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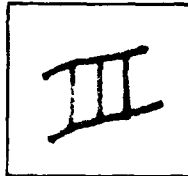
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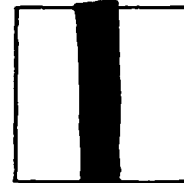


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GENERAL ELECTRIC CO CINCINNATI OHIO AIRCRAFT
ENGINE GROUP

HIGH VELOCITY JET NOISE SOURCE LOCATION AND
REDUCTION. TASK 6. SUPPLEMENT - COMPUTER PROGRAMS:

ENGINEERING CORRELATION(M*S) JET NOISE PREDICTION METHOD and
UNIFIED AEROACOUSTIC PREDICTION MODEL (M*G*B) FOR NOZZLES OF
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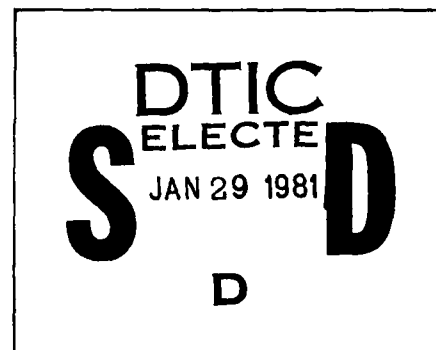
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HIGH VELOCITY JET NOISE SOURCE LOCATION AND REDUCTION

TASK 6 SUPPLEMENT - COMPUTER PROGRAMS:

ENGINEERING CORRELATION (M*S)

JET NOISE PREDICTION METHOD and

UNIFIED AEROACOUSTIC PREDICTION MODEL (M*G*B)

FOR NOZZLES OF ARBITRARY SHAPE

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MARCH 1979

FINAL REPORT

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16. Abstract This General Supplement Report documents two (2) Computerized Jet Noise Prediction Techniques: the Engineering Method (M*S) and the Unified Aeroacoustic Prediction Model (M*G*B). A complete description of the computer programs is provided, including examples of input preparation and output cases, plus a listing of the FORTRAN computer code. The comprehensive, empirical, jet noise prediction method (M*S) has been developed by correlating extensive data from this program and available data from other published sources. The data were correlated by means of basic engineering principles and physical parameters. The resulting (M*S) prediction method includes unsuppressed conical nozzles; multitube and multichute single- and dual-flow suppressed nozzles; and multitube/multichute nozzles with hardwall and treated sectors. A unified aerodynamic/acoustic prediction technique has also been developed (M*G*B) for assessing the noise characteristics of suppressor nozzles. The technique utilizes an extension of Reichardt's method so as to provide predictions of the jet plume flow field. The turbulent fluctuations in the mixing regions of the jet are assumed to be the primary source of noise generation, as in Classical Theories of Jet Noise. The alteration of the generated noise by the jet plume itself as it propagates through the jet to the farfield is modeled utilizing the high-frequency shielding theory based on Lilley's equation. These basic modeling elements have been coupled together in a discrete volume-element formulation. The individual volume elements are assumed to be uncorrelated with each other, so that the total contribution to the farfield is simply the sum of the individual volume element contributions. The programs presented herein are primarily directed toward prediction of high-velocity jet noise (1500-2900 feet per second) for arbitrary nozzle shapes, including sound pressure level spectra at any observer location. Static as well as in-flight capability is included in both models, albeit the "flight" data base and subsequent verification are quite limited.					
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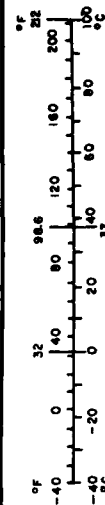
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
VOLUME				
tsp	teaspoons	5	milliliters	ml
fl oz	fluid ounces	15	milliliters	ml
c	cups	30	milliliters	ml
pt	pints	0.24	liters	l
qt	quarts	0.47	liters	l
gal	gallons	0.96	liters	l
ft ³	cubic feet	3.8	liters	l
yd ³	cubic yards	0.03	cubic meters	m ³
		0.76	cubic meters	m ³
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Approximate Conversions from Metric Measures				
Symbol	When You Know	Multiply by	To Find Symbol	
LENGTH				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
AREA				
cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10,000 m ²)	2.5	acres	
MASS (weight)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
VOLUME				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³
TEMPERATURE (exact)				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



*1 in = 2.54 exactly. For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, NIST 25, 50 Catalog No. C 13.10 286.

PREFACE

This report describes the work performed under the DOT/FAA High-Velocity Jet Noise Source Location and Reduction Program (Contract DOT-OS-30034).

- Investigation, including scaling effects, of the aerodynamic and acoustic mechanisms of various jet noise suppressors.
- Analytical and experimental studies of the acoustic source distribution in such suppressors, including identification of source location, nature, and strength and noise reduction potential.
- Investigation of in-flight effects on the aerodynamic and acoustic performance of these suppressors.

The results of these investigations led to the preparation of a design guide report for predicting the overall characteristics of suppressor concepts, from models to full scale, from static to in-flight conditions, as well as a quantitative and qualitative prediction of the phenomena involved.

The work effort in this program was organized under the following major Tasks, each of which is reported in a separate Final Report:

Task 1 - Activation of Facilities and Validation of Source Location Techniques.

Task 2 - Theoretical Developments and Basic Experiments.

Task 3 - Experimental Investigation of Suppression Principles.

Task 4 - Development and Evaluation of Techniques for In-Flight Investigation.

Task 5 - Investigation of In-Flight Aeroacoustic Effects on Suppressed Exhausts.

Task 6 - Preparation of Noise Abatement Nozzle Design Guide Report.

Task 1 was an investigative and survey effort designed to identify acoustic facilities and test methods best suited to jet noise studies.

Task 2 was a theoretical effort complemented by theory verification experiments which extended across the entire contract period of performance.

Task 3 represented a substantial contract effort to gather various test data on a wide range of high-velocity jet noise suppressors. These data, intended to help identify five optimum nozzles for in-flight testing in Task 5, provided an extensive high quality data bank useful to the preparation of the Task 6 design guide as well as for future studies.

Task 4 was similar to Task 1, except that it dealt with the specific test facility requirements, measurement techniques, and analytical methods necessary to evaluate the in-flight noise characteristics of simple and complex suppressor nozzles. This effort provided the capability to conduct the flight effects test program of Task 5.

Task 6 embodies the salient results of Task 2, 3, 4 and 5, and combines them with other contractor results into a noise abatement nozzle design guide which permits acoustic and performance prediction of future high-speed engine-suppressor installations.

The present volume, a supplement to the design guide, documents two jet noise prediction methods developed under the contract: the engineering correlation of (M*S) model and the unified aeroacoustic model (M*G*B) (each capable of accounting for flight effects). The objective of this report is to provide users with a description of the methods and associated computational procedures in sufficient detail that either method can be implemented and utilized as a useful engineering tool. The empirical M*S method is capable of predicting static and in-flight acoustic characteristics of multi-element suppressors applicable to both advanced turbojet and variable-cycle engines. The theoretically based M*G*B method is capable of predicting static and in-flight aerodynamic and acoustic characteristics of jets from nozzles of arbitrary shape, and as such provides more insight into the fundamental mechanisms involved in a given configuration's noise signature.

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1.0 SUMMARY

This supplement to the Task 6, Noise Abatement Nozzle Design Guide documents two computerized jet noise prediction techniques: the engineering correlation method, and the unified aeroacoustic prediction model. A complete description of the computer programs are provided, including examples of input preparation and output cases, plus a listing of the FORTRAN computer code.

1.1 THE ENGINEERING CORRELATION (M*S) METHOD

A comprehensive, empirical, jet-noise-prediction method has been developed by correlating extensive data from this program with available data from other published sources. This engineering correlation prediction model has been designated as the M*S model (after the authors: Motsinger and Sieckman) for ease of reference, as well as to distinguish it from the more theoretical prediction model (M*G*B) developed by authors Mani, Gliebe and Balsa.

The data were correlated by means of basic engineering principles and physical parameters. The resulting M*S prediction methods includes unsuppressed conical nozzles; multitube and multichute, single and dual-flow, suppressed nozzles; and multitube/chute nozzles with **hardwall** and **treated** ejectors.

1.2 THE UNIFIED AEROACOUSTIC PREDICTION (M*G*B) METHOD

A unified aerodynamic/acoustic prediction technique has been developed for assessing the noise characteristics of suppressor nozzles. The technique utilizes an extension of Reichardt's method so as to provide predictions of the jet plume flow field (velocity, temperature and turbulence intensity distributions). The turbulent fluctuations produced in the mixing regions of the jet are assumed to be the primary source of noise generation, as in the classical theories of jet noise. The altering of the generated noise by the jet plume itself as it propagates through the jet to the **farfield observer** (sound/flow interaction or fluid shielding) is modeled utilizing the high-frequency shielding theory based on Lilley's equation.

These basic modeling elements (flow field prediction, turbulent mixing noise generation, and sound/flow interaction) have been coupled together in a discrete volume-element formulation. The jet plume is divided into elemental volumes, each roughly the size of a representative turbulence correlation volume appropriate to that particular location in the plume. Each volume element is assigned its own characteristic frequency, spectrum, and acoustic intensity. The sound/flow interaction effects for each volume element are evaluated from the flow environment of the element. The individual

volume elements are assumed to be uncorrelated with each other, so that the total contribution to the farfield is simply the sum of the individual volume element contributions.

The programs presented herein are primarily directed toward prediction of high-velocity jet noise (1500-2900 feet per second) for arbitrary nozzle shapes, including sound pressure level spectra at any observer location. Static as well as in-flight capability is included in both models; however, the flight data base and subsequent verifications are somewhat limited at the time of this program's conclusion.

2.0 INTRODUCTION

Many jet noise suppressor nozzles have been designed utilizing intuitive notions of how to suppress jet noise which have demonstrated substantial noise reduction, but often at the expense of considerable thrust loss as well as increased engine weight, manufacturing cost, and complexity. Seemingly minor changes in suppressor nozzle design, for the purpose of improving thrust performance, often result in substantial loss of noise suppression. It is therefore highly desirable to have available a quantitative prediction technique for estimating the aerodynamic flow field and acoustic characteristics of suppressor-type nozzle configurations, so that design and optimization studies can be made prior to construction and testing in order to minimize the time and cost of development. Ideally, any technique should be sensitive to the controllable design variables and contain a little empiricism as possible. When empiricism is necessary, it should be based more or less on physical characteristics (flow, acoustic propagation, etc.) engineering principles rather than on geometric parameters.

The computer programs included herein represent a conventional engineering correlation technique and a more theoretical approach derived from engineering principles. The design engineer can exercise either or both models, depending on the type of results required. The correlation method provides a preliminary design prediction of aerodynamic and acoustic performance; the theoretical M*G*B method provides a means of assessing the relative importance of various jet noise mechanisms.

Section 3.0 describes the computer program for the engineering correlation jet noise prediction method (M*S model); Section 4.0 presents the computer program for the unified aeroacoustic prediction method (M*G*B model).

3.0 ENGINEERING CORRELATION (M*S) JET NOISE PREDICTION COMPUTER PROGRAM

3.1 INTRODUCTION

This section documents the computer program for the prediction of jet noise by the engineering correlation method (M*S). The mathematical model appears in detail in Reference 1. A description of the computer program is provided herein including examples of input preparation and output cases, plus a listing of the FORTRAN computer code.

The computer program is written in FORTRAN Y language. It has been programmed for use on both the GE/Honeywell 6080 and the CDC 7600 computers.

The range of valid application of the program, the limiting assumptions, and documentation of the data base used for developing the correlation can be found in both the Task 3 (Reference 1) and Task 6 (Reference 2) reports.

3.2 PROGRAM NOMENCLATURE

Table 3-1 defines the FORTRAN symbols used in the program. The listing and descriptions of input variables are given in the Input Description section.

3.3 DESCRIPTION OF PROGRAM AND SUBROUTINES

Table 3-2 gives a description of the overall flow of the computer program including all routines used in each step. Figure 3-1 gives a detailed flow chart of the computer program logic. A description of the main program and each of the subroutines is given in the following paragraphs.

M*S Routine - This routine reads the input curves needed for the various prediction routines. Depending on nozzle type it reads the nozzle input, initializes variables, and computes flow parameters and flow and physical geometries. The computation of gamma (ratio of specific heats) involves an iteration using input temperature and pressure ratio. The output and use of prediction subroutines are controlled by this routine.

Following the preliminary calculations, control is routed through the multielement, conical, or dual-flow section of the program. In the multielement part, calculations are first made for the postmerged noise. The coefficients for the Potter and Crocker equation are set up, and, because it is a third-order equation (after simplification), a Newtonian convergence routine is used to determine the first root. Density and diameter are then calculated and a check is made for other possible roots. Static and total

Table 3-1. Definition of FORTRAN Symbols.

<u>FORTRAN Symbol</u>	<u>Meaning</u>	<u>Related Subroutines</u>
A	Ejector treatment parameters	MS, EJECTS
AA8, A8	Inner nozzle flow area	MS, SHKSUB
AJ	Acoustic angle, degrees	MS, SUB3, SUB5 EXTP, SHKSUB, EJECTS
AJA	Jet plume spreading angle, radians	
AJR	Acoustic angle, radians	MS, EXTP, EJECTS
ALT	Input altitude or arc distance	MS, EXTP
AN	Noy Weighting	PNLPT
AN1	Number of elements	MS
ASK	Intermediate variable	PNTT8
A0	Ambient speed of sound	MS, SUB1 SHKSUB, PNTT8
A1	Intermediate variable	MS, EJECTS
A1	Ratio of merged to exit area	MS
A2	Ratio of merged to exit area	EJECTS
A3	Single-flow nozzle total exit area	MS
A3	Intermediate variable	EJECTS
A4	Intermediate variable	MS
A4	Ejector treatment PWL Insertion loss	EJECTS
A5	Area of multielement merged stream	MS
A5	Ejector treatment SPL insertion loss at given acoustic angle	EJECTS
A6	Ratio of ejector inlet area to nozzle total area	MS, EJECTS
A7	Multielement nozzle area ratio	MS
A9	Outer nozzle flow area	MS
B	Shock strength parameter, β	SHKSUB
B1	Intermediate variable	EXTP
B2	Intermediate variable	EXTP
B3	Intermediate variable	EATP
B8	Tube or chute/spoke cant angle, radians	MS
B9	Tube or chute/spoke cant angle, degrees	MS
C	Normalized OASPL jet mixing noise curve-fit coefficients	MS, SUB1 PNTT8
CJ	Ten dB down value for EPNL	TPNLC
CMAx	Intermediate tone correction	MS, SUB1
C1	Jet mixing noise OASPL corrections	EXTP, SHKSUB
C1J	Intermediate variable	
C2	Jet mixing noise relative velocity exponents	MS, SUB1
C3	Inner stream specific heat	MS
C4	Outer stream specific heat	MS
C9	Local speed of sound	MS, SHKSUB

Table 3-1. Definition of FORTRAN Symbols (Continued).

<u>FORTTRAN Symbol</u>	<u>Meaning</u>	<u>Related Subroutines</u>
D	Intermediate variable	MS, PNTT8
DE	Hard-wall ejector reference effect at θ_T	EJECTS
DEK	Flight Effect at 90° on Shock Cell Noise	SHKSUB
DEN	Density correction $(\rho_j/\rho_o)^\omega$	SUB1
DIS	Intermediate variable	EXTP
DJ	Characteristic element dimension	MS
DN	Nozzle outer diameter	MS
DOP	Doppler Factor	EXTP
DT	Tube diameter	MS
DUM	Intermediate variable	SUB1
D0	Shock-noise normalization parameter	SHKSUB
D1	Reference far-field distance	MS, EXTP, SHKSUB
D2	Hard-wall ejector reference effect	EJECTS
D3	Ejector radius or diameter	EJECTS
D4	Equivalent area diameter	MS, EJECTS
D5	Merged flow diameter	MS
D7	Initial time for EPNL	PNTT8
D8	Nozzle characteristic dimension for shock noise	MS, SHKSUB
D9	Final time for EPNL	PNTT8
E	Jet mixing noise spectral distribution at θ	SUB1
E	Intermediate Variable	EXTP
E1	Ejector effect	EJECTS
E3	EPNL	PNTT8
E9	EGA indicator	MS, EXTP, PNTT8
F	Center frequency	MS, EXTP, SHKSUB PNTT8, EJECTS
F	Intermediate variable	TPNLC
FP	Peak frequency	EJECTS
F0	Critical frequency for effective number of elements	MS
F1	Intermediate variable	MS, SHKSUB
F2	Intermediate variable	MS, SHKSUB
F3	Intermediate variable	SHKSUB
G	Shock-cell noise prediction input curve	MS, SHKSUB
GJ	Critical refraction angle indicator	MS
G1	Intermediate variable	SHKSUB
G2	Outer stream ratio of specific heats, γ	MS
G3	EGA at output distance	EXTP
G8	Intermediate γ	MS
G9	Inner stream ratio of specific heats, γ	MS
H	Output sideline or arc distance	MS, EXTP, PNTT8
H1	Intermediate variable	SHKSUB
I	Index	MS, SUB1, SUB5, SUB4, SUB2, SUB6, EXTP, SHKSUB, TPNLC, PNTT8, EJECTS

Table 3-1. Definition of FORTRAN Symbols (Continued).

<u>FORTTRAN</u> <u>Symbol</u>	<u>Meaning</u>	<u>Related</u> <u>Subroutines</u>
IDCASE	Case Description	MS
IDENT	Run Description	MS
IM	Intermediate variable	MS
IP	Intermediate variable	EJECTS
II	Indicator	TPNLC
IIAS	Noise component identification	MS, PNNT8
IICASE	Case Description	MS, PNNT8
IIP	Intermediate variable	MS
ISPLF	Intermediate variable	TPNLC
J	Index	All Subroutines
JJ	Index	PNNT8, EJECTS
K	Index	SUB1, SUB3
KK	Jet mixing noise spectral distribution curve-fit coefficients	MS, SUB1
KSTART	Index	SHKSUB
KT	Intermediate variable	PNNT8
K0	Intermediate variable	MS
K1	Extrapolation indicator	MS, SUB3
K2	Intermediate variable	MS
K6	Intermediate variable	SUB1, EJECTS
K7	Shock-noise case indicator	MS
K8	Index	SHKSUB, EJECTS
K9	Print Indicator	MS
L	PNL calculation coefficients	MS, PNLPT
L1	Output acoustic range	EXTP
L2	Reflected axial source location	EJECTS
L3	Ejector length	EJECTS
L8	Ejector length effect	EJECTS
L9	Ejector length to suppressor nozzle equivalent diameter	
M	Mach number	MS, EJECTS
MP	Maximum PNL	PNNT8
MM	Intermediate variable	MS
N	Number of elements in nozzle	MS
NFLT	Flight Effects Exponent Indicator	MS, SUB1
N1	Angle indicator	MS, SUB1
O	OASPL	SUB1, SUB3, PNNT8
OJ	Critical refraction angle	MS, EJECTS
O9	OAPWL	SUB5, SUB6, PNNT8
P	PNL	SUB3, PNNT8
PA	Air attenuation	EXTP
PJ	Intermediate variable	MS
PTCOR	Tone correction	TPNLC
P0	Ambient static pressure	MS

Table 3-1. Definition of FORTRAN Symbols (Continued).

<u>FORTRAN Symbol</u>	<u>Meaning</u>	<u>Related Subroutines</u>
P1	π (3.14159)	EXTP, SHKSUB
P3	Frequency	EXTP, EJECTS
P4	Inner nozzle total to ambient pressure ratio	MS
P5	Outer nozzle total to ambient pressure ratio	MS
P9	Nozzle total to ambient pressure ratio	MS
Q	Spherical spreading effect	EXTP
Q1	Intermediate variable	MS, PNTT8
Q2	Jet mixing noise normalization parameter	SUB1
R	Intermediate storage variable	SUB4, SUB6
RJ	Ambient density	MS, SUB1
RJ1	Intermediate variable	SUB1, PNTT8
RP	Centerbody plug radius	MS
RS, RR	Specific resistance	EJECTS
RVE	Flight Effects	SUB1
RX	Specific reactance	EJECTS
R1	Tube equivalent radius	MS
R2	Nozzle outer diameter	MS
R3	Inner flow density	MS
R4	Chute/spoke outer flow width	MS
R5	Outer flow density	MS
R6	Chute/spoke inner flow width	MS
R7	Outer nozzle duct height	MS, SUB1
R8	Outer nozzle radius ratio	MS
R9	Centerbody plug radius	MS
S	Predicted SPL	MS, SUB1, SUB3, SUB5, SUB4, SUB2, SUB6, SHKSUB, PNTT8
SBAR	Intermediate variable	TPNLC
SC	Intermediate variable	TPNLC
SJ	Intermediate variable	MS, PNTT8
SL	Input sideline distance	MS, EXTP
SP	Intermediate variable	TPNLC
SPI	Intermediate variable	TPNLC
SPLP	Intermediate variable	TPNLC
SPLPP	Intermediate variable	TPNLC
SS	Outer chute/spoke width	MS
SX	Source location	MS
S1	Shock-cell noise prediction input curves	MS, SHKSUB
SIJ	Outer element spacing to characteristic diameter ratio	MS
S2J	Relative source strength	EJECTS

Table 3-1. Definition of FORTRAN Symbols (Continued).

<u>FORTRAN Symbol</u>	<u>Meaning</u>	<u>Related Subroutines</u>
S6	Nozzle outer radius	MS, EJECTS
T	Temperature	SUB1
T	PNL	SUB3
T	Flyover time	PNTT8
TC	Cutoff effect	MS
TC2	Intermediate variable	TPNLC
TC3	Intermediate variable	TPNLC
TJ	Intermediate variable	PNLPT, PNTT8
TT	Intermediate variable	PNTT8
TT3, T3	Nozzle total temperature	MS
TT4, T4	Inner nozzle total temperature	MS
TT5, T5	Outer nozzle total temperature	MS, SUB1
TZ	Initial time for EPNL	PNTT8
T0	Ambient temperature	MS, SUB1, PNTT8
T1	Intermediate variable	PNTT8, EJECTS
T2	Intermediate variable	MS
T8	Total temperature	MS, SUB1
U	Arc or sideline indicator	MS, EXTP, PNTT8
U3	Nozzle fully expanded velocity	MS
U5	Outer nozzle fully expanded velocity	MS
V	Intermediate variable	SUB3, PNLPT
VJ	Suppressor merged velocity	MS
V0	Aircraft velocity	MS, SUB1, SHKSUB, PNTT8
V1	Ratio of merged velocity to exit velocity	MS
V6	Intermediate variable	MS
V7	Intermediate variable	MS
V8	Fully expanded jet velocity input to jet mixing noise routine	MS, SUB1
V9	Fully expanded jet velocity input to shock-cell noise routine	MS, SHKSUB
W	Density exponent curve-fit coefficients	MS, SUB1
WE	Density exponent	SUB1
WJ	Intermediate variable	SUB1, PNTT8
W4	Inner stream weight flow	MS
W5	Outer stream weight flow	MS
W8	Weight flow	MS, SUB1
X	Source location	MS, EJECTS
X	SPL	SUB3, EXTP, PNLPT
XJ	Intermediate variable	SUB1, EJECTS
XM	Point of merging	MS
X0	Potter and Crocker equation coefficient	MS
X1	Potter and Crocker equation coefficient	MS
X2	Potter and Crocker equation coefficient	MS

Table 3-1. Definition of FORTRAN Symbols (Concluded).

<u>FORTRAN Symbol</u>	<u>Meaning</u>	<u>Related Subroutines</u>
X3	Potter and Crocker equation coefficient	MS
X4	Specific reactance	EJECTS
Y	PWL	SUB5, SUB4, SUB6, PNTT8
YJ	Intermediate variable	SUB5, EJECTS
Y1	Intermediate variable	MS, SUB4, SUB6
Y1J	Intermediate variable	MS
Y2	Intermediate variable	MS
Y9	Nozzle type indicator	MS, SUB1
Z1	Intermediate variable	SHKSUB
ZJ	Intermediate variable	EXTP, EJECTS
ZK	Intermediate variable	SHKSUB
ZZ	Effective number of elements effect	MS
Z1	Intermediate variable	SUB1, PNTT8
Z2	Intermediate variable	MS
Z3	Intermediate variable	MS, PNTT8
Z5	Number of rows of tubes	MS
Z8	Effective number of elements adder	MS
Z9	Total number of elements adder	MS
Z9	Constant	MS, SUB2

Table 3-2. Overall Flow of Program.

1. Read Input Curves (M*S).
2. Read Input and Calculate Flow Parameters for each Stream (M*S).

The Following through 11 are used or Skipped as Necessary.

3. Determine Postmerged Noise (M*S, SUB1, SUB5).
4. Determine Premerged Noise (M*S, SUB1).
5. Determine Premerged Cutoff and Shielding Effects (M*S).
6. Calculate Ejector Effects and Correct the Premerged Noise (M*S, EJECTS, SUB5).
7. Sum the Premerged and Postmerged Noise (SUB6).
8. Calculate Shock Noise for Outer Stream and Apply Cutoff, Shielding, and Ejector Effects (M*S, SHKSUB, EJECTS, SUB5).
9. Add to the Sum of Premerged and Postmerged (SUB6).
10. Calculate Shock Noise for Inner Stream (M*S, SHKSUB, SUB5).
11. Add to the Sum of Premerged and Postmerged and Outer Stream Shock (SUB6).
12. Extrapolate and Calculate OASPL, PNL and PNLT (this may be done after each Component is Calculated for Print Purposes) (SUB3).
13. Print Output and Calculate EPNL (PNTT8).

M*S Routine

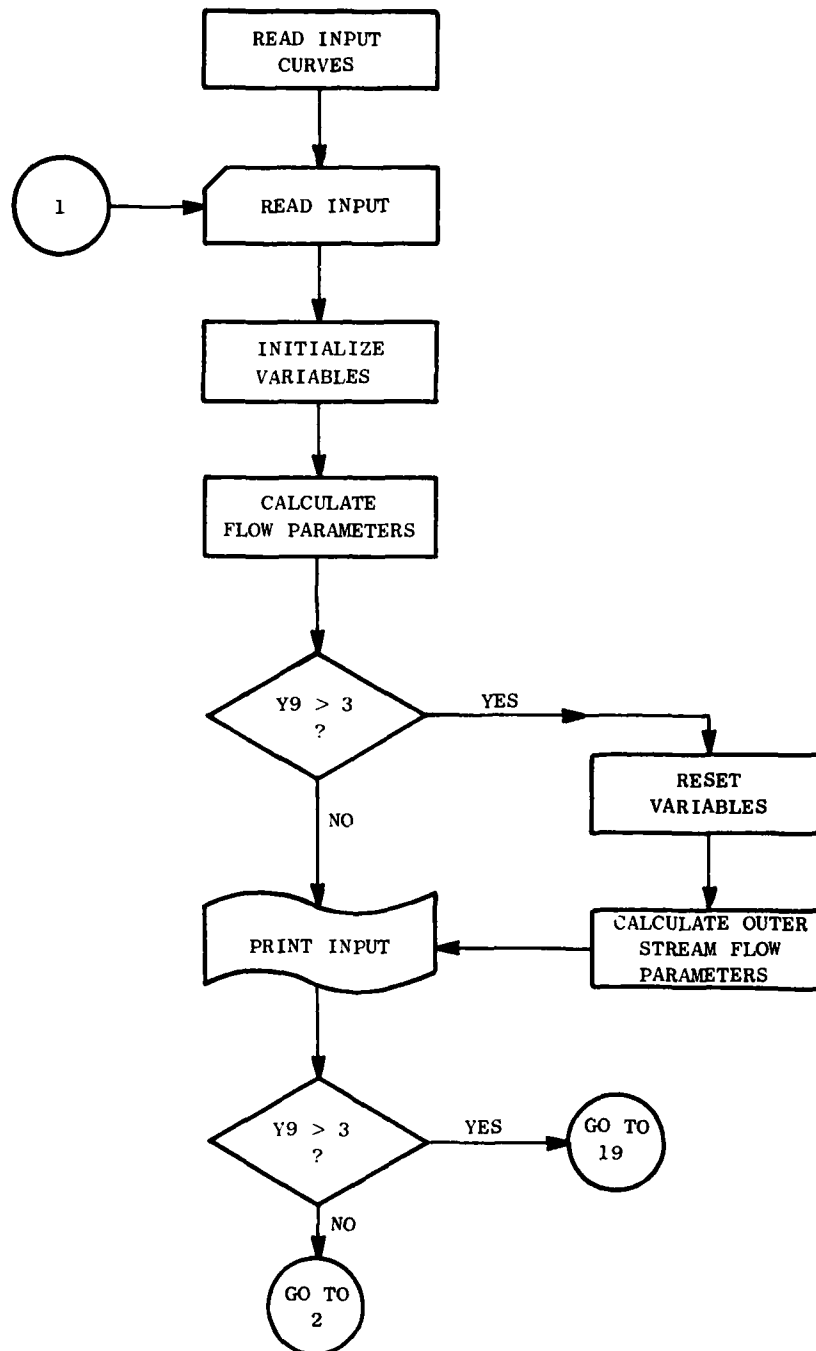


Figure 3-1. Computer Program Flow Chart.

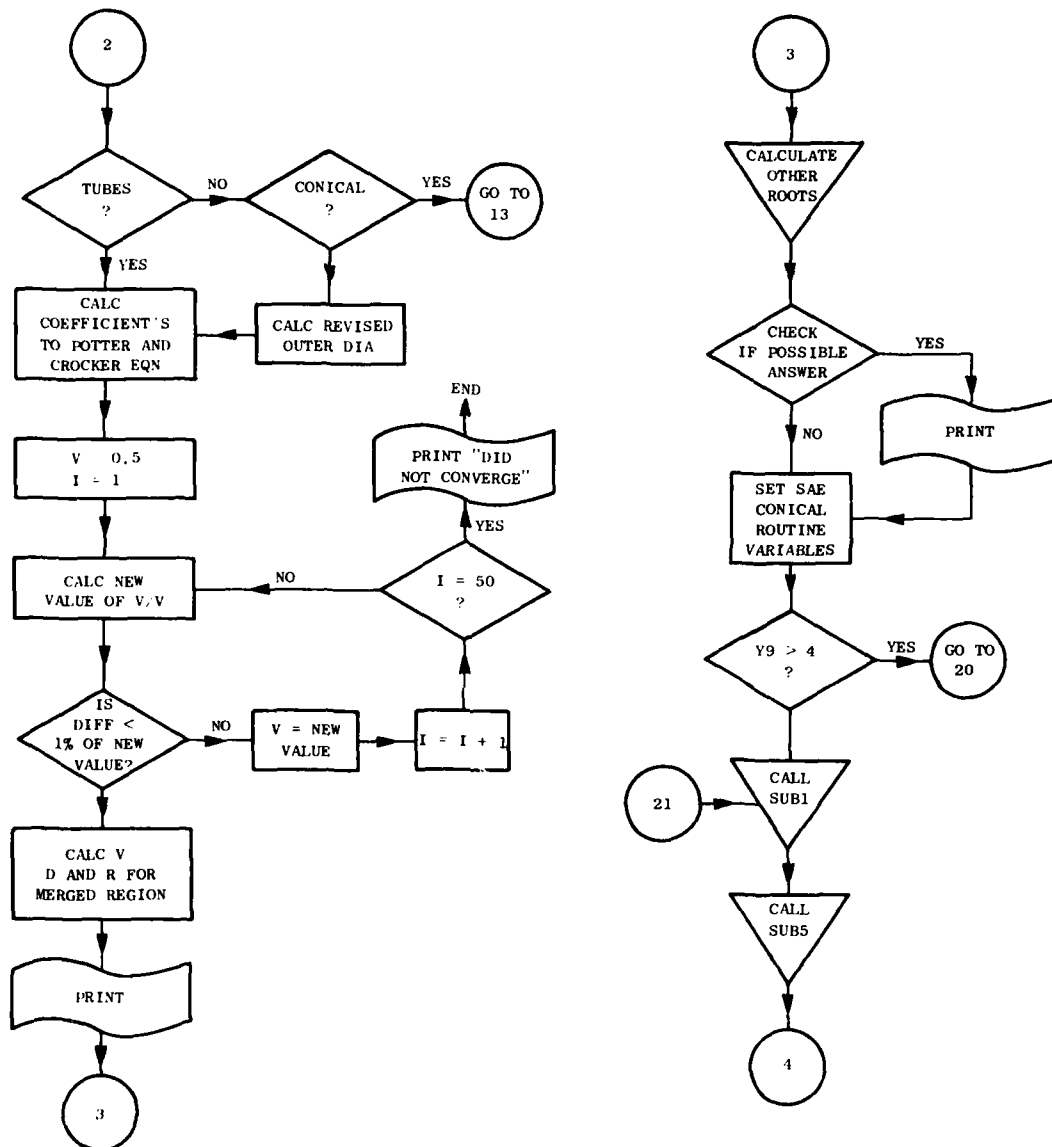


Figure 3-1. Computer Program Flow Chart (Continued).

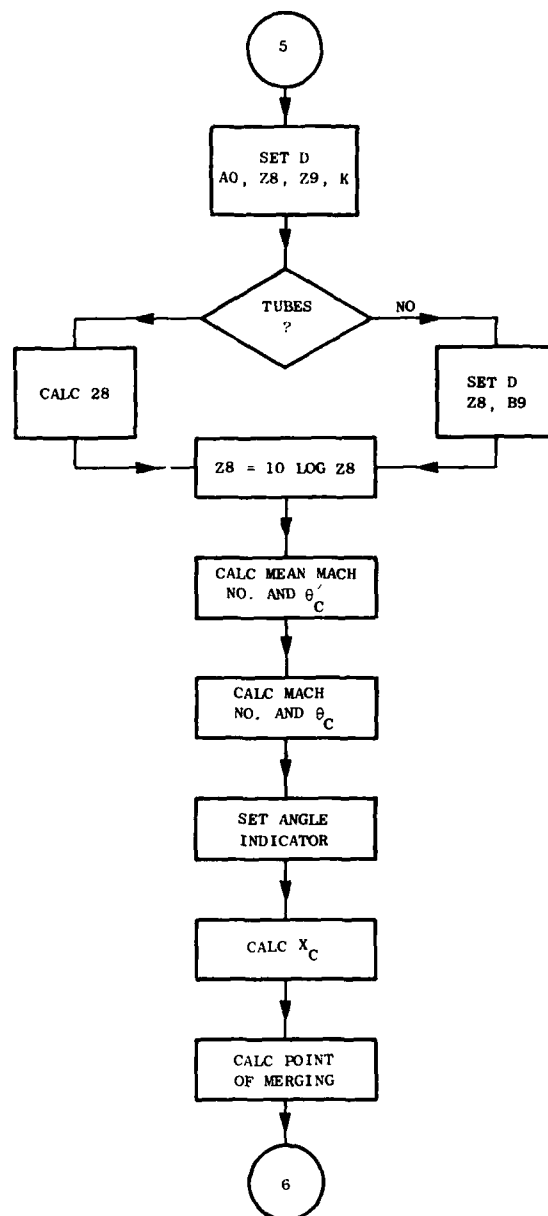
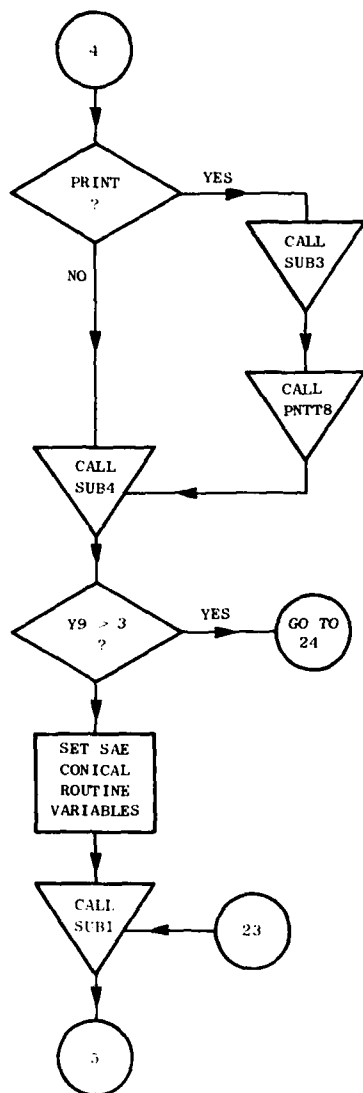


Figure 3-1. Computer Program Flow Chart (Continued).

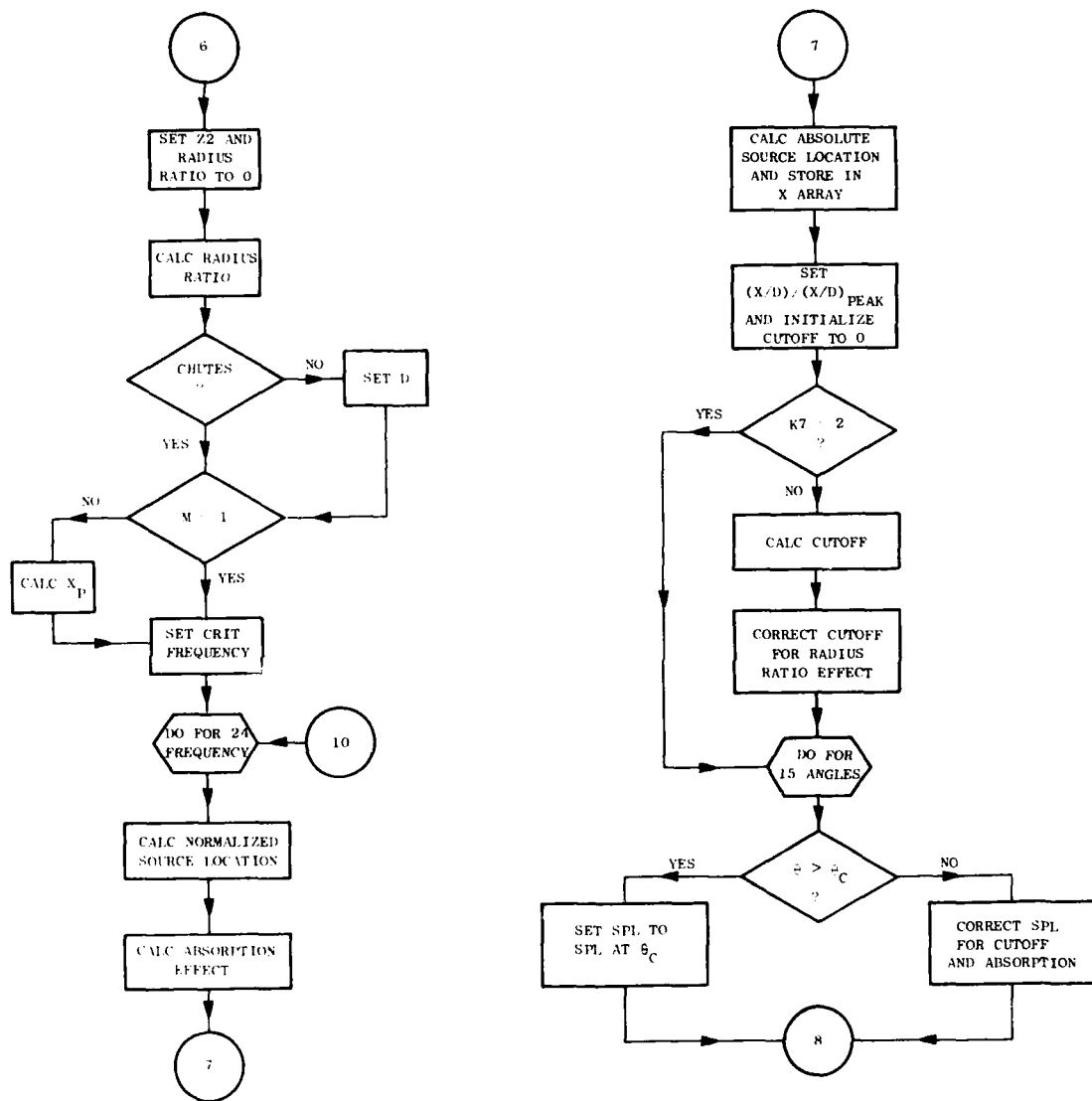


Figure 3-1. Computer Program Flow Chart (Continued).

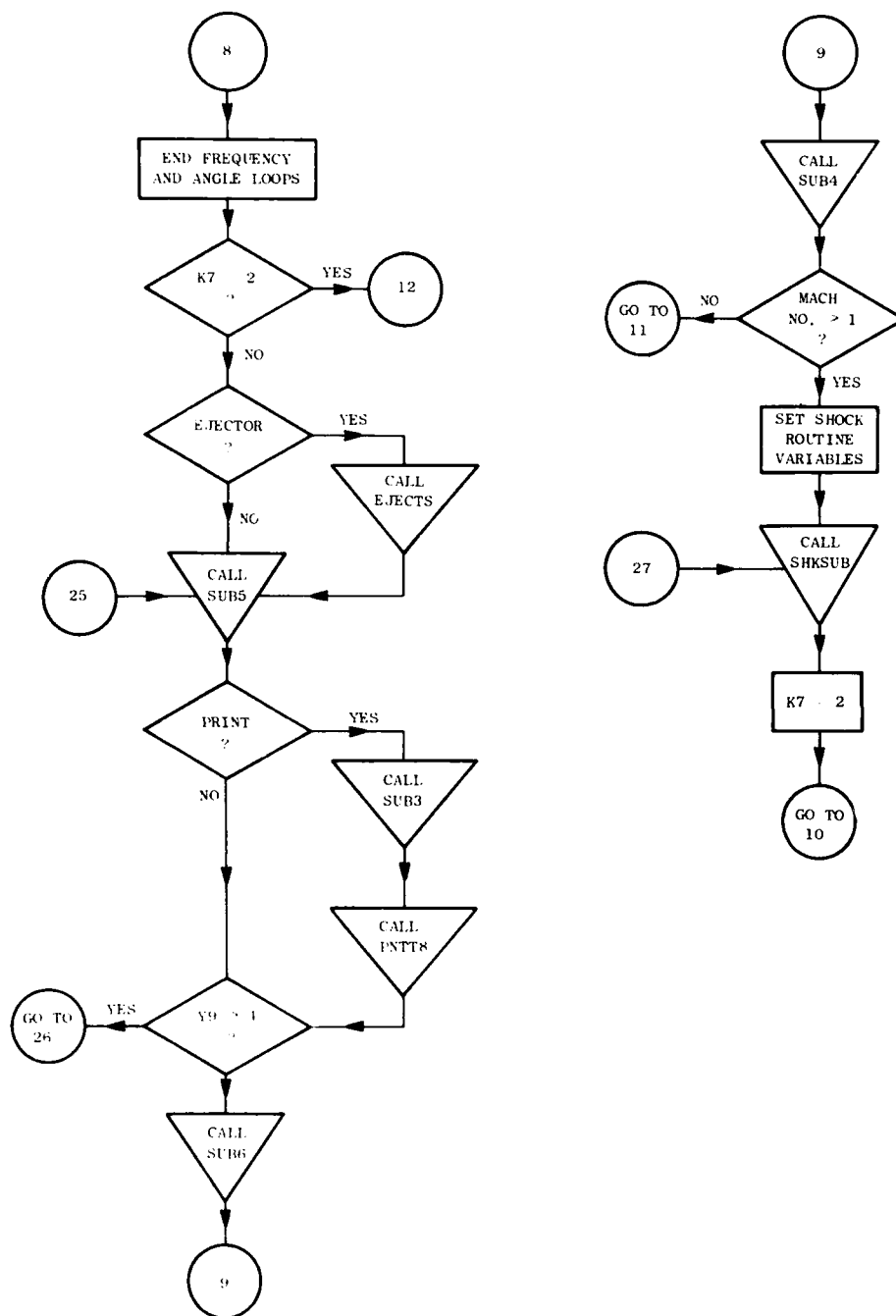


Figure 3-1. Computer Program Flow Chart (Continued).

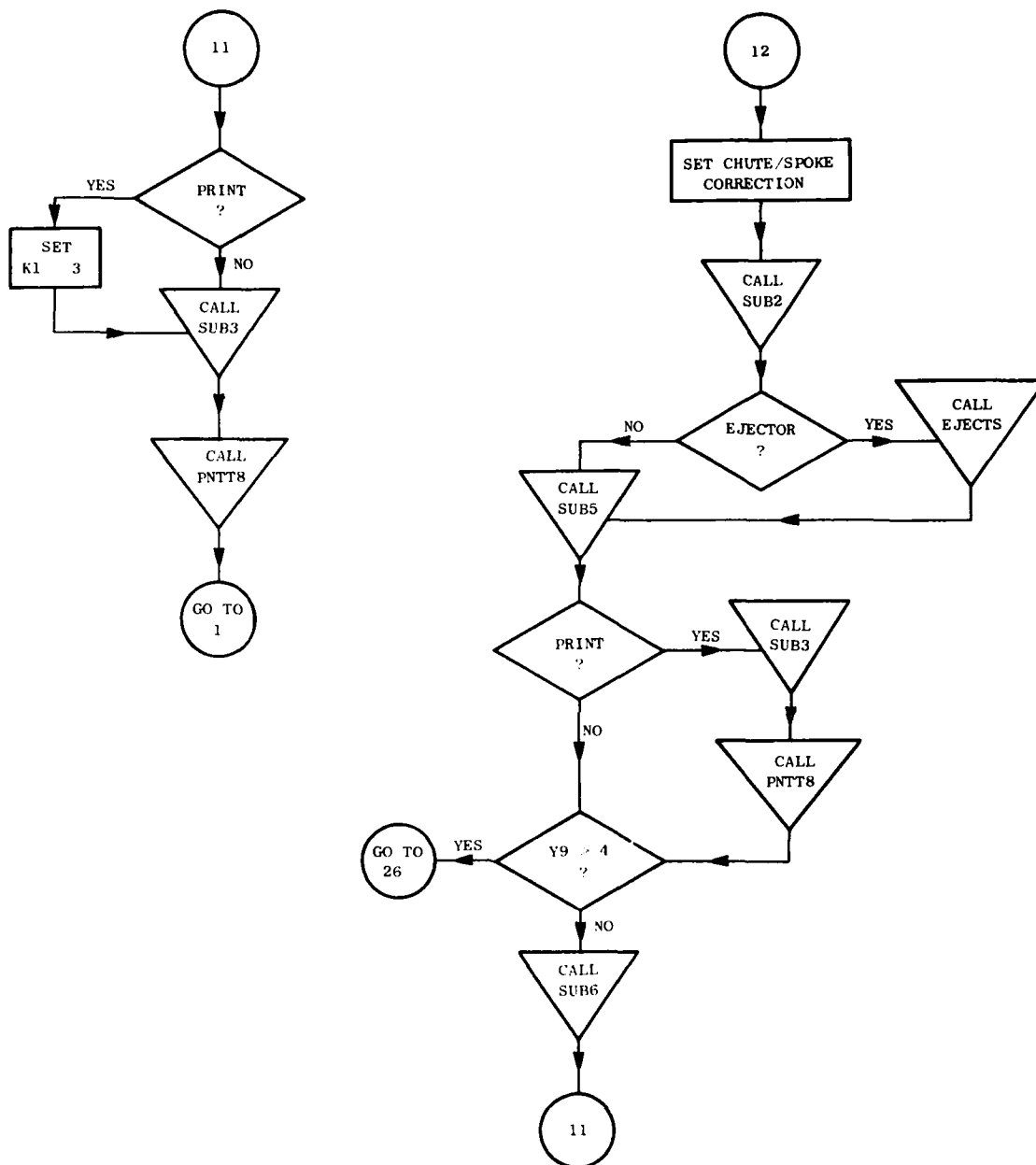


Figure 3-1. Computer Program Flow Chart (Continued).

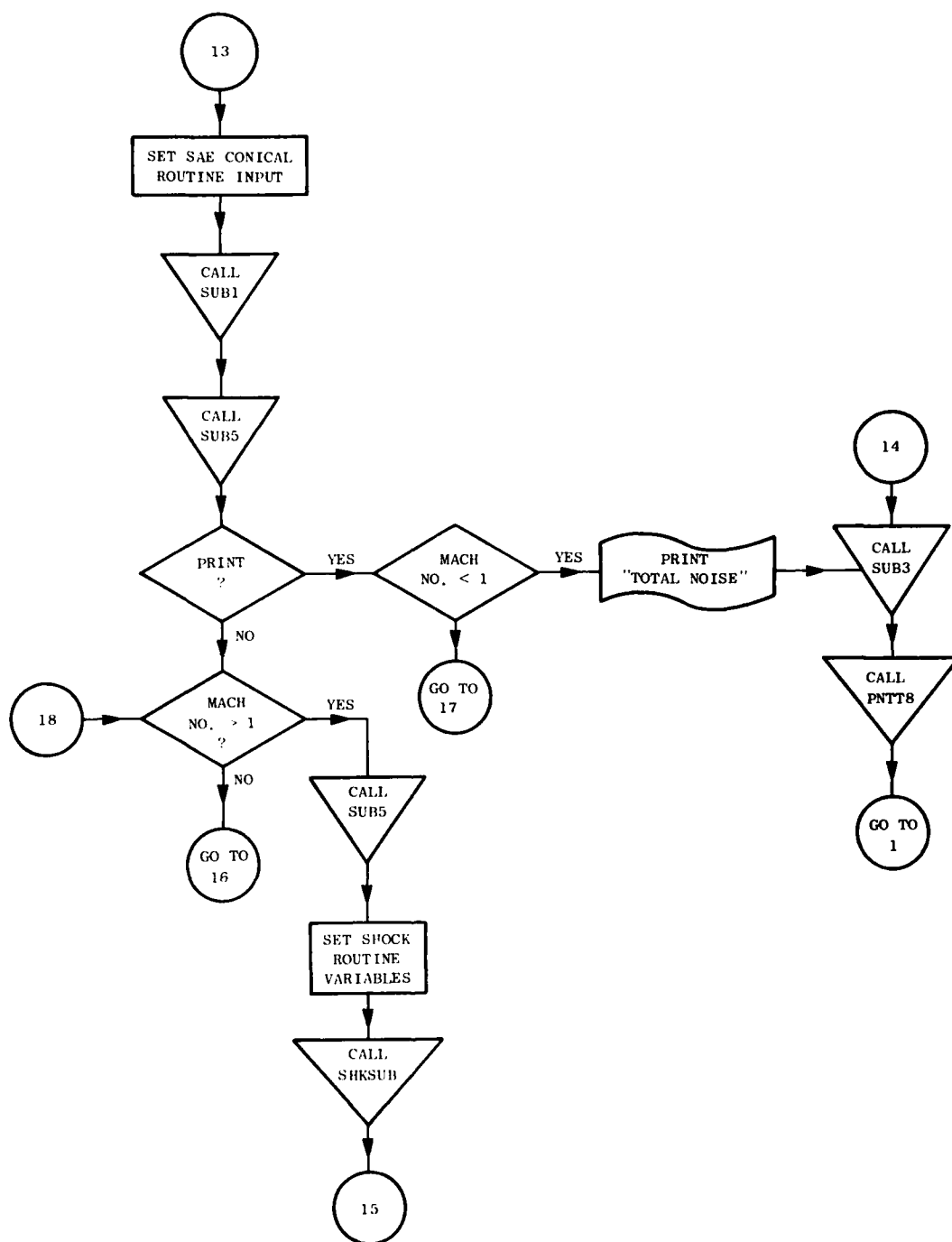


Figure 3-1. Computer Program Flow Chart (Continued).

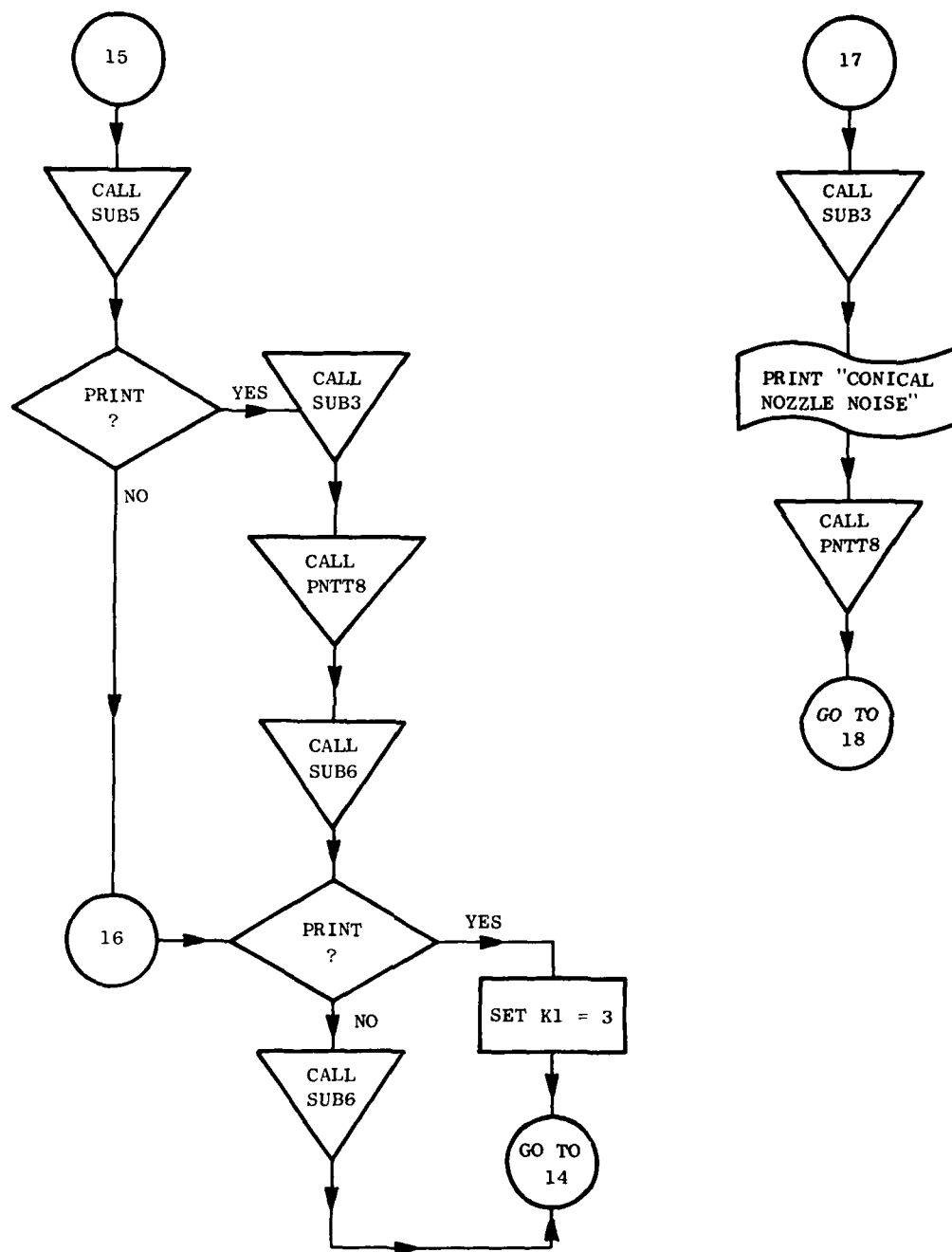


Figure 3-1. Computer Program Flow Chart (Continued).

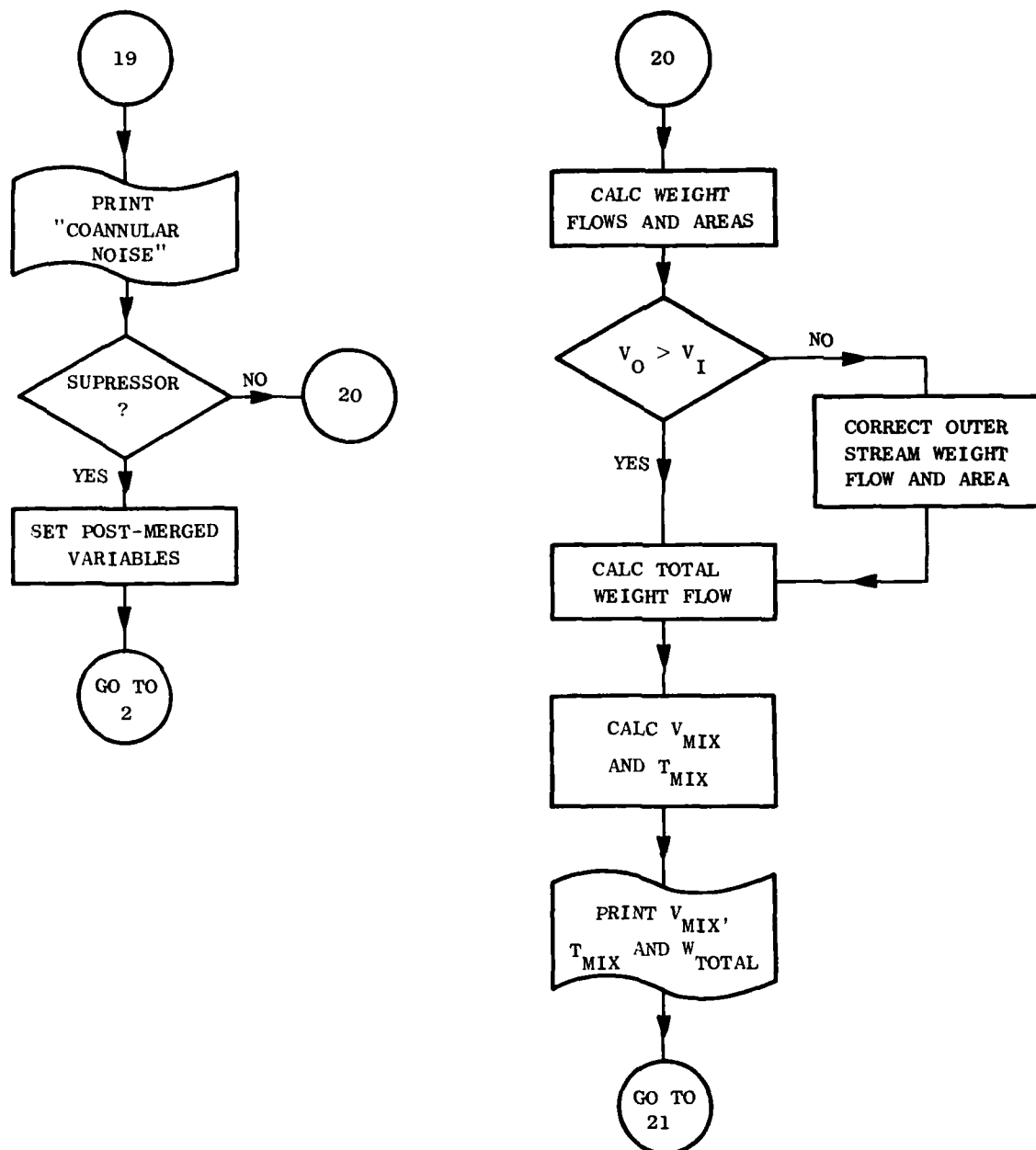


Figure 3-1. Computer Program Flow Chart (Continued).

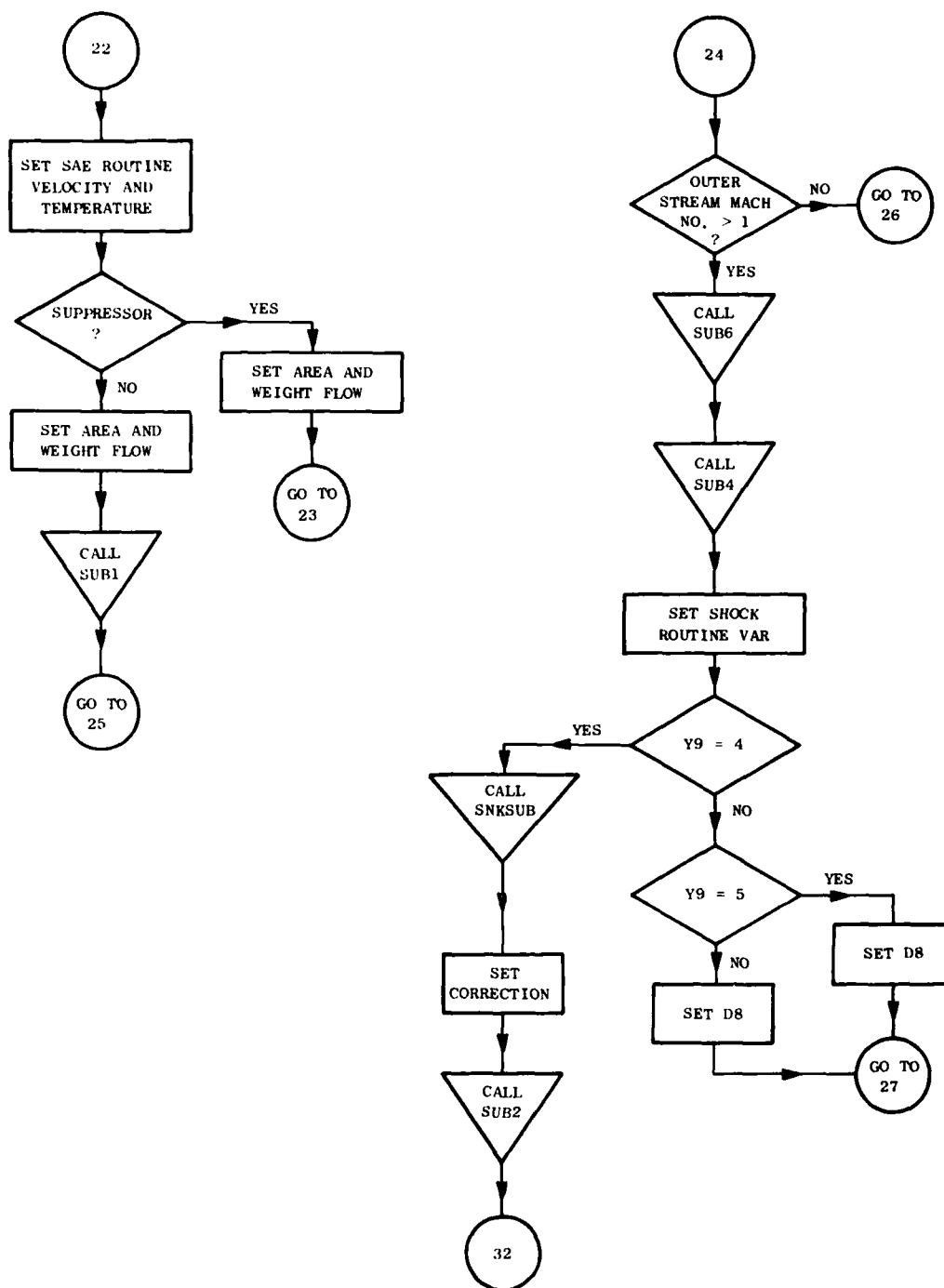


Figure 3-1. Computer Program Flow Chart (Continued).

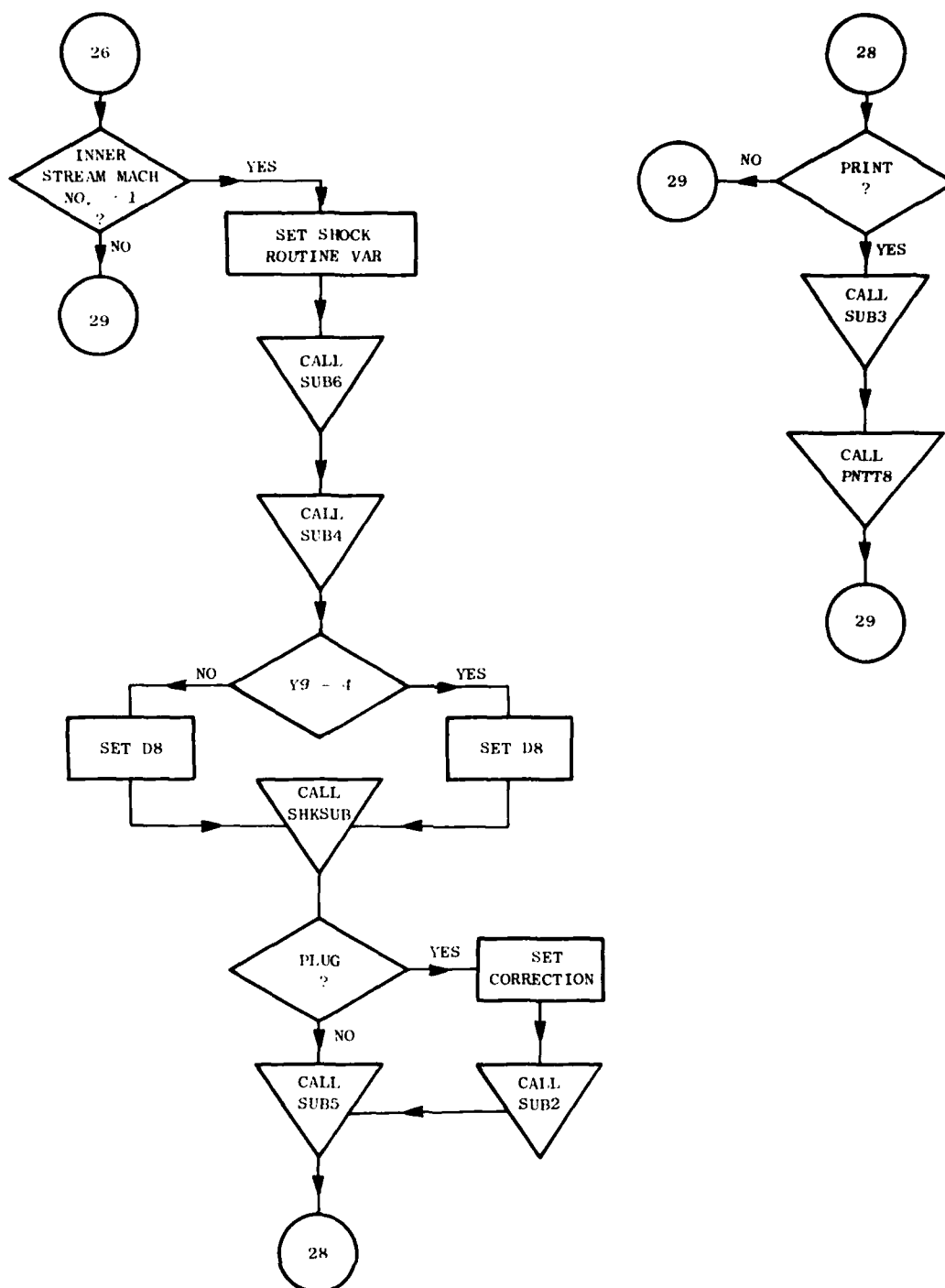


Figure 3-1. Computer Program Flow Chart (Continued).

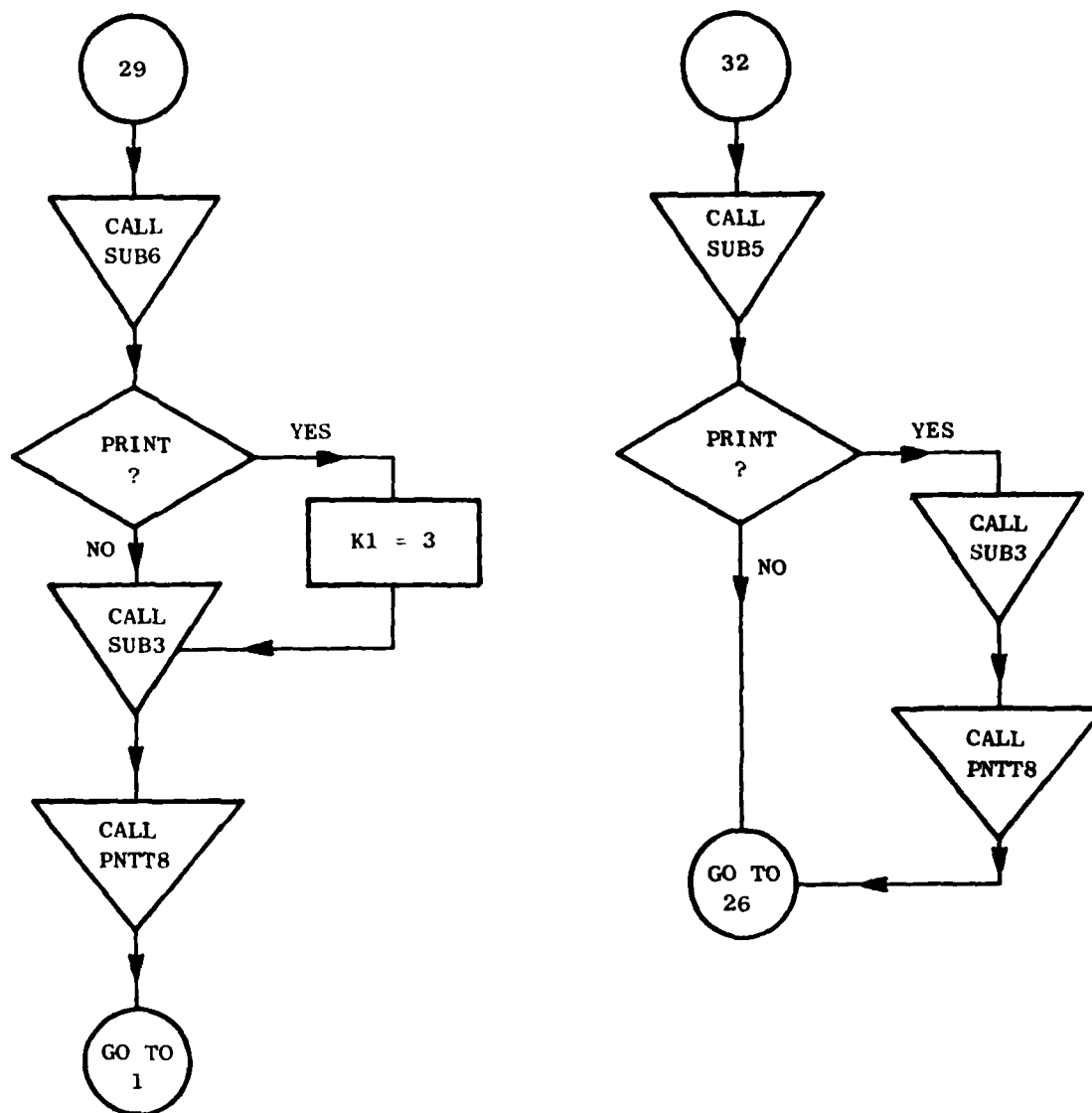


Figure 3-1. Computer Program Flowchart (Continued).

a) SUBROUTINE SUB1

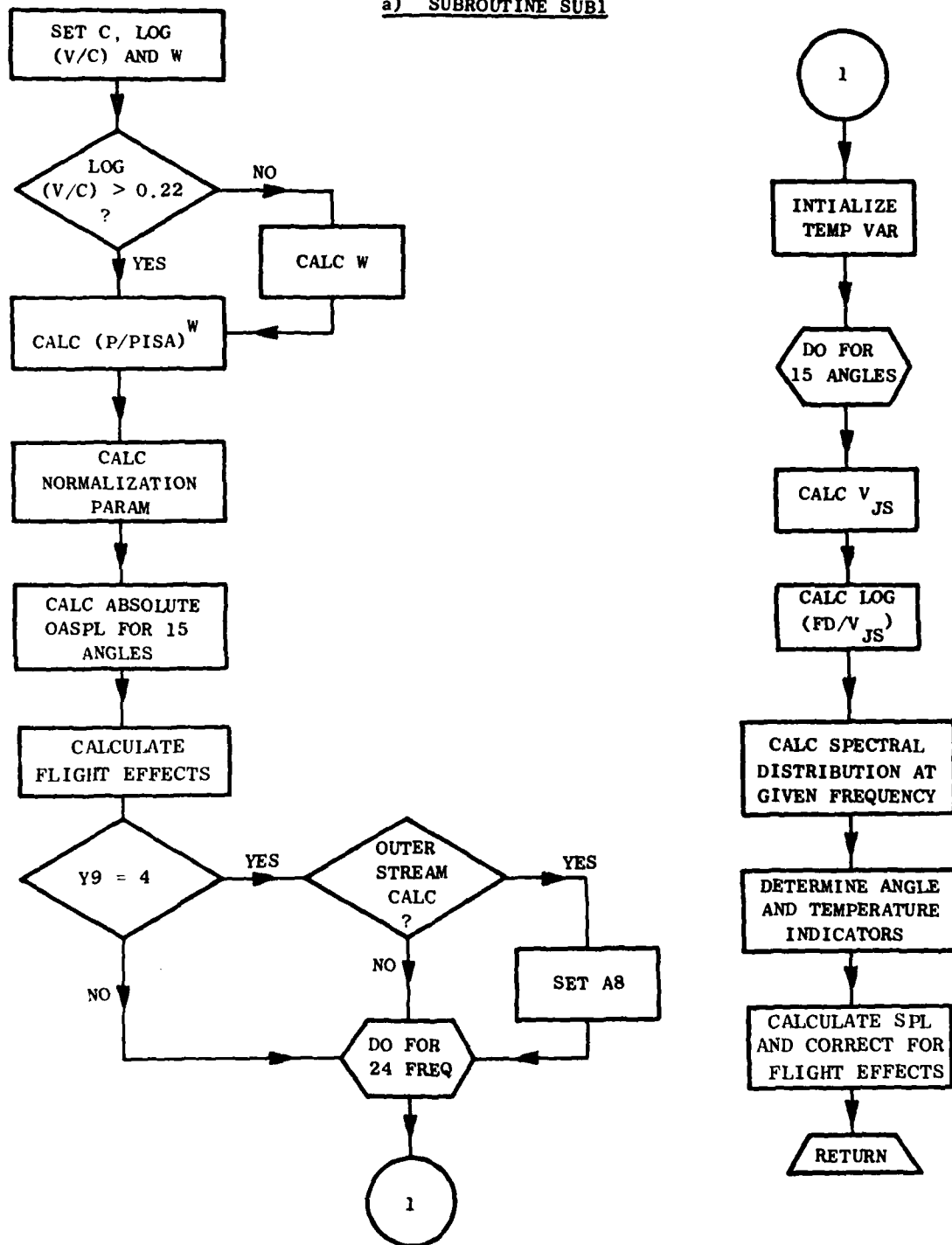


Figure 3-1. Computer Program Flow Chart (Continued).

b) SUBROUTINE SUB3

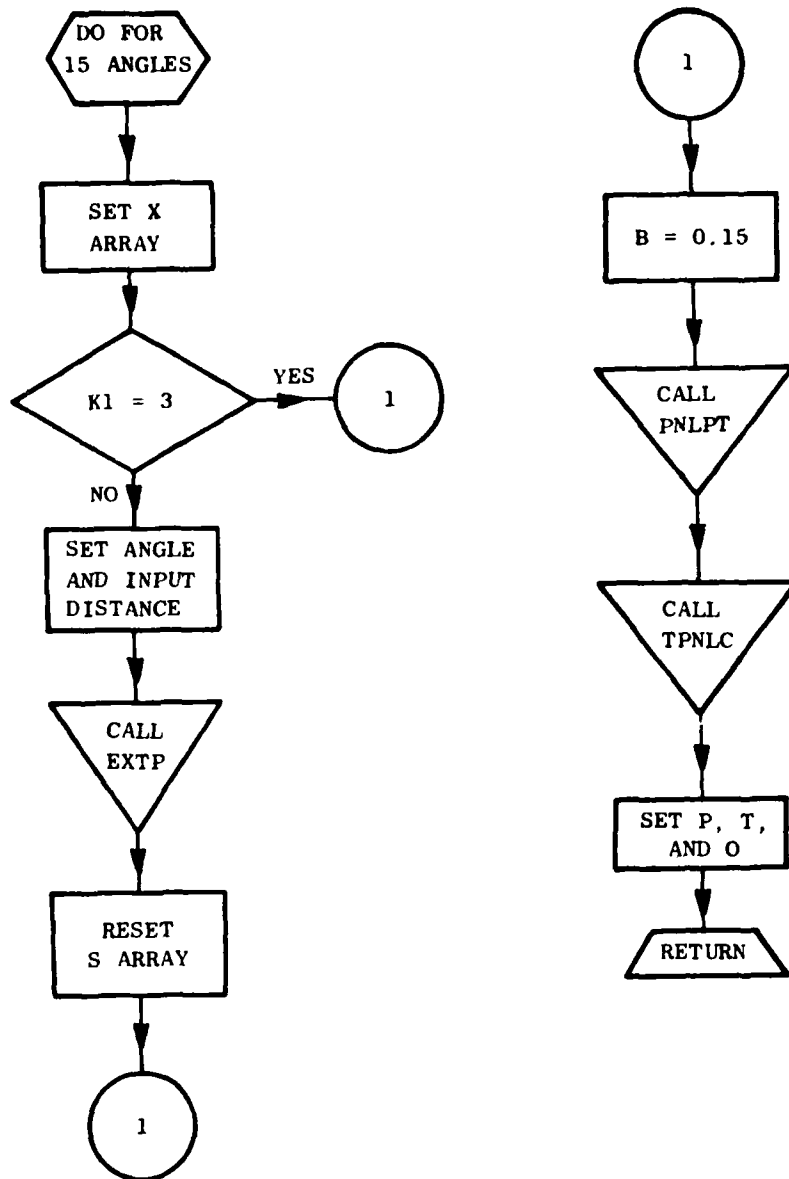


Figure 3-1. Computer Program Flowchart (Continued).

c) SUBROUTINE SUB5

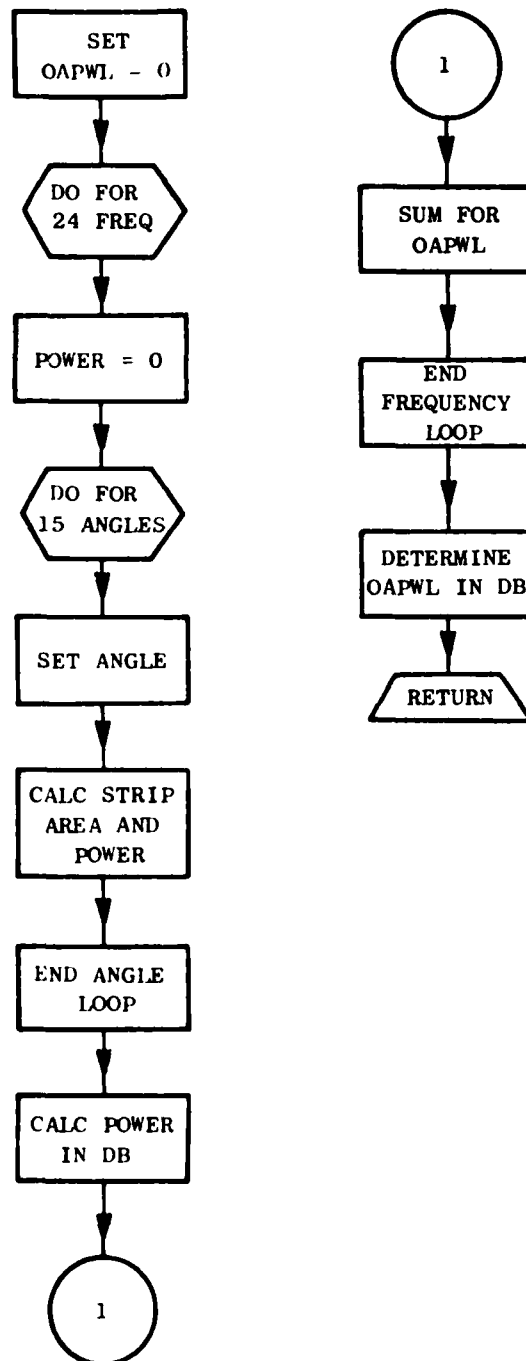
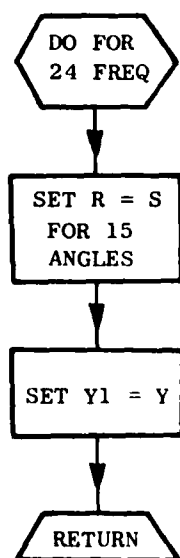


Figure 3-1. Computer Program Flowpath (Continued).

d) SUBROUTINE SUB4



e) SUBROUTINE SUB2

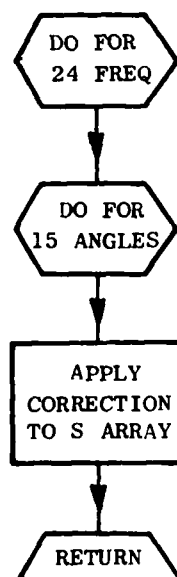


Figure 3-1. Computer Program
Flowchart (Continued).

1) SUBROUTINE SUB6

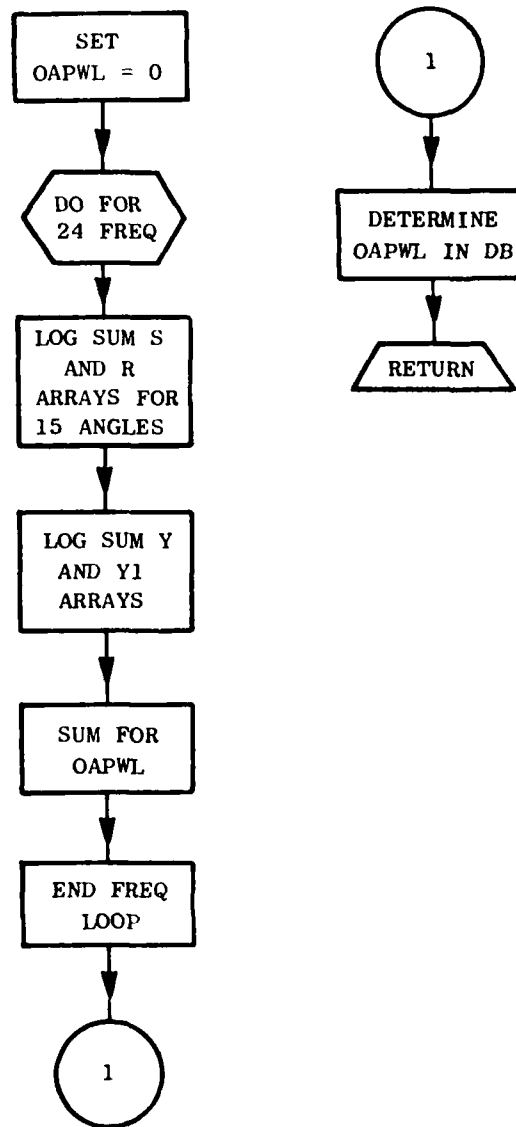


Figure 3-1. Computer Program
Flowchart (Continued).

g) SUBROUTINE EXTP

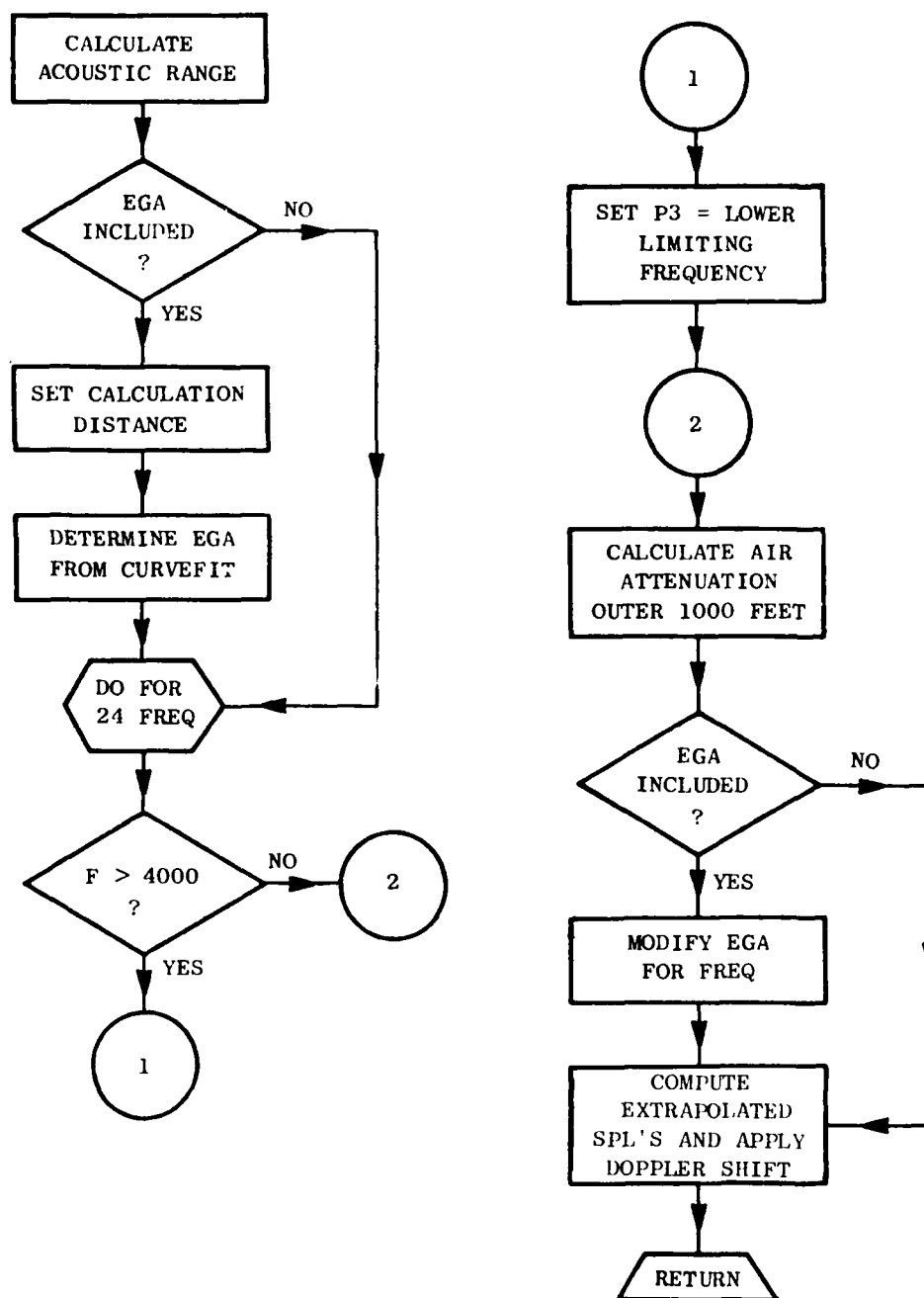


Figure 3-1. Computer Program Flowchart (Continued).

h) SUBROUTINE PNTT8

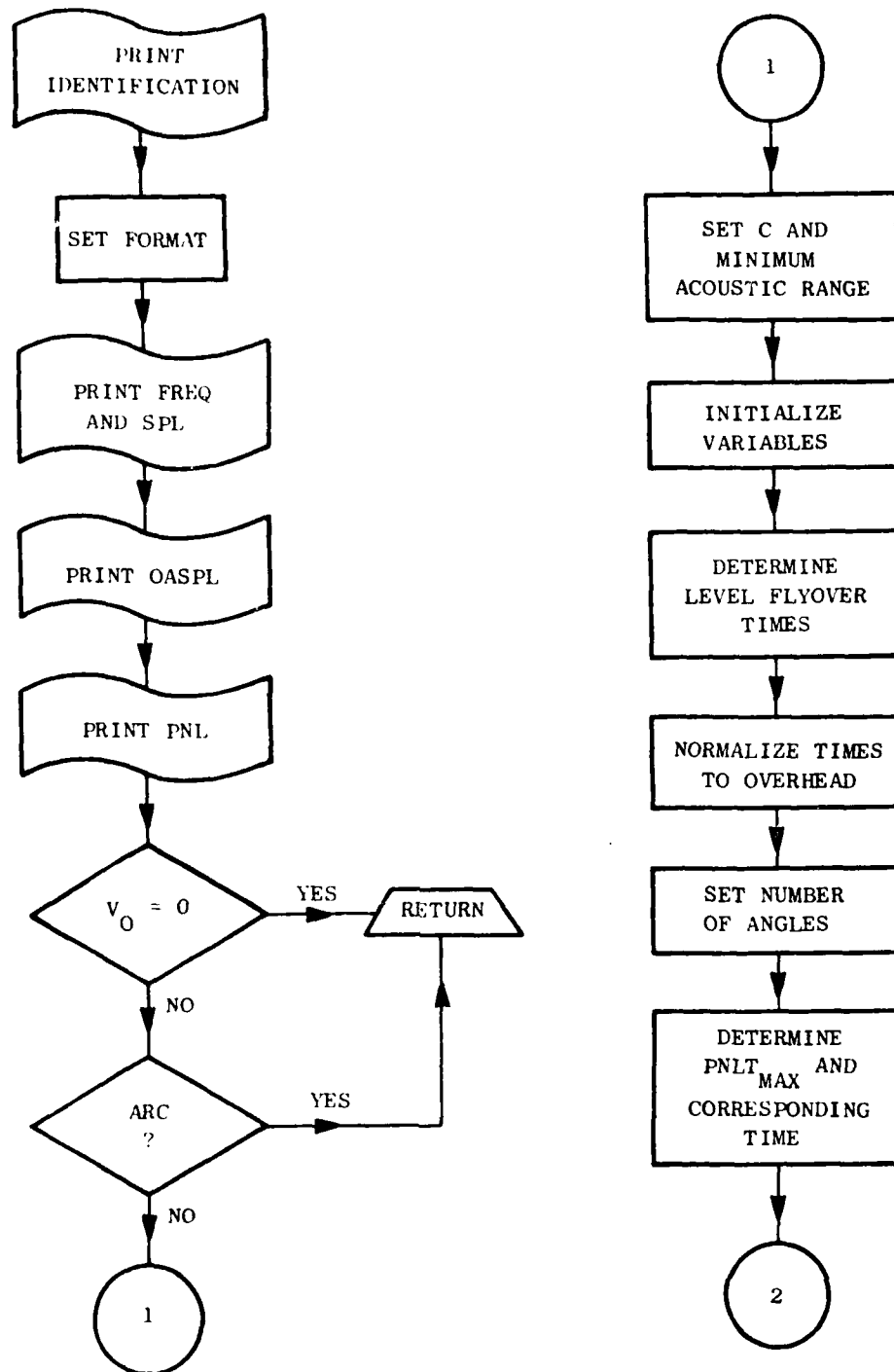


Figure 3-1. Computer Program Flowchart (Continued).

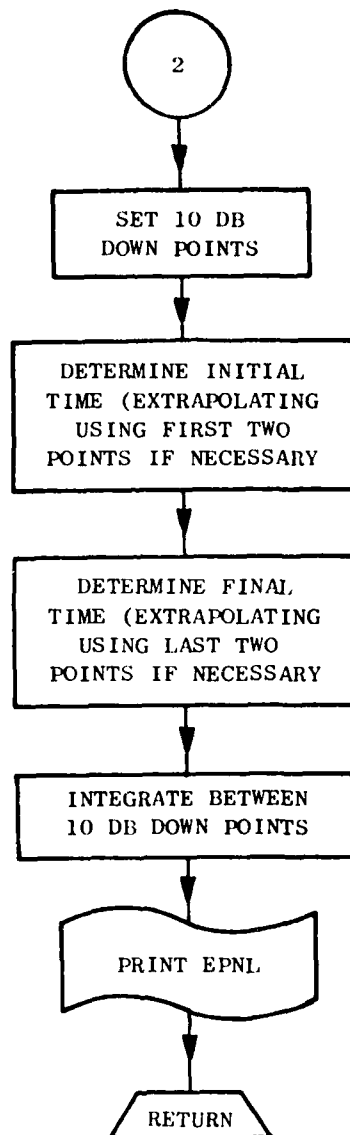


Figure 3-1. Computer Program Flowchart (Continued).

i) SUBROUTINE EJECTS

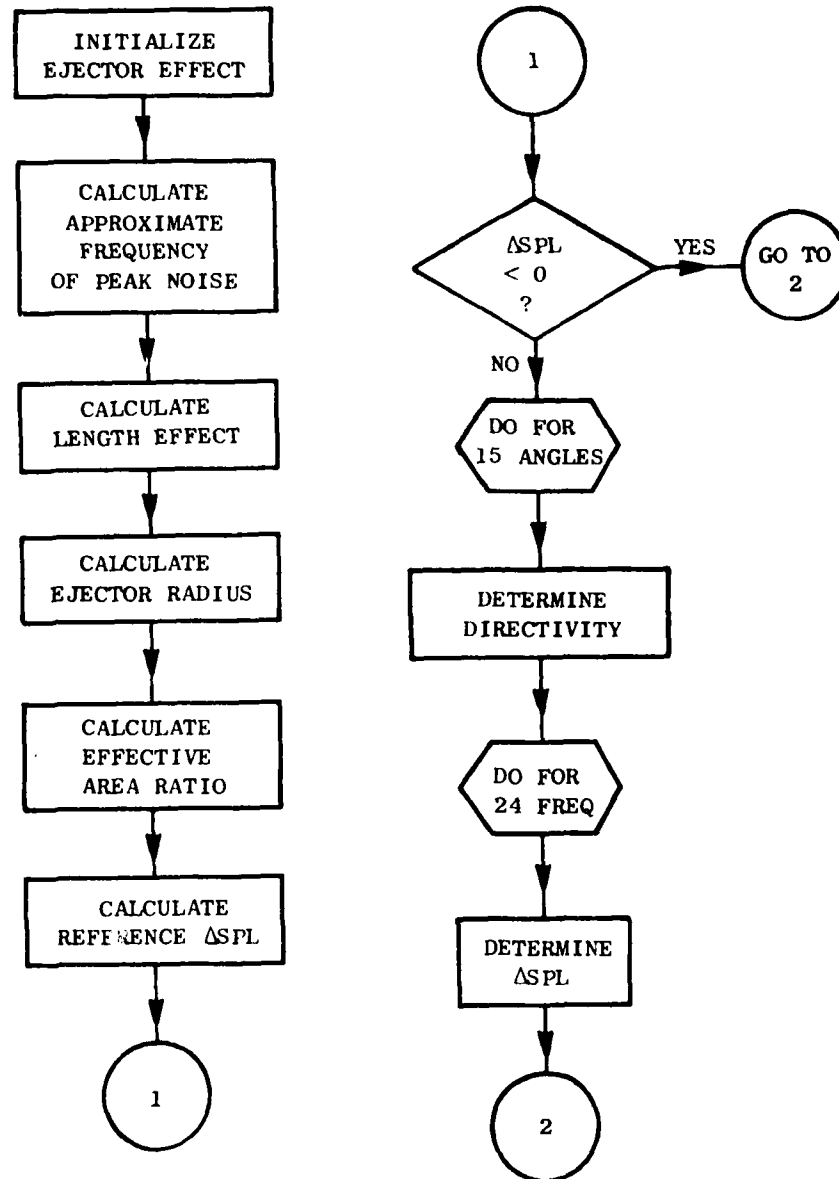


Figure 3-1. Computer Program Flowchart (Continued).

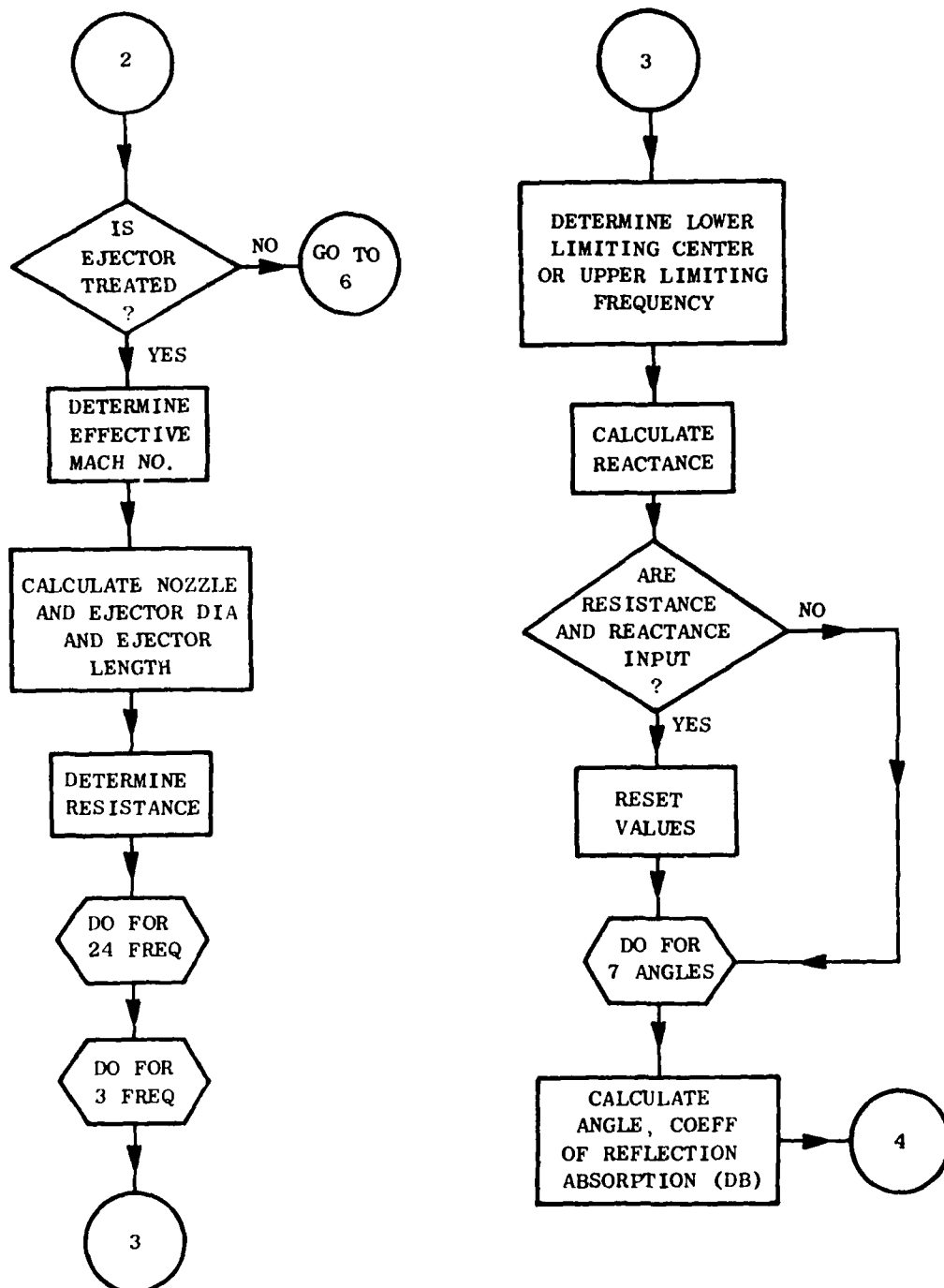
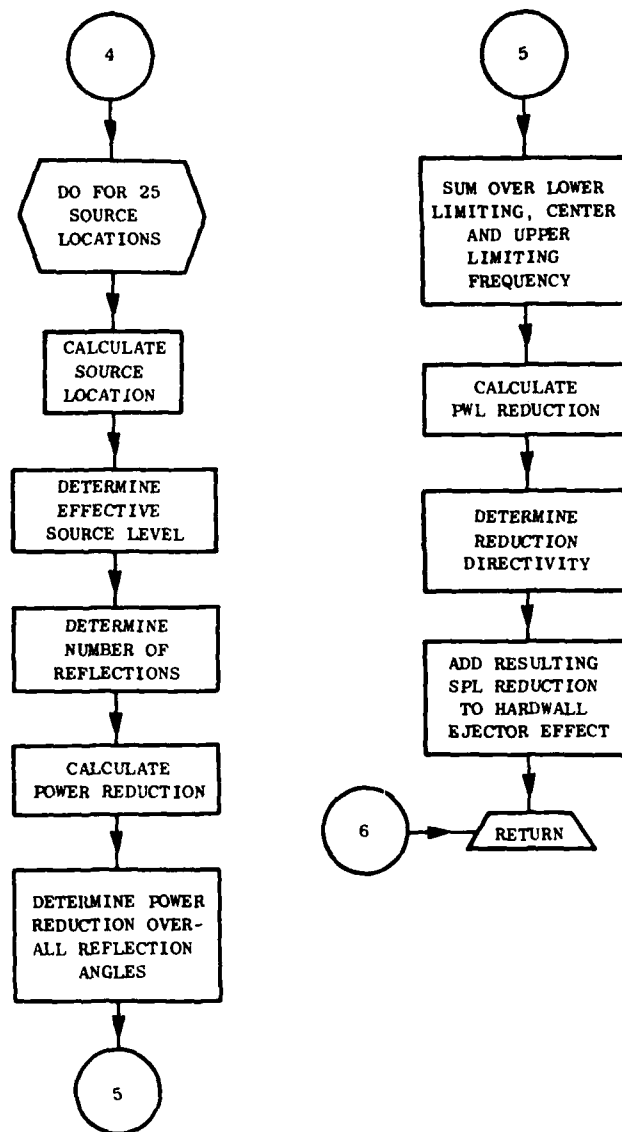


Figure 3-1. Computer Program Flowchart (Continued).



NO FLOW CHART IS SUPPLIED FOR THE FOLLOWING ROUTINES BECAUSE OF THE COMPLETE NATURE OF THEIR DOCUMENTATION IN PUBLISHED LITERATURE

- SHKSUB
- PNLPT
- TPNLC

Figure 3-1. Computer Program Flow Chart (Concluded).

temperature are determined, the input variables to the conical nozzle noise routine are set, the noise is calculated, and flight effects are applied if necessary. This component is then extrapolated and (if desired) printed.

The premerged noise is then calculated. The effective number of tubes and the critical angle are determined. Then the length of the potential core, X_c , the point of merging (used for cutoff only), and the radius ratio are determined. The axial location of the beginning of peak noise generation, X_p , and the critical frequency for absorption are calculated before entering the frequency loop to calculate source locations, absorption effects, and cutoff effects. These are then applied to all angles forward of critical with angles aft of critical set equal to critical angle SPL. Ejector effects are determined and applied before extrapolation and (if desired) printed. Shock-cell noise (if applicable) is determined after summing the premerged and postmerged components. It is then corrected for ejector effects and flight effects, whereupon multielement corrections are applied, extrapolated, printed, and added to the other components. The total is then extrapolated (if required) and printed, and a return is made for the next case.

The conical part of the routine calculates the conical mixing noise and shock noise, applies flight effects, extrapolates and prints them separately if desired, sums them, and prints the total; after which, a return is made for the next case.

The coannular part uses the premerged and postmerged routines of the multielement part if a suppressor is involved. Variables are set, and, if a suppressor is involved, the postmerged routine of the multielement part is entered to calculate merged flow conditions. Mixed conditions are then determined and the merged noise is calculated, extrapolated, and printed (if desired).

The premerged noise is now calculated in accordance with whether a suppressor is present or not. This component is extrapolated, printed if desired, and added to the postmerged. Outer-stream, shock-cell noise is determined, depending on whether a suppressor is present or not, extrapolated, printed (if desired), and added to the other components. Finally, the inner stream shock is computed, extrapolated, printed (if desired), and added to the other components. The total is then extrapolated as required, and printed; and control is returned for the next case.

SUB1 Subroutine - This subroutine provides SAE ARP 876 (1975 revision) conical nozzle noise predictions and determines and applies mixing noise flight effects. Use and limitations are as described in the aforementioned documents. Output from this routine is on a one-foot arc. Basically, polynomial curve fits of the data in SAE ARP 876 (1975 revision) were used. A correction was made to the predicted OASPL to increase the accuracy of the routine based on available data on suppressor nozzles. This correction amounts to +1 dB at all angles and frequencies.

SUB3 Subroutine - This routine resets the variables for input into the extrapolation and PNL calculation subroutines. It determines whether extrapolation is required and calls EXTP. PNLPT is called to determine PNL and OASPL. TPNLC is called from PNLPT to determine PNLT. The variables are then reset maintaining the newly calculated values.

SUB5 Subroutine - This routine calculates sound power level from sound pressure level for each one-third-octave band, and then antilogarithmically sums them to obtain the overall levels.

SUB4 Subroutine - This routine places previously calculated sound pressure level and sound power level in other variable name storage for future use in the program.

SUB2 Subroutine - This routine adds a constant value to the one-third-octave band SPL at all angles and frequencies.

SUB6 Subroutine - This routine antilogarithmically sums different SPL and PWL spectra to obtain a total spectra, and then sums the total PWL spectrum to obtain OAPWL.

EXTP Subroutine - This routine extrapolates an input spectrum to a desired acoustic range using the inverse-square law (spherical spreading), air attenuation per SAE ARP 866 (Reference 3), and, if desired, extra ground attenuation (EGA) per the routine presented in SAE AIR 923 (Reference 4). A curve fit of the 59° F, 70% relative humidity, standard-day-air attenuation is used, as well as curve fits for EGA. The routine automatically accounts for range changes from angle to angle on a sideline and includes the option of a 100-ft layer of EGA, full EGA, or no EGA as per SAE AIR 923.

SHKSUB Subroutine - This routine predicts shock-cell noise by the procedure defined in SAE ARP 876 (1976 proposed revision). Output from this routine is on a one-foot arc. The definition of D8 was varied to allow calculations for nonround nozzles. Shock-cell noise flight effects are determined and applied in this section.

PNLPT Subroutine - This routine sums the SPL in a given spectrum antilogarithmically to obtain OASPL and uses the procedure defined in SAE ARP 865A (Reference 31) to calculate PNL.

TPNLC Subroutine - This routine calculated tone-corrected PNL via Section B36.3 of the FAA Noise Certification Document (Nov. 17, 1969) as a function of the uncorrected one-third-octave spectrum SPL.

PNTT8 Subroutine - This routine sets the format and prints the noise output from the main program. It prints the identification of the noise output and one-third-octave band SPL and PWL for 24 frequencies and 15 angles (20° to 160° to the inlet) as well as OASPL, PNL, and PNLT for each angle.

The second part of the routine calculates EPNL (if required) according to the procedure described in FAR Part 36, using PNL rather than PNLT. Times associated with given acoustic angles for a level flyover (assuming the engine centerline is parallel to the ground) are determined first. Peak PNL,

the associated time, and the 10-dB down levels are determined. Initial and final times are then determined by linear interpolation (using, when necessary, extrapolation using the first or last two points). The PNL history is then integrated between the 10-dB down points by summing half-second increments (determined by linear interpolation) to obtain the duration correction. This is added to the maximum PNL to obtain EPNL; the EPNL is then printed. It should also be noted that the program automatically calculates an EPNL for static sideline cases assuming a 300 ft/sec flyover velocity.

EJECTS Subroutine - This routine first determines the effect of a hard-wall ejector of given geometry in terms of the reference SPL. Directivity and spectral effects are then determined. If no treatment is present in the ejector, control is returned to the main program. If treatment is present, an impedance prediction routine for SDOF treatment (single degree of freedom) is entered. The resistance and reactance of the treatment panel is determined; this yields a coefficient of absorption. The location of a given source and the strength relative to the peak are then calculated. The coefficient of absorption multiplied by the number of reflections for a given acoustic angle plus the relative source strength when summed over all sources yields an SPL reduction. This, when integrated over all angles, gives a sound power insertion loss. This reduction is log-averaged over the lower limiting, center, and upper limiting frequencies for the given one-third-octave band. The sound power insertion loss is then converted into a delta SPL for each acoustic angle and added to the hard-wall effect. Control is then returned to the main program.

3.4 INPUT DESCRIPTION

The input data are supplied through NAMELIST input format. Any number of successive cases can be run consecutively, limited only by the users execution time available. Each successive case requires only the INPUT NAMELIST. The data from preceding cases remain in storage; thus, only those variables which are to be changed from the preceding case input value need be included in the INPUT file of succeeding cases.

The input format is given in Table 3-3. The definitions of each of the input variables given in Table A-3 are given in Table 3-4. All variables are preset to zero before the first-case input is read. Only the input variables listed under a nozzle type in Table 3-3 need be input for any case. Notes on the input follow the tables. Further descriptions of input variables are given in Figures 3-2 and 3-3.

3.4.1 Notes on Input

1. The ALT variable is used as the main distance indicator; therefore, for ground static arc or sideline cases the distance of interest is input through this variable, and the SL variable is set to zero. In flyover cases, ALT is used as the altitude indicator, and SL is used as the sideline distance.

2. EGA is "Extra Ground Attenuation" as defined in SAE AIR 923 "Method for Calculating the Attenuation of Aircraft Ground to Ground Noise Propagation During Takeoff and Landing." The "100-ft layer" is defined in Figure 3 of the above-mentioned document.

3. Major nozzle dimensions are input in feet; element or ejector-treatment dimensions are input in inches. This alleviates inputting very small numbers (i.e., 0.1 inch versus 0.0083 foot).

4. Cant angles for multitube and multichute/spoke nozzles are defined in Figure 3-4.

5. The "A" variables are input as 10 if treatment other than SDOF is used. In this case RR and RX must be input.

6. The specific resistances and reactances of the treatment used in the ejector are input through the RR and RX variables. Values at the lower limiting, upper limiting, and midpoint frequencies are used. For ease of input, the program assumes the value at the upper limiting frequency of one one-third-octave band to be equal to the value at the lower limiting frequency of the next highest band. Therefore, only 49 values must be input.

3.5 OUTPUT DESCRIPTION

The output format is generally self-explanatory. The input is printed out using the nomenclature defined in Table 3-5. Output flow conditions follow. Finally, SPL and PWL spectra, OASPL, OAPWL, PNL, PNLT, and EPNL are printed as required.

A warning flag is built into the iterations for gamma and merged velocity. The flag message for either iteration is: DID NOT CONVERGE; and when it appears the run terminates. Gross input errors have been the only cause of this message encountered in the development of the program.

At the beginning of each run, an unlimited number of cards can be input for the run identification. (A case identification card is available before each case also). The format for each card is:

60 - Character Title Card, Columns 1-60

To enter the case section of the input the following card is required:

CASES (Starting in Column 2)

The run or case identification cards may be omitted but the "CASES" card must be present. The case identification is saved and will be printed on succeeding cases unless another case identification card is read.

Table 3-3. Input Format.

(FOR CONICAL NOZZLES)

Column

2



(60-Character Identification Card, Columns 1-60)

\$ INPUT Y9 = 1,

P9 = _____, TT3 = _____, A9 = _____,

K9 = _____, ALT = _____, SL = _____,

U = _____, E9 = _____, VO = _____, NFLT = _____,

\$

Table 3-3. Input Format (Continued).

(FOR SINGLE-FLOW, MULTITUBE NOZZLES)

Column

2



(60-Character Identification Card, Columns 1-60)

\$ INPUT Y9 = 2,

N = _____, RP = _____, B9 = _____,

DT = _____, A7 = _____, Z5 = _____,

S1J = _____, TT3 = _____, P9 = _____,

K9 = _____, ALT = _____, SL = _____,

U = _____, E9 = _____, V0 = _____,

A6 = _____, L9 = _____, NFLT = _____,

A = _____, _____, _____, _____,

Table 3-3. Input Format (Continued).

Column

2



RR = _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,

RX = _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,
 _____, _____, _____, _____, _____, _____, _____,

\$

Table 3-3. Input Format (Continued).

(FOR SINGLE-FLOW, MULTICHUTE/SPOKE NOZZLES)

Column

2



(60-Character Identification Card, Columns 1-60)

\$ INPUT Y9 = 3,

N = _____, RP = _____, B9 = _____,

R4 = _____, R6 = _____, SS = _____, A7 = _____,

TT3 = _____, P9 = _____, NFLT = _____,

K9 = _____, ALT = _____, SL = _____, U = _____,

E9 = _____, VO = _____, A6 = _____, L9 = _____,

A = _____, _____, _____, _____,

RR and RX as per the multitube nozzle case.

\$

Table 3-3. Input Format (Continued).

(FOR DUAL-FLOW NOZZLES WITH MULTITUBE
SUPPRESSORS ON THE OUTER STREAM)

Column

2



(60-Character Identification Card, Columns 1-60)

\$ INPUT Y9 = 5,

RP = _____, DN = _____, AA8 = _____, A9 = _____,

TT4 = _____, P4 = _____, TT5 = _____, P5 = _____,

N = _____, DT = _____, A7 = _____, B9 = _____,

Z5 = _____, S1J = _____, NFLT = _____,

K9 = _____, ALT = _____, SL = _____, U = _____,

E9 = _____, VO = _____, A6 = _____, L9 = _____,

A = _____, _____, _____, _____,

RR and RX as per multitube case.

\$

Table 3-3. Input Format (Concluded).

(FOR DUAL-FLOW NOZZLES WITH MULTICHUTE/SPOKE
SUPPRESSOR ON THE OUTER STREAM)

Column

2



(60-Character Identification Card, Columns 1-60)

\$ INPUT Y9 = 6,

RP = _____, DN = _____, AA8 = _____, A9 = _____,

TT4 = _____, P4 = _____, TT5 = _____, P5 = _____,

N = _____, B9 = _____, NFLT = _____,

R4 = _____, R6 = _____, SS = _____, A7 = _____,

K9 = _____, ALT = _____, SL = _____, U = _____,

E9 = _____, VO = _____, A6 = _____, L9 = _____,

A = _____, _____, _____, _____,

RR and RX as per multitube case.

\$

Table 3-4. Input Variable Descriptions.

(FOR CONICAL NOZZLES)

Variable	Note	Description
P9		Nozzle Total to Ambient Pressure Ratio
TT3		Nozzle Exit Total Temperature, ° R
A9		Nozzle Exit Flow Area, ft ²
K9		Print Indicator: 0 = Total Nozzle Noise Only 1 = Nozzle Component and Total Noise
ALT	1	Altitude, Ground Sideline, or Arc Distance at which Prediction is to be made, ft
SL	1	Sideline Distance at Which Prediction is to be made, ft (Used for Flyover Cases Only)
U		Arc or Sideline Indicator 1 = Predictions to be made on an Arc 2 = Predictions to be made on a Sideline (or Flyover)
E9	2	EGA Indicator 0 = No EGA 1 = Full EGA 2 = 100-ft Layer of EGA
VO		Aircraft Flight Velocity
NFLT		Flight Effects Indicator 1 = "Free Jet" 2 = "True Flight"

Table 3-4. Input Variable Descriptions (Continued).

(FOR SINGLE-FLOW, MULTITUBE NOZZLES)

Variable	Note	Description
N		Number of Tubes
RP	3	Centerbody Plug Radius, ft
B9	4	Tube Centerline Cant Angle, degrees
DT	3	Tube Diameter, in.
A7		Nozzle Area Ratio
Z5		Number of Rows of Tubes Counting Center Tube (if Present) as zero
SLJ		Tube Centerline Spacing to Tube Diameter Ratio
TT3, P9, K9, ALT, SL, U, E9, VO		Same as Conical Nozzle
A6		Ratio of Ejector Inlet Area to Nozzle Total (or Annulus) Area (Input Zero for no Ejector)
L9		Ratio of Ejector Length to Suppressor Nozzle Equivalent Diameter
A(1)	3,5	Ejector Treatment Faceplate Thickness, in.
A(2)	3,5	Ejector Treatment Hole Diameter, in.
A(3)	3,5	Ejector Treatment Cavity Depth, in.
A(4)	3,5	Ejector Treatment Open Area Ratio
RR	6	Ejector Treatment Specific Resistance, Rayls (49 Values Required)
RX	6	Ejector Treatment Specific Reactance, Rayls (49 Values Required)

Table 3-4. Input Variable Descriptions (Continued).

(FOR SINGLE-FLOW, MULTICHUTE/SPOKE NOZZLES)

Variable	Note	Description
N		Number of Elements
RP	3	Centerbody Plug Radius, ft
B9	4	Chute/Spoke Exit Cant Angle, degrees
R4		Outer Circumferential Flow Dimension, in.
R6		Inner Circumferential Flow Dimension, in.
SS		Outer Circumferential Element Dimension, in.
A7		Nozzle Area Ratio
TT3, P9, K9, ALT, SL, V, E9, VO,		Same as Conical Nozzle
A6, L9, A, RR, RX		Same as Multitube Nozzle

Table 3-4. Input Variable Descriptions (Continued).

(FOR DUAL-FLOW NOZZLES WITH A MULTITUBE
SUPPRESSOR ON THE OUTER STREAM)

Variable	Note	Description
RP		Centerbody Plug Radius, ft
DN		Nozzle Outer Diameter, ft
AA8		Inner Nozzle Flow Area, ft ²
A9		Outer Nozzle Flow Area, ft ²
TT4		Inner Nozzle Exit Total Temperature, ° R
P4		Inner Nozzle Total to Ambient Pressure Ratio
TT5		Outer Nozzle Exit Total Temperature, ° R
P5		Outer Nozzle Total to Ambient Pressure Ratio
N, DT, A7, B9, Z5, S1J, A6, L9, A, RR, RX		Same as Multitube Nozzle
K9, ALT, SL, U, E9, VO		Same as Conical Nozzle

Table 3-4. Input Variable Descriptions (Concluded).

(FOR DUAL-FLOW NOZZLES WITH MULTICHUTE/SPOKE
SUPPRESSORS ON THE OUTER STREAM)

Variable	Note	Description
RP, DN, AA8, A9, TT4, P4, TT5, P5		Same as Dual-Flow/Multitube
N, B9, R4, R6, SS, A7		Same as Multichute/Spoke
K9, ALT, SL, U, E9, VO		Same as Conical
A6, L9, A, RR, RX		Same as Multitube

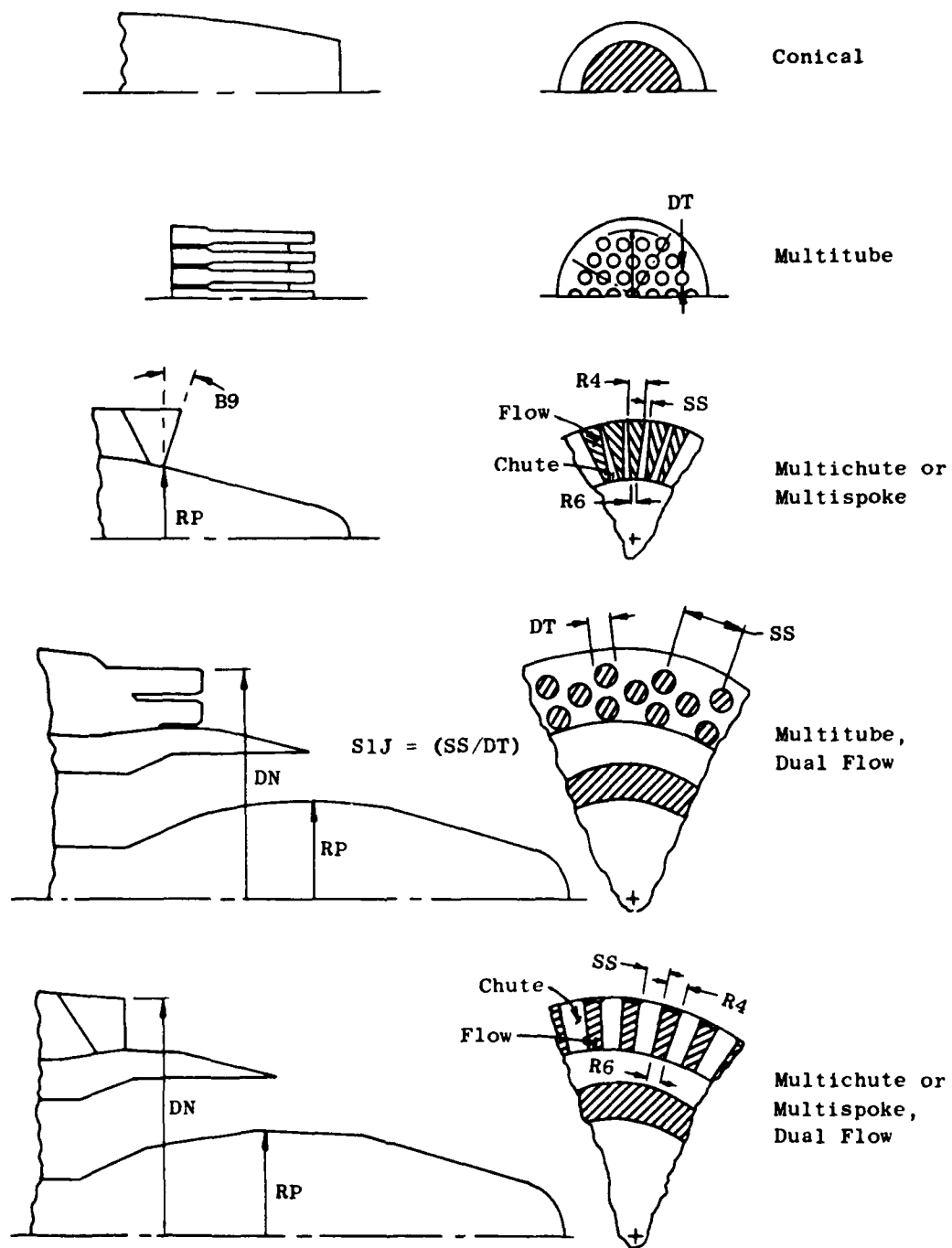


Figure 3-2. Nozzle Types Included in the Correlation.

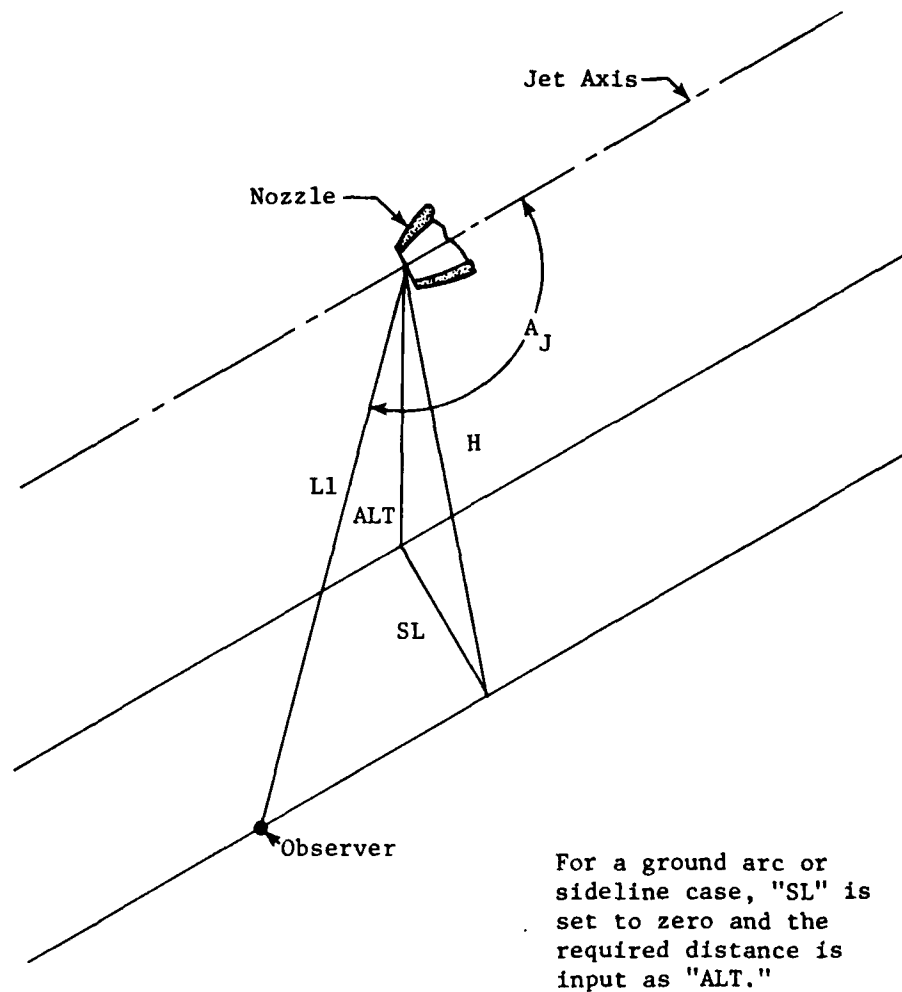
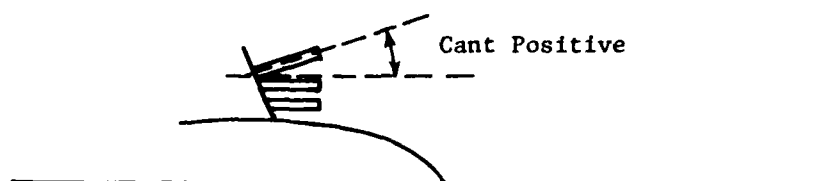


Figure 3-3. FORTRAN Symbol Convention for Acoustic Arena Variables.

Multitube Nozzles



Multichute/Spoke Nozzles

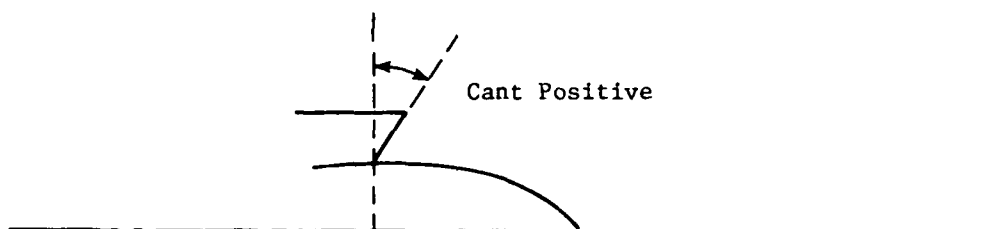


Figure 3-4. Definition of Cant Angles for Multielement Nozzles.

Table 3-5. Output Symbol Descriptions.

Symbol	Description
ARD	Suppressor Nozzle Area Ratio
AT	Area of an Individual Flow Element
A5	Merged Flow Area
A6	Mixed Flow Area
A8	Inner Nozzle Flow Area
A28	Outer Nozzle Flow Area
DUCT H	Outer Nozzle Duct Height
D5	Diameter of the Merged Flow Stream
P0	Ambient Pressure
PT8/P0	Inner Nozzle Pressure Ratio
PT28/P0	Outer Nozzle Pressure Ratio
RH05	Density of the Merged Stream
RH08	Density of the Inner Stream
RH028	Density of the Outer Stream
T0	Ambient Temperature
TT5	Total Temperature of the Merged Stream
TT6	Total Temperature of the Mixed Stream
TT8	Total Temperature of the Inner Stream
TT28	Total Temperature of the Outer Stream
U5	Fully Expanded Merged Velocity
U6	Fully Expanded Mixed Velocity
U8	Fully Expanded Inner Stream Velocity
U28	Fully Expanded Outer Stream Velocity
W6	Mixed Stream Weight Flow
PWL	Sound Power Level, dB re: 10^{-13} watts
OASPL	Overall Sound Pressure Level re: 2 dynes/m ²
OAPWL	Overall PWL
PNL	Perceived Noise Level, PNdB
PNLT	Tone-Corrected PNL, PNdB
EPNL	Static Effective Perceived Noise Level, EPNdB

3.6 SAMPLE CASES

Example cases for a conical nozzle with and without EGA, a dual-flow nozzle with a multitube suppressor and a treated ejector, and a dual-flow nozzle with a multichute suppressor are given. The input data cards are listed in Table 3-6 as per the format given in Table 3-3.

Table 3-6. Input Data Card Listing Sample Case.

```
AR SIECKMAN      TASK 3 HIGH VELOCITY JET NOISE PROGRAM
GENERAL ELECTRIC CO. BLDG 300 RIN 79 M.D. H77 X2261
MS -- ENGINEERING CORRELATION MODEL -- CDC VERSION

CASES
CONICAL NOZZLE CHECK CASE
$INPUT Y9#1,
P9#3.247, TT3#1380, A9#2.346, RP#0, K9#1,
ALT#2400, U#2, F9#0, V0#350, A6#0, L9#0, A#4*0,
$
$INPUT E9#2$
DUAL FLOW MULTI-TUBE CHECK CASE
$INPUT Y9#5,
RP#1.423, DN#6.687, AAR#7.649, A9#5.0A3, TT4#1010,
P4#1.567, TT5#1632, P5#3.278, K9#1, N#69,
DT#3.672, A7#2.75, R9#0, Z5#3,
SIJ#2.818, ALT#320, U#1, E9#0, V0#0,
A6#0, L9#0, A#4*0,
A6#1.303, L9#3.952, A#4*10,
RR#49*0.311,
RX#-87.135, -77.549, -69.239, -61.153, -54.949, -48.463,
-43.269, -38.767, -34.611, -31.008, -27.683, -24.219, -21.620,
-19.367, -17.287, -15.484, -13.819, -12.277, -10.954, -9.652, -8.608,
-7.702, -6.864, -6.088, -5.370, -4.762, -4.232, -3.771, -3.342,
-2.968, -2.619, -2.251, -1.970, -1.722, -1.487, -1.278, -1.077, -.882,
-.704, -.515, -.347, -.185, -.010, .185, .401, .703, 1.1, 1.794, 4.097,
$
DUAL FLOW MULTI-CHUTE CHECK CASE
$INPUT Y9#6,
RP#.624, DN#2.671, AAR#.811, A9#1.555, TT4#1470,
P4#1.490, TT5#1750, P5#3.97, K9#0, N#20,
B9#0, R4#2.874, R6#2.060, SS#2.155,
A7#1.75, ALT#2400, U#2, E9#0, V0#350,
A6#0, L9#0, A#4*0,
$
```

NOTE: The symbol # indicates an equal sign (=).

```

      XX      XX      XXXXXX
      XXX      XXX      XXXXXX
      XXXX     XXXX      XX
      XX XXXX XX      XX
      XX XX XX      XXXXXX
      XX      XX      XXXXXX
      XX      XX      XX
      XX      XX      XX
      XX      XX      XXXXXX
      XX      XX      XXXXXX

```

```

      XXXXX X      X      XXXXX XXXXXX XXXXXX X      X
      X      X X X      X      X      X XX XX
      XXX      XX      XXX      X      X      X XX X
      XXX      X      XXX      X      XXXX      X      X
      X      X      X      X      X      X      X
      XXXXX      X      XXXXX      X      XXXXXX X      X

```

HIGH VELOCITY JET NOISE PROGRAM(CONTRACT DOT-OS.30034)
 TASK 3 -- ENGINEERING CORRELATION

AR DIECKMAN TASK 3 HIGH VELOCITY JET NOISE PROGRAM
 GENERAL ELECTRIC CO. BLDG 300 RIN 79 M.D. H77 X2261
 MS -- ENGINEERING CORRELATION MODEL -- CDC VERSION

HIGH VELOCITY JET NOISE PROGRAM - ENGINEERING CORRELATION

CONICAL NOZZLE CHECK CASE

*** INPUT ***

$T_0 = 519.$ $P_0 = 14.7$
 $WTR = 13.$ $P/P_0 = 3.247$
 EFFICIENCY AREA RATIO PARAMETER = 0.000 $VC = 352.0$
 PLUG DIA = 0.50 CANT = 0.006

*** OUTPUT ***

DIA OF JETTER GORE = 1.728 COLLIV AREA DIA = 1.728

NOZZLE EXIT CONDITIONS

$MR = 2184.6$ $PHOR = 0.0397$ $AT = 2.346$ $A8 = 2.346$

HIGH VELOCITY JET NOISE PROGRAM - ENGINEERING CORRELATION

CUTICAL NOZZLE CHECK CASE

- * GEOMETRIC MIXING NOISE
- * 2400.0 FOOT ALTITUDE
- * 9.0 FOOT SIDE LINE
- * NO ECA
- * 519.0 DEGREE STANDARD DAY

ACOUSTIC ANGLE FROM INLET

FREQ	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	PWL
50	54.1	56.9	59.5	62.4	65.4	68.4	71.4	74.4	77.4	80.4	83.4	86.4	89.4	92.4	95.4	158.4
63	57.0	59.8	62.4	65.4	68.4	71.4	74.4	77.4	80.4	83.4	86.4	89.4	92.4	95.4	98.4	161.0
80	59.7	62.4	65.4	68.4	71.4	74.4	77.4	80.4	83.4	86.4	89.4	92.4	95.4	98.4	101.4	163.0
100	62.3	65.4	68.4	71.4	74.4	77.4	80.4	83.4	86.4	89.4	92.4	95.4	98.4	101.4	104.4	164.4
125	64.6	67.4	70.4	73.4	76.4	79.4	82.4	85.4	88.4	91.4	94.4	97.4	100.4	103.4	106.4	165.2
160	67.4	70.4	73.4	76.4	79.4	82.4	85.4	88.4	91.4	94.4	97.4	100.4	103.4	106.4	109.4	165.8
200	70.4	73.4	76.4	79.4	82.4	85.4	88.4	91.4	94.4	97.4	100.4	103.4	106.4	109.4	112.4	166.0
250	73.4	76.4	79.4	82.4	85.4	88.4	91.4	94.4	97.4	100.4	103.4	106.4	109.4	112.4	115.4	166.0
315	76.4	79.4	82.4	85.4	88.4	91.4	94.4	97.4	100.4	103.4	106.4	109.4	112.4	115.4	118.4	165.8
400	79.4	82.4	85.4	88.4	91.4	94.4	97.4	100.4	103.4	106.4	109.4	112.4	115.4	118.4	121.4	165.4
500	82.4	85.4	88.4	91.4	94.4	97.4	100.4	103.4	106.4	109.4	112.4	115.4	118.4	121.4	124.4	165.0
630	85.4	88.4	91.4	94.4	97.4	100.4	103.4	106.4	109.4	112.4	115.4	118.4	121.4	124.4	127.4	164.5
800	88.4	91.4	94.4	97.4	100.4	103.4	106.4	109.4	112.4	115.4	118.4	121.4	124.4	127.4	130.4	163.9
1000	91.4	94.4	97.4	100.4	103.4	106.4	109.4	112.4	115.4	118.4	121.4	124.4	127.4	130.4	133.4	163.2
1250	94.4	97.4	100.4	103.4	106.4	109.4	112.4	115.4	118.4	121.4	124.4	127.4	130.4	133.4	136.4	162.4
1600	97.4	100.4	103.4	106.4	109.4	112.4	115.4	118.4	121.4	124.4	127.4	130.4	133.4	136.4	139.4	161.5
2000	100.4	103.4	106.4	109.4	112.4	115.4	118.4	121.4	124.4	127.4	130.4	133.4	136.4	139.4	142.4	160.5
2500	103.4	106.4	109.4	112.4	115.4	118.4	121.4	124.4	127.4	130.4	133.4	136.4	139.4	142.4	145.4	159.4
3150	106.4	109.4	112.4	115.4	118.4	121.4	124.4	127.4	130.4	133.4	136.4	139.4	142.4	145.4	148.4	158.2
4000	109.4	112.4	115.4	118.4	121.4	124.4	127.4	130.4	133.4	136.4	139.4	142.4	145.4	148.4	151.4	156.9
5000	112.4	115.4	118.4	121.4	124.4	127.4	130.4	133.4	136.4	139.4	142.4	145.4	148.4	151.4	154.4	154.5
6300	115.4	118.4	121.4	124.4	127.4	130.4	133.4	136.4	139.4	142.4	145.4	148.4	151.4	154.4	157.4	154.5
8000	118.4	121.4	124.4	127.4	130.4	133.4	136.4	139.4	142.4	145.4	148.4	151.4	154.4	157.4	160.4	152.5
10000	121.4	124.4	127.4	130.4	133.4	136.4	139.4	142.4	145.4	148.4	151.4	154.4	157.4	160.4	163.4	151.0
WASPL	73.4	76.4	79.4	82.4	85.4	88.4	91.4	94.4	97.4	100.4	103.4	106.4	109.4	112.4	115.4	176.7
PWL	77.4	80.4	83.4	86.4	89.4	92.4	95.4	98.4	101.4	104.4	107.4	110.4	113.4	116.4	119.4	91.3
PWL	77.4	80.4	83.4	86.4	89.4	92.4	95.4	98.4	101.4	104.4	107.4	110.4	113.4	116.4	119.4	91.3

FOH = 103.5

NOISE VELOCITY JET ENGINE PROGRAM - ENGINEERING CORPORATION

CONICAL NOZZLE ENGINE CASE

* CONICAL SHOCK NOISE
 * 24000.0 FOOT ALTITUDE
 * 0.0 FOOT SIDELINE
 * NO EGA
 * 519 DEGREE STANDARD DAY

ACOUSTIC ANGLE FROM INLET

FEET	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	DNL
50	52.4	55.0	57.6	59.6	61.6	63.6	65.6	67.6	69.6	71.6	73.6	75.6	77.6	79.6	81.6	140.6
60	55.7	58.8	60.6	61.5	61.9	62.4	62.9	63.4	63.9	64.4	64.9	65.4	65.9	66.4	66.9	143.9
70	58.2	61.7	63.4	64.5	65.1	65.6	66.1	66.6	67.1	67.6	68.1	68.6	69.1	69.6	70.1	147.2
80	60.3	64.7	65.4	65.8	66.2	66.6	67.0	67.4	67.8	68.2	68.6	69.0	69.4	69.8	70.2	150.0
90	61.5	65.1	67.4	69.0	70.0	70.6	71.0	71.4	71.8	72.2	72.6	73.0	73.4	73.8	74.2	152.7
100	62.9	65.8	68.3	70.2	71.6	72.6	73.4	74.2	75.0	75.8	76.6	77.4	78.2	79.0	79.8	155.8
110	64.7	66.5	69.0	70.9	72.6	74.0	75.3	76.6	77.7	78.9	80.1	81.3	82.5	83.7	84.9	158.4
120	65.2	67.5	70.3	71.6	73.3	74.5	76.2	77.1	78.1	79.1	80.1	81.1	82.1	83.1	84.1	160.9
130	65.8	68.4	71.4	72.6	74.1	75.4	76.6	77.8	78.8	79.8	80.8	81.8	82.8	83.8	84.8	164.4
140	66.4	69.4	72.7	73.9	75.4	76.6	77.8	78.8	79.8	80.8	81.8	82.8	83.8	84.8	85.8	167.7
150	67.1	70.1	73.3	74.5	76.0	77.2	78.4	79.4	80.4	81.4	82.4	83.4	84.4	85.4	86.4	168.3
160	67.9	70.9	74.1	75.3	76.8	78.0	79.2	80.2	81.2	82.2	83.2	84.2	85.2	86.2	87.2	167.5
170	68.6	71.6	74.8	76.0	77.5	78.7	79.9	81.1	82.1	83.1	84.1	85.1	86.1	87.1	88.1	166.6
180	69.3	72.3	75.5	76.7	78.2	79.4	80.6	81.8	82.8	83.8	84.8	85.8	86.8	87.8	88.8	166.0
190	70.1	73.1	76.3	77.5	79.0	80.2	81.4	82.6	83.6	84.6	85.6	86.6	87.6	88.6	89.6	165.1
200	70.9	73.9	77.1	78.3	79.8	81.0	82.2	83.4	84.4	85.4	86.4	87.4	88.4	89.4	90.4	164.2
210	71.7	74.7	77.9	79.1	80.6	81.8	83.0	84.2	85.2	86.2	87.2	88.2	89.2	90.2	91.2	163.3
220	72.5	75.5	78.7	79.9	81.4	82.6	83.8	85.0	86.0	87.0	88.0	89.0	90.0	91.0	92.0	162.3
230	73.3	76.3	79.5	80.7	82.2	83.4	84.6	85.8	86.8	87.8	88.8	89.8	90.8	91.8	92.8	161.3
240	74.1	77.1	80.3	81.5	83.0	84.2	85.4	86.6	87.6	88.6	89.6	90.6	91.6	92.6	93.6	160.3
250	74.9	77.9	81.1	82.3	83.8	85.0	86.2	87.4	88.4	89.4	90.4	91.4	92.4	93.4	94.4	159.3
260	75.7	78.7	81.9	83.1	84.6	85.8	87.0	88.2	89.2	90.2	91.2	92.2	93.2	94.2	95.2	158.3
270	76.5	79.5	82.7	83.9	85.4	86.6	87.8	89.0	90.0	91.0	92.0	93.0	94.0	95.0	96.0	157.3
280	77.3	80.3	83.5	84.7	86.2	87.4	88.6	89.8	90.8	91.8	92.8	93.8	94.8	95.8	96.8	156.3
290	78.1	81.1	84.3	85.5	87.0	88.2	89.4	90.6	91.6	92.6	93.6	94.6	95.6	96.6	97.6	155.3
300	78.9	81.9	85.1	86.3	87.8	89.0	90.2	91.4	92.4	93.4	94.4	95.4	96.4	97.4	98.4	154.3
310	79.7	82.7	85.9	87.1	88.6	89.8	91.0	92.2	93.2	94.2	95.2	96.2	97.2	98.2	99.2	153.3
320	80.5	83.5	86.7	87.9	89.4	90.6	91.8	93.0	94.0	95.0	96.0	97.0	98.0	99.0	100.0	152.3
330	81.3	84.3	87.5	88.7	90.2	91.4	92.6	93.8	94.8	95.8	96.8	97.8	98.8	99.8	100.8	151.3
340	82.1	85.1	88.3	89.5	91.0	92.2	93.4	94.6	95.6	96.6	97.6	98.6	99.6	100.6	101.6	150.3
350	82.9	85.9	89.1	90.3	91.8	93.0	94.2	95.4	96.4	97.4	98.4	99.4	100.4	101.4	102.4	149.3
360	83.7	86.7	89.9	91.1	92.6	93.8	95.0	96.2	97.2	98.2	99.2	100.2	101.2	102.2	103.2	148.3
370	84.5	87.5	90.7	91.9	93.4	94.6	95.8	97.0	98.0	99.0	100.0	101.0	102.0	103.0	104.0	147.3
380	85.3	88.3	91.5	92.7	94.2	95.4	96.6	97.8	98.8	99.8	100.8	101.8	102.8	103.8	104.8	146.3
390	86.1	89.1	92.3	93.5	95.0	96.2	97.4	98.6	99.6	100.6	101.6	102.6	103.6	104.6	105.6	145.3
400	86.9	89.9	93.1	94.3	95.8	97.0	98.2	99.4	100.4	101.4	102.4	103.4	104.4	105.4	106.4	144.3
410	87.7	90.7	93.9	95.1	96.6	97.8	99.0	100.2	101.2	102.2	103.2	104.2	105.2	106.2	107.2	143.3
420	88.5	91.5	94.7	95.9	97.4	98.6	99.8	101.0	102.0	103.0	104.0	105.0	106.0	107.0	108.0	142.3
430	89.3	92.3	95.5	96.7	98.2	99.4	100.6	101.8	102.8	103.8	104.8	105.8	106.8	107.8	108.8	141.3
440	90.1	93.1	96.3	97.5	99.0	100.2	101.4	102.6	103.6	104.6	105.6	106.6	107.6	108.6	109.6	140.3
450	90.9	93.9	97.1	98.3	99.8	101.0	102.2	103.4	104.4	105.4	106.4	107.4	108.4	109.4	110.4	139.3
460	91.7	94.7	97.9	99.1	100.6	101.8	103.0	104.2	105.2	106.2	107.2	108.2	109.2	110.2	111.2	138.3
470	92.5	95.5	98.7	99.9	101.4	102.6	103.8	105.0	106.0	107.0	108.0	109.0	110.0	111.0	112.0	137.3
480	93.3	96.3	99.5	100.7	102.2	103.4	104.6	105.8	106.8	107.8	108.8	109.8	110.8	111.8	112.8	136.3
490	94.1	97.1	100.3	101.5	103.0	104.2	105.4	106.6	107.6	108.6	109.6	110.6	111.6	112.6	113.6	135.3
500	94.9	97.9	101.1	102.3	103.8	105.0	106.2	107.4	108.4	109.4	110.4	111.4	112.4	113.4	114.4	134.3
510	95.7	98.7	101.9	103.1	104.6	105.8	107.0	108.2	109.2	110.2	111.2	112.2	113.2	114.2	115.2	133.3
520	96.5	99.5	102.7	103.9	105.4	106.6	107.8	109.0	110.0	111.0	112.0	113.0	114.0	115.0	116.0	132.3
530	97.3	100.3	103.5	104.7	106.2	107.4	108.6	109.8	110.8	111.8	112.8	113.8	114.8	115.8	116.8	131.3
540	98.1	101.1	104.3	105.5	107.0	108.2	109.4	110.6	111.6	112.6	113.6	114.6	115.6	116.6	117.6	130.3
550	98.9	101.9	105.1	106.3	107.8	109.0	110.2	111.4	112.4	113.4	114.4	115.4	116.4	117.4	118.4	129.3
560	99.7	102.7	105.9	107.1	108.6	109.8	111.0	112.2	113.2	114.2	115.2	116.2	117.2	118.2	119.2	128.3
570	100.5	103.5	106.7	107.9	109.4	110.6	111.8	113.0	114.0	115.0	116.0	117.0	118.0	119.0	120.0	127.3
580	101.3	104.3	107.5	108.7	110.2	111.4	112.6	113.8	114.8	115.8	116.8	117.8	118.8	119.8	120.8	126.3
590	102.1	105.1	108.3	109.5	111.0	112.2	113.4	114.6	115.6	116.6	117.6	118.6	119.6	120.6	121.6	125.3
600	102.9	105.9	109.1	110.3	111.8	113.0	114.2	115.4	116.4	117.4	118.4	119.4	120.4	121.4	122.4	124.3
610	103.7	106.7	110.9	112.1	113.6	114.8	116.0	117.2	118.2	119.2	120.2	121.2	122.2	123.2	124.2	123.3
620	104.5	107.5	111.7	112.9	114.4	115.6	116.8	118.0	119.0	120.0	121.0	122.0	123.0	124.0	125.0	122.3
630	105.3	108.3	112.5	113.7	115.2	116.4	117.6	118.8	119.8	120.8	121.8	122.8	123.8	124.8	125.8	121.3
640	106.1	109.1	113.3	114.5	116.0	117.2	118.4	119.6	120.6	121.6	122.6	123.6	124.6	125.6	126.6	120.3
650	106.9	109.9	114.1	115.3	116.8	118.0	119.2	120.4	121.4	122.4	123.4	124.4	125.4	126.4	127.4	119.3
660	107.7	110.7	114.9	116.1	117.6	118.8	120.0	121.2	122.2	123.2	124.2	125.2	126.2	127.2	128.2	118.3
670	108.5	111.5	115.7	116.9	118.4	119.6	120.8	122.0	123.0	124.0	125.0	126.0	127.0	128.0	129.0	117.3
680	109.3	112.3	116.5	117.7	119.2	120.4	121.6	122.8	123.8	124.8	125.8	126.8	127.8	128.8	129.8	116.3
690	110.1	113.1	117.3	118.5	120.0	121.2	122.4	123.6	124.6	125.6	126.6	127.6	128.6	129.6	130.6	115.3
700	110.9	113.9	118.1	119.3	120.6	121.8	123.0	124.2	125.2	126.2	127.2	128.2	129.2	130.2	131.2	114.3
710	111.7	114.7	118.9	120.1	121.4	122.6	123.8	125.0	126.0	127.0	128.0	129.0	130.0	131.0	132.0	113.3
720	112.5	115.5	119.7	120.9	122.2	123.4	124.6	125.8	126.8	127.8	128.8	129.8	130.8	131.8	132.8	112.3
730	113.3	116.3	120.5	121.7	123.0	124.2	125.4	126.6	127.6	128.6	129.6	130.6	131.6	132.6	133.6	111.3
740	114.1	117.1	121.3	122.5	123.8	125.0	126.2	127.4	128.4	129.4	130.4	131.4	132.4	133.4	134.4	110.3
750	114.9	117.9	122.1	123.3	124.6	125.8	127.0	128.2	129.2	130.2	131.2	132.2	133.2	134.2	135.2	109.3
760	115.7	118.7	122.9	124.1	125.4	126.6	127.8	129.0	130.0	131.0	132.0	133.0	134.0	135.0	136.0	108.3
7																

100 VELOCITY DBI ROUTING SCHEMATA - CONSTRUCTION CORRELATION

CUT-AND-FILL CORRELATION

- * CIRCULAR TOTAL NOISE
- * 2500 Hz FOOT ALIQUID
- * 6.0 FOOT STOE LINE
- * 140 FGA
- * 519.0 DEGREE STANDARD DAY

ACOUSTIC ANGLE FROM INLET

FOUR	20	30	40	50	60	70	80	90	100	110	120	130	140	150	FWL
51	56.5	59.4	61.1	62.1	62.4	63.1	63.6	67.0	65.8	67.1	74.1	82.4	84.2	83.1	168.5
54	59.4	62.3	64.0	65.2	65.7	66.1	66.1	69.1	68.6	69.8	76.7	82.8	86.6	84.5	161.1
57	61.6	64.5	66.4	67.4	67.7	68.2	68.2	71.6	71.4	72.5	78.9	84.8	88.3	85.0	163.1
125	63.3	66.5	68.5	69.7	70.1	71.1	71.8	74.8	74.0	75.0	81.0	86.5	89.5	85.0	164.5
128	64.5	67.9	69.1	70.4	70.8	71.1	71.1	75.8	75.3	76.4	81.3	86.1	89.4	84.4	165.5
160	65.3	68.0	71.2	72.7	74.1	74.9	77.6	78.5	79.2	80.3	85.2	89.1	90.9	89.8	166.2
200	66.2	69.8	72.2	73.8	75.2	76.3	78.6	79.8	81.1	82.6	86.8	90.1	91.1	89.1	166.7
250	67.7	71.2	73.2	74.6	75.9	77.1	79.2	80.5	82.3	84.2	88.1	90.8	91.0	88.3	167.1
315	72.5	75.3	76.3	77.6	78.4	79.4	81.6	82.7	84.4	85.4	88.9	91.3	90.8	87.3	168.2
400	78.4	82.1	83.0	84.2	85.0	86.2	88.6	89.9	92.7	93.7	94.6	91.0	90.0	85.9	169.7
500	80.7	85.2	87.4	89.0	90.4	92.2	95.8	92.2	92.2	95.1	97.7	92.2	86.7	83.9	170.0
630	78.0	83.3	86.4	88.3	89.1	91.2	94.1	95.2	92.4	93.7	96.3	94.9	86.9	81.3	171.9
800	75.9	81.0	83.4	85.2	86.9	87.9	90.4	91.4	84.1	82.7	84.8	87.3	84.8	78.4	168.5
1000	73.3	79.2	82.3	83.9	84.1	84.5	86.5	86.4	84.4	82.6	83.2	82.4	82.5	75.1	167.8
1250	70.4	77.3	80.6	82.0	82.4	83.0	84.4	84.3	81.7	82.7	81.7	83.0	79.5	71.0	167.0
1400	65.2	73.2	77.3	79.8	81.1	81.6	82.3	79.9	80.1	81.1	79.9	74.9	75.9	66.5	166.1
2000	59.4	68.2	74.1	76.5	77.8	78.6	77.7	77.6	77.9	78.2	77.4	75.4	71.7	61.8	165.2
2500	51.8	63.5	69.4	72.6	74.5	75.1	74.5	74.2	74.7	74.5	73.2	71.8	66.2	56.3	164.1
3150	40.5	55.4	63.0	67.2	69.4	71.5	69.6	69.5	70.0	69.7	67.6	65.8	58.9	48.3	162.8
4000	23.4	43.4	53.3	59.7	61.9	63.5	62.1	62.8	63.3	62.7	60.1	57.5	48.2	36.1	161.3
5000	17.5	35.5	46.4	53.1	56.7	59.6	58.2	58.3	58.8	57.9	54.9	51.8	42.3	28.0	159.4
6300	14.7	31.1	40.6	46.4	47.2	47.3	47.3	47.3	47.3	46.4	42.3	37.7	25.9	7.4	158.6
8000	-12.2	-18.2	6.0	14.6	25.1	29.0	35.0	31.2	28.9	23.4	16.5	5.9	-24.1	-71.0	157.1
10000	-123.2	-78.6	-27.3	-9.7	7.7	6.7	8.5	9.4	9.0	5.7	-3.3	-13.2	-33.9	-68.0	155.7
0ASPL	85.7	90.3	92.8	94.0	94.4	94.1	94.2	93.3	93.4	94.4	97.2	100.2	100.5	98.9	93.3
PNL	90.0	95.2	99.1	100.6	101.5	101.3	101.5	100.6	100.7	101.5	103.2	105.4	105.4	100.6	93.2
PNL 7	90.0	95.2	99.1	100.6	101.5	101.3	101.5	100.6	100.7	101.5	103.2	105.4	107.7	102.0	93.2

EPNL = 104.5

HIGH VELOCITY JET NOISE PROGRAM - ENGINEERING CORRELATION

CONICAL NOZZLE CHECK CASE

*** INPUT ***

$T_c = 519.$ $P = 14.728$
 $W = 134.$ $P/W = 3.247$
 EJECTOR AREA RATIO PARAMETER = 0.000 $V = 357.1$
 PLUG DIA = 0.00 CANT = 0.000

*** OUTPUT ***

DIA OF OUTER NOSE = 1.728 QUIV AREA DIA = 1.728

NOZZLE EXIT CONDITIONS
 $PR = 2184.7$ $PHOR = .397$ $AT = 2.346$ $AR = 2.346$

WIND VELOCITY JET NOISE PROGRAM - ENGINEERING CORRELATION

CIRCULAR NOZZLE CASE

- * CIRCULAR MIXING POINT
- * 2500.0 FOOT ALTITUDE
- * 0.0 FOOT SIDELINE
- * 100 FOOT LAYER EGA
- * 519.0 DEGREE STANDARD DAY

ACOUSTIC ANGLE FROM INLET

FREQ	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	PWL
50	51.6	-6.3	54.0	54.0	59.9	60.5	64.3	65.2	63.6	65.5	73.2	79.8	83.7	85.7	82.5	158.4
63	56.9	59.2	60.9	61.9	62.8	63.4	66.3	67.2	65.2	67.1	75.6	82.2	86.0	87.5	83.8	161.0
80	58.0	58.9	62.7	63.4	66.8	67.3	69.3	69.2	68.1	70.0	77.6	84.0	87.6	89.1	84.6	163.0
100	59.5	62.6	64.4	65.0	68.0	67.2	69.9	70.8	70.0	72.0	79.3	85.6	88.7	89.1	84.1	164.4
125	60.5	63.9	65.9	67.1	68.2	68.9	71.4	72.3	71.8	73.4	81.0	86.9	89.5	89.2	83.3	165.2
160	61.6	65.1	67.2	68.5	69.6	70.7	72.9	73.8	73.6	75.6	82.2	87.7	89.8	88.7	82.0	165.8
200	62.4	66.2	68.4	69.8	71.1	71.7	74.0	75.0	75.0	77.1	83.1	88.3	89.7	87.8	80.3	166.0
250	62.8	66.9	69.3	70.8	72.1	72.8	75.2	75.9	76.2	78.3	83.8	88.5	89.2	86.4	78.1	166.0
315	62.0	67.3	69.9	71.5	72.8	73.7	75.7	76.6	77.3	79.3	84.3	88.4	88.4	84.7	75.4	165.8
400	62.7	67.4	70.2	72.0	73.4	74.3	76.4	77.2	78.0	80.1	84.3	88.0	87.2	82.6	72.4	165.4
500	62.1	67.3	70.3	72.2	73.8	74.7	76.4	77.4	78.5	80.5	84.1	87.3	85.7	80.2	69.0	165.0
630	60.9	66.7	70.0	72.1	73.7	74.8	76.3	77.3	78.6	80.5	83.5	86.2	83.8	77.4	65.1	164.5
800	59.2	65.6	69.3	71.6	73.4	74.5	75.9	76.9	78.4	80.2	82.6	84.7	81.6	74.3	60.8	163.9
1000	56.9	64.1	68.2	70.7	72.7	73.9	75.2	76.2	77.8	79.5	81.3	82.9	79.1	70.8	56.1	163.2
1250	53.8	61.9	66.5	69.4	71.5	72.9	74.2	75.1	76.4	78.3	79.5	80.6	75.9	66.6	50.6	162.4
1600	49.2	57.7	64.0	67.3	69.7	71.2	72.2	73.1	75.1	76.4	77.0	77.7	72.2	61.7	44.0	161.5
2000	43.4	51.7	59.8	64.5	67.1	69.0	72.0	72.9	73.9	74.0	74.1	67.8	56.2	36.5	160.5	
2500	35.8	49.3	56.5	60.9	64.1	65.9	66.9	68.0	69.9	70.6	70.1	69.7	62.4	49.4	27.1	159.4
3150	24.7	41.5	50.3	55.6	59.3	61.5	62.5	63.7	65.5	65.9	64.7	63.6	55.1	40.3	14.5	158.2
4000	8.0	29.8	41.0	47.7	52.2	55.0	56.1	57.4	59.1	59.0	57.1	55.1	45.1	27.6	-3.3	156.9
5000	-2.2	22.2	34.4	42.4	47.5	50.6	51.8	53.1	54.7	54.3	51.8	49.3	38.2	19.2	-14.9	155.5
6300	-11.7	14.9	28.9	36.9	43.4	46.9	48.4	49.9	51.4	51.4	48.4	45.9	35.1	21.6	-1.9	154.1
8000	-27.6	-10.6	-5.7	8.0	16.8	22.1	24.3	26.0	27.1	25.2	20.1	13.8	-3.6	-33.8	-90.8	152.5
10000	-138.2	-71.7	-38.9	-21.0	-8.2	-1.0	2.2	4.3	5.0	1.9	-6.5	-15.9	-38.4	-77.7	-153.6	151.0
NOISEL	72.2	76.9	79.4	81.7	84.1	86.1	87.1	88.0	89.0	89.9	93.9	98.0	98.4	97.6	91.9	176.7
PWL	75.7	-1.7	45.4	88.1	90.4	91.8	93.2	94.3	95.6	97.0	99.8	102.9	101.5	98.4	90.0	
DIFF	75.7	-3.1	86.5	88.1	90.4	91.8	93.2	94.3	95.6	97.0	99.8	102.9	103.0	90.5	90.0	

EPNL = 102.5

LOW VELOCITY JET NOISE PROGRAM - ENGINEERING CORRELATION

CEMENT TUBULE ENGINE CASE

- * GEOMETRIC SPOKE NOISE
- * 24.0 DECIBEL FOOT ALIQUID
- * 6.0 FOOT SIDE LINE
- * 100 FOOT LAYER LGA
- * 519 DEGREE STANDARD DAY

ACOUSTIC ANGLE FROM TUBE

FEET	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	PWL
50	52.7	45.4	37.1	28.1	18.9	9.6	0.3	61.1	60.4	60.5	60.1	53.2	42.1	30.6	19.3	140.6
60	55.0	47.7	39.4	30.4	21.2	12.0	2.7	63.4	62.7	62.8	62.4	55.5	44.4	32.9	21.4	143.9
70	57.3	49.9	41.6	32.6	23.4	14.2	4.9	65.6	64.9	65.0	64.6	57.7	46.6	35.1	23.6	147.2
80	59.6	52.2	43.9	34.9	25.6	16.4	7.1	67.8	67.1	67.2	66.8	60.0	48.9	37.4	25.8	150.5
90	61.9	54.5	46.2	37.2	27.8	18.6	9.3	69.9	69.3	69.4	69.0	62.2	51.1	39.6	28.0	153.8
100	64.2	56.8	48.5	39.5	30.0	20.8	11.5	72.1	71.5	71.6	71.2	64.4	53.3	41.8	30.2	157.1
110	66.5	59.1	50.8	41.8	32.2	23.0	13.7	74.3	73.7	73.8	73.4	66.6	55.5	44.0	32.4	160.4
120	68.8	61.4	53.1	44.1	34.4	25.2	15.9	76.5	75.9	76.0	75.6	68.8	57.7	46.2	34.6	163.7
130	71.1	63.7	55.4	46.4	36.6	27.4	18.1	78.7	78.1	78.2	77.8	71.0	59.9	48.4	36.8	167.0
140	73.4	66.0	57.7	48.7	38.8	29.6	20.3	80.9	80.3	81.0	80.6	73.8	62.7	50.6	39.0	170.3
150	75.7	68.3	60.0	51.0	41.0	31.8	22.5	83.1	82.5	83.2	82.8	76.0	65.0	52.8	41.2	173.6
160	78.0	70.6	62.3	53.3	43.3	34.0	24.7	85.3	84.7	85.4	85.0	78.2	67.1	55.0	43.4	176.9
170	80.3	72.9	64.6	55.6	45.6	36.2	26.9	87.5	86.9	87.6	87.2	80.4	69.3	57.2	45.6	180.2
180	82.6	75.2	66.9	57.9	47.9	38.4	29.1	89.7	89.1	89.8	89.4	82.6	71.5	59.4	47.8	183.5
190	84.9	77.5	69.2	60.2	50.2	40.6	31.3	91.9	91.3	92.0	91.6	84.8	73.7	61.6	50.0	186.8
200	87.2	79.8	71.5	62.5	52.5	42.8	33.5	94.1	93.5	94.2	93.8	87.0	76.0	63.8	52.2	190.1
210	89.5	82.1	73.8	64.8	54.8	45.0	35.7	96.3	95.7	96.4	96.0	89.2	78.3	66.0	54.4	193.4
220	91.8	84.4	76.1	67.1	57.1	47.2	37.9	98.5	97.9	98.6	98.2	91.4	80.5	68.2	56.6	196.7
230	94.1	86.7	78.4	69.4	59.4	49.4	40.1	100.7	100.1	100.8	100.4	93.6	82.7	70.4	58.8	200.0
240	96.4	89.0	80.7	71.7	61.7	51.6	42.3	102.9	102.3	103.0	102.6	95.8	84.9	72.6	61.0	203.3
250	98.7	91.3	83.0	74.0	64.0	53.8	44.5	105.1	104.5	105.2	104.8	98.0	87.1	74.8	63.2	206.6
260	101.0	93.6	85.3	76.3	66.3	56.0	46.7	107.3	106.7	107.4	107.0	100.2	89.3	77.0	65.4	209.9
270	103.3	95.9	87.6	78.6	68.6	58.2	48.9	109.5	108.9	109.6	109.2	102.4	91.5	79.2	67.6	213.2
280	105.6	98.2	90.0	80.9	70.9	60.4	51.1	111.7	111.1	111.8	111.4	104.6	93.7	81.4	69.8	216.5
290	107.9	100.5	92.2	83.2	73.2	62.6	53.3	113.9	113.3	114.0	113.6	106.8	95.9	83.6	72.0	219.8
300	110.2	102.8	94.5	85.5	75.5	64.8	55.5	116.1	115.5	116.2	115.8	109.0	98.1	85.8	74.2	223.1
310	112.5	105.1	96.8	87.8	77.8	67.0	57.7	118.3	117.7	118.4	118.0	111.2	100.3	88.0	76.4	226.4
320	114.8	107.4	99.1	90.1	80.1	69.2	59.9	120.5	119.9	120.6	120.2	113.4	102.5	90.2	78.6	229.7
330	117.1	109.7	101.4	92.4	82.4	71.4	62.1	122.7	122.1	122.8	122.4	115.6	104.7	92.4	80.8	233.0
340	119.4	112.0	103.7	94.7	84.7	73.6	64.3	124.9	124.3	125.0	124.6	117.8	106.9	94.6	83.0	236.3
350	121.7	114.3	106.0	97.0	87.0	75.8	66.5	127.1	126.5	127.2	126.8	119.9	109.1	96.8	85.2	239.6
360	124.0	116.6	108.3	99.3	89.3	78.0	68.7	129.3	128.7	129.4	129.0	122.1	111.3	99.0	87.4	242.9
370	126.3	118.9	110.6	101.6	91.6	80.2	70.9	131.5	130.9	131.6	131.2	124.3	113.5	101.2	89.6	246.2
380	128.6	121.2	112.9	103.9	93.9	82.4	73.1	133.7	133.1	133.8	133.4	126.5	115.7	103.4	91.8	249.5
390	130.9	123.5	115.2	106.2	96.2	84.6	75.3	135.9	135.3	136.0	135.6	128.7	117.9	105.6	94.0	252.8
400	133.2	125.8	117.5	108.5	98.5	86.8	77.5	138.1	137.5	138.2	137.8	130.9	120.1	107.8	96.2	256.1
410	135.5	128.1	119.8	110.8	100.8	89.0	79.7	140.3	139.7	140.4	140.0	133.1	122.3	109.9	98.4	259.4
420	137.8	130.4	122.1	113.1	103.1	91.2	81.9	142.5	141.9	142.6	142.2	135.3	124.5	112.1	100.6	262.7
430	140.1	132.7	124.4	115.4	105.4	93.4	84.1	144.7	144.1	144.8	144.4	137.5	126.7	114.3	102.8	266.0
440	142.4	135.0	126.7	117.7	107.7	95.6	86.3	146.9	146.3	147.0	146.6	139.7	128.9	116.5	105.0	269.3
450	144.7	137.3	129.0	119.9	109.9	97.8	88.5	149.1	148.5	149.2	148.8	141.9	131.1	118.7	107.2	272.6
460	147.0	139.6	131.3	122.2	112.2	100.0	90.7	151.3	150.7	151.4	151.0	144.1	133.3	120.9	109.4	275.9
470	149.3	141.9	133.6	124.5	114.5	102.2	92.9	153.5	152.9	153.6	153.2	146.3	135.5	123.1	111.6	279.2
480	151.6	144.2	135.9	126.8	116.8	104.4	95.1	155.7	155.1	155.8	155.4	148.5	137.7	125.3	113.8	282.5
490	153.9	146.5	138.2	129.1	119.1	106.6	97.3	157.9	157.3	158.0	157.6	150.7	139.9	127.5	116.0	285.8
500	156.2	148.8	140.5	131.4	121.4	108.8	99.5	160.1	159.5	160.2	159.8	152.9	142.1	129.7	118.2	289.1
510	158.5	151.1	142.8	133.7	123.7	111.0	101.7	162.3	161.7	162.4	162.0	155.1	144.3	131.9	120.4	292.4
520	160.8	153.4	145.1	136.0	126.0	113.2	103.9	164.5	163.9	164.6	164.2	157.3	146.5	134.1	122.6	295.7
530	163.1	155.7	147.4	138.3	128.3	115.4	106.1	166.7	166.1	166.8	166.4	159.5	148.7	136.3	124.8	299.0
540	165.4	158.0	149.7	140.6	130.6	117.6	108.3	168.9	168.3	169.0	168.6	161.7	150.9	138.5	127.0	302.3
550	167.7	160.3	152.0	142.9	132.9	119.8	110.5	171.1	170.5	171.2	170.8	163.9	153.1	140.7	129.2	305.6
560	170.0	162.6	154.3	145.2	135.2	122.0	112.7	173.3	172.7	173.4	173.0	166.1	155.3	142.9	131.4	308.9
570	172.3	164.9	156.6	147.5	137.5	124.2	114.9	175.5	174.9	175.6	175.2	168.3	157.5	145.1	133.6	312.2
580	174.6	167.2	158.9	149.8	139.8	126.4	117.1	177.7	177.1	177.8	177.4	170.5	159.7	147.3	135.8	315.5
590	176.9	169.5	161.2	152.1	142.1	128.6	119.3	179.9	179.3	180.0	179.6	172.7	161.9	149.5	138.0	318.8
600	179.2	171.8	163.5	154.4	144.4	130.8	121.5	182.1	181.5	182.2	181.8	174.9	164.1	151.7	140.2	322.1
610	181.5	174.1	165.8	156.7	146.7	133.0	123.7	184.3	183.7	184.4	184.0	177.1	166.3	153.9	142.4	325.4
620	183.8	176.4	168.1	159.0	149.0	135.2	125.9	186.5	185.9	186.6	186.2	179.3	168.5	156.1	144.6	328.7
630	186.1	178.7	170.4	161.3	151.3	137.4	128.1	188.7	188.1	188.8	188.4	181.5	170.7	158.3	146.8	332.0
640	188.4	181.0	172.7	163.6	153.6	139.6	130.3	190.9	190.3	191.0	190.6	183.7	172.9	160.5	149.0	335.3
650	190.7	183.3	175.0	165.9	155.9	141.8	132.5	193.1	192.5	193.2	192.8	185.9	175.1	162.7	151.2	338.6
660	193.0	185.6	177.3	168.2	158.2	144.0	134.7	195.3	194.7	195.4	195.0	188.1	177.3	164.9	153.4	341.9
670	195.3	187.9	179.6	170.5	160.5	146.2	136.9	197.5	196.9	197.6	197.2	190.3	179.5	167.1	155.6	345.2
680	197.6	190.2	181.9	172.8	162.8	148.4	139.1	199.7	199.1	199.8	199.4	192.5	181.7	169.3	157.8	348.5
690	199.9	192.5	184.2	175.1	165.1	150.6	141.3	201.9	201.3	202.0	201.6	194.7	183.9	171.5	159.9	351.8
700	202.2	194.8	186.5	177.4	167.4	152.8	143.5	204.1	203.5	204.2	203.8	196.9	186.1	173.7	162.1	355.1
710	204.5	197.1	188.8	179.7	169.7	155.0	145.7	206.3	205.7	206.4	206.0	199.1	188.3	175.9	164.3	358.4
720	206.8	199.4	191.1	182.0	172.0	157.2	147.9	208.5	207.9	208.6	208.2	201.3	190.5	178.1	166.5	361.7
730	209.1	201.7	193.4	184.3	1747											

U.S. NAVY AIR FORCE BUREAU - FORT BELLE CONSTRUCTION

U.S. NAVY AIR FORCE BUREAU - FORT BELLE CONSTRUCTION

1. CRITICAL TOTAL PROFILE
2. 2500.0 FOOT ALTITUDE
3. 0.6 FOOT SLOPE
4. 100 FOOT LAYER FEA
5. 519.0 DEGREE STANDARD DAY

ACOUSTIC ANGLE FROM INLET

FEET	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	PWL
50	56.0	54.0	50.0	48.0	45.0	42.0	40.0	38.0	36.0	34.0	32.0	30.0	28.0	26.0	24.0	154.5
60	59.5	57.5	53.5	51.5	48.5	45.5	43.5	41.5	39.5	37.5	35.5	33.5	31.5	29.5	27.5	161.1
70	63.0	61.0	57.0	55.0	52.0	50.0	48.0	46.0	44.0	42.0	40.0	38.0	36.0	34.0	32.0	167.7
80	66.5	64.5	60.5	58.5	55.5	53.5	51.5	49.5	47.5	45.5	43.5	41.5	39.5	37.5	35.5	174.3
90	70.0	68.0	64.0	62.0	59.0	57.0	55.0	53.0	51.0	49.0	47.0	45.0	43.0	41.0	39.0	180.9
100	73.5	71.5	67.5	65.5	62.5	60.5	58.5	56.5	54.5	52.5	50.5	48.5	46.5	44.5	42.5	187.5
110	77.0	75.0	71.0	69.0	66.0	64.0	62.0	60.0	58.0	56.0	54.0	52.0	50.0	48.0	46.0	194.1
120	80.5	78.5	74.5	72.5	69.5	67.5	65.5	63.5	61.5	59.5	57.5	55.5	53.5	51.5	49.5	200.7
130	84.0	82.0	78.0	76.0	73.0	71.0	69.0	67.0	65.0	63.0	61.0	59.0	57.0	55.0	53.0	207.3
140	87.5	85.5	81.5	79.5	76.5	74.5	72.5	70.5	68.5	66.5	64.5	62.5	60.5	58.5	56.5	213.9
150	91.0	89.0	85.0	83.0	80.0	78.0	76.0	74.0	72.0	70.0	68.0	66.0	64.0	62.0	60.0	220.5
160	94.5	92.5	88.5	86.5	83.5	81.5	79.5	77.5	75.5	73.5	71.5	69.5	67.5	65.5	63.5	227.1
170	98.0	96.0	92.0	90.0	87.0	85.0	83.0	81.0	79.0	77.0	75.0	73.0	71.0	69.0	67.0	233.7
180	101.5	99.5	95.5	93.5	90.5	88.5	86.5	84.5	82.5	80.5	78.5	76.5	74.5	72.5	70.5	240.3
190	105.0	103.0	99.0	97.0	94.0	92.0	90.0	88.0	86.0	84.0	82.0	80.0	78.0	76.0	74.0	246.9
200	108.5	106.5	102.5	100.5	97.5	95.5	93.5	91.5	89.5	87.5	85.5	83.5	81.5	79.5	77.5	253.5
210	112.0	110.0	106.0	104.0	101.0	99.0	97.0	95.0	93.0	91.0	89.0	87.0	85.0	83.0	81.0	260.1
220	115.5	113.5	109.5	107.5	104.5	102.5	100.5	98.5	96.5	94.5	92.5	90.5	88.5	86.5	84.5	266.7
230	119.0	117.0	113.0	111.0	108.0	106.0	104.0	102.0	100.0	98.0	96.0	94.0	92.0	90.0	88.0	273.3
240	122.5	120.5	116.5	114.5	111.5	109.5	107.5	105.5	103.5	101.5	99.5	97.5	95.5	93.5	91.5	279.9
250	126.0	124.0	120.0	118.0	115.0	113.0	111.0	109.0	107.0	105.0	103.0	101.0	99.0	97.0	95.0	286.5
260	129.5	127.5	123.5	121.5	118.5	116.5	114.5	112.5	110.5	108.5	106.5	104.5	102.5	100.5	98.5	293.1
270	133.0	131.0	127.0	125.0	122.0	120.0	118.0	116.0	114.0	112.0	110.0	108.0	106.0	104.0	102.0	299.7
280	136.5	134.5	130.5	128.5	125.5	123.5	121.5	119.5	117.5	115.5	113.5	111.5	109.5	107.5	105.5	306.3
290	140.0	138.0	134.0	132.0	129.0	127.0	125.0	123.0	121.0	119.0	117.0	115.0	113.0	111.0	109.0	312.9
300	143.5	141.5	137.5	135.5	132.5	130.5	128.5	126.5	124.5	122.5	120.5	118.5	116.5	114.5	112.5	319.5
310	147.0	145.0	141.0	139.0	136.0	134.0	132.0	130.0	128.0	126.0	124.0	122.0	120.0	118.0	116.0	326.1
320	150.5	148.5	144.5	142.5	139.5	137.5	135.5	133.5	131.5	129.5	127.5	125.5	123.5	121.5	119.5	332.7
330	154.0	152.0	148.0	146.0	143.0	141.0	139.0	137.0	135.0	133.0	131.0	129.0	127.0	125.0	123.0	339.3
340	157.5	155.5	151.5	149.5	146.5	144.5	142.5	140.5	138.5	136.5	134.5	132.5	130.5	128.5	126.5	345.9
350	161.0	159.0	155.0	153.0	150.0	148.0	146.0	144.0	142.0	140.0	138.0	136.0	134.0	132.0	130.0	352.5
360	164.5	162.5	158.5	156.5	153.5	151.5	149.5	147.5	145.5	143.5	141.5	139.5	137.5	135.5	133.5	359.1
370	168.0	166.0	162.0	160.0	157.0	155.0	153.0	151.0	149.0	147.0	145.0	143.0	141.0	139.0	137.0	365.7
380	171.5	169.5	165.5	163.5	160.5	158.5	156.5	154.5	152.5	150.5	148.5	146.5	144.5	142.5	140.5	372.3
390	175.0	173.0	169.0	167.0	164.0	162.0	160.0	158.0	156.0	154.0	152.0	150.0	148.0	146.0	144.0	378.9
400	178.5	176.5	172.5	170.5	167.5	165.5	163.5	161.5	159.5	157.5	155.5	153.5	151.5	149.5	147.5	385.5
410	182.0	180.0	176.0	174.0	171.0	169.0	167.0	165.0	163.0	161.0	159.0	157.0	155.0	153.0	151.0	392.1
420	185.5	183.5	179.5	177.5	174.5	172.5	170.5	168.5	166.5	164.5	162.5	160.5	158.5	156.5	154.5	398.7
430	189.0	187.0	183.0	181.0	178.0	176.0	174.0	172.0	170.0	168.0	166.0	164.0	162.0	160.0	158.0	405.3
440	192.5	190.5	186.5	184.5	181.5	179.5	177.5	175.5	173.5	171.5	169.5	167.5	165.5	163.5	161.5	411.9
450	196.0	194.0	190.0	188.0	185.0	183.0	181.0	179.0	177.0	175.0	173.0	171.0	169.0	167.0	165.0	418.5
460	199.5	197.5	193.5	191.5	188.5	186.5	184.5	182.5	180.5	178.5	176.5	174.5	172.5	170.5	168.5	425.1
470	203.0	201.0	197.0	195.0	192.0	190.0	188.0	186.0	184.0	182.0	180.0	178.0	176.0	174.0	172.0	431.7
480	206.5	204.5	200.5	198.5	195.5	193.5	191.5	189.5	187.5	185.5	183.5	181.5	179.5	177.5	175.5	438.3
490	210.0	208.0	204.0	202.0	199.0	197.0	195.0	193.0	191.0	189.0	187.0	185.0	183.0	181.0	179.0	444.9
500	213.5	211.5	207.5	205.5	202.5	200.5	198.5	196.5	194.5	192.5	190.5	188.5	186.5	184.5	182.5	451.5
510	217.0	215.0	211.0	209.0	206.0	204.0	202.0	200.0	198.0	196.0	194.0	192.0	190.0	188.0	186.0	458.1
520	220.5	218.5	214.5	212.5	209.5	207.5	205.5	203.5	201.5	199.5	197.5	195.5	193.5	191.5	189.5	464.7
530	224.0	222.0	218.0	216.0	213.0	211.0	209.0	207.0	205.0	203.0	201.0	199.0	197.0	195.0	193.0	471.3
540	227.5	225.5	221.5	219.5	216.5	214.5	212.5	210.5	208.5	206.5	204.5	202.5	200.5	198.5	196.5	477.9
550	231.0	229.0	225.0	223.0	220.0	218.0	216.0	214.0	212.0	210.0	208.0	206.0	204.0	202.0	200.0	484.5
560	234.5	232.5	228.5	226.5	223.5	221.5	219.5	217.5	215.5	213.5	211.5	209.5	207.5	205.5	203.5	491.1
570	238.0	236.0	232.0	230.0	227.0	225.0	223.0	221.0	219.0	217.0	215.0	213.0	211.0	209.0	207.0	497.7
580	241.5	239.5	235.5	233.5	230.5	228.5	226.5	224.5	222.5	220.5	218.5	216.5	214.5	212.5	210.5	504.3
590	245.0	243.0	239.0	237.0	234.0	232.0	230.0	228.0	226.0	224.0	222.0	220.0	218.0	216.0	214.0	510.9
600	248.5	246.5	242.5	240.5	237.5	235.5	233.5	231.5	229.5	227.5	225.5	223.5	221.5	219.5	217.5	517.5
610	252.0	250.0	246.0	244.0	241.0	239.0	237.0	235.0	233.0	231.0	229.0	227.0	225.0	223.0	221.0	524.1
620	255.5	253.5	249.5	247.5	244.5	242.5	240.5	238.5	236.5	234.5	232.5	230.5	228.5	226.5	224.5	530.7
630	259.0	257.0	253.0	251.0	248.0	246.0	244.0	242.0	240.0	238.0	236.0	234.0	232.0	230.0	228.0	537.3
640	262.5	260.5	256.5	254.5	251.5	249.5	247.5	245.5	243.5	241.5	239.5	237.5	235.5	233.5	231.5	543.9
650	266.0	264.0	260.0	258.0	255.0	253.0	251.0	249.0	247.0	245.0	243.0	241.0	239.0	237.0	235.0	550.5
660	269.5	267.5	263.5	261.5	258.5	256.5	254.5	252.5	250.5	248.5	246.5	244.5	242.5	240.5	238.5	557.1
670	273.0	271.0	267.0	265.0	262.0	260.0	258.0	256.0	254.0	252.0	250.0	248.0	246.0	244.0	242.0	563.7
680	276.5	274.5	270.5	268.5	265.5	263.5	261.5	259.5	257.5	255.5	253.5	251.5	249.5	247.5	245.5	570.3
690	280.0	278.0	274.0	272.0	269.0	267.0	265.0	263.0	261.0	259.0	257.0	255.0	253.0	251.0	249.0	576.9
700	283.5	281.5	277.5	275.5	272.5	270.5	268.5	266.5	264.5	262.5	260.5	258.5	256.5	254.5	252.5	583.5
710	287.0	285.0	281.0	279.0	276.0	274.0	272.0	270.0	268.0	266.0	264.0	262.0	260.0	258.0	256.0	590.1
720	290.5	288.5	284.5	282.5	279.5	277.5	275.5	273.5	271.5	269.5	267.5	265.5	263.5	261.5	259.5	596.7
730	294.0	292.0	288.0	286.0	283.0	281.0	279.0	277.0	275.0	273.0	271.0	269.0	267.0	265.0	263.0	603.3
740	297.5	295.5	291.5	289.5	286.5	284.5	282.5	280.5	278.5	276.5	274.5	272.5	270.5	268.5	266.5	609.9
750	301.0	299.0	295.0	293.0	290.0											

HIGH VELOCITY JET NOISE PROGRAM - ENGINEERING CORRELATION

COAXIAL FLOW MULTI-TUBE CHECK GAS

*** INPUT ***

NO OF TUBES=	69		
DIA OF TUBES=	.34	AREA=	2.750
NOZZLE OUTER DIA=	5.687		
AR=	7.649	A2R=	5.083
IT28=	1632.	DI28/D3=	3.218
IG=	519.	PG=	14.730
ITR=	101.	DI4/D1=	1.567
EJECTOR AREA RATIO PARAMETER=	1.333	V=	0.0
PLUG DIA=	2.440	CANT=	5.000

*** OUTPUT ***

OUTER NOZZLE EXIT CONDITIONS			
IPR=	2389.2	PH02R=	.333
		DUCT H=	.749

INNER NOZZLE EXIT CONDITIONS	
IR=	1209.8
	PH0R=
	.0445

COAXIAL NOZZLE FLOW PARAMETERS

MERGED FLOW CONDITIONS			
US=	1024.5	PH0S=	.0550
		D5=	6.178
		A5=	29.978

MIXED FLOW CONDITIONS			
UG=	1209.8	PH6=	2627.78
		A6=	37.627

ACoustic VELOCITY JET NOISE PROGRAM - ENGINEERING CORRELATION

NOAL FLOW MULTITIME CHECK CASE

- * MEASURED NOISE
- * 32.0 V FOOT ABC
- * 40 FGA
- * 519.0 DEGREE STANDARD DAY

ACOUSTIC ANGLE FROM INLET

FOUR	21	30	40	5	61	71	80	90	100	110	120	130	140	150	160	PWL
50	82.7	83.2	83.6	84.1	84.8	85.5	86.5	87.8	89.4	90.8	93.7	97.0	100.2	102.5	102.9	155.1
60	83.4	83.9	84.4	84.9	85.6	86.3	87.3	88.6	89.9	91.8	94.5	97.4	100.1	101.8	101.7	154.9
80	84.0	84.5	84.9	85.5	86.2	86.9	87.9	89.2	90.7	92.6	95.1	97.6	99.8	100.8	100.2	154.6
100	84.3	84.8	85.3	85.8	86.5	87.3	88.3	89.6	91.2	93.2	95.4	97.5	99.2	99.6	98.5	154.2
120	84.5	85.0	85.5	86.0	86.7	87.5	88.5	89.7	91.6	93.5	95.5	97.3	98.5	98.3	96.6	153.8
140	84.5	85.0	85.5	86.0	86.7	87.5	88.5	89.7	91.6	93.6	95.4	96.7	97.4	96.6	94.3	153.2
200	84.2	84.8	85.3	85.8	86.5	87.3	88.3	89.6	91.6	93.5	95.1	96.1	96.3	94.9	92.2	152.5
250	83.8	84.4	84.9	85.4	86.2	86.9	87.9	89.2	91.4	93.2	94.5	95.2	95.1	93.1	89.9	151.8
315	83.2	83.8	84.3	84.9	85.6	86.4	87.4	88.7	90.9	92.7	93.8	94.2	93.7	91.1	87.5	150.9
400	82.5	83.0	83.5	84.1	84.8	85.6	86.6	87.9	90.2	91.9	92.9	92.9	92.0	89.0	84.9	149.9
500	81.6	82.1	82.7	83.2	84.0	84.8	85.8	87.1	89.4	91.3	91.8	91.6	90.4	87.0	82.6	148.8
630	80.5	81.1	81.6	82.2	83.0	83.7	84.7	86.0	88.4	90.0	90.6	90.1	88.7	84.9	80.1	147.7
800	79.3	79.8	80.4	81.0	81.7	82.5	83.5	84.8	87.3	88.7	89.1	88.5	86.8	82.6	77.6	146.3
1000	78.0	78.6	79.1	79.7	80.5	81.3	82.3	83.6	86.0	87.3	87.7	86.9	85.0	80.5	75.2	145.0
1250	76.6	77.2	77.8	78.3	79.1	79.9	80.9	82.2	84.7	85.8	86.1	85.1	83.1	78.4	73.0	143.6
1600	75.0	75.6	76.2	76.7	77.5	78.3	79.3	80.6	83.1	84.1	84.3	83.2	81.0	76.1	70.5	142.0
2000	73.5	74.1	74.6	75.2	76.0	76.8	77.8	79.1	81.6	82.3	82.6	81.3	79.1	74.0	68.3	140.6
2500	71.9	72.5	73.0	73.6	74.4	75.2	76.2	77.5	80.0	80.5	80.8	79.4	77.0	71.9	65.1	139.2
3150	70.1	70.7	71.2	71.8	72.6	73.4	74.4	75.7	78.3	78.5	78.8	77.3	74.8	69.6	63.9	137.7
4000	68.1	68.7	69.2	69.8	70.6	71.4	72.4	73.7	76.3	76.3	76.6	75.0	72.4	67.1	61.5	136.3
5000	66.6	67.2	67.7	68.3	69.1	69.8	70.8	72.1	74.7	74.5	74.9	73.2	70.5	65.1	59.5	135.1
6300	64.4	65.0	65.4	66.0	66.8	67.6	68.5	69.8	72.5	71.9	72.4	70.6	67.7	62.2	56.9	133.9
8000	61.5	62.1	62.6	63.2	63.9	64.7	65.7	67.0	69.6	68.4	69.3	67.3	64.3	58.7	53.5	132.9
10000	58.3	58.8	59.3	59.9	60.6	61.4	62.4	63.7	66.4	65.4	65.9	63.7	60.3	54.6	49.7	132.2
OASPL	94.7	95.2	95.7	96.2	97.0	97.7	98.7	100.0	102.0	103.7	105.4	106.9	108.2	108.7	108.0	163.9
PWL	100.6	101.2	101.7	102.3	103.1	103.8	104.8	106.1	108.4	109.8	110.7	110.9	110.5	108.7	106.2	
PWL	100.6	101.2	101.7	102.3	103.1	103.8	104.8	106.1	108.4	109.8	110.7	110.9	110.5	108.7	106.2	

NOISE MEASUREMENT PROGRAM - ENGINEERING CORRELATION

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FREQ	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	PNL
50	66.1	65.2	64.7	64.5	64.5	65.1	65.4	65.4	65.4	65.4	65.4	65.4	65.4	65.4	65.4	65.4
63	68.6	67.8	67.3	67.0	67.0	67.5	67.9	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0
80	71.2	70.4	69.9	69.6	69.6	70.1	70.5	70.5	70.5	70.5	70.5	70.5	70.5	70.5	70.5	70.5
100	73.6	72.8	72.3	72.0	72.0	72.5	72.9	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0
125	75.9	75.1	74.7	74.4	74.4	74.9	75.3	75.4	75.4	75.4	75.4	75.4	75.4	75.4	75.4	75.4
150	78.3	77.5	77.2	77.0	77.0	77.5	77.9	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0
200	80.5	79.8	79.4	79.3	79.3	79.8	80.2	80.3	80.3	80.3	80.3	80.3	80.3	80.3	80.3	80.3
250	82.5	81.8	81.5	81.4	81.4	81.9	82.3	82.4	82.4	82.4	82.4	82.4	82.4	82.4	82.4	82.4
315	84.4	83.7	83.4	83.3	83.3	83.8	84.2	84.3	84.3	84.3	84.3	84.3	84.3	84.3	84.3	84.3
400	86.3	85.6	85.3	85.2	85.2	85.7	86.1	86.2	86.2	86.2	86.2	86.2	86.2	86.2	86.2	86.2
500	87.7	87.0	86.7	86.6	86.6	87.1	87.5	87.6	87.6	87.6	87.6	87.6	87.6	87.6	87.6	87.6
630	89.1	88.4	88.1	88.0	88.0	88.5	88.9	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0
800	90.2	89.5	89.2	89.1	89.1	89.6	90.0	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1
1000	91.0	90.3	90.0	89.9	89.9	90.4	90.8	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9
1250	91.6	90.9	90.6	90.5	90.5	91.0	91.4	91.5	91.5	91.5	91.5	91.5	91.5	91.5	91.5	91.5
1500	92.1	91.4	91.1	91.0	91.0	91.5	91.9	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0
2000	93.6	92.9	92.6	92.5	92.5	93.0	93.4	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5
2500	94.7	94.0	93.7	93.6	93.6	94.1	94.5	94.6	94.6	94.6	94.6	94.6	94.6	94.6	94.6	94.6
3150	95.1	94.4	94.1	94.0	94.0	94.5	94.9	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
4000	95.6	94.9	94.6	94.5	94.5	95.0	95.4	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5
5000	96.1	95.4	95.1	95.0	95.0	95.5	95.9	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0
6300	96.6	95.9	95.6	95.5	95.5	96.0	96.4	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5
8000	97.1	96.4	96.1	96.0	96.0	96.5	96.9	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0
10000	97.6	96.9	96.6	96.5	96.5	97.0	97.4	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5
12500	98.1	97.4	97.1	97.0	97.0	97.5	97.9	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0	98.0
15000	98.6	97.9	97.6	97.5	97.5	98.0	98.4	98.5	98.5	98.5	98.5	98.5	98.5	98.5	98.5	98.5
20000	99.1	98.4	98.1	98.0	98.0	98.5	98.9	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0
25000	99.6	98.9	98.6	98.5	98.5	99.0	99.4	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5
31500	100.1	99.4	99.1	99.0	99.0	99.5	99.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
40000	100.6	99.9	99.6	99.5	99.5	100.0	100.4	100.5	100.5	100.5	100.5	100.5	100.5	100.5	100.5	100.5
50000	101.1	100.4	100.1	100.0	100.0	100.5	100.9	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
63000	101.6	100.9	100.6	100.5	100.5	101.0	101.4	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5
80000	102.1	101.4	101.1	101.0	101.0	101.5	101.9	102.0	102.0	102.0	102.0	102.0	102.0	102.0	102.0	102.0
100000	102.6	101.9	101.6	101.5	101.5	102.0	102.4	102.5	102.5	102.5	102.5	102.5	102.5	102.5	102.5	102.5
GASPL	103.0	102.3	102.0	101.9	101.9	102.4	102.8	102.9	102.9	102.9	102.9	102.9	102.9	102.9	102.9	102.9
PNL	110.0	111.1	111.3	111.4	111.4	111.9	112.3	112.4	112.4	112.4	112.4	112.4	112.4	112.4	112.4	112.4
PNL	112.9	111.1	111.3	111.4	111.4	111.9	112.3	112.4	112.4	112.4	112.4	112.4	112.4	112.4	112.4	112.4

LOW VELOCITY JET NOISE PROGRAM - ENGINEERING CORRELATION

DATA FROM MULTI-TONE CHECK CASE

1 SHOCK (M-F) NOISE
2 32.5% FOOT APL
3 40 FGA
4 51% DEGREE STANDARD DAY

ACOUSTIC ANGLE FROM INLET

FOUR	20	40	60	80	100	120	140	160	180	190
50	42.5	42.5	42.5	44.1	44.6	44.6	44.6	44.6	44.6	44.6
60	46.1	46.1	46.1	47.8	48.3	48.3	48.3	48.3	48.3	48.3
70	49.9	49.9	49.9	51.7	52.2	52.2	52.2	52.2	52.2	52.2
80	53.4	53.4	53.4	55.2	55.7	55.7	55.7	55.7	55.7	55.7
90	56.9	56.9	56.9	58.7	59.2	59.2	59.2	59.2	59.2	59.2
100	60.4	60.4	60.4	62.2	62.7	62.7	62.7	62.7	62.7	62.7
110	63.9	63.9	63.9	65.7	66.2	66.2	66.2	66.2	66.2	66.2
120	67.4	67.4	67.4	69.2	69.7	69.7	69.7	69.7	69.7	69.7
130	70.9	70.9	70.9	72.7	73.2	73.2	73.2	73.2	73.2	73.2
140	74.4	74.4	74.4	76.2	76.7	76.7	76.7	76.7	76.7	76.7
150	77.9	77.9	77.9	79.7	80.2	80.2	80.2	80.2	80.2	80.2
160	81.4	81.4	81.4	83.2	83.7	83.7	83.7	83.7	83.7	83.7
170	84.9	84.9	84.9	86.7	87.2	87.2	87.2	87.2	87.2	87.2
180	88.4	88.4	88.4	90.2	90.7	90.7	90.7	90.7	90.7	90.7
190	91.9	91.9	91.9	93.7	94.2	94.2	94.2	94.2	94.2	94.2
200	95.4	95.4	95.4	97.2	97.7	97.7	97.7	97.7	97.7	97.7
210	98.9	98.9	98.9	100.7	101.2	101.2	101.2	101.2	101.2	101.2
220	102.4	102.4	102.4	104.2	104.7	104.7	104.7	104.7	104.7	104.7
230	105.9	105.9	105.9	107.7	108.2	108.2	108.2	108.2	108.2	108.2
240	109.4	109.4	109.4	111.2	111.7	111.7	111.7	111.7	111.7	111.7
250	112.9	112.9	112.9	114.7	115.2	115.2	115.2	115.2	115.2	115.2
260	116.4	116.4	116.4	118.2	118.7	118.7	118.7	118.7	118.7	118.7
270	119.9	119.9	119.9	121.7	122.2	122.2	122.2	122.2	122.2	122.2
280	123.4	123.4	123.4	125.2	125.7	125.7	125.7	125.7	125.7	125.7
290	126.9	126.9	126.9	128.7	129.2	129.2	129.2	129.2	129.2	129.2
300	130.4	130.4	130.4	132.2	132.7	132.7	132.7	132.7	132.7	132.7
310	133.9	133.9	133.9	135.7	136.2	136.2	136.2	136.2	136.2	136.2
320	137.4	137.4	137.4	139.2	139.7	139.7	139.7	139.7	139.7	139.7
330	140.9	140.9	140.9	142.7	143.2	143.2	143.2	143.2	143.2	143.2
340	144.4	144.4	144.4	146.2	146.7	146.7	146.7	146.7	146.7	146.7
350	147.9	147.9	147.9	149.7	150.2	150.2	150.2	150.2	150.2	150.2
360	151.4	151.4	151.4	153.2	153.7	153.7	153.7	153.7	153.7	153.7
370	154.9	154.9	154.9	156.7	157.2	157.2	157.2	157.2	157.2	157.2
380	158.4	158.4	158.4	160.2	160.7	160.7	160.7	160.7	160.7	160.7
390	161.9	161.9	161.9	163.7	164.2	164.2	164.2	164.2	164.2	164.2
400	165.4	165.4	165.4	167.2	167.7	167.7	167.7	167.7	167.7	167.7
410	168.9	168.9	168.9	170.7	171.2	171.2	171.2	171.2	171.2	171.2
420	172.4	172.4	172.4	174.2	174.7	174.7	174.7	174.7	174.7	174.7
430	175.9	175.9	175.9	177.7	178.2	178.2	178.2	178.2	178.2	178.2
440	179.4	179.4	179.4	181.2	181.7	181.7	181.7	181.7	181.7	181.7
450	182.9	182.9	182.9	184.7	185.2	185.2	185.2	185.2	185.2	185.2
460	186.4	186.4	186.4	188.2	188.7	188.7	188.7	188.7	188.7	188.7
470	189.9	189.9	189.9	191.7	192.2	192.2	192.2	192.2	192.2	192.2
480	193.4	193.4	193.4	195.2	195.7	195.7	195.7	195.7	195.7	195.7
490	196.9	196.9	196.9	198.7	199.2	199.2	199.2	199.2	199.2	199.2
500	200.4	200.4	200.4	202.2	202.7	202.7	202.7	202.7	202.7	202.7
510	203.9	203.9	203.9	205.7	206.2	206.2	206.2	206.2	206.2	206.2
520	207.4	207.4	207.4	209.2	209.7	209.7	209.7	209.7	209.7	209.7
530	210.9	210.9	210.9	212.7	213.2	213.2	213.2	213.2	213.2	213.2
540	214.4	214.4	214.4	216.2	216.7	216.7	216.7	216.7	216.7	216.7
550	217.9	217.9	217.9	219.7	220.2	220.2	220.2	220.2	220.2	220.2
560	221.4	221.4	221.4	223.2	223.7	223.7	223.7	223.7	223.7	223.7
570	224.9	224.9	224.9	226.7	227.2	227.2	227.2	227.2	227.2	227.2
580	228.4	228.4	228.4	230.2	230.7	230.7	230.7	230.7	230.7	230.7
590	231.9	231.9	231.9	233.7	234.2	234.2	234.2	234.2	234.2	234.2
600	235.4	235.4	235.4	237.2	237.7	237.7	237.7	237.7	237.7	237.7
610	238.9	238.9	238.9	240.7	241.2	241.2	241.2	241.2	241.2	241.2
620	242.4	242.4	242.4	244.2	244.7	244.7	244.7	244.7	244.7	244.7
630	245.9	245.9	245.9	247.7	248.2	248.2	248.2	248.2	248.2	248.2
640	249.4	249.4	249.4	251.2	251.7	251.7	251.7	251.7	251.7	251.7
650	252.9	252.9	252.9	254.7	255.2	255.2	255.2	255.2	255.2	255.2
660	256.4	256.4	256.4	258.2	258.7	258.7	258.7	258.7	258.7	258.7
670	259.9	259.9	259.9	261.7	262.2	262.2	262.2	262.2	262.2	262.2
680	263.4	263.4	263.4	265.2	265.7	265.7	265.7	265.7	265.7	265.7
690	266.9	266.9	266.9	268.7	269.2	269.2	269.2	269.2	269.2	269.2
700	270.4	270.4	270.4	272.2	272.7	272.7	272.7	272.7	272.7	272.7
710	273.9	273.9	273.9	275.7	276.2	276.2	276.2	276.2	276.2	276.2
720	277.4	277.4	277.4	279.2	279.7	279.7	279.7	279.7	279.7	279.7
730	280.9	280.9	280.9	282.7	283.2	283.2	283.2	283.2	283.2	283.2
740	284.4	284.4	284.4	286.2	286.7	286.7	286.7	286.7	286.7	286.7
750	287.9	287.9	287.9	289.7	290.2	290.2	290.2	290.2	290.2	290.2
760	291.4	291.4	291.4	293.2	293.7	293.7	293.7	293.7	293.7	293.7
770	294.9	294.9	294.9	296.7	297.2	297.2	297.2	297.2	297.2	297.2
780	298.4	298.4	298.4	300.2	300.7	300.7	300.7	300.7	300.7	300.7
790	301.9	301.9	301.9	303.7	304.2	304.2	304.2	304.2	304.2	304.2
800	305.4	305.4	305.4	307.2	307.7	307.7	307.7	307.7	307.7	307.7
810	308.9	308.9	308.9	310.7	311.2	311.2	311.2	311.2	311.2	311.2
820	312.4	312.4	312.4	314.2	314.7	314.7	314.7	314.7	314.7	314.7
830	315.9	315.9	315.9	317.7	318.2	318.2	318.2	318.2	318.2	318.2
840	319.4	319.4	319.4	321.2	321.7	321.7	321.7	321.7	321.7	321.7
850	322.9	322.9	322.9	324.7	325.2	325.2	325.2	325.2	325.2	325.2
860	326.4	326.4	326.4	328.2	328.7	328.7	328.7	328.7	328.7	328.7
870	329.9	329.9	329.9	331.7	332.2	332.2	332.2	332.2	332.2	332.2
880	333.4	333.4	333.4	335.2	335.7	335.7	335.7	335.7	335.7	335.7
890	336.9	336.9	336.9	338.7	339.2	339.2	339.2	339.2	339.2	339.2
900	340.4	340.4	340.4	342.2	342.7	342.7	342.7	342.7	342.7	342.7
910	343.9	343.9	343.9	345.7	346.2	346.2	346.2	346.2	346.2	346.2
920	347.4	347.4	347.4	349.2	349.7	349.7	349.7	349.7	349.7	349.7
930	350.9	350.9	350.9	352.7	353.2	353.2	353.2	353.2	353.2	353.2
940	354.4	354.4	354.4	356.2	356.7	356.7	356.7	356.7	356.7	356.7
950	357.9	357.9	357.9	359.7	360.2	360.2	360.2	360.2	360.2	360.2
960	361.4	361.4	361.4	363.2	363.7	363.7	363.7	363.7	363.7	363.7
970	364.9	364.9	364.9	366.7	367.2	367.2	367.2	367.2	367.2	367.2
980	368.4	368.4	368.4	370.2	370.7	370.7	370.7	370.7	370.7	370.7
990	371.9	371.9	371.9	373.7	374.2	374.2	374.2	374.2	374.2	374.2
1000	375.4	375.4	375.4	377.2	377.7	377.7	377.7	377.7	377.7	377.7
1010	378.9	378.9	378.9	380.7	381.2	381.2	381.2	381.2	381.2	381.2
1020	382.4	382.4	382.4	384.2	384.7	384.7	384.7	384.7	384.7	384.7
1030	385.9	385.9	385.9	387.7	388.2	388.2	388.2	388.2	388.2	388.2
1040	389.4	389.4	389.4	391.2	391.7	391.7	391.7	391.7	391.7	391.7
1050	392.9	392.9	392.9	394.7	395.2	395.2	395.2	395.2	395.2	395.2
1060	396.4	396.4	396.4	398.2	398.7	398.7	398.7	398.7	398.7	398.7
1070	399.9	399.9	399.9	401.7	402.2	402.2	402.2	402.2	402.2	402.2
1080	403.4	403.4	403.4	405.2	405.7	405.7	405.7	405.7	405.7	405.7
1090	406.9	406.9	406.9	408.7	409.2	409.2	409.2	409.2	409.2	409.2
1100	410.4	410.4	410.4	412.2	412.7	412.7	412.7	412.7	412.7	412.7
1110	413.9	413.9	413.9	415.7	416.2	416.2	416.2	416.2	416.2	416.2

PROGRAM - ENGINEERING CORRELATION

TABLE 1 - CORRELATION DATA

1. TOTAL NOISE

2. 1/3 OCTAVE BAND

3. 1/3 OCTAVE BAND

4. 1/3 OCTAVE BAND

5. 1/3 OCTAVE BAND

6. 1/3 OCTAVE BAND

7. 1/3 OCTAVE BAND

8. 1/3 OCTAVE BAND

9. 1/3 OCTAVE BAND

10. 1/3 OCTAVE BAND

11. 1/3 OCTAVE BAND

12. 1/3 OCTAVE BAND

13. 1/3 OCTAVE BAND

14. 1/3 OCTAVE BAND

15. 1/3 OCTAVE BAND

16. 1/3 OCTAVE BAND

17. 1/3 OCTAVE BAND

18. 1/3 OCTAVE BAND

19. 1/3 OCTAVE BAND

20. 1/3 OCTAVE BAND

21. 1/3 OCTAVE BAND

22. 1/3 OCTAVE BAND

23. 1/3 OCTAVE BAND

24. 1/3 OCTAVE BAND

25. 1/3 OCTAVE BAND

26. 1/3 OCTAVE BAND

27. 1/3 OCTAVE BAND

28. 1/3 OCTAVE BAND

29. 1/3 OCTAVE BAND

30. 1/3 OCTAVE BAND

31. 1/3 OCTAVE BAND

32. 1/3 OCTAVE BAND

33. 1/3 OCTAVE BAND

34. 1/3 OCTAVE BAND

35. 1/3 OCTAVE BAND

36. 1/3 OCTAVE BAND

37. 1/3 OCTAVE BAND

38. 1/3 OCTAVE BAND

39. 1/3 OCTAVE BAND

40. 1/3 OCTAVE BAND

41. 1/3 OCTAVE BAND

42. 1/3 OCTAVE BAND

43. 1/3 OCTAVE BAND

44. 1/3 OCTAVE BAND

45. 1/3 OCTAVE BAND

46. 1/3 OCTAVE BAND

— 10 —

11-11-11

$$1.750 = 1.750$$

100

17. 11. 1971

111
A21 = 1.555

$$124 = 175^\circ \quad - 124/10 = 3.9\%$$

14.71

771

THE UNIVERSITY OF CHICAGO

11

*** 117110 ***

WILLIAM - 27 - 11115

124 = 2670
125 = 2671

92.

111

372

UNIFORM NOZZLE EXIT CONDITIONS

$$x = 1 \quad x = 2 \quad x = 3 \quad x = 4 \quad x = 5 \quad x = 6 \quad x = 7 \quad x = 8 \quad x = 9 \quad x = 10$$

●

COMMUNAL - 40776 FL., PARATIFLS

MERGED FLOW CONDITIONS

$$15 = 1475.7 \quad 1475.7 = 1475.7$$

• 954 •

2.473

$$A5 =$$

5.612

AIXF: Flow Controls

16 = 1449.2

TTT, =

• 27

10. 4

4-15.254

$$\Delta h =$$

5.423

[illegible]

TOTAL 10159

• 2600.0 FOOT ALTITUDE

0.0 FOOT SIDELINE

793 011

519. DEGREE STANDARD DAY

ACQUISITION FROM INFANT

AREA	20	30	40	5	60	70	80	90	100	110	120	130	140	150	160	PWL
50	53.6	56.3	58.1	59.2	60.1	60.6	63.9	64.2	63.5	64.6	69.4	73.8	77.4	79.9	78.3	156.4
60	56.3	58.3	61.0	62.1	62.2	62.2	65.5	65.4	65.2	66.3	71.0	75.2	78.4	80.4	78.3	156.4
70	58.3	60.3	62.6	63.7	64.1	64.1	67.1	67.4	66.9	67.9	72.3	76.2	79.0	80.5	77.4	156.4
80	60.3	62.3	64.1	65.2	65.6	65.6	68.1	68.7	68.3	69.4	73.5	76.9	79.3	80.2	76.9	156.4
90	62.3	64.3	66.4	67.5	67.9	67.9	70.4	71.0	70.9	71.9	75.2	77.7	79.0	78.5	74.0	156.4
100	64.3	66.4	68.5	69.6	69.9	69.9	72.4	72.0	72.0	73.0	75.7	77.9	78.5	77.3	72.1	156.4
110	66.4	68.5	70.6	71.7	71.9	71.9	74.4	73.0	72.9	74.0	76.9	77.7	77.8	75.8	70.0	156.3
120	68.5	70.6	72.7	73.8	73.9	73.9	76.4	74.1	74.0	75.0	77.9	77.6	77.0	74.3	67.9	156.4
130	70.6	72.7	74.8	75.9	75.9	75.9	78.4	75.3	75.1	76.1	77.6	77.6	76.3	73.0	66.4	156.9
140	72.7	74.8	76.9	77.9	77.9	77.9	80.4	76.5	76.4	77.4	78.9	78.1	76.2	72.5	66.0	157.7
150	74.8	76.9	79.0	80.1	80.1	80.1	82.6	78.5	78.4	79.4	80.9	79.0	76.7	72.6	66.2	159.0
160	76.9	79.0	81.1	82.2	82.2	82.2	84.7	80.7	80.6	81.6	83.1	80.7	77.2	72.8	65.9	160.5
170	79.0	81.1	83.2	84.3	84.3	84.3	86.8	82.7	82.6	83.6	85.1	82.7	77.6	72.7	65.1	162.0
180	81.1	83.2	85.3	86.4	86.4	86.4	88.9	84.9	84.8	85.8	87.3	84.9	77.0	71.4	62.8	164.2
190	83.2	85.3	87.4	88.5	88.5	88.5	91.0	87.0	86.9	87.9	89.4	87.0	74.1	67.7	57.8	166.0
200	85.3	87.4	89.5	90.6	90.6	90.6	93.1	89.0	88.9	89.9	91.4	89.0	69.6	62.4	51.1	167.4
210	87.4	89.5	91.6	92.7	92.7	92.7	95.2	91.1	91.0	92.1	93.6	91.1	56.8	47.5	31.6	168.7
220	89.5	91.6	93.7	94.8	94.8	94.8	97.3	93.2	93.1	94.2	95.7	93.2	47.5	35.5	15.1	169.1
230	91.6	93.7	95.8	96.9	96.9	96.9	99.4	95.3	95.2	96.3	97.8	95.3	39.9	27.7	4.2	169.4
240	93.7	95.8	97.9	99.0	99.0	99.0	101.5	97.4	97.3	98.4	100.0	97.4	24.0	7.7	-25.2	156.8
250	95.8	97.9	100.0	101.1	101.1	101.1	103.6	99.5	99.4	100.5	102.0	99.5	11.1	-23.2	-52.9	155.6
260	97.9	100.0	102.1	103.2	103.2	103.2	105.7	101.6	101.5	102.6	104.1	101.6	-34.7	-67.1	-132.7	154.9
270	100.0	102.1	104.2	105.3	105.3	105.3	107.8	103.7	103.6	104.7	106.2	103.7	89.8	89.1	85.6	174.0
280	102.1	104.2	106.3	107.4	107.4	107.4	109.9	105.8	105.7	106.8	108.3	105.8	95.1	91.1	85.0	
290	104.2	106.3	108.4	109.5	109.5	109.5	112.0	107.9	107.8	108.9	110.4	107.9	97.7	92.5	85.0	

Feb 2 1963

3.7 PROGRAM SOURCE CODE LISTING

This section contains the FORTRAN IV source code listing for the engineering correlation computer program, suitable for running on the CDC 7600 computer. The listing of subroutines is as follows:

- (1) Main Program (MS)
- (2) SUB1 (Contains SUB1 through SUB6)
- (3) EXTP
- (4) SHKSUB
- (5) PNLPT
- (6) TPNLC
- (7) PNTT8
- (8) A block data listing
- (9) EJECTS

73

[illegible]


```

CALL FATP
DO 20 J=1,245(K,J)=X(J)
CONTINUE
300 CALL PDL013(K)=V(2)*0(P)=V(1)*0(P)=V(3)
CONTINUE$FETURN$
CSUR5
ENTRY SUR5
C PML CALCULATION
09=0.0 J=0.7 I=1.245(K,J)=1.245 J=1.155(K,J)=J+1.0
YJ=1.501*(COS((A1-5)*0.1/180)-COS((AJ+5)*0.1/180))
A2=A2+12.227525E-064E-06YJ*1000(S(J,1)/10)
CONTINUE
3204 Y(I)=1 *ALOG10(A2)+130*1.24939
09=09+10**((Y(I)/10)
CONTINUE
3207 09=10**ALOG10(09)
RETURN$
CSUR6
ENTRY SUR6
C RESET VARIABLES
DO 340 J=1,245(K,J)=1.155(K,J)=5(I,J)
3401 CONTINUE$Y(I,J)=Y(I)
CONTINUE$FETURN$
CSUR2
ENTRY SUR2
C DELTA SPL CORRECTION
DO 340 J=1,245(K,J)=1.155(K,J)=5(I,J)+79
3404 CONTINUE$FETURN$
CSUR6
ENTRY SUR6
C SPL AND PML ADDITION
09=0
DO 350 J=1,245(K,J)=1.155(K,J)=1.155
S(I,J)=10*ALOG10(10**((S(I,J)/10)+10**((I,J)/10))
CONTINUE
3503 Y(J)=10*ALOG10(10**((Y(I,J)/10)+10**((I,J)/10))
09=09+10**((Y(J)/10)
CONTINUE
3506 09=10*ALOG10(09)
RETURN$END

```


SYMBOL	LINE	7/74	05/74	FILE	10/33/593	10/33/593
60	600	63=(7/)* (G1-62))*62				
61	650	COR=0*G1*PA*(11-011)/10.01				
		IF (COR>0.0) SHIFT APPLIC				
		IF (COR>0.0) GO TO 662				
		IF (COR>0.0) GO TO 661				
		F(J)=X(J)-COR \$ GO TO 670				
65	661	IF (J=0.1) GO TO 663 \$ F(J)=X(J-1)-COR \$ GO TO 670				
	662	IF (J=0.24) GO TO 663 \$ F(J)=X(J-1)-COR \$ GO TO 670				
	663	F(J)=X(J)-COR				
		GO TO 670				
70	680	X(J)=E(J)				
		RETURN				
		END				

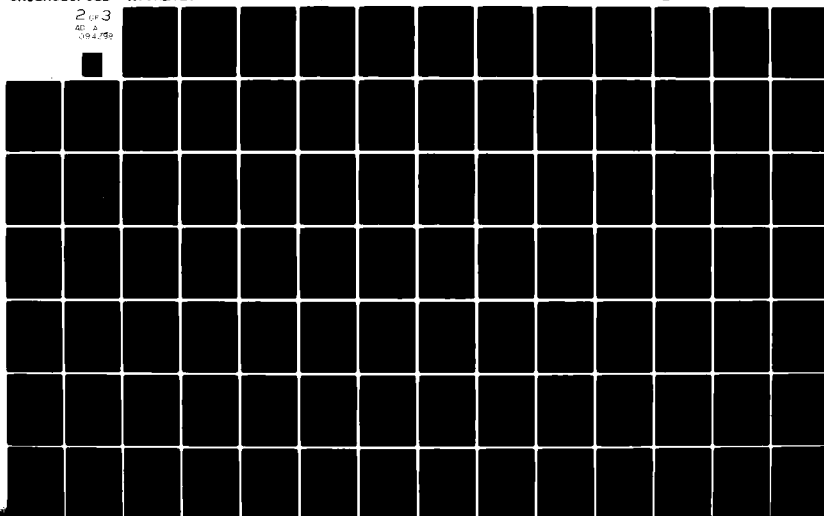
[illegible]

AD-A094 298

GENERAL ELECTRIC CO CINCINNATI OH AIRCRAFT ENGINE GROUP F/G 20/1
HIGH VELOCITY JET NOISE SOURCE LOCATION AND REDUCTION. TASK 6. --ETC(U)
MAR 79 P R GLIEBE, R E MOTSINGER, A SIECKMAN DOT-05-30034
R79AE6290 FAA-RD-76-79-6A NL

UNCLASSIFIED

2 of 3
AD-A
1984-09



```

C
C *STEP 6*
DO 35 I=3,23
  SP(1) = (SP(1)+SP(I+1)+SP(I+2))/3.
35
C
C *STEP 7*
  SPLPP(1) = SPL(1)
  SPLPP(2) = SPL(2)
  SPLPP(3) = SPL(3)
  DO 40 I=4,24
    SPLPP(I) = SPLPP(I-1)+SP(1)
40
C
C *STEP 8*
DO 45 I=1,24
  F(I) = SPL(1)-SPLPP(I)
45
C
C *STEP 9 AND 10*
  CMAX = 0.0
  DO 65 I=1,24
    IF (I.GE.11.AND.I.LE.21) GO TO 50
    *FREQ 5.0HZ OR FREQ=500HZ*
    TC2 = F(I)/6.
    TC3 = 3.333
    GO TO 55
  *500 = FREQ = 500HZ*
  TC2 = F(I)/3.
  TC3 = 6.666
  IF (F(I).LT.3.0) GO TO 65
  IF (F(I).GE.20.0) GO TO 60
  CMAX = AMAX1(CMAX,TC2)
  GO TO 65
  CMAX = AMAX1(CMAX,TC3)
  CONTINUE
  PICOP=CMAX
  RETURN
END

```

SUBROUTINE DNTT
C DNTT -- PRINT AND EPNL CALC SUBROUTINE

```
COMMON/CH1/L(9,24)*X(24)*F(24)*E(24)*S(15,24)*KK(24,5)*C(15,5)*
1 0(20),R(49),X(49),P(20),R(15,24),Y(24),L(15),RVE(20),
1 S(24),G(2,24),C2(15,2),T(20),D(20),W(5),A(4)*V(3)*E(15,24)
COMMON /CM2/ VR,AD,WR,K1,Y9,TR,TS,RT,P1,Z9,DJ,AJ,H,U,E9
1 TDAV9,C9,DR,DL,VD,09,AB,0,L9,A6,AZ,S6,B9,B9,AL,SL,AN,NE,LT
COMMON /CM3/ TIAS(2),TICASE(6),IDCASE(6),IDENT(6)
REAL L,KK,K1
PEAL MP,KT
```

```
C
1000 FORMAT(////50X,3H* ,2A10)
1001 FORMAT(50A,1H*,F7.1,* FOOT ALTITUDE*)
1002 FORMAT(50X,1H*,F7.1,* FOOT SIDE LINE*)
1004 FORMAT(50X,1H*,F7.1,* FOOT ARC*)
1006 FORMAT(50A,9H* NO EGA )
1008 FORMAT(50X,11H* FULL EGA )
1009 FORMAT(50X,21H* 100 FOOT LAYER EGA )
1010 FORMAT(50X,1H*,F6.0,*DEGREE STANDARD DAY*//50X,*ACOUSTIC ANGLE*,
1 * FROM INLET*/*, FREQ 20 30 40 50 60 70*,
1 * 60 90 100 110 120 130 140 150*,
1 * 160 PNL*)
1012 FORMAT(F7.0,16F7.1)
1014 FORMAT(1X,A6,16F7.1)
1016 FORMAT(* EPNL*,F6.1)
1017 FORMAT(1H1///.33X,*HIGH VELOCITY JET NOISE PROGRAM - *
1 *ENGINEERING CORRELATION*//)
1018 FORMAT(1X,6A10)
```

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```
C
PRINT 1,17
WRITE(6,1018)TICASE(1),I=1,6)
999 PRINT 1000,(TIAS(1),I=1,2)
IF (E(1,1)) GO TO 160
IF (SL,NE,0,0) GO TO 159 $ IF (V(0,NE,0,0) GO TO 159
PRINT 1002,H $ GO TO 170
PRINT 1001,ALT
PRINT 1002,SL
GO TO 170
160 PRINT 1004,H
170 IF (E9-1) 171,172,173
171 PRINT 1006 $ GO TO 200
172 PRINT 1008 $ GO TO 200
173 PRINT 1009
200 PRINT 1010,T0
DO 320 J=1,24
PRINT 1012,F(J),(S(1,J),I=1,15),Y(J)
CONTINUE
TIAS(1)=SHOASPL
PRINT 1,16,TIAS(1),100(I),I=1,15),09
TIAS(1)=3HPNL
PRINT 1,16,TIAS(1),1(I),I=1,15)
TIAS(1)=4HPNL
PRINT 1,16,TIAS(1),P(1),I=1,15)
PRINT 1,5
325 FORMAT(1H0)
DO 1015 I=1,15
```

```

1015 P(1)=T(1)
XXX=V0 * IF (V0.GT.0.) GO TO B025
V0=V0.
B025 CONTINUE
IF (V0.GT.0.) GO TO 1040
IF (V0.EQ.1.) GO TO 1040
EPNL CALCULATION
1100 I=0.
MP=0.0
Z1=0.
Z3=0.
SJ=0.
70 C FLYOVER TIME CALCULATION
DO 500 JJ=1,15
AJ=(JJ+1)*10
T(JJ)=(H/2)*SIN(AJ*PI/180.)/A0
WJ=MZ(SIN(AJ*PI/180.)/COS(AJ*PI/180.))
7670 ASK=(AJ-10)*PI/180.
KT=(H/2)*(SIN(ASK)/COS(ASK))-WJ/V0
7685 IF (JJ.EQ.1) GO TO 490
D(JJ)=T(JJ)-D(JJ-1)+KT-T(JJ-1)
GO TO 500
490 D(JJ)=D(JJ)+KI
500 CONTINUE
KT=D(R)
DO 540 JJ=1,15
T(JJ)=D(JJ)-KT
CONTINUE
PHLT MAX SEARCH
85 C
DO 610 JJ=1,15
IF (P(J).GT.MP) GO TO 590
60 TO 610
MP=P(J)
TJ=T(J)
90 C CONTINUE
610 CJ=MP-10.
INITIAL AND FINAL TIME DETERMINATION
95 C
DO 680 JJ=1,15
IF (P(J).LT.CJ) GO TO 680
IF (JJ-1).LT.1) GO TO 750
D7=T(J)-T(JJ-1)+CJ*(P(J)-CJ)/(P(J)-P(JJ-1))
60 TO 690
100 C CONTINUE
DO 740 JJ=1,15
JJ=14-JJ
IF (P(J).LT.CJ) GO TO 740
IF (JJ-1.GT.15) GO TO 780
D9=T(J)+(T(JJ-1)-T(J))*P(J)-CJ)/(P(J)-P(JJ-1))
60 TO 720
740 CONTINUE
750 Z1=P(2)-P(1)
D7=T(1)-(P(1)-CJ)/Z1*(T(2)-T(1))
60 TO 790
780 Z3=P(14)-P(15)
D9=T(14)-(P(15)-CJ)/Z3*(T(15)-T(14))
1116 Z09
P(16)=CJ

```

115 C INTEGRATION START
 920 IE(71,0,0,0) GO TO 880

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

11=IF(1,0,0,0)

1=1

GO TO 900

3333

C		FREQUENCY DETERMINATION	
60	755	44=1.3 \$ 16.18=2) 52.510.540	
61	671	PI=1.0 \$ 2.318.89 \$ GO TO 550	
62	672	PI=1.0 \$ 2.318.89 \$ GO TO 550	
63	673	PI=1.0 \$ 2.318.89 \$ GO TO 550	
64	674	PI=1.0 \$ 2.318.89 \$ GO TO 550	
65	675	PI=1.0 \$ 2.318.89 \$ GO TO 550	
C		IF (A(1)*NF.10) GO TO 590	
C		PI=KXZ.0J-2	
C		PI=KXZ.0J-2	
C		X4=DX(1P)	
C		A1=0.1 100 736 1=9.15 \$ K6=0 \$ A10=((1.1)*10-90)*PI/180	
C		A1=4*PI*CO5(AJR)/(1.5*CO5(AJR))*2*(K4*CO5(AJR))*2	
C		A2=1.0*LOG10(1-A1)	
C		D0 695 K=1.25 \$ XJ=((2.5*X(J))/25)*K	
C		ZJ=XJ/A(J)	
C		S2J=-1.19136*32.76997*ZJ-37.633732*ZJ**2+23.970385*ZJ**3	
C		S2J=S2J-19.115712*ZJ**4+2.4045214*ZJ**5-.23576959*ZJ**6	
C		S2J=S2J-11.6	
C		EFFECT FOR ALL REFLECTIONS	
C		D0 675 JJ=1.11*IF (JJ.6T.1) GO TO 660SLP=(D3/2-S6)*TAN(AJR)*XJ	
C		GO TO 670	
C		L2=L2+D3*TAN(AJR)	
C		IF (L2.6T.13) GO TO 680	
C		CO-TIME	
C		K6=K6+10*((1.1-1)*A2+S2J)/10	
C		CO-TIME	
C		POWER LEVEL REDUCTION	
C		AJ=((1.1)*10 \$ K6=10*ALOG10(K6)	
C		YJ=1.5*PI*CO5((AJ-S)*PI/180)-CO5((AJ.5)*PI/180)	
C		A3=A3*(2.227525E-6*4E-8*YJ*10** (K6/10))	
C		CO-TIME	
C		A3=1.0*ALOG10(A3)+130-6.45175	
C		A4=A4+10** (A3/10)	
C		CONTINUE \$ A4=10*ALOG10(A4/3)	
C		DISSIPATIVITY EFFECTS	
C		D0 A15 1=1.15 \$ AJ=((1.1)*10 \$ A5=A4	
C		IF (AJ.0J-50) GO TO 600 \$ IF (AJ.LT.0J) GO TO A10	
C		A5=A4/2	
C		E11.1)=E1((1.1)*A5*1.2)	
C		CO-TIME	
C		RETURN \$ END	
C		RETURN \$ END	

3.0 REFERENCES

1. Clapper, W.S., Sieckman, A., Motsinger, R.E., et al., "High Velocity Jet Noise Source Location and Reduction: Task 3 - Experimental Investigation of Suppression Principles," General Electric Company, FAA-RD-76-79, 111-1, (to be published).
2. Stringas, E.J., Sieckman, A., Whittaker, R., Wolf, J., et al, "High Velocity Jet Noise Source Location and Reduction: Task 6 - Noise Abatement Nozzle Design Guide," General Electric Company, FAA-RD-76-79, V1, (to be published).
3. "Standard Values of Atmospheric Absorption as a Function of Temperature and Humidity for Use in Evaluating Aircraft Flyover Noise," SAE, ARP 866, August 1964.
4. "Method of Calculating the Attenuation of Aircraft Ground-to-Ground Noise Propagation During Takeoff and Landing," SAE, AIR 923, August 1965.

4.0 UNIFIED AEROACOUSTIC PREDICTION MODEL (M*G*B) COMPUTER PROGRAM

4.1 INTRODUCTION

This section describes the computational algorithms and associated computer program that provide the necessary link between the symbolic representation of the M*G*B model and the actual numerical results of the prediction method.

The computer program is written in FORTRAN IV language. It has been run on both the GE/Honeywell 6080 and CDC 7600 computers, and can easily be modified for running on other systems. The program subdivides the jet plume utilizing a built-in grid system which requires minimal input for specification. This grid system can be superseded by the user through more complex input if desired. The nozzle geometry is input through discrete point coordinates for each nozzle element boundary, and up to 109 elements can be input for a given case. A maximum of 24 axial stations along the jet plume is permitted, and up to 200 radial points per axial station can be accommodated. These limits can be changed if so desired by modifying the appropriate DIMENSION and COMMON statements in the program logic.

The limiting assumptions made in developing the method have been discussed in Reference 1, but it is appropriate to summarize them here to warn against indiscriminate violation of these limitations. They are as follows:

1. The exhaust nozzle elements should be coplanar; that is, each tube or chute of a multielement configuration should exhaust at the same axial plane. However, nozzle element exit planes can be staggered, provided that the mixing layer of a given element does not impinge on the wall of another element.
2. The jet exhaust gases must all be of the same constituent, for the calculation cannot accommodate gas mixtures or species concentrations.
3. Within any nozzle element, the flow is assumed to be uniform at the exit plane.
4. The time-averaged static pressure is assumed to be constant and uniform throughout the jet flow field and surrounding ambient field.
5. The exhaust nozzle elements must discharge axially, radial mean flow and swirl are neglected in the model.

6. The effects of shock formations on mixing and turbulence levels are neglected.

These assumptions and limitations are those which pertain to the types of problems which can be analyzed. There are, of course, additional assumptions that went into the formulation of the model itself which may restrict the accuracy of the model, but which do not restrict the type of problem which can be analyzed. The user is advised to consult Reference 2 for the details of the model formulation.

4.2 PROGRAM NOMENCLATURE AND SYMBOL CONVENTION

The jet plume and nozzle geometry coordinates are computed in the MAIN routine. The jet plume is divided into KX axial slices, specified by KA ($1 \leq KA \leq KX$). The FORTRAN symbol variables for the various coordinate parameters and indices are shown in Figure 4-1. Note that the radial subdivision, specified by index M ($1 \leq M \leq NR$), proceeds in increments DSIG(KA), from SIG = RMIN(KA) to the maximum value set by NR. The value of NR is determined during the calculation from the location where the axial momentum flux is within a certain tolerance of being equal to the ambient level, i.e.,

$$|RU2 - RU2E(1)| \leq RU2M$$

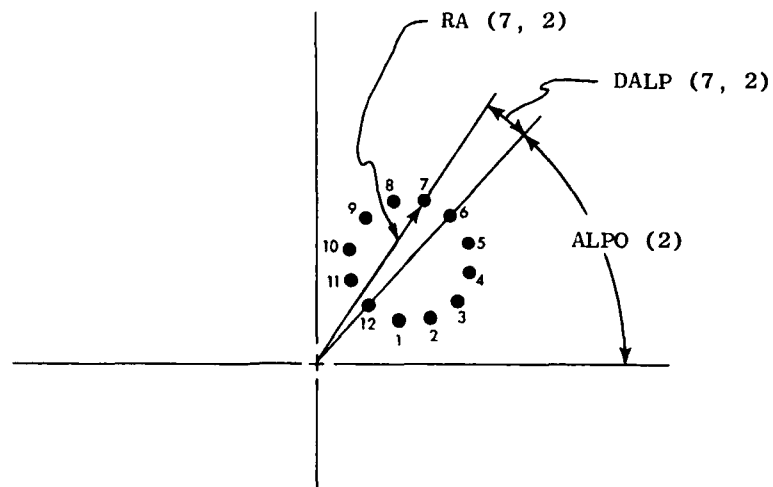
where RU2M is a specified input tolerance. The maximum allowable value of NR can be specified by the input variable IQUIT. The program dimension sizes limit KX and IQUIT to the following maximum values:

$$KX \leq 24$$

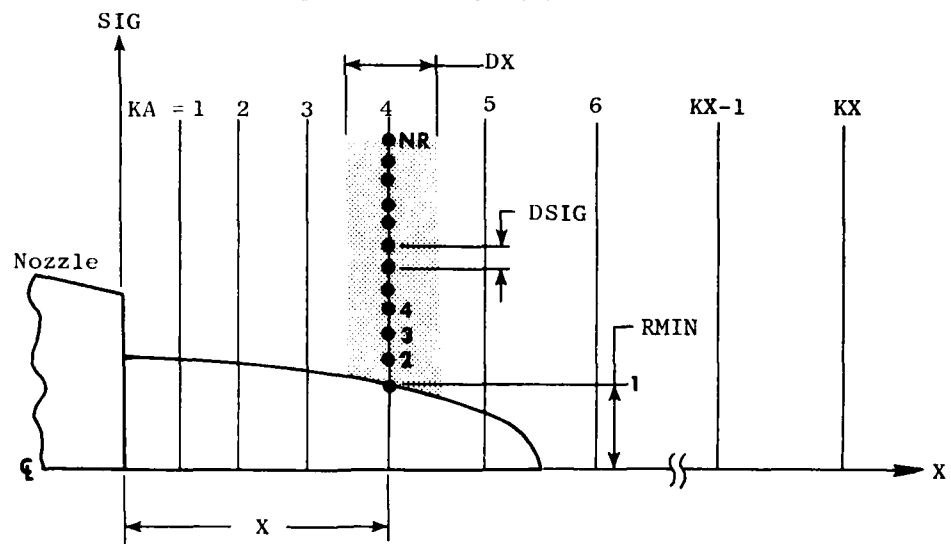
$$IQUIT \leq 200$$

The nozzle geometry itself is input as a number (NEST) of boundary elements. Each element is specified by coordinate pairs RA(I,J) and DALP(I,J), where RA(I,J) denotes the radius and DALP(I,J) denotes the angular increment, as shown in Figure 4-1. The index I denotes the boundary contour point number, and the index J denotes the boundary number. The reference angular location for each boundary is given by ALPO(J). For each boundary, the exit-plane values of total pressure PT(J) and total temperature TT(J) are also specified. Boundary Number One (J=1) is always considered to be the ambient field.

The farfield acoustic calculations are performed on either a constant-radius arc or a sideline parallel to the jet axis, according to whether the input variable NUMANG is set equal to 1 or 2, respectively. For NUMANG = 1, the input DIST is the arc radius; for NUMANG = 2, DIST is the sideline distance. The acoustic arena geometry specification in terms of FORTRAN variables is shown in Figure 4-2. Note that a distinction is made between the source-to-observer distance RSTAR and the nozzle-to-observer distance RADIUS. The observer angle relative to the jet axis THETA is always in units of radians, while the observer angle relative to the inlet axis THETD is in units of degrees. The farfield sound pressure level SPL(I,J) is computed at



(b) Nozzle Exit Plane Example Nozzle
Element Coordinates



(a) Radial/Axial Plane

Figure 4-1. FORTRAN Symbol Convention for Coordinates and
Geometric Variables.

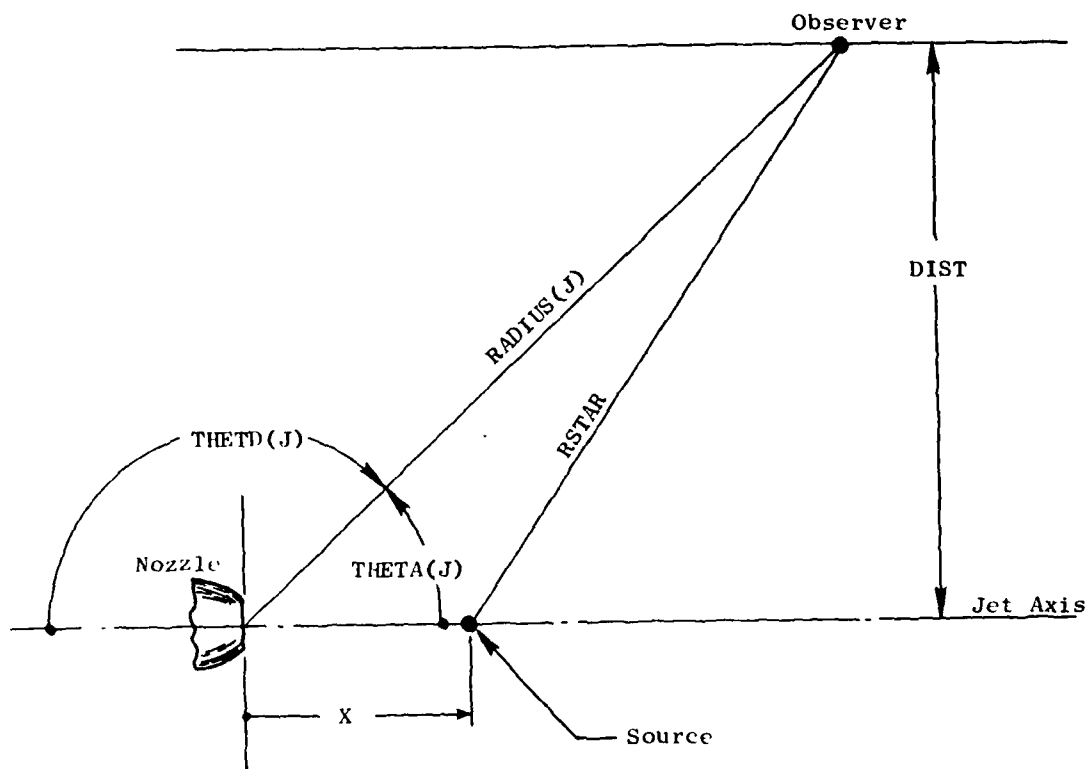


Figure 4-2. FORTRAN Symbol Convention for Acoustic Arena Variables.

every 1/3-octave frequency from FMIN to FMAX, at ten-degree increments from THETD = 20° to 160°.

A list of the important FORTRAN symbols used in the computer program is given in Table 4-1, along with their algebraic equivalents where possible. A complete description of all of the input variables and examples of input preparation are given in Section 4.5.

4.3 DESCRIPTION OF PROGRAM AND SUBROUTINES

A flow chart of the computer program logic is shown in Figure 4-3. It indicates the sequence of operations, the interconnections of various portions of the program, and their functions. A description of the main program and each of the subroutines is given in the following paragraphs.

4.3.1 MAIN

The main program initiates the computation and controls the sequence of operations. It reads the input data, computes the grid system for the aerodynamic flow field, and computes the various required nozzle exit plane flow parameters such as velocities, Mach numbers, momentum and enthalpy fluxes, etc. The main program prints out all input data, nozzle exit conditions, nozzle geometry, and coordinate system parameters.

The main program controls and executes the jet plume flow field computation. After each axial slice has been evaluated, the MAIN program calls subroutine SLICE to perform the requested acoustic calculations. Upon completing the calculations at all axial slices, MAIN then calls OUTPUT to perform some final calculations and print out the farfield noise levels. If additional cases are requested, the entire procedure is repeated, beginning with reading of input data; otherwise the execution is halted.

4.3.2 ARCCOS(X)

This is a function subroutine which computes the principal value of the arc cosine of the variable X. It is used in MAIN in evaluating certain angles relating boundary coordinate points and flow field location points.

4.3.3 ERF(X)

This function subroutine evaluates the error function of argument X using polynomial approximations as given in Reference 3. It is used in MAIN for evaluating flow field integrands.

Table 4-1. List of FORTRAN Symbols.

FORTRAN Symbol	Meaning	Related Subroutines
AA	Air attenuation factor	ATMOS
AAA	Intermediate variable	LSPFIT, MAIN
ABDTH	$ \Delta\phi $	MAIN
ABLE	Intermediate variable	MAIN
ABPA	$ \phi-\alpha $	MAIN
ACH	Mach number M	MAIN
ACHM	Average mach number	MAIN
ACH2	M^2	MAIN
AK	Sound level constant	MAIN, OUTPUT
AL	Lighthill parameter	MAIN
ALFA	Frequency constant	MAIN
ALP	Angle	MAIN
ALPHT	Convection constant α_t	SLICE
ALPØ	Reference boundary angle	MAIN
AMUIN	Input turbulence constant μ_t	MAIN
AMULT	Intermediate value for μ_t	MAIN
AO	Speed of sound C_a	MAIN
ATOTAL	Total flow area	MAIN
B	Intermediate variable	LSPFIT
BETA	Shock strength parameter β	SHOCK
BETAIN	Input turbulence constant β_t	MAIN
BETAMC	Convection constant β_{Mc}	MAIN, SLICE
BK	Intermediate variable	SLICE
BKR	Intermediate variable	MAIN
BOT	Intermediate variable	LSPFIT
BUG	Intermediate variable	MAIN
C	Constant	LSPFIT
CH	Spreading parameter C_h/C_m	MAIN
CHX	Spreading parameter C_{hx}	MAIN
CJOCO	Ratio of C_j/C_a	SLICE
CM	Spreading parameter C_m	MAIN
CMAX	Intermediate variable	TPNLC
CMC	Intermediate variable	MAIN
CMMC	Spreading constant C_1	MAIN
CMVR	Spreading constant C_2	MAIN
CNST	Constant	SLICE
CO	Ambient speed of sound C_a	MAIN, SLICE, SHOCK
COEF	Conversion factor	OUTPUT
CONV	Convection factor	SHOCK
CONVF	Flight dynamic factor	SLICE
CONVO	Convection factor	SLICE
CONV2	Modified convection factor C	SLICE
CON1	Constant	SLICE

Table 4-1. List of FORTRAN Symbols (Continued).

FORTRAN Symbol	Meaning	Related Subroutines
CON2	Constant	SLICE
COST	$\cos \phi$	MAIN
COSTO	$\cos \phi$	MAIN
CP	Specific heat C_p	MAIN
CT	$\cos \theta$	SLICE, CRD
CTSQ	$\cos^2 \theta$	SLICE
CTH	$\cos \theta$	SHOCK
CVR	Intermediate variable	MAIN
DALP	Boundary coordinate $\Delta\alpha$	MAIN
DDTHE	Tolerance on $\Delta\theta$, radians	SLICE
DDTHED	Tolerance on $\Delta\theta$, degrees	SLICE
DELRA	Transformed boundary radius Δv	MAIN
DELSIG	Transformed radius Δr	MAIN
DELTA	Turbulence constant δ_t	MAIN
DELTIN	Input array of δ_t	MAIN
DEQ	Equivalent diameter D_{eq}	MAIN, SLICE, SHOCK
DIA	Reference D_{eq}	MAIN
DIRECT	Directivity factor	SLICE
DIST	Sideline or arc distance	MAIN, SLICE
DJET	Reference diameter	MAIN
DPHI	$\Delta\phi$	MAIN
DRMIN	Δr - minimum value	SLICE
DS	Source strength amplitude	SLICE
DSIG	Δr	MAIN, SLICE
DSPL	Mixing noise pressure	SLICE, OUTPUT
DSPL1	Intermediate variable	SHOCK
DSPL2	Intermediate variable	SHOCK
DTHED	$\Delta\theta$, degrees	SLICE
DTHM	Maximum increment of ϕ	MAIN
DU	Intermediate variable	MAIN
DUDR	$\partial U / \partial r$	MAIN, SLICE
DV	Eddy volume dV	SLICE
DX	Axial step size Δx	MAIN, SLICE
EF	Enthalpy flux	MAIN
EFE	Enthalpy flux	MAIN
EM	Mach number	SLICE
EMACH	Exit Mach number	MAIN, SLICE, OUTPUT
F	Intermediate variable	LSPFIT
FAC	Intermediate variable	PNLC
FC	Center frequency	SLICE
FIRSTU	Flight velocity U_a	MAIN, SLICE
FIS	Intermediate variable	MAIN
FM	Mass flow	MAIN

Table 4-1. List of FORTRAN Symbols (Continued).

FORTRAN Symbol	Meaning	Related Subroutines
FMAX	Maximum observed frequency	MAIN, OUTPUT
FMIN	Minimum observed frequency	MAIN, OUTPUT
FO	Observed frequency	SLICE, SHOCK, OUTPUT
FP	Peak frequency	SHOCK
FR	Frequency ratio	SLICE
FRSQ	Intermediate variable	SLICE
FS	Source frequency	SLICE
GAM	Specific heat ratio γ	MAIN, SHOCK
GAMA	Gas constant parameter	MAIN
GEXP	Gas constant parameter	SHOCK
GM	Shielding function	CRD
GOSQ	Shielding function	CRD
G2	Shielding function	SLICE, CRD
HF	Spectrum function	SLICE
HPSI	Intermediate variable	MAIN
HTR	Stagnation enthalpy	MAIN
I	Index	ALL
IC	Index	LSPFIT
IDENT	Title (80-characters)	MAIN
II	Index	TPNLC
IMH	Index	MAIN
IQUIT	Maximum number of points	MAIN
IS	Index	MAIN
ISSY	Index	MAIN
ISAVE	Index	LSPFIT
ISYM	Symmetry indicator	MAIN
IT	Symmetry indicator	MAIN
J	Index	ALL
JMAX	Maximum band number	OUTPUT, SHOCK, SLICE
JMIN	Minimum band number	OUTPUT, SHOCK, SLICE
J1	Index	CRD
J11	Index	CRD
J2	Index	CRD
J21	Index	CRD
J211	Index	CRD
K	Index, also wave number	MAIN, SLICE, PNL
KN	Surrounding boundary index	MAIN
KNCAS	Case counter	MAIN
KNK	Surrounding boundary index	MAIN
KX	Number of axial slices	MAIN
L	Index	MAIN
LAVG	Shock spacing	SHOCK
LEAF	Number of boundary leaves	MAIN

Table 4-1. List of FORTRAN Symbols (Continued).

FORTRAN Symbol	Meaning	Related Subroutines
LEAV	Number of boundary leaves	MAIN
LINE	Printout counter	MAIN
LPHI	Number of flow field leaves	MAIN
LQ	Index	MAIN
M	Index	MAIN, SLICE
MACH	Mach number	SLICE
MAXNOY	Maximum noy value	PNLC
MC	Convection Mach number	SLICE, SHOCK, CRD
MCIN	Input array of M_c	SLICE
MIN	Input array of M_0	CRD
MJ	Jet exit Mach number	SHOCK
N	Index, also number of shocks	MAIN, SHOCK, LSPFIT
NBREF	Reference boundary number	MAIN
NCASE	Number of cases	MAIN
NCBDY	Number of centerbody points	MAIN
NCELL	Number of shock cells	MAIN, SHOCK
NCOUNT	Counter	LSPFIT
NN	Acoustic calculation selector	MAIN, SLICE
NODE	Intermediate variable	MAIN
NOV	Minimum number of points	MAIN
NOY	Noy value	PNLC
NPAGE	Page counter	MAIN
NPR	Printout counter	MAIN
NPRINT	Printout selector	MAIN, SLICE
NPTS	Number of points	LSPFIT
NR	Number of points	SLICE, CRD
NR1	Index	SLICE
NTP	Number of turning points	SLICE, CRD
NUM	Number of boundary points	MAIN
NUMANG	Arena selector	MAIN, SLICE
NUMK	Number of boundary points	MAIN
NXC	Index	LSPFIT
OAPWL	Overall power level	OUTPUT
OASPL	Overall sound pressure level	OUTPUT, PNLC
OBSTN	Observed Strouhal number	OUTPUT
OMEGR	Source radian frequency	SLICE
PAA	Ambient static pressure	MAIN
PC	Intermediate variable	PNLC
PGC	Gas constant parameter	MAIN
PHI	Angle ϕ	MAIN
PI	Constant π	MAIN, SLICE, OUTPUT
PI02	$\pi/2$	CRD
PI2	2π	MAIN

Table 4-1. List of FORTRAN Symbols (Continued).

FORTRAN Symbol	Meaning	Related Subroutines
PNDB	PNdB	PNLC
PNL	PNL	OUTPUT, PNLC
PNLT	PNL_t , tone-corrected PNL	OUTPUT
POWER	Exponent	MAIN
PS	Ambient static pressure	MAIN, SHOCK
PSQ	Square of acoustic pressure	OUTPUT
PSQM	Mixing noise $\overline{p^2}$	SHOCK
PSQS	Shock noise $\overline{p^2}$	SHOCK
PSQT	Total noise $\overline{p^2}$	SHOCK
PT	Stagnation pressure	MAIN, SHOCK
PWL	Power level	OUTPUT
PWR	Sound power, watts	OUTPUT
Q	Intermediate variable	MAIN
RA	Boundary coordinate radius	MAIN
RAD	Flow integration variable R_0	MAIN
RADO	Flow integration variable R_0	MAIN
RADIUS	Nozzle-to-observer radius R	SLICE, OUTPUT, ATMOS
RADX	Argument R_0/C_{mx}	MAIN
RCBDY	Centerbody radial coordinate	MAIN
PRCRIT	Critical pressure ratio	SHOCK
RCRC	Intermediate variable	MAIN
RFO	Intermediate variable	OUTPUT
RHO	Density ρ	MAIN
RHOE	Ambient density ρ_a	MAIN, SLICE
RHOESQ	ρ^2	SLICE
RHOR	Azimuthally-averaged ρ	MAIN, SLICE
RIN	Input radius	SLICE, CRD
RJET	Reference jet density ratio	MAIN
RMIN	Minimum value of r	MAIN
RMINEX	Exit plane value of RMIN	MAIN
RMINSQ	Square of RMIN	MAIN
RMNSQE	Square of RMINEX	MAIN
RMP	Dummy variable	MAIN
RND	Normalized radius r/D_{eq}	MAIN
ROOT	Root (zero) of g^2	SLICE
ROOT2	$\sqrt{2}$	SLICE
RO	Source radius r_0	CRD
RSIG	Turning point radius r_σ	SLICE, CRD
RSIG1	$r_{\sigma 1}$	CRD
RSIG2	$r_{\sigma 2}$	CRD
RSORSQ	Source location correction $(R^*/R)^2$	SLICE
RSTAR	Source-to-observer radius R^*	SLICE

Table 4-1. List of FORTRAN Symbols (Continued).

FORTRAN Symbol	Meaning	Related Subroutines
RU	Mass flux ρU	MAIN
RU2	Momentum flux ρU^2	MAIN
RU2E	Exit plane value of ρU^2	MAIN
RU2M	Minimum value of ρU^2	MAIN
RU2REF	Reference value of ρU^2	MAIN
R1	Intermediate variable	CRD
R2	Intermediate variable	CRD
S	Intermediate variable	TPNLC
SA	Intermediate variable	MAIN
SAC	Intermediate value of τ_ϕ	MAIN
SACO	Intermediate value of τ_ϕ	MAIN
SAR	Intermediate value of τ_r	MAIN
SARO	Intermediate value of τ_r	MAIN
SAX	Intermediate value of τ_x	MAIN
SAXO	Intermediate value of τ_x	MAIN
SBAR	Intermediate variable	TPNLC
SDU	Intermediate value of $\partial U / \partial r$	MAIN
SEFE	Integral of enthalpy flux	MAIN
SGN	Sign	LSPFIT
SGN1	Sign	CRD
SGN2	Sign	CRD
SG1	Intermediate variable	CRD
SG2	Intermediate variable	CRD
SHIELD	Shielding integral	SLICE, CRD
SIC	Intermediate value of τ_ϕ	MAIN
SIG	Radius r	MAIN
SIGN	Sign	ERF
SIGSQ	r^2	MAIN
SIGR	Radius r	MAIN, SLICE
SINT	Sin θ	MAIN
SINTO	Sin θ_0	MAIN
SIR	Intermediate value of τ_r	MAIN
SIX	Intermediate value of τ_x	MAIN
SPL	SPL array	ALL
SPLL	Intermediate variable	TPNLC
SPLMAX	Maximum SPL	SHOCK
SPLP	Intermediate variable	TPNLC
SPLPP	Intermediate variable	TPNLC
SPLU	Intermediate variable	TPNLC
SRU	Mass flux integral	MAIN
SRUM	Mass flux integral	MAIN
SRU2	Momentum flux integral	MAIN
SRU2M	Momentum flux integral	MAIN

Table 4-1. List of FORTRAN Symbols (Continued).

FORTRAN Symbol	Meaning	Related Subroutines
SS	SPL array	PNLC
SSPL	Shock noise SPL array	SHOCK
STC	Azimuthal shear stress τ_ϕ	MAIN
STR	Radial shear stress τ_r	MAIN
STRFR	Radial coordinate stretching factor	MAIN
STRFX	Axial coordinate stretching factor	MAIN
STX	Axial shear stress τ_x	MAIN
SUE	Reference velocity	MAIN
SUM	Sum	OUTPUT
SUMNOY	Sum of noy value	PNLC
SUMSPL	Sum of SPL	PNLC
SUM1	Sum	CRD
SUM2	Sum	CRD
SU8	Integral of source strength	MAIN
SU8M	Integral of source strength	MAIN
SV2	Square of velocity	MAIN
S1	Intermediate variable	LSPFIT
T	Temperature	ERF, MAIN
TA	Intermediate variable	MAIN
TAA	Ambient static temperature	MAIN
TAO	Intermediate variable	MAIN
TAU	Total shear stress τ	MAIN
TAUR	Azimuthal average of τ	MAIN, SLICE
TC2	Intermediate variable	TPNLC
TC3	Intermediate variable	TPNLC
TE	Exit static temperature	MAIN
TEMP	Normalized temperature T/T_a	SLICE
TERM	Directivity factor	SLICE
TH	Angle ϕ	MAIN
THCR	Critical angle θ_{cr}	SHOCK
TERM	Directivity factor	SLICE
THE	Angle θ	SLICE, CRD
THETA	Observer angle θ , radians	SLICE, OUTPUT
THETD	Observer angle θ_I , degrees	SLICE, OUTPUT, SHOCK
THO	θ_0	MAIN
THT	Observer angle θ_I , radians	SHOCK
T1	Intermediate value of enthalpy flux	MAIN
TOP	Intermediate variable	LSPFIT
TSR	Static temperature	MAIN
TSTD	Circumferential asymmetry test parameter	MAIN
TSTH	Circumferential asymmetry test parameter	MAIN
TSTHL	Circumferential asymmetry test parameter	MAIN
TSTL	Circumferential asymmetry test parameter	MAIN

Table 4-1. List of FORTRAN Symbols (Concluded).

FORTRAN Symbol	Meaning	Related Subroutines
TT	Stagnation temperature	MAIN
TTR	Stagnation temperature	MAIN
TURBIN	Turbulence intensity, u'	MAIN
U	Mean velocity	MAIN
UAP	Intermediate variable	MAIN
UAVG	Mass-average of U at x	MAIN
UC	Convection velocity U_c	SHOCK
UE	Exit plane velocity U_j	MAIN, SHOCK
UGLY	Intermediate variable	MAIN
UJET	Reference exit velocity	MAIN
UMAX	Maximum local value of U at x	MAIN
UND	Normalized value of U, $U/UREF$	MAIN
UNITS	Constant for units conversion	MAIN, OUTPUT
UR	Azimuthal average of U	MAIN, SLICE
UREF	Reference exit velocity	MAIN
U8	Intermediate value of source strength	MAIN
U8I	Integral of source strength	MAIN
VA	Intermediate value of momentum	MAIN
VAO	Intermediate value of momentum	MAIN
VI	Intermediate value of momentum	MAIN
VMAX	Maximum of velocities inside and outside	MAIN
VMIN	Minimum of velocities inside and outside	MAIN
VO	Flight velocity U_a	SHOCK
VR	Velocity ratio $VMIN/VMAX$	MAIN
WITHIN	Dummy variable	LSPFIT
X	Axial distance x	MAIN, SLICE
XCBDY	Centerbody axial coordinate	MAIN
XD	Intermediate variable	LSPFIT
XE	Exit plane axial coordinate	MAIN
XND	Normalized axial coordinate X/D_{eq}	MAIN
XOR	Variable x/R	SLICE
X1	Intermediate variable for curve fitting	LSPFIT
X13	Intermediate variable for curve fitting	LSPFIT
X4	Intermediate variable for curve fitting	LSPFIT
X43	Intermediate variable for curve fitting	LSPFIT
Y	Intermediate variable for curve fitting	LSPFIT
YC	Intermediate variable for curve fitting	LSPFIT
YI	Intermediate variable for curve fitting	LSPFIT
Y3	Intermediate variable for curve fitting	LSPFIT

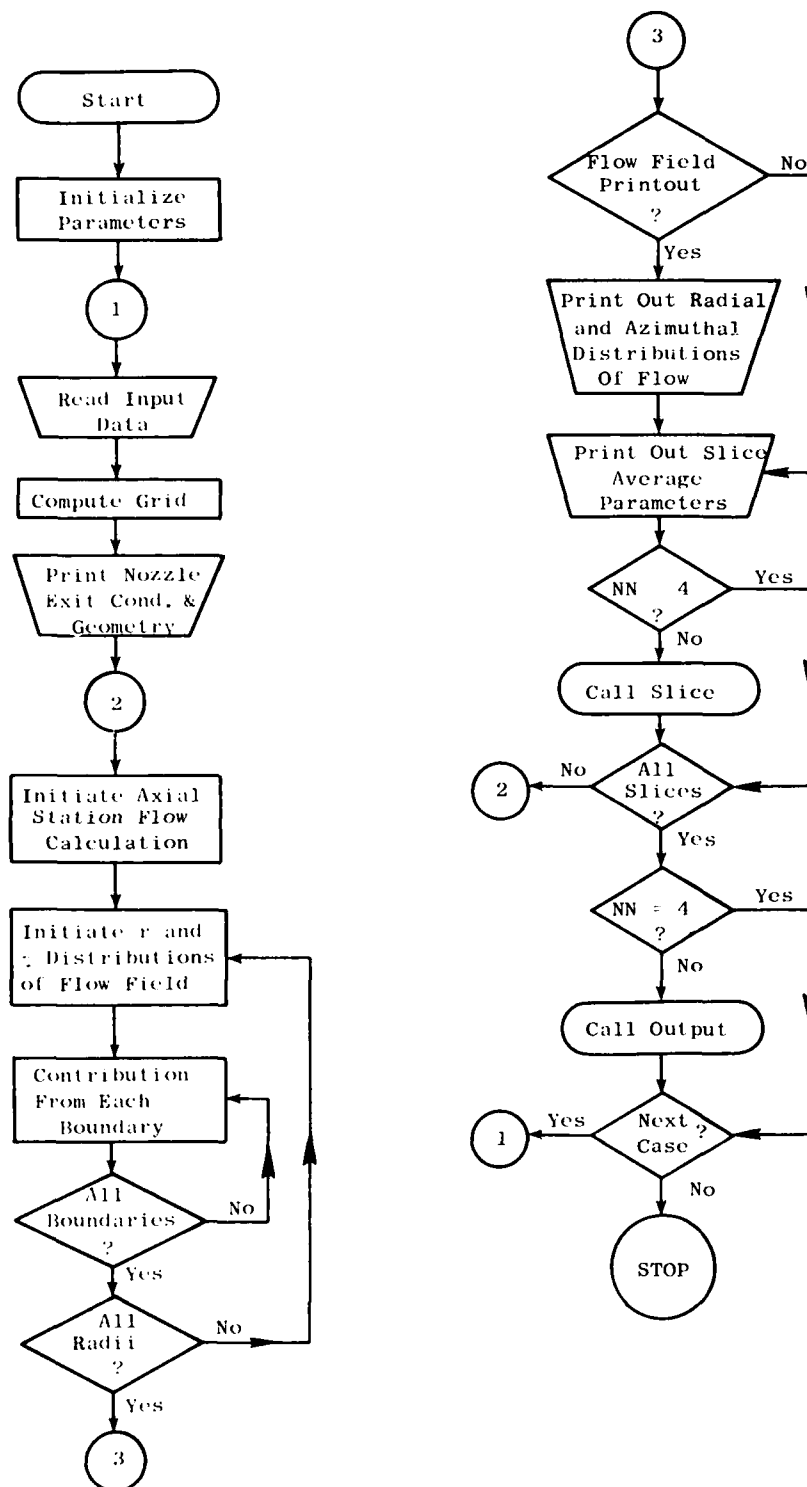
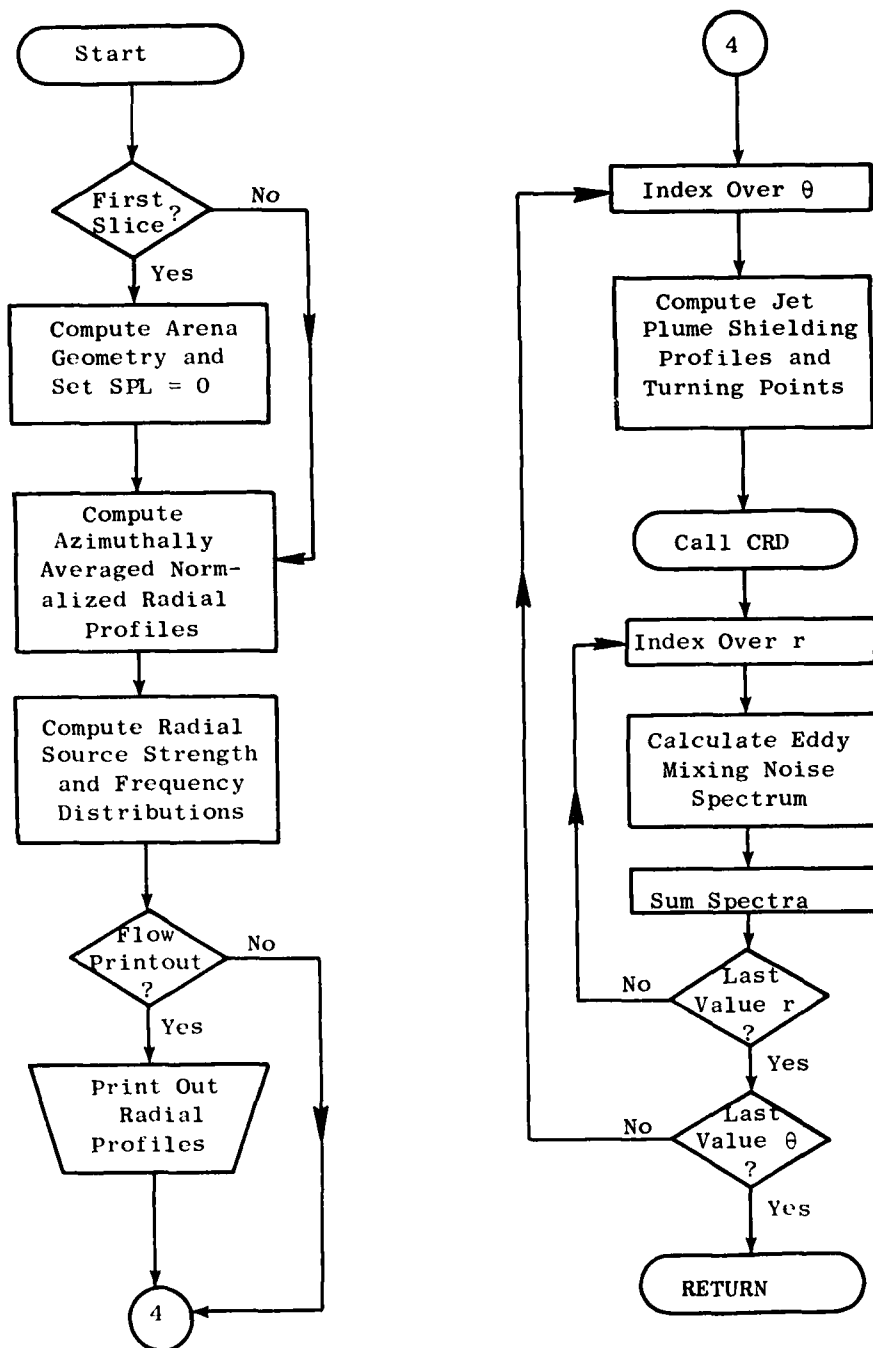
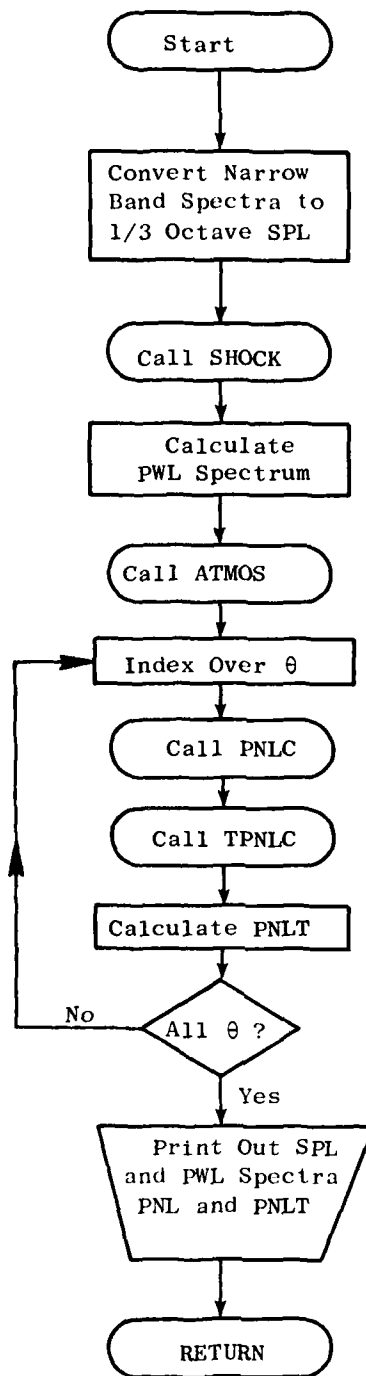


Figure 4-3. Computer Program Flow Chart.



(b) Subroutine SLICE

Figure 4-3. Computer Program Flow Chart (Continued).



(c) Subroutine OUTPUT

Figure 4-3. Computer Program Flow Chart (Concluded).

4.3.4 LSPFIT

Subroutine LSPFIT is a curve-fitting routine which utilizes least-squares polynomial fits of second order to perform interpolation, differentiation and integration of input discrete-point data. The calling statement is:

```
CALL LSPFIT(X, Y, N, XC, YC, NC, NF, A)
```

where (X, Y) are the input data coordinates (N values of each), XC are the values of X where output is requested, YC are the output functions, NC is the number of output data points, and NF indicates the type of output desired. The coding for NF is as follows:

NF = 0, YC are interpolated values of Y

NF = 1, YC are derivatives of Y

NF = -1, YC is the integral of Y from
XC(1) to XC(J), $1 \leq J \leq NC$.

The parameter A is the second derivative of Y. Subroutine LSPFIT is used in MAIN to interpolate input plug/centerbody geometry coordinates at various axial stations in the flow field, and to obtain radial gradients of density from the computed density profiles.

4.3.5 SLICE

Subroutine SLICE directs the mixing noise calculation for each axial slice. The calling sequence is as follows:

```
CALL SLICE (X(KA), DSIG(KA), DX, M)
```

where X(KA) is the axial location, DSIG(KA) is the radial step size, DX is the axial slice thickness, and M is the number of radial points in the slice. The flow parameters (which are circumferentially mass-averaged values) are transferred through labeled COMMON statements. Subroutine SLICE computes the acoustic arena geometry parameters THETA, THETD, RADIUS and initializes SPL (I,J) to zero during the first call, skipping this calculation on succeeding calls. The normalized radial profiles of velocity (MACH) and temperature (TEMP) are evaluated, followed by a calculation of source strength amplitude DS and characteristic frequency FS for each radial volume element.

Subroutine SLICE computes the acoustic shielding function profiles $G2(J)$, the number of turning points NTP, and their locations RSIG. Subroutine CRD is then called to calculate the acoustic shielding exponentials and quadrupole directivity functions. Subroutine SLICE then sums up the mixing noise contributions from each radial volume element, factoring in their individual source strengths, characteristic frequencies, spectrum shapes, directivities, and shielding factors. The resulting noise spectrum from each slice is stored as the variable DSPL(I,J), where I denotes the observer angle index and J is the 1/3-octave frequency band index. Upon completing the calculation for a given slice, SLICE returns control to MAIN.

4.3.6 CRD

Subroutine CRD computes the shielding function integrals and quadrupole directivity factors for a given axial slice as a function of radial source location. The radial distributions of normalized velocity (MACH) and temperatures (TEMP) and shielding function (G2) are transferred to CRD through labeled COMMON statements. The calling statement is:

CALL CRD

At each source radius, subroutine CRD interrogates the data to determine which of the six shielding conditions in Figure 4-4 applies, and computes the appropriate shielding integral (β_{01} , β_{02} , or β_{12}) and the appropriate directivity factors. After all radial source volumes have been evaluated, CRD returns control to SLICE.

4.3.7 OUTPUT

Subroutine OUTPUT performs the final acoustic calculations and prints out the far field SPL spectra, OASPL, PNL and PNLT directivities. The calling sequence is as follows:

CALL OUTPUT (EMACH, DJET, RJET, UJET, UNITS)

where EMACH, DJET, RJET, and UJET are the characteristic (usually reference) jet Mach number, diameter, density ratio and velocity, respectively. The parameter UNITS is a conversion factor for converting from lb_f/ft^2 to dynes/cm^2 relative to $0.0002 \text{ dynes}/\text{cm}^2$. Subroutine OUTPUT converts the narrowband spectra from SLICE into 1/3-octave levels. Subroutine SLICE then calls SHOCK to compute SSPL spectra (shock noise) and adds these to the turbulent mixing noise spectra to obtain the total-noise spectra. The corresponding power spectrum (PWL) is then computed, and subroutine ATMOS is then called to correct all SPL spectra for atmospheric attenuation. Subroutines PNLC and TPNLC are then called to calculate perceived noise level

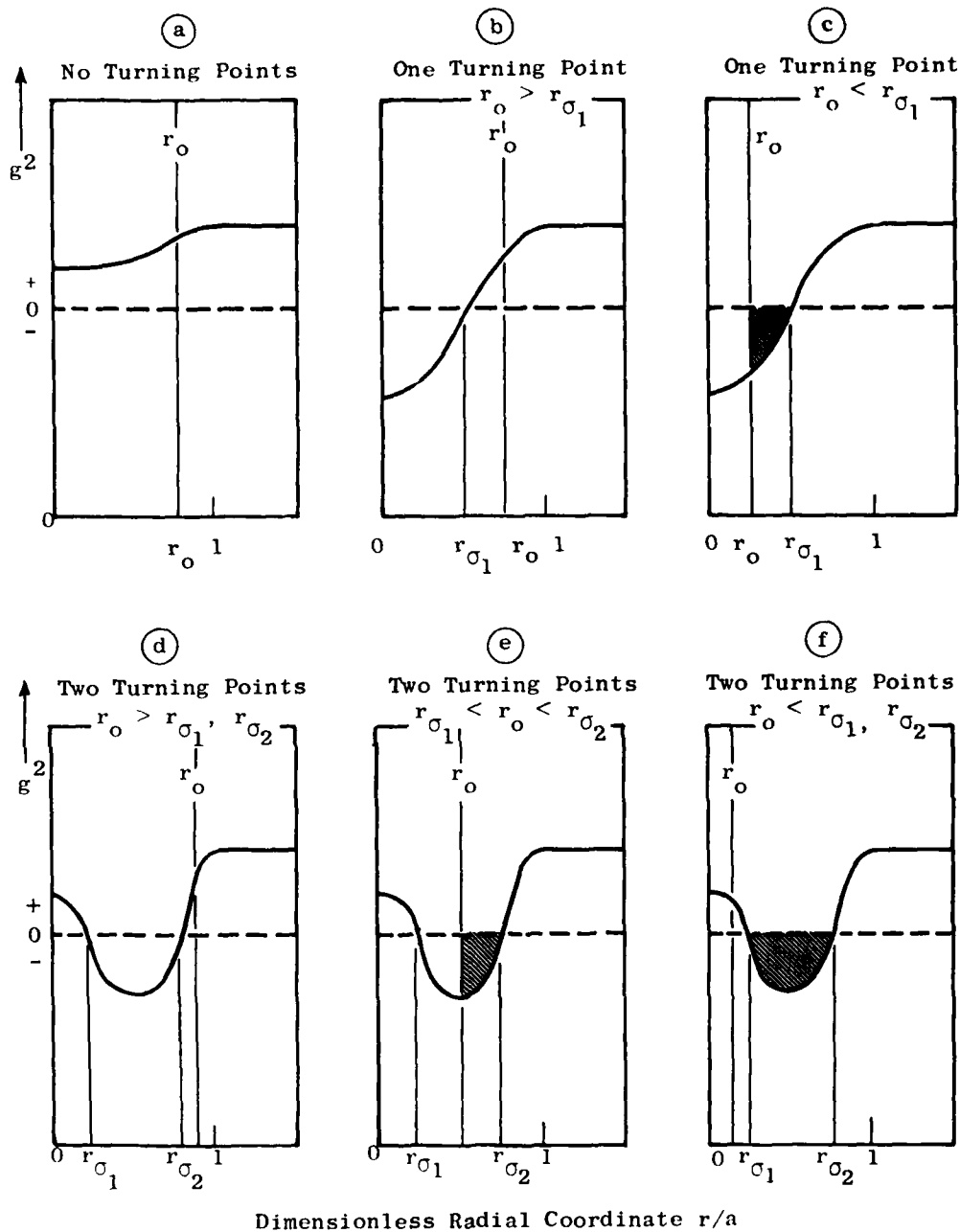


Figure 4-4. Possible Solution Types for a Maximum of Two Turning Points. (Shaded Areas Denote Shielding of Source.)

PNL and tone-corrected noise level PNLT. Finally, overall sound pressure level OASPL is computed, and all of these acoustic parameters are then printed out. Subroutine OUTPUT then returns control to MAIN.

4.3.8 SHOCK

Subroutine SHOCK computes the broadband shock-associated noise spectra at each observer angle. The calling statement is as follows:

CALL SHOCK

All parameters are transferred into and out of this subroutine through labeled COMMON statements. Subroutine SHOCK computes the 1/3-octave SPL spectra for each nozzle boundary element which has a non-zero shock cell number input, NCELL > 0. The individual boundary contributions are summed on a mean-square pressure basis and added to the mixing noise spectra.

4.3.9 ATMOS

Subroutine ATMOS corrects the input SPL spectra for atmospheric attenuation effects using standard-day atmospheric absorption factors for 70% relative humidity and 59° F ambient conditions. The calling sequence is as follows:

CALL ATMOS (SPL, RADIUS)

where SPL(I,J) is the sound pressure spectrum array, I denotes the index for observer angle, J denotes the index on frequency, and RADIUS(I) is the nozzle-to-observer distance array. The atmospheric absorption in dB per 1000 ft, from Reference 4, is corrected to the proper distance RADIUS(J), and the result is subtracted from SPL(I,J). The array of SPL(I,J) returned to OUTPUT is the corrected array.

4.3.10 PNLC

Subroutine PNLC computes the perceived noise level in PNdB at each observer angle from the input 1/3-octave spectra. The calling sequence is as follows:

CALL PNLC (SS, FAC, PNDB, OASPL)

where SS is the input array of either 1/3-octave or octave SPL values, FAC is a constant equal to 0.15 for 1/3-octave and 0.3 for octave levels, PNDB is the output PNL, and OASPL is the conventional overall level. The method used to calculate PNL is taken from Reference 5. The OASPL output from subroutine PNLC is discarded because it only computes the summation for the first 24 values of SS. This is sometimes insufficient for scale model condition, where the frequency range of interest can cover as many as thirty-three 1/3-octave frequency bands.

4.3.11 TPNLC

Subroutine TPNLC determines a pure-tone correction factor to the PNL value as a function of the 1/3-octave SPL spectrum. The calling sequence is as follows:

CALL TPNLC (SPL, PTCOR)

where SPL is the input 1/3-octave spectrum and PTCOR is the correction to be applied to PNL to account for the presence of tones in the spectrum. Subroutine TPNLC reads in SPL and returns PTCOR. The tone correction and detection procedure is based on the method proposed in Reference 7.

4.4 PROGRAM USAGE AND LOGIC

A complete description of the program input variables and input format is given in Section 4.5. A list of notes and suggestions on running the program is also included. A description of program output format, including warning flags and diagnostics, is given in Section 4.6. A sample case listing (including input data card images) is given in Section 4.7 for a 7-tube suppressor nozzle, one of the data-theory comparison cases presented in Reference 2. A complete FORTRAN source listing of the program logic is given in Section 4.8.

Program users should be completely familiar with Appendix A, since there are many pitfalls which can be avoided by giving attention to the recommendations presented therein. The program flexibility permits analysis of nozzle planforms of any imaginable shape, so long as certain input rules and guidelines are followed. When non-axisymmetric nozzles are run, a completely three-dimensional, turbulent, compressible flow field analysis is performed, and input mistakes can be costly in terms of computer processor time. The user should make initial checkout runs for complex nozzles, running just one or two axial slices at first, to ensure that all input is as desired, before running a complete jet plume.

The program is designed to serve as a diagnostic tool, in addition to functioning in the standard jet noise prediction mode. Individual slice calculations can be made by suitable input selection, running each slice (or

axial station) as a separate case. This mode permits evaluation of the relative contributions of each slice at each frequency and observer angle. Various components of the acoustic model can be bypassed to assess, for example, the separate effects of convection, acoustic shielding, etc. The program can also be used to predict only the jet flow field, if desired.

4.5 DESCRIPTION OF INPUT

The input data is supplied through NAMELIST input format, with the exception of the alphanumeric title data card, which precedes the input NAMELIST data. Any number of successive cases can be run consecutively, limited only by the user's execution time available. Each successive case requires a title card (80 - character label in columns 1 - 80), followed by the INPUT NAMELIST. The data from preceding cases remain in storage, so only those variables which are to be changed from the preceding case input value need be included in the INPUT file of succeeding cases.

A suggested input preparation format is given in Table 4-2. Those variables marked by an asterisk (*) have preset values built into the program, and need not be input unless the user desires to override the preset values with a different one. The definitions of each of the input variables given in Table 4-2 are listed in Table 4-3. Again, preset variables are marked by an asterisk (*). The values of those variables which are preset are given in Table 4-4. The format of Table 4-3 is such that a note number (where appropriate) is given for each variable which corresponds to the note number in Section 4.5.1 ("Notes on Input"). These notes give further elaboration on how to specify and prepare the input data.

Table 4-2. Suggested Input Format.

Column
2

(80 - CHARACTER TITLE CARD, COLUMNS 1-80)

\$INPUT

KX* = _____, NEST = _____, LPHI* = _____, ISYM = _____,
 IQUIT* = _____, NN* = _____, NCASE* = _____, NBREF* = _____,
 NPRINT* = _____, NCB DY = _____,

NØV = _____, _____, _____, _____, _____, _____,
 X = _____, _____, _____, _____, _____, _____,
 DSIG = _____, _____, _____, _____, _____, _____,
 BETAIN* = _____, _____, _____, _____, _____, _____,
 DELTIN* = _____, _____, _____, _____, _____, _____,
 AMUIN* = _____, _____, _____, _____, _____, _____,
 RMIN = _____, _____, _____, _____, _____, _____,

XE = 0 _____, _____, _____, _____, _____, _____,
 ALPØ = 0 _____, _____, _____, _____, _____, _____,
 LEAV = 1 _____, _____, _____, _____, _____, _____,
 NUM = 1 _____, _____, _____, _____, _____, _____,
 KN = 1 _____, _____, _____, _____, _____, _____,
 DEQ = _____, _____, _____, _____, _____, _____,
 DS = _____, _____, _____, _____, _____, _____,
 NCELL = _____, _____, _____, _____, _____, _____,

PT = _____, _____, _____, _____, _____, _____,
 TT = _____, _____, _____, _____, _____, _____,

Table 4-2. Suggested Input Format (Concluded).

Column
2

DALP(1,2) = _____, _____, _____, _____, _____,
 DALP(1,3) = _____, _____, _____, _____, _____,
 (etc., for boundary 4, 5, 6, ...NEST)
 RA(1, 2) = _____, _____, _____, _____, _____,
 RA(1, 3) = _____, _____, _____, _____, _____,
 (etc., for boundary 4, 5, 6, ...Nest)
 CM* = _____, CH* = _____, CMVR* = _____, CMMC* = _____,
 GAM = _____, CP = _____, PS = _____, ALFA* = _____,
 DTHM* = _____, RU2M* = _____, AK* = _____, BK* = _____,
 STRFR* = _____, STRFX* = _____, ATOTAL = _____,
 ALPHMC* = _____, BETAMC* = _____,
 NUMANG = _____, DIST = _____, FMIN* = _____, FMAX* = _____,
 ALPHT* = _____, _____, _____, _____, _____, _____,
 XCBDY = _____, _____, _____, _____, _____, _____,
 RCB DY = _____, _____, _____, _____, _____, _____,
 \$

(NEXT CASE, IF ANY)

Table 4-3. Input Variable Definitions.

Variable	Note	Description
KX*		Number of axial stations to be analyzed; a maximum of 24 stations is permitted.
NEST	1	Number of closed boundary contours defining the nozzle exit geometry; a maximum of 110 is permitted.
LPHI	7	Number of symmetric leaves (repeating segments in the nozzle exit planform.
ISYM		Nozzle symmetry indicator; ISYM = 1 for axisymmetric nozzles or completely asymmetric nozzles, = 0 otherwise.
IQUIT		Maximum number of radii at which flow field is calculated (≤ 200).
NN*	12	Acoustic Calculation option indicator.
NCASE*		Number of cases to be run consecutively.
NBREF*		Reference condition boundary number.
NPRINT*	13	Aerodynamic station printout indicator.
NCBDY	9	Number of centerbody input coordinate points. A maximum of 40 is permitted.
NØV		Minimum number of radii at which flow field is to be calculated, for each axial station (KX values required).
X	11	Axial location of each axial station, ft. (KX values required).
DSIG	11	Radial step size to be taken for flow field calculation at each axial station, ft. (KX values required).
BETAIN*	15	Axial shear stress turbulence constant (KX values required).
DELTIN*		Azimuthal shear stress turbulence constant (KX values required).

Table 4-3. Input Variable Definitions. (Continued)

Variable	Note	Description
AMUIN*		Azimuthal velocity gradient turbulence frequency constant (KX values required).
RMIN	9	Minimum radius for flow field calculation at each axial station (KC values required).
XE	8	Axial location of exit plane of each boundary, ft. (NEST values required).
ALP $\emptyset$	2	Reference angle α_0 from which the coordinates of each boundary point are specified, radians (NEST values required).
LEAV	1,4	Number of symmetric leaves (repeating segments) of each boundary (NEST values required).
NUM	1,5	Number of input points (coordinate pairs) to be supplied for each boundary (NEST values required).
KN	1	The number of the boundary which encloses a given boundary (NEST values required).
DEQ	16	Equivalent flow area diameter of each boundary, ft. (NEST values required).
DS	16	Shock-cell spacing characteristic dimension, usually hydraulic diameter, of each boundary, ft. (NEST values required).
NCELL	16	Number of shock cells for each boundary element (NEST values required).
PT	6	Stagnation pressure inside each boundary, lb_f/ft^2 (NEST values required).
TT	6	Stagnation temperature inside each boundary $^{\circ}\text{R}$ (NEST values required).
DALP(I,J)	2,3,5	Angular increment $\Delta\alpha$ from preceding boundary point which locates the given boundary point I on boundary J, radians (omit boundary number 1, ambient field).

Table 4-3. Input Variable Definitions (Continued).

Variable	Note	Description
RA (I,J)	2,3,5	Radial coordinates of boundary point I on boundary J, ft. (omit boundary number 1, ambient field).
CM*	10	Empirical jet momentum diffusion rate spreading parameter C_m .
CH*	10	Ratio of enthalpy-to-momentum spreading parameters C_h/C_m .
CMVR*	10	Momentum spreading parameter velocity ratio influence coefficient.
CMMC*	10	Momentum spreading parameter Mach number influence coefficient.
GAM		Specific heat ratio $\gamma = C_p/C_v$.
CP		Specific heat at constant pressure C_p , in (ft-lbf)/(slug - ° R)
PS		Ambient static pressure, lbf/ft ² .
ALFA*		Turbulence characteristic frequency constant.
DTHM*	7	Maximum allowable increment in angular coordinate, $(d\phi)_{\max}$, for flow field calculation.
RU2M*		Minimum value of jet momentum flux, $(\rho U^2)_{\min}$, below which the flow is not calculated.
AK*		Sound pressure level proportionality constant for mixing noise calculation.
BK*		Sound pressure level proportionality constant for dipole density-gradient noise calculation.
STRFR*	11	Radial coordinate stretching factor for use of automatic mesh calculation.
STRFX*	11	Axial coordinate stretching factor for use of automatic mesh calculation.

Table 4-3. Input Variable Definitions (Concluded).

Variable	Note	Description
ATOTAL		Nozzle Total exit flow area, ft ² .
ALPHMC*	14	Convection Mach number weighting factor.
BETAMC*	14	Convection Mach number weighting factor.
NUMANG		Arena selection indicator; NUMANG = 1 indicates constant radius arc, NUMANG = 2 indicates sideline parallel to the jet axis.
DIST		Arc or sideline distance, ft.
FMIN*		Minimum frequency for which acoustic calculations are required, Hz (>50); an integer variable.
FMAX*		Maximum frequency for which acoustic calculations are required, Hz (<100,000); an integer variable.
ALPHT*		Convective amplification factor turbulence constant α_t ; 15 values required, one for each observer angle θ_I from $\theta_I = 20^\circ$ to 160° in 10° increments.
XCBDY	9	Centerbody input point axial coordinate, NCBDY values required.
RCBDY	9	Centerbody input point radial coordinate, NCBDT values required.

Table 4-4. Preset Input Values.

<u>Variable</u>	<u>Value</u>
AK	0.08
ALFA	1.0
ALPHT	15* 0.5
ALPHMC	0.5
AMUIN	24* 0.2
BETA IN	24* 4.0
BETAMC	0.325
BK	0.0
CH	1.15
CM	0.075
CMMC	0.08
CMVR	0.25
DELTIN	24* 4.0
DTHM	0.1
FMAX	100000
FMIN	50
IQUIT	50
KX	15
LPHI	9999
NBREF	2
NCASE	1
NN	0
NPRINT	1
RU2M	3.0
STRFR	0.01
STRFX	1.259921

4.5.1 Notes on Input

1. The jet nozzle geometry is specified by input of the number of component boundaries, NEST, along with pairs of coordinates, RA and DALP, for each boundary element. The ambient field is always treated as the first boundary in the input arrays for UE, PT, TT, LEAV, NUM, KN, XE, and ALPO. This is why some numbers have already been filled in on Table 4-2 in the first column for these arrays. A nozzle with N elements has $NEST = N + 1$ boundaries.
2. The steps to specifying nozzle geometry input are as follows, referring to Figure 4-1:
 - a. Obtain sketch or drawing of nozzle exit cross section and select a coordinate origin which is optimum from the standpoint of symmetry and boundary point specification.
 - b. Number each boundary, reserving boundary Number 1 for the ambient field.
 - c. With respect to the coordinate origin, select a reference angular location for each boundary, $ALP\emptyset$.
 - d. For each boundary, select points represented by pairs of coordinates. The coordinates used as input are radius, $RA(I,J)$, and angular increment from the preceding point, $DALP(I,J)$. For the first point, $DALP(I,J)$ is the angular increment from the reference angle $ALP\emptyset$. The index I is the boundary point number, and the index J is the boundary number. Both $ALP\emptyset$ and DALP are to be input in radians, and RA is input in feet.
3. The last point on a given boundary should be located at $ALP\emptyset$ if the boundary has only one leaf. The sum of all $DALP(I,J)$ should equal zero if the boundary has only one leaf.
4. If the boundary is a circle about the origin, only one point on the boundary need be supplied, and the value of LEAV for that boundary is set equal to the number of boundary points desired on the circle.
5. The program uses linear interpolation between input boundary points. If a boundary is made up of or contains straight line segments, only the end-points of the straight line segments need be input.
6. The variables PT and TT refer to stagnation pressure and temperature at the exit plane inside the boundary of interest. Setting the first value of PT equal to PS gives a static ambient field. The first value of PT greater than PS simulates non-zero flight velocity.

7. The variable LPHI determines what angular extent of the flow field needs to be calculated. If the nozzle geometry is axisymmetric, setting LPHI equal to a large number (such that $2\pi/\text{LPHI}$ is less than DFHM) forces the program to calculate the flow field at only one angular location. The flow field for a nozzle containing two adjacent circular jets, for example, has $\text{LPHI} = 4$, since the flow is the same each quadrant. Several examples of how boundary parameters are specified are shown in Figure 4-5.
8. The program can currently only handle coplanar nozzles; that is, every nozzle element must terminate at the same axial location. Therefore XE must be the same for all input boundaries.
9. The centerbody, if any, is input through coordinates pairs XCBDY(J), RCBDY(J), where $1 \leq J \leq \text{NCBDY}$. A maximum of 40 points can be input. The LSPFIT subroutine uses this input to interpolate for finding the values of RMIN at each axial location X. The LSPFIT routine can treat line segments, both straight and curved. Typical examples of centerbody coordinate input are shown in Figure 4-6. If there is no centerbody, the user can avoid automatic computation of the potential core of axisymmetric nozzles (which has no impact on mixing noise) by specifying RMIN as input, but with $\text{NCBDY} = 0$. This option causes the computation to begin at $r = \text{RMIN}(\text{KA})$, where KA is the axial station number.
10. The input value of CM is modified for velocity ratio and Mach number effects by the relation

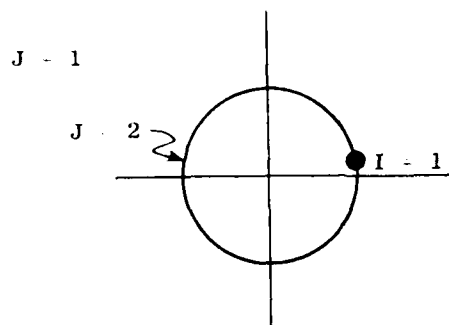
$$\text{DBDX} = \frac{\text{CM}}{(1 + \text{CMVR} * \text{VR})(1 + \text{CMMC} * \text{ACH})}$$

where DBDX is the modified value of C_m , and VR and ACH are the velocity ratio and Mach number, respectively, of a given boundary. The heat transport spreading parameter is then calculated from the relation

$$C_h = C_h * \text{DBDX}$$

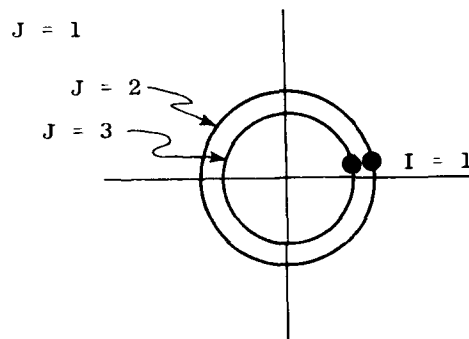
The values of CM, CMMC, CMVR and CH recommended and preset in the program are given in Table 4-4. These values can be changed by the user to reflect experimental evidence if so desired.

11. The axial locations of the axial stations can be input by the array X(KA), where $1 \leq \text{KA} \leq \text{KX}$. The radial mesh step size can also be input by the array DSIG(KA). An automatic grid selection procedure has been devised to obviate the need for supplying all values of X(KA) and DSIG(KA). The only input required is the first axial station X(1), and the grid stretching factors STRFR and STRFX. The grid is then calculated from the following relations:



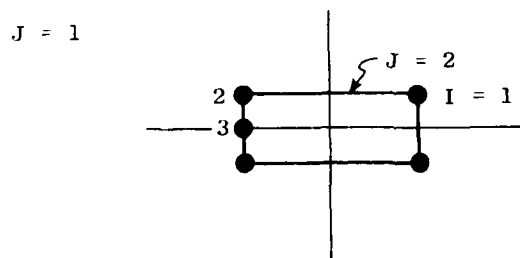
(a) Circular Jet

NEST = 2
 LPHI = 999
 ISYM = 1
 LEAV = 1,36
 NUM = 1,1,
 ALP_φ = 0,0,
 KN = 1,1,



(b) Coannular Jet

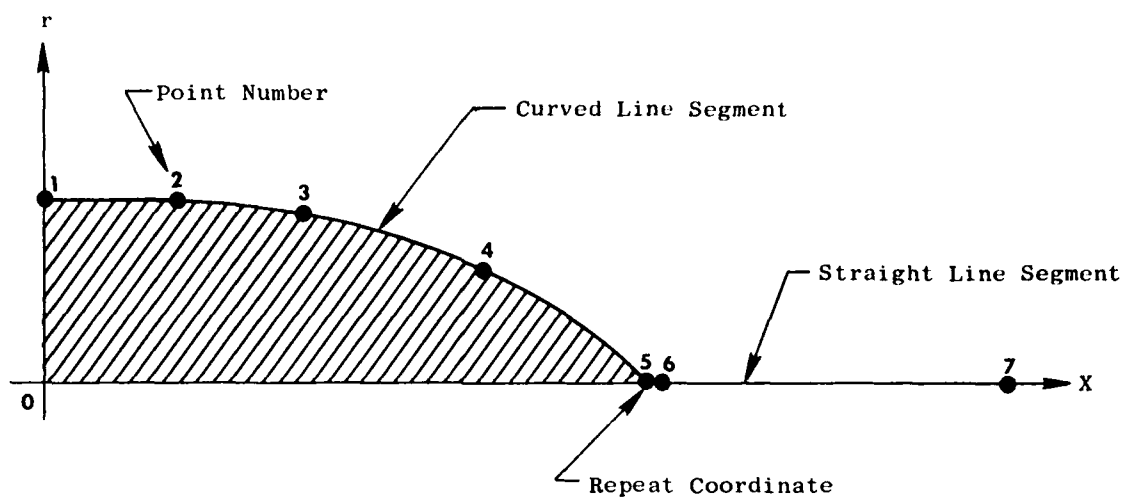
NEST = 3
 LPHI = 999
 ISYM = 1
 LEAV = 1,36,36,
 NUM = 1,1,1,
 ALP_φ = 0,0,0,
 KN = 1,1,2,



(c) Rectangular Jet

NEST = 2
 LPHI = 4
 ISYM = 0
 LEAV = 1,2,
 NUM = 1,3,
 ALP_φ = 0,0,
 KN = 1,1,

Figure 4-5. Examples of How Boundary Parameters are Specified.

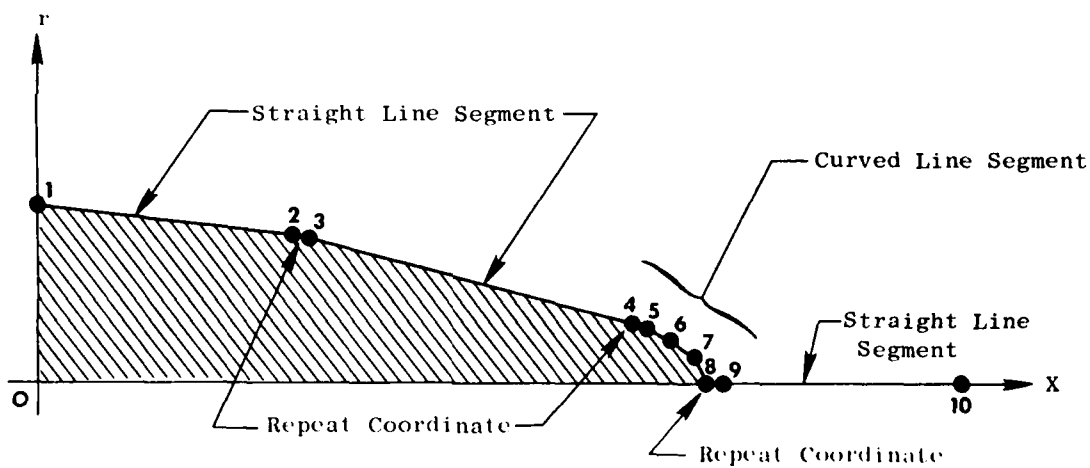


NCBDY = 7,

XCBDY = $X_1, X_2, X_3, X_4, X_5, X_6 (=X_5), X_7,$

RCBDY = $R_1, R_2, R_3, R_4, 0, 0, 0,$

(a) Example 1 - Curved Centerbody



NCBDY = 10,

XCBDY = $X_1, X_2, X_3 (=X_2), X_4, X_5 (=X_4), X_6, X_7, X_8, X_9 (=X_8), X_{10},$

RCBDY = $R_1, R_2, R_3 (=R_2), R_4, R_5 (=R_4), R_6, R_7, R_8, R_9 (=R_8), R_{10},$

(b) Example 2 - Segmented-Cone Centerbody with Curved Tip

Figure 4-6. Centerbody Input Coordinate Examples.

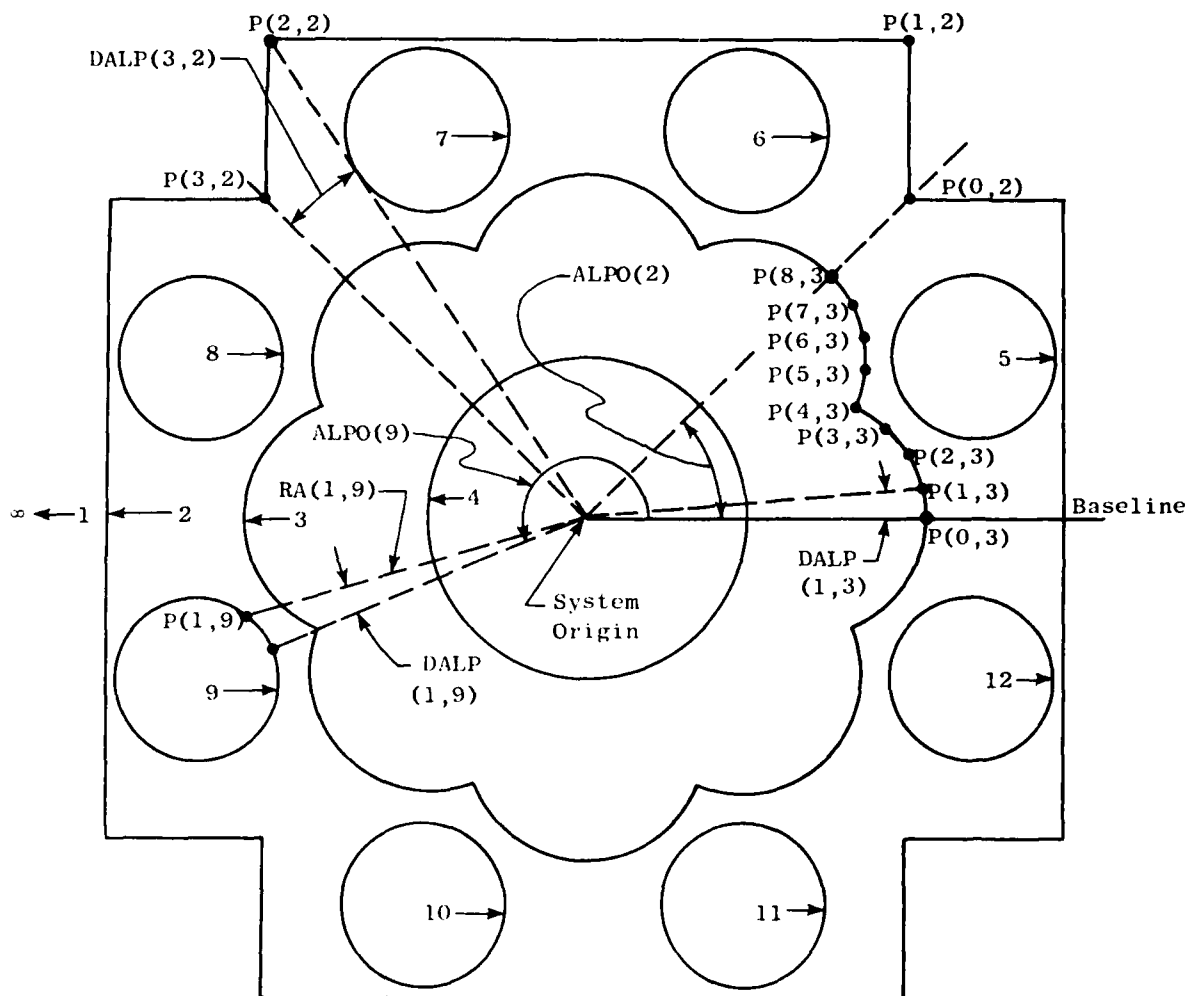


Figure 4-7. Example Demonstration of Nozzle Geometry Specification with a Generalized Nozzle Exit Configuration.

$$X(KA) = STRFX * X(KA-1)$$

$$DSIG(KA) = STRFR * X(KA)$$

This provides a grid which exhibits larger and larger step sizes as the plume is developed downstream. Recommended value of STRFR and STRFX are preset and listed in Table 4-4.

12. The variable NN determines the type of acoustic calculation desired. Normal (preset) operation is with NN = 0, which give the complete acoustic calculation. The user may desire to perform diagnostic computations to assess the relative importance of convection, shielding, etc. By selecting the appropriate value of NN, the various components of the acoustic calculation can be switched on and off in various combinations. Setting NN = 4 gives only the aerodynamic calculation, and the acoustic calculations are bypassed. The various options for NN are listed below:

NN = 0 - complete acoustic calculation.

NN = 1 - convective amplification, no shielding.

NN = 2 - no convective amplification, no shielding.

NN = 3 - no convective amplification, with shielding.

NN = 4 - no acoustic calculation, aerodynamics only.

13. The printout of aerodynamic flow field data is controlled by NPRINT. When NPRINT = 0, no aerodynamic printout is provided. If NPRINT = 1, aerodynamic printout is provided at every axial station. If NPRINT = 2, aerodynamic printout is provided at every second axial station (i.e., KA = 1, 3, 5, 7, etc). For PRINT = 3, printout is provided at every third station, etc.
14. For dual flow nozzles, if the inner stream has a higher velocity than the outer stream, use ALPHMC = 0.5 and BETAMC = 0.325 (preset values). These variables are weighting factors in the convection Mach number calculation, which is computed from the relation

$$MC = ALPHMC * MACH + BETAMC * EMACH$$

where MACH is the local acoustic Mach number U/C_a and EMACH is the exit plane reference Mach number U_j/C_a . If the outer stream has a higher velocity than the inner stream, use ALPHMC = 0.5 and BETAMC = 0.325/VR, where $VR = (U_{outer}/U_{inner})_j$. For multielement suppressor nozzles, $VR = U_j/U_m$, where U_m is the postmerged potential core velocity. If U_m is not known, BETAMC = 0.2 to 0.25 is usually a good approximation.

15. For dual flow nozzles, input BETAIN = 4.0 (preset) for all values of X, provided the inner stream velocity is higher than the outer stream velocity at the exit plane. If the outer stream velocity is higher than the inner stream velocity at the exit plane, input BETAIN = 0 for all axial stations where $X \leq 10 \cdot \text{DEQ}(\text{NBREF})$, and BETAIN = 4.0 thereafter, where NBREF is the outer stream boundary number. For multielement nozzles, input BETAIN = 0 for axial distances less than $10 \cdot \text{DEQ}(1)$, where DEQ(1) is the equivalent diameter based on total flow area at the exit plane.
16. For each boundary element DEQ, DS and NCELL are input. The first value of DEQ is the total flow area equivalent diameter. The first value of NCELL determines whether or not the shock cell noise is computed. If NCELL(1) is input zero, no shock noise is computed; for NCELL(1) > 0, the shock cell noise routine is called. The shock noise of each boundary element is computed separately and added to the total noise. If any boundary has a value of NCELL = 0, that boundary element is bypassed in the shock noise calculation. It is recommended that NCELL = 8 be used for each element unless the actual number is known.

4.5.2 Example Case Input Selection

To illustrate how geometric input parameters are selected for a complex nozzle geometry, an example is presented, taken from Reference 6. The example nozzle exit geometry is shown in Figure 4-7. Consideration of this figure indicates that information over a 45° sector of the flow field will be sufficient to describe the complete flow field. This is one-eighth of a circle, thus LPHI = 8. Neither axial total similarity or dissimilarity exists so ISYM is 0. Counting the number of closed contours indicates a value of NEST of 12, where one is included for the ambient or external field. Values of PT and TT must be provided for the exit state existing just within each of these contours. Values of XE, ALPO, LEAV, NUM, KN, DEQ, DS, and NCELL must be provided for all the contours except the first which is the boundary at infinity. Values of these parameters for the contours shown in Figure A-3 are now considered in the following discussion.

Boundary 2: Description of this boundary starting at 45° to the system baseline is convenient. Thus ALPO = $\pi/4$ radians. Since each 90° sector of the contour is identical with the proceeding one, LEAV = 4. Since the program assumes straight lines to exist between successive boundary points, description of this boundary is possible with only three points for each quadrant. These are P(1,2), P(2,2), and P(3,2). Each point is described by (1) its distance from the system origin and (2) the angle between (a) the line joining it with the origin and (b) the line joining the preceding point with the origin. Note that no value of RA is given for the point P(0,2) since it will be identical to RA(3,2). The value of NUM for boundary 2 will therefore be 3.

Boundary 3: This contour has eight symmetric leaves; thus LEAV = 8. ALPO of 0.0 is as convenient as any other value. The eight points indicated, P(1,3) through P(8,3), probably are sufficient to describe the boundary. Thus NUM = 8.

Boundary 4: Since this is a circle about the origin, it can be divided into a convenient number of leaves and only one point need be given for each (NUM = 1). If a hundred boundary points are desired, set LEAV = 100, DALP(1,4) = $\pi/50$ and RA(1,4) equal to the circle radius.

Boundary 5 through 12: Each of these contours must be described individually unless certain artificial changes are made in the arrangement. A partial representation of Boundary 9 is shown in Figure 4-7. Note that successive points on the boundary are obtained by progressing around the boundary in a counter-clockwise fashion. In order to reduce the labor of representing each circle separately, a straight line can be drawn connecting each circle. Two contours can then be visualized, one consisting of the outer halves of the circles and the lines, the other consisting of the inner halves of the circles and the lines. Each contour has eight leaves and only one need be represented by the programmer. Since this technique requires the computer to integrate along each straight line twice in the course of computation, it will definitely increase the computational time over the method in which each contour is represented separately.

4.6 OUTPUT DESCRIPTION

The output format is generally self-explanatory. The input data are first printed out, using the same nomenclature previously defined in Table 4-1. Nozzle exit plane flow conditions (static temperature, velocity, Mach number, momentum flux, and enthalpy flux) are then printed out for each boundary contour.

At each axial location specified, the radial and tangential distributions of flow field properties are printed out. After the flow field information, the noise characteristics of that particular axial station are then listed.

Following all of the axial station flow field data, a summary table of the noise characteristics (SPL spectra, PNL, PWL, OASPL) is given.

Section 4.7 contains an input deck card listing and output printout for a sample case run. This particular case is for a 7-tube nozzle presented in Reference 2. For brevity, only a portion of the total output is shown; but the formats of the various output data are all included.

Two warning flags are built into the program. The first is a case termination flag, which occurs whenever an input total pressure (P_T) is less than the input static pressure (P_S). The flag message is as follows:

****ERROR - MACH NO. SQUARE IS NOT GREATER THAN ZERO - CASE WILL
TERMINATE****

The second flag is a warning detected in subroutine SLICE, which occurs whenever the number of turning points (NTP) is found to be greater than 2. The flag message is as follows:

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

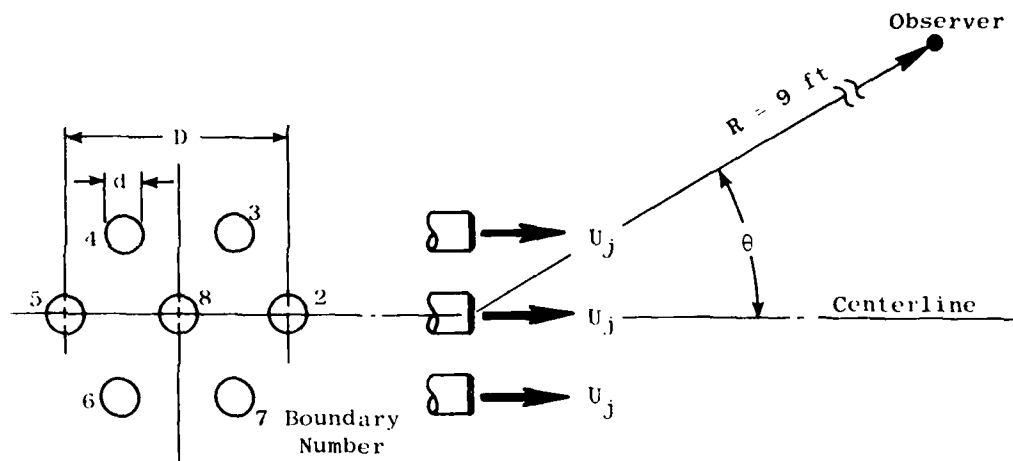
KA = _____, X = _____, ITH = _____, THETA = _____, NTP = _____

where KA is the axial station number, X is the axial location, ITH is the observer angle index, THETA is the observer angle in degrees (θ_I), and NTP is the number of turning points found. The two outermost turning points are used and those inboard of these two are discarded in such cases, since the acoustic shielding model can only accommodate up to 2 turning points. The noise output at those values of θ_I where this warning appears should be

treated as suspect, since the acoustic shielding effects are not properly modeled. This is most likely to occur in the initial mixing regions of multitube nozzles, where multiple peaks in the azimuthally averaged velocity profiles are likely to occur.

4.7 SAMPLE OUTPUT LISTING

An example case of a 7-tube multielement nozzle is described here, selected from one of the data/theory comparison cases presented in Reference 2. The nozzle consists of a hexagonal array of 0.875-inch-diameter tubes, with a spacing/diameter ratio of 3. The acoustic arena is a 9-ft-radius arc. The geometry is illustrated in the sketch below.



$d = 0.875$ in.

$D = 3.0$ in.

The input data cards for this case are listed in Table 4-5. Note that all geometry input lengths are in feet, and all input geometry angles are in radians. The output listing for this case follows Table 4-5.

Table 4-5. Input Data Card Listing Sample Case.

```

SR329 01 10-06-77 16.471 *** INPUT DATA CARD LISTING -- M*G*B ***
      CRD 7-TURE AR#2.3 Nn7ZLE = VJ#2200 FPS = T1J#1600 DEG-R
$INPUT
NEST=8, LPHI=12, ISYM=0, IQUIT=100,
RU2M=3, DTHM=0.1, PS=2116,
ATOTAL=0.029231, DEQ=8*0.0729167, DS=8*0.0729167, NCELL=8*3,
KN=8*1, XE=8*0,
GAM=1.35, CP=6619,

ALPJ=0.0,5.96144,0.725447,1.77264,2.8198,3.8670,4.9142,0.0,
LEAV=0,6*1,24, NUM=1,6*24,1, KN=8*1, XE=8*0,
DALP(1,2)=
.033596,.045590,.054084,.059862,.063450,.065168,
.065168,.063450,.059862,.054084,.045590,.033596,
.017039,-.005317,-.034336,-.068984,-.103591,-.126562,
-.126562,-.103591,-.068984,-.034336,-.005317,.017039,
DALP(1,3)=
.033596,.045590,.054084,.059862,.063450,.065168,
.065168,.063450,.059862,.054084,.045590,.033596,
.017039,-.005317,-.034336,-.068984,-.103591,-.126562,
-.126562,-.103591,-.068984,-.034336,-.005317,.017039,
DALP(1,4)=
.033596,.045590,.054084,.059862,.063450,.065168,
.065168,.063450,.059862,.054084,.045590,.033596,
.017039,-.005317,-.034336,-.068984,-.103591,-.126562,
-.126562,-.103591,-.068984,-.034336,-.005317,.017039,
DALP(1,5)=
.033596,.045590,.054084,.059862,.063450,.065168,
.065168,.063450,.059862,.054084,.045590,.033596,
.017039,-.005317,-.034336,-.068984,-.103591,-.126562,
-.126562,-.103591,-.068984,-.034336,-.005317,.017039,
DALP(1,6)=
.033596,.045590,.054084,.059862,.063450,.065168,
.065168,.063450,.059862,.054084,.045590,.033596,
.017039,-.005317,-.034336,-.068984,-.103591,-.126562,
-.126562,-.103591,-.068984,-.034336,-.005317,.017039,
DALP(1,7)=
.033596,.045590,.054084,.059862,.063450,.065168,
.065168,.063450,.059862,.054084,.045590,.033596,
.017039,-.005317,-.034336,-.068984,-.103591,-.126562,
-.126562,-.103591,-.068984,-.034336,-.005317,.017039,
RA(1,2)=
.12392,.13145,.13759,.14212,.14489,.14583,
.14489,.14212,.13759,.13145,.12392,.11529,
.10596,.09646,.08748,.07991,.07476,.07292,
.07476,.07991,.08748,.09646,.10596,.11529,
RA(1,3)=
.12392,.13145,.13759,.14212,.14489,.14583,
.14489,.14212,.13759,.13145,.12392,.11529,
.10596,.09646,.08748,.07991,.07476,.07292,
.07476,.07991,.08748,.09646,.10596,.11529,
RA(1,4)=
.12392,.13145,.13759,.14212,.14489,.14583,
.14489,.14212,.13759,.13145,.12392,.11529,
.10596,.09646,.08748,.07991,.07476,.07292,

```

Table 4-5. Input Data Card Listing Sample Case (Concluded).

SR329 01 10-06-77 16.471 *** INPUT DATA CARD LISTING -- M*G*B ***

.07476,.07991,.08748,.09646,.10596,.11529,
 RA(1,5)=
 .12392,.13145,.13759,.14212,.14489,.14583,
 .14489,.14212,.13759,.13145,.12392,.11529,
 .10596,.09646,.08748,.07991,.07476,.07292,
 .07476,.07991,.08748,.09646,.10596,.11529,
 RA(1,6)=
 .12392,.13145,.13759,.14212,.14489,.14583,
 .14489,.14212,.13759,.13145,.12392,.11529,
 .10596,.09646,.08748,.07991,.07476,.07292,
 .07476,.07991,.08748,.09646,.10596,.11529,
 RA(1,7)=
 .12392,.13145,.13759,.14212,.14489,.14583,
 .14489,.14212,.13759,.13145,.12392,.11529,
 .10596,.09646,.08748,.07991,.07476,.07292,
 .07476,.07991,.08748,.09646,.10596,.11529,
 DALP(1,8)=0.2618, RA(1,8)=0.036453,

ALPHMC=0.5, BETAMC=0.25,
 FMIN=100, FMAX=80000, NUMANG=1, DIST=9.0,
 KX=24, X=0.0729167, STRFR=0.01,
 DSIG=10*0.00729167, 14*0, NOV=10*20, 14*0,
 BETAIN=15*0.0,
 NPRINT=
 NCASE=1,

PJ=2116,7*5732, TT#540,7*1605,
 S

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSION NOZZLES

CASE NO. 1 CHU 7-TIME 42=2.3 NOZZLE - VJ=2200 FPS - TTJ=1400 DEG-P

INPUT DATA

KX= 24 NEST= 6 LPHI= 12 ISYM= 3 NPRINT= 6 CM= .075
CH= 1.150 GAM= 1.350 CP= 6619.0 DTMM= .1000 RIIM= 3.0000 PS= 2116.0

COMPUTATION MESH CONTROL PARAMETERS...../ TURBULENCE CONSTANTS

SLICE NO.	X	DSIG	RMIN	NOV	RFTA	DELTA	MU
1	.07292	.06729	0.00000	20	0.00	4.00	.20
2	.09187	.05729	0.00000	20	0.00	4.00	.20
3	.11575	.05729	0.00000	20	0.00	4.00	.20
4	.14583	.06729	0.00000	20	0.00	4.00	.20
5	.18374	.06729	0.00000	20	0.00	4.00	.20
6	.23150	.06729	0.00000	20	0.00	4.00	.20
7	.29167	.06729	0.00000	20	0.00	4.00	.20
8	.36767	.06729	0.00000	20	0.00	4.00	.20
9	.46293	.07292	0.00000	20	0.00	4.00	.20
10	.58333	.07292	0.00000	20	0.00	4.00	.20
11	.73495	.06729	0.00000	0	0.00	4.00	.20
12	.92544	.06729	0.00000	0	0.00	4.00	.20
13	1.16667	.06729	0.00000	0	0.00	4.00	.20
14	1.46941	.06729	0.00000	0	0.00	4.00	.20
15	1.83167	.06729	0.00000	0	0.00	4.00	.20
16	2.25333	.06729	0.00000	0	4.00	4.00	.20
17	2.73492	.06729	0.00000	0	4.00	4.00	.20
18	3.27193	.06729	0.00000	0	4.00	4.00	.20
19	4.86667	.06729	0.00000	0	4.00	4.00	.20
20	5.87963	.06729	0.00000	0	4.00	4.00	.20
21	7.40787	.06729	0.00000	0	4.00	4.00	.20
22	9.33333	.06729	0.00000	0	4.00	4.00	.20
23	11.75426	.11759	0.00000	0	4.00	4.00	.20
24	14.81574	.16516	0.00000	0	4.00	4.00	.20

XE(2)= .00 ALPO(2)= 5.9614 LEAV(2)= 1 NUM(2)= 24 KN(2)= 1

DALP(1, 2)= .1336	RA(1, 2)= .1239	DALP(2, 2)= .0456	RA(2, 2)= .1315
DALP(3, 2)= .0541	RA(3, 2)= .1376	DALP(4, 2)= .0599	RA(4, 2)= .1421
DALP(5, 2)= .0635	RA(5, 2)= .1449	DALP(6, 2)= .0652	RA(6, 2)= .1458
DALP(7, 2)= .0652	RA(7, 2)= .1449	DALP(8, 2)= .0635	RA(8, 2)= .1421
DALP(9, 2)= .0599	RA(9, 2)= .1376	DALP(10, 2)= .0541	RA(10, 2)= .1315
DALP(11, 2)= .0456	RA(11, 2)= .1239	DALP(12, 2)= .0336	RA(12, 2)= .1153
DALP(13, 2)= .0170	RA(13, 2)= .1060	DALP(14, 2)= -.0053	RA(14, 2)= .0965
DALP(15, 2)= -.0343	RA(15, 2)= .0875	DALP(16, 2)= -.0690	RA(16, 2)= .0799
DALP(17, 2)= -.1036	RA(17, 2)= .0748	DALP(18, 2)= -.1266	RA(18, 2)= .0729
DALP(19, 2)= -.1266	RA(19, 2)= .0748	DALP(20, 2)= -.1036	RA(20, 2)= .0799
DALP(21, 2)= -.0690	RA(21, 2)= .0875	DALP(22, 2)= -.0343	RA(22, 2)= .0965
DALP(23, 2)= -.0053	RA(23, 2)= .1060	DALP(24, 2)= .0170	RA(24, 2)= .1153

COMPUTATION OF AERO-AcouSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TURE AR=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

XE(3)=	0.00	ALPO(3)=	.7254	LEAV(3)=	1	NUM(3)=	24	KN(3)=	1
DALP(1, 3)=	.0336	RA(1, 3)=	.1239	DALP(2, 3)=	.0456	RA(2, 3)=	.1315		
DALP(3, 3)=	.0541	RA(3, 3)=	.1376	DALP(4, 3)=	.0599	RA(4, 3)=	.1421		
DALP(5, 3)=	.0635	RA(5, 3)=	.1449	DALP(6, 3)=	.0652	RA(6, 3)=	.1458		
DALP(7, 3)=	.0652	RA(7, 3)=	.1449	DALP(8, 3)=	.0635	RA(8, 3)=	.1421		
DALP(9, 3)=	.0599	RA(9, 3)=	.1376	DALP(10, 3)=	.0541	RA(10, 3)=	.1315		
DALP(11, 3)=	.0456	RA(11, 3)=	.1239	DALP(12, 3)=	.0336	RA(12, 3)=	.1153		
DALP(13, 3)=	.0170	RA(13, 3)=	.1060	DALP(14, 3)=	-.0053	RA(14, 3)=	.0965		
DALP(15, 3)=	-.0343	RA(15, 3)=	.0875	DALP(16, 3)=	-.0690	RA(16, 3)=	.0799		
DALP(17, 3)=	-.1036	RA(17, 3)=	.0748	DALP(18, 3)=	-.1266	RA(18, 3)=	.0729		
DALP(19, 3)=	-.1266	RA(19, 3)=	.0748	DALP(20, 3)=	-.1036	RA(20, 3)=	.0799		
DALP(21, 3)=	-.0690	RA(21, 3)=	.0875	DALP(22, 3)=	-.0343	RA(22, 3)=	.0965		
DALP(23, 3)=	-.0053	RA(23, 3)=	.1060	DALP(24, 3)=	.0170	RA(24, 3)=	.1153		
XE(4)=	0.00	ALPO(4)=	1.7726	LEAV(4)=	1	NUM(4)=	24	KN(4)=	1
DALP(1, 4)=	.0336	RA(1, 4)=	.1239	DALP(2, 4)=	.0456	RA(2, 4)=	.1315		
DALP(3, 4)=	.0541	RA(3, 4)=	.1376	DALP(4, 4)=	.0599	RA(4, 4)=	.1421		
DALP(5, 4)=	.0635	RA(5, 4)=	.1449	DALP(6, 4)=	.0652	RA(6, 4)=	.1458		
DALP(7, 4)=	.0652	RA(7, 4)=	.1449	DALP(8, 4)=	.0635	RA(8, 4)=	.1421		
DALP(9, 4)=	.0599	RA(9, 4)=	.1376	DALP(10, 4)=	.0541	RA(10, 4)=	.1315		
DALP(11, 4)=	.0456	RA(11, 4)=	.1239	DALP(12, 4)=	.0336	RA(12, 4)=	.1153		
DALP(13, 4)=	.0170	RA(13, 4)=	.1060	DALP(14, 4)=	-.0053	RA(14, 4)=	.0965		
DALP(15, 4)=	-.0343	RA(15, 4)=	.0875	DALP(16, 4)=	-.0690	RA(16, 4)=	.0799		
DALP(17, 4)=	-.1036	RA(17, 4)=	.0748	DALP(18, 4)=	-.1266	RA(18, 4)=	.0729		
DALP(19, 4)=	-.1266	RA(19, 4)=	.0748	DALP(20, 4)=	-.1036	RA(20, 4)=	.0799		
DALP(21, 4)=	-.0690	RA(21, 4)=	.0875	DALP(22, 4)=	-.0343	RA(22, 4)=	.0965		
DALP(23, 4)=	-.0053	RA(23, 4)=	.1060	DALP(24, 4)=	.0170	RA(24, 4)=	.1153		

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TUNE AR=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

XE(5)=	0.00	ALPO(5)= 2.8198	LEAV(5)= 1	NUM(5)= 24	KN(5)= 1		
DALP(1, 5)=	.0336	RA(1, 5)=	.1239	DALP(2, 5)=	.0456	RA(2, 5)=	.1315
DALP(3, 5)=	.0541	RA(3, 5)=	.1376	DALP(4, 5)=	.0599	RA(4, 5)=	.1421
DALP(5, 5)=	.0635	RA(5, 5)=	.1449	DALP(6, 5)=	.0652	RA(6, 5)=	.1458
DALP(7, 5)=	.0652	RA(7, 5)=	.1449	DALP(8, 5)=	.0635	RA(8, 5)=	.1421
DALP(9, 5)=	.0599	RA(9, 5)=	.1376	DALP(10, 5)=	.0541	RA(10, 5)=	.1315
DALP(11, 5)=	.0456	RA(11, 5)=	.1239	DALP(12, 5)=	.0336	RA(12, 5)=	.1153
DALP(13, 5)=	.0170	RA(13, 5)=	.1060	DALP(14, 5)=	-.0053	RA(14, 5)=	.0965
DALP(15, 5)=	-.0343	RA(15, 5)=	.0875	DALP(16, 5)=	-.0690	RA(16, 5)=	.0799
DALP(17, 5)=	-.1036	RA(17, 5)=	.0748	DALP(18, 5)=	-.1266	RA(18, 5)=	.0729
DALP(19, 5)=	-.1266	RA(19, 5)=	.0748	DALP(20, 5)=	-.1036	RA(20, 5)=	.0799
DALP(21, 5)=	-.0690	RA(21, 5)=	.0875	DALP(22, 5)=	-.0343	RA(22, 5)=	.0965
DALP(23, 5)=	-.0053	RA(23, 5)=	.1060	DALP(24, 5)=	.0170	RA(24, 5)=	.1153
XE(6)=	0.00	ALPO(6)= 3.8670	LEAV(6)= 1	NUM(6)= 24	KN(6)= 1		
DALP(1, 6)=	.0336	RA(1, 6)=	.1239	DALP(2, 6)=	.0456	RA(2, 6)=	.1315
DALP(3, 6)=	.0541	RA(3, 6)=	.1376	DALP(4, 6)=	.0599	RA(4, 6)=	.1421
DALP(5, 6)=	.0635	RA(5, 6)=	.1449	DALP(6, 6)=	.0652	RA(6, 6)=	.1458
DALP(7, 6)=	.0652	RA(7, 6)=	.1449	DALP(8, 6)=	.0635	RA(8, 6)=	.1421
DALP(9, 6)=	.0599	RA(9, 6)=	.1376	DALP(10, 6)=	.0541	RA(10, 6)=	.1315
DALP(11, 6)=	.0456	RA(11, 6)=	.1239	DALP(12, 6)=	.0336	RA(12, 6)=	.1153
DALP(13, 6)=	.0170	RA(13, 6)=	.1060	DALP(14, 6)=	-.0053	RA(14, 6)=	.0965
DALP(15, 6)=	-.0343	RA(15, 6)=	.0875	DALP(16, 6)=	-.0690	RA(16, 6)=	.0799
DALP(17, 6)=	-.1036	RA(17, 6)=	.0748	DALP(18, 6)=	-.1266	RA(18, 6)=	.0729
DALP(19, 6)=	-.1266	RA(19, 6)=	.0748	DALP(20, 6)=	-.1036	RA(20, 6)=	.0799
DALP(21, 6)=	-.0690	RA(21, 6)=	.0875	DALP(22, 6)=	-.0343	RA(22, 6)=	.0965
DALP(23, 6)=	-.0053	RA(23, 6)=	.1060	DALP(24, 6)=	.0170	RA(24, 6)=	.1153

COMPUTATION OF AERO-Acoustic PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CPO 7-TURB AP=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

XF(7)= 0.00 ALP0(7)= 4.9142 LEAV(7)= 1 NUM(7)= 24 KN(7)= 1
 DALP(1, 7)= .0336 PA(1, 7)= .1239 DALP(2, 7)= .0456 PA(2, 7)= .1315
 DALP(3, 7)= .0541 PA(3, 7)= .1376 DALP(4, 7)= .0599 PA(4, 7)= .1421
 DALP(5, 7)= .0636 PA(5, 7)= .1449 DALP(6, 7)= .0652 PA(6, 7)= .1458
 DALP(7, 7)= .0652 PA(7, 7)= .1449 DALP(8, 7)= .0635 PA(8, 7)= .1421
 DALP(9, 7)= .0549 PA(9, 7)= .1376 DALP(10, 7)= .0541 PA(10, 7)= .1315
 DALP(11, 7)= .0456 PA(11, 7)= .1239 DALP(12, 7)= .0336 PA(12, 7)= .1153
 DALP(13, 7)= .0170 PA(13, 7)= .1060 DALP(14, 7)= -.0053 PA(14, 7)= .0965
 DALP(15, 7)= -.0343 PA(15, 7)= .0875 DALP(16, 7)= -.0690 PA(16, 7)= .0799
 DALP(17, 7)= -.1036 PA(17, 7)= .0748 DALP(18, 7)= -.1266 PA(18, 7)= .0729
 DALP(19, 7)= -.1266 PA(19, 7)= .0748 DALP(20, 7)= -.1036 PA(20, 7)= .0799
 DALP(21, 7)= -.0690 PA(21, 7)= .0875 DALP(22, 7)= -.0343 PA(22, 7)= .0965
 DALP(23, 7)= -.0053 PA(23, 7)= .1060 DALP(24, 7)= .0170 PA(24, 7)= .1153

XE(4)= 0.00 ALP0(4)= 0.0000 LEAV(4)= 24 NUM(4)= 1 KN(4)= 1

DALP(1, 4)= .2618 PA(1, 4)= .0365 DALP(

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CPD 7-TUBE AR=2.3 NOZZLE - VJ=2200 FPS - ITJ=1600 DEG-P

EXIT CONDITIONS

CON- TOUR	TOTAL PRESS. (PSF)	TOTAL TEMP. (DEG R)	STATIC TEMP. (DEG R)	VELOCITY (FPS)	MACH NUMBER	MOMENTUM FLUX (LR/SQ-FT)	ENTHALPY FLUX (LR/SQ-FT)
1	2116.00	540.00	540.00	30	.0003	.20000E-03	0.
2	5732.00	1605.00	1239.57	2199.45	1.2979	.48123E+04	.15423E+08
3	5732.00	1605.00	1239.57	2199.45	1.2979	.48123E+04	.15423E+08
4	5732.00	1605.00	1239.57	2199.45	1.2979	.48123E+04	.15423E+08
5	5732.00	1605.00	1239.57	2199.45	1.2979	.48123E+04	.15423E+08
6	5732.00	1605.00	1239.57	2199.45	1.2979	.48123E+04	.15423E+08
7	5732.00	1605.00	1239.57	2199.45	1.2979	.48123E+04	.15423E+08
8	5732.00	1605.00	1239.57	2199.45	1.2979	.48123E+04	.15423E+08

BOUNDARY NO. 2 HAS BEEN DESIGNATED AS THE REFERENCE

AL = .20886E+08	ALFA = 1.00000	AK = .80000E-01	BK = 0.
ATOTAL = .02423	DEO = .07292	IOUIT = 100	NN = 0
STPEX = 1.25992	STPEX = .01000		
ALPHMC = .5000	RETAMC = .2500		
CMVCE = .080000	CMVPE = .250000		
			URFF = 2199.45

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1

CPD 7-TURB AR=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

AXIAL LOCATION = .07292 (X/DEQ = 1.00000)

M	P	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	R/DEQ
1	.00001	0.00	2199.45	.0009948	1239.57	1.00000	.00037	.00010
1	.00001	15.00	2199.45	.0009948	1239.57	1.00000	.00038	.00010
1	.00001	30.00	2199.45	.0009948	1239.57	1.00000	.00040	.00010
1	.00001	39.00	2199.45	.0009948	1239.57	1.00000	.00043	.00010
2	.00729	0.00	2199.46	.0009948	1239.57	1.00000	.00156	.10000
2	.00729	10.00	2199.46	.0009948	1239.57	1.00000	.00189	.10000
2	.00729	20.00	2199.46	.0009948	1239.57	1.00000	.00186	.10000
2	.00729	30.00	2199.46	.0009948	1239.57	1.00000	.00180	.10000
3	.01458	0.00	2199.46	.0009948	1239.57	1.00000	.00044	.20000
3	.01458	7.50	2199.46	.0009948	1239.57	1.00000	.00079	.20000
3	.01458	15.00	2199.46	.0009948	1239.57	1.00000	.00122	.20000
3	.01458	22.50	2199.46	.0009948	1239.57	1.00000	.00090	.20000
3	.01458	30.00	2199.46	.0009948	1239.57	1.00000	.00099	.20000
4	.02188	0.00	2199.20	.0009950	1239.31	.99988	.00289	.30000
4	.02188	7.50	2199.20	.0009950	1239.31	.99988	.00303	.30000
4	.02188	15.00	2199.20	.0009950	1239.31	.99988	.00288	.30000
4	.02188	22.50	2199.20	.0009950	1239.31	.99988	.00298	.30000
4	.02188	30.00	2199.19	.0009950	1239.31	.99988	.00293	.30000
5	.02917	0.00	2145.44	.0010195	1209.46	.97562	.05247	.40000
5	.02917	6.00	2145.76	.0010195	1209.52	.97559	.05261	.40000
5	.02917	12.00	2145.80	.0010195	1209.48	.97561	.05253	.40000
5	.02917	18.00	2145.80	.0010195	1209.48	.97560	.05253	.40000
5	.02917	24.00	2145.75	.0010195	1209.52	.97558	.05261	.40000
5	.02917	30.00	2145.83	.0010195	1209.46	.97562	.05247	.40000
6	.03646	0.00	1378.61	.0011597	1063.24	.62680	.13781	.50000
6	.03646	6.00	1371.48	.0011595	1063.44	.62355	.13785	.50000
6	.03646	12.00	1373.67	.0011602	1062.79	.62428	.13785	.50000
6	.03646	18.00	1373.67	.0011602	1062.79	.62428	.13785	.50000
6	.03646	24.00	1371.48	.0011595	1063.44	.62355	.13785	.50000
6	.03646	30.00	1378.61	.0011597	1063.24	.62680	.13781	.50000
7	.04375	0.00	203.54	.0016983	726.07	.09254	.04225	.60000
7	.04375	5.00	202.12	.0016972	726.54	.09189	.04202	.60000
7	.04375	10.00	202.14	.0016972	726.54	.09190	.04202	.60000
7	.04375	15.00	203.59	.0016983	726.06	.09257	.04224	.60000
7	.04375	20.00	202.17	.0016972	726.53	.09192	.04200	.60000
7	.04375	25.00	202.17	.0016972	726.53	.09192	.04200	.60000
7	.04375	30.00	203.61	.0016983	726.06	.09257	.04223	.60000
8	.05104	0.00	2.52	.0021214	581.26	.00114	.00253	.70000
8	.05104	5.00	2.53	.0021241	580.51	.00115	.00292	.70000
8	.05104	10.00	2.94	.0021451	574.83	.00134	.00294	.70000
8	.05104	15.00	3.47	.0021627	570.17	.00158	.00284	.70000
8	.05104	20.00	3.64	.0021692	568.44	.00166	.00287	.70000
8	.05104	25.00	3.86	.0021748	566.98	.00175	.00287	.70000
8	.05104	30.00	4.12	.0021794	565.79	.00187	.00278	.70000
9	.05833	0.00	3.24	.0021555	572.06	.00147	.00145	.80000
9	.05833	4.29	1.35	.0020752	594.21	.00062	.00191	.80000
9	.05833	8.57	0.50	.0022835	540.00	0.00000	0.00000	.80000
9	.05833	12.86	0.00	.0022835	540.00	0.00000	0.00000	.80000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TURE AR=2.3 NOZZLE - VJ=2200 FPS - ITJ=1600 DFG-P

AXIAL LOCATION = .07292 (X/DEQ = 1.00000)

M	R	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	P/DEQ
9	.05833	17.14	0.00	.0022835	540.00	0.00000	0.00000	.80000
9	.05833	21.43	0.00	.0022835	540.00	0.00000	0.00000	.80000
9	.05833	25.71	0.00	.0022835	540.00	0.00000	0.00000	.80000
9	.05833	30.00	0.00	.0022835	540.00	0.00000	0.00000	.80000
10	.06563	0.00	203.37	.0016986	725.94	.09246	.04216	.90000
10	.06563	4.29	168.10	.0017420	707.84	.07638	.03710	.90000
10	.06563	8.57	95.14	.0018676	660.25	.04335	.02447	.90000
10	.06563	12.86	33.49	.0020323	606.73	.01523	.01067	.90000
10	.06563	17.14	5.94	.0021636	569.91	.00266	.00325	.90000
10	.06563	21.43	0.00	.0022835	540.00	0.00000	0.00000	.90000
10	.06563	25.71	0.00	.0022835	540.00	0.00000	0.00000	.90000
10	.06563	30.00	0.00	.0022835	540.00	0.00000	0.00000	.90000
11	.07292	0.00	1378.45	.0011548	1363.19	.62672	.13779	1.00000
11	.07292	3.75	1282.33	.0011754	1349.07	.58302	.13990	1.00000
11	.07292	7.50	1015.37	.0012396	994.75	.46165	.13664	1.00000
11	.07292	11.25	608.69	.0013846	890.58	.27674	.10947	1.00000
11	.07292	15.00	242.76	.0016504	747.13	.11037	.05941	1.00000
11	.07292	18.75	57.26	.0019585	629.60	.02600	.01884	1.00000
11	.07292	22.50	6.44	.0021637	569.90	.00293	.00379	1.00000
11	.07292	26.25	0.00	.0022835	540.00	0.00000	0.00000	1.00000
11	.07292	30.00	0.00	.0022835	540.00	0.00000	0.00000	1.00000
12	.08021	0.00	2145.74	.0010196	1209.42	.97558	.05248	1.10000
12	.08021	3.75	2124.54	.0010266	1201.14	.96594	.06481	1.10000
12	.08021	7.50	2025.14	.0010525	1171.60	.92075	.10460	1.10000
12	.08021	11.25	1717.49	.0011852	1115.68	.78087	.15852	1.10000
12	.08021	15.00	1059.87	.0012270	1004.97	.48188	.16340	1.10000
12	.08021	18.75	353.54	.0015447	798.27	.16074	.08533	1.10000
12	.08021	22.50	53.70	.0019665	627.03	.02441	.01880	1.10000
12	.08021	26.25	2.21	.0021721	567.69	.00100	.00334	1.10000
12	.08021	30.00	0.00	.0022835	540.00	0.00000	0.00000	1.10000
13	.08750	0.00	2199.19	.0009950	1239.31	.99988	.00213	1.20000
13	.08750	3.33	2198.94	.0009952	1239.07	.99977	.00350	1.20000
13	.08750	6.67	2196.64	.0009967	1237.12	.99872	.01146	1.20000
13	.08750	10.00	2175.80	.0010076	1223.80	.98925	.04213	1.20000
13	.08750	13.33	2032.46	.0010508	1173.47	.92408	.11890	1.20000
13	.08750	16.67	1500.16	.0011379	1083.61	.68216	.18610	1.20000
13	.08750	20.00	616.35	.0013828	891.74	.28023	.13029	1.20000
13	.08750	23.33	110.21	.0018367	671.34	.05011	.03566	1.20000
13	.08750	26.67	7.85	.0021552	572.14	.00357	.00463	1.20000
13	.08750	30.00	0.00	.0022835	540.00	0.00000	0.00000	1.20000
14	.09479	0.00	2199.45	.0009948	1239.57	1.00000	.00140	1.30000
14	.09479	3.33	2199.45	.0009948	1239.57	1.00000	.00161	1.30000
14	.09479	6.67	2199.44	.0009948	1239.55	.99999	.00087	1.30000
14	.09479	10.00	2198.75	.0009953	1238.90	.99968	.00583	1.30000
14	.09479	13.33	2175.18	.0010078	1223.48	.98897	.04684	1.30000
14	.09479	16.67	1911.43	.0010745	1147.62	.86905	.15684	1.30000
14	.09479	20.00	1022.56	.0012373	996.57	.46469	.17621	1.30000
14	.09479	23.33	208.79	.0016920	728.79	.09489	.06070	1.30000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TURE AR=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

AXIAL LOCATION = .7292 (X/DEQ = 1.00000)

M	R	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	R/DEG
14	.09479	26.67	14.75	.0021165	582.59	.00671	.00707	1.30000
14	.09479	35.00	0.00	.0022835	540.00	0.00000	0.00000	1.30000
15	.10208	0.00	2199.45	.0009948	1239.57	1.00000	.00031	1.40000
15	.10208	3.00	2199.45	.0009948	1239.57	1.00000	.00146	1.40000
15	.10208	6.00	2199.45	.0009948	1239.57	1.00000	.00140	1.40000
15	.10208	9.00	2199.45	.0009948	1239.56	1.00000	.00159	1.40000
15	.10208	12.00	2198.55	.0009954	1238.72	.99959	.00723	1.40000
15	.10208	15.00	2161.63	.0010135	1216.62	.98280	.06160	1.40000
15	.10208	18.00	1801.51	.0010921	1129.12	.81907	.17685	1.40000
15	.10208	21.00	834.46	.0012917	954.61	.37939	.16055	1.40000
15	.10208	24.00	146.71	.0017738	695.16	.06670	.04583	1.40000
15	.10208	27.00	9.45	.0021459	574.63	.00430	.00516	1.40000
15	.10208	30.00	0.00	.0022835	540.00	0.00000	0.00000	1.40000
16	.10938	0.00	2199.45	.0009948	1239.57	1.00000	.00104	1.50000
16	.10938	3.00	2199.45	.0009948	1239.57	1.00000	.00222	1.50000
16	.10938	6.00	2199.45	.0009948	1239.57	1.00000	.00272	1.50000
16	.10938	9.00	2199.45	.0009948	1239.56	1.00000	.00182	1.50000
16	.10938	12.00	2198.81	.0009953	1238.95	.99971	.00629	1.50000
16	.10938	15.00	2161.18	.0010137	1216.41	.98260	.06199	1.50000
16	.10938	18.00	1752.59	.0010996	1121.40	.79660	.18152	1.50000
16	.10938	21.00	710.45	.0013394	920.63	.32331	.14531	1.50000
16	.10938	24.00	98.26	.0018615	662.41	.04468	.03259	1.50000
16	.10938	27.00	4.21	.0021836	564.70	.00192	.00363	1.50000
16	.10938	30.00	0.00	.0022835	540.00	0.00000	0.00000	1.50000
17	.11667	0.00	2199.45	.0009948	1239.57	1.00000	.00206	1.60000
17	.11667	2.73	2199.45	.0009948	1239.57	1.00000	.00239	1.60000
17	.11667	5.45	2199.45	.0009948	1239.57	1.00000	.00178	1.60000
17	.11667	8.18	2199.45	.0009948	1239.56	1.00000	.00157	1.60000
17	.11667	10.91	2198.91	.0009952	1239.54	.99975	.00557	1.60000
17	.11667	13.64	2174.93	.0010080	1223.34	.98885	.04751	1.60000
17	.11667	16.36	1906.35	.0010753	1144.71	.86674	.15670	1.60000
17	.11667	19.09	1039.63	.0012332	999.94	.47241	.17474	1.60000
17	.11667	21.82	235.27	.0016608	742.44	.10687	.06531	1.60000
17	.11667	24.55	20.71	.0020856	591.22	.00942	.00875	1.60000
17	.11667	27.27	0.00	.0022835	540.00	0.00000	0.00000	1.60000
17	.11667	30.00	0.00	.0022835	540.00	0.00000	0.00000	1.60000
18	.12396	0.00	2199.45	.0009948	1239.57	1.00000	.00154	1.70000
18	.12396	2.73	2199.45	.0009948	1239.57	1.00000	.00141	1.70000
18	.12396	5.45	2199.45	.0009948	1239.56	1.00000	.00162	1.70000
18	.12396	8.18	2199.13	.0009950	1239.25	.99985	.00436	1.70000
18	.12396	10.91	2188.71	.0010013	1231.46	.99512	.02817	1.70000
18	.12396	13.64	2051.20	.0010465	1178.33	.93259	.11403	1.70000
18	.12396	16.36	1433.87	.0011478	1074.26	.65192	.18468	1.70000
18	.12396	19.09	478.50	.0014574	846.19	.21756	.10756	1.70000
18	.12396	21.82	62.84	.0019401	635.56	.02857	.02146	1.70000
18	.12396	24.55	2.89	.0021965	561.37	.00127	.00342	1.70000
18	.12396	27.27	0.00	.0022835	540.00	0.00000	0.00000	1.70000
18	.12396	30.00	0.00	.0022835	540.00	0.00000	0.00000	1.70000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TURE AR=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

AXIAL LOCATION = .07292 (X/DEQ = 1.00000)

M	R	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	R/DEQ
19	.13125	2.00	2199.19	.0009950	1239.31	.99988	.00325	1.80000
19	.13125	2.50	2198.99	.0009951	1239.12	.99979	.00412	1.80000
19	.13125	5.00	2197.42	.0009962	1237.75	.99908	.00926	1.80000
19	.13125	7.50	2185.40	.0010030	1229.37	.99361	.02954	1.80000
19	.13125	10.00	2166.46	.0010321	1194.73	.95772	.08446	1.80000
19	.13125	12.50	1776.53	.0010963	1124.82	.80771	.15885	1.80000
19	.13125	15.00	1938.20	.0012327	1009.33	.47203	.16182	1.80000
19	.13125	17.50	318.73	.0015743	783.25	.14491	.07710	1.80000
19	.13125	20.00	47.64	.0019859	620.91	.02166	.01638	1.80000
19	.13125	22.50	2.44	.0021988	560.79	.00131	.00320	1.80000
19	.13125	25.00	0.00	.0022835	540.00	0.00000	0.00000	1.80000
19	.13125	27.50	0.00	.0022835	540.00	0.00000	0.00000	1.80000
19	.13125	30.00	0.00	.0022835	540.00	0.00000	0.00000	1.80000
20	.13854	0.00	2145.68	.0010196	1209.39	.97555	.05255	1.90000
20	.13854	2.50	2129.85	.0010249	1263.69	.96835	.06116	1.90000
20	.13854	5.00	2061.96	.0010438	1181.31	.93749	.08886	1.90000
20	.13854	7.50	1867.77	.0010820	1139.60	.84920	.13235	1.90000
20	.13854	10.00	1436.12	.0011483	1073.86	.65295	.16129	1.90000
20	.13854	12.50	756.51	.0013212	933.33	.34395	.12913	1.90000
20	.13854	15.00	231.75	.0016626	741.66	.10537	.05730	1.90000
20	.13854	17.50	37.77	.0020185	610.90	.01717	.01295	1.90000
20	.13854	20.00	2.50	.0022007	560.32	.00114	.00315	1.90000
20	.13854	22.50	0.00	.0022835	540.00	0.00000	0.00000	1.90000
20	.13854	25.00	0.00	.0022835	540.00	0.00000	0.00000	1.90000
20	.13854	27.50	0.00	.0022835	540.00	0.00000	0.00000	1.90000
20	.13854	30.00	0.00	.0022835	540.00	0.00000	0.00000	1.90000
21	.14583	0.00	1378.11	.0011599	1063.10	.62657	.13781	2.00000
21	.14583	2.31	1303.87	.0011715	1052.52	.59281	.13796	2.00000
21	.14583	4.62	1100.68	.0012170	1013.17	.56043	.13495	2.00000
21	.14583	6.92	773.97	.0013145	938.05	.35189	.11671	2.00000
21	.14583	9.23	414.00	.0015002	821.91	.18823	.08055	2.00000
21	.14583	11.54	154.16	.0017639	699.08	.07009	.03861	2.00000
21	.14583	13.85	37.12	.0020204	610.32	.01688	.01201	2.00000
21	.14583	16.15	4.97	.0021826	564.95	.00226	.00328	2.00000
21	.14583	18.46	0.00	.0022835	540.00	0.00000	0.00000	2.00000
21	.14583	20.77	0.00	.0022835	540.00	0.00000	0.00000	2.00000
21	.14583	23.08	0.00	.0022835	540.00	0.00000	0.00000	2.00000
21	.14583	25.38	0.00	.0022835	540.00	0.00000	0.00000	2.00000
21	.14583	27.69	0.00	.0022835	540.00	0.00000	0.00000	2.00000
21	.14583	30.00	0.00	.0022835	540.00	0.00000	0.00000	2.00000
22	.15313	0.00	203.27	.0016988	725.85	.09242	.04220	2.10000
22	.15313	2.14	181.15	.0017236	715.40	.08236	.03875	2.10000
22	.15313	4.29	131.99	.0018010	684.65	.06001	.03049	2.10000
22	.15313	6.43	73.29	.0019140	644.25	.03332	.01912	2.10000
22	.15313	8.57	31.17	.0020427	603.66	.01417	.00955	2.10000
22	.15313	10.71	9.03	.0021524	572.88	.00410	.00396	2.10000
22	.15313	12.86	1.10	.0021963	561.44	.00050	.00274	2.10000
22	.15313	15.00	0.00	.0022835	540.00	0.00000	0.00000	2.10000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TURE AR=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

AXIAL LOCATION = .07292 (X/DEQ = 1.00000)

M	R	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	R/DEQ
22	.15313	17.14	0.00	.0022835	540.00	0.00000	0.00000	2.10000
22	.15313	19.29	0.00	.0022835	540.00	0.00000	0.00000	2.10000
22	.15313	21.43	0.00	.0022835	540.00	0.00000	0.00000	2.10000
22	.15313	23.57	0.00	.0022835	540.00	0.00000	0.00000	2.10000
22	.15313	25.71	0.00	.0022835	540.00	0.00000	0.00000	2.10000
22	.15313	27.86	0.00	.0022835	540.00	0.00000	0.00000	2.10000
22	.15313	30.00	0.00	.0022835	540.00	0.00000	0.00000	2.10000
23	.16042	3.00	4.61	.0021890	563.29	.00210	.00280	2.20000
23	.16042	2.14	3.77	.0021944	561.93	.00172	.00285	2.20000
23	.16042	4.29	2.16	.0022076	558.56	.00098	.00276	2.20000
23	.16042	6.43	0.00	.0022835	540.00	0.00000	0.00000	2.20000
23	.16042	8.57	0.00	.0022835	540.00	0.00000	0.00000	2.20000
23	.16042	10.71	0.00	.0022835	540.00	0.00000	0.00000	2.20000
23	.16042	12.86	0.00	.0022835	540.00	0.00000	0.00000	2.20000
23	.16042	15.00	0.00	.0022835	540.00	0.00000	0.00000	2.20000
23	.16042	17.14	0.00	.0022835	540.00	0.00000	0.00000	2.20000
23	.16042	19.29	0.00	.0022835	540.00	0.00000	0.00000	2.20000
23	.16042	21.43	0.00	.0022835	540.00	0.00000	0.00000	2.20000
23	.16042	23.57	0.00	.0022835	540.00	0.00000	0.00000	2.20000
23	.16042	25.71	0.00	.0022835	540.00	0.00000	0.00000	2.20000
23	.16042	27.86	0.00	.0022835	540.00	0.00000	0.00000	2.20000
23	.16042	30.00	0.00	.0022835	540.00	0.00000	0.00000	2.20000

CIRCUMFERENTIALLY-AVERAGED PARAMETERS

NP	RADIUS	MACH NO.	TEMP.	INTENSITY	FREQUENCY
1	.0001	1.9662	2.2955	.66906E-12	0.
2	.1000	1.9662	2.2955	.24773E-06	3.
3	.2000	1.9662	2.2955	.95416E-08	0.
4	.3000	1.9660	2.2951	.21384E-04	7.
5	.4000	1.9182	2.2398	.16103E+05	2416.
6	.5000	1.2278	1.9688	.17198E+08	25958.
7	.6000	.1809	1.3452	.51043E+04	16407.
8	.7000	.0028	1.0583	.39885E-04	4377.
9	.8000	.0019	1.0777	.41234E-06	524.
10	.9000	.1277	1.2755	.10304E+04	5139.
11	1.0000	.8929	1.8257	.11824E+08	12312.
12	1.1000	1.5573	2.1133	.29016E+08	5707.
13	1.2000	1.7232	2.2014	.42213E+08	2595.
14	1.3000	1.7745	2.2247	.49608E+08	1676.
15	1.4000	1.7964	2.2343	.41582E+08	1326.
16	1.5000	1.8024	2.2367	.42918E+08	1313.
17	1.6000	1.7963	2.2339	.38624E+08	1513.
18	1.7000	1.7761	2.2255	.43543E+08	1888.
19	1.8000	1.7236	2.2014	.30032E+08	2593.
20	1.9000	1.5589	2.1139	.24184E+08	4755.
21	2.0000	.8929	1.8257	.14303E+08	8933.
22	2.1000	.1275	1.2750	.15046E+04	3436.
23	2.2000	.0029	1.0397	.19514E-04	733.

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
KA= 1 X= .07292 ITH= 10 THETA= 110.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
KA= 1 X= .07292 ITH= 11 THETA= 120.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
KA= 1 X= .07292 ITH= 12 THETA= 130.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
KA= 1 X= .07292 ITH= 13 THETA= 140.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
KA= 1 X= .07292 ITH= 14 THETA= 150.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
KA= 1 X= .07292 ITH= 15 THETA= 160.00 NTP= 3

X(1)= .0729 UR1(1)= .25899E+21 FMC(1)= .2419E+01 UAVG(1)= 1847.59 UMAX(1)= 2199.46

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 2 X= .09187 ITH= 10 THETA= 110.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 2 X= .09187 ITH= 11 THETA= 120.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 2 X= .09187 ITH= 12 THETA= 130.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 2 X= .09187 ITH= 13 THETA= 140.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 2 X= .09187 ITH= 14 THETA= 150.00 NTP= 3

X(2)= .0919 UR1(2)= .26305E+21 FMC(2)= .2529E+01 UAVG(2)= 1767.58 UMAX(2)= 2199.46

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 3 X= .11575 ITH= 10 THETA= 110.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 3 X= .11575 ITH= 11 THETA= 120.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 3 X= .11575 ITH= 12 THETA= 130.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 3 X= .11575 ITH= 13 THETA= 140.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 3 X= .11575 ITH= 14 THETA= 150.00 NTP= 3

X(3)= .1157 UR1(3)= .26192E+21 FMC(3)= .2669E+01 UAVG(3)= 1674.56 UMAX(3)= 2199.45

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 4 X= .14583 ITH= 10 THETA= 110.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT

KA= 4 X= .14583 ITH= 11 THETA= 120.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
 KA= 4 X= .14583 ITH= 12 THETA= 130.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
 KA= 4 X= .14583 ITH= 13 THETA= 140.00 NTP= 3

X(4)= .1458 U81(4)= .25722E+21 FM(4)= .2843E+01 UAVG(4)= 1572.60 UMAX(4)= 2199.41

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
 KA= 5 X= .18374 ITH= 11 THETA= 110.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
 KA= 5 X= .18374 ITH= 11 THETA= 120.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
 KA= 5 X= .18374 ITH= 12 THETA= 130.00 NTP= 3

X(5)= .1837 U81(5)= .24966E+21 FM(5)= .3047E+01 UAVG(5)= 1467.27 UMAX(5)= 2197.57

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
 KA= 6 X= .23150 ITH= 10 THETA= 110.00 NTP= 3

WARNING - NO. OF TURNING POINTS IS GREATER THAN 2 AT
 KA= 6 X= .23150 ITH= 11 THETA= 120.00 NTP= 3

X(6)= .2315 U81(6)= .23294E+21 FM(6)= .3277E+01 UAVG(6)= 1364.33 UMAX(6)= 2179.00

COMPUTATION OF AERO-AcouSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TURE AR=2.3 NOZZLE - VJ=2200 FPS - ITJ=1600 DEG-R

AXIAL LOCATION = .29167 (X/DEQ = 4.05060)

N	A	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	X/DEQ
1	.00001	1.00	2136.11	.0010468	1177.90	.95756	.00168	.00010
1	.00001	15.00	2136.11	.0010468	1177.90	.95756	.00168	.00010
1	.00001	29.00	2136.11	.0010468	1177.90	.95756	.00168	.00010
1	.00001	30.00	2136.11	.0010468	1177.90	.95756	.00168	.00010
2	.00729	1.00	2079.72	.0010551	1168.73	.94555	.05657	.10000
2	.00729	15.00	2079.72	.0010551	1168.73	.94555	.05658	.10000
2	.00729	29.00	2079.72	.0010551	1168.73	.94555	.05658	.10000
2	.00729	30.00	2079.72	.0010551	1168.73	.94555	.05658	.10000
3	.01458	1.00	1994.74	.0010776	1144.29	.90694	.08729	.20000
3	.01458	15.00	1994.74	.0010776	1144.27	.90692	.08729	.20000
3	.01458	29.00	1994.73	.0010776	1144.28	.90694	.08730	.20000
3	.01458	30.00	1994.73	.0010776	1144.27	.90692	.08730	.20000
3	.01458	31.00	1994.77	.0010776	1144.28	.90694	.08730	.20000
4	.02188	1.00	1838.10	.0011099	1111.01	.83571	.11429	.30000
4	.02188	15.00	1838.13	.0011099	1111.02	.83572	.11430	.30000
4	.02188	29.00	1838.04	.0011099	1111.97	.83568	.11431	.30000
4	.02188	30.00	1838.06	.0011099	1111.95	.83569	.11432	.30000
4	.02188	31.00	1837.09	.0011100	1111.92	.83566	.11432	.30000
5	.02917	1.00	1601.57	.0011489	1073.31	.72811	.13158	.40000
5	.02917	15.00	1601.44	.0011489	1073.23	.72811	.13160	.40000
5	.02917	29.00	1601.30	.0011491	1073.07	.72804	.13166	.40000
5	.02917	30.00	1601.02	.0011493	1072.85	.72792	.13172	.40000
5	.02917	31.00	1600.72	.0011496	1072.64	.72778	.13176	.40000
5	.02917	35.00	1600.68	.0011496	1072.58	.72776	.13178	.40000
6	.03646	1.00	1298.70	.0011959	1031.04	.59046	.13255	.50000
6	.03646	15.00	1298.61	.0011963	1030.74	.59043	.13268	.50000
6	.03646	29.00	1298.97	.0011975	1029.74	.58968	.13295	.50000
6	.03646	30.00	1295.36	.0011988	1028.56	.58895	.13329	.50000
6	.03646	31.00	1294.41	.0011999	1027.64	.58851	.13355	.50000
6	.03646	35.00	1293.49	.0012004	1027.20	.58810	.13363	.50000
7	.04375	1.00	980.18	.0012487	987.46	.44565	.11324	.60000
7	.04375	15.00	978.21	.0012502	986.28	.44475	.11362	.60000
7	.04375	29.00	973.63	.0012537	983.54	.44267	.11462	.60000
7	.04375	30.00	967.62	.0012554	979.85	.43994	.11590	.60000
7	.04375	31.00	961.38	.0012636	975.87	.43710	.11703	.60000
7	.04375	35.00	956.95	.0012673	972.99	.43508	.11782	.60000
7	.04375	39.00	955.55	.0012685	972.08	.43445	.11812	.60000
8	.05104	1.00	758.09	.0012799	963.41	.34467	.06822	.70000
8	.05104	15.00	751.56	.0012834	960.81	.34170	.07114	.70000
8	.05104	29.00	733.93	.0012928	953.81	.33369	.07705	.70000
8	.05104	30.00	710.08	.0013064	943.84	.32285	.08252	.70000
8	.05104	31.00	686.08	.0013216	933.04	.31193	.08631	.70000
8	.05104	35.00	668.47	.0013335	924.72	.30393	.08843	.70000
8	.05104	39.00	662.07	.0013379	921.68	.30101	.08911	.70000
9	.05833	1.00	758.05	.0012799	963.41	.34465	.06817	.80000
9	.05833	15.00	745.61	.0012839	960.44	.33900	.07124	.80000
9	.05833	29.00	710.47	.0012950	952.16	.32302	.07635	.80000
9	.05833	30.00	658.39	.0013121	939.74	.29934	.07855	.80000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1

CRD 7-TUBE AR=2.3 NOZZLE - VJ=2200 FPS - ITJ=1600 DEG-R

AXIAL LOCATION = .29167 (X/DEQ = 4.00000)

M	P	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	K/DEQ
9	.05833	17.14	597.48	.0013330	925.00	.27183	.07582	.80000
9	.05833	21.43	540.35	.0013531	911.29	.24567	.06819	.80000
9	.05833	25.71	498.87	.0013676	901.61	.22682	.05718	.80000
9	.05833	30.00	483.69	.0013728	898.19	.21991	.05027	.80000
10	.06563	0.00	980.09	.0012487	987.45	.44561	.11321	.90000
10	.06563	4.29	958.96	.0012541	983.25	.43599	.11533	.90000
10	.06563	8.57	898.45	.0012692	971.57	.40849	.11892	.90000
10	.06563	12.86	805.40	.0012938	953.09	.36618	.11906	.90000
10	.06563	17.14	692.79	.0013244	931.01	.31498	.11248	.90000
10	.06563	21.43	579.98	.0013541	910.63	.26369	.09745	.90000
10	.06563	25.71	492.43	.0013716	899.03	.22389	.07158	.90000
10	.06563	30.00	458.84	.0013755	896.38	.20861	.03069	.90000
11	.07292	0.00	1298.64	.0011965	1031.04	.59144	.13253	1.00000
11	.07292	3.75	1278.97	.0011997	1027.81	.58150	.13588	1.00000
11	.07292	7.50	1213.17	.0012120	1017.42	.55158	.14287	1.00000
11	.07292	11.25	1109.42	.0012334	999.73	.50459	.14800	1.00000
11	.07292	15.00	977.73	.0012630	976.32	.44453	.14727	1.00000
11	.07292	18.75	829.45	.0012980	950.66	.37712	.13834	1.00000
11	.07292	22.50	686.00	.0013309	926.50	.31190	.11965	1.00000
11	.07292	26.25	576.12	.0013516	912.95	.26189	.08882	1.00000
11	.07292	30.00	533.54	.0013553	909.80	.24258	.04985	1.00000
12	.08021	0.00	1601.50	.0011489	1073.30	.72813	.13157	1.10000
12	.08021	3.75	1577.02	.0011528	1069.60	.71701	.13788	1.10000
12	.08021	7.50	1503.70	.0011648	1058.63	.68367	.15133	1.10000
12	.08021	11.25	1383.35	.0011848	1040.71	.62895	.16335	1.10000
12	.08021	15.00	1219.62	.0012135	1016.11	.55451	.16798	1.10000
12	.08021	18.75	1028.14	.0012507	985.89	.46745	.16135	1.10000
12	.08021	22.50	838.03	.0012885	956.97	.38102	.14139	1.10000
12	.08021	26.25	688.35	.0013137	938.60	.31296	.10494	1.10000
12	.08021	30.00	629.41	.0013201	934.09	.28617	.05050	1.10000
13	.08750	0.00	1838.04	.0011099	1111.01	.83568	.11428	1.20000
13	.08750	3.33	1817.98	.0011135	1107.37	.82656	.12296	1.20000
13	.08750	6.67	1756.96	.0011241	1096.90	.79882	.14180	1.20000
13	.08750	10.00	1653.43	.0011412	1080.52	.75174	.16119	1.20000
13	.08750	13.33	1507.73	.0011642	1059.16	.68550	.17533	1.20000
13	.08750	16.67	1326.82	.0011932	1033.45	.60325	.18014	1.20000
13	.08750	20.00	1116.83	.0012287	1003.54	.50778	.17240	1.20000
13	.08750	23.33	915.38	.0012641	975.46	.41619	.15031	1.20000
13	.08750	26.67	750.19	.0012869	958.20	.34563	.11059	1.20000
13	.08750	30.00	699.78	.0012926	953.93	.31816	.03942	1.20000
14	.09479	0.00	1994.74	.0010776	1144.28	.93693	.08729	1.30000
14	.09479	3.33	1974.99	.0010822	1139.40	.89795	.10155	1.30000
14	.09479	6.67	1914.02	.0010953	1125.76	.87023	.12855	1.30000
14	.09479	10.00	1807.55	.0011154	1105.52	.82182	.15554	1.30000
14	.09479	13.33	1652.47	.0011410	1080.71	.75131	.17663	1.30000
14	.09479	16.67	1451.76	.0011721	1052.06	.66005	.18673	1.30000
14	.09479	20.00	1218.12	.0012089	1019.96	.55383	.18205	1.30000
14	.09479	23.33	982.66	.0012485	987.61	.44673	.15998	1.30000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TUBE AR=2.3 NOZZLE - VJ=2200 FPS - TIJ=1600 DEG-R

AXIAL LOCATION = .29167 (X/DEQ = 4.00000)

M	R	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	R/DEQ
14	.09479	26.67	798.24	.0012757	966.58	.36291	.11775	1.30000
14	.09479	30.00	725.24	.0012831	961.98	.32973	.00455	1.30000
15	.10208	3.00	2079.68	.0010551	1168.72	.94554	.05655	1.40000
15	.10208	3.00	2064.83	.0010596	1163.69	.93843	.07855	1.40000
15	.10208	6.00	2015.26	.0010726	1149.60	.91626	.10976	1.40000
15	.10208	9.00	1928.64	.0010923	1128.86	.87687	.14000	1.40000
15	.10208	12.00	1799.20	.0011168	1104.68	.81812	.16625	1.40000
15	.10208	15.00	1624.99	.0011454	1076.54	.73881	.18425	1.40000
15	.10208	18.00	1411.64	.0011788	1046.01	.64181	.19610	1.40000
15	.10208	21.00	1172.55	.0012181	1012.27	.53311	.18135	1.40000
15	.10208	24.00	942.79	.0012592	979.23	.42865	.15690	1.40000
15	.10208	27.00	766.69	.0012872	957.97	.34858	.11462	1.40000
15	.10208	30.00	698.15	.0012947	952.41	.31742	.04002	1.40000
16	.10938	3.00	2106.08	.0010469	1177.88	.95755	.00131	1.50000
16	.10938	3.00	2089.92	.0010520	1172.16	.95020	.06982	1.50000
16	.10938	6.00	2039.21	.0010665	1156.23	.92714	.10518	1.50000
16	.10938	9.00	1948.12	.0010882	1133.09	.88573	.13772	1.50000
16	.10938	12.00	1810.36	.0011151	1105.80	.82310	.16571	1.50000
16	.10938	15.00	1623.35	.0011464	1075.63	.73807	.18444	1.50000
16	.10938	18.00	1393.64	.0011837	1041.70	.63363	.18980	1.50000
16	.10938	21.00	1135.88	.0012310	1002.50	.51644	.17962	1.50000
16	.10938	24.00	888.64	.0012818	962.75	.40403	.15401	1.50000
16	.10938	27.00	698.73	.0013180	935.53	.31767	.11212	1.50000
16	.10938	30.00	624.17	.0013230	927.94	.28378	.05158	1.50000
17	.11667	0.00	2079.64	.0010551	1168.69	.94553	.05661	1.60000
17	.11667	2.73	2064.86	.0010594	1163.93	.93881	.07639	1.60000
17	.11667	5.45	2018.48	.0010717	1150.53	.91790	.10564	1.60000
17	.11667	8.18	1937.32	.0010936	1130.61	.88082	.13436	1.60000
17	.11667	10.91	1815.35	.0011144	1106.47	.82536	.15985	1.60000
17	.11667	13.64	1650.35	.0011426	1079.16	.75034	.17834	1.60000
17	.11667	16.36	1445.39	.0011768	1047.82	.65716	.18636	1.60000
17	.11667	19.09	1210.33	.0012211	1010.61	.55029	.18208	1.60000
17	.11667	21.82	965.46	.0012752	966.93	.43895	.16525	1.60000
17	.11667	24.55	743.54	.0013331	924.94	.33806	.13778	1.60000
17	.11667	27.27	578.88	.0013749	896.83	.26319	.09931	1.60000
17	.11667	30.00	515.41	.0013875	888.71	.23434	.05403	1.60000
18	.12396	0.00	1994.54	.0010777	1144.15	.91685	.08734	1.70000
18	.12396	2.73	1977.29	.0010819	1139.85	.89849	.09823	1.70000
18	.12396	5.45	1924.71	.0010935	1127.67	.87477	.12066	1.70000
18	.12396	8.18	1831.25	.0011116	1109.29	.83259	.14455	1.70000
18	.12396	10.91	1695.34	.0011354	1086.06	.77080	.16479	1.70000
18	.12396	13.64	1516.33	.0011654	1058.07	.68941	.17735	1.70000
18	.12396	16.36	1322.89	.0012043	1023.87	.59237	.17931	1.70000
18	.12396	19.09	1057.75	.0012582	979.99	.48091	.16939	1.70000
18	.12396	21.82	818.59	.0013262	929.78	.37218	.14918	1.70000
18	.12396	24.55	606.74	.0013991	881.32	.27586	.12107	1.70000
18	.12396	27.27	452.02	.0014540	848.04	.20551	.08555	1.70000
18	.12396	30.00	392.42	.0014709	838.30	.17842	.04972	1.70000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CPU 7-TURF AR=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

AXIAL LOCATION = .29167 (X/DEG = 4.00000)

M	R	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	R/DEG
19	.13125	1.00	1837.39	.0011105	1116.42	.83539	.11439	1.80000
19	.13125	2.50	1820.44	.0011136	1107.30	.82768	.12007	1.80000
19	.13125	5.00	1768.89	.0011228	1098.22	.80424	.13359	1.80000
19	.13125	7.50	1681.62	.0011378	1083.77	.76447	.14907	1.80000
19	.13125	10.00	1556.92	.0011587	1064.21	.70787	.16204	1.80000
19	.13125	12.50	1397.48	.0011866	1039.14	.63537	.16931	1.80000
19	.13125	15.00	1206.70	.0012245	1006.97	.54864	.16868	1.80000
19	.13125	17.50	997.64	.0012764	968.33	.45354	.15935	1.80000
19	.13125	20.00	787.82	.0013429	918.24	.35819	.14249	1.80000
19	.13125	22.50	593.76	.0014217	867.36	.26996	.12005	1.80000
19	.13125	25.00	431.22	.0015017	821.12	.19606	.09427	1.80000
19	.13125	27.50	316.29	.0015595	790.68	.14408	.06595	1.80000
19	.13125	30.00	273.46	.0015771	781.86	.12433	.04087	1.80000
20	.13854	1.00	1548.74	.0011516	1071.72	.72688	.13194	1.90000
20	.13854	2.50	1579.89	.0011548	1067.74	.71831	.13512	1.90000
20	.13854	5.00	1523.25	.0011644	1058.99	.69256	.14277	1.90000
20	.13854	7.50	1429.27	.0011818	1044.23	.64983	.15099	1.90000
20	.13854	10.00	1301.85	.0012052	1023.13	.59190	.15622	1.90000
20	.13854	12.50	1136.77	.0012467	993.84	.51684	.15577	1.90000
20	.13854	15.00	954.54	.0012896	956.17	.43399	.14844	1.90000
20	.13854	17.50	766.15	.0013530	911.36	.34834	.13455	1.90000
20	.13854	20.00	585.08	.0014320	861.07	.26601	.11549	1.90000
20	.13854	22.50	425.42	.0015230	809.65	.19342	.09352	1.90000
20	.13854	25.00	296.85	.0016132	764.39	.13496	.07079	1.90000
20	.13854	27.50	208.01	.0016788	734.48	.09457	.04826	1.90000
20	.13854	30.00	174.26	.0016987	725.87	.07923	.03019	1.90000
21	.14583	1.00	1287.46	.0012079	1020.84	.58535	.13417	2.00000
21	.14583	2.50	1273.23	.0012109	1018.35	.57888	.13532	2.00000
21	.14583	5.00	1221.46	.0012216	1009.39	.55535	.13771	2.00000
21	.14583	7.50	1140.20	.0012400	994.44	.51840	.13956	2.00000
21	.14583	10.00	1033.50	.0012672	973.68	.46989	.13924	2.00000
21	.14583	11.54	905.48	.0013048	944.99	.41169	.13506	2.00000
21	.14583	13.85	764.63	.0013539	910.74	.34764	.12545	2.00000
21	.14583	16.15	619.74	.0014161	870.74	.28137	.11370	2.00000
21	.14583	18.46	481.43	.0014913	826.87	.21889	.09777	2.00000
21	.14583	20.77	357.91	.0015764	782.20	.16273	.08012	2.00000
21	.14583	23.08	254.57	.0016664	739.96	.11574	.06236	2.00000
21	.14583	25.38	175.01	.0017501	704.58	.07957	.04584	2.00000
21	.14583	27.69	121.64	.0018279	682.03	.05530	.03092	2.00000
21	.14583	29.99	101.49	.0018249	675.70	.04614	.02011	2.00000
22	.15313	1.00	937.77	.0012946	952.48	.42637	.11983	2.10000
22	.15313	2.14	924.05	.0012987	949.49	.42063	.11979	2.10000
22	.15313	4.29	887.81	.0013103	941.04	.40365	.11943	2.10000
22	.15313	6.43	828.08	.0013308	926.50	.37549	.11795	2.10000
22	.15313	8.57	749.54	.0013598	906.86	.34679	.11460	2.10000
22	.15313	10.71	656.09	.0013900	881.41	.29870	.10870	2.10000
22	.15313	12.86	556.37	.0014486	851.20	.25296	.10008	2.10000
22	.15313	15.00	454.56	.0015083	817.51	.20667	.08910	2.10000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TURE AP=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

AXIAL LOCATION = .29167 (X/DFD = 4.00000)

M	P	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	R/DFD
22	.15313	17.14	357.45	.0015777	781.57	.16252	.07634	2.10000
22	.15313	19.29	270.54	.0016543	745.39	.12361	.06280	2.10000
22	.15313	21.43	197.22	.0017346	714.86	.08967	.04961	2.10000
22	.15313	23.57	137.95	.0018142	679.67	.06272	.03736	2.10000
22	.15313	25.71	93.70	.0018844	654.37	.04260	.02675	2.10000
22	.15313	27.86	64.47	.0019313	638.46	.02931	.01780	2.10000
22	.15313	30.00	53.60	.0019445	634.12	.02477	.01197	2.10000
23	.16042	0.00	613.13	.0014195	864.70	.27876	.09412	2.20000
23	.16042	2.14	603.28	.0014242	865.80	.27429	.09360	2.20000
23	.16042	4.29	575.54	.0014387	857.06	.26145	.09196	2.20000
23	.16042	6.43	530.34	.0014629	842.91	.24114	.08886	2.20000
23	.16042	8.57	472.73	.0014970	823.72	.21493	.08401	2.20000
23	.16042	10.71	406.78	.0015439	800.25	.18495	.07770	2.20000
23	.16042	12.86	337.15	.0015942	773.46	.15329	.06887	2.20000
23	.16042	15.00	269.33	.0016558	744.68	.12246	.05929	2.20000
23	.16042	17.14	206.72	.0017239	715.30	.09399	.04904	2.20000
23	.16042	19.29	152.21	.0017959	686.64	.06920	.03887	2.20000
23	.16042	21.43	117.77	.0018681	660.08	.04900	.02951	2.20000
23	.16042	23.57	73.44	.0019367	636.75	.03339	.02149	2.20000
23	.16042	25.71	48.22	.0019964	617.66	.02193	.01484	2.20000
23	.16042	27.86	31.74	.0020367	605.42	.01443	.00958	2.20000
23	.16042	30.00	25.54	.0020684	601.96	.01161	.00650	2.20000
24	.16771	0.00	357.30	.0016779	781.48	.16245	.06487	2.30000
24	.16771	2.00	351.61	.0016824	779.25	.15986	.06431	2.30000
24	.16771	4.00	335.59	.0016957	772.74	.15258	.06270	2.30000
24	.16771	6.00	310.28	.0016176	762.26	.14098	.05991	2.30000
24	.16771	8.00	277.57	.0016481	748.17	.12597	.05592	2.30000
24	.16771	10.00	240.00	.0016861	731.32	.10912	.05096	2.30000
24	.16771	12.00	200.67	.0017312	712.27	.09123	.04505	2.30000
24	.16771	14.00	161.87	.0017820	691.95	.07360	.03854	2.30000
24	.16771	16.00	126.11	.0018367	671.37	.05734	.03189	2.30000
24	.16771	18.00	94.96	.0018929	651.41	.04319	.02550	2.30000
24	.16771	20.00	68.57	.0019495	632.46	.03122	.01954	2.30000
24	.16771	22.00	47.91	.0020039	615.35	.02178	.01446	2.30000
24	.16771	24.00	32.27	.0020531	600.60	.01467	.01031	2.30000
24	.16771	26.00	20.97	.0020947	588.65	.00954	.00709	2.30000
24	.16771	28.00	13.73	.0021219	581.12	.00624	.00464	2.30000
24	.16771	30.00	10.98	.0021459	578.95	.00499	.00327	2.30000
25	.17500	0.00	186.12	.0017495	704.81	.08462	.03924	2.40000
25	.17500	2.00	182.65	.0017538	703.08	.08304	.03877	2.40000
25	.17500	4.00	173.41	.0017661	698.20	.07884	.03741	2.40000
25	.17500	6.00	159.16	.0017860	690.39	.07236	.03532	2.40000
25	.17500	8.00	140.63	.0018134	679.99	.06394	.03232	2.40000
25	.17500	10.00	120.68	.0018468	667.68	.05460	.02878	2.40000
25	.17500	12.00	99.15	.0018850	654.15	.04573	.02488	2.40000
25	.17500	14.00	78.44	.0019274	639.77	.03566	.02070	2.40000
25	.17500	16.00	59.51	.0019714	625.49	.02724	.01663	2.40000
25	.17500	18.00	44.13	.0020153	611.86	.02006	.01290	2.40000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1

CRD 7-TURE AW=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

AXIAL LOCATION = .29167 (X/DEQ = 4.00000)

M	R	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	R/DEQ
25	.17500	20.00	31.18	.0020583	599.09	.01418	.00964	2.40000
25	.17500	22.00	21.12	.0020987	587.55	.00960	.00694	2.40000
25	.17500	24.00	13.77	.0021344	577.71	.00626	.00481	2.40000
25	.17500	26.00	8.66	.0021636	569.92	.00394	.00334	2.40000
25	.17500	28.00	5.41	.0021826	564.96	.00246	.00232	2.40000
25	.17500	30.00	4.18	.0021877	563.64	.00190	.00192	2.40000
26	.18229	0.00	86.65	.0019698	645.67	.03940	.02081	2.50000
26	.18229	1.87	85.19	.0019131	644.56	.03869	.02052	2.50000
26	.18229	3.75	80.94	.0019217	641.64	.03680	.01974	2.50000
26	.18229	5.62	74.69	.0019357	637.02	.03396	.01860	2.50000
26	.18229	7.50	66.40	.0019552	630.67	.03019	.01697	2.50000
26	.18229	9.37	57.15	.0019786	623.19	.02598	.01510	2.50000
26	.18229	11.25	47.65	.0020048	615.05	.02166	.01303	2.50000
26	.18229	13.12	38.29	.0020337	606.33	.01741	.01087	2.50000
26	.18229	15.00	29.65	.0020641	597.41	.01348	.00879	2.50000
26	.18229	16.87	22.17	.0020942	588.81	.01008	.00693	2.50000
26	.18229	18.75	16.03	.0021229	580.84	.00729	.00534	2.50000
26	.18229	20.62	11.14	.0021501	573.50	.00507	.00396	2.50000
26	.18229	22.50	7.44	.0021746	567.05	.00338	.00293	2.50000
26	.18229	24.37	4.76	.0021955	561.63	.00216	.00224	2.50000
26	.18229	26.25	2.88	.0022116	557.56	.00131	.00172	2.50000
26	.18229	28.12	1.66	.0022189	555.72	.00076	.00151	2.50000
26	.18229	30.00	1.19	.0022174	556.08	.00054	.00132	2.50000
27	.18958	0.00	36.06	.0020411	604.12	.01640	.00971	2.60000
27	.18958	1.87	35.36	.0020436	603.37	.01608	.00957	2.60000
27	.18958	3.75	33.52	.0020500	601.50	.01524	.00917	2.60000
27	.18958	5.62	30.72	.0020600	598.59	.01397	.00858	2.60000
27	.18958	7.50	27.12	.0020736	594.64	.01233	.00776	2.60000
27	.18958	9.37	23.02	.0020905	589.84	.01046	.00681	2.60000
27	.18958	11.25	18.93	.0021087	584.75	.00861	.00587	2.60000
27	.18958	13.12	14.96	.0021285	579.32	.00680	.00485	2.60000
27	.18958	15.00	11.39	.0021486	573.90	.00518	.00392	2.60000
27	.18958	16.87	8.30	.0021685	568.62	.00378	.00304	2.60000
27	.18958	18.75	5.84	.0021868	563.87	.00265	.00246	2.60000
27	.18958	20.62	3.89	.0022033	559.65	.00177	.00192	2.60000
27	.18958	22.50	2.43	.0022167	556.26	.00111	.00165	2.60000
27	.18958	24.37	1.34	.0022241	554.42	.00061	.00160	2.60000
27	.18958	26.25	.34	.0021745	567.06	.00015	.00148	2.60000
27	.18958	28.12	0.00	.0022835	546.00	0.00000	0.00000	2.60000
27	.18958	30.00	0.00	.0022835	546.00	0.00000	0.00000	2.60000

$$S_{\text{eff}} = S_{\text{YM}} + \int d^4x \sqrt{-g} \left(-\frac{1}{4} F_{\mu\nu}^2 - \frac{1}{2} (\partial_\mu \phi)^2 - V(\phi) \right)$$
[illegible]

WABLING - 10% OF THE 15 POINTS IS AWARDED 144'. 2 AT

$x \Delta = 7$	$x = .29107$	$TM = 11$	$TM \Delta = 129.00$	$TM = 3$
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$x(7) =$	.2917	$u_1(7) =$	.16492E+21	$F_1(7) =$	.3531E+01	$u_{AVG}(7) =$	1266.03	$u_{MAX}(7) =$	2106.11
$x(8) =$	.3475	$u_1(8) =$	.13113E+21	$F_1(8) =$	.3226E+01	$u_{AVG}(8) =$	1170.16	$u_{MAX}(8) =$	1951.26
$x(9) =$	.4635	$u_1(9) =$	.65935E+20	$F_1(9) =$	.4151E+01	$u_{AVG}(9) =$	1077.16	$u_{MAX}(9) =$	1731.67
$x(10) =$	.5233	$u_1(10) =$	.17529E+20	$F_1(10) =$	.4533E+01	$u_{AVG}(10) =$	996.98	$u_{MAX}(10) =$	1506.85
$x(11) =$	.7350	$u_1(11) =$	.32714E+19	$F_1(11) =$	.4722E+01	$u_{AVG}(11) =$	899.31	$u_{MAX}(11) =$	1347.75
$x(12) =$	.9263	$u_1(12) =$	.12729E+19	$F_1(12) =$	.5529E+01	$u_{AVG}(12) =$	808.47	$u_{MAX}(12) =$	1276.87

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TURE AR=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

AXIAL LOCATION = 1.16567 (X/OEO = 15.99999)

M	R	ANGLE	H	DENSITY	TEMP.	U/UREF	TURB.INT.	R/OEO
1	.00001	0.00	1238.43	.0012299	1002.62	.56306	.00079	.00016
1	.00001	15.00	1238.43	.0012299	1002.62	.56306	.00079	.00016
1	.00001	25.00	1238.43	.0012299	1002.62	.56306	.00079	.00016
1	.00001	30.00	1238.43	.0012299	1002.62	.56306	.00079	.00016
2	.01167	0.00	1236.43	.0012310	1001.65	.56215	.01959	.16000
2	.01167	15.00	1236.43	.0012310	1001.65	.56215	.01960	.16000
2	.01167	25.00	1236.44	.0012310	1001.66	.56216	.01961	.16000
2	.01167	30.00	1236.44	.0012310	1001.66	.56216	.01960	.16000
3	.02333	0.00	1230.98	.0012345	998.88	.55964	.02794	.32000
3	.02333	7.50	1230.98	.0012345	998.88	.55964	.02794	.32000
3	.02333	15.00	1230.98	.0012345	998.88	.55964	.02797	.32000
3	.02333	22.50	1230.92	.0012345	998.88	.55965	.02797	.32000
3	.02333	30.00	1230.98	.0012344	998.90	.55967	.02798	.32000
4	.03500	0.00	1221.34	.0012405	994.04	.55529	.03476	.48000
4	.03500	7.50	1221.34	.0012404	994.07	.55535	.03477	.48000
4	.03500	15.00	1221.34	.0012404	994.07	.55532	.03482	.48000
4	.03500	22.50	1221.41	.0012404	994.08	.55532	.03489	.48000
4	.03500	30.00	1221.32	.0012404	994.07	.55528	.03491	.48000
5	.04667	0.00	1206.98	.0012493	988.99	.54872	.04115	.64000
5	.04667	0.00	1206.98	.0012493	987.02	.54875	.04119	.64000
5	.04667	12.00	1206.98	.0012493	987.05	.54876	.04135	.64000
5	.04667	18.00	1206.98	.0012492	987.07	.54871	.04154	.64000
5	.04667	24.00	1206.74	.0012492	987.10	.54865	.04169	.64000
5	.04667	30.00	1206.64	.0012492	987.12	.54870	.04170	.64000
6	.05833	0.00	1187.62	.0012613	977.66	.53996	.04768	.80000
6	.05833	0.00	1187.62	.0012612	977.69	.53996	.04783	.80000
6	.05833	12.00	1187.26	.0012611	977.75	.53989	.04814	.80000
6	.05833	18.00	1187.16	.0012610	977.86	.53971	.04850	.80000
6	.05833	24.00	1187.19	.0012618	977.98	.53972	.04878	.80000
6	.05833	30.00	1187.17	.0012618	978.03	.53971	.04888	.80000
7	.07000	0.00	1162.27	.0012765	966.01	.52843	.05460	.96000
7	.07000	0.00	1162.31	.0012764	966.08	.52845	.05478	.96000
7	.07000	10.00	1161.97	.0012762	966.24	.52830	.05520	.96000
7	.07000	15.00	1161.48	.0012759	966.44	.52808	.05571	.96000
7	.07000	20.00	1161.28	.0012755	966.70	.52799	.05618	.96000
7	.07000	25.00	1160.97	.0012753	966.86	.52784	.05648	.96000
7	.07000	30.00	1160.92	.0012752	966.94	.52782	.05655	.96000
8	.08167	0.00	1130.21	.0012946	952.48	.51386	.06181	1.12000
8	.08167	0.00	1130.05	.0012944	952.61	.51378	.06208	1.12000
8	.08167	10.00	1129.59	.0012940	952.92	.51358	.06272	1.12000
8	.08167	15.00	1128.75	.0012935	953.32	.51320	.06347	1.12000
8	.08167	20.00	1128.07	.0012928	953.79	.51289	.06411	1.12000
8	.08167	25.00	1127.39	.0012924	954.10	.51258	.06453	1.12000
8	.08167	30.00	1127.07	.0012923	954.20	.51243	.06465	1.12000
9	.09333	0.00	1090.28	.0013155	937.34	.49570	.06894	1.28000
9	.09333	0.00	1090.08	.0013153	937.50	.49561	.06919	1.28000
9	.09333	0.00	1089.36	.0013147	937.91	.49529	.06987	1.28000
9	.09333	12.00	1088.33	.0013139	938.49	.49482	.07072	1.28000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1

CPD 7-TUBE AR=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

AXIAL LOCATION = 1.16667 (X/DEO = 15.99999)

M	R	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	R/DEO
9	.09333	17.14	1087.31	.0013129	939.17	.49436	.07151	1.28000
9	.09333	21.43	1086.34	.0013122	939.73	.49378	.07268	1.28000
9	.09333	25.71	1085.25	.0013115	940.17	.49342	.07242	1.28000
9	.09333	30.00	1084.88	.0013113	940.31	.49325	.07253	1.28000
10	.10500	3.66	1042.41	.0013387	921.08	.47394	.07553	1.44000
10	.10500	4.29	1041.87	.0013385	921.26	.47369	.07585	1.44000
10	.10500	8.57	1040.72	.0013376	921.88	.47317	.07667	1.44000
10	.10500	12.86	1038.96	.0013363	922.76	.47237	.07767	1.44000
10	.10500	17.14	1037.13	.0013348	923.78	.47154	.07854	1.44000
10	.10500	21.43	1035.17	.0013336	924.64	.47065	.07914	1.44000
10	.10500	25.71	1033.91	.0013326	925.39	.47007	.07946	1.44000
10	.10500	30.00	1033.26	.0013323	925.51	.46978	.07954	1.44000
11	.11667	3.00	985.90	.0013642	903.86	.44829	.08105	1.60000
11	.11667	3.75	985.67	.0013639	904.08	.44805	.08133	1.60000
11	.11667	7.50	984.89	.0013629	904.73	.44742	.08206	1.60000
11	.11667	11.25	981.92	.0013615	905.70	.44644	.08298	1.60000
11	.11667	15.00	979.34	.0013598	906.84	.44526	.08384	1.60000
11	.11667	18.75	976.76	.0013586	908.00	.44409	.08448	1.60000
11	.11667	22.50	974.34	.0013565	908.49	.44299	.08488	1.60000
11	.11667	26.25	972.70	.0013545	909.65	.44225	.08504	1.60000
11	.11667	30.00	972.01	.0013551	909.95	.44217	.08510	1.60000
12	.12833	3.00	921.78	.0013917	885.49	.41909	.08510	1.76000
12	.12833	3.75	920.97	.0013914	886.24	.41873	.08538	1.76000
12	.12833	7.50	918.91	.0013901	887.02	.41779	.08610	1.76000
12	.12833	11.25	915.85	.0013883	888.21	.41640	.08701	1.76000
12	.12833	15.00	912.22	.0013861	889.63	.41475	.08781	1.76000
12	.12833	18.75	908.30	.0013838	891.05	.41297	.08835	1.76000
12	.12833	22.50	904.86	.0013820	892.27	.41140	.08861	1.76000
12	.12833	26.25	902.56	.0013807	893.49	.41036	.08866	1.76000
12	.12833	30.00	901.71	.0013802	893.38	.40947	.08866	1.76000
13	.14000	3.00	850.11	.0014216	867.36	.38651	.08730	1.92000
13	.14000	3.33	849.37	.0014212	867.60	.38617	.08750	1.92000
13	.14000	6.67	847.30	.0014201	868.33	.38523	.08805	1.92000
13	.14000	10.00	843.77	.0014183	869.38	.38363	.08876	1.92000
13	.14000	13.33	839.44	.0014161	870.72	.38166	.08943	1.92000
13	.14000	16.67	834.79	.0014138	872.18	.37954	.08988	1.92000
13	.14000	20.00	830.35	.0014115	873.58	.37753	.09009	1.92000
13	.14000	23.33	826.45	.0014096	874.76	.37593	.09009	1.92000
13	.14000	26.67	824.45	.0014084	875.51	.37484	.09001	1.92000
13	.14000	30.00	823.73	.0014079	875.80	.37452	.08998	1.92000
14	.15167	3.00	772.49	.0014541	847.97	.35122	.08750	2.08000
14	.15167	3.33	771.38	.0014538	848.19	.35072	.08767	2.08000
14	.15167	6.67	768.45	.0014525	848.91	.34943	.08813	2.08000
14	.15167	10.00	764.35	.0014506	850.06	.34752	.08871	2.08000
14	.15167	13.33	759.01	.0014482	851.47	.34519	.08918	2.08000
14	.15167	16.67	753.67	.0014455	853.05	.34257	.08943	2.08000
14	.15167	20.00	747.99	.0014430	854.52	.34008	.08941	2.08000
14	.15167	23.33	743.72	.0014409	855.79	.33814	.08923	2.08000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TURF AR=2.3 NOZZLE - VJ=2200 FPS - TIJ=1600 DEG-R

AXIAL LOCATION = 1.16667 (X/DEQ = 15.99999)

M	R	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	R/DEQ
14	.15167	26.67	740.75	.0014395	856.58	.33679	.08902	2.08000
14	.15167	31.00	739.65	.0014391	856.84	.33629	.08893	2.08000
15	.16333	0.00	690.42	.0014898	827.68	.31391	.08564	2.24000
15	.16333	3.00	689.59	.0014894	827.88	.31353	.08575	2.24000
15	.16333	6.00	686.80	.0014885	828.43	.31226	.08603	2.24000
15	.16333	9.00	682.73	.0014868	829.35	.31041	.08638	2.24000
15	.16333	12.00	677.69	.0014846	831.56	.30812	.08667	2.24000
15	.16333	15.00	671.45	.0014822	831.93	.30546	.08677	2.24000
15	.16333	18.00	665.83	.0014799	833.24	.30272	.08666	2.24000
15	.16333	21.00	660.62	.0014775	834.56	.30035	.08640	2.24000
15	.16333	24.00	656.27	.0014757	835.59	.29838	.08605	2.24000
15	.16333	27.00	653.51	.0014745	836.28	.29712	.08578	2.24000
15	.16333	30.00	652.88	.0014740	836.57	.29675	.08568	2.24000
16	.17500	0.00	606.41	.0015289	806.53	.27549	.08184	2.40000
16	.17500	3.00	605.09	.0015285	806.75	.27552	.08193	2.40000
16	.17500	6.00	602.40	.0015276	807.20	.27411	.08208	2.40000
16	.17500	9.00	598.56	.0015260	808.66	.27214	.08227	2.40000
16	.17500	12.00	592.66	.0015240	809.09	.26946	.08234	2.40000
16	.17500	15.00	586.47	.0015216	810.36	.26661	.08225	2.40000
16	.17500	18.00	579.83	.0015192	811.65	.26362	.08193	2.40000
16	.17500	21.00	574.00	.0015169	812.90	.26097	.08149	2.40000
16	.17500	24.00	569.29	.0015150	813.93	.25883	.08101	2.40000
16	.17500	27.00	566.13	.0015138	814.56	.25740	.08062	2.40000
16	.17500	30.00	565.13	.0015133	814.81	.25694	.08049	2.40000
17	.18667	0.00	524.23	.0015714	784.89	.23834	.07644	2.56000
17	.18667	2.73	523.45	.0015711	784.83	.23799	.07647	2.56000
17	.18667	5.45	520.84	.0015715	785.15	.23680	.07651	2.56000
17	.18667	8.18	516.92	.0015693	785.74	.23502	.07655	2.56000
17	.18667	10.91	511.73	.0015678	786.50	.23266	.07649	2.56000
17	.18667	13.64	505.65	.0015661	787.38	.22990	.07627	2.56000
17	.18667	16.36	499.45	.0015643	788.42	.22708	.07592	2.56000
17	.18667	19.09	493.33	.0015619	789.45	.22430	.07540	2.56000
17	.18667	21.82	487.93	.0015600	791.42	.22184	.07483	2.56000
17	.18667	24.55	483.66	.0015585	791.20	.21990	.07429	2.56000
17	.18667	27.27	481.62	.0015574	791.74	.21871	.07392	2.56000
17	.18667	30.00	480.13	.0015570	791.94	.21829	.07378	2.56000
18	.19833	0.00	444.45	.0016173	762.41	.20226	.06978	2.72000
18	.19833	2.73	444.86	.0016171	762.53	.20190	.06978	2.72000
18	.19833	5.45	441.44	.0016166	762.75	.20170	.06974	2.72000
18	.19833	8.18	437.39	.0016157	763.17	.19886	.06964	2.72000
18	.19833	10.91	432.15	.0016145	763.74	.19648	.06942	2.72000
18	.19833	13.64	426.15	.0016130	764.46	.19373	.06906	2.72000
18	.19833	16.36	419.72	.0016113	765.27	.19083	.06854	2.72000
18	.19833	19.09	413.45	.0016095	766.11	.18798	.06790	2.72000
18	.19833	21.82	407.49	.0016078	766.94	.18550	.06722	2.72000
18	.19833	24.55	403.63	.0016064	767.62	.18352	.06660	2.72000
18	.19833	27.27	400.90	.0016054	768.08	.18227	.06616	2.72000
18	.19833	30.00	399.40	.0016051	768.23	.18182	.06600	2.72000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRN 7-TURE AR=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

AXIAL LOCATION = 1.16667 (X/DEQ = 15.99999)

M	P	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	P/DEQ
19	.21000	0.00	373.73	.0016662	740.06	.16855	.06224	2.88000
19	.21000	2.50	370.71	.0016661	740.13	.16823	.06225	2.88000
19	.21000	5.00	367.92	.0016658	740.23	.16728	.06217	2.88000
19	.21000	7.50	364.58	.0016653	740.45	.16576	.06200	2.88000
19	.21000	10.00	360.11	.0016647	740.74	.16373	.06172	2.88000
19	.21000	12.50	354.93	.0016637	741.15	.16137	.06133	2.88000
19	.21000	15.00	349.35	.0016625	741.68	.15883	.06081	2.88000
19	.21000	17.50	343.59	.0016613	742.23	.15621	.06017	2.88000
19	.21000	20.00	338.18	.0016599	742.84	.15376	.05948	2.88000
19	.21000	22.50	333.44	.0016587	743.41	.15160	.05879	2.88000
19	.21000	25.00	329.79	.0016576	743.89	.14994	.05821	2.88000
19	.21000	27.50	327.48	.0016565	744.21	.14889	.05781	2.88000
19	.21000	30.00	326.69	.0016566	744.32	.14853	.05767	2.88000
20	.22167	0.00	323.31	.0017173	718.03	.13790	.05436	3.04000
20	.22167	2.50	322.67	.0017173	718.02	.13758	.05431	3.04000
20	.22167	5.00	320.64	.0017172	718.06	.13669	.05418	3.04000
20	.22167	7.50	319.45	.0017171	718.13	.13524	.05394	3.04000
20	.22167	10.00	317.36	.0017167	718.30	.13338	.05359	3.04000
20	.22167	12.50	314.49	.0017161	718.52	.13116	.05312	3.04000
20	.22167	15.00	310.14	.0017155	718.80	.12873	.05252	3.04000
20	.22167	17.50	307.74	.0017145	719.18	.12628	.05183	3.04000
20	.22167	20.00	302.66	.0017136	719.60	.12394	.05109	3.04000
20	.22167	22.50	298.15	.0017125	720.03	.12142	.05038	3.04000
20	.22167	25.00	294.66	.0017117	720.43	.11933	.04977	3.04000
20	.22167	27.50	292.47	.0017113	720.66	.11823	.04937	3.04000
20	.22167	30.00	291.72	.0017109	720.75	.11809	.04922	3.04000
21	.23333	0.00	293.54	.0017699	696.68	.11173	.04640	3.20000
21	.23333	2.31	293.12	.0017700	696.67	.11049	.04635	3.20000
21	.23333	4.62	291.46	.0017701	696.63	.10978	.04621	3.20000
21	.23333	6.92	289.36	.0017701	696.62	.10869	.04598	3.20000
21	.23333	9.23	285.86	.0017701	696.61	.10721	.04564	3.20000
21	.23333	11.54	281.86	.0017701	696.62	.10542	.04520	3.20000
21	.23333	13.85	277.52	.0017699	696.70	.10344	.04466	3.20000
21	.23333	16.15	272.96	.0017695	696.83	.10136	.04404	3.20000
21	.23333	18.46	268.66	.0017690	697.04	.09932	.04336	3.20000
21	.23333	20.77	264.31	.0017683	697.31	.09744	.04268	3.20000
21	.23333	23.08	260.74	.0017676	697.58	.09582	.04204	3.20000
21	.23333	25.38	258.05	.0017670	697.83	.09457	.04152	3.20000
21	.23333	27.69	256.28	.0017666	698.00	.09379	.04118	3.20000
21	.23333	30.00	255.69	.0017664	698.07	.09352	.04106	3.20000
22	.24500	0.00	191.46	.0018229	676.44	.08727	.03874	3.36000
22	.24500	2.14	191.56	.0018230	676.41	.08709	.03869	3.36000
22	.24500	4.29	190.41	.0018231	676.35	.08657	.03857	3.36000
22	.24500	6.43	188.54	.0018234	676.25	.08572	.03835	3.36000
22	.24500	8.57	186.14	.0018237	676.15	.08459	.03804	3.36000
22	.24500	10.71	183.00	.0018240	676.04	.08320	.03765	3.36000
22	.24500	12.86	179.59	.0018242	675.97	.08165	.03718	3.36000
22	.24500	15.00	175.91	.0018242	675.94	.07998	.03666	3.36000

COMPUTATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CRD 7-TUBE AR=2.3 NOZZLE - VJ=2200 FPS - ITJ=1600 DEG-R

AXIAL LOCATION = 1.16667 (X/DEQ = 15.99999)

M	R	ANGLE	U	DENSITY	TEMP.	U/URPF	TURB.INT.	R/DEQ
22	.24500	17.14	172.18	.0018241	675.97	.07828	.03605	3.36000
22	.24500	19.29	168.57	.0018239	676.07	.07664	.03544	3.36000
22	.24500	21.43	165.28	.0018235	676.21	.07515	.03484	3.36000
22	.24500	23.57	162.49	.0018231	676.37	.07388	.03430	3.36000
22	.24500	25.71	160.36	.0018226	676.53	.07291	.03386	3.36000
22	.24500	27.86	159.03	.0018223	676.64	.07231	.03358	3.36000
22	.24500	30.00	158.58	.0018222	676.68	.07210	.03348	3.36000
23	.25667	1.00	148.57	.0018751	657.61	.06755	.03165	3.52000
23	.25667	2.14	148.24	.0018752	657.58	.06740	.03160	3.52000
23	.25667	4.29	147.26	.0018754	657.48	.06695	.03147	3.52000
23	.25667	6.43	145.87	.0018759	657.34	.06623	.03126	3.52000
23	.25667	8.57	143.53	.0018764	657.16	.06526	.03096	3.52000
23	.25667	10.71	140.94	.0018769	656.97	.06408	.03058	3.52000
23	.25667	12.86	138.71	.0018774	656.79	.06275	.03013	3.52000
23	.25667	15.00	134.87	.0018778	656.66	.06132	.02962	3.52000
23	.25667	17.14	131.67	.0018780	656.58	.05987	.02906	3.52000
23	.25667	19.29	128.57	.0018780	656.57	.05846	.02849	3.52000
23	.25667	21.43	125.74	.0018779	656.62	.05717	.02794	3.52000
23	.25667	23.57	123.33	.0018776	656.71	.05607	.02744	3.52000
23	.25667	25.71	121.49	.0018774	656.81	.05524	.02704	3.52000
23	.25667	27.86	120.34	.0018771	656.89	.05471	.02678	3.52000
23	.25667	30.00	119.95	.0018771	656.92	.05453	.02669	3.52000
24	.26833	1.00	112.24	.0019255	641.34	.05132	.02529	3.68000
24	.26833	2.14	112.64	.0019256	641.34	.05121	.02526	3.68000
24	.26833	4.29	111.93	.0019263	641.24	.05089	.02515	3.68000
24	.26833	6.43	110.78	.0019264	640.68	.05037	.02497	3.68000
24	.26833	8.57	109.22	.0019271	639.87	.04966	.02473	3.68000
24	.26833	10.71	107.32	.0019278	639.64	.04879	.02442	3.68000
24	.26833	12.86	105.13	.0019285	639.41	.04780	.02406	3.68000
24	.26833	14.00	102.75	.0019291	639.19	.04672	.02364	3.68000
24	.26833	16.00	100.27	.0019296	639.02	.04559	.02319	3.68000
24	.26833	18.00	97.79	.0019310	638.90	.04446	.02272	3.68000
24	.26833	20.00	95.44	.0019312	638.84	.04339	.02224	3.68000
24	.26833	22.00	93.31	.0019302	638.83	.04242	.02179	3.68000
24	.26833	24.00	91.51	.0019311	638.87	.04161	.02139	3.68000
24	.26833	26.00	89.16	.0019299	638.92	.04099	.02108	3.68000
24	.26833	28.00	89.31	.0019294	638.97	.04060	.02088	3.68000
24	.26833	30.00	89.72	.0019297	638.99	.04047	.02081	3.68000
25	.28000	1.00	84.19	.0019734	624.84	.03828	.01978	3.84000
25	.28000	2.00	84.17	.0019735	624.85	.03819	.01975	3.84000
25	.28000	4.00	83.42	.0019734	624.69	.03793	.01966	3.84000
25	.28000	6.00	82.55	.0019745	624.51	.03751	.01950	3.84000
25	.28000	8.00	81.24	.0019752	624.28	.03694	.01928	3.84000
25	.28000	10.00	79.77	.0019761	624.01	.03624	.01901	3.84000
25	.28000	12.00	77.94	.0019761	623.74	.03544	.01868	3.84000
25	.28000	14.00	76.71	.0019777	623.48	.03456	.01832	3.84000
25	.28000	16.00	74.77	.0019785	623.25	.03365	.01792	3.84000
25	.28000	18.00	71.99	.0019793	623.08	.03273	.01751	3.84000

COMPUTATION OF AERO-AcouSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1

CRD 7-TURF AR=2.3 NOZZLE - VJ=2200 FPS - TTJ=1600 DEG-R

AXIAL LOCATION = 1.16667 (X/DEQ = 15.99999)

M	P	ANGLE	U	DENSITY	TEMP.	U/UPEF	TURB.INT.	K/DEG
25	.28000	21.33	70.17	.0019794	622.97	.03186	.01710	3.84000
25	.28000	22.00	68.33	.0019795	622.91	.03107	.01671	3.84000
25	.28000	24.00	66.47	.0019795	622.91	.03040	.01637	3.84000
25	.28000	26.00	65.76	.0019795	622.93	.02990	.01611	3.84000
25	.28000	28.00	65.6	.0019794	622.96	.02958	.01593	3.84000
25	.28000	30.00	64.83	.0019793	622.97	.02947	.01587	3.84000
26	.29167	1.00	61.63	.0020180	611.04	.02800	.01514	4.00000
26	.29167	1.87	61.50	.0020181	611.00	.02796	.01512	4.00000
26	.29167	3.75	61.11	.0020185	610.90	.02778	.01505	4.00000
26	.29167	5.62	60.46	.0020190	610.73	.02749	.01493	4.00000
26	.29167	7.50	59.50	.0020197	610.52	.02709	.01476	4.00000
26	.29167	9.37	58.51	.0020206	610.26	.02660	.01455	4.00000
26	.29167	11.25	57.26	.0020215	609.99	.02603	.01431	4.00000
26	.29167	13.12	55.84	.0020224	609.71	.02540	.01403	4.00000
26	.29167	15.00	54.41	.0020232	609.46	.02474	.01373	4.00000
26	.29167	16.87	52.91	.0020240	609.24	.02406	.01341	4.00000
26	.29167	18.75	51.46	.0020245	609.06	.02339	.01308	4.00000
26	.29167	20.62	50.06	.0020249	608.95	.02276	.01277	4.00000
26	.29167	22.50	48.61	.0020252	608.88	.02219	.01247	4.00000
26	.29167	24.37	47.26	.0020252	608.86	.02172	.01222	4.00000
26	.29167	26.25	46.04	.0020252	608.86	.02136	.01202	4.00000
26	.29167	28.12	46.00	.0020252	608.87	.02114	.01189	4.00000
26	.29167	30.00	46.02	.0020252	608.88	.02106	.01185	4.00000
27	.30333	1.00	44.28	.0020548	598.94	.02013	.01135	4.16000
27	.30333	1.87	44.18	.0020549	598.90	.02009	.01133	4.16000
27	.30333	3.75	43.69	.0020549	598.86	.01995	.01127	4.16000
27	.30333	5.62	43.39	.0020548	598.83	.01973	.01117	4.16000
27	.30333	7.50	42.72	.0020546	598.42	.01942	.01103	4.16000
27	.30333	9.37	41.84	.0020544	598.16	.01904	.01086	4.16000
27	.30333	11.25	40.93	.0020544	597.88	.01861	.01066	4.16000
27	.30333	13.12	39.97	.0020544	597.66	.01813	.01043	4.16000
27	.30333	15.00	38.76	.0020543	597.34	.01761	.01018	4.16000
27	.30333	16.87	37.58	.0020541	597.10	.01704	.00992	4.16000
27	.30333	18.75	36.45	.0020540	596.91	.01657	.00966	4.16000
27	.30333	20.62	35.37	.0020540	596.77	.01608	.00940	4.16000
27	.30333	22.50	34.41	.0020540	596.69	.01564	.00916	4.16000
27	.30333	24.37	33.60	.0020540	596.65	.01528	.00895	4.16000
27	.30333	26.25	32.94	.0020540	596.63	.01500	.00879	4.16000
27	.30333	28.12	32.61	.0020540	596.64	.01482	.00869	4.16000
27	.30333	30.00	32.48	.0020540	596.64	.01477	.00865	4.16000
28	.31500	1.00	31.22	.0020955	588.45	.01419	.00832	4.32000
28	.31500	1.76	31.15	.0020955	588.42	.01416	.00831	4.32000
28	.31500	3.53	30.95	.0020953	588.34	.01407	.00827	4.32000
28	.31500	5.29	30.63	.0020954	588.19	.01392	.00819	4.32000
28	.31500	7.06	30.18	.0020970	588.01	.01372	.00810	4.32000
28	.31500	8.82	29.62	.0020978	587.78	.01347	.00798	4.32000
28	.31500	10.59	28.97	.0020987	587.54	.01317	.00783	4.32000
28	.31500	12.35	28.25	.0020996	587.28	.01284	.00767	4.32000

COMPUTATION OF AERO-AcouSTIC PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CYD 7-TURE AR=2.3 NOZZLE - VJ=2200 FPS - TIJ=1600 DEG-R

AXIAL LOCATION = 1.14647 (X/DEG = 15.99999)

M	P	ANGLE	U	DENSITY	TEMP.	U/UREF	TURB.INT.	R/DEG
28	.31500	14.12	27.47	.0021006	587.32	.01249	.00749	4.32000
28	.31500	15.48	26.66	.0021014	586.78	.01212	.00730	4.32000
28	.31500	17.65	25.84	.0021022	586.57	.01175	.00710	4.32000
28	.31500	19.41	25.15	.0021028	586.41	.01139	.00691	4.32000
28	.31500	21.18	24.31	.0021032	586.28	.01105	.00672	4.32000
28	.31500	22.94	23.64	.0021035	586.21	.01075	.00655	4.32000
28	.31500	24.71	23.19	.0021036	586.16	.01050	.00640	4.32000
28	.31500	26.47	22.68	.0021037	586.15	.01031	.00629	4.32000
28	.31500	28.24	22.42	.0021037	586.14	.01020	.00622	4.32000
28	.31500	30.00	22.34	.0021037	586.14	.01016	.00619	4.32000

CIRCUMFERENTIALLY-AVERAGED PARAMETERS

	WAVELENGTH	WAVELENGTH	TEMP.	INTENSITY	FREQUENCY
1	1.100	1.107	1.4567	.16459E+04	0.
2	1.100	1.1062	1.4563	.16473E+03	36.
3	1.100	1.1053	1.4544	.39414E+04	75.
4	1.100	1.1041	1.4529	.27742E+05	117.
5	1.100	1.1040	1.4524	.12514E+06	167.
6	1.100	1.1013	1.4518	.45402E+06	236.
7	1.100	1.1003	1.4514	.14434E+07	312.
8	1.120	1.1084	1.7455	.42472E+07	416.
9	1.120	.4722	1.7346	.16442E+08	543.
10	1.140	.4274	1.7304	.23371E+08	683.
11	1.150	.4763	1.7294	.42290E+08	824.
12	1.160	.4151	1.6475	.53477E+08	972.
13	1.160	.7485	1.6130	.20412E+08	1102.
14	1.180	.474	1.5743	.44269E+08	1204.
15	1.200	.4005	1.5416	.73449E+08	1242.
16	1.200	.5242	1.5014	.54403E+08	1314.
17	1.200	.4494	1.4594	.33414E+08	1317.
18	1.220	.3742	1.4147	.17411E+08	1279.
19	1.240	.3124	1.3739	.70784E+07	1209.
20	1.260	.2533	1.3316	.35469E+07	1113.
21	1.260	.2614	1.2934	.99454E+06	994.
22	1.260	.1574	1.2523	.27404E+06	872.
23	1.260	.1217	1.2167	.66764E+05	743.
24	1.280	.1010	1.1842	.13745E+05	614.
25	1.300	.1671	1.1551	.24359E+04	501.
26	1.300	.1447	1.1293	.37173E+03	396.
27	1.300	.1346	1.1144	.44923E+02	306.
28	1.320	.1241	1.0474	.55651E+01	231.
X(13)=	1.1667	W(13)= .7441E+14	F(13)= .6247E+01	U(13)= 715.30	U(13)= 1238.43
X(14)=	1.4609	W(14)= .5668E+14	F(14)= .7156E+01	U(14)= 623.99	U(14)= 1165.93
X(15)=	1.4520	W(15)= .3572E+14	F(15)= .4293E+01	U(15)= 537.77	U(15)= 1043.43
X(16)=	2.3333	W(16)= .9489E+14	F(16)= .9076E+01	U(16)= 446.90	U(16)= 892.50
X(17)=	2.4394	W(17)= .4276E+14	F(17)= .1217E+02	U(17)= 366.21	U(17)= 737.45
X(18)=	3.7039	W(18)= .1489E+14	F(18)= .1471E+02	U(18)= 302.27	U(18)= 595.63

COMPUTATION OF AERO-Acoustic PROPERTIES OF SUPPRESSOR NOZZLES

CASE NO. 1 CND 7-TURF AR=2.3 L07ZLF - VJ=2296 FPS - ITJ=1600 DEG-R

AXIAL LOCATION = 4.06667 (X/DE0 = 63.99995)

M	P	ANGLE	U	DENSITY	TEMP.	U/UDEF	TURB.INT.	P/DE0
1	.00005	0.00	474.50	.0017583	701.27	.21573	.08242	.00064
2	.04667	0.00	469.72	.0017611	700.58	.21356	.08109	.64000
3	.19333	0.00	455.47	.0017655	698.44	.20708	.07720	1.28000
4	.14000	0.00	432.79	.0017745	694.90	.19677	.07119	1.92000
5	.18667	0.00	402.88	.0017872	689.95	.18317	.06377	2.56000
6	.23333	0.00	367.44	.0018037	683.64	.16706	.05599	3.20000
7	.28000	0.00	328.34	.0018239	676.06	.14928	.04928	3.84000
8	.32667	0.00	287.48	.0018476	667.39	.13071	.04473	4.48000
9	.37333	0.00	246.62	.0018745	657.82	.11213	.04208	5.12000
10	.42000	0.00	207.33	.0019039	647.65	.09426	.04001	5.76000
11	.46667	0.00	170.82	.0019353	637.15	.07766	.03750	6.40000
12	.51333	0.00	137.05	.0019678	626.63	.06272	.03426	7.03999
13	.56000	0.00	109.22	.0020017	616.34	.04966	.03041	7.67999
14	.60667	0.00	84.77	.0020331	606.50	.03854	.02621	8.31999
15	.65333	0.00	64.52	.0020645	597.29	.02933	.02197	8.95999
16	.70000	0.00	48.15	.0020941	588.82	.02189	.01791	9.59999
17	.74667	0.00	35.23	.0021217	581.17	.01602	.01423	10.23999

Submitted for publication, April 1, 1991; accepted, June 1, 1991.

CASE	WAVELENGTH	FLUX	INTENSITY	EFFICIENCY
1	.424	1.2947	.1746F+04	9.
2	.4197	1.2974	.2192F+04	45.
3	.4376	1.2934	.31172F+03	48.
4	.3847	1.2964	.26523F+03	126.
5	.3549	1.2777	.16363F+04	157.
6	.3283	1.2665	.22945F+04	141.
7	.2932	1.252	.40375F+04	197.
8	.2544	1.2359	.23905E+04	204.
9	.2822	1.2142	.17621F+04	203.
10	.1851	1.1934	.14879F+04	195.
11	.1529	1.1769	.69452F+07	182.
12	.1231	1.1614	.58112F+07	164.
13	.674	1.1414	.27496F+07	145.
14	.6755	1.1232	.18542E+07	124.
15	.1574	1.1161	.32955F+06	103.
16	.424	1.0964	.84690F+05	84.
17	.312	1.0763	.18614F+05	66.
X(19)=	URI(19)= .42138F+17	FM(19)= .1615F+02	UAVG(19)= 244.56	UMAX(19)= 474.50
X(21)=	URI(21)= .1747E+17	FM(21)= .2238F+02	UAVG(20)= 197.74	UMAX(20)= 375.14
X(21)=	URI(21)= .23617E+16	FM(21)= .2746F+02	UAVG(21)= 160.31	UMAX(21)= 295.51
X(22)=	URI(22)= .51728E+15	FM(22)= .3491E+02	UAVG(22)= 126.19	UMAX(22)= 232.49
X(23)=	URI(23)= .11560E+15	FM(23)= .4246F+02	UAVG(23)= 102.85	UMAX(23)= 182.92
X(24)=	URI(24)= .21549E+14	FM(24)= .5099F+02	UAVG(24)= 84.39	UMAX(24)= 144.02

*** SOUND PROFILES LEVEL DIRECTIVITY ***

JET MACH NO. = 1.542 JET DENSITY RATIO = .4356

JET VELOCITY = 2199.16 JET EQUIV. DIAM. = .629

9.0 FT. ARC

ANGLE =	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	PWL
FREQ.																
100	73.4	73.7	74.1	74.7	75.5	76.4	77.4	77.6	77.1	75.7	73.1	69.4	62.7	97.6	162.1	119.6
125	74.0	74.3	74.8	75.4	76.2	77.1	78.1	78.3	77.7	76.2	73.5	69.8	63.1	100.6	164.9	122.5
150	74.5	74.8	75.4	76.0	76.9	77.8	78.8	79.0	78.3	76.7	73.9	70.2	63.5	103.7	167.8	125.4
200	75.4	75.8	76.4	77.1	78.0	78.9	79.9	80.1	79.3	77.6	74.7	71.0	64.3	106.8	170.7	128.3
250	76.1	76.5	77.1	77.8	78.7	79.6	80.6	80.8	80.0	78.2	75.2	71.5	64.8	109.9	173.6	131.2
315	76.7	77.2	77.9	78.6	79.5	80.4	81.4	81.6	80.7	78.8	75.7	72.0	65.3	113.0	176.5	134.1
400	77.4	77.9	78.6	79.3	80.2	81.1	82.1	82.3	81.4	79.4	76.2	72.5	65.8	116.1	179.4	137.0
500	78.1	78.6	79.3	80.0	80.9	81.8	82.8	83.0	82.0	80.0	76.7	73.0	66.3	119.2	182.3	140.0
600	78.8	79.3	80.0	80.7	81.6	82.5	83.5	83.7	82.7	80.6	77.2	73.5	66.8	122.3	185.2	142.9
800	79.4	79.9	80.6	81.3	82.2	83.1	84.1	84.3	83.3	81.1	77.6	74.0	67.3	125.4	188.1	145.8
1000	80.0	80.5	81.2	81.9	82.8	83.7	84.7	84.9	83.8	81.5	78.0	74.4	67.8	128.5	191.0	148.7
1250	80.6	81.1	81.8	82.5	83.4	84.3	85.3	85.5	84.4	82.0	78.5	74.9	68.3	131.6	193.9	151.6
1500	81.2	81.7	82.4	83.1	84.0	84.9	85.9	86.1	85.0	82.5	79.0	75.4	68.8	134.7	196.8	154.5
2000	81.8	82.3	83.0	83.7	84.6	85.5	86.5	86.7	85.6	83.0	79.5	75.9	69.3	137.8	199.7	157.4
2500	82.4	82.9	83.6	84.3	85.2	86.1	87.1	87.3	86.2	83.5	80.0	76.4	69.8	140.9	202.6	160.3
3150	83.0	83.5	84.2	84.9	85.8	86.7	87.7	87.9	86.8	84.1	80.5	76.9	70.3	144.0	205.5	163.2
4000	83.6	84.1	84.8	85.5	86.4	87.3	88.3	88.5	87.4	84.5	81.0	77.4	70.8	147.1	208.4	166.1
5000	84.2	84.7	85.4	86.1	87.0	87.9	88.9	89.1	88.0	85.1	81.5	77.9	71.3	150.2	211.3	169.0
6000	84.8	85.3	86.0	86.7	87.6	88.5	89.5	89.7	88.6	85.6	82.0	78.4	71.8	153.3	214.2	171.9
8000	85.4	85.9	86.6	87.3	88.2	89.1	90.1	90.3	89.2	86.1	82.5	78.9	72.3	156.4	217.1	174.8
10000	86.0	86.5	87.2	87.9	88.8	89.7	90.7	90.9	89.8	86.6	83.0	79.4	72.8	159.5	220.0	177.7
12500	86.6	87.1	87.8	88.5	89.4	90.3	91.3	91.5	90.4	87.1	83.5	79.9	73.3	162.6	222.9	180.6
15000	87.2	87.7	88.4	89.1	90.0	90.9	91.9	92.1	91.0	87.6	84.0	80.4	73.8	165.7	225.8	183.5
20000	87.8	88.3	89.0	89.7	90.6	91.5	92.5	92.7	91.6	88.1	84.5	80.9	74.3	168.8	228.7	186.4
25000	88.4	88.9	89.6	90.3	91.2	92.1	93.1	93.3	92.2	88.6	85.0	81.4	74.8	171.9	231.6	189.3
31500	89.0	89.5	90.2	90.9	91.8	92.7	93.7	93.9	92.8	89.1	85.5	81.9	75.3	175.0	234.5	192.2
40000	89.6	90.1	90.8	91.5	92.4	93.3	94.3	94.5	93.4	89.6	86.0	82.4	75.8	178.1	237.4	195.1
50000	90.2	90.7	91.4	92.1	93.0	93.9	94.9	95.1	94.0	90.1	86.5	82.9	76.3	181.2	240.3	198.0
60000	90.8	91.3	92.0	92.7	93.6	94.5	95.5	95.7	94.6	90.6	87.0	83.4	76.8	184.3	243.2	200.9
80000	91.4	91.9	92.6	93.3	94.2	95.1	96.1	96.3	95.2	91.1	87.5	83.9	77.3	187.4	246.1	203.8
100000	92.0	92.5	93.2	93.9	94.8	95.7	96.7	96.9	95.8	91.6	88.0	84.4	77.8	190.5	249.0	206.7
125000	92.6	93.1	93.8	94.5	95.4	96.3	97.3	97.5	96.4	92.1	88.5	84.9	78.3	193.6	251.9	209.6
150000	93.2	93.7	94.4	95.1	96.0	96.9	97.9	98.1	97.0	92.6	89.0	85.4	78.8	196.7	254.8	212.5
200000	93.8	94.3	95.0	95.7	96.6	97.5	98.5	98.7	97.6	93.1	89.5	85.9	79.3	199.8	257.7	215.4
250000	94.4	94.9	95.6	96.3	97.2	98.1	99.1	99.3	98.2	93.6	90.0	86.4	79.8	202.9	260.6	218.3
315000	95.0	95.5	96.2	96.9	97.8	98.7	99.7	99.9	98.8	94.1	90.5	86.9	80.3	206.0	263.5	221.2
400000	95.6	96.1	96.8	97.5	98.4	99.3	100.3	100.5	99.4	94.6	91.0	87.4	80.8	209.1	266.4	224.1
500000	96.2	96.7	97.4	98.1	99.0	99.9	100.9	101.1	100.0	95.1	91.5	87.9	81.3	212.2	269.3	227.0
600000	96.8	97.3	98.0	98.7	99.6	100.5	101.5	101.7	100.6	95.6	92.0	88.4	81.8	215.3	272.2	229.9
800000	97.4	97.9	98.6	99.3	100.2	101.1	102.1	102.3	101.2	96.1	92.5	88.9	82.3	218.4	275.1	232.8
1000000	98.0	98.5	99.2	99.9	100.8	101.7	102.7	102.9	101.8	96.6	93.0	89.4	82.8	221.5	278.0	235.7
1250000	98.6	99.1	99.8	100.5	101.4	102.3	103.3	103.5	102.4	97.1	93.5	89.9	83.3	224.6	280.9	238.6
1500000	99.2	99.7	100.4	101.1	102.0	102.9	103.9	104.1	103.0	97.6	94.0	90.4	83.8	227.7	283.8	241.5
2000000	100.0	100.5	101.2	101.9	102.8	103.7	104.7	104.9	103.8	98.1	94.5	90.9	84.3	230.8	286.7	244.4
2500000	100.6	101.1	101.8	102.5	103.4	104.3	105.3	105.5	104.4	98.6	95.0	91.4	84.8	233.9	289.6	247.3
3150000	101.2	101.7	102.4	103.1	104.0	104.9	105.9	106.1	105.0	99.1	95.5	91.9	85.3	237.0	292.5	250.2
4000000	101.8	102.3	103.0	103.7	104.6	105.5	106.5	106.7	105.6	99.6	96.0	92.4	85.8	240.1	295.4	253.1
5000000	102.4	102.9	103.6	104.3	105.2	106.1	107.1	107.3	106.2	100.1	96.5	92.9	86.3	243.2	298.3	256.0
6000000	103.0	103.5	104.2	104.9	105.8	106.7	107.7	107.9	106.8	100.6	97.0	93.4	86.8	246.3	301.2	258.9
8000000	103.6	104.1	104.8	105.5	106.4	107.3	108.3	108.5	107.4	101.1	97.5	93.9	87.3	249.4	304.1	261.8
10000000	104.2	104.7	105.4	106.1	107.0	107.9	108.9	109.1	108.0	101.6	98.0	94.4	87.8	252.5	307.0	264.7
12500000	104.8	105.3	106.0	106.7	107.6	108.5	109.5	109.7	108.6	102.1	98.5	94.9	88.3	255.6	310.0	267.6
15000000	105.4	105.9	106.6	107.3	108.2	109.1	110.1	110.3	109.2	102.6	99.0	95.4	88.8	258.7	312.9	270.5
20000000	106.0	106.5	107.2	107.9	108.8	109.7	110.7	110.9	109.8	103.1	99.5	95.9	89.3	261.8	315.8	273.4
25000000	106.6	107.1	107.8	108.5	109.4	110.3	111.3	111.5	110.4	103.6	100.0	96.4	89.8	264.9	318.7	276.3
31500000	107.2	107.7	108.4	109.1	110.0	110.9	111.9	112.1	111.0	104.1	100.5	96.9	90.3	268.0	321.6	279.2
40000000	107.8	108.3	109.0	109.7	110.6	111.5	112.5	112.7	111.6	104.6	101.0	97.4	90.8	271.1	324.5	282.1
50000000	108.4	108.9	109.6	110.3	111.2	112.1	113.1	113.3	112.2	105.1	101.5	97.9	91.3	274.2	327.4	285.0
60000000	109.0	109.5	110.2	110.9	111.8	112.7	113.7	113.9	112.8	105.6	102.0	98.4	91.8	277.3	330.3	287.9
80000000	109.6	110.1	110.8	111.5	112.4	113.3	114.3	114.5	113.4	106.1	102.5	98.9	92.3	280.4	333.2	290.8
100000000	110.2	110.7	111.4	112.1	113.0	113.9	114.9	115.1	114.0	106.6	103.0	99.4	92.8	283.5	336.1	293.7
125000000	110.8	111.3	112.0	112.7	113.6	114.5	115.5	115.7	114.6	107.1	103.5	99.9	93.3	286.6	339.0	296.6
150000000	111.4	111.9	112.6	113.3	114.2	115.1	116.1	116.3	115.2	107.6	104.0	100.4	93.8	289.7	341.9	299.5
200000000	112.0	112.5	113.2	113.9	114.8	115.7	116.7	116.9	115.8	108.1	104.5	100.9	94.3	292.8	344.8	302.4
250000000	112.6	113.1	113.8	114.5	115.4	116.3	117.3	117.5	116.4	108.6	105.0	101.4	94.8	295.9	347.7	305.3
315000000	113.2	113.7	114.4	115.1	116.0	116.9	117.9	118.1	117.0	109.1	105.5	101.9	95.3	299.0	350.6	308.2
400000000	113.8	114.3	115.0	115.7	116.6	117.5	118.5	118.7	117.6	109.6	106.0	102.4	95.8	302.1	353.5	311.1
500000000	114.4	114.9	115.6	116.3	117.2	118.1	119.1	119.3	118.2	110.1	106.5	102.9	96.3	305.2	356.4	314.0
600000000	115.0	115.5	116.2	116.9	117.8	118.7	119.7	119.9	118.8	110.6	107.0	103.4	96.8	308.3	359.3	316.9
800000000	115.6	116.1	116.8	117.5	118.4	119.3	120.3	120.5	119.4	111.1	107.5	103.9	97.3	311.4	362.2	319.8
1000000000	116.2	116.7	117.4	118.1	119.0	119.9	120.9	121.1	120							

4.8 PROGRAM SOURCE CODE LISTING

This section contains the FORTRAN IV source code listing for the aeroacoustic prediction model, suitable for running on the CDC 7600 computer. The listing of subroutines is in alphabetical order, as follows:

1. MAIN Program (MGB)
2. ARRCCOS
3. ATMOS
4. CRD
5. ERF
6. LSPFIT
7. OUTPUT
9. PNLC
9. SHOCK
10. SLICE
11. TPNLC


```

135      IF (ACH2.GT.0.0) GO TO 200
      WRITE (6,510) ACH2
      STOP
      200 ACH(K)=SORT(ACH2)
      UREF=UE(NHREF)
      RU2REF=RU2P(NHREF)
      FIPSTU=UE(1)
      SUF=UREF
      TAA=TF(1)
      PAA=PS
      RHOF=PAA/(1716.0*TAA)
      CO=SPORT(1716.0*GAM*TAA)
      AG=CO
      AL=RHOF*(SUF/CO)**5*SUF**3*ATOTAL
      ASP=PS*GAM*GAM*PGC*SOPT(GAM*PGC*TE(1))*TE(1)
      RJFT=TAA/TE(NHREF)
      DIA=DEQ(1)
      DJFT=DIA
      UJFT=SUE-FIPSTU
      EMACH=UJFT/CO
      UNITS=478.8*478.8*.2589*RHOE*CO
      C
150      WRITE EXIT CONDITIONS
      C
      NPAGE=NPAGE+1
      WRITE (6,503) NPAGE,KHCAS,(IDENT(K),K=1,P)
      WRITE (6,514)
      WRITE (6,520)(K,PT(K),TT(K),TE(K),UF(K),ACH(K),RU2P(K),EF(K),
      1K=1,NEST)
      WRITE (6,540) NHREF
      C
165      WRITE ADDITIONAL INPUT
      C
      RETA=RETAIN(1)
      AMULT=AMULIN(1)
      WRITE (6,522) AL,ALFA,AK,PK,ATOTAL,DIA,IQUIT,NN,UREF
      WRITE (6,544) STFX,STFP
      WRITE (6,550) ALPHMC,HETAMC
      WRITE (6,542) CMMC,CMVN
      C
175      BEGINNING OF X LOOP ( KA = INDEX ON X )
      C
      NPRE=NPRINT
      IF (NPRINT.LF.0) WRITE (6,552)

```

181	MGR	181
182	MGR	182
183	MGR	183
184	MGR	184
185	MGR	185
186	MGR	186
187	MGR	187
188	MGR	188
189	MGR	189
190	MGR	190
191	MGR	191
192	MGR	192
193	MGR	193
194	MGR	194
195	MGR	195
196	MGR	196
197	MGR	197
198	MGR	198
199	MGR	199
200	MGR	200
201	MGR	201
202	MGR	202
203	MGR	203
204	MGR	204
205	MGR	205
206	MGR	206
207	MGR	207
208	MGR	208
209	MGR	209
210	MGR	210
211	MGR	211
212	MGR	212
213	MGR	213
214	MGR	214
215	MGR	215
216	MGR	216
217	MGR	217
218	MGR	218
219	MGR	219
220	MGR	220
221	MGR	221
222	MGR	222
223	MGR	223
224	MGR	224
225	MGR	225
226	MGR	226
227	MGR	227
228	MGR	228
229	MGR	229

230	CU=0.0	MGB	230
231		MGB	231
232		MGB	232
233	INITIALIZATION AND BOUNDARY INTEGRATION. (K = INDEX ON BOUNDARY)	MGB	233
234		MGB	234
235	DO 1100 K=2,NFST	MGB	235
236	NODE=2	MGB	236
237	SIC=0.0	MGB	237
238	SIP=0.0	MGB	238
239	SIX=0.0	MGB	239
240	VI=0.0	MGB	240
241	TI=0.0	MGB	241
242	NUMK=NUM(K)	MGB	242
243	LEAF=LEAF(K)	MGB	243
244	KNK=KN(K)	MGB	244
245	IMH=1	MGB	245
246	IF (X(KA).LE.XE(K)) GO TO 1100	MGB	246
247	IF ((UE(K).EQ.0.0).AND.(UE(KNK).EQ.0.0)) GO TO 1100	MGB	247
248	VMAX=AMAX1 (UE(K),UE(KNK))	MGB	248
249	VMIN=AMIN1 (UE(K),UE(KNK))	MGB	249
250	VP=VMIN/VMAX	MGB	250
251	CVR=1./ (1.+CVRP*VP)	MGB	251
252	CMC=1.+CMC*ACH(K)	MGB	252
253	DRDX=CM*CVR/CMC	MGB	253
254	DRDX=CH*DRDX	MGB	254
255	IF (DRDX.FU.DRDX) IMH=2	MGB	255
256	CMX=DRDX*(X(KA)-XE(K))	MGB	256
257	CHX=DRDX*(X(KA)-XE(K))	MGB	257
258	PHAL=PHI-ALPO(K)	MGB	258
259	ARPA=ABS(PHAL)	MGB	259
260	IF (ARPA.LE.PI) GO TO 575	MGB	260
261	PHAL=PHAL-SIGN(PI,PHAL)	MGB	261
262	GO TO 560	MGB	262
263		MGB	263
264		MGB	264
265	560 COSPA=COS(ARPA)	MGB	265
266	DEL SIG=SIG	MGB	266
267	DELRA=RA(NUMK,K)	MGB	267
268	IF (NCRDY.LE.0) GO TO 605	MGB	268
269	CALL LSPFIT(XCRDY,PCRDY,NCRDY,XE(K),RMINEK,1,0,AAA)	MGB	269
270	RMNSOE=RMINEK*RMINEK	MGB	270
271	SIGSO=SIG*SIG	MGB	271
272	RMINSO=RMIN(KA)*RMIN(KA)	MGB	272
273	PASO=RA(NUMK,K)*RA(NUMK,K)	MGB	273
274	DELSIG=SIGN(SIGSO-RMINSO)	MGB	274
275	DELPA=SIGN(PASO-RMNSOE)	MGB	275
	605 CONTINUE		

275	276	MGR
	277	MGR
	278	MGR
	279	MGR
	280	MGR
280	281	MGR
	282	MGR
	283	MGR
	284	MGR
285	285	MGR
	286	MGR
	287	MGR
	288	MGR
	289	MGR
	290	MGR
290	291	MGR
	292	MGR
	293	MGR
	294	MGR
	295	MGR
295	296	MGR
	297	MGR
	298	MGR
	299	MGR
300	300	MGR
	301	MGR
	302	MGR
	303	MGR
	304	MGR
305	305	MGR
	306	MGR
	307	MGR
	308	MGR
	309	MGR
	310	MGR
310	311	MGR
	312	MGR
	313	MGR
	314	MGR
	315	MGR
315	316	MGR
	317	MGR
	318	MGR
	319	MGR
320	320	MGR
	321	MGR
	322	MGR
	323	MGR
	324	MGR
	325	MGR

```

RADU=SQRT((DELPA-DELSIG)*(DELPA-DELSIG)
1+2.)*DELPA*DELSIG*(1.0-COSPA))
C
IF (RADU.GT.(.0005*DELSIG)) GO TO 600
NDEF=1
GO TO 650
600 COSTO=(DELSIG-DELPA*COSPA)/RADU
C
IF (ABS(COSTO).LT.1.0) GO TO 610
THO=(PI-SIGN(PI,COSTO))/2.0
SINTO=0.0
GO TO 620
C
610 SINTO=SIGN(SQRT(1.0-COSTO*COSTO),PHAL)
THO=PI-SIGN(PI-ARCCOS(COSTO),PHAL)
C
620 RADX=PADU/CHX
POWER=PADX*RADX
IF (POWER.GT.25.0) GO TO 625
VAO=1.0-EXP(-POWER)
GO TO (630,640),IMH
630 TAO=1.0-EXP(-(RADU/CHX)*(RADU/CHX))
640 SA=IBROX*(0.88623*ERF(RADX)+RADX*(VAO-1.0))
SARQ=SA*COSTO
SACO=SA*SINTO
SAXO=((DROX*RADX)**2)*(1.-VAO)
GO TO 635
625 CONTINUE
VAO=1.0
TAO=1.0
SA=0.88623*DROX
SARQ=SA*COSTO
SACO=SA*SINTO
SAXO=0.0
635 CONTINUE
C
C LEAF INTEGRATION
C J = LEAF NUMBER OF BOUNDARY K
C N = POINT NUMBER OF BOUNDARY K
C
650 DO 1000 J=1,LEAF
DO 1000 N=1,NUMK
PHAL=PHAL-DALP(N,K)
660 ARPA=ARS(PHAL)
IF (ARPA.LE.PI) GO TO 670
PHAL=PHAL-SIGN(PI2,PHAL)
GO TO 660
C
670 COSPA=COS(ARPA)
DELPA=RA(N,K)

```

325	IF (DCHDY.GT.0) DELPA=SQRT(RA(RI.*)*PA(RI.*)-DMNSQ(I))	MGR	326
	RAD=SQRT((DELPA-DELSIG)*(DELPA+DELSIG))	MGR	327
	1+2 *DELPA*DELSIG*(1.0-COSPA)	MGR	328
	IF (RAD.GT.(.0005*DELSIG)) GO TO 690	MGR	329
	NOPE=1	MGR	330
330	GO TO 900	MGR	331
		MGR	332
		MGR	333
	690 COST=(DELSIG-DELPA*COSPA)/RAD	MGR	334
	IF (ABS(COST).LT.1.0) GO TO 690	MGR	335
	TH=(PI-SIG/(PI*COST))/2.0	MGR	336
335	SINT=0.0	MGR	337
	GO TO 710	MGR	338
		MGR	339
		MGR	340
		MGR	341
340	700 SINT=SIGN(SQRT(1.0-COST*COST),PHAL)	MGR	342
	TH=PI-SIG/(PI-ARCCOS(COST),PHAL)	MGR	343
	GO TO (700,710),NOPE	MGR	344
	700 NOPE=2	MGR	345
	DTH=0.0	MGR	346
	GO TO 800	MGR	347
345	710 DTH=TH-TH0	MGR	348
	AROTH=ABS(DTH)	MGR	349
	IF (AROTH.LE.DTHM) GO TO 800	MGR	350
	IF (AROTH.LE.PI) GO TO 730	MGR	351
350	C CORRECTION=-0-360	MGR	352
		MGR	353
		MGR	354
		MGR	355
355	720 TH0=TH0+SIGN(PI2,DTH)	MGR	356
	GO TO 710	MGR	357
		MGR	358
		MGR	359
		MGR	360
		MGR	361
360	PCRC=RADO*COST0-RAD*COST	MGR	362
	RCRC=PCRC+SIGN(.0000001,RCRC)	MGR	363
	ABLE=(RADO*SINT0-RAD*SINT)/RCRC	MGR	364
	RKP=RADO*SINT0-ABLE*RADO*COST0	MGR	365
365	AUXILIARY INTEGRATION	MGR	366
		MGR	367
		MGR	368
		MGR	369
		MGR	370

370	SINT=514(TI-)	MGR	371
	PAO=PAO/(SINT-AM(E*COST))	MGR	372
	PAO=PAO/CMX	MGR	373
	POWR=PADO*PAOX	MGR	374
375	IF(POWR.GT.25.0) GO TO 725	MGR	375
	VA=1.0-FXP(-POWR)	MGR	376
	SQ=SQDX*(0.88623*(BF(PAOX)+PAOX*(VA-1.0))	MGR	377
	SAP=SAC*COST	MGR	378
	SAC=SAC*SINT	MGR	379
	SAX=((PADO*PAOX)**2)*(1.-VA)	MGR	380
380	GO TO 735	MGR	381
	725 CONTINUE	MGR	382
	VA=1.0	MGR	383
	TA=1.0	MGR	384
	SA=0.88623*ORDX	MGR	385
385	SAP=SAC*COST	MGR	386
	SAC=SAC*SINT	MGR	387
	SAX=0.0	MGR	388
	735 CONTINUE	MGR	389
	VI=VI+(VA*VAO)*DTH	MGR	390
390	SIP=SIP+(SAP*SAR)*DTH	MGR	391
	SIC=SIC+(SAC*SAC)*DTH	MGR	392
	SIX=SIX+(SAX*SAX)*DTH	MGR	393
	GO TO(740,750)*IMH	MGR	394
395		MGR	395
	740 CONTINUE	MGR	396
	IF(POWR.GT.25.0) GO TO 745	MGR	397
	TA=-EXP(-(PAO/CHX)*(PAO/CHX))+1.0	MGR	398
	745 CONTINUE	MGR	399
	TI=TI+(TA*TAO)*DTH	MGR	400
400	TAO=TA	MGR	401
	750 VAO=VA	MGR	402
	SACO=SAC	MGR	403
	SAP0=SAP	MGR	404
405	SAX0=SAX	MGR	405
	THO=TH	MGR	406
	790 CONTINUE	MGR	407
	GO TO 900	MGR	408
410		MGR	409
	C MAIN LINE INTEGRATION	MGR	410
	C	MGR	411
	C	MGR	412
	R00 PADO=PAO/CMX	MGR	413
	POWER=PAOX*PAOX	MGR	414
	IF(POWER.GT.25.0) GO TO R25	MGR	415

515	WRITE (6,534) X(RA)*XCB	MGR	515
516	LINE=8	MGR	516
517	1120 CONTINUE	MGR	517
518	WRITE (6,534) M,SIG*PHIO,I,RHO,T,URJD,TURHII,PND	MGR	518
519	1114 CONTINUE	MGR	519
520	IF (1.6T.1) GO TO 1130	MGR	520
521	C	MGR	521
522	TSTH=RU2-RU2E(1)	MGR	522
523	TSTL=TSTH	MGR	523
524	GO TO 1140	MGR	524
525	1130 TSTH=MAX1(TSTH,(RU2-RU2E(1)))	MGR	525
526	TSTL=MIN1(TSTL,(RU2-RU2E(1)))	MGR	526
527	IF (1.6E.ISSY) GO TO 1145	MGR	527
528	1140 IF (1SYM.E2.1) GO TO 1145	MGR	528
529	C	MGR	529
530	SUR=SUH*RU/2.0	MGR	530
531	SRI=SRU*RU/2.0	MGR	531
532	SRI2=SRU2*RU/2.0	MGR	532
533	SRII=SRU*RU/2.0	MGR	533
534	SEFF=SEFF*EFF/2.0	MGR	534
535	GO TO 1150	MGR	535
536	C	MGR	536
537	1145 CONTINUE	MGR	537
538	SRII=SRU*RU	MGR	538
539	SRII=SRU*RU	MGR	539
540	SRI2=SRU2*RU2	MGR	540
541	SRII=SRU*RU	MGR	541
542	SEFF=SEFF*EFF	MGR	542
543	1150 CONTINUE	MGR	543
544	C	MGR	544
545	PHI=PHI+DPHI	MGR	545
546	1200 CONTINUE	MGR	546
547	FIS=IS	MGR	547
548	TSTD=MAX1(TSTD,ABS(TSTH-TSTL))	MGR	548
549	SRIIM=SRU/FIS*SIG+SRIIM	MGR	549
550	SRIIM=SRU/FIS*SIG+SRIIM	MGR	550
551	SRI2M=SRU2/FIS*SIG+SRI2M	MGR	551
552	TARI(M)=(SRII/FIS)*0.2857143	MGR	552
553	RU2P(M)=SRII/FIS	MGR	553
554	IF (SRII.LE.0.0) GO TO 1210	MGR	554
555	IF (SRI2.LE.0.0) GO TO 1210	MGR	555
556	UR(M)=SRI2/SRI	MGR	556
557	HTP=SEFF/SRI	MGR	557
558	TTP=HTP/CP*TT(1)	MGR	558
559	TSP=TTP-0.5*UR(M)*UR(M)/CP	MGR	559
560	PHGP(M)=PS/PGC*TSR	MGR	560

AD-A094 298

GENERAL ELECTRIC CO CINCINNATI OH AIRCRAFT ENGINE GROUP F/O 20/1
HIGH VELOCITY JET NOISE SOURCE LOCATION AND REDUCTION. TASK 6. --ETC(U)
MAR 79 P R GLIEBE, R E MOTSINGER, A SIECKMAN DOT-05-30034
R79AE6290 FAA-RD-76-79-6A NL

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560	GO TO 1220	MGR	561
	1210 CONTINUE	MGR	562
	UR(M)=0.0	MGR	563
	RHOR(M)=RH0E	MGR	564
	TAIR(M)=0.0	MGR	565
	NUDR(M)=0.0	MGR	566
565	1220 CONTINUE	MGR	567
	SIGR(M)=SIG	MGR	568
	TSTHL=AMAX1(TSTHL,ABS(TSTH),ABS(TSTL))	MGR	569
	IF(M.LE.NOVI(KA)) GO TO 1260	MGR	570
570	IF(TSTHL.LE.PU2M)GO TO 1510	MGR	571
	1260 SIG=SIG+DSIG(KA)-RUG	MGR	572
	RUG=0.0	MGR	573
	1500 CONTINUE	MGR	574
575	1510 IF(TSTD.GT.2.0*PU2M)GO TO 1600	MGR	575
	IT=2	MGR	576
	IS=1	MGR	577
	IF(TSTD.GT.PU2M)GO TO 1600	MGR	578
	ISYM=1	MGR	579
580	1600 CONTINUE	MGR	580
	C	MGR	581
	C	MGR	582
	CALL LSPFIT(SIGR,RHOR,M,SIGR,DROP,M.1,DPRDR2)	MGR	583
	CMX=CMX(X(KA))	MGR	584
	DO 1605 IR=1,M	MGR	585
585	IF(UR(IR).LE.0.0) GO TO 1605	MGR	586
	NUDR(IR)=NUDR(IR)/(UR(IR)*CMX)	MGR	587
	1605 CONTINUE	MGR	588
	FM (KA)=PI2*SRUM*DSIG(KA)*32.17405	MGR	589
590	UAVG(KA)=SPU2M/SRUM	MGR	590
	UBI (KA)=PI2*SURM*DSIG(KA)*UMAX(KA)/X(KA)	MGR	591
	IF(NN.EQ.4) GO TO 1800	MGR	592
	CALL SLICE(X(KA),DSIG(KA),DX,M)	MGR	593
	1800 CONTINUE	MGR	594
	WRITE(6,524)	MGR	595
595	WRITE(6,526) KA,X(KA),KA,URI(KA),KA,FM(KA),KA,UAVG(KA),KA,UMAX(KA)	MGR	596
	IF(NPR.GE.NPRINT) NPR=0	MGR	597
	2000 CONTINUE	MGR	598
	C	MGR	599
600	IF(NN.EQ.4) GO TO 4000	MGR	600
	CALL OUTPUT(EMACH,DJET,PJET,UJET,UNITS)	MGR	601
	4000 CONTINUE	MGR	602
	IF(KNCAS.LT.NCASE) GO TO 1	MGR	603
	STOP	MGR	604
605	C	MGR	605
	C	MGR	606
	C	MGR	607
	FORMAT SECTION		

```

500 FORMAT(1H1,10X,21H* * M G R * * *,20X,4HPAGE14//5X,61HCOMPU MGB
      ITATION OF AERO-ACOUSTIC PROPERTIES OF SUPPRESSOR NOZZLES//2X, MGB
28HCASE NO.15,5X,8A10//) MGB
502 FORMAT(1H6,40X,10HINPUT DATA//) MGB
504 FORMAT( MGB
      115,12H ISYM=12,14H KX=13,13H NPRINT=13, 11H CM=F6.3// LPHI= MGB
      3M=F7.4,10H RU2M=F7.4,8H GAM=F6.3,8H CP=F7.1,10H DTH MGB
      24HDSIG,11X,4HRMIN,09X,3HNOV,6X,4HBETA,5X,5HDELTA,6X,2HMU//) MGB
      1,...../ TUPRULFENCE CONSTANTS//15X,9HSLICE NO.,5X,1HX,14X, MGB
508 FORMAT(120,3F15.5,110,3F10.2) MGB
510 FORMAT(13H0 MGB
      1(12,2H)=F7.4, 7H LEAV(12,2H)=13, 7H NUM(12,2H)=13,7H 7H ALPO MGB
      22,2H)=13) MGB
512 FOPMAT(23H0 MGB
      112,2H)=F7.4,7H DALP(12,1H,12,2H)=F7.4,7H RA(12,1H, MGB
516 FOPMAT(//R0H*** ERROR - MACH NO. SQUARE IS NOT GREATER THAN ZERO MGB
      1- CASE WILL TERMINATE ****) MGB
518 FOPMAT(1H0,35X,15HEXIT CONDITIONS//3X,4HCON-2X,5HTOTAL,6X,5HTOTAL MGB
      1,5X,6HSTATIC,2X,4HVELOCITY,5X,4HMACH,5X,4HMMOMENTUM,6X,4HENTHALPY/ MGB
      23X,4HTOUR,2X,4HMPRESS,5X,5HTEMP,5X,5HTEMP,4X,5H(FPS),6X,6HNUMBER MGB
      3,6X,4HFLUX,10X,4HFLUX/9X,5H(PSF),5X,7H(DEG R),3X,7H(DEG R),23X, MGB
      410H(LR/50-FT),4X,10H(LR/SQ-FT)//) MGB
520 FOPMAT(16,4F10.2,2F10.4,2E14.5) MGB
522 FOPMAT(1H0, 5X,5H AL =F11.5, 5X,6HALFA =F10.5, MGB
      15X,4HAK =E12.5,5X,4HAK =E12.5// 6X,7HTOTAL=F 9.5,5X,6HDEQ =F10.5 MGB
      2, 5X,6HIQUIT=15, 5X,4HNN =13, 5X,6HUREF =F10.2) MGB
524 FOPMAT(11H ) MGB
526 FOPMAT(3H X(12,2H)=F9.4,6H U8I(12,2H)=E11.5,5H FM(12,2H)=E10.4, MGB
      17H UAVG(12,2H)=F8.2,7H UMAX(12,2H)=F8.2) MGB
528 FOPMAT(6E12.5) MGB
534 FOPMAT(17H AXIAL LOCATION =F10.5,11H (X/DE0 = F10.5,1H)// MGB
      13X,1HM,5X,1HR,7X,5HANGLE,5X,1HU,7X,7HODENSITY,6X,5HTEMP,3X,4HU/UREF MGB
      2,2X,9HTURP,INT,2X,5HR/DE0//) MGB
536 FOPMAT(14,F10.5,F8.2,F9.2,F12.7,F10.2,3F9.5) MGB
540 FOPMAT(1H0,//12HROUNDAPY NO. 105,38H HAS BEEN DESIGNATED AS THE R MGB
      REFERENCE//) MGB
542 FOPMAT(1H0, 5X,5HCHMC=F11.6,05X,5HCHMVR=F11.6//) MGB
548 FOPMAT(1H0, 5X,6HSTRFX=F10.5,5X,6HSTRFR=F10.5 ) MGB
550 FOPMAT(1H0,5X,7HALPHMC=F9.4,5X,7HBETAMC=F9.4) MGB
552 FOPMAT(1H1) MGB
554 FOPMAT(8A10) MGB
      END MGB

```


10/10/77 14.30.05\$

FTN 4.5+410

76/76 OPT=1

SUBROUTINE CRD

```

1      SURROUTINE CRD
      *
      *
5      COMMON/SHLD/ G2(200),RIN(200),MACH(200),TEMP(200),RSIG(19,5),
      1TERM(200),SHIELD(200),MCIN(200),THE,CT,NTP,NP,ALPHT(19),ITH
      REAL MACH,MCIN,MC,KIN,K,M0
      *
      *
10     CALCULATION OF DIRECTIVITY
      *
      *
      PI=3.1415926
      PIO2=PI/2.
      DO 11 IR=1,NR
      R0=RIN(IP)
      MC=MCIN(IR)
      SHIELD(IP)=0.0
      *****
      IF (THE.GT.PIO2 ) GO TO 260
      *****
20     *
      *
      *
      FINDING RELATIONSHIP BETWEEN R0 AND TURNING PTS.
      *
      *
      IF (NTP.EQ.0) GO TO 260
      IF (NTP.EQ.1) GO TO 230
      IF (NTP.EQ.2) GO TO 250
      RSIG(ITH,1)=RSIG(ITH,NTP-1)
      RSIG(ITH,2)=RSIG(ITH,NTP)
      NTP=2
      GO TO 250
      CONTINUE
230   *
      *
      *
      ONE TURNING POINT
      *
      *
      RSIG1=RSIG(ITH,1)
      IF (R0.GE.RSIG1) GO TO 260
      R1=R0
      R2=RSIG1
      GO TO 261
      CONTINUE
250   *
      *
      *
      TWO TURNING POINTS
      *
      *
      *
      RSIG1=RSIG(ITH,1)
      RSIG2=RSIG(ITH,2)

```

45	IF (R0.GE.RSIG2) GO TO 260	CRD	46
	IF (R0.LE.RSIG1) GO TO 262	CRD	47
	R1=R0	CRD	48
	P2=RSIG2	CRD	49
50	GO TO 261	CRD	50
	CONTINUE	CRD	51
	R1=RSIG1	CRD	52
	P2=RSIG2	CRD	53
	CONTINUE	CRD	54
55	* CALCULATION OF EXP. SHIELDING	CRD	55
	* FINDING INTERVAL INTO WHICH R1 AND R2 FALL	CRD	56
	*	CRD	57
	*	CRD	58
	*	CRD	59
60	DO 265 J=1,NR	CRD	60
	IF (RIN(J).GT.R1) GO TO 266	CRD	61
	CONTINUE	CRD	62
	CONTINUE	CRD	63
	J1=J	CRD	64
	J11=J1-1	CRD	65
65	DO 267 J=1,NR	CRD	66
	IF (RIN(J).GT.R2) GO TO 268	CRD	67
	CONTINUE	CRD	68
	CONTINUE	CRD	69
	J2=J	CRD	70
70	J21=J2-1	CRD	71
	EVALUATION OF INTEGRAL OF G	CRD	72
	*	CRD	73
	*	CRD	74
75	IF (J1.EQ.J2) GO TO 269	CRD	75
	IF (J1.EQ.J21) GO TO 270	CRD	76
	J211=J21-1	CRD	77
	SUM=0.	CRD	78
	DO 281 J=J1,J211	CRD	79
80	GM=.5*(SORT(ABS(G2(J)))+SORT(ABS(G2(J+1))))	CRD	80
	SUM=SUM+GM*(RIN(J+1)-RIN(J))	CRD	81
	CONTINUE	CRD	82
	GO TO 284	CRD	83
	CONTINUE	CRD	84
85	J1=J2	CRD	85
	SGN1=1.	CRD	86
	SGN2=1.	CRD	87
	IF (G2(J11).LT.0.) SGN1=-1.	CRD	88
	IF (G2(J1).LT.0.) SGN2=-1.	CRD	89
90	SG1=SORT(ABS(G2(J11)))*SGN1	CRD	90
	SG2=SORT(ABS(G2(J1)))*SGN2	CRD	91
		CRD	92
		CRD	93

95	SLOPE=(SG2-SG1)/(RIN(J1)-RIN(J11))	CRD	94
	SUM=SG1*R2+SLOPE*(.5*R2**2-RIN(J11)*R2)	CRD	95
	A-SG1*R1-SLOPE*(.5*R1**2-RIN(J11)*R1)	CRD	96
	SUM=-SUM	CRD	97
	GO TO 286	CRD	98
100	CONTINUE	CRD	99
	SUM=0.	CRD	100
	CONTINUE	CRD	101
	•	CRD	102
	•	CRD	103
	•	CRD	104
	•	CRD	105
105	SGN1=1.	CRD	106
	SGN2=1.	CRD	107
	IF (G2(J11).LT.0.) SGN1=-1.	CRD	108
	IF (G2(J1).LT.0.) SGN2=-1.	CRD	109
	SG1=SQRT(ABS(G2(J11)))*SGN1	CRD	110
	SG2=SQRT(ABS(G2(J1)))*SGN2	CRD	111
110	SLOPE=(SG2-SG1)/(RIN(J1)-RIN(J11))	CRD	112
	SUM1=SG1*RIN(J1)+SLOPE*(.5*RIN(J1)**2	CRD	113
	A-RIN(J11)*RIN(J1)-SG1*R1	CRD	114
	H-SLOPE*(.5*R1**2-RIN(J11)*R1)	CRD	115
	SUM1=-SUM1	CRD	116
115	SGN1=1.	CRD	117
	SGN2=1.	CRD	118
	IF (G2(J21).LT.0.) SGN1=-1.	CRD	119
	IF (G2(J2).LT.0.) SGN2=-1.	CRD	120
	SG1=SQRT(ABS(G2(J21)))*SGN1	CRD	121
120	SG2=SQRT(ABS(G2(J2)))*SGN2	CRD	122
	SLOPE=(SG2-SG1)/(RIN(J2)-RIN(J21))	CRD	123
	SUM2=SG1*R2+SLOPE*(.5*R2**2	CRD	124
	A-RIN(J21)*R2-SG1*R1+RIN(J21)	CRD	125
125	H-SLOPE*(.5*RIN(J21)**2-RIN(J21)*RIN(J21))	CRD	126
	SUM2=-SUM2	CRD	127
	SUM=SUM1+SUM2+SUM	CRD	128
	CONTINUE	CRD	129
	SHIELD(IR)=SUM	CRD	130
130	CONTINUE	CRD	131
	•	CRD	132
	•	CRD	133
	•	CRD	134
	•	CRD	135
135	GOSQ=ABS(G2(IR))	CRD	136
	IF (G2(IR).LT.0.0) GOSQ=0.0	CRD	137
	T0=TFMP(IR)	CRD	138
	TEMP(IR)=(CT*CT+GOSQ)**2/T0	CRD	139
79	CONTINUE	CRD	140
11	CONTINUE	CRD	141
	RETURN	CRD	
	END	CRD	


```

25      C      OUTPUT      COORDINATE OR DERIVATIVE AT XC      OP      LSPFIT
      C      YC      YC(IC)= INTEGRAL(Y*DX) FROM XC(1) TO XC(IC) WHERE IC=2*NXC LSPFIT
      C      LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
30      C      NOTES-
      C      *X* MAY BE IN EITHER ASCENDING OR DESCENDING ORDER.
      C      FOR INTEGRATION *XC* MUST BE IN THE SAME ORDER AS *X*. FOR INTERP LSPFIT
      C      NO SPECIAL ORDER IS REQUIRED. LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
35      C      COMMON /CLSPF / I LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      LOGICAL WITHIN LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      N = NPTS-1 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      I = MAX0(I,MIN0(I,N)) LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      IF(ND.EQ.(-1)) I=1 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      ISAVE = 0 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      SGN = SIGN(1.,X(N+1))-X(1)) LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
40      C      BEGIN INTERPOLATION LOOP FOR XC(IC) IC=1*NXC LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      IC = 1 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
45      C      LOCATE APPROPRIATE INTERVAL LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      ICO WITHIN=.FALSE. LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      NCOUNT= N LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      102 IF(NCOUNT) 119,103,103 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      103 NCOUNT= NCOUNT-1 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      XI = X(I) LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      XD = XC(IC)-XI LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      IF(N) 104,120,104 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      104 IF(SGN*XD) 105,107,110 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      F.LI.0. (F IS THE FRACTIONAL POSITION IN THE INTERVAL) LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      105 IF(I.EQ.1) GO TO 120 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      IF(ND.EQ.(-1)) GO TO 119 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      I = I-1 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      GO TO 102 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      F.EQ.0 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      107 IF(X(I+1).NE.XI) GO TO 120 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      GO TO 116 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      F.GT.0. LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      110 IF(SGN*(XC(IC)-X(I+1))) 120,112,114 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      F.FO.1.0. CHECK FOR INTEGRATION AND DOUBLE POINT BEFORE INCREMEN LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
      C      112 IF((ND.EQ.(-1)) .OR. (I.NE.N.AND. X(I+1).EQ.X(I+2))) GO TO 120 LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT
70      C      LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT LSPFIT

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```

C      F,GT,1.0
114 IF(I,EG,N) GO TO 120
    IF(ND,EO,(-1)) GO TO 122
116 I = I+1
    GO TO 102
119 CONTINUE

C      PRELIMINARY CALCULATIONS FOR INTERPOLATION OR INTEGRATION
120 WITHIN=.TRUE.
122 IF(1-ISAVE) 124,129,124
124 ISAVE = I
    YI = Y(I)
    X3 = X(I+1)-XI
    Y3 = Y(I+1)-YI
    C = 0.
    TOP = 0.
    ROT = 0.
    IF(1,LF,1) GO TO 127
    XI = X(I-1)-XI
    XI3 = X(I-1)-X(I+1)
    TOP = XI*(Y3*X1-(Y(I-1)-YI)*X3)*XI3
    ROT = XI*X1*X13*X13*X3
127 IF(1,GF,N .OR. (XD,EG,0. .AND. BOT,NE,0.)) GO TO 128
    X4 = X(I+2)-XI
    X43 = X(I+2)-X(I+1)
    TOP = TOP + X4*(Y3*X4-(Y(I+2)-YI)*X3)*X43
    ROT = ROT + X4*X4*X43*X43*X3
128 IF(HOT,NE,0.) C = -TOP/ROT
    R = 0.
    IF(N,GT,0. .AND. X3,NE,0.) R = (Y(I+1)-YI)/X3 - C*X3
129 IF(ND) 130,140,141

C      ND=-1, INTEGRATE
130 IF(.NOT.WITHIN) XD=X3
    S1 = (YI + (R/2. + C/3.)*XD)*XD
    IF(WITHIN) GO TO 135
    #I# IS BEING INCREMENTED TO FIND APPROPRIATE INTERVAL. HENCE.
C      CUMULATE THE INTEGRAL OF THE ITH INTERVAL.
    SA = SA + S1
    GO TO 116
C      APPROPRIATE INTERVAL FOUND. X(I)-XC(IC)-X(I+1)
135 IF(IC,EO,1) SA=YC(IC)-S1
    IF(IC,NE,1) YC(IC)=SA+S1
    GO TO 150

```


25	IF(DSPL(I,J),LE,0.0) GO TO 7	OUTPUT	26
	IF(ORSTN(J),GT,30.0) GO TO 7	OUTPUT	27
	SPL(I,J)=10.*ALOG10(COFF*DSPL(I,J))	OUTPUT	28
	PFO=FLOAT(F0(J))	OUTPUT	29
30	SPL(I,J)=SPL(I,J)+10.*ALOG10(RFO)-6.3536	OUTPUT	30
	GO TO 5	OUTPUT	31
	7 CONTINUE	OUTPUT	32
	SPL(I,J)=0.0	OUTPUT	33
	5 CONTINUE	OUTPUT	34
35	CALL SHOCK	OUTPUT	35
		OUTPUT	36
	OVERALL POWER LEVEL CALCULATION	OUTPUT	37
		OUTPUT	38
	SUM=0.0	OUTPUT	39
	DO 70 J=JMIN,JMAX	OUTPUT	40
40	IF(ORSTN(J),GT,30.0) GO TO 70	OUTPUT	41
	PWR=0.0	OUTPUT	42
	DO 60 I=1,15	OUTPUT	43
	PSQ=10.**((SPL(I,J)/10.))	OUTPUT	44
45	PWR=PWR+PSQ*(RADIUS(I)**2)*SIN(THETA(I))	OUTPUT	45
	60 CONTINUE	OUTPUT	46
	PWP=2.0*PI/UNITS*DELTH*PWR	OUTPUT	47
	PWL(J)=130.+10.*ALOG10(1.3558*PWR)	OUTPUT	48
	SUM=SUM+PWL	OUTPUT	49
50	70 CONTINUE	OUTPUT	50
	OAPWL=130.0+10.*ALOG10(1.3558*SUM)	OUTPUT	51
	CALL ATMOS(SPL,RADIUS)	OUTPUT	52
	COMPUTE PNL AND PNLT	OUTPUT	53
55		OUTPUT	54
	DO 55 I=1,19	OUTPUT	55
	DO 54 J=1,33	OUTPUT	56
	TSPL(J,I)=SPL(I,J)	OUTPUT	57
	54 CONTINUE	OUTPUT	58
60	CALL PNLC(TSPL(1,I),.15,PNL(I),OASPL(I))	OUTPUT	59
	CALL TPNLC(TSPL(1,I),PNLT(I))	OUTPUT	60
	PNLT(I)=PNLT(I)+PNL(I)	OUTPUT	61
	55 CONTINUE	OUTPUT	62
65	OVERALL SOUND PRESSURE LFVEL CALCULATION	OUTPUT	63
		OUTPUT	64
	DO 80 I=1,15	OUTPUT	65
	SUM=0.0	OUTPUT	66
	DO 90 J=JMIN,JMAX	OUTPUT	67
70	IF(ORSTN(J),GT,30.0) GO TO 90	OUTPUT	68
	SUM=SUM+10.**((SPL(I,J)/10.))	OUTPUT	69
	90 CONTINUE	OUTPUT	70
	OASPL(I)=10.*ALOG10(SUM)	OUTPUT	71
	80 CONTINUE	OUTPUT	72
		OUTPUT	73
		OUTPUT	74
		OUTPUT	75

75	C					76	OUTPUT
	C					77	OUTPUT
	C					78	OUTPUT
80						79	OUTPUT
						80	OUTPUT
						81	OUTPUT
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95						95	OUTPUT
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						99	OUTPUT
100						100	OUTPUT
						101	OUTPUT
						102	OUTPUT
						103	OUTPUT
						104	OUTPUT

```

      PRINT OBSERVED SOUND PRESSURE LEVEL SPECTRA
      WRITE(6,100) EMACH,RJET,UJET,DJET
      IF(NUMANG.LE.1) WRITE(6,114) RADIUS(8)
      IF(NUMANG.GE.2) WRITE(6,116) RADIUS(8)
      WRITE(6,106) (THETD(I),I=1,15)
      DO 40 J=JMIN,JMAX
      IF(ORSTN(J).GT.30.0) GO TO 40
      WRITE(6,110) F0(J),(SPL(I,J),I=1,15),PWL(J)
      40 CONTINUE
      WRITE(6,112) (OASPL(I),I=1,15),OAPWL
      WRITE(6,124) (PNL(I),I=1,15)
      WRITE(6,130) (PNLT(I),I=1,15)
      RETURN
      FORMAT SECTION
      100 FORMAT(1H1//20X,40H*** SOUND PRESSURE LEVEL DIRECTIVITY ***//
      110X,15HJET MACH NO. = F10.4,5X,20HJET DENSITY RATIO = F10.4//
      210X,15HJET VELOCITY = F10.2,5X,20HJET EQUIV. DIAM. = F10.4//)
      106 FORMAT(1H0,7HANGLE =15F7.1,3X,7HPWL/8H FREQ.)
      110 FORMAT(18,16F7.1)
      112 FORMAT(8H00OVERALL,16F7.1)
      114 FORMAT(1H0,30X,F10.1,2X,7HFT. ARC//)
      116 FORMAT(1H0,27X,F10.1,2X,12HFT. SIDELINE//)
      124 FORMAT (8H0 PNL ,15F7.1)
      130 FORMAT (8H0 PNLT ,15F7.1)
      END

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10/10/77 14.30.05\$

FTN 4.5+410

75/76 OPT=1

SUBROUTINE PNLC

```

1      *PNLC      CALCULATION OF PNDR.OASPL*PT. CORR.*TPNL
      SUMROUTINE PNLC(SS,FAC,PNDR,OASPL)
      REAL MAXNOY,NOY
      DIMENSION PC(9,24),SS(24)
      *
      DATA FROM SAE AND R45A (1969 REVISION)
      DATA ((PC(I,J),I=1,9),J=1,12)/
10      149.,0.079520,55.,0.058098,64.,0.043478,91.,0.010301,103.,52.,
      144.,0.068110,51.,0.058098,60.,0.040570,85.,88.,0.030103,51.,
      139.,0.068110,46.,0.052249,56.,0.036831,87.,32.,0.030103,49.,
      134.,0.059640,42.,0.047534,53.,0.036831,79.,85.,0.030103,47.,
      130.,0.065301,39.,0.043573,51.,0.035336,79.,76.,0.030103,46.,
      127.,0.053013,36.,0.043573,48.,0.033333,75.,96.,0.030103,45.,
      124.,0.053013,33.,0.040221,46.,0.033333,73.,96.,0.030103,43.,
      121.,0.053013,30.,0.037349,44.,0.032051,74.,91.,0.030103,42.,
      118.,0.053013,27.,0.034859,42.,0.030675,94.,63.,0.030103,41.,
      116.,0.053013,25.,0.034859,40.,0.030103,100.,00.,0.030103,40.,
      116.,0.053013,25.,0.034859,40.,0.030103,100.,00.,0.030103,40.,
      DATA ((PC(I,J),I=1,9),J=13,24)/
      116.,0.053013,25.,0.034859,40.,0.030103,100.,00.,0.030103,40.,
      116.,0.053013,25.,0.034859,40.,0.030103,100.,00.,0.030103,40.,
      116.,0.053013,25.,0.034859,40.,0.030103,100.,00.,0.030103,40.,
      115.,0.059640,23.,0.034859,38.,0.030103,100.,00.,0.030103,38.,
      112.,0.053013,21.,0.040221,34.,0.029960,100.,00.,0.029960,34.,
      109.,0.053013,18.,0.037349,32.,0.029960,100.,00.,0.029960,32.,
      15.,0.047712,15.,0.034859,30.,0.029960,100.,00.,0.029960,30.,
      14.,0.047712,14.,0.034859,29.,0.029960,100.,00.,0.029960,29.,
      15.,0.053013,14.,0.034859,29.,0.029960,100.,00.,0.029960,29.,
      16.,0.053013,15.,0.034859,30.,0.029960,100.,00.,0.029960,30.,
      119.,0.068110,17.,0.037349,31.,0.029960,100.,00.,0.029960,31.,
      117.,0.079520,23.,0.037349,37.,0.042285,44.,29.,0.029960,34.,
      121.,0.059640,29.,0.043573,41.,0.042285,50.,72.,0.029960,37./

35     SUMSPL=0.
      SUMNOY=0.
      MAXNOY=0.

      * FIND MAXIMUM NOY VALUE AND SUM OF NOY VALUES AND SUMSPL

40     DO 50 K=1,24
      I=K
      IF (FAC.LT..2) GO TO 10
      I=3*K-1

```

45	IF(I,GT,23) GO TO 55	PNLC	46
	10 EXPSP=10.**(.1*SS(I))	PNLC	47
	SUMSPL=SUMSPL+EXPSP	PNLC	48
	IF(SS(I).GE.PC(7,I)) GO TO 300	PNLC	49
	IF(SS(I).GE.PC(5,I)) GO TO 280	PNLC	50
	IF(SS(I).GE.PC(3,I)) GO TO 260	PNLC	51
	IF(SS(I).GE.PC(1,I)) GO TO 240	PNLC	52
	NOY=0.	PNLC	53
	GO TO 30	PNLC	54
	240 NOY=.1*10.**((PC(2,I)*(SS(I)-PC(1,I)))	PNLC	55
	GO TO 30	PNLC	56
	260 NOY=10.**((PC(4,I)*(SS(I)-PC(5,I)))	PNLC	57
	GO TO 30	PNLC	58
	280 NOY=10.**((PC(6,I)*(SS(I)-PC(5,I)))	PNLC	59
	GO TO 30	PNLC	60
	300 NOY=10.**((PC(8,I)*(SS(I)-PC(9,I)))	PNLC	61
	30 SUMNOY=SUMNOY+NOY	PNLC	62
	IF(MAXNOY.GT.NOY) GO TO 50	PNLC	63
	MAXNOY=NOY	PNLC	64
	50 CONTINUE	PNLC	65
	* CALCULATE OASPL,PNDH,TPNL	PNLC	66
		PNLC	67
	55 OASPL=10.*ALOG10(SUMSPL)	PNLC	68
	PNL=MAXNOY*FAC*(SUMNOY-MAXNOY)	PNLC	69
	IF(PNL.GT..0025) GO TO 60	PNLC	70
	PNDH="	PNLC	71
	RETURN	PNLC	72
	60 PNDH=40.+33.22*ALOG10(PNL)	PNLC	73
	RETURN	PNLC	74
	FND	PNLC	75
75		PNLC	76

		FTN 4.5+410	10/10/77	14.30.05\$
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1	CSHOCK	EMPIRICAL SHOCK-CELL NOISE CORRELATION	SHOCK	2
	C		SHOCK	3
	C		SHOCK	4
	C		SHOCK	5
5	C	EMPIRICAL SHOCK CELL NOISE PREDICTION BASED ON SNECMA CORRELATION	SHOCK	6
	C	AND MODIFICATIONS BY GLIERE (GE TM 76-673)	SHOCK	7
	C		SHOCK	8
	C		SHOCK	9
	C	SURROUTINE SHOCK	SHOCK	10

[illegible]

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60 C COMPUTE PEAK FREQUENCY AND MAXIMUM SPL
C
C
CONV=1.0*W*CTH
FP =UC/1AVG/CONV/(1.0-V0*CTH/CO)
NSPL2=20.0*ALOG10(NEJ(NH)/RADIUS(1))
SPLMAX=151.5*DSPL1+DSPL2
2 - 41.0*ALOG10(1.0-V0*CTH/CO)
65 C
C COMPUTE SPECTRA
C
C
DO 1A J=JMIN,JMAX
FR=FLOAT(F0(J))/FP
IF(FR.GT.1.0) GO TO 1B
SSPL(I,J)=SPLMAX+70.0*ALOG10(FR)
GO TO 19
1B CONTINUE
SSPL(I,J)=SPLMAX-10.0*ALOG10(FR)
19 CONTINUE
1A CONTINUE
10 CONTINUE
75 C
C ADD SHOCK NOISE TO TOTAL NOISE
C
C
DO 40 I=1,15
DO 40 J=JMIN,JMAX
IF(SSPL(I,J).LT.0.0) GO TO 40
PSOM=10.0**((SPL(I,J)/10.0)
PSOS=10.0**((SSPL(I,J)/10.0)
PSOT=PSOM*PSOS
SPL(I,J)=10.0*ALOG10(PSOT)
40 CONTINUE
1 CONTINUE
RETURN
END
80 C
C
C
85 C
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C
90 C

10/10/77 14.30.053

FTN 4.5.410

76/7A OPT=1

SUBROUTINE SLICE

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      SUBROUTINE SLICE(X,DSIG,DX,M)
      COMMON/NOTS/ALFA,BETA,K,K,DEO,ASP,AL,NUMANG,DIST
      COMMON/AERU/SUE,FIPSTU,K,K,K,CM,CO,RHOE,ATOTAL,WJET,NPRINT,NPR
      IUM,RHOM,ALPHMC,RETAMC,RN
      COMMON/PROFL/UP(200),TAUR(200),RHOP(200),SIGP(200)
      I,DPDR(200),DPDRP(200),DUDR(200)
      COMMON/FAPELD/SSIN(34),ORSTN(34),FO(34),SPL(34),PWL(34),OASPL(19),
      THETA(19),THETD(19),DSPL(19,34),SPL(19,34),PWL(34),OASPL(19),
      P,FMIN,FMAX
      COMMON/SHLZ/GR(200),HIN(200),MACH(200),TEMP(200),RSIG(19,5),
      ITEMP(200),SHIFLD(200),MCIN(200),THE,CT,NTP,RP,ALPHT(19),ITH
      DIMENSION DS(200),FS(200),AAA(200)
      REAL MACH,MCIN,MCINP,K,MU
      INTEGER FO,FMIN,FMAX

      INITIALIZE CONSTANTS AND AREA GEOMETRY
      IF(KA.GT.1) GO TO 10
      PI=3.1415926
      PAD=PI/180.
      CON1=SQRT(PI/2.0)
      CON2=SQRT(PI)
      CNST=6.2831853
      WOFSC=RWOF**2
      WJET= SUE-FIPSTU
      FMACH=UJET/CO
      NDTHED=.01
      OTTHED=19.0
      NDTHED=NDTHED*PI*PAD
      THETD(1)=20.0
      THETA(1)=140.0*PI*PAD
      DO 11 I=1,15
      IF(I,FO,1) GO TO 12
      THETD(I)=THETD(I-1)+OTTHED
      THETA(I)=RAD*(180.0-THETD(I))
12 CONTINUE
      DO 11 J=1,34
      DSPL(I,J)=0.0
      SPL(I,J)=0.0
11 CONTINUE
      IF(NUMANG.LE.1) GO TO 7

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10 = 1+1.14
RADIUS(1)=RIST/SLP(NA)*TIME TO(1)
* CONTINUE
GO TO 2
7 CONTINUE
IF (LIMANG.GT.C) GO TO 4
WRITE(6,110)
110 FORMAT(4H***** APC RADIUS OMITTED - 100 FT. APC ASSUMED ***)
RIST=100.0
4 CONTINUE
DO 3 I=1,15
RADIUS(I)=RIST
3 CONTINUE
2 CONTINUE
10 CONTINUE
C
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C
C
CALCULATION OF DIMENSIONLESS RADIAL PROFILES
DO 1 NP=1,N
RIN(NP)=SIGR(NP)/DEQ
MACHING(1)=(1+RIN(1)-FIPS(1))/CO
MCIN(NP)=ALPHMC*MACH(NP)+ETAMC*EMACH
TEMP(NP)=PHOF*EMOF(NP)
1 CONTINUE
C
C
C
C
SOURCE STRENGTH EVALUATION
DV=.25*PI*(NSIG**2)*DX
NPMIN=NSIG/2.0
DO 5 NP=1,N
IF (NPMIN.LE.1.AND.SIGR(1).LE.NPMIN) GO TO 6
DV=.25*PI*SIGR(NP)*NSIG*PI*H
5 CONTINUE
NSIGR(1)=1.0
OMEGR=ARS(NUDR(NP))
IF (OMEGR.LE.0.0) GO TO 5
HPR=SQRT(TAUR(NP))
NS(NP)=RHQESQ*DV*UPR**7
FS(NP)=0.5*ALF*OMEGR/PI
5 CONTINUE
IF (NPRINT.LE.0) GO TO 135
IF (NPR.GE.NPMINT) WRITE(6,120)
120 FORMAT(1H1///PI*37HC1MCUMF PENTIALLY-AVERAGED PARAMETERS//4X,2HNP
14X,6HVAL115.5X,6HMAC110.5X,5HTEMP.5X,9HINTENSITY.5X,9HFREQUENCY
2//)

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      ) - 100 FT. APC ASSUMED ***

      AL PROFILES

      IMACH

      GO TO 4

      UALLY-AVERAGED PARAMETER/4X.2MNR
      MP.05X.9MININTENSITY.5X.9HFREQUENCY

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        (C=400*PI*FTU(1))

        GO TO 4

        C RADIUS OMITTED - 100 FT. APC ASSUMED ***

        DIMENSIONLESS RADIAL PROFILES

        DEQ
        FIPS(11)/CO
        ACH(NP)*RETAMC*EMACH
        P(NM)

        EVALUATION

        P)*DUX

        GGR(1)*LE,NOMIN) GO TO 6
        *DISIC*PX

        ))
        GO TO 5
        )
        *DP*07
        MEGR/PI

        GO TO 135
        WRITE(6,120)
        37MCLICUMFDEPENDENTIALLY-AVERAGED PARAMETER5//4X,2MNP
        MACH NO.,5X,5MTEMP.,5X,9MINENSITY,5X,9MFREQUENCY

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      /ZSIP(NA)*IHT(I))
      GO TO 4
      APC RADIIUS OMITTED - 100 FT. APC ASSUMED ***
      T
      F DIMENSIONLESS RADIAL PROFILES
      R)/DEG
      N)-FIPS(J)/CN
      MCMAC(NR)*RETAMC*EWACH
      VMOP(NR)
      TM EVALUATION
      C(GO?)*UX
      D
      O,SIG(I),LE,NRMN) GO TO 6
      N)*NSJGNX
      E(NR))
      GO GC TO 5
      N(NP))
      ENVSUPPO?
      FAONMGP/PI
      N) GO TO 135
      ENT) WRITE(6,120)
      PPA*,37HCICUMFFPENTIAALLY-AVERAGED PARAMFTPS//4X,2MNP
      *,MMACM NO.,5X,5HTEMP.,5X,9HINTENSITY,5X,9HFREQUENCY

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5      LIST/5IN(4A0)*1*FTU(1))
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          *** APC RADII'S OMITTED - 100 FT. APC ASSUMED ***

5      LIST

          *** OF DIMENSIONLESS RADIAL PROFILES ***

          ***
          (C*NR)/DEG
          (10*NR)-F15(11)/C0
          LPHMC*WACH(NR)*RETANC*EWACH
          -HOF/RHOR(NR)

          *** LENGTH EVALUATION ***
          (NSIG*2)*UX
          /2*0
          ***
          (AND, SIG(1)*LE, NRMIN) GO TO 4
          SIG(NR)*ESIG*PX
          ***
          (WUPR(NR))
          F*0*0) GO TO 5
          (AUP(NR))
          DESO*NV*UPP*7
          *ALFA*OMEGA/PI
          LE*0) GO TO 135
          (NRMIN) WRITE(6,120)
          (1//P0X*37MC14CUMF*DIFF*ENTIALLY-AVERAGED PARAM*F*P*5//4X*2*NR
          15*5X*MMACH NO*05X*5*TEMP*05X*9*INTENSITY*5X*9*HF*FREQUENCY
          15X*9*

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=1.15
(I)=(IST/5)*R*(CA)*TIMETO(I)
DEF
P
DEF
ANG,C,I,C) GO TO 4
C,I,I)
(40M*** APC RADIUS OMITTED - 100 FT. APC ASSUMED ***
OC,C
DEF
=1.15
(I)=(IST
DEF
DEF
DEF

ATION OF DIMENSIONLESS RADIAL PROFILES
IP=1.0
I)=SIG(MP)/DEQ
IE)=(I-INK)-FIRST(CO
UP)=ALPHACOMACH(MP)*RETANCOEMACH
MP)=PHOF/KHOP(NK)
DEF
DEF

STRENGTH EVALUATION
EPT=(NSIG**2)*UX
DSIG(G/2.0
IP=1.0
EQ.I.AND.SIG(I).LE.NRMN) GO TO 6
DSIG(NP)*SIG(NP)*DSIG(PX
DEF
=1.0
ARS(VUDR(MP))
GR.LF.O.O) GO TO 5
DRT(TAUR(MP))
=RHOSCONV*UPRO*7
=0.5*ALFA*OME(G/P)
DEF
INT.LE.O) GO TO 135
GE,NPRINT) WRITE(6,120)
(IHI///20X,.37HCICUMDIFFERENTIALLY-AVERAGED PARAMETER%/4X.2MNP
ADJUS.5X.MMACH NO. .5X.5HTEMP. .5X.9MINENSITY.5X.9HFREQUENCY

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      I=1,15
      DPLUS(I)=CIST/STP*(400+I*400/(I))
      CONTINUE
      GO TO 2
    2 CONTINUE
      (CUMANG,CT,C) GO TO 4
    4 CONTINUE
      JTE(C,110)
      MAT(400+I)=APC RADIUS OMITTED - 100 FT. APC ASSUMED ***
      ST=105.0
      CONTINUE
      I=1,15
      DPLUS(I)=CIST
      CONTINUE
      CONTINUE

      CALCULATION OF DIMENSIONLESS RADIAL PROFILES

      I=1,NR=1,0
      N(NR)=SIG(NR)/DEQ
      CH(NR)=(1/(NR))-FIPS(1)/CO
      IP(NR)=ALPHMC*WACH(NR)+ETAMC*EWACH
      MP(NR)=PHOF/KHNP(NR)
      CONTINUE

      SURFACE STRENGTH EVALUATION

      S=.25*PI*(NSIG**2)*DX
      MIN=NSIG/2*0
      I=1,NR=1,0
      (NR,EQ,1,AND,SIG(I)) LE,NMIN) GO TO 6
      S=S+PI*SIG(NR)*SIG(NR)
      CONTINUE
      (NR)=S,0
      EGR=ARS(1/UDR(NR))
      (ONEGR*LF,0,0) GO TO 5
      W=SQRT(TAUP(NR))
      (NR)=RHO*SQ(NV*UPR**7
      (NR)=0.5*ALFA*ONEGR/PI
      CONTINUE
      (MPRINT,LE,0) GO TO 135
      (NPR,GE,NPRINT) WRITE(6,120)
      120 MAT(141111//20X,37MC1CUMFEMPENTIALLY-AVERAGED PARAMFTF95//4X,2MNP
      14M94AD115,5X,MHMACM MIN,5X,5MTEMP,5X,9MINTENSITY,5X,9MFREQUENCY

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10 = 1+1.15
RADIUS(I)=IST/5*(WANG)*147*(I)
2 CONTINUE
3 GO TO 2
4 CONTINUE
5 IF (WANG.GT.C) GO TO 4
6 WRITE(6,110)
7 FORMAT(40H:*** AOC RADIUS OMITTED - 100 FT. APC ASSUMED ***
8 RIST=100.0
9 CONTINUE
10 = 1+1.15
RADIUS(I)=IST
11 CONTINUE
12 CONTINUE
13 CONTINUE
14 CONTINUE
15 CONTINUE

CALCULATION OF DIMENSIONLESS RADIAL PROFILES

10 1 NP=1.0
P1(NP)=SIG(NP)/DEQ
WACH(NP)=(WACH)-FIRST(I)/CO
WCIN(NP)=ALPHACOMACH(NP)*RETAMCOMACH
TEMP(NP)=PHOF/KHOF(NP)
1 CONTINUE

SOURCE STRENGTH EVALUATION

DV=.25*PI*(DSIG**2)*DX
NPIN=DSIG/2.0
10 5 NP=1.0
IF (NP.EQ.1.AND.SIG(I).LE.NPIN) GO TO 4
DV=.2*PI*SIG(NP)*DSIG*DX
2 CONTINUE
3 DSIG=1.0
4 NMEGR=ARS(WUPR(NP))
5 IF (NMEGR.LE.0) GO TO 5
6 NPH=SORT(TAUP(NP))
7 NS(NP)=RHOFCONV*UPR**7
8 FSNP=.05*ALFA*OMEGR/PI
9 CONTINUE
10 IF (NPINT.LE.0) GO TO 135
11 IF (NP.GE.NPINT) WRITE(6,120)
12 FORMAT(1H1///20X.37HCLICUMFPEFFICIENTIALLY-AVERAGED PARAMFTPS/4X.2HNR
13 14X.6H9AD1US.5X.6HMACM NO.5X.5HTEMP.5X.9HFREQUENCY
14 //)

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10 = 1.0, 1.0
RADIUS(1) = R1ST / SIN(ANG) * TIME T(1)
* CONTINUE
GO TO 2
7 CONTINUE
IF (LIMANG.GT.C) GO TO 4
WRITE(6,110)
110 FORMAT(40H**** APC RADIUS OMITTED - 100 FT. APC ASSUMED ****)
R1ST = 100.0
4 CONTINUE
DO 3 I = 1, 15
RADIUS(I) = R1ST
3 CONTINUE
2 CONTINUE
10 CONTINUE

CALCULATION OF DIMENSIONLESS RADIAL PROFILES

DO 1 NR = 1, N
R1(NR) = SIGR(NR) / DEF
MACHINE(1) = (NR(NR) - FIRST) / CO
MC1(NR) = ALPHA * CMACH(NR) * RETANG * EMACH
TEMP(NR) = PHOF / CMOR(NR)
1 CONTINUE

SOURCE STRENGTH EVALUATION

DV = .25 * PI * (NSIG**2) * OR
NRMIN = NSIG / 2.0
DO 5 NR = 1, N
IF (NR.EQ.1.AND.SIGR(1).LE.NRMIN) GO TO 6
DV = 2. * PI * SIGR(NR) * NSIG * OR
5 CONTINUE
NS(1) = 1.0
NMEGR = NARS / (NR(NR))
IF (NMEGR.LF.0.0) GO TO 5
NPR = SORT(TAUR(NR))
NS(1) = RHOF * SQRT(NPR**2)
FS(NR) = 0.5 * ALFA * NMEGR / PI
5 CONTINUE
IF (NPRINT.LE.N) GO TO 135
IF (NPR.GE.NPRINT) WRITE(6,120)
120 FORMAT(1H1///20X,37HCLICUMFERENCEIALLY-AVEAGED PAMAMFTEW5//4X,2HNR
14X,4HNOAD115.5X,4HMACM NO.5X,5HTEMP.5X,9HFREQUENCY
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100 N=1+1.15
101 RADIUS(1)=R1ST/514*(N-1)*PI*Y(1)
102 CONTINUE
103 GO TO 2
104 CONTINUE
105 IF (CUMANG.GT.C) GO TO 4
106 WRITE(6,110)
107 FORMAT(40F4.0) APC RADIUS OMITTED - 100 FT. APC ASSUMED ***
108 R1ST=100.0
109 CONTINUE
110 N=1+1.15
111 RADIUS(1)=R1ST
112 CONTINUE
113 GO TO 2
114 CONTINUE
115 CONTINUE

116 CALCULATION OF DIMENSIONLESS RADIAL PROFILES
117 NO 1 NR=1.0
118 P1(NR)=SIGP(NR)/DEQ
119 WACH(NR)=(UB(NR)-F1PS(1))/CO
120 WCTP(NR)=ALPHMC*WACH(NR)*RETAMC*EWACH
121 TEMP(NR)=DMOF/WMP(NR)
122 CONTINUE
123 CONTINUE

124 SOURCE STRENGTH EVALUATION
125 NV=.25*PI*(NSIG**2)*DX
126 NPMIN=NSIG/2.0
127 NO 5 NR=1.0
128 IF (NR.EQ.1) AND (SIG(1).LE.NPMIN) GO TO 6
129 NV=2.*PI*SIG(NR)*SIG(NR)
130 CONTINUE
131 NS(NR)=1.0
132 NMEGR=ARS(1)/DPR(NR)
133 IF (NMEGR.LF.0.0) GO TO 5
134 NPM=SORT(TAUP(NR))
135 N(NR)=RMVCSQ(NV*DPR**7
136 FS(NR)=0.5*ALFA*NMEGR/PI
137 CONTINUE
138 IF (NPRINT.LE.0) GO TO 135
139 IF (NPR.GE.NPRINT) WRITE(6,120)
140 FORMAT(1H1///20X,37C10)CUMPEPENTIALLY-AVERAGED PARAMETPS/14X,2HNP
141 14X,6H9AD115,5X,6HMAC MIN,5X,5HTEMP,5X,9HINTENSITY,5X,9HFREQUENCY
142 2//)

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10 = 1+1.14
RADIUS(1)=DIST/SIP*(A)*TIME TO(I)
C CONTINUE
GO TO 2
7 CONTINUE
IF (LIMMANG.CI.C) GO TO 4
WRITE(6,110)
110 FORMAT(40H*** APC RADIUS OMITTED - 100 FT. APC ASSUMED *** )
RIST=100.0
4 CONTINUE
DO 3 I=1,15
RADIUS(I)=LIST
3 CONTINUE
2 CONTINUE
10 CONTINUE

CALCULATION OF DIMENSIONLESS RADIAL PROFILES
DO 1 NP=1,N
P1(NP)=SIG(NP)/DEQ
WACHING=(W(NP)-FIRSH)/CO
MCIN(NP)=ALPHACOMACH(NP)+ETAMC*EMACH
TEMP(NP)=PHOF/CMOP(NP)
1 CONTINUE

SOURCE STRENGTH EVALUATION
DV=.25*PI*(NSIG**2)*DX
NPMIN=NSIG/2.0
DO 5 NP=1,N
IF (NP.EQ.1.AND.SIG(1).LE.NPMIN) GO TO 6
DV=.25*PI*SIG(NP)*NSIG*PX
5 CONTINUE
NS(NP)=1.0
OMEGP=ARS(JUDR(NP))
IF (OMEGP.LE.0.0) GO TO 5
UPW=SQRT(TAUR(NP))
NS(NP)=RHOCSDV*UPW**7
FS(NP)=0.5*ALFA*OMEGP/PI
5 CONTINUE
IF (MPINT.LE.0) GO TO 135
IF (MPP_GE.NPMINT) WRITE(6,120)
120 FORMAT(1H1///PDA*.37HC1PCUMF PENTENTIALLY-AVERAGED PARAMFTPS//4X.2HNR
14X.HVAD115.5X.HVMACH NO.05X.5HTEMP.05X.9HINTENSITY.5X.9HFREQUENCY
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10 = 1+1+15
RADIUS(1)=CIST/5*(1+40*TEMP(T))
* CONTINUE
GO TO 2
7 CONTINUE
IF (CUMANG.GT.C) GO TO 4
WRITE(6,110)
110 FORMAT(40F10.0) APC RADIUS OMITTED - 100 FT. APC ASSUMED ***
CIST=100.0
4 CONTINUE
NO 1 1=1+15
RADIUS(1)=CIST
3 CONTINUE
2 CONTINUE
10 CONTINUE

CALCULATION OF DIMENSIONLESS RADIAL PROFILES

NO 1 NR=1.0
PIN(NR)=SIG(NR)/DEQ
WACH(NR)=(1+P(NR))-FIP(1)/CO
WCP(NR)=ALPHMC*WACH(NR)*RETANCOEMACH
TEMP(NR)=PHOF/WOP(NR)
1 CONTINUE

SOURCE STRENGTH EVALUATION

NV=.25*PI*(NSIG**2)*UX
NRMIN=NSIG/2.0
NO 5 NR=1.0
IF (NR.EQ.1.AND.SIG(1).LE.NRMIN) GO TO 6
NV=2.0*PI*SIG(NR)*NSIG*PI
4 CONTINUE
NS(NR)=1.0
NMEGR=ARS(1/UPR(NR))
IF (NMEGR.LF.0.0) GO TO 5
NPM=SORT(TAUP(NR))
NS(NR)=RMQESQ*NV*UPR**7
FS(NR)=0.5*ALFA*NMEGR/PI
5 CONTINUE
IF (NPRINT.LE.0) GO TO 135
IF (NPR.GE.NPRINT) WRITE(6,120)
120 FORMAT(1H1///20X.37HCLICUMFPPENTIALLY-AVERAGED PARAMFTPS/4X.2HNR
1X.6H9ADJUS.5X.6HMMACH NO.5X.5HTEMP.5X.9HFREQUENCY
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10 = 1.15
RADIUS(1)=CIST/SIG*(NA)*T*F(1)
  4 CONTINUE
  5 GO TO 2
  7 CONTINUE
  8 IF (LIMANG.GT.C) GO TO 4
  9 WRITE(4,110)
110 FORMAT(40H**** APC RADIUS OMITTED - 100 FT. APC ASSUMED ****)
  11 CIST=100.0
  12 CONTINUE
  13 11 = 1.15
  14 RADIUS(1)=CIST
  15 CONTINUE
  16 CONTINUE
  17 CONTINUE
  18 CONTINUE

      CALCULATION OF DIMENSIONLESS RADIAL PROFILES
      19 1 NR=1.0
      20 R1(NR)=SIG(NR)/DEFQ
      21 MACH(NR)=(1.0/(NR))-FIPS(1)/CO
      22 MCIP(NR)=ALPHMCOMACH(NR)*RETAMC*EMACH
      23 TEMP(NR)=PHOF/KHOF(NR)
      24 CONTINUE
      25 CONTINUE

      SOURCE STRENGTH EVALUATION
      26 DV=.25*PI*(NSIG**2)*DX
      27 NPMIN=SIG/2.0
      28 DO 5 NR=1.0
      29 IF (NR.EQ.1.AND.SIG(1).LE.NPMIN) GO TO 6
      30 DV=2.0*PI*SIG(NR)*R1*SIG(NR)
      31 CONTINUE
      32 NS(1)=1.0
      33 OMEGR=ARS(NUDP(NR))
      34 IF (OMEGR.LF.0.0) GO TO 5
      35 IPR=SORT(TAUP(NR))
      36 NS(NR)=RHOF50*NU*UPR**7
      37 FS(NR)=0.5*ALFA*OMEGR/PI
      38 CONTINUE
      39 IF (IPRINT.LE.0) GO TO 135
      40 IF (IPR.GE.NPMINT) WRITE(6,120)
120 FORMAT(1H1///PAX,37HCTICUMPERENTIALLY-AVERAGED PARAMETER,5X,2HNR
14X,4HRAIDUS,5X,4HMAC MIN,5X,5HTEMP,5X,9HFREQUENCY
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DO = 1+1,15
RADIUS(1)=C1ST/PI*(RAD)*TIME(TO(1))
2 CONTINUE
GO TO 2
7 CONTINUE
IF((H*WANG,GT,C1) GO TO 4
WRITE(4,110)
110 FORMAT(4H**** APC RADIUS OMITTED - 100 FT. APC ASSUMED ****)
R1ST=100.0
4 CONTINUE
DO 3 1=1,15
RADIUS(1)=C1ST
3 CONTINUE
2 CONTINUE
10 CONTINUE
C
C
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C
CALCULATION OF DIMENSIONLESS RADIAL PROFILES
DO 1 NR=1,M
PI1(P1)=SIG(P1)/DEQ
WACH(NR)=(1+PI1(NR))-F1P5(PI)/CO
MC1(P1)=ALPHMC*WACH(NR)+ETAMC*EWACH
TEMP(P1)=PHOF/WHOF(NR)
1 CONTINUE
C
C
C
C
SOURCE STRENGTH EVALUATION
DV=.25*PI*(NSIG**2)*DX
NPMIN=NSIG/2.0
DO 5 NR=1,M
IF(NR,EO,1,AND,STGR(1).LE,NPMIN) GO TO 4
DV=.25*PI*STGR(NR)*NSIG*PI
5 CONTINUE
NS(P1)=1.0
OMEGP=ARS(NUDP(NR))
IF(OMEGP,LF,0.0) GO TO 5
HPR=SORT(TAUP(NR))
NS(P1)=PHOF*SQ(NV+UPR**2
FS(NR)=0.5*ALFA*OMEGP/PI
5 CONTINUE
IF(MPRINT,LE,0) GO TO 135
IF(NR,GE,NPMINT) WRITE(6,120)
120 FORMAT(1H1///2PX,37HCLUMFEMPENTIALLY-AVERAGED PARAMFTPS//4X,2HNR
1X,6HNRADIIUS,5X,6HMACM NO,5X,5HTEMP,5X,9HINTENSITY,5X,9HFREQUENCY
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10 = 1.1, 1.5
RADIUS(I) = (1.5T/512*(HAT))*.147T(I)
4 CONTINUE
5 GO TO 2
7 CONTINUE
IF (CUMMANG.CT.C) GO TO 4
WRITE (4,110)
110 FORMAT(40H:*** APC RADIUS OMITTED - 100 FT. APC ASSUMED ***
4 CONTINUE
55 NO 1 I=1,15
RADIUS(I)=LIST
3 CONTINUE
2 CONTINUE
10 CONTINUE

60 C
61 C
62 C
63 C
64 C
65 NO 1 NP=1,M
PT(NP)=SIG(NP)/DEQ
WACH(NP)=(H(NP)-FIRST)/CO
WCIN(NP)=ALPHMC*WACH(NP)*RETAMC*EMACH
TEMP(NP)=PHOF/KHOP(NP)
70 1 CONTINUE
C
C
C
C
SOURCE STRENGTH EVALUATION
DV=.25*PI*(NSIG**2)*DX
NPMIN=NSIG/2.0
DO 5 NP=1,M
IF (NP.EQ.1.AND.SIG(1).LE.NPMIN) GO TO 4
DV=.2*PI*SIG(NP)*NSIG*DX
4 CONTINUE
NS(NP)=1.0
NMEGR=ARS(NUPR(NP))
IF (NMEGR.LE.0.0) GO TO 5
NPM=SORT(TAUP(NP))
NS(NP)=RHOF*Q*NV*UPR**7
FS(NP)=0.5*ALFA*NMEGR/PI
5 CONTINUE
IF (NPMIN.LE.0) GO TO 135
IF (NPM.GE.NPMINT) WRITE (4,120)
120 FORMAT(1H1///20X,37HCLICUMFPEENTALLY-AVERAGED PARAMFTPS//4X,2HNR
14X,64H9AD1US,5X,4HMACM NO,5X,5HTEMP,5X,9HFREQUENCY
2//)

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Line	Code	Statement
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10 N=1.0,15
RADIUS(I)=CIST/512*(N+1)*PI*(I)
3 CONTINUE
4 GO TO 2
7 CONTINUE
IF (CUMANG.GT.C) GO TO 4
WRITE (6,110)
110 FORMAT(40H*** APC RADIUS OMITTED - 100 FT. APC ASSUMED ***
CIST=105.0
4 CONTINUE
N0 3 I=1,15
RADIUS(I)=CIST
3 CONTINUE
2 CONTINUE
10 CONTINUE
C
C
C
C
CALCULATION OF DIMENSIONLESS RADIAL PROFILES
N0 1 NR=1,0
PIN(NR)=SIGP(NR)/DEQ
WACH(NR)=(UW(NR)-FIPSPH)/CO
WCPH(NR)=ALPHMCOWACH(NR)*RETAMC*EWACH
TEMP(NR)=PHOF/WMPH(NR)
1 CONTINUE
C
C
C
C
SOURCE STRENGTH EVALUATION
DV=.25*PI*(NSIG**2)*DX
NPMIN=NSIG/2.0
N0 5 NR=1,0
IF (NR.EQ.1.AND.SIGP(1).LE.NPMIN) GO TO 6
DV=2*PI*SIGP(NR)*NSIG*DX
6 CONTINUE
NS(NR)=1.0
NMEGR=ARS(NUDR(NR))
IF (NMEGR.LE.0.0) GO TO 5
NPM=SQRT(TAUP(NR))
NS(NR)=RHOESQ*NU*PI*P**7
FS(NR)=0.5*ALFA*NMEGR/PI
5 CONTINUE
IF (NPRINT.LE.0) GO TO 135
IF (NPR.GE.NPRINT) WRITE (6,120)
120 FORMAT(1H1///20X,37HCLICUMFEMPENTIALLY-AVERAGED PARAMFTPS//4X,2HNP
14X,6H9AD115.5X,6HMACM 110.5X,5HTEMP.5X,9HINTENSITY.5X,9HFREQUENCY
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DO = 1.1, .15
RADIUS(1) = R1ST / SLP * (MA) * TIME TO (1)
C CONTINUE
GO TO 2
7 CONTINUE
IF (LUMANG.CI.C) GO TO 4
WRITE(*,110)
110 FORMAT(40H*** APC RADIUS OMITTED - 100 FT. APC ASSUMED *** )
R1ST = 100.0
4 CONTINUE
DO 3 I=1,15
RADIUS(I) = R1ST
3 CONTINUE
2 CONTINUE
10 CONTINUE
C
C
C
C
CALCULATION OF DIMENSIONLESS RADIAL PROFILES
NO 1 NP=1,M
P1(NP)=SIG(NP)/DEQ
WACH(NP)=(NINP)-FIRSLIN/CO
MCIN(NP)=ALPHACOMACH(NP)*RETAMCOMEMACH
TEMP(NP)=PHOF/KMOP(NP)
1 CONTINUE
C
C
C
C
SOURCE STRENGTH EVALUATION
DV=.25*PI*(NSIG**2)*DX
NPMIN=NSIG/2.0
DO 5 NP=1,M
IF (NP.EQ.1.AND.SIG(1).LE.NPMIN) GO TO 6
DV=2.*PI*SIG(NP)*NSIG*PX
5 CONTINUE
NS(NP)=1.0
OMEGA=ARS(NUDPR(NP))
IF (OMEGA.LE.0.0) GO TO 5
IPW=SQRT(TAUR(NP))
NS(NP)=RHOCOSQ*V*UPR**7
FS(NP)=0.5*ALFA*OMEGA/PI
5 CONTINUE
IF (MPRINT.LE.0) GO TO 135
IF (MPR_GE.NPRINT) WRITE(*,120)
120 FORMAT(1H1///2X,.37HC1CM*DIFFERENTIALLY-AVERAGED PARAMETERS//4X,.2HNR
1AX.6H9AD115.5F.6HMACH NO.5X.5HTEMP.5X.9HINTENSITY.5X.9HFREQUENCY
2//)

```

94	IF (NPP.GE.100) PRINT	WRITE(6,125) (NG,PIN(P),MACH(P),TEMP(NP),DS(NP)	SLICE
95	1,FS(NP),NR=1,M)		SLICE
96	125 FORMAT(16,F12.4,E14.5,F19.0)		SLICE
97	135 CONTINUE		SLICE
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140			SLICE


```

IF (NPP.GE.100) PRINT
1,FS(NP),NR=1,M)
125 FORMAT(16,F12.4,E14.5,F19.0)
135 CONTINUE

INDEX OF THETA FOR SHIELDING/DIRECTIVITY

NR=M
NRI=NP-1
DO 15 ITH=1,15

CALCULATION OF G AND ITS ZEROS

THE=THETA(ITH)
CONTINUE
CT=COS(TH)
CTSQ=CT*CT

CALCULATION OF G-SQUARE

DO 20 J=1,NR
G2(J)=(1.0-MACH(J)*CT)**2/TEMP(J)-CTSQ
IF (G2(J).EQ.0.) GO TO 42
CONTINUE
GO TO 44

CONTINUE
THE=THE+DNTHE
GO TO 43
CONTINUE

CALCULATION OF ZEROS OF G

PSIG(ITH,1)=0.
PSIG(ITH,2)=0.
PSIG(ITH,3)=0.
PSIG(ITH,4)=0.
PSIG(ITH,5)=0.
NTP=0
DO 21 J=1,NRI
SLOPE=(G2(J,1)-G2(J))/(PIN(J,1)-PIN(J))
IF (SLOPE.EQ.0.) GO TO 21
ROOT=PIN(J,1)-G2(J,1)/SLOPE
IF (ROOT.GE.PIN(J).AND.ROOT.LE.PIN(J,1)) GO TO 40
GO TO 21
CONTINUE
NTP=NTP+1

```

```

140      PSIG(ITH,NPI)=PONT
141      CONTINUE
142      IF(PTP.GT.0) GO TO 41
143      IF(G2(NPI).GT.0.0) GO TO 41
144      NTP=1
145      PSIG(ITH,1)=RTH(NW)
146      41 CONTINUE
147      IF(PTP.GT.2) WRITE(6,150)KA,X*ITH*THETO(ITH),NTP
148      150 FORMAT(53H*WADH*G - NO. OF TURNING POINTS IS GREATER THAN 2 AT /
149      14H KA=13.5X.2PX=F10.5X.4MITH=13.5X.6HMETAE=F4.2X.4HNTPE=13//)
150
151      C
152      C
153      C
154      C
155      CALCULATION OF DIRECTIVITY
156      XOP=X/RADIUS(ITH)
157      PSORSQ=1.-2.0*XOP*CT+XOP**2
158      2STAN=RADIUS(ITH)*SINT(PSORSQ)
159      CONVEARS(1.0,FIRSTH*CT/CO)
160      CALL CND
161      DO 30 IP=1,M
162      IF(FS(IP).LE.0.0) GO TO 30
163      MC=MCIN(IP)
164      CONVO=1.0-MC*CT
165      CONV2=CONVO**2*TAUR(IP)*(ALPHT(ITH)/CO)**2
166      IF(EN.GT.1) CONV2=1.0
167      IF(M.GT.3) ARD=NN.I(3) SHIELD(IP)=0.0
168      DO 45 J=1,34
169      FC=FLOAT(F0(J))
170      K=CONST*FC*DF0/CO
171      FR=FC/FS(IP)
172      FRSC=FR*FR
173      POWER=.125*FRSQ*CONV2
174      IF(POWER.GT.20.0) GO TO 45
175      EXPON=EXP(-POWER)
176      WF=FRSQ*FRSQ*EXPON
177      DIRECT=TERM(IP)
178      IF(SHIELD(IP).GT.0.0) GO TO 46
179      GO TO 47
180      44 CONTINUE
181      POWER=2.0J*SHIELD(IP)
182      IF(POWER.GT.20.0) GO TO 45
183      DIRECT=DIRECT*EXP(-POWER)
184      47 CONTINUE
185      DSPL(ITH,J)=DSPL(ITH,J)+WF*DS(IP)*DIRECT/PSORSQ/CONV2
186      1/CONVF
187      45 CONTINUE
188      30 CONTINUE
189      15 CONTINUE
190      RETURN
191      END

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10/10/77 14.30.055

FTN 4.5.410

74/74 OUT=1

SOUNDOUT THE TPNLC

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1  *TPNLC      THIS SECTION CALCULATES TONE CORRECTED PNL
   C          SPECTRAL IRREGULARITY CORRECTION
   C
   C          THIS PROCEDURE DETERMINES A SPECTRAL IRREGULARITY
   C          (E.S.,PHASE TONE) CORRECTION FACTOR ECE VIA SECTION B36.3
   C          OF THE FAA NOISE CERTIFICATION DOCUMENT (NOV 17,1969) AS
   C          A FUNCTION OF THE UNCORRECTED 1/3 OCTAVE SPECTRUM,SPL.
   C
   C          SOUNDOUT THE TPNLC(SPL,PTCOR)
   C          DIMENSION SPL(24),ISPLF(24),S(24),SPLPP(24),SP(25),
   C          1 SHAP(24),F(24)
   C
   C          *INITIALIZE SPL FLAG*
   C          DO 1 I=1,24
   C          1 ISPLF(I) = 0
   C
   C          *STEP 1*
   C          DO 5 I=4,24
   C          5 S(I)=SPL(I) - SPL(I-1)
   C
   C          *STEP 2 AND 3*
   C          DO 10 I=5,24
   C          IF (ABS(S(I)-S(I-1)).LE.S,3) GO TO 10
   C          IF (S(I).GT.0.0.AND.S(I).GT.S(I-1)) ISPLF(I)=1
   C          IF (S(I).LE.0.0.AND.S(I-1).GT.0.0) ISPLF(I-1)=1
   C          10 CONTINUE
   C
   C          *STEP 4*
   C          DO 25 I=1,24
   C          IF (ISPLF(I).EQ.0) GO TO 20
   C          IF (I.EQ.24) GO TO 15
   C          STEP 4B MODIFIED SUCH THAT PRECEDING AND FOLLOWING
   C          NON-FLAGGED SOUND PRESSURE LEVELS EMPLOYED IN AVERAGE.
   C          11 = 1
   C          DO 11 J=1,20
   C          11 = 11-1
   C          IF (ISPLF(11).EQ.0) GO TO 12
   C          11 CONTINUE
   C          12 SPL = SPL(11)
   C          12 IPI = 1.01
   C          DO 13 J=1,24
   C          IF (ISPLF(J).EQ.0) GO TO 14
   C          13 CONTINUE
   C          J = 24

```

45	14	SPL(I) = SPL(J) SPLP(I) = (SPLP+SPLU)/2. GO TO 25	46 TPNLC
	15	SPLP(24) = SPL(23)+S(23) GO TO 25	47 TPNLC
50	20	SPLP(I) = SPL(I) 25 CONTINUE	48 TPNLC
			49 TPNLC
			50 TPNLC
			51 TPNLC
			52 TPNLC
			53 TPNLC
			54 TPNLC
			55 TPNLC
55	30	SP(I) = SPLP(I)-SPLP(I-1) SP(3) = SP(4) SP(25) = SP(24)	56 TPNLC
			57 TPNLC
			58 TPNLC
			59 TPNLC
			60 TPNLC
60	35	SHAR(I) = (SP(I)+SP(I+1)+SP(I+2))/3.	61 TPNLC
			62 TPNLC
			63 TPNLC
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			65 TPNLC
65			66 TPNLC
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			94 TPNLC

4.0 REFERENCES

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5.0 CONCLUDING REMARKS

Two computer programs capable of predicting the jet noise of high velocity exhausts from nozzles of arbitrary geometry are presented. The computerized procedures presented herein provide reasonably accurate methods of predicting maximum sideline PNL as well as EPNL (with and without flight effects) over the range of flow conditions and observer angles of interest.

