	0.10062033E+03	0.33103144E+00	0.34749222E-12	0.16553949E-03	0.16297727E+08
126	0.13576512E+06	0.34749222E-12	0.16553949E-03	0.16297727E+08	0.13576512E+06
131	0.16000003E+00	0.13676512E+06	0.11624937E+06	0.16400220E+08	0.61655000E+07
136	0.79992562E+05	0.25000000E+06	0.17826774E+00	0.69999999E+00	0.20924968E+00
141	0.0	0.0	0.0	0.0	0.0
146	0.0	0.0	0.0	0.0	0.0
151	0.10062033E+03	0.33103144E+00	0.34749222E-12	0.16553949E-03	0.16297727E+08
156	0.13576512E+06	0.34749222E-12	0.16553949E-03	0.16297727E+08	0.13576512E+06
161	0.16000003E+00	0.13676512E+06	0.11624937E+06	0.16400220E+08	0.61655000E+07
166	0.79992562E+05	0.25000000E+06	0.17826774E+00	0.69999999E+00	0.20924968E+00
171	0.0	0.0	0.0	0.0	0.0
176	0.0	0.0	0.0	0.0	0.0

Figure 28. Sample output from MCNTL1 of component material properties data (IP(64)).

## SUBROUTINE MATLF1

### General Description

Deck name: MATLF1  
Entry name: MATLF1  
Called by: MCNTL1  
Subroutines called: None

This subroutine interpolates the material file data for properties at the design temperature, and converts the tabulated stress-strain data into an approximation equation based on least squares fit. The curves through points 1, 2, 5 or 1, 3, 5 or 1, 4, 5 of the tabulated data are examined for the best fit.

### Arrays and Variables Used

D Constants (refer to Table 11)  
TMD Material properties file record date (refer to Table 22)  
TT(1) Material identification number  
TT(2) Material temperature, °F

### Arrays and Variables Calculated

TM Calculated material data (refer to Table 21)  
TT Intermediate calculations (refer to Table 25)

### Labeled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

- \*\*\* MATL TEMPERATURE ERROR \*\*\* MATL NO. XXX.X THERE IS ONE TEMPERATURE ON FILE REQD TEMP = YYY.Y ASSUMED TEMP = ZZZ.Z

The foregoing message is printed when the file consists of material properties at only one temperature which does not agree with the design

temperature. The routines use the properties in the file. If this assumption is not acceptable, the file data should be corrected.

- \*\*\* MATL TEMPERATURE ERROR \*\*\* MATL NO. XXX.X TEMPERATURE IS BEYOND RANGE OF TABLE REQD TEMP = YYY.Y LAST TEMP = ZZZ.Z

The foregoing message is printed when the program extrapolates the material file data. This message may be followed by a catastrophic failure. In most cases, the extrapolation should provide acceptable results and no correction would be required. If the extrapolation results in failure or if the results are not satisfactory, the library data should be extended to include the design temperature.

#### SUBROUTINE MATLP2

##### General Description

Deck name: MATLP2  
Entry name: MATLP2  
Called by: MCNTL1  
Subroutines called: None

This subroutine is called to print the material properties of the nacelle and air induction system components for the first speed profile point if IP(63) = 0. The curve fit constants and tabulated stress-strain data are presented in the output. (See Figures 25 through 27.)

##### Arrays and Variables Used

II Counter through nine speed profile points  
KK Structural component counter

1 = duct  
2 = ramps  
3 = nacelles

MATLI Material identification number  
RM Material descriptive title  
TM Calculated material data (refer to Table 21)  
TMD Material properties file record data (refer to Table 22)

##### Arrays and Variables Calculated

None

## Labeled Common Arrays

None

## Mass Storage File Records

None

## Error Messages

None

## SUBROUTINE DSGNP

### General Description

Deck name: DSGNP  
Entry name: DSGNP  
Called by: AISMN  
Subroutines called: None

This subroutine calculates static pressure at the inlet throat and hammer shock pressures at both the engine face and the throat for points on the level-flight maximum speed and limit speed envelopes.

### Arrays and Variables Used

ALT Nine altitudes on speed profile, ft  
D Constants (refer to Table 11)

EGTP Engine type (DATS(1))

0.0 = turbojet  
+X.X = fanjet by pass ratio

EQU Equation and physical constants (refer to Table 17)

IP Print control (refer to "Labeled Common Arrays")

IVG Inlet type indicator

1 = fixed duct  
2 = fixed spike  
3 = horizontal ramp

- 4 = vertical ramp
- 5 = translating spike
- 6 = translating and expanding spike

PTH Total pressure at engine on  $M_H$  diagram, psia  
 PTL Total pressure at engine on  $M_L$  diagram, psia  
 TEMH Total temperature on  $M_H$  diagram, °R  
 TEMPL Total temperature on  $M_L$  diagram, °R  
 VH Level flight maximum speed,  $M_H$ , at the nine speed profile altitudes, M  
 VL Limit speed,  $M_L$ , at the nine speed profile altitudes, M  
 XMISC Refer to "Labeled Common Arrays"

### Arrays and Variables Calculated

PHEH Hammershock pressure at engine on  $M_H$  diagram, psia  
 PHEL Hammershock pressure at engine on  $M_L$  diagram, psia  
 PHTH Hammershock pressure at throat on  $M_H$  diagram, psia  
 PHTL Hammershock pressure at throat on  $M_L$  diagram, psia  
 PST Static absolute pressure at throat on  $M_L$  diagram, psia  
 R1H Ratio of static pressure at throat to free-stream total pressure on  $M_H$  diagram  
 R1L Ratio of static pressure at throat to free-stream total pressure on  $M_L$  diagram  
 R2H Ratio of hammershock pressure at engine face to total pressure on  $M_H$  diagram  
 R2L Ratio of hammershock pressure at engine face to total pressure on  $M_L$  diagram  
 R3H Ratio of hammershock pressure at inlet throat to total pressure on  $M_H$  diagram  
 R3L Ratio of hammershock pressure at inlet throat to total pressure on  $M_L$  diagram  
 S Intermediate calculations

### Labeled Common Arrays

IP(65) Print/no print indicator  
     0 = print inlet pressure data (see Figure 29)  
     1 = no print  
  
 XMISC(85) Alphanumeric case title  
 to  
 XMISC(100)

SPEED PROFILE DESIGN CONSTANTS

BYPASS RATIO = 0.0 IVG = 4

ALT	VH	TEMP(H)	STATIC (H)	HAMMERSMOCK (H)
		DEG RANKINE	PRES. RATIO	FACE THROAT
0.0	0.53	547.808	0.7735	1.6111
14500.0	0.70	512.483	0.7651	1.5671
29000.0	0.95	490.204	0.7525	1.5757
37500.0	1.38	538.908	0.7309	1.5661
46000.0	1.93	640.489	0.7035	1.4927
53000.0	2.28	796.395	0.6859	1.5339
60000.0	2.70	958.545	0.6650	1.2219
65000.0	2.70	959.545	0.6650	1.3975
70000.0	2.70	964.455	0.6650	1.0793
				1.0774

ALT	VL	TEMP(L)	STATIC (L)	HAMMERSMOCK (L)
		DEG RANKINE	PRES. RATIO	FACE THROAT
0.0	0.64	560.629	0.7682	1.6036
14500.0	0.84	532.513	0.7581	1.5534
29000.0	1.14	523.183	0.7430	1.5540
37500.0	1.61	593.097	0.7193	1.6251
46000.0	2.22	774.182	0.6890	1.5846
53000.0	2.63	927.468	0.6687	1.4833
60000.0	3.10	1141.910	0.6448	1.2430
65000.0	3.08	1129.007	0.6461	1.4107
70000.0	2.92	1059.650	0.6542	1.1051
				0.9795
				0.9487
				1.0029

ALT	PRES(H)	ENGINE-PSIA	PRES(L)	ENGINE-PSIA	STATIC
	THROAT-PSIA	ENGINE-PSIA	THROAT-PSIA	ENGINE-PSIA	THROAT
0.0	27.885	28.668	29.972	30.942	12.496
14500.0	18.464	19.114	20.826	21.708	9.099
29000.0	12.783	13.410	15.601	16.572	7.118
37500.0	13.914	15.065	18.313	20.268	8.644
46000.0	17.832	20.456	25.197	30.067	13.121
53000.0	19.382	23.351	28.561	36.461	16.238
60000.0	22.124	28.648	33.382	67.186	21.574
65000.0	17.398	22.529	25.588	5.937	16.371
70000.0	13.666	17.696	17.123	23.178	10.494

Figure 29. Sample output from DSGNP of inlet pressure data (IP(65)).

## Mass Storage File Records

None

## Error Messages

- \*\*\* WARNING MESSAGE \*\*\*  
RAM TEMPERATURE EXCEEDED FOR FANJET BPR = XXX.X  
RAM TEMP = YYY.Y LIMIT = ZZZ.Z
  
- \*\*\* WARNING MESSAGE \*\*\*  
SPEED EXCEEDED FOR ENGINE INLET COMBINATION  
BPR = XXX.X INLET TYPE = I SPEED = YYY.Y LIMIT = ZZZ.Z

These messages are printed when the condition from which the pressure calculation curves were formulated are exceeded. YYY.Y designates the actual value, and ZZZ.Z designates the applicable range of the data base.

## SUBROUTINE PRECRT

### General Description

Deck name: PRECRT  
Entry name: PRECRT  
Called by: AISMN  
Subroutines called: None

This routine determines the critical design pressure for two-dimensional variable-geometry ramps. Ramp structural material properties are also determined at the design pressure. Critical design pressure is defined by the condition which produces the maximum ratio of design pressure to material compression yield stress. Design pressure is defined as:

1. 1.5 times the hammershock pressure for points on the level flight maximum speed,  $M_H$ , diagram
2. 1.2 times the hammershock pressure for points on the limit speed,  $M_L$ , diagram.

### Arrays and Variables Used

ALT Nine altitudes on speed profile, ft  
D Constants (refer to Table 11)  
EQU(28) Conversion °R to °F, 460 °R  
IP Print control, see "Labeled Common Arrays"  
PHIH Hammershock pressure at throat on  $M_H$  diagram, psia  
PHIL Hammershock pressure at throat on  $M_L$  diagram, psia  
TEMH Total temperature on  $M_H$  diagram, °R  
TEML Total temperature on  $M_L$  diagram, °R  
TMS Material properties (refer to Table 23)  
VH Level flight maximum speed,  $M_H$ , at the nine speed profile altitudes, M  
VL Limit speed,  $M_L$ , at the nine speed profile altitudes, M

### Arrays and Variables Calculated

DENS DATR(14), ramp material density, lb/in.<sup>3</sup>  
FACT DATR(16), limit to ultimate design factor  
FCY DATR(12), ramp material compression yield stress at design pressure, psi  
FSU DATR(13), ramp material ultimate shear strength at design pressure, psi  
ICRT Critical design point on speed profile  
IF4 Material properties file record number  
PHS DATR(3), critical ramp design pressure, psia  
S Intermediate calculations  
XMAT DATR(15), material type identification

1.0 = aluminum  
2.0 = titanium  
3.0 = steel

### Labeled Common Arrays

IP(66) Print/no print indicator

0 = print ramp design point data (see Figure 30)  
1 = do not print

```
*** RAMP DESIGN CONDITIONS ***
POINT              7
ALTITUDE          60000.00
SPEED             3.10
TEMPERATURE - F   681.91
PRESSURE - PSIA   40.06
LIMIT TO ULT. FACTOR 1.20
COMPRESSION YIELD 83947.19
ULTIMATE SHEAR STRESS 56133.15
MATERIAL DENSITY  0.160
```

```
** PRECRT - IP(66) **
```

Figure 30. Sample output from PRECRT of ramp design criteria data (IP(66)).

## Mass Storage File Records

Read by routine:

Records 109 through 117

Written by routine:

None

## Error Messages

None

## SUBROUTINE RAMPS

### General Description

Deck name: RAMPS  
Entry name: RAMPS  
Called by: AISMN  
Subroutines called: None

This subroutine calculates two-dimensional variable-geometry ramp structure weights for either two-, three-, or four-ramp systems. Methods described in Section II of this volume are used to calculate component weights for either stiffened sheet construction or honeycomb panel structure.

### Arrays and Variables Used

ALPHA2 Refer to Table 10  
ALPHA3 Refer to Table 10  
CONST Refer to Table 10  
DADH Refer to Table 10  
DATR Refer to Table 15  
DCORE Refer to Table 10  
DENS Refer to Table 10  
DR Refer to Table 15  
F Refer to Table 18  
FCT Refer to Table 10  
FCY Refer to Table 10  
FSU Refer to Table 10  
GAMMA Refer to Table 10

IP	Printed control (refer to "Labeled Common Arrays")
PHS	Refer to Table 10
SIGMAR	Refer to Table 10
TBARFA	Refer to Table 10
TBARFS	Refer to Table 10
TBARRA	Refer to Table 10
TBARRS	Refer to Table 10
TBARRT	Refer to Table 10
TCA	Refer to Table 10
TCS	Refer to Table 10
TCT	Refer to Table 10
TSA	Refer to Table 10
TSS	Refer to Table 10
TST	Refer to Table 10
TWA	Refer to Table 10
TWS	Refer to Table 10
TWT	Refer to Table 10
W1	Refer to Table 10
W2	Refer to Table 10
W3	Refer to Table 10
W4	Refer to Table 10
XCL	Refer to Table 10
XCT	Refer to Table 10
XFCY	Refer to Table 10
XFSU	Refer to Table 10
XHTA2	Refer to Table 10
XHTA3	Refer to Table 10
XHTA4	Refer to Table 10
XHT2	Refer to Table 10
XHT3	Refer to Table 10
XHT4	Refer to Table 10
XH11	Refer to Table 10
XH12	Refer to Table 10
XH31	Refer to Table 10
XH32	Refer to Table 10
XH33	Refer to Table 10
XH41	Refer to Table 10
XH.2	Refer to Table 10
XH43	Refer to Table 10
XH44	Refer to Table 10
XIL41	Refer to Table 10
XIL42	Refer to Table 10
XIL43	Refer to Table 10
XIL44	Refer to Table 10

XIM21 Refer to Table 10  
XIM22 Refer to Table 10  
XIM31 Refer to Table 10  
XIM32 Refer to Table 10  
XIM33 Refer to Table 10  
XIM41 Refer to Table 10  
XIM42 Refer to Table 10  
XIM43 Refer to Table 10  
XIM44 Refer to Table 10  
XITAA4 Refer to Table 10  
XITAH4 Refer to Table 10  
XITA2 Refer to Table 10  
XITA3 Refer to Table 10  
XITFA4 Refer to Table 10  
XITFH2 Refer to Table 10  
XITFH3 Refer to Table 10  
XITH4 Refer to Table 10  
XIT21 Refer to Table 10  
XIT31 Refer to Table 10  
XIT32 Refer to Table 10  
XIT41 Refer to Table 10  
XIT42 Refer to Table 10  
XIT43 Refer to Table 10  
XK21 Refer to Table 10  
XK22 Refer to Table 10  
XK31 Refer to Table 10  
XK33 Refer to Table 10  
XK41 Refer to Table 10  
XK42 Refer to Table 10  
XK43 Refer to Table 10  
XK44 Refer to Table 10  
XL1 Refer to Table 10  
XL2 Refer to Table 10  
XL3 Refer to Table 10  
XL4 Refer to Table 10  
XMAT Refer to Table 10  
XNUM Refer to Table 10  
XP21 Refer to Table 10  
XP22 Refer to Table 10  
XP31 Refer to Table 10  
XP32 Refer to Table 10  
XP33 Refer to Table 10  
XP41 Refer to Table 10  
XP42 Refer to Table 10  
XP43 Refer to Table 10  
XP44 Refer to Table 10  
XW Refer to Table 10

## Arrays and Variables Calculated

AACT	Refer to Table 10
ACT	Refer to Table 10
AHINGE	Refer to Table 10
BNUM	Number of transverse members
CG	Cosine of angle between projected face of ramp 2 and ramp 3 of four-ramp system
CS	Cosine of angle between projected face of ramp 3 and ramp 4 of four-ramp system
FACT	Refer to Table 10
FHINGE	Refer to Table 10
GAMMAR	Angle between projected face of ramp 2 and ramp 3 of four-ramp system, radians
HL	Panel depth, in
HT	Panel depth, in.
HTA	Actuator beam depth, in.
I	Scratch counter
IND	Minimum weight calculation counter
INONE	Predefined data usage indicator
	0 = predefined data used
	1 = certain predefined variables changed by user input, print revised data information
MAT	Material type indicator
	1 = aluminum
	2 = titanium
	3 = steel
N	Scratch counter
P1	Differential pressure on ramp 1, psig
P2	Differential pressure on ramp 2, psig
P3	Differential pressure on ramp 3, psig
P4	Differential pressure on ramp 4, psig
R	Actuator reaction for two-ramp system, lb
RA	Aft hinge reaction on ramp 2 of two-ramp system, lb
RA3	Aft hinge reaction on ramp 3, lb
RF	Forward hinge reaction on ramp 2 of two-ramp system, lb
RF3	Forward hinge reaction on ramp 3, lb
R1	Actuator reaction on ramp 1 of three- or four-ramp system, lb
R1LONG	Refer to Table 10

**R1TRAN** Refer to Table 10  
**R2** Forward actuator reaction on ramp 3, lb  
**R2LONG** Refer to Table 10  
**R2TRAN** Refer to Table 10  
**R3** Aft actuator reaction on ramp 3, lb  
**R3LONG** Refer to Table 10  
**R4LONG** Refer to Table 10  
**R4TRAN** Refer to Table 10  
**SG** Sine of angle between projected face of ramp 2 and 3 of four-ramp system  
**SIGMAR** Angle between projected face of ramp 3 and ramp 4 of four-ramp system, radians  
**SS** Sine of angle between projected face of ramp 3 and ramp 4 of four-ramp system  
**TBARF** Minimum front sheet thickness, in.  
**TBARR** Minimum rear sheet thickness, in.  
**TC** Minimum cap thickness, in.  
**TG** Tangent of angle between projected face of ramp 3 and ramp 4 of four-ramp system  
**TOTAL** Refer to Table 10  
**TS** Minimum honeycomb facesheet thickness, in.  
**TW** Minimum web thickness, in.  
**VAVG** Design shear, for ramp 3 of four-ramp system, lb  
**V1** Force on ramp 1 due to differential pressure, lb  
**V2** Force on ramp 2 due to differential pressure, lb  
**V3** Force on ramp 3 due to differential pressure, lb  
**V4** Force on ramp 4 due to differential pressure, lb  
**W** Panel width, in.  
**WTMA** Minimum actuator beam weight, lb  
**WTMH** Minimum hinge beam weight, lb  
**WTML** Minimum panel weight, lb  
**WTML1** Minimum ramp 1 panel weight, lb  
**WTML2** Minimum ramp 2 panel weight, lb  
**WTML3** Minimum ramp 3 panel weight, lb  
**WTML4** Minimum ramp 4 panel weight, lb  
**WMT** Minimum transverse beam(s) weight, lb  
**WMTA** Minimum actuator beam weight, lb  
**WMT1** Minimum ramp 1 transverse beams weight, lb  
**WMT2** Minimum ramp 2 transverse means weight, lb  
**WMT4** Minimum ramp 4 transverse beams weight, lb  
**XIM** Minimum weight correlation factor  
**XL** Panel length, in.  
**XMAFT** Bending moment at aft actuator location on ramp 3, in.-lb.  
**XMAVG** Design bending moment for ramp 3 of four-ramp system, in.-lb.

XMC Bending moment at midspan on ramp 3, in.-lb.  
XMFWD Bending moment at forward actuator location on ramp 3, in.-lb.  
Z1 Shear at point on ramp 3, lb  
Z2 Shear at point on ramp 3, lb  
Z3 Shear at point on ramp 3, lb  
Z4 Shear at point on ramp 3, lb  
Z5 Shear at point on ramp 3, lb  
Z6 Shear at point on ramp 3, lb

#### Labeled Common Arrays

IP (67) Print/no print indicator

0 = print ramp predefined variables, input variables,  
and weight and load summary (see Figure 31)  
1 = do not print

#### Mass Storage File Records

None

#### Error Messages

None

SUBROUTINE SPIKE

#### General Description

Deck name: SPIKE  
Entry name: SPIKE  
Called by: AISMN  
Subroutines called: None

This routine calculated the weight of three-dimensional inlet throat area control spikes. Statistical equations are used to calculate these weights.

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BUILT-IN PARAMETERS	
21	CL
22	PERCENT OF COMPRESSION YIELD
23	PERCENT OF SHEAR ULTIMATE
24	XV
25	CT
26	DENSITY OF CORE (PSF)
27	DENSITY OF ADHESIVE (PSF)
** 3 RAMP SYSTEM **	
45	INDEX RAMP 1 LONGITUDINAL
46	INDEX RAMP 1 TRANSVERSE
47	INDEX RAMP 1 MINIMUM GAGE
48	INDEX RAMP 2 LONGITUDINAL
49	INDEX RAMP 2 TRANSVERSE
50	INDEX RAMP 2 MINIMUM GAGE
51	INDEX RAMP 3 LONGITUDINAL
52	INDEX RAMP 3 FWD HINGE BEAM
53	INDEX RAMP 3 ACTUATOR BEAM
54	INDEX RAMP 3 AFT HINGE BEAM
55	INDEX RAMP 3 MINIMUM GAGE
56	PERCENT HAMMERSHOCK RAMP 1
57	PERCENT HAMMERSHOCK RAMP 2
58	PERCENT HAMMERSHOCK RAMP 3
59	K31
60	K32
61	K33
62	H31
63	H32
64	H33
65	HT3
66	HTA3
67	ANGLE RAMP 2 - RAMP 3

0.900  
0.500  
0.500  
0.200  
0.900  
4.400  
0.100

1.000  
1.000  
1.000  
1.000  
1.000  
1.000  
1.000  
1.000  
1.000  
1.000  
1.000  
1.000  
1.000  
1.000  
0.200  
0.500  
0.400  
0.900  
0.200  
0.800  
0.100  
0.100  
0.070  
0.100  
0.150  
30.000

Figure 31. Sample output from RAMPS of design constants, reaction forces, and detail weights (IP(67)).

\*\* RAMPS - IP(67) \*\*

\*\* MINIMUM GAGES \*\*

CG	ALUMINIUM	TC	0.040
100	ALUMINIUM	TW	0.020
101	ALUMINIUM	TS	0.015
102	ALUMINIUM	TRADE	0.040
104	ALUMINIUM	TC	0.010
105	TITANIUM	TW	0.025
106	TITANIUM	TS	0.013
107	TITANIUM	TRADE	0.010
108	TITANIUM	TC	0.024
109	STEEL	TC	0.010
110	STEEL	TW	0.020
111	STEEL	TS	0.010
112	STEEL	TRADE	0.010
113	STEEL	TRADE	0.020
			0.010

INPUT DATA

NUMBER OF RAMPS	3.00
CONST INP (0=STND, 1=MCUMP)	0.0
HAMMERSHOCK PRESSEIPE (PST)	40.06
LENGTH OF RAMP 1 (IN)	58.00
LENGTH OF RAMP 2 (IN)	90.00
LENGTH OF RAMP 3 (IN)	704.00
LENGTH OF RAMP 4 (IN)	0.0
WIDTH OF RAMP 1 (IN)	56.00
WIDTH OF RAMP 2 (IN)	96.00
WIDTH OF RAMP 3 (IN)	56.00
WIDTH OF RAMP 4 (IN)	0.0
FCY (PST)	#3947.19
FSH (PST)	#6133.15
DENSITY OF MATERIAL (LBS/CI IN)	0.16
MATERIAL (1=AL, 2=TI, 3=ST)	2.00
LIMIT TO ULTIMATE FACTOR	1.20

CHANGES TO RUILT-IN PARAMETERS

\*\* NONE \*\*

Figure 31. Sample output from RAMPS of design constants, reaction forces, and detail weights (IP(67)) (cont).

REACTION FORCES (LBS)

RAMP 1 ACTUATOR	133743.
RAMP 3 ACTUATOR	417161.
RAMP 3 FWD HINGE	99913.
RAMP 3 AFT HINGE	150384.

RAMP WEIGHTS (LBS)

RAMP 1 - LONGITUDINAL	81.93
RAMP 1 - TRANSVERSE	28.86
RAMP 2 - LONGITUDINAL	214.24
RAMP 2 - TRANSVERSE	49.19
RAMP 3 - LONGITUDINAL	1451.67
RAMP 3 - FORWARD HINGE	28.40
RAMP 3 - ACTUATOR	95.96
RAMP 3 - AFT HINGE	42.75
TOTAL	1993.01

Figure 31. Sample output from RAMPs of design constants, reaction forces, and detail weights (IP(67)) (concl).

### Arrays and Variables Used

D Constants (refer to Table 11)  
DATS(1) Number of nacelles  
DATS(4) Capture area per inlet, in.<sup>2</sup>  
DATS(5) Number of inlets per air vehicle  
DATS(6) Distance, leading edge of inlet to throat, in.  
EQU(29) Fixed spike weight estimate constant  
EQU(30) Translating spike weight estimate constant  
EQU(31) Translating and expanding spike weight estimate constant  
IVG Inlet type

1 = fixed duct  
2 = fixed spike  
3 = horizontal ramp  
4 = vertical ramp  
5 = translating spike  
6 = translating and expanding spike

### Arrays and Variables Calculated

S(1) Fraction of spike weight per nacelle  
SUMM(13) Weight of fixed spike per nacelle (per vehicle for fuselage mounted engines), lb  
SUMM(14) X-CG of fixed spike relative to inlet leading edge, in.  
SUMM(15) Weight of translating spike per nacelle (per vehicle for fuselage mounted engines), lb  
SUMM(16) X-CG of translating spike relative to inlet leading edge, in.  
SUMM(17) Weight of translating and expanding spike per nacelle (per vehicle for fuselage mounted engines), lb  
SUMM(18) X-CG of translating and expanding spike relative to inlet leading edge, in.  
WFTS TOT (36), weight of translating spike per nacelle, lb  
WHFS TOT (35), weight of fixed spike per nacelle, lb  
WTES TOT (37), weight of translating and expanding spike per nacelle, lb

### Labeled Common Arrays

None

### Mass Storage File Records

None

## Error Messages

None

### SUBROUTINE DUCTS

#### General Description

Deck name: DUCTS  
Entry name: DUCTS  
Called by: AISMN  
Subroutines called: DCTGEO, FRMND3, FRMELD, DUCPNL, DUCFRM, DUCWET

This subroutine controls the inlet duct weight estimating procedure by calling geometry and design synthesis routines. Subroutine DCTGEO is called to calculate geometry data at each of the duct cuts. The routine then controls the synthesis calculations starting at the first complete duct section and proceeding through the last cut. Subroutines FRMND3, FRMLD, DUCPNL, and DUCFRM are called to synthesize duct panel and frame structure at each of the duct cuts. The synthesis cut counter, either I or L, is stored in common for use by these routines.

Duct frame spacing search is performed at each duct cut. The type of program operation is defined by input frame spacing data. If a thousand has been added to the desired frame spacing, a fixed spacing is indicated. Frame spacing search is indicated by an input minimum spacing. The search starts at this minimum and progresses at fixed spacing increments until the combined weight of ducts and frames increases with increased spacing. A final pass is then made at the spacing prior to that which produced an increase in weight. Should the initial spacing or any intermediate spacing exceed the predefined maximum, the search is abbreviated at the maximum spacing. The indicator IFRM is used to direct the search process as follows:

IFRM = 1 Initial spacing pass  
IFRM = 2 Second or subsequent spacing pass  
IFRM = 3 Final spacing or fixed spacing pass

Subroutine DUCWET is called to calculate duct weight based on the sizing data. DUCWET also calculates the weight of one-dimensional inlet leading structure. Weight correlation factors are applied to the resultant weights which are then summarized in the SUMM array. Duct structure center-of-gravity calculations assume longitudinal segment weight centroids to be midway between bounding cuts. Leading edge structure center of gravity is assumed to be located at two thirds of the leading edge segment length.

## Arrays and Variables Used

AA	Unit internal axial load at frame segment centroids, lb/(lb/in.)
BB2	Frame cap width at frame segment centroids, in.
BEN	Unit internal bending, moment at frame segment centroids, in.-lb/(lb/in.)
BLD	Lower sector duct panel peripheral length at cuts, in.
BSD	Side sector duct panel peripheral length at cuts, in.
BUD	Upper sector duct panel peripheral length at cuts, in.
D	Constants (refer to Table 11)
DATD	Duct geometry and design data (refer to Table 12)
DATK(1)	Duct weight index factor
DLXD	Duct segment lengths between cuts, in.
DOD	Vertical flat length of duct contour at cuts, in.
FRWT	Weight of one frame at duct cuts, lb.
IGD	Duct leading edge type indicator
	0 = complete section
	1 = vertical lip
	2 = horizontal lip
IP	Print control, see labeled common arrays
ROD	Corner radius of duct contour at cuts, in.
SFD	Surface area of duct segments, in. <sup>2</sup>
TC	Duct panel field thickness at cuts, in.
TCC	Frame cap thickness at frame segment centroids, in.
TL	Duct panel land thickness at cuts, in.
TOT	Weight summary data (refer to Table 24)
TWW	Frame web thickness at frame segment centroids, in.
VV	Unit internal shear at frame segment centroids, lb/(lb/in.)
WOD	Horizontal flat length of duct contour at cuts, in.
WTD	Duct segment weights, lb.
WTLP	TOT (23), Weight inlet lip per nacelle, lb.
XMISC	Refer to "Labeled Common Arrays"

## Arrays and Variables Calculated

FD	S(41), frame depth, in.
I	Duct synthesis cut counter
IC	Number of frame cuts
IFF	Number of frame segments
IFRM	Frame spacing search pass counter

IQ Number of frame segments per quadrant  
KC Duct perimeter code  
  
1 = perimeter input  
2 = perimeter correction factor input  
  
L Duct synthesis cut counter  
NC Number of input duct cuts  
S(1) Summation of duct weight times X-arms, in.-lb  
SFRM Duct frame spacing at duct cuts, in.  
SUMM Weight summary (refer to Table 20).  
TOT Weight summary (refer to Table 24)

#### Labeled Common Arrays

IP(69) Print/no print indicator  
0 = print detail duct frame, geometry, and sizing data  
(Figures 32 and 33)  
1 = do not print  
  
XMISC(85) Alphanumeric case title  
XMISC(100)

#### Mass Storage File Records

None

#### Error Messages

None

SUBROUTINE DCTGEO

#### General Description

Deck name: DCTGEO  
Entry name: DCTGEO  
Called by: DUCTS  
Subroutines called: None

This subroutine calculates shape parameters at the duct cuts and length, and surface area for segments bounded by cuts. The surface area is calculated for the total number of ducts in the fuselage or, for podded engines, the total number of ducts in a nacelle.

VARI-SWEEP WING CONFIGURATION

\*\*\* DUCT GEOMETRY - SECTION DATA \*\*\*  
 LIP TYPE = 1 SHAPE CODE = 1

CUT	STA.	DEPTH	WIDTH	PER.	CO	RO	WD	RU	RL	RS
1	0.0	99.00	0.0	99.00	0.0	0.0	0.0	0.0	0.0	0.0
2	190.00	99.00	80.00	358.00	49.53	0.0	40.00	90.00	90.00	99.00
3	280.00	99.00	83.00	364.00	49.50	0.0	41.50	83.00	93.00	99.00
4	510.00	99.00	100.00	398.00	49.53	0.0	50.00	100.00	100.00	99.00
5	679.00	82.00	148.00	430.00	23.53	17.47	56.53	140.50	140.50	74.50
6	680.00	82.00	74.00	212.00	41.00	0.0	37.00	74.00	74.00	82.00
7	806.00	72.00	72.00	226.70	0.00	30.00	0.00	56.55	56.55	56.55

CUT	STA.	FR.SP.	FR.WT.	LAND	RASIC
1	0.0	0.0	0.0	0.0	0.0
2	190.00	10.00	93.72	0.4319	0.1727
3	280.00	10.00	93.49	0.4319	0.1727
4	510.00	10.00	109.49	0.5182	0.2850
5	679.00	10.00	240.00	0.5936	0.4157
6	680.00	10.00	76.86	0.5941	0.4165
7	806.00	10.00	23.75	0.6496	0.5330

SFG	LFNGTH	AREA	WT COVER
1	190.00	34010.00	0.0
2	90.00	32490.00	847.10
3	230.00	87630.00	2919.13
4	169.00	63966.00	4407.81
5	1.00	624.00	53.61
6	126.00	67813.19	5383.31

TOTAL 806.00 292533.19 13610.97 WEIGHT LIP = 944.72

Figure 32. Sample output from DUCTS of unit internal frame loads and frame sizing data (IP(69)).

\*\* DUCTS - IP(69) \*\*

DUCT FRAME

SECTION 2

K	TW	YCC	BBZ	BEN	VV	AA
1	0.6132008E-01	0.3294829E-01	0.4477990E+01	-0.2383214E+02	0.8950063E+01	0.4949971E+02
2	0.8843869E-01	0.6595653E-01	0.6000000E+01	0.3137300E+03	0.2695704E+02	0.4949971E+02
3	0.9143013E-01	0.6849074E-01	0.6000000E+01	0.3337800E+03	-0.2966780E+02	0.4873637E+02
4	0.8843839E-01	0.4127844E-01	0.5610140E+01	-0.1504861E+03	-0.2684973E+02	0.4000003E+02
5	0.6131938E-01	0.8525056E-01	0.6000000E+01	-0.4774431E+03	-0.8949737E+01	0.4000003E+02
6	0.6132061E-01	0.8524978E-01	0.6000000E+01	-0.4774390E+03	0.8950286E+01	0.4000003E+02
7	0.8843899E-01	0.4127741E-01	0.5610001E+01	-0.1504727E+03	0.2695029E+02	0.4000003E+02
8	0.9143060E-01	0.6849319E-01	0.6000000E+01	0.3337969E+03	0.2966835E+02	0.4873654E+02
9	0.8843869E-01	0.6595963E-01	0.6000000E+01	0.3137500E+02	0.2695704E+02	0.4950026E+02
10	0.6132008E-01	0.3294656E-01	0.4477757E+01	-0.2381250E+02	-0.8950063E+01	0.4950026E+02
11	0.6131979E-01	0.3294618E-01	0.4477705E+01	-0.2380859E+02	0.8949928E+01	0.4950026E+02
12	0.8843851E-01	0.6595963E-01	0.6000000E+01	0.3137500E+03	0.2684990E+02	0.4950026E+02
13	0.9143072E-01	0.6849259E-01	0.6000000E+01	0.3337930E+03	-0.2966840E+02	0.4973640E+02
14	0.8843899E-01	0.4127796E-01	0.5610073E+01	-0.1504802E+03	-0.2685028E+02	0.3999989E+02
15	0.6132061E-01	0.8525056E-01	0.6000000E+01	-0.4774436E+03	-0.8950286E+01	0.3999989E+02
16	0.6131938E-01	0.8525121E-01	0.6000000E+01	-0.4774482E+03	0.8949737E+01	0.3999989E+02
17	0.8843839E-01	0.4127843E-01	0.5610142E+01	-0.1504866E+03	0.2684973E+02	0.3999989E+02
18	0.9143019E-01	0.6849188E-01	0.6000000E+01	0.3337883E+03	0.2966785E+02	0.4873624E+02
19	0.8843951E-01	0.6595850E-01	0.6000000E+01	0.3137439E+03	-0.2684990E+02	0.4949971E+02
20	0.6131979E-01	0.3294678E-01	0.4477786E+01	-0.2381642E+02	-0.8949928E+01	0.4949971E+02

Figure 33. Sample output from DUCTS of duct detail geometry and weight data (IP(69)).

Data input to this routine consists of depth, width, lateral centroid, and either perimeter or perimeter correction factor at as many as 10 duct stations. The first cut describes geometry at the leading edge, and the last cut describes geometry at the engine face. Perimeter code, KC, is used to designate whether the perimeter or perimeter correction factor is defined. If KC is 1, the perimeter is input at the cuts. If KC is 2, the perimeter correction factor is input data, and the perimeter is calculated and substituted for the correction factors.

Input geometry describes a single duct. If the lateral centroid at a cut is a positive value, two ducts are indicated and the surface area is calculated for the two ducts. Should the lateral centroid at a cut be zero followed by a cut where the lateral centroid is a positive value, this indicates division of a single duct into two ducts. Conversely, two ducts could join to become a single duct. In either case, geometry at the aft cut is used to calculate the surface area for the segment in which the transition occurs.

In most instances, the duct leading edge is a complete section. However, should there be a one-dimensional leading edge, the single dimension is described in the input data set; the perimeter or perimeter correction factor is not input for this station. The second cut would then describe the first complete duct section. The surface area for this leading edge segment is then calculated from the geometry at the two bounding cuts. The segment longitudinal centroid is assumed to be two-thirds of the distance aft of the leading edge. The longitudinal centroid for all other segments or for a continuous leading edge segment is assumed to be midway between bounding cuts.

#### Arrays and Variables Used

D        Constants (refer to Table 11)  
DATD    Duct geometry and design data (refer to Table 12)  
KC       Duct perimeter code  
  
          1 = perimeter input  
          2 = perimeter correction factor input  
  
NC       Number of input duct cuts

#### Arrays and Variables Calculated

BLD       Lower sector duct panel peripheral length at cuts, in.  
BSD       Side sector duct panel peripheral length at cuts, in.  
BJD       Upper sector duct panel peripheral length at cuts, in.

DATD(61)- Duct perimeter, in., at cut; calculated when  
 DATD(70) perimeter correction factor input  
 DLXD Duct segment lengths between cuts, in.  
 DOD Vertical flat length of duct contour at cuts, in.  
 IGD Duct leading edge type indicator  
  
     0 = complete section  
     1 = vertical lip  
     2 = horizontal lip  
  
 ROD Corner radius of duct contour at cuts, in.  
 S Intermediate calculations  
 SFD Surface area of duct segments, in.<sup>2</sup>  
 WOD Horizontal flat length of duct contour at cuts, in.

#### Labled Common Arrays

None

#### Mass Storage File Records

None

#### Error Messages

- WARNING FROM DCTGEO IN AIR INDUCTION SYSTEM  
DUCT LIP GEOMETRY ERROR

The foregoing message is printed when a one-dimensional leading edge is indicated by zero in input location DATD (61) and neither depth or width are defined for the leading edge station. The surface area calculated for the leading edge segment represents two triangular sides and a triangular top.

- WARNING FROM DCTGEO IN AIR INDUCTION SYSTEM  
SECTION XX IS RECTANGLE OR ROUNDED RECT. CORRECTION IS Y.YYY

The foregoing warning message appears when the program encounters difficulty in fitting the shape, base on input geometry. XX locates the cut at which the difficulty occurred, and Y.YYY is the scaling factor applied to depth and width. The perimeter is assumed to be the independent variable and is not revised. Should the scaling factor indicate a significant revision, the input data should be examined for possible errors.

## SUBROUTINE FRMND3

### General Description

Deck name: FRMND3  
Entry name: FRMND3  
Called by: DUCTS  
Subroutines called: None

This subroutine calculates the duct frame node coordinates based on rounded rectangle shapes. This routine is entered to perform these calculations at each duct station, starting at the first complete duct section.

Frame synthesis cut coordinates are based on equal length segments along the duct contour. The first cut is taken at the top centerline, which also defines coordinates of the last synthesis cut.

### Arrays and Variables Used

D Constants (refer to Table 11)  
DOD Vertical flat length of duct contour at cuts, in.  
IFF Number of frame segments  
IQ Number of frame segments per quadrant  
L Duct synthesis cut location counter  
ROD Corner radius of duct contour at cuts, in.  
WOD Horizontal flat length of duct contour at cuts, in.

### Arrays and Variables Calculated

DLS Frame segment lengths at duct mold line, in.  
S Intermediate calculations  
Y Y-coordinate of frame cuts at duct mold line, in.  
YB Y-centroid of frame segments at duct mold line, in.  
Z Z-coordinate of frame cuts at duct mold line, in.  
ZB Z-centroid of frame segments at duct mold line, in.

### Labeled Common Arrays

None

## Mass Storage File Records

None

## Error Messages

None

## SUBROUTINE FRMELD

### General Description

Deck name: FRMELD  
Entry name: FRMELD  
Called by: DUCTS  
Subroutines called: None

This subroutine calculates internal frame loads for a unit pressure loading by the elastic center method. A loading of 1 pound per inch normal to the duct mold line contour is assumed to be reacted by the frame. Unit internal loads are calculated at the neutral axis of frame segments. Inner frame cap coordinates at frame cuts are defined in subroutine FRMND3. These coordinates and frame depth are used to calculate neutral axis coordinates.

### Arrays and Variables Used

D Constants (refer to Table 11)  
DLS Frame segment lengths at duct mold line, in.  
FD S(41), frame depth, in.  
IC Number of frame cuts  
IFF Number of frame segments  
IP Print control, see labeled common arrays  
IQ Number of frame segments per quadrant  
L Duct synthesis cut location counter  
Y Y-coordinate of frame cuts at duct mold line, in.  
YB Y-centroid of frame segments at duct mold line, in.  
Z Z-coordinate of frame cuts at duct mold line, in.  
ZB Z-centroid of frame segments at duct mold line, in.

### Arrays and Variables Calculated

A Static lateral load at frame cuts, lb/(lb/in.)  
AA Unit internal axial load of frame segment centroids, lb/(lb/in.)  
BEN Unit internal bending moment at frame segment centroids, in.-lb/  
(lb/in.)  
BM Static bending moment at frame cuts, in.-lb/(lb/in.)  
BMO S(43), frame moment redundant, in-lb/(lb/in.)  
DLSP Frame segment length at frame centroids, in.  
HO S(44), frame lateral load redundant, lb/(lb/in.)  
S Intermediate calculations  
V Static vertical load at frame cuts, lb/(lb/in.)  
VO S(45), frame vertical load redundant, lb/(lb/in.)  
VV Unit internal shear at frame segment centroids, lb/(lb/in.)  
YP Y-coordinate of frame neutral axis at cuts, in.  
YPB Z-centroid of frame segment at neutral axis, in.  
ZP Z-coordinate of frame neutral axis at cuts, in.  
ZPB A-centroid of frame segment at neutral axis, in.  
ZZS S(42), Z-centroid of elastic center, in.

### Labeled Common Arrays

IP(68) Print/no print indicator

0 = print duct frame redundants and geometry data  
1 = do not print

### Mass Storage File Records

None

### Error Messages

None

\*\*\* DUCT FRAME DATA \*\*\*

SECTION 2 UNIT REDUNDANTS RND = -2702.670 HJ = 49.500 VC = 0.000

DUCT PERIMETER = 342.717 PING PERIMETER = 361.572

CUT/SEC	V	Z	YR	ZR	DLS	VP	ZP	VPR	ZPB	DLSP
1	0.0	42.500	8.950	42.500	17.900	0.0	52.500	8.950	52.500	17.900
2	17.900	42.500	26.850	42.500	17.900	17.900	52.500	27.640	52.275	19.486
3	35.800	42.500	37.900	42.650	14.329	37.381	52.050	40.177	44.123	16.812
4	40.000	35.900	41.000	26.850	17.900	42.974	36.195	42.987	27.048	18.295
5	40.000	17.900	40.000	8.950	17.900	43.000	17.900	43.000	8.950	17.900
6	40.000	0.0	40.000	-8.950	17.900	43.000	0.0	43.000	-8.950	17.900
7	40.000	-17.900	40.000	-26.850	17.900	43.000	-17.900	42.987	-27.048	18.295
8	40.000	-35.800	37.900	-42.650	14.329	42.974	-36.195	40.177	-44.123	16.812
9	35.800	-42.500	26.850	-49.500	17.900	37.381	-52.050	27.640	-52.275	19.486
10	17.900	-42.500	8.950	-49.500	17.900	17.900	-52.500	8.950	-52.500	17.900
11	0.0	-42.500	-8.950	-49.500	17.900	0.0	-52.500	-8.950	-52.500	17.900
12	-17.900	-42.500	-26.850	-42.650	17.900	-17.900	-52.500	-27.640	-52.275	19.486
13	-35.800	-42.500	-37.900	-42.650	14.329	-37.381	-52.050	-40.177	-44.123	16.812
14	-40.000	-35.900	-40.000	-26.850	17.900	-42.974	-36.195	-42.987	-27.048	18.295
15	-40.000	-17.900	-40.000	-8.950	17.900	-43.000	-17.900	-43.000	-8.950	17.900
16	-40.000	0.0	-40.000	8.950	17.900	-43.000	0.0	-43.000	8.950	17.900
17	-40.000	17.900	-40.000	26.850	17.900	-43.000	17.900	-42.987	27.048	18.295
18	-40.000	35.900	-37.900	42.650	14.329	-42.974	36.195	-40.177	44.123	16.812
19	-35.800	42.500	-26.850	49.500	17.900	-37.381	52.050	-27.640	52.275	19.486
20	-17.900	42.500	-8.950	42.500	17.900	-17.900	52.500	-8.950	52.500	17.900

Figure 34. Sample output from FRMELD of unit redundants and duct frame geometry (IP(68)).

## SUBROUTINE DUCPNL

### General Description

Deck name: DUCPNL  
Entry name: DUCPNL  
Called by: DUCTS  
Subroutines called: None

This subroutine calculates duct panel thickness required to satisfy strength and deflection criteria for either milled or constant thickness construction. The process consists of a systematic evaluation which starts at minimum gage and investigates each of the speed-altitude profile points in search of the designing condition.

This routine is called to perform these calculations at each duct station, starting at the first complete duct section. Throat pressures are used for duct stations forward of the inlet throat. Pressures at duct stations aft of the throat are obtained by interpolating between pressure at the inlet throat and at the engine front face.

### Arrays and Variables Used

D Constants (refer to Table 11)  
DATD Duct geometry and design data (refer to Table 12)  
DATS(6) Distance, leading edge of inlet to throat, in.  
EH Duct material modulus of elasticity on  $M_H$  diagram, psi  
EL Duct material modulus of elasticity on  $M_L$  diagram, psi  
EQU Equation and physical constants (refer to Table 17)  
FKTH Duct material tensile strength under cyclic loading on  $M_H$  diagram, fraction of ultimate tensile strength  
FKTL Duct material tensile strength under cyclic loading on  $M_L$  diagram, fraction of ultimate tensile strength  
FTUH Duct material ultimate tensile strength on  $M_H$  diagram, psi  
FTUL Duct material ultimate tensile strength on  $M_L$  diagram, psi  
I Duct synthesis cut location counter  
NC Number of input duct cuts  
PHEH Hammershock pressure at engine on  $M_H$  diagram, psia  
PHEL Hammershock pressure at engine on  $M_L$  diagram, psia  
PHIH Hammershock pressure at throat on  $M_H$  diagram, psia  
PHTL Hammershock pressure at throat on  $M_L$  diagram, psia  
PO Ambient pressure at nine speed profile altitude, psf  
PSL Static absolute pressure at engine on  $M_L$  diagram, psia  
PST Static absolute pressure at throat on  $M_L$  diagram, psia  
RHOD Duct material density, lb/in.<sup>3</sup>  
SFRM Duct frame spacing at duct cuts, in.  
XO Duct cut stations, in. (refer to DATD)

### Arrays and Variables Calculated

IML     Duct panel mill indicator

      0 = panel not milled  
      1 = panel milled, lands at frames

S(1)     Interpolation factor for pressure  
S(2)     Ultimate tensile strength, psi  
S(3)     Fraction of ultimate tensile strength for cyclic loading  
S(4)     Modulus of elasticity, psi  
S(5)     Limit to ultimate design factor  
S(6)     Limit design stress, psi  
S(7)     Limit pressure at throat, psig  
S(8)     Limit pressure at engine, psig  
S(9)     Allowable panel deflection, in.  
S(10)    Limit pressure at duct cut, psig  
S(11)    Intermediate calculation  
S(20)    Intermediate calculation, panel field thickness, in.  
S(21)    Intermediate calculation, panel land thickness, in.  
S(22)    Intermediate calculation  
TC       Duct panel field thickness at duct cuts, in.  
TL       Duct panel land thickness at duct cuts, in.  
TOT(3)   Duct weight per inch of length at duct cuts, lb/in.

### Labled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

None

## SUBROUTINE DUCFRM

### General Description

Deck name: DUCFRM  
Entry name: DUCFRM  
Called by: DUCTS  
Subroutines called: None

This subroutine calculates duct frame weight for a specified frame spacing and duct cut station. Weight is derived from a frame element sizing procedure based on internal loads, material properties, and fabrication minimums.

The sizing procedure consists of a systematic evaluation of internal loads due to static and hammer shock pressure at each of the nine speed profile altitudes. The lower limit in the sizing procedure is defined by initializing frame elements to fabrication minimums. Internal loads are obtained by multiplying unit internal loads, calculated by subroutine FRMELD, by design pressure and frame spacing. Throat pressures are used for duct stations forward of the inlet throat. Design pressures for stations aft of the throat are obtained by interpolation between pressures at the inlet throat and the engine front face.

### Arrays and Variables Used

AA	Unit internal axial load at frame segment centroids, lb/(lb/in.)
BEN	Unit internal bending moment at frame segment centroids, in.-lb/(lb/in.)
D	Constants (refer to Table 11)
DATS(6)	Distance leading edge of inlet to throat, in.
DLSP	Frame segment lengths at frame centroids, in.
D1	D(1), constant 1.0
D2	D(2), constant 2.0
EH	Duct material modulus of elasticity on $M_H$ diagram, psi
EL	Duct material modulus of elasticity on $M_L$ diagram, psi
FCYH	Duct material compression yield stress on $M_H$ diagram, psi
FCYL	Duct material compression yield stress on $M_L$ diagram, psi
FD	S(41), frame depth, in.
FMUH	Duct material Poisson's ratio on $M_H$ diagram
FMUL	Duct material Poisson's ratio on $M_L$ diagram
FSUH	Duct material ultimate shear strength on $M_H$ diagram, psi
FSUL	Duct material ultimate shear strength on $M_L$ diagram, psi
I	Duct synthesis cut location counter
IFF	Number of frame segments
NC	Number of input duct cuts
PHSH	Hammershock pressure at engine on $M_H$ diagram, psia

PHEH	Hammershock pressure at engine on $M_H$ diagram, psia
PHEL	Hammershock pressure at engine on $M_L$ diagram, psia
PHTH	Hammershock pressure at throat on $M_H$ diagram, psia
PHTL	Hammershock pressure at throat on $M_L$ diagram, psia
PI	$D(15)$ , constant $\pi$
PO	Ambient pressure at nine speed profile altitudes, psf
PSL	Static absolute pressure at engine on $M_L$ diagram, psia
PST	Static absolute pressure at throat on $M_L$ diagram, psia
RHOD	Duct material density, lb/in. <sup>3</sup>
SFRM	Duct frame spacing at duct cuts, in.
VV	Unit internal shear at frame segment centroids lb/(ln/in.)
XO	Duct cut stations, in. (refer to DATD array Table 12)
ZERO	$D(24)$ , constant 0.0

#### Arrays and Variables Calculated

AC	$S(58)$ , frame cap area, in. <sup>2</sup>
AMI	$S(54)$ , minimum frame cap area, in. <sup>2</sup>
BB2	Frame cap width at frame segment centroids, in.
BC2	$S(62)$ , frame cap width, in.
E	$S(51)$ , frame material modulus of elasticity, psi
FCY	$S(47)$ , frame material compression yield stress, psi
FKC	$S(48)$ , frame buckling coefficient
FMJ	$S(50)$ , frame material Poisson's ratio.
FRWT	Weight of one frame at duct cuts, lb
FSU	$S(48)$ , frame material ultimate shear strength, psi
ICNT	Design pressure point counter
PAA	$S(57)$ , frame cap axial load from combined axial and bending load, lb
PAX	$S(56)$ , frame axial load, lb
RHO	$S(52)$ , frame material density, lb/in. <sup>3</sup>
S	Intermediate calculations
TCAP	$S(61)$ , frame cap thickness, in.
TCAP2	$S(63)$ , half of frame cap thickness, in.
TCC	Frame cap thickness at frame segment centroids, in.
TEM2	$S(55)$ , intermediate calculation
TOT(4)	Frame weight per inch of duct length at duct cut, in.
TW	$S(59)$ , frame web thickness, in.
TWS	$S(60)$ , frame stiffener thickness, in.
TWT	$S(67)$ , frame weight, lb
TWW	Frame web thickness at frame segment centroids, in.
WTF	$S(64)$ , frame cap weight, lb
WTST	$S(66)$ , frame stiffener weight, lb
WTW	$S(65)$ , frame web weight, lb

### Labeled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

None

### SUBROUTINE DUCWET

#### General Description

Deck name: DUCWET  
Entry name: DUCWET  
Called by: DUCTS  
Subroutines called: None

This subroutine calculates inlet duct weight for each of the duct segments. Duct weight calculation is based on linear thickness taper between forward and aft boundaries of segments.

Structural arrangement is evaluated so that calculated weights account for the total duct weight in a single nacelle or, for fuselage buried engine concepts, the total duct weight in the vehicle. These calculations account for:

1. One-dimensional inlet lip
2. Variable geometry ramps
3. One or two ducts and the transition from two ducts to one

One-dimensional inlet lip structure weight is calculated on a unit weight basis. Surface area for the first inlet segment is used to calculate this structure. Variable-geometry ramps are assumed to form part of duct wall. Should ramps exist, that portion of duct which is covered by ramps is deleted in the calculation of duct panel weights. One or two ducts may exist in a nacelle or fuselage. On some configurations, the inlet system may consist

of two ducts which combine to form a single duct. Weight calculation for the segment in which this geometric transition occurs is performed by using geometry and sizing data at the aft boundary of the affected segment.

#### Arrays and Variables Used

BSD	Side sector duct panel peripheral length at cuts, in.
BUD	Upper sector duct panel peripheral length at cuts, in.
D	Constants (refer to Table 11).
DATD	Duct geometry and design data (refer to Table 12)
DATR	Ramp geometry and design data (refer to Table 15)
DLXD	Duct segment lengths between cuts, in.
EQU(96)	Duct lip unit weight, psf
IGD	Duct leading edge type indicator 0 = complete section 1 = vertical lip 2 = horizontal lip
IVG	Inlet type indicator 1 = fixed duct 2 = fixed spike 3 = horizontal ramp 4 = vertical ramp 5 = translating spike 6 = translating and expanding spike
NC	Number of input duct cuts
RHOD	Duct material density, lb/in. <sup>3</sup>
SFD	Surface area of duct segments, in. <sup>2</sup>
SFRM	Duct frame spacing at duct cuts, in.
TC	Duct panel field thickness at duct cuts, in.
TL	Duct panel land thickness at duct cuts, in.
XO	Duct cut stations, in. (refer to DATD array Table 12)

#### Arrays and Variables Calculated

S	Intermediate calculations
WTD	Duct segment weights, lb
WILP	TOT(23), weight inlet lip per nacelle, lb

#### Labeled Common Arrays

None

## Mass Storage File Records

None

## Error Messages

None

## SUBROUTINE NACELE

### General Description

Deck name: NACELE  
Entry name: NACELE  
Called by: AISMN  
Subroutines called: NCLGEO

This subroutine is called to estimate nacelle shell structure for externally mounted engine installations. Weight and balance data for nacelle panels, frames, and load redistribution members are calculated in this routine. The estimating procedure consists of the evaluation of structural minimums, local panel flutter, and duct-nacelle compatibility. Subroutine NCLGEO is called to develop the required nacelle geometry data.

The nacelle is assumed to consist of an inlet section and an engine compartment section. This distinction is made to evaluate structural arrangement differences in the two sections. In the inlet section, frame weight and spacing are determined for duct design requirements. These data are developed by the duct estimating routines. Frame weight and spacing at nacelle cuts are obtained by interpolating between bounding duct cuts. Should two inlet ducts exist at a nacelle cut, the corresponding nacelle frame is assumed to be equivalent to two duct frames. Frame spacing in the engine compartment section is defined by input nacelle data. Frame weight in the engine compartment is calculated from predefined shape and minimum thickness.

Nacelle cover thicknesses at nacelle cuts are established by minimum gage and, for supersonic aircraft, by local panel flutter requirements if critical. Critical panel flutter requirements are obtained by a systematic evaluation of mach number, dynamic pressure, and material modulus of elasticity at each of the nine speed-altitude profile points. The appropriate frame spacing is used to determine thickness required to prevent local panel flutter at each nacelle cut.

Nacelle component weights are calculated for each nacelle segment. Should the first nacelle segment geometry define a one-dimensional leading edge structure, weight for that segment is not calculated to avoid duplication since the weight for that segment is calculated as part of the inlet duct structure.

Cover weight calculations are based on linear thickness taper between the forward and aft boundaries of segments. Cover panels which are replaced by engine removal doors are deleted in these weight calculations. Frame weight within segments are based on weight per linear inch at the bounding cuts.

Load redistribution structure weight is based on nacelle profile area. This calculation is performed for multiple engine nacelle arrangements where engine loads are reacted by nacelle structure which then transfers the loads to pylons.

Weight correlation factors are applied to the resultant weights which are then summarized in the SUMM array. Center-of-gravity calculations assume longitudinal segment weight centroids to be midway between bounding cuts.

#### Arrays and Variables Used

ALT	Nine altitudes on speed profile, ft
BLN	Lower sector nacelle panel peripheral length at cuts, in.
BSN	Side sector nacelle panel peripheral length at cuts, in.
BUN	Upper sector nacelle panel peripheral length at cuts, in.
D	Constants (refer to Table 11)
DATD	Duct geometry and design data (refer to Table 12)
DATK	Weight correlation factors (refer to EQU array, Table 17)
DATN	Nacelle geometry and design data (refer to Table 14)
DATS	Air induction system, nacelle, and engine section design data (refer to Table 16)
DLXN	Nacelle segment lengths between cuts, in.
DON	Vertical flat length of nacelle contour at cuts, in.
EQU	Equation and physical constants (refer to Table 17)
FRWT	Weight of one duct frame at duct cuts, lb
IGN	Nacelle leading edge type indicator 0 = complete section 1 = vertical lip 2 = horizontal lip
IP	Print control (refer to "Labeled Common Arrays")
NC	Number of input duct cuts
QL	Dynamic pressure on $M_L$ diagram, psf

RCSN	Side sector nacelle panel radius of curvature at cuts, in.
RCUN	Upper sector nacelle panel radius of curvature at cuts, in.
RON	Corner radius of nacelle contour at cuts, in.
SFN	Surface area of nacelle segments, in. <sup>2</sup>
SFRM	Duct frame spacing at duct cuts, in.
TMS	Material properties (refer to Table 23)
VL	Limit speed, $M_L$ , at nine speed profile altitudes, M
WON	Horizontal flat length of nacelle contour at cuts, in.
XMISC	Refer to "Labeled Common Arrays"

### Arrays and Variables Calculated

DATN	Nacelle flutter design data (refer to Table 14)
ELN	Nacelle material modulus of elasticity, psi
FRWN	Weight of one nacelle frame at nacelle cuts, lb
ICN	Engine support type indicator 0 = engine directly mounted to pylon or one engine per nacelle 1 = multiple engines per nacelle with engines mounted to nacelle structure
IF4	Calculated material properties file record number
KCN	Nacelle perimeter code 1 = perimeter input 2 = perimeter correction factor input
NCN	Number of input nacelle cuts
NFLT	Speed profile point critical for local panel flutter design
RHON	Nacelle material density, lb/in. <sup>3</sup>
SFRN	Nacelle frame spacing at nacelle cuts, in.
SUMM	Weight summary data (refer to Table 20)
TCN	Nacelle panel thickness at nacelle cuts, in.
TOT	Weight summary data (refer to Table 24)
WTCN	Nacelle panel weights within nacelle segments, lb
WTFN	Nacelle frame weights within nacelle segments, lb
WTLN	Nacelle load redistribution member weights within nacelle segments, lb

### Labeled Common Arrays

(IP(70)	Print/no print indicator 0 = print nacelle geometry and weight data (Figure 35) 1 = do not print
XMISC(85)	Alphanumeric case title
XMISC(100)	

\*\*\* NACELLE GEOMETRY - SECTION DATA \*\*\*

LIP TYPE = 1 SHAPE CODE = 1

CUT	STA.	DEPTH	WIDTH	PER.	NO	RO	MC	AU	RL	BS	RCU	RCS
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	100.0	110.0	170.0	420.0	55.0	0.0	50.0	100.0	100.0	110.0	0.0	0.0
3	200.0	110.0	114.0	440.0	50.3	4.7	52.3	112.0	112.0	100.0	1134.6	1054.6
4	300.0	110.0	140.0	400.0	34.0	21.0	53.0	130.0	130.0	101.0	377.9	197.4
5	400.0	110.0	160.0	520.0	39.7	16.3	67.7	161.0	161.0	103.0	659.3	266.4
6	500.0	110.0	160.0	520.0	39.7	16.3	67.7	161.0	161.0	103.0	659.3	266.4
7	600.0	110.0	170.0	520.0	25.9	29.1	60.4	166.5	166.5	97.5	308.6	130.0
8	700.0	106.0	192.0	530.0	26.2	26.8	64.2	170.5	170.5	94.5	444.5	133.0
9	800.0	02.0	107.0	500.0	10.0	29.0	63.0	170.0	170.0	00.0	422.0	01.4

CUT	STA.	FR.SP.	FR.MT.	COVER
1	0.0	0.0	0.0	0.0320
2	100.0	10.00	93.72	0.0426
3	200.0	10.00	93.60	0.0426
4	300.0	10.00	109.40	0.0425
5	400.0	10.00	740.00	0.0425
6	500.0	10.00	157.71	0.0425
7	600.0	10.00	47.51	0.0424
8	700.0	20.00	21.04	0.0021
9	800.0	20.00	20.16	0.0011

SEG	LENGTH	AREA	WT COVER	WT FP	WT LONGERON
1	100.00	19300.00	0.0	0.0	0.0
2	00.00	30700.00	263.62	843.34	0.0
3	230.00	105000.00	719.78	2336.49	0.0
4	160.00	95176.00	575.11	2953.11	0.0
5	1.00	570.00	3.50	19.89	0.0
6	126.00	66520.00	452.07	1292.00	0.0
7	204.00	107016.00	1075.64	595.98	0.0
8	77.00	39655.00	517.04	00.05	0.0
TOTAL	1007.00	463303.00	3611.64	0122.53	0.0

Figure 35. Sample output from NACELE of nacelle detail geometry and weight data (IP(70)).

## Mass Storage File Records

Read by routine:

Records 109 through 117

Written by routine:

None

## Error Messages

None

## SUBROUTINE NCLGEO

### General Description

Deck name: NCLGEO  
Entry name: NCLGEO  
Called by: NACELE  
Subroutines called: None

This routine calculates shape parameters at the nacelle cuts, and length and surface area for segments bounded by cuts. These calculations are based on a family of shapes that may be defined by straight lines and circular arcs.

Data input to this routine consist of depth, width, and either perimeter or perimeter correction factor at as many as 10 nacelle stations. The first cut describes geometry at the inlet leading edge, and the last cut describes geometry at the last full nacelle section. Perimeter code, KCN, is used to designate whether the perimeter or perimeter correction factor is defined. If KCN is 1, the perimeter is input at the cuts. If KCN is 2, the perimeter correction factor is input data, and the perimeter is calculated and substituted for the correction factors.

For one-dimensional leading edges, the single dimension is described at the first cut; the perimeter or perimeter correction factor is not input for this station. The second cut describes the first complete nacelle section. The surface area for this segment is not calculated, since it is already accounted for in the duct calculations.

### Arrays and Variables Used

D Constants (refer to Table 11)  
DATN Nacelle geometry and design data (refer to Table 14)  
KCN Nacelle perimeter code  
    1 = perimeter input  
    2 = perimeter correction factor input  
NCN Number of input nacelle cuts

### Arrays and Variables Calculated

BLN Lower sector nacelle panel peripheral length at cuts, in.  
BSN Side sector nacelle panel peripheral length at cuts, in.  
BUN Upper sector nacelle panel peripheral length at cuts, in.  
DATN(61)- Nacelle perimeter at cut, in., calculated when perimeter  
DATN(70) Correction factor input  
DLXN Nacelle segment lengths between cuts, in.  
DON Vertical flat length of nacelle contour at cuts, in.  
IGN Nacelle leading-edge-type indicator  
    0 = complete section  
    1 = vertical lip  
    2 = horizontal lip  
RCLN Lower sector nacelle panel radius of curvature at cuts, in.  
RCSN Side sector nacelle panel radius of curvature at cuts, in.  
RCUN Upper sector nacelle panel radius of curvature at cuts, in.  
RON Corner radius of nacelle contour at cuts, in.  
S Intermediate calculations  
SFN Surface area of nacelle segments, in.<sup>2</sup>  
WON Horizontal flat length of nacelle contour at cuts, in.

### Labeled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

●WARNING FROM NCLGEO IN AIR INDUCTION SYSTEM  
NACELLE LIP GEOMETRY ERROR

The foregoing message is printed when a one-dimensional leading edge is indicated by zero in input location DATN(961) and neither depth or width are

defined for the leading edge station. Unit inertias are calculated for this segment, assuming a horizontal lip-type configuration.

- WARNING FROM NCLGEO IN AIR INDUCTION SYSTEM  
SECTION XX IS RECTANGLE OR ROUNDED RECT. CORRECTION IS Y.YYY

The foregoing warning message appears when the program encounters some difficulty in fitting the shape, based on input geometry. XX locates the cut at which the difficulty occurred, and Y.YYY is the scaling factor applied to depth and width. The perimeter is assumed to be the independent variable and is not revised. Should the scaling factor indicate a significant revision, input data should be examined for possible errors.

## SUBROUTINE MISCOM

### General Description

Deck name: MISCOM  
Entry name: MISCOM  
Called by: AISMN  
Subroutines called: None

This subroutine is called to calculate weight and balance data for miscellaneous nacelle and engine section components. Following is a list of components which are considered in this routine.

Engine mounts  
Duct by pass doors  
Auxiliary inlet doors  
Engine removal doors  
Miscellaneous access doors  
Firewall  
Nacelle exterior finish  
Engine compartment shroud

Statistical equations and rule-of-thumb methods are used to compute weight and balance data for all of the foregoing items. Engine mounts calculations are performed for all propulsion system arrangements. Tests are made to determine whether calculations for the other components are required.

### Arrays and Variables Used

D Constants (refer to Table 11)  
DATD Duct geometry and design data (refer to Table 12)

DATN	Nacelle geometry and design data (refer to Table 14)
DATS	Air induction system, nacelle, and engine section design data (refer to Table 16)
DOD	Vertical flat length of duct contour at cuts, in.
DON	Vertical flat length of nacelle contour at cuts, in.
EQU	Equation and physical constants (refer to Table 17)
NC	Number of input duct cuts
ROD	Corner radius of duct contour at cuts, in.
RON	Corner radius of nacelle contour at cuts, in.
TOT(12)	Nacelle surface area per nacelle, in. <sup>2</sup>
WOD	Horizontal flat length of duct contour at cuts, in.
WON	Horizontal flat length of nacelle contour at cuts, in.

### Arrays and Variables Calculated

NCN	Number of input nacelle cuts
S	Intermediate calculations
SUMM	Weight summary data (refer to Table 20)
WTAI	TOT(41), weight auxiliary inlets per nacelle, lb
WTBP	TOT(42), weight duct by pass doors per nacelle, lb
WTED	TOT(43), weight engine removal doors per nacelle, lb
WTEF	TOT(47), weight engine mounts per nacelle, lb
WIEM	TOT(40), weight engine mounts per nacelle, lb
WIFW	TOT(45), weight firewall per nacelle, lb
WIMD	TOT(44), weight miscellaneous doors per nacelle, lb
WISD	TOT(46), weight engine compartment shroud per nacelle, lb

### Labeled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

None

## SUBROUTINE PYLONS

### General Description

Deck name: PYLONS  
Entry name: PYLONS  
Called by: AISMN  
Subroutines called: None

This subroutine is called to calculate weight and balance data for pylons and nacelle attach fittings. Separate weight calculations are performed for inboard and outboard pylons should they exist. Attach fitting weights are calculated for the nacelle and content inertia loads. Centers of gravity for these components are based on engine center of gravity and pylon span and sweep angle.

### Arrays and Variables Used

D Constants (refer to Table 11)  
DATN Nacelle geometry and design data (refer to Table 14)  
DATS Air induction system, nacelle, and engine section design data (refer to Table 16)  
EQU Equation and physical constants (refer to Table 17)  
SUM(22) X-CG of inboard engine mounts relative to inlet leading edge, in.  
TMS Material properties (refer to Table 23)  
TOT Weight summary data (refer to Table 24)

### Arrays and Variables Calculated

IF4 Material properties file record number  
S Intermediate calculations  
SUM Weight summary data (refer to Table 20)  
WFTI TOT(53), weight inboard fittings per nacelle, lb  
WFTO TOT(54), weight outboard fittings per nacelle, lb  
WPI TOT(51), weight inboard pylons per nacelle, lb  
WPO TOT(52), weight outboard pylons per nacelle, lb

### Labeled Common Arrays

None

## Mass Storage File Records

Read by routine:

Record 109

Written by routine:

None

## Error Messages

None

## SUBROUTINE SUMMARY

### General Description

Deck name:           SUMARY  
Entry name:           SUMARY  
Called by:            AISMN  
Subroutines called:  None

This subroutine performs computations which summarize weight and balance data for the air induction system, nacelle, and engine section structure. These summary results are printed as shown in Figures 3, 4, and 5.

Data provided to this routine are for component details in the inlet coordinate system. These detail data are combined to account for the proper number of items, such as number of ramps or nacelles, and to compute required balance data in the vehicle coordinate system. Summary results are organized for transfer to the labeled common array FDAT by module control routine, AISMN.

### Arrays and Variables Used

DATR       Ramp geometry and design data (refer to Table 15)  
DATS       Air induction system, nacelle, and engine section  
           design data (refer to Table 16)  
IVG        Inlet type indicator  
           1 = fixed duct  
           2 = fixed spike

3 = horizontal ramp  
4 = vertical ramp  
5 = translating spike  
6 = translating and expanding spike  
SUMM Weight summary data (refer to Table 20)  
TOT Weight summary data (refer to Table 24)

Arrays and Variables Calculated

S Intermediate calculations  
SUMM Weight summary data (refer to Table 20)

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

None

## Section IV

### REFERENCES

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5. Bruhn, E. F., Analysis and Design of Flight Vehicle Structures, Tri State Offset Company, Ohio, 1965
6. Crosthwait, E. L., Kennon, I. G. Jr., and Roland, H. L., "Preliminary Design Methodology For Air-Induction Systems", SEG-TR-67-1, Air Force Systems Command, WPAFB, Ohio, 1967
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APPENDIX A  
AIR INDUCTION SYSTEM MODULE  
FLOW CHARTS AND  
FORTRAN LISTS

## APPENDIX A

### AUTOFLOW DESCRIPTION

The AUTOFLOW documentation system is a series of software packages owned and maintained by Applied Data Research, Inc. Rockwell International has leased a software system for use in producing flow charts on their IBM 370 system. The flow charts are drawn on a CRT, and a photograph is taken and printed on paper by Microfilm Services.

Because the AUTOFLOW system used is IBM-oriented, the function of the BUFFERIN and BUFFEROUT statements is not recognized, but these statements appear in proper order in note boxes. Also, the PROGRAM name does not appear on the main program, and library routines REALMS and WRITMS are listed as undefined external references.

The AUTOFLOW product requested for this present document includes the listing, a cross-reference list, and the flow charts.

#### LISTING

AUTOFLOW produces an 80-column listing of all the cards in the program. The cards are sequenced and grouped by routine.

#### CROSS-REFERENCE LIST

This list is broken into two parts.- procedural statements and nonprocedural statements. The procedural statements cross-reference list gives the interconnections which will appear on the flow charts. The presentation lists the following from left to right:

- The card identification from columns 73 through 80 of this card, or card sequence number. When sequence number is used in place of card identification, it is enclosed in parentheses.
- The page and box number where this card is displayed in a flow chart.
- The FORTRAN statement number from columns 1 through 5 of this card.
- The card identification from columns 73 through 80 of the card referring to this card, or sequence number.
- The page and box number where the card referring to this card is displayed in a flow chart.

(The last two items are repeated for each reference until the list is exhausted.)

Those cards which are not referred to in the procedural list are listed between the flow charts. Typical in the lists are type statements, dimension statements, equivalence statements, common block statements, format statements, and data statements. This comprises the nonprocedural statements used in FORTRAN.

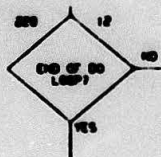
## FLOW CHARTS

The flow charts produced by AUTOFLOW use USASI conventional symbols. Since the flow charts are mechanically drawn from the program source deck, there are no omissions or vague generalizations about the processing within the boxes.

Every box on each page is uniquely numbered and may be referred to from elsewhere in the program. The source of a reference to a box will be indicated by showing the page and box number. If the number is followed by an asterisk, there are multiple references to this point, and the others may be found by using the cross-reference list.



The most-often-used symbol is the decision box. Like all boxes, its box number is above and to the right of the box. Its FORTRAN statement number is above and to the left of the box. The decision choices for the paths are printed.



The unconditional transfer connector has its page number destination printed above or to the left of the box number destination within the connector. If there is a FORTRAN statement number at the destination, it is printed below the connector.



The exit box example shows a connector from page 9, box 15.



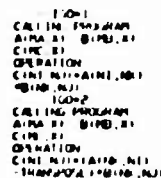
The subroutine call box includes the calling sequence. The page and box numbers of the flow chart of the called subroutine are shown on the left-hand side of the box. The page number is above the box number.



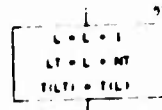
The note box encloses comments of a functional nature,



as differentiated from the 21 column comments, which are left justified without a box, that show the comment cards included in the FORTRAN deck.



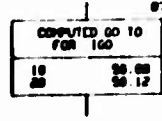
The process box is used to enclose FORTRAN arithmetic statements.



Input and output are shown as communicating with a device. The list used follows, if appropriate:



The computed  $\overline{M} \overline{N}$  becomes a branch table showing the page and box number of each of the ordered branches.



The column connectors and initial connectors are the only boxes without external box numbers. The function of the initial connector is always clear, but the label given is the symbol in the next FORTRAN card, which is often blank.



The column connector identifies the page and box number to which it connects.



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FORTRAN MOBILE AIR INDUCTION SYSTEM MOBILE

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(00000)	0.04	1010	(00000)	2.03	(00000)	2.03
(00000)	0.05		(00001)	2.05		
(00001)	0.05	00				
(00002)	0.05	40				
(00004)	0.11	0003				
(00010)	0.21	0004	(00003)	0.10		
(00010)	0.24	00				
(00012)	0.25	00	(00012)	0.23		
(00012)	0.25	07				
(00012)	0.24	100	(00012)	0.23	(00012)	0.23
(00012)	0.25	101				
(00012)	0.25	102	(00012)	0.24	(00012)	0.24
(00012)	0.11		(00012)	0.20		
(00012)	0.13	140				
(00012)	0.13		(00012)	0.14		
(00014)	0.01	200	(00012)	0.23	(00012)	0.23
(00014)	0.02	200	(00012)	0.23	(00012)	0.14
(00014)	0.04	310				
(00014)	0.05	300	(00014)	0.23		
(00014)	0.07	370				
(00014)	0.08	400	(00014)	0.20		
(00015)	0.10	1010	(00012)	0.27		
(00015)	0.10	1020	(00014)	0.14	(00014)	0.14

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(00017)	0.01	00000	(00073)	00.00-X		
(00018)	0.02	10	(00018)	0.01		
(00018)	0.03		(00001)	0.05		
(00000)	0.04	10				
(00001)	0.05	10	(00018)	0.03		
(00002)	0.05	20	(00018)	0.01		
(00004)	0.07		(00001)	0.10		
(00000)	0.08	20	(00004)	0.07		
(00011)	0.09	34	(00000)	0.05		
(00017)	0.10	20				
(00018)	0.11	20	(00011)	0.00		
(00000)	0.01	20	(00000)	0.05		
(00018)	0.02	100	(00004)	0.07		
(00003)	0.04	101				
(00000)	0.05	102	(00002)	0.03		
(00021)	0.05	100				
(00020)	0.05	1000	(00027)	0.05		
(00020)	0.11	110	(00020)	0.07		
(00042)	0.13	111				
(00043)	0.14	112	(00041)	0.12		
(00044)	0.15	114				
(00045)	0.15	115	(00043)	0.14		
(00051)	0.10	200	(00010)	0.11	(00010)	0.04
(00050)	10.01	200	(00050)	0.00		
(00050)	10.03	200				
(00071)	10.04	200	(00027)	10.00		
(00000)	10.05	210	(00000)	10.00		
(00070)	10.05	204	(00071)	10.04		
(00070)	10.07	200	(00003)	0.00	(00000)	10.00
(00070)	10.08		(00000)	11.00	(00003)	11.00
(00000)	10.10	200			(00000)	11.00
(00000)	10.11	200				
(00004)	10.12	270	(00000)	10.13		
(00000)	10.13	200	(00001)	10.00		

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000008	11.01	200	(000000) 10.03
000009	11.02	207	(000000) 11.01
000010	11.03	200	(000000) 11.01
000075	11.04	002	(000071) 10.04
000011	11.05	204	(000000) 10.13
000012	11.06	200	(000000) 10.12 (000000) 10.14

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000040	14.02		(000000) 10.17
000060	14.03	10	(000040) 14.04
000080	15.01	20	(000040) 14.04
000100	15.02	22	(000040) 15.01
000120	15.03	24	
000140	15.07	50	(000062) 14.08 (000000) 15.04 (000000) 15.05 (000000) 16.04 (000071) 16.05
000160	16.01	20	(000024) 15.01
000180	16.02	22	(000000) 16.01
000200	16.03	24	
000220	16.07	40	(000000) 16.01
000240	16.10	42	
000260	16.12	50	(000000) 15.07
000280	16.13	00	
000300	16.15	00	(000000) 15.07 (000000) 16.12
000320	16.17	200	(000077) 16.00 (000070) 16.11
000401	16.18		(000400) 17.01
000402	17.01	210	
000403	17.03	2000	
000404	17.16	000	(000400) 17.02

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000412	20.02	120	
000413	20.04	140	(000404) 20.01
000414	20.05	150	(000407) 20.03
000415	20.07		(000407) 20.00
000416	20.08	170	
000417	20.10		(000070) 21.13
000418	20.11	200	
000419	20.15	220	(000071) 21.12
000420	20.16	240	(000071) 21.12
000421	20.20	260	(000074) 20.14 (000000) 20.17
000422	20.22		(000070) 21.11
000423	20.25	440	
000424	20.27	410	(000000) 20.04
000425	21.01	400	(000000) 20.05
000426	21.03		(000000) 21.01
000427	21.05		(000000) 21.03
000428	21.06		(000000) 21.05
000429	21.10	440	
000430	21.11	500	(000000) 21.00
000431	21.13	000	(000071) 21.12
000432	21.14		(000000) 21.10
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(00007)	24.02	130	
(00007)	24.03	140	(00025) 24.01
(00007)	24.04	200	(00025) 24.02
(00007)	24.05		(00004) 25.21
(00007)	24.06	310	
(00007)	24.10	320	(00074) 24.08
(00007)	24.12	330	
(00007)	24.14	340	(00074) 24.11
(00007)	24.17		(00003) 24.15
(00007)	24.20		(00000) 24.10
(00007)	24.22		(00007) 24.20
(00007)	24.23	300	(00003) 25.20
(00007)	24.27		(00007) 24.25
(00007)	25.01		(00000) 25.11
(00007)	25.03		(00007) 25.01
(00071)	25.04	300	(00003) 25.20
(00000)	25.08		(00070) 25.08
(00000)	25.09	300	(00000) 24.22 (00000) 24.27
(00000)	25.11	302	
(00000)	25.13	304	(00000) 25.10
(00000)	25.18	300	(00000) 25.03
(00000)	25.16		(00000) 25.14
(00000)	25.18		(00001) 25.16
(00003)	25.20		(00000) 25.10
(00004)	25.21	400	

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(00075)	28.04		(00070) 28.10
(00075)	28.05	10	
(00075)	28.07	20	(00070) 28.05
(00075)	28.11	200	
(00075)	28.12	250	(00070) 28.10
(00075)	28.01	300	(00073) 28.11 (00070) 28.08 (00070) 28.11
(00075)	28.02	310	
(00075)	28.03	400	(00070) 28.12 (00070) 28.01 (00070) 28.12
(00075)	28.07	410	
(00075)	28.08	420	
(00075)	28.09	430	(00074) 28.07
(00075)	28.11	440	
(00075)	28.12	450	(00070) 28.10
(00075)	28.13	460	(00073) 28.05 (00070) 28.10
(00075)	28.14	401	
(00075)	28.18	500	(00075) 28.05 (00070) 28.13
(00000)	28.22		(00004) 30.01
(00004)	30.01	502	
(00010)	30.04	503	
(00070)	30.21	67	
(00017)	30.23	80	(00004) 30.05
(00030)	30.24	504	(00000) 30.03

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(00007)	33.01	BUCKET	(00070) 28.10-X
(00077)	33.02	10	(00070) 33.01 (00070) 33.01
(00000)	33.04		(00001) 35.05
(00001)	33.05	12	
(00004)	33.07	20	(00070) 33.01 (00070) 33.01 (00070) 33.01 (00070) 33.01
(00000)	33.08	30	
(00001)	33.11	100	(00000) 30.05
(00000)	33.12		(00001) 34.10

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(00008)	23.17	116	
(00003)	24.01	122	(00001) 23.14
(00004)	24.02	124	
(00005)	24.03	126	
(00006)	24.04	128	(00001) 23.14 (00004) 24.02 (00008) 23.16 (00007) 23.16 (00009) 23.17 (00003) 24.01
(00010)	24.05	130	
(00011)	24.07	132	
(00013)	24.09	170	(00008) 24.05
(00016)	24.09	300	(00010) 24.05
(00021)	24.10	400	(00017) 24.12

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(00002)	27.03	10	
(00007)	27.05		(00073) 27.06
(00073)	27.06	50	
(00077)	27.11		(00000) 27.12
(00000)	27.12	52	
(00002)	27.14		(00000) 27.16
(00000)	27.16	54	
(00000)	27.16		(00002) 27.20
(00002)	27.20	70	
(00004)	27.23		(00000) 27.24
(00000)	27.24	72	
(00000)	27.26		(00101) 27.27
(00101)	27.27	80	
(00103)	27.28		(00101) 28.01
(00104)	27.28		(00100) 27.28
(00100)	27.28	800	
(00101)	28.01	800	
(00102)	28.03		(00101) 28.05
(00101)	28.05	700	
(00101)	28.05		(00107) 28.11
(00107)	28.11	800	
(00100)	28.13	80	
(00104)	28.17	84	(00100) 28.12

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(00100)	41.05	2	
(00100)	41.07	3	
(00100)	41.09	4	(00100) 41.05
(00100)	41.09		(00101) 41.10
(00101)	41.10	5	
(00104)	41.12	100	(00100) 41.04 (00107) 41.07
(00100)	41.13	102	
(00100)	41.15	103	
(00100)	41.15	120	(00107) 41.14
(00100)	41.15	123	
(00104)	41.20	124	(00100) 41.17
(00117)	41.23		(00100) 41.24
(00100)	41.24	126	
(00100)	41.25	200	(00104) 41.12 (00100) 41.15 (00100) 41.16
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(00100)	42.01	205	
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(001137)	42.05	200	(001123) 41.25 (001127) 41.20
(001142)	42.06		(001145) 42.09
(001146)	42.09	401	
(001148)	42.12		(001151) 42.13
(001151)	42.13	402	
(001154)	42.16		(001157) 42.17
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(001160)	42.19		(001162) 42.21
(001162)	42.21	500	

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(001181)	45.01	100	
(001182)	45.02		(001183) 45.03
(001183)	45.03	101	
(001186)	45.04	102	
(001187)	45.05		(001188) 45.06
(001188)	45.06	103	
(001200)	45.08	31	
(001201)	45.09	32	
(001207)	45.10	104	(001188) 45.07
(001208)	45.11		(001211) 45.14
(001210)	45.13	107	
(001211)	45.14	110	
(001217)	45.19	108	(001200) 45.12
(001219)	45.22	109	(001210) 45.13 (001216) 45.16
(001221)	45.24		(001222) 45.25
(001222)	45.25	121	
(001225)	45.29		(001226) 45.30
(001226)	45.30	122	
(001229)	45.31	120	(001200) 45.08
(001230)	45.32	127	(001200) 45.18
(001241)	45.35	121	
(001242)	45.37	122	(001240) 45.35
(001244)	45.39	123	
(001246)	45.40	124	(001243) 45.38
(001247)	45.42	125	
(001248)	45.43	126	(001246) 45.41
(001253)	46.01	140	
(001256)	46.03		(001255) 46.04
(001258)	46.04	141	
(001260)	46.06	142	(001302) 46.25
(001262)	46.07	143	
(001266)	46.08		(001262) 46.20
(001273)	46.09	144	
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(001289)	46.19	148	(001287) 46.17
(001292)	46.20	150	(001288) 46.18
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(001300)	46.24		(001301) 46.25
(001301)	46.25	152	
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(00124)	40.04	30	(00123)	40.01	
(00125)	40.05	40	(00123)	40.01	
(00125)	40.08	105	(00124)	40.03	(00124) 40.05
(00125)	40.10	107			
(00127)	40.14	100			
(00127)	40.15	101			
(00128)	40.20	203			
(00128)	40.22		(00128)	40.25	
(00128)	40.25	204			
(00127)	40.25	205			
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(00140)	02.01	MEMLI	(00124)	3.01-E	
(00140)	02.02		(00127)	04.17	
(00140)	02.03		(00140)	04.05	
(00140)	02.04	10			
(00140)	02.07		(00142)	02.05	
(00140)	02.08	20	(00142)	02.05	
(00140)	02.09	22			
(00147)	02.10		(00140)	02.11	
(00140)	02.11	04			
(00140)	02.12	20	(00140)	02.09	
(00140)	02.10	100	(00144)	02.07	
(00140)	02.15		(00140)	02.13	
(00140)	02.16		(00140)	04.02	
(00140)	02.18	40			
(00147)	02.19	30	(00140)	02.17	
(00140)	02.20	22			
(00140)	02.21	04	(00140)	02.20	(00140) 02.20
(00140)	02.22	20	(00140)	02.01	
(00140)	02.01	70	(00147)	02.10	
(00140)	02.02	110	(00140)	02.10	(00140) 02.22
(00140)	02.04	113			
(00140)	02.05	114	(00140)	02.03	
(00147)	02.09	118	(00140)	02.04	
(00147)	02.11	120			
(00140)	02.14	127	(00147)	02.10	
(00140)	02.16	130	(00140)	02.21	
(00140)	02.18		(00140)	02.19	
(00140)	02.19	151			
(00140)	02.21	160			
(00140)	02.22	162			
(00147)	04.01	200			
(00140)	04.02	204	(00140)	02.02	(00140) 02.02 (00140) 02.21 (00140) 02.02 (00140) 02.20 (00140) 02.01
(00140)	02.22		(00140)	02.22	
(00140)	04.03	200	(00140)	02.11	
(00140)	04.03	210			
(00147)	04.03		(00140)	04.11	
(00140)	04.11	200			
(00141)	04.12	200	(00140)	04.04	
(00147)	04.17	400			

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(00138)	07.04	100	(00138)	07.02	
(00137)	07.05	100			

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(001976)	07.09	000	(001976)	07.07	
(001981)	07.10	000	(001976)	07.08	
(001982)	07.11	000			
(001988)	07.13	000	(001976)	07.09	(001981) 07.10
(001988)	07.14	000	(001988)	07.13	
(001981)	07.15	000	(001988)	07.13	
(001983)	08.01	000	(001981)	07.15	
(001988)	08.03	000			
(001988)	08.04	000	(001984)	08.02	
(001801)	08.05	001	(001803)	08.07	
(001802)	08.07	002			
(001804)	08.08	004	(001801)	08.08	
(001822)	08.15	000	(001820)	08.14	
(001829)	08.17	002			
(001829)	08.18	000	(001824)	08.18	
(001832)	08.20	000	(001831)	07.18	(001829) 08.14

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(001763)	01.08		(001768)	03.08	
(001767)	01.12	10			
(001768)	01.13	12	(001767)	01.12	
(001711)	02.01	00	(001767)	01.12	
(001713)	02.02	02	(001711)	02.01	
(001717)	03.01	00	(001711)	02.01	
(001718)	03.02	00	(001718)	01.13	(001718) 02.02
(001768)	03.04	02			
(001768)	03.06	00	(001718)	03.03	
(001768)	03.08	100	(001768)	01.11	(001721) 03.05
(001731)	03.11		(001732)	03.12	
(001732)	03.12	110			
(001734)	03.13	100			
(001738)	03.14		(001767)	08.08	
(001737)	03.15	130	(001738)	03.14	
(001738)	03.16	132			
(001738)	03.17	138			
(001742)	03.18	137			
(001744)	03.20	140	(001737)	03.15	
(001745)	03.21	141	(001747)	03.02	
(001746)	03.22	142			
(001748)	04.01	144	(001748)	03.21	
(001751)	04.03	145			
(001752)	04.04	146	(001750)	04.02	
(001753)	04.05	147			
(001754)	04.06	148	(001752)	04.04	
(001758)	05.01	180	(001758)	03.14	
(001763)	05.02	000	(001741)	03.18	(001743) 03.18 (001767) 04.07
(001764)	05.03	210			
(001768)	05.05	211			
(001767)	05.06	212	(001768)	05.04	
(001770)	05.10		(001771)	05.08	
(001773)	05.11	230	(001763)	05.02	
(001774)	05.12	202			
(001776)	05.13	204			
(001778)	05.14	208			
(001782)	05.16	200	(001774)	05.12	(001776) 05.13
(001784)	05.17	202	(001782)	05.16	
(001788)	05.01	200	(001782)	05.16	
(001782)	05.03	200	(001788)	05.17	
(001788)	05.05	200	(001778)	05.15	(001788) 05.04
(001767)	05.08	200	(001788)	03.18	(001773) 05.11 (001788) 05.18 (001783) 05.04
(001803)	05.09		(001812)	05.13	
(001812)	05.13	202			

(001010)	00.10	(001010)	00.10
(001000)	00.10 0001		
(001040)	00.10 0002	(001010)	00.10

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE RELEASE

(001004)	00.01 RELEASE	(001000)	01.00-X
(001070)	00.02 10	(001077)	00.01
(001000)	00.03	(001002)	00.00
(001001)	00.04 12		
(001002)	00.05 10	(001000)	00.03
(001004)	00.05 00	(001077)	00.01
(001000)	00.07	(001041)	70.01
(001007)	00.08 20	(001000)	00.07
(001002)	00.09 24	(001007)	00.00
(001000)	00.10 20		
(001007)	00.11 20	(001002)	00.00
(001000)	70.01 20	(001007)	00.00
(001001)	70.02 100	(001000)	00.07
(001000)	70.04 101		
(001010)	70.05 100	(001004)	70.00
(001013)	70.06 100		
(001017)	70.08 1000	(001000)	70.00
(001021)	70.11 110	(001012)	70.07
(001004)	70.13 111		
(001000)	70.14 110	(001023)	70.10
(001000)	70.16 114		
(001007)	70.16 110	(001000)	70.14
(001004)	70.19 110		
(001041)	70.21 000	(001000)	00.11
(001040)	71.01 000	(001043)	70.03
(001040)	71.03 010		
(001000)	71.04 000	(001047)	71.00
(001002)	71.05 000	(001043)	70.03
(001000)	71.06	(001040)	71.00
(001000)	71.07 200	(001000)	71.07
		(001001)	70.01
		(001003)	70.10

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE FREIGHT

(001000)	74.01 FREIGHT	(000100)	3.00-X
(001000)	74.03	(000017)	74.13
(001000)	74.07 10		
(000007)	74.08 00	(001000)	74.00
(000000)	74.11 20		
(000017)	74.13 40	(000000)	74.10
(000002)	74.10 40		
(000000)	74.10 44		
(000000)	74.10 40	(000002)	74.10
(000001)	74.02 00	(000004)	74.17
(000004)	74.03 70	(000000)	74.01
(000000)	74.24 0001		
(000044)	74.00 0000	(000004)	74.00

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE PYLENS

(000000)	77.01 PYLENS	(000047)	4.07-X
(000074)	77.02 10	(000070)	77.01
(000070)	77.03 00		

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(00000)	77.00 00	(000070)	77.00		
(00000)	77.00 000	(000070)	77.01	(000077)	77.04 (000070) 77.00
(00000)	77.00 014				
(000007)	77.11	(000000)	77.12		
(00000)	77.12 010				
(000007)	77.10 000				
(000101)	77.21 000	(000110)	77.20		
(000100)	77.20 000				
(000104)	77.24 004	(000100)	77.02		
(000107)	77.00 000	(000000)	77.10		
(000111)	70.01 070	(000100)	77.04		
(000117)	70.00 000	(000110)	70.02		
(000103)	70.00 000				
(000104)	70.07 004	(000100)	70.00		
(000100)	70.00 000	(000110)	70.02		

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE RAPP

(000137)	01.01 RAPP	(000130)	3.00-1		
(000004)	01.00 0001				
(000010)	01.00	(000030)	02.00		
(000012)	01.07 01				
(000013)	01.00 010				
(000010)	01.00 03	(000011)	01.00		
(000017)	01.10 011				
(000002)	01.11 00	(000010)	01.00		
(000023)	01.12 012				
(000000)	01.13 00	(000002)	01.11		
(000000)	01.14 013				
(000010)	02.01 04	(000010)	01.00		
(000010)	02.02 040				
(000004)	02.00 07	(000002)	01.11		
(000000)	02.04 070				
(000030)	02.00 00	(000000)	01.10		
(000030)	02.00 00	(000011)	01.00	(000010) 01.00 (000011) 02.00 (000017) 01.10 (000000) 01.12 (000000) 01.13	
(000030)	02.00 100	(000017)	01.07	(000017) 01.10 (000000) 01.12 (000000) 01.14 (000000) 02.01	
		(000004)	02.00	(000017) 01.10 (000000) 01.12 (000000) 01.14 (000000) 02.01	
(000000)	02.12 0002				
(000004)	02.10	(000000)	02.10		
(000000)	02.10 001				
(000000)	02.10 000	(000004)	02.10		
(000070)	02.21 101				
(000070)	02.22 100	(000000)	01.01	(000077) 02.00	
(000070)	02.24 401	(000077)	02.20		
(000077)	03.01 010	(000000)	03.00		
(000000)	03.04 402	(000077)	02.20		
(000000)	03.00 400	(000077)	02.20		
(000000)	03.00 400	(000004)	02.04	(000001) 02.04	
(000001)	03.07 000	(000000)	03.00		
(000400)	03.10 000	(000077)	02.02	(000011) 02.00 (000001) 04.00 (000000) 01.10 (000000) 04.00	
(000013)	04.01 002	(000011)	03.00		
(000017)	04.07 004	(000470)	03.11		
(000000)	04.00 000	(000470)	03.11		
(000000)	04.00 012	(000077)	03.03		
(000000)	04.07 014	(000470)	03.11		
(000000)	04.11 010	(000000)	04.10		
(000070)	04.12 010	(000470)	03.11		
(000077)	04.10 000	(000470)	03.11		
(000000)	04.10 040	(000000)	03.00		
(000400)	04.10 040	(000000)	04.10		
(000400)	04.20 044	(000470)	03.11		
(000400)	04.24 040	(000001)	04.20		
(000407)	03.01 040	(000470)	03.11		
(000400)	03.00 000	(000400)	03.04		
(000400)	03.00 000	(000470)	03.11		
(000400)	03.01 000	(000400)	03.10		
(000401)	03.00 004	(000470)	03.11		

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(002470)	00.00	010	(002219) 04.01 (002444) 00.00
(002472)	00.10	010	(002400) 00.10
(002470)	00.12	000	(002320) 04.00
(002400)	00.14	000	(002400) 00.10
(002407)	00.00	000	(002400) 00.10
(002003)	07.01	000	(002400) 00.10
(002000)	07.03	070	(002001) 00.01
(002000)	07.10	0000	
(002000)	07.17	010	(002007) 00.07
(002001)	00.01	000	(002007) 00.07
(002002)	00.00	000	(002070) 07.00
(002010)	00.14	0007	
(002037)	00.01	400	(002400) 00.10
(002001)	00.10	410	(002070) 00.14
(002000)	00.21	400	(002070) 00.14
(002710)	00.27	430	(002007) 00.00
(002742)	00.07	0000	
(002700)	00.14	000	(002007) 07.00

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SIGNATURE SPAL

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(000012)	04.02		(000004) 00.02
(000013)	04.03	4	
(000010)	04.04	0	(000012) 04.02
(000017)	04.00	10	(000010) 04.00
(000021)	04.00	12	
(000023)	00.01	10	(000000) 04.07
(000024)	00.02	00	(000000) 04.00
(000027)	00.04		(000000) 00.00
(000000)	00.00	40	
(000000)	00.07		(000000) 00.10
(000000)	00.10	100	
(000041)	00.12		(000044) 00.10
(000044)	00.13	100	
(000040)	00.10		(000001) 00.02
(000000)	00.17	100	
(000003)	00.10	100	(000040) 00.10
(000000)	00.10	100	(000002) 00.17
(000000)	00.20	100	
(000000)	00.21	100	(000000) 00.10
(000001)	00.02	140	(000000) 00.00
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(000007)	00.00	100	
(000000)	00.27	100	
(000000)	00.00	100	
(000071)	00.01	100	(000000) 00.07
(000070)	00.02	170	(000070) 00.00
(000070)	00.00	170	
(000070)	00.04	170	(000070) 00.02
(000070)	00.00	170	(000074) 00.00
(000077)	00.00	170	
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(000000)	00.10	100	
(000010)	00.17	000	(000000) 00.00
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(000000)	00.00	000	(000000) 00.10
(000000)	00.00	000	(000004) 00.10
(000000)	00.00	000	(000000) 00.00

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100006	97.02	101	100004	97.04
100008	97.03	102		
100009	97.04	200	100007	95.25
100010	97.05	400	100008	95.32
100020	97.08		100009	97.11
100030	97.11	500		
100040	97.13	5001		
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CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

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100001	100.02	SPIKE	100011	9.01-2
100002	100.04	30		
100003	100.05	50	100005	100.05
100004	100.05	100	100006	100.05
100004	100.07	300	100008	100.05
100007	100.09	500	100001	100.01
			100005	100.05

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CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - DESCRIPTIVE SUMMARY

100017	103.01	SUMMARY	100016	9.00-2
100018	103.03	10	100014	103.02
100017	103.05	12		100.02
100001	103.06	50	100016	103.04
100003	103.08	52		
100005	103.09	30	100002	103.07
100009	103.11	50	100016	103.05
100004	103.12	70	100014	103.02
100008	103.15		100009	103.13
100009	103.17		100017	103.10
100011	103.18	75		
100015	104.01	50	100013	103.20
100016	104.02		100017	104.05
100017	104.03	55		
100001	104.05	100		
100002	104.05	110		
100004	104.06	300	100013	103.20
100007	104.11		100102	104.13
100102	104.13	210		
100103	104.16	212		
100103	104.17	214	100104	104.15
100103	104.19	200		
100110	104.21	300	100103	104.16
100110	104.23	302		
100110	104.24	310	100117	104.22
100100	104.25		100123	104.23
100102	104.27	312		
100103	104.28	300	100121	104.25
100103	104.30		100120	104.23
100127	104.32	300		
100100	104.33	300	100120	104.24
100120	104.35		100137	104.41
100124	104.38	304		
100125	104.39	300	100125	104.37
100126	104.40	300		
100127	104.41	400	100125	104.38
100100	105.10		100100	105.10
100100	105.21		100100	105.10
100100	105.24		100100	105.21
100000	105.30	5002		

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE TOPS

(002057)	100.01	30	(002051)	100.03	(002050)	100.05				
(002059)	100.02	TOPS	(002052)	05.07-II						
(002058)	100.04	10								
(002056)	100.05	20	(002051)	100.03						
(002055)	110.01	40	(002050)	100.05						
(002051)	110.02	50	(002050)	110.01	(002070)	111.03				
(002050)	111.01	55	(002050)	110.01						
(002057)	111.03	57								
(002071)	111.04	100	(002050)	100.01	(002053)	100.04	(002050)	110.02	(002050)	111.02
(002070)	111.05	110	(002070)	111.05						
(002070)	112.01	120	(002070)	111.05						
(002050)	112.02	125	(002070)	111.05	(002070)	112.01				
(002052)	112.03	140	(002070)	112.01						
(002054)	112.04	145	(002052)	112.03						
(002057)	113.01	160	(002050)	112.03						
(002050)	113.03	010								
(002052)	113.04	030	(002077)	111.05	(002051)	112.02	(002050)	112.04	(002050)	113.02

CHART TITLE - NON-PROCEDURAL STATEMENTS

CARD NO	PAGE/BOX	DIAGNOSTIC
(000004)	2.00	UNRECOGNIZED SWYAK
(000001)	3.00	UNDEF INED - 'LEASH' - EXTERNAL REFERENCE
(000100)	4.12	UNRECOGNIZED SWYAK
(001470)	00.00	UNDEF INED - 'LEASH' - EXTERNAL REFERENCE
(001042)	04.12	UNDEF INED - 'WRITH' - EXTERNAL REFERENCE
(001704)	04.00	UNDEF INED - 'LEASH' - EXTERNAL REFERENCE
(001000)	74.04	UNDEF INED - 'LEASH' - EXTERNAL REFERENCE
(000001)	77.14	UNDEF INED - 'LEASH' - EXTERNAL REFERENCE

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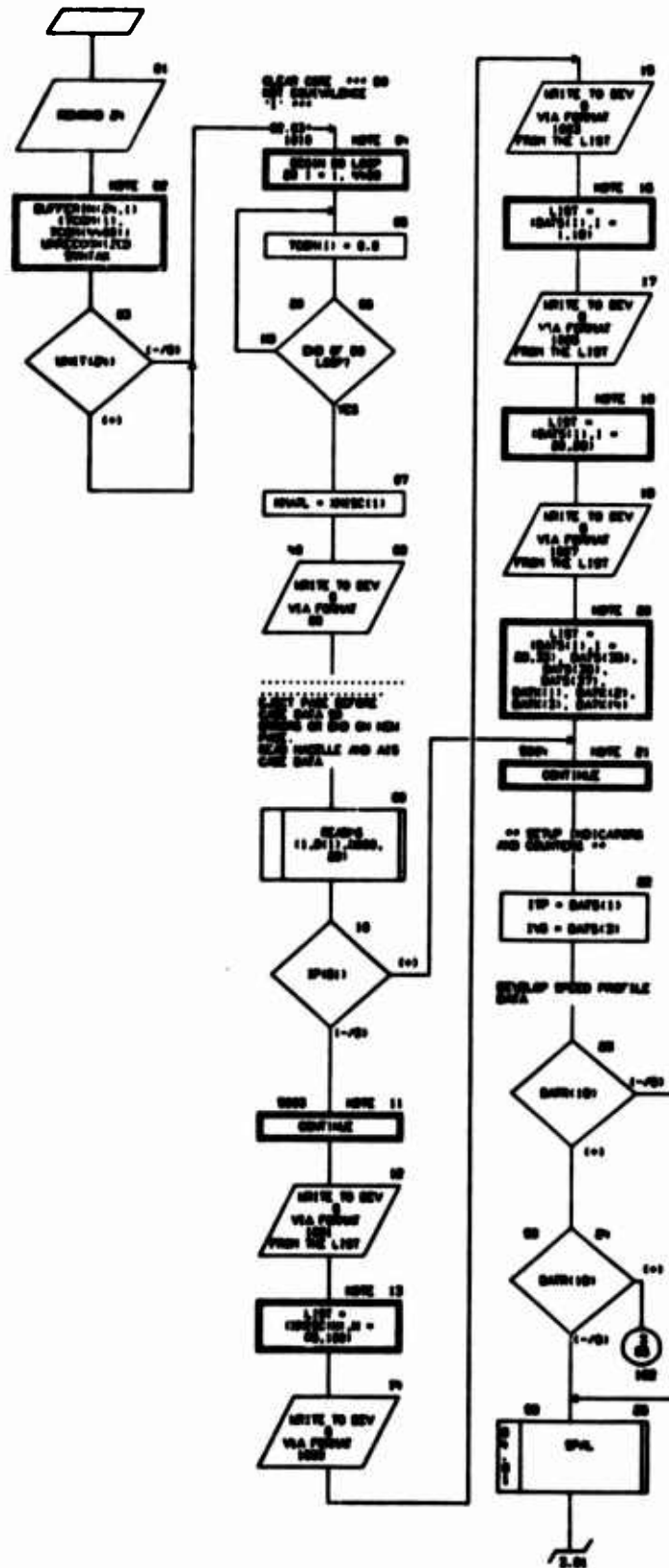
PROGRAM FLOW CHARTS  
OF  
AIR INDUCTION SYSTEM MODULE

CHART TITLE - INJECTION CONTROL

\*\*\*\*\*  
FUSION AIRS  
\*\*\*\*\*

\*\* AIR INJECTION SYSTEM, MANEUVER AND ENGINE SECTION  
CONTROL, REVERSE \*\*  
WRITTEN BY WARDEN 1078

QUARTER TITLE - PROCEDURES



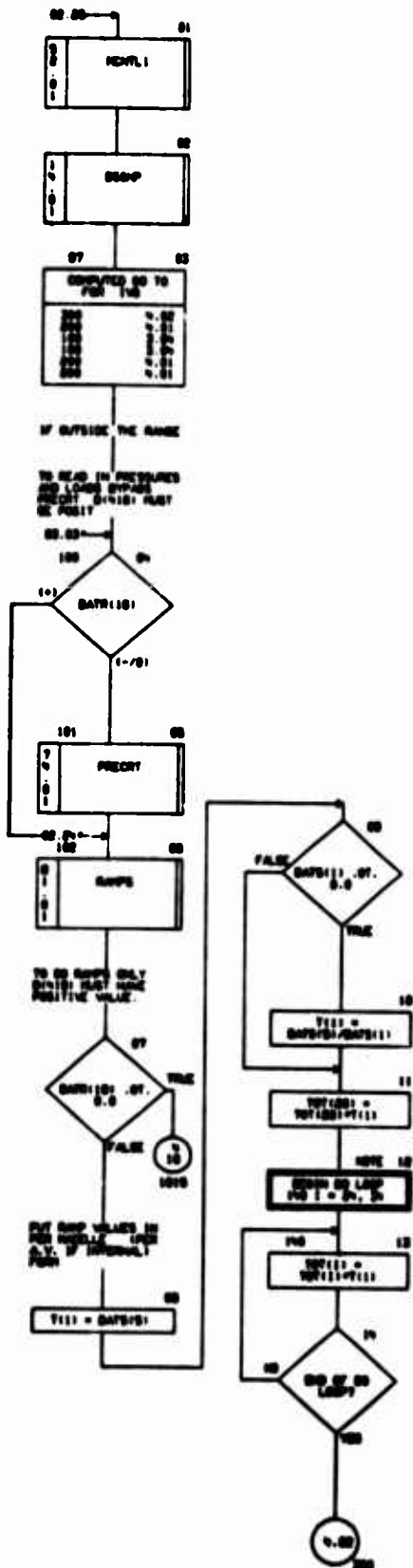
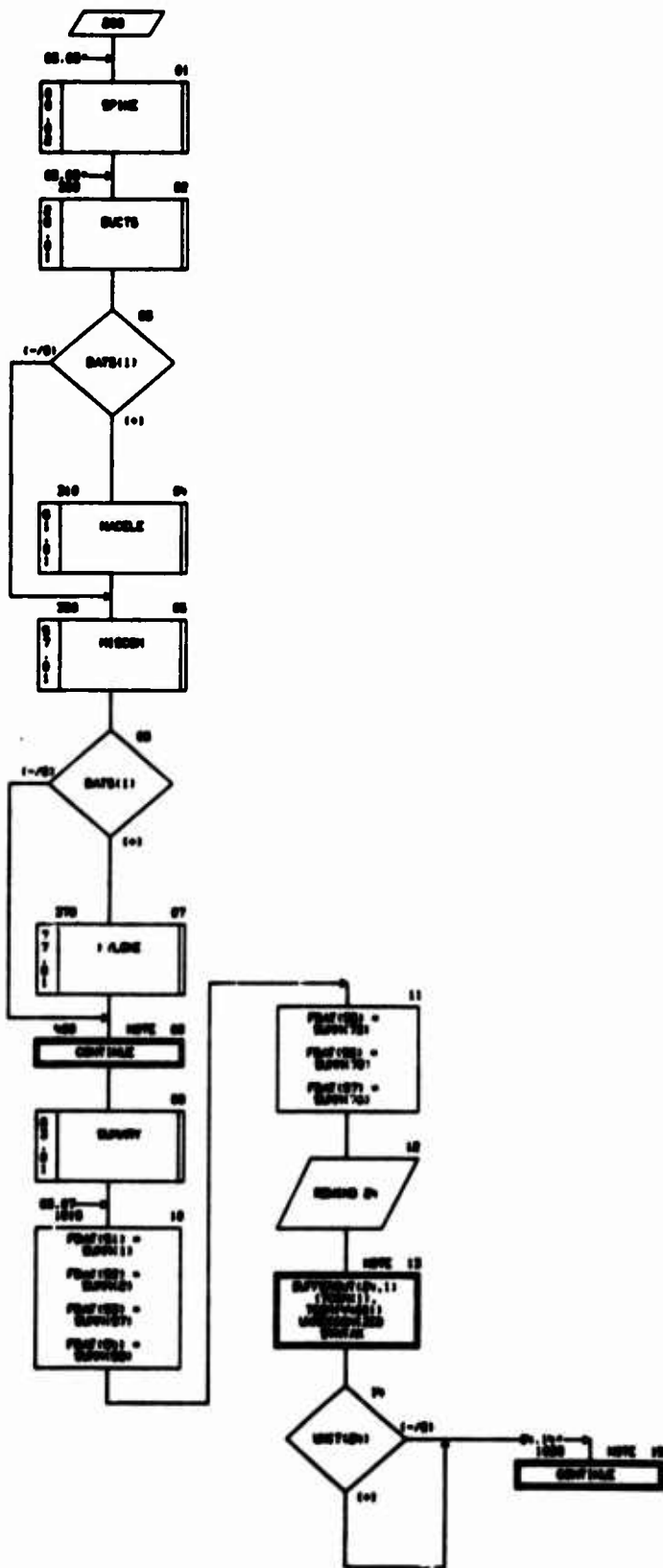


CHART TITLE - PROCEDURES



## CART TITLE - NON-PROCEDURAL STATEMENTS

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PROGRAM AISHN
COMMON TCDM(400)
COMMON /MISC/SHIC(100)
COMMON /SPRINT/ IP(100)
COMMON /DATA/ FDATA(100)
DIMENSION SUPM(200)
DIMENSION ID(2000),L(2000),SC(100),ND(200)
DIMENSION WD(200),RW(20)
DIMENSION DATS(40)
DIMENSION TOT(100)
DIMENSION DATR(120),DR(100)
DIMENSION DARR(10)
DIMENSION F(100)
DIMENSION ID(170),SUPM(1)
DIMENSION ID(1),TCDM(1),IT(1),TCDM(200),SC(1),TCDM(410),
ND(1),TCDM(80)
DIMENSION ID(20),DATS(1)
DIMENSION ID(40),DARR(1),ID(40),DR(1)
DIMENSION ID(27),DARR(1)
DIMENSION ID(77),F(1)
DIMENSION IT(10),TOT(1)
DIMENSION IT(100),TDM(1),TDM(20),RW(1)
DIMENSION ND(10),IPAGE)
DIMENSION ND(50),IPAR)
DIMENSION ND(10),IF1),ND(10),IF2),ND(10),IF3),ND(10),IF4)
DIMENSION ND(11),ITP),ND(11),ITB)
DIMENSION ND(11),IPWT)
00 FORMAT(1H)
1001 FORMAT(1H,END,END** AISHN - IP(10) **/END,END,END,END)
1000 FORMAT(1H, 40, 20-AIR INDUCTION SYSTEM DATA)
1000 FORMAT(1H,10-#PERCENT OF NEEDLES, YES, YES, YES /
1000 10-#SPARE RATIO, YES, YES, YES /
1000 07-#NO. OF FIXED DUCT 2-#FIXED SPIKE) /
1000 10-#VEHICLE TYPE (2-#VERT. RAMP 4-#VERT. RAMP), YES, YES, YES /
1000 07-#NO. OF TRAIL SPIKE 0-#NO. OF SPIKE) /
1000 10-#CAPTURE AREA FOR INLET, YES, YES, YES /
1000 10-#NUMBER OF INLETS FOR AIR VEHICLE, YES, YES, YES /
1000 10-#MIN. DISTANCE OF TRUCK FROM L.S. OF COIL OR LIP, YES, YES, YES /
1000 10-#NUMBER OF ENGINES, YES, YES, YES /
1000 10-#TRUCKS PER ENGINE, YES, YES, YES /
1000 10-#TRUCKS PER ENGINE, YES, YES, YES /
1000 10-#LENGTH OF ENGINE, YES, YES, YES /
1000 10-#DIAMETER OF ENGINE, YES, YES, YES /
1000 10-#ENGINE C.O., DISTANCE AFT OF FACE, YES, YES, YES /
1000 10-#ENR AT COIL OR LIP, SET 1, YES, YES, YES /
1000 10-#ENR AT ENGINE FACE, SET 1, YES, YES, YES /
1000 10-#ENR AT ENGINE FACE, SET 1, YES, YES, YES /
1000 10-#ENR AT COIL OR LIP, SET 2, YES, YES, YES /
1000 10-#ENR AT ENGINE FACE, SET 2, YES, YES, YES /
1000 10-#ENR AT ENGINE FACE, SET 2, YES, YES, YES )
1000 FORMAT(1H, 20-#MIN. SHEEP OF PULP, YES, YES, YES /
1000 10-#VEHICLE TYPE (0-#VERT. 1-#VERT.) 10-#PULP, YES, YES, YES /
1000 10-#MIN. SHEEP OF INBOARD PULP, YES, YES, YES /
1000 10-#MIN. SHEEP OF INBOARD PULP, YES, YES, YES /
1000 10-#MIN. SHEEP OF OUTBOARD PULP, YES, YES, YES /
1000 10-#MIN. SHEEP OF OUTBOARD PULP, YES, YES, YES /
1000 10-#PULP THICKNESS TO COIL RATIO, YES, YES, YES /
1000 10-#TRAIL INLET AREA FOR NEEDLE OR AIR VEHICLE,
YES, YES, YES /
1000 10-#DUCT SPARE AREA FOR NEEDLE OR AIR VEHICLE, YES, YES, YES )
1007 FORMAT(1H, 20-AREA OF MISCELLANEOUS BORDS, YES, YES, YES /
1007 10-#BORDER INDICATORS-#0,1-YES-CALC,AT 1-#BORDER AREA,
YES, YES, YES /

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GAWT TITLE - NON-PROBABLE STATEMENTS

- MIN. ENGINEERING NUMBER FOR SUCTS. YES. F0.1 /
- MIN. ENGINEERING NUMBER FOR SUCTS. YES. F0.1 /
- MIN. ENGINEERING NUMBER FOR SUCTS. YES. F0.1 /
- MIN. ENGINEERING NUMBER (11-1000, 2-1000, 3-1000, ... 9-1000),  
YES. F0.1 /
- MIN. ENGINEERING ACCELERATION, YES. F11.3 /
- MIN. ENGINEERING LOAD FACTOR, YES. F10.2 /
- MIN. ENGINE FACTOR...SUCTS-/F0.2, 2-1000-/F0.2, 3-1000-,  
F0.2, 4-1000-/F0.2 /

02/05/79

AUTOFLON CHART SET - BEEP AIR INJECTION SYSTEM MODULE PAGE 07

CHART TITLE - INTRODUCTION CONTENTS

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SUBROUTINE CONTENTS  
oo



CHART TITLE - BUBBLYTIME 02700

02700

08.08 →

WRITTEN 23 MARCH 1976  
BY [unclear] SGT

STEP INDICATORS AND

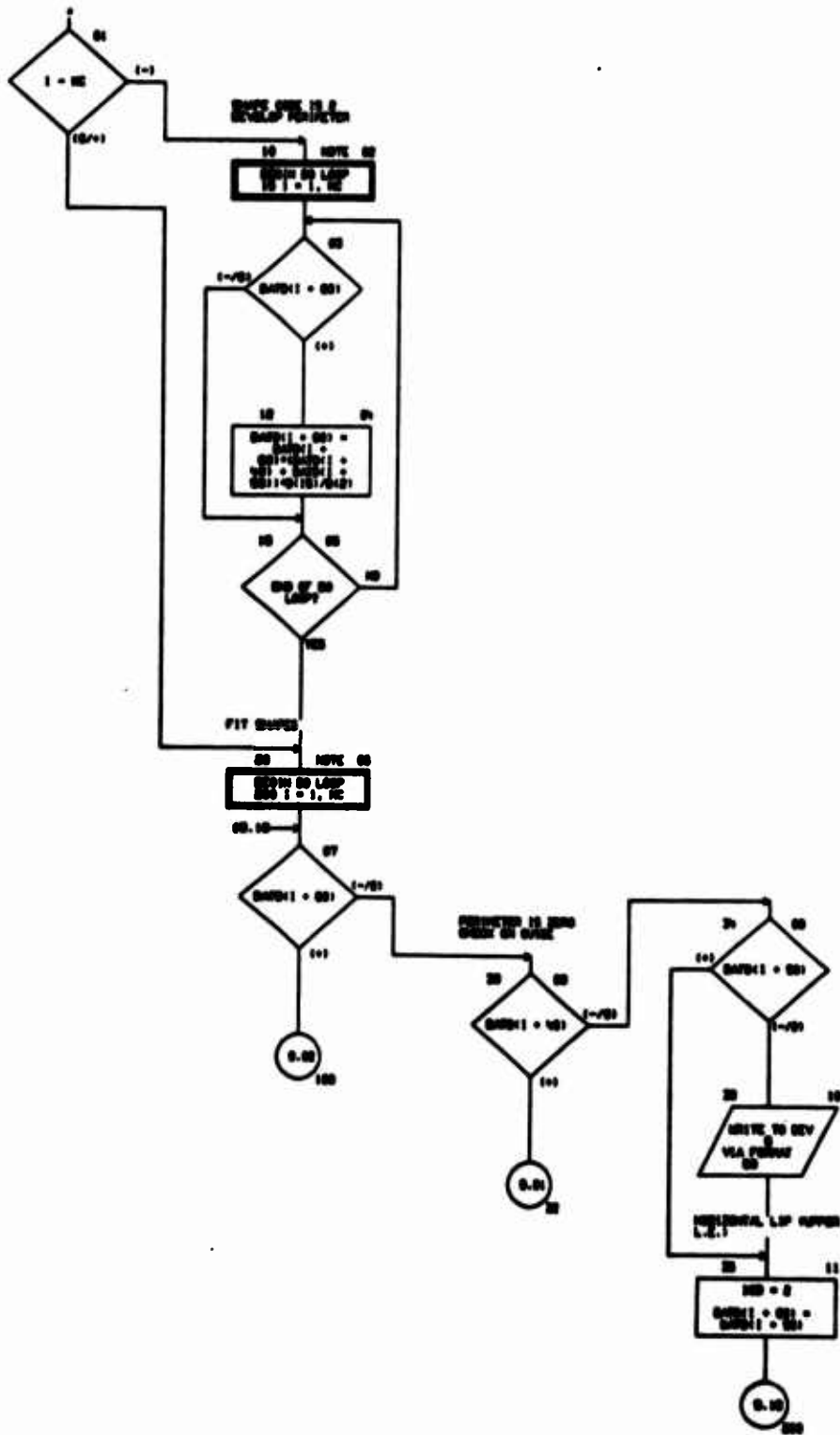
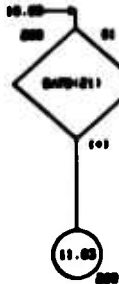




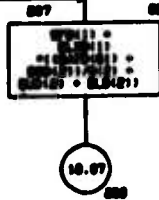


CHART TITLE - SUBROUTINE CRJ200

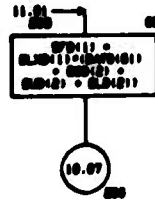
END OF 10.07  
NO INJECTS FOR  
NOZZLE



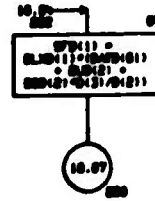
FOR VERTICAL LIP  
CALCULATE LIP  
INJECTS AND  
VERTICAL LIP



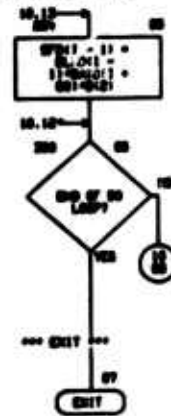
NO INJECTS FOR  
NOZZLE



NO INJECTS FOR  
NOZZLE



CRJ200 TRANSITION ONE  
EXIT OCCURS FOR



GAUGE TITLE - NON-PRESSURE STATEMENTS

```

GIVEN T0000001
DIMENSION D10001, T10001, DC11001, ND10001
DIMENSION D100101
DIMENSION D11001
DIMENSION ND1101, JND1101, SD1101, LD1101, RD1101, DD1101
DIMENSION LD1101, JFD1101
DIMENSION ND111, T000111, T111, T00010011, DC111, T00010111,
ND111, T00010011
DIMENSION ND1201, D100111
DIMENSION T111, D111
DIMENSION T1201, JND111, T1001, JND111, T1001, SD111,
T101, LD111, T1001, LD111, T1001, SD111
DIMENSION T1001, LD111, T1001, JFD111
DIMENSION ND1001, J1, ND1001, J1
DIMENSION ND1101, J0, ND1101, J0, ND1101, J0
00 PERMIT VARIATIONS FROM SETTED IN AIR INDUCTION SYSTEM / SON,
CORRECT LIP GEOMETRY ERROR )
00 PERMIT VARIATIONS FROM SETTED IN AIR INDUCTION SYSTEM / INK,
THECTION, 112, ND1 IS RECTABLE OR RELATED RECT., CORRECTION IS
MFD.3 )

```

CONTENTS - INTRODUCTORY COMMENTS

.....  
CONTENTS  
.....



CHART TITLE - SUBROUTINE DEEP

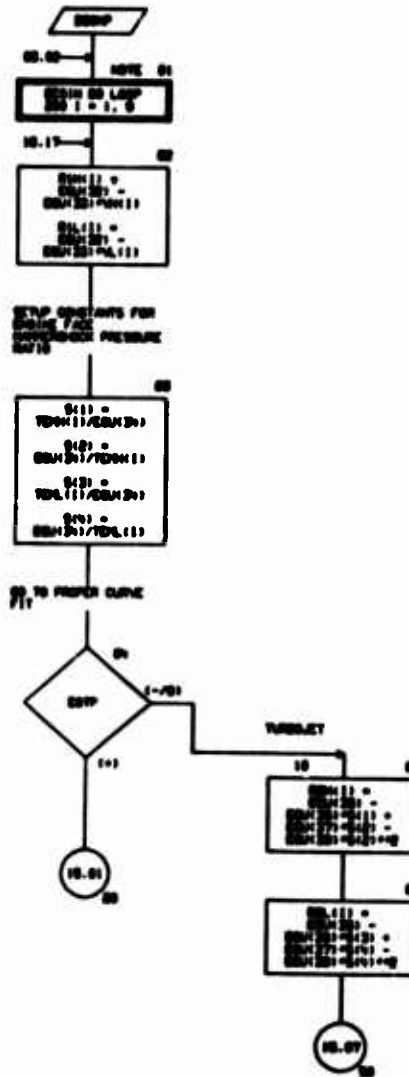


CHART TITLE - SUBROUTINE 040P

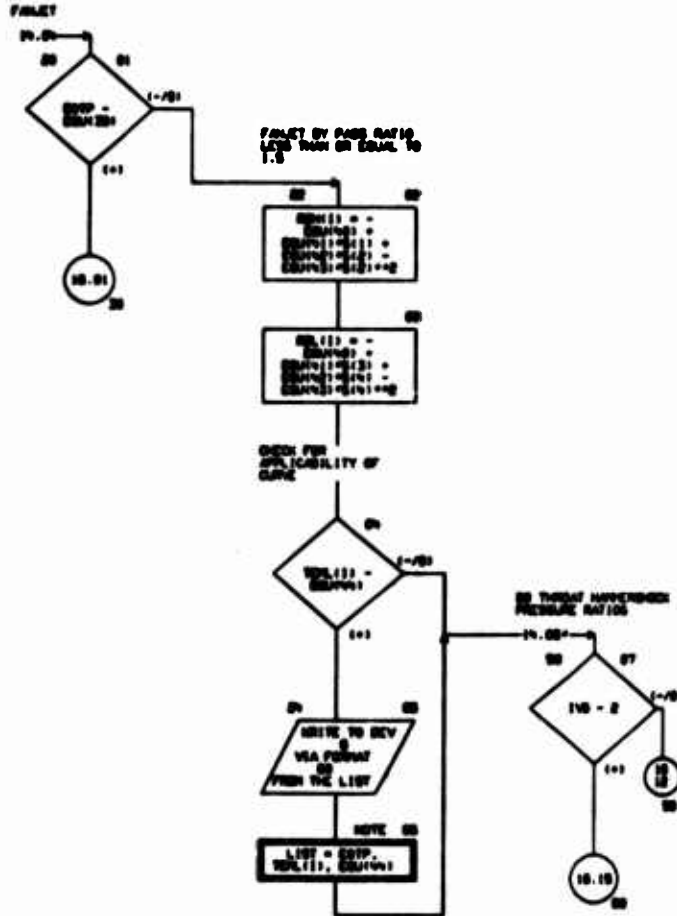


CHART TITLE - SUBROUTINE 080P

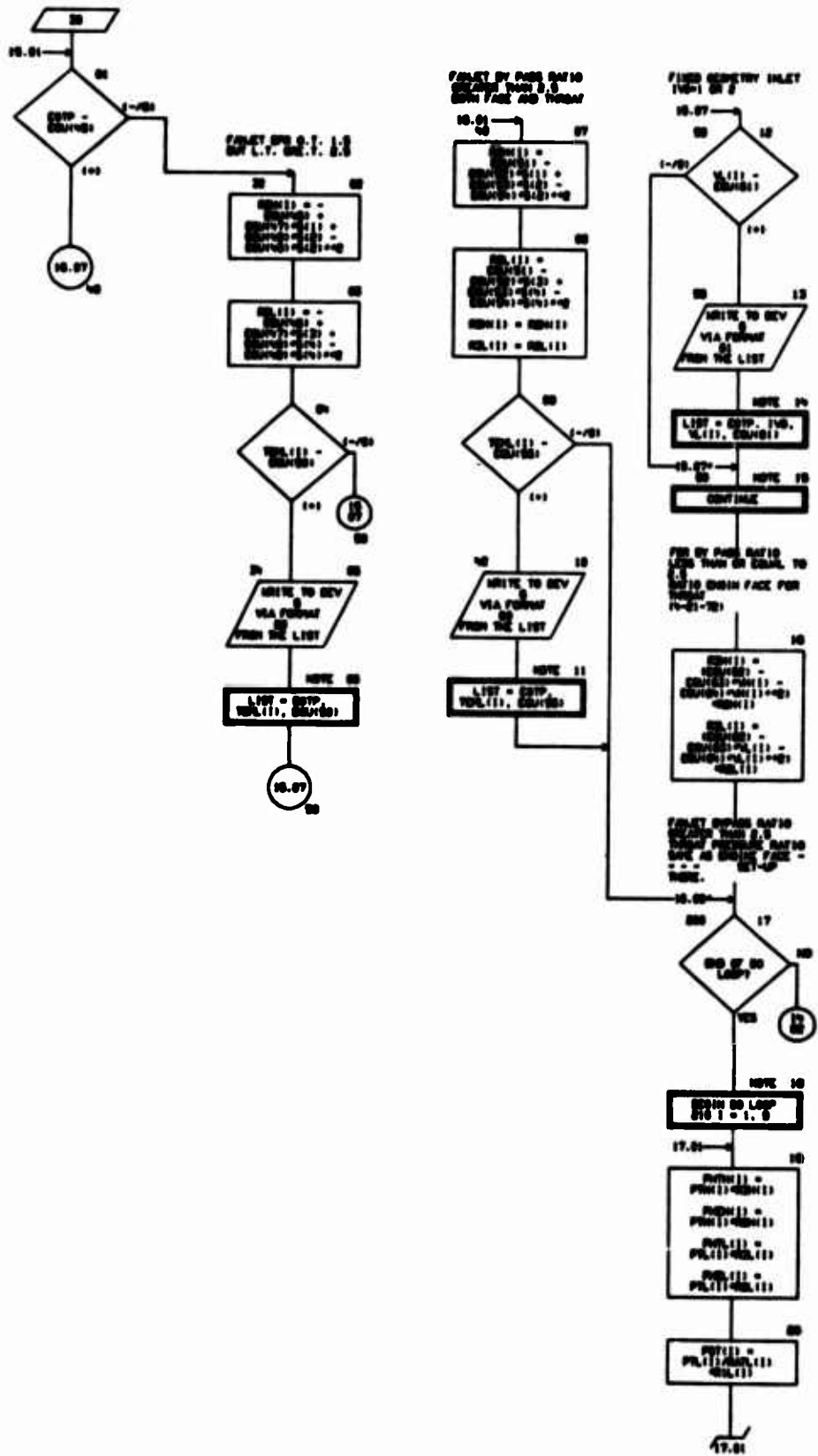
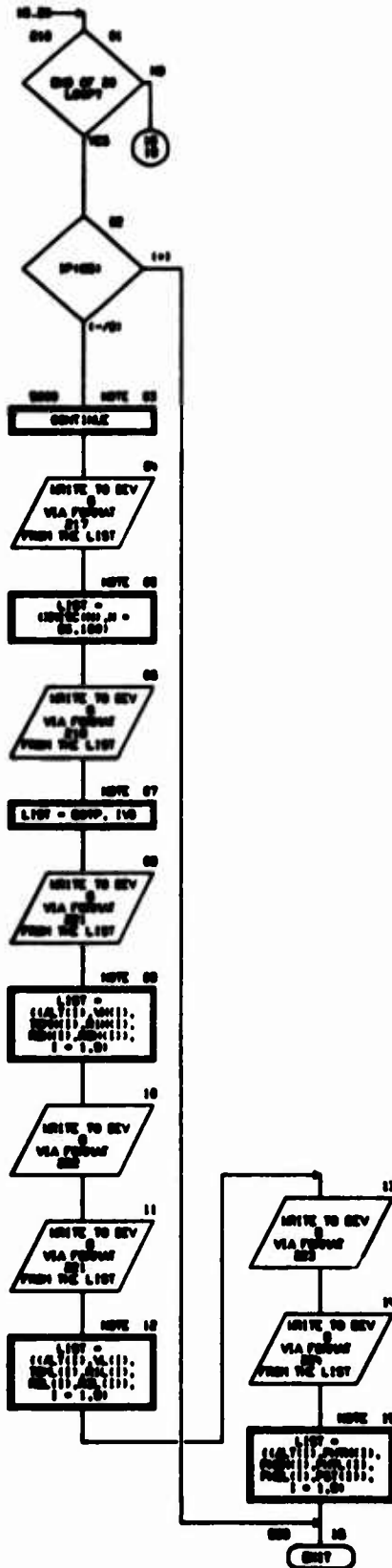


CHART TITLE - SUBROUTINE GSDP



GART TITLE - NON-FEDERAL STANDARDS

```

GIVEN TONV400
GIVEN AWC/ INSC100
GIVEN /FRMT/ SP00
GIVENEN (1000),T1000),SC100),M1000)
GIVENEN AL100)
GIVENEN      GEM000),
G100),      GAF040),
M100),      M100),          TON100),
TDL100),    PRM100),      PL100),
PL100),     RUM100),      RL100),
RM100),     REL100),      RM100),
RL100),     PRM100),      RMN100),
PRL100),    PFC100),      PFT100),
, RAL100)
GIVENEN TITLE100)
GEMVALUE (G100),TON100),T100),TONM000),SC100),TONM100),
M100),TONM000)
GEMVALUE      G100),P1),      G100),GEM100),
G100),GAF100),      G100),G0TP)
GEMVALUE:(G100),TITLE100)
GEMVALUE (T100),G100)
GEMVALUE      (T000),M100),      (T070),M100),
(T100),TON100),      (T100),TDL100),      (T100),PRM100),
(T100),PL100),      (T100),PL100),      (T100),RUM100),
(T100),RL100),      (T100),RM100),      (T100),REL100),
(T100),RM100),      (T100),REL100),      (T100),PRM100),
(T100),RMN100),      (T100),PRL100),      (T100),PFC100),
(T100),PFT100),      (T100),RAL100)
GEMVALUE (T100),AL100)
GEMVALUE (M100),PAGE)
GEMVALUE (M100),1),M100),J)
GEMVALUE (M100),100), M100),SP00)
00  FORMATTING,EN,EN*** WARNING MESSAGE ***/EN,
    QMAN TEMPERATURE CHECKED FOR FAULT SP = /S.1/100,
    ISMAN TDP = /S.2,RLIMIT = /S.3)
01  FORMATTING,EN,EN*** WARNING MESSAGE ***/EN,
    QSPED CHECKED FOR DYNAMIC SILEY CONDITIONS,
    QSP = /S.1,EN,ISMILEY TYPE = /S.2,THE SPEED = /S.3,EN,
    ISLIMIT SPEED = /S.3)
017 FORMATTING,SAID,EN,EN** GSEP - SP00) **/12,SAID)
018 FORMATTING, EN, IMPRES PROFILE DESIGN CONSTANTS,
    / MD, EN, IMPRES RATIO =, W/S.2, EN, DMV =, I12 /
    MD, VUL, SWDPM, EN, DYNAMIC, LEN, ISMANVERDICK EN /
    MD, DULT, IEN, DM, EN, IMPRES RATIO, EN, IMPRES. RATIO,
    EN, WFACE, I12, OTHERS )
021 FORMATTING, EN, W13.1, W14.2, W17.3, W18.4 )
022 FORMATTING,VN,SWDPM,EN, DYNAMIC,LEN, ISMANVERDICK G1) /
    MD, DULT, IEN, DM, EN, IMPRES RATIO, EN, IMPRES. RATIO,
    EN, WFACE, I12, OTHERS )
023 FORMATTING, EN, T0RESM, EN, T0RESM, EN, T0RESL), EN,
    T0RESL), IEN, DYNAMIC / EN, IMPRES-PSIA, EN,
    IMPRES-PSIA, EN, IMPRES-PSIA, EN, IMPRES-PSIA, EN,
    IMPRES T0RES )
024 FORMATTING, EN, W13.1, W18.3, W18.3)

```

CHART TITLE - INTRODUCTORY COMMENTS

.....  
AIRFLOW CHART SET  
.....



GURT TITLE - SUBROUTINE SUCTRN

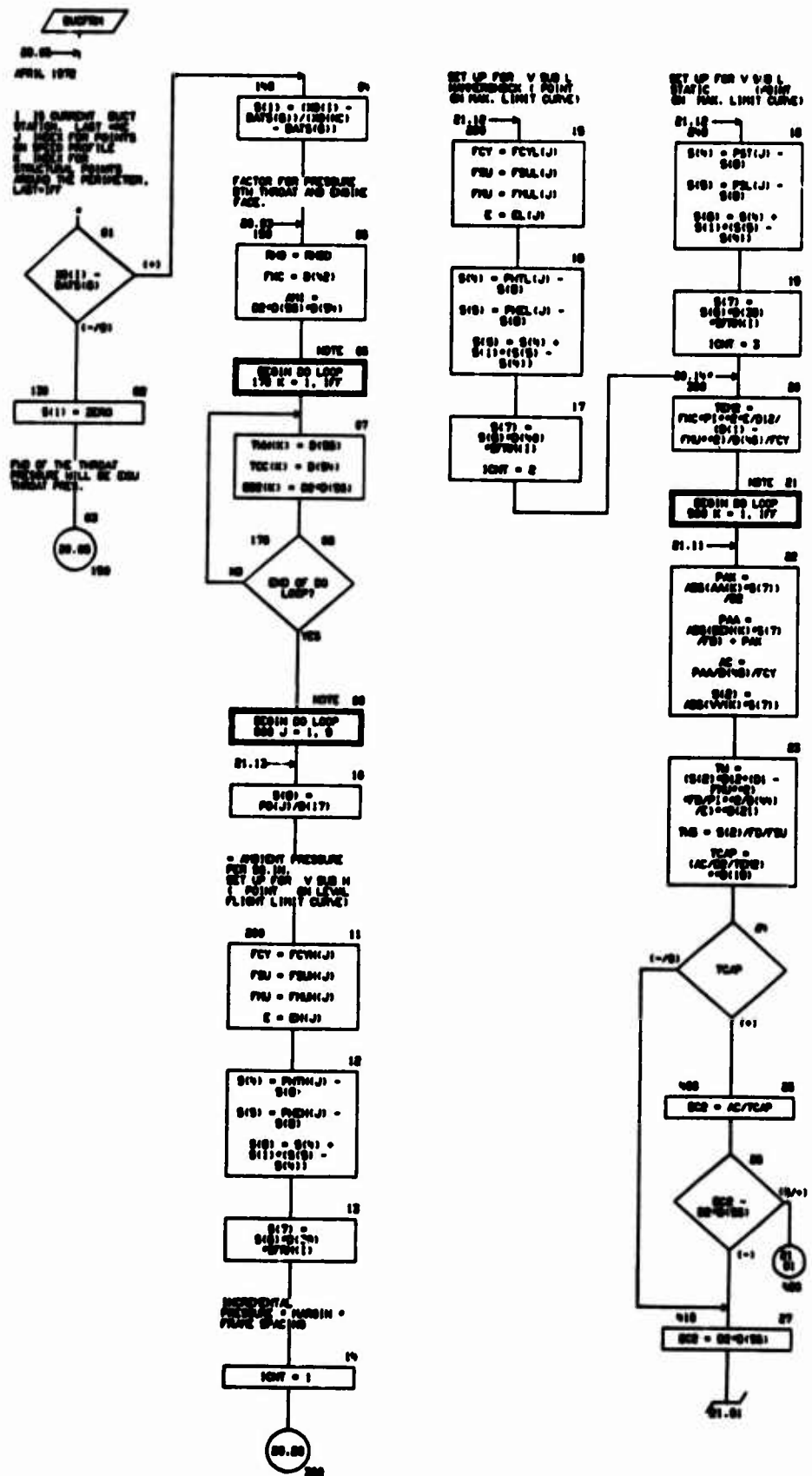
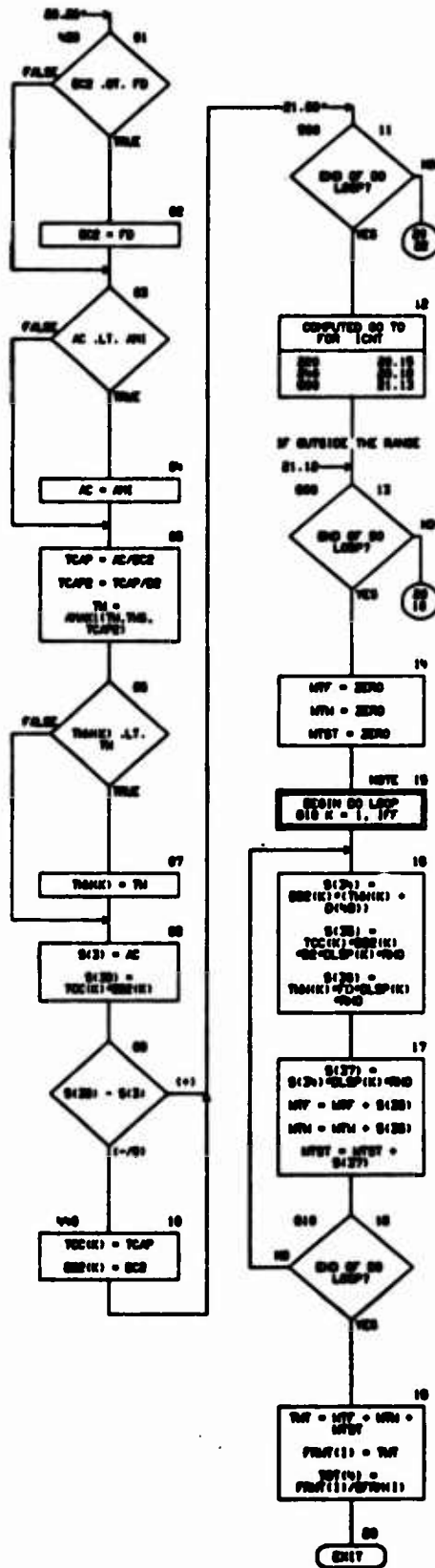


CHART TITLE - SUBROUTINE 040P01



DURT 117.2 - NON-PROCEDURAL STATEMENTS

```

GIVEN TORN400)
DIMENSION S(2000),T(2000),ZC(100),JD(100)
DIMENSION S(100)
DIMENSION TOT(100),SPRN(10),FBR(10)
DIMENSION ALD(40), SLP(100), SDH(20), VV(20),
AA(20), TAD(20), TCC(100), SD(100)
DIMENSION DAT(40), DAD(100), SD(10)
DIMENSION FCY(10), FCY(10), FPM(10), FBA(10),
FPM(10), FAL(10), SH(10), SL(10)
DIMENSION PD(10), PL(10), PTH(10), PDK(10),
PRL(10), PHL(10), PST(10)
EQUIVALENCE (H(1),TORN(1)),(T(1),TORN(20)),(C(1),TORN(10)),
(H(1),TORN(20))
EQUIVALENCE (H(1),S(1), (H(2),S(2),
(H(3),S(3), (H(4),S(4), (H(5),S(5),
(H(6),S(6), (H(7),S(7), (H(8),S(8),
(H(9),S(9), (H(10),S(10), (H(11),S(11),
(H(12),S(12), (H(13),S(13), (H(14),S(14),
EQUIVALENCE (S(20),DAT(1)), (S(21),DAT(1)),
(S(22),S(1))
EQUIVALENCE (T(1),S(1)), (T(100),ALD(1))
EQUIVALENCE (S(4),F(4), (S(47),F(7),
(S(48),F(8), (S(49),F(9), (S(50),F(10),
(S(51),F(11), (S(52),F(12), (S(53),F(13),
(S(54),F(14), (S(55),F(15), (S(56),F(16),
(S(57),F(17), (S(58),F(18), (S(59),F(19),
(S(60),F(20), (S(61),F(21), (S(62),F(22),
(S(63),F(23), (S(64),F(24), (S(65),F(25),
(S(66),F(26), (S(67),F(27), (S(68),F(28),
(S(69),F(29), (S(70),F(30),
EQUIVALENCE (ALD(1),SLP(1)), (ALD(6),SDH(1)),
(ALD(12),VV(1)), (ALD(18),AA(1))
EQUIVALENCE (T(10),TOT(1)),(T(70),SPRN(1)),(T(74),FBR(1))
EQUIVALENCE (T(42),PD(1)), (T(43),PL(1)),
(T(44),PTH(1)), (T(47),PDK(1)), (T(48),PRL(1)),
(T(49),PHL(1)), (T(50),PST(1)), (T(51),FCY(1)),
(T(52),FCY(1)), (T(53),FPM(1)), (T(54),FBA(1)),
(T(55),FPM(1)), (T(56),FAL(1)), (T(57),SH(1)),
(T(58),SL(1)), (T(70),RSD)
EQUIVALENCE (T(100),TAD(1)), (T(170),TCC(1)),
(T(101),SD(1))
EQUIVALENCE (H(10), I), (H(100), J),
(H(105), K), (H(110), L), (H(115), M)
EQUIVALENCE (H(120),TAD)

```

CHART TITLE - INTRODUCTORY COMMENTS

.....  
SUBROUTINE SUCPA  
.....



DUET TITLE - SUBROUTINE SUCPL

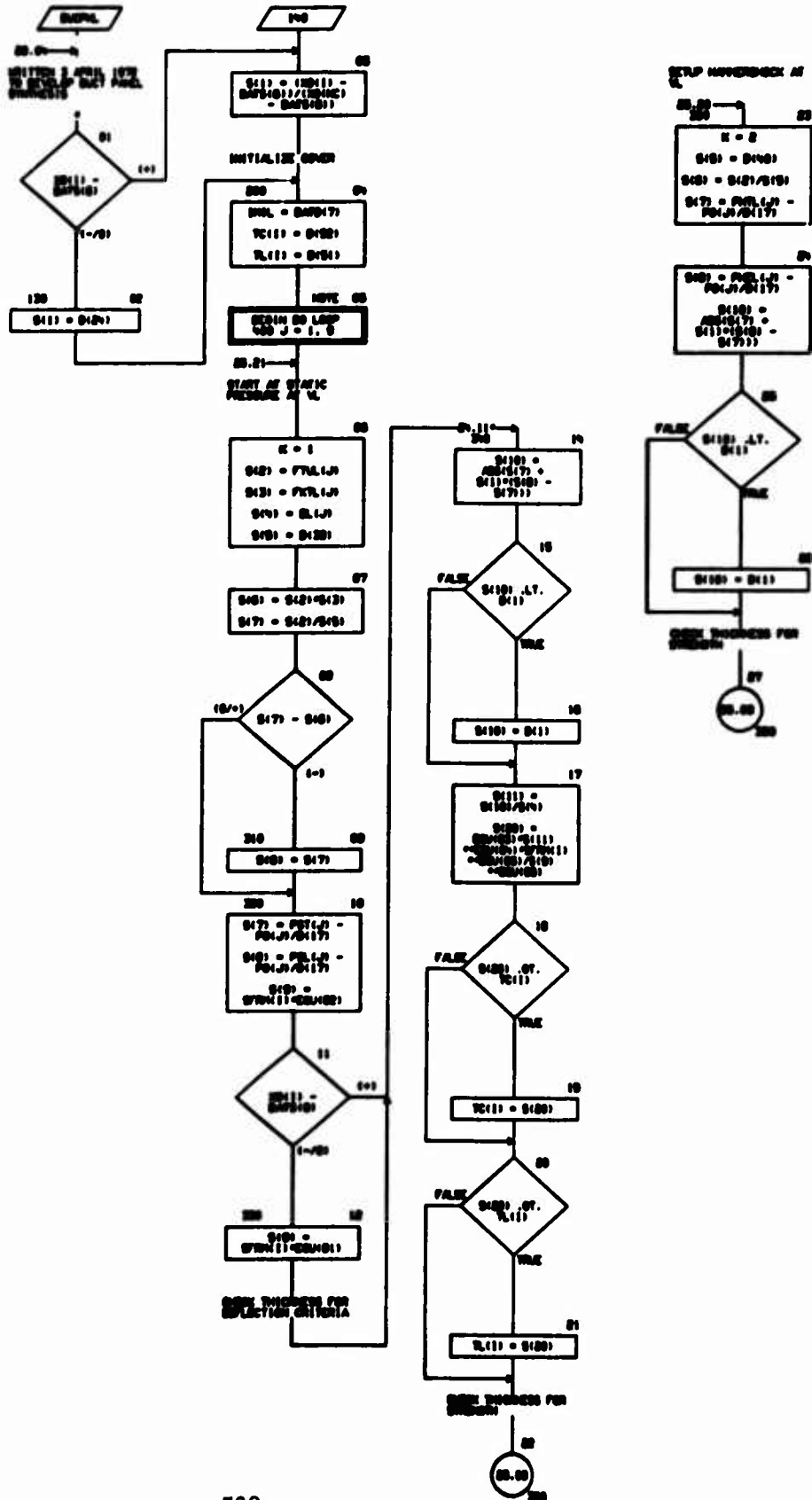
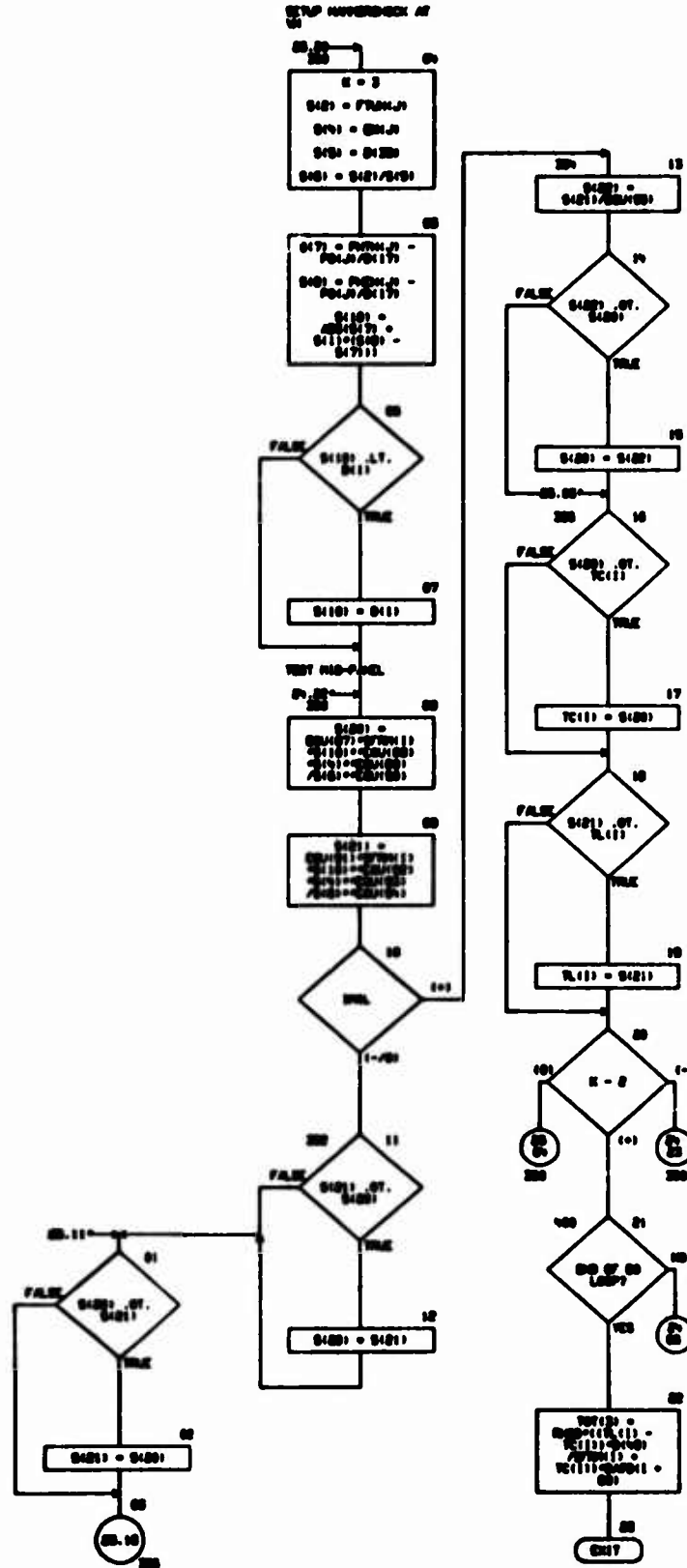


Chart Title - SUBROUTINE BUCPL





08/06/76

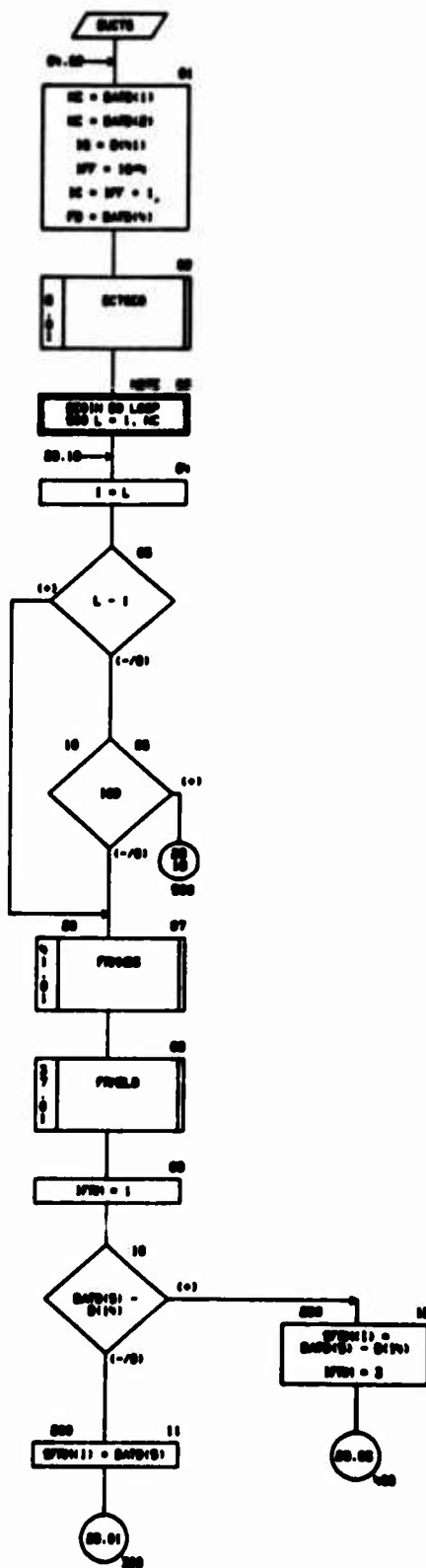
AUTOFLIGHT CHART SET - SKEP AIR INDUCTION SYSTEM MANUAL PAGE 07

CHART TITLE - INTRODUCTORY COMMENTS

.....  
SUBROUTINE DUCTS  
.....



GMMT TITLE - SUBROUTINE DUCTS



SHUT TITLE - SUBROUTINE SUCTS

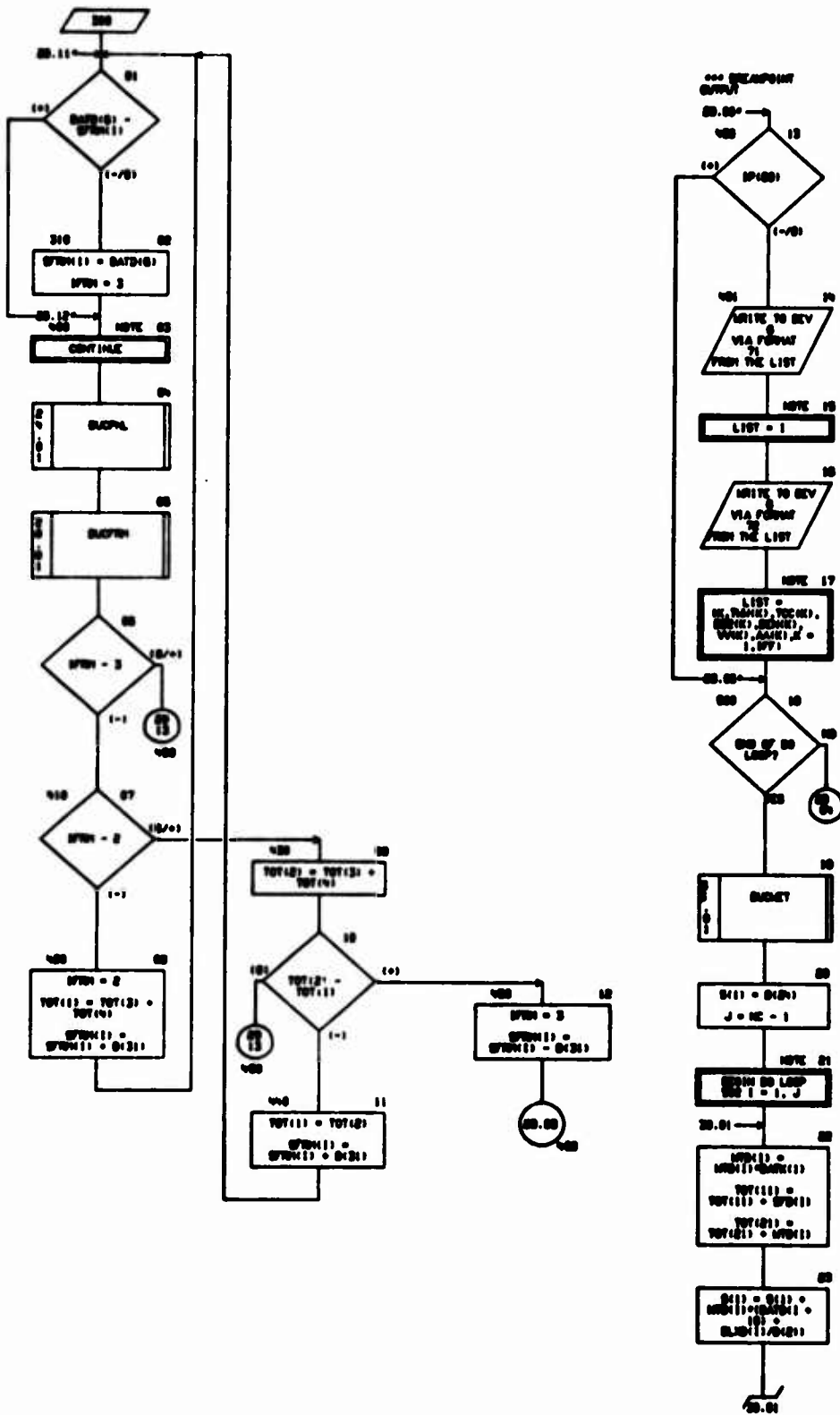
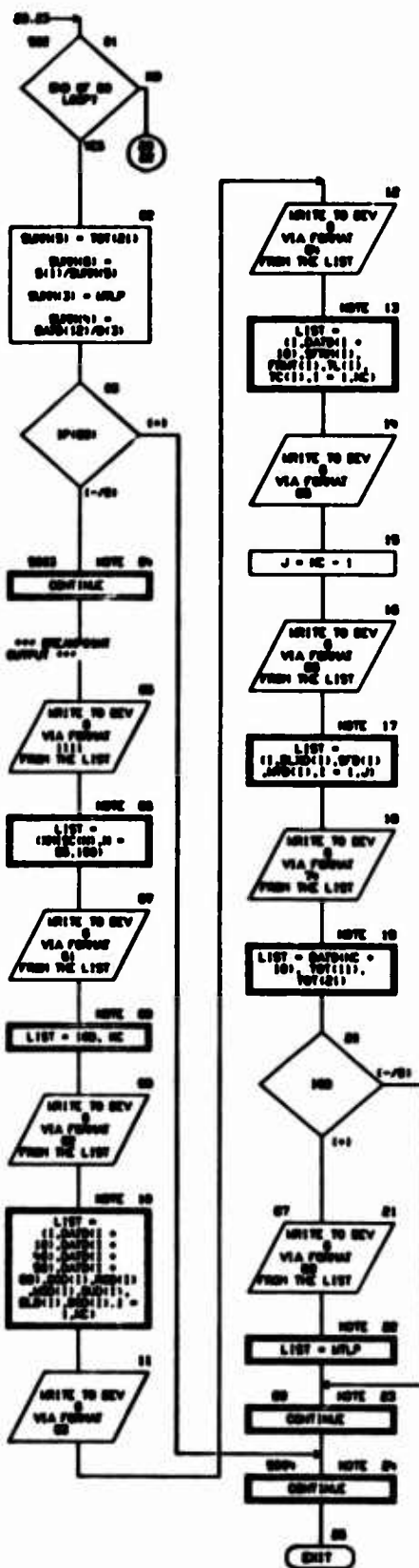


CHART TITLE - SURVEYING DEVS





03/03/74

AUTOLIN CHART SET - SHEEP AIR INJECTION SYSTEM MANUAL PAGE 22

CHART TITLE - INTRODUCTORY COMMENTS

.....  
SUBROUTINE SUCKET  
.....





CHART TITLE - NON-PROCEDURAL STATEMENTS

```

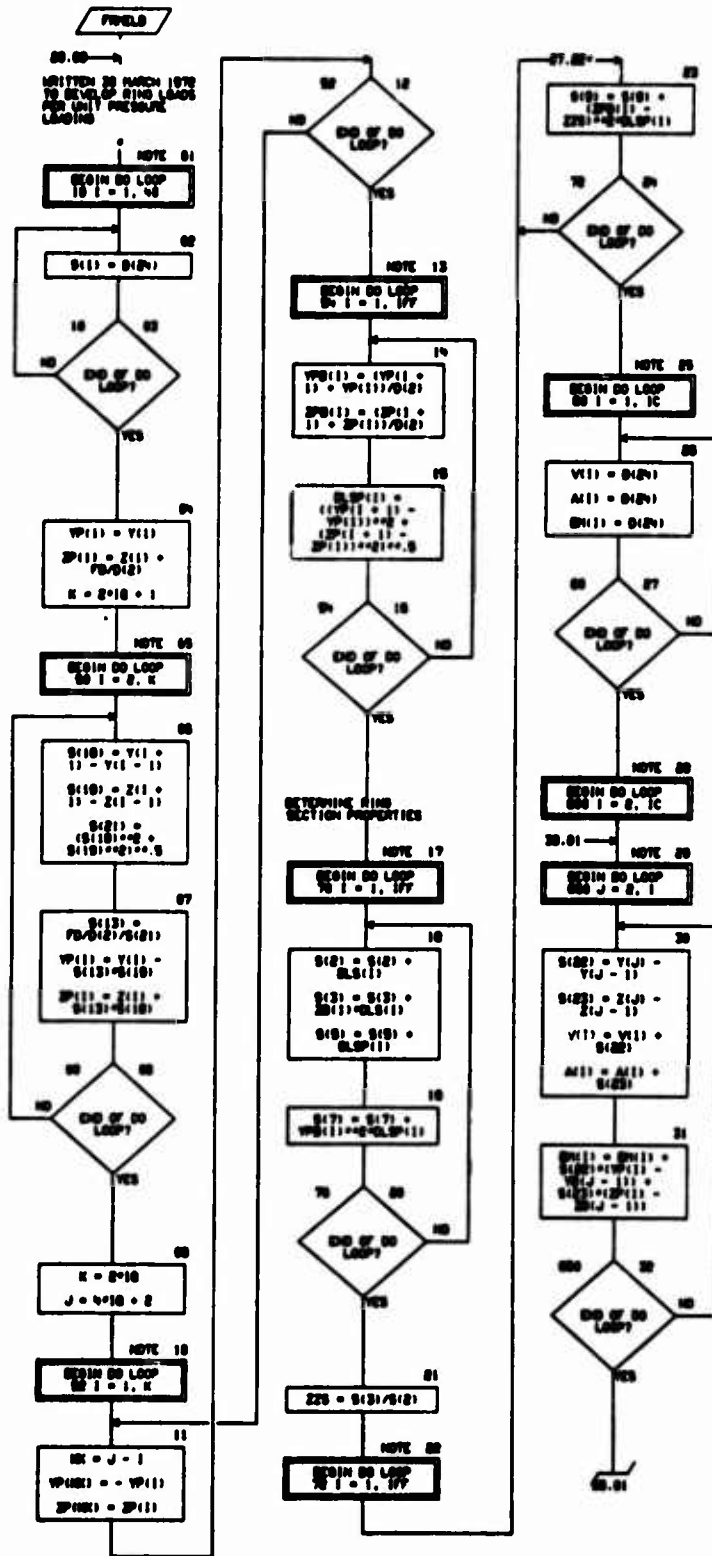
OPEN TCRW(40)
DIMENSION D(200),T(200),DC(10),ND(20)
DIMENSION DB(200)
DIMENSION DADR(20),DATR(120),ND(10)
DIMENSION T(10),TOT(100)
DIMENSION BLJ(10),BBD(10),BLJD(20),BTD(10)
DIMENSION BTRW(10),TC(10),TL(10),BTRT(10)
DIMENSION MTD(10)
EQUIVALENCE (D(1),TCRW(1)),(T(1),TCRWB(1)),(DC(1),TCR(410)),
  (D(1),TCR(401))
EQUIVALENCE (D(2),DB(1))
EQUIVALENCE (D(20),DADR(1)),(D(40),DATR(1)),(D(60),DADR(1)),(D(80),ND(1))
EQUIVALENCE (T(1),B(1)),(T(10),TOT(1))
EQUIVALENCE (TOT(2),MTP)
EQUIVALENCE (T(5),BLJ(1)),(T(10),BBD(1)),(T(15),BLJD(1)),
  (T(20),BTD(1))
EQUIVALENCE (T(30),MTD(1))
EQUIVALENCE (T(70),B(2))
EQUIVALENCE (T(71),BTRW(1)),(T(72),TC(1)),(T(73),TL(1)),
  (T(74),BTRT(1))
EQUIVALENCE (ND(10),J),(ND(10),K)
EQUIVALENCE (ND(11),I),(ND(11),L),(ND(11),M)

```

CHART TITLE - INSTRUMENTS REPORTS

.....  
SUBROUTINE FIELDS  
.....

CHART TITLE - SUBROUTINE FFIELD



CHRT TITLE - SERVICING FEEDBACK

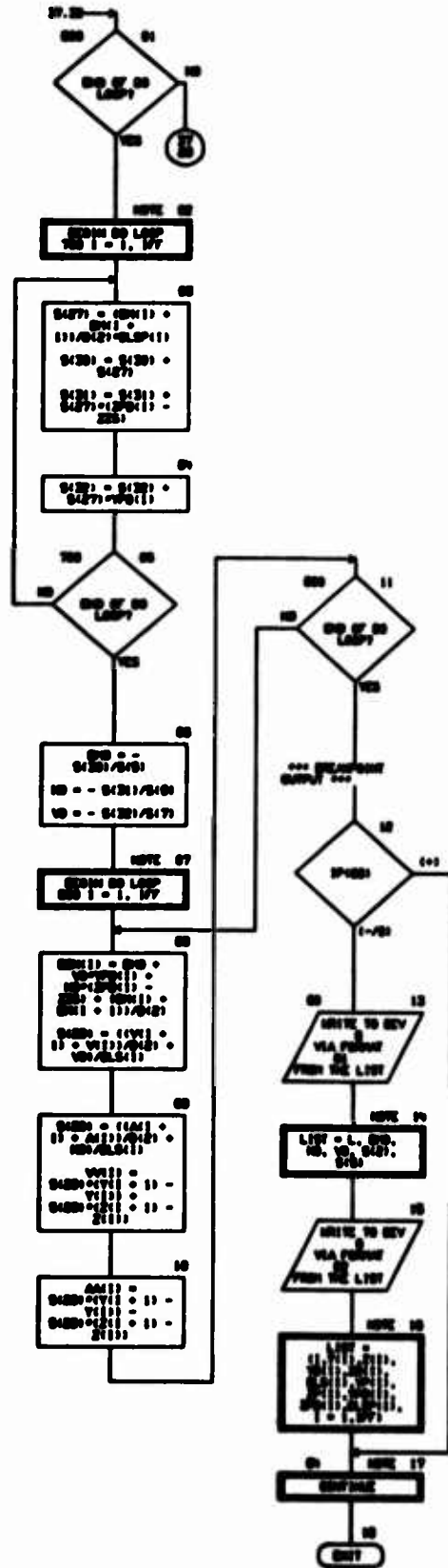


CHART TITLE - NON-PROCEDURAL STATEMENTS

```

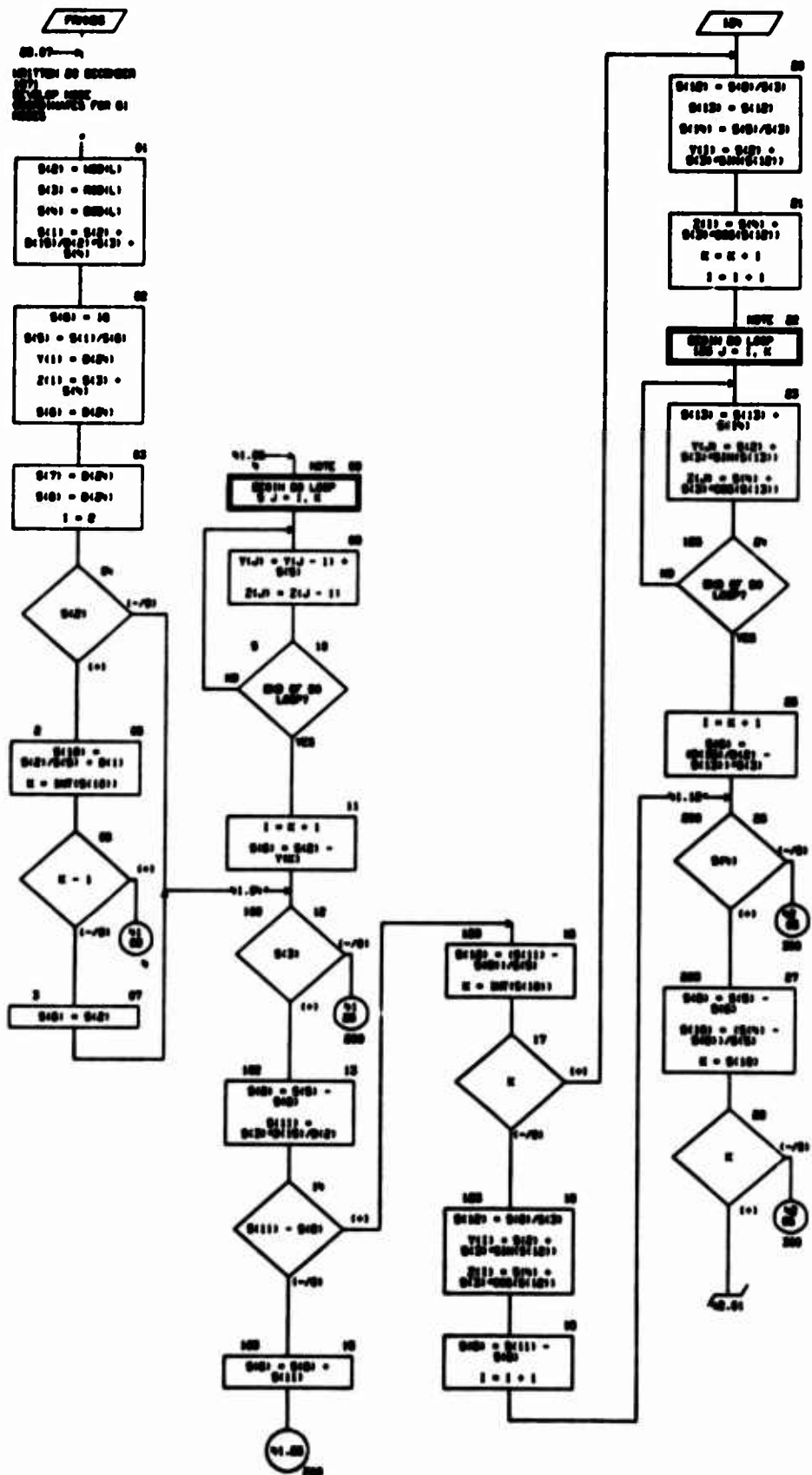
00000 TCON4400)
00000 /PRINT / SP100)
00000 DIMENSION O(1000),T(1000),JC(100),NB(200)
00000 DIMENSION S(100)
00000 DIMENSION SLP(00),SDM(00),VW(00),AA(00)
00000 DIMENSION VB(00),Z(00),JLS(00),WP(00),ZP(00)
00000 DIMENSION Y(01),Z(01),WP(01),SP(01)
00000 DIMENSION VI(01),AI(01),BH(01)
00000 EQUIVALENCE (011),TCON11),VT11),TCON20011),JC11),TCON41011),
    NB11),TCON4011)
00000 EQUIVALENCE(T11),S(11)
00000 EQUIVALENCE (S141),ZP),S142),Z21),S143),ZP),S144),J(01),
    S145),V(01)
00000 EQUIVALENCE (T1001),SLP100),VT1001),SDM11),VT1141),VW11),
    VT1001),AA11)
00000 EQUIVALENCE (T1001),VB11),VT1001),Z(11),VT1001),JLS11),
    VT1001),WP11),VT1001),ZP11)
00000 EQUIVALENCE (T1001),Y(11),VT1001),Z(11),VT1001),WP11),
    VT1001),SP11)
00000 EQUIVALENCE (T1001),VW11),VT1001),AA11),VT1001),BH11)
00000 EQUIVALENCE      (01001),J), (00100),K), (00100),L),
    (0100),M)
00000 EQUIVALENCE (00111),SPRT)
00000 EQUIVALENCE (00110),I), (00110),J), (00110),K), (00110),L)
01  FORMAT(1H1,2H,2M** SUCT FILVE DATA ***,ZIK,
    2H** FIELDS - (P100) ** /AN,3SECTION,13,
    2H,13ANIT RECORDS,2K,20P0 = /P.3,2K,400 = /P.3,2K,400 = ,
    2H,3AN,10SUCT PERIMETER = /P.3,2K,10SING PERIMETER = /P.3/2K,
    2H,OUT/20,2K,1H,2K,1K,2H,20P0,2K,20P0,2K,20S,2K,20P,2K,20P,
    2H,20P0,2K,20P0,2K,40LSP)
02  FORMAT(10,10/10,3)

```

CHART TITLE - INTRODUCTORY COMMENTS

.....  
IDENTIFY FIGURE  
.....

GURT TITLE - SUBROUTINE F1000



START TITLE - SUBROUTINE FROGS

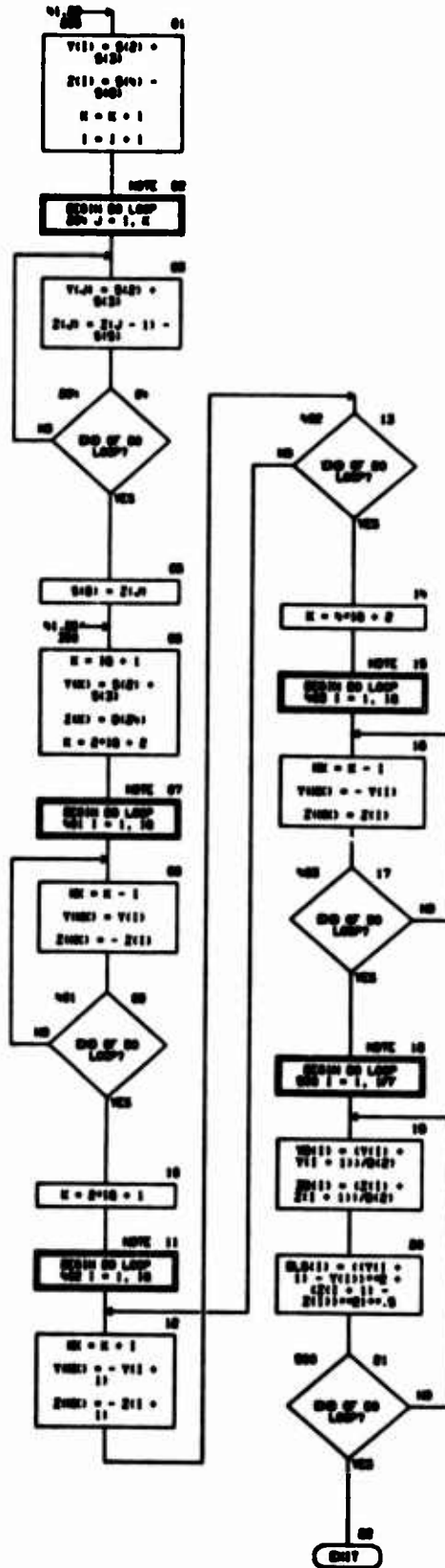


CHART TITLE - NON-FEDERAL STATEMENTS

```

CONFER 7000000)
CONFER 01000) 71000) 0C100) 40100)
CONFER 0100)
CONFER 4010) 40010) 00010)
CONFER 7010) 2010) 0L010)
CONFER 701) 210)
CONFER 01) 70001) 711) 7000001) 0C11) 7000101)
401) 700001)
CONFER 711) 011)
CONFER 7101) 4001) 71001) 0001) 71001) 0001)
CONFER 71001) 701) 71001) 201) 71001) 0L01)
CONFER 71001) 71) 71000) 21)
CONFER 00100) 40 00100) 41 00100) 41
00100) 40)
CONFER 00110) 10) 00110) 07)

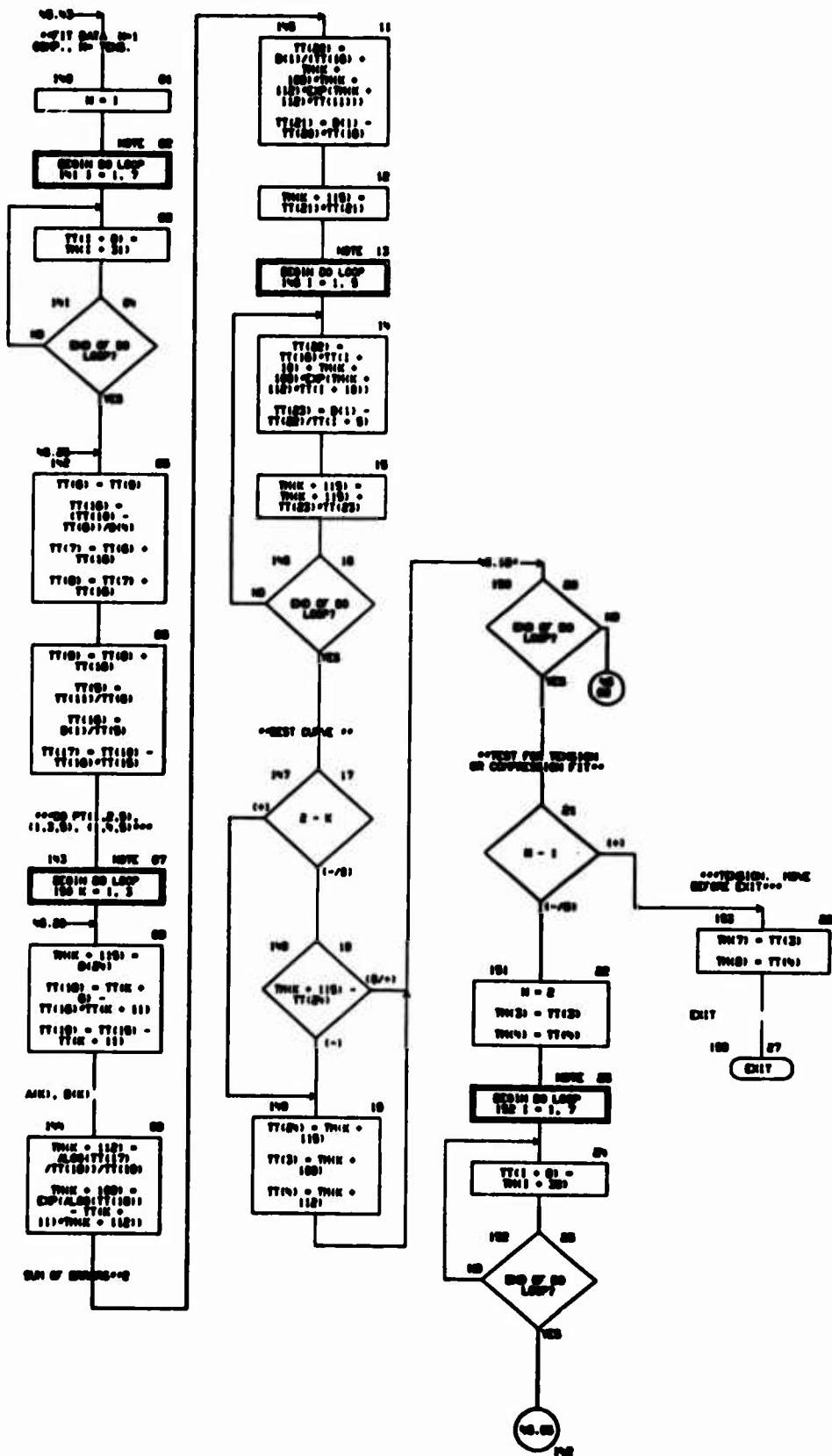
```

CHART TITLE - INTRODUCTORY COMMENTS

.....  
SUBROUTINE NAME/1  
.....



CHART TITLE - SUBROUTINE PAW/1



## CHART TITLE - NON-PROCEDURAL STATEMENTS

```

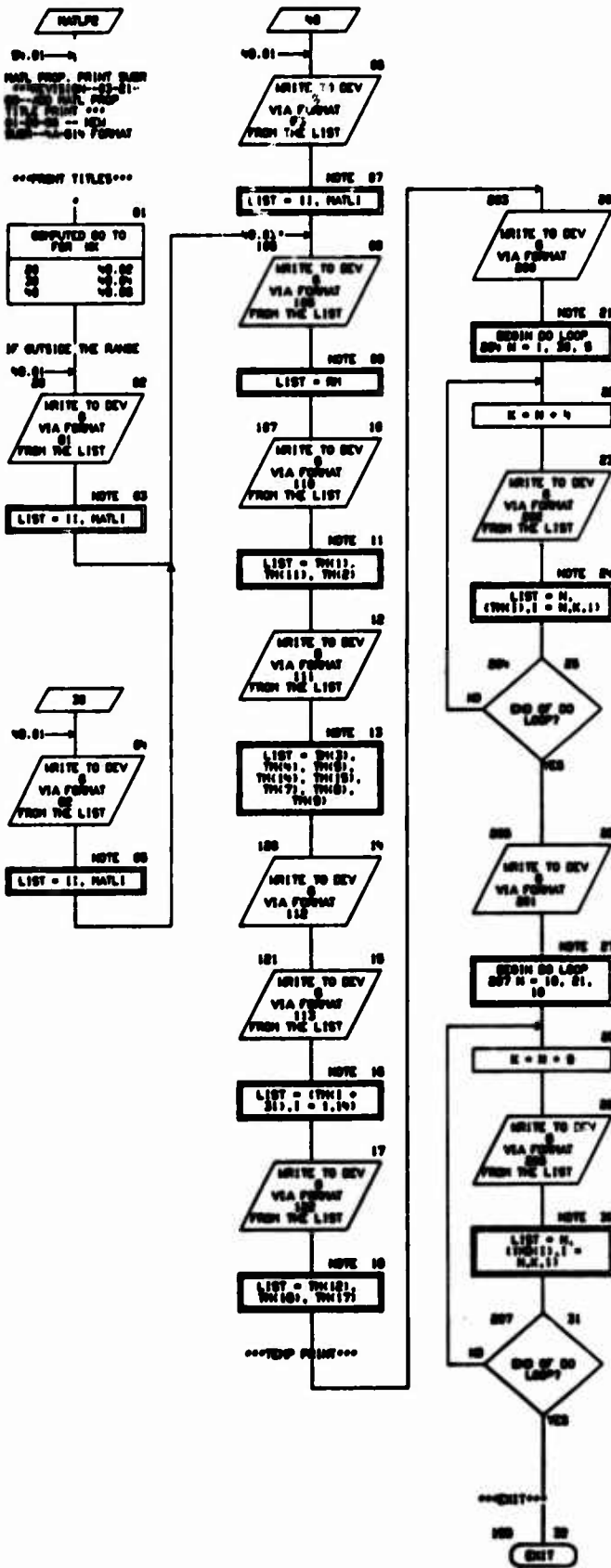
DIMENSION TCM(400)
DIMENSION S(2000),T(2000),DC(100),ND(200)
DIMENSION TW(200),TH(100),TY(20)
DIMENSION (M(1),TCM(1)),(T(1),TCM(200)),(DC(1),TCM(400)),
(ND(1),TCM(20))
DIMENSION (T(100),ND(1)),(T(100),TH(1)),(T(100),TY(1))
DIMENSION (M(10),I),ND(10),K,ND(10),L,ND(10),N)
00 FORM(10),I,K,2M** MAX. TEMPERATURE ERROR **//M,0**MPL NO.,
F7.1,2M THERE IS ONE TEMPERATURE ON FILE,/I,K,13**RED. TDP. =,
F7.1,2M,13**RED. TDP. =,F7.1)
01 FORM(10),I,K,2M** MAX. TEMPERATURE ERROR **//M,0**MPL NO.,
F7.1,2M,13**TEMPERATURE IS BEYOND RANGE OF TABLE,/I,K,
13**RED. TDP. =,F7.1,2M,13**LAST TDP. =,F7.1)

```

DIRT TITLE - INTERPRETARY COMMENTS

.....  
SUBROUTINE MAPLE  
.....

CHART TITLE - SUBROUTINE MARLPS



CART TITLE - NON-FEDERAL STATMENTS

```

COPPER TERN4000
COMPRESSOR 040001,140001,0C1001,0D4000
COMPRESSOR 0M0001,0N1001,0N1001
CONTROLLER 0B11,0C0011,(11),0D000011,(0C11),0D00001011,
0D11,0D000011
CONTROLLER 111001,0N1011,(11001),0N11,(100000),0N11
CONTROLLER 0B001,0P01,0D4001,0M11
CONTROLLER 0B101,11,0B1001,0,0B1001,01,0B1001,00
CONTROLLER 0B107,11,0B1001,0K
01 FORMAT (M,01,0P001,13,0K,0B)**SUCT MATERIAL DATA .
   000L 00.,13,00---,13,0M** 0M0P0 - 1P100 **
02 FORMAT (M,01,0P001,13,0K,0B)**SUP MATERIAL DATA .
   000L 00.,13,00---,13,0M** 0M0P0 - 1P100 **
03 FORMAT (M,01,0P001,13,0K,0B)**MISCELL MATERIAL DATA .
   000L 00.,13,00---,13,0M** 0M0P0 - 1P100 **
100 FORMAT (M,01,0A010K,0A10)
110 FORMAT (100) TSP.4P0.0,10M 0001Y=07.0,0M 0M=07.0,0/00M
       A          B          C
      (CMT)      (CMT) )
111 FORMAT (10M) COMPRESSOR 1K,0E10.0,0F10.1,10M TENSION 1K
   .0E10.0,0F10.1)
112 FORMAT (1000)          0P001) 0P01Y) 0P0)
       F10)  F10)  F10)  F1Y) )
113 FORMAT (10M) COMPRESSOR 1K,0F10.0,0F10.1,10M TENSION 1K
   ,0F10.0,0F10.1)
120 FORMAT (0000)          0P001,0M 0P001,1,0M 0P001,1)
200 FORMAT (000) 0M
201 FORMAT (000) 0M
202 FORMAT (0M 0K,0E10.0)
203 FORMAT (0M 0K,10,0P0.1)

```

CHART TITLE - INTRODUCTORY COMMENTS

.....  
SUBSTITUTE MODEL  
.....





CHART TITLE - SUBROUTINE RMDL1

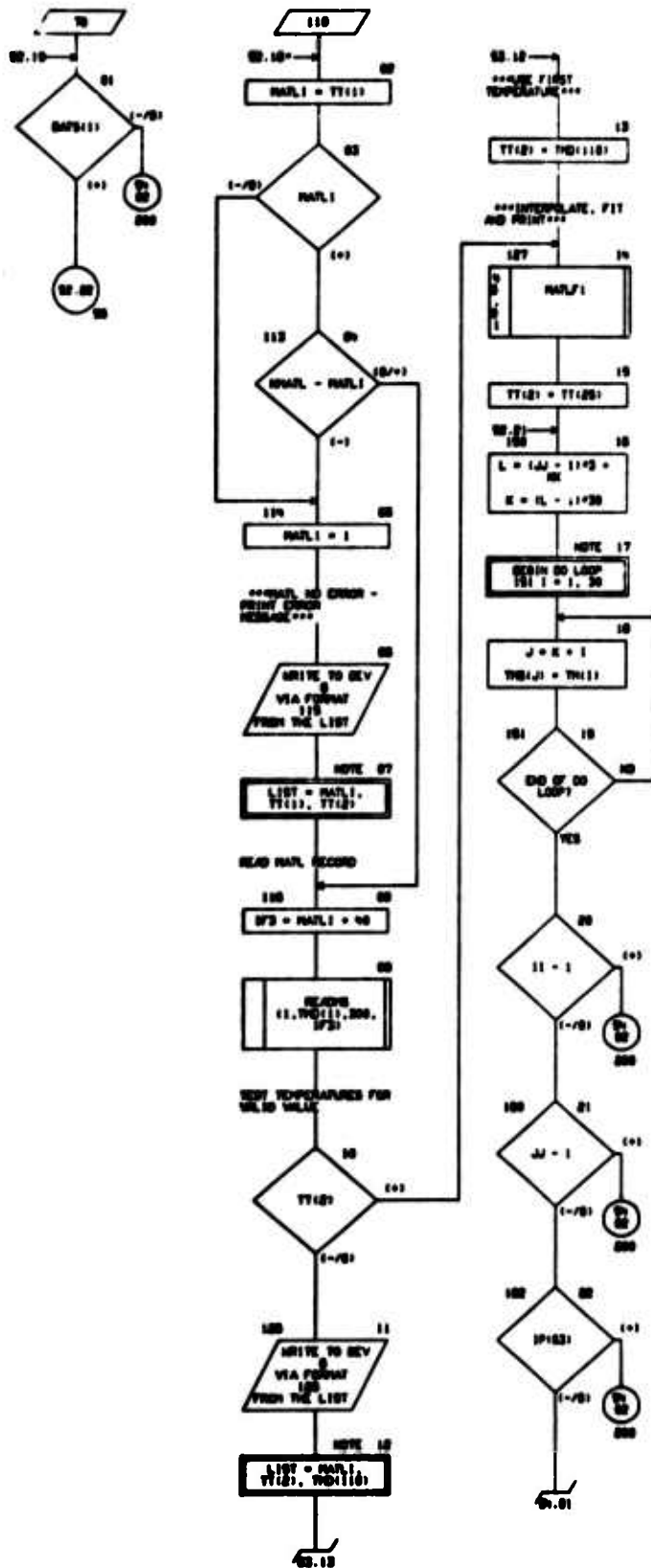
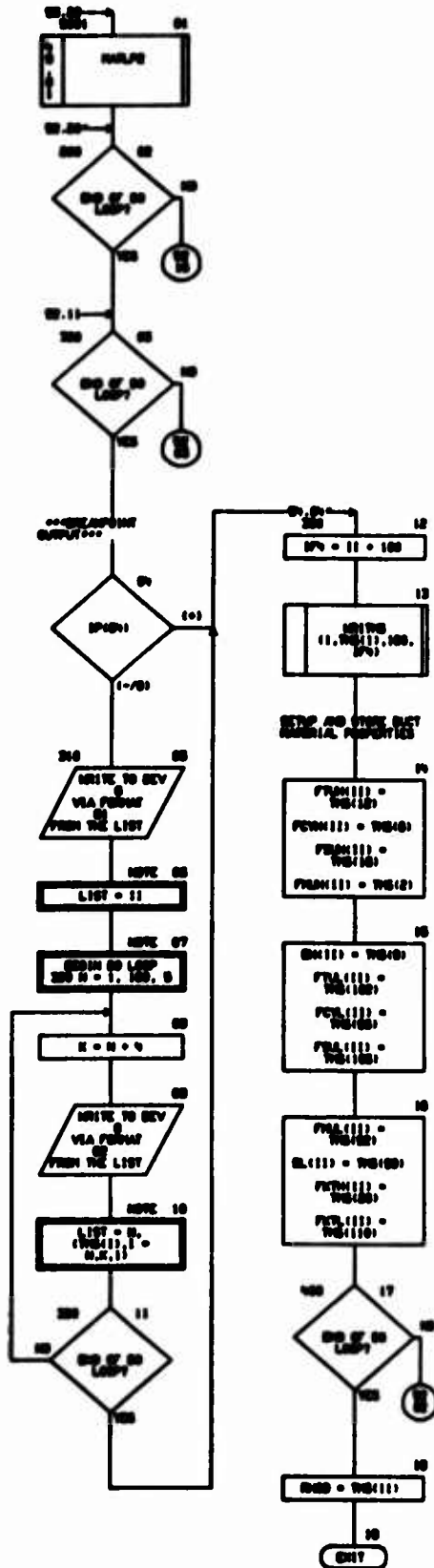


CHART TITLE - BEEP/THINE FUEL



SHWT TITLE - NON-PROCEDURAL STATEMENTS

```

OPEN TCON(400)
OPEN /PRINT/ SP(00)
DIMENSION D(1000),T(2000),DC(100),JD(100)
DIMENSION SB(100)
DIMENSION TDM(10),TDL(10)
DIMENSION SBF(40)
DIMENSION TDI(20),TNI(20),TT(20),TNS(100)
DIMENSION FDM(10),FTL(10),FCM(10),FCL(10),FDM(10),FBL(10),
FDM(10),FAL(10),DM(10),DL(10),FTM(10),FTL(10)
EQUIVALENCE (D(1),TDM(1)),(T(1),TDM(200)),(DC(1),TCON(410)),
(D(1),TCON(20))
EQUIVALENCE (D(41),SB(1))
EQUIVALENCE (D(40),SBF(1))
EQUIVALENCE (T(3),TDM(1)),(T(5),TDL(1))
EQUIVALENCE (T(10),TNI(1)),(T(10),TNI(2)),(T(10),TT(1)),
(T(10),TNS(1))
EQUIVALENCE (T(10),FDM(1)),(T(10),FTL(1)),(T(10),FCM(1)),
(T(10),FCL(1)),(T(10),FDM(1)),(T(10),FBL(1)),
(T(10),FDM(1)),(T(10),FAL(1)),(T(10),DM(1)),
(T(10),DL(1)),(T(10),FTM(1)),(T(10),FTL(1))
EQUIVALENCE (T(10),SDF)
EQUIVALENCE (ND(5),I7), (ND(6),I7)
EQUIVALENCE (ND(5),J4L), (ND(6),J4L)
EQUIVALENCE (ND(10),I), (ND(10),J), (ND(10),K), (ND(10),L)
EQUIVALENCE (ND(10),M)
EQUIVALENCE (ND(10),I), (ND(10),J), (ND(10),K)
EQUIVALENCE (ND(10),L)
EQUIVALENCE (ND(10),M)
115 FORMAT (4D+ '***MFL INPUT ERROR. ASSUMED MATL NO. 1.***',/INSE,
13,F0.1,F0.1)
120 FORMAT (2D+ '***MFL TEMPERATURE ERROR. MATL NO.,F0.1,ON RES.,
F7.1,ON RES. ASSUMED TEMP.,F7.1,ON RES.)
01 FORMAT(1H1,3H,5D7H5 RESIGN PROFILE POINT =,13,5D8,
2H** MFL1 = SP(0) **)
02 FORMAT(1H 2H,13,5E10.0)

```

05/05/75

ARFLEN CHRY SET - DEEP AIR INJECTION SYSTEM MODEL PAGE 05

CHRY TITLE - INJECTION SYSTEM

.....  
INJECTION SYSTEM  
.....

CHART TITLE - SUBROUTINE MISC01

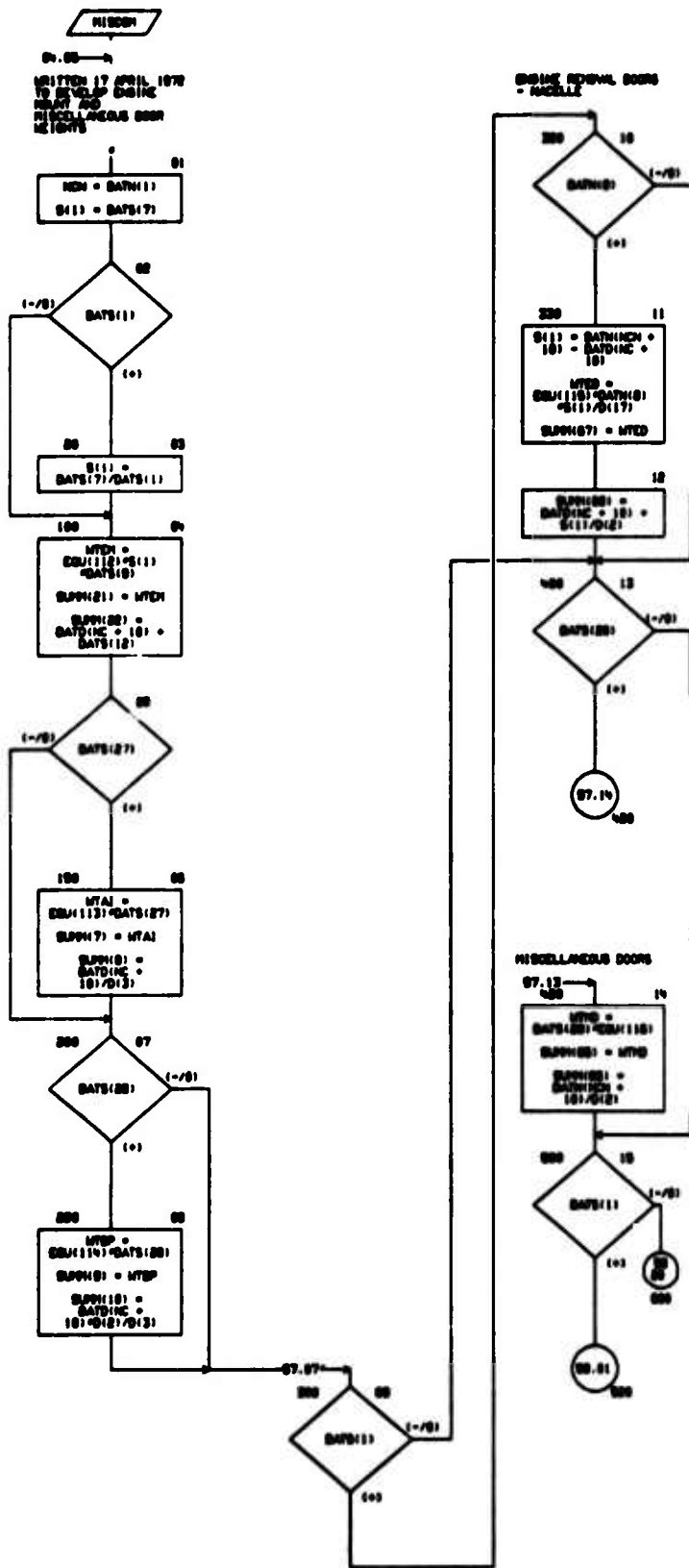




CHART TITLE - NON-FRIGORAL STANDARDS

```

DIMENSION TCM(1400)
DIMENSION Q(1000), T(000), DC(100), JD(000)
DIMENSION QM(100)
DIMENSION DAFS(10), DAFB(10), DAFN(00)
DIMENSION QP(1000)
DIMENSION Q(100), TOT(100)
DIMENSION JEM(10), JEM(10), JEM(10)
DIMENSION JEM(10), JEM(10), JEM(10)
DIMENSIONLE Q(1), TCM(100), (T(1), TCM(000)), (DC(1), TCM(100)),
JEM(1), TCM(001))
DIMENSIONLE Q(10), JEM(10)
DIMENSIONLE Q(100), DAFS(10), Q(100), DAFB(10), Q(100), DAFN(10)
DIMENSIONLE Q(170), QP(10)
DIMENSIONLE (T(1), Q(1)), (T(100), TOT(10))
DIMENSIONLE (TOT(0), JEM(1), (TOT(0), JEM(1), (TOT(0), JEM(1),
(TOT(0), JEM(1), (TOT(0), JEM(1)
DIMENSIONLE (TOT(0), JEM(1), (TOT(0), JEM(1), (TOT(0), JEM(1)
DIMENSIONLE (T(0), JEM(10), (T(0), JEM(10), (T(0), JEM(10)
DIMENSIONLE (T(70), JEM(10), (T(70), JEM(10), (T(70), JEM(10)
DIMENSIONLE QM(100), J)
DIMENSIONLE QM(100), J, QM(100), JEM(10)

```

CHART TITLE - MANUFACTORY COMMENTS

.....  
DISTRIBUTING MODULE  
.....



GURT TITLE - SUBROUTINE MACCLE

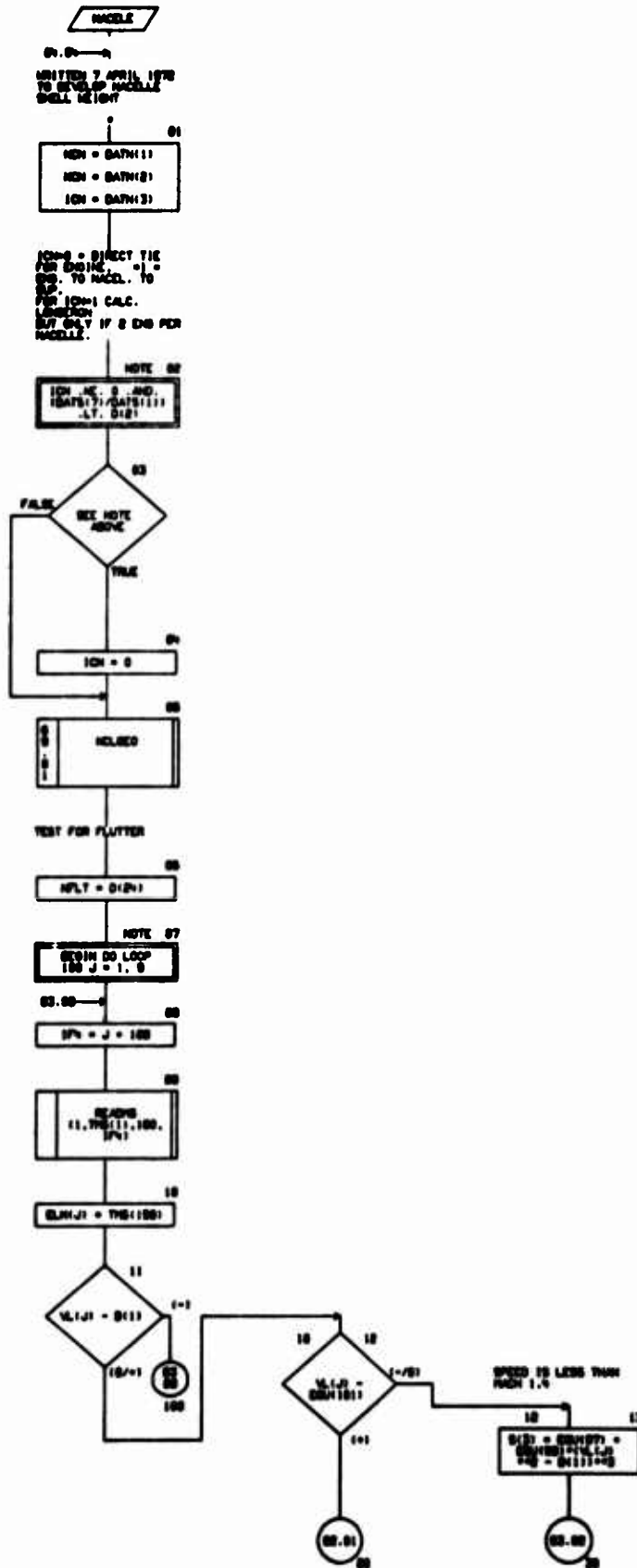


CHART TITLE - SUBROUTINE NACDL

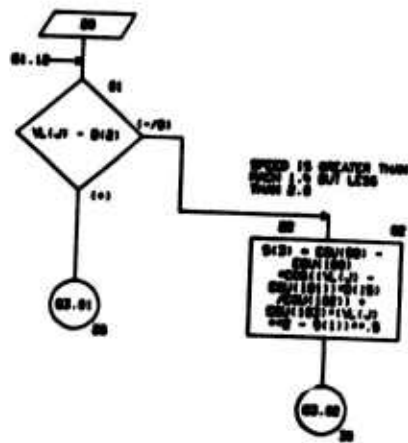


CHART TITLE - SUBROUTINE NOZZLE

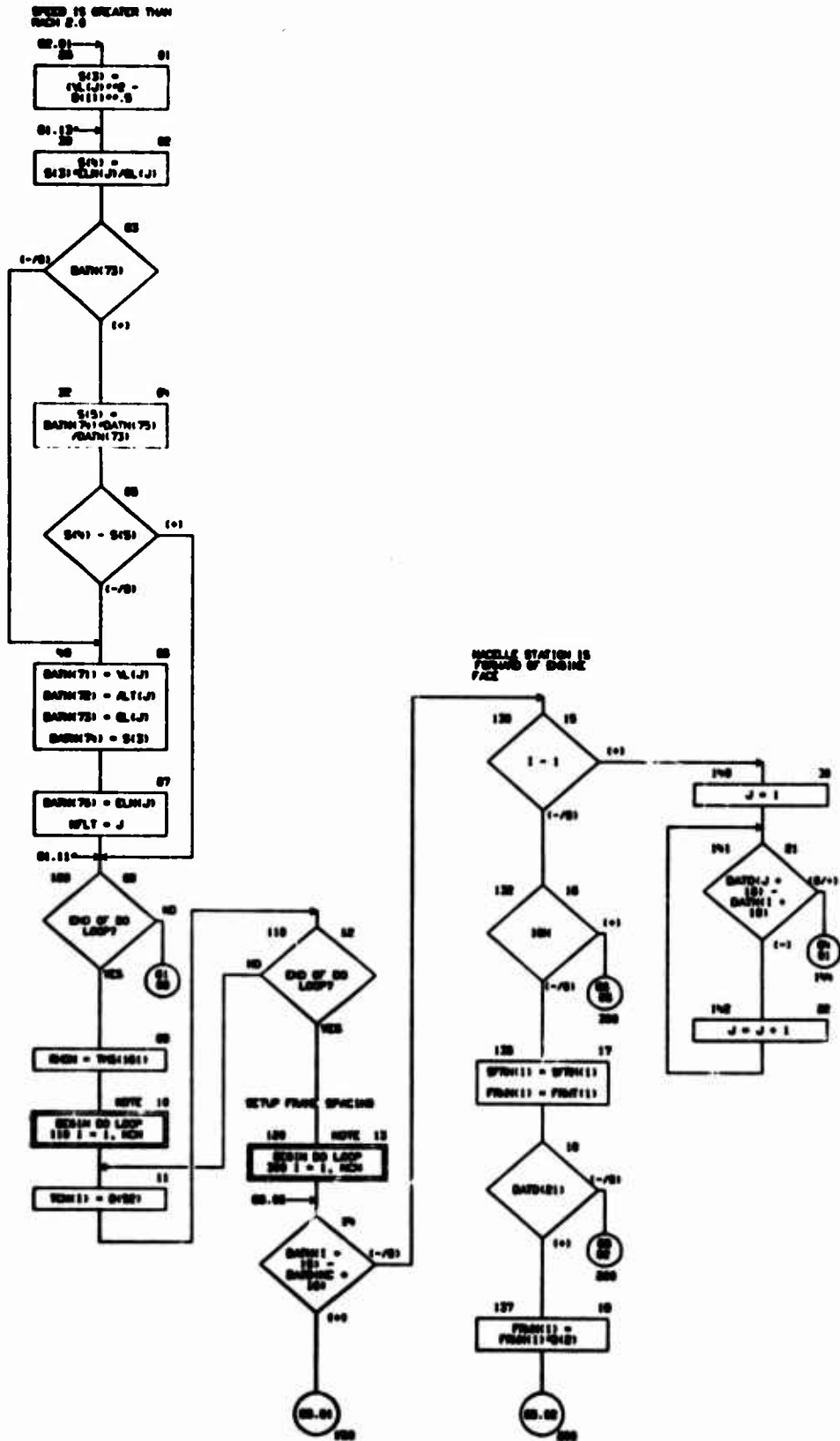


CHART TITLE - SUBROUTINE INCDLE

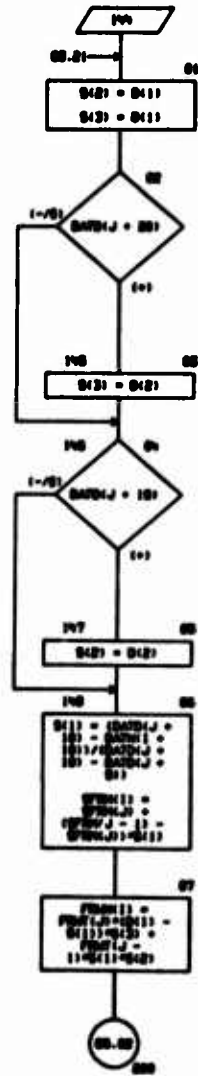
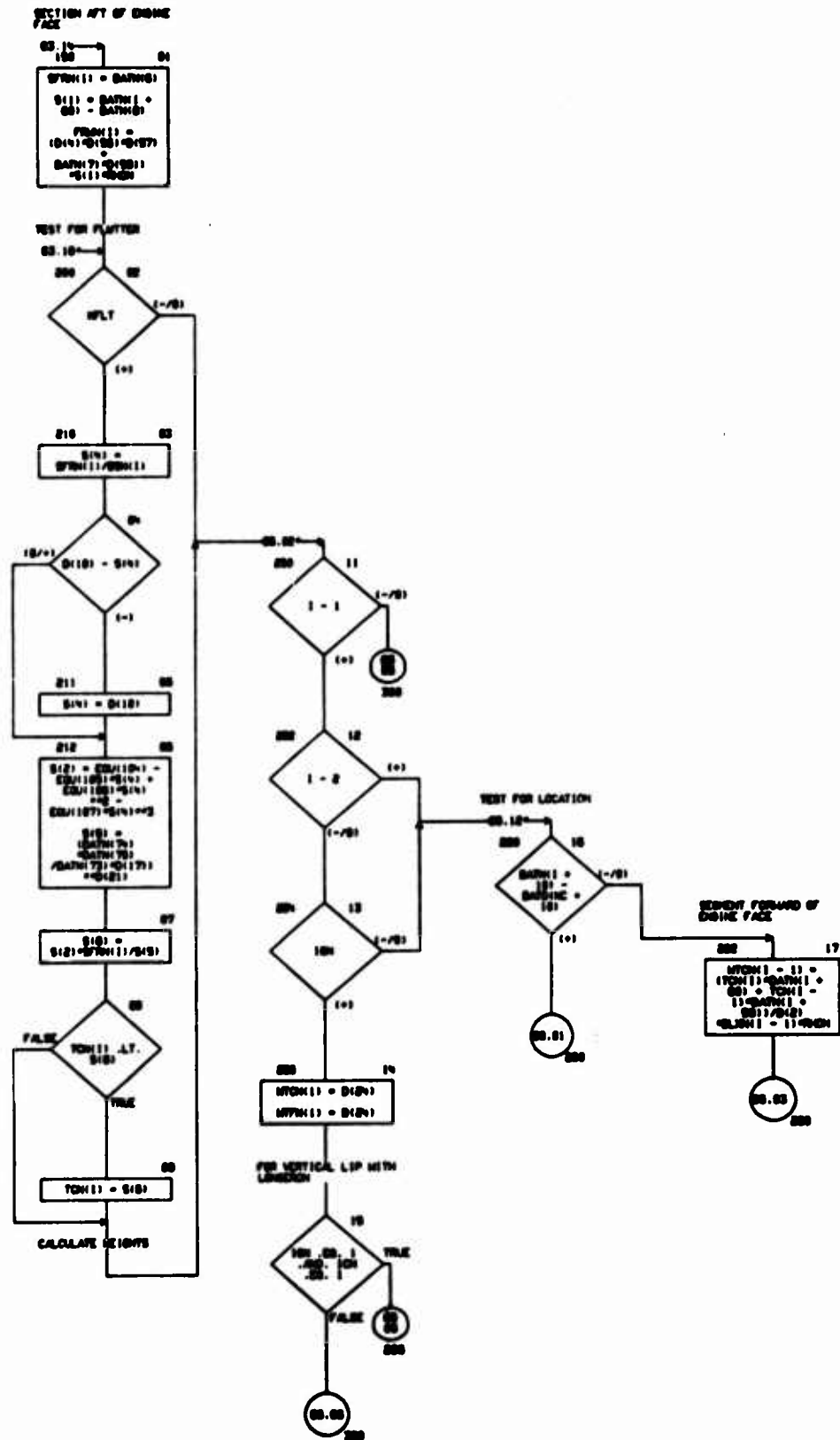


CHART TITLE - SUBROUTINE MODLS



CHRT TITLE - SUBROUTINE NOBLE

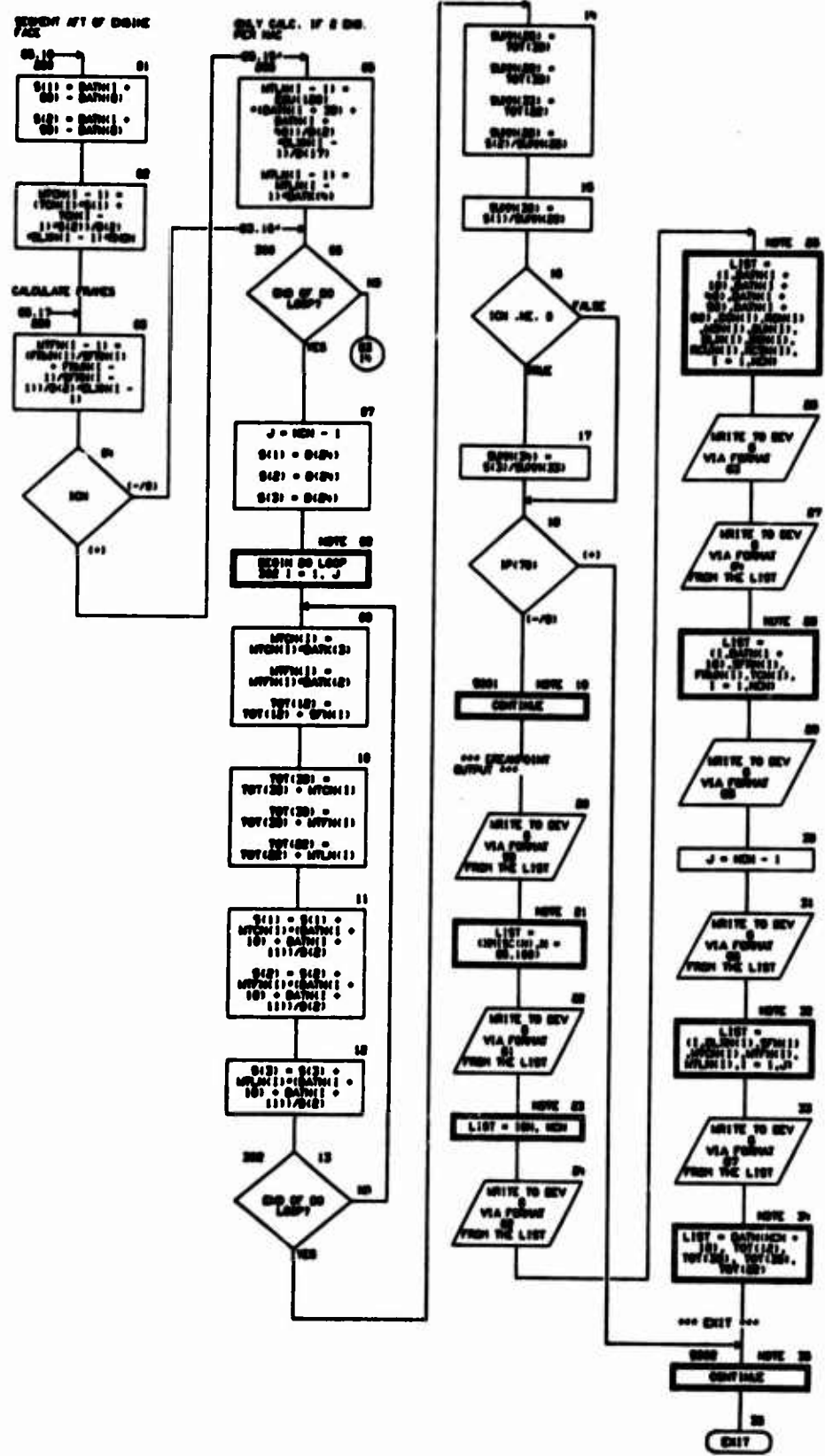


CHART TITLE - NON-PROCEDURAL STATEMENTS

```

OPEN TOM400)
OPEN /PRINT/ IP100)
OPEN /IN/ INEC100)
DIMENSION D1(200),T1(200),EC1(100),J04(200)
DIMENSION D2(100),D3(100),D4(100)
DIMENSION D5(100)
DIMENSION T07(100)
DIMENSION T08(100)
DIMENSION D475(40)
DIMENSION T10(20),D47(10)
DIMENSION AL(10),VL(10),BL(10)
DIMENSION S70(10),F70(10)
DIMENSION J08(10),J09(10),J04(10),J05(10),J06(10)
DIMENSION J07(10),J08(10)
DIMENSION S70(10),J08(10),J09(10)
DIMENSION J04(10)
DIMENSION T08(10),S70(10),F70(10),J70(10),J77(10)
DIMENSION J74(10)
EQUIVALENCE (D1),T08(10),T1(10),T08(200),EC1(100),T08(410),
  J04(10),T08(40)
EQUIVALENCE (D2),J08(10),D4(20),D47(10),D4(10),D47(10)
EQUIVALENCE (D3),D47(10)
EQUIVALENCE (D4),D47(10),D4(10),T10(10),T10(10)
EQUIVALENCE (T1),S1(10)
EQUIVALENCE (T10),T07(10)
EQUIVALENCE (T20),AL(10),T1(20),VL(10),T10(10),BL(10)
EQUIVALENCE (T17),S70(10),T1(70),F70(10)
EQUIVALENCE (T18),J08(10),T1(80),J09(10),T1(77),J08(10),
  T1(70),J08(10),T1(70),J08(10)
EQUIVALENCE (T40),J08(10),T1(40),J08(10)
EQUIVALENCE (T08),S70(10),T1(08),J08(10),T1(08),J08(10)
EQUIVALENCE (T40),J08(10)
EQUIVALENCE (J08),J08
EQUIVALENCE (T07),T08(10),T1(07),S70(10),T1(07),F70(10),
  T1(07),J70(10),T1(07),J77(10)
EQUIVALENCE (T10),J74(10)
EQUIVALENCE (T100),T08(100)
EQUIVALENCE (D10),IP1)
EQUIVALENCE (D110),JE),D1(12),J08),D1(14),J08),
  D1(15),J08),D1(15),J08),D1(17),J08)
00  FORMAT(10H,BA10,EC,F000 MACLE - IP170) **/1X,BA10)
01  FORMAT(10H,IN,IN*** MACLE SECRETRY - SECTION DATA ***
  /7X,10H,IP TYPE =,13,4X,10H,TYPE CODE =,13/7X,
  3HOUT,3X,INSTA,3X,DEPTH,3X,WIDTH,4X,INPER,3X,BOO,3X,
  3HBO,3X,D40,3X,D47,3X,D4,3X,D47,3X,D40,3X,D47,3X,D40,3X,D47)
02  FORMAT(17,15F0.1)
03  FORMAT( / 3H,3HOUT,4X,INSTA,4X,DEPTH,3X,WIDTH,3X,INPER,3X,BOO,3X,
  3HBO,3X,D40,3X,D47,3X,D4,3X,D47,3X,D40,3X,D47,3X,D40,3X,D47)
04  FORMAT(3X,17,15F0.2/3.0)
05  FORMAT( / 3H,3HBO,4X,WIDTH,3X,INPER,3X,BOO,3X,3HOUT,4X,INSTA,3X,
  3H,10H,LENGTH)
06  FORMAT(3X,17,15F11.2)
07  FORMAT(3X,3HOUT,17F11.2)

```

CHART TITLE - INTRODUCTORY COMMENTS

.....  
CENTRIFUGAL PUMPS  
.....

CHART TITLE - SUBROUTINE HCL02

REL02

01.00  
WRITTEN 6 APRIL 1970  
TO DEVELOP FACELLE  
SUBROUTINE

SETUP INDICATORS AND  
COUNTS

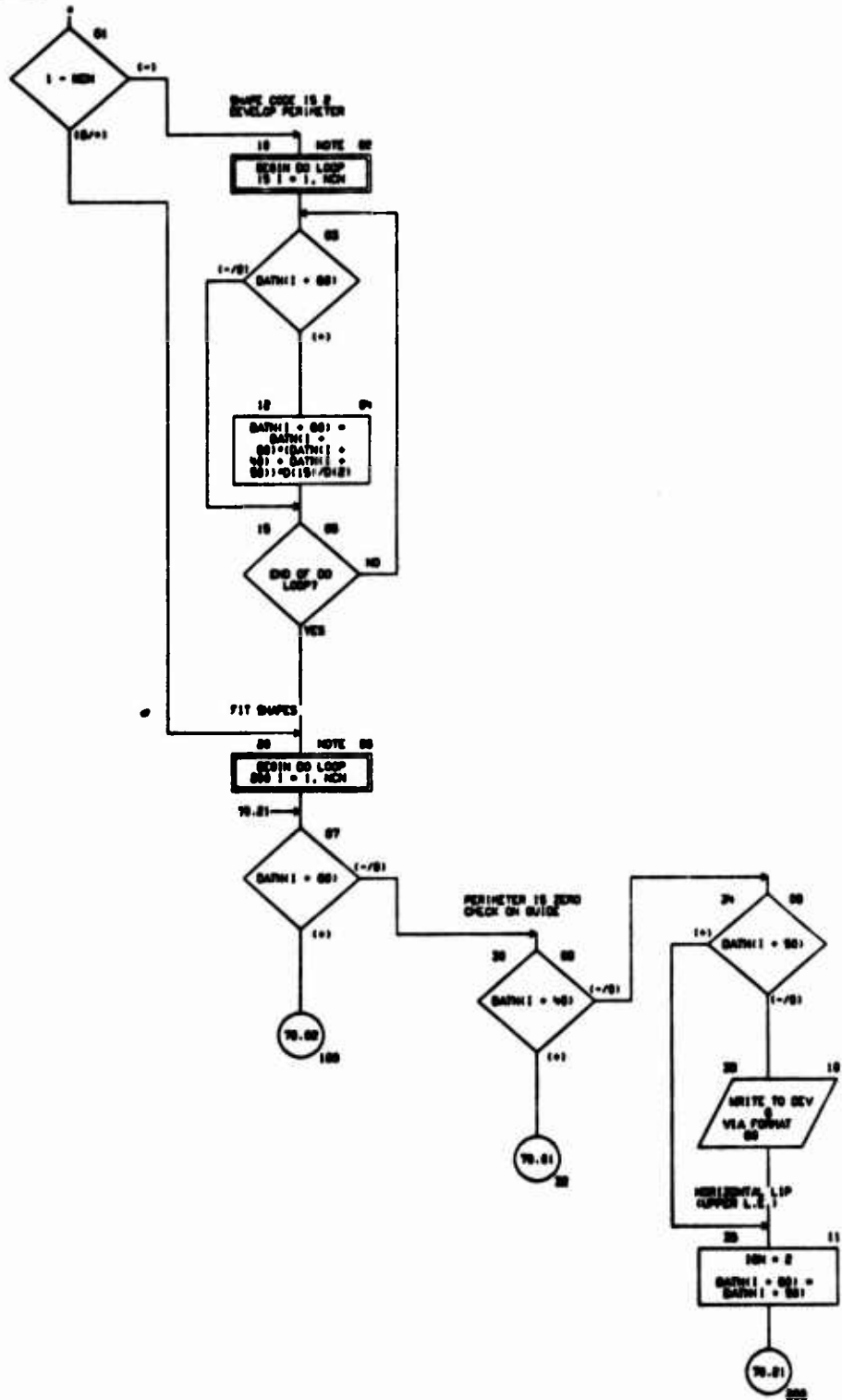


CHART TITLE - SUBROUTINE HELD

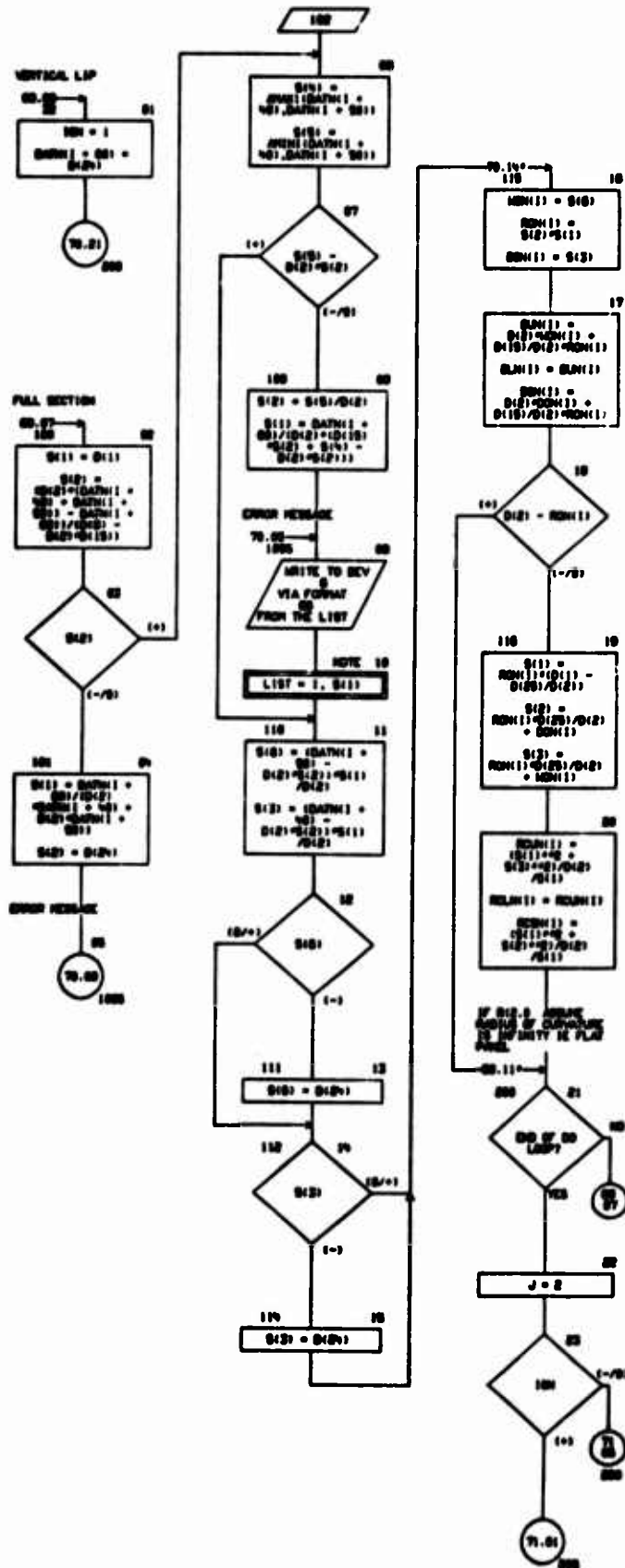
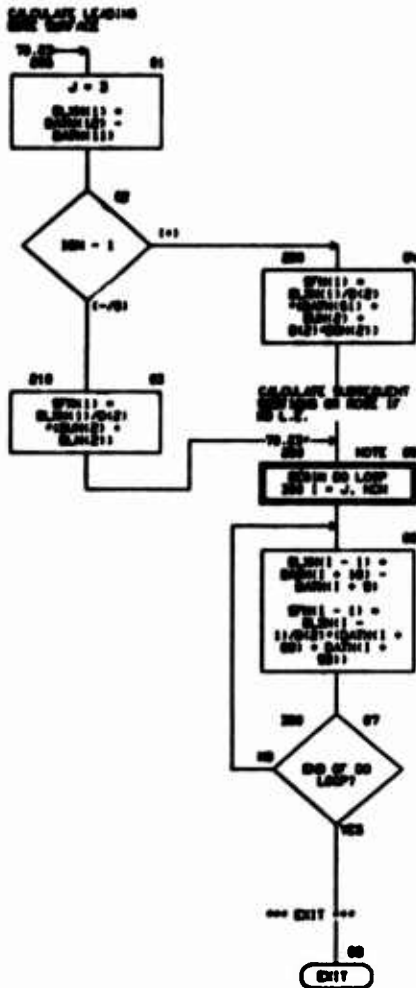


CHART TITLE - SUBROUTINE HELDED



## CHART TITLE - NON-PROCEDURAL STATEMENTS

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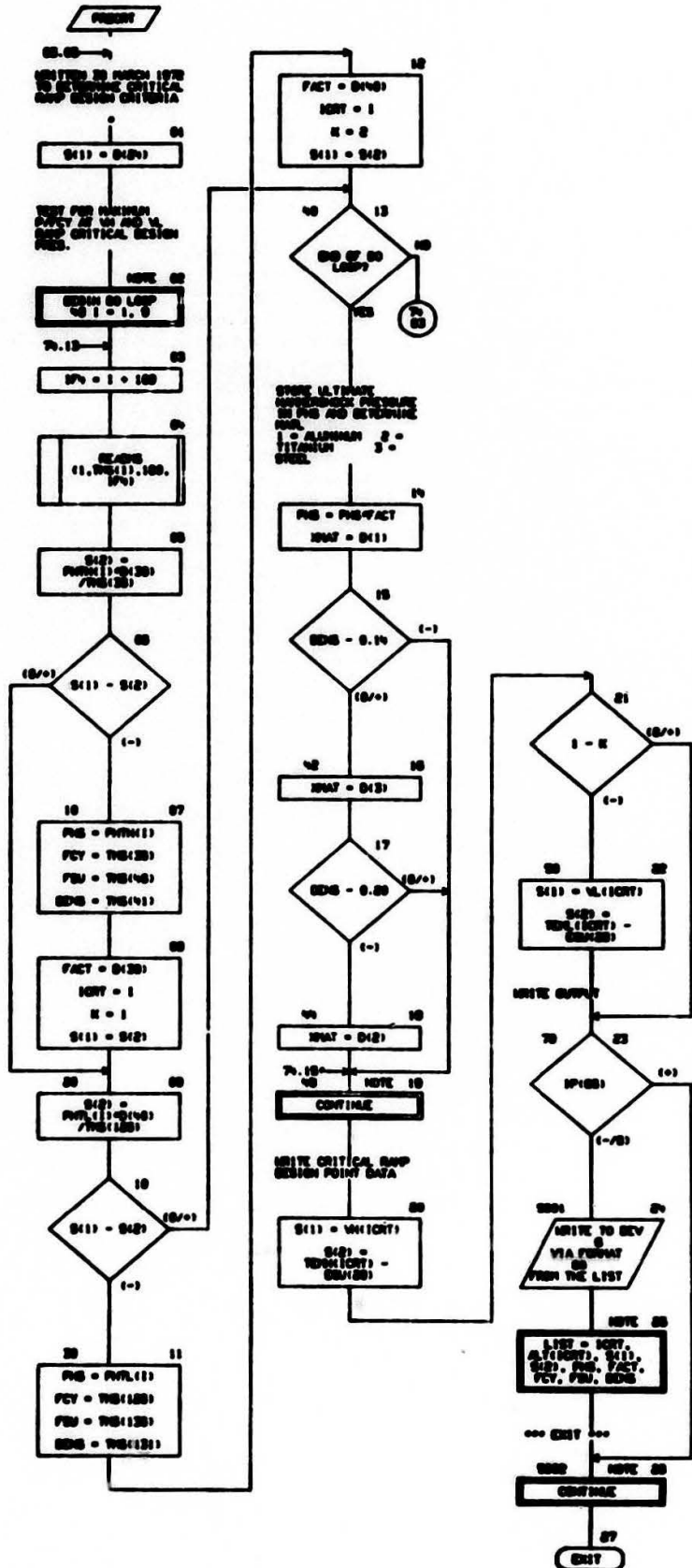
OPEN TCON(400)
DIMENSION S(2000),T(2000),DC(100),ND(200)
DIMENSION DATH(60)
DIMENSION S(100)
DIMENSION MDH(10),RDN(10),SDN(10),BLM(10),BLN(10),BDM(10)
DIMENSION BLM(10),BDM(10),RDM(10),RDN(10),RDN(10)
EQUIVALENCE (D(1),TCON(1)),(T(1),TCON(2001)),(DC(1),TCON(4101)),
(ND(1),TCON(801))
EQUIVALENCE (D(60),DATH(1))
EQUIVALENCE (T(1),S(1))
EQUIVALENCE (T(70),MDH(1)),(T(70),RDN(1)),(T(71),SDN(1)),
(T(70),BLM(1)),(T(70),BLN(1)),(T(80),BDM(1))
EQUIVALENCE (T(81),BLM(1)),(T(80),BDM(1)),(T(81),RDM(1)),
(T(81),RDN(1)),(T(81),RDN(1))
EQUIVALENCE (ND(10),1),(ND(10),J)
EQUIVALENCE (ND(12),NDH),(ND(12),NDH),(ND(10),10H)
00  FORMAT(4#BARBARING FROM HELD IN AIR INDUCTION SYSTEM /
    NON-REPARABLE LIP GEOMETRY ERROR )
00  FORMAT(4#BARBARING FROM HELD IN AIR INDUCTION SYSTEM /
    11X, 'INSECTION, 113, 30H IS RECTANGLE OR ROUNDED RECT.,
    13CORRECTION IS, 170.3 )

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CHART TITLE - INTRODUCTORY COMMENTS

.....  
SUBROUTINE PRECUT  
.....

CHART TITLE - DETERMINING POINT



CURT TITLE - NON-PROCEDURAL STATEMENTS

```

COMMON TCRH(400)
COMMON /SPRINT/ SP(80)
DIMENSION D(2000),T(2000),DC(100),JCH(500)
DIMENSION ED(1000)
DIMENSION BATH(100)
DIMENSION S(100)
DIMENSION AL(10),MH(0),VL(10),TCH(10),TEL(10)
DIMENSION PWH(10),PWL(10)
DIMENSION TW(100)
DIMENSIONLE (0(1),TCR(1)),(1(1),TCR(200)),(0C(1),TCR(410)),
(0H(1),TCR(450))
DIMENSIONLE (0(01),ED(1))
DIMENSIONLE (0(401),BATH(1)),(0BATH(2),PWS),(0BATH(12),FCT),
(0BATH(13),FBU),(0BATH(14),DDB),(0BATH(15),DWT),(0BATH(16),FACT)
DIMENSIONLE (T(1),S(1))
DIMENSIONLE (T(201),AL(1)),(T(201),MH(1)),(T(271),VL(1)),
(T(31),TCR(1)),(T(301),TEL(1))
DIMENSIONLE (T(401),PWH(1)),(T(401),PWL(1))
DIMENSIONLE (T(1001),TW(1))
DIMENSIONLE (ND(101),J),(ND(102),J),(ND(103),J),(ND(117),SCRT)
DIMENSION (ND(10),NPADE),(ND(9),IPN)
**
FORMAT(M,4X,30)*** RAMP DESIGN CONDITIONS ***.10X,
    20** FRECY - SP(80) ***
4X,0POINT,0X,144X,0VALTITL,14X,F10.24X,0SPEED,17X,
F10.24X,10TEMPERATURE - F,7X,F10.24X,10PRESSURE - PSIA,
7X,F10.24X,00LIMIT TO ULT. FACTOR,0X,F10.24X,
10COMPRESSION YIELD,0X,F10.24X,0MULTIPLY BEAR STRESS,
F11.24X,10MATERIAL DENSITY,11X,F0.3)

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CHART TITLE - INTRODUCTORY COMMENTS

.....  
SUBSTITUTE PLANS  
.....



CHART TITLE - SUBROUTINE FLOW

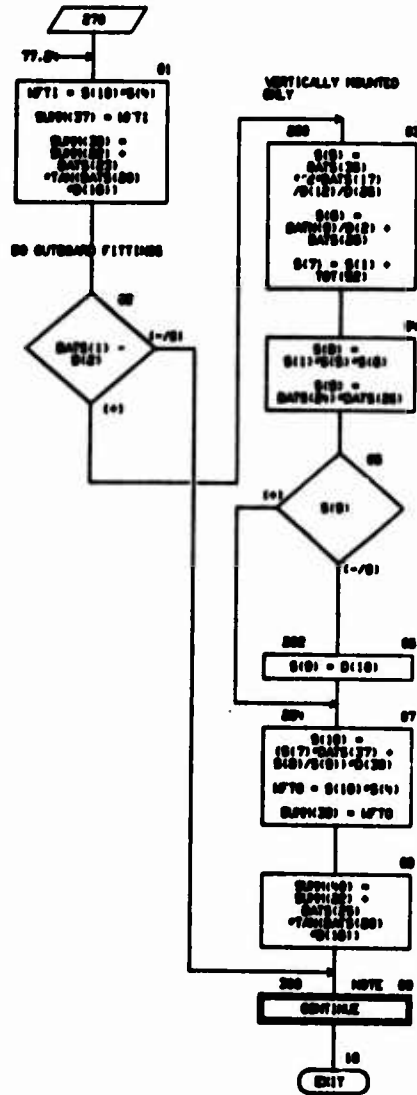


CHART TITLE - NON-PROCEDURAL STATEMENTS

```

DIMENSION DBM(200),SATS(10),SARW(5)
OPEN TCON(400)
DIMENSION S(2000),T(2000),SC(100),JS(100)
DIMENSION SUPW(20)
DIMENSION S(100),TOT(100),TW(100)
EQUIVALENCE (S(1),TCON(1)),(T(1),TCON(20)),(SC(1),TCON(10)),
             (S(1),TCON(20))
EQUIVALENCE (S(1),S(1)),(S(20),SATS(1)),(S(20),SARW(1))
EQUIVALENCE (S(70),SUPW(1))
EQUIVALENCE (T(1),S(1)),(T(10),TOT(1)),(T(100),TW(1))
EQUIVALENCE (TOT(1),JTP(1)),(TOT(2),JTP(2)),(TOT(10),JFT(1)),
             (TOT(20),JFT(2))
EQUIVALENCE (S(10),JFT(1)),(S(10),J)

```

GWT TITLE - DIRECTORY CONTENTS

.....  
SUBJECTIVE GWT'S  
.....

CHRT TITLE - SUBROUTINE RAPP

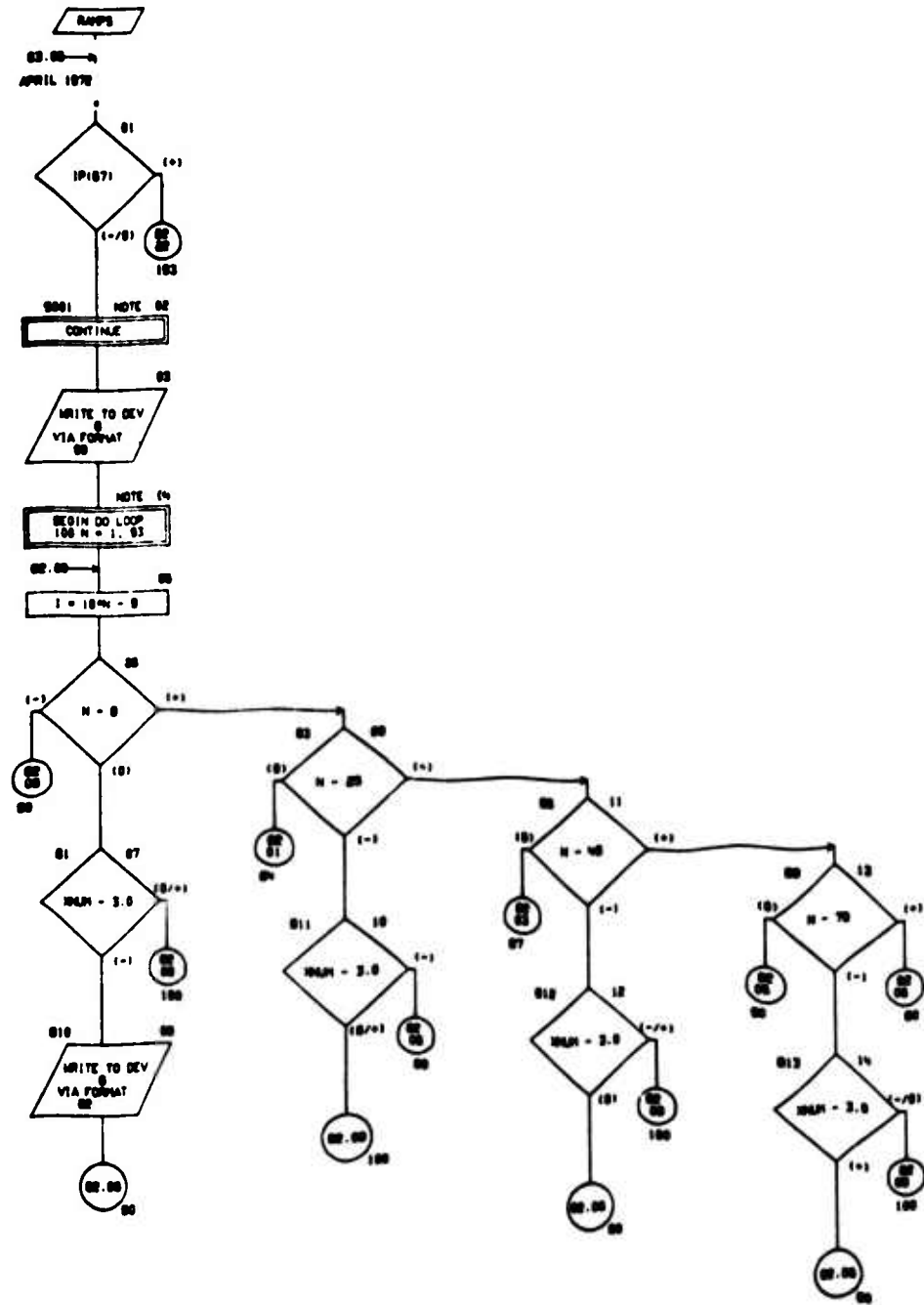
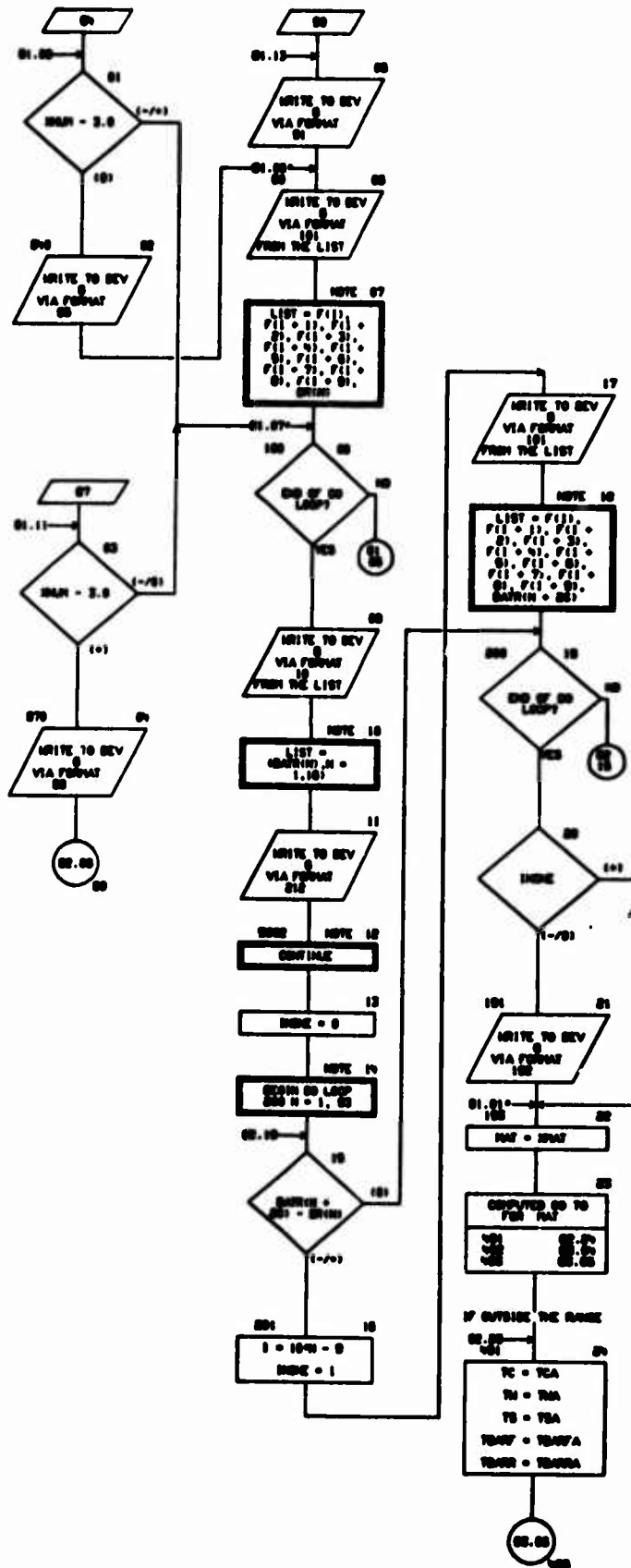
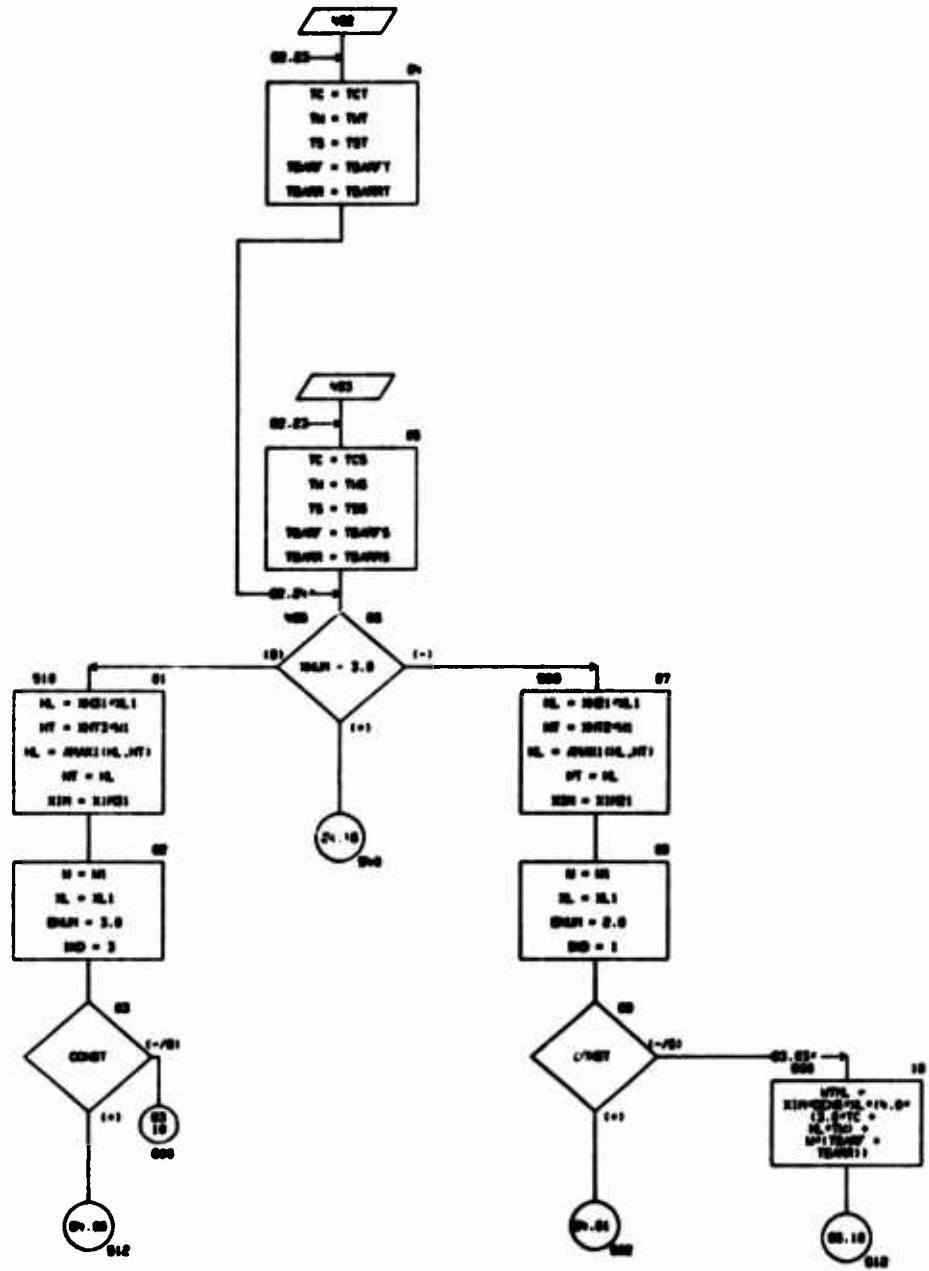


CHART TITLE - SUBROUTINE RAPP



CART TITLE - SUBROUTINE RAPP



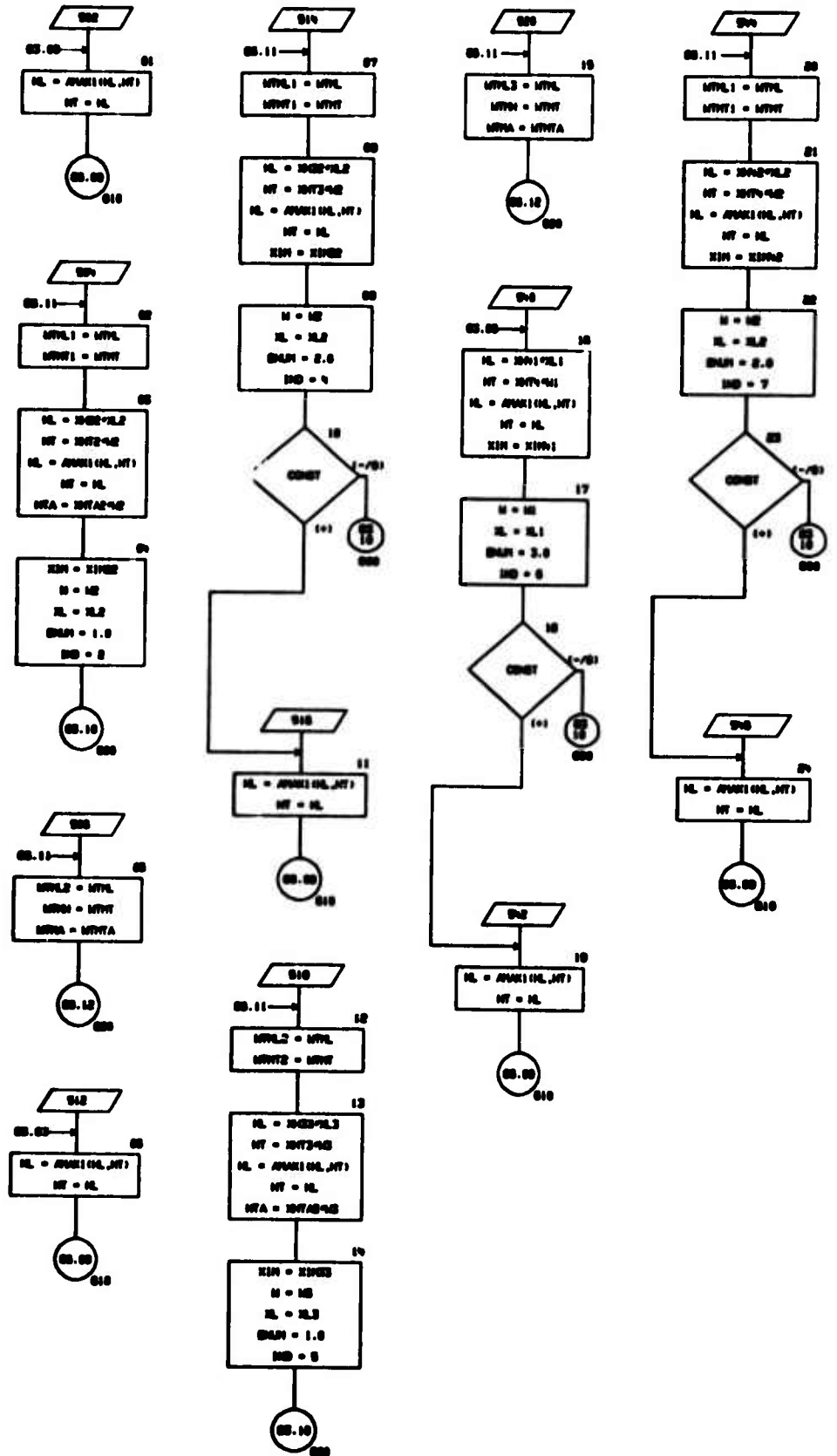


CHART TITLE - SUPERFLEX 800PS



CHART TITLE - SUBROUTINE RAPP

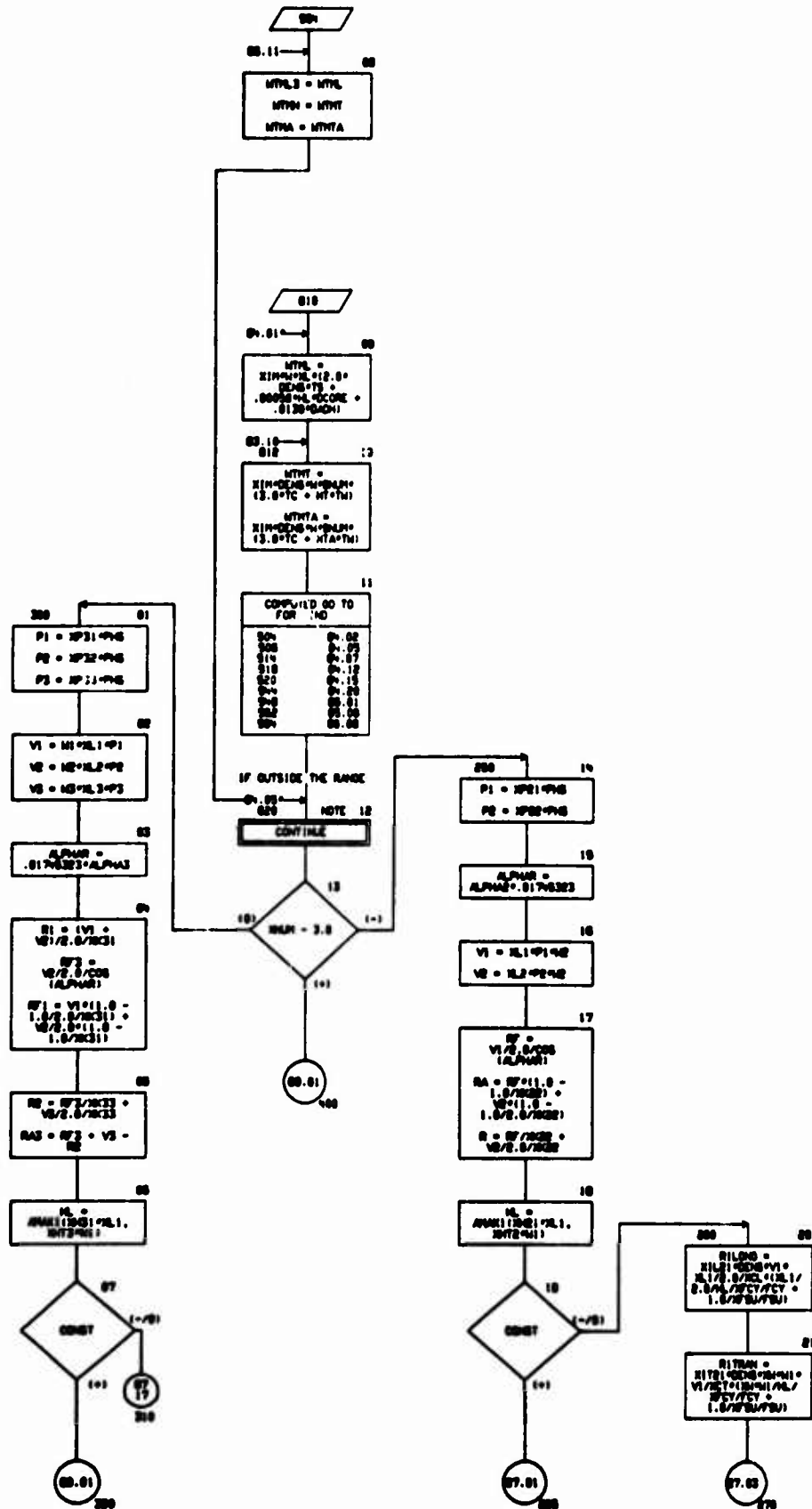
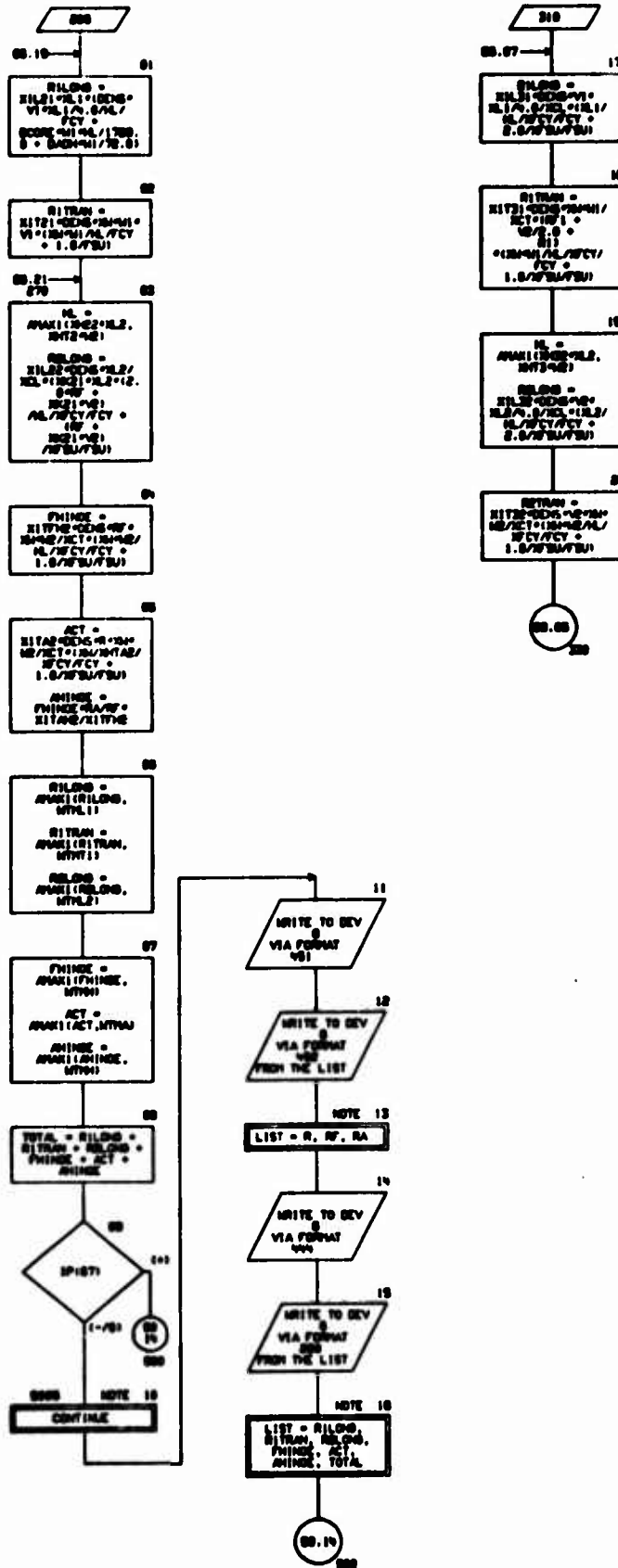


CHART TITLE - SUBROUTINE RAPP



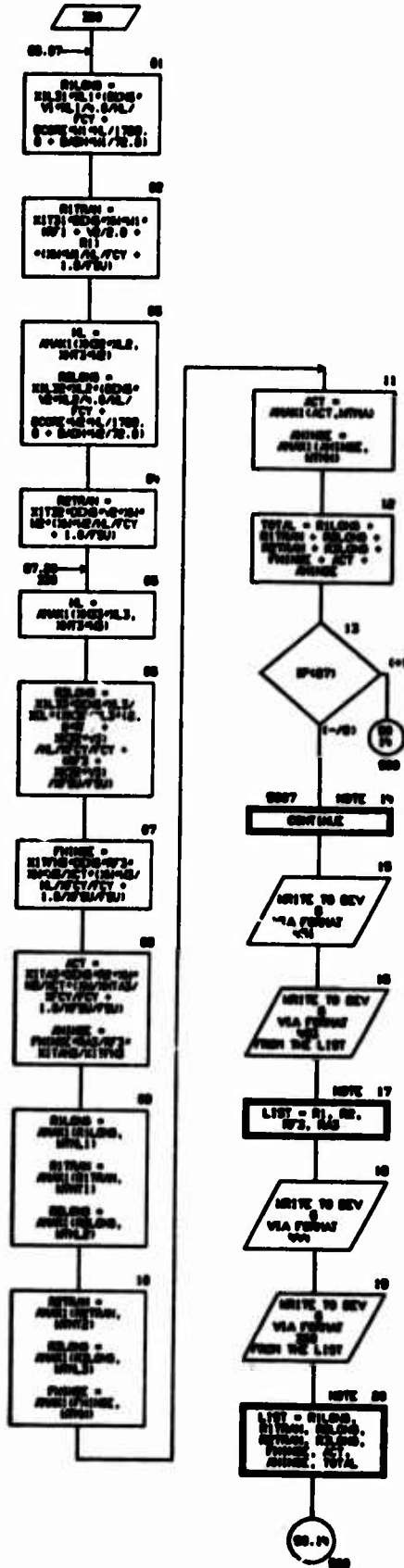
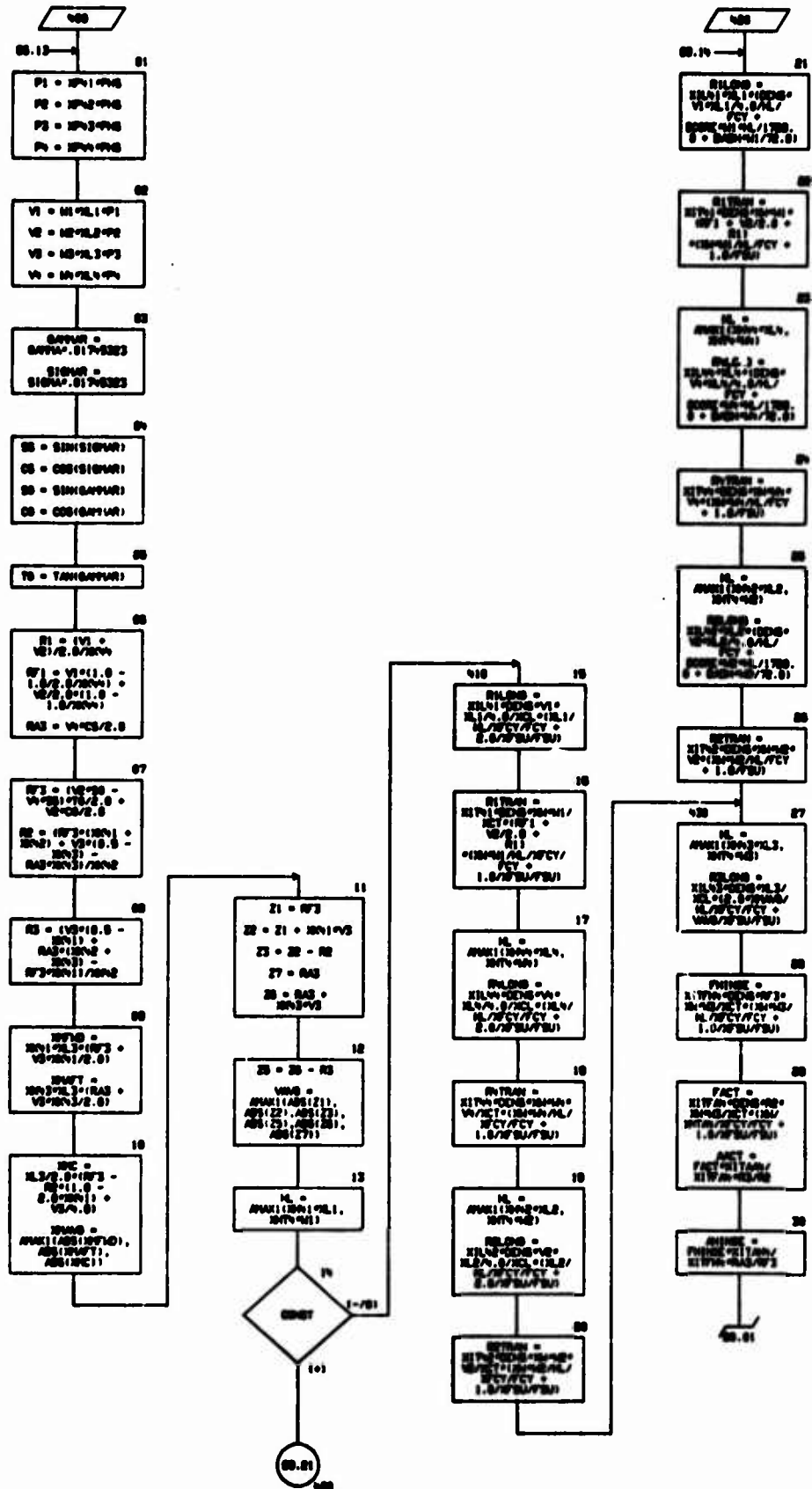
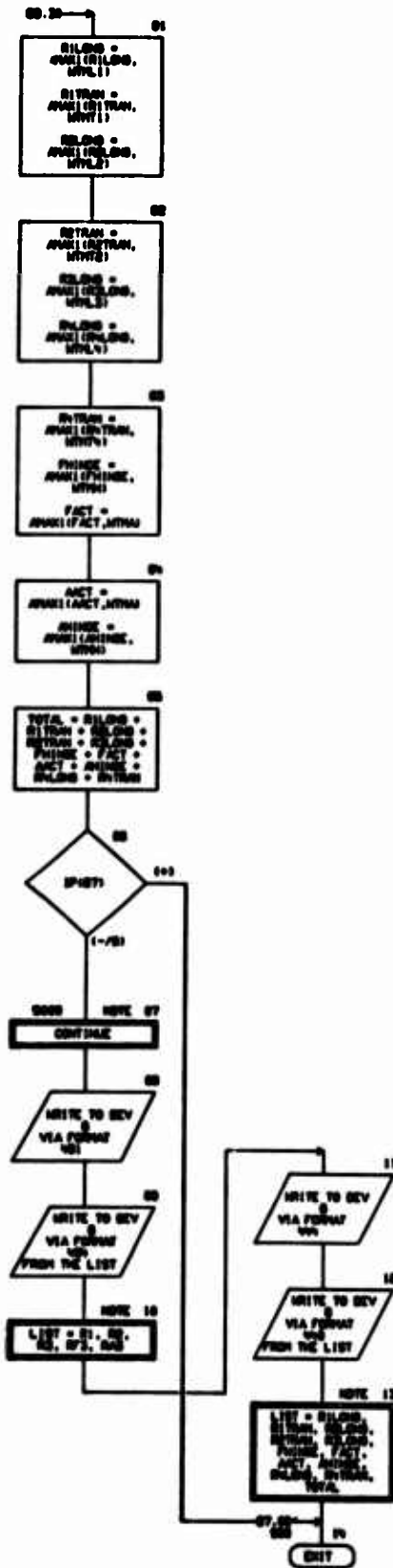


CHART TITLE - SUBROUTINE RAPP



CART TITLE - SUBROUTINE RAPP



CURT TITLE - NON-PROCEDURAL STATEMENTS

```

COPEN TCON400)
COPEN /PRINT/ IP(00)
DIMENSION B(2000), Y(2000), DC(100), ND(200)
DIMENSION F(60), BATH(120), BR(60), TITLE(20)
DIMENSION TOT(100)
EQUIVALENCE (B(1),TCON(1)),(Y(1),TCON200), (DC(1),TCON400),
             (ND(1),TCON400))
EQUIVALENCE (BATH(1),B40(1)), (BR(1),B(0)),
             (TITLE(1),B170), (F(1),B177))
EQUIVALENCE (X0M ,BATH( 1)), (C0M0T ,BATH( 2)),
             (P0S ,BATH( 3)), (X1L1 ,BATH( 4)), (X1L2 ,BATH( 5)),
             (X1L3 ,BATH( 6)), (X1L4 ,BATH( 7)), (M1 ,BATH( 8)),
             (M2 ,BATH( 9)), (M3 ,BATH(10)), (M4 ,BATH(11)),
             (FCY ,BATH(12)), (FBU ,BATH(13)), (GDS ,BATH(14)),
             (M0AT ,BATH(15)), (FCT ,BATH(16))
EQUIVALENCE (X1L ,BATH( 21)), (FCY ,BATH( 22)),
             (FBU ,BATH( 23)), (M ,BATH( 24)), (MCT ,BATH( 25)),
             (GDS ,BATH( 26)), (GDM ,BATH( 27)), (X1L01 ,BATH( 28)),
             (X1T01 ,BATH( 29)), (X1M01 ,BATH( 30)), (X1L02 ,BATH( 31)),
             (X1T02 ,BATH( 32)), (X1T03 ,BATH( 33)), (X1T04 ,BATH( 34)),
             (X1M02 ,BATH( 35)), (X1P01 ,BATH( 36)), (X1P02 ,BATH( 37)),
             (X1M03 ,BATH( 38)), (X1M04 ,BATH( 39)), (X1M05 ,BATH( 40)),
             (X1M06 ,BATH( 41)), (X1M07 ,BATH( 42)), (X1T05 ,BATH( 43)),
             (ALP01 ,BATH( 44)), (X1L03 ,BATH( 45)), (X1T03 ,BATH( 46)),
             (X1M01 ,BATH( 47)), (X1L02 ,BATH( 48)), (X1T02 ,BATH( 49))
EQUIVALENCE (X1M02 ,BATH( 50)), (X1L03 ,BATH( 51)),
             (X1T05 ,BATH( 52)), (X1T03 ,BATH( 53)), (X1T04 ,BATH( 54)),
             (X1M03 ,BATH( 55)), (X1P01 ,BATH( 56)), (X1P02 ,BATH( 57)),
             (X1P03 ,BATH( 58)), (X1C01 ,BATH( 59)), (X1C02 ,BATH( 60)),
             (X1C03 ,BATH( 61)), (X1M01 ,BATH( 62)), (X1M02 ,BATH( 63)),
             (X1C03 ,BATH( 64)), (X1M03 ,BATH( 65)), (X1T05 ,BATH( 66)),
             (ALP02 ,BATH( 67)), (X1L04 ,BATH( 68)), (X1T04 ,BATH( 69)),
             (X1M01 ,BATH( 70)), (X1L02 ,BATH( 71)), (X1T02 ,BATH( 72)),
             (X1M02 ,BATH( 73)), (X1L03 ,BATH( 74)), (X1T04 ,BATH( 75)),
             (X1T04 ,BATH( 76)), (X1T04 ,BATH( 77)), (X1T04 ,BATH( 78))
EQUIVALENCE (X1M03 ,BATH( 79)), (X1L04 ,BATH( 80)),
             (X1T04 ,BATH( 81)), (X1M04 ,BATH( 82)), (X1P01 ,BATH( 83)),
             (X1P02 ,BATH( 84)), (X1P03 ,BATH( 85)), (X1P04 ,BATH( 86)),
             (X0M1 ,BATH( 87)), (X0M2 ,BATH( 88)), (X0M3 ,BATH( 89)),
             (X0M4 ,BATH( 90)), (X0M1 ,BATH( 91)), (X0M2 ,BATH( 92)),
             (X0M3 ,BATH( 93)), (X0M4 ,BATH( 94)), (X0T01 ,BATH( 95)),
             (X0T01 ,BATH( 96)), (X0P01 ,BATH( 97)), (X0P01 ,BATH( 98)),
             (TCA ,BATH( 99)), (TMA ,BATH(100)), (TBA ,BATH(101)),
             (TBA01 ,BATH(102)), (TBA02 ,BATH(103)), (TCT ,BATH(104)),
             (TMT ,BATH(105)), (TST ,BATH(106)), (TBA01 ,BATH(107)),
             (TBA01 ,BATH(108)), (TCS ,BATH(109)), (TMS ,BATH(110)),
             (TSS ,BATH(111)), (TBA01 ,BATH(112)), (TBA01 ,BATH(113))
EQUIVALENCE (Y(101),TOT(1)),(Y(100),TOTAL),(TOT(0),X1L00),
             (TOT(0),X1TRAN),(TOT(0),X1L00),(TOT(0),X1TRAN),
             (TOT(0),X1L00),(TOT(0),X1M01),(TOT(0),X1ACT),
             (TOT(0),X1ACT,ACT),(TOT(0),X1M01),(TOT(0),X1L00),
             (TOT(0),X1TRAN)
EQUIVALENCE (ND(113),IPRT), (ND(0),IPAGE)
00  FORMAT(1H,10X,10HINPUT-IN PARAMETERS,END,END** RAPP - IP(07) **
      / 3)
02  FORMAT(1H,10H** 2 RAPP SYSTEM ** )
03  FORMAT(1H,10H** 3 RAPP SYSTEM ** )
04  FORMAT(1H,10H** 4 RAPP SYSTEM ** )
01  FORMAT(1H,10X,10H** MINIMUM GAGES **,END,
      END** RAPP - IP(07) ** )
101  FORMAT(10X,10H, F10.3 )
10  FORMAT(1H,10HINPUT DATA//
      10X,ENDNUMBER OF RAPP           /10.0/

```

CHART TITLE - NON-PROCEDURAL STATEMENTS

	IN,INDUCT NO (P-STD,1+CDP)	J10.0/
	IN,INDUCTOR PRESSURE (PSI)	J10.0/
	IN,INDUCT OF RUP 1 (IN)	J10.0/
	IN,INDUCT OF RUP 2 (IN)	J10.0/
	IN,INDUCT OF RUP 3 (IN)	J10.0/
	IN,INDUCT OF RUP 4 (IN)	J10.0/
	IN,INDUCT OF RUP 1 (IN)	J10.0/
	IN,INDUCT OF RUP 2 (IN)	J10.0/
	IN,INDUCT OF RUP 3 (IN)	J10.0/
	IN,INDUCT OF RUP 4 (IN)	J10.0/
	IN,INDUCT (PSI)	J10.0/
	IN,INDUCT (PSI)	J10.0/
	IN,INDUCT OF MATERIAL (LBS/IN)	J10.0/
	IN,INDUCT (1+L,0+T1,0+T)	J10.0/
	IN,INDUCT TO ULTIMATE FACTOR	J10.0/
010	FORMAT (IN,INDUCT TO BUILT-IN PARAMETERS)	
020	FORMAT (IN,INDUCT *)	
030	FORMAT (IN,INDUCT FORCES (LBS), IN,INDUCT * RUP 5 - 0+T) **	
	*)	
040	FORMAT (IN,INDUCT 2 ACTUATOR	J10.0/
	IN,INDUCT 2 FID HINGE	J10.0/
	IN,INDUCT 2 FT HINGE	J10.0/
050	FORMAT (IN,INDUCT HEIGHTS (LBS)/)	
060	FORMAT ( IN,INDUCT 1 - LONGITUDINAL	J10.0/
	IN,INDUCT 1 - TRANSVERSE	J10.0/
	IN,INDUCT 2 - LONGITUDINAL	J10.0/
	IN,INDUCT 2 - FORWARD HINGE	J10.0/
	IN,INDUCT 2 - ACTUATOR	J10.0/
	IN,INDUCT 2 - FT HINGE	J10.0/
	IN,INDUCTA HEIGHT	J10.0/
070	FORMAT (IN,INDUCT 1 ACTUATOR	J10.0/
	IN,INDUCT 3 ACTUATOR	J10.0/
	IN,INDUCT 3 FID HINGE	J10.0/
	IN,INDUCT 3 FT HINGE	J10.0/
080	FORMAT ( IN,INDUCT 1 - LONGITUDINAL	J10.0/
	IN,INDUCT 1 - TRANSVERSE	J10.0/
	IN,INDUCT 2 - LONGITUDINAL	J10.0/
	IN,INDUCT 2 - TRANSVERSE	J10.0/
	IN,INDUCT 3 - LONGITUDINAL	J10.0/
	IN,INDUCT 3 - FORWARD HINGE	J10.0/
	IN,INDUCT 3 - ACTUATOR	J10.0/
	IN,INDUCT 3 - FT HINGE	J10.0/
	IN,INDUCTA	J10.0/
090	FORMAT (IN,INDUCT 1 ACTUATOR	J10.0/
	IN,INDUCT 3 FID ACTUATOR	J10.0/
	IN,INDUCT 3 FT ACTUATOR	J10.0/
	IN,INDUCT 3 FID HINGE	J10.0/
	IN,INDUCT 3 FT HINGE	J10.0/
100	FORMAT ( IN,INDUCT 1 - LONGITUDINAL	J10.0/
	IN,INDUCT 1 - TRANSVERSE	J10.0/
	IN,INDUCT 2 - LONGITUDINAL	J10.0/
	IN,INDUCT 2 - TRANSVERSE	J10.0/
	IN,INDUCT 3 - LONGITUDINAL	J10.0/
	IN,INDUCT 3 - FORWARD HINGE	J10.0/
	IN,INDUCT 3 - FORWARD ACTUATOR	J10.0/
	IN,INDUCT 3 - FT ACTUATOR	J10.0/
	IN,INDUCT 3 - FT HINGE	J10.0/
	IN,INDUCT 4 - LONGITUDINAL	J10.0/
	IN,INDUCT 4 - TRANSVERSE	J10.0/
	IN,INDUCTA	J10.0/

CHART TITLE - INTRODUCTORY COMMENTS

\*\*\*\*\*  
SERIAL NO. 001  
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CHART TITLE - SUBROUTINE SP4

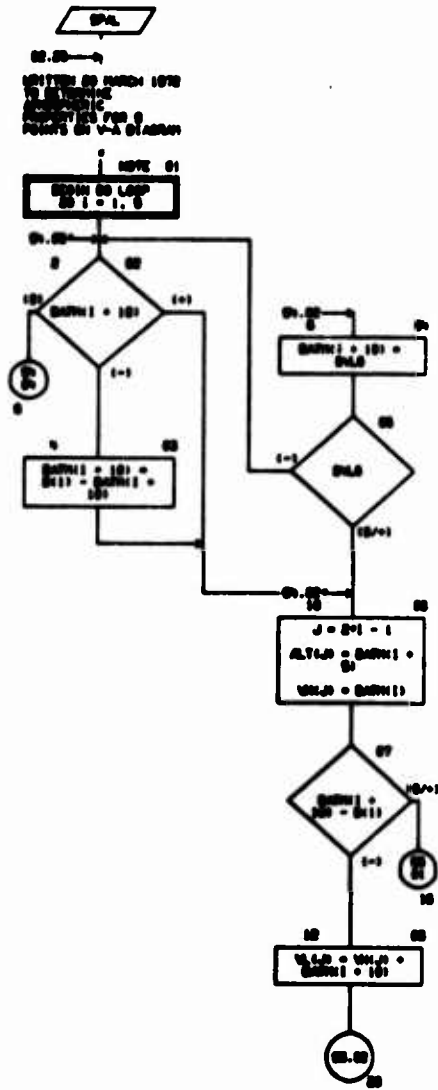
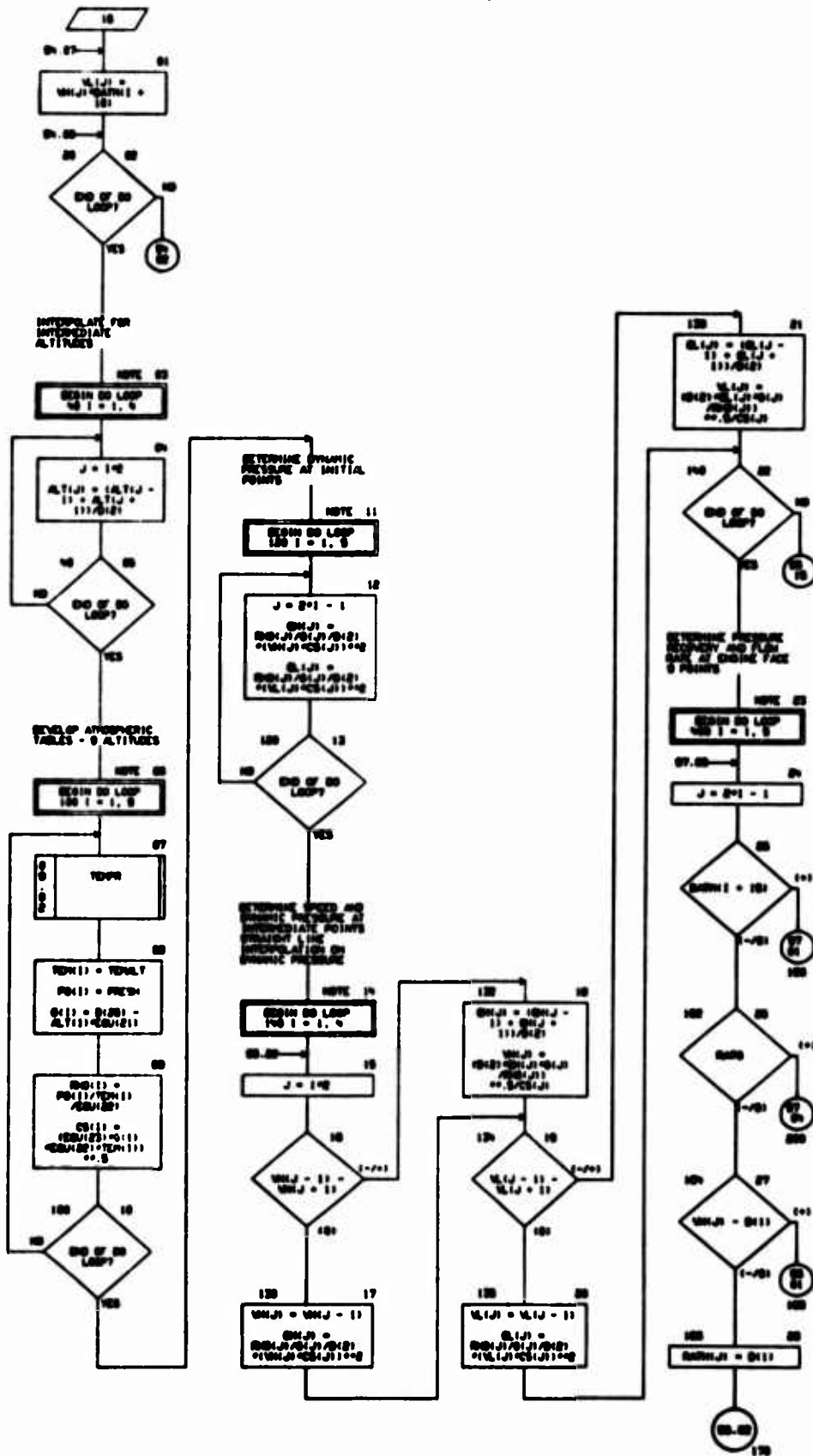


CHART TITLE - SUBROUTINE SPA







CURT TITLE - NON-FREEDAL STAYDOWN

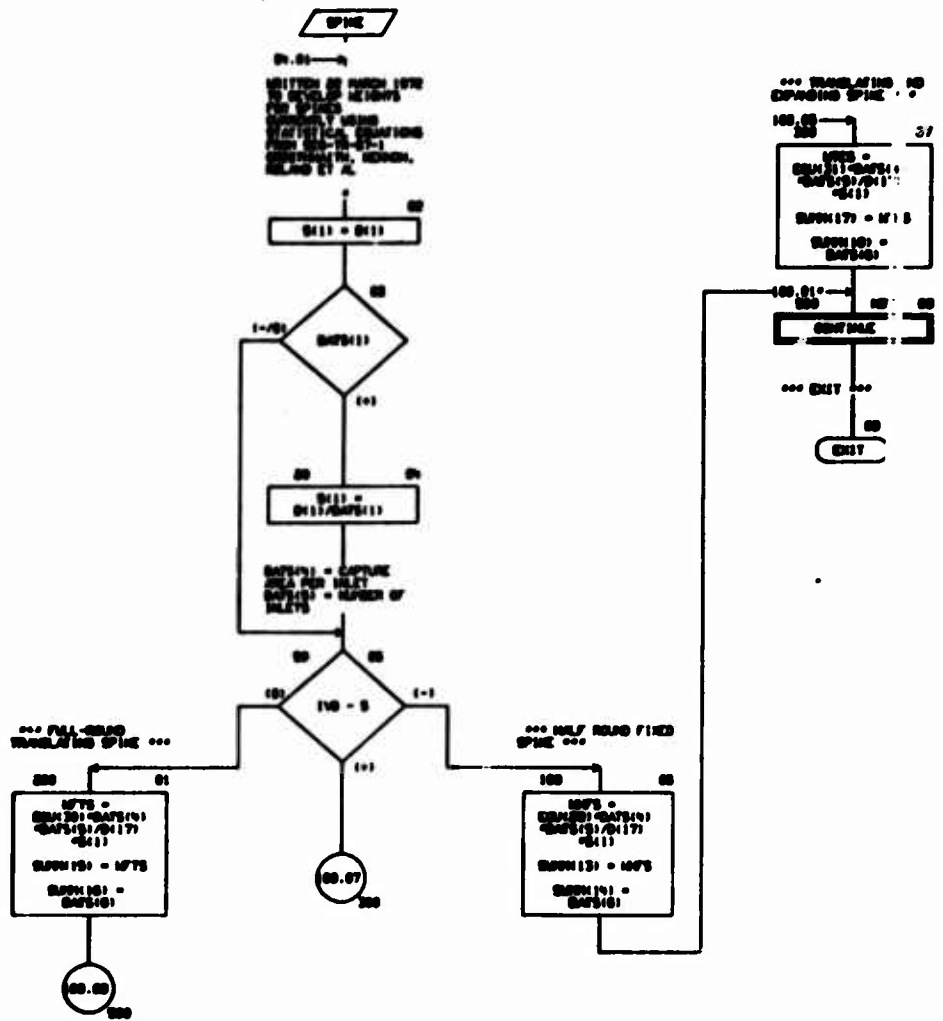
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COPEN /PFRM/ P100)
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CSECTION (M400)
CSECTION (I100)
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P0L10)
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CSECTION (I01),T0M10),T10),T0M000),SC10),T0M010),
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CSECTION (I01),B0M10)
CSECTION (I000),B0M10)
CSECTION (B0M3),D0L0),B0M3),B0)
CSECTION (I070),TITLE10)
CSECTION (T10),G10)
CSECTION (I01),T0M10),I040),P0E0)
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T100),G10),T100),CS10),T100),R010)
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T100),T0L10),T100),P0M10),T100),P0L10),
T100),P0M10),T100),P0L10)
CSECTION (M010),P0E0)
CSECTION (M010),I),M010),J)
1111 FORM100,B0L0,IN,1000 SPL - P100) **/R,B0L0)
00 FORM100,IN,30000 SPEED ALTITUDE PROFILE TABLES ***IN,
//IN,10000000 AIRSPACE//IN,0,ALTITUDE,IN,
TEMPERATURE,IN,WEEDSITY,IN,DEPTH,IN,IN,IN,
NUMBER OF CURTAIN,WEED,IN,IN,IN,IN,IN,IN,IN,
SDF,IN,DEPTH,IN,IN,DEPTH)
00 FORM100,P10.1,P10.2,IN,P10.7,P10.8,P11.3,P14.0)
00 FORM100//IN,1000000 TABLE//IN,
MULT,IN,00000,IN,0000,IN,000,IN,000/00,IN,
0000 T,IN,000,IN,000,IN,000,IN,000,IN,000,IN,000,IN,
000/00,IN,0000 T,IN,000,IN,000,IN,
WEED,IN,000,IN,000,IN,000,IN,000,IN,000,IN,000,IN,000,
IN,000,IN,000,IN,000,IN,000,IN,000,IN,000,IN,000,
00 FORM10.1,P0.2,P0.3,P0.4,P0.5,P0.6,P0.7,P0.8,P0.9,P0.0,
P0.1,P0.2,P0.3

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UNIT TITLE - INTRODUCTORY COMMENTS

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BIBLIOGRAPHY  
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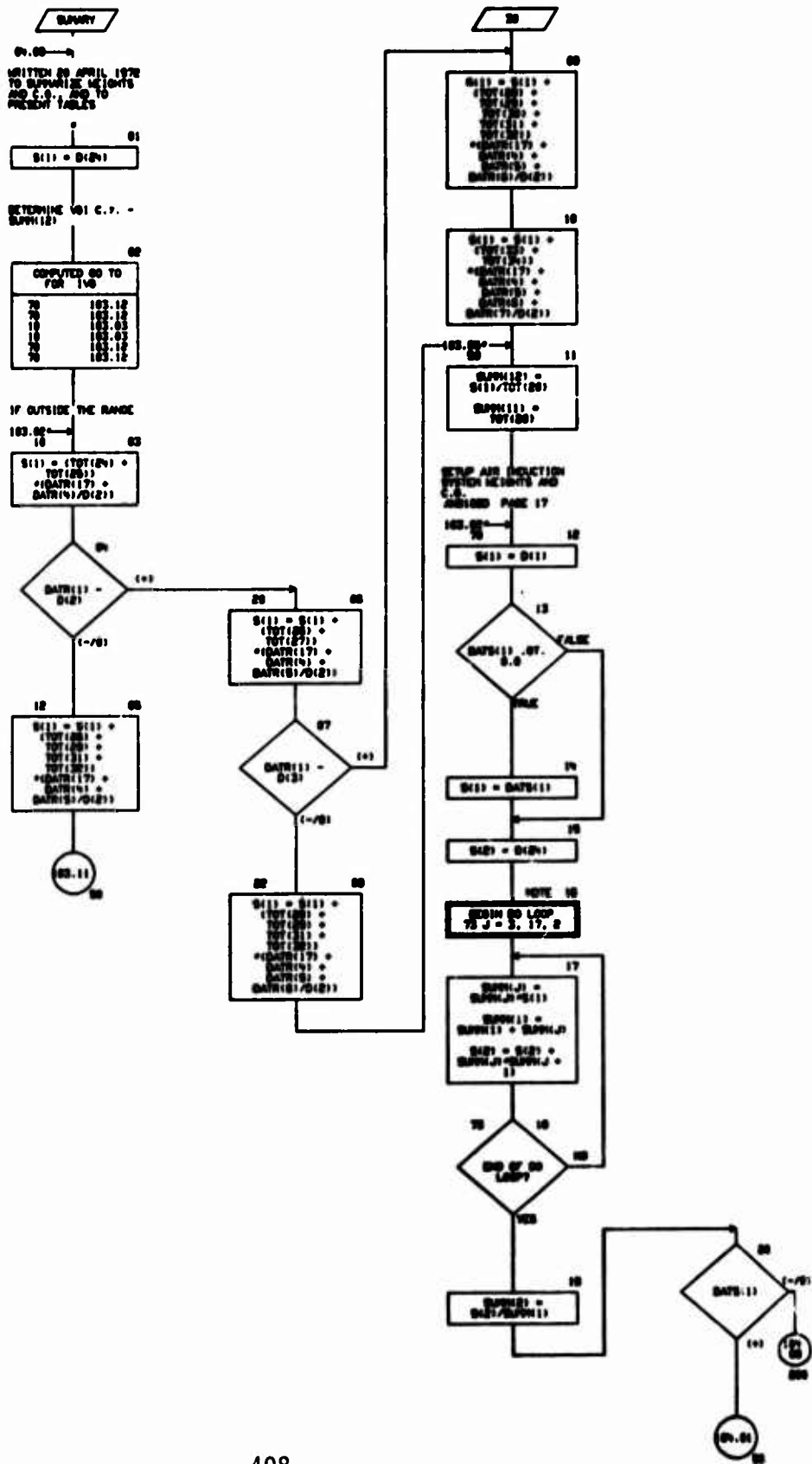
## CHART TITLE - NON-PROCEDURAL STATEMENTS

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GIVEN TCON(400)
DIMENSION S(2000),T(2000),BC(100),ND(200)
DIMENSION CU(200)
DIMENSION BATS(40)
DIMENSION SUPP(200)
DIMENSION S(100)
DIMENSION TOT(100)
EQUIVALENCE (S(1),TCON(1)),(T(1),TCON(200)),(BC(1),TCON(401)),
(ND(1),TCON(401))
EQUIVALENCE (S(0),CU(1))
EQUIVALENCE (S(20),BATS(1))
EQUIVALENCE (S(170),SUPP(1))
EQUIVALENCE (T(1),S(1))
EQUIVALENCE (T(10),TOT(1)),(TOT(30),MFTS),(TOT(30),MFTS),
(TOT(37),MFTS)
EQUIVALENCE (ND(12),140)
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CHART TITLE - INTRODUCTORY COMMENTS

.....  
SUBROUTINE SUAWY  
.....

CHART TITLE - SUBROUTINE SUPPLY







## CHART TITLE - NON-PROCEDURAL STATEMENTS

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OPEN TCON(400)
OPEN /HSC/ HISC(100)
OPEN /IPRINT/ IP(00)
DIMENSION B(2000),T(2000),SC(100),ND(200)
DIMENSION BATS(40),BATH(100)
DIMENSION TITLE(20)
DIMENSION SUPP(200)
DIMENSION S(100),TOT(100)
EQUIVALENCE (B(1),TCON(1)),(T(1),TCON(200)),(SC(1),TCON(101)),
(ND(1),TCON(401))
EQUIVALENCE (B(20),BATS(1)),(B(40),BATH(1))
EQUIVALENCE (B(70),TITLE(1))
EQUIVALENCE (B(170),SUPP(1))
EQUIVALENCE (T(1),S(1)),(T(101),TOT(1))
EQUIVALENCE (ND(10),NPAE)
EQUIVALENCE (ND(101),1),(ND(100),J)
EQUIVALENCE (ND(110),100)
EQUIVALENCE (ND(112),IPRT)
400 FORMAT(1H1,BA10,17H,10** SUPPLY **/1X,BA10//
ENR,STMA. 1. S. * ENGINE SECTION OR NACELLE GROUP HEIGHT * C.G. .
THUSMARY // ENR,BAT.,7H,WC.0.,ENR,BAT.,7H,WC.0. )
405 FORMAT(EN,ENHAR INDUCTION SYSTEM,T00,BF11.2/EN,11HINLET MEDG.
T00,BF11.2/ EN,11HAR DUCTING,T00,BF11.2 /
EN,ENHINTAKE DOORS * OP. MECHANISM,T00,BF11.2 /
EN,ENHYPASS DOORS * OP. MECHANISM,T00,BF11.2 /
EN,ENHVARIBLE GEOMETRY STRUCTURE,T00,BF11.2 /
EN,ENHHALF ROUND FIXED SPIKE,T00,BF11.2 /
EN,ENHFULL ROUND TRANSLATING SPIKE,T00,BF11.2 /
EN,ENHFULL ROUND * EXPND. SPIKE,T00,BF11.2 / )
408 FORMAT(EN,THINBOARD,10H,ENHOUTBOARD,10H,ENHTOTAL //
ENR,BAT.,7H,WC.0.,11H,BAT.7H,WC.0.,10H,BAT.7H,WC.0./
EN,10ENGINE HEARTS,T00,BF11.2,T00,BF11.2/
EN,10BALLHEADS * FRAMES,T00,BF11.2,T00,BF11.2/
EN,ENHCOVERING * STIFFENERS,T00,BF11.2,T00,BF11.2/
EN, ENHCLAMPERS,T00,BF11.2,T00,BF11.2/
EN, ENHFITTINGS, T00,BF11.2,T00,BF11.2/
EN, ENHPLANS,T00,BF11.2,T00,BF11.2/
EN, ENHREBALL,T00,BF11.2,T00,BF11.2 /
EN, ENHROD,T00,BF11.2,T00,BF11.2 /
EN,10TOTAL,ENR,SEC./WC.GROUP,T00,BF11.2,T00,BF11.2,T00,BF11.2/)
409 FORMAT(ENHACCESS DOORS,T00,BF11.2 /
EN, 10ENGINE DOORS,T00,BF11.2/ EN,10EXTERIOR FINISH,T00,BF11.2/
EN,10TOTAL HISC,T00,BF11.2 //
EN,10TOTAL,ENR,SEC./WC.GROUP * HISC,T00, BF11.2 )
500 FORMAT(1H1,BA10,17H,10** SUPPLY **/1X,BA10)
505 FORMAT(10H,ENR,47H * * P R O P U L S I O N   G R O U P   * * *
/ ENR, ENR----- )
510 FORMAT(10H, 17H, ENHAR INDUCTION SYSTEM, T00, BF12.2 / ENR,
11HINLET MEDG. T07, BF12.2 / ENR, 11HAR DUCTING, T07, BF12.2 /
ENR, ENHINTAKE DOORS * OPERATING MECHANISM, T07, BF12.2 /
ENR, ENHYPASS DOORS * OPERATING MECHANISM, T07, BF12.2 / ENR,
ENHVARIBLE GEOMETRY STRUCTURE, T07, BF12.2 )
515 FORMAT (10H, ENR, ENHHALF ROUND FIXED SPIKE, T07, BF12.2 )
520 FORMAT(10H,ENR,ENHFULL ROUND TRANSLATING SPIKE,T07,BF12.2)
525 FORMAT (10H, ENR, ENHFULL TRANSLATING * EXPANDING SPIKE,T07,BF12.2)
530 FORMAT(10H, ENR, ENHENGINE SECTION OR NACELLE
GROUP, / ENR, ENR-----
-----, //
T00,THINBOARD,T00,ENHOUTBOARD,T00,ENHTOTAL)
535 FORMAT(10H, 17H, 10ENGINE HEARTS, T00, BF12.2 )
540 FORMAT(10H, 17H, 10NACELLE STRUCTURE / ENR, 10BALLHEADS * FRAMES
T00, BF12.2 / ENR, ENHCOVERING * STIFFENERS, T00, BF12.2 /
ENR, ENHCLAMPERS, T00, BF12.2 / ENR, ENHFITTINGS, T00, BF12.2 )

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CURT TITLE - NON-PROCEDURAL STATEMENTS

020 FORMING, 17K, @PFLN, 700, @12.2 / 140, 17K, @FINMALL, 700,  
 @12.2 / 140, 17K, @PFLS, 700, @12.2 )  
 040 FORMING, 17K, @TOTAL .....  
 700, @12.2 / )  
 040 FORMING, 17K, @SBS + MISCELLANEOUS / @N, @SBS / @N,  
 @SBS, 700, @12.2 / @N, @SBS, 700, @12.2 / 140, 17K,  
 @EXTERIOR FINISH, 700, @12.2 / 140, 17K,  
 @TOTAL @SBS + MISCELLANEOUS ..... 700, @12.2 )  
 060 FORMING/140, 17K, @TOTAL @ONE SECTION OR @ACCLE GRP, @N,  
 @N ..... 700, @12.2 )

CHART TITLE - INTRODUCTORY COMMENTS

.....  
SERIAL NO. 1000  
.....

CHRT TITLE - SERVICING T800

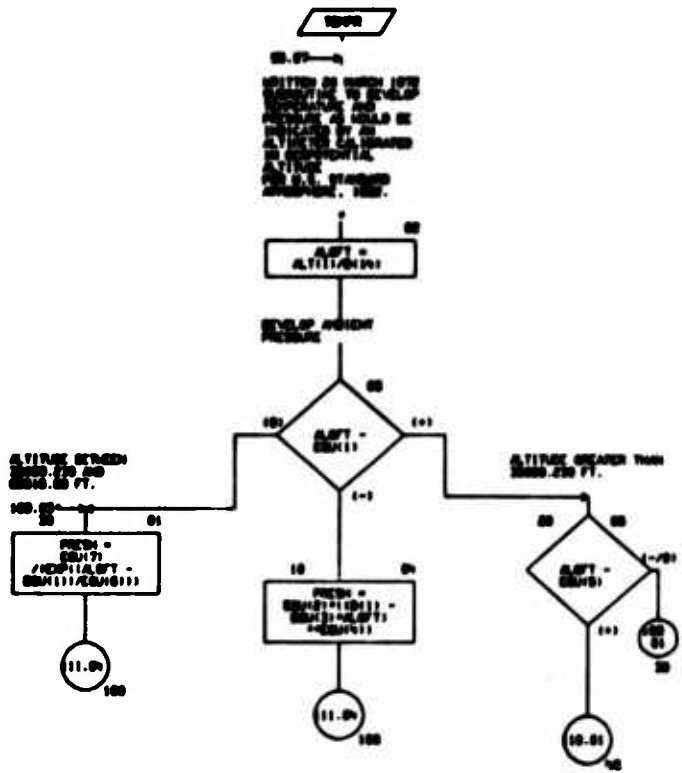
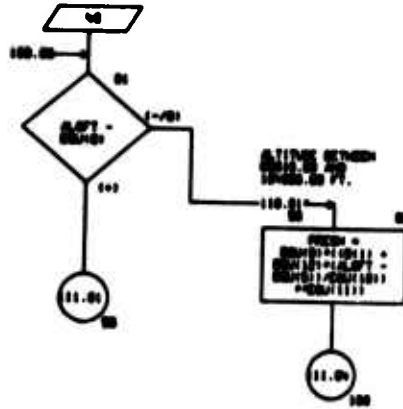


CHART TITLE - SUBROUTINE 1000



CHRT TITLE - SUBROUTINE TEMP

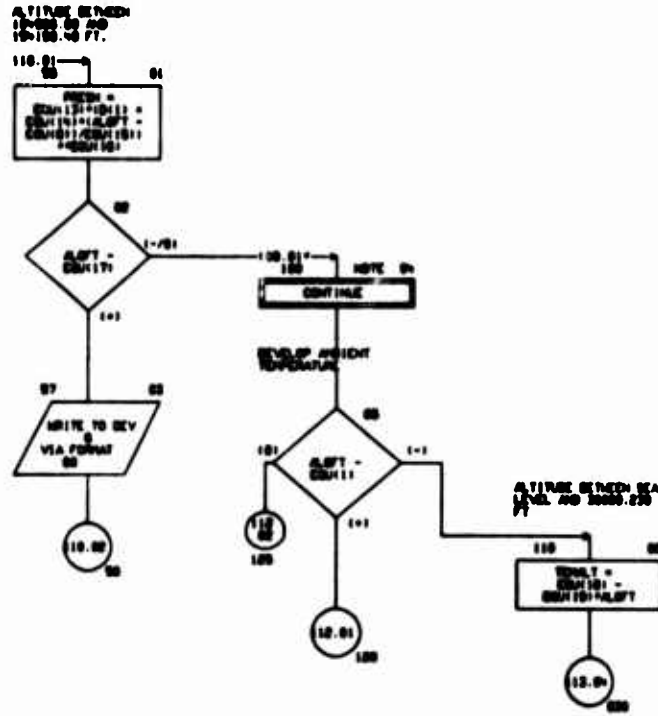
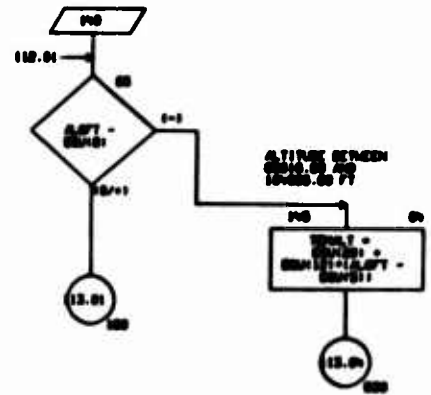
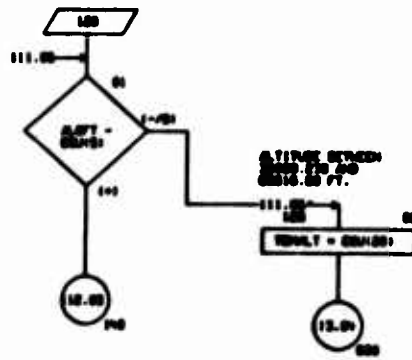


CHART TITLE - SURFACE TOWN



PROGRAM TITLE: DEEP AIR INDUCTION SYSTEM

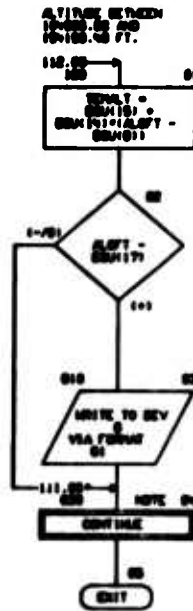


CHART TITLE - NON-PROCEDURAL STATEMENTS

```

000001 T00N400)
000002 DIMENSION D(1000),T(1000),SC(100),JD(100)
000003 DIMENSION SM(100)
000004 DIMENSION S(100)
000005 EQUIVALENCE (S(1),T00N1), (T(1),T00N100), (SC(1),T00N101),
000006 (JD(1),T00N102)
000007 EQUIVALENCE (S(10),T00N11)
000008 EQUIVALENCE (T(1),S(1))
000009 EQUIVALENCE (S(1),T00N1), (S(2),T00N2), (S(3),T00N3)
000010 DIMENSION ALT(10)
000011 EQUIVALENCE (T(10),ALT(1))
000012 EQUIVALENCE (JD(10),I)
01 FORMATTING,SH,SD*** MARKING MESSAGE ***,IGN.
02 %MULTIPLY IS BEYOND VALID RANGE OF PRESSURE
03 FORMATTING,SH,SD*** MARKING MESSAGE ***,IGN.
04 %MULTIPLY IS BEYOND VALID RANGE OF TEMPERATURE

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FORTRAN LISTING  
OF  
AIR INDUCTION SYSTEM MODULE

FORTRAN MODULE (LIST,AUTOGEN)

CARD NO	****	CONTENTS	****
1	C		
2	C	*****	
3	C	PROGRAM A150N	
4	C	*****	
5	C		
6		PROGRAM A150N	00010000
7	C	** AIR INDUCTION SYSTEM, NOELLE AND ENGINE SECTION	00010010
8	C	CONTROL ROUTINE **	00010020
9	C	WRITTEN 22 MARCH 1972	00010030
10	C		00010040
11		CONVEN TCON(400)	00010050
12		CONVEN /NISC/2NISC(100)	
13	C		
14		CONVEN /IPRINT/ IP(00)	
15	C		00010060
16		CONVEN /FBATT/ FBAT(00)	
17	C		
18		DIMENSION SUPN(200)	
19		DIMENSION D(2000),T(2000),DC(100),ND(200)	00010070
20		DIMENSION TND(200),JN(20)	00010080
21		DIMENSION BATS(40)	00010090
22		DIMENSION TOT(100)	00010100
23		DIMENSION BATR(120),BR(00)	00010110
24		DIMENSION BARK(10)	00010120
25		DIMENSION F(000)	00010130
26	C		00010140
27		EQUIVALENCE (D(170),SUPN(1))	
28		EQUIVALENCE (D(1),TCON(1)),(T(1),TCON(200)),(DC(1),TCON(40)),	00010150
29		(ND(1),TCON(40))	00010160
30		EQUIVALENCE (D(20),BATS(1))	00010170
31		EQUIVALENCE (D(40),BATR(1)),(D(41),BR(1))	00010180
32		EQUIVALENCE (D(27),BARK(1))	
33		EQUIVALENCE (D(77),F(1))	00010190
34		EQUIVALENCE (T(10),TOT(1))	00010210
35		EQUIVALENCE (T(100),TND(1)),(TND(200),JN(1))	00010220
36		EQUIVALENCE (ND(0),JN(0))	00010230
37		EQUIVALENCE (ND(0),JN(0))	00010240
38		EQUIVALENCE (ND(01),JF(1)),(ND(02),JF(2)),(ND(03),JF(3)),(ND(04),JF(4))	00010250
39		EQUIVALENCE (ND(111),JTP(1)),(ND(112),JTV(1))	00010260
40		EQUIVALENCE (ND(113),JPT(1))	00010270
41	C		00010280
42		REMARK 24	
43	C		
44		BUFFER INH(4,1)(TCON(1),TCON(40))	
45	C		
46		IF UNIT(4)=1010,1010,1010	
47	C		00010290
48	C	CLEAR CORE *** DO NOT EQUIVALENCE '1' ***	00010370
49		1010 DO DO 1=1,400	00010380
50		TCON(1) = 0.0	00010390
51		DO CONTINUE	00010400
52	C		
53		ISML = 2NISC(1)	
54	C		
55	C	.....	00010500
56		40 WRITE(6,00)	00010700
57		00 FORMAT(10H)	00010710
58	C	.....EJECT PAGE BEFORE CASE DATA DO	00010720
59	C	ERRORS OR DO ON NEW PAGE.	00010730
60	C	READ NOELLE AND AIS CASE DATA	00010770
61		CALL READN(1,41),2000,20)	
62	C	.....	00010780
63		IF (IP(0))=0000,0000,0000	
64		DOO CONTINUE	
65		WRITE(6,100)(NISC(100),N=00,100)	
66		1001 PERM(100,000,000) A150N = IP(0) **/00N,0A10/00N,0A10)	
67		WRITE(6,1000)	00010800
68		1000 PERM(100,000,000) AIR INDUCTION SYSTEM DATA)	
69		WRITE(6,1000)(DATA(1),I=1,10)	00010820
70		1000 PERM(100,1000)PERM OF NOELLES, TON, FB, I /	00010830

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CARD NO      *****      CONTENTS      *****
71          1 16X, 18-BYPASS RATIO, T02, F10.2 /      00010070
72          2 27X, 3-4-11, 4-FINED DUCT 2, 4-FINED SPINE /      00010080
73          3 16X, 4-8-INLET TYPE (3, 4-HORIZ, RAMP 4, 4-VERT, RAMP 1, T02, F0.1 / 00010090
74          4 27X, 3-4-11, 4-TRAMEL, SPINE 6, 4-CPND, SPINE /      00010090
75          5 16X, 28-CAPTURE AREA PER INLET, T02, F10.2 /      00010010
76          6 16X, 28-NUMBER OF INLETS PER AIR VEHICLE, T02, F0.1 /      00010020
77          7 16X, 4-8X DISTANCE OF THROAT FROM L.E. OF COAL OR LIP, T02, F11.3 / 00010030
78          8 16X, 17-NUMBER OF ENGINES, T02, F0.1 /      00010040
79          9 16X, 17-THRUST PER ENGINE, T02, F10.2 /      00010050
80          A 16X, 17-LENGTH PER ENGINE, T02, F11.3 /      00010060
81          B 16X, 18-LENGTH OF ENGINE, T02, F11.3 /      00010070
82          C 16X, 18-DIAMETER OF ENGINE, T02, F11.3 /      00010080
83          D 16X, 28-ENGINE C.O., DISTANCE AFT OF FACE, T02, F11.3 /      00010090
84          E 16X, 28X AT COAL OR LIP, SET 1, T02, F11.3 /      00011000
85          F 16X, 28X AT ENGINE FACE, SET 1, T02, F11.3 /      00011010
86          G 16X, 28X AT ENGINE FACE, SET 1, T02, F11.3 /      00011020
87          H 16X, 28X AT COAL OR LIP, SET 2, T02, F11.3 /      00011030
88          I 16X, 28X AT ENGINE FACE, SET 2, T02, F11.3 /      00011040
89          J 16X, 28X AT ENGINE FACE, SET 2, T02, F11.3 /      00011050
90          WRITE(6,1005) (DATS(1), 1-20,20)      00011060
91          1005 FORMAT( 16X, 28-ANALOGUE SHEEP OF PYLON, T02, F10.2 /      00011070
92          1 16X, 4-8-MOUNTING TYPE (0, 4-VERT, 1, 4-HORIZ) 18-PYLON, T02, F0.1 /      00011080
93          2 16X, 28-ANALOGUE CHORD OF INBOARD PYLON, T02, F10.2 /      00011090
94          3 16X, 28-SPAN OF INBOARD PYLON, T02, F10.2 /      00011100
95          4 16X, 28-ANALOGUE CHORD OF OUTBOARD PYLON, T02, F10.2 /      00011110
96          5 16X, 28-SPAN OF OUTBOARD PYLON, T02, F10.2 /      00011120
97          A 16X, 28-PYLON THICKNESS TO CHORD RATIO, T02, F11.3 /      00011130
98          B 16X, 4-8-AUXILIARY INLET AREA PER MACELLE OR AIR VEHICLE,      00011140
99          C      T02, F11.3 /      00011150
100         D 16X, 4-8-DUCT BYPASS AREA PER MACELLE OR AIR VEHICLE, T02, F11.3 / 00011160
101         WRITE(6,1007) (DATS(1), 1-20, 33), DATS(30), DATS(30), DATS(37)      00011170
102         * , DATS(1), DATS(2), DATS(3), DATS(4)      00011180
103         1007 FORMAT( 16X, 28-AREA OF MISCELLANEOUS DOORS, T02, F11.3 /      00011190
104         1 16X, 28-DOOR INDICATOR (0, 4-1, 4-YES-CALC, 0, 1, 4-DOOR AREA),      00011200
105         2      T02, F11.3 /      00011210
106         3 16X, 28-MATERIAL NUMBER FOR DUCTS, T02, F0.1 /      00011220
107         4 16X, 28-MATERIAL NUMBER FOR RAPP, T02, F0.1 /      00011230
108         5 16X, 28-MATERIAL NUMBER FOR MACELLES, T02, F0.1 /      00011240
109         6 16X, 28-PRINT CHOICE (1, 4-1IN, 2, 4-ADD SPD, PRP, ... 4, 4-4X, 1,      00011250
110         7      T02, F0.1 /      00011260
111         8 16X, 28-ITCHING ACCELERATION, T02, F11.3 /      00011270
112         9 16X, 28-NOMINAL LOAD FACTOR, T02, F10.2 /      00011280
113         A 16X, 18X FACTORS... *FACTS=, F0.2, 2X, *FRAMES=, F0.2, 2X, *COVERS=,      00011290
114         B F0.2, 2X, 18-LENGTHS=, F0.2 )      00011300
115         0004 CONTINUE
116         C .....      00011310
117         C ** SETUP INDICATORS AND COUNTERS **      00011320
118         ITP = DATS(1)      00011330
119         IVG = DATS(3)      00011340
120         C DEVELOP SPEED PROFILE DATA      00011350
121         IF (DATS(10) .EQ. 00, 00)
122         GO IF (DATS(10) .EQ. 00, 102)
123         GO CALL SPAL      00011370
124         CALL MENTL1      00011380
125         CALL 000P      00011390
126         GO TO (300, 200, 100, 100, 200, 200), IVG      00011400
127         C TO READ IN PRESSURES AND LOADS BYPASS PRECIT D(4) MUST BE POSIT
128         100 IF (DATS(10)) 101, 101, 102
129         101 CALL PRECIT
130         102 CALL RAPP
131         C TO GO RAPP ONLY D(4) MUST HAVE POSITIVE VALUE.
132         IF (DATS(10) .GT. 0.0) GO TO 101B
133         C PUT RAPP VALUES IN PER MACELLE (FOR A.V. IF INTERNAL) FORM      00011430
134         T(1) = DATS(5)      00011440
135         IF (DATS(11) .GT. 0.0) T(1) = DATS(5) / DATS(11)      00011450
136         TOT(20) = TOT(20) + T(1)      00011460
137         GO 140 (4, 3)      00011470
138         140 TOT(1) = TOT(1) + T(1)      00011480
139         GO TO 700      00011490
140         C      00011500
141         000 CALL SPINE      00011510

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03/25/74	INPUT LISTING	AUTOFLON CHART SET - SHEEP	AIR INDUCTION SYSTEM MODULE
CARD NO	****	CONTENTS	****
142	200 CALL SUCTS		0011000
143	IF(BAT(1)) 200,200,210		0011000
144	310 CALL NUCELE		0011000
145	200 CALL NISCON		0011000
146	IF(BAT(1)) 400,400,270		0011000
147	270 CALL PFL08		0011070
148	400 CONTINUE		0011000
149	CALL SUPPLY		0011000
150	C		
151	1010 FBAT(51) = SUPPLY 11		
152	FBAT(52) = SUPPLY 21		
153	FBAT(53) = SUPPLY 37		
154	FBAT(54) = SUPPLY 50		
155	FBAT(55) = SUPPLY 73		
156	FBAT(56) = SUPPLY 75		
157	FBAT(57) = SUPPLY 70		
158	C		
159	C		
160	REXIND 24		
161	C		
162	BUFFER OUT (24,1)(TCOM(1),TCOM(400))		
163	C		
164	IF(NUNIT(2))1000,1000,1000		
165	C		
166	1000 CONTINUE		
167	END		0011000
168	C		
169	C		
170	C	SUBROUTINE OCT020	
171	C	))	
172	C		
173		SUBROUTINE OCT020	0010010
174	C	WRITTEN 23 MARCH 1972	0010000
175	C	TO DEVELOP SUCT GEOMETRY	0010000
176	C		0010000
177	C	COMMON TCOM(400)	0010000
178	C		0010000
179		DIMENSION O(2000),Y(2000),DC(100),ND(200)	0010070
180		DIMENSION BATH(50)	0010000
181		DIMENSION O(100)	0010000
182		DIMENSION MD(10),MED(10),DOD(10),BLD(10),BLD(10),ROD(10)	0010010
183		DIMENSION BLMD(10),BFD(10)	0010010
184	C		0010010
185		OSUWALDICE (O(1),TCOM(1)),(Y(1),TCOM(200)),(O(1),TCOM(410)),	0010010
186		(ND(1),TCOM(400))	0010010
187		OSUWALDICE (O(20),BATH(1))	0010010
188		OSUWALDICE (Y(1),O(1))	0010010
189		OSUWALDICE (Y(51),MD(1)),(Y(52),ROD(1)),(Y(53),DOD(1)),	0010010
190		(Y(54),BLD(1)),(Y(55),BLD(1)),(Y(56),MED(1))	0010010
191		OSUWALDICE (Y(57),BLMD(1)),(Y(58),BFD(1))	0010010
192		OSUWALDICE (ND(10),1),ND(10),J)	0010020
193		OSUWALDICE (ND(11),100),ND(11),NC),ND(11),NC)	0010020
194	C		0010000
195	C	SETUP INDICATORS AND COLORS	0010020
196		IF(1 - NC) 10,20,20	0010000
197	C	SHAPE CODE IS 2 DEVELOP PERIMETER	0010020
198		10 GO TO 1=1,NC	0010000
199		IF(BATH(1-50)) 19,19,12	0010070
200		12 BATH(1-50) = BATH(1-50)+BATH(1-50) + BATH(1-50)+O(15)/O(2)	0010000
201		15 CONTINUE	0010000
202	C	FIT SHAPES	0010030
203		20 GO TO 1=1,NC	0010030
204		IF(BATH(1-50)) 20,20,100	0010030
205	C	PERIMETER IS ZERO CHECK ON GUIDE	0010030
206		20 IF(BATH(1-50)) 24,24,22	0010000
207	C	VERTICAL LIP (INDIC MEDIC)	0010030
208		22 100 = 1	0010030
209		BATH(1-50) = BATH(1-50)	0010070
210		GO TO 200	0010030
211		24 IF(BATH(1-50)) 20,20,20	0010030
212		20 WRITE(6,00)	0010000

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03/20/74      INPUT LISTING      AUPFLIN CHART SET - SHEP      AIR INDUCTION SYSTEM NOBLE

CARD NO      ****      COMMENTS      ****

213      00      FORMAT WARNING FROM DETECTED IN AIR INDUCTION SYSTEM / 30K.      00120410
214      1      SELECT LIP GEOMETRY ERROR      00120400
215      C      HORIZONTAL LIP (UPPER L.E.)      00120430
216      20      100 = 2      00120440
217      DATD(1+00) = DATD(1+00)      00120400
218      GO TO 200      00120400
219      100      S(1) = D(1)      00120470
220      S(2) = (D(2)*(DATD(1+00) + DATD(1+00)) - DATD(1+00)) /      00120400
221      (D(2) - D(2)*D(1))      00120400
222      IF(S(2)) 101,101,102      00120000
223      101      S(1) = DATD(1+00)/(D(2)*(DATD(1+00) + D(2)*DATD(1+00))      00120510
224      S(2) = D(2)      00120000
225      C      00120030
226      C      ERROR MESSAGE      00120040
227      GO TO 1000      00120000
228      100      S(4) = APM1(DATD(1+00),DATD(1+00))      00120000
229      S(5) = APM1(DATD(1+00),DATD(1+00))      00120010
230      IF(S(5)) 101,101,110      00120000
231      100      S(2) = S(5)/D(2)      00120030
232      S(1) = DATD(1+00)/(D(2)*(D(1)*S(2) + S(4) - D(2)*S(2)))      00120040
233      C      00120000
234      C      ERROR MESSAGE      00120000
235      1000      WRITE(6,00) 1, S(1)      00120070
236      00      FORMAT WARNING FROM DETECTED IN AIR INDUCTION SYSTEM / 14K.      00120000
237      1      SECTION. 112. 40K IS RECTANGLE OR REDUCED RECT., CORRECTION 1000:20000      00120000
238      2      170.3      00120700
239      110      S(0) = (DATD(1+00) - D(2)*S(2))*S(1)/D(2)      00120710
240      S(3) = (DATD(1+00) - D(2)*S(2))*S(1)/D(2)      00120700
241      IF(S(0)) 111,112,112      00120730
242      111      S(0) = D(2)      00120740
243      112      IF(S(2)) 114,115,115      00120700
244      114      S(2) = D(2)      00120700
245      110      MOD(1) = S(0)      00120770
246      MOD(1) = S(2)*S(1)      00120700
247      MOD(1) = S(2)      00120700
248      SLD(1) = D(2)*MOD(1) + D(1)*D(2)*MOD(1)      00120000
249      SLD(1) = SLD(1)      00120010
250      MOD(1) = D(2)*MOD(1) + D(1)*D(2)*MOD(1)      00120020
251      200      CONTINUE      00120000
252      J = 2      00120040
253      IF(100) 250,250,205      00120000
254      C      CALCULATE LEADING EDGE SURFACE      00120000
255      200      J = 3      00120070
256      SLD(1) = DATD(12) - DATD(11)      00120000
257      IF(100-1) 200,200,200      00120000
258      200      IF(DATD(12)) 210,210,200      00120000
259      C      SECOND CUT IS OFFSET THEREFORE THERE ARE TWO INLETS PER NACELLE0120000
260      200      IF(DATD(21)) 207,207,200      00120007
261      C      PER VERTICAL LIP CALCULATE LIP. TWO TRIANGLES PLUS VERTICAL MESSAGE120010
262      207      SFD(1) = SLD(1)*(DATD(01) + SLD(2)/D(2) + SLD(2) + SLD(2))      00120020
263      GO TO 200      00120030
264      C      SPLIT INLET AS PER FUELAGE HEATED      00120000
265      200      SFD(1) = SLD(1)*(DATD(01) + SLD(2) + SLD(2) + SLD(2))      00120004
266      GO TO 200      00120030
267      C      THERE IS A SINGLE INLET PER NACELLE      00120000
268      210      SFD(1) = SLD(1)/D(2)*(DATD(01) + SLD(2) + SLD(2) + SLD(2))      00120040
269      GO TO 200      00120000
270      C      HORIZONTAL LIP      00120000
271      200      IF(DATD(02)) 274,274,200      00120000
272      C      TWO INLETS PER NACELLE      00120000
273      200      SFD(1) = SLD(1)*(DATD(01) + SLD(2) + SLD(2)*D(2)/D(2))      00120004
274      GO TO 200      00120000
275      C      ONE INLET PER NACELLE      00120007
276      274      SFD(1) = SLD(1)/D(2)*(DATD(01) + SLD(2) + D(2)*SLD(2))      00120000
277      C      CALCULATE SUBSEQUENT SECTIONS OR HERE IF NO L.E.      00120070
278      200      GO 200 1-JAC      00120000
279      SLD(1-1) = DATD(1+10) - DATD(1+0)      00120000
280      S(1) = D(2)      00121000
281      IF(DATD(1+00)) 200,200,200      00121010
282      200      IF(DATD(1+10)) 200,200,200      00121020
283      200      S(1) = D(1)      00121000

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03/03/74	INPUT LISTING	AUTOFLN CHRT SET - SHEEP	AIR INDUCTION SYSTEM MODULE	
CARD NO	CONTENTS			
270	270 SFN(1-1) = BLN(1-1)*B(2)*B(1)*(BATS(1-60) + BATS(1-90))		0012104	
271	GO TO 300		0012105	
272	C SHEEP TRANSITION TWO DUCTS BECOMING ONE		0012106	
273	273 SFN(1-1) = BLN(1-1)*BATS(1-60)		0012107	
274	GO TO 300		0012107	
275	275 SFN(1-10) = SFN(270),271		0012107	
276	C SHEEP TRANSITION ONE DUCT BECOMING TWO		0012107	
277	277 SFN(1-1) = BLN(1-1)*BATS(1-60)*B(2)		0012107	
278	278 CONTINUE		0012108	
279	C *** EXIT ***		0012109	
280	RETURN		0012110	
281	END		0012110	
282	C			
283	C CCC			
284	C SUBROUTINE SHEEP			
285	C DDD			
286	C			
287	C SUBROUTINE SHEEP		0070010	
288	C		0070020	
289	C OPEN TOSH(40)		0070030	
290	C		0070040	
291	C OPEN /MISC/ MISC(100)			
292	C OPEN /PRINT/ IP(60)			
293	C			
294	C DIMENSION Q(2000),T(2000),SC(100),ND(200)		0070050	
295	C DIMENSION ALT(10)		0070060	
296	C DIMENSION	SEM(50),	0070070	
297	1 S(100),	BATS(40),	0070080	
298	2 V(10),	V(10),	TCM(10),	0070090
299	3 TDL(10),	PTH(10),	PL(10),	0070100
300	4 RL(10),	RHM(10),	RL(10),	0070110
301	5 RHM(10),	REL(10),	RHM(10),	0070120
302	6 RL(10),	RTH(10),	RHM(10),	0070130
303	7 PTH(10),	PRL(10),	PST(10),	0070140
304	7 , RAL(10)		0070140	
305	C DIMENSION TITLE(20)		0070150	
306	C		0070160	
307	C EQUIVALENCE (Q(1),TCM(1)),(T(1),TCM(200)),(SC(1),TCM(410)),		0070170	
308	(ND(1),TCM(400))		0070180	
309	C EQUIVALENCE (Q(10),P1), (Q(10),SEM(1)),		0070190	
310	(Q(20),BATS(1)), (BATS(2),BTP)		0070200	
311	C EQUIVALENCE (Q(70),TITLE(1))		0070210	
312	C EQUIVALENCE (T(10),V(1)), (T(2),V(1)),		0070220	
313	(T(3),TCM(1)), (T(3),TDL(1)), (T(3),PTH(1)),		0070230	
314	(T(4),PL(1)), (T(4),RL(1)), (T(4),RHM(1)),		0070240	
315	(T(5),RHM(1)), (T(5),REL(1)), (T(5),PTH(1)),		0070250	
316	(T(6),RHM(1)), (T(6),REL(1)), (T(6),PTH(1)),		0070260	
317	(T(7),PTH(1)), (T(7),PRL(1)), (T(7),PST(1)),		0070270	
318	(T(8),RAL(1))		0070280	
319	C EQUIVALENCE (T(80),ALT(1))		0070290	
320	C EQUIVALENCE (ND(80),MPAGE)		0070300	
321	C EQUIVALENCE (ND(10),I), (ND(10),J)		0070310	
322	C EQUIVALENCE (ND(12),I40), (ND(12),IPRT)		0070320	
323	C		0070330	
324	C GO TO 10,10		0070340	
325	C RHM(1) = SEM(2) - SEM(3)*V(1)		0070350	
326	C RL(1) = SEM(2) - SEM(3)*V(1)		0070360	
327	C		0070370	
328	C SETUP CONSTANTS FOR ENGINE FACE HAYWARD PRESSURE RATIO		0070380	
329	C S(1) = TCM(1)/SEM(2)		0070390	
330	C S(2) = SEM(2)/TCM(1)		0070400	
331	C S(3) = TDL(1)/SEM(2)		0070410	
332	C S(4) = SEM(2)/TDL(1)		0070420	
333	C		0070430	
334	C GO TO PAPER CURVE FIT		0070440	
335	C IF(BTP) 10,10,20		0070440	
336	C		0070450	
337	C PAPER		0070460	
338	C 10 RHM(1) = SEM(2) - SEM(3)*S(1) + SEM(3)*S(2) - SEM(3)*S(2)*S(2)		0070470	
339	C RL(1) = SEM(2) - SEM(3)*S(1) + SEM(3)*S(2) - SEM(3)*S(2)*S(2)		0070480	
340	C GO TO 60		0070490	
341	C		0070500	
342	C PAPER		0070510	
343	C GO IF(BTP) - SEM(2) 20,20,20		0070520	

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0000      C      FAULET BY PASS RATIO LESS THAN OR EQUAL TO 1.0      00070010
0001      00 RDN1) = -CBM140) + CBM141)*5(1) + CBM142)*5(2) - CBM143)*5(2)**2 00070020
0002      REL1) = -CBM140) + CBM141)*5(3) + CBM142)*5(4) - CBM143)*5(4)**2 00070030
0003      C      CHECK FOR APPLICABILITY OF CURVE      00070040
0004      00 IF (VDL1) - CBM140) 00.00,24      00070050
0005      24 WRITE(6,00) COTP,VDL1,CBM140)      00070060
0006      00 FORMAT(1H1,2H,24)** WARNING MESSAGE **//10H,      00070070
0007      14HMIN TEMPERATURE EXCEEDED FOR FAULET SPR =,FS.1/10H,      00070080
0008      210HMIN TEMP =,FS.2,24,LIMIT =,FS.2)      00070090
0009      00 TO 00      00070100
0010      20 IF (COTP - CBM140) 20.20,40      00070110
0011      C      FAULET SPR O.T. 1.0 BUT L.T. ONE.T. 2.0      00070120
0012      20 RDN1) = -CBM140) + CBM147)*5(1) + CBM148)*5(2) - CBM149)*5(2)**2 00070130
0013      REL1) = -CBM140) + CBM147)*5(3) + CBM148)*5(4) - CBM149)*5(4)**2 00070140
0014      00 IF (VDL1) - CBM140) 00.00,24      00070150
0015      24 WRITE(6,00) COTP,VDL1,CBM140)      00070160
0016      00 TO 00      00070170
0017      C      FAULET BY PASS RATIO GREATER THAN 2.0      BOTH FACE AND THROAT 00070180
0018      40 RDN1) = CBM151) - CBM152)*5(1) + CBM153)*5(2) - CBM154)*5(2)**2 00070190
0019      REL1) = CBM151) - CBM152)*5(3) + CBM153)*5(4) - CBM154)*5(4)**2 00070200
0020      RDN1) = RDN1)      00070210
0021      REL1) = REL1)      00070220
0022      00 IF (VDL1) - CBM150) 000.000,40      00070230
0023      40 WRITE(6,00) COTP,VDL1,CBM150)      00070240
0024      00 TO 000      00070250
0025      C      00 THROAT HANDBOOK PRESSURE RATIOS      00070260
0026      00 00 IF (V0 - 2) 00.00,00      00070270
0027      C      FIXED GEOMETRY INLET      140-1 OR 2 00070280
0028      00 00 IF (V1) - CBM161) 00.00,00      00070290
0029      00 00 WRITE(6,01) COTP,V1,CBM161)      00070300
0030      01 01 FORMAT(1H1,2H,24)** WARNING MESSAGE **//10H,      00070310
0031      14H0SPEED EXCEEDED FOR ENGINE INLET COMBINATION/ENH,      00070320
0032      200HPR =,FS.1,2H,16HINLET TYPE =,13,2H,200HPR =,FS.2,2H,      00070330
0033      24HLIMIT SPEED =,FS.2)      00070340
0034      00 CONTINUE      00071000
0035      C      PER BY PASS RATIO LESS THAN OR EQUAL TO 2.5      00071010
0036      C      RATIO ENGIN FACE FOR THROAT      (4-21-72) 00071020
0037      RDN1) = (CBM162) - CBM163)*4(1) - CBM164)*4(1)**2) + RDN1)      00071030
0038      REL1) = (CBM162) - CBM163)*4(3) - CBM164)*4(3)**2) + REL1)      00071070
0039      C      00071080
0040      C      FAULET BYPASS RATIO GREATER THAN 2.5 THROAT PRESSURE RATIO 00071090
0041      C      SAVE AS ENGINE FACE - - - SET-UP THERE.      00071100
0042      C      00071110
0043      000 CONTINUE      00071120
0044      C      00071130
0045      00 210 1=1.0      00071140
0046      PTH1) = PTH1)+RDN1)      00071150
0047      PTH2) = PTH1)+RDN1)      00071160
0048      PTL1) = PTL1)+REL1)      00071170
0049      PTL2) = PTL1)+REL1)      00071180
0050      PST1) = PTL1)+RDL1)+REL1)      00071190
0051      210 CONTINUE      00071200
0052      C      00071210
0053      00 00 IF (P100) 0000.0000,000      00071220
0054      0000 CONTINUE      00071230
0055      00 00 WRITE(6,217) (P100) IN, N=00.100)      00071240
0056      217 217 FORMAT(1H1,24H,2H,24)** 000P = P100) **//12,24H)      00071250
0057      00 00 WRITE(6,218)      COTP, 140      00071260
0058      218 218 FORMAT(1H0, 20H, 20-SPEED PROFILE DESIGN CONSTANTS,      00071270
0059      0 / 140, 20H, 140-BYPASS RATIO =, 1FS.2, 20H, 20H10 =, 110 /      00071280
0060      2 140, 44H, 200P1) IN, 20HSTATIC1) IN, 100H000P100) IN /      00071290
0061      3 140, 24H1, 12H, 24H, 20H, 140H000 R00KINE, 20H, 140HPR00, RATIO,      00071300
0062      4 20H, 40FACE, 12H, 20H000AT )      00071310
0063      00 00 WRITE(6,201) ((AL7)1), 4H1), 20H1), 24H1), 20H1), 20H1), 1=1, 0)      00071320
0064      201 201 FORMAT( 2H, 1F13.1, 1F14.2, 1F17.3, 1F16.4 )      00071330
0065      00 00 WRITE(6,202)      00071340
0066      202 202 FORMAT(1H0,44H, 200P1), 20H, 20HSTATIC1), 12H, 100H000P100) (L) /      00071350
0067      1 140, 24H1, 12H, 24H, 20H, 140H000 R00KINE, 20H, 140HPR00, RATIO,      00071360
0068      2 20H, 40FACE, 12H, 20H000AT )      00071370
0069      00 00 WRITE(6,203) ((AL7)1), 4H1), 20H1), 24H1), 20H1), 20H1), 1=1, 0)      00071380
0070      00 00 WRITE(6,203)      00071390

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CARD NO      ****                                COMMENTS                                ****
005          003 FURNACE, BR. 2000000, BR. 2000000, BR. 2000000, BR. 2000000
006          1 2000000, BR. 2000000 / 2000000, 2000000-2000000, BR. 2000000
007          0 2000000-2000000, BR. 2000000-2000000, BR. 2000000-2000000, BR.
008          3 2000000 2000000
009          00100,00100,00100,00100,00100,00100,00100,00100,00100,00100,
010          1 00100
011          003 FURNACE, BR. 00100, 00100, 00100, 00100
012          003 RETURN
013          000
014          C
015          C *****
016          C                                SUBROUTINE SUBFM
017          C *****
018          C
019          C                                SUBROUTINE SUBFM                                00100010
020          C                                APRIL 1972                                00100010
021          C                                00100010
022          C                                00100010
023          C                                00100010
024          C                                00100010
025          C                                00100010
026          C                                00100010
027          C                                00100010
028          C                                00100010
029          C                                00100010
030          C                                00100010
031          C                                00100010
032          C                                00100010
033          C                                00100010
034          C                                00100010
035          C                                00100010
036          C                                00100010
037          C                                00100010
038          C                                00100010
039          C                                00100010
040          C                                00100010
041          C                                00100010
042          C                                00100010
043          C                                00100010
044          C                                00100010
045          C                                00100010
046          C                                00100010
047          C                                00100010
048          C                                00100010
049          C                                00100010
050          C                                00100010
051          C                                00100010
052          C                                00100010
053          C                                00100010
054          C                                00100010
055          C                                00100010
056          C                                00100010
057          C                                00100010
058          C                                00100010
059          C                                00100010
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061          C                                00100010
062          C                                00100010
063          C                                00100010
064          C                                00100010
065          C                                00100010
066          C                                00100010
067          C                                00100010
068          C                                00100010
069          C                                00100010
070          C                                00100010
071          C                                00100010
072          C                                00100010
073          C                                00100010
074          C                                00100010
075          C                                00100010
076          C                                00100010
077          C                                00100010
078          C                                00100010
079          C                                00100010
080          C                                00100010
081          C                                00100010
082          C                                00100010
083          C                                00100010
084          C                                00100010
085          C                                00100010
086          C                                00100010
087          C                                00100010
088          C                                00100010
089          C                                00100010
090          C                                00100010
091          C                                00100010
092          C                                00100010
093          C                                00100010
094          C                                00100010
095          C                                00100010
096          C                                00100010
097          C                                00100010
098          C                                00100010
099          C                                00100010
100          C                                00100010

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08/05/74	INPUT LISTING	AUTOFLEX CHART SET - 500P	AIR INDUCTION SYSTEM HEADLINE
CARD NO	***	COMMENTS	***
007	GO TO 100		00100000
008	100 S(1) = (1001) - (S(101)/(1001) - (S(101)))		00100000
009	C FACTOR FOR PRESSURE FROM THROAT AND BOWING FACE.		00100000
010	100 R(0) = 0.000		00100010
011	100 F(0) = 0.1421		00100000
012	100 AM = 0.04125*(0.10)		00100000
013	GO TO 0-1, 0.07		00100000
014	100 R(1) = 0.100		00100000
015	100 F(1) = 0.100		00100000
016	100 R(2) = 0.04125		00100070
017	170 CONTINUE		00100000
018	C		00100000
019	C		00100700
020	GO 000 J=1 0		00100710
021	S(0) = (1001)/(17)		00100700
022	C = AVERAGE PRESSURE FOR 00. IN.		00100700
023	C SET UP FOR V SUB M (POINT ON LEVEL FLIGHT LIMIT CURVE)		00100700
024	200 F(0) = F(00, J)		00100700
025	200 F(1) = F(00, J)		00100700
026	200 F(2) = F(00, J)		00100770
027	200 E = 0.00, J		00100700
028	S(4) = F(00, J) - S(0)		00100700
029	S(5) = F(00, J) - S(0)		00100000
030	S(6) = S(4) + S(1)*(S(5)-S(4))		00100010
031	S(7) = S(6)*(0.25)*(0.75)		00100000
032	C INCREMENTAL PRESSURE * MARGIN * FRAME SPACING		00100000
033	1000 = 1		00100000
034	GO TO 200		00100000
035	C		00100000
036	C SET UP FOR V SUB L (MARGINED) (POINT ON MAX. LIMIT CURVE)		00100070
037	200 F(0) = F(00, L, J)		00100000
038	200 F(1) = F(00, L, J)		00100000
039	200 F(2) = F(00, L, J)		00100000
040	200 E = 0.00, L, J		00100010
041	S(4) = F(00, L, J) - S(0)		00100000
042	S(5) = F(00, L, J) - S(0)		00100000
043	S(6) = S(4) + S(1)*(S(5)-S(4))		00100070
044	S(7) = S(6)*(0.25)*(0.75)		00100000
045	1000 = 2		00100000
046	GO TO 200		00100070
047	C		00100000
048	C SET UP FOR V SUB L STATIC (POINT ON MAX. LIMIT CURVE)		00100000
049	S(4) = F(00, L, J) - S(0)		00100000
050	S(5) = F(00, L, J) - S(0)		00100100
051	S(6) = S(4) + S(1)*(S(5)-S(4))		00100000
052	S(7) = S(6)*(0.25)*(0.75)		00100000
053	1000 = 3		00100000
054	C		00100000
055	200 W(0) = F(0) + P1*(E) = E/D12 / (0.111*(F(0)+E)/(0.1421)*F(0))		00100000
056	GO 000 0-1, 0.07		00100070
057	200 P(0) = ABS(A(00, 0)+S(7))/0.0		00100000
058	200 P(1) = ABS(A(00, 1)+S(7))/0.0 + P(0)		00100000
059	200 AC = P(1) / (0.1421) / F(0)		00100100
060	S(8) = ABS(W(00, 0)+S(7))		00100110
061	T(0) = (S(8)*0.12*(0.111*(F(0)+E)/(0.1421)*F(0)+E)/(0.1421)*E)/(0.12)		00100100
062	T(1) = S(8)/(0.1421)*F(0)		00100100
063	TEAP = (AC/0.02)/T(0)+0.110		00100100
064	C		00100100
065	IF (TEAP) 410, 410, 400		00100100
066	400 EC2 = AC/TEAP		00100170
067	IF (EC2 - 0.04125) 410, 400, 400		00100100
068	410 EC2 = 0.04125		00100100
069	400 IF (EC2 .GT. 0.0) EC2 = 0.0		00100000
070	IF (AC .LT. 0.0) AC = 0.0		00100100
071	TEAP = AC/EC2		00100100
072	TEAP = TEAP/0.0		00100100
073	T(0) = ABS(T(0), T(1), TEAP)		00100100
074	IF (T(0) .LT. T(1)) T(0) = T(1)		00100000
075	S(8) = AC		00100000
076	S(9) = W(00, 0)+S(8)		00100170
077	IF (S(9) - S(8)) 400, 400, 000		00100000

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03/05/74      INPUT LISTING      AUTOFLUX CURT SET - SHEEP      AIR INDUCTION SYSTEM MODEL
CARD NO      ***      CONTENTS      ***
000      440      TCC(1) = TCAP      00101200
000      000(1) = 000      00101200
070      000      CONTINUE      00101310
071      00 TO (200, 240, 000), 1000      00101200
070      000      CONTINUE      00101200
070      C      00101240
070      000      MY = ZERO      00101200
070      000      MW = ZERO      00101200
070      000      MYS = ZERO      00101270
077      00 010 K=1,177      00101200
070      01(1) = 00(1)*(TANK) + 01401      00101200
070      01(2) = TCC(1)*000(1)*00(1)*000      00101400
000      01(3) = TANK(1)*00(1)*000      00101410
001      01(37) = 01(3)*00(1)*000      00101400
002      000      MY = MY + 01(3)      00101400
003      000      MW = MW + 01(3)      00101440
004      000      MYS = MYS + 01(37)      00101400
000      010      CONTINUE      00101400
000      000      TWT = MY + MW + MYS      00101470
007      000      FWT(1) = TWT      00101400
000      000      TOT(1) = FWT(1)/0700(1)      00101400
000      000      RETURN      00101000
000      000      END      00101000
001      C
002      C (((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((((
003      C SUBROUTINE SUBPL      00100000
004      C ))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))))
005      C
006      SUBROUTINE SUBPL      00100010
007      C WRITTEN 3 APRIL 1972      00100000
008      C TO DEVELOP SUCT PANEL SYNTHESIS      00100000
009      C
010      COMMON TCC(1400)      00100000
011      C      00100000
012      DIMENSION 01(2000), T1(2000), JC(100), ND(200)      00100070
013      DIMENSION 02(1400)      00100000
014      DIMENSION 03(140), 04(100), 05(10)      00100000
015      DIMENSION 06(100), 07(100)      00100100
016      DIMENSION 08(10), 09(10), 10(10), 11(10), 12(10), 13(10)      00100110
017      DIMENSION 14(10), 15(10), 16(10), 17(10), 18(10), 19(10), 20(10)      00100120
018      100(10)      00100120
019      DIMENSION 21(10), 22(10), 23(10)      00100140
020      C      00100100
021      EQUIVALENCE (0(1), T000(1)), (1(1), T001(200)), (0C(1), T001(10)),      00100100
022      (10(1), T001(400))      00100170
023      EQUIVALENCE (0(01), 02(1))      00100100
024      EQUIVALENCE (0(02), 03(1)), (0(20), 04(1)), (04(10), 05(1)), (05(10), 06(1))      00100100
025      EQUIVALENCE (1(1), 07(1)), (1(10), 07(10))      00100000
026      EQUIVALENCE (1(00), 08(1)), (1(00), 09(1)), (1(07), 10(1)),      00100010
027      (1(08), 11(1)), (1(09), 12(1)), (1(10), 13(1)), (1(10), 14(1)), (1(10), 15(1)),      00100020
028      EQUIVALENCE (1(20), 16(1)), (1(20), 17(1)), (1(40), 18(1)),      00100030
029      (1(40), 19(1)), (1(40), 20(1)), (1(40), 21(1)),      00100040
030      (1(40), 22(1))      00100000
031      EQUIVALENCE (1(70), 23(1)), (1(70), 24(1)), (1(70), 25(1)),      00100000
032      EQUIVALENCE (10(10), 01), (10(100), 01), (10(100), 01)      00100070
033      EQUIVALENCE (10(100), 01)      00100000
034      EQUIVALENCE (10(100), 01)      00100000
035      C      00100000
036      IF(10(1) - 04(10)) 120, 120, 140      00100010
037      120 0(1) = 01(1)      00100000
038      00 TO 000      00100000
039      140 0(1) = (10(1) - 04(10))/(10(10)) - 04(10)      00100040
040      C      00100000
041      C INITIALIZE COMMON      00100000
042      000 10(1) = 04(17)      00100070
043      000 2C(1) = 01(0)      00100000
044      000 2L(1) = 01(0)      00100000
045      00 400 J=1,0      00100400
046      C START AT STATIC PRESSURE AT VL      00100410
047      K = 1      00100400
048      01(0) = 07(1,0)      00100420

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00/00/74      INPUT LISTING      AUTOFLSH DUMP SET - SHEEP      AIR INDUCTION SYSTEM MODULE

CARD NO      ****      COMMENTS      ****

000          S(3) = P(L,J)      0010040
001          S(4) = D(L,J)      0010050
002          S(5) = D(30)      0010060
003          S(6) = S(2)/S(5)      0010070
004          S(7) = S(2)/S(5)      0010080
005          IF(S(7) - S(6)) 310,300,300      0010090
006          310 S(8) = S(7)      0010100
007          320 S(7) = P(L,J) - P(L,J)/D(17)      0010110
008          S(8) = P(L,J) - P(L,J)/D(17)      0010120
009          S(9) = S(7)/(1+EQUB2)      0010130
010          IF(XD(1) - DATS(8)) 330,330,340      0010140
011          330 S(9) = S(7)/(1+EQUB1)      0010150
012          C      CHECK THICKNESS FOR DEFLECTION CRITERIA      0010160
013          340 S(10) = ABS(S(7) + S(11)*(S(8)-S(7)))      0010170
014          IF(S(10).LT.D(11)) S(10) = D(11)      0010180
015          S(11) = S(10)/S(4)      0010190
016          S(20) = EQUB3*S(11)+EQUB4*(S(7)/(1+EQUB2)+S(9)+EQUB5)      0010200
017          IF(S(20) .GT. TC(1)) TC(1) = S(20)      0010210
018          IF(S(20) .GT. TL(1)) TL(1) = S(20)      0010220
019          C      CHECK THICKNESS FOR STRENGTH      0010230
020          GO TO 300      0010240
021          C      SETUP HAPPERCHECK AT VL      0010250
022          350 K = 2      0010260
023          S(9) = D(40)      0010270
024          S(10) = S(2)/S(5)      0010280
025          S(7) = P(L,J) - P(L,J)/D(17)      0010290
026          S(8) = P(L,J) - P(L,J)/D(17)      0010300
027          S(10) = ABS(S(7) + S(11)*(S(8)-S(7)))      0010310
028          IF(S(10).LT.D(11)) S(10) = D(11)      0010320
029          C      CHECK THICKNESS FOR STRENGTH      0010330
030          GO TO 300      0010340
031          C      SETUP HAPPERCHECK AT WH      0010350
032          360 K = 3      0010360
033          S(2) = P(L,J)      0010370
034          S(4) = D(L,J)      0010380
035          S(5) = D(30)      0010390
036          S(6) = S(2)/S(5)      0010400
037          S(7) = P(L,J) - P(L,J)/D(17)      0010410
038          S(8) = P(L,J) - P(L,J)/D(17)      0010420
039          S(10) = ABS(S(7) + S(11)*(S(8)-S(7)))      0010430
040          IF(S(10).LT.D(11)) S(10) = D(11)      0010440
041          C      TEST MID-PANEL      0010450
042          380 S(20) = EQUB7*(S(7)/(1+EQUB2)+S(9)+EQUB5)/      0010460
043          S(8)+EQUB6)      0010470
044          S(21) = EQUB8*(S(7)/(1+EQUB2)+S(9)+EQUB5)/      0010480
045          S(8)+EQUB9)      0010490
046          IF(XML) 300,300,300      0010500
047          390 IF(S(21) .GT. S(20)) S(20) = S(21)      0010510
048          IF(S(20) .GT. S(21)) S(21) = S(20)      0010520
049          GO TO 300      0010530
050          390 S(20) = S(21)/EQUB5)      0010540
051          IF(S(20) .GT. S(20)) S(20) = S(20)      0010550
052          380 IF(S(20) .GT. TC(1)) TC(1) = S(20)      0010560
053          IF(S(20) .GT. TL(1)) TL(1) = S(20)      0010570
054          IF(K - 2) 300,300,400      0010580
055          400 CONTINUE      0010590
056          TOT(S) = Q400*(TL(1) - TC(1))+Q(40)/S(7)      0010600
057          RETURN      0010610
058          END      0010620

060          C
061          C      SUBROUTINE DUCTS
062          C      SUBROUTINE DUCTS
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200          C      SUBROUTINE DUCTS

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DATE/TM	INPUT LISTING	AUTOLIN OUTPUT SET - CDS	AIR INJECTION SYSTEM MANUAL
CARD NO	****	CONTENTS	****
710	***** @1000, T1000, JC100, J0100		0010000
711	***** @A001		0010000
712	***** @A002		0010000
713	***** @1001, T01100		0010000
714	***** TITLE101, @A0110		0010000
715	***** @FN101		0010000
716	***** @A101, @A210, @A310, @A410, @A510, @A610		0010010
717	***** @A101, @FN101, @A010		0010010
718	***** TC101, T1101, FT01101		0010010
719	***** @A101		0010010
720	***** @A001, @A100, @A200		0010010
721	***** @A001, @A101, @A201		0010010
722	C		0010010
723	***** @A11, T00111, T111, T0010011, @C11, T0011011,		0010010
724	***** T00111		0010010
725	***** @A111, @A0111		0010010
726	***** @A011, @A0111, @A1001, T10111		0010010
727	***** @A1011, @A0111		0010010
728	***** T111, @A111, T1101, T0111		0010010
729	***** T1011, T01		0010010
730	***** T1011, @FN111		0010010
731	***** T0101, @A01		0010010
732	***** T1011, @A011, T1001, @A011, T1001, @A011,		0010010
733	***** T1011, @A011, T1001, @A011, T1001, @A011		0010010
734	***** T1011, @A011, T1001, @FN111, T1001, @A011		0010010
735	***** T1011, TC111, T1011, T111, T1011, FT0111		0010010
736	***** T1001, @A011		0010010
737	***** @A001, @A011, @A0101, @A111, @A0101, @A111		0010010
738	***** T1001, T0011, T1011, T0011, T1001, @A011		0010010
739	***** @A001, @PAGE		0010010
740	***** @A001, @P1		0010010
741	***** @A101, T1, @A1001, @A, @A1001, @A, @A101, L1		0010010
742	***** @A1101, @P01		0010010
743	***** @A1101, @A01, @A1101, @A1, @A1101, @A1, @A1101, @A1,		0010010
744	***** @A1101, @P1, @A1101, @A1		0010010
745	***** @A1101, @FN0		0010010
746	C		0010010
747	NE = @A011		0010010
748	NE = @A010		0010010
749	SE = @A01		0010010
750	WF = @A0		0010010
751	IC = WF + 1		0010010
752	FD = @A010		0010010
753	CALL @CT00		0010010
754	DO DOO L=1, IC		0010010
755	I = L		0010010
756	IF L - 1) 10, 10, 20		0010010
757	10 IF (DO) DO, DO, DO		0010010
758	DO CALL @FN00		0010010
759	CALL @FN00		0010010
760	@FN = 1		0010010
761	IF @A0101 - @A101) DO, DO, DO		0010010
762	DO @FN11 = @A010		0010010
763	GO TO 200		0010010
764	DO @FN11 = @A010 - @A101		0010010
765	@FN = 2		0010010
766	GO TO 400		0010010
767	DO IF @A0101 - @FN11) 200, 200, 400		0010010
768	DO @FN11 = @A010		0010010
769	@FN = 2		0010010
770	400 CONTINUE		0010010
771	CALL @A00L		0010010
772	CALL @A00N		0010010
773	IF @FN - 2) 400, 400, 400		0010010
774	410 IF @FN - 2) 400, 400, 400		0010010
775	400 @FN = 2		0010010
776	T0111 = T0120 + T0101		0010010
777	@FN11 = @FN11 + @A11		0010010
778	GO TO 200		0010010
779	400 T0101 = T0120 + T0101		0010010
780	IF T0101 - T0111) 400, 400, 400		0010010



CARD NO	****	CONTENTS	****
002		DIMENSION D(2000),T(2000),DC(100),JD(200)	0017070
003		DIMENSION D(2000)	0017080
004		DIMENSION D(2000),DARR(100),ND(10)	0017090
005		DIMENSION D(100),TOT(100)	0017100
006		DIMENSION D(200),D(200),D(200),D(200)	0017110
007		DIMENSION D(200),TC(100),TL(100),F(200)	0017120
008		DIMENSION D(200)	0017130
009	C		0017140
010		INITIALIZE D(1),TC(1),TL(1),D(2000),DC(1),D(2000),	0017150
011		IND(1),TOT(100)	0017160
012		INITIALIZE D(200),D(200)	0017170
013		INITIALIZE D(200),D(200),D(200),D(200),D(200),D(200)	0017180
014		INITIALIZE (T(1),D(1)),(T(100),TOT(1))	0017190
015		INITIALIZE (TOT(100),J(1))	0017200
016		INITIALIZE (T(200),D(200)),(T(200),D(200)),(T(200),D(200)),	0017210
017		(T(200),D(200))	0017220
018		INITIALIZE (T(200),D(200))	0017230
019		INITIALIZE (T(200),D(200))	0017240
020		INITIALIZE (T(200),D(200)),(T(200),TC(1)),(T(200),TL(1)),	0017250
021		(T(200),F(200))	0017260
022		INITIALIZE D(200),J(1),D(200),J(1)	0017270
023		INITIALIZE D(200),J(1),D(200),J(1),D(200),J(1)	0017280
024	C		0017290
025		DO T(200),D(10),D(10),D(10),D(10)	0017300
026	C	DO DO T(200),D(10),D(10),D(10),D(10)	0017310
027		DO D(10) = D(10)	0017320
028		D = DARR(1)	0017330
029		DO D(10) = D(10)	0017340
030		D(10) = D(10) + DARR(J)	0017350
031		DO CONTINUE	0017360
032		D(10) = D(10) + DARR(J)	0017370
033	C	TEST FOR LIP	0017380
034		DO J = 2	0017390
035		IF (IND(1) - DARR(1)) 100,100,20	0017400
036		DO J = 3	0017410
037	C	CALCULATE LIP HEIGHT - HLP	0017420
038		H(1) = D(10)	0017430
039		HLP = D(10) - D(10) + DARR(1)	0017440
040	C	CALCULATE HEIGHT OF DUCTS AND FRAMES	0017450
041		DO DO T(200),D(10),J(1)	0017460
042		D(1) = D(1)	0017470
043		D(1) = D(1)	0017480
044		IF (IND(1) - DARR(1)) 100,100,100	0017490
045	C	HORIZONTAL RAPP	0017500
046		100 IF (IND(1) - DARR(1)) 100,100,100	0017510
047		100 IF (IND(1) - D(1)) 100,100,100	0017520
048		100 D(1) = (DARR(1) - D(1) - D(1)) / DARR(1)	0017530
049		D(1) = (DARR(1) - D(1) - D(1)) / DARR(1)	0017540
050		DO TO 100	0017550
051		100 IF (IND(1) - D(1)) 100,100,100	0017560
052	C	VERTICAL RAPP - TEST FOR LOCATION	0017570
053		100 IF (IND(1) - DARR(1)) 100,100,100	0017580
054		100 IF (IND(1) - D(1)) 100,100,100	0017590
055		100 D(1) = (DARR(1) - D(1) - D(1)) / DARR(1)	0017600
056		D(1) = (DARR(1) - D(1) - D(1)) / DARR(1)	0017610
057	C	CALCULATE HEIGHTS	0017620
058		100 D(1) = D(1)	0017630
059		IF (IND(1) - D(1)) 100,100,100	0017640
060		100 IF (IND(1) - D(1)) 100,100,100	0017650
061		100 D(1) = D(1)	0017660
062	C	VERTICAL DUCT TRANSITION	0017670
063		100 D(1) = (TC(1) - TL(1) - TC(1) - D(1) - D(1)) / DARR(1)	0017680
064		D(1) = (TC(1) - TL(1) - TC(1) - D(1) - D(1)) / DARR(1)	0017690
065		D(1) = (TC(1) - TL(1) - TC(1) - D(1) - D(1)) / DARR(1)	0017700
066		IND(1) = (D(1) - D(1) - D(1)) / DARR(1)	0017710
067		DO TO 400	0017720
068	C	SHIP GEOMETRIC TRANSITION TWO DUCTS BECOMING ONE	0017730
069		200 IND(1) = (TC(1) - TL(1) - TC(1) - D(1) - D(1)) / DARR(1)	0017740
070		IND(1) = (TC(1) - TL(1) - TC(1) - D(1) - D(1)) / DARR(1)	0017750
071		400 CONTINUE	0017760
072		RETURN	0017770

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05/05/74      INPUT LISTING      AURFLIN CURT SET - BEEP      AIR INDUCTION SYSTEM MODEL
CARD NO      ***      COMMENTS      ***
003          END          0040000
004          C
005          C (*****
006          C          SUBROUTINE FFIELD
007          C (*****
008          C
009          SUBROUTINE FFIELD          0040010
010          C WRITTEN 20 MARCH 1978          0040020
011          C TO DEVELOP RING LOADS PER UNIT PRESSURE LOADING          0040030
012          C          0040040
013          COMMON TCRN(400)          0040050
014          COMMON /PRINT/ IP(10)          0040060
015          C          0040070
016          DIMENSION D(1000),T(1000),DC(100),ND(100)          0040080
017          DIMENSION S(100)          0040090
018          DIMENSION BLP(10),BDM(5),VW(5),AM(5)          0040100
019          DIMENSION YB(10),ZB(10),JL(10),WP(10),SP(10)          0040110
020          DIMENSION Y(10),Z(10),YB(10),ZB(10)          0040120
021          DIMENSION Y(10),A(10),B(10)          0040130
022          C          0040140
023          EQUIVALENCE (D(1),TCRN(1)),(T(1),TCRN(1001)),(DC(1),TCRN(1011)),          0040150
024          (ND(1),TCRN(1021))          0040160
025          EQUIVALENCE (T(1),S(1))          0040170
026          EQUIVALENCE (B(1),YB(1),ZB(1),Y(1),VW(1),ND(1),          0040180
027          (1),VW(1),VW(1))          0040190
028          EQUIVALENCE (T(1001),BLP(1)),(T(1001),BDM(1)),(T(1011),VW(1)),          0040200
029          (T(1021),AM(1))          0040210
030          EQUIVALENCE (T(1031),YB(1)),(T(1031),ZB(1)),(T(1041),JL(1)),          0040220
031          (T(1041),WP(1)),(T(1051),SP(1))          0040230
032          EQUIVALENCE (T(1061),Y(1)),(T(1061),Z(1)),(T(1071),Y(1)),          0040240
033          (T(1071),Z(1))          0040250
034          EQUIVALENCE (T(1081),V(1)),(T(1081),A(1)),(T(1087),B(1))          0040260
035          EQUIVALENCE          (ND(102),J), (ND(102),K), (ND(102),L),          0040270
036          (ND(102),M)          0040280
037          EQUIVALENCE (ND(113),IP(1))          0040290
038          EQUIVALENCE (ND(118),I), (ND(118),JF), (ND(118),IC)          0040300
039          C          0040310
040          DO 10 I=1,40          0040320
041          S(I) = S(I)*          0040330
042          10 CONTINUE          0040340
043          YP(1) = Y(1)          0040350
044          ZP(1) = Z(1) + YB(1)          0040360
045          K = S*10 + 1          0040370
046          DO 20 I=2,K          0040380
047          S(I) = Y(I) - Y(I-1)          0040390
048          S(I) = Z(I) - Z(I-1)          0040400
049          S(I) = (S(I)-S) + S(I)*S**0.5          0040410
050          S(I) = YB(I)/S(I)          0040420
051          YP(I) = Y(I) - S(I)*S(I)          0040430
052          ZP(I) = Z(I) + S(I)*S(I)          0040440
053          20 CONTINUE          0040450
054          K = S*10          0040460
055          J = S*10 + 2          0040470
056          DO 30 I=1,K          0040480
057          M = J - 1          0040490
058          YP(M) = - YP(I)          0040500
059          ZP(M) = ZP(I)          0040510
060          30 CONTINUE          0040520
061          DO 40 I=1,100          0040530
062          YB(I) = (YP(I)+1) + YP(I)/B(I)          0040540
063          ZB(I) = (ZP(I)+1) + ZP(I)/B(I)          0040550
064          BLP(I) = ((YP(I)+1) + YP(I))*B + (ZP(I)+1) - ZP(I))*B**0.5          0040560
065          40 CONTINUE          0040570
066          C          DETERMINE RING SECTION PROPERTIES          0040580
067          DO 70 I=1,100          0040590
068          S(I) = S(I) + B(I)*B(I)          0040600
069          S(I) = S(I) + BLP(I)          0040610
070          S(I) = S(I) + YB(I)*B*BLP(I)          0040620
071          70 CONTINUE          0040630
072          ZB = S(I)/B(I)          0040640

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05/20/74          INPUT LISTING          AUTOFLAN CHART SET - SHEEP          AIR INDUCTION SYSTEM MODULE
CARD NO          ****          CONTENTS          ****
004          DO TO I=1,177          00140000
005          S(0) = S(0) + (ZP(1) - ZS)**2*SLP(1)          00140000
006          TO CONTINUE          00140070
007          DO 00 I=1,10          00140000
008          V(1) = S(0)          00140000
009          A(1) = S(0)          00140700
0100          BH(1) = S(0)          00140710
0101          00 CONTINUE          00140700
0102          DO 000 I=2,10          00140700
0103          DO 000 J=1          00140700
0104          S(2J) = V(J) - V(J-1)          00140700
0105          S(2J+1) = Z(J) - Z(J-1)          00140700
0106          V(1) = V(1) + S(20)          00140770
0107          A(1) = A(1) + S(20)          00140700
0108          BH(1) = BH(1) + S(20)*V(1) - V(1-1) + S(20)*Z(1) - Z(1-1)          00140700
0109          000 CONTINUE          00140000
0110          000 CONTINUE          00140010
0111          DO 700 I=1,177          00140000
0112          S(27) = (BH(1) + BH(1))/D(2)*SLP(1)          00140030
0113          S(30) = S(30) + S(27)          00140040
0114          S(31) = S(31) + S(27)*(ZP(1) - ZS)          00140050
0115          S(32) = S(32) + S(27)*V(1)          00140060
0116          700 CONTINUE          00140070
0117          BH = - S(30)/S(0)          00140000
0118          HD = - S(31)/S(0)          00140000
0119          VD = - S(32)/S(0)          00140000
0120          DO 000 I=1,177          00140010
0121          BH(1) = BH + VD*V(1) + HD*(ZP(1) - ZS) +          00140000
0122          (BH(1) + BH(1))/D(2)          00140030
0123          S(20) = (V(1+1) + V(1))/D(2) + VD/SLP(1)          00140040
0124          S(20) = (A(1+1) + A(1))/D(2) + HD/SLP(1)          00140050
0125          V(1) = S(20)*V(1+1) - V(1) + S(20)*Z(1+1) - Z(1)          00140000
0126          A(1) = S(20)*V(1+1) - V(1) - S(20)*Z(1+1) - Z(1)          00140070
0127          000 CONTINUE          00140000
0128          C          *** BREAKPOINT OUTPUT ***          00140000
0129          IF(IPI00)100,00,0          00140010
0130          00 WRITE(6,3) L,D,D,HD,VD,S(2),S(5)          00140100
0131          01 FORMAT(1H1,4X,23H** DUCT FRAME DATA **2X,          00140000
0132          1 2H** FRIELD = IPI00) **          /4X,3HECTION,13,          00140000
0133          14X,10AHMT REDUNDANT,3X,0000 =,F0.3,3X,440 =,F0.3,3X,440 =,          00140030
0134          070.34X,10-DUCT PERIMETER =,F0.3,4X,10HMTG PERIMETER =,F0.3//2X,          00140040
0135          3XOUT/00,07.14Y,3X,14Z,3X,04V0,3X,04Z0,7X,3DLS,3X,04V1,3X,04D1,          00140000
0136          47X,34V0,7X,34Z0,7X,40SLP)          00140000
0137          WRITE(6,2) (1,V(1),Z(1),V(1),Z(1),SLP(1),V(1),Z(1),          00140700
0138          17P(1),ZP(1),SLP(1),I=1,177)          00140000
0139          02 FORMAT(10,10F10.3)          00140000
0140          04 CONTINUE          00140100
0141          RETURN          00140110
0142          END          00140100
0143          C
0144          C          *****          00140000
0145          C          SUBROUTINE FINDES          00140000
0146          C          *****          00140000
0147          C
0148          SUBROUTINE FINDES          00130010
0149          C          WRITTEN 20 DECEMBER 1971          00130000
0150          C          DEVELOP NODE COORDINATES FOR 01 NODES          00130030
0151          C          *****          00130040
0152          COMMON TCON(400)          00130000
0153          C          *****          00130000
0154          DIMENSION D(2000),T(2000),DC(100),HD(200)          00130070
0155          DIMENSION S(100)          00130000
0156          DIMENSION HSD(10),HSD(10),DD(10)          00130000
0157          DIMENSION Y(400),Z(100),SLS(100)          00130100
0158          DIMENSION Y(01),Z(01)          00130110
0159          C          *****          00130100
0160          EQUIVALENCE (S(1),TCON(1)),(T(1),TCON(2001)),(DC(1),TCON(4101)),          00130130
0161          (HD(1),TCON(4001))          00130140
0162          C          *****          00130100
0163          EQUIVALENCE (T(1),S(1))          00130100
0164          EQUIVALENCE (T(01),HSD(1)),(T(02),HSD(2)),(T(03),DD(1))          00130170

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03/20/76	INPUT LISTING	AUTOFLN DWRT SET - SHEEP	AIR INJECTION SYSTEM MODEL
CARD NO	****	COMMENTS	****
1065		EQUIVALENCE (T(100),Y0(1),T(102),Z0(1),T(104),L0(1))	00130100
1066		EQUIVALENCE (T(100),Y1(1),T(102),Z1(1))	00130100
1067		EQUIVALENCE (M(100),J, M(100),K, M(100),L,1,	00130200
1068		1 M(100),NK)	00130210
1069		EQUIVALENCE (M(110),I0, M(110),I7)	00130220
1070		S(2) = M(1)	00130230
1071		S(3) = M(1)	00130240
1072		S(4) = M(1)	00130250
1073		S(1) = S(2) + S(3)/S(2) + S(4)	00130260
1074		S(5) = I0	00130270
1075		S(6) = S(1)/S(5)	00130280
1076		Y(1) = S(2)	00130290
1077		Z(1) = S(3) + S(4)	00130300
1078		S(6) = S(2)	00130310
1079		S(7) = S(2)	00130320
1080		S(8) = S(2)	00130330
1081		I = 2	00130340
1082		IF(S(2)) 100,100,2	00130350
1083		2 S(10) = S(2)/S(5) + S(1)	00130360
1084		K = INT(S(10))	00130370
1085		IF(K-1) 3,3,4	00130380
1086		3 S(8) = S(2)	00130390
1087		GO TO 100	00130400
1088		4 DO J=1,K	00130410
1089		Y(J) = Y(J-1) + S(5)	00130420
1090		Z(J) = Z(J-1)	00130430
1091		5 CONTINUE	00130440
1092		I = K+1	00130450
1093		S(8) = S(2) - Y(K)	00130460
1094		100 IF(S(2)) 200,200,100	00130470
1095		102 S(8) = S(5) - S(8)	00130480
1096		S(11) = S(3)*S(5)/S(2)	00130490
1097		IF(S(11) - S(8)) 103,103,120	00130500
1098		103 S(8) = S(8) + S(11)	00130510
1099		GO TO 200	00130520
1100		120 S(10) = (S(11) - S(8))/S(5)	00130530
1101		K = INT(S(10))	00130540
1102		IF(K) 123,123,124	00130550
1103		123 S(12) = S(8)/S(3)	00130560
1104		Y(1) = S(2) + S(3)*SIN(S(12))	00130570
1105		Z(1) = S(4) + S(3)*COS(S(12))	00130580
1106		S(8) = S(11) - S(8)	00130590
1107		I = I+1	00130600
1108		GO TO 200	00130610
1109		124 S(12) = S(8)/S(3)	00130620
1110		S(13) = S(12)	00130630
1111		S(14) = S(5)/S(3)	00130640
1112		Y(1) = S(2) + S(3)*SIN(S(12))	00130650
1113		Z(1) = S(4) + S(3)*COS(S(12))	00130660
1114		K = K+1	00130670
1115		I = I+1	00130680
1116		DO 125 J=1,K	00130690
1117		S(13) = S(13) + S(14)	00130700
1118		Y(J) = S(2) + S(3)*SIN(S(13))	00130710
1119		Z(J) = S(4) + S(3)*COS(S(13))	00130720
1120		125 CONTINUE	00130730
1121		I = K+1	00130740
1122		S(8) = (S(10)/S(2) - S(13))/S(3)	00130750
1123		200 IF(S(4)) 300,300,203	00130760
1124		203 S(8) = S(5) - S(8)	00130770
1125		S(10) = (S(4) - S(8))/S(5)	00130780
1126		I = S(10)	00130790
1127		IF(I) 300,300,300	00130800
1128		300 Y(1) = S(2) + S(3)	00130810
1129		Z(1) = S(4) - S(8)	00130820
1130		K = K+1	00130830
1131		I = I+1	00130840
1132		DO 204 J=1,K	00130850
1133		Y(J) = S(2) + S(3)	00130860
1134		Z(J) = Z(J-1) - S(8)	00130870
1135		204 CONTINUE	00130880

05/25/74	INPUT LISTING	AUTOFLOW CHART SET - SHEEP	AIR INJECTION SYSTEM MODULE
CARD NO	CONTENTS		
1135	S(1) = Z(1)		00130000
1137	DO K = 10 + 1		00130000
1138	Y(K) = S(2) + S(3)		00130010
1139	Z(K) = S(2)		00130000
1140	K = 2*10 + 2		00130000
1141	DO 401 1=1,10		00130040
1142	IK = K-1		00130000
1143	Y(IK) = Y(1)		00130000
1144	Z(IK) = -Z(1)		00130070
1145	401 CONTINUE		00130000
1146	K = 2*10 + 1		00130000
1147	DO 402 1=1,10		00131000
1148	IK = 1		00131010
1149	Y(IK) = - Y(I+1)		00131020
1150	Z(IK) = - Z(I+1)		00131030
1151	402 CONTINUE		00131040
1152	K = 4*10 + 2		00131000
1153	DO 403 1=1,10		00131000
1154	IK = K-1		00131070
1155	Y(IK) = - Y(1)		00131000
1156	Z(IK) = Z(1)		00131000
1157	403 CONTINUE		00131100
1158	DO 500 1=1,177		00131110
1159	Y(1) = (Y(1) + Y(1+1))/2		00131120
1160	Z(1) = (Z(1) + Z(1+1))/2		00131130
1161	ELS(1) = ((Y(1+1) - Y(1))**2 + (Z(1+1) - Z(1))**2)**.5		00131140
1162	500 CONTINUE		00131150
1163	RETURN		00131100
1164	END		00131170
1165	C		
1166	C		
1167	C SUBROUTINE MATLF1		
1168	C		
1169	C		
1170	C SUBROUTINE MATLF1		0000010
1171	C MATL PROP. FIT SUB		0000000
1172	C		0000000
1173	C **REVISION--03-21-66--ADD MATL. PROP. TITLE. **		0000000
1174	C REVISION -- 01-11-66 -- NEW LOGIC, LINKAGE, NO PRINT OR MOVE		0000000
1175	C		0000000
1176	C		0000070
1177	C		0000000
1178	C		0000000
1179	C COMMON TCOM(400)		0000100
1180	C		0000110
1181	C DIMENSION P(200),T(200),DC(100),ND(200)		0000120
1182	C DIMENSION TH(300),TH(100),TT(30)		0000130
1183	C		0000140
1184	C EQUIVALENCE (D(1),TCOM(1)),(T(1),TCOM(200)),(DC(1),TCOM(401)),		0000150
1185	C (ND(1),TCOM(420))		0000160
1186	C EQUIVALENCE (T(120),TH(1)),(T(180),TH(1)),(T(180),TT(1))		0000170
1187	C EQUIVALENCE (ND(101),I),(ND(103),K),(ND(104),L),(ND(100),N)		0000180
1188	C		0000190
1189	C		0000200
1190	C		0000210
1191	DO 101 1=1,100		0000220
1192	TH(1) = S(2)		0000230
1193	101 CONTINUE		0000240
1194	C		0000250
1195	C **SETUP FOR INTERPOLATION**		0000260
1196	DO 102 1=1,2		0000270
1197	TH(1+20) = TH(1+10)		0000280
1198	102 CONTINUE		0000290
1199	IF(TH(120)) 31,31,104		0000300
1200	31 IF(TH(120) - TT(2)) 32,130,32		0000310
1201	32 WRITE(6,90) TT(1),TT(2),TH(110)		0000320
1202	90 FORMAT(1X,10X,20X) MATL TEMPERATURE ERROR **//EX.0+MAT. NO.,		0000330
1203	91.1,2X THERE IS NO TEMPERATURE ON FILE./10X,13XEND. TOP. =,		0000340
1204	97.1,2X. 13XENDED TOP. =,77.1)		0000350
1205	TH(1) = TH(110)		0000360
1206	DO TO 127		0000370

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CARD NO      ****      CONTENTS      ****
1007      104 DD 110 MD=120.270.05
1008      KA = MD - 05
1009      IF (TH(100)) 105,105,107
1010      107 IF (TH(100)) - TT(2)) 110,105,105
1011      110 CONTINUE
1012      WRITE(6,01) TT(1),TT(2),TH(100)
1013      01 FORMAT(////10X,20H*** MAX. TEMPERATURE ERROR **/,2X,0PARL NO.,
1014      1P5.1,2X,20HTEMPERATURE IS BEYOND RANGE OF TABLE,/10X,
1015      21DREC'D. TEMP. =,F7.1,2X,10HLAST TEMP. =,F7.1)
1016      GO TO 105
1017      105 KA = KA - 05
1018      WRITE(6,01) TT(1),TT(2),TH(KA-05)
1019      105 MD = KA + 05
1020      DD (2) =1,05
1021      TH(1-04) = TH(1-KA)
1022      101 TH(1-70) = TH(1-05)
1023      TT(3) = (TH(05) - TT(2))/(TH(05) - TH(01))
1024      DD (2) =1,24
1025      TH(1-20) = TH(1-05) + TT(3)*(TH(1-05) - TH(1-01))
1026      102 CONTINUE
1027      C
1028      C      ***PROCESS BASIC DATA***
1029      120 TH(1) = TT(2)
1030      127 TH(2) = TH(3)
1031      TH(11) = TH(2)
1032      TH(14) = TH(13)
1033      TH(15) = TH(14)
1034      TH(5) = TH(24)/TH(22)
1035      TH(6) = TH(25)
1036      TH(8) = TH(41)/TH(20)
1037      TH(10) = TH(45)
1038      TH(13) = TH(24)
1039      TH(12) = TH(45)
1040      IF (TH(12)) 131,131,132
1041      131 TH(12) = TH(10)
1042      132 TH(10) = TH(47)
1043      IF (TH(10)) 133,133,134
1044      133 TH(10) = TH(12)/0.100
1045      134 TH(17) = TH(45)
1046      IF (TH(17)) 135,135,136
1047      135 TH(17) = 0.12*TH(5)
1048      136 TH(10) = TH(50)
1049      TH(10) = TH(51)
1050      TH(20) = TH(52)
1051      C
1052      C      *FIT DATA N=1 COMP., N= TCH.
1053      140 N = 1
1054      DD (4) =1,7
1055      TT(1-0) = TH(1-31)
1056      141 CONTINUE
1057      C
1058      142 TT(0) = TT(0)
1059      TT(10) = (TT(10) - TT(0))/0.14
1060      TT(7) = TT(0) + TT(10)
1061      TT(8) = TT(7)+TT(10)
1062      TT(9) = TT(0)+TT(10)
1063      TT(5) = TT(11)/TT(8)
1064      TT(10) = 0.11/TT(5)
1065      TT(17) = TT(10) - TT(10)+TT(10)
1066      C
1067      C      **00 PT(1,0,0), (1,3,0), (1,4,0)***
1068      143 DD 100 K=1,3
1069      TH(K-10) = 0(24)
1070      TT(10) = TT(K-0) - TT(10)+TT(K-11)
1071      TT(10) = TT(10) - TT(K-11)
1072      C      A(K), 0(K)
1073      144 TH(K-112) = A,00(TT(17)/TT(10))/TT(10)
1074      TH(K-100) = EXP(A,00(TT(10)) - TT(K-11)+TH(K-110))
1075      C
1076      C      0(K) OF ERROR=0
1077      145 TT(20) = 0.11/TT(10) + TH(K-100)+TH(K-112)+EXP(TH(K-110)+TT(111))0001130

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CARD NO	CONTENTS	00000000
1270	TT(21) = 0(11) - TT(20)*TT(10)	00001140
1270	THK(110) = TT(21)*TT(21)	00001150
1280	DO 140 I=1,5	00001160
1281	TT(22) = TT(10)*TT(1-10) + THK(100)*EXP(THK(112)*TT(1-10))	00001170
1282	TT(23) = 0(11) - TT(22)/TT(1-9)	00001180
1283	THK(115) = THK(110) + TT(23)*TT(23)	00001190
1284	140 CONTINUE	00001200
1285	C	00001210
1286	C       **BEST CURVE**	00001220
1287	147 IF(2 - N) 140,140,140	00001230
1288	148 IF (THK(115) - TT(24)) 140,150,150	00001240
1289	149 TT(24) = THK(115)	00001250
1290	TT(2) = THK(100)	00001260
1291	TT(4) = THK(112)	00001270
1292	150 CONTINUE	00001280
1293	C	00001290
1294	C       **TEST FOR TENSION OR COMPRESSION FIT**	00001300
1295	IF(N - 1) 151,151,153	00001310
1296	151 N = 2	00001320
1297	TH(3) = TT(3)	00001330
1298	TH(4) = TT(4)	00001340
1299	DO 152 I=1,7	00001350
1300	TT(1-8) = TH(1-30)	00001360
1301	152 CONTINUE	00001370
1302	GO TO 142	00001380
1303	C	00001390
1304	C       ***TENSION. NONE BEFORE EXIT***	00001400
1305	153 TH(7) = TT(3)	00001410
1306	TH(8) = TT(4)	00001420
1307	C	00001430
1308	C	00001440
1309	C	00001450
1310	C       EXIT	00001460
1311	100 RETURN	00001470
1312	END	00001480
1313	C	
1314	C (.....)	
1315	C       SUBROUTINE MATLPR	
1316	C (.....)	
1317	C	
1318	SUBROUTINE MATLPR	00000010
1319	C   MATL PROP. PRINT SUBR	00000020
1320	C   **REVISION--03-21-68--ADD MATL PROP TITLE PRINT**	00000030
1321	C   01-20-68 -- NEW SUBR--4A-014 FORMAT	00000040
1322	C	00000050
1323	C	00000060
1324	C	00000070
1325	COMMON TCON(1400)	00000080
1326	C	00000090
1327	DIMENSION D(2000),T(2000),DC(100),ND(200)	00000100
1328	DIMENSION TH(200),TH(100),RH(10)	00000110
1329	C	00000120
1330	EQUIVALENCE (D(1),TCON(1)),(T(1),TCON(200)),(DC(1),TCON(101)),	00000130
1331	(ND(1),TCON(401))	00000140
1332	EQUIVALENCE (T(120),TH(1)),(T(150),TH(1)),(TH(205),RH(1))	00000150
1333	EQUIVALENCE (ND(80),MPAGE), (ND(80),MATL)	00000160
1334	EQUIVALENCE (ND(10),J), (ND(102),J), (ND(103),N), (ND(100),N)	00000170
1335	EQUIVALENCE (ND(107),I), (ND(100),JK)	00000180
1336	C	00000190
1337	C	00000200
1338	C       **PRINT TITLES**	00000210
1339	DO 1340,20,40,JK	00000220
1340	DO WRITE(6,01) I,MATL	00000230
1341	01 FORMAT(1H,0X,0POINT,13,2X,25H--DUCT MATERIAL DATA. ,	00000240
1342	(0MATL,ND.,13,4X--.,13X,21H** MATLPR - (P(3)) **)	
1343	02 FORMAT(1H,0X,0POINT,13,2X,25H--RAPP MATERIAL DATA. ,	00000250
1344	(0MATL,ND.,13,4X--.,13X,21H** MATLPR - (P(3)) **)	
1345	03 FORMAT(1H,0X,0POINT,13,21X,20H--WACELLE MATERIAL DATA. ,	00000260
1346	(0MATL,ND.,13,4X--.,13X,21H** MATLPR - (P(3)) **)	
1347	DO 1348	00000270
1348	DO WRITE(6,02) I,MATL	00000280

CARD NO	CONTEXT	CONTEXT
134	GO TO 105	0000020
135	NO WRITE (0,03) 11,PAR1	0000020
136	105 WRITE (0,100)M1	0000020
137	106 FORMAT (M0,01,0A10/10M,0A10)	0000020
138	C	0000020
139	107 WRITE (0,110)TM1),TM11),TM2)	0000020
140	C	0000020
141	110 FORMAT(10M TEMP,4F0.0,10M DENSITY=77.0,7M RW=77.0,7F0M	0000020
142	1 A B C	0000020
143	2 (M1) (M1) 1)	0000020
144	111 FORMAT (10M COMPRESSION 1X,0E10.0,0F10.1,10M TENSION	10000020
145	1,0E10.0,0F10.1)	0000020
146	C	0000020
147	WRITE (0,111)TM3),TM4),TM5),TM10),TM10),TM10),TM10),TM10)	0000020
148	C	0000020
149	112 FORMAT (10M0	0000020
150	1 F(1) F(2) F(3) F(4) F(5) 1)	0000020
151	113 FORMAT (10M COMPRESSION 1X,0F10.0,0F10.1,10M TENSION	10000020
152	1,0F10.0,0F10.1)	0000020
153	C	0000020
154	155 WRITE (0,112)	0000020
155	156 WRITE (0,113)(TM1-3),1-1,1)	0000020
156	C	0000020
157	WRITE (0,156)TM12),TM10),TM17)	0000020
158	157 FORMAT (23M	0000020
159	C	0000020
160	C	0000020
161	C	0000020
162	160 FORMAT (0M TM)	0000020
163	161 FORMAT (0M TM)	0000020
164	162 FORMAT (1M 21,12,0E10.0)	0000020
165	163 WRITE (0,200)	0000020
166	DO 200 N=1,20,5	0000020
167	K = N + 9	0000020
168	WRITE (0,200)M1,(TM11),1+M,K,1)	0000020
169	200 CONTINUE	0000020
170	C	0000020
171	164 WRITE (0,201)	0000020
172	165 FORMAT (1M 21,12,10F0.4)	0000020
173	DO 207 N=10,21,10	0000020
174	K = N + 9	0000020
175	WRITE (0,200)M1,(TM11),1+M,K,1)	0000020
176	207 CONTINUE	0000020
177	C	0000020
178	C	0000020
179	100 RETURN	0000020
180	END	0000020
181	C	
182	C	
183	C	
184	C	
185	C	
186	C	
187	C	
188	C	
189	C	
190	C	
191	C	
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397	C	
398	C	
399	C	
400	C	

CARD NO	CONTENTS	***
140	EQWALDICE (D100),DAYS(11)	000+010
141	EQWALDICE (T101),TDM(11),TT(20),TDL(11)	000+010
142	EQWALDICE (T101),TDM(11),TT(20),TDL(11),TT(11),	000+020
143	TT(100),TMS(11)	000+020
144	EQWALDICE (T101),TDM(11),TT(20),TDL(11),TT(11),TCYH(11),	000+020
145	TT(20),TCYH(11),TT(20),TDM(11),TT(20),TDL(11),	000+020
146	TT(20),TDM(11),TT(20),TDL(11),TT(20),DWH(11),	000+020
147	TT(20),DWH(11),TT(20),TDM(11),TT(20),TDL(11)	000+020
148	EQWALDICE (T170),R400	000+020
149	EQWALDICE (ND103),IF3),ND104),IF4)	000+020
150	EQWALDICE (ND100),M4L1),ND100),M4L1)	000+020
151	EQWALDICE (ND101),I1),ND102),J1),ND103),E1),ND104),L1)	000+020
152	EQWALDICE (ND100),N)	000+020
153	EQWALDICE (ND107),I1),ND108),J1),ND109),K1)	000+020
154	EQWALDICE (ND112),I10)	000+020
155	EQWALDICE (ND113),I101)	000+020
156	C	000+020
157	GO 400 I1=1.0	000+020
158	GO 300 J1=1.0	000+020
159	IF1,J1 - 1) 10,10,20	000+020
160	10 TT(2) = TDM(11) - EQU(20)	000+020
161	C *** IF TEMP LOWER THAN BEEP. SET TO 80, BECAUSE ***	000+020
162	C *** GO TO LOWEST TABLE TEMPERATURE. ***	000+020
163	IF(TT(2) .LT. 80.0) TT(2)=80.0	000+020
164	GO TO 100	000+020
165	20 IF(TDL(11) - TDM(11)) 20,20,20	000+020
166	22 GO 24 I=1,50	000+020
167	TMS(I+20) = TMS(I)	000+020
168	24 CONTINUE	000+020
169	GO TO 300	000+020
170	20 TT(2) = TDL(11) - EQU(20)	000+020
171	IF(TT(2) .LT. 80.0) TT(2)=80.0	000+020
172	100 GO 200 IK=1,3	000+020
173	TT(20) = TT(2)	000+020
174	IF(IK - 1) 40,40,50	000+020
175	40 TT(1) = DAYS(IK+20)	000+020
176	GO TO 110	000+020
177	50 IF(IK - 2) 52,52,70	000+020
178	52 GO TO (200,200,20,20,200,200),100	000+020
179	54 IF(DAYS(IK+20) - TT(1)) 60,100,20	000+020
180	60 TT(1) = DAYS(IK+20)	000+020
181	GO TO 110	000+020
182	70 IF(DAYS(11) 200,200,20	000+020
183	110 M4L1 = TT(1)	000+020
184	IF(M4L1) 114,114,113	000+020
185	113 IF(M4L1 - M4L1) 114,110,110	000+020
186	114 M4L1 = 1	000+020
187	C	000+020
188	C ***M4L1 NO ERROR - PRINT ERROR MESSAGE***	000+020
189	WRITE(6,115) M4L1,TT(1),TT(2)	000+020
190	115 FORMAT (4D4) ***M4L1 INPUT ERROR. ASSUMED M4L1 NO. 1.*** ,/10D2,	000+020
191	113,F8.1,F8.1)	000+020
192	C	000+020
193	C READ M4L1 RECORD	000+020
194	110 IF3 = M4L1 * 40	000+020
195	CALL READM4L1,TM(11,200,173)	000+020
196	C	000+020
197	C TEST TEMPERATURES FOR VALID VALUE	000+020
198	IF(TT(2)) 100,100,127	000+020
199	100 WRITE(6,100) M4L1,TT(2),TM(110)	000+020
200	100 FORMAT (2D4) ***M4L1 TEMPERATURE ERROR. M4L1 NO.,T1,1,SH REC.,	000+020
201	177.1,2SH REC. ASSUMED TEMP.,177.1,SH REC.)	000+020
202	C	000+020
203	C ***USE FIRST TEMPERATURE***	000+020
204	TT(2) = TM(110)	000+020
205	C ***INTERPOLATE, FIT AND PRINT***	000+020
206	177 CALL M4L1	000+020
207	TT(2) = TT(20)	000+020
208	100 L = (LJ - 1)*2 + IK	000+020
209	K = KL - 1)*2	000+020
210	GO 104 I=1,20	000+020

LINE NO	CONTENTS	ADDRESS
1401	J = 0.1	00040000
1402	TRN(J) = TRN(I)	00040000
1403	101 CONTINUE	00040010
1404	IF(II - 1) 100,100,200	00040020
1405	100 IF(IJ - 1) 102,102,200	00040030
1406	102 IF(IPI3) 1001,0001,200	
1407	0001 CALL RFLPB	
1408	000 CONTINUE	00040030
1409	200 CONTINUE	00040030
1000	C	00040070
1001	C ***RELAYPOINT OUTPUT***	00040080
1002	IF(IPI0) 1310,310,330	
1003	310 WRITE(6,0) II	00041000
1004	01 FORMAT(1H,3I,20THE REGION PROFILE POINT =,13,00H,	
1005	1 0H** MENTL - IPI0H **/)	
1006	00 200 H=1,100.0	00041020
1007	K = 0 + 4	00041030
1008	WRITE(6,0) H,ITR(1),I=K,K,1)	00041040
1009	2 FORMAT(1H 3I,13,0E10.0)	00041050
1010	200 CONTINUE	00041060
1011	300 IF( = 1) = 100	00041070
1012	CALL WRITE(1,TRN(1),100,IF( = 1))	00041080
1013	C	00041090
1014	C SETUP AND STORE DUCT MATERIAL PROPERTIES	00041100
1015	FTN(1) = TRN(12)	00041110
1016	FTN(2) = TRN(10)	00041120
1017	FTN(3) = TRN(10)	00041130
1018	FTN(4) = TRN(12)	00041140
1019	DN(1) = TRN(0)	00041150
1020	FTL(1) = TRN(100)	00041160
1021	FTL(2) = TRN(100)	00041170
1022	FTL(3) = TRN(100)	00041180
1023	FTL(4) = TRN(100)	00041190
1024	EL(1) = TRN(100)	00041200
1025	FTN(1) = TRN(20)	00041210
1026	FTL(1) = TRN(110)	00041220
1027	400 CONTINUE	00041230
1028	000 = TRN(1)	00041240
1029	RETURN	00041250
1030	000	00041260
1001	C	
1002	C	
1003	C SUBROUTINE MISC0N	
1004	C	
1005	C	
1006	C SUBROUTINE MISC0N	00010010
1007	C WRITTEN 17 APRIL 1972	00010020
1008	C TO DEVELOP DOWNE POINT AND MISCELLANEOUS DUCT HEIGHTS	00010030
1009	C	00010040
1010	C	00010050
1011	C	00010060
1012	C	00010070
1013	C	00010080
1014	C	00010090
1015	C	00010100
1016	C	00010110
1017	C	00010120
1018	C	00010130
1019	C	00010140
1020	C	00010150
1021	C	00010160
1022	C	00010170
1023	C	00010180
1024	C	00010190
1025	C	00010200
1026	C	00010210
1027	C	00010220
1028	C	00010230
1029	C	00010240
1030	C	00010250
1031	C	00010260

CARD NO	****	CONTENTS	****
1002		EQUIVALENCE (IND(119),NC1,IND(123),NCH)	00210270
1003	C		00210300
1004		NCH = BARK(1)	00210300
1005		S(1) = BATS(7)	00210300
1006		IF(BATS(1)) 100,100,20	00210310
1007		20 S(1) = BATS(7)/BATS(1)	00210320
1008		100 MTCM = CBM(12)*S(1)*BATS(9)	00210320
1009		SUPN(2) = MTCM	00210340
1010		SUPN(2) = BATS(10) + BATS(12)	00210350
1011		IF(BATS(27)) 200,200,100	00210360
1012		100 MTAJ = CBM(13)*BATS(27)	00210370
1013		SUPN(7) = MTAJ	00210380
1014		SUPN(8) = BATS(10)/D(3)	00210380
1015		200 IF(BATS(20)) 300,300,200	00210400
1016		200 MTP = CBM(14)*BATS(20)	00210410
1177		SUPN(9) = MTP	00210420
1018		SUPN(10) = BATS(10)*D(2)/D(3)	00210430
1019		300 IF(BATS(1)) 400,400,200	00210440
1020	C	ENGINE REVERSAL BOORS - MACELLE	00210450
1021		200 IF(BATH(8)) 400,400,200	00210462
1022		200 S(1) = BATH(NCH+10) - BATS(10)	00210460
1023		MTCM = CBM(15)*BATH(8)*S(1)/D(17)	00210470
1024		SUPN(6) = MTCM	00210480
1025		SUPN(6) = BATS(10) + S(1)/D(2)	00210480
1026		400 IF(BATS(20)) 500,500,400	00210500
1027	C	MISCELLANEOUS BOORS	00210510
1028		400 MTH = BATS(20)*CBM(16)	00210520
1029		SUPN(5) = MTH	00210530
1030		SUPN(5) = BATH(NCH+10)/D(2)	00210540
1031		500 IF(BATS(1)) 600,600,200	00210550
1032	C	FIREWALL AT FRONT FACE OF ENGINE MACELLE TYPE ONLY	00210560
1033		500 S(1) = D(1)	00210570
1034		IF(BATS(10)) 500,500,200	00210580
1035		500 S(1) = D(2)	00210580
1036		D(3) = D(2)*RED(NC) + MED(NC)	00210600
1037		S(4) = D(2)*RED(NC) + SOB(NC)	00210610
1038		S(5) = S(3)*S(4) + RED(NC)*D(10) - D(4)	00210620
1039	C	INTERPOLATE FOR MACELLE GEOMETRY AT ENGINE FRONT FACE	00210630
1040		I = 1	00210640
1041		D(1) IF(BATH(1+10) - BATS(10)) 502,504,504	00210650
1042		D(2) I = I + 1	00210660
1043		GO TO D(1)	00210670
1044		D(4) S(2) = (BATS(10) - BATH(1+10))/(BATH(1+10) - BATH(1+9))	00210680
1045		S(6) = RED(1-1) + (RED(1) - RED(1-1))*S(2)	00210690
1046		S(7) = SOB(1-1) + (SOB(1) - SOB(1-1))*S(2)	00210700
1047		S(8) = MED(1-1) + (MED(1) - MED(1-1))*S(2)	00210710
1048		S(10) = D(2)*S(6) + S(8)	00210720
1049		S(11) = D(2)*S(6) + S(7)	00210730
1010		S(12) = S(10)*S(11) + S(8)*D(10) - D(4)	00210740
1011		S(13) = S(12) - S(11)*S(5)	00210750
1012		MTH = CBM(17)*S(13)/D(17)	00210760
1013		SUPN(4) = MTH	00210770
1014		SUPN(4) = BATS(10)	00210780
1015	C	EXTERIOR FINISH - MACELLE TYPE ONLY	00210790
1016		MTP = TOT(12)/D(17)*CBM(11)	00210800
1017		SUPN(7) = MTP	00210810
1018		SUPN(7) = BATH(NCH+10)/D(2)	00210820
1019	C	SHROUD INDICATOR ZERO NO SHROUD	00210830
1020		IF(BATS(20)) 600,600,500	00210840
1021	C	ENGINE COMPARTMENT SHROUD	00210850
1022		500 S(3) = BATS(20)	00210860
1023	C	IF INDICATOR AREA IS MORE THAN 1.0 VALUE IS AREA, IF NOT O.I.C. AREA	00210870
1024		IF(BATS(20) - D(1)) 600,600,570	00210880
1025		500 S(4) = BATH(1+20) + (BATH(1+40) - BATH(1+20))*S(2)	00210890
1026		S(5) = BATH(NCH+10) - BATS(10)	00210900
1027		S(6) = D(15)*BATS(11) + CBM(11)/D(2) + S(4)	00210910
1028		S(3) = S(1)*S(5)*S(6)/D(17)	00210920
1029		570 MTP = S(3)*CBM(11)	00210930
1030		SUPN(4) = MTP	00210940
1031		SUPN(4) = BATS(10)/D(2) + BATH(NCH+10)/D(2)	00210950
1032		600 CONTINUE	00210960

CARD NO	****	CONTENTS	****
1000		RETURN	0010070
1001		END	0010000
1002	C		
1003	C	!!	
1004	C	SUBROUTINE MACCLE	
1005	C	))	
1006	C		
1007		SUBROUTINE MACCLE	00100010
1008	C	WRITEN 7 APRIL 1973	00100000
1009	C	TO DEVELOP MACCLE SHELL HEIGHT	00100000
1010	C		00100000
1011		OPEN TCON(400)	00100000
1012		OPEN /PRINT/ (P(00))	
1013	C		00100000
1014		OPEN /MISC/ (MISC(100))	
1015	C		
1016		DIMENSION D(1000),T(2000),SC(100),ND(200)	00100070
1017		DIMENSION ECU(100),DAYS(00),DATH(00)	00100000
1018		DIMENSION SUPH(00)	00100000
1019		DIMENSION S(100)	00100100
1020		DIMENSION TOT(100)	00100110
1021		DIMENSION TH(100)	00100100
1022		DIMENSION DATS(40)	00100120
1023		DIMENSION TITL(20), BATH(10)	00100140
1024		DIMENSION AL(10),VL(10),GL(10)	00100100
1025		DIMENSION SFTH(0),FRHT(10)	00100100
1026		DIMENSION RDN(10),RDN(10),RDN(10),BLN(10),BLN(10)	00100170
1027		DIMENSION RDN(10),BLN(10)	00100100
1028		DIMENSION SFTH(10),RDN(10),RDN(10)	00100100
1029		DIMENSION BLN(10)	00100000
1030		DIMENSION TON(10),SFTH(10),FRHT(10),MTCN(10),MTCN(10)	00100010
1031		DIMENSION MFLX(10)	00100000
1032	C		00100000
1033		EQUIVALENCE (D(1),TCON(1)),(T(1),TCON(200)),(SC(1),TCON(410)),	00100000
1034		(ND(1),TCON(400))	00100000
1035		EQUIVALENCE (D(0),ECU(1)),(D(20),DAYS(1)),(D(20),DATH(1))	00100000
1036		EQUIVALENCE (D(20),DATS(1))	00100070
1037		EQUIVALENCE (D(27),BATH(1)), (D(70),TITL(1))	00100000
1038		EQUIVALENCE (D(170),SUPH(1))	00100000
1039		EQUIVALENCE (T(1),S(1))	00100000
1040		EQUIVALENCE (T(10),TOT(1))	00100010
1041		EQUIVALENCE (T(20),AL(1)),(T(27),VL(1)),(T(20),GL(1))	00100000
1042		EQUIVALENCE (T(71),SFTH(1)),(T(74),FRHT(1))	00100000
1043		EQUIVALENCE (T(70),RDN(1)),(T(70),RDN(1)),(T(77),RDN(1)),	00100000
1044		(T(70),BLN(1)),(T(70),BLN(1))	00100000
1045		EQUIVALENCE (T(00),RDN(1)),(T(01),BLN(1))	00100000
1046		EQUIVALENCE (T(02),SFTH(1)),(T(03),RDN(1)),(T(03),RDN(1))	00100070
1047		EQUIVALENCE (T(00),BLN(1))	00100000
1048		EQUIVALENCE (BLN(1),RDN(1))	00100000
1049		EQUIVALENCE (T(07),TON(1)),(T(08),SFTH(1)),(T(08),FRHT(1)),	00100000
1050		(T(08),MTCN(1)),(T(01),MTCN(1))	00100010
1051		EQUIVALENCE (T(02),MFLX(1))	00100000
1052		EQUIVALENCE (T(100),TH(100))	00100000
1053		EQUIVALENCE (ND(0),MPAC)	00100000
1054		EQUIVALENCE (ND(0),IF(1))	00100000
1055		EQUIVALENCE (ND(10),I), (ND(10),J)	00100000
1056		EQUIVALENCE (ND(11),IC), (ND(12),RDN), (ND(13),RDN),	00100070
1057		(ND(13),ICN), (ND(10),ICN), (ND(12),MFLX)	00100000
1058	C		00100000
1059		RDN = BATH(1)	00100000
1060		RDN = BATH(2)	00100010
1061		RDN = BATH(3)	00100000
1062	C	ICN=0 = DIRECT THE FOR ENGINE, =1 = END. TO MACCLE. TO SUP.	00100000
1063	C	FOR ION=1 CALC. LONGERON	00100000
1064	C	BUT ONLY IF 2 END PER MACCLE.	00100000
1065		IF (ION .NE. 0 .AND. (DAYS(7)/DATS(1))) .LT. D(2) ) ICN = 0	00100000
1066		CALL HELD	00100070
1067	C	TEST FOR FLUTTER	00100000
1068		MFLX = D(4)	00100000
1069		DD ION J=1,0	00100000
1070		IF( J = I + 100	00100010

CARD NO	****	CONTENTS	****
1704		CALL READB(1,705(1),100,170)	00100000
1705		ELM(J) = 705(100)	00100030
1706		IF(VL(J) - 0(1)) 100,10,10	00100040
1707		10 IF(VL(J) - 0(1)) 12,12,00	00100050
1708	C	SPEED IS LESS THAN MACH 1.0	00100060
1709		12 S(3) = 0(107) + 0(100)*VL(J)**2 - 0(111)**3	00100070
1710		00 TO 20	00100080
1711		20 IF(VL(J) - 0(12)) 22,22,00	00100090
1712	C	SPEED IS GREATER THAN MACH 1.0 BUT LESS THAN 2.0	00100700
1713		22 S(3) = 0(100) - 0(100)*COS(VL(J) - 0(101)) + 0(101)*0(10)/0(102)	00100710
1714		MODX(03)*VL(J)**2 - 0(111)**3	00100720
1715		00 TO 30	00100730
1716	C	SPEED IS GREATER THAN MACH 2.0	00100740
1717		22 S(3) = VL(J)**2 - 0(111)**3	00100750
1718		20 S(4) = S(3)*ELM(J)/EL(J)	00100760
1719		IF(BATH(7)) 40,40,20	00100770
1720		22 S(5) = BATH(7)*BATH(7)/BATH(7)	00100780
1721		IF(S(4) - 0(0)) 40,40,100	00100790
1722		40 BATH(7) = VL(J)	00100800
1723		BATH(7) = ALT(J)	00100810
1724		BATH(7) = EL(J)	00100820
1725		BATH(7) = S(3)	00100830
1726		BATH(7) = ELM(J)	00100840
1727		MFLT = J	00100850
1728		100 CONTINUE	00100860
1729		NDEN = 705(101)	00100870
1730		00 110 [=1,NDEN	00100880
1731		TDEN(1) = 0(102)	00100890
1732		110 CONTINUE	00100900
1733	C	SETUP FRAME SPACING	00100910
1734		100 00 200 [=1,NDEN	00100920
1735		IF(BATH(1+10) - BATH(10+10)) 120,120,100	00100930
1736	C	NOZZLE STATION IS FORWARD OF ENGINE FACE	00100940
1737		120 IF(1 - 1) 122,122,140	00100950
1738		122 IF(100) 120,120,200	00100960
1739		120 FTRN(1) = FTRN(1)	00100970
1740		FTRN(1) = FTRN(1)	00100980
1741		IF(BATH(2)) 200,200,127	00100990
1742		127 FTRN(1) = FTRN(1)*0(12)	00101000
1743		00 TO 200	00101010
1744		140 J = 1	00101020
1745		141 IF(BATH(J+10) - BATH(10+10)) 142,140,140	00101030
1746		142 J = J + 1	00101040
1747		00 TO 141	00101050
1748		140 S(2) = 0(1)	00101060
1749		S(2) = 0(1)	00101070
1750		IF(BATH(J+20)) 140,140,140	00101080
1751		140 S(2) = 0(2)	00101090
1752		140 IF(BATH(J+10)) 140,140,147	00101100
1753		147 S(2) = 0(2)	00101110
1754		140 S(3) = (BATH(J+10) - BATH(10+10))/(BATH(J+10) - BATH(J+0))	00101120
1755		FTRN(1) = FTRN(J) + (FTRN(J+1) - FTRN(J))*S(3)	00101130
1756		FTRN(1) = FTRN(J)*0(10(1)) - S(3)*0(12) + FTRN(J+1)*0(11)*0(0)	00101140
1757		00 TO 200	00101150
1758	C	SECTION AFT OF ENGINE FACE	00101160
1759		100 FTRN(1) = BATH(0)	00101170
1760		S(1) = BATH(1+00) - BATH(0)	00101180
1761		FTRN(1) = 0(4)*0(100)*0(107) + BATH(7)*0(100)*0(11)*0(0)	00101190
1762	C	TEST FOR FLUTTER	00101200
1763		200 IF(MFLT) 200,200,210	00101210
1764		210 S(4) = FTRN(1)/NDEN(1)	00101220
1765		IF(S(10) - S(4)) 211,210,210	00101230
1766		211 S(4) = 0(10)	00101240
1767		212 S(2) = 0(104) - 0(100)*S(4) + 0(100)*S(4)**2 - 0(107)*	00101250
1768		10(4)**3	00101260
1769		S(5) = (BATH(7)*BATH(7)/BATH(7)*0(17))**0(21)	00101270
1770		S(5) = S(5)*FTRN(1)/S(0)	00101280
1771		IF(TDEN(1) .LT. 0(0)) TDEN(1) = 0(0)	00101290
1772	C	CALCULATE MACH NO	00101300
1773		200 IF(1 - 1) 200,200,200	00101310
1774		200 IF(1 - 0) 200,200,200	00101320

03/08/76	INPUT LISTING	AUTOPLAN CHART SET - BEEP	AIR INDUCTION SYSTEM TABLE
CARD NO	****	CONTENTS	****
1776	200 IF(ICH) 200,200,200		00101200
1776	200 MTCN(1) = S(2)		00101200
1777	MFTN(1) = S(2)		00101200
1778	C FOR VERTICAL LIP WITH LONGERON		00101200
1779	IF(ICH .EQ. 1 .AND. ICH .EQ. 1) GO TO 200		00101270
1780	GO TO 200		00101200
1781	C TEST FOR LOCATION		00101200
1782	200 IF(BATH(1+10) - BATH(1+10)) 200,200,200		00101400
1783	C SEARCH FORWARD OF ENGINE FACE		00101410
1784	200 MTCN(1-1) = (TCN(1)+BATH(1+00) + TCN(1-1)+BATH(1+00))/S(2)		00101400
1785	SLJN(1-1)=0EN		00101430
1786	GO TO 200		00101440
1787	C SEARCH AFT OF ENGINE FACE		00101400
1788	200 S(1) = BATH(1+00) - BATH(0)		00101400
1789	S(2) = BATH(1+00) - BATH(0)		00101470
1790	MTCN(1-1) = (TCN(1)+S(1) + TCN(1-1)+S(2))/S(2)+SLJN(1-1)+0EN		00101400
1791	C CALCULATE FRAMES		00101400
1792	200 MFTN(1-1)=FRON(1)/FTN(1) + FRON(1-1)/FTN(1-1)/S(2) + SLJN(1-1)+00101500		
1793	IF(ICH) 200,200,200		00101510
1794	C ONLY CALC. IF 2 ENDS PER MAC		00101520
1795	200 MFLN(1-1) = (SLJN(1)+BATH(1+00)+BATH(1+00))/S(2)+SLJN(1-1)/S(1)+00101530		
1796	MFLN(1-1) = MFLN(1-1)+BATH(1)		00101540
1797	200 CONTINUE		00101550
1798	J = NCH - 1		00101560
1799	S(1) = S(2)		00101570
1800	S(2) = S(2)		00101580
1801	S(3) = S(2)		00101590
1802	GO 200 I=1,J		00101600
1803	MTCN(1) = MTCN(1)+BATH(2)		00101610
1804	MFTN(1) = MFTN(1)+BATH(2)		00101620
1805	TOT(12) = TOT(12) + FTN(1)		00101630
1806	TOT(13) = TOT(13) + MTCN(1)		00101640
1807	TOT(14) = TOT(14) + MFTN(1)		00101650
1808	TOT(22) = TOT(22)+MFLN(1)		00101660
1809	S(1) = S(1) + MTCN(1)+BATH(1+10) + BATH(1+11)/S(2)		00101670
1810	S(2) = S(2) + MFTN(1)+BATH(1+10) + BATH(1+11)/S(2)		00101680
1811	S(3) = S(3) + MFLN(1)+BATH(1+10)+BATH(1+11)/S(2)		00101690
1812	200 CONTINUE		00101700
1813	SLPH(25) = TOT(20)		00101710
1814	SLPH(26) = TOT(20)		00101720
1815	SLPH(33) = TOT(22)		00101730
1816	SLPH(28) = S(2)/SLPH(25)		00101740
1817	SLPH(30) = S(1)/SLPH(26)		00101750
1818	IF(ICH .NE. 0) SLPH(34)=S(3)/SLPH(33)		00101760
1819	IF(IP(70))0001,0001,0002		
1820	2001 CONTINUE		
1821	C *** BREAKPOINT OUTPUT ***		00101770
1822	WRITE(0,001)N(1:3),N=05,100		00101780
1823	00 FORMAT(1H1,BA10,EN,2)*** MACLE - IP(70) **/1X,BA10		
1824	WRITE(0,01) 10N,NCH		00101810
1825	01 FORMAT(10,2X,20)*** MACLE GEOMETRY - SECTION DATA ***		00101820
1826	1 /FTN,10SLIP TYPE =,13,4X,10ENAVE CORK =,13/EN,		00101830
1827	ENCLUT,EN,4ENSTA,EN,ENDEPTH,EN,EN10TH,4X,4ENPER,EN,EN200,EN,		00101840
1828	EN200,EN,EN40,EN,EN50,EN,EN60,EN,EN70,EN,EN80,EN,EN90		00101850
1829	WRITE(0,02) (1,BATH(1+10),BATH(1+00),BATH(1+00),BATH(1+00),		00101860
1830	0EN(1),0EN(1),0EN(1),0EN(1),0EN(1),0EN(1),0EN(1),0EN(1),1=1,NCH		00101870
1831	00 FORMAT(17,1F0.1)		00101880
1832	WRITE(0,03)		00101890
1833	03 FORMAT(7,EN,ENCLUT,4X,4ENSTA,4X,ENFR.SP,EN,ENFR.MT,EN,ENCOVER)		00101900
1834	WRITE(0,04) (1,BATH(1+10),FTN(1),FRON(1),TCN(1),1=1,NCH)		00101910
1835	04 FORMAT(13H,17,3F0.2,F0.4)		00101920
1836	WRITE(0,05)		00101930
1837	05 FORMAT(7,EN,EN200,4X,EN10TH,EN,4ENPER,EN,EN200 COVER,4X,EN200 FR,		00101940
1838	EN,EN10000 LONGERON)		00101950
1839	J = NCH - 1		00101960
1840	WRITE(0,06) (1,SLJN(1),FTN(1),MTCN(1),MFTN(1),MFLN(1),1=1,J)		00101970
1841	06 FORMAT(23H,17,3F11.2)		00101980
1842	WRITE(0,07) BATH(1+10),TOT(12),TOT(13),TOT(14),TOT(22)		00101990
1843	07 FORMAT(5EN,EN10TA,3F11.2)		00102000
1844	C *** EXIT ***		00102010
1845	2002 CONTINUE		

02/02/74	INPUT LISTING	AIRFLUX CHART SET - SHEEP	AIR INDUCTION SYSTEM MESSAGE
CARD NO	***	COMMENTS	***
1040	RETURN		0010000
1041	END		0010000
1042	C		
1043	C	*****	
1044	C	SUBROUTINE HELD	
1045	C	*****	
1046	C	SUBROUTINE HELD	0010010
1047	C	WRITTEN 8 APRIL 1972	0010000
1048	C	TO DEVELOP NOZZLE GEOMETRY	0010000
1049	C		0010000
1050	C	OPEN TOSH400)	0010000
1051	C		0010000
1052	C	DIMENSION S(2000),T(2000),DC(100),ND(200)	0010070
1053	C	DIMENSION BARK(50)	0010000
1054	C	DIMENSION S(100)	0010000
1055	C	DIMENSION ND(10),RD(10),SD(10),BL(10),BL(10),SD(10)	0010010
1056	C	DIMENSION BL(10),DN(10),RL(10),RL(10),RDN(10)	0010010
1057	C		0010010
1058	C	DO 100 I=1,TCOH(1),T(1),TCOH(2000),DC(1),TCOH(101),	0010010
1059	C	ND(1),TCOH(2000))	0010010
1060	C	DO 100 I=1,BARK(1)	0010010
1061	C	DO 100 I=1,S(1)	0010010
1062	C	DO 100 I=1,ND(1),RD(1),SD(1),BL(1),BL(1),SD(1),	0010010
1063	C	BL(1),BL(1),SD(1),SD(1),DC(1),RDN(1),	0010010
1064	C	DO 100 I=1,ND(1),RD(1),SD(1),BL(1),BL(1),SD(1),	0010010
1065	C	BL(1),BL(1),SD(1),SD(1),DC(1),RDN(1),	0010010
1066	C	DO 100 I=1,ND(1),RD(1),SD(1),BL(1),BL(1),SD(1),	0010010
1067	C	BL(1),BL(1),SD(1),SD(1),DC(1),RDN(1),	0010010
1068	C	DO 100 I=1,ND(1),RD(1),SD(1),BL(1),BL(1),SD(1),	0010010
1069	C	BL(1),BL(1),SD(1),SD(1),DC(1),RDN(1),	0010010
1070	C	DO 100 I=1,ND(1),RD(1),SD(1),BL(1),BL(1),SD(1),	0010010
1071	C	BL(1),BL(1),SD(1),SD(1),DC(1),RDN(1),	0010010
1072	C	DO 100 I=1,ND(1),RD(1),SD(1),BL(1),BL(1),SD(1),	0010010
1073	C	BL(1),BL(1),SD(1),SD(1),DC(1),RDN(1),	0010010
1074	C	DO 100 I=1,ND(1),RD(1),SD(1),BL(1),BL(1),SD(1),	0010010
1075	C	BL(1),BL(1),SD(1),SD(1),DC(1),RDN(1),	0010010
1076	C	SETUP INDICATORS AND COUNTERS	0010000
1077	C	IF(1) - ND(1) 10,20,30	0010000
1078	C	SHAPE CODE IS 2 DEVELOP PERIMETER	0010000
1079	C	10 20 30 1=1,ND(1)	0010070
1080	C	IF(BARK(1-00)) 10,10,10	0010000
1081	C	10 BARK(1-00) = BARK(1-00)+BARK(1-00) + BARK(1-00)+BARK(1-00)	0010000
1082	C	10 CONTINUE	0010000
1083	C	FIT SHAPES	0010010
1084	C	20 20 20 1=1,ND(1)	0010000
1085	C	IF(BARK(1-00)) 20,20,100	0010000
1086	C	PERIMETER IS ZERO CHECK ON GUIDE	0010000
1087	C	20 IF(BARK(1-00)) 20,20,20	0010000
1088	C	VERTICAL LIP	0010000
1089	C	20 10 = 1	0010070
1090	C	BARK(1-00) = B(1)	0010000
1091	C	GO TO 200	0010000
1092	C	20 IF(BARK(1-00)) 20,20,20	0010000
1093	C	20 WRITE(6,20)	0010010
1094	C	20 FORMAT ('WARNING FROM HELD IN AIR INDUCTION SYSTEM /	0010000
1095	C	1 001,SEMIVERTICAL LIP GEOMETRY ERROR')	0010000
1096	C	HORIZONTAL LIP (UPPER L.E.)	0010000
1097	C	20 10 = 2	0010000
1098	C	BARK(1-00) = BARK(1-00)	0010000
1099	C	GO TO 200	0010070
1100	C	FULL SECTION	0010000
1101	C	100 S(1) = S(1)	0010000
1102	C	S(2) = (S(2)+BARK(1-00) + BARK(1-00)) - BARK(1-00)/	0010000
1103	C	(S(2) - S(2)+B(1))	0010010
1104	C	IF(S(2)) 101,101,100	0010000
1105	C	101 S(1) = BARK(1-00)/B(2)+BARK(1-00) + S(2)+BARK(1-00)	0010000
1106	C	S(2) = S(2)	0010000
1107	C		0010000
1108	C	ERROR MESSAGE	0010000
1109	C	GO TO 1000	0010000
1110	C	100 S(4) = 2*BARK(1-00)+BARK(1-00)	0010010
1111	C	S(5) = 2*BARK(1-00)+BARK(1-00)	0010000
1112	C	IF(S(5)) 102,102,110	0010000
1113	C	100 S(2) = S(4)/S(5)	0010000
1114	C	S(1) = BARK(1-00)/B(2)+B(1)+S(2) + S(4) - S(2)+S(2))	0010000
1115	C		0010000
1116	C	ERROR MESSAGE	0010070

CARD NO	CONTENTS	CONTENTS
1017	1000 WRITE(6,80) 1, 5(11)	00100000
1018	00 FORMAT(44HWARNING FROM RELEASE IN AIR INDUCTION SYSTEM /	00100000
1019	1 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200)	00100700
1020	2 112CORRECTION IS, 170.3 )	00100710
1021	110 S(0) = (BATH(1+00) - D(2)*S(2))*S(11)/D(2)	00100700
1022	S(3) = (BATH(1+0) - D(2)*S(2))*S(11)/D(2)	00100700
1023	IF(S(0)) 111,112,112	00100700
1024	111 S(0) = S(2)	00100700
1025	112 IF(S(3)) 114,115,115	00100700
1026	114 S(3) = S(2)	00100700
1027	115 MDX(1) = S(0)	00100700
1028	MDX(1) = S(2)*S(11)	00100700
1029	MDX(1) = S(3)	00100000
1030	BLX(1) = S(2)*MDX(1) + D(15)/D(2)*MDX(1)	00100010
1031	BLX(1) = BLX(1)	00100000
1032	MDX(1) = S(2)*MDX(1) + D(15)/D(2)*MDX(1)	00100000
1033	IF(D(2) - MDX(1)) 116,116,200	00100000
1034	116 S(1) = MDX(1)*D(1) - D(25)/D(2)	00100000
1035	S(2) = MDX(1)*D(25)/D(2) + MDX(1)	00100000
1036	S(3) = MDX(1)*D(25)/D(2) + MDX(1)	00100070
1037	RLX(1) = (S(1)**2 + S(2)**2)/D(2)/S(1)	00100000
1038	RLX(1) = RLX(1)	00100000
1039	RCMD(1) = (S(1)**2 + S(2)**2)/D(2)/S(1)	00100000
1040	C IF R(2.0) ABSLPE RADIUS OF CURVATURE IS INFINITY IE FLAT PANEL	00100010
1041	200 CONTINUE	00100000
1042	J = 2	00100000
1043	IF(100) 200,200,200	00100000
1044	C CALCULATE LEADING EDGE SURFACE	00100000
1045	200 J = 3	00100000
1046	BLX(1) = BATH(2) - BATH(1)	00100070
1047	IF(100 - 1) 210,210,200	00100000
1048	210 S(1) = BLX(1)/D(2)*(BLX(2) + BLX(2))	00100000
1049	GO TO 200	00101000
1050	200 S(1) = BLX(1)/D(2)*(BATH(0) + BLX(2) + D(2)*MDX(2))	00101010
1051	C CALCULATE SUBSEQUENT SECTIONS OR MORE IF NO L.E.	00101000
1052	200 GO 200 1-J,MDX	00101000
1053	BLX(1-1) = BATH(1+0) - BATH(1+0)	00101000
1054	S(1-1) = BLX(1-1)/D(2)*(BATH(1+00) + BATH(1+00))	00101000
1055	200 CONTINUE	00101000
1056	C *** EXIT ***	00101070
1057	RETURN	00101000
1058	END	00101000
1059	C	
1060	C	
1061	C SUBROUTINE PRCRT	
1062	C	
1063	C	
1064	SUBROUTINE PRCRT	0000010
1065	C WRITTEN 20 MARCH 1970	00000000
1066	C TO DETERMINE CRITICAL RAMP DESIGN CRITERIA	00000030
1067	C	00000000
1068	COMMON TCDM(400)	00000000
1069	COMMON /SPRINT/ IP(100)	
1070	C	00000000
1071	DIMENSION D(200), T(2000), DC(100), MD(200)	00000070
1072	DIMENSION EDX(200)	00000000
1073	DIMENSION BATH(100)	00000000
1074	DIMENSION S(100)	00001000
1075	DIMENSION AL(10), WM(10), ML(10), TDM(10), TDL(10)	0000110
1076	DIMENSION PWRH(10), JMW(10)	0000120
1077	DIMENSION TH(100)	0000130
1078	C	0000140
1079	EDX(1) = (D(1), TCDM(1)), (T(1), TCDM(2001)), (DC(1), TCDM(401)),	0000150
1080	(MD(1), TCDM(801))	0000160
1081	EDX(2) = (D(2), EDX(1))	0000170
1082	EDX(3) = (D(3), BATH(1)), (BATH(3), JMW), (BATH(2), JMW),	0000180
1083	(BATH(1), JMW), (BATH(4), EDX), (BATH(5), JMW), (BATH(6), JMW), (BATH(7), JMW), (BATH(8), JMW), (BATH(9), JMW), (BATH(10), JMW), (BATH(11), JMW),	0000190
1084	EDX(4) = (T(1), S(1))	0000200
1085	EDX(5) = (T(2), AL(1)), (T(201), WM(1)), (T(271), ML(1)),	0000210
1086	(T(241), TDM(1)), (T(251), TDL(1))	0000220
1087	EDX(6) = (T(401), PWRH(1)), (T(401), JMW(1))	0000230

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CARD NO      ****      COMMENTS      ****
1046         RETURN      00100000
1047         END          00100000
1048         C
1049         C *****
1050         C SUBROUTINE HELD0
1051         C *****
1052         C
1053         SUBROUTINE HELD0      00100010
1054         C WRITTEN 8 APRIL 1972 00100000
1055         C TO DEVELOP NACELLE GEOMETRY 00100000
1056         C
1057         C OPEN TOSH(400)      00100040
1058         C
1059         DIMENSION D(2000),T(2000),DC(100),ND(200) 00100070
1060         DIMENSION DARN(80)   00100000
1061         DIMENSION S(100)     00100000
1062         DIMENSION MDN(10),ADM(10),SDN(10),BLM(10),JLN(10),SDN(10) 00100100
1063         DIMENSION BLDN(10),SPN(10),RDLN(10),JRLN(10),RCDN(10) 00100110
1064         C
1065         EQUIVALENCE (D(1),TOSH(1)),(T(1),TOSH(2001)),(DC(1),TOSH(4101)), 00100120
1066         (ND(1),TOSH(4001)) 00100140
1067         EQUIVALENCE (D(81),DARN(1)) 00100100
1068         EQUIVALENCE (T(1),S(1)) 00100100
1069         EQUIVALENCE (T(70),ADM(1)),(T(701),ADM(11)),(T(771),SDN(1)), 00100170
1070         (T(701),BLM(1)),(T(701),JLN(1)),(T(801),SDN(1)) 00100100
1071         EQUIVALENCE (T(81),JLN(1)),(T(801),SPN(1)),(T(801),RDLN(1)), 00100100
1072         (T(801),JRLN(1)),(T(801),RCDN(1)) 00100000
1073         EQUIVALENCE (ND(101),J),ND(100),J) 00100210
1074         EQUIVALENCE (ND(103),ADM), (ND(104),RCDN), (ND(100),JCN) 00100000
1075         C
1076         C SETUP INDICATORS AND COUNTERS 00100040
1077         IF(1 - MDN 10,20,20) 00100000
1078         C SHAPE CODE IS 2 DEVELOP PERIMETER 00100000
1079         10 00 IS (=1,MDN 00100270
1080         IF(DARN(1-00)) IS,10,12 00100000
1081         12 DARN(1-00) = DARN(1-00)+DARN(1-40) + DARN(1-00)*D(10)/D(2) 00100000
1082         IS CONTINUE 00100000
1083         C FIT SHAPES 00100010
1084         20 00 000 (=1,MDN 00100000
1085         IF(DARN(1-00)) 20,20,100 00100000
1086         C PERIMETER IS ZERO CHECK ON GUIDE 00100040
1087         20 IF(DARN(1-40)) 20,20,20 00100000
1088         C VERTICAL LIP 00100000
1089         22 MDN = 1 00100070
1090         DARN(1-00) = D(24) 00100000
1091         GO TO 200 00100000
1092         20 IF(DARN(1-00)) 20,20,20 00100400
1093         20 WRITE(6,20) 00100410
1094         00 FORMAT ('PARAMETERS FROM HELD0 IN AIR INDUCTION SYSTEM' / 00100420
1095         ' 1 40N,20-PARALLEL LIP GEOMETRY ERROR ') 00100420
1096         C HORIZONTAL LIP (UPPER L.I.) 00100440
1097         20 MDN = 2 00100400
1098         DARN(1-00) = DARN(1-00) 00100400
1099         GO TO 200 00100470
1100         C FULL SECTION 00100400
1101         100 S(1) = S(1) 00100400
1102         S(2) = (S(2)+DARN(1-40) + DARN(1-00)) - DARN(1-00)/ 00100400
1103         (D(4) - D(2)*D(10)) 00100410
1104         IF(S(2)) 101,101,100 00100000
1105         101 S(1) = DARN(1-00)/(D(2)*DARN(1-40) + D(2)*DARN(1-00)) 00100430
1106         S(2) = S(24) 00100440
1107         C
1108         C ERROR MESSAGE 00100000
1109         GO TO 1000 00100000
1110         100 S(4) = 4*MDN(DARN(1-40),DARN(1-00)) 00100010
1111         S(5) = 4*MDN(DARN(1-40),DARN(1-00)) 00100000
1112         IF(S(5) - S(2)*S(2)) 100,100,110 00100000
1113         100 S(2) = S(4)/S(5) 00100040
1114         S(1) = DARN(1-00)/(D(4)*D(10)*S(2) + S(4) - S(2)*S(2)) 00100000
1115         C
1116         C ERROR MESSAGE 00100070

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CARD NO      ****      COMMENTS      ****
1017      1000 WRITE(6,95) 1, 5(1)      00100000
1018      05 FORMAT(4MBWARNING FROM MODULE IN AIR INDUCTION SYSTEM) /      00100000
1019      1 112, 12SECTION, 113, 204 IS RECTANGLE OR ROUNDED RECT.,      00100700
1020      2 12SECTION IS, 176.3 1      00100710
1021      110 S(0) = (BATH(1)*90) - D(2)*S(2)**5(11)/D(2)      00100720
1022      S(3) = (BATH(1)*90) - D(2)*S(2)**5(11)/D(2)      00100730
1023      IF(15(0)) 111,112,112      00100740
1024      111 S(0) = D(2*)      00100750
1025      112 IF(15(3)) 114,115,115      00100760
1026      114 S(3) = D(2*)      00100770
1027      115 MDX(1) = S(0)      00100780
1028      RDN(1) = S(2)*5(11)      00100790
1029      DDN(1) = S(3)      00100800
1030      BLN(1) = D(2)*RDN(1) + D(15)/D(2)*RDN(1)      00100810
1031      BLN(1) = BLN(1)      00100820
1032      DDN(1) = D(2)*DDN(1) + D(15)/D(2)*DDN(1)      00100830
1033      IF(D(2) - RDN(1)) 116,116,200      00100840
1034      116 S(1) = RDN(1)*D(11) - D(25)/D(2)      00100850
1035      S(2) = RDN(1)*D(25)/D(2) + DDN(1)      00100860
1036      S(3) = RDN(1)*D(25)/D(2) + MDX(1)      00100870
1037      RDN(1) = (S(1)**2 + S(2)**2)/D(2)*5(11)      00100880
1038      RDN(1) = RDN(1)      00100890
1039      RDN(1) = (S(1)**2 + S(2)**2)/D(2)*5(11)      00100900
1040      C      IF R(2.0) ASSUME RADIUS OF CURVATURE IS INFINITY IE FLAT PANEL      00100910
1041      200 CONTINUE      00100920
1042      J = 2      00100930
1043      IF(10M) 250,250,205      00100940
1044      C      CALCULATE LEADING EDGE SURFACE      00100950
1045      205 J = 3      00100960
1046      BLN(1) = BATH(12) - BATH(11)      00100970
1047      IF(10M - 1) 210,210,205      00100980
1048      210 SFN(1) = BLN(11)/D(2)*BLN(2) + BLN(2)      00100990
1049      GO TO 250      00101000
1050      220 SFN(1) = BLN(11)/D(2)*(BATH(01) + BLN(2) + D(2)*DDN(2))      00101010
1051      C      CALCULATE SUBSEQUENT SECTIONS OR NONE IF NO L.E.      00101020
1052      250 GO 200 1-J,MDX      00101030
1053      BLN(1-1) = BATH(1+10) - BATH(1+0)      00101040
1054      SFN(1-1) = BLN(1-1)/D(2)*(BATH(1+00) + BATH(1+90))      00101050
1055      300 CONTINUE      00101060
1056      C      *** EXIT ***      00101070
1057      RETURN      00101080
1058      END      00101090
1059      C      00000000
1060      C      00000000
1061      C      SUBROUTINE PRECRT      00000000
1062      C      00000000
1063      C      00000000
1064      SUBROUTINE PRECRT      00000010
1065      C      WRITTEN 30 MARCH 1972      00000020
1066      C      TO DETERMINE CRITICAL RAMP DESIGN CRITERIA      00000030
1067      C      00000040
1068      COMMON TCON(4*90)      00000050
1069      COMMON /PRINT/ IP(60)      00000060
1070      C      00000070
1071      DIMENSION D(2*90),T(2*90),DC(100),MD(200)      00000070
1072      DIMENSION EDU(200)      00000080
1073      DIMENSION BATH(100)      00000090
1074      DIMENSION S(100)      00000100
1075      DIMENSION ALT(10),WH(10),VL(10),TDM(10),YDL(10)      00000110
1076      DIMENSION PWH(10),PYL(10)      00000120
1077      DIMENSION WS(100)      00000130
1078      C      00000140
1079      EQUIVALENCE (D(1),TCON(1)),(T(1),TCON(200)),(DC(1),TCON(410)),      00000150
1080      (MD(1),TCON(480))      00000160
1081      EQUIVALENCE (D(01),EDU(1))      00000170
1082      EQUIVALENCE (D(401),BATH(1)),(BATH(3),PWS), (BATH(12),FCY),      00000180
1083      (BATH(13),FBU), (BATH(14),DCM), (BATH(15),MMAT), (BATH(16),FACT)      00000190
1084      EQUIVALENCE (T(1),S(1))      00000200
1085      EQUIVALENCE (T(201),ALT(1)),(T(202),WH(1)),(T(271),VL(1)),      00000210
1086      (T(281),TDM(1)),(T(301),YDL(1))      00000220
1087      EQUIVALENCE (T(401),PWH(1)),(T(402),PYL(1))      00000230
    
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CARD NO	INPUT LISTING	AUTOFLOW CHART SET - SHEEP	AIR INJECTION SYSTEM MODULE
1000	EQUIVALENCE (7(100),7HS(1))		
1000	EQUIVALENCE (ND(101),J,(ND(102),J),(ND(103),K),(ND(117),ICRT)		0000240
1001	EQUIVALENCE (ND(80),NPAGE),(ND(84),IPN)		0000250
1001	C		0000000
1002	S(1) = S(2)		0000270
1003	C TEST FOR MAXIMUM P/FCY AT W AND VL RAMP CRITICAL DESIGN PRES.		0000000
1004	DO NO I=1,0		0000270
1005	IPN = I + 100		0000300
1006	CALL REACH(1,7HS(1),100,IPN)		
1007	S(2) = PWTN(1)*D(20)/7HS(20)		0000320
1008	IF(S(1) - S(2)) 10,20,20		0000330
1009	10 PWS = PWTN(1)		0000340
2000	FCY = 7HS(20)		0000350
2001	FSU = 7HS(40)		0000360
2002	DENS = 7HS(41)		0000370
2003	FACT = D(20)		0000380
2004	ICRT = I		0000390
2005	K = 1		0000400
2006	S(1) = S(2)		0000410
2007	20 S(2) = PWTN(1)*D(40)/7HS(120)		0000420
2008	IF(S(1) - S(2)) 30,40,40		0000430
2009	30 PWS = PWTN(1)		0000440
2010	FCY = 7HS(120)		0000450
2011	FSU = 7HS(120)		0000460
2012	DENS = 7HS(121)		0000470
2013	FACT = D(40)		0000480
2014	ICRT = I		0000490
2015	K = 2		0000500
2016	S(1) = S(2)		0000510
2017	NO CONTINUE		0000520
2018	C STORE ULTIMATE HAPERSHOCK PRESSURE IN PWS AND DETERMINE MATL		0000530
2019	C 1 = ALUMINUM 2 = TITANIUM 3 = STEEL		0000540
2020	PWS = PWS*FACT		0000550
2021	3MAT = D(1)		0000560
2022	IF(DENS - 0.14) 40,42,42		0000570
2023	40 3MAT = D(3)		0000580
2024	IF(DENS - 0.20) 44,46,46		0000590
2025	44 3MAT = D(2)		0000600
2026	NO CONTINUE		0000610
2027	C WRITE CRITICAL RAMP DESIGN POINT DATA		0000620
2028	S(1) = W(1CRT)		0000630
2029	S(2) = TDM(1CRT) - EQU(20)		0000640
2030	W(1) = K) 50,70,70		0000650
2031	50 S(1) = V(1CRT)		0000660
2032	S(2) = TDM(1CRT) - EQU(20)		0000670
2033	C WRITE OUTPUT		0000680
2034	70 IF(IP(80)15001,5001,5002		0000690
2035	8001 WRITE(8,80) ICRT,AL(1CRT),S(1),S(2),PWS,FACT,FCY,FSU,DENS		0000710
2036	80 FORMAT(1H,40X,30H*** RAMP DESIGN CONDITIONS ***.10X,		
2037	1 21H** PRECRT - IP(80) ****		
2038	14X,8POINT,20X,14/40X,8MULTITUDE,14X,F10.2/40X,50SEFOLD,17X,		0000730
2039	8F10.2/40X,15TEMPERATURE - F,7X,F10.2/40X,15PRESSURE - PSIA,		0000740
2040	27X,F10.2/40X,20LIMIT TO ULT. FACTOR,2X,F10.2/40X,		0000750
2041	417COMPRESSION YIELD,5X,F10.2/40X,21ULTIMATE SHEAR STRESS,		0000760
2042	1711.2/40X,10MATERIAL DENSITY,11X,F0.3)		0000770
2043	C *** EXIT ***		0000780
2044	8002 CONTINUE		0000790
2045	RETURN		
2046	800		0000790
2047	C		0000800
2048	C		
2049	C		
2050	C		
2051	C		
2052	C		
2053	C SUBROUTINE PLYNS		0020010
2054	C WRITTEN 7 APRIL 1972		0020020
2055	C TO DEVELOP PLYNS AND FITTING HEIGHTS		0020030
2056	C DIMENSION EQU(200) (A75(40),BATH(80))		0020040
2057	C		0020050
2058	C		0020060
2059	C		0020070

05/00/74	INPUT LISTING	AUTOFLEX CHART SET - BACP	AIR INDUCTION SYSTEM MODULE
CARD NO	****	CONTENTS	****
0000		DIMENSION D(2000),T(2000),DC(100),HD(200)	0000000
0000		DIMENSION SUPH(200)	0000000
0001		DIMENSION S(100),TOT(100),TWS(100)	0000100
0002	C		0000110
0003		CBUWLDNCE (D(1),TCOH(1),T(1),TCOH(200)),DC(1),TCOH(101),	0000120
0004		(HD(1),TCOH(201))	0000130
0005		CBUWLDNCE (D(0),CBU(1),D(0),DATS(1),D(0),DATH(1))	0000140
0006		CBUWLDNCE (D(170),SUPH(1))	0000150
0007		CBUWLDNCE (T(1),S(1),T(101),TOT(1),T(100),TWS(1))	0000160
0008		CBUWLDNCE (TOT(0),MTP(1),TOT(0),MTP(1),TOT(0),MTP(1),	0000170
0009		(TOT(0),MTP(1))	0000180
0010		CBUWLDNCE (HD(0),IP(1),HD(101),)	0000190
0011	C		0000200
0012		IF(DATS(02)) 200,200,10	0000210
0013	C	INBOARD PYLON HEIGHT	0000220
0014		10 MTP = DATS(02)*DATS(23)/D(17)*CBU(100)	0000230
0015		SUPH(4) = MTP	0000240
0016		SUPH(2) = SUPH(02) + DATS(23)*TAN(DATS(00)*D(101)/D(2)	0000250
0017		IF(DATS(1) - D(2)) 200,200,20	0000260
0018		20 IF(DATS(24)) 200,200,20	0000270
0019	C	OUTBOARD PYLON HEIGHT	0000280
0020		22 MTP = DATS(24)*DATS(23)/D(17)*CBU(100)	0000290
0021		SUPH(4) = MTP	0000300
0022		SUPH(2) = SUPH(02) + DATS(23)*TAN(DATS(00)*D(101)/D(2)	0000310
0023	200	CONTINUE	0000320
0024	C	FITTINGS - WING OR FUELSAE ATTACH	0000330
0025		214 S(1) = D(24)	0000340
0026		20 210 1=1,30	0000350
0027		S(1) = S(1) + TOT(1=20)	0000360
0028		216 CONTINUE	0000370
0029		S(1) = S(1) + DATS(0)*DATS(7)/DATS(1)	0000380
0030		IP(4) = 100	
0031		CALL READS(1),TWS(1),100,IP(4)	0000400
0032		S(2) = (TWS(100) + TWS(100))/TWS(101)	0000410
0033		S(3) = (TWS(100) + TWS(107))/TWS(101)	0000420
0034		S(4) = CBU(100)/S(2) + CBU(110)/S(3) + CBU(111)	0000430
0035	C	20 INBOARD FITTING HEIGHT	0000440
0036		IF(DATS(01)) 200,200,200	0000450
0037		200 S(5) = DATS(20)*D(2)*DATS(14)/D(12)/D(20)	0000460
0038		S(6) = DATH(0)/D(2) + DATS(23)	0000470
0039		S(7) = S(1) + TOT(0)	0000480
0100		S(8) = S(1)*S(5)*S(6)	0000490
0101		230 S(9) = DATS(02)*DATS(00)	0000500
0102		IF(S(9)) 232,232,234	0000510
0103		232 S(9) = D(10)	0000520
0104		234 S(10) = (S(7)*DATS(27) + S(8)/S(9))*D(20)	0000530
0105		20 TO 270	0000540
0106	C	HORIZONTALLY MOUNTED	0000550
0107		200 S(6) = DATH(10)/D(2) + DATS(23)	0000560
0108		S(7) = S(1) + TOT(0)	0000570
0109		S(8) = S(1)*DATS(27)*S(6)	0000580
0110		20 TO 230	0000590
0111		270 MTP1 = S(10)*S(4)	0000600
0112		SUPH(27) = MTP1	0000610
0113		SUPH(20) = SUPH(02) + DATS(23)*TAN(DATS(00)*D(101)	0000620
0114	C	20 OUTBOARD FITTINGS	0000630
0115		IF(DATS(1) - D(2)) 200,200,200	0000640
0116	C	VERTICALLY MOUNTED ONLY	0000650
0117		200 S(5) = DATS(20)*D(2)*DATS(17)/D(12)/D(20)	0000660
0118		S(6) = DATH(0)/D(2) + DATS(23)	0000670
0119		S(7) = S(1) + TOT(0)	0000680
0120		S(8) = S(1)*S(5)*S(6)	0000690
0121		S(9) = DATS(04)*DATS(00)	0000700
0122		IF(S(9)) 202,202,204	0000710
0123		202 S(9) = D(10)	0000720
0124		204 S(10) = (S(7)*DATS(27) + S(8)/S(9))*D(20)	0000730
0125		MTP0 = S(10)*S(4)	0000740
0126		SUPH(20) = MTP0	0000750
0127		SUPH(4) = SUPH(02) + DATS(23)*TAN(DATS(00)*D(101)	0000760
0128	200	CONTINUE	0000770
0129		RETURN	0000780



LINE NO	INPUT LISTING	AMPLIM CHART SET - DEEP	AIR INDUCTION SYSTEM FEEDBACK
0001	C		0000000
0002	C		0000000
0003	IF(IP107)0001,0001,100		
0004	0001 CONTINUE		
0005	WRITE(0,00)		0000070
0006	00 FORMAT(10X,10X,10X)BUILT-IN PARAMETERS,00X,00** RAPP5 - (P107) **		
0007	1 / 1		
0008	C		0000000
0009	00 100 N=1,00		0000700
0010	1 = 10**0		0000710
0011	IFIN = 0100,01,03		0000720
0012	01 IFINLN = 3.0101,100,100		
0013	010 WRITE(0,00)		
0014	00 FORMAT(10X,10X** 2 RAPP SYSTEM **)		0000730
0015	00 TO 00		0000730
0016	00 IFIN = 03101,04,00		
0017	011 IFINLN = 3.0100,100,100		
0018	04 IFINLN = 3.0100,040,100		
0019	040 WRITE(0,00)		
0020	00 FORMAT(10X,10X** 3 RAPP SYSTEM **)		0000740
0021	00 TO 00		0000740
0022	00 IFIN = 40102,07,00		
0023	012 IFINLN = 3.0100,00,100		
0024	07 IFINLN = 3.0100,100,070		
0025	070 WRITE(0,00)		
0026	00 FORMAT(10X,10X** 4 RAPP SYSTEM **)		0000000
0027	00 TO 00		0000000
0028	00 IFIN = 70103,00,00		
0029	013 IFINLN = 3.0100,100,00		
0030	00 WRITE(0,01)		
0031	01 FORMAT(10X,10X** MINIMUM GAGES **,00X,		
0032	1 00** RAPP5 - (P107) **)		
0033	00 WRITE(0,10) F(1),F(1+1),F(1+2),F(1+3),F(1+4),F(1+5),F(1+6),		0000070
0034	1 F(1+7),F(1+8),F(1+9),BRIN		0000000
0035	101 FORMAT(10X,10X, F10.3)		0000000
0036	100 CONTINUE		0000000
0037	C		0000000
0038	C		0000000
0039	WRITE(0,10) (DATAIN),N=1,10)		0000070
0040	10 FORMAT(10X,10X)INPUT DATA//		
0041	1 10X,20X)NUMBER OF RAPP5 F10.2/		
0042	• 10X,20X)CONST MD (0-0700,1-4000) F10.2/		0000000
0043	• 10X,20X)OVERSHOCK PRESSURE (PSI) F10.2/		0000100
0044	• 10X,20X)LENGTH OF RAPP 1 (IN) F10.2/		0000101
0045	• 10X,20X)LENGTH OF RAPP 2 (IN) F10.2/		0000102
0046	• 10X,20X)LENGTH OF RAPP 3 (IN) F10.2/		0000103
0047	• 10X,20X)LENGTH OF RAPP 4 (IN) F10.2/		0000104
0048	• 10X,20X)WIDTH OF RAPP 1 (IN) F10.2/		0000105
0049	• 10X,20X)WIDTH OF RAPP 2 (IN) F10.2/		0000106
0050	• 10X,20X)WIDTH OF RAPP 3 (IN) F10.2/		0000107
0051	• 10X,20X)WIDTH OF RAPP 4 (IN) F10.2/		0000108
0052	• 10X,20X)CY (PSI) F10.2/		0000109
0053	• 10X,20X)SU (PSI) F10.2/		0000110
0054	• 10X,20X)DENSITY OF MATERIAL (LB/CC IN) F10.2/		0000111
0055	• 10X,20X)MATERIAL ((=L,D=71,D=07) F10.2/		0000112
0056	• 10X,20X)LIMIT TO ULTIMATE FACTOR F10.2/ 1		0000113
0057	C		0000114
0058	WRITE(0,212)		0000110
0059	212 FORMAT(10X,20X)CHANGES TO BUILT-IN PARAMETERS/		0000110
0060	0000 CONTINUE		
0061	C		0000117
0062	INDE = 0		0000110
0063	00 200 N=1,00		0000110
0064	IF(DATAIN=00) - BRIN) 001,000,001		0000100
0065	001 1 = 10**0		0000101
0066	INDE = 1		0000100
0067	WRITE(0,101) F(1),F(1+1),F(1+2),F(1+3),F(1+4),F(1+5),F(1+6),		0000120
0068	1 F(1+7),F(1+8),F(1+9),DATAIN=00)		0000120
0069	000 CONTINUE		0000100
0070	C		0000100
0071	IF(INDE)104,104,100		0000120

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## INPUT LISTING

AUTOFLON CHART SET - SHEEP

AIR INDUCTION SYSTEM PEGDALE

CARD NO	CONTENTS	****
0272	101 WRITE(6,10E)	00001200
0273	102 FORMAT( 2X,10X** NONE **)	00001200
0274	C	00001200
0275	103 MAT = 1000	00001210
0276	C	00001220
0277	00 TO 1001,40E,4001,MAT	00001230
0278	C	00001240
0279	401 TC = TCA	00001250
0280	TM = TMA	00001260
0281	TS = TSA	00001270
0282	TEARF = TEARFA	00001280
0283	TEARR = TEARRA	00001290
0284	00 TO 400	00001400
0285	C	00001410
0286	402 TC = TCT	00001420
0287	TM = TMT	00001430
0288	TS = TST	00001440
0289	TEARF = TEARFT	00001450
0290	TEARR = TEARRT	00001460
0291	00 TO 400	00001470
0292	C	00001480
0293	403 TC = TCS	00001490
0294	TM = TMS	00001500
0295	TS = TSS	00001510
0296	TEARF = TEARFS	00001520
0297	TEARR = TEARRS	00001530
0298	C	00001540
0299	404 IF 100001 - 3.0*500,510,540	00001550
2300	C	00001560
2301	500 ML = 1001 = ML1	00001570
2302	MT = 1002 = M1	00001580
2303	ML = APARI(ML,MT)	
2304	MT = ML	
2305	X1M = X1M01	00001590
2306	M = M1	00001600
2307	ML = ML1	00001610
2308	00LM = 2.0	00001620
2309	MD = 1	00001630
2310	C	00001640
2311	IF 100001*000,000,502	00001650
2312	C	00001660
2313	502 ML = APARI(ML,MT)	00001670
2314	MT = ML	
2315	00 TO 010	00001680
2316	C	00001690
2317	504 MTL1 = MTL	00001700
2318	MWT1 = MWT	00001710
2319	C	00001720
2320	ML = 1002 = ML2	00001730
2321	MT = 1002 = M2	00001740
2322	ML = APARI(ML,MT)	
2323	MT = ML	
2324	MTA = 1002 = M2	00001750
2325	X1M = X1M02	00001760
2326	M = M2	00001770
2327	ML = ML2	00001780
2328	00LM = 1.0	00001790
2329	MD = 2	00001800
2330	00 TO 000	00001810
2331	C	00001820
2332	505 MTL2 = MTL	00001830
2333	MWT2 = MWT	00001840
2334	MTMA = MWTMA	00001850
2335	00 TO 000	00001860
2336	C	00001870
2337	010 ML = 1001 = ML1	00001880
2338	MT = 1002 = M1	00001890
2339	ML = APARI(ML,MT)	
2340	MT = ML	
2341	X1M = X1M01	00001900
2342	M = M1	00001910

CARD NO	CONTENTS	0000
0243	IL = IL1	00001000
0244	SLM = 3.0	00001000
0245	MS = 3	00001040
0246	C	00001000
0247	IFICNST1000,000,010	00001000
0248	C	00001070
0249	010 ML = APXK1(ML,MT)	00001000
0250	MT = ML	
0251	GO TO 010	00001000
0252	C	00002000
0253	014 MTL1 = MTL	00002010
0254	MTW1 = MWT	00002000
0255	C	00002030
0256	ML = 1002 * IL2	00002040
0257	MT = 1073 * MS	00002050
0258	ML = APXK1(ML,MT)	
0259	MT = ML	
0260	X1M = X1M02	00002000
0261	M = MS	00002070
0262	IL = IL2	00002000
0263	SLM = 2.0	00002000
0264	MS = 4	00002100
0265	C	00002110
0266	IFICNST1000,000,010	00002100
0267	C	00002130
0268	010 ML = APXK1(ML,MT)	00002140
0269	MT = ML	
0270	GO TO 010	00002100
0271	C	00002100
0272	010 MTL2 = MTL	00002170
0273	MTW2 = MWT	00002100
0274	C	00002100
0275	ML = 1003 * IL3	00002000
0276	MT = 1073 * MS	00002100
0277	ML = APXK1(ML,MT)	
0278	MT = ML	
0279	MTA = 107AS * MS	00002000
0280	X1M = X1M03	00002030
0281	M = MS	00002040
0282	IL = IL3	00002000
0283	SLM = 1.0	00002000
0284	MS = 5	00002070
0285	GO TO 000	00002000
0286	C	00002000
0287	000 MTL3 = MTL	00002300
0288	MTW3 = MWT	00002310
0289	MTWA = MWT A	00002300
0290	GO TO 000	00002300
0291	C	00002340
0292	040 ML = 1041 * IL1	00002300
0293	MT = 1074 * MS	00002300
0294	ML = APXK1(ML,MT)	
0295	MT = ML	
0296	X1M = X1M41	00002370
0297	M = MS	00002300
0298	IL = IL1	00002300
0299	SLM = 2.0	00002400
0300	MS = 5	00002410
0301	C	00002420
0302	IFICNST1000,000,040	00002430
0303	C	00002440
0304	040 ML = APXK1(ML,MT)	00002400
0305	MT = ML	
0306	GO TO 010	00002400
0307	C	00002470
0308	044 MTL1 = MTL	00002400
0309	MTW1 = MWT	00002400
0310	C	00002000
0311	ML = 1042 * IL2	00002010
0312	MT = 1074 * MS	00002000
0313	ML = APXK1(ML,MT)	

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INPUT LISTING

AUTOFLOW CHART SET - SHEEP

AIR INDUCTION SYSTEM MODULE

CARD NO	CONTENTS	*****
0414	MT = ML	
0415	XIH = XIH4	
0416	M = M2	0002530
0417	XL = XL2	0002540
0418	DLJM = 2.0	0002550
0419	IND = 7	0002560
0420	C	0002570
0421	IF(CONST)000,000,040	0002580
0422	C	0002590
0423	040 ML = AMAXI(ML,MT)	0002600
0424	MT = ML	0002610
0425	GO TO 618	
0426	C	0002620
0427	040 MTHL2 = MTHL	0002630
0428	MHTH2 = MHTH	0002640
0429	C	0002650
0430	ML = 1044 * XL1	0002660
0431	MT = 10174 * M4	0002670
0432	ML = AMAXI(ML,MT)	0002680
0433	MT = ML	
0434	XIH = XIH44	
0435	M = M4	0002690
0436	XL = XL4	0002700
0437	DLJM = 2.0	0002710
0438	IND = 8	0002720
0439	C	0002730
0440	IF(CONST)000,000,050	0002740
0441	C	0002750
0442	050 ML = AMAXI(ML,MT)	0002760
0443	MT = ML	0002770
0444	GO TO 618	
0445	C	0002780
0446	050 MTHL4 = MTHL	0002790
0447	MHTH4 = MHTH	0002800
0448	C	0002810
0449	ML = 1043 * XL3	0002820
0450	MT = 10174 * M3	0002830
0451	ML = AMAXI(ML,MT)	0002840
0452	MT = ML	
0453	MTA = 101744 * M3	
0454	XIH = XIH43	0002850
0455	M = M3	0002860
0456	XL = XL3	0002870
0457	DLJM = 1.0	0002880
0458	IND = 9	0002890
0459	GO TO 600	0002900
0460	C	0002910
0461	060 MTHL3 = MTHL	0002920
0462	MHTH = MHTH	0002930
0463	MHTA = MHTA	0002940
0464	GO TO 620	0002950
0465	C	0002960
0466	060 MTHL = XIH * DENB * ML * (4.0 * (3.0 * TC * ML * TM) * * M * (TBAR * TBARR))	0002970
0467		0002980
0468	GO TO 612	0002990
0469	C	0003000
0470	610 MTHL = XIH * M * XL * (2.0 * DENB * TB * .00050 * ML * DCORF * .0120 * BACH)	0003010
0471		0003020
0472	C	0003030
0473	610 MHTH = XIH * DENB * M * DLJM * (3.0 * TC * MT * TM) MHTA = XIH * DENB * M * DLJM * (3.0 * TC * MTA * TM)	0003040
0474		0003050
0475	C	0003060
0476	GO TO(004,006,014,016,020,044,046,062,064),IND	0003070
0477	C	0003080
0478	070 CONTINUE	0003090
0479	C	0003100
0480	IF(INDM - 3.0)250,300,400	0003110
0481	C	0003120
0482	080 P1 = 1P21 * P45	0003130
0483	P2 = 1P22 * P45	0003140
0484	C	0003150
		0003160

05/05/74	INPUT LISTING	AUTOFLIGHT CHART SET - 040P	AIR INDUCTION SYSTEM MESSAGE
CASE NO	****	CONTENTS	****
0405		ALPHAR = ALPHA * .01745329	0000170
0406	C		0000180
0407		V1 = XL1 * P1 * M2	0000190
0408		V2 = XL2 * P2 * M2	0000200
0409	C		0000210
0410		W = V1 / 2.0 / COS(ALPHAR)	0000220
0411		RA = W * (1.0 - 1.0/TK22) * M2 * (1.0 - 1.0/0.0/TK22)	0000230
0412		R = W/TK22 * M2/0.0/TK22	0000240
0413	C		0000250
0414		ML = AMX1(M221 * XL1 * M22 * M1)	0000260
0415		W/CONT1=20.000,000	0000270
0416	C		0000280
0417		200 R1LND = XL21 * EDG * V1 * XL1 / 2.0 / XL *	0000290
0418		* (XL1 / 2.0 / M / WCY / FCY * 1.0 / WBU / FBW)	0000300
0419		R1TRN = X1T21 * EDG * M * M1 * V1 / MCT *	0000310
0420		* (M * M1 / M / WCY / FCY * 1.0 / WBU / FBW)	0000320
0421		GO TO 270	0000330
0422	C		0000340
0423		200 R1LND = XL21 * XL1 * EDG * V1 * XL1 / 4.0 / M / FCY *	0000350
0424		* (COS * M1 * M / 1700.0 * M2M * M1 / 70.0)	0000360
0425		R1TRN = X1T21 * EDG * M * M1 * V1 *	0000370
0426		* (M * M1 / M / FCY * 1.0 / FBW)	0000380
0427	C		0000390
0428		270 M = AMX1(M22 * XL2 * M22 * M2)	0000400
0429		R1LND = XL22 * EDG * XL2 / XL *	0000410
0430		* (M21 * XL2 * (2.0 * W * M21 * M2) / M / WCY / FCY *	0000420
0431		* (W * M21 * M2) / WBU / FBW)	0000430
0432		PHINE = X1T22 * EDG * W * M * M2 / MCT *	0000440
0433		* (M * M2 / M / WCY / FCY * 1.0 / WBU / FBW)	0000450
0434		ACT = X1T22 * EDG * R * M * M2 / MCT *	0000460
0435		* (M * M2 / M / WCY / FCY * 1.0 / WBU / FBW)	0000470
0436		AMINE = PHINE * RA/W * X1T22/X1T22	0000480
0437	C		0000490
0438		R1LND = AMX1(R1LND , M2L1)	0000500
0439		R1TRN = AMX1(R1TRN , M2L1)	0000510
0440		R1LND = AMX1(R1LND , M2L2)	0000520
0441		PHINE = AMX1(PHINE , M2L1)	0000530
0442		ACT = AMX1(ACT , M2L1)	0000540
0443		AMINE = AMX1(AMINE , M2L1)	0000550
0444	C		0000560
0445		TOTAL = R1LND + R1TRN + R1LND + PHINE + ACT + AMINE	0000570
0446	C		0000580
0447		W/CONT1=2000,000,000	0000590
0448		CONTINUE	0000600
0449		WRITE(4,61)	0000610
0450		61 FORMAT(1X,21,REACTION FORCES (LBS),6X,20** RAPP - (P107) **	0000620
0451		1 //)	0000630
0452		WRITE(4,62),W,RA	0000640
0453		62 FORMAT(1X,20,RAPP 2 ACTUATOR /10.0/	0000650
0454		* 10X,20,RAPP 2 FWD NINE /10.0/	0000660
0455		* 10X,20,RAPP 2 AFT NINE /10.0/	0000670
0456		WRITE(4,64)	0000680
0457		64 FORMAT(//10X,10,RAPP HEIGHTS (LBS)//)	0000690
0458		WRITE(4,65),R1LND,R1TRN,R1LND,PHINE,ACT,AMINE,TOTAL	0000700
0459		65 FORMAT( 10X,20,RAPP 1 - LONGITUDINAL /10.0/	0000710
0460		* 10X,20,RAPP 1 - TRANSVERSE /10.0/	0000720
0461		* 10X,20,RAPP 2 - LONGITUDINAL /10.0/	0000730
0462		* 10X,20,RAPP 2 - FORWARD NINE /10.0/	0000740
0463		* 10X,20,RAPP 2 - ACTUATOR /10.0/	0000750
0464		* 10X,20,RAPP 2 - AFT NINE /10.0//	0000760
0465		* 10X,20,TOTAL HEIGHT /10.0/	0000770
0466	C		0000780
0467		GO TO 600	0000790
0468	C		0000800
0469		200 P1 = W31 * P45	0000810
0470		P2 = W32 * P45	0000820
0471		P3 = W33 * P45	0000830
0472	C		0000840
0473		V1 = M * XL1 * P1	0000850
0474		V2 = M * XL2 * P2	0000860
0475		V3 = M * XL3 * P3	0000870

CARD NO	CONTENTS	00000000
0005	C	00000000
0007	ALPHA = .01745329 * ALPHA3	00000000
0008	C	00000070
0009	R1 = (V1 * VE) / 2.0 / KC31	00000000
0010	WF3 = VE / 2.0 / COS(ALPHA)	00000000
0011	WF1 = V1 * (1.0 - 1.0 / 2.0 / KC31) *	00000000
0012	• VE / 2.0 * (1.0 - 1.0 / KC31)	00000000
0013	RE = WF3 / KC33 * VS / 2.0 / KC33	00000000
0014	RAS = WF3 * VS - RE	00000010
0015	C	00000000
0016	ML = ANK1( KC31 * ML1 , INT3 * M1)	00000000
0017	MF(CDST)310,310,320	00000000
0018	C	00000000
0019	310 RILND = XIL31 * CDNS * V1 * ML1 / 4.0 / XCL *	00000000
0020	• (ML1 / ML / WCY / FCY * 2.0 / WBU / FBU)	00000000
0021	RITRAN = XIT31 * CDNS * IM * M1 / XCT * (WF1 * VE / 2.0 * R1) *	00000070
0022	• (IM * M1 / ML / WCY / FCY * 1.0 / WBU / FBU)	00000000
0023	C	00000000
0024	ML = ANK1( KC32 * ML2 , INT3 * M2)	00000000
0025	RILND = XIL32 * CDNS * VE * ML2 / 4.0 / XCL *	00000000
0026	• (ML2 / ML / WCY / FCY * 2.0 / WBU / FBU)	00000010
0027	RETRAN = XIT32 * CDNS * VE * IM * M2 / XCT *	00000000
0028	• (IM * M2 / ML / WCY / FCY * 1.0 / WBU / FBU)	00000000
0029	GO TO 320	00000000
0030	C	00000000
0031	320 RILND = XIL31 * ML1 * (CDNS * V1 * ML1 / 4.0 / ML / FCY *	00000070
0032	• CDNS * M1 * ML / 1700.0 * DASH * M1 / 70.0)	00000000
0033	RITRAN = XIT31 * CDNS * IM * M1 * (WF1 * VE / 2.0 * R1) *	00000000
0034	• (IM * M1 / ML / FCY * 1.0 / FBU)	00000000
0035	C	00000000
0036	ML = ANK1( KC32 * ML2 , INT3 * M2)	00000000
0037	RILND = XIL32 * ML2 * (CDNS * VE * ML2 / 4.0 / ML / FCY *	00000000
0038	• CDNS * M2 * ML / 1700.0 * DASH * M2 / 70.0)	00000010
0039	RETRAN = XIT32 * CDNS * VE * IM * M2 *	00000000
0040	• (IM * M2 / ML / FCY * 1.0 / FBU)	00000000
0041	C	00000000
0042	330 ML = ANK1( KC33 * ML3 , INT3 * M3)	00000070
0043	RILND = XIL33 * CDNS * ML3 / XCL *	00000000
0044	• (KC32 * ML3 * ( 2.0 * WF3 * KC33 * VS) / ML / WCY / FCY *	00000000
0045	• WF3 * KC32 * VS) / WBU / FBU)	00000000
0046	PHINDE = XIT33 * CDNS * WF3 * IM * M3 / XCT *	00000000
0047	• (IM * M3 / ML / WCY / FCY * 1.0 / WBU / FBU)	00000000
0048	ACT = XIT33 * CDNS * RE * IM * M3 / XCT *	00000000
0049	• (IM * INT33 / WCY / FCY * 1.0 / WBU / FBU)	00000000
0050	ANINDE = PHINDE * RAS/WF3 * XIT33/XIT33	00000000
0051	C	00000000
0052	RILND = ANK1(RILND , MTH1)	00000070
0053	RITRAN = ANK1(RITRAN , MTH1)	00000000
0054	RILND = ANK1(RILND , MTH2)	00000000
0055	RETRAN = ANK1(RETRAN , MTH2)	00000000
0056	RILND = ANK1(RILND , MTH3)	00000000
0057	PHINDE = ANK1(PHINDE , MTH3)	00000000
0058	ACT = ANK1(ACT , MTH3)	00000000
0059	ANINDE = ANK1(ANINDE , MTH3)	00000000
0060	C	00000000
0061	TOTAL = RILND + RITRAN + RILND + RETRAN + RILND *	00000000
0062	• PHINDE + ACT + ANINDE	00000000
0063	C	00000000
0064	MF( SP(87) ) 0007,0007,000	00000000
0065	0007 CONTINUE	00000000
0066	WRITE(8,VB1)	00000000
0067	WRITE(8,VB2)R1,RE,WF3,RAS	00000000
0068	FOR I=1,3 DO WRITE(8,VB3) I,ACTUATOR ,F10.0/	00000010
0069	• I,RETRAP 3 ACTUATOR ,F10.0/	00000000
0070	• I,RETRAP 3 FWD HINGE ,F10.0/	00000000
0071	• I,RETRAP 3 AFT HINGE ,F10.0/	00000000
0072	WRITE(8,VB4)	00000000
0073	WRITE(8,VB5)RILND,RITRAN,RILND,RETRAN,RILND,	00000000
0074	• PHINDE,ACT,ANINDE,TOTAL	00000000
0075	FOR I=1,2 DO WRITE(8,VB6) I - LONGITUDINAL ,F10.0/	00000000
0076	• I - TRANSVERSE ,F10.0/	00000000

03/20/74	INPUT LISTING	AUTOFLEX CHART SET - BEEP	AIR INDUCTION SYSTEM MODULE
CARD NO	****	CONTENTS	****
0027	*	1EN,2ENRAPP 2 - LONGITUDINAL	F10.0/ 0000500
0028	*	1EN,2ENRAPP 2 - TRANSVERSE	F10.0/ 0000510
0029	*	1EN,2ENRAPP 3 - LONGITUDINAL	F10.0/ 0000520
0030	*	1EN,2ENRAPP 3 - FORWARD HINGE	F10.0/ 0000530
0031	*	1EN,2ENRAPP 3 - ACTUATOR	F10.0/ 0000540
0032	*	1EN,2ENRAPP 3 - AFT HINGE	F10.0/ 0000550
0033	*	1EN,2ENTOTAL	F10.0/ 0000560
0034	C		0000570
0035		GO TO 000	0000580
0036	C		0000590
0037		N00 P1 = IP41 + P45	0000600
0038		P2 = IP42 + P45	0000610
0039		P3 = IP43 + P45	0000620
0040		P4 = IP44 + P45	0000630
0041	C		0000640
0042		V1 = M1 + XL1 + P1	0000650
0043		V2 = M2 + XL2 + P2	0000660
0044		V3 = M3 + XL3 + P3	0000670
0045		V4 = M4 + XL4 + P4	0000680
0046	C		0000690
0047		SINPAR = SINPA * .01745329	0000710
0048		SICPAR = SICPA * .01745329	0000720
0049	C		0000730
0050		S1 = SIN(SINPAR)	0000740
0051		C1 = COS(SINPAR)	0000750
0052		S2 = SIN(SICPAR)	0000760
0053		C2 = COS(SICPAR)	0000770
0054		T0 = TAN(SINPAR)	0000780
0055	C		0000790
0056		R1 = (V1 + V2) / 2.0 / 1000	0000810
0057		R2 = V1 + 11.0 - 1.0 / 2.0 / 1000 +	0000820
0058		+ V2 / 2.0 + (1.0 - 1.0 / 1000)	0000830
0059		RA3 = V4 + C1 / 2.0	0000840
0060		R2 = (V2 + V3 - V4 + S1) * T0 / 2.0 + V2 * C2 / 2.0	0000850
0061		R2 = (R2 * (1000 + 1000) + V3 * (0.5 - 1000) - RA3 * 1000) / 1000000 + 0.50	0000860
0062		R3 = (V3 * (0.5 - 1000) + RA3 * (1000 + 1000) - R2 * 1000) / 1000000 + 0.50	0000870
0063	C		0000880
0064		IPW1 = IP41 + XL3 + (R2 * V3 + 1000) / 2.0	0000890
0065		IPW2 = IP42 + XL3 + (RA3 * V3 + 1000) / 2.0	0000900
0066		IPC = XL3 / 2.0 + (R2 * R3 + (1.0 - 2.0 * 1000) + V3 / 4.0)	0000910
0067		IPW3 = IPW1(ABS(IPW1)), ABS(IPW2)), ABS(IPC))	0000920
0068	C		0000930
0069		Z1 = R2	0000940
0070		Z2 = Z1 + 1000 + V3	0000950
0071		Z3 = Z2 - R2	0000960
0072		Z7 = RA3	0000970
0073		Z8 = RA3 + 1000 + V3	0000980
0074		Z5 = Z5 - R3	0000990
0075		IPW4 = IPW1(ABS(Z1), ABS(Z2), ABS(Z3), ABS(Z5), ABS(Z6),	0001010
0076		+ ABS(Z7))	0001020
0077	C		0001030
0078		ML = IPW1(1000 + XL1, 1000 + M1)	0001040
0079		IF(CDSTN10,110,120)	0001050
0080	C		0001060
0081		N10 R1L05 = X1L41 + S05 * V1 + XL1 / 4.0 + XL *	0001070
0082		+ (XL1 / ML + IPCY / FCY + 2.0 / IPBU / FBU)	0001080
0083		R1TR4N = X1T41 + S05 * XM + M1 / XCT + (R1 * V2 / 2.0 + R1) *	0001090
0084		+ (XM + M1 / ML + IPCY / FCY + 1.0 / IPBU / FBU)	0001100
0085	C		0001110
0086		ML = IPW1(1000 + XL4, 1000 + M4)	0001120
0087		R4L05 = X4L44 + S05 * V4 + XL4 / 4.0 + XL *	0001130
0088		+ (XL4 / ML + IPCY / FCY + 2.0 / IPBU / FBU)	0001140
0089		R4TR4N = X4T44 + S05 * XM + M4 / XCT *	0001150
0090		+ (XM + M4 / ML + IPCY / FCY + 1.0 / IPBU / FBU)	0001160
0091	C		0001170
0092		ML = IPW1(1000 + XL2, 1000 + M2)	0001180
0093		R2L05 = X2L42 + S05 * V2 + XL2 / 4.0 + XL *	0001190
0094		+ (XL2 / ML + IPCY / FCY + 2.0 / IPBU / FBU)	0001200
0095		R2TR4N = X2T42 + S05 * XM + M2 / XCT *	0001210
0096		+ (XM + M2 / ML + IPCY / FCY + 1.0 / IPBU / FBU)	0001220
0097		GO TO 430	0001230

CARD NO	CONTENTS	****
8700	C	00000010
8700	NO RILONG = XILN1 * ML1 * (DENS * V1 * ML1 / 4.0 / ML / FCY * * SCORE * M1 * ML / 1700.0 * DASH * M1 / 70.0)	00000020
8701	RITRAN = XITN1 * DENB * XM * M1 * (R1 * VE / 2.0 * R1) * * (XM * M1 / ML / FCY * 1.0 / FBU)	00000030
8702	C	00000040
8704	ML = APMX(1044 * XL4 * INTN * M)	00000070
8705	RILONG = XIL4 * XL4 * (DENS * V4 * XL4 / 4.0 / ML / FCY * * SCORE * M4 * ML / 1700.0 * DASH * M4 / 70.0)	00000080
8706	RNTRAN = XIT4 * DENB * XM * M4 * V4 * * (XM * M4 / ML / FCY * 1.0 / FBU)	00000090
8707	C	00000100
8710	ML = APMX(1042 * XL2 * INTN * M2)	00000130
8711	RILONG = XIL2 * XL2 * (DENS * V2 * XL2 / 4.0 / ML / FCY * * SCORE * M2 * ML / 1700.0 * DASH * M2 / 70.0)	00000140
8712	RETRAN = XIT2 * DENB * XM * M2 * V2 * * (XM * M2 / ML / FCY * 1.0 / FBU)	00000150
8713	C	00000160
8716	NO ML = APMX(1043 * XL3 * INTN * M3)	00000190
8717	RILONG = XIL3 * DENB * XL3 * XCL * * (2.0 * RNTRAN / ML / FCY / FCY * V40 / XFBU / FBU)	00000200
8718	PHINCE = XIT7 * DENB * R2 * XM * M3 * XCT * * (XM * M3 / ML / FCY / FCY * 1.0 / XFBU / FBU)	00000210
8719	FACT = XIT7 * DENB * R2 * XM * M3 * XCT * * (XM / INTAN / FCY / FCY * 1.0 / XFBU / FBU)	00000220
8720	ACT = FACT * XITAN / XIT7 * R2 / R2	00000230
8721	ANINCE = PHINCE * XITAN / XIT7 * R2 / R2	00000240
8722	C	00000250
8725	RILONG = APMX(RILONG , MTHL1)	00000260
8726	RITRAN = APMX(RITRAN , MTHL1)	00000270
8727	RETRAN = APMX(RETRAN , MTHL2)	00000280
8728	RETRAN = APMX(RETRAN , MTHL2)	00000290
8729	RILONG = APMX(RILONG , MTHL3)	00000300
8730	RILONG = APMX(RILONG , MTHL3)	00000310
8731	RILONG = APMX(RILONG , MTHL4)	00000320
8732	RILONG = APMX(RILONG , MTHL4)	00000330
8733	RNTRAN = APMX(RNTRAN , MTHL4)	00000340
8734	PHINCE = APMX(PHINCE , MTH5)	00000350
8735	PHINCE = APMX(PHINCE , MTH5)	00000360
8736	FACT = APMX(FACT , MTH6)	00000370
8737	FACT = APMX(FACT , MTH6)	00000380
8738	ACT = APMX(ACT , MTH6)	00000390
8739	ACT = APMX(ACT , MTH6)	00000400
8740	ANINCE = APMX(ANINCE , MTH6)	00000410
8741	C	00000420
8742	TOTAL = RILONG + RITRAN + RELONG + RETRAN + RELONG * * PHINCE + FACT + ACT + ANINCE + RILONG + RNTRAN	00000430
8743	C	00000440
8744	IF(1P(871)5000,5000,5000	00000450
8745	CONTINUE	00000460
8746	WRITE(8,40)(R1,R2,R3,R2,R3)	00000470
8747	NO FORMAT(10X,20X) 1 ACTUATOR .F10.0/	00000480
8748	* 10X,20X) 3 FWD ACTUATOR .F10.0/	00000490
8749	* 10X,20X) 3 AFT ACTUATOR .F10.0/	00000500
8750	* 10X,20X) 3 FWD HINCE .F10.0/	00000510
8751	* 10X,20X) 3 AFT HINCE .F10.0/	00000520
8752	WRITE(8,40)	00000530
8753	WRITE(8,40)(RILONG,RITRAN,RELONG,RETRAN,RELONG,PHINCE,FACT, * ACT,ANINCE,RILONG,RNTRAN,TOTAL	00000540
8754	NO FORMAT: 10X,20X) 1 - LONGITUDINAL .F10.0/	00000550
8755	* 10X,20X) 1 - TRANSVERSE .F10.0/	00000560
8756	* 10X,20X) 2 - LONGITUDINAL .F10.0/	00000570
8757	* 10X,20X) 2 - TRANSVERSE .F10.0/	00000580
8758	* 10X,20X) 3 - LONGITUDINAL .F10.0/	00000590
8759	* 10X,20X) 3 - FORWARD HINCE .F10.0/	00000600
8760	* 10X,20X) 3 - FORWARD ACTUATOR .F10.0/	00000610
8761	* 10X,20X) 3 - AFT ACTUATOR .F10.0/	00000620
8762	* 10X,20X) 3 - AFT HINCE .F10.0/	00000630
8763	* 10X,20X) 4 - LONGITUDINAL .F10.0/	00000640
8764	* 10X,20X) 4 - TRANSVERSE .F10.0/	00000650
8765	* 10X,20X) TOTAL .F10.0/	00000660
8766	C	00000670
8767	END RETURN	00000680
8768	C	00000690
8769	END	00000700

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CARD NO      ****      CONTENTS      ****
2760      C
2770      C *****
2771      C      SUBROUTINE SPAL
2772      C *****
2773      C
2774      C      SUBROUTINE SPAL      0000010
2775      C      WRITTEN 20 MARCH 1972      0000020
2776      C      TO DETERMINE ATMOSPHERIC PROPERTIES FOR 9 POINTS ON V-A DIAGRAM      0000030
2777      C      0000040
2778      C      COMMON TCOH(400)      0000050
2779      C      0000060
2780      C      COMMON /HISC/ IHISC(100)
2781      C      COMMON /IPIRINT/ IPIR(0)
2782      C
2783      C      DIMENSION D(2000),T(2000),DC(100),ND(200)      0000070
2784      C      DIMENSION BATH(40)      0000080
2785      C      DIMENSION EQU(200)      0000090
2786      C      DIMENSION S(100)      0000100
2787      C      DIMENSION ALT(10),TCH(10),PO(10),O(10),CS(10),RND(10)      0000110
2788      C      DIMENSION WH(10),ML(10),OH(10),GL(10),DWH(10),DL(10),      0000120
2789      C      MATH(10),RATL(10),TDM(10),TDL(10),PTM(10),PTL(10),PBH(10),      0000130
2790      C      SPAL(10)      0000140
2791      C      DIMENSION TITLE(30)      0000150
2792      C
2793      C      EQUIVALENCE (D(1),TCOH(1)),(T(1),TCOH(200)),(DC(1),TCOH(410)),      0000170
2794      C      (IND(1),TCOH(420))      0000180
2795      C      EQUIVALENCE (D(10),EQU(1))      0000190
2796      C      EQUIVALENCE (D(60),BATH(1))      0000200
2797      C      EQUIVALENCE (BATH(3),DVL0),(BATH(32),RAT0)      0000210
2798      C      EQUIVALENCE (D(75),TITLE(1))      0000220
2799      C      EQUIVALENCE (T(1),S(1))      0000230
2800      C      EQUIVALENCE (S(1),TDM(1),(S(2),PRES))      0000240
2801      C      EQUIVALENCE (T(20),ALT(1)),(T(21),TCH(1)),(T(22),PO(1)),      0000250
2802      C      (T(23),O(1)),(T(24),CS(1)),(T(25),RND(1))      0000260
2803      C      EQUIVALENCE (T(26),WH(1)),(T(27),ML(1)),(T(28),OH(1)),      0000270
2804      C      (T(29),GL(1)),(T(30),DWH(1)),(T(31),DL(1)),      0000280
2805      C      (T(32),MATH(1)),(T(33),RATL(1)),(T(34),TDM(1)),      0000290
2806      C      (T(35),TDL(1)),(T(36),PTM(1)),(T(37),PTL(1)),      0000300
2807      C      (T(38),PBH(1)),(T(39),SPAL(1))      0000310
2808      C      EQUIVALENCE (ND(50),IPAGE)      0000320
2809      C      EQUIVALENCE (ND(101),I),(ND(102),J)      0000330
2810      C
2811      C      DO 20 I=1,9      0000340
2812      C      2 IF(BATH(I+10)) 4,0,10      0000350
2813      C      4 BATH(I+10) = D(I) - BATH(I+10)      0000370
2814      C      GO TO 10      0000380
2815      C      0 BATH(I+10) = DVL0      0000390
2816      C      IF(DVL0) 2,10,10      0000400
2817      C      10 J = 2*I - 1      0000410
2818      C      ALT(J) = BATH(I+5)      0000420
2819      C      WH(J) = BATH(I)      0000430
2820      C      IF(BATH(I+10) - D(I)) 12,10,10      0000440
2821      C      12 ML(J) = WH(J) + BATH(I+10)      0000450
2822      C      GO TO 20      0000460
2823      C      10 ML(J) = WH(J)*BATH(I+10)      0000470
2824      C      20 CONTINUE      0000480
2825      C      INTERPOLATE FOR INTERMEDIATE ALTITUDES      0000490
2826      C      DO 40 I=1,4      0000500
2827      C      J = 1+I*2      0000510
2828      C      ALT(J) = (ALT(J-1) + ALT(J+1))/2      0000520
2829      C      40 CONTINUE      0000530
2830      C      DEVELOP ATMOSPHERIC TABLES - 0 ALTITUDES      0000540
2831      C      DO 100 I=1,9      0000550
2832      C      CALL TDMR      0000560
2833      C      TDM(I) = TDMR,T      0000570
2834      C      PO(I) = PRES      0000580
2835      C      O(I) = D(O) - ALT(I)*EQU(I)      0000590
2836      C      RND(I) = PO(I)/TDM(I)*EQU(I)      0000600
2837      C      CS(I) = (EQU(I)*O(I)-EQU(0)*TDM(I))**.5      0000610
2838      C      100 CONTINUE      0000620
2839      C      DETERMINE DYNAMIC PRESSURE AT INITIAL POINTS      0000630

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01/25/74	INPUT LISTING	AUTOFLOW CHART SET - SHEEP	AIR INDUCTION SYSTEM MODULE
CARD NO	****	CONTENTS	****
2040	DO 120 I=1,5		0002040
2041	J = 2*1 - 1		0002050
2042	OH(J) = RND(J)/D(J)/D(2)*VH(J)*CS(J)**2		0002060
2043	OL(J) = RND(J)/D(J)/D(2)*VL(J)*CS(J)**2		0002070
2044	120 CONTINUE		0002080
2045	C DETERMINE SPEED AND DYNAMIC PRESSURE AT INTERMEDIATE POINTS		0002090
2046	C STRAIGHT LINE INTERPOLATION ON DYNAMIC PRESSURE		0002100
2047	DO 140 I=1,4		0002110
2048	J = I*2		0002120
2049	IF(VH(J-1) - VH(J)) 132,130,132		0002130
2050	130 VH(J) = VH(J-1)		0002140
2051	OH(J) = RND(J)/D(J)/D(2)*VH(J)*CS(J)**2		0002150
2052	GO TO 134		0002160
2053	132 OH(J) = (OH(J-1) + OH(J))/D(2)		0002170
2054	VH(J) = (D(2)*OH(J)+RND(J))**.5/CS(J)		0002180
2055	134 IF(VL(J-1) - VL(J)) 136,136,136		0002190
2056	136 VL(J) = VL(J-1)		0002200
2057	OL(J) = RND(J)/D(J)/D(2)*VL(J)*CS(J)**2		0002210
2058	GO TO 140		0002220
2059	138 OL(J) = (OL(J-1) + OL(J))/D(2)		0002230
2060	VL(J) = (D(2)*OL(J)+RND(J))**.5/CS(J)		0002240
2061	140 CONTINUE		0002250
2062	C DETERMINE PRESSURE RECOVERY AND FLOW RATE AT ENGINE FACE		0002260
2063	C 9 POINTS		0002270
2064	DO 400 I=1,5		0002280
2065	J = 2*1 - 1		0002290
2066	IF(DATH(1+IS)) 162,162,100		0002300
2067	162 IF(RAT0) 164,164,200		0002310
2068	164 IF(VH(J) - D(1)) 166,166,166		0002320
2069	166 RATH(J) = D(1)		0002330
2070	GO TO 170		0002340
2071	168 RATH(J) = D(1) - EQU(2)*VH(J) - D(1)**EQU(25)		0002350
2072	170 IF(VL(J) - D(1)) 172,172,174		0002360
2073	172 RAL(J) = D(1)		0002370
2074	GO TO 176		0002380
2075	174 RAL(J) = D(1) - EQU(2)*VL(J) - D(1)**EQU(25)		0002390
2076	176 IF(J - 9) 178,200,200		0002400
2077	178 IF(VH(J-1) - D(1)) 180,180,182		0002410
2078	180 RATH(J-1) = D(1)		0002420
2079	GO TO 184		0002430
2080	182 RATH(J-1) = D(1) - EQU(2)*VH(J-1) - D(1)**EQU(25)		0002440
2081	184 IF(VL(J-1) - D(1)) 186,186,188		0002450
2082	186 RAL(J-1) = D(1)		0002460
2083	GO TO 200		0002470
2084	188 RAL(J-1) = D(1) - EQU(2)*VL(J-1) - D(1)**EQU(25)		0002480
2085	GO TO 200		0002490
2086	190 RATH(J) = DATH(1+IS)		0002500
2087	RAL(J) = DATH(1+9)		0002510
2088	194 IF(1 - J) 192,200,200		0002520
2089	192 RATH(J-1) = (RATH(J-2) + RATH(J))/D(2)		0002530
2090	RAL(J-1) = (RAL(J-2) + RAL(J))/D(2)		0002540
2091	GO TO 200		0002550
2092	200 RATH(J) = RAT0		0002560
2093	RAL(J) = RAT0		0002570
2094	GO TO 101		0002580
2095	C		0002590
2096	200 IF(DATH(1+9)) 310,310,300		0002600
2097	310 OH(J) = EQU(26)		0002610
2098	OL(J) = EQU(26)		0002620
2099	IF(VH(J) - D(1)) 312,312,300		0002630
2100	312 OH(J) = EQU(27)		0002640
2101	IF(VH(J) - EQU(27)) 314,310,300		0002650
2102	314 OH(J) = VH(J)		0002660
2103	GO TO 300		0002670
2104	200 IF(VL(J) - D(1)) 302,302,330		0002680
2105	302 OL(J) = EQU(27)		0002690
2106	IF(VL(J) - EQU(27)) 304,330,330		0002700
2107	304 OL(J) = VL(J)		0002710
2108	200 IF(1 - J) 320,320,400		0002720
2109	320 OH(J-1) = (OH(J-2) + OH(J))/D(2)		0002730
2110	OL(J-1) = (OL(J-2) + OL(J))/D(2)		0002740

CARD NO	INPUT LISTING	AUTOFLOW CHART SET - SHEET	AIR INDUCTION SYSTEM MODULE
0011	GO TO 400		00021300
0012	Z00 (DWHJ) = BATH(1-25)		00021300
0013	DL(J) = BATH(1-25)		00021370
0014	GO TO 330		00021300
0015	400 CONTINUE		00021300
0016	S(1) = (EQU(23)/(EQU(23) - 0(1)))		00021400
0017	S(2) = (EQU(23) - 0(1))/0(2)		00021410
0018	C DETERMINE RAM TEMPERATURE, TOTAL AND STATIC PRESSURE		00021420
0019	DO 500 I=1,0		00021430
0020	TDH(I) = TDH(I)*0(1) + S(2)*W(I)**2		00021440
0021	TDL(I) = TDH(I)*0(1) + S(2)*VL(I)**2		00021450
0022	PTH(I) = P0(I)*RATH(I)*0(1) + S(2)*W(I)**2**0(1)/0(17)		00021460
0023	PTL(I) = P0(I)*RATL(I)*0(1) + S(2)*VL(I)**2**0(1)/0(17)		00021470
0024	PDH(I) = PTH(I)/(0(1) + S(2)*DWH(I)**2**0(1))		00021480
0025	PDL(I) = PTL(I)/(0(1) + S(2)*DL(I)**2**0(1))		00021490
0026	500 CONTINUE		00021500
0027	IF(IP(02)+0001.0001.0002		
0028	5001 CONTINUE		
0029	C BREAKPOINT OUTPUT		00021510
0030	WRITE(6,1121) (MISC(N),N=00,100)		00021530
0031	1111 FORMAT(1H,BA0,10X,10H** SPAL - (P(02) **/IX,BA10)		
0032	WRITE(6,00)		00021550
0033	00 FORMAT(1H,0X,37H** SPEED ALTITUDE PROFILE TABLES ** ,0X,		00021560
0034	1 //A0X,10HSTANDARD ATMOSPHERE//10X,0H ALTITUDE,0X,		00021570
0035	21HTEMPERATURE,0X,7H DENSITY,0X,0HPRESSURE,0X,10H,0X,		00021580
0036	31HVELOCITY OF SOUND/17X,4HFEET,0X,11HDEG RANKINE,7X,3HCF,10X,		00021590
0037	43HMPF,0X,0HFT/SEC 00,7X,0HFT/SEC)		00021600
0038	WRITE(6,02) (ALT(I),TDH(I),RD(I),P0(I),0(1),CS(I),I=1,0)		00021610
0039	02 FORMAT(10X,F11.1,F12.3,0X,F10.7, F12.2,F11.3,F14.2)		00021620
0040	WRITE(6,04)		00021630
0041	04 FORMAT(//A0X,13HPROFILE TABLE//A0X,		00021640
0042	14HALT.,0X,4HWH(I),0X,4HWH(I),0X,3HPE,0X,7HPTS/PT0,0X,		00021650
0043	20HRAH T,0X,3HPTS,0X,3HPE,0X,4HWH(L),0X,4HWH(L),0X,3HPE,0X,		00021660
0044	37HPTS/PT0,0X,3HRAH T,0X,3HPTS,0X,3HPE/0X,		00021670
0045	44HFEET,0X,3HWH,0X,3HPE,0X,3HWH,11X,3HDEG R,0X,3HPS1,0X,3HPS1,		00021680
0046	5X,3HWH,0X,3HPE,0X,3HWH,11X,3HDEG R,0X,3HPS1,0X,3HPS1)		00021690
0047	WRITE(6,05) (ALT(I),WH(I),WH(I),DWH(I),RATH(I),TDH(I),PTH(I),		00021700
0048	1PH(I),VL(I),GL(I),DL(I),RATL(I),TDL(I),PTL(I),PL(I),I=1,0)		00021710
0049	05 FORMAT(10.1,F0.2,F0.2,F0.2,F7.4,F0.2,F7.2,F7.2,F0.2,F0.2,		00021720
0050	1F7.4,F0.2,F7.2)		00021730
0051	5002 CONTINUE		
0052	RETURN		00021740
0053	END		00021750
0054	C		
0055	C (.....)		
0056	C SUBROUTINE SPIKE		
0057	C (.....)		
0058	C		
0059	C SUBROUTINE SPIKE		00100010
0060	C WRITTEN 22 MARCH 1978		00100020
0061	C TO DEVELOP ELEMENTS FOR SPIKES		00100030
0062	C CURRENTLY USING STATISTICAL EQUATIONS FROM SEA-TR-67-1		00100040
0063	C CRUSHMAN, HENKIN, ROLAND ET AL		00100050
0064	C		00100060
0065	C OPEN TCOH(400)		00100070
0066	C		00100080
0067	DIMENSION 0(2000),T(2000),DC(100),AD(200)		00100090
0068	DIMENSION EQU(200)		00100100
0069	DIMENSION BATS(40)		00100110
0070	DIMENSION SPPH(200)		00100120
0071	DIMENSION 0(100)		00100130
0072	DIMENSION TOT(100)		00100140
0073	C		00100150
0074	001VALDC0 (0(1),TCOH(1),T(1),TCOH(2001)),DC(1),TCOH(401),		00100160
0075	1(AD(1),TCOH(401))		00100170
0076	001VALDC0 (0(1),EQU(1))		00100180
0077	001VALDC0 (0(201),BATS(1))		00100190
0078	001VALDC0 (0(1701),SPPH(1))		00100200
0079	001VALDC0 (T(1),0(1))		00100210
0080	001VALDC0 (T(101),TOT(11),TOT(20),WFS(1),TOT(201),WFS(1),		00100220
0081	1TOT(271),WFS(1))		00100230

CARD NO	CONTENTS	****
0002	EQUIVALENCE (ND(112),1V0)	00100240
0003	C	00100250
0004	S(1) = 0(1)	00100260
0005	SF(DATS(1)) 50,50,20	00100270
0006	DO S(1) = 0(1)/DATS(1)	00100280
0007	C DATS(4) = CAPTURE AREA PER INLET	00100290
0008	C DATS(5) = NUMBER OF INLETS	00100300
0009	DO M(1) = 0 100,200,300	00100310
0010	C	00100320
0011	C *** HALF ROUND FIXED SPIKE ***	00100330
0012	100 MFTS = EQU(20)*DATS(4)*DATS(5)/D(17)*S(1)	00100340
0013	SUPN(12) = MFTS	00100350
0014	SUPN(14) = DATS(5)	00100360
0015	GO TO 500	00100370
0016	C	00100380
0017	C *** FULL-ROUND TRANSLATING SPIKE ***	00100390
0018	200 MFTS = EQU(20)*DATS(4)*DATS(5)/D(17)*S(1)	00100400
0019	SUPN(15) = MFTS	00100410
0020	SUPN(16) = DATS(5)	00100420
0021	GO TO 500	00100430
0022	C	00100440
0023	C *** TRANSLATING AND EXPANDING SPIKE ***	00100450
0024	300 MFTS = EQU(30)*DATS(4)*DATS(5)/D(17)*S(1)	00100460
0025	SUPN(17) = MFTS	00100470
0026	SUPN(18) = DATS(5)	00100480
0027	500 CONTINUE	00100490
0028	C *** EXIT ***	00100500
0029	RETURN	00100510
0030	END	00100520
0031	C	
0032	C	
0033	C SUBROUTINE SUMMARY	
0034	C	
0035	C	
0036	C SUBROUTINE SUMMARY	00000010
0037	C WRITTEN 20 APRIL 1972	00000020
0038	C TO SUMMARIZE HEIGHTS AND C.S., AND TO PRESENT TABLES	00000030
0039	C	00000040
0040	CONVERSION TO(400)	00000050
0041	CONVERSION /MISC/ MISC(100)	
0042	CONVERSION /PRINT/ IP(100)	
0043	C	
0044	C	00000060
0045	DIMENSION D(2000),T(2000),DC(100),ND(200)	00000070
0046	DIMENSION DATS(40),DATR(120)	00000080
0047	DIMENSION TITLE(20)	00000090
0048	DIMENSION SUPN(200)	00000100
0049	DIMENSION S(100),TOT(100)	00000110
0050	C	00000120
0051	EQUIVALENCE (D(1),TCOH(1)),(T(1),TCOH(200)),(DC(1),TCOH(101)),	00000130
0052	(ND(1),TCOH(401))	00000140
0053	EQUIVALENCE (D(20),DATS(1)),(G(40),DATR(1))	00000150
0054	EQUIVALENCE (D(70),TITLE(1))	00000160
0055	EQUIVALENCE (D(170),SUPN(1))	00000170
0056	EQUIVALENCE (T(1),S(1)),(T(101),TOT(1))	00000180
0057	EQUIVALENCE (ND(50),NPAGE)	00000190
0058	EQUIVALENCE (ND(101),J),(ND(102),J)	00000200
0059	EQUIVALENCE (ND(112),1V0)	00000210
0060	EQUIVALENCE (ND(113),1PRT)	00000220
0061	C	00000230
0062	S(1)=0(1)	00000240
0063	C DETERMINE NO1 C.P. - SUPN(12)	00000250
0064	DO TO(70,70,10,10,70,70),1V0	00000260
0065	10 S(1) = (TOT(24) + TOT(25))*(DATR(17) + DATR(4)/D(2))	00000270
0066	M(DATR(1) - 0(2)) 10,10,20	00000280
0067	10 S(1) = S(1) + (TOT(20) + TOT(20) + TOT(31) + TOT(32))*	00000290
0068	(DATR(17) + DATR(4) + DATR(5)/D(2))	00000300
0069	GO TO 50	00000310
0070	DO S(1) = S(1) + (TOT(20) + TOT(27))*	00000320
0071	(DATR(17) + DATR(4) + DATR(5)/D(2))	00000330
0072	M(DATR(1) - 0(3)) 20,20,30	00000340

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CARD NO      ****      CONTENTS      ****
3053      20 S(1) = S(1) + (TOT(20) + TOT(20) + TOT(31) + TOT(32)) *      0000350
3054      1:(BARR(17) + BARR(14) + BARR(15) + BARR(16)/D(2))      0000360
3055      GO TO 20      0000370
3056      20 S(1) = S(1) + (TOT(20) + TOT(20) + TOT(30) + TOT(31) + TOT(32)) *      0000380
3057      1:(BARR(17) + BARR(14) + BARR(15) + BARR(16)/D(2))      0000390
3058      S(1) = S(1) + (TOT(32) + TOT(31)) *      0000400
3059      1:(BARR(17) + BARR(14) + BARR(15) + BARR(16) + BARR(7)/D(2))      0000410
3060      20 SUPH(2) = S(1)/TOT(20)      0000420
3061      SUPH(1) = TOT(20)      0000430
3062      C      SETUP AIR INDUCTION SYSTEM HEIGHTS AND C.O.      0000440
3063      C      ANGLEED PAGE 17      0000450
3064      70 S(1) = D(1)      0000460
3065      IF(DATS(1),07,0,0) S(1)=DATS(1)      0000470
3066      S(2)=D(2)      0000480
3067      DO 75 J=3,17,2      0000490
3068      SUPH(J) = SUPH(J)+S(1)      0000500
3069      SUPH(1) = SUPH(1) + SUPH(J)      0000510
3070      S(2) = S(2) + SUPH(J)*SUPH(J+1)      0000520
3071      75 CONTINUE      0000530
3072      SUPH(2) = S(2)/SUPH(1)      0000540
3073      IF(DATS(1)) 200,200,00      0000550
3074      C      FOR MALLEE TYPE HLT. HEIGHTS BY 2      0000560
3075      DO 80 J=21,40,4      0000570
3076      SUPH(J) = SUPH(J)+S(2)      0000580
3077      80 CONTINUE      0000590
3078      C      ALSO SINCE OUTBOARD PULS. + FITTINGS ARE CALCULATED DO THEM.      0000600
3079      SUPH(20) = SUPH(20)+D(2)      0000610
3080      SUPH(43) = SUPH(43)+D(2)      0000620
3081      100 IF(D(2) - DATS(1)) 112,200,200      0000630
3082      112 SUPH(23) = SUPH(23)      0000640
3083      SUPH(24) = SUPH(22)      0000650
3084      SUPH(27) = SUPH(25)      0000660
3085      SUPH(28) = SUPH(26)      0000670
3086      SUPH(31) = SUPH(29)      0000680
3087      SUPH(32) = SUPH(30)      0000690
3088      SUPH(38) = SUPH(33)      0000700
3089      SUPH(39) = SUPH(34)      0000710
3090      SUPH(47) = SUPH(45)      0000720
3091      SUPH(48) = SUPH(46)      0000730
3092      SUPH(51) = SUPH(49)      0000740
3093      SUPH(52) = SUPH(50)      0000750
3094      200 S(1) = D(2)      0000760
3095      S(2) = D(2)      0000770
3096      DO 210 I=1,9      0000780
3097      J = 4+I      0000790
3098      S(1) = S(1) + SUPH(J+17)*SUPH(J+18)      0000800
3099      S(2) = S(2) + SUPH(J+19)*SUPH(J+20)      0000810
3100      SUPH(57) = SUPH(57) + SUPH(J+17)      0000820
3101      SUPH(58) = SUPH(58) + SUPH(J+19)      0000830
3102      210 CONTINUE      0000840
3103      SUPH(59) = S(1)/SUPH(57)      0000850
3104      IF(SUPH(59)) 214,214,212      0000860
3105      212 SUPH(60) = S(2)/SUPH(59)      0000870
3106      214 SUPH(61) = SUPH(57) + SUPH(59)      0000880
3107      SUPH(62) = (S(1) + S(2))/SUPH(61)      0000890
3108      IF(DATS(1)) 300,300,200      0000900
3109      300 SUPH(63) = SUPH(62)*DATS(1)      0000910
3110      SUPH(67) = SUPH(67)+DATS(1)      0000920
3111      SUPH(71) = SUPH(71)+DATS(1)      0000930
3112      SUPH(73) = SUPH(63) + SUPH(67) + SUPH(71)      0000940
3113      SUPH(74) = (SUPH(63)*SUPH(63) + SUPH(67)*SUPH(67) + SUPH(71)*      0000950
3114      SUPH(71))/SUPH(73)      0000960
3115      C      REVISE CG TO FUELAGE SYSTEM      0000970
3116      200 S(1) = DATS(13)      0000980
3117      IF(D(2) - DATS(13)) 302,310,310      0000990
3118      302 S(1) = (DATS(13) + DATS(16))/D(2)      0001000
3119      310 DO 310 I=1,9      0001010
3120      J = 8+I      0001020
3121      IF(SUPH(J-1)) 312,310,312      0001030
3122      312 SUPH(J) = SUPH(J) + S(1)      0001040
3123      300 CONTINUE      0001050

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CARD NO	CONTENTS	*****
3124	00 330 1=31.37	00021000
3125	J = 2*1	00021000
3126	IF(SUPN(J-1)) 300,330,300	00021070
3127	300 SUPN(J) = SUPN(J) + S(1)	00021000
3128	300 CONTINUE	00021000
3129	S(1) = S(ATS(13))	00021100
3130	S(2) = S(ATS(16))	00021110
3131	00 400 1=1.10	00021100
3132	J = 4*1	00021130
3133	IF(SUPN(J-17)) 304,300,304	00021130
3134	304 SUPN(J-18) = SUPN(J-18) + S(1)	00021140
3135	300 IF(SUPN(J-18)) 300,400,300	00021140
3136	300 SUPN(J-20) = SUPN(J-20) + S(2)	00021100
3137	400 CONTINUE	00021100
3138	SUPN(73) = SUPN(61) + SUPN(73)	00021170
3139	SUPN(75) = (S(PH(61)+SUPN(62)) + SUPN(73)+SUPN(74))/SUPN(75)	00021100
3140	C WRITE (BREAKPOINT OUTPUT	00021100
3141	WRITE(6,400)(PHISC(IN),N=05,100)	00021200
3142	400 FORMAT(1M,6A10.17X,12M** SUPARY **/1X,6A10//	
3143	1 2EX,37A. 1. 0. + ENGINE SECTION OR NACELLE GROUP HEIGHT + C.O.	00021250
3144	2 7A5UPARY // 2EX,30A7.7X,4C.0.,2EX,30A7.7X,4C.0. )	00021250
3145	C	00021240
3146	WRITE(6,400) (SUPN(1),1=1,10)	00021250
3147	400 FORMAT(6X,20HAIR INDUCTION SYSTEM,705,8F11.2/6X,11MINLET MEDGE.	00021200
3148	1 705,8F11.2/ 6X,11HAIR DUCTING,705,8F11.2 /	00021270
3149	2 6X,20INTAKE DOORS + OP. MECHANISM,705,8F11.2 /	00021200
3150	3 6X,20BYPASS DOORS + OP. MECHANISM,705,8F11.2 /	00021250
3151	4 6X,20VARIABLE GEOMETRY STRUCTURE,705,8F11.2 /	00021300
3152	5 6X,20HALF ROUND FIXED SPIRE,705,8F11.2 /	00021310
3153	6 6X,20FULL ROUND TRANSLATING SPIRE,705,8F11.2 /	00021320
3154	7 6X,20FULL TRANS. + EXPND. SPIRE,705,8F11.2 / )	00021330
3155	C	00021340
3156	WRITE(6,400) (SUPN(1),1=21,22),(SUPN(1),1=57,62)	00021350
3157	400 FORMAT(4X,7HINBOARD,10X,8HOUTBOARD,10X,8HTOTAL //	00021300
3158	+ 4EX,30A7.7X,4C.0.,11X,30A7.7X,4C.0.,12X,30A7.7X,4C.0. /	00021370
3159	1 6X,10ENGINE MOUNTS,733,8F11.2,705,8F11.2/	00021300
3160	2 6X,10BELLHEADS + FRAMES,733,8F11.2,705,8F11.2/	00021300
3161	3 6X,20COVERING + STIFFERS,733,8F11.2,705,8F11.2/	00021400
3162	4 6X, 6X,60GORDS,733,8F11.2,705,8F11.2/	00021410
3163	5 6X, 6X,60FITTINGS, 733,8F11.2,705,8F11.2/	00021420
3164	6 6X, 6X,60FLWS,733,8F11.2,705,8F11.2/	00021430
3165	7 6X, 6X,60FRMALL,733,8F11.2,705,8F11.2 /	00021440
3166	8 6X, 6X,60FRD,733,8F11.2,705,8F11.2 /	00021450
3167	9 6X,10TOTAL ENG.SEC./NAC. 733,8F11.2,705,8F11.2,705,8F11.2/)	00021460
3168	C	00021470
3169	WRITE(6,400) (SUPN(1),1=60,60),(SUPN(1),1=71,76)	00021400
3170	400 FORMAT(6X,10ACCESS DOORS,705,8F11.2 /	00021400
3171	1 6X, 10ENGINE DOORS,705,8F11.2/ 6X,10EXTERIOR FINISH,705,8F11.2/0021500	
3172	2/6X,10TOTAL MISC. 705,8F11.2 //	00021510
3173	3 6X,10TOTAL ENG.SEC./NAC.GROUP + MISC.,705, 8F11.2 )	00021520
3174	C	00021530
3175	WRITE(6,500)(PHISC(IN),N=05,100)	00021500
3176	500 FORMAT(1M,6A10.17X,12M** SUPARY **/1X,6A10)	
3177	WRITE(6,502)	00021570
3178	502 FORMAT(1M, 20X,47A* * * P R O P U L S I O N G R O U P * * *	00021500
3179	/ 2EX, 31A----- )	00021500
3180	WRITE (6,505) ( SUPN(1), 1=1,11,2 )	00021600
3181	505 FORMAT(1M, 17X, 20HAIR INDUCTION SYSTEM, 707, 1F12.2 / 2X,	00021610
3182	+ 10MINLET MEDGE, 707, 1F12.2 / 2X, 11HAIR DUCTING, 707, 1F12.2 /	00021620
3183	+ 2X, 20INTAKE DOORS + OPERATING MECHANISM, 707, 1F12.2 /	00021630
3184	+ 2X, 20BYPASS DOORS + OPERATING MECHANISM, 707, 1F12.2 / 2X,	00021640
3185	+ 20VARIABLE GEOMETRY STRUCTURE, 707, 1F12.2 )	00021650
3186	IF (SUPN(13) .NE. 0.0) WRITE (6,510) SUPN(13)	00021600
3187	510 FORMAT (1M, 2X, 20HALF ROUND FIXED SPIRE, 707, 1F12.2 )	00021670
3188	IF (SUPN(15) .NE. 0.0) WRITE (6,512) SUPN(15)	00021600
3189	512 FORMAT(1M,2X,20FULL ROUND TRANSLATING SPIRE,707,1F12.2)	00021600
3190	IF (SUPN(17) .NE. 0.0) WRITE (6,514) SUPN(17)	00021700
3191	514 FORMAT (1M, 2X, 20FULL TRANSLATING + EXPANDING SPIRE,707,1F12.2)0021710	
3192	C	00021700
3193	WRITE(6,500)(PHISC(IN),N=05,100)	00021740
3194	WRITE(6,502)	00021700



CARD NO	****	CONTENTS	****
3006		IF(ALOFT - EQU(17)) 100.100.57	00030000
3007		97 WRITE(6,00)	00030400
3008		00 FORMAT(10G,2X,23H*** WARNING MESSAGE ***.10X,	00030410
3009		14#ALTITUDE IS BEYOND VALID RANGE OF PRESSURE)	00030420
3070		00 TO 90	00030430
3071		100 CONTINUE	00030440
3072		C	00030450
3073		C DEVELOP AMBIENT TEMPERATURE	00030460
3074		IF(ALOFT - EQU(1)) 110.125.120	00030470
3075		C ALTITUDE BETWEEN SEA LEVEL AND 30000.230 FT	00030480
3076		110 TEMP1 = EQU(10) - EQU(10)*ALOFT	00030490
3077		00 TO 030	00030500
3078		100 IF(ALOFT - EQU(5)) 125.125.140	00030510
3079		C ALTITUDE BETWEEN 30000.230 AND 05010.00 FT.	00030520
3080		125 TEMP1 = EQU(20)	00030530
3081		00 TO 030	00030540
3082		140 IF(ALOFT - EQU(8)) 145.100.100	00030550
3083		C ALTITUDE BETWEEN 05010.00 AND 104000.00 FT	00030560
3084		140 TEMP1 = EQU(20) + EQU(12)*(ALOFT-EQU(5))	00030570
3085		00 TO 030	00030580
3086		C ALTITUDE BETWEEN 104000.00 AND 154199.40 FT.	00030590
3087		100 TEMP1 = EQU(15) + EQU(14)*(ALOFT - EQU(8))	00030600
3088		IF(ALOFT - EQU(17)) 030.030.010	00030610
3089		010 WRITE(6,01)	00030620
3090		01 FORMAT(10G,2X,23H*** WARNING MESSAGE ***.10X,	00030630
3091		14#ALTITUDE IS BEYOND VALID RANGE OF TEMPERATURE)	00030640
3092		030 CONTINUE	00030650
3093		RETURN	00030660
3094		END	00030670